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======================================================================VIRGIN
                                                                      VIRGIN
     PROGRAM VIRGIN                                                   VIRGIN
     VERSION 76-1 (NOVEMBER 1976)                                     VIRGIN
     VERSION 84-1 (JUNE 1984)    *DOUBLE PRECISION ENERGY             VIRGIN
     VERSION 86-1 (JANUARY 1986)*FORTRAN-77/H VERSION                 VIRGIN
     VERSION 88-1 (JULY 1988)    *OPTION...INTERNALLY DEFINE ALL I/O  VIRGIN
                                  FILE NAMES (SEE, SUBROUTINE FILEIO  VIRGIN
                                  FOR DETAILS).                       VIRGIN
                                 *IMPROVED BASED ON USER COMMENTS.    VIRGIN
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO   VIRGIN
                                  INSURE PROGRAM WILL NOT DO ANYTHING VIRGIN
                                  CRAZY.                              VIRGIN
                                 *UPDATED TO USE NEW PROGRAM CONVERT  VIRGIN
                                  KEYWORDS.                           VIRGIN
                                 *ADDED LIVERMORE CIVIC COMPILER      VIRGIN
                                  CONVENTIONS.                        VIRGIN
     VERSION 92-1 (JANUARY 1992)*COMPLETE RE-WRITE                    VIRGIN
                                 *OUTPUT IN PLOTTAB FORMAT            VIRGIN
                                 *UP TO 2000 THICKNESSES              VIRGIN
                                 *INCREASED INCORE PAGE SIZE TO 6000  VIRGIN
                                  CROSS SECTION POINTS                VIRGIN
                                 *ADDED PHOTON CALCULATIONS           VIRGIN
                                 *ADDED BLACKBODY SPECTRUM            VIRGIN
                                 *ADDED MULTIPLE LAYERS               VIRGIN
                                 *ADDED SPATIALLY DEPENDENT DENSITY   VIRGIN
                                 *ADDED FORTRAN SAVE OPTION           VIRGIN
                                 *COMPLETELY CONSISTENT I/O ROUTINES - VIRGIN
                                  TO MINIMIZE COMPUTER DEPENDENCE.    VIRGIN
     VERSION 92-2 (MAY 1992)     *CORRECTED TO HANDLE MULTIGROUP CROSS VIRGIN
                                  SECTIONS AS INPUT IN ENDF/B FORMAT. VIRGIN
     VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                   VIRGIN
                                 *IMPROVED COMPUTER INDEPENDENCE      VIRGIN
                                 *ALL DOUBLE PRECISION                VIRGIN
                                 *ON SCREEN OUTPUT                    VIRGIN
                                 *UNIFORM TREATMENT OF ENDF/B I/O     VIRGIN
                                 *IMPROVED OUTPUT PRECISION           VIRGIN
                                 *DEFINED SCRATCH FILE NAMES          VIRGIN
     VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING     VIRGIN
                                  POINT READ FOR MORE DIGITS          VIRGIN
                                 *UPDATED TEST FOR ENDF/B FORMAT      VIRGIN
                                  VERSION BASED ON RECENT FORMAT CHANGEVIRGIN
                                 *GENERAL IMPROVEMENTS BASED ON       VIRGIN
                                  USER FEEDBACK                       VIRGIN
     VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON       VIRGIN
                                  USER FEEDBACK                       VIRGIN
     VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS           VIRGIN
     VERS. 2004-1 (MARCH 2004)   *ADDED INCLUDE FOR COMMON            VIRGIN
                                 *UP TO 2000 THICKNESSES              VIRGIN
                                 *INCREASED INCORE PAGE SIZE TO 60,000 VIRGIN
     VERS. 2007-1 (JAN.  2007)   *CHECKED AGAINST ALL ENDF/B-VII.     VIRGIN
                                 *INCREASED INCORE PAGE SIZE TO       VIRGIN
                                  240,000 FROM 60,000.                VIRGIN
     VERS. 2007-2 (DEC.  2007)   *72 CHARACTER FILE NAME.            VIRGIN
     VERS. 2010-1 (Apr.  2010)   *General update based on user feedbackVIRGIN
                                 *INCREASED INCORE PAGE SIZE TO       VIRGIN
                                  600,000 FROM 240,000.               VIRGIN
     VERS. 2012-1 (Aug.  2012)   *Added CODENAME                      VIRGIN
                                 *32 and 64 bit Compatible            VIRGIN
                                 *Added ERROR stop                    VIRGIN
     VERS. 2015-1 (Jan.  2015)   *Extended OUT9.                      VIRGIN
                                 *Replaced ALL 3 way IF Statements.   VIRGIN
                                 *Generalized TART Group Structures.  VIRGIN
                                 *Generalized SAND-II Group Structures.VIRGIN
                                 *Extended SAND-II to 60, 150, 200 MeV.VIRGIN
     VERS. 2015-2 (Apr.  2015)   *Changed ALL data to "D" instead of  VIRGIN
                                  "E" to insure it is REAL*8 and avoid VIRGIN
                                  Truncation ERRORS.                  VIRGIN
     VERS. 2017-1 (May   2017)   *Added UKAEA 1102 Group Structure.   VIRGIN
                                 *Increased points to 3,000,000       VIRGIN
                                 *Increased groupd to 30,000          VIRGIN
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                          *Updated based on user feedback       VIRGIN
                          *Defintion of built-in group structureVIRGIN
                           using SUBROUTINE GROPE is identical  VIRGIN
                           for GROUPIE and VIRGIN.              VIRGIN
                          *All floating point parameters changedVIRGIN
                           to character inout + IN9 conversion. VIRGIN
VERS. 2018-1 (Jan.  2018)  *Decreased PAGE size from 3,000,000   VIRGIN
                           to 1,500,000                         VIRGIN
                          *On-line output for ALL ENDERROR      VIRGIN
VERS. 2019-1 (June  2019)  *Additional Interpolation Law Tests   VIRGIN
                          *Checked Maximum Tabulated Energy to  VIRGIN
                           insure it is the same for all MTs -  VIRGIN
                           if not, print WARNING messages.      VIRGIN
