```
====================================================================== Activate
                                                                       Activate
     PROGRAM ACTIVATE                                                  Activate
     VERS. 2000-1 (APRIL 2000)   *INITIAL VERSION.                     Activate
     VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS            Activate
     VERS. 2004-1 (JAN. 2004)    *CORRECTED ERROR - FIRST RECORD AFTER  Activate
                                  MF=10 WAS MISSING.                   Activate
                                 *ADDED INCLUDE TO DEFINE COMMON       Activate
                                 *INCREASED MAX. POINTS FROM 100,000   Activate
                                  TO 1,000,000.                        Activate
                                                                       Activate
     Acknowledgement 2004                                              Activate
     --------------------                                              Activate
     Currently almost all improvements to this code are based upon     Activate
     feedback from code users who report problems. This feedback       Activate
     benefits ALL users of this code, and ALL users are encouraged     Activate
     to report problems.                                               Activate
                                                                       Activate
     Improvements on the 2004 version of this code based on user       Activate
     feedback including,                                               Activate
     1) Andrej Trkov - reported that the first record of the section   Activate
                       after an inserted MF=10 was missing.            Activate
                                                                       Activate
     OWNED, MAINTAINED AND DISTRIBUTED BY                              Activate
     ------------------------------------                              Activate
     THE NUCLEAR DATA SECTION                                          Activate
     INTERNATIONAL ATOMIC ENERGY AGENCY                                Activate
     P.O. BOX 100                                                      Activate
     A-1400, VIENNA, AUSTRIA                                           Activate
     EUROPE                                                            Activate
                                                                       Activate
     ORIGINALLY WRITTEN BY                                             Activate
     ------------------------------------                              Activate
     DERMOTT E. CULLEN                                                 Activate
     UNIVERSITY OF CALIFORNIA                                          Activate
     LAWRENCE LIVERMORE NATIONAL LABORATORY                            Activate
     L-159                                                             Activate
     P.O. BOX 808                                                      Activate
     LIVERMORE, CA 94550                                               Activate
     U.S.A.                                                            Activate
     TELEPHONE  925-423-7359                                           Activate
     E. MAIL    CULLEN1@LLNL.GOV                                       Activate
     WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                            Activate
                                                                       Activate
     AUTHORS MESSAGE                                                   Activate
     ---------------                                                   Activate
     THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION  Activate
     FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED Activate
     THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE Activate
     READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION.                 Activate
                                                                       Activate
     AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER Activate
     INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE    Activate
     OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT Activate
     IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY      Activate
     COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO  Activate
     IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF   Activate
     THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR         Activate
     COMPUTER.                                                         Activate
                                                                       Activate
     PURPOSE                                                           Activate
     -------                                                           Activate
     THIS PROGRAM IS DESIGNED TO CREATE FILE 10 ACTIVATION CROSS       Activate
     SECTIONS BY COMBINING FILE 3 CROSS SECTIONS AND FILE 9 MULTIPLIERS Activate
                                                                       Activate
     IN THE FOLLOWING DISCUSSION FOR SIMPLICITY THE ENDF/B TERMINOLOGY  Activate
     ---ENDF/B TAPE---WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE    Activate
     TAPE, CARDS, DISK OR ANY OTHER MEDIUM.                            Activate
                                                                       Activate
     ASSUMPTIONS                                                       Activate
     -----------                                                       Activate
```

```
IT IS ASSUMED THAT THE FILE 3 AND 9 DATA HAVE BEEN LINEARIZED      Activate
BEFORE THIS CODE IS USED - FILE 3 AND 9 DATA CAN BE LINEARIZED     Activate
USING PROGRAM LINEAR.                                              Activate
                                                                   Activate
IT IS ASSUMED THAT THE FILE 9 MULTIPLIERS ARE FAIRLY SMOOTH VERSUS Activate
ENERGY, AND THAT THE ACTIVATION CROSS SECTIONS FOR FILE 10 CAN BE  Activate
DEFINED AT EXACTLY THE SAME ENERGIES AS THE FILE 3 CROSS SECTIONS, Activate
AND THAT THESE NEED MERELY BE MULTIPLIED BY THE FILE 9 TO DEFINE   Activate
THE FILE 10 ACTIVATION CROSS SECTIONS.                             Activate
                                                                   Activate
ENDF/B FORMAT                                                      Activate
-------------                                                      Activate
THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS     Activate
OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION   Activate
OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT). Activate
                                                                   Activate
IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B       Activate
FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS     Activate
ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE  Activate
NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE          Activate
CORRECTLY OUTPUT ON ALL LINES. THE FORMAT OF SECTION MF=1, MT=451  Activate
AND ALL SECTIONS OF MF=3 MUST BE CORRECT. THE PROGRAM COPIES ALL   Activate
OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO   Activate
THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.             Activate
                                                                   Activate
OUTPUT FORMAT                                                      Activate
-------------                                                      Activate
ALL ENERGIES WILL BE OUTPUT IN F (INSTEAD OF E) FORMAT IN ORDER    Activate
TO ALLOW ENERGIES TO BE WRITTEN WITH UP TO 9 DIGITS OF ACCURACY.   Activate
