```
====================================================================== Groupie
                                                                       Groupie
     PROGRAM GROUPIE                                                   Groupie
     ===============                                                   Groupie
     VERSION 76-1 (NOVEMBER 1976)                                      Groupie
     VERSION 79-1 (OCTOBER 1979) CDC-7600 AND CRAY-1 VERSION.          Groupie
     VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION                 Groupie
     VERSION 81-1 (JANUARY 1981) EXTENSION TO 3000 GROUPS              Groupie
     VERSION 81-2 (MARCH 1981) IMPROVED SPEED                          Groupie
     VERSION 81-3 (AUGUST 1981) BUILT-IN 1/E WEIGHTING SPECTRUM        Groupie
     VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY       Groupie
     VERSION 83-1 (JANUARY 1983)*MAJOR RE-DESIGN.                      Groupie
                               *ELIMINATED COMPUTER DEPENDENT CODING.  Groupie
                               *NEW, MORE COMPATIBLE I/O UNIT NUMBERS. Groupie
                               *NEW MULTI-BAND LIBRARY BINARY FORMAT.  Groupie
     VERSION 83-2 (OCTOBER 1983) ADDED OPTION TO ALLOW SIGMA-0 TO BE   Groupie
                                 DEFINED EITHER AS MULTIPLES OF        Groupie
                                 UNSHIELDED TOTAL CROSS SECTION IN EACH Groupie
                                 GROUP, OR POWERS OF 10 IN ALL GROUPS. Groupie
     VERSION 84-1 (APRIL 1984)   ADDED MORE BUILT IN MULTIGROUP ENERGY  Groupie
                                 STRUCTURES.                           Groupie
     VERSION 85-1 (APRIL 1985)  *UPDATED FOR ENDF/B-VI FORMATS.        Groupie
                               *SPECIAL I/O ROUTINES TO GUARANTEE      Groupie
                                ACCURACY OF ENERGY.                    Groupie
                               *DOUBLE PRECISION TREATMENT OF ENERGY   Groupie
                                (REQUIRED FOR NARROW RESONANCES).      Groupie
                               *MINIMUM TOTAL CROSS SECTION TREATMENT  Groupie
     VERSION 85-2 (AUGUST 1985) *FORTRAN-77/H VERSION                  Groupie
     VERSION 86-1 (JANUARY 1986)*ENDF/B-VI FORMAT                      Groupie
     VERSION 86-2 (JUNE 1986)   *BUILT-IN MAXWELLIAN, 1/E AND FISSION  Groupie
                                 WEIGHTING SPECTRUM.                   Groupie
     VERSION 88-1 (JULY 1988)   *OPTION...INTERNALLY DEFINE ALL I/O    Groupie
                                 FILE NAMES (SEE, SUBROUTINES FILIO1   Groupie
                                 FILIO2 FOR DETAILS).                  Groupie
                               *IMPROVED BASED ON USER COMMENTS.       Groupie
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO    Groupie
                                 INSURE PROGRAM WILL NOT DO ANYTHING   Groupie
                                 CRAZY.                                Groupie
                               *UPDATED TO USE NEW PROGRAM CONVERT     Groupie
                                KEYWORDS.                              Groupie
                               *ADDED LIVERMORE CIVIC COMPILER         Groupie
                                CONVENTIONS.                           Groupie
     VERSION 91-1 (JUNE 1991)   *INCREASED PAGE SIZE FROM 1002 TO 5010 Groupie
                                 POINTS                                Groupie
                               *UPDATED BASED ON USER COMMENTS         Groupie
                               *ADDED FORTRAN SAVE OPTION              Groupie
                               *COMPLETELY CONSISTENT ROUTINE TO READ  Groupie
                                FLOATING POINT NUMBERS.                Groupie
     VERSION 92-1 (JANUARY 1992)*ADDED RESONANCE INTEGRAL CALCULATION - Groupie
                                 UNSHIELDED AND/OR SHIELDED - FOR      Groupie
                                 DETAILS SEE BELOW                     Groupie
                               *INCREASED NUMBER OF ENERGY POINTS      Groupie
                                IN BUILT-IN SPECTRA - TO IMPROVE       Groupie
                                ACCURACY.                              Groupie
                               *ALLOW SELECTION OF ZA/MF/MT OR         Groupie
                                MAT/MF/MT RANGES - ALL DATA NOT        Groupie
                                SELECTED IS SKIPPED ON INPUT AND       Groupie
                                NOT WRITTEN AS OUTPUT.                 Groupie
                               *COMPLETELY CONSISTENT I/O ROUTINES -   Groupie
                                TO MINIMIZE COMPUTER DEPENDENCE.       Groupie
                               *NOTE, CHANGES IN INPUT PARAMETER       Groupie
                                FORMAT - FOR ZA/MF/MT OR MAT/MF/MT     Groupie
                                RANGES.                                Groupie
     VERSION 92-2 (JUNE 1992)   *MULTIBAND PARAMETERS OUTOUT AS         Groupie
                                 CHARACTER (RATHER THAN BINARY) FILE.  Groupie
     VERSION 93-1 (APRIL 1993)  *INCREASED PAGE SIZE FROM 5010 TO      Groupie
                                 30000 POINTS                          Groupie
                               *ELIMINATED COMPUTER DEPENDENCE.        Groupie
     VERSION 94-1 (JANUARY 1994)*VARIABLE ENDF/B DATA FILENAMES        Groupie
                                 TO ALLOW ACCESS TO FILE STRUCTURES     Groupie
                                 (WARNING - INPUT PARAMETER FORMAT      Groupie
```