VERS. 2020-1 (Feb.  2020)  *Identical to 2019-1.                 VIRGIN
                                                                VIRGIN
2015-2 Acknowledgment                                           VIRGIN
======================                                          VIRGIN
I thank Andrej Trkov (NDS, IAEA) for finding the problem with   VIRGIN
the "E" formatted DATA (this effected both VIRGIN and GROUPIE).  VIRGIN
I also thank Andrej for overseeing the entire PREPRO project    VIRGIN
at IAEA, Vienna; he is part of a truly International team who   VIRGIN
worked together to produce PREPRO-2015-2, and to make it        VIRGIN
available Internationally on-line for FREE to ALL users.        VIRGIN
                                                                VIRGIN
OWNED, MAINTAINED AND DISTRIBUTED BY                            VIRGIN
-----------------------------------                             VIRGIN
THE NUCLEAR DATA SECTION                                        VIRGIN
INTERNATIONAL ATOMIC ENERGY AGENCY                              VIRGIN
P.O. BOX 100                                                    VIRGIN
A-1400, VIENNA, AUSTRIA                                         VIRGIN
EUROPE                                                          VIRGIN
                                                                VIRGIN
ORIGINALLY WRITTEN BY                                           VIRGIN
-----------------------------------                             VIRGIN
Dermott E. Cullen                                               VIRGIN
                                                                VIRGIN
PRESENT CONTACT INFORMATION                                     VIRGIN
---------------------------                                     VIRGIN
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                                                                VIRGIN
PURPOSE                                                         VIRGIN
-------                                                         VIRGIN
THIS PROGRAM IS DESIGNED TO CALCULATE UNCOLLIDED (I.E. VIRGIN)  VIRGIN
FLUX AND REACTIONS DUE TO TRANSMISSION OF A MONODIRECTIONAL      VIRGIN
BEAM OF NEUTRONS THROUGH ANY THICKNESS OF MATERIAL. IN ORDER    VIRGIN
TO SIMULATE AN EXPERIMENTAL MEASUREMENT THE RESULTS ARE GIVEN   VIRGIN
AS INTEGRALS OVER ENERGY TALLY GROUPS (AS OPPOSED TO POINTWISE  VIRGIN
IN ENERGY). BY TAKING THE RATIO OF REACTIONS TO FLUX IN EACH    VIRGIN
GROUP AN EQUIVALENT SPATIALLY DEPENDENT GROUP AVERAGED CROSS    VIRGIN
SECTION IS CALCULATED BY THE PROGRAM.                           VIRGIN
                                                                VIRGIN
EVALUATED DATA                                                  VIRGIN
--------------                                                  VIRGIN
THE EVALUATED DATA MUST BE IN THE ENDF/B FORMAT. HOWEVER IT     VIRGIN
MUST BE LINEAR-LINEAR INTERPOLABLE IN ENERGY-CROSS SECTION      VIRGIN
BETWEEN TABULATED POINTS. SINCE ONLY CROSS SECTIONS (FILE 3 OR 23)VIRGIN
ARE USED, THIS PROGRAM WILL WORK ON ANY VERSION OF ENDF/B       VIRGIN
(I.E. ENDF/B-I, II, III, IV, V OR VI).                          VIRGIN
                                                                VIRGIN
RELATED COMPUTER CODES                                          VIRGIN
----------------------                                          VIRGIN
IN ORDER TO CONVERT ENDF/B DATA TO THE FORM REQUIRED BY THIS CODE VIRGIN
THE FOLLOWING COMPUTER CODES MAY BE USED,                       VIRGIN
                                                                VIRGIN
LINEAR  - CONVERT FROM GENERAL ENDF/B INTERPOLATION TO LINEAR-  VIRGIN
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          LINEAR INTERPOLATION.                                          VIRGIN
RECENT  - ADD THE RESONANCE CONTRIBUTION TO TABULATED BACKGROUND         VIRGIN
          CROSS SECTIONS TO OBTAIN LINEAR-LINEAR INTERPOLABLE            VIRGIN
          RESULTS.                                                       VIRGIN
SIGMA1  - DOPPLER BROADEN CROSS SECTION TO OBTAIN LINEAR-LINEAR          VIRGIN
          INTERPOLABLE RESULTS.                                          VIRGIN
MIXER   - MIX INDIVIDUAL MATERIALS TOGETHER TO DEFINE COMPOSITE          VIRGIN
          MIXTURES, E.G., COMBINE MATERIALS TO DEFINE STAINLESS          VIRGIN
          STELL.                                                         VIRGIN
                                                                         VIRGIN
IN ORDER TO PLOT THE OUTPUT RESULTS OF THIS CODE USE PROGRAM             VIRGIN
PLOTTAB.                                                                 VIRGIN
                                                                         VIRGIN
COPIES OF ANY OR ALL OF THESE CODES MAY BE OBTAINED FROM D.E.            VIRGIN
CULLEN AT THE ABOVE ADDRESS.                                             VIRGIN
                                                                         VIRGIN
OUTPUT FORMAT                                                            VIRGIN
-------------                                                            VIRGIN
FOR ALL VERSIONS OF THIS PROGRAM PRIOR TO VERSION 92-1 OUTPUT WAS        VIRGIN
IN TABULAR FORM.                                                         VIRGIN
                                                                         VIRGIN
FOR VERSION 92-1 AND LATER VERSIONS OF THIS CODE ALL OUTPUT IS IN        VIRGIN
THE PROGRAM PLOTTAB FORMAT TO ALLOW RESULTS TO BE EASILY PLOTTED.        VIRGIN
FOR A COPY OF PROGRAM PLOTTAB CONTACT D.E. CULLEN AT THE ABOVE           VIRGIN
ADDRESS.                                                                 VIRGIN
                                                                         VIRGIN
TALLY GROUPS                                                             VIRGIN
------------                                                             VIRGIN
THE TALLY GROUP STRUCTURE MAY BE ANY SET OF MONONTONICALLY               VIRGIN
INCREASING ENERGY BOUNDARIES. THERE MAY BE UP TO 2000 TALLY              VIRGIN
GROUPS. BY USING THE INPUT PARAMETERS THE USER MAY SPECIFY ANY           VIRGIN
ARBITRARY TALLY GROUP STRUCTURE OR SELECT ONE OF THE FOLLOWING           VIRGIN
BUILT-IN GROUP STRUCTURES.                                               VIRGIN
                                                                         VIRGIN