COMPARISON OF THE NORMAL ENDF/B CONVENTION OF 6 DIGITS TO THE 9    Activate
DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE TO USE    Activate
THE 9 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA DUE TO     Activate
TRUNCATION OF ENERGIES TO 6 DIGITS DURING OUTPUT.                  Activate
                                                                   Activate
CONTENTS OF OUTPUT                                                 Activate
------------------                                                 Activate
ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE PROCESSED DATA, E.G.,  Activate
ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO INCLUDED.                Activate
                                                                   Activate
DOCUMENTATION                                                      Activate
-------------                                                      Activate
THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED  Activate
BY THE ADDITION OF 3 COMMENT LINES AT THE END OF EACH HOLLERITH    Activate
SECTION IN THE FORM                                                Activate
                                                                   Activate
***************** PROGRAM ACTIVATE (2004-1) ***************        Activate
FILE 10 ACTIVATION CROSS SECTIONS HAVE BEEN DEFINED BY COMBINING   Activate
FILE 3 CROSS SECTIONS AND FILE 9 MULTIPLIERS. FILE 9 DELETED.      Activate
                                                                   Activate
THE ORDER OF SIMILAR COMMENTS (FROM RECENT, SIGMA1 AND GROUPIE)    Activate
REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON       Activate
THE DATA BY THESE PROGRAMS.                                        Activate
                                                                   Activate
THESE COMMENT LINES ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS, Activate
I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT Activate
OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF      Activate
EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451    Activate
IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF      Activate
THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF      Activate
MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO          Activate
DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND   Activate
AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT  Activate
SHOULD BE USED TO CREATE A HOLLERITH SECTION.                      Activate
                                                                   Activate
REACTION INDEX                                                     Activate
--------------                                                     Activate
THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN     Activate
SECTION MF=1, MT=451 OF EACH EVALUATION.                           Activate
                                                                   Activate
THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451.   Activate
THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT         Activate
```

```
REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS Activate
NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING  Activate
A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE  Activate
A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM Activate
YOU MAY USE PROGRAM DICTIN TO CREATE A CORRECT REACTION INDEX.     Activate
                                                                   Activate
SECTION SIZE                                                       Activate
------------                                                       Activate
SECTIONS OF MF=9 MULTIPLIERS ARE LIMITED TO A MAXIMUM OF 10,000    Activate
ENERGY POINTS.                                                     Activate
                                                                   Activate
THERE IS NO LIMIT ON THE NUMBER OF ENERGY POINTS IN MF=3 AND 10    Activate
TABLES.                                                            Activate
                                                                   Activate
SELECTION OF DATA                                                  Activate
-----------------                                                  Activate
THE PROGRAM PROCESSES ALL ENDF/B DATA ON A SERIES OF ENDF/B TAPES. Activate
                                                                   Activate
PROGRAM OPERATION                                                  Activate
-----------------                                                  Activate
PASS #1                                                            Activate
-------                                                            Activate
THE ENTIRE MAT IS COPIED TO A SCRATCH FILE IN THE ENDF/B ASCII     Activate
FORMAT AND WHILE COPYING IT TO SCRATCH MF=3, 9, AND 10 ARE ALSO    Activate
COPIED TO SEPERATE SCRATCH FILES, I.E., THERE ARE A TOTAL OF 4     Activate
SCRATCH FILES - SEE THEIR DEFINITIONS BELOW.                       Activate
                                                                   Activate
PASS #2                                                            Activate
-------                                                            Activate
IF NO MF=9 MULTIPLIERS ARE FOUND DURING PASS #1, THE ENTIRE MAT    Activate
IS COPIED FROM SCRATCH TO THE OUTPUT FILE, WITHOUT ANY CHECKS.     Activate
                                                                   Activate
IF MF=9 MULTIPLIERS ARE FOUND THEY ARE USED WITH MF=3 CROSS        Activate
SECTIONS TO CREATE MF=10 ACTIVATION CROSS SECTIONS.                Activate
                                                                   Activate
FOR ANY SECTION OF MF=10 DATA FOR WHICH NO MF=9 MULTIPLIERS ARE    Activate
FOUND, THE ORIGINAL MF=10 IS OUTPUT.                               Activate
                                                                   Activate
FOR CONSISTENCY ALL MF=9 MULTIPLIERS ARE DELETED, I.E., THEY ARE   Activate
NOT INCLUDED IN THE OUTPUT.                                        Activate
                                                                   Activate
KEEP EVALUATED DATA POINTS                                         Activate
--------------------------                                         Activate
THE FILE 10 OUTPUT WILL BE AT EXACTLY THE SAME ENERGY POINTS AS    Activate
THE FILE 3 CROSS SECTIONS USED TO DEFINE THE FILE 10 ACTIVATION    Activate
CROSS SECTIONS.                                                    Activate
                                                                   Activate
INPUT FILES                                                        Activate
-----------                                                        Activate
UNIT  DESCRIPTION                                                  Activate
----  -----------                                                  Activate
   2  INPUT LINES (BCD - 80 CHARACTERS/RECORD)                     Activate
  10  ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)            Activate
                                                                   Activate
OUTPUT FILES                                                       Activate
------------                                                       Activate
UNIT  DESCRIPTION                                                  Activate
----  -----------                                                  Activate
   3  OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)                  Activate
  11  FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)               Activate
                                                                   Activate
SCRATCH FILES                                                      Activate
