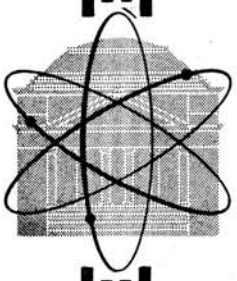
LUTE and LATEX, Special-Purpose Codes to Translate from Modified - UK to ENDF/B Format

Technical Report
Contract No. DASA01-69-C-0029
Defense Atomic Support Agency
Washington, D.C. 20305

ENDF-128

Submitted by:
Donald J. Dudziak
and
Jason M. Cook



Research Laboratories for the Engineering Sciences

University of Virginia

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Division of Nuclear Engineering
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ABSTRACT

Two special-purpose FORTRAN IV codes have been written to translate neutron interaction and photon production data from an extended version of the UK Data File format to ENDF/B Data File format. The codes operate only on the subset of the general UK neutron data format which was used for the Defense Atomic Support Agency (DASA)-sponsored evaluations of sodium, magnesium, silicon, chlorine, potassium and calcium. Descriptions of the codes' functions and operation are given, along with input instructions, output descriptions, and INDEX'ed listings of all main programs and subroutines.

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LUTE and LATEX, Special-Purpose Codes to Translate from Modified - UK to ENDF/B Format

Donald J. Dudziak and Jason M. Cook

I. Introduction and Summary

At the inception of the ENDF/B (Evaluated Nuclear Data File/B)[1] effort of the CSEWG (Cross Section Evaluation Working Group), the University of California, Los Alamos Scientific Laboratory undertook the task of providing evaluations of ^{6}Li and ^{7}Li[2] for the file. Part of that task involved translating data from the UK Data File format to the ENDF/B Data File format, so a simple single-purpose code was written to perform the translation. Later (1967) the Los Alamos Laboratory undertook to translate an evaluation of Na[3] from modified UK format to ENDF/B format. These Na data included photon production data to be translated into the appropriate extended ENDF/B format,[4] and from this effort evolved two *ad hoc* FORTRAN IV codes, LUTE and LATE, for the CDC 6600 Computer. The present report is intended to document the extended versions of these codes, LUTE and LATEX, which were used at the University of Virginia to translate evaluations of Mg, Cl, K, and Ca[3] into ENDF/B. Both of these codes are written in FORTRAN IV and are now operational on the Burrough's B5500 computer at the University of Virginia. They should be readily adaptable to other computers if the need arises.

In the context of this report, the modification of the UK format used by Drake, *et al*[3] will be referred to as the "UK format." However, LUTE and LATEX are interim translation codes which can accommodate only the subset of the options in the general format of the UK Data File[5] which was used by Drake, *et al* (e.g., angular distributions given by tabulations but not as Legendre coefficients, and secondary energy distributions given by tabulations only). They were never intended for general use, and a program to produce a much more ambitious and general translation code is being undertaken by Oak Ridge National Laboratory. However, they may have some further usefulness in the interim period.

The need for two separate codes may not be apparent. However, because of

differences in photon production formats for inelastic scattering to discrete levels, as well as indexing requirements in File I of the ENDF/B data, and other reasons, this was the most expeditious approach. Briefly, LUTE translates into ENDF/B format the photon production cross sections and/or yields, as well as the angular distributions of these photons. When combined with punched-card data for File I and photon production transition probability arrays (cf. §3.2 of Ref. 4), the LUTE output is used by LATEX, in conjunction with the data tape in UK format, to produce a complete ENDF/B data tape. LATEX translates the neutron interaction data (ENDF/B Files 3, 4, and 5) and shuffles the data files into the proper arrangements.[1,4]

2. Functions and Operation of the Codes LUTE and LATEX

In order to understand either code it is essential that the user be familiar with the ENDF/B and UK formats, and such familiarity is assumed in the discussions to follow. The first versions of both codes were written before the standard ENDF/B retrieval subroutines[6] were available. They read and write in card-image format, and both are now in the FORTRAN IV dialect characteristic of the B5500 computer.

A listing of the LUTE code, along with an INDEX of the code statement numbers and variable names, is given in Appendix A. A similar listing and INDEX of LATEX are given in Appendix B.

Typical running times for LUTE were about 20 minutes central processor and 15 minutes I/O on the B5500. For LATEX the corresponding times were about 35 minutes and 25 minutes, respectively. Essentially the same codes (previous versions) on the CDC6600 ran in about 2 minutes central processor time and 10 minutes peripheral processor time.

2.1. Burroughs B5500 Computer FORTRAN Compiler Features

The only major change which should affect the running of either of these programs on other machines is the method of expressing the End-of-File and parity error branches. The method used by the B5500 is

```
READ (U, F, END=S) LIST
```

where U is the unit number

F is the format number

S is the statement to go to if an End-of-File is reached

LIST is the list of variables to be read.

The same form is used when a parity error is detected.

READ (U, F, ERR=S) LIST

where the symbols have the same meaning as above except that S is the statement to proceed to upon detection of a parity error.

Unit Designation

The following designations are used by LUTE for the I/O units:

7 -- card reader
9 -- line printer
10 -- UK-format input tape
11 -- card punch

The following designations are used by LATEX for the I/O units:

2 -- ENDF/B-format output tape
3 -- scratch tape (or equivalent disk or extended core storage)
4 -- scratch tape (or equivalent disk or extended core storage)
5 -- scratch tape (or equivalent disk or extended core storage)
6 -- scratch tape (or equivalent disk or extended core storage)
7 -- scratch tape (or equivalent disk or extended care storage)
8 -- UK-format input tape
9 -- line printer
10 -- card reader
12 -- scratch tape (or equivalent disk or extended core storage)

2.2. LUTE Code and Subroutines

The LUTE code reads a card-image tape of data in the UK format and translates photon production cross sections and angular distributions into ENDF/B format. It consists of a main program and six subroutines, the main program being essentially a calling routine. All ENDF/B data cards are both written on the line printer and punched. The first subroutine called is SKIPTOP, which searches the tape until photon production data are found; i.e., UK general classification numbers (GCN) 11, 12, or 13. The remaining five subroutines are each functionally related to one specific class of data

(e.g., angular distributions, discrete photon yields, etc.) as follows:

2.2.1. RADCAP and DISCRT: The subroutine RADCAP is called when data for photon production from radiative capture are encountered; i.e., when GCN=12. This subroutine then reads the section of data in UK format, finds the total photon yields, and calls DISCRT. Then the DISCRT subroutine writes (and punches) the ENDF/B section for radiative capture (MF=15, MT=102).

2.2.2. ANGLE: The subroutine ANGLE is called when data for angular distributions of photons are encountered; i.e., when GCN=11. If the total number of angular distributions given in the UK file is zero, an isotropic distribution is written for the corresponding ENDF/B section, by use of a flag on the HEAD card (cf. §3.1 of Ref. 4). Otherwise, all angular distributions for all discrete photons are read in, converted to ENDF/B format, and punched. It is assumed that the angular distributions in the UK format are already normalized.

2.2.3. PRODXS: The subroutine PRODXS is called when data for photon production are encountered in the UK format, with GCN=13. However, sections for photon production by inelastic scattering to discrete levels (PCN=5 to 14 and 51 to 80) are referred to the subroutine PHO, because these data are often entered into ENDF/B as transition probability arrays. For inelastic scattering to the continuum (MT=15), the differential photon production cross section is integrated over photon energy to get a total photon production cross section (XS) at each incident neutron energy. These cross sections are then divided by the corresponding neutron interaction cross sections (EP, which appear in MF=3, MT=15), which are read from input cards, to compute total photon yields. After the yields are punched in ENDF/B format, the photon production cross sections are normalized (by dividing by the integrated values) to probability density functions and punched in ENDF/B format.

2.2.4. PHO: The subroutine PHO is called by PRODXS for reaction types which have proton production data specified in ENDF/B as transition probability arrays. Using a cutoff energy read from card input, PHO punches a section of unit cross section for ENDF/B File 3, MT=110. This reaction type (MT) number is used for residual photon production cross sections above the energy of the highest level entered in the transition probability array. By using the ruse of a unit cross section in File 3, the "yields" in File 15 are thus in reality total photon production cross sections, the same as in the UK format. If photon production cross sections are desired in lieu of transition probability arrays for any or all sections, they can easily be obtained by the device of setting the cutoff energy at zero.

2.2.5. SKIPTOP: The "searching" subroutine, SKIPTOP (NMAT), is called by LUTE for the purpose of determining the location of the material of interest on the input tape, where several materials may be in the same tape file. The method used to accomplish this is 1) to skip a number, as read from card input, of cards without checking the material number, and 2) to read card-by-card and check for proper material number (NIN), for PCN not equal to 0, and for GCN equal to either 11, 12, or 13. If SKIPTOP is unsuccessful in finding the material on tape, a statement to that effect (viz., "MATERIAL IS NOT ON TAPE") is printed and the run is then terminated.

2.3 LATEX Code and Subroutines

The LATEX code reads a card-image tape of data in the UK format, along with punched card input for photon production, photon energy distribution, and photon angular distribution data. A complete ENDF/B data tape is then produced by a translation. LATEX consists of a main program and five subroutines, where the main program is the calling routine and principal writing routine. One subroutine (SKPMAT) serves to find the material on the tape, while another (SHUFL) rearranges the various ENDF/B files into a complete ENDF/B data tape. The other subroutines are each functionally related

to one specific class of data (e.g., angular distributions, average cosine of the scattering angle, or energy distributions). Included in the code are several temporary logical "IF" statements to correct erroneous data on the UK data tape.

The main program reads the UK data type and, depending upon the value of GCN/PCN, then calls the appropriate subroutine. It also performs some preliminary conversion of units of the data. The subroutines ANGULO and ENERGIA translate their appropriate sections of data, write HEAD, CONT, TAB2, and partial TAB1 records, and then return control to the main program for writing the remainder of the TAB1 record. All of the File 3 translation is done by the main program, and after the translation is completed a section (MT=251) is added for the $\bar{\mu}_{LAB}$ values. These values are computed by AVERIA from the tabulated angular distributions for elastic scattering (MF=4, MT=2).

2.3.1. ANGULO: This subroutine translates data for the angular distributions of secondary neutrons, assuming the distributions are given in UK format as tabulations vice Legendre coefficients. The angular distributions as given in UK format are integrated and then normalized for the ENDF/B Data File.

2.3.2. AVERIA: This subroutine computes $\bar{\mu}_{LAB}$, the average cosine of the scattering angle in the laboratory system. In the case of elastic scattering (MT=2), the $\bar{\mu}_{LAB}$ data are stored and then used at the end of File 3 to construct the MT=251 section. The values of $\bar{\mu}_{LAB}$ are extended down to the lowest energy for which an elastic scattering cross section is given in File 3(MF=3, MT=2), using a value of $\bar{\mu}_{LAB}=2/(3\cdot$ÄWR) at this lowest energy. This value is also used at 0.75 times the lowest incident neutron energy in (MF=4, MT=2). The integration to determine $\bar{\mu}_{LAB}$ is performed by Simpson's rule. The incident neutron energy and corresponding $\bar{\mu}_{LAB}$ are listed on the output.

2.3.3. ENERGIA: This subroutine translates data for energy distributions of secondary neutrons, assuming the distributions are given in UK format as tabulations. The given tabulated distributions are integrated over secondary energy and then normalized for the ENDF/B Data File. These integrals over secondary energy are

listed on the output.

2.3.4. SKPMAT: This short subroutine just searches the input UK data tape until the proper material is found, and then returns control to the main program. If the material is not found on the tape, a statement to that effect (viz. "MATERIAL IS NOT ON TAPE") is printed and the run terminated.

2.3.5. SHUFL: This subroutine takes as input all the ENDF/B files for the material being processed, and rearranges them onto tape 2 (the final output tape). It reads the TPID record, all of Files 1, 14, and 15 and Section 110 of File 3(MF=3, MT=110) from cards. The rest of the data are read from the scratch tape (#12) used during the LATEX translation phase. If the final output tape is successfully written, a comment to that effect is printed, and the tape is then listed.

3. Input and Output Specifications

3.1. LUTE Input/Output

3.1.1. LUTE Input: The input for LUTE consists of both cards and tape.

The tape should contain a cross-section data set of the material of interest, in UK format. Other materials may be listed in the same tape file. The tape is designated as unit 10.

The card input is as follows:

Card 1: MAT(ENDF/B), NMAT(UK NiN), MTP, ED, ZA, AWR. These are entered in (3I12, 3E12.4) format. This card lists the material numbers in both ENDF/B and UK systems, the MT number for the residual photon production cross-sections (usually 110), the cutoff energy dividing the transition probability array option from photon production option (in eV), and the ZA and AWR of the material of interest.

Card 2: N

This is entered in I6 format.

This card lists the number of cards to be skipped by SKIPTOP without checking NIN (material number), GCN, or PCN.

Card 3: EP(J)

These are entered in 6E12.5 format and may require more than one card.

The card(s) lists the values of EP, the neutron cross sections for MT=15 at the incident neutron energies which appear in GCN/PCN=13015.

3.1.2. LUTE Output

The output from LUTE should consist of File 14 and File 15 data along with some File 3 data.

Data in ENDF/B format, both punched cards and a listing, will appear in the same order in which the data are encountered on the UK-format tape. However, the first time the subroutine PHO is called, (i.e., the first time photon production data appear for inelastic scattering to discrete levels, and the incident neutron energy is above the cutoff energy), all File 3 data records for a unit cross section in MT=110 will appear. This usually occurs after MF=14, MT=5.

At the end of each section, the printer listing will show a line with "VVVV...VVV." This line is used only to separate the different sections and has no meaning. Other lines on the printer listing which will not appear in the card output are

1) the first card in LUTE's input deck,
2) the EP(J) values (neutron cross sections for MT=15 at the incident neutron energies), which come before MF=15, MT=15 and
3) the integrals of the differential photon production cross sections over photon energy, XS(J), which will also come before MF=15, MT=15, but after the EP(J) values.

3.2. LATEX Input/Output

3.2.1. LATEX Input

The input to LATEX will consist essentially of the output from LUTE with some additional cards, and the tape with the data in UK format. The output from LUTE will also have to be rearranged.

These changes are as follows:

1) The MF=3, MT=110 cards are placed immediately before any File 14 cards.

2) All of the File 14 cards are then placed in increasing order of MT number, as one would expect an ENDF/B listing to appear. The same is then done for File 15.

3) The MF=15, MT=110 cards are usually placed in the order in which they are produced by LUTE, though this is not essential. They are then placed in their appropriate location in File 15. HEAD, TAB1 (total yields) and SEND records for this section must be punched by hand, since LUTE only punches the subsections.

4) The transition probability arrays (MF=15, MT=5 through 14 and 51 through 80) must be punched by hand and added to File 15.

In addition to these changes and additions to the LUTE output, additional input must be added. The final LATEX card input consists of

1) Two control cards which are inserted at the beginning of the data deck. These are as follows:

Card 1: ZA, AWR, NMAT(UK NIN), MAT(ENDF/B)
These are entered in (2E12.5, 2I6) format with the remainder of the card being free alpha field.

Card 2: TPID
This is entered in I6 format.

2) All File 1 cards,including both the table of contents and the index, along with the SEND and FEND cards.

3) The rearranged and supplemented LUTE output as described above.

It should be pointed out that the only FEND card which is included in the input data is the File 1 FEND card. LATEX will

write the other FEND cards, as well as MEND and TEND cards.

The same tape which is used for input to LUTE is also used by LATEX, i.e., the tape with the data in UK format for the material of interest. This tape is designated as unit 8.

3.2.2. LATEX Output

The output from LATEX will consist of both a listing and an ENDF/B-format tape, designated unit 2. The listing will contain the following information:

1) the input control card (first card in the input deck).

2) HEAD cards for the different sections.

3) groups of two lines for File 4 data, consisting of
   a) the integral of $P(\mu, E_i)$ over all μ.
   b) E_i, the incident neutron energy, and $\bar{\mu}_{LAB}$.
   These lines will always appear in File 4 where the distribution is non-isotropic.

4) the integral of $\sigma(E',E_i)$ over all E' for all File 5 sections. Due to a quirk in the code, the HEAD card for the section will always be written after the first integral value.

5) the last line is a TEND card.

The above groups, other than the first and last line, will be repeated throughout in the order the data were found on the UK-format tape.

If the final output tape is successfully written, the output will contain the statement "THE ENDF/B TAPE, AS GIVEN BELOW, WAS SUCCESSFULLY WRITTEN." Finally, a copy of the entire ENDF/B data tape (tape 2) will be listed, including TPID and TEND records.