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                          HAS BEEN CHANGED)                        Groupie
                         *CLOSE ALL FILES BEFORE TERMINATING       Groupie
                          (SEE, SUBROUTINE ENDIT)                  Groupie
VERSION 95-1 (JANUARY 1994)*CORRECTED MAXWELLIAN WEIGHTING         Groupie
                         *CHANGING WEIGHTING SPECTRUM FROM         Groupie
                          0.1 TO 0.001 % UNCERTAINTY               Groupie
VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                     Groupie
                         *IMPROVED COMPUTER INDEPENDENCE           Groupie
                         *ALL DOUBLE PRECISION                     Groupie
                         *ON SCREEN OUTPUT                         Groupie
                         *UNIFORM TREATMENT OF ENDF/B I/O          Groupie
                         *IMPROVED OUTPUT PRECISION                Groupie
                         *DEFINED SCRATCH FILE NAMES               Groupie
                         *UP TO 1000 GROUP MULTI-BAND              Groupie
                          CALCULATION (PREVIOUSLY 175)             Groupie
                         *MAXIMUM NUMBER OF GROUPS REDUCED         Groupie
                          FROM 3,000 TO 1,000                      Groupie
                         *UP TO 1000 MATERIALS                     Groupie
                          (PREVIOUSLY 100)                         Groupie
                         *CORRECTED USE OF MAXWELLIAN +            Groupie
                          1/E + FISSION SPECTRUM                   Groupie
                         *ONLY 2 BAND VERSION DISTRIBUTED          Groupie
                          (CONTACT AUTHOR FOR DETAILS)             Groupie
                         *DEFINED SCRATCH FILE NAMES               Groupie
VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING       Groupie
                          POINT READ FOR MORE DIGITS               Groupie
                         *UPDATED TEST FOR ENDF/B FORMAT           Groupie
                          VERSION BASED ON RECENT FORMAT CHANGE    Groupie
                         *GENERAL IMPROVEMENTS BASED ON            Groupie
                          USER FEEDBACK                            Groupie
VERSION 99-2 (JUNE 1999)    *ASSUME ENDF/B-VI, NOT V, IF MISSING   Groupie
                          MF=1, MT-451.                            Groupie
VERS. 2000-1 (FEBRUARY 2000)*ADDED MF=10, ACTIVATION CROSS SECTION Groupie
                          PROCESSING.                              Groupie
                         *GENERAL IMPROVEMENTS BASED ON            Groupie
                          USER FEEDBACK                            Groupie
VERS. 2002-1 (FEBRUARY 2002)*ADDED TART 700 GROUP STRUCTURE        Groupie
                         *ADDED VARIABLE SIGMA0 INPUT OPTION       Groupie
             (MAY 2002)     *OPTIONAL INPUT PARAMETERS             Groupie
             (NOV. 2002)    *ADDED SAND-II EXTENDED DOWN TO        Groupie
                          1.0D-5 EV.                               Groupie
             (JUNE 2003)    *CORRECTED SAND-II 620 AND 640 GROUP   Groupie
                          ENERGY BOUNDARIES DEFINITIONS.           Groupie
VERS. 2004-1 (SEPT. 2004)  *INCREASED PAGE SIZE FROM 30000 TO      Groupie
                          120000 POINTS                            Groupie
                         *ADDED "OTHER" AS ADDITIONAL REACTION     Groupie
                          TO IMPROVE MULTI-BAND FITTING            Groupie
                         *ADDED ITERATION FOR "BEST" PARTIAL       Groupie
                          PARAMETERS.                              Groupie
                         *DO NOT SKIP LOW TOTAL ENERGY RANGES      Groupie
                          WHEN DEFINING AVERAGE CROSS SECTIONS -   Groupie
                          THIS MAKES OUTPUT COMPATIBLE WITH        Groupie
                          ANY STANDARD AVERAGING PROCEDURE         Groupie
VERS. 2005-1 (JAN. 2005)   *ADDED OPTION TO CHANGE TEMPERATURE OF  Groupie
                          BUILT-IN STANDARD SPECTRUM.              Groupie
VERS. 2007-1 (JAN. 2007)   *CHECKED AGAINST ALL ENDF/B-VII.        Groupie
                         *INCREASED PAGE SIZE FROM 120,000 TO      Groupie
                          600,000 POINTS                           Groupie
VERS. 2008-1 (JAN. 2008)   *72 CHARACTER FILE NAMES.               Groupie
                         *GENERAL UPDATES                          Groupie
VERS. 2010-1 (Apr. 2010)   *INCREASED WEIGHTING SPECTRUM TO 30,000 Groupie
                          FROM 3,000 ENERGY POINTS.                Groupie
                         *ADDED OUTPUT TO PLOT/COMPARE SHIELDED    Groupie
                          AND UNSHIELDED CROSS SECTIONS.           Groupie
VERS. 2011-1 (June 2011)   *Corrected TART 700 groups to extend up Groupie
                          to 1 GeV (1,000 MeV) - previously it     Groupie
                          was ERRONEOUSLY cutoff at 20 MeV.        Groupie
VERS. 2011-2 (Nov. 2011)   *Corrected TART 616 groups lowest       Groupie
                          energy from 1.0D-4 eV to 1.0D-5 eV.      Groupie
                         *Added TART 666 to 200 MeV (for TENDL).   Groupie
                         *Optional high energy cross section       Groupie
```

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                          extension above tabulated energy range Groupie
                          (either = 0 = standard, or constant)   Groupie
                          WARNING - ENDF/B standard convention   Groupie
                          is that the cross section = 0 where it Groupie
                          is not explicitly defined - extension  Groupie
                          = 0 is standard, constant is NOT, so   Groupie
                          constant extension is NOT RECOMMENDED. Groupie
VERS. 2012-1 (Aug. 2012)  *Added CODENAME                        Groupie
                         *32 and 64 bit Compatible               Groupie
                         *Added ERROR stop.                      Groupie
VERS. 2013-1 (Nov. 2013)  *Extended OUT9.                        Groupie
                         *Uses OUTG, not OUT10 for energies.     Groupie
VERS. 2015-1 (Jan. 2015)  *Corrected SPECTM - handle ALL included Groupie
                          group structures, i.e., even those     Groupie
                          that start above thremal range by      Groupie
                          ALWAYS constructing weigthing spectrum Groupie
                          to be AT LEAST 1.0D-5 eV to 20 MeV.    Groupie
                         *Extended OUTG                          Groupie
                         *Replaced ALL 3 way IF Statements.      Groupie
                         *Generalized TART Group Strructures.    Groupie
                         *Generalized SAND-II Group Structures.  Groupie
                         *Extended SAND-II to 60, 150, 200 MeV.  Groupie
VERS. 2015-2 (Mar. 2015)  *Deleted 1P from formats reading input  Groupie
                          parameters, causing incorrect scaling  Groupie
                         *Changed ALL data to "D" instead of     Groupie
                          "E" to insure it is REAL*8 and avoid   Groupie
                          Truncation ERRORS.                     Groupie
VERS. 2015-3 (July 2015)  *Insure no 10 digit output - not       Groupie
                          needed for multi-group and this makes  Groupie
                          listings simpler.                      Groupie
                         *Corrected High Energy Extension =      Groupie
                          Can effect highest energy group.       Groupie
VERS. 2016-1 (July 2016)  *Added UKAEA 1102 Group Structure.     Groupie
                         *Increased storage to accommodate       Groupie
                          much larger group structures =         Groupie
                          up to 20,000 Groups.                   Groupie
                         *Added output listing of the complete   Groupie
                          input parameters for URRFIT, including Groupie
                          the NJOY parameters LSSF and ICOMP.    Groupie
                         *Changed multiple IF statements to      Groupie
                          accommodate compiler optimizer         Groupie
                         *Cosmetic changes based on FREUD        Groupie
                          psychoanalysis.                        Groupie
                         *Updated multi-band treatment to        Groupie
                          explcitly handle small shielding       Groupie
                          limit - without this update the small  Groupie
                          limit becomes numerically unstable.    Groupie
VERS. 2017-1 (May  2017)  *Increased max. points to 3,000,000.   Groupie
                         *METHODB was incorrecctly named         Groupie
                          METHOD  in one routine = corrected.    Groupie
                         *Default multi-band is method #2 =      Groupie
                          conserve <x>, <1/(x+<x>>, <1/x>.       Groupie
                         *Definition of built-in group structure Groupie
                          using SUBROUTINE GROPE is identical    Groupie
                          for GROUPIE and VIRGIN.                Groupie
                         *All floating input parameters changed  Groupie
                          to character input + IN9 conversion.   Groupie
                         *Output report identfies MF now that    Groupie
                          this code does more than just MF=3.    Groupie
                         *Added NRO = energy dependent scatter   Groupie
                          radius to copying FILE2 parameters     Groupie
                          to define unresolved energy range.     Groupie
                         *Corrected energy dependent scatter     Groupie
                          for all resonance types (see, above    Groupie
                          comments) = for multi-band output      Groupie
VERS. 2018-1 (Jan. 2018)  *Added on-line output for ALL ENDERROR Groupie
VERS. 2019-1 (June 2019)  *Major re-write to re-order output to  Groupie
                          include Unresolved Resonance Region    Groupie
                          self-shielding.                        Groupie
                         *Added Unresolved self-shielding by     Groupie
                          Extrapolating cross section moments    Groupie
```

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                            from Resolved (supersedes URRDO and    Groupie
                            URRFIT codes).                         Groupie
                           *Added entire self-shielding array to   Groupie
                            memory - previously only one group     Groupie
                            results were in memory - saving ALL    Groupie
                            greatly simplifies the logic.          Groupie
                           *Additional Interpolation Law Tests     Groupie
                           *Check maximum Tabulated Energy of MTs  Groupie
                            to insure they ALL end at the same     Groupie
                            energy.                                Groupie
                           *Multi-band = 1 no longer allowed.      Groupie
                            The only allowed values are,           Groupie
                            0 = no multi-band calculations, or,    Groupie
                            2 = Conserve 1/[total + <total>]       Groupie
                           *Unresolved Resonance Region            Groupie
                            Self-Shielding Requires all of these,  Groupie
                            1) Unresolved data with ENDF input     Groupie
                            2) 616 TART Groups (input -11)         Groupie
                            3) Define Sigma0 standard (input = 0)  Groupie
                           *Unresolved Resonance Region            Groupie
                            Self-Shielding Always Outputs,         Groupie
                            1) LSSF   = 0 = Output cross sections  Groupie
                            2) INTUNR = 2 = Interpolation law      Groupie
                           *Added ZAzzzaaa to filenames.           Groupie
                                                                   Groupie
2015-2 Acknowledgment                                              Groupie
=====================                                              Groupie
I thank Chuck Whitmer (TerraPower,WA) and Andrej Trkov (NDS,IAEA)  Groupie
for reporting the errors that led to the 2015-2 Improvements in    Groupie
this code.                                                         Groupie
                                                                   Groupie
I thank Jean-Christophe Sublet (UKAEA) for contributing MAC        Groupie
executables and Bojan Zefran (IJS, Slovenia) for contributing      Groupie
LINUX (32 or 63 bit) executables. And most of all I must thank     Groupie
Andrej Trkov (NDS, IAEA) for overseeing the entire PREPRO project  Groupie
at IAEA, Vienna. This was a truly International team who worked    Groupie
together to produce PREPRO 2015-2.                                 Groupie
                                                                   Groupie
OWNED, MAINTAINED AND DISTRIBUTED BY                               Groupie
-----------------------------------                                Groupie
THE NUCLEAR DATA SECTION                                           Groupie
INTERNATIONAL ATOMIC ENERGY AGENCY                                 Groupie
P.O. BOX 100                                                       Groupie
A-1400, VIENNA, AUSTRIA                                            Groupie
EUROPE                                                             Groupie
                                                                   Groupie
ORIGINALLY WRITTEN BY                                              Groupie
---------------------------------                                  Groupie
Dermott E. Cullen                                                  Groupie
                                                                   Groupie
PRESENT CONTACT INFORMATION                                        Groupie
---------------------------                                        Groupie
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Website    RedCullen1.net/HOMEPAGE.NEW                             Groupie
                                                                   Groupie
AUTHORS MESSAGE                                                    Groupie
---------------                                                    Groupie
THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION   Groupie
FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED Groupie
THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE Groupie
READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY     Groupie
THE COMMENTS CONCERNING MACHINE DEPENDENT CODING.                  Groupie
                                                                   Groupie
AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER Groupie
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE     Groupie
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT Groupie
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IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR COMPUTER.

PURPOSE

THIS PROGRAM IS DESIGNED TO CALCULATE ANY COMBINATION OF THE FOLLOWING QUANTITIES FROM LINEARLY INTERPOLABLE TABULATED CROSS SECTIONS IN THE ENDF/B FORMAT

(1) UNSHIELDED GROUP AVERAGED CROSS SECTIONS
(2) BONDARENKO SELF-SHIELDED GROUP AVERAGED CROSS SECTIONS
(3) MULTI-BAND PARAMETERS

IN THE FOLLOWING FOR SIMPLICITY THE ENDF/B TERMINOLOGY--ENDF/B TAPE--WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE TAPE, CARDS, DISK OR ANY OTHER MEDIUM.

ENDF/B FORMAT

THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV OR V FORMAT).

IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS ASSUMED THAT THE MAT, MF AND MT ON EACH CARD IS CORRECT. SEQUENCE NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE CORRECTLY OUTPUT ON ALL CARDS. THE FORMAT OF SECTION MF=1, MT=451 AND ALL SECTIONS OF MF= 3 MUST BE CORRECT. THE PROGRAM COPIES ALL OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.

ALL FILE 3 CROSS SECTIONS THAT ARE USED BY THIS PROGRAM MUST BE LINEARLY INTERPOLABLE IN ENERGY AND CROSS SECTION (ENDF/B INTERPOLATION LAW 2). FILE 3 BACKGROUND CROSS SECTIONS MAY BE MADE LINEARLY INTERPOLABLE USING PROGRAM LINEAR (UCRL-50400, VOL. 17, PART A). THE RESONANCE CONTRIBUTION MAY BE ADDED TO THE BACKGROUND CROSS SECTIONS USING PROGRAM RECENT (UCRL-50400, VOL. 17, PART B). IF THIS PROGRAM FINDS THAT THE FILE 3 CROSS SECTIONS ARE NOT LINEARLY INTERPOLABLE THIS PROGRAM WILL TERMINATE EXECUTION.