-------------                                                      Activate
UNIT  DESCRIPTION                                                  Activate
----  -----------                                                  Activate
  12  SCRATCH FILE FOR ALL MAT (BCD - 80 CHARACTERS/RECORD)        Activate
  14  SCRATCH FILE FOR MF=3 DATA (BCD - 80 CHARACTERS/RECORD)      Activate
  15  SCRATCH FILE FOR MF=9 DATA (BCD - 80 CHARACTERS/RECORD)      Activate
  16  SCRATCH FILE FOR MF=10 DATA (BCD - 80 CHARACTERS/RECORD)     Activate
                                                                   Activate
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILEIO)               Activate
```

```
    ------------------------------------------------              Activate
    UNIT  FILE NAME                                               Activate
    ----  ----------                                              Activate
      2   ACTIVATE.INP                                            Activate
      3   ACTIVATE.LST                                            Activate
     10   ENDFB.IN                                                Activate
     11   ENDFB.OUT                                               Activate
     12   (SCRATCH)                                               Activate
     14   (SCRATCH)                                               Activate
     15   (SCRATCH)                                               Activate
                                                                  Activate
    INPUT PARAMETERS                                              Activate
    ---------------                                               Activate
                                                                  Activate
    LINE  COLS.  DESCRIPTION                                      Activate
    ----  -----  -----------                                      Activate
       1   1-60  ENDF/B INPUT DATA FILENAME                       Activate
                 (STANDARD OPTION = ENDFB.IN)                     Activate
       2   1-60  ENDF/B OUTPUT DATA FILENAME                      Activate
                 (STANDARD OPTION = ENDFB.OUT)                    Activate
                                                                  Activate
    ANY NUMBER OF PAIRS OF INPUT LINES MAY BE USED, TO PROCESS ANY Activate
    NUMBER OF ENDF/B TAPES, ONE AFTER ANOTHER.                    Activate
                                                                  Activate
    EXAMPLE INPUT NO. 1                                           Activate
    ------------------                                            Activate
    PROCESS ENDF/B TAPES NAMED, TAPE121, TAPE122, AND TAPE123, AND Activate
    NAME THE OUTPUT FILES ACTIVATE121, ACTIVATE122, AND ACTIVATE123. Activate
                                                                  Activate
    IN THIS CASE THE FOLLOWING 6 INPUT LINES ARE REQUIRED         Activate
                                                                  Activate
TAPE121                                                           Activate
ACTIVATE121                                                       Activate
TAPE122                                                           Activate
ACTIVATE122                                                       Activate
TAPE123                                                           Activate
ACTIVATE123                                                       Activate
                                                                  Activate
    EXAMPLE INPUT NO. 2                                           Activate
    ------------------                                            Activate
    SAME AS THE ABOVE CASE, EXCEPT THAT IN THIS CASE THE ORIGINAL Activate
    3 TAPES ARE IN A DIRECTORY NAMED \ENDFB6\ORIGINAL, AND THE    Activate
    RESULTS WILL BE WRITTEN INTO A DIRECTORY NAMED \ENDFB6\ACTIVATE. Activate
                                                                  Activate
    IN THIS CASE THE FOLLOWING 6 INPUT LINES ARE REQUIRED         Activate
                                                                  Activate
\ENDFB6\ORIGINAL\TAPE121                                          Activate
\ENDFB6\ACTIVATE\ACTIVATE121                                      Activate
\ENDFB6\ORIGINAL\TAPE122                                          Activate
\ENDFB6\ACTIVATE\ACTIVATE122                                      Activate
\ENDFB6\ORIGINAL\TAPE123                                          Activate
\ENDFB6\ACTIVATE\ACTIVATE123                                      Activate
                                                                  Activate
================================================================= Activate
```

```
====================================================================== Complot
                                                                       Complot
      PROGRAM COMPLOT                                                  Complot
      ===============                                                  Complot
      VERSION 83-1 (FEBRUARY, 1983)                                    Complot
      VERSION 83-2 (MAY, 1983)                                         Complot
      VERSION 83-3 (DECEMBER, 1983) *MAJOR MODIFICATION.               Complot
                                   *ADDED SELECTION OF PLOTS BY MAT OR  Complot
                                    ZA/MT/ENERGY RANGE (EV).           Complot
                                   *ADDED VARIABLE AXIS UNITS (PROGRAM  Complot
                                    CONTROLLED..X=MILLI-EV, EV, KEV,   Complot
                                    MEV...Y=MILLI-BARNS, BARNS).       Complot
      VERSION 84-1 (APRIL, 1984)    *ADDED SELECTION BY REACTION/ENERGY  Complot
                                    RANGE.                             Complot
                                   *ADDED IDENTIFY DATA POINTS OPTION   Complot
                                    (SMALL BOX DRAWN AROUND EACH CROSS  Complot
                                     SECTION AND RATIO POINT).         Complot
                                   *IMPROVED NON-IBM GRAPHICS INTERFACE Complot
                                    (ALL CHARACTER POSITIONING NOW      Complot
                                     BASED ON CHARACTER, NOT RASTER,   Complot
                                     SIZE).                            Complot
      VERSION 85-1 (APRIL, 1985)    *SPECIAL I/O ROUTINES TO GUARANTEE   Complot
                                    ACCURACY OF ENERGY.                Complot
                                   *DOUBLE PRECISION TREATMENT OF       Complot
                                    ENERGY (REQUIRED FOR NARROW        Complot
                                    RESONANCES).                       Complot
                                   *ADDED (ZA,MT) EQUIVALENCE OPTION.   Complot
                                   *ADDED SMALL PLOT OPTION.            Complot
      VERSION 85-2 (AUGUST, 1985)   *FORTRAN-77/H VERSION              Complot
      VERSION 86-1 (JANUARY, 1986)  *ENERGY DEPENDENT SCATTERING RADIUS  Complot
      VERSION 86-2 (DECEMBER, 1986) *DOUBLE PRECISION PLOT SCALING       Complot
                                    (REQUIRED FOR NARROW ENERGY RANGES) Complot
      VERSION 88-1 (JULY 1988)      *MAJOR REVISION TO MAKE CODE EASILY  Complot
                                    INTERFACEABLE TO ALMOST ANY PLOTTER Complot
                                   *WARNING..INPUT PARAMETERS FROM BEEN Complot
                                    CHANGED (SEE, DESCRIPTION BELOW)    Complot
                                   *COMPUTER INDEPENDENT SOFTWARE       Complot
                                    CHARACTERS.                        Complot