ACKNOWLEDGMENT

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APPENDIX A

```
C
C++++++++++++++++++++++++++++++++++  LUTE  ++++++++++++++++++++++++++++
C                                                                      LUT    1
C                                                                      LUT    2
C     LOS ALAMOS CODE FOR UKAEA TO ENDF/B FORMAT CONVERSION            LUT    3
C     -                    -     -  -                                  LUT    4
C                                                                      LUT    5
C     WRITTEN BY**DONALD J. DUDZIAK                                    LUT    6
C                UNIVERSITY OF CALIFORNIA, LOS ALAMOS SCIENTIFIC LAB.  LUT    7
C                LOS ALAMOS, NM  87544                                 LUT    8
C                                                                      LUT    9
C                                                                      LUT   10
C        1.  MAT = ENDF/B MAT                                          LUT   11
C        2. NMAT = UK NIN                                              LUT   12
C        3.  MTP = MT NUMBER FOR PHOTON PRODUCTION                     LUT   13
C        4.   ED = ENERGY DIVIDING TRANSITION ARRAY SYSTEM FROM PHOTON LUT   14
C                  PRODUCTION SYSTEM (= ENERGY OF HIGHEST LEVEL IN     LUT   15
C                  FILE15, OPTION 2). **** EV ****                     LUT   16
C                                                                      LUT   17
C     EP(J) ARE THE NEUT XSEC FOR MT=15 AT THE INCIDENT NEUT ENERGIES, LUT   18
C     IN 6E12.5 FORMAT. INSERT AFTER CARD 3 OF RTN=13015.              LUT   19
C                                                                      LUT   20
 1          DIMENSION EG(270), E(270), XS(270), Y(270)                LUT   21
 2          DIMENSION A(7,25,30), P(7,25,30), EP(175), NE(7), NANGS(175)LUT  22
 3          COMMON A,P,EG,E,XS,NGC,NPC,N2,NB,LLAW,NB2,ES,MAT,AWR,ZA,Y,NANGS,EPLUT  23
           1,NE,NPRS,EL,EU,  NTM,MTP,NFL, ED                           LUT   24
 4          COMMON  LTS, NMAT                                         LUT   25
 5          READ (7,3) MAT, NMAT, MTP, ED, ZA, AWR                    LUT   26
 6          WRITE (9,4) MAT, NMAT, MTP, ED, ZA, AWR                   LUT   27
 7          CALL SKIPTOP(NMAT)                                        LUT   28
 8      1   READ (10,5,END=2) NGC, NPC, N2, NB, NLAW, NB2, ES         LUT   29
 9          IF (NGC.EQ.11) CALL ANGLE                                 LUT   30
10          IF (LTS.EQ.1 .AND. NGC.EQ.11) GO TO 1                     LUT   31
11          IF (LTS.EQ.1 .AND. NGC.EQ.13) CALL ANGLE                  LUT   32
12          IF (NGC.EQ.12) CALL RADCAP                                LUT   33
13          IF (NGC.EQ.13) CALL PRODXS                                LUT   34
14          IF (NGC.EQ.11 .OR. NGC.EQ.12 .OR. NGC.EQ.13) GO TO 1      LUT   35
15          WRITE (9,6)                                               LUT   36
16      2   STOP                                                      LUT   37
17      3   FORMAT (3I12, 1P3E12.4)                                   LUT   38
18      4   FORMAT (5X, 3I12, 1P3E12.4)                               LUT   39
19      5   FORMAT (I8, I3, 4I12, E12.4)                              LUT   40
20      6   FORMAT (5X, 20HWHAT THE HELL IS GNC)                      LUT   41
21          END                                                       LUT   42-
```

SYMBOL	REFERENCES							
1	8*	10	14					
2	16*							
3	5RD	17*						
4	6WR	18*						
5	8RD	19*						
6	15WR	20*						
A	2DI	3CO						
ANGLE	9	11						
AWR	3CO	5RD	6WR					
E	1DI	3CO						
ED	3CO	5RD	6WR					
EG	1DI	3CO						
EL	3CO							
END	8RD							
EP	2DI	3CO						
ES	3CO	8RD						
EU	3CO							
LLAW	3CO							
LTS	4CO	10	11					
MAT	3CO	5RD	6WR					
MTP	3CO	5RD	6WR					
N2	3CO	8RD						
NANGS	2DI	3CO						
NB	3CO	8RD						
NB2	3CO	8RD						
NE	2DI	3CO						
NFL	3CO							
NGC	3CO	8RD	9	10	11	12	13	14
NLAW	8RD							
NMAT	4CO	5RD	6WR	7AG				
NPC	3CO	8RD						
NPRS	3CO							
NTM	3CO							
P	2DI	3CO						
PRODXS	13							
RADCAP	12							
SKIPTOP	7							
STOP	16							
XS	1DI	3CO						
Y	1DI	3CO						
ZA	3CO	5RD	6WR					

SUBROUTINE ANGLE

```
1            SUBROUTINE ANGLE                                                    ANG   1
             C                                                                   ANG   2
             C  WRITTEN BY**  DONALD J. DUDZIAK                                  ANG   3
             C                                                                   ANG   4
2            DIMENSION EG(270), E(270), XS(270), Y(270)                          ANG   5
3            DIMENSION A(7,25,30), P(7,25,30), EP(175), NE(7), NANGS(175), NCDSANG   6
            1(175)                                                               ANG   7
4            COMMON A,P,EG,E,XS,NGC,NPC,N2,NB,LLAW,NB2,ES,MAT,AWR,ZA,Y,NANGS,EPANG   8
            1,NE,NPRS,EL,EU,  NTM,MTP,NFL, ED                                    ANG   9
5            COMMON  LTS, NMAT                                                   ANG  10
6            Z = 0.0                                                             ANG  11
7            JZ = 0                                                              ANG  12
8            J1 = 1                                                              ANG  13
9            J2 = 2                                                              ANG  14
10           NR = 1                                                              ANG  15
11           MF = 14                                                             ANG  16
12           MT = NPC                                                            ANG  17
             C                                                                   ANG  18
             C     INDEX M=ND COUNTS NUMBER OF PHOTON ENERGIES                   ANG  19
             C     INDEX NE(M) AND I COUNT NUMBER OF NEUTRON ENERGIES PER DISCRETE ANG  20
             C     PHOTON INDEX K COUNTS TOTAL NUMBER OF ANGULAR DISTRIBUTIONS   ANG  21
             C                                                                   ANG  22
13           M=1                                                                 ANG  23
14           IF  (LTS.EQ.1)                    NTEM=N2                           ANG  24
15           IF  (LTS.EQ.1)                    N2=0                              ANG  25
16           IF  (N2.NE.0)                     GO TO 403                         ANG  26
17           IF  (LTS.EQ.1)                    GO TO 402                         ANG  27
18           LTS=1                                                               ANG  28
19           RETURN                                                              ANG  29
20      402  CONTINUE                                                            ANG  30
             C                                                                   ANG  31
             C  WRITE ISOTROPIC ANGULAR DISTRIBUTION FOR ENDF/B WHEN N2=0.       ANG  32
             C                                                                   ANG  33
21           GO TO 456                                                           ANG  34
22      403  CONTINUE                                                            ANG  35
23           ND=1                                                                ANG  36
24           DO 415 K=1,N2                                                       ANG  37
25           READ (10,460) E(K),BLANK,NCDS(K),EP(K),PLAW,NANGS(K)                ANG  38
26           E(K) = E(K) * 1.0E+6                                                ANG  39
27           EG(1)=EP(1)                                                         ANG  40
28           IF (K.EQ.1) GO TO 405                                               ANG  41
29           K1=K-1                                                              ANG  42
30           IF (EP(K).EQ.EP(K1)) GO TO 410                                      ANG  43
31           ND=ND+1                                                             ANG  44
32           M=M+1                                                               ANG  45
33           EG(M)=EP(K)                                                         ANG  46
34      405  CONTINUE                                                            ANG  47
35           NE(M)=0                                                             ANG  48
36           I=0                                                                 ANG  49
37      410  CONTINUE                                                            ANG  50
```

```
38              NE(M)=NE(M)+1                                                   ANG  51
39              I=I+1                                                           ANG  52
40              NAN=NANGS(K)                                                    ANG  53
41              READ (10,470) (A(M,I,J),P(M,I,J),J=1,NAN)                       ANG  54
42        415   CONTINUE                                                        ANG  55
          C                                                                     ANG  56
          C     WRITE HEAD CARD                                                 ANG  57
          C                                                                     ANG  58
43              WRITE  (11,466)  ZA,AWR,JZ, J2, ND, JZ, MAT, MF, MT, J1         ANG  59
44              WRITE  ( 9,466)  ZA,AWR,JZ, J2, ND, JZ, MAT, MF, MT, J1         ANG  60
45              NSEQ=2                                                          ANG  61
46              ES = ES * 1.0E+6                                                ANG  62
47              DO 455 K=1,ND                                                   ANG  63
48              EG(K) = EG(K) * 1.0E+6                                          ANG  64
          C                                                                     ANG  65
          C     WRITE TAB2 CARD FOR EACH EG                                     ANG  66
          C                                                                     ANG  67
49              WRITE (9,465) ES,EG(K),JZ,JZ,NR,NE(K),MAT,MF,MT,NSEQ           ANG  68
50              WRITE (11,465) ES,EG(K),JZ,JZ,NR,NE(K),MAT,MF,MT,NSEQ          ANG  69
51              NSEQ=NSEQ+1                                                     ANG  70
52              WRITE (9,475) NE(K),J2,MAT,MF,MT,NSEQ                           ANG  71
53              WRITE (11,475) NE(K),J2,MAT,MF,MT,NSEQ                          ANG  72
          C                                                                     ANG  73
          C     WRITE TAB1 RECORD FOR EACH NEUTRON ENERGY                       ANG  74
          C                                                                     ANG  75
54              NEN=NE(K)                                                       ANG  76
55              DO 450 J=1,NEN                                                  ANG  77
56              M=J*K                                                           ANG  78
57              NP=NANGS(M)                                                     ANG  79
58              NSEQ=NSEQ+1                                                     ANG  80
59              WRITE (9,465) Z,E(J),JZ,JZ,NR,NP,MAT,MF,MT,NSEQ                 ANG  81
60              WRITE (11,465) Z,E(J),JZ,JZ,NR,NP,MAT,MF,MT,NSEQ                ANG  82
61              NSEQ=NSEQ+1                                                     ANG  83
62              WRITE (9,475) NP,J2,MAT,MF,MT,NSEQ                              ANG  84
63              WRITE (11,475) NP,J2,MAT,MF,MT,NSEQ                             ANG  85
64              NSEQ=NSEQ+1                                                     ANG  86
          C                                                                     ANG  87
          C     CALC. NBR OF FULL LINES OF P(MU,E) TABLE,AND PRINT AND PUNCH    ANG  88
          C                                                                     ANG  89
65              NFULL=NCDS(M)-2                                                 ANG  90
66              NLAST=NP-(3*NFULL)                                              ANG  91
67              LL=-2                                                           ANG  92
68              DO 420 LPRIME = 1, NFULL                                        ANG  93
69              LL=LL+3                                                         ANG  94
70              LU=LL+2                                                         ANG  95
71              WRITE (9,480) (A(K,J,L),P(K,J,L),L=LL,LU),MAT,MF,MT,NSEQ        ANG  96
72              WRITE (11,480) (A(K,J,L),P(K,J,L),L=LL,LU),MAT,MF,MT,NSEQ       ANG  97
73              NSEQ=NSEQ+1                                                     ANG  98
74        420   CONTINUE                                                        ANG  99
75              NDIFF=NP-LU                                                     ANG 100
```

SUBROUTINE ANGLE

```
      LUP=LU+1                                                          ANG 101
      IF (NDIFF.EQ.1) GO TO 425                                         ANG 102
      IF (NDIFF.EQ.2) GO TO 430                                         ANG 103
      IF (NDIFF.EQ.3) GO TO 435                                         ANG 104
      IF (NDIFF.NE.1 .AND. NDIFF.NE.2 .AND. NDIFF.NE.3) GO TO 440       ANG 105
425   WRITE (9,485) A(K,J,NP),P(K,J,NP),MAT,MF,MT,NSEQ                  ANG 106
      WRITE (11,485) A(K,J,NP),P(K,J,NP),MAT,MF,MT,NSEQ                 ANG 107
      GO TO 445                                                         ANG 108
430   WRITE (9,490) (A(K,J,M),P(K,J,M),M=LUP,NP),MAT,MF,MT,NSEQ         ANG 109
      WRITE (11,490) (A(K,J,M),P(K,J,M),M=LUP,NP),MAT,MF,MT,NSEQ        ANG 110
      GO TO 445                                                         ANG 111
435   WRITE (9,480) (A(K,J,M),P(K,J,M),M=LUP,NP),MAT,MF,MT,NSEQ         ANG 112
      WRITE (11,480) (A(K,J,M),P(K,J,M),M=LUP,NP),MAT,MF,MT,NSEQ        ANG 113
      GO TO 445                                                         ANG 114
440   WRITE (9,495)                                                     ANG 115
445   CONTINUE                                                          ANG 116
450   CONTINUE                                                          ANG 117
      NSEQ=NSEQ+1                                                       ANG 118
455   CONTINUE                                                          ANG 119
      GO TO 458                                                         ANG 120
456   CONTINUE                                                          ANG 121
      ND=NTEM                                                           ANG 122
      WRITE ( 9,466)  ZA, AWR, J1, J2, ND, JZ, MAT, MF, MT, J1          ANG 123
      WRITE (11,466)  ZA, AWR, J1, J2, ND, JZ, MAT, MF, MT, J1          ANG 124
      NSEQ=2                                                            ANG 125
      LTS=0                                                             ANG 126
      N2=NTEM                                                           ANG 127
458   CONTINUE                                                          ANG 128
C                                                                       ANG 129
C     WRITE SEND CARD                                                   ANG 130
C                                                                       ANG 131
      WRITE (9,505) MAT,MF,JZ,NSEQ                                      ANG 132
      WRITE (11,505) MAT,MF,JZ,NSEQ                                     ANG 133
      RETURN                                                            ANG 134
460   FORMAT (E11.4,E12.5,I12,2E12.5,I12)                               ANG 135
465   FORMAT (1P2E11.4,4I11,I4,I2,I3,I5)                                ANG 136
466   FORMAT (F11.1, 1PE11.4, 4I11, I4, I2, I3, I5)                     ANG 137
470   FORMAT (E11.4,5E12.5)                                             ANG 138
475   FORMAT (2I11,44X,I4,I2,I3,I5)                                     ANG 139
480   FORMAT (1P6E11.4,I4,I2,I3,I5)                                     ANG 140
485   FORMAT (1P2E11.4,44X,I4,I2,I3,I5)                                 ANG 141
490   FORMAT (1P4E11.4,22X,I4,I2,I3,I5)                                 ANG 142
495   FORMAT (30HYOUR CARD-COUNT ROUTINE STINKS)                        ANG 143
500   FORMAT (1H1)                                                      ANG 144
505   FORMAT (66X,I4,I2,I3,I5)                                          ANG 145
      END                                                               ANG 146-
```

SUBROUTINE ANGLE

SYMBOL	=	REFERENCES									
.402	=	17	20*								
403	=	16	22*								
405	=	28	34*								
410	=	30	37*								
415	=	24	42*								
420	=	68	74*								
425	=	77	81*								
430	=	78	84*								
435	=	79	87*								
440	=	80	90*								
445	=	83	86	89	91*						
450	=	55	92*								
455	=	47	94*								
456	=	21	96*								
458	=	95	103*								
460	=	25RD	107*								
465	=	49WR	50WR	59WR	60WR	108*					
466	=	43WR	44WR	98WR	99WR	109*					
470	=	41RD	110*								
475	=	52WR	53WR	62WR	63WR	111*					
480	=	71WR	72WR	87WR	88WR	112*					
485	=	81WR	82WR	113*							
490	=	84WR	85WR	114*							
495	=	90WR	115*								
500	=	116*									
505	=	104WR	105WR	117*							
A	=	3DI	4C0	41RD	71WR	72WR	81WR	82WR	84WR	85WR	87WR
		88WR									
ANGLE	=	1									
AWR	=	4C0	43WR	44WR	98WR	99WR					
BLANK	=	25RD									
E	=	2DI	4C0	25RD	26=	59WR	60WR				
ED	=	4C0									
EG	=	2DI	4C0	27=	33=	48=	49WR	50WR			
EL	=	4C0									
EP	=	3DI	4C0	25RD	27	30	33				
ES	=	4C0	46=	49WR	50WR						
EU	=	4C0									
I	=	36=	39=	41RD							
J	=	41RD	55	56	59WR	60WR	71WR	72WR	81WR	82WR	84WR
		85WR	87WR	88WR							
J1	=	8=	43WR	44WR	98WR	99WR					
J2	=	9=	43WR	44WR	52WR	53WR	62WR	63WR	98WR	99WR	
JZ	=	7=	43WR	44WR	49WR	50WR	59WR	60WR	98WR	99WR	104WR
		105WR									
K	=	24	25RD	26	28	29	30	33	40	47	48
		49WR	50WR	52WR	53WR	54	56	71WR	72WR	81WR	82WR
		84WR	85WR	87WR	88WR						

SUBROUTINE ANGLE

```
Y       =     2DI     4CO
Z       =     6=      59WR    60WR
ZA      =     4CO     43WR    44WR    98WR    99WR
```