CONTENTS OF OUTPUT

IF ENDF/B FORMATTED OUTPUT IS REQUESTED ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE MULTI-GROUPED FILE 3 CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO INCLUDED.

DOCUMENTATION

THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED BY THE ADDITION OF THREE COMMENT CARDS AT THE END OF EACH HOLLERITH SECTION TO DESCRIBE THE GROUP STRUCTURE AND WEIGHTING SPECTRUM, E.G.

********** PROGRAM GROUPIE (2019-1) **********
UNSHIELDED GROUP AVERAGES USING 69 GROUPS (WIMS)
MAXWELLIAN, 1/E AND FISSION WEIGHTING SPECTRUM

THE ORDER OF ALL SIMILAR COMMENTS (FROM LINEAR, RECENT AND SIGMA1) REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON THE DATA.

THESE COMMENT CARDS ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS, I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451 IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF

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MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO          Groupie
DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND   Groupie
AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT  Groupie
SHOULD BE USED TO CREATE A HOLLERITH SECTION.                      Groupie
                                                                   Groupie
REACTION INDEX                                                     Groupie
--------------                                                     Groupie
THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN     Groupie
SECTION MF=1, MT=451 OF EACH EVALUATION.                           Groupie
                                                                   Groupie
THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451.   Groupie
THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT         Groupie
REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS Groupie
NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING  Groupie
A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE  Groupie
A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM Groupie
YOU MAY USE PROGRAM DICTIN TO CREATE A CORRECT REACTION INDEX.     Groupie
                                                                   Groupie
SECTION SIZE                                                       Groupie
------------                                                       Groupie
SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT  Groupie
TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS      Groupie
SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.                 Groupie
                                                                   Groupie
SELECTION OF DATA                                                  Groupie
-----------------                                                  Groupie
THE PROGRAM SELECTS MATERIALS TO BE PROCESSED BASED EITHER ON      Groupie
MAT (ENDF/B MAT NO.) OR ZA. THE PROGRAM ALLOWS UP TO 100 MAT OR    Groupie
ZA RANGES TO BE SPECIFIED. THE PROGRAM WILL ASSUME THAT THE        Groupie
ENDF/B TAPE IS IN EITHER MAT OR ZA ORDER, WHICHEVER CRITERIA IS    Groupie
USED TO SELECT MATERIALS, AND WILL TERMINATE WHEN A MAT OR ZA      Groupie
IS FOUND THAT IS ABOVE THE RANGE OF ALL REQUESTS.                  Groupie
                                                                   Groupie
ENERGY ORDER AND UNITS                                             Groupie
----------------------                                             Groupie
ALL ENERGIES (FOR CROSS SECTIONS, WEIGHTING SPECTRUM OR GROUP      Groupie
BOUNDARIES) MUST BE IN UNITS OF EV AND MUST BE IN ASCENDING        Groupie
NUMERICAL ORDER.                                                   Groupie
                                                                   Groupie
ENERGY GRID                                                        Groupie
-----------                                                        Groupie
ALTHOUGH ALL REACTIONS MUST TO LINEARLY INTERPOLABLE, THEY DO NOT  Groupie
ALL HAVE TO USE THE SAME ENERGY GRID. EACH REACTION CAN BE GIVEN   Groupie
BY AN INDEPENDENT ENERGY GRID. THIS PROGRAM WILL PROCEED FROM      Groupie
THE LOWEST TO HIGHEST ENERGY SELECTING EACH ENERGY INTERVAL OVER   Groupie
WHICH ALL DATA, FOR ANY GIVEN CALCULATION, ARE ALL LINEARLY        Groupie
INTERPOLABLE.                                                      Groupie
                                                                   Groupie
GROUP STRUCTURE                                                    Groupie
---------------                                                    Groupie
THIS PROGRAM IS DESIGNED TO USE AN ARBITRARY ENERGY GROUP          Groupie
STRUCTURE WHERE THE ENERGIES ARE IN EV AND ARE IN INCREASING       Groupie
ENERGY ORDER. THE MAXIMUM NUMBER OF GROUPS IS 20,000.              Groupie
                                                                   Groupie
THE USER MAY INPUT AN ARBITRARY GROUP STRUCTURE OR THE USER MAY    Groupie
USE USE ONE OF THE SEVEN BUILT-IN GROUP STRUCTURES.                Groupie
 (0) 175 GROUP (TART STRUCTURE)                                    Groupie
 (1)  50 GROUP (ORNL STRUCTURE)                                    Groupie
 (2) 126 GROUP (ORNL STRUCTURE)                                    Groupie
 (3) 171 GROUP (ORNL STRUCTURE)                                    Groupie
 (4) 620 GROUP (SAND-II STRUCTURE, UP TO 18 MEV)                   Groupie
 (5) 640 GROUP (SAND-II STRUCTURE, UP TO 20 MEV)                   Groupie
 (6)  69 GROUP (WIMS STRUCTURE)                                    Groupie
 (7)  68 GROUP (GAM-I STRUCTURE)                                   Groupie
 (8)  99 GROUP (GAM-II STRUCTURE)                                  Groupie
 (9)  54 GROUP (MUFT STRUCTURE)                                    Groupie
(10)  28 GROUP (ABBN STRUCTURE)                                    Groupie
(11) 616 GROUP (TART STRUCTURE TO 20 MeV)                          Groupie
(12) 700 GROUP (TART STRUCTURE TO 1 GEV)                           Groupie
(13) 665 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 18 MEV)        Groupie
(14) 685 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 20 MEV)        Groupie
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(15) 666 GROUP (TART STRUCTURE TO 200 MeV)                                Groupie
(16) 725 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO  60 MEV)              Groupie
(17) 755 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 150 MEV)              Groupie
(18) 765 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 200 MEV)              Groupie
(19)1102 GROUP (UKAEA   STRUCTURE, 1.0D-5 eV, UP TO   1 GeV)              Groupie
                                                                          Groupie
 GROUP AVERAGES                                                           Groupie
 --------------                                                           Groupie
 THIS PROGRAM DEFINES GROUP AVERAGED CROSS SECTIONS AS...                 Groupie
                                                                          Groupie
           (INTEGRAL E1 TO E2) (SIGMA(E)*S(E)*WT(E)*DE)                   Groupie
 AVERAGE = ----------------------------------------                       Groupie
           (INTEGRAL E1 TO E2) (S(E)*WT(E)*DE)                            Groupie
 WHERE...                                                                 Groupie
                                                                          Groupie
 AVERAGE  = GROUP AVERAGED CROSS SECTION                                  Groupie
 E1, E2   = ENERGY LIMITS OF THE GROUP                                    Groupie
 SIGMA(E) = ENERGY DEPENDENT CROSS SECTION FOR ANY GIVEN REACTION         Groupie
 S(E)     = ENERGY DEPENDENT WEIGHTING SPECTRUM                           Groupie
 WT(E)    = ENERGY DEPENDENT SELF-SHIELDING FACTOR.                       Groupie
                                                                          Groupie
 ENERGY DEPENDENT WEIGHTING SPECTRUM                                      Groupie
 -----------------------------------                                      Groupie
 THE ENERGY DEPENDENT WEIGHTING SPECTRUM IS GIVEN BY AN ARBITRARY         Groupie
 TABULATED LINERLY INTERPOLABLE FUNCTION WHICH CAN BE DESCRIBED           Groupie
 BY AN ARBITRARY NUMBER OF POINTS. THIS ALLOWS THE USER TO                Groupie
 SPECIFY ANY DESIRED WEIGHTING SPECTRUM TO ANY GIVEN DEGREE OF            Groupie
 ACCURACY. REMEMBER THAT THE PROGRAM WILL ASSUME THAT THE SPECTRUM        Groupie
 IS LINEARLY INTERPOLABLE BETWEEN TABULATED POINTS. THEREFORE THE         Groupie
 USER SHOULD USE ENOUGH POINTS TO INSURE AN ADEQUATE REPRESENTATION       Groupie
 OF THE SPECTRUM BETWEEN TABULATED DATA POINTS.                           Groupie
                                                                          Groupie
 THE PRESENT VERSION OF THE CODE HAS THREE BULIT-IN WEIGHTING             Groupie
 SPECTRA,                                                                 Groupie
                                                                          Groupie
 (1) CONSTANT                                                             Groupie
 (2) 1/E                                                                  Groupie
 (3) MAXWELLIAN = E*EXP(-E/KT)/KT                (0.0 TO 4*KT)            Groupie
     1/E        = C1/E                           (4*KT TO 67 KEV)         Groupie
     FISSION    = C2*EXP(-E/WA)*SINH(SQRT(E*WB)) (ABOVE 67 KEV)           Groupie
                                                                          Groupie
     KT     = 0.253 EV (293 KELVIN)                                       Groupie
     WA     = 9.65D+5                                                     Groupie
     WB     = 2.29D-6                                                     Groupie
     C1, C2 = DEFINED TO MAKE SPECTRUM CONTINUOUS                         Groupie
                                                                          Groupie
     FISSION SPECTRUM CONSTANTS FROM                                      Groupie
     A.F.HENRY, NUCLEAR REACTOR ANALYSIS, P. 11, MIT PRESS (1975)         Groupie
                                                                          Groupie
 UNSHIELDED GROUP AVERAGES                                                Groupie
 -------------------------                                                Groupie
 FOR UNSHIELDED AVERAGES THE SELF-SHIELDING FACTOR (WT(E)) IS SET         Groupie
 TO UNITY. THIS PROGRAM ALLOWS UP TO 20,000 GROUPS.                       Groupie
                                                                          Groupie
 SELF-SHIELDED GROUP AVERAGES                                             Groupie
 ----------------------------                                             Groupie
 IF SELF-SHIELDED AVERAGES AND/OR MULTI-BAND PARAMETERS ARE               Groupie
 CALCULATED THIS PROGRAM ALLOWS UP TO 20,000 GROUPS. SELF-SHIELDED        Groupie
 AVERAGES AND/OR MULTI-BAND PARAMETERS ARE CALCULATED FOR THE             Groupie
 TOTAL, ELASTIC, CAPTURE AND FISSION.                                     Groupie
                                                                          Groupie
 FOR THE TOTAL, ELASTIC, CAPTURE AND FISSION THE PROGRAM USES A           Groupie
 WEIGHTING FUNCTION THAT IS A PRODUCT OF THE ENERGY DEPENDENT             Groupie
 WEIGHTING SPECTRUM TIMES A BONDERENKO TYPE SELF-SHIELDING FACTOR.        Groupie
                                                                          Groupie
 WT(E) = S(E)/(TOTAL(E)+SIGMA0)**N                                        Groupie
                                                                          Groupie
 WHERE...                                                                 Groupie
                                                                          Groupie
 S(E)     - ENERGY DEPENDENT WEIGHTING SPECTRUM (DEFINED BY               Groupie
            TABULATED VALUES AND LINEAR INTERPOLATION BETWEEN             Groupie
```