                                   *COLOR PLOTS.                        Complot
                                   *MT NUMBER DEFINITIONS FROM DATA     Complot
                                    FILE READ BY PROGRAM               Complot
                                   *FORTRAN-77 REQUIRED (FORTRAN-H NO   Complot
                                    SUPPORTED BY THIS PROGRAM).        Complot
                                   *OPTION...INTERNALLY DEFINE ALL I/O  Complot
                                    FILE NAMES (SEE, SUBROUTINE FILEIO  Complot
                                    FOR DETAILS).                      Complot
                                   *IMPROVED BASED ON USER COMMENTS.    Complot
      VERSION 88-2 (OCTOBER 1988)   *IMPROVED BASED ON USER COMMENTS.    Complot
                                   *ADDED LIVERMORE CIVIC COMPILER      Complot
                                    CONVENTIONS.                       Complot
                                   *UPDATED TO USE NEW PROGRAM CONVERT  Complot
                                    KEYWORDS.                          Complot
      VERSION 89-1 (JANUARY 1989)   *PSYCHOANALYZED BY PROGRAM FREUD TO  Complot
                                    INSURE PROGRAM WILL NOT DO ANYTHING Complot
                                    CRAZY.                             Complot
                                   *FORTRAN-77/FORTRAN-H COMPATIBLE     Complot
                                   *SPECIAL ENDF/B MATERIAL DEFINITIONS Complot
                                    (ZA.LT.1000) FROM DATA FILE READ    Complot
                                    BY PROGRAM.                        Complot
      VERSION 89-2 (MARCH 1989)     *ADDED ENDF/B-V AND VI MT            Complot
                                    DEFINITIONS. PROGRAM WILL DETERMINE Complot
                                    ENDF/B FORMAT BASED ON MF=1,        Complot
                                    MT=451 AND USE AS PPROPRIATE MT     Complot
                                    DEFINITIONS. IF NO MF=1, MT=451     Complot
                                    PROGRAM WILL USE ENDF/B-VI          Complot
                                    MT DEFINITIONS.                    Complot
      VERSION 90-1 (AUGUST 1990)    *A NEW PROGRAM                       Complot
                                   *ADDED INTERACTIVE MOUSE INPUT       Complot
                                   *ADDED 3 CHARACTER FONTS             Complot
                                   *ADDED PHOTON DATA, MF=23 AND 27     Complot
                                   *ADDED FORTRAN SAVE OPTION.          Complot
```

```
                            *ADDED MAXIMUM RATIO RANGE WHEN      Complot
                             PLOTTING RATIOS.                    Complot
                            *ADDED GRID TYPES                    Complot
                            *ADDED VARIABLE LINE THICKNESS       Complot
                            *WARNING...INPUT PARAMETER FORMAT    Complot
                             HAS BEEN CHANGED...SEE DESCRIPTION  Complot
                             BELOW.                              Complot
VERSION 92-1 (JANUARY 1992) *ADDED INCIDENT CHARGED PARTICLES    Complot
                             (IDENTIFIED IN PLOT TITLES)         Complot
                            *ADDED COMPLETELY COMPATIBLE I/O     Complot
                             FOR READING FLOATING POINT NUMBERS. Complot
VERSION 92-2 (MAY 1992)     *CORRECTED DESCRIPTION OF INPUT      Complot
                             PARAMETERS AND EXAMPLE PROBLEMS.    Complot
                            *ADDED VARIABLE CHARACTER SIZE INPUT Complot
VERSION 93-1 (MARCH 1993)   *UPDATE FOR ON SCREEN GRAPHIC        Complot
                             OUTPUT USING THE LAHEY COMPILER     Complot
                            *ADDED NU-BAR (TOTAL, DELAYED,       Complot
                             PROMPT).                            Complot
VERSION 94-1 (JANUARY 1994) *VARIABLE ENDF/B DATA FILENAMES      Complot
                             TO ALLOW ACCESS TO FILE STRUCTURES  Complot
                             (WARNING - INPUT PARAMETER FORMAT   Complot
                             HAS BEEN CHANGED)                   Complot
                            *CLOSE ALL FILES BEFORE TERMINATING  Complot
                             (SEE, SUBROUTINE ENDIT)             Complot
VERSION 95-1 (MARCH 1995)   *CORRECTED CROSS SECTION             Complot
                             MULTIPLIER FOR EQUIVALENCES         Complot
                            *CORRECTED RATIO SCALING, FOR        Complot
                             MAXIMUM RATIO LESS THAN 1.0         Complot
VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                   Complot
                            *IMPROVED COMPUTER INDEPENDENCE      Complot
                            *ALL DOUBLE PRECISION                Complot
                            *UNIFORM TREATMENT OF ENDF/B I/O     Complot
                            *IMPROVED OUTPUT PRECISION           Complot
                            *DEFINED SCRATCH FILE NAMES          Complot
                            *INCREASED PAGE SIZE FROM 24000      Complot
                             TO 48000 POINTS                     Complot
VERSION 97-1 (APRIL 1997)   *INCREASED PAGE SIZE FROM 48000      Complot
                             TO 480000 POINTS                    Complot
VERSION 99-1 (MARCH 1999)  *CORRECTED CHARACTER TO FLOATING      Complot
                            POINT READ FOR MORE DIGITS           Complot
                           *UPDATED TEST FOR ENDF/B FORMAT       Complot
                            VERSION BASED ON RECENT FORMAT CHANGE Complot
                           *GENERAL IMPROVEMENTS BASED ON        Complot
                            USER FEEDBACK                        Complot
VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON       Complot
                            USER FEEDBACK                        Complot
VERS. 2002-1 (MAY 2002)    *INPUT PARAMETERS OPTIONAL            Complot
                           *CONTROL MINIMUM RATIO RANGE BY INPUT Complot
                           *OPTIONAL BLACK OR WHITE BACKGROUND   Complot
VERS. 2004-1 (SEPT. 2004)  *ADDED INCLUDE FOR COMMON             Complot
                           *INCREASED PAGE SIZE FROM 480000      Complot
                            TO 600000 POINTS                     Complot
                           *ADDED NEW REICH-MOORE TO FILE2 TO    Complot
                            ALLOW IDENTIFICATION OF RESOLVED AND Complot
                            ANY FOLLOWING UNRESOLVED RESONANCE   Complot
                            REGIONS.                             Complot
                                                                 Complot
OWNED, MAINTAINED AND DISTRIBUTED BY                             Complot
-----------------------------------                              Complot
THE NUCLEAR DATA SECTION                                         Complot
INTERNATIONAL ATOMIC ENERGY AGENCY                               Complot
P.O. BOX 100                                                     Complot
A-1400, VIENNA, AUSTRIA                                          Complot
EUROPE                                                           Complot
                                                                 Complot
ORIGINALLY WRITTEN BY                                            Complot
---------------------------------                                Complot
DERMOTT E. CULLEN                                                Complot
UNIVERSITY OF CALIFORNIA                                         Complot
LAWRENCE LIVERMORE NATIONAL LABORATORY                           Complot
L-159                                                            Complot
```