SUBROUTINE DISCRT

```
1            SUBROUTINE DISCRT                                                  DIS    1
      C                                                                         DIS    2
      C  WRITTEN BY**  DONALD J. DUDZIAK                                        DIS    3
      C                                                                         DIS    4
2            DIMENSION EG(270), E(270), XS(270), Y(270)                         DIS    5
3            DIMENSION A(7,25,30), P(7,25,30), EP(175), NE(7), NANGS(175)       DIS    6
4            COMMON A,P,EG,E,XS,NGC,NPC,N2,NB,LLAW,NB2,ES,MAT,AWR,ZA,Y,NANGS,EPDIS    7
            1,NE,NPRS,EL,EU,  NTM,MTP,NFL, ED                                   DIS    8
5            COMMON  LTS, NMAT                                                  DIS    9
6            JZ=0                                                               DIS   10
7            J1=1                                                               DIS   11
8            MT=NPC                                                             DIS   12
9            Z=0.0                                                              DIS   13
10           NR=1                                                               DIS   14
11           NP=2                                                               DIS   15
12           J2=2                                                               DIS   16
13           MF=15                                                              DIS   17
14           J3=3                                                               DIS   18
15           J4=4                                                               DIS   19
16           J5=5                                                               DIS   20
17           NSEQ=4                                                             DIS   21
18           DO 305 I=1,NPRS;NSEQ=NSEQ+1                                        DIS   22
19           WRITE (9,310) Z,EG(I),JZ,J2,NR,NP,MAT,MF,MT,NSEQ                   DIS   23
20           WRITE (11,310) Z,EG(I),JZ,J2,NR,NP,MAT,MF,MT,NSEQ                  DIS   24
21           NSEQ=NSEQ+1                                                        DIS   25
22           WRITE (9,315) J2,J2,MAT,MF,MT,NSEQ                                 DIS   26
23           WRITE (11,315) J2,J2,MAT,MF,MT,NSEQ                                DIS   27
24           NSEQ=NSEQ+1                                                        DIS   28
25           WRITE (9,320) EL,Y(I),EU,Y(I),MAT,MF,MT,NSEQ                       DIS   29
26           WRITE (11,320) EL,Y(I),EU,Y(I),MAT,MF,MT,NSEQ                      DIS   30
27     305   CONTINUE                                                           DIS   31
28           NSEQ=NSEQ+1                                                        DIS   32
      C                                                                         DIS   33
      C     WRITE SEND CARD                                                     DIS   34
      C                                                                         DIS   35
29           WRITE (9,325) MAT,MF,JZ,NSEQ                                       DIS   36
30           WRITE (11,325) MAT,MF,JZ,NSEQ                                      DIS   37
31           RETURN                                                             DIS   38
32     310   FORMAT (1P2E11.4,4I11,I4,I2,I3,I5)                                 DIS   39
33     315   FORMAT (2I11,44X,I4,I2,I3,I5)                                      DIS   40
34     320   FORMAT (1P4E11.4,22X,I4,I2,I3,I5)                                  DIS   41
35     325   FORMAT  (66X,I4,I2,I3,I5)                                          DIS   42
36           END                                                                DIS   43-
```

SUBROUTINE DISCRT

SYMBOL	REFERENCES								
305	18	27*							
310	19WR	20WR	32*						
315	22WR	23WR	33*						
320	25WR	26WR	34*						
325	29WR	30WR	35*						
A	3DI	4CO							
AWR	4CO								
DISCRT	1								
E	2DI	4CO							
ED	4CO								
EG	2DI	4CO	19WR	20WR					
EL	4CO	25WR	26WR						
EP	3DI	4CO							
ES	4CO								
EU	4CO	25WR	26WR						
I	18	19WR	20WR	25WR	26WR				
J1	7=								
J2	12=	19WR	20WR	22WR	23WR				
J3	14=								
J4	15=								
J5	16=								
JZ	6=	19WR	20WR	29WR	30WR				
LLAW	4CO								
LTS	5CO								
MAT	4CO	19WR	20WR	22WR	23WR	25WR	26WR	29WR	30WR
MF	13=	19WR	20WR	22WR	23WR	25WR	26WR	29WR	30WR
MT	8=	19WR	20WR	22WR	23WR	25WR	26WR		
MTP	4CO								
N2	4CO								
NANGS	3DI	4CO							
NB	4CO								
NB2	4CO								
NE	3DI	4CO							
NFL	4CO								
NGC	4CO								
NMAT	5CO								
NP	11=	19WR	20WR						
NPC	4CO	8							
NPRS	4CO	18							
NR	10=	19WR	20WR						
NSEQ	17=	18	19WR	20WR	21=	22WR	23WR	24=	25WR	26WR
	28=	29WR	30WR						
NTM	4CO								
P	3DI	4CO							
RETURN	31								
XS	2DI	4CO							
Y	2DI	4CO	25WR	26WR					
Z	9=	19WR	20WR						

ZA - 4C0

SUBROUTINE RADCAP

```
1            SUBROUTINE RADCAP                                                  RAD    1
      C                                                                         RAD    2
      C  WRITTEN BY**  DONALD J. DUDZIAK                                        RAD    3
      C                                                                         RAD    4
2            DIMENSION EG(270), E(270), XS(270), Y(270)                         RAD    5
3            DIMENSION A(7,25,30), P(7,25,30), EP(175), NE(7), NANGS(175)       RAD    6
4            COMMON A,P,EG,E,XS,NGC,NPC,N2,NB,LLAW,NB2,ES,MAT,AWR,ZA,Y,NANGS,EPRAD    7
            1,NE,NPRS,EL,EU,  NTM,MTP,NFL, ED                                   RAD    8
5            COMMON  LTS, NMAT                                                  RAD    9
      C                                                                         RAD   10
      C     THIS SUBROUTINE WILL ONLY WORK FOR ONE NEUTRON ENERGY RANGE (N2=1)  RAD   11
      C     DO 445  K=1,N2                                                      RAD   12
      C                                                                         RAD   13
6            READ (10,220) EL,EU,NCDS,NLAWS,PLAW,LLAW                           RAD   14
7            EL=1.0E+6*EL                                                       RAD   15
8            EU=1.0E+6*EU                                                       RAD   16
9            READ (10,225) NPRS,(EG(I),Y(I),I=1,2),EG(3)                        RAD   17
10           IF (NPRS.LE.2) GO TO 210                                           RAD   18
11           IF (NPRS.GT.3) GO TO 205                                           RAD   19
12           READ (10,230) Y(3)                                                 RAD   20
13           GO TO 210                                                          RAD   21
14     205   CONTINUE                                                           RAD   22
15           READ (10,230) Y(3),(EG(I),Y(I),I=4,NPRS)                           RAD   23
16     210   CONTINUE                                                           RAD   24
17           IF (LLAW.NE.1) WRITE (9,235)                                       RAD   25
18           JZ = 0                                                             RAD   26
19           J1 =1                                                              RAD   27
20           J2 = 2                                                             RAD   28
21           J3 = 3                                                             RAD   29
22           J4 = 4                                                             RAD   30
23           Z = 0                                                              RAD   31
24           MT = NPC                                                           RAD   32
25           NR = 1                                                             RAD   33
26           NP = 2                                                             RAD   34
27           MF=15                                                              RAD   35
      C                                                                         RAD   36
      C     CUMULATE TO FIND TOTAL YIELD                                        RAD   37
      C                                                                         RAD   38
28           YT=0.0                                                             RAD   39
29           DO 215 K=1,NPRS                                                    RAD   40
30           EG(K)=1.0E+6*EG(K)                                                 RAD   41
31           YT=YT+Y(K)                                                         RAD   42
32     215   CONTINUE                                                           RAD   43
      C                                                                         RAD   44
      C     WRITE HEAD AND TAB1 CARDS                                           RAD   45
      C                                                                         RAD   46
33           WRITE (9,255)                                                      RAD   47
34           WRITE  (11,241)  ZA,AWR,J1,JZ,NPRS,NPRS,MAT,MF,MT,J1               RAD   48
35           WRITE  ( 9,241)  ZA,AWR,J1,JZ,NPRS,NPRS,MAT,MF,MT,J1               RAD   49
36           WRITE (9,240) Z,Z,JZ,JZ,NR,NP,MAT,MF,MT,J2                         RAD   50
```

SUBROUTINE RADCAP

```
      WRITE (11,240) Z,Z,JZ,JZ,NR,NP,MAT,MF,MT,J2                       RAD  51
      WRITE (9,245) J2,J2,MAT,MF,MT,J3                                  RAD  52
      WRITE (11,245) J2,J2,MAT,MF,MT,J3                                 RAD  53
      WRITE (9,250) EL,YT,EU,YT,MAT,MF,MT,J4                            RAD  54
      WRITE (11,250) EL,YT,EU,YT,MAT,MF,MT,J4                           RAD  55
      IF (LLAW.EQ.1) CALL DISCRT                                        RAD  56
      RETURN                                                            RAD  57
  220 FORMAT (E11.4,E12.5,2I12,E12.5,I12)                               RAD  58
  225 FORMAT (I11,5E12.5)                                               RAD  59
  230 FORMAT (E11.4,5E12.5)                                             RAD  60
  235 FORMAT (39HWHAT LAW DO YOU WANT FOR CAPTURE GAMMAS)               RAD  61
  240 FORMAT (1P2E11.4,4I11,I4,I2,I3,I5)                                RAD  62
  241 FORMAT (F11.1, 1PE11.4, 4I11, I4, I2, I3, I5)                     RAD  63
  245 FORMAT (2I11,44X,I4,I2,I3,I5)                                     RAD  64
  250 FORMAT (1P4E11.4,22X,I4,I2,I3,I5)                                 RAD  65
  255 FORMAT (1H1)                                                      RAD  66
      END                                                               RAD  67-
```

SUBROUTINE RADCAP

SYMBOL	REFERENCES							
205	11	14*						
210	10	13	16*					
215	29	32*						
220	6RD	44*						
225	9RD	45*						
230	12RD	15RD	46*					
235	17WR	47*						
240	36WR	37WR	48*					
241	34WR	35WR	49*					
245	38WR	39WR	50*					
250	40WR	41WR	51*					
255	33WR	52*						
A	3DI	4CO						
AWR	4CO	34WR	35WR					
DISCRT	42							
E	2DI	4CO						
ED	4CO							
EG	2DI	4CO	9RD	15RD	30=			
EL	4CO	6RD	7=	40WR	41WR			
EP	3DI	4CO						
ES	4CO							
EU	4CO	6RD	8=	40WR	41WR			
I	9RD	15RD						
J1	19=	34WR	35WR					
J2	20=	36WR	37WR	38WR	39WR			
J3	21=	38WR	39WR					
J4	22=	40WR	41WR					
JZ	18=	34WR	35WR	36WR	37WR			
K	29	30	31					
LLAW	4CO	6RD	17	42				
LTS	5CO							
MAT	4CO	34WR	35WR	36WR	37WR	38WR	39WR	40WR	41WR
MF	27=	34WR	35WR	36WR	37WR	38WR	39WR	40WR	41WR
MT	24=	34WR	35WR	36WR	37WR	38WR	39WR	40WR	41WR
MTP	4CO							
N2	4CO							
NANGS	3DI	4CO						
NB	4CO							
NB2	4CO							
NCDS	6RD							
NE	3DI	4CO						
NFL	4CO							
NGC	4CO							
NLAWS	6RD							
NMAT	5CO							
NP	26=	36WR	37WR					
NPC	4CO	24						
NPRS	4CO	9RD	10	11	15RD	29	34WR	35WR

SUBROUTINE RADCAP

NR	-	25=	36WR	37WR			
NTM	-	4C0					
P	-	3DI	4C0				
PLAW	-	6RD					
RADCAP	-	1					
RETURN	-	43					
XS	-	2DI	4C0				
Y	-	2DI	4C0	9RD	12RD	15RD	31
YT	-	28=	31=	40WR	41WR		
Z	-	23=	36WR	37WR			
ZA	-	4C0	34WR	35WR			

SUBROUTINE PHO

```
1            SUBROUTINE PHO                                                    PHO   1
      C                                                                        PHO   2
      C  WRITTEN BY D.J. DUDZIAK                                               PHO   3
      C  THIS SUBROUTINE READS PRODUCTION CROSS SECTIONS BEYOND HIGHEST LEVEL  PHO   4
      C        IN OPTION 2, AND PUTS THEM IN MT=MTP AS YIELDS. ALSO IT WRITES  PHO   5
      C        A FILE 3 SECTION WITH UNIT XS.  HEAD CARD AND TOTAL YIELDS      PHO   6
      C        MUST BE ENTERED SEPARATELY.                                     PHO   7
      C                                                                        PHO   8
2            DIMENSION EG(270), E(270), XS(270), Y(270)                        PHO   9
3            DIMENSION A(7,25,30), P(7,25,30), EP(175), NE(7), NANGS(175)      PHO  10
4            COMMON A,P,EG,E,XS,NGC,NPC,N2,NB,LLAW,NB2,ES,MAT,AWR,ZA,Y,NANGS,EPPHO  11
            1,NE,NPRS,EL,EU,  NTM,MTP,NFL, ED                                  PHO  12
5            COMMON  LTS, NMAT                                                 PHO  13
6            J0=0                                                              PHO  14
7            J1=1                                                              PHO  15
8            J2=2                                                              PHO  16
9            J5=5                                                              PHO  17
10           J99=99                                                            PHO  18
11           MF3=3                                                             PHO  19
12           MF15=15                                                           PHO  20
13           Z=0.0                                                             PHO  21
14           UNO=1.0                                                           PHO  22
15           EXL=1.0E-2                                                        PHO  23
16           EXU=2.0E+7                                                        PHO  24
      C                                                                        PHO  25
      C CHANGE FOR CHLORINE (NFL=1 IF NMAT=221 AND NPC=52,53, OR 54)           PHO  26
      C                                                                        PHO  27
17           IF  (NFL .EQ. 1)                    ETEM=ED                      PHO  28
18           IF  (NFL .EQ. 1)                    ED=0.0                       PHO  29
19           ES=ES*1.0E+6                                                      PHO  30
      C                                                                        PHO  31
      C  LOOP ON DISCRETE ENERGIES (EG).                                       PHO  32
      C                                                                        PHO  33
20           DO 100  J=1,N2                                                    PHO  34
21           NTM = NTM+1                                                       PHO  35
      C                                                                        PHO  36
      C  NOW WRITE AND PUNCH FILE 3 IF FIRST TIME THRU. OTHERWISE GO TO 65.    PHO  37
      C                                                                        PHO  38
22           IF  (NTM .NE. 1)                    GO TO 65                     PHO  39
      C                                                                        PHO  40
      C  HEAD CARD, TAB1 RECORD, AND SEND CARD OF FILE 3.                      PHO  41
      C                                                                        PHO  42
23           NSEQ=1                                                            PHO  43
24           WRITE  ( 9,211)  ZA,AWR,J0,J99,J0,J0,MAT,MF3,MTP,NSEQ             PHO  44
25           WRITE  (11,211)  ZA,AWR,J0,J99,J0,J0,MAT,MF3,MTP,NSEQ             PHO  45
26           NSEQ=NSEQ+1                                                       PHO  46
27           WRITE  ( 9,210)  Z,Z,J0,J0,J1,J2,MAT,MF3,MTP,NSEQ                 PHO  47
28           WRITE  (11,210)  Z,Z,J0,J0,J1,J2,MAT,MF3,MTP,NSEQ                 PHO  48
29           NSEQ=NSEQ+1                                                       PHO  49
30           WRITE  ( 9,215)  J2,J2,MAT,MF3,MTP,NSEQ                           PHO  50
```

SUBROUTINE PHO

```
31          WRITE  (11,215)  J2,J2,MAT,MF3,MTP,NSEQ                    PHO  51
32          NSEQ=NSEQ+1                                                 PHO  52
33          WRITE  ( 9,220)  EXL,UNO,EXU,UNO,MAT,MF3,MTP,NSEQ           PHO  53
34          WRITE  (11,220)  EXL,UNO,EXU,UNO,MAT,MF3,MTP,NSEQ           PHO  54
35          NSEQ=NSEQ+1                                                 PHO  55
36          WRITE  ( 9,240)  MAT,MF3, JO,NSEQ                           PHO  56
37          WRITE  (11,240)  MAT,MF3, JO, NSEQ                          PHO  57
38    65    CONTINUE                                                    PHO  58
39          READ (10,200) EL,EU,NCDS, EG(1), PROB, NPRS                 PHO  59
40          EU=EU*1.0E+6                                                PHO  60
41          EG(1)=EG(1)*1.0E+6                                          PHO  61
      C                                                                 PHO  62
      C   READ ALL DATA IN FOR ONE DISCRETE PHOTON                      PHO  63
      C                                                                 PHO  64
42          READ  (10,205)  (E(I), XS(I), I=1,NPRS)                     PHO  65
43          IF  (EU .LE. ED)                    GO TO 100               PHO  66
      C                                                                 PHO  67
      C   SEARCH FOR FIRST ENERGY ABOVE ED.                             PHO  68
      C                                                                 PHO  69
44          DO 5  I=1,NPRS                                              PHO  70
45          E(I)=E(I)*1.0E+6                                            PHO  71
46    5     CONTINUE                                                    PHO  72
47          IF  (E(1).GT.ED)                    GO TO 59                PHO  73
48          IF  (E(1).EQ.ED)                    GO TO 49                PHO  74
49          NC=1                                                        PHO  75
50    10    CONTINUE                                                    PHO  76
51          NC=NC+1                                                     PHO  77
52          IF  (NC.GT.NPRS)                    GO TO 100               PHO  78
53          IF  (E(NC).LT.ED)                   GO TO 10                PHO  79
54          IF  (E(NC).EQ.ED)                   GO TO 48                PHO  80
55          IF  (E(NPRS).LE.ED)                 GO TO 100               PHO  81
      C                                                                 PHO  82
      C   INTERPOLATE FOR XS AT ED UNLESS E(1).GE.ED OR E(NC).EQ.ED.  IF SO,  PHO  83
      C   SKIP INTERPOLATE ROUTINE.                                     PHO  84
      C                                                                 PHO  85
56          EA=E(NC-1)                                                  PHO  86
57          EB=E(NC)                                                    PHO  87
58          DEN=EB-EA                                                   PHO  88
59          XS2=XS(NC)                                                  PHO  89
60          XS1=XS(NC-1)                                                PHO  90
61          EE=1.0001*ED                                                PHO  91
62          NU1=EB-EE                                                   PHO  92
63          NU2=EE-EA                                                   PHO  93
64          XS(1)=(NU1/DEN)*XS1 + (NU2/DEN)*XS2                         PHO  94
65          E(1)=EE                                                     PHO  95
66          NC=NC-1                                                     PHO  96
      C                                                                 PHO  97
      C   INTERPOLATION ROUTINE ENDS                                   PHO  98
      C                                                                 PHO  99
67          GO TO 50                                                    PHO 100
```

