**======================================================================= 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 CHANGE Virgin**

**\*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 feedback Virgin**

**\*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**

**\*Updated based on user feedback Virgin**

**\*Defintion of built-in group structure Virgin**

**using SUBROUTINE GROPE is identical Virgin**

**for GROUPIE and VIRGIN. Virgin**

**\*All floating point parameters changed Virgin**

**to character inout + IN9 conversion. 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**

**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**

**------------------------- Virgin**

**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**

**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 Virgin**

**----- ----- Virgin**

**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**

**----------- 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 MEV Virgin**

**=-17 SAND-II 755 GROUPS..1.0D-5 eV TO 150 MEV Virgin**

**=-18 SAND-II 765 GROUPS..1.0D-5 eV TO 200 MEV Virgin**

**=-19 UKAEA 1102 GROUPS..1.0D-5 eV to 1 GeV Virgin**

**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**

**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 THIS Virgin**

**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+00 Virgin**

**3.00000+00 3.50000+00 4.00000+00 4.50000+00 5.00000+00 5.50000+00 Virgin**

**6.00000+00 6.50000+00 7.00000+00 7.50000+00 8.00000+00 8.50000+00 Virgin**

**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**