P.O. BOX 808
LIVERMORE, CA 94550
U.S.A.
TELEPHONE  925-423-7359
E. MAIL    CULLEN1@LLNL.GOV
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1

AUTHORS MESSAGE

THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENTATION ALL RECENT IMPROVEMENTS. PLEASE READ ALL OF THESE COMMENTS BEFORE, PARTICULARLY THE COMMENTS CONCERNING MACHINE DEPENDENT CODING.

AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT 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

COMPARE ENDF/B FORMATTED DATA FROM TWO SEPARATE INPUT TAPES. REACTIONS ARE CONSIDERED TO BE COMPARABLE IF THEY HAVE THE SAME (ZA,MF,MT). RESULTS ARE PRESENTED IN GRAPHICAL FORM.

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.

ON WHAT COMPUTERS WILL THE PROGRAM RUN

THE PROGRAM HAS BEEN IMPLEMENTED ON A VARIETY OF COMPUTERS FROM CRAY AND IBM MAINFRAME TO SUN WORKSTATIONS TO AN IBM-AT PC. THE PROGRAM IS SMALL ENOUGH TO RUN ON VIRTUALLY ANY COMPUTER.

THE PROGRAM USES A SIMPLE CALCOMP LIKE GRAPHICS INTERFACE (DESCRIBED BELOW) AND ALLOWS THE USER SPECIFY THE PHYSICAL SIZE OF THE PLOTTER BEING USED, BY INPUT PARAMETERS. USING THESE CONVENTIONS THIS PROGRAM CAN BE EASILY INTERFACED TO VIRTUALLY ANY PLOTTER.

FOR SPECIAL CONSIDERATIONS SEE THE SECTIONS BELOW ON,
(1) COMPUTER DEPENDENT CODING
(2) PLOTTER/GRAPHICS TERMINAL INTERFACE

GRAPHICS INTERFACE

THIS PROGRAM USES A SIMPLE CALCOMP LIKE GRAPHICS INTERFACE WHICH REQUIRES ONLY 3 SUBROUTINES...PLOTS, PLOT AND PEN (DESCRIBED IN DETAIL BELOW). ALL CHARACTERS AND SYMBOLS ARE DRAWN USING TABLES OF PEN STROKES (SUPPLIED WITH THIS PROGRAM). USING THIS METHOD THE PROGRAM SHOULD BE SIMPLE TO INTERFACE TO VIRTUALLY ANY PLOTTER OR GRAPHICS TERMINAL AND THE APPEARANCE AND LAYOUT OF THE PLOTS SHOULD BE INDEPENDENT OF WHICH PLOTTER IS USED.

ON WHAT PLOTTERS WILL THE PROGRAM RUN

THE PLOTTER MAY USE UNITS OF INCHES, CENTIMETERS, MILLIMETERS, VIRTUALLY ANYTHING. INTERNALLY THE PROGRAM WILL DEFINE PLOTS IN APPROXIMATELY A4 OR 8-1/2 BY 11 INCH FORMAT. AS PART OF THE INPUT THE USER DEFINES THE ACTUAL SIZE OF THE PLOT IN THE UNITS (I.E., INCHES, CENTIMETERS, MILLIMETERS, WHATEVER) OF THE REAL PLOT. THE PLOT IS TRANSFORMED TO THE SIZE OF THE LOCAL PLOTTER AND OUTPUT. USING THIS CONVENTION THIS PROGRAM SHOULD BE EASY TO INTERFACE TO VIRTUALLY ANY PLOTTER OR GRAPHICS TERMINAL.