SUBROUTINE PHO

```
      C                                                                       PHO 101
      C  ADVANCE ENERGY SLIGHTLY IF E(NC),EQ,ED, TO AVOID DOUBLE VALUE AT ED. PHO 102
      C                                                                       PHO 103
   68 48    CONTINUE                                                         PHO 104
   69       E(1)=1.0001*E(NC)                                                PHO 105
   70       XS(1)=XS(NC)                                                     PHO 106
   71       GO TO 50                                                         PHO 107
   72 49    CONTINUE                                                         PHO 108
   73       E(1)=1.0001*E(1)                                                 PHO 109
   74       NP=NPRS                                                          PHO 110
   75       GO TO 60                                                         PHO 111
      C                                                                       PHO 112
      C  SHIFT TABLE OF E(I) AND XS(I) FOR COMMON PUNCH ROUTINE               PHO 113
      C                                                                       PHO 114
   76 50    CONTINUE                                                         PHO 115
   77       NP=NPRS-NC+1                                                     PHO 116
   78       DO 55 K=2,NP                                                     PHO 117
   79       JK=NC+K-1                                                        PHO 118
   80       E(K)=E(JK)                                                       PHO 119
   81       XS(K)=XS(JK)                                                     PHO 120
   82 55    CONTINUE                                                         PHO 121
      C                                                                       PHO 122
      C END OF SHIFT ROUTINE                                                  PHO 123
      C                                                                       PHO 124
   83       GO TO 60                                                         PHO 125
      C                                                                       PHO 126
   84 59    CONTINUE                                                         PHO 127
   85       NP=NPRS                                                          PHO 128
      C                                                                       PHO 129
   86 60    CONTINUE                                                         PHO 130
      C                                                                       PHO 131
      C  NON WRITE AND PUNCH PHOTON PRODUCTION XS AS YIELDS IN FILE 15, LF=2. PHO 132
      C  FIRST TWO CARDS OF TAB1 RECORD FOR DISCRETE PHOTON ENERGY.           PHO 133
      C                                                                       PHO 134
   87       NSEQ=1                                                           PHO 135
   88       WRITE ( 9,210)  ES,EG(1),J0,J2,J1,NP,MAT,MF15,MTP,NSEQ          PHO 136
   89       WRITE (11,210)  ES,EG(1),J0,J2,J1,NP,MAT,MF15,MTP,NSEQ          PHO 137
   90       NSEQ=NSEQ+1                                                      PHO 138
   91       WRITE ( 9,215)  NP, J5, MAT,MF15,MTP,NSEQ                       PHO 139
   92       WRITE (11,215)  NP, J5, MAT,MF15,MTP,NSEQ                       PHO 140
      C                                                                       PHO 141
      C  COMPUTE NUMBER OF FULL LINES AND LENGTH OF PARTIAL LINE.             PHO 142
      C                                                                       PHO 143
   93       NLIN=NP/3                                                        PHO 144
   94       NREM=NP-3*NLIN                                                   PHO 145
   95       LL=-2                                                            PHO 146
   96       DO 70 K=1,NLIN                                                   PHO 147
   97       NSEQ=NSEQ+1                                                      PHO 148
   98       LL=LL+3                                                          PHO 149
   99       LU=LL+2                                                          PHO 150
```

SUBROUTINE PHO

```
100           WRITE ( 9,225)  (E(I),XS(I), I=LL,LU), MAT,MF15,MTP,NSEQ                PHO 151
101           WRITE (11,225)  (E(I),XS(I), I=LL,LU), MAT,MF15,MTP,NSEQ                PHO 152
102     70    CONTINUE                                                                 PHO 153
103           IF  (NREM .EQ. 0)                    GO TO 85                            PHO 154
104           NSEQ=NSEQ+1                                                              PHO 155
105           IF  (NREM .EQ. 1)                    GO TO 80                            PHO 156
106           LUP=LU+1                                                                 PHO 157
107           WRITE ( 9,220)  (E(I),XS(I), I=LUP,NP), MAT,MF15,MTP,NSEQ                PHO 158
108           WRITE (11,220)  (E(I),XS(I), I=LUP,NP), MAT,MF15,MTP,NSEQ                PHO 159
109           GO TO 85                                                                 PHO 160
110     80    CONTINUE                                                                 PHO 161
111           WRITE ( 9,230)  E(NP),XS(NP), MAT,MF15,MTP,NSEQ                          PHO 162
112           WRITE (11,230)  E(NP),XS(NP), MAT,MF15,MTP,NSEQ                          PHO 163
113     85    CONTINUE                                                                 PHO 164
114     100   CONTINUE                                                                 PHO 165
115           WRITE ( 9,235)                                                           PHO 166
              C                                                                        PHO 167
              C CHANGE FOR CHLORINE (NFL=1 IF MAT=221 AND MT=52,53,OR54)               PHO 168
              C                                                                        PHO 169
116           IF  (NFL .EQ. 1)                     ED=ETEM                             PHO 170
117           RETURN                                                                   PHO 171
118     200   FORMAT  (E11.4, E12.5, I12, 2E12.5, I12)                                 PHO 172
119     205   FORMAT  (E11.4, 5E12.5)                                                  PHO 173
120     210   FORMAT  (1P2E11.4, 4I11, I4, I2, I3, I5)                                 PHO 174
121     211   FORMAT  ( F11.1, 1PE11.4, 4I11, I4, I2, I3, I5)                          PHO 175
122     215   FORMAT  (2I11, 44X, I4, I2, I3, I5)                                      PHO 176
123     220   FORMAT  (1P4E11.4, 22X, I4, I2, I3, I5)                                  PHO 177
124     225   FORMAT  (1P6E11.4, I4, I2, I3, I5)                                       PHO 178
125     230   FORMAT  (1P2E11.4, 44X, I4, I2, I3, I5)                                  PHO 179
126     235   FORMAT  (80H  VVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVPHO 180
            1VVVVVVVVVVVVVVVV                                                        PHO 181
127     240   FORMAT (66X,I4,I2,I3,I5)                                                PHO 182
128           END                                                                      PHO 183
```

SUBROUTINE PHO

SYMBOL	REFERENCES									
5	44	46*								
10	50*	53								
48	54	68*								
49	48	72*								
50	67	71	76*							
55	78	82*								
59	47	84*								
60	75	83	86*							
65	22	38*								
70	96	102*								
80	105	110*								
85	103	109	113*							
100	20	43	52	55	114*					
200	39RD	118*								
205	42RD	119*								
210	27WR	28WR	88WR	89WR	120*					
211	24WR	25WR	121*							
215	30WR	31WR	91WR	92WR	122*					
220	33WR	34WR	107WR	108WR	123*					
225	100WR	101WR	124*							
230	111WR	112WR	125*							
235	115WR	126*								
240	36WR	37WR	127*							
A	3DI	4CO								
AWR	4CO	24WR	25WR							
DEN	58=	64								
E	2DI	4CO	42RD	45=	47	48	53	54	55	56
	57	65=	69=	73=	80=	100WR	101WR	107WR	108WR	111WR
	112WR									
EA	56=	58	63							
EB	57=	58	62							
ED	4CO	17	18=	43	47	48	53	54	55	61
	116=									
EE	01=	62	63	65						
EG	2DI	4CO	39RD	41=	88WR	89WR				
EL	4CO	39RD								
EP	3DI	4CO								
ES	4CO	19=	88WR	89WR						
ETEM	17=	116								
EU	4CO	39RD	40=	43						
EXL	15=	33WR	34WR							
EXU	16=	33WR	34WR							
I	42RD	44	45	100WR	101WR	107WR	108WR			
J	20									
J0	6=	24WR	25WR	27WR	28WR	88WR	89WR			
J1	7=	27WR	28WR	88WR	89WR					
J2	8=	27WR	28WR	30WR	31WR	88WR	89WR			
J5	9=	91WR	92WR							

SUBROUTINE PHO

SUBROUTINE PHO

Y	-	2DI	4CO	
Z	-	13=	27WR	28WR
ZA	-	4CO	24WR	25WR

SUBROUTINE PRODXS

```
 1            SUBROUTINE PRODXS                                                  PXS    1
      C                                                                          PXS    2
      C  WRITTEN BY**  DONALD J. DUDZIAK                                         PXS    3
      C                                                                          PXS    4
 2            DIMENSION NGE(10)                                                  PXS    5
 3            DIMENSION EG(270), E(270), XS(270), Y(270)                         PXS    6
 4            DIMENSION A(7,25,30), P(7,25,30), EP(175), NE(7), NANGS(175)       PXS    7
 5            COMMON A,P,EG,E,XS,NGC,NPC,N2,NB,LLAW,NB2,ES,MAT,AWR,ZA,Y,NANGS,EPPXS    8
             1,NE,NPRS,EL,EU,  NTM,MTP,NFL, ED                                  PXS    9
 6            COMMON  LTS, NMAT                                                  PXS   10
 7            IF (NPC.EQ.15) GO TO 615                                           PXS   11
      C                                                                          PXS   12
      C CHANGE FOR CHLORINE * 1052 IS FOR EXCITATION OF 6.04 MEV LEVEL IN        PXS   13
      C          CL35, BUT 13052 IS FOR 1.728 MEV LEVEL IN CL37.  SIMILARLY FORPXS   14
      C          13053 AND 13054.  SO PUT THESE XS-S IN MT=110.                  PXS   15
      C                                                                          PXS   16
 8            NFL=0                                                              PXS   17
 9            IF (NMAT.EQ.221.AND.(NPC.EQ.52.OR.NPC.EQ.53.OR.NPC.EQ.54)) NFL=1   PXS   18
10            CALL PHO                                                           PXS   19
11            RETURN                                                             PXS   20
12       615  CONTINUE                                                           PXS   21
13            READ (10,725) EL,EU,NCDS,NU,PLAW,NLAW                              PXS   22
      C                                                                          PXS   23
      C     A(I,J,K) = PHOTON ENERGY,  P(I,J,K) = CROSS SECTION (B/EV)           PXS   24
      C                                                                          PXS   25
14            READ (10,730) NE(1),E(1),NGE(1),A(1,1,1),P(1,1,1),A(1,1,2)         PXS   26
15            IF  (MAT.EQ.5001)                    E(1) = 9.05                   PXS   27
16            EL = E1                                                            PXS   28
17            NEC=NE(1)                                                          PXS   29
      C                                                                          PXS   30
      C     READ EP(J) VALUES FROM CARDS FOLLOWING CARD 3 OF 13015. (MEV)        PXS   31
      C                                                                          PXS   32
18            READ (7 ,740) (EP(J),J=1,NEC)                                      PXS   33
19            NG=NGE(1)                                                          PXS   34
20            READ (10,735) P(1,1,2),(A(1,1,K),P(1,1,K),K=3,NG)                  PXS   35
21            DO 620 J=2,NEC                                                     PXS   36
22            READ (10,730) NI,E(J),NGE(J),A(1,J,1),P(1,J,1),A(1,J,2)            PXS   37
23            NG=NGE(J)                                                          PXS   38
24            READ (10,735) P(1,J,2),(A(1,J,K),P(1,J,K),K=3,NG)                  PXS   39
25       620  CONTINUE                                                           PXS   40
      C                                                                          PXS   41
      C     PRINT AND PUNCH IN OPTION 1 OF FILE 15, LF=1.  INTEGRATE BY TRAPE-PXS   42
      C     ZOIDAL RULE TO GET Y(E).                                             PXS   43
      C     INTEGRATION --XS= TOTAL XSEC (B) AT NEUTRON ENERGY E.                PXS   44
      C                                                                          PXS   45
26            DO 630 J=1,NEC                                                     PXS   46
27            XS(J)=0.0                                                          PXS   47
28            NG1=NGE(J)-1                                                       PXS   48
29            DO 625 K=1,NG1                                                     PXS   49
30            XS(J)=XS(J)+(((P(1,J,K)+P(1,J,K+1))*(A(1,J,K+1)-A(1,J,K)))/2.)     PXS   50
```

```
31      625   CONTINUE                                                          PXS  51
              C                                                                 PXS  52
              C     EP(J) IS, HERE , XSEC FROM GCN=1, PCN=15,(VALUES INPUT BY HAND),  PXS  53
              C                                                                 PXS  54
32                  Y(J)=XS(J)/EP(J)                                            PXS  55
33            630   CONTINUE                                                    PXS  56
34                  DO 640 J=1,NEC                                              PXS  57
35                  E(J)=(1.0E+6)*E(J)                                          PXS  58
36                  NG=NGE(J)                                                   PXS  59
37                  DO 635 K=1,NG                                               PXS  60
38                  A(1,J,K)=(1.0E+6)*A(1,J,K)                                  PXS  61
39            635   CONTINUE                                                    PXS  62
40            640   CONTINUE                                                    PXS  63
41                  WRITE (9,780)                                               PXS  64
42                  WRITE (9,775) (EP(J),J=1,NEC)                               PXS  65
43                  WRITE (9,775) (XS(J),J=1,NEC)                               PXS  66
44                  JZ = 0                                                      PXS  67
45                  J1 = 1                                                      PXS  68
46                  J2 = 2                                                      PXS  69
47                  NR = 1                                                      PXS  70
48                  MF = 15                                                     PXS  71
49                  MT = 15                                                     PXS  72
50                  LO = 1                                                      PXS  73
51                  Z = 0.0                                                     PXS  74
52                  NSEQ = 1                                                    PXS  75
53                  WRITE  (11,746)  ZA,AWR,LO,JZ,JZ,J1,MAT,MF,MT,NSEQ          PXS  76
54                  WRITE  ( 9,746)  ZA,AWR,LO,JZ,JZ,J1,MAT,MF,MT,NSEQ          PXS  77
55                  NSEQ=NSEQ+1                                                 PXS  78
56                  WRITE (9,745) Z,Z,JZ,JZ,NR,NEC,MAT,MF,MT,NSEQ               PXS  79
57                  WRITE (11,745) Z,Z,JZ,JZ,NR,NEC,MAT,MF,MT,NSEQ              PXS  80
58                  NSEQ=NSEQ+1                                                 PXS  81
59                  WRITE (9,765) NEC,J2,MAT,MF,MT,NSEQ                         PXS  82
60                  WRITE (11,765) NEC,J2,MAT,MF,MT,NSEQ                        PXS  83
61                  NLINES=NEC/3                                                PXS  84
62                  NLOOP=0                                                     PXS  85
63            645   LL=-2;NLOOP=NLOOP+1                                         PXS  86
64                  NREM=NEC-3*NLINES                                           PXS  87
65                  DO 650 I=1,NLINES                                           PXS  88
66                  NSEQ=NSEQ+1                                                 PXS  89
67                  LL=LL+3                                                     PXS  90
68                  LU=LL+2                                                     PXS  91
69                  WRITE (9,750) (E(J),Y(J),J=LL,LU),MAT,MF,MT,NSEQ            PXS  92
70                  WRITE (11,750) (E(J),Y(J),J=LL,LU),MAT,MF,MT,NSEQ           PXS  93
71            650   CONTINUE                                                    PXS  94
72                  LUP=LU+1;NSEQ=NSEQ+1                                        PXS  95
73                  IF (NREM.EQ.0) GO TO 665                                    PXS  96
74                  IF (NREM.EQ.1) GO TO 655                                    PXS  97
75                  IF (NREM.EQ.2) GO TO 660                                    PXS  98
76                  IF (NREM.NE.0.AND.NREM.NE.1.AND.NREM.NE.2) GO TO 705        PXS  99
77            655   WRITE (9,755) E(NEC),Y(NEC),MAT,MF,MT,NSEQ                  PXS 100
```

```
 78            WRITE (11,755) E(NEC),Y(NEC),MAT,MF,MT,NSEQ                    PXS 101
 79            GO TO 665                                                      PXS 102
 80      660   WRITE (9,760) (E(J),Y(J),J=LUP,NEC),MAT,MF,MT,NSEQ            PXS 103
 81            WRITE (11,760) (E(J),Y(J),J=LUP,NEC),MAT,MF,MT,NSEQ           PXS 104
 82      665   CONTINUE                                                       PXS 105
 83            IF (NLOOP.EQ.2) GO TO 670                                      PXS 106
       C                                                                      PXS 107
       C                                                                      PXS 108
       C     PUNCH TAB1 CARD FOR LF=1 (TABULATED FUNCTION),  RECALL YSUBK(E)= PXS 109
       C     Y(E)  SO USE SAME ROUTINE STARTING AT 331 TO PUNCH TABLE OF      PXS 110
       C     YSUBK(E).                                                        PXS 111
       C                                                                      PXS 112
 84            NSEQ=NSEQ+1                                                    PXS 113
 85            WRITE (9,745) Z,Z,JZ,J1,NR,NEC,MAT,MF,MT,NSEQ                  PXS 114
 86            WRITE (11,745) Z,Z,JZ,J1,NR,NEC,MAT,MF,MT,NSEQ                 PXS 115
 87            NSEQ=NSEQ+1                                                    PXS 116
 88            WRITE (9,765) NEC,J2,MAT,MF,MT,NSEQ                            PXS 117
 89            WRITE (11,765) NEC,J2,MAT,MF,MT,NSEQ                           PXS 118
 90            GO TO 645                                                      PXS 119
 91      670   CONTINUE                                                       PXS 120
       C                                                                      PXS 121
       C     NOW PUNCH TAB2 RECORD (2 CARDS)                                  PXS 122
       C                                                                      PXS 123
 92            NSEQ=NSEQ+1                                                    PXS 124
 93            WRITE (9,745) Z,Z,JZ,JZ,NR,NEC,MAT,MF,MT,NSEQ                 PXS 125
 94            WRITE (11,745) Z,Z,JZ,JZ,NR,NEC,MAT,MF,MT,NSEQ                PXS 126
 95            NSEQ=NSEQ+1                                                    PXS 127
 96            WRITE (9,765) NEC,J2,MAT,MF,MT,NSEQ                            PXS 128
 97            WRITE (11,765) NEC,J2,MAT,MF,MT,NSEQ                           PXS 129
 98            DO 700 J=1,NEC                                                 PXS 130
 99            NSEQ=NSEQ+1                                                    PXS 131
       C                                                                      PXS 132
       C     PUNCH TAB1 RECORD FOR EACH E(J).                                 PXS 133
       C                                                                      PXS 134
100            WRITE (9,745) Z,E(J),JZ,JZ,NR,NGE(J),MAT,MF,MT,NSEQ           PXS 135
101            WRITE(11,745) Z,E(J),JZ,JZ,NR,NGE(J),MAT,MF,MT,NSEQ           PXS 136
102            NSEQ=NSEQ+1                                                    PXS 137
103            WRITE (9,765) NGE(J),J2,MAT,MF,MT,NSEQ                         PXS 138
104            WRITE (11,765) NGE(J),J2,MAT,MF,MT,NSEQ                        PXS 139
       C                                                                      PXS 140
       C     COMPUTE AND PUNCH NORMALIZED TABULATED FUNCTION, G(ESUBG,ESUBI)  PXS 141
       C                                                                      PXS 142
105            NG=NGE(J)                                                      PXS 143
106            NLINES=NG/3                                                    PXS 144
107            NREM=NG-3*NLINES                                               PXS 145
108            LL=-2                                                          PXS 146
109            DO 675 K=1,NG                                                  PXS 147
110            P(1,J,K)=P(1,J,K)/(XS(J)*1.0E+6)                               PXS 148
111     675    CONTINUE                                                       PXS 149
112            DO 680 I=1,NLINES                                              PXS 150
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```
113             NSEQ=NSEQ+1                                                     PXS 151
114             LL=LL+3                                                         PXS 152
115             LU=LL+2                                                         PXS 153
116             WRITE (9,750) (A(1,J,K),P(1,J,K),K=LL,LU),MAT,MF,MT,NSEQ        PXS 154
117             WRITE (11,750) (A(1,J,K),P(1,J,K),K=LL,LU),MAT,MF,MT,NSEQ       PXS 155
118     680     CONTINUE                                                        PXS 156
119             LUP=LU+1                                                        PXS 157
120             IF (NREM.EQ.0) GO TO 695                                        PXS 158
121             NSEQ=NSEQ+1                                                     PXS 159
122             IF (NREM.EQ.1) GO TO 685                                        PXS 160
123             IF (NREM.EQ.2) GO TO 690                                        PXS 161
124             IF (NREM.NE.0.AND.NREM.NE.1.AND.NREM.NE.2) GO TO 705            PXS 162
125     685     WRITE (9,755) A(1,J,NG),P(1,J,NG),MAT,MF,MT,NSEQ                PXS 163
126             WRITE (11,755) A(1,J,NG),P(1,J,NG),MAT,MF,MT,NSEQ               PXS 164
127             GO TO 695                                                       PXS 165
128     690     WRITE (9,760) (A(1,J,K),P(1,J,K),K=LUP,NG),MAT,MF,MT,NSEQ       PXS 166
129             WRITE (11,760) (A(1,J,K),P(1,J,K),K=LUP,NG),MAT,MF,MT,NSEQ      PXS 167
130     695     CONTINUE                                                        PXS 168
131     700     CONTINUE                                                        PXS 169
        C                                                                       PXS 170
        C       PUNCH SEND CARD                                                 PXS 171
        C                                                                       PXS 172
132             NSEQ=NSEQ+1                                                     PXS 173
133             WRITE (9,785) MAT,MF,JZ,NSEQ                                    PXS 174
134             WRITE (11,785) MAT,MF,JZ,NSEQ                                   PXS 175
135             GO TO 710                                                       PXS 176
136     705     WRITE (9,770)                                                   PXS 177
137     710     RETURN                                                          PXS 178
138     725     FORMAT (E11.4,E12.5,2I12,E12.5,I12)                             PXS 179
139     730     FORMAT (I11,E12.5,I12,3E12.5)                                   PXS 180
140     735     FORMAT (E11.4,5E12.5)                                           PXS 181
141     740     FORMAT (6E12.5)                                                 PXS 182
142     745     FORMAT (1P2E11.4,4I11,I4,I2,I3,I5)                              PXS 183
143     746     FORMAT (F11.1, 1PE11.4, 4I11, I4, I2, I3, I5)                   PXS 184
144     750     FORMAT (1P6E11.4,I4,I2,I3,I5)                                   PXS 185
145     755     FORMAT (1P2E11.4,44X,I4,I2,I3,I5)                               PXS 186
146     760     FORMAT (1P4E11.4,22X,I4,I2,I3,I5)                               PXS 187
147     765     FORMAT (2I11,44X,I4,I2,I3,I5)                                   PXS 188
148     770     FORMAT (30HYOUR LINE-COUNT ROUTINE STINKS)                      PXS 189
149     775     FORMAT (1H0,6E12.5)                                             PXS 190
150     780     FORMAT (1H1)                                                    PXS 191
151     785     FORMAT  (66X,I4,I2,I3,I5)                                       PXS 192
152             END                                                             PXS 193-
```