```
           TABULATED VALUES).                                          Groupie
TOTAL(E) - ENERGY DEPENDENT TOTAL CROSS SECTION FOR ONE MATERIAL       Groupie
           (DEFINED BY TABULATED VALUES AND LINEAR INTERPOLATION       Groupie
           BETWEEN TABULATED VALUES).                                  Groupie
SIGMA0   - CROSS SECTION TO REPRESENT THE EFFECT OF ALL OTHER          Groupie
           MATERIALS AND LEAKAGE (DEFINED WITHIN EACH GROUP TO BE      Groupie
           A MULTIPLE OF THE UNSHIELDED TOTAL CROSS SECTION WITHIN     Groupie
           THAT GROUP OR POWERS OF 10 - INPUT OPTION).                 Groupie
N        - A POSITIVE INTEGER (0, 1, 2 OR 3).                         Groupie
                                                                       Groupie
THE PROGRAM WILL USE ONE ENERGY DEPENDENT WEIGHTING SPECTRUM S(E)      Groupie
AND 25 DIFFERENT BONDERENKO TYPE SELF-SHIELDING FACTORS (25 SIGMA0     Groupie
AND N COMBINATIONS) TO DEFINE 25 DIFFERENT AVERAGE CROSS SECTIONS,     Groupie
FOR EACH REACTION, WITHIN EACH GROUP.                                  Groupie
                                                                       Groupie
THE 25 WEIGHTING FUNCTIONS USED ARE....                                Groupie
(1)   - UNSHIELDED CROSS SECTIONS (N=0)                                Groupie
(2-22)- PARTIALLY SHIELDED CROSS SECTIONS (N=1 ,VARIOUS SIGMA0)        Groupie
        THE VALUES OF SIGMA0 USED WILL BE EITHER,                      Groupie
        (A) THE VALUES OF SIGMA0 THAT ARE USED VARY FROM 1024          Groupie
        TIMES THE UNSHIELDED TOTAL CROSS SECTIONS IN STEPS OF 1/2      Groupie
        DOWN TO 1/1024 TIMES THE UNSHIELDED TOTAL CROSS SECTION        Groupie
        (A RANGE OF OVER 1 MILLION, CENTERED ON THE UNSHIELDED         Groupie
        TOTAL CROSS SECTION WITHIN EACH GROUP).                        Groupie
        (B) THE SAME CONSTANT VALUES OF SIGMA0 IN EACH GROUP. THE      Groupie
        VALUES OF SIGMA0 USED INCLUDE 40000, 20000, 10000, 7000,       Groupie
        4000, 2000, 1000, 700, 400, 200, 100, 70, 40, 20, 10, 7,       Groupie
        4, 2, 1, 0.7, 0.4 (A RANGE OF 100,000 SPANNING MORE THAN       Groupie
        THE RANGE OF SIGMA0 VALUES THAT MAY BE ENCOUNTERED IN          Groupie
        ACTUAL APPLICATIONS)                                           Groupie
(23)  - TOTALLY SHIELDED FLUX WEIGHTED CROSS SECTION                   Groupie
        (N=1, SIGMA0=0)                                                Groupie
(24)  - TOTALLY SHIELDED CURRENT WEIGHTED CROSS SECTION                Groupie
        (N=2, SIGMA0=0)                                                Groupie
(25)  - TOTALLY SHIELDED COSINE SQUARED WEIGHTED CROSS SECTION         Groupie
        (N=3, SIGMA0=0)                                                Groupie
                                                                       Groupie
FOR ALL OTHER REACTIONS (EXCEPT TOTAL, ELASTIC, CAPTURE AND            Groupie
FISSION) THE PROGRAM WILL USE THE ENERGY DEPENDENT WEIGHTING           Groupie
SPECTRUM S(E) TO DEFINE THE UNSHIELDED (BONDERENKO N=0)                Groupie
AVERAGED CROSS SECTION WITHIN EACH GROUP.                              Groupie
                                                                       Groupie
CALCULATION OF RESONANCE INTEGRALS                                     Groupie
---------------------------------                                      Groupie
IN A PURE ELASTIC ISOTROPICALLY SCATTERING MATERIAL WITH A             Groupie
CONSTANT CROSS SECTION THE SPECTRUM WILL BE 1/E AND THERE WILL         Groupie
BE NO SELF-SHIELDING.                                                  Groupie
                                                                       Groupie
IN THIS CASE IF THE CROSS SECTION VARIES WITH ENERGY THE               Groupie
SPECTRUM WILL STILL BE 1/E AND THE SELF-SHIELDING FACTOR WILL          Groupie
BE EXACTLY 1/SIG-TOT(E) - WHERE SIG-TOT(E) = SIG-EL(E), SINCE          Groupie
THERE IS ONLY SCATTERING.                                              Groupie
                                                                       Groupie
IF WE HAVE AN INFINITELY DILUTE AMOUNT OF A MATERIAL UNIFORMLY         Groupie
MIXED WITH A PURE ELASTIC ISOTROPICALLY SCATTERING MATERIAL WITH       Groupie
A CONSTANT CROSS SECTION THE STANDARD DEFINITION OF THE RESONANCE      Groupie
INTEGRAL CAN BE USED TO DEFINE REACTION RATES FOR EACH REACTION.       Groupie
                                                                       Groupie
THE RESONANCE INTEGRAL IS DEFINED AS,                                  Groupie
                                                                       Groupie
RI      = (INTEGRAL E1 TO E2) (SIGMA(E)*S(E)*WT(E)*DE)                 Groupie
                                                                       Groupie
WHERE NORMALLY,                                                        Groupie
S(E)    = 1/E                                                          Groupie
WT(E)   = 1    - NO SELF-SHIELDING                                     Groupie
                                                                       Groupie
FROM THE ABOVE DEFINITION OF GROUP AVERAGED CROSS SECTIONS THE         Groupie
RESONANCE INTEGRAL IS,                                                 Groupie
                                                                       Groupie
RI      = AVERAGE * (INTEGRAL E1 TO E2) (S(E)*WT(E)*DE)                Groupie
                                                                       Groupie
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FOR A 1/E SPECTRUM AND NO SELF-SHIELDING THIS REDUCES TO,          Groupie
                                                                   Groupie
RI      = AVERAGE* LOG(E2/E1)                                      Groupie
                                                                   Groupie
IN ANY OTHER SITUATION, INCLUDING ABSORPTION AND/OR ENERGY         Groupie
DEPENDENT CROSS SECTIONS, THE SPECTRUM WILL NOT BE 1/E -           Groupie
ABSORPTION WILL TEND TO DECREASE THE SPECTRUM PROGRESSIVELY        Groupie
MORE AT LOWER ENERGIES - ENERGY DEPENDENCE OF THE CROSS SECTION    Groupie
WILL LEAD TO SELF-SHIELDING.                                       Groupie
                                                                   Groupie
HERE WE WILL NOT ATTEMPT TO PERFORM A DETAILED SPECTRUM            Groupie
CALCULATION TO ACCOUNT FOR ABSORPTION.                             Groupie
                                                                   Groupie
HOWEVER, WE WILL EXTEND THE DEFINITION OF THE RESONANCE INTEGRAL   Groupie
TO ACCOUNT FOR SELF-SHIELDING EFFECTS BY ALLOWING FOR INCLUSION    Groupie
OF SELF-SHIELDING EFFECTS IN THE DEFINITION OF GROUP AVERAGES      Groupie
AND THEN DEFINING THE RESONANCE INTEGRAL AS,                       Groupie
                                                                   Groupie
RI      = AVERAGE* LOG(E2/E1)                                      Groupie
                                                                   Groupie
IN ORDER TO CALCULATE RESONANCE INTEGRALS YOU MUST FOLLOW THESE    Groupie
STEPS,                                                             Groupie
                                                                   Groupie
1) SELECT A 1/E SPECTRUM - ON FIRST LINE OF INPUT PARAMETERS.      Groupie
2) SELECT THE ENERGY BOUNDARIES - NORMALLY ONLY 1 GROUP FROM       Groupie
   0.5 EV UP TO 20 MEV - HOWEVER, YOU ARE FREE TO SELECT ANY       Groupie
   ENERGY RANGE THAT YOU WISH - YOU MAY EVEN SELECT MORE THAN      Groupie
   1 GROUP MERELY BY SPECIFYING MORE THAN 1 GROUP AS INPUT -       Groupie
   THIS CAN BE USED TO DEFINE THE CONTRIBUTIONS TO THE RESONANCE   Groupie
   INTEGRAL FROM INDIVIDUAL ENERGY RANGES.                         Groupie
3) SELECT THIS OPTION FOR THE UNSHIELDED AND/OR SHIELDED OUTPUT    Groupie
   LISTING - ON THE SECOND LINE OF INPUT PARAMETERS.               Groupie
                                                                   Groupie
WHEN THIS OPTION IS USED THE PROGRAM WILL CALCULATE GROUP AVERAGED Groupie
CROSS SECTIONS - AS DEFINED ABOVE - PRIOR TO OUTPUT THE RESULTS    Groupie
WILL MERELY BE MULTIPLIED BY THE WIDTH OF THE GROUP ASSUMING YOU   Groupie
HAVE SELECTED A 1/E SPECTRUM - THERE IS NO CHECK ON THIS - THE     Groupie
PROGRAM MERELY MULTIPLIES THE GROUP AVERAGED CROSS SECTIONS BY,     Groupie
                                                                   Groupie
LOG(E2/E1) - WHERE E2 AND E1 ARE THE GROUP ENERGY BOUNDARIES.      Groupie
                                                                   Groupie
WARNING - IT IS UP TO YOU TO INSURE THAT YOU FOLLOW EXACTLY THE    Groupie
          STEPS OUTLINED ABOVE IF YOU WISH TO OBTAIN MEANINGFUL    Groupie
          RESULTS.                                                 Groupie
                                                                   Groupie
NOTE - OUTPUT IN THE ENDF/B FORMAT IS ALWAYS GROUP AVERAGED CROSS  Groupie
       SECTIONS, REGARDLESS OF WHETHER YOU ASK FOR AVERAGED CROSS  Groupie
       SECTIONS OR RESONANCE INTEGRALS - THIS IS BECAUSE DATA IN   Groupie
       THE ENDF/B FORMAT IS EXPLICITLY DEFINED TO BE CROSS         Groupie
       SECTIONS.                                                   Groupie
                                                                   Groupie
       RESONANCE INTEGRAL OUTPUT CAN ONLY BE OBTAINED IN THE       Groupie
       LISTING FORMATS.                                            Groupie
                                                                   Groupie
MINIMUM TOTAL CROSS SECTION TREATMENT                              Groupie
-----------------------------------                                Groupie
SINCE THE BONDARENKO SELF-SHIELDING DEPENDS ON 1/TOTAL CROSS       Groupie
SECTION, THE ALGORITHM WILL BECOME NUMERICALLY UNSTABLE IF THE     Groupie
TOTAL CROSS SECTION IS NEGATIVE (AS OCCURS IN MANY ENDF/B          Groupie
EVALUATIONS). IF THE TOTAL IS LESS THAN SOME MINIMUM ALLOWABLE     Groupie
VALUE (DEFINE BY OKMIN, PRESENTLY 1 MILLI-BARN) AN ERROR MESSAGE   Groupie
WILL BE PRINTED AND FOR THE SELF-SHIELDING CALCULATION ALL ENERGY  Groupie
INTERVALS IN WHICH THE TOTAL IS LESS THAN THE MINIMUM WILL BE      Groupie
IGNORED.                                                           Groupie
                                                                   Groupie
NOTE, FOR THE UNSHIELDED CALCULATIONS ALL CROSS SECTIONS WILL BE   Groupie
CONSIDERED WHETHER THEY ARE POSITIVE OR NEGATIVE. THEREFORE IF     Groupie
THE TOTAL CROSS SECTION IS NEGATIVE OR LESS THAN THE MINIMUM       Groupie
VALUE THERE MAY BE AN INCONSISTENCY BETWEEN THE UNSHIELDED AND     Groupie
THE SELF-SHIELDED CROSS SECTIONS. IF THE TOTAL CROSS SECTION IS    Groupie
NEGATIVE AND SELF-SHIELDED CROSS SECTIONS ARE CALCULATED THE       Groupie
```

PROGRAM WILL PRINT AN ERROR MESSAGE INDICATING THAT THE SELF- Groupie
SHIELDED RESULTS ARE UNRELIABLE AND SHOULD NOT BE USED. THEREFORE Groupie
IN THIS CASE THE PROGRAM WILL NOT ATTEMPT TO MODIFY THE UNSHIELDED Groupie
RESULTS TO ELIMINATE THE EFFECT OF NEGATIVE CROSS SECTIONS, SINCE Groupie
THE UNSHIELDED RESULTS ARE THE ONLY ONES WHICH TRULY REFLECT THE Groupie
ACTUAL INPUT. Groupie
Groupie

RESOLVED RESONANCE REGION Groupie
------------------------- Groupie
IN THE RESOLVED RESONANCE REGION (ACTUALLY EVERYWHERE BUT IN THE Groupie
UNRESOLVED RESONANCE REGION) THE CROSS SECTIONS OUTPUT BY LINEAR- Groupie
RECENT-SIGMA1 WILL BE ACTUAL ENERGY DEPENDENT CROSS SECTIONS AND Groupie
THE CALCULATIONS BY THIS PROGRAM WILL YIELD ACTUAL SHIELDED AND Groupie
UNSHIELDED CROSS SECTIONS. Groupie
Groupie

UNRESOLVED RESONANCE REGION Groupie
--------------------------- Groupie
IN THE UNRESOLVED RESONANCE REGION PROGRAM RECENT USES THE Groupie
UNRESOLVED RESONANCE PARAMETERS TO CALCULATE INFINITELY DILUTE Groupie
AVERAGE CROSS SECTIONS. THIS PROGRAM WILL MERELY READ THIS Groupie
INFINITELY DILUTE DATA AS IF IT WERE ENERGY DEPENDENT DATA AND Groupie
GROUP AVERAGE IT. AS SUCH THIS PROGRAM WILL PRODUCE THE CORRECT Groupie
UNSHIELDED CROSS SECTION IN THE UNRESOLVED RESONANCE REGION, BUT Groupie
IT WILL NOT PRODUCE THE CORRECT SELF-SHIELDING EFFECTS. Groupie
Groupie

ACCURACY OF RESULTS Groupie
------------------- Groupie
ALL INTEGRALS ARE PERFORMED ANALYTICALLY. THEREFORE NO ERROR IS Groupie
INTRODUCED DUE TO THE USE OF TRAPAZOIDAL OR OTHER INTEGRATION Groupie
SCHEME. THE TOTAL ERROR THAT CAN BE ASSIGNED TO THE RESULTING Groupie
AVERAGES IS JUST THAT DUE TO THE ERROR IN THE CROSS SECTIONS Groupie
AND ENERGY DEPENDENT WEIGHTING SPECTRUM. GENERALLY SINCE THE Groupie
THE ENERGY DEPENDENT WEIGHTING SPECTRUM APPEARS IN BOTH THE Groupie
NUMERATOR AND THE DENOMINATOR THE AVERAGES RAPIDLY BECOME Groupie
INSENSITIVE TO THE WEIGHTING SPECTRUM AS MORE GROUPS ARE USED. Groupie
SINCE THE WEIGHTING SPECTRUM IS LOADED IN THE PAGING SYSTEM THE Groupie
USER CAN DESCRIBE THE SPECTRUM TO ANY REQUIRED ACCURACY USING Groupie
ANY NUMBER OF ENERGY VS. SPECTRUM PAIRS. Groupie
Groupie

MULTI-BAND PARAMETERS Groupie
---------------------- Groupie
MULTI-BAND PARAMETERS ARE CALCULATED FOR THE TOTAL, ELASTIC, Groupie
CAPTURE AND FISSION REACTIONS. WITH THE NUMBER OF GROUPS THAT Groupie
ARE NORMALLY USED (SEE BUILT IN GROUP STRUCTURES) ALL OTHER Groupie
REACTIONS RESULT IN A NEGLIGABLE AMOUNT OF SELF-SHIELDING. AS Groupie
SUCH THEIR EQUIVALENT BAND CROSS SECTION WILL MERELY BE THEIR Groupie
UNSHIELDED VALUE WITHIN EACH BAND. Groupie
Groupie

FOR ANY GIVEN EVALUATION, WITHIN ANY GIVEN GROUP THIS PROGRAM Groupie
WILL GENERATE THE MINIMUM NUMBER OF BANDS REQUIRED WITHIN THAT Groupie
GROUP. AS OUTPUT TO THE COMPUTER READABLE DISK FILE THE BAND Groupie
PARAMETERS FOR EACH EVALUATION WILL BE FORMATTED TO HAVE THE Groupie
SAME NUMBER OF BANDS IN ALL GROUPS (WITH ZERO WEIGHT FOR SOME Groupie
BANDS WITHIN ANY GROUP). THE USER MAY DECIDE TO HAVE OUTPUT Groupie
EITHER WITH THE MINIMUM NUMBER OF BANDS REQUIRED FOR EACH Groupie
EVALUATION (E.G. 2 BANDS FOR HYDROGEN AND 4 BANDS FOR U-233) OR Groupie
THE SAME NUMBER OF BANDS FOR ALL EVALUATIONS (E.G. 4 BANDS FOR Groupie
BOTH HYDROGEN AND U-233). Groupie
Groupie

FOR 2 OR FEWER BANDS THE PROGRAM USES AN ANALYTIC EXPRESSION Groupie
TO DEFINE ALL MULTI-BAND PARAMETERS. FOR MORE THAN 2 BANDS THE Groupie
PROGRAM PERFORMS A NON-LINEAR FIT TO SELECT THE MULTI-BAND Groupie
PARAMETERS THAT MINIMIZE THE MAXIMUM FRACTIONAL ERROR AT ANY Groupie
POINT ALONG THE ENTIRE SELF-SHIELDING CURVE. THE NUMBER OF BANDS Groupie
REQUIRED WITHIN ANY GIVEN GROUP IS DEFINED BY INSURING THAT THE Groupie
MULTI-BAND PARAMETERS CAN BE USED TO ACCURATELY DEFINE SELF- Groupie
SHIELDED CROSS SECTIONS ALONG THE ENTIRE SELF-SHIELDING CURVE Groupie
FROM SIGMA0 = 0 TO INFINITY. THE USER MAY DEFINE THE ACCURACY Groupie
REQUIRED. Groupie
Groupie

ENDF/B FORMATTED UNSHIELDED AVERAGES Groupie

---------- Groupie
UNSHIELDED MULTI-GROUP AVERAGED CROSS SECTIONS FOR ALL REACTIONS Groupie
MAY BE OBTAINED IN THE ENDF/B FORTRAN IN EITHER HISTOGRAM Groupie
(INTERPOLATION LAW 1) OR LINEARLY INTERPOLABLE (INTERPOLATION Groupie
LAW 2) FORM. SEE INPUT BELOW FOR DETAILS. Groupie
Groupie
MIXTURES OF MATERIALS AND RESONANCE OVERLAP Groupie
---------- Groupie
THE SELF-SHIELDED CROSS SECTIONS FOR THE INDIVIDUAL CONSTITUENTS Groupie
OF ANY MIXTURE CAN BE CALCULATED BY THIS PROGRAM BY REALIZING THAT Groupie
THIS PROGRAM ESSENTIALLY ONLY USES THE TOTAL CROSS SECTION AS A Groupie
WEIGHTING FUNCTION TO ACCOUNT FOR SELF-SHIELDING EFFECTS. FOR A Groupie
MIXTURE IT IS THEREFORE ONLY NECESSARY TO USE THE TOTAL CROSS Groupie
SECTION FOR THE MIXTURE IN PLACE OF THE ACTUAL TOTAL CROSS SECTION Groupie
FOR EACH CONSTITUENT AND TO RUN THIS PROGRAM. THIS CAN BE DONE BY Groupie
FIRST RUNNING PROGRAM MIXER TO CALCULATE THE ENERGY DEPENDENT Groupie
TOTAL CROSS SECTION FOR ANY COMPOSITE MIXTURE. NEXT, SUBSTITUTE Groupie
THIS COMPOSITE TOTAL CROSS SECTION FOR THE ACTUAL TOTAL CROSS Groupie
SECTION OF EACH CONSTITUENT (IN EACH ENDF/B FORMATTED EVALUATION). Groupie
FINALLY, RUN THIS PROGRAM TO CALCULATE THE SELF-SHIELDED CROSS Groupie
SECTION FOR EACH CONSTITUENT, PROPERLY ACCOUNTING FOR RESONANCE Groupie
OVERLAP BETWEEN THE RESONANCES OF ALL OF THE CONSTITUENTS OF THE Groupie
MIXTURE. DURING THE SAME RUN THESE SELF-SHIELDED CROSS SECTIONS Groupie
CAN IN TURN BE USED TO CALCULATE FULLY CORRELATED MULT-BAND Groupie
Groupie
MULTI-BAND PARAMETER OUTPUT FORMAT Groupie
---------- Groupie
FOR VERSIONS 92-2 AND LATER VERSIONS THE MULTI-BAND PARAMETERS Groupie
ARE OUTPUT IN A SIMPLE CHARACTER FORMAT, THAT CAN BE TRANSFERRED Groupie
AND USED ON VIRTUALLY ANY COMPUTER. Groupie
Groupie
THE BINARY FORMAT USED IN EARLIER VERSIONS OF THIS CODE IS NO Groupie
LONGER USED. Groupie
Groupie
CONTACT THE AUTHOR IF YOU WOULD LIKE TO RECEIVE A SIMPLE PROGRAM Groupie
TO READ THE CHARACTER FORMATTED MULTI-BAND PARAMETER FILE AND Groupie
CREATE A BINARY, RANDOM ACCESS FILE FOR USE ON VIRTUALLY ANY Groupie
COMPUTER. Groupie
Groupie
THE FORMAT OF THE CHARACTER FILE IS, Groupie
Groupie

RECORD	COLUMNS	FORMAT	DESCRIPTION	
1	1-72	18A4	LIBRARY DESCRIPTION (AS READ)	Groupie
2	1-11	I11	MATERIAL ZA	Groupie
	12-22	I11	NUMBER GROUPS	Groupie
	23-33	I11	NUMBER OF BANDS	Groupie
	34-44	E11.4	TEMPERATURE (KELVIN)	Groupie
	45-55	1X,10A1	HOLLERITH DESCRIPTION OF ZA	Groupie
3	1-11	E11.4	ENERGY (EV) - GROUP BOUNDARY.	Groupie
	12-22	E11.4	TOTAL (FIRST BAND)	Groupie
	23-33	E11.4	ELASTIC	Groupie
	34-44	E11.4	CAPTURE	Groupie
	35-55	E11.4	FISSION	Groupie
4	1-11	-----	BLANK	Groupie
	12-22	E11.4	TOTAL (SECOND BAND)	Groupie
	23-33	E11.4	ELASTIC	Groupie
	34-44	E11.4	CAPTURE	Groupie
	35-55	E11.4	FISSION	Groupie

Groupie
LINES 3 AND 4 ARE REPEATED FOR EACH GROUP. THE LAST LINE FOR EACH Groupie
MATERIAL (ZA) IS, Groupie
Groupie

N	1-11	E11.4	ENERGY (EV) - UPPER ENERGY LIMIT OF LAST GROUP.	Groupie

Groupie
FOR EXAMPLE, A 175 GROUP, 2 BAND FILE, FOR EACH MATERIAL WILL Groupie
CONTAIN 352 LINES = 1 HEADER LINE, 175 * 2 LINES OF PARAMETERS, Groupie
AND 1 FINAL LINE WITH THE UPPER ENERGY LIMIT Groupie
OF THE LAST GROUP. Groupie
Groupie
INPUT FILES Groupie