PROGRAM IDENTIFICATION

```
---------------------                                                  Complot
AS DISTRIBUTED THE FIRST FRAME OF PLOTTED OUTPUT WILL DOCUMENT         Complot
THE PROGRAM NAME, VERSION AND INSTALLATION. THIS INFORMATION IS        Complot
STORED AS DATA IN THE ARRAY VERSES NEAR THE BEGINNING OF               Complot
SUBROUTINE FRAME1. IF YOU WISH TO CUSTOMIZE THE OUTPUT TO IDENTIFY     Complot
YOUR INSTALLATION CHANGE THE LAST TWO LINES OF THE ARRAY (VERSES).     Complot
                                                                       Complot
ENDF/B FORMAT                                                          Complot
------------                                                           Complot
THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS         Complot
OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION       Complot
OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT).     Complot
                                                                       Complot
BOTH SETS OF EVALUATED DATA MUST BE IN THE ENDF/B FORMAT. ONLY         Complot
SECTIONS OF FILE 2 (RESONANCE PARAMETERS) AND FILES 3, 23 AND 27       Complot
(TABULATED DATA) WILL BE READ AND ALL OTHER SECTIONS WILL BE           Complot
SKIPPED. IN FILE 2 THE ONLY IMPORTANT INFORMATION IS THE ENERGY        Complot
LIMITS OF THE RESOLVED AND UNRESOLVED RESONANCE REGION WHICH IS        Complot
LOCATED IN THE SAME FIELDS IN ALL VERSIONS OF THE ENDF/B FORMAT.       Complot
SIMILARLY THE FORMAT OF FILES 3, 23 AND 27 IS THE SAME IN ALL          Complot
VERSIONS OF ENDF/B. THEREFORE THIS PROGRAM CAN BE USED WITH DATA       Complot
IN ANY ENDF/B FORMAT (I.E. ENDF/B-I, II, III, IV, V OR VI).            Complot
                                                                       Complot
CROSS SECTION INTERPOLATION                                            Complot
---------------------------                                            Complot
CROSS SECTIONS MUST BE IN EITHER HISTOGRAM (I.E., INTERPOLATION        Complot
LAW 1) OR LINEARLY INTERPOLABLE (I.E. INTERPOLATION LAW 2) FORM.       Complot
IF THEY ARE NOT A WARNING MESSAGE WILL BE PRINTED AND EXECUTION        Complot
WILL BE TERMINATED. SEE INSTRUCTIONS BELOW ON HOW TO CONVERT           Complot
DATA TO HISTOGRAM OR LINEARLY INTERPOLABLE FORM.                       Complot
                                                                       Complot
REACTION INDEX                                                         Complot
--------------                                                         Complot
THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN         Complot
SECTION MF=1, MT=451 OF EACH EVALUATION.                               Complot
                                                                       Complot
SECTION SIZE                                                           Complot
------------                                                           Complot
SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT      Complot
TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS          Complot
SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.                     Complot
                                                                       Complot
DATA SELECTION                                                         Complot
--------------                                                         Complot
THE USER MAY SPECIFYING THE DATA TO BE COMPARED BY INPUTTING UP        Complot
TO 100 MAT/MT/ENERGY OR ZA/MT/ENERGY RANGES. IF THE UPPER LIMIT        Complot
OF THE MAT OR ZA RANGE IS LESS THAN THE LOWER LIMIT IT WILL BE SET     Complot
EQUAL TO THE LOWER LIMIT (I.E. THIS INDICATE ONLY COMPARE ONE          Complot
MAT OR ZA). IF THE UPPER LIMIT IS STILL ZERO IT WILL BE SET TO         Complot
9999 (NO LIMIT). IF THE UPPER MF OR MT LIMIT IS ZERO IT WILL BE        Complot
SET TO 99 OR 999, RESPECTIVELY (NO LIMIT). IF THE UPPER ENERGY         Complot
LIMIT IS ZERO IT WILL BE SET TO A LARGE NUMBER (NO LIMIT).             Complot
                                                                       Complot
THE LIST OF RANGES MUST BE TERMINATED BY A BLANK LINE (I.E. ZERO       Complot
LOWER AND UPPER MAT/MF/MT OR ZA/MF/MT LIMITS).                         Complot
                                                                       Complot
IF THE FIRST RANGE LINE IS BLANK THIS LINE WILL TERMINATE THE          Complot
LIST OF REQUESTS (I.E. A SECOND BLANK LINE NEED NOT BE INPUT)          Complot
AND ALL PHYSICALLY COMPARABLE DATA WILL BE PLOTTED.                    Complot
                                                                       Complot
WHICH REACTIONS WILL BE PLOTTED                                        Complot
-------------------------------                                        Complot
THOSE REACTIONS WITH THE SAME (ZA, MF, MT) WILL BE COMPARED, BUT       Complot
ONLY THOSE DATA WHICH DIFFER BY A USER SPECIFIED ALLOWABLE             Complot
DIFFERENCE WILL BE PLOTTED. IN ORDER TO FORCE ALL COMPARABLE           Complot
REACTIONS TO BE PLOTTED THE USER NEED ONLY SPECIFY AN ALLOWABLE        Complot
DIFFERENCE OF ZERO.                                                    Complot
                                                                       Complot
EQUIVALENT REACTIONS                                                   Complot
--------------------                                                   Complot
IN ORDER TO COMPARE REACTIONS WHICH HAVE DIFFERENT ZA, MF OR MT        Complot
```

```
THE USER IS ALLOWED TO SPECIFY AN EQUIVALENCE LIST OF UP TO        Complot