 (0) TART 175 GROUPS                                                     VIRGIN
 (1) ORNL  50 GROUPS                                                     VIRGIN
 (2) ORNL 126 GROUPS                                                     VIRGIN
 (3) ORNL 171 GROUPS                                                     VIRGIN
 (4) SAND-II 620 GROUPS - 1.0D-4 eV UP TO 18 MEV                         VIRGIN
 (5) SAND-II 640 GROUPS - 1.0D-4 eV UP TO 20 MEV                         VIRGIN
 (6) WIMS 69 GROUPS                                                      VIRGIN
 (7) GAM-I 68 GROUPS                                                     VIRGIN
 (8) GAM-II 99 GROUPS                                                    VIRGIN
 (9) MUFT 54 GROUPS                                                      VIRGIN
(10) ABBN 28 GROUPS                                                      VIRGIN
(11) TART 616 GROUPS TO  20 MeV                                          VIRGIN
(12) TART 700 GROUPS To   1 GeV                                          VIRGIN
(13) SAND-II 665 GROUPS - 1.0D-5 eV UP TO 18 MEV                         VIRGIN
(14) SAND-II 685 GROUPS - 1.0D-5 eV UP TO 20 MEV                         VIRGIN
(15) TART 666 GROUPS TO 200 MeV                                          VIRGIN
(16) SAND-II 725 GROUPS - 1.0D-5 eV UP TO  60 MEV                        VIRGIN
(17) SAND-II 755 GROUPS - 1.0D-5 eV UP TO 150 MEV                        VIRGIN
(18) SAND-II 765 GROUPS - 1.0D-5 eV UP TO 200 MEV                        VIRGIN
(19) UKAEA  1102 GROUPS - 1.0D-5 eV UP TO 1 GeV                          VIRGIN
                                                                         VIRGIN
 INCIDENT SPECTRUM                                                       VIRGIN
 -----------------                                                       VIRGIN
 THE INCIDENT SPECTRUM MAY BE ANY TABULATED FUNCTION THAT IS             VIRGIN
 GIVEN BY A SET OF POINTS THAT IS MONOTONICALLY INCREASING IN            VIRGIN
 ENERGY AND LINEAR-LINEAR INTERPOLABLE IN ENERGY-SPECTRUM                VIRGIN
 BETWEEN TABULATED POINTS. THERE IS NO LIMIT TO THE NUMBER OF            VIRGIN
 POINTS USED TO DESCRIBE THE SPECTRUM. THERE ARE FIVE BUILT-IN           VIRGIN
 OPTIONS FOR THE SPECTRUM.                                               VIRGIN
                                                                         VIRGIN
 (1) CONSTANT...ENERGY INDEPENDENT (INPUT 0)                             VIRGIN
 (2) 1/E (INPUT 1)                                                       VIRGIN
 (3) BLACKBODY - PHOTON SPECTRUM                                         VIRGIN
 (4) BLACKBODY - ENERGY SPECTRUM (E TIMES THE PHOTON SPECTRUM)           VIRGIN
 (5) TRANSMITTED SPECTRUM FROM PREVIOUS CASE                             VIRGIN
                                                                         VIRGIN
 NORMALIZATION OF SPECTRUM                                               VIRGIN
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ANY INCIDENT SPECTRUM, EITHER READ AS INPUT OR ONE OF THE          VIRGIN
BUILT-IN SPECTRA, WILL BE NORMALIZED TO UNITY WHEN INTEGRATED      VIRGIN
OVER THEIR ENTIRE ENERGY RANGE.                                    VIRGIN
                                                                   VIRGIN
TRANSMITTED SPECTRA WILL NOT BE RE-NORMALIZED, SINCE IT ALREADY    VIRGIN
INCLUDES THE NORMALIZATION OF THE INCIDENT SPECTRUM.               VIRGIN
                                                                   VIRGIN
NOTE, INCIDENT SPECTRA IS NORMALIZED TO UNITY OVER THEIR ENTIRE    VIRGIN
ENERGY RANGE - NOT OVER THE ENERGY RANGE OF THE GROUPS. IF THE     VIRGIN
ENERGY RANGE OF THE GROUPS IS LESS THAN THAT OF THE SPECTRUM       VIRGIN
ONLY THAT PORTION OF THE SPECTRUM WILL BE USED AND THIS WILL       VIRGIN
NOT BE RE-NORMALIZED TO UNITY.                                     VIRGIN
                                                                   VIRGIN
COMPOSITION OF A LAYER                                             VIRGIN
----------------------                                             VIRGIN
YOU MAY RUN PROBLEMS INVOLVING                                     VIRGIN
1) A LAYER OF UNIFORM DENSITY - DENSITY FOR ATTENUATION IS THAT    VIRGIN
   OF THE TOTAL. DENSITY FOR REACTIONS IS THAT OF THE REACTION.    VIRGIN
2) A LAYER OF UNIFORM DENSITY - DENSITY IS THE SUM OF THE TOTAL    VIRGIN
   AND REACTION DENSITIES - THE SUM OF THE CROSS SECTIONS IS       VIRGIN
   USED FOR ATTENUATION AND REACTIONS.                             VIRGIN
3) A LAYER OF VARYING DENSITY BASED ON A UNIFORM TOTAL DENSITY     VIRGIN
   PLUS A VARIATION BETWEEN 0 AND A MAXIMUM BASED ON THE           VIRGIN
   REACTION DENSITY - 0 AT 0 THICKNESS AND MAXIMUM AT MAXIMUM      VIRGIN
   THICKNESS. IN THIS CASE THE AVERAGE REACTION DENSITY IS EQUAL   VIRGIN
   TO THE INPUT REACTION DENSITY. THE VARIATION IN REACTION        VIRGIN
   DENSITY CAN BE LINEAR, SQUARE OR CUBIC.                         VIRGIN
4) A LAYER OF VARYING DENSITY BASED ON A TOTAL DENSITY WHICH       VIRGIN
   VARYING FROM MAXIMUM AT 0 THICKNESS TO 0 AT MAXIMUM THICKNESS   VIRGIN
   PLUS A REACTION DENSITY WHICH VARIES FROM 0 AT 0 THICKNESS      VIRGIN
   TO MAXIMUM AT MAXIMUM THICKNESS. IN THIS CASE THE AVERAGE       VIRGIN
   DENSITY OF THE TOTAL AND REACTION WILL BOTH BE EQUAL TO THE     VIRGIN
   INPUT TOTAL AND REACTION DENSITIES. THE VARIATION IN TOTAL      VIRGIN
   AND REACTION DENSITY CAN BE LINEAR, SQUARE OR CUBIC.            VIRGIN
                                                                   VIRGIN
IN THE FIRST CASE THE TWO REQUESTED CROSS SECTIONS ARE CONSIDERED  VIRGIN
TO BE INDEPENDENT - THE TOTAL CROSS SECTION IS USED TO CALCULATE   VIRGIN
ATTENUATION AND THE REACTION CROSS SECTION IS USED TO CALCULATE    VIRGIN
REACTIONS, E.G., TRANSMISSION THROUGH NATURAL URANIUM (THE TOTAL   VIRGIN
CROSS SECTION SHOULD BE THAT OF NATURAL URANIUM) AND REACTIONS     VIRGIN
IN A U-235 DETECTOR (THE REACTION CROSS SECTION SHOULD BE THAT OF  VIRGIN
U-235).                                                            VIRGIN
                                                                   VIRGIN
IN THE OTHER THREE CASES THE TWO REQUESTED CROSS SECTIONS ARE      VIRGIN
TREATED AS TWO CONSTITUENTS OF A MIXTURE OF TWO MATERIALS AND      VIRGIN
THE TWO CROSS SECTIONS ARE USED BOTH TO DEFINE A TOTAL CROSS       VIRGIN
SECTION FOR ATTENUATION AND A REACTION CROSS SECTION TO DEFINE     VIRGIN