```
     -----------                                                        Groupie
     UNIT  DESCRIPTION                                                  Groupie
     ----  -----------                                                  Groupie
       2   INPUT DATA (BCD - 80 CHARACTERS/RECORD)                      Groupie
      10   ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)            Groupie
                                                                        Groupie
     OUTPUT FILES                                                       Groupie
     ------------                                                       Groupie
     UNIT  DESCRIPTION                                                  Groupie
     ----  -----------                                                  Groupie
       3   OUTPUT REPORT (BCD - 80 CHARACTERS/RECORD)                   Groupie
      11   MULTI-GROUP ENDF/B DATA - OPTIONAL                           Groupie
           (BCD - 80 CHARACTERS/RECORD)                                 Groupie
      16   PLOTTAB FORMATTED SELF-SHIELDING RESULTS                     Groupie
           (BCD - 80 CHARACTERS/RECORD)                                 Groupie
      31   MULTI-BAND PARAMETERS CHARACTER FILE - OPTIONAL              Groupie
           (BCD - 80 CHARACTERS/RECORD)                                 Groupie
      32   UNRESOLVED FSELF-SHIELDED PSEUDO ENDF FORMAT - OPTIONAL      Groupie
           (BCD - 120 CHARACTERS/RECORD)                                Groupie
      33   SELF-SHIELDED CROSS SECTION LISTING - OPTIONAL               Groupie
           (BCD - 120 CHARACTERS/RECORD)                                Groupie
      34   MULTI-BAND PARAMETER LISTING - OPTIONAL                      Groupie
           (BCD - 120 CHARACTERS/RECORD)                                Groupie
      35   UNSHIELDED CROSS SECTION LISTING - OPTION                    Groupie
           (BCD - 120 CHARACTERS/RECORD)                                Groupie
                                                                        Groupie
     SCRATCH FILES                                                      Groupie
     -------------                                                      Groupie
     UNIT  FILENAME  DESCRIPTION                                        Groupie
     ----  --------  -----------                                        Groupie
       8   ENERGY DEPENDENT WEIGHTING SPECTRUM                          Groupie
           (BINARY - 40080 WORDS/BLOCK)                                 Groupie
       9   TOTAL CROSS SECTION                                          Groupie
           (BINARY - 40080 WORDS/BLOCK)                                 Groupie
      12   ELASTIC CROSS SECTION - ONLY FOR SELF-SHIELDING CALCULATION  Groupie
           (BINARY - 40080 WORDS/BLOCK)                                 Groupie
      13   CAPTURE CROSS SECTION - ONLY FOR SELF-SHIELDING CALCULATION  Groupie
           (BINARY - 40080 WORDS/BLOCK)                                 Groupie
      14   FISSION CROSS SECTION - ONLY FOR SELF-SHIELDING CALCULATION  Groupie
           (BINARY - 40080 WORDS/BLOCK)                                 Groupie
                                                                        Groupie
     OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINES FILIO1 AND FILIO2)   Groupie
     ---------------------------------------------------------------    Groupie
     UNIT  FILE NAME                                                    Groupie
     ----  ----------                                                   Groupie
       2   GROUPIE.INP                                                  Groupie
       3   GROUPIE.LST                                                  Groupie
----------------------                                                  Groupie
       8   (SCRATCH)                                                    Groupie
       9   (SCRATCH)                                                    Groupie
      10   ENDFB.IN                                                     Groupie
      11   ENDFB.OUT                                                    Groupie
      12   (SCRATCH)                                                    Groupie
      13   (SCRATCH)                                                    Groupie
      14   (SCRATCH)                                                    Groupie
-----2019/6/23 - New Filenames (added ZAzzzaaa at Beginning)-----------Groupie
-----------(OLD)-------------(NEW)-------------------------------------Groupie
      16   PLOTTAB.CUR      ZAzzzaaa.PLOT.CUR                           Groupie
      31   MULTBAND.TAB     ZAzzzaaa.MULTBAND.TAB                       Groupie
      32                    ZAzzzaaa.URR.ENDF                           Groupie
      33   SHIELD.LST       ZAzzzaaa.SHIELD.LST                         Groupie
      34   MULTBAND.LST     ZAzzzaaa.MULTBAND.LST                       Groupie
      35   UNSHIELD.LST     ZAzzzaaa.UNSHIELD.LST                       Groupie
                                                                        Groupie
      I/O UNITS USED                                                    Groupie
      --------------                                                    Groupie
      UNITS 2, 3 8, 9 AND 10 WILL ALWAYS BE USED.                       Groupie
      UNITS 31 THROUGH 35, 11 AND 16 ARE OPTIONALLY USED DEPENDING      Groupie
      ON THE OUTPUT REQUESTED.                                          Groupie
      UNITS 12, 13 AND 14 WILL ONLY BE USED IF SELF-SHIELDED OR         Groupie
      MULTIBAND OUTPUT IS REQUESTED.                                    Groupie
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                                                                        Groupie
     INPUT CARDS                                                        Groupie
     -----------                                                        Groupie
     CARD  COLS.  FORMAT  DESCRIPTION                                   Groupie
     ----  -----  ------  -----------                                   Groupie
       1    1-11    I11   SELECTION CRITERIA (0=MAT, 1=ZA)              Groupie
       1   12-22    I11   NUMBER OF GROUPS.                             Groupie
--------------------------2019/6/23 -11 (TART 616 groups) required for  Groupie
                          Unresolved Resonance Region Self-Shielding    Groupie
                          calculation.                                  Groupie
                          =.GT.0 - ARBITRARY GROUP BOUNDARIES ARE READ  Groupie
                                   FROM INPUT FILE (N GROUPS REQUIRE    Groupie
                                   N+1 GROUP BOUNDARIES). CURRENT       Groupie
                                   PROGRAM MAXIMUM IS 20,000 GROUPS.    Groupie
                                   BUILT-IN OPTIONS INCLUDE....         Groupie
                          =  0   - TART    175 GROUPS                   Groupie
                          = -1   - ORNL     50 GROUPS                   Groupie
                          = -2   - ORNL    126 GROUPS                   Groupie
                          = -3   - ORNL    171 GROUPS                   Groupie
                          = -4   - SAND-II 620 (665) GROUPS TO 18 MEV   Groupie
                          = -5   - SAND-II 640 (685) GROUPS TO 20 MEV   Groupie
                          = -6   - WIMS     69 GROUPS                   Groupie
                          = -7   - GAM-I    68 GROUPS                   Groupie
                          = -8   - GAM-II   99 GROUPS                   Groupie
                          = -9   - MUFT     54 GROUPS                   Groupie
                          =-10   - ABBN     28 GROUPS                   Groupie
    Current TART Standard =-11   - TART    616 GROUPS TO 20 MEV         Groupie
    (-11 is required for  =-12   - TART    700 GROUPS TO 1 GEV          Groupie
     unresolved resonance =-13   - SAND-II 665 GROUPS TO 18 MEV         Groupie
     region self-shielding=-14   - SAND-II 685 GROUPS TO 20 MEV         Groupie
     calculations)        =-15   - TART    666 GROUPS TO 200 MEV        Groupie
                          =-16   - SAND-II 725 GROUPS TO 60 MEV         Groupie
                          =-17   - SAND-II 755 GROUPS TO 150 MEV        Groupie
                          =-18   - SAND-II 765 GROUPS TO 200 MEV        Groupie
                          =-19   - UKAEA  1102 GROUPS TO   1 GeV        Groupie
       1   23-33    I11   MULTI-BAND SELECTOR                           Groupie
--------------------------2019/6/23 - ONLY 0 or 2 allowed = the = 1     Groupie
                          option has proven to give very poor results,  Groupie
                          and therefore is no longer allowed.           Groupie
                          =  0 - NO MULTI-BAND CALCULATIONS             Groupie
      No longer allowed   =  1 - 2 BAND. CONSERVE AV(TOT), AV(1/TOT)    Groupie
                                 AND AV(1/TOT**2)                       Groupie
                          =  2 - 2 BAND. CONSERVE AV(TOT), AV(1/TOT)    Groupie
                                 AND AV(1/(TOT+SIGMA0)) WHERE           Groupie
                                 SIGMA0 = AV(TOT) IN EACH GROUP         Groupie
      No longer allowed   = 3-5- MULTI-BAND FIT. CONSERVE AV(TOT) AND   Groupie
                                 MINIMIZE FRACTIONAL ERROR FOR ENTIRE   Groupie
                                 SELF-SHIELDING CURVE (SIGMA0 = 0 TO    Groupie
                                 INFINITY)                              Groupie
                          IF THE SELECTOR IS POSITIVE (1 TO 5) THE      Groupie
                          MINIMUM NUMBER OF BANDS WILL BE OUTPUT FOR    Groupie
                          EACH ISOTOPE INDEPENDENTLY. IF THE SELECTOR   Groupie
                          IS NEGATIVE (-1 TO -5) THE SAME NUMBER OF     Groupie
                          BANDS (ABS(SELECTOR)) WILL BE OUTPUT FOR      Groupie
                          ALL ISOTOPES.                                 Groupie
       1   34-44    I11   NUMBER OF POINTS USED TO DESCRIBE ENERGY      Groupie
                          DEPENDENT WEIGHTING SPECTRUM S(E).            Groupie
                          = 0 or 1 - Flat (Constant)                    Groupie
                          = -1     - 1/E at ALL energies                Groupie
                          = -2     - MAXWELLIAN - UP TO 0.1 EV          Groupie
                                     1/E        - 0.1 EV TO 67 KEV      Groupie
                                     FISSION    - ABOVE 67 KEV          Groupie
                          = > 1    - Read input table                   Groupie
 2005/01/20---------------ADDED OPTION TO ALLOW TEMPERATURE OF THE       Groupie
                          MAXWELLIAN TO BE CHANGED - SEE INPUT LINE 4,  Groupie
                          COLUMNS 55 - 66.                              Groupie
                          = -1    - 1/E                                 Groupie
                          = 0 OR 1- ENERGY INDEPENDENT (SO CALLED FLAT  Groupie
                                    WEIGHTING SPECTRUM).                Groupie
                          = .GT.1 - READ THIS MANY POINTS FROM INPUT    Groupie
                                    TO DESCRIBE WEIGHTING SPECTRUM.     Groupie
```