SUBROUTINE PRODXS

SYMBOL	REFERENCES									
615	7	12*								
620	21	25*								
625	29	31*								
630	26	33*								
635	37	39*								
640	34	40*								
645	63*	90								
650	65	71*								
655	74	77*								
660	75	80*								
665	73	79	82*							
670	83	91*								
675	109	111*								
680	112	118*								
685	122	125*								
690	123	128*								
695	120	127	130*							
700	98	131*								
705	76	124	136*							
710	135	137*								
725	13RD	138*								
730	14RD	22RD	139*							
735	20RD	24RD	140*							
740	18RD	141*								
745	56WR	57WR	85WR	86WR	93WR	94WR	100WR	101WR	142*	
746	53WR	54WR	143*							
750	69WR	70WR	116WR	117WR	144*					
755	77WR	78WR	125WR	126WR	145*					
760	80WR	81WR	128WR	129WR	146*					
765	59WR	60WR	88WR	89WR	96WR	97WR	103WR	104WR	147*	
770	136WR	148*								
775	42WR	43WR	149*							
780	41WR	150*								
785	133WR	134WR	151*							
A	4DI	5CO	14RD	20RD	22RD	24RD	30	38=	116WR	117WR
	125WR	126WR	128WR	129WR						
AWR	5CO	53WR	54WR							
E	3DI	5CO	14RD	15=	22RD	35=	69WR	70WR	77WR	78WR
	80WR	81WR	100WR	101WR						
E1	16									
ED	5CO									
EG	3DI	5CO								
EL	5CO	13RD	16=							
EP	4DI	5CO	18RD	32	42WR					
ES	5CO									
EU	5CO	13RD								
I	65	112								
J	18RD	21	22RD	23	24RD	26	27	28	30	32

SUBROUTINE PRODXS

NPRS	-	5C0								
NR	-	47=	56WR	57WR	85WR	86WR	93WR	94WR	100WR	101WR	
NREM	-	64=	73	74	75	76	107=	120	122	123	124
NSEQ	-	52=	53WR	54WR	55=	56WR	57WR	58=	59WR	60WR	66=
		69WR	70WR	77WR	78WR	80WR	81WR	84=	85WR	86WR	87=
		88WR	89WR	92=	93WR	94WR	95=	96WR	97WR	99=	100WR
		101WR	102=	103WR	104WR	113=	116WR	117WR	121=	125WR	126WR
		128WR	129WR	132=	133WR	134WR					
NTM	-	5C0									
NU	-	13RD									
P	-	4DI	5C0	14RD	20RD	22RD	24RD	30	110=	116WR	117WR
		125WR	126WR	128WR	129WR						
PHO	-	10									
PLAW	-	13RD									
PRODXS	-	1									
RETURN	-	11	137								
XS	-	3DI	5C0	27=	30=	32	43WR	110			
Y	-	3DI	5C0	32=	69WR	70WR	77WR	78WR	80WR	81WR	
Z	-	51=	56WR	57WR	85WR	86WR	93WR	94WR	100WR	101WR	
ZA	-	5C0	53WR	54WR							

```
1            SUBROUTINE SKIPTOP(NMAT)                                                SKP    1
2            DIMENSION B(32760)                                                      SKP    2
3            READ (7,5) N                                                            SKP    3
4       1    IF (N .LE. 2340) GO TO 2                                                SKP    4
5            READ (10,6) (B(I),I=1,32760)                                            SKP    5
6            N = N - 2340                                                            SKP    6
7            GO TO 1                                                                 SKP    7
8       2    N = N*14                                                                SKP    8
9            READ (10,6) (B(I),I=1,N)                                                SKP    9
10      3    READ (10,7,END=4) GCN, PCN, (B(I),I=1,11), NM, B(12)                    SKP   10
11           NCG=IFIX(GCN)                                                           SKP   11
12           NCP=IFIX(PCN)                                                           SKP   12
13           IF (NM.NE.NMAT .OR. NCP.EQ.0 .OR. (NCG.NE.11 .AND. NCG.NE.12 .AND.SKP   13
            XNGC.NE.13)) GO TO 3                                                     SKP   14
14           BACKSPACE 10                                                            SKP   15
15           RETURN                                                                  SKP   16
16      4    WRITE (9,8)                                                             SKP   17
17           STOP                                                                    SKP   18
18      5    FORMAT (I6)                                                             SKP   19
19      6    FORMAT (13A6,A2)                                                        SKP   20
20      7    FORMAT (F8.0,F3.0, 10A6, A1, I3, A5)                                    SKP   21
21      8    FORMAT (5X, 24HMATERIAL IS NOT ON TAPE.)                                SKP   22
22           END                                                                     SKP   23-
```

SUBROUTINE SKIPTOP(NMAT)

SYMBOL		REFERENCES				
1	-	4*	7			
2	-	4	8*			
3	-	10*	13			
4	-	16*				
5	-	3RD	18*			
6	-	5RD	9RD	19*		
7	-	10RD	20*			
8	-	16WR	21*			
B	-	2DI	5RD	9RD	10RD	
END	-	10RD				
GCN	-	10RD	11			
I	-	5RD	9RD	10RD		
IFIX	-	11	12			
N	-	3RD	4	6=	8=	9RD
NCG	-	11=	13			
NCP	-	12=	13			
NGC	-	13				
NM	-	10RD	13			
NMAT	-	1AG	13			
PCN	-	10RD	12			
RETURN	-	15				
SKIPTOP	-	1				
STOP	-	17				