REACTIONS. IN THESE CASES THE MIXTURE WILL VARY CONTINUOUSLY,      VIRGIN
E.G., IN CASE 4) HALF WAY THROUGH THE LAYER THE COMPOSITION WILL   VIRGIN
BE 1/2 THE MATERIAL DEFINED BY THE TOTAL AND 1/2 THE MATERIAL      VIRGIN
BASED ON THE REACTION. IN THESE CASES RATHER THAN THINKING OF      VIRGIN
THE TWO CROSS SECTIONS AS A TOTAL AND REACTION CROSS SECTION,      VIRGIN
IT IS BETTER TO THINK OF THEM AS THE TOTAL CROSS SECTIONS FOR      VIRGIN
MATERIALS A AND B AND THE CALCULATED REACTIONS WILL BE BASED       VIRGIN
ON THESE TWO TOTAL CROSS SECTIONS.                                 VIRGIN
                                                                   VIRGIN
MULTIPLE LAYERS                                                    VIRGIN
---------------                                                    VIRGIN
THIS CODE MAY BE USED TO RUN EITHER A NUMBER OF INDEPENDENT        VIRGIN
PROBLEMS, EACH INVOLVING TRANSMISSION THROUGH A SINGLE LAYER OF    VIRGIN
MATERIAL, OR TRANSMISSION THROUGH A NUMBER OF LAYERS ONE AFTER     VIRGIN
THE OTHER.                                                         VIRGIN
                                                                   VIRGIN
IN THE CASE OF MULTIPLE LAYERS, ONE LAYER AFTER ANOTHER, THE       VIRGIN
TRANSMITTED ENERGY DEPENDENT SPECTRUM IS USED AS THE INCIDENT      VIRGIN
SPECTRUM FOR THE NEXT LAYER. THERE IS NO LIMIT TO THE NUMBER       VIRGIN
OF LAYERS WHICH MAY BE USED - EACH LAYER IS TREATED AS A           VIRGIN
COMPLETELY INDEPENDENT PROBLEM WITH A DEFINED INCIDENT SOURCE,     VIRGIN
AND AS SUCH THE CYCLE OF TRANSMISSION THROUGH EACH LAYER AND       VIRGIN
USING THE TRANSMITTED SPECTRUM AS THE INCIDENT SPECTRUM FOR THE    VIRGIN
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NEXT LAYER MAY BE REPEATED ANY NUMBER OF TIMES.                    VIRGIN
                                                                   VIRGIN
REMEMBER - THE INCIDENT SPECTRUM IS ASSUMED TO BE LINEARLY         VIRGIN
INTERPOLABLE IN ENERGY AND SPECTRUM BETWEEN THE ENERGIES AT        VIRGIN
WHICH IT IS TABULATED. THE TRANSMITTED SPECTRUM WILL BE TABULATED VIRGIN
AT THE UNION OF ALL ENERGIES OF THE INCIDENT SPECTRUM AND CROSS    VIRGIN
SECTIONS (TOTAL AND REACTION). IN ORDER TO INSURE THE ACCURACY     VIRGIN
OF THE RESULT WHEN PERFORMING MULTIPLE LAYER CALCULATION BE SURE   VIRGIN
TO SPECIFY THE INCIDENT SPECTRUM ON THE FIRST LAYER TO SUFFICIENT VIRGIN
DETAIL (ENOUGH ENERGY POINTS CLOSELY SPACED TOGETHER) IN ORDER TO VIRGIN
ALLOW THE TRANSMITTED SPECTRUM TO BE ACCURATELY REPRESENTED BY     VIRGIN
LINEAR INTERPOLATION BETWEEN SUCCESSIVE ENERGY POINTS - THERE IS   VIRGIN
NO LIMIT TO THE NUMBER OF POINTS ALLOWED IN THE INCIDENT SPECTRUM,VIRGIN
SO IF YOU ARE IN DOUBT, SIMPLY USE MORE ENERGY POINTS TO SPECIFY   VIRGIN
THE INCIDENT SPECTRUM.                                             VIRGIN
                                                                   VIRGIN
RESULT OUTPUT UNITS                                                VIRGIN
------------------                                                 VIRGIN
FLUX      = EXACTLY AS CALCULATED                                  VIRGIN
REACTIONS = 1/CM OR 1/GRAM                                         VIRGIN
AVERAGE   = 1/CM - MACROSCOPIC UNITS                               VIRGIN
CROSS                                                              VIRGIN
SECTION                                                            VIRGIN
                                                                   VIRGIN
THICKNESS AND DENSITY                                              VIRGIN
---------------------                                              VIRGIN
THE UNCOLLIDED CALCULATION ONLY DEPENDS ON THE PRODUCT OF          VIRGIN
THICKNESS AND DENSITY (I.E. GRAMS PER CM SQUARED). THIS FACT       VIRGIN
MAY BE USED TO SIMPLIFY INPUT BY ALLOWING THE THICKNESS AND        VIRGIN
DENSITY TO BE GIVEN EITHER AS CM AND GRAMS/CC RESPECTIVELY         VIRGIN
OR ELSE TO GIVE THICKNESS IN GRAMS/(CM*CM) AND INPUT A             VIRGIN
DENSITY OF 1.0 - OR IN ANY OTHER CONVENIENT UNITS AS LONG AS       VIRGIN
THE PRODUCT OF THICKNESS AND DENSITY IS IN THE CORRECT GRAMS       VIRGIN
PER CENTIMETER SQUARED.                                            VIRGIN
                                                                   VIRGIN
GRAMS/(CM*CM) ARE RELATED TO ATOMS/BARN THROUGH THE RELATIONSHIP   VIRGIN
                                                                   VIRGIN
GRAMS/(CM*CM)=(ATOMS/BARN)*(GRAMS/MOLE)*(MOLE/ATOM)                VIRGIN
                                                                   VIRGIN
OR...                                                              VIRGIN
                                                                   VIRGIN
GRAMS/(CM*CM)=(ATOMS/BARN)*(ATOMIC WEIGHT)/0.602                   VIRGIN
                                                                   VIRGIN
CROSS SECTIONS AT A SPACE POINT AND OPTICAL THICKNESS              VIRGIN
-----------------------------------------------------              VIRGIN
THIS PROGRAM ALLOWS LAYERS OF EITHER UNIFORM DENSITY OR            VIRGIN
CONTINUOUSLY VARYING DENSITY. THE DENSITY CAN BE ONE OF THE        VIRGIN
FOLLOWING FORMS,                                                   VIRGIN
1) C                   = UNIFORM DENSITY                           VIRGIN
2) C*2*(X/T)           = LINEAR VARIATION FROM 0 TO C              VIRGIN
3) C*(2-2*(X/T))       = LINEAR VARIATION FROM C TO 0              VIRGIN
4) C*3*(X/T)**2        = SQUARE VARIATION FROM 0 TO C              VIRGIN
5) C*(3-3*(X/T)**2)/2  = SQUARE VARIATION FROM C TO 0              VIRGIN
6) C*4*(X/T)**3        = CUBIC VARIATION FROM 0 TO C               VIRGIN
7) C*(4-4*(X/T)**3)/3  = CUBIC VARIATION FROM C TO 0               VIRGIN
                                                                   VIRGIN
IN ORDER TO CALCULATE REACTIONS AT A POINT THE MICROSCOPIC         VIRGIN
REACTION CROSS SECTION NEED MERELY BE SCALED BY THESE DENSITIES.   VIRGIN
                                                                   VIRGIN
IN ORDER TO CALCULATE TRANSMISSION WE MUST DEFINE THE OPTICAL      VIRGIN
PATH LENGTH WHICH MAY BE DEFINED BY INTEGRATING EACH OF THE        VIRGIN
ABOVE DENSITY FORMS TO FIND,                                       VIRGIN
1) C*X                                                             VIRGIN
2) C*X*(X/T)                                                       VIRGIN