```
                                    NO LIMIT TO THE NUMBER OF POINTS    Groupie
                                    USED TO DESCRIBE WEIGHTING.         Groupie
      1   45-55   E11.4  MULTI-BAND CONVERGENCE CRITERIA.               Groupie
-------------------------2019/6/23 - No longer used now that code      Groupie
                        is restricted to no more than 2 bands.        Groupie
                        ONLY USED FOR 3 OR MORE BANDS. THE NUMBER OF  Groupie
                        BANDS IN EACH GROUPS IS SELECTED TO INSURE    Groupie
                        THAT THE ENTIRE SELF-SHIELDING CURVE CAN BE   Groupie
                        REPRODUCED TO WITHIN THIS FRACTIONAL ERROR.   Groupie
                        = .LT. 0.0001 - USE STANDARD 0.001            Groupie
                                        (0.1 PER-CENT)                Groupie
                        = .GE. 0.0001 - USE AS CONVERGENCE CRITERIA   Groupie
      1   56-66    I11   SIGMA-0 DEFINITION SELECTOR.                  Groupie
-------------------------2019/6/23 - For multi-band calculations       Groupie
                        only 0 is alllowed = mulriples of unshielded  Groupie
                        total in each group = This is required for    Groupie
                        the BEST self-shielding results.              Groupie
                        < 0 - 21 VALUES OF SIGMA0 ARE READ INPUT AND  Groupie
                              INTERPRETED AS FIXED VALUES = SAME AS   Groupie
                              = 1 DESCRIPTION BELOW                   Groupie
                              INPUT VALUES MUST ALL BE,               Groupie
                              1) GREATER THAN 0                       Groupie
                              2) IN DESCENDING VALUE ORDER            Groupie
                        = 0 - SIGMA-0 WILL BE DEFINED AS A MULTIPLE   Groupie
                              OF THE UNSHIELDED TOTAL CROSS SECTION   Groupie
                              IN EACH GROUP (VALUES OF 1/1024 TO      Groupie
                              1024 IN STEPS OF A FACTOR OF 2 WILL     Groupie
                              BE USED AS THE MULTIPLIER).             Groupie
                        = 1 - SIGMA-0 WILL BE DEFINED AS THE SAME     Groupie
                              NUMBER OF BARNS IN EACH GROUP (VALUES   Groupie
                              40000 TO 0.4 BARNS WILL BE USED. WITHIN Groupie
                              EACH DECADE VALUES OF 10, 7, 4, 2, 1    Groupie
                              BARNS WILL BE USED).                    Groupie
      1   67-70    I4    High energy extension = definition of cross   Groupie
                        section above highest tabulated energy.       Groupie
-------------------------2019/6/23 - Ignored - will always use ENDF    Groupie
                        Standard Definition = 0.                      Groupie
                        = 0 = cross section = 0 (standard ENDF/B)     Groupie
                        = 1 = cross section = constant (equal to      Groupie
                              value at highest tabulated energy).     Groupie
    2-4    1-66 6E11.4   SIGMA-0 Definition                           Groupie
-------------------------2019/6/23 - Only the GROUPIE standard = 0     Groupie
                        in allowed for Unresolved Resonance Region    Groupie
                        Self-Shielding calculation                    Groupie
                        IF SIGMA-0 DEFINITION SELECTOR < 0, THE NEXT  Groupie
                        4 LINES OF INPUT ARE THE 22 VALUES OF SIGMA0, Groupie
                        6 PER LINE.                                   Groupie
      2    1-72    A72   ENDF/B INPUT DATA FILENAME                    Groupie
                        (STANDARD OPTION = ENDFB.IN)                  Groupie
      3    1-72    A72   ENDF/B OUTPUT DATA FILENAME                   Groupie
                        (STANDARD OPTION = ENDFB.OUT)                 Groupie
                                                                      Groupie
    THE FOURTH INPUT CARD IS USED TO SELECT ALL DESIRED OUTPUT MODES.  Groupie
    EACH OUTPUT DEVICE MAY BE TURNED OFF (0) OR ON (1). THEREFORE     Groupie
    THEREFORE EACH OF THE FOLLOWING INPUT PARAMETERS MAY BE EITHER    Groupie
    ZERO TO INDICATE NO OUTPUT OR NON-ZERO TO INDICATE OUTPUT.        Groupie
                                                                      Groupie
      4     1-11   I11   SELF-SHIELDED CROSS SECTION LISTING          Groupie
                        = 1 - CROSS SECTIONS                          Groupie
                        = 2 - RESONANCE INTEGRALS                     Groupie
      4    12-22   I11   MULTI-BAND PARAMETER LISTING                 Groupie
      4    23-33   I11   MULTI-BAND PARAMETERS COMPUTER READABLE      Groupie
      4    34-44   I11   UNSHIELDED CROSS SECTIONS IN ENDF/B FORMAT   Groupie
                        = 1 - HISTOGRAM FORMAT (INTERPOLATION LAW 1)  Groupie
                        = 2 - LINEAR-LINEAR (INTERPOLATION LAW 2)     Groupie
      4    45-55   I11   UNSHIELDED CROSS SECTIONS LISTING            Groupie
                        = 1 - CROSS SECTIONS                          Groupie
                        = 2 - RESONANCE INTEGRALS                     Groupie
 05/01/20 - ADDED THE BELOW OPTION                                    Groupie
      4    56-66   E11.4 IF THE STANDARD BUILT-IN SPECTRA IS USED,    Groupie
                        INPUT LINE 1, COLUMNS 34-44 = 2, THIS FIELD   Groupie
```