APPENDIX B

```
      C
      C++++++++++++++++++++++++++++++++++  LATEX  ++++++++++++++++++++++++++++
      C                                                                      LAT    1
      C          WRITTEN BY**   DONALD J. DUDZIAK                           LAT    2
      C                         UNIVERSITY OF CALIFORNIA                     LAT    3
      C                         LOS ALAMOS SCIENTIFIC LABORATORY             LAT    4
      C                         LOS ALAMOS, NM  87544                        LAT    5
      C     THIS PROGRAM TRANSFORMS CROSS SECTIONS FROM DRAKE TO THE FORM     LAT    6
      C     REQUIRED BY *ENDF/B*                                             LAT    7
      C     1.      MT=TYPE OF REACTION (SEE APPENDIX *B* OF HONECK*S REPORT  LAT    8
      C              ON ENDF/B,BNL-50066).                                   LAT    9
      C     2.      LIN = MAT NUMBER                                         LAT   10
      C     3.      NPAREJA=NUMBER OF DATA PAIRS                             LAT   11
      C     4.      MT=4 USES ANGULO AND AVERIA                              LAT   12
      C     5.      MT=5 USES ENERGIA                                        LAT   13
      C     6.      SHUFL SUBROUTINE REARRANGES DATA TO MODE3 ENDF/B TAPE.   LAT   14
      C                                                                      LAT   15
            DIMENSION E(2000), XS(2000), PAL(8)                              LAT   16
            DIMENSION EMUBAR(300), BARMUL(300)                               LAT   17
            COMMON NINC,NE,NP,EIN,ENEXT,EL,EU,NTOT,LAW,NPNEXT,JT             LAT   18
            COMMON NPAREJA,E,XS,PE,N,GMU,LIN,IFILE,MT,NU,NPRIMO              LAT   19
            COMMON ZA,AWR,N0,N1,N2,N5,XXA,KK,INT,NMAT                        LAT   20
            COMMON EMUBAR,BARMUL,NMU                                         LAT   21
            XXA=0.                                                           LAT   22
            MMM=0                                                            LAT   23
            N0=0                                                             LAT   24
            N1=1                                                             LAT   25
            NPRIMO=1                                                         LAT   26
            N2=2                                                             LAT   27
            N3=3                                                             LAT   28
            N5=5                                                             LAT   29
            N99=99                                                           LAT   30
            READ (8,275) BASURA                                              LAT   31
      C                                                                      LAT   32
      C     READ ZA, AWR, NMAT(DRAKE NO), LIN(ENDF/B MAT NO)                 LAT   33
      C                                                                      LAT   34
   15 CONTINUE                                                             LAT   35
            READ (10, 335, END=195) ZA, AWR, NMAT, LIN, (PAL(K),K=1,7)       LAT   36
            WRITE  (9,336)  ZA, AWR, NMAT, LIN, (PAL(K), K=1,7)              LAT   37
            CALL SKPMAT (NMAT)                                               LAT   38
   35 READ (8, 285, END=165) IFILE, MT, NE, Q, INT                          LAT   39
      C                                                                      LAT   40
      C     IF PHOTON FILE IS FOUND, GO WRITE MT=3, MF=251.  THEN SEARCH     LAT   41
      C     TAPE FOR NEXT MATERIAL.                                          LAT   42
      C                                                                      LAT   43
   22       IF (IFILE.NE.1.AND.IFILE.NE.2.AND.IFILE.NE.3) GO TO 165          LAT   44
      C                                                                      LAT   45
      C     TEMPORARY IF TO CORRECT ERROR IN TAPE                            LAT   46
      C                                                                      LAT   47
   23       IF (Q.EQ.-0.0) Q=0.0                                             LAT   48
```

```
24              Q=Q*1.0E+6                                                      LAT  49
25              JT=0                                                            LAT  50
26              IFILE=IFILE+2                                                   LAT  51
27              IF (IFILE.NE.5) GO TO 55                                        LAT  52
28              IF (NE.NE.1) WRITE (9,205)                                      LAT  53
29              READ (8,345) EL,EU,NTOT,LAW                                     LAT  54
30              EL=EL*1.0E+6                                                    LAT  55
31              EU=EU*1.0E+6                                                    LAT  56
32              READ (8,355) NINC,EIN,NP,E(1),XS(1),E(2)                        LAT  57
33              NE=NINC                                                         LAT  58
34        55    CONTINUE                                                        LAT  59
35              IF (NE .EQ. 0 .AND. IFILE .EQ. 4) NE=1                          LAT  60
36              DO 145 KK=1,NE                                                  LAT  61
37              IF (IFILE.NE.4) GO TO 65                                        LAT  62
38              CALL ANGULO                                                     LAT  63
39              IF  (NE. EQ. 1)                    GO TO 155                    LAT  64
          C                                                                     LAT  65
          C     TEMPORARY IF.                                                   LAT  66
          C     ELIMINATE ANGULAR DISTRIBUTIONS FOR INCIDENT ENERGY BELOW THRESH. LAT  67
          C                                                                     LAT  68
40              IF (NMAT.EQ.205.AND.IFILE.EQ.4.AND.(MT.EQ.10.OR.MT.EQ.12.OR.MT.EQ.LAT  69
               113.OR.MT.EQ.14.OR.MT.EQ.51.OR.MT.EQ.52.OR.MT.EQ.54).AND.KK.EQ.2) GLAT  70
               20 TO 145                                                        LAT  71
41              GO TO 95                                                        LAT  72
42        65    IF (IFILE.NE.5) GO TO 75                                        LAT  73
          C                                                                     LAT  74
          C     ENERGIA ASSUMES TABULATED SEC. ENERGY DISTR. (UK-DRAKE LAW 8)   LAT  75
          C                                                                     LAT  76
43              CALL ENERGIA                                                    LAT  77
44              GO TO 105                                                       LAT  78
45        75    READ (8,295) NPAREJA                                            LAT  79
46              READ (8,215) (E(K),XS(K),K=1,NPAREJA)                           LAT  80
          C                                                                     LAT  81
          C  TEMPORARY IF TO CORRECT CA DATA FOR INEL. SCAT. TO CONTINUUM       LAT  82
          C                                                                     LAT  83
47              IF (NMAT .EQ. 231 .AND. MT .EQ. 15)          XS(2)=0.2387       LAT  84
48              IF (MT.EQ.1) EUNO=E(1)*1.0E+6                                   LAT  85
49              DO 85 K=1,NPAREJA                                               LAT  86
50              E(K)=(1.0E+6)*(E(K))                                            LAT  87
51        85    CONTINUE                                                        LAT  88
52        95    CONTINUE                                                        LAT  89
53              IF (IFILE.NE.3) GO TO 105                                       LAT  90
          C                                                                     LAT  91
          C     WRITE HEAD CARD, ETC FOR FILE 3.                                LAT  92
          C                                                                     LAT  93
54              NU=1                                                            LAT  94
55              WRITE (12,265) ZA,AWR,NO,N99,NO,NO,LIN,IFILE,MT,NU              LAT  95
56              WRITE (9,265) ZA,AWR,NO,N99,NO,NO,LIN,IFILE,MT,NU               LAT  96
57              NU=2                                                            LAT  97
58              WRITE (12,255) XXA,Q,NO,NO,N1,NPAREJA,LIN,IFILE,MT,NU           LAT  98
```

```
      C     WRITE (9,255) XXA,Q,NO,NO,N1,NPAREJA,LIN,IFILE,MT,NU                LAT  99
59          NU=3                                                                LAT 100
60          WRITE (12,325) NPAREJA,N5,LIN,IFILE,MT,NU                           LAT 101
      C     WRITE (9,325) NPAREJA,N5,LIN,IFILE,MT,NU                            LAT 102
61    105   CONTINUE                                                            LAT 103
62          YY=3.0                                                              LAT 104
63          ANT=(FLOAT(NPAREJA))/YY                                             LAT 105
64          NT=IFIX(ANT)                                                        LAT 106
65          BNT=FLOAT(NT)                                                       LAT 107
66          DIFF=ANT-BNT+0.01                                                   LAT 108
67          L=-2                                                                LAT 109
68          DO 115 K=1,NT                                                       LAT 110
69          L=L+3                                                               LAT 111
70          L2=L+2                                                              LAT 112
71          NU=NU+1                                                             LAT 113
72          WRITE (12,225) (E(I),XS(I),I=L,L2),LIN,IFILE,MT,NU                  LAT 114
      C     WRITE (9,225) (E(I),XS(I),I=L,L2),LIN,IFILE,MT,NU                   LAT 115
73    115   CONTINUE                                                            LAT 116
74          IF (DIFF.LE.0.1) GO TO 135                                          LAT 117
75          NULT=(IFIX(3.0*DIFF))-1                                             LAT 118
76          NU=NU+1                                                             LAT 119
77          IF (NULT.EQ.1) GO TO 125                                            LAT 120
78          WRITE (12,235) E(NPAREJA),XS(NPAREJA),LIN,IFILE,MT,NU               LAT 121
      C     WRITE (9,235) E(NPAREJA),XS(NPAREJA),LIN,IFILE,MT,NU                LAT 122
79          GO TO 135                                                           LAT 123
80    125   CONTINUE                                                            LAT 124
81          NB=NPAREJA-1                                                        LAT 125
82          WRITE (12,245) (E(I),XS(I),I=NB,NPAREJA),LIN,IFILE,MT,NU            LAT 126
      C     WRITE (9,245) (E(I),XS(I),I=NB,NPAREJA),LIN,IFILE,MT,NU             LAT 127
83    135   CONTINUE                                                            LAT 128
84          IF (MT.EQ.251) GO TO 155                                            LAT 129
85          IF (IFILE.EQ.4) CALL AVERIA                                         LAT 130
86    145   CONTINUE                                                            LAT 131
87    155   CONTINUE                                                            LAT 132
      C                                                                         LAT 133
      C     WRITE SEND CARD.                                                    LAT 134
      C                                                                         LAT 135
88          NU=NU+1                                                             LAT 136
89          WRITE (12,315) LIN,IFILE,NU                                         LAT 137
      C     WRITE (9,315) LIN,IFILE,NU                                          LAT 138
90          IF (MT.EQ.251) GO TO 185                                            LAT 139
91          GO TO 35                                                            LAT 140
92    165   CONTINUE                                                            LAT 141
      C                                                                         LAT 142
      C     WRITE FILE3, MT=251 DATA FOR MUBAR/LAB VS ENERGY                    LAT 143
      C                                                                         LAT 144
93          IFILE=3                                                             LAT 145
94          MT=251                                                              LAT 146
95          NMU=NMU+2                                                           LAT 147
96          NU=1                                                                LAT 148
```

```
 97             WRITE (12,26 5) ZA,AWR,NU,N99,NO,NO,LIN,IFILE,MT,NU                LAT 149
       C        WRITE (9,265) ZA,AWR,NO,N99,NO,NO,LIN,IFILE,MT,NU                  LAT 150
 98             NU=2                                                               LAT 151
 99             WRITE (12,255) XXA,XXA,NO,NO,N1,NMU,LIN,IFILE,MT,NU                LAT 152
       C        WRITE (9,255) XXA,XXA,NO,NO,N1,NMU,LIN,IFILE,MT,NU                 LAT 153
100             NU=3                                                               LAT 154
101             WRITE (12,325) NMU,N3,LIN,IFILE,MT,NU                              LAT 155
       C        WRITE (9,325) NMU,N3,LIN,IFILE,MT,NU                               LAT 156
102             NPAREJA=NMU                                                        LAT 157
103             E(1)=EUNO                                                          LAT 158
104             XS(1)=2.0/(3.0*AWR)                                                LAT 159
105             XS(2)=XS(1)                                                        LAT 160
106             DO 175 I=3,NMU                                                     LAT 161
107             E(I)=EMUBAR(I-2)                                                   LAT 162
108             XS(I)=BARMUL(I-2)                                                  LAT 163
109      175    CONTINUE                                                           LAT 164
110             E(2)=0.75*E(3)                                                     LAT 165
111             GO TO 105                                                          LAT 166
112      185    CONTINUE                                                           LAT 167
               C                                                                  LAT 168
               C      WRITE MEND (END OF MATERIAL) CARD                           LAT 169
               C                                                                  LAT 170
113             WRITE (12,315) NO,NO,NO                                            LAT 171
114             WRITE (9,315) NO,NO,NO                                             LAT 172
115             ENDFILE 12                                                         LAT 173
116             CALL SHUFL                                                         LAT 174
117             GO TO 15                                                           LAT 175
118      195    STOP                                                               LAT 176
119      205    FORMAT (1H1,32H ONLY ONE ENERGY RANGE, OLD BOY )                   LAT 177
120      215    FORMAT (E11.5,5E12.5,9X)                                           LAT 178
121      225    FORMAT (1P6E11.4,I4,I2,I3,I5)                                      LAT 179
122      235    FORMAT (1P2E11.4,44X,I4,I2,I3,I5)                                  LAT 180
123      245    FORMAT (1P4E11.4,22X,I4,I2,I3,I5)                                  LAT 181
124      255    FORMAT (1P2E11.4,4I11,I4,I2,I3,I5)                                 LAT 182
125      265    FORMAT (F11.1,1PE11.4,4I11,I4,I2,I3,I5)                            LAT 183
126      275    FORMAT (A10)                                                       LAT 184
127      285    FORMAT (I8,I3,I12,E12.5,I12)                                       LAT 185
128      295    FORMAT (55X,I4)                                                    LAT 186
129      305    FORMAT (1H1,8A6///)                                                LAT 187
130      315    FORMAT (66X,I4,I2,3H  0,I5)                                        LAT 188
131      325    FORMAT (2I11,44X,I4,I2,I3,I5)                                      LAT 189
132      335    FORMAT (2E12.5,216,7A6)                                            LAT 190
133      336    FORMAT  (1H1, 2E12.5, 2I6, 7A6)                                    LAT 191
134      345    FORMAT (E11.4,E12.5,[12,24X,I12)                                   LAT 192
135      355    FORMAT (I11,E12.5,I12,3E12.5)                                      LAT 193
136             END                                                                LAT 194-
```

SYMBOL = = = = = = = = = = = = = = = = REFERENCES = = = = = = = = = = = = = = = =

```
15      -    17*    117
35      -    21*     91
55      -    27      34*
65      -    37      42*
75      -    42      45*
85      -    49      51*
95      -    41      52*
105     -    44      53      61*     111
115     -    68      73*
125     -    77      80*
135     -    74      79      83*
145     -    36      40      86*
155     -    39      84      87*
165     -    22      92*
175     -   106     109*
185     -    90     112*
195     -   118*
205     -    28WR   119*
215     -    46RD   120*
225     -    72WR   121*
235     -    78WR   122*
245     -    82WR   123*
255     -    58WR    99WR   124*
265     -    55WR    56WR    97WR   125*
275     -    16RD   126*
285     -    21RD   127*
295     -    45RD   128*
305     -   129*
315     -    89WR   113WR   114WR   130*
325     -    60WR   101WR   131*
335     -    18RD   132*
336     -    19WR   133*
345     -    29RD   134*
355     -    32RD   135*
ANGULO  -    38
ANT     -    63=     64      66
AVERIA  -    85
AWR     -     5CO    18RD    19WR    55WR    56WR    97WR   104
BARMUL  -     2DI     6CO   108
BASURA  -    16RD
BNT     -    65=     66
DIFF    -    66=     74      75
E       -     1DI     4CO    32RD    46RD    48      50=     72WR    78WR    82WR   103=
             107=    110=
EIN     -     3CO    32RD
EL      -     3CO    29RD    30=
EMUBAR  -     2DI     6CO   107
END     -    18RD    21RD
```

```
SKPMAT  -    20
STOP    -   118
XS      -    101     4C0    32RD    46RD    47=     72WR    78WR    82WR   104=    105=
            108=
XXA     -    5C0     7=     58WR    99WR
YY      -    62=    63
ZA      -    5C0    18RD    19WR    55WR    56WR    97WR
```

SUBROUTINE ANGULO

```
      SUBROUTINE ANGULO                                                  ANG   1
C                                                                        ANG   2
C         WRITTEN BY**   DONALD J. DUDZIAK                               ANG   3
C                                                                        ANG   4
      DIMENSION E(2000), XS(2000)                                        ANG   5
      COMMON NINC,NE,NP,EIN,ENEXT,EL,EU,NTOT,LAW,NPNEXT,JT               ANG   6
      COMMON NPAREJA,E,XS,PE,N,GMU,LIN,IFILE,MT,NU,NPRIMO                ANG   7
      COMMON ZA,AWR,NO,N1,N2,N5,XXA,KK,INT,NMAT                          ANG   8
      COMMON EMUBAR,BARMUL,NMU                                           ANG   9
      N3=3                                                               ANG  10
      IF (KK.NE.1) GO TO 210                                             ANG  11
C                                                                        ANG  12
C     WRITE HEAD CARD ASSUMING TABULATION AND NO TRANSFORMATION MATRIX.  ANG  13
C                                                                        ANG  14
      NU=1                                                               ANG  15
      WRITE (12,280) ZA,AWR,NO,N2,NO,NO,LIN,IFILE,MT,NU                  ANG  16
      WRITE (9,280) ZA,AWR,NO,N2,NO,NO,LIN,IFILE,MT,NU                   ANG  17
C                                                                        ANG  18
C     FOR ANGULAR DISTRIBUTION, INT=1 IS CM SYSTEM, INT=2 IS LAB SYSTEM  ANG  19
C                                                                        ANG  20
      LCT=2                                                              ANG  21
      IF (INT.EQ.1) LCT=2                                                ANG  22
      IF (INT.EQ.2) LCT=1                                                ANG  23
C                                                                        ANG  24
C     WRITE CONT CARD .  LCT=2 MEANS CM SYSTEM, =1 MEANS LAB SYSTEM.     ANG  25
C                                                                        ANG  26
      NU=2                                                               ANG  27
      WRITE (12,270) XXA,XXA,NO,LCT,NO,NO,LIN,IFILE,MT,NU                ANG  28
C     WRITE (9,270) XXA,XXA,NO,LCT,NO,NO,LIN,IFILE,MT,NU                 ANG  29
      ND=NE                                                              ANG  30
C                                                                        ANG  31
C     TEMPORARY IF.                                                      ANG  32
C                                                                        ANG  33
      IF (NMAT.EQ.205.AND.IFILE.EQ.4.AND.(MT.EQ.10.OR.MT.EQ.12.OR.MT.EQ.ANG  34
     113.OR.MT.EQ.14.OR.MT.EQ.51.OR.MT.EQ.52.OR.MT.EQ.54)) ND=NE-1       ANG  35
      NU=3                                                               ANG  36
C                                                                        ANG  37
C     WRITE TAB2 CARDS ASSUMING LINEAR-LN INTERPOLATION IN ENERGY.       ANG  38
C                                                                        ANG  39
      IF  (NE .EQ. 1)                    ND=2                            ANG  40
C                                                                        ANG  41
C  FOR ISOTROPIC DISTRIBUTION USE 2 ENERGIES (NE=2) FROM EXTREMES AS     ANG  42
C         GIVEN IN FILE 3.                                               ANG  43
C                                                                        ANG  44
      WRITE (12,270) XXA,XXA,NO,NO,N1,ND,LIN,IFILE,MT,NU                 ANG  45
C     WRITE (9,270) XXA,XXA,NO,NO,N1,ND,LIN,IFILE,MT,NU                  ANG  46
      NU=4                                                               ANG  47
      WRITE (12,290) ND,N3,LIN,IFILE,MT,NU                               ANG  48
C     WRITE (9,290) ND,N3,LIN,IFILE,MT,NU                                ANG  49
  210 CONTINUE                                                           ANG  50
```

```
      C                                                                      ANG  51
      C  ISOTROPIC ROUTINE FOR NE=1 EXTENDS TO STATEMENT 212.                ANG  52
      C                                                                      ANG  53
25          IF  (NE .NE. 1)                    GO TO 212                   ANG  54
26          NU=5                                                           ANG  55
27          WRITE  (12,270)  XXA,E(1),NO,NO,N1,N2,LIN,IFILE,MT,NU          ANG  56
      C     WRITE  ( 9,270)  XXA,E(1),NO,NO,N1,N2,LIN,IFILE,MT,NU          ANG  57
28          NU=6                                                           ANG  58
29          WRITE  (12,290)  N2,N2,LIN,IFILE,MT,NU                         ANG  59
      C     WRITE  (9,290)  N2,N2,LIN,IFILE,MT,NU                          ANG  60
30          NU=7                                                           ANG  61
31          UNO=1.0                                                        ANG  62
32          HAF=0.5                                                        ANG  63
33          UNOM=-1.0                                                      ANG  64
34          WRITE  (12,295)  UNOM, HAF, UNO,  HAF, LIN, IFILE, MT, NU      ANG  65
      C     WRITE  (9,295)  UNOM, HAF, UNO, HAF, LIN, IFILE, MT, NU        ANG  66
35          NU=8                                                           ANG  67
36          WRITE  (12,270)  XXA,E(NPAREJA),NO,NO,N1,N2,LIN,IFILE,MT,NU    ANG  68
      C     WRITE  (9,270)  XXA,E(NPAREJA),NO,NO,N1,N2,LIN,IFILE,MT,NU     ANG  69
37          NU=9                                                           ANG  70
38          WRITE  (12,290)  N2,N2,LIN,IFILE,MT,NU                         ANG  71
      C     WRITE  ( 9,290)  N2,N2,LIN,IFILE,MT,NU                         ANG  72
39          NU=10                                                          ANG  73
      C     WRITE  (9,295)  UNOM, HAF, UNO, HAF, LIN, IFILE, MT, NU        ANG  74
40          RETURN                                                         ANG  75
41    212   CONTINUE                                                       ANG  76
42          READ (8,250) PE,NPAREJA                                        ANG  77
43          READ (8,260) (E(I),XS(I),I=1,NPAREJA)                          ANG  78
      C                                                                    ANG  79
      C     TEMPORARY IF.                                                  ANG  80
      C                                                                    ANG  81
44          IF (NMAT.EQ.205.AND.IFILE.EQ.4.AND.(MT.EQ.10.OR.MT.EQ.12.OR.MT.EQ.ANG  82
           113.OR.MT.EQ.14.OR.MT.EQ.51.OR.MT.EQ.52.OR.MT.EQ.54).AND.KK.EQ.2) GANG  83
           20 TO 240                                                       ANG  84
45          PE=PE*1.0E+6                                                   ANG  85
      C                                                                    ANG  86
      C     WRITE TAB1 CARDS ASSUMING LINEAR-LINEAR INTERPOLATION IN MU(=COS) ANG  87
      C                                                                    ANG  88
46          NU=NU+1                                                        ANG  89
47          WRITE (12,270) XXA,PE,NO,NO,N1,NPAREJA,LIN,IFILE,MT,NU         ANG  90
      C     WRITE (9,270) XXA,PE,NO,NO,N1,NPAREJA,LIN,IFILE,MT,NU          ANG  91
48          NU=NU+1                                                        ANG  92
49          WRITE (12,290) NPAREJA,N2,LIN,IFILE,MT,NU                      ANG  93
      C     WRITE (9,290) NPAREJA,N2,LIN,IFILE,MT,NU                       ANG  94
      C                                                                    ANG  95
      C     INTEGRATE ANGULAR DISTRIBUTION (LINEAR-LINEAR) OVER MU (E(I))  ANG  96
      C     AND DIVIDE INTO PROBABILITIES (XS(I)) TO NORMALIZE.            ANG  97
      C                                                                    ANG  98
50          ANS=0.0                                                        ANG  99
51          DO 220 I=2,NPAREJA                                             ANG 100
```