3) C*X*(2-(X/T))                                                   VIRGIN
4) C*X*(X/T)**2                                                    VIRGIN
5) C*X*(3-(X/T)**2)/2                                              VIRGIN
6) C*X*(X/T)**3                                                    VIRGIN
7) C*X*(4-(X/T)**3))/3                                             VIRGIN
                                                                   VIRGIN
IN ORDER TO CALCULATE TRANSMISSION TO A POINT THE MICROSCOPIC      VIRGIN
```

TOTAL CROSS SECTION NEED MERELY BE SCALED BY THESE DENSITIES VIRGIN
TO DEFINE THE OPTICAL PATH LENGTH. VIRGIN
VIRGIN
THE VARIATION OF THE DENSITY THROUGH THE LAYER MAY BE DEFINED VIRGIN
BY SETTING X = 0 OR X = T TO FIND, VIRGIN

	X = 0	X = T	
1)	C	C	VIRGIN
2)	0	2*C	VIRGIN
3)	2*C	0	VIRGIN
4)	0	3*C	VIRGIN
5)	3*C/2	0	VIRGIN
6)	0	4*C	VIRGIN
7)	4*C/3	0	VIRGIN

VIRGIN
THE OPTICAL PATH THROUGH A LAYER OF THICKNESS T MAY BE DEFINED VIRGIN
FROM THE ABOVE EXPRESSIONS BY SETTING X=T TO FIND THAT IN ALL VIRGIN
CASES THE ANSWER WILL BY C*T. THE CONSTANTS IN THE ABOVE VIRGIN
EXPRESSIONS HAVE BEEN INTRODUCED IN ORDER TO FORCE THIS RESULT. VIRGIN
WITH THESE FACTORS THE OPTICAL PATH LENGTH THROUGH THE LAYER VIRGIN
WILL EXACTLY CORRESPOND TO AN AVERAGE DENSITY CORRESPONDING TO VIRGIN
THAT INPUT FOR THE TOTAL AND/OR REACTION, I.E., C CORRESPONDS VIRGIN
TO THE INPUT DENSITY. VIRGIN
VIRGIN
NOTE - FOR THE SAME OPTICAL PATH LENGTHS THROUGH THE LAYER THE VIRGIN
TRANSMISSION WILL BE EXACTLY THE SAME. HOWEVER, VARYING THE VIRGIN
DENSITY WILL ALLOW YOU TO MODIFY THE REACTION RATES AT SPECIFIC VIRGIN
DEPTHS INTO THE LAYER. VIRGIN
VIRGIN
COMPUTATION OF INTEGRALS VIRGIN
---------- VIRGIN
STARTING FROM TOTAL CROSS SECTIONS, REACTION CROSS SECTIONS AND VIRGIN
A SOURCE SPECTRUM ALL OF WHICH ARE GIVEN IN TABULAR FORM WITH VIRGIN
LINEAR INTERPOLATION BETWEEN TABULATED POINTS ALL REQUIRED VIRGIN
INTEGRALS CAN BE DEFINED BY ANALYTICAL EXPRESSIONS INVOLVING VIRGIN
NOTHING MORE COMPLICATED THAN EXPONENTIALS. THE INTEGRALS THAT VIRGIN
MUST BE EVALUATED ARE OF THE FORM... VIRGIN
VIRGIN
FLUX VIRGIN
---- VIRGIN
(INTEGRAL EK TO EK+1) (S(E)* EXP(-XCT(E)*Z)*DE) VIRGIN
VIRGIN
REACTIONS VIRGIN
--------- VIRGIN
(INTEGRAL EK TO EK+1) (S(E)*XCR(E)*EXP(-XCT(E)*Z)*DE) VIRGIN
VIRGIN
WHERE.. VIRGIN
EK TO EK+1 = LONGEST ENERGY INTERVAL OVER WHICH S(E), XCT(E) AND VIRGIN
XCR(E) ARE ALL LINEARLY INTERPOLABLE. VIRGIN
S(E) = ENERGY DEPENDENT WEIGHTING SPECTRUM VIRGIN
XCR(E) = REACTION CROSS SECTION VIRGIN
XCT(E) = OPTICAL PATH LENGTH (BASED ON TOTAL CROSS SECTION) VIRGIN
Z = MATERIAL THICKNESS VIRGIN
VIRGIN
S(E), XCR(E) AND XCT(E) ARE ALL ASSUMED TO BE GIVEN IN TABULAR VIRGIN
FORM WITH LINEAR INTERPOLATION USED BETWEEN TABULATED POINTS. VIRGIN
IN OTHER WORDS BETWEEN TABULATED POINTS EACH OF THESE THREE IS VIRGIN
DEFINED BY A FUNCTION OF THE FORM... VIRGIN
VIRGIN
F(E)=((E - EK)*FK+1 + (EK+1 - E)*FK)/(EK+1 - EK) VIRGIN
VIRGIN
EACH OF THESE THREE CAN BE CONVERTED TO NORMAL FORM BY THE VIRGIN
CHANGE OF VARIABLES.... VIRGIN
VIRGIN
X=(E - 0.5*(EK+1 + EK))/(EK+1 - EK) VIRGIN
VIRGIN
IN WHICH CASE X WILL VARY FROM -1 (AT EK) TO +1 (AT EK+1) AND VIRGIN
EACH FUNCTION REDUCES TO THE NORMAL FORM... VIRGIN
VIRGIN
F(X)=0.5*(FK*(1 - X) + FK+1*(1 + X)) VIRGIN
=0.5*(FK+1 + FK) + 0.5*(FK+1 - FK)*X VIRGIN

```
                                                                      VIRGIN
BY DEFINING THE AVERAGE VALUE AND 1/2 THE CHANGE ACROSS THE           VIRGIN
INTERVAL.                                                             VIRGIN
                                                                      VIRGIN
AVF=0.5*(FK+1 + FK)                                                   VIRGIN
DF= 0.5*(FK+1 - FK)                                                   VIRGIN
DE= 0.5*(EK+1 - EK)                                                   VIRGIN
                                                                      VIRGIN
EACH OF THE THREE FUNCTIONS REDUCES TO THE SIMPLE FORM...             VIRGIN
                                                                      VIRGIN
F(X)=AVF+DF*X                                                         VIRGIN
                                                                      VIRGIN
AND THE TWO REQUIRED INTEGRALS REDUCE TO...                           VIRGIN
                                                                      VIRGIN
FLUX                                                                  VIRGIN
----                                                                  VIRGIN
DE*EXP(-AVXCT*Z) * (INTEGRAL -1 TO +1)                                VIRGIN
((AVS+DS*X)*EXP(-DXCT*Z*X)*DX)                                        VIRGIN
                                                                      VIRGIN
REACTION                                                              VIRGIN
--------                                                              VIRGIN
DE*EXP(-AVXCT*Z) * (INTEGRAL -1 TO +1)                                VIRGIN
((AVS*AVXCR+(AVS*DXCR+AVXCR*DS)*X+DS*DXCR*X*X)*EXP(-DXCT*Z*X)*DX)      VIRGIN
                                                                      VIRGIN
WHERE                                                                 VIRGIN
                                                                      VIRGIN
AVXCT   = AVERAGE VALUE OF THE TOTAL CROSS SECTION                    VIRGIN
AVXCR   = AVERAGE VALUE OF THE REACTION CROSS SECTION                 VIRGIN
AVS     = AVERAGE VALUE OF THE SOURCE                                 VIRGIN
DXCT    = 1/2 THE CHANGE IN THE TOTAL CROSS SECTION                   VIRGIN
DXCR    = 1/2 THE CHANGE IN THE REACTION CROSS SECTION                VIRGIN
DS      = 1/2 THE CHANGE IN THE SOURCE                                VIRGIN
DE      = 1/2 THE CHANGE IN THE ENERGY                                VIRGIN
                                                                      VIRGIN
NOTE THAT IN THIS FORM THE ENERGY ONLY APPEARS IN FRONT OF THE        VIRGIN
INTEGRALS AND THE INTEGRALS ARE EXPRESSED ONLY IN TERMS OF THE        VIRGIN
TABULATED VALUES OF S(E), XCT(E) AND XCR(E). IN PARTICULAR NO         VIRGIN
DERIVATIVES ARE USED, SO THAT THERE ARE NO NUMERICAL INSTABILITY      VIRGIN
PROBLEMS IN THE VACINITY OF DISCONTINUITIES IN S(E), XCT(E) OR        VIRGIN
XCR(E). INDEED, SINCE (EK+1 - EK) APPEARS IN FRONT OF THE INTEGRAL    VIRGIN
POINTS OF DISCONTINUITY AUTOMATICALLY MAKE ZERO CONTRIBUTION TO       VIRGIN