```
                        CAN BE USED TO OPTIONALLY CHANGE TEMPERATURE  Groupie
                        OF THE MAXWELLIAN.                            Groupie
                        INPUT IS IN EV (0.0253 EV = ROOM TEMPERATURE) Groupie
                        = 0 - USE DEFAULT 0.0253 EV, ROOM TEMPERATURE Groupie
                        > 0 - USE THIS AS THE TEMPERATURE             Groupie
                        RESTRICTION - TEMPERATURE CANNOT EXCEED       Groupie
                        1000 EV.                                      Groupie
                                                                      Groupie
 5      1-80    18A4    LIBRARY IDENTIFICATION. ANY TEXT THAT THE     Groupie
                        USER WISHES TO IDENTIFY THE MULTI-BAND        Groupie
                        PARAMETERS. THIS LIBRARY IDENTIFICATION IS    Groupie
                        WRITTEN INTO THE COMPUTER READABLE MULTI-BAND Groupie
                        DATA FILE.                                    Groupie
                                                                      Groupie
6-N     1- 6     I6     LOWER MAT OR ZA LIMIT                         Groupie
        7- 8     I2     LOWER MF LIMIT                                Groupie
        9-11     I3     LOWER MT LIMIT                                Groupie
       12-17     I11    UPPER MAT OR ZA LIMIT                         Groupie
       18-19     I2     UPPER MF LIMIT                                Groupie
       20-22     I3     UPPER MT LIMIT                                Groupie
                        UP TO 100 RANGES MAY BE SPECIFIED, ONE RANGE  Groupie
                        PER LINE. THE LIST OF RANGES IS TERMINATED    Groupie
                        BY A BLANK CARD. IF THE UPPER MAT OR ZA       Groupie
                        LIMIT IS LESS THAN THE LOWER LIMIT THE UPPER  Groupie
                        IS SET EQUAL TO THE LOWER LIMIT. IF THE UPPER Groupie
                        MF OR MT LIMIT IS ZERO IT WILL BE SET EQUAL   Groupie
                        TO ITS MAXIMUM VALUE, 99 OR 999, RESPECTIVELY Groupie
                        IF THE FIRST REQUEST LINE IS BLANK IT WILL    Groupie
                        TERMINATE THE LIST OF REQUESTS AND CAUSE ALL  Groupie
                        DATA TO BE RETRIEVED (SEE EXAMPLE INPUT).     Groupie
                                                                      Groupie
VARY    1-66    6E11.4  ENERGY GROUP BOUNDARIES. ONLY REQUIRED IF     Groupie
                        THE NUMBER OF GROUPS INDICATED ON THE FIRST   Groupie
                        INPUT CARD IS POSITIVE. ALL ENERGIES MUST     Groupie
                        BE IN ASCENDING ENERGY IN EV. THE PRESENT     Groupie
                        LIMITS ARE 1 TO 20,000 GROUPS. FOR N GROUPS   Groupie
                        N+1 BOUNDARIES WILL BE READ FROM THE          Groupie
                        INPUT FILE, E.G. IF THE FIRST INPUT CARD      Groupie
                        INDICATES 20 GROUPS, 21 ENERGY BOUNDARIES     Groupie
                        WILL BE READ FROM THE INPUT FILE.             Groupie
                                                                      Groupie
VARY    1-66    6E11.4  ENERGY DEPENDENT WEIGHTING SPECTRUM. ONLY     Groupie
                        REQUIRED IF THE NUMBER OF POINTS INDICATED    Groupie
                        ON FIRST CARD IS MORE THAN ONE. DATA IS       Groupie
                        GIVEN IN (ENERGY, WEIGHT) PAIRS, UP TO 3      Groupie
                        PAIRS PER CARD, USING ANY NUMBER OF CARDS     Groupie
                        REQUIRED. ENERGIES MUST BE IN ASCENDING       Groupie
                        ORDER IN EV. THE SPECTRUM VALUES MUST BE      Groupie
                        NON-NEGATIVE. THE ENERGY RANGE OF SPECTRUM    Groupie
                        MUST AT LEAST SPAN THE ENERGY RANGE OF THE    Groupie
                        ENERGY GROUPS. SINCE SPECTRUM IS STORED IN    Groupie
                        PAGING SYSTEM THERE IS NO LIMIT TO NUMBER     Groupie
                        OF POINTS THAT CAN BE USED TO DESCRIBE THE    Groupie
                        WEIGHTING SPECTRUM.                           Groupie
                                                                      Groupie
    EXAMPLE INPUT NO. 1                                               Groupie
    ------------------                                                Groupie
    REQUEST DATA BY MAT AND PROCESS ALL DATA (ALL MAT BETWEEN 1 AND   Groupie
    9999). USE THE TART 175 GROUP STRUCTURE, GENERATE 2 BAND          Groupie
    PARAMETERS (THE FOR ALL ISOTOPES) TO 0.1 PER-CENT ACCURACY        Groupie
    IN THE SELF-SHIELDING CURVE. OUTPUT ALL  LISTING, COMPUTER        Groupie
    READABLE AND ENDF/B FORMAT GROUP AVERAGES.                        Groupie
                                                                      Groupie
    EXPLICITLY SPECIFY THE STANDARD FILENAMES.                        Groupie
                                                                      Groupie
    THE FOLLOWING 7 INPUT LINES ARE REQUIRED.                         Groupie
                                                                      Groupie
        0          0         -2          0 1.00000-03          0     Groupie
ENDFB.IN                                                              Groupie
ENDFB.OUT                                                             Groupie
        1          1          1          1          1                 Groupie
```