SUBROUTINE ANGULO

```
52          X3=E(I-1)                                                    ANG 101
53          X4=E(I)                                                      ANG 102
54          Y3=XS(I-1)                                                   ANG 103
55          Y4=XS(I)                                                     ANG 104
56          B=(Y4-Y3)/(X4-X3)                                            ANG 105
57          A=Y3-B*X3                                                    ANG 106
58          AN=(X4-X3)*(A+0.5*B*(X4+X3))                                 ANG 107
59          ANS=ANS+AN                                                   ANG 108
60    220   CONTINUE                                                     ANG 109
61          WRITE (9,270) ANS                                            ANG 110
62          DO 230 I=1,NPAREJA                                           ANG 111
63          XS(I)=XS(I)/ANS                                              ANG 112
64    230   CONTINUE                                                     ANG 113
65    240   CONTINUE                                                     ANG 114
66          RETURN                                                       ANG 115
67    250   FORMAT (E11.5,48X,I12)                                       ANG 116
68    260   FORMAT (E11.5,5E12.5,9X)                                     ANG 117
69    270   FORMAT (1P2E11.4,4I11,I4,I2,I3,I5)                           ANG 118
70    280   FORMAT (F11.1,1PE11.4,4I11,I4,I2,I3,I5)                      ANG 119
71    290   FORMAT (2I11,44X,I4,I2,I3,I5)                                ANG 120
72    295   FORMAT  (1P4E11.4, 22X, I4, I2, I3, I5)                      ANG 121
73          END                                                          ANG 122-
```

SUBROUTINE ANGULO

SYMBOL = = = = = = = = = = = = = = = REFERENCES = = = = = = = = = = = = = = =

210	-	8	24*							
212	-	25	41*							
220	-	51	60*							
230	-	62	64*							
240	-	44	65*							
250	-	42RD	67*							
260	-	43RD	68*							
270	-	16WR	21WR	27WR	36WR	47WR	61WR	69*		
280	-	10WR	11WR	70*						
290	-	23WR	29WR	38WR	49WR	71*				
295	-	34WR	72*							
A	-	57=	58							
AN	-	58=	59							
ANGULO	-	1								
ANS	-	50=	59=	61WR	63					
AWR	-	5CO	10WR	11WR						
B	-	56=	57	58						
BARMUL	-	6CO								
E	-	2DI	4CO	27WR	36WR	43RD	52	53		
EIN	-	3CO								
EL	-	3CO								
EMUBAR	-	6CO								
ENEXT	-	3CO								
EU	-	3CO								
GMU	-	4CO								
HAF	-	32=	34WR							
I	-	43RD	51	52	53	54	55	62	63	
IFILE	-	4CO	10WR	11WR	16WR	18	21WR	23WR	27WR	29WR
		34WR	36WR	38WR	44	47WR	49WR			
INT	-	5CO	13	14						
JT	-	3CO								
KK	-	5CO	8	44						
LAW	-	3CO								
LCT	-	12=	13=	14=	16WR					
LIN	-	4CO	10WR	11WR	16WR	21WR	23WR	27WR	29WR	34WR
		36WR	38WR	47WR	49WR					
MT	-	4CO	10WR	11WR	16WR	18	21WR	23WR	27WR	29WR
		34WR	36WR	38WR	44	47WR	49WR			
N	-	4CO								
NO	-	5CO	10WR	11WR	16WR	21WR	27WR	36WR	47WR	
N1	-	5CO	21WR	27WR	36WR	47WR				
N2	-	5CO	10WR	11WR	27WR	29WR	36WR	38WR	49WR	
N3	-	7=	23WR							
N5	-	5CO								
ND	-	17=	18=	20=	21WR	23WR				
NE	-	3CO	17	18	20	25				
NINC	-	3CO								
NMAT	-	5CO	18	44						

SUBROUTINE ANGULO

NMU	-	6CO									
NP	-	3CO									
NPAREJA	-	4CO	36WR	42RD	43RD	47WR	49WR	51	62		
NPNEXT	-	3CO									
NPRIMO	-	4CO									
NTOT	-	3CO									
NU	-	4CO	9=	10WR	11WR	15=	16WR	19=	21WR	22=	23WR
		26=	27WR	28=	29WR	30=	34WR	35=	36WR	37=	38WR
		39=	46=	47WR	48=	49WR					
PE	-	4CO	42RD	45=	47WR						
RETURN	-	40	66								
UNO	-	31=	34WR								
UNOM	-	33=	34WR								
X3	-	52=	56	57	58						
X4	-	53=	56	58							
XS	-	2DI	4CO	43RD	54	55	63=				
XXA	-	5CO	16WR	21WR	27WR	36WR	47WR				
Y3	-	54=	56	57							
Y4	-	55=	56								
ZA	-	5CO	10WR	11WR							

SUBROUTINE AVERIA

```
 1            SUBROUTINE AVERIA                                                  AVG   1
      C                                                                          AVG   2
      C          WRITTEN BY**   DONALD J. DUDZIAK                                AVG   3
      C     THIS SUBRT. CALCULATES MU-BAR IN LAB SYSTEM FROM TABULATED ANGULARAVG   4
      C     DISTRIBUTION IN CM SYSTEM.                                           AVG   5
      C                                                                          AVG   6
 2            DIMENSION E(2000), XS(2000), ETA(99)                               AVG   7
 3            DIMENSION EMUBAR(300), BARMUL(300)                                 AVG   8
 4            COMMON NINC,NE,NP,LIN,ENEXT,EL,EU,NTOT,LAW,NPNEXT,JT               AVG   9
 5            COMMON NPAREJA,E,XS,PE,N,GMU,LIN,IFILE,MT,NU,NPRIMO                AVG  10
 6            COMMON ZA,AWR,N0,N1,N2,N5,XXA,KK,INT,NMAT                          AVG  11
 7            COMMON EMUBAR,BARMUL,NMU                                           AVG  12
      C                                                                          AVG  13
      C     CALCULATE MU-BAR (GMU)                                               AVG  14
      C                                                                          AVG  15
 8            GMU=0.0                                                            AVG  16
 9            A=AWR                                                              AVG  17
10            DO 410 I=1,NPAREJA                                                 AVG  18
11            ETA(I)=E(I)                                                        AVG  19
12            TOP=(A*E(I))+1.0                                                   AVG  20
13            BOT=SQRT(A*A+2*A*E(I)+1.0)                                         AVG  21
14            E(I)=TOP/BOT                                                       AVG  22
15       410  CONTINUE                                                          AVG  23
      C                                                                          AVG  24
      C     SIMPSON*S RULE FOR INTEGRATION.  CF PENNINGTON, P.193 FF.            AVG  25
      C                                                                          AVG  26
16            NP=NPAREJA-1                                                       AVG  27
17            NF=NPAREJA                                                         AVG  28
18            DX=2.0/NP                                                          AVG  29
19            GMU=(XS(1)*E(1))+(XS(NF)*E(NF))                                    AVG  30
20            AI=0.0                                                             AVG  31
21            BI=0.0                                                             AVG  32
22            NN=NP/2                                                            AVG  33
23            DO 420 J=1,NN                                                      AVG  34
24            AI=AI+XS(2*J)*E(2*J)                                               AVG  35
25       420  CONTINUE                                                          AVG  36
26            NM=NN-1                                                            AVG  37
27            DO 430 J=1,NM                                                      AVG  38
28            BI=BI+XS(2*J+1)*E(2*J+1)                                           AVG  39
29       430  CONTINUE                                                          AVG  40
30            GMU=DX*(GMU+4.0*AI+2.0*BI)/3.0                                     AVG  41
31            WRITE (9,450) PE,GMU                                               AVG  42
      C                                                                          AVG  43
      C     NOW STORE PE AND MUBAR/LAB (BARMUL) FOR LATER WRITING OF FILE3,      AVG  44
      C     MT=251 SECTION (AT END OF MAIN PROGRAM).  ELASTIC SCATTER (MT=2)     AVG  45
      C     ONLY.                                                                AVG  46
      C                                                                          AVG  47
32            IF (MT.NE.2) GO TO 440                                             AVG  48
33            IF (KK.EQ.1) NMU=0                                                 AVG  49
34            NMU=NMU+1                                                          AVG  50
```

```
      EMUBAR(NMU)=PE                                                    AVG  51
      BARMUL(NMU)=GMU                                                   AVG  52
  440 CONTINUE                                                          AVG  53
      RETURN                                                            AVG  54
  450 FORMAT (E12.5,48H = ENERGY                          MU-BAR = ,    AVG  55
     1E12.5,5X,I4,1X,I3)                                                AVG  56
      END                                                               AVG  57-
```

SUBROUTINE AVERIA

SYMBOL = = = = = = = = = = = = = = = REFERENCES = = = = = = = = = = = = = = =

410 - 10 15*
420 - 23 25*
430 - 27 29*
440 - 32 37*
450 - 31WR 39*
A - 9= 12 13
AI - 20= 24= 30
AVERIA - 1
AWR - 6CO 9
BARMUL - 3DI 7CO 36=
BI - 21= 28= 30
BOT - 13= 14
DX - 18= 30
E - 2DI 5CO 11 12 13 14= 19 24 28
EIN - 4CO
EL - 4CO
EMUBAR - 3DI 7CO 35=
ENEXT - 4CO
ETA - 2DI 11=
EU - 4CO
GMU - 5CO 8= 19= 30= 31WR 36
I - 10 11 12 13 14
IFILE - 5CO
INT - 6CO
J - 23 27
JT - 4CO
KK - 6CO 33
LAW - 4CO
LIN - 5CO
MT - 5CO 32
N - 5CO
NO - 6CO
N1 - 6CO
N2 - 6CO
N5 - 6CO
NE - 4CO
NF - 17= 19
NINC - 4CO
NM - 26= 27
NMAT - 6CO
NMU - 7CO 33= 34= 35 36
NN - 22= 23 26
NP - 4CO 16= 18 22
NPAREJA - 5CO 10 16 17
NPNEXT - 4CO
NPRIMO - 5CO
NTOT - 4CO
NU - 5CO

SUBROUTINE AVERIA

PE	-	5C0	31WR	35		
RETURN	-	38				
SQRT	-	13				
TOP	-	12=	14			
XS	-	2DI	5C0	19	24	28
XXA	-	6C0				
ZA	-	6C0				

SUBROUTINE ENERGIA

```
1           SUBROUTINE ENERGIA                                                ENG   1
      C                                                                       ENG   2
      C          WRITTEN BY**   DONALD J. DUDZIAK                             ENG   3
      C     ENERGIA PUNZA UNA BARAJA PARA LA DISTRIBUCIO-N DE ENERGIA EN      ENG   4
      C     LISTA CINCO (MF=5).                                               ENG   5
      C     ENERGIA ASSUMES TABULATED SEC. ENERGY DISTR. (UK=DRAKE LAW 8)     ENG   6
      C                                                                       ENG   7
2           DIMENSION E(2000), XS(2000)                                       ENG   8
3           COMMON NINC,NE,NP,EIN,ENEXT,EL,EU,NTOT,LAW,NPNEXT,JT              ENG   9
4           COMMON NPAREJA,E,XS,PE,N,GMU,LIN,IFILE,MT,NU,NPRIMO               ENG  10
5           COMMON ZA,AWR,N0,N1,N2,N5,XXA,KK,INT,NMAT                         ENG  11
6           COMMON EMUBAR,BARMUL,NMU                                          ENG  12
7           N3=3                                                              ENG  13
8           P1=1.0                                                            ENG  14
9           IF (LAW.NE.8) WRITE (9,700)                                       ENG  15
10          IF (NE.NE.1) GO TO 610                                            ENG  16
11          WRITE (9,700)                                                     ENG  17
12          STOP                                                              ENG  18
13    610   CONTINUE                                                          ENG  19
14          IF (KK.NE.1) GO TO 620                                            ENG  20
      C                                                                       ENG  21
      C     READ TABLE FOR FIRST TIME THRU                                    ENG  22
      C                                                                       ENG  23
15          READ (8,690) XS(2),(E(I),XS(I),I=3,NP)                            ENG  24
16          GO TO 630                                                         ENG  25
17    620   CONTINUE                                                          ENG  26
18          READ (8,710) NINC,EIN,NP,E(1),XS(1),E(2)                          ENG  27
19          READ (8,690) XS(2),(E(I),XS(I),I=3,NP)                            ENG  28
      C                                                                       ENG  29
      C     TEMPORARY IF.                                                     ENG  30
      C                                                                       ENG  31
20          IF (NMAT.EQ.206.AND.MT.EQ.15.AND.KK.EQ.21) E(24)=5.0              ENG  32
21    630   CONTINUE                                                          ENG  33
      C                                                                       ENG  34
      C     TEMPORARY IF.                                                     ENG  35
      C                                                                       ENG  36
22          IF (NMAT.EQ.206.AND.MT.EQ.16) E(2)=1.01E-2                        ENG  37
23          IF (NMAT.EQ.206.AND.MT.EQ.22) E(2)=1.01E-2                        ENG  38
24          IF (NMAT.EQ.206.AND.MT.EQ.32) E(2)=1.01E-2                        ENG  39
25          EIN=EIN*1.0E+6                                                    ENG  40
26          DO 640 I=1,NP                                                     ENG  41
27          E(I)=E(I)*1.0E+6                                                  ENG  42
28          XS(I)=XS(I)*1.0E-6                                                ENG  43
29    640   CONTINUE                                                          ENG  44
      C                                                                       ENG  45
      C     INTEGRATE SECONDARY ENERGY DISTRIBUTION (LINEAR-LINEAR INTERPOLA  ENG  46
      C     TION ASSUMED).                                                    ENG  47
      C     INTEGRATE XS(E*)OVER E*TO NORMALIZE XS(E*,E). ASSUME LN-LN INTERPOENG  48
      C                 LATION.  ROUTINE PLAGIARIZED FROM TEST9, CHECKER.     ENG  49
      C     FOR FCSI OF CHECKER, X1=X3 AND X2=X4 ARE INTEGRATION LIMITS.      ENG  50
```

SUBROUTINE ENERGIA

```
      C                                                                      ENG  51
30          ANS=0.0                                                          ENG  52
31          DO 650 I=2,NP                                                    ENG  53
32          X3=E(I-1)                                                        ENG  54
33          X4=E(I)                                                          ENG  55
34          Y3=XS(I-1)                                                       ENG  56
35          Y4=XS(I)                                                         ENG  57
36          B=(Y4-Y3)/(X4-X3)                                                ENG  58
37          A=Y3-B*X3                                                        ENG  59
38          AN=(X4-X3)*(A+0.5*B*(X4+X3))                                     ENG  60
39          ANS=ANS+AN                                                       ENG  61
40    650   CONTINUE                                                         ENG  62
41          WRITE (9,680) ANS                                                ENG  63
42          DO 660 I=1,NP                                                    ENG  64
43          XS(I)=XS(I)/ANS                                                  ENG  65
44    660   CONTINUE                                                         ENG  66
45          IF (KK.NE.1) GO TO 670                                           ENG  67
      C                                                                      ENG  68
      C     WRITE HEAD CARD, ASSUMING LAW 1 (TABULATION) ONLY (LF=1).  NK=NE ENG  69
      C                                                                      ENG  70
46          NU=1                                                             ENG  71
47          WRITE (12,730) ZA,AWR,N0,N0,N1,N0,LIN,IFILE,MT,NU                ENG  72
48          WRITE (9,730) ZA,AWR,N0,N0,N1,N0,LIN,IFILE,MT,NU                 ENG  73
      C                                                                      ENG  74
      C     WRITE TAB1 RECORD FOR LAW 1 (LF=1)                               ENG  75
      C                                                                      ENG  76
49          NU=NU+1                                                          ENG  77
50          WRITE (12,720) XXA,XXA,N0,N1,N1,N2,LIN,IFILE,MT,NU               ENG  78
      C     WRITE (9,720) XXA,XXA,N0,N1,N2,LIN,IFILE,MT,NU                   ENG  79
51          NU=NU+1                                                          ENG  80
52          WRITE (12,740) N2,N2,LIN,IFILE,MT,NU                             ENG  81
      C     WRITE (9,740) N2,N2,LIN,IFILE,MT,NU                              ENG  82
53          NU=NU+1                                                          ENG  83
54          WRITE (12,750) EL,P1,EU,P1,LIN,IFILE,MT,NU                       ENG  84
      C     WRITE (9,750) EL,P1,EU,P1,LIN,IFILE,MT,NU                        ENG  85
      C                                                                      ENG  86
      C     WRITE TAB2 RECORD                                                ENG  87
      C                                                                      ENG  88
55          NU=NU+1                                                          ENG  89
56          WRITE (12,720) XXA,XXA,N0,N0,N1,NE,LIN,IFILE,MT,NU               ENG  90
      C     WRITE (9,720) XXA,XXA,N0,N0,N1,NE,LIN,IFILE,MT,NU                ENG  91
57          NU=NU+1                                                          ENG  92
58          WRITE (12,740) NE,N3,LIN,IFILE,MT,NU                             ENG  93
      C     WRITE (9,740)NE,N3,LIN,IFILE,MT,NU                               ENG  94
59    670   CONTINUE                                                         ENG  95
      C                                                                      ENG  96
      C     WRITE TAB1 FOR SECONDARY DISTRIBUTION AT FIXED INITIAL ENERGY    ENG  97
      C                                                                      ENG  98
60          NU=NU+1                                                          ENG  99
61          WRITE (12,720) XXA,EIN,N0,N0,N1,NP,LIN,IFILE,MT,NU               ENG 100
```