THE INTEGRALS.                                                        VIRGIN
                                                                      VIRGIN
THE REQUIRED INTEGRALS CAN BE EXPRESSED IN TERMS OF THE THREE         VIRGIN
INTEGRALS IN NORMAL FORM....                                          VIRGIN
                                                                      VIRGIN
F(A,N) = (INTEGRAL -1 TO 1) (X**N*EXP(-A*X)*DX), N=0,1 AND 2.         VIRGIN
                                                                      VIRGIN
THESE THREE INTEGRALS CAN BE EVALUATED TO FIND...                     VIRGIN
                                                                      VIRGIN
N=0                                                                   VIRGIN
---                                                                   VIRGIN
F(A,0) = (EXP(A)-EXP(-A))/A                                           VIRGIN
                                                                      VIRGIN
N=1                                                                   VIRGIN
---                                                                   VIRGIN
F(A,1) = ((1-A)*EXP(A)-(1+A)*EXP(-A))/(A*A)                           VIRGIN
                                                                      VIRGIN
N=2                                                                   VIRGIN
---                                                                   VIRGIN
F(A,2) = ((2-2*A+A*A)*EXP(A)-(2+2*A+A*A)*EXP(-A))/(A*A*A)             VIRGIN
                                                                      VIRGIN
HOWEVER THESE EXPRESSIONS ARE NUMERICALLY UNSTABLE FOR SMALL          VIRGIN
VALUES OF A. THEREFORE FOR SMALL A THE EXPONENTIAL IN THE             VIRGIN
INTEGRALS ARE EXPANDED IN A POWER SERIES...                           VIRGIN
                                                                      VIRGIN
EXP(-AX)=1.0-(AX)+(AX)**2/2-(AX)**3/6+(AX)**4/24-.....                VIRGIN
        =(SUM K=0 TO INFINITY) (-AX)**K/(K FACTORIAL)                 VIRGIN
                                                                      VIRGIN
AND THE INTEGRAL REDUCES TO THE FORM....                              VIRGIN
                                                                      VIRGIN
```

```
(SUM K=0 TO INFINITY) ((-A)**K/(K FACTORIAL)) *                    VIRGIN
(INTEGRAL -1 TO 1) (X**(N+K))*DX                                   VIRGIN
                                                                   VIRGIN
WHICH CAN BE ANALYTICALLY EVAULATED TO FIND....                    VIRGIN
(K(N) = K FACTORIAL)                                               VIRGIN
                                                                   VIRGIN
N=0                                                                VIRGIN
---                                                                VIRGIN
F(A,0) = 2*(1+(A**2)/K(3)+(A**4)/K(5)+(A**6)/K(7)+....             VIRGIN
                                                                   VIRGIN
N=1                                                                VIRGIN
---                                                                VIRGIN
F(A,1) = -2*A*(2/K(3)+4*(A**2)/K(5)+6*(A**4)/K(7)+8*(A**6)/K(9)+..VIRGIN
                                                                   VIRGIN
N=2                                                                VIRGIN
---                                                                VIRGIN
F(A,2) = 2*(2/K(3)+3*4*(A**2)/K(5)+5*6*(A**4)/K(7)+                VIRGIN
         7*8*(A**6)/K(9)+....                                      VIRGIN
                                                                   VIRGIN
THESE EXPANSIONS ARE USED WHEN THE ABSOLUTE VALUE OF A IS LESS     VIRGIN
THAN 0.1. BY TRUNCATING THE ABOVE SERIES BEFORE A**8 THE ERROR     VIRGIN
RELATIVE TO THE LEADING TERM OF THE SERIES WILL BE 10**(-10),      VIRGIN
YIELDING 10 DIGIT ACCURACY.                                        VIRGIN
                                                                   VIRGIN
AFTER EVALUATING THE ABOVE FUNCTIONS, EITHER DIRECTLY OR BY USING VIRGIN
THE EXPANSION THE TWO REQUIRED INTEGRALS CAN BE WRITTEN AS...      VIRGIN
                                                                   VIRGIN
FLUX                                                               VIRGIN
----                                                               VIRGIN
DE*EXP(-AVXCT*Z)*(AVS*F(A,0) + DS*F(A,1))                          VIRGIN
                                                                   VIRGIN
REACTIONS                                                          VIRGIN
---------                                                          VIRGIN
DE*EXP(-AVXCT*Z)*                                                  VIRGIN
(AVS*AVXCR*F(A,0) + (AVS*DXCR+AVXCR*DS)*F(A,1) + DS*DXCR*F(A,2))   VIRGIN
                                                                   VIRGIN
INPUT FILES                                                        VIRGIN
-----------                                                        VIRGIN
FILENAME  UNIT  DESCRIPTION                                        VIRGIN
--------  ----  -----------                                        VIRGIN
INPUT       2   INPUT LINES                                        VIRGIN
ENDFIN     10   EVALUATED DATA IN ENDF/B FORMAT                    VIRGIN
                                                                   VIRGIN
OUTPUT FILES                                                       VIRGIN
------------                                                       VIRGIN
FILENAME  UNIT  DESCRIPTION                                        VIRGIN
--------  ----  -----------                                        VIRGIN
OUTPUT      3   OUTPUT LISTING                                     VIRGIN
                                                                   VIRGIN
SCRATCH FILES                                                      VIRGIN
-------------                                                      VIRGIN
FILENAME  UNIT  DESCRIPTION                                        VIRGIN
--------  ----  -----------                                        VIRGIN
SCR1       12   REACTION, FLUX AND CROSS SECTION RESULTS (BCD)     VIRGIN
                (SORTED AT END OF RUN AND OUTPUT SEPARATELY)       VIRGIN
SCR2       13   TALLY GROUP ENERGY BOUNDARIES (BINARY)             VIRGIN
SCR3       14   SOURCE SPECTRUM (BINARY)                           VIRGIN
