```
 ======================================================================
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
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```
      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
                                   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
                                  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 OUT9, 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 OUT9
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

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

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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

```
      IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY
Groupie
      COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO
Groupie
      IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF
Groupie
      THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR
Groupie
      COMPUTER.
Groupie

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

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

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

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

Groupie
      IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B
Groupie
```

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

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

Groupie
      CONTENTS OF OUTPUT
Groupie

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

Groupie
      DOCUMENTATION
Groupie

Groupie
      THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED
Groupie
      BY THE ADDITION OF THREE COMMENT CARDS AT THE END OF EACH
Groupie

```
      HOLLERITH SECTION TO DESCRIBE THE GROUP STRUCTURE AND WEIGHTING
Groupie
      SPECTRUM, E.G.
Groupie

Groupie
      ********************** PROGRAM GROUPIE (2015-2) ***************
Groupie
      UNSHIELDED GROUP AVERAGES USING   69 GROUPS (WIMS)
Groupie
      MAXWELLIAN, 1/E AND FISSION WEIGHTING SPECTRUM
Groupie

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

Groupie
      THESE COMMENT CARDS ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS,
Groupie
      I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT
Groupie
      OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF
Groupie
      EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451
Groupie
      IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF
Groupie
      THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF
Groupie
      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 1000.
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

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      (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
     (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

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 1000 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 1000 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
      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
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```
      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)
2	1-11	I11	MATERIAL ZA
	12-22	I11	NUMBER GROUPS
	23-33	I11	NUMBER OF BANDS
	34-44	D11.4	TEMPERATURE (KELVIN)
	45-55	1X,10A1	HOLLERITH DESCRIPTION OF ZA
3	1-11	D11.4	ENERGY (EV) - GROUP BOUNDARY.
	12-22	D11.4	TOTAL (FIRST BAND)
	23-33	D11.4	ELASTIC
	34-44	D11.4	CAPTURE
	35-55	D11.4	FISSION
4	1-11	-----	BLANK
	12-22	D11.4	TOTAL (SECOND BAND)
	23-33	D11.4	ELASTIC
	34-44	D11.4	CAPTURE
	35-55	D11.4	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 D11.4 ENERGY (EV) - UPPER ENERGY LIMIT OF
Groupie
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
31 MULTI-BAND PARAMETERS CHARACTER FILE - OPTIONAL
Groupie
(BCD - 80 CHARACTERS/RECORD)
Groupie
32 SELF-SHIELDED CROSS SECTION LISTING - OPTIONAL
Groupie
(BCD - 120 CHARACTERS/RECORD)
Groupie
33 MULTI-BAND PARAMETER LISTING - OPTIONAL
Groupie
(BCD - 120 CHARACTERS/RECORD)
Groupie
34 UNSHIELDED CROSS SECTION LISTING - OPTION
Groupie

```
            (BCD - 120 CHARACTERS/RECORD)
Groupie
        3   OUTPUT REPORT (BCD - 80 CHARACTERS/RECORD)
Groupie
       11   MULTI-GROUP ENDF/B DATA - OPTIONAL
Groupie
            (BCD - 80 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
        8   (SCRATCH)
Groupie
```

```
        9   (SCRATCH)
Groupie
       10   ENDFB.IN
Groupie
       11   ENDFB.OUT
Groupie
       12   (SCRATCH)
Groupie
       13   (SCRATCH)
Groupie
       14   (SCRATCH)
Groupie
       31   MULTBAND.TAB
Groupie
       32   SHIELD.LST
Groupie
       33   MULTBAND.LST
Groupie
       34   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 34 AND 11 ARE OPTIONALLY USED DEPENDING ON THE
Groupie
       OUTPUT REQUESTED.
Groupie
       UNITS 12, 13 AND 14 WILL ONLY BE USED IF SELF-SHIELDED OR
Groupie
       MULTIBAND OUTPUT IS REQUESTED.
Groupie

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
                           =.GT.0 - ARBITRARY GROUP BOUNDARIES ARE READ
Groupie
                                    FROM INPUT FILE (N GROUPS REQUIRE
Groupie
```

```
                                   N+1 GROUP BOUNDARIES). CURRENT
Groupie
                                   PROGRAM MAXIMUM IS 1000 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
                              =-11   - TART    616 GROUPS TO 20 MEV
Groupie
                              =-12   - TART    700 GROUPS TO 1 GEV
Groupie
                              =-13   - SAND-II 665 GROUPS TO 18 MEV
Groupie
                              =-14   - SAND-II 685 GROUPS TO 20 MEV
Groupie
                              =-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
        1   23-33    I11   MULTI-BAND SELECTOR
Groupie
                              =  0 - NO MULTI-BAND CALCULATIONS
Groupie
                              =  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
                           = 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
                           = -2    - MAXWELLIAN - UP TO 0.1 EV
Groupie
                                     1/E        - 0.1 EV TO 67 KEV
Groupie
                                     FISSION    - ABOVE 67 KEV
Groupie
  05/01/20-----------------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   D11.4  MULTI-BAND CONVERGENCE CRITERIA.
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
                           < 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
```

```
                              = 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 6D11.4   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

4	56-66	D11.4	IF THE STANDARD BUILT-IN SPECTRA IS USED, INPUT LINE 1, COLUMNS 34-44 = 2, THIS FIELD CAN BE USED TO OPTIONALLY CHANGE TEMPERATURE OF THE MAXWELLIAN. INPUT IS IN EV (0.0253 EV = ROOM TEMPERATURE) = 0 - USE DEFAULT 0.0253 EV, ROOM TEMPERATURE > 0 - USE THIS AS THE TEMPERATURE RESTRICTION - TEMPERATURE CANNOT EXCEED 1000 EV.
5	1-80	18A4	LIBRARY IDENTIFICATION. ANY TEXT THAT THE USER WISHES TO IDENTIFY THE MULTI-BAND PARAMETERS. THIS LIBRARY IDENTIFICATION IS WRITTEN INTO THE COMPUTER READABLE MULTI-BAND DATA FILE.
6-N	1- 6	I6	LOWER MAT OR ZA LIMIT
	7- 8	I2	LOWER MF LIMIT
	9-11	I3	LOWER MT LIMIT
	12-17	I11	UPPER MAT OR ZA LIMIT
	18-19	I2	UPPER MF LIMIT
	20-22	I3	UPPER MT LIMIT UP TO 100 RANGES MAY BE SPECIFIED, ONE RANGE PER LINE. THE LIST OF RANGES IS TERMINATED BY A BLANK CARD. IF THE UPPER MAT OR ZA LIMIT IS LESS THAN THE LOWER LIMIT THE UPPER

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 6D11.4 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 1000 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 6D11.4 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/V 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
 ========================================================================
Groupie
```