100 (ZA,MF,MT) COMBINATIONS ON THE MASTER FILE WHICH ARE TO BE     Complot
EQUATED TO DIFFERENT (ZA,MF,MT) ON THE SECOND FILE. THIS OPTION    Complot
MAY BE USED TO COMPARE SIMILAR REACTIONS FROM DIFFERENT MATERIALS  Complot
(E.G. IRON AND NICKEL INELASTIC SCATTERING) OR DIFFERENT REACTIONS Complot
FROM THE SAME OR DIFFERENT MATERIALS (E.G. U-235 CAPTURE AND       Complot
FISSION - IN WHICH CASE THE RATIO WILL BE THE CAPTURE TO FISSION   Complot
RATIO) OR THE SAME REACTION IN DIFFERENT VERSIONS OF THE ENDF/B    Complot
FORMAT WHICH MAY BE ASSIGNED DIFFERENT MT NUMBERS, E.G., THE       Complot
PHOTOELECTRIC CROSS SECTION IS MT=602 IN ENDF/B-V AND EARLIER      Complot
VERSIONS OF ENDF/B, BUT IS MT=522 IN ENDF/B-VI.                    Complot
                                                                   Complot
IN THESE EQUIVALENCE LISTS A ZERO FIELD IMPLIES ALL. FOR EXAMPLE,  Complot
TO EQUATE MT=522 FROM ONE FILE TO MT=602 ON THE OTHER, FOR ALL     Complot
MATERIALS, ONE NEED ONLY SPECIFY ZA=0, MF=23, MT=522 EQUIVALENT    Complot
TO ZA=0, MF=23 AND MT=602.                                         Complot
                                                                   Complot
PLOT FORMATS                                                       Complot
------------                                                       Complot
THE TWO CROSS SECTIONS ARE CONSIDERED TO BE A STANDARD (THE FIRST  Complot
CROSS SECTION) AND A CROSS SECTION TO BE COMPARED TO THE STANDARD  Complot
(THE SECOND CROSS SECTION). THE OUTPUT FROM THIS PROGRAM IS A      Complot
SERIES OF PLOTS. EACH PLOT WILL CONTAIN THE STANDARD CROSS SECTION Complot
AND IN ADDITION THE USER MAY SPECIFY THAT EACH PLOT ALSO CONTAIN   Complot
THE SECOND CROSS SECTION AND/OR THE RATIO OF THE SECOND CROSS      Complot
SECTION TO THE FIRST CROSS SECTION.                                Complot
                                                                   Complot
THE USER MAY SELECT ONE OF THE FOLLOWING FIVE PLOT FORMATS (THE    Complot
NUMBER PRECEDING THE OPTION IS THE VALUE OF THE PLOT MODE SELECTOR Complot
THAT THE USER SHOULD SPECIFY AS INPUT ON THE FIRST LINE).          Complot
                                                                   Complot
(0) THE STANDARD CROSS SECTION (I.E. FIRST EVALUATION) AND THE     Complot
    RATIO OF THE SECOND EVALUATION TO THE FIRST EVALUATION. THE    Complot
    DATA WILL BE PRESENETED AS TWO SUB-PLOTS PER PLOT WITH THE     Complot
    STANDARD CROSS SECTION IN THE UPPER HALF OF THE PLOT AND THE   Complot
    RATIO IN THE LOWER HALF OF THE PLOT.                           Complot
                                                                   Complot
(1) THE STANDARD CROSS SECTION (I.E. FIRST EVALUATION) AND THE     Complot
    SECOND EVALUATION. THE DATA WILL BE PRESENTED AS TWO SUB-PLOTS Complot
    PER PLOT WITH THE STANDARD CROSS SECTION ON THE UPPER HALF     Complot
    OF THE PLOT AND THE SECOND CROSS SECTION IN THE LOWER HALF OF  Complot
    THE PLOT.                                                      Complot
                                                                   Complot
(2) THE STANDARD CROSS SECTION (I.E. FIRST EVALUATION) AND THE     Complot
    SECOND EVALUATION. THE DATA WILL BE PRESENTED AS ONE PLOT      Complot
    CONTAINING BOTH THE STANDARD AND SECOND CROSS SECTION. THE     Complot
    STANDARD CROSS SECTION WILL BE PRESENTED AS A SOLID LINE AND   Complot
    THE SECOND CROSS SECTION WILL BE PRESENTED AS A DASHED LINE.   Complot
                                                                   Complot
(3) THE STANDARD CROSS SECTION, SECOND CROSS SECTION AND RATIO OF  Complot
    THE SECOND CROSS SECTION TO THE FIRST CROSS SECTION. THE DATA  Complot
    WILL BE PRESENTED AS THREE SUB-PLOTS PER PLOT WITH THE         Complot
    STANDARD CROSS SECTION IN THE UPPER THIRD OF THE PLOT, THE     Complot
    SECOND CROSS SECTION IN THE MIDDLE THIRD AND THE RATIO OF THE  Complot
    TWO IN THE LOWER THIRD OF THE PLOT (RECOMMENDED OPTION).       Complot
                                                                   Complot
(4) THE STANDARD CROSS SECTION, SECOND CROSS SECTION AND RATIO OF  Complot
    THE SECOND CROSS SECTION TO THE FIRST CROSS SECTION. THE DATA  Complot
    WILL BE PRESENTED AS TWO SUB-PLOTS PER PLOT WITH THE STANDARD  Complot
    AND SECOND CROSS SECTION ON THE SAME SUB-PLOT IN THE UPPER     Complot
    TWO THIRDS OF THE PLOT AND THE RATIO OF THE TWO IN THE LOWER   Complot
    THIRD OF THE PLOT. THE STANDARD CROSS SECTION WILL BE          Complot
    PRESENTED AS A SOLID LINE AND THE SECOND CROSS SECTION WILL BE Complot
    PRESENTED AS A DASHED LINE.                                    Complot
                                                                   Complot
ADDITIONAL PLOT FEATURES                                           Complot
------------------------                                           Complot
IN ADDITION TO THE CROSS SECTIONS AND/OR RATIO THE FOLLOWING       Complot
INFORMATIONS WILL BE INCLUDED ON EACH PLOT.                        Complot
                                                                   Complot
(1) AN IDENTIFICATION FOR EACH SET OF CROSS SECTIONS (UP TO 30     Complot
```

```
    CHARACTERS FOR EACH SET).                                          Complot
                                                                       Complot
(2) THE MAXIMUM NEGATIVE AND POSITIVE PER-CENT DIFFERENCE BETWEEN      Complot
    THE TWO CROSS SECTIONS.                                            Complot
                                                                       Complot