SCR4       15   TOTAL CROSS SECTION (BINARY)                       VIRGIN
SCR5       16   REACTION CROSS SECTION (BINARY)                    VIRGIN
                                                                   VIRGIN
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILIO1 AND FILEIO2)   VIRGIN
-----------------------------------------------------------------  VIRGIN
UNIT  FILE NAME   FORMAT                                           VIRGIN
----  ----------  ------                                           VIRGIN
  2   VIRGIN.INP   BCD                                             VIRGIN
  3   VIRGIN.LST   BCD                                             VIRGIN
 10   ENDFB.IN     BCD                                             VIRGIN
11-15 (SCRATCH)   BINARY                                           VIRGIN
 16   PLOTTAB.CUR PLOTTAB OUTPUT FORMAT DATA                       VIRGIN
                                                                   VIRGIN
INPUT LINES                                                        VIRGIN
```

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-----------                                                          VIRGIN
ANY NUMBER OF CASES MAY BE RUN ONE AFTER THE OTHER. AFTER THE        VIRGIN
FIRST CASE HAS BEEN RUN THE FOLLOWING CASES MAY USE THE SAME         VIRGIN
THICKNESSES, GROUP STRUCTURE AND SPECTRUM AS THE PRECEDING CASE.     VIRGIN
IN ADDITION THE TRANSMITTED SPECTRUM FROM ONE CASE MAY BE USED       VIRGIN
AS THE INCIDENT SPECTRUM IN THE NEXT CASE, TO ALLOW MULTIPLE         VIRGIN
LAYERS OF DIFFERENT MATERIALS.                                       VIRGIN
                                                                     VIRGIN
LINE  COLS.  FORMAT  DESCRIPTION                                     VIRGIN
----  -----  ------  ----------                                      VIRGIN
   1   1-60   ENDF/B INPUT DATA FILENAME                             VIRGIN
                (STANDARD OPTION = ENDFB.IN)                         VIRGIN
                                                                     VIRGIN
LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL       VIRGIN
THEN USE STANDARD FILENAMES.                                         VIRGIN
                                                                     VIRGIN
 2-3   1-72   18A4   TWO LINE TITLE DESCRIBING PROBLEM               VIRGIN
   4   1- 6    I6    ZA (1000*Z+A) OF TARGET FOR TOTAL               VIRGIN
       7-11    I5    MT OF TOTAL                                     VIRGIN
      12-22   E11.4  DENSITY FOR TOTAL                               VIRGIN
      23-28    I6    ZA (1000*Z+A) OF TARGET FOR REACTION            VIRGIN
      29-33    I5    MT OF REACTION                                  VIRGIN
                     = 0 - NO REACTION CALCULATION (ONLY FLUX).      VIRGIN
                     = GREATER THAN 0 - CALCULATE REACTIONS.         VIRGIN
      34-44   E11.4  DENSITY FOR REACTION                            VIRGIN
      45-50    I6    NUMBER OF TARGET THICKNESSES                    VIRGIN
                     = GREATER THAN 0 = READ FROM INPUT              VIRGIN
                       (1 TO 2000 ALLOWED)                           VIRGIN
                     =  0 = SAME AS LAST CASE                        VIRGIN
      51-55    I5    NUMBER OF TALLY GROUPS                          VIRGIN
                     (REMEMBER NUMBER OF GROUP BOUNDARIES            VIRGIN
                     IS ONE MORE THAN THE NUMBER OF GROUPS)          VIRGIN
                     UP TO 2000 GROUPS ARE ALLOWED                   VIRGIN
                     BUILT-IN GROUP STRUCTURES.                      VIRGIN
                     = GREATER THAN 0 = READ FROM INPUT              VIRGIN
                     =  0 TART 175 GROUPS                            VIRGIN
                     = -1 ORNL  50 GROUPS                            VIRGIN
                     = -2 ORNL 126 GROUPS                            VIRGIN
                     = -3 ORNL 171 GROUPS                            VIRGIN
                     = -4 SAND-II 620 GROUPS..1.0D-4 eV TO 18 MEV    VIRGIN
                     = -5 SAND-II 640 GROUPS..1.0D-4 eV TO 20 MEV    VIRGIN
                     = -6 WIMS 69 GROUPS                             VIRGIN
                     = -7 GAM-I 68 GROUPS                            VIRGIN
                     = -8 GAM-II 99 GROUPS                           VIRGIN
                     = -9 MUFT 54 GROUPS                             VIRGIN
                     =-10 ABBN 28 GROUPS                             VIRGIN
                     =-11 TART 616 GROUPS TO  20 MeV                 VIRGIN
                     =-12 TART 700 GROUPS TO   1 GeV                 VIRGIN
                     =-13 SAND-II 665 GROUPS..1.0D-5 eV TO 18 MEV    VIRGIN
                     =-14 SAND-II 685 GROUPS..1.0D-5 eV TO 20 MEV    VIRGIN
                     =-15 TART 666 GROUPS TO 200 MeV                 VIRGIN
                     =-16 SAND-II 725 GROUPS..1.0D-5 eV TO  60 MEVVIRGIN
                     =-17 SAND-II 755 GROUPS..1.0D-5 eV TO 150 MEVVIRGIN
                     =-18 SAND-II 765 GROUPS..1.0D-5 eV TO 200 MEVVIRGIN
                     =-19 UKAEA  1102 GROUPS..1.0D-5 eV to   1 GeVVIRGIN
      56-60    I5    NUMBER OF POINTS IN SOURCE SPECTRUM              VIRGIN
                     (MUST BE AT LEAST TWO POINTS)                   VIRGIN
                     = GREATER THAN 1 = READ FROM INPUT              VIRGIN
                     =  0 = SAME AS LAST CASE                        VIRGIN
                     = -1 = CONSTANT (ENERGY INDEPENDENT)            VIRGIN
                     = -2 = 1/E                                      VIRGIN
                     = -3 = BLACKBODY - PHOTON SPECTRUM              VIRGIN
                     = -4 = BLACKBODY - ENERGY SPECTRUM              VIRGIN
                     = -5 = TRANSMITTED SPECTRUM FROM LAST CASE      VIRGIN
                     NOTE, ALL SPECTRA, EXCEPT THE TRANSMITTED       VIRGIN
                     SPECTRUM FROM THE LAST CASE, WILL BE            VIRGIN
                     NORMALIZED SUCH THAT ITS INTEGRAL OVER          VIRGIN
                     ENERGY WILL BE UNITY.                           VIRGIN
      61-64  1X,3I1  SPATIALLY DEPENDENT OUTOUT                      VIRGIN
                     = 0 = NO                                        VIRGIN
                     = 1 = YES                                       VIRGIN