```
TART 175 GROUP, 2 BAND LIBRARY TO 0.1 PER-CENT ACCURACY                Groupie
    1 1  1  9999 0  0                                                  Groupie
                     (BLANK CARD TERMINATES REQUEST LIST)              Groupie
                                                                       Groupie
    EXAMPLE INPUT NO. 2                                                Groupie
    -------------------                                                Groupie
    THE SAME EXAMPLE 1, AS ABOVE, ONLY THE ENDF/B DATA WILL BE READ    Groupie
    FROM \ENDFB6\SIGMA1\K300\ZA092238 (U-238 AT 300 KELVIN) AND        Groupie
    WRITTEN TO \ENDFB6\GROUPIE\K300\ZA092238                           Groupie
                                                                       Groupie
    THE FOLLOWING 7 INPUT LINES ARE REQUIRED.                          Groupie
                                                                       Groupie
         0          0         -2          0 1.00000-03          0      Groupie
\ENDFB6\SIGMA1\K300\ZA092238                                           Groupie
\ENDFB6\GROUPIE\K300\ZA092238                                          Groupie
         1          1          1          1          1                 Groupie
TART 175 GROUP, 2 BAND LIBRARY TO 0.1 PER-CENT ACCURACY                Groupie
    1 1  1  9999 0  0                                                  Groupie
                     (BLANK CARD TERMINATES REQUEST LIST)              Groupie
                                                                       Groupie
    EXAMPLE INPUT NO. 3                                                Groupie
    -------------------                                                Groupie
    PROCESS ALL DATA. USE 1/E WEIGHTING IN ORDER TO CALCULATE          Groupie
    UNSHIELDED ONE GROUP CROSS SECTIONS OVER THE ENERGY RANGE 0.5 EV   Groupie
    TO 1 MEV (NOTE THAT THE RESULTS ARE SIMPLY PROPORTIONAL TO THE     Groupie
    RESONANCE INTEGRAL FOR EACH REACTION). OUTPUT UNSHIELDED LISTING.  Groupie
                                                                       Groupie
    LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL     Groupie
    THEN USE STANDARD FILENAMES.                                       Groupie
                                                                       Groupie
    THE FOLLOWING 7 INPUT CARDS ARE REQUIRED.                          Groupie
                                                                       Groupie
         0          0          1         -1                    0      Groupie
                     (USE STANDARD FILENAME = ENDFB.IN)                Groupie
                     (USE STANDARD FILENAME = ENDFB.OUT)               Groupie
         0          0          0          0          1                 Groupie
RESONANCE INTEGRAL CALCULATION (FROM 0.5 EV TO 1 MEV)                  Groupie
                     (RETRIEVE ALL DATA, TERMINATE REQUEST LIST)       Groupie
5.00000-01 1.00000+06                                                  Groupie
                                                                       Groupie
    EXAMPLE INPUT NO. 4                                                Groupie
    -------------------                                                Groupie
    THIS EXAMPLE USES A USER DEFINED GROUP STRUCTURE AND WEIGHTING     Groupie
    FUNCTION - THESE ARE NOT REALISTIC IN TERMS OF ACTUAL ENERGIES     Groupie
    AND WEIGHTS - THEY ARE ONLY INTENDED TO ILLUSTRATE THE ORDER OF    Groupie
    THE INPUT PARAMETERS.                                              Groupie
                                                                       Groupie
         0         11          0          6                    0      Groupie
RECENT.OUT                                                             Groupie
GROUPIE.OUT                                                            Groupie
         1          1          1          1          1                 Groupie
Example with users defined groupus and spectrum weighting              Groupie
    1 1  1  999999999                                                  Groupie
                     (blabk line terminates request list)              Groupie
1.00000-05 1.00000-04 1.00000-03 1.00000-02 1.00000-01 1.00000+00 grou Groupie
1.00000+01 1.00000+02 1.00000+03 1.00000+04 1.00000+05 1.00000+06 grou Groupie
1.00000-05 1.0        1.00000-02 0.1        1.00000+00 0.01       weig Groupie
1.00000+02 0.001      1.00000+04 0.0001     1.00000+06 0.000001   weig Groupie
                                                                       Groupie
======================================================================= Groupie
```