SUBROUTINE ENERGIA

```
      C     WRITE (9,720) XXA,EIN,NO,NO,N1,NP,LIN,IFILE,MT,NU                 ENG 101
62          NU=NU+1                                                           ENG 102
63          WRITE (12,740) NP,N2,LIN,IFILE,MT,NU                              ENG 103
      C     WRITE (9,740) NP,N2,LIN,IFILE,MT,NU                               ENG 104
64          NPAREJA=NP                                                        ENG 105
65          RETURN                                                            ENG 106
66    680   FORMAT (1H0,39H XSEC INTEGRATED OVER SECONDARY ENERGY ,E17.5)     ENG 107
67    690   FORMAT (E11.5,5E12.5,9X)                                          ENG 108
68    700   FORMAT (1H1,34H WHAT THE HELL KIND OF ENERGY LAW )                ENG 109
69    710   FORMAT (I11,E12.5,I12,3E12.5)                                     ENG 110
70    720   FORMAT (1P2E11.4,4I11,I4,I2,I3,I5)                                ENG 111
71    730   FORMAT (F11.1,1PE11.4,4I11,I4,I2,I3,I5)                           ENG 112
72    740   FORMAT (2I11,44X,I4,I2,I3,I5)                                     ENG 113
73    750   FORMAT (1P4E11.4,22X,I4,I2,I3,I5)                                 ENG 114
74          END                                                               ENG 115
```

SUBROUTINE ENERGIA

SYMBOL	REFERENCES									
610	10	13*								
620	14	17*								
630	16	21*								
640	26	29*								
650	31	40*								
660	42	44*								
670	45	59*								
680	41WR	66*								
690	15RD	19RD	67*							
700	9WR	11WR	68*							
710	18RD	69*								
720	50WR	56WR	61WR	70*						
730	47WR	48WR	71*							
740	52WR	58WR	63WR	72*						
750	54WR	73*								
A	37=	38								
AN	38=	39								
ANS	30=	39=	41WR	43						
AWR	5CO	47WR	48WR							
B	36=	37	38							
BARMUL	6CO									
E	2DI	4CO	15RD	18RD	19RD	20=	22=	23=	24=	27=
	32	33								
EIN	3CO	18RD	25=	61WR						
EL	3CO	54WR								
EMUBAR	6CO									
ENERGIA	1									
ENEXT	3CO									
EU	3CO	54WR								
GMU	4CO									
I	15RD	19RD	26	27	28	31	32	33	34	35
	42	43								
IFILE	4CO	47WR	48WR	50WR	52WR	54WR	56WR	58WR	61WR	63WR
INT	5CO									
JT	3CO									
KK	5CO	14	20	45						
LAW	3CO	9								
LIN	4CO	47WR	48WR	50WR	52WR	54WR	56WR	58WR	61WR	63WR
MT	4CO	20	22	23	24	47WR	48WR	50WR	52WR	54WR
	56WR	58WR	61WR	63WR						
N	4CO									
NO	5CO	47WR	48WR	50WR	56WR	61WR				
N1	5CO	47WR	48WR	50WR	56WR	61WR				
N2	5CO	50WR	52WR	63WR						
N3	7=	58WR								
N5	5CO									
NE	3CO	10	56WR	58WR						
NINC	3CO	18RD								

SUBROUTINE ENERGIA

NMAT	-	5C0	20	22	23	24				
NMU	-	6C0								
NP	-	3C0	15RD	18RD	19RD	26	31	42	61WR	63WR	64
NPAREJA	-	4C0	64=							
NPNEXT	-	3C0								
NPRIMO	-	4C0								
NTOT	-	3C0								
NU	-	4C0	46=	47WR	48WR	49=	50WR	51=	52WR	53=	54WR
		55=	56WR	57=	58WR	60=	61WR	62=	63WR		
P1	-	8=	54WR								
PE	-	4C0									
RETURN	-	65									
STOP	-	12									
X3	-	32=	36	37	38						
X4	-	33=	36	38							
XS	-	2DI	4C0	15RD	18RD	19RD	28=	34	35	43=	
XXA	-	5C0	50WR	56WR	61WR						
Y3	-	34=	36	37							
Y4	-	35=	36								
ZA	-	5C0	47WR	48WR							

SUBROUTINE SKPMAT (NMAT)

```
1           SUBROUTINE SKPMAT (NMAT)                                    SKP   1
      C                                                                 SKP   2
      C     WRITTEN BY**DONALD J. DUDZIAK                               SKP   3
      C                                                                 SKP   4
2           DIMENSION B(12)                                             SKP   5
3     1     READ (8,3,END=2) (B(I),I=1,12),MAT,NSEQ                     SKP   6
4           IF (MAT .NE. NMAT) GO TO 1                                  SKP   7
5           IF (NSEQ .EQ. 0) GO TO 1                                    SKP   8
6           BACKSPACE 8                                                 SKP   9
7           RETURN                                                      SKP  10
8     2     WRITE (9,4)                                                 SKP  11
9           STOP                                                        SKP  12
10    3     FORMAT (12A6,I3,I2)                                         SKP  13
11    4     FORMAT (1X,25H MATERIAL IS NOT ON TAPE.)                    SKP  14
12          END                                                         SKP  15-
```

SUBROUTINE SKPMAT (NMAT)

SYMBOL	REFERENCES
1	3* 4 5
2	8*
3	3RD 10*
4	8WR 11*
B	2DI 3RD
END	3RD
I	3RD
MAT	3RD 4
NMAT	1AG 4
NSEQ	3RD 5
RETURN	7
SKPMAT	1
STOP	9

SUBROUTINE SHUFL

```
      SUBROUTINE SHUFL                                                      SHF    1
C                                                                           SHF    2
C         WRITTEN BY **   DONALD J. DUDZIAK                                 SHF    3
C     THIS SBRT REARRANGES A TRANSLATION OF DRAKE-S DATA (UK FORMAT)TO      SHF    4
C     ENDF/B INTO MODE3 ENDF/B TAPE                                         SHF    5
C     TAPE12 IS INPUT ENDF/B TAPE, TAPE2 IS OUTPUT REGULAR MODE3 ENDF/B     SHF    6
C                                                                           SHF    7
      DIMENSION E(2000), XS(2000)                                           SHF    8
      DIMENSION B(12), ICT(9), A(1500)                                      SHF    9
      COMMON NINC,NE,NP,EIN,ENEXT,EL,EU,NTOT,LAW,NPNEXT,JT                  SHF   10
      COMMON NPAREJA,E,XS,PE,N,GMU,LIN,IFILE,MT,NU,NPRIMO                   SHF   11
      COMMON ZA,AWR,N0,N1,N2,N5,XXA,KK,INT,NMAT                             SHF   12
      ICT(3)=0                                                              SHF   13
      ICT(4)=0                                                              SHF   14
      ICT(5)=0                                                              SHF   15
      ICT(6) =0                                                             SHF   16
      ICT(7) =0                                                             SHF   17
      NU=0                                                                  SHF   18
      REWIND 12                                                             SHF   19
C                                                                           SHF   20
C     LABEL = TAPE LABEL NUMBER FOR TPID RECORD (NBR LESS THAN 100).        SHF   21
C                                                                           SHF   22
      READ (10, 1050, END=1020)  LABEL                                      SHF   23
C                                                                           SHF   24
C     WRITE TPID CARD TO LABEL TAPE (NBR LESS THAN 100)                     SHF   25
C                                                                           SHF   26
      WRITE (2,1060) LABEL                                                  SHF   27
C                                                                           SHF   28
C     WRITE FILE1 ON ENDF/B TAPE (READ FROM CARDS)                          SHF   29
C                                                                           SHF   30
  920 CONTINUE                                                              SHF   31
      NU=NU+1                                                               SHF   32
      READ (10,1080, ERR=915) (A(K),K=1,14), MF, A(15), NS                  SHF   33
      WRITE (2,1080) (A(K),K=1,14), MF, A(15), NU                           SHF   34
      GO TO 925                                                             SHF   35
  915 WRITE (9,1081) NU                                                     SHF   36
  925 CONTINUE                                                              SHF   37
      IF (MF .NE. 0)                          GO TO 920                     SHF   38
C                                                                           SHF   39
C     READ FROM LATE OUTPUT TAPE, RE-ARRANGE, OUTPUT ON TAPE2.              SHF   40
C                                                                           SHF   41
  930 CONTINUE                                                              SHF   42
      READ (12, 1030, END=960)  (B(I),I=1,11), MAT, MF, MT, NSEQ            SHF   43
      IF (MAT.NE.LIN) GO TO 960                                             SHF   44
C                                                                           SHF   45
C     IF MUBAR DATA FOUND (MF=3, MT=251), SKIP AND GO TO CARDS WITH         SHF   46
C     PHOTON DATA TO GET MF=3, MT=110 (UNIT CROSS SECTION).                 SHF   47
C                                                                           SHF   48
      IF (MF .EQ. 3 .AND. MT .EQ. 251)     GO TO 960                        SHF   49
C                                                                           SHF   50
```

SUBROUTINE SHUFL

```
      C     TEMPORARY IF.                                                    SHF  51
      C                                                                      SHF  52
28          IF (MT.EQ.32) MT=28                                              SHF  53
29          IF (MF.EQ.0) GO TO 950                                           SHF  54
30          NTP=MF                                                           SHF  55
31    950   CONTINUE                                                         SHF  56
32          WRITE (NTP,1030) (B(I),I=1,11),MAT,MF,MT,NSEQ                    SHF  57
33          ICT(NTP)=ICT(NTP)+1                                              SHF  58
34          GO TO 930                                                        SHF  59
35    960   CONTINUE                                                         SHF  60
      C                                                                      SHF  61
      C     READ AND WRITE PHOTON DATA (FROM CARDS)                          SHF  62
      C                                                                      SHF  63
36    990   READ (10, 1030, END=1010) (A(I), I=1,11), MAT, MF, MT, NSEQ      SHF  64
37          IF  (MF.EQ.0)                          GO TO 2000                SHF  65
38          IF  (MF.EQ.3)                          MF=11                     SHF  66
39          NTP=MF-8                                                         SHF  67
40          IF  (MF.EQ.11)                         MF=3                      SHF  68
41    2000  CONTINUE                                                         SHF  69
42          WRITE  (NTP,1030) (A(I),I=1,11), MAT,MF,MT,NSEQ                  SHF  70
43          ICT(NTP)=ICT(NTP)+1                                              SHF  71
44          GO TO 990                                                        SHF  72
45    1010  CONTINUE                                                         SHF  73
      C                                                                      SHF  74
      C     NOW READ MUBAR (MG=3, MT=251) FROM TAPE 12 AND WRITE ON TAPE 3   SHF  75
      C     AFTER MT=110.                                                    SHF  76
      C                                                                      SHF  77
46          BACKSPACE 12                                                     SHF  78
47    1100  READ (12, 1030, END=1190)  (B(I),I=1,11), MAT, MF, MT, NSEQ      SHF  79
48          IF  (MF.NE.3)                          GO TO 1190                SHF  80
49          WRITE  (3,1030)  (B(I),I=1,11),MAT,MF,MT,NSEQ                    SHF  81
50          ICT(3)=ICT(3)+1                                                  SHF  82
51          GO TO 1100                                                       SHF  83
52    1190  CONTINUE                                                         SHF  84
53          REWIND 3                                                         SHF  85
54          REWIND 4                                                         SHF  86
55          REWIND 5                                                         SHF  87
56          REWIND 6                                                         SHF  88
57          REWIND 7                                                         SHF  89
58          DO 980  J=3,7                                                    SHF  90
59          IU=ICT(J)                                                        SHF  91
60          DO 970  K=1, IU                                                  SHF  92
61          READ (J,1030,END=970) (A(I),I=1,11),MAT,MF,MT,NSEQ               SHF  93
62          NU=NU+1                                                          SHF  94
63          WRITE (2,1030) (A(I),I=1,11),MAT,MF,MT,NU                        SHF  95
64    970   CONTINUE                                                         SHF  96
65          NU=NU+1                                                          SHF  97
66          WRITE (2,1060) MAT,NU                                            SHF  98
67    980   CONTINUE                                                         SHF  99
68          NU=NU+1                                                          SHF 100
```

SUBROUTINE SHUFL

```
      C                                                                 SHF 101
      C     WRITE MEND CARD AND TEND (TAPE END) CARDS                   SHF 102
      C                                                                 SHF 103
   69         WRITE (2,1040) NU                                        SHF 104
   70         NU=NU+1                                                  SHF 105
   71         WRITE (2,1070) NU                                        SHF 106
   72         ENDFILE 2                                                SHF 107
   73         REWIND 2                                                 SHF 108
   74         WRITE (9,1082)                                           SHF 109
   75    982  CONTINUE                                                 SHF 110
   76         READ (2, 1030, END=986)  (B(I),I=1,11), MAT, MF, MT, NSEQ SHF 111
   77         WRITE (9,1030)  (B(I),I=1,11), MAT,MF,MT,NSEQ            SHF 112
   78         GO TO 982                                                SHF 113
   79       986 CONTINUE                                               SHF 114
   80         RETURN                                                   SHF 115
   81    1020 STOP                                                     SHF 116
   82    1030 FORMAT (11A6,I4,I2,I3,I5)                                SHF 117
   83    1040 FORMAT (66X,4H   0,2H 0,3H  0,I5)                        SHF 118
   84    1050 FORMAT (4I6)                                             SHF 119
   85    1060 FORMAT (66X,I4,2H 0,3H  0,I5)                            SHF 120
   86    1070 FORMAT (66X,4H  -1,2H 0,3H  0,I5)                        SHF 121
   87    1080 FORMAT (14A5,I2,A3,I5)                                   SHF 122
   88    1081 FORMAT (1H0, 31H ERROR IN FILE1 AT SEQ. NBR. =  , I5)    SHF 123
   89    1082 FORMAT (1H1,10X,37HTHE ENDF/B TAPE, AS GIVEN BELOW, WAS ,SHF 124
        X20HSUCESSFULLY WRITTEN.//)                                     SHF 125
   90         END                                                      SHF 126-
```

SUBROUTINE SHUFL

SYMBOL	REFERENCES									
915	21*									
920	16*	23								
925	20	22*								
930	24*	34								
950	29	31*								
960	26	27	35*							
970	60	64*								
980	58	67*								
982	75*	78								
986	79*									
990	36*	44								
1010	45*									
1020	81*									
1030	25RD	32WR	36RD	42WR	47RD	49WR	61RD	63WR	76RD	77WR
	82*									
1040	69WR	83*								
1050	14RD	84*								
1060	15WR	66WR	85*							
1070	71WR	86*								
1080	18RD	19WR	87*							
1081	21WR	88*								
1082	74WR	89*								
1100	47*	51								
1190	48	52*								
2000	37	41*								
A	3DI	18RD	19WR	36RD	42WR	61RD	63WR			
AWR	6CO									
B	3DI	25RD	32WR	47RD	49WR	76RD	77WR			
E	2DI	5CO								
EIN	4CO									
EL	4CO									
END	14RD	25RD	36RD	47RD	61RD	76RD				
ENEXT	4CO									
ERR	18RD									
EU	4CO									
GMU	5CO									
I	25RD	32WR	36RD	42WR	47RD	49WR	61RD	63WR	76RD	77WR
ICT	3DI	7=	8=	9=	10=	11=	33=	43=	50=	59
IFILE	5CO									
INT	6CO									
IU	59=	60								
J	58	59	61RD							
JT	4CO									
K	18RD	19WR	60							
KK	6CO									
LABEL	14RD	15WR								
LAW	4CO									
LIN	5CO	26								

SUBROUTINE SHUFL

MAT	-	25RD	26	32WR	36RD	42WR	47RD	49WR	61RD	63WR	66WR
		76RD	77WR								
MF	-	18RD	19WR	23	25RD	27	29	30	32WR	36RD	37
		38	39	40	42WR	47RD	48	49WR	61RD	63WR	76RD
		77WR									
MT	-	5C0	25RD	27	28	32WR	36RD	42WR	47RD	49WR	61RD
		63WR	76RD	77WR							
N	-	5C0									
NO	-	6C0									
N1	-	6C0									
N2	-	6C0									
NS	-	6C0									
NE	-	4C0									
NINC	-	4C0									
NMAT	-	6C0									
NP	-	4C0									
NPAREJA	-	5C0									
NPNEXT	-	4C0									
NPRIMO	-	5C0									
NS	-	18RD									
NSEQ	-	25RD	32WR	36RD	42WR	47RD	49WR	61RD	76RD	77WR	
NTOT	-	4C0									
NTP	-	30=	32WR	33	39=	42WR	43				
NU	-	5C0	12=	17=	19WR	21WR	62=	63WR	65=	66WR	68=
		69WR	70=	71WR							
PE	-	5C0									
RETURN	-	80									
SHUFL	-	1									
STOP	-	81									
XS	-	2DI	5C0								
XXA	-	6C0									
ZA	-	6C0									

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13. ABSTRACT

Two special-purpose FORTRAN IV codes have been written to translate neutron interaction and photon production data from an extended version of the UK Data File format to ENDF/B Data File format. The codes operate only on the subset of the general UK neutron data format which was used for the Defense Atomic Support Agency (DASA) sponsored evaluations of sodium, magnesium, silicon, chlorine, potassium and calcium. Descriptions of the codes' functions and operation are given, along with input instructions, output descriptions, and INDEX'ed listings of all main programs and subroutines.

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