```

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                    FOR THE 3 QUANTITIES                              VIRGIN
                    COLUMN 67 FLUX                                    VIRGIN
                           68 REACTIONS                               VIRGIN
                           69 AVERAGE CROSS SECTION                   VIRGIN
      65-65    I1    ENERGY DEPENDENT OUTOUT                           VIRGIN
                     = 0 = NONE                                        VIRGIN
                     = 1 = INCIDENT SPECTRUM                           VIRGIN
                     = 2 = TRANSMITTED SPECTRUM                        VIRGIN
                     = 3 = INCIDENT REACTIONS                          VIRGIN
                     = 4 = TRANSMIITED REACTIONS                       VIRGIN
                     = 5 = TOTAL CROSS SECTION                         VIRGIN
                     = 6 = REACTION CROSS SECTION                      VIRGIN
   5   1-11   E11.4  BLACKBODY TEMPERATURE IN eV                       VIRGIN
      12-22   E11.4  FLUX NORMALIZATION                                VIRGIN
      23-33   E11.4  REACTION NORMALIZATION                            VIRGIN
                     CALCULATIONS WILL BE BASED ON THE SPECTRUM        VIRGIN
                     AND CROSS SECTIONS AS READ. AT OUTPUT THE         VIRGIN
                     RESULTS WILL BE MULTIPLIED BY THESE               VIRGIN
                     NORMALIZATION FACTORS.                            VIRGIN
      34-44    I11   DENSITY PROFILE                                   VIRGIN
                     = 0 - UNIFORM - BASED ON TOTAL DENSITY            VIRGIN
                     = 1 - UNIFORM - TOTAL + REACTION DENSITY          VIRGIN
                     = 2 - TOTAL + LINEAR REACTION                     VIRGIN
                     = 3 - LINEAR (TOTAL + REACTION)                   VIRGIN
                     = 4 - TOTAL + SQUARE REACTION                     VIRGIN
                     = 5 - SQUARE (TOTAL + REACTION)                   VIRGIN
                     = 6 - TOTAL + CUBIC REACTION                      VIRGIN
                     = 7 - CUBIC (TOTAL + REACTION)                    VIRGIN
 6-N   1-66  6E11.4  TARGET THICKNESSES IN CM                          VIRGIN
                     IF SAME AS LAST CASE THIS SECTION IS NOT          VIRGIN
                     INCLUDED IN THE INPUT.                            VIRGIN
VARY   1-66  6E11.4  TALLY GROUP ENERGY BOUNDARIES                     VIRGIN
                     (NUMBER OF BOUNDARIES IS ONE MORE THAN            VIRGIN
                     THE NUMBER OF TALLY GROUPS)                       VIRGIN
                     IF THE STANDARD OPTION (-14 TO 0) IS              VIRGIN
                     SELECTED THIS SECTION IS NOT INCLUDED             VIRGIN
                     IN THE INPUT                                      VIRGIN
VARY   1-66  6E11.4  SOURCE SPECTRUM IN ENERGY (eV)-SOURCE PAIRS       VIRGIN
                     (MUST BE AT LEAST TWO POINTS)                     VIRGIN
                     IF STANDARD OPTION (-5 TO 0) IS SELECTED THISVIRGIN
                     SECTION IS NOT INCLUDED IN THE INPUT              VIRGIN
                                                                       VIRGIN
ANY NUMBER OF CASES MAY BE RUN ONE AFTER ANOTHER.                      VIRGIN
                                                                       VIRGIN
EXAMPLE INPUT NO. 1                                                    VIRGIN
-------------------                                                    VIRGIN
CALCULATE THE UNCOLLIDED FLUX AND CAPTURE (MT=102) THROUGH             VIRGIN
30 CM OF IRON (DENSITY 7.87 G/CC). TALLY THE RESULTS USING             VIRGIN
THE TART 175 GROUP STRUCTURE. THE SOURCE WILL BE CONSTANT              VIRGIN
FROM 1 KEV TO 20 MEV. USE THE STANDARD ENDF/B INPUT DATA               VIRGIN
FILENAME.                                                              VIRGIN
                                                                       VIRGIN
ENDFB.IN                                                               VIRGIN
IRON 0 TO 30 CM THICK.                                                 VIRGIN
CONSTANT SOURCE FROM 1 KEV TO 20 MEV.                                  VIRGIN
 26000    1 7.8700D+ 0 26000  102 7.8700D+ 0     2    0    2 1100 VIRGIN
 0.0000D+ 0 1.0000D+ 0 1.0000D+ 0          0 0.0000D+00               VIRGIN
 0.0000D+00 3.0000D+01                                                 VIRGIN
 1.0000D+03 1.0000D+00 2.0000D+07 1.0000D+00                           VIRGIN
                                                                       VIRGIN
EXAMPLE INPUT NO. 2                                                    VIRGIN
-------------------                                                    VIRGIN
CALCULATE THE UNCOLLIDED PHOTON FLUX THROUGH A MIXTURE OF SILICON VIRGIN
AND IRON FOR 100 MEV PHOTONS INCIDENT. THE TRANSMISSION WILL BE   VIRGIN
CALCULATED FOR 21 THICKNESSES VARYING BETWEEN 0 AND 1 CM. THERE   VIRGIN
WILL BE ONLY 1 TALLY GROUP SPANNING A VERY NARROW ENERGY RANGE    VIRGIN
NEAR 100 MEV, AND THE SOURCE SPECTRUM WILL BE CONSTANT OVER THE   VIRGIN
SAME ENERGY RANGE. USE THE STANDARD ENDF/B INPUT DATA FILENAME    VIRGIN
BY LEAVING THE FIRST INPUT LINE BLANK.                            VIRGIN
                                                                  VIRGIN
(THIS IS A BLANK LINE TO USE THE STANDARD INPUT FILENAME)         VIRGIN
```

```
100 MEV PHOTONS                                                          VIRGIN
SILICON + 5 % IRON                                                       VIRGIN
 14000  521 2.30000+ 0 26000  521 1.15000- 1    21    1    2 1000 VIRGIN
 0.00000+ 0 1.00000+ 0 1.00000+ 0          1 0.00000+00           VIRGIN
 0.00000+00 5.00000-01 1.00000+00 1.50000+00 2.00000+00 2.50000+00VIRGIN
 3.00000+00 3.50000+00 4.00000+00 4.50000+00 5.00000+00 5.50000+00VIRGIN
 6.00000+00 6.50000+00 7.00000+00 7.50000+00 8.00000+00 8.50000+00VIRGIN
 9.00000+00 9.50000+00 1.00000+01                                        VIRGIN
 9.99000+ 7 1.00100+ 8                                                   VIRGIN
 9.99000+ 7 1.00000+ 4 1.00100+ 8 1.00000+ 4                             VIRGIN
                                                                         VIRGIN
==========================================================================VIRGIN
```