(3) ARROWS INDICATING THE ENERGY AT WHICH THE MAXIMUM DIFFERENCES      Complot
    (MINIMUM AND MAXIMUM RATIO) OCCUR.                                 Complot
                                                                       Complot
(4) THE ENERGY LIMITS OF THE RESOLVED AND UNRESOLVED RESONANCE         Complot
    REGION (IF THEY FALL WITHIN THE ENERGY LIMITS OF THE PLOT).        Complot
                                                                       Complot
RATIO DATA                                                             Complot
----------                                                             Complot
IF RATIO OUTPUT IS REQUESTED THE RATIO WILL BE DEFINED AT EACH         Complot
ENERGY THAT APPEARS IN EITHER EVALUATION. BETWEEN THESE ENERGIES       Complot
THE RATIO WILL BE PLOTTED ASSUMING LINEAR DEPENDENCE BETWEEN           Complot
TABULATED VALUES. FOR HISTOGRAM OR LINEARLY INTERPOLABLE CROSS         Complot
SECTIONS THIS REPRESENTATION WILL POINT OUT ALL EXTREMA OF THE         Complot
RATIO, BUT NOT NECESSARILY THE ENERGY DEPENDENCE BETWEEN TABULATED     Complot
VALUES.                                                                Complot
                                                                       Complot
IF THE EVALUATED DATA IS NOT IN EITHER HISTOGRAM OR LINRARLY           Complot
INTERPOLABLE FORM THE RATIO MAY NOT EVEN FIND ALL EXTREMA. FOR         Complot
EXAMPLE, IF ONE EVALUATION IS LINEARLY INTERPOLABLE AND THE            Complot
OTHER NON-LINEAR, BUT BOTH AGREE AT ALL TABULATED ENERGIES THE         Complot
RATIO WILL APPEAR TO BE EQUAL TO UNITY AT ALL ENERGIES, BUT IN         Complot
FACT THE CROSS SECTION BETWEEN TABULATED ENERGIES MAY BE QUITE         Complot
DIFFERENT USING LINEAR VS. NON-LINEAR INTERPOLATION. FOR THIS         Complot
REASON ONLY LINEARLY INTERPOLABLE OR HISTOGRAM DATA IS ALLOWED         Complot
AS INPUT TO THIS PROGRAM.                                              Complot
                                                                       Complot
LINEAR INTERPOLABLE                                                    Complot
-------------------                                                    Complot
ALL CROSS SECTIONS MAY BE CONVERTED TO LINEARLY INTERPOLABLE FORM       Complot
BE USING PROGRAM LINEAR (UCRL-50400, VOL. 17, PART A).                 Complot
                                                                       Complot
HISTOGRAM                                                              Complot
---------                                                              Complot
ALL LINEARLY INTERPOLABLE CROSS SECTION MAY BE CONVERTED TO            Complot
HISTOGRAM (I.E. MULTIGROUP) FORM BY USING PROGRAM GROUPIE               Complot
(UCRL-50400, VOL. 17, PART D).                                         Complot
                                                                       Complot
INPUT UNITS                                                            Complot
-----------                                                            Complot
UNIT  DESCRIPTION                                                      Complot
----  -----------                                                      Complot
  2   INPUT LINE                                                       Complot
  9   MT DEFINITIONS.                                                  Complot
 10   FIRST ENDF/B FORMATTED EVALUATION (STANDARD).                    Complot
 11   SECOND ENDF/B FORMATTED EVALUATION.                              Complot
 17   SOFTWARE CHARACTERS.                                             Complot
 18   SOFTWARE SYMBOLS AND LINE TYPES                                  Complot
                                                                       Complot
OUTPUT UNITS                                                           Complot
------------                                                           Complot
UNIT  DESCRIPTION                                                      Complot
----  -----------                                                      Complot
  3   NORMAL OUTPUT REPORT.                                            Complot
 16   PLOTTER UNIT                                                     Complot
                                                                       Complot
SCRATCH UNITS                                                          Complot
-------------                                                          Complot
UNIT  DESCRIPTION                                                      Complot
----  -----------                                                      Complot
 12   SCRATCH UNIT FOR FIRST EVALUATION                                Complot
 13   SCRATCH UNIT FOR SECOND EVALUATION                               Complot
 14   SCRATCH UNIT FOR RATIO (ONLY USED IF RATIOS REQUESTED).          Complot
                                                                       Complot
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILIO1 AND FILIO2)        Complot
------------------------------------------------------------           Complot
UNIT  FILE NAME                                                        Complot
```

```
 ----  ----------                                                      Complot
   2   COMPLOT.INP                                                     Complot
   3   COMPLOT.LST                                                     Complot
   9   MT.DAT                                                          Complot
  10   ENDFB.IN1    (OR AS READ FROM INPUT)                            Complot
  11   ENDFB.IN2    (OR AS READ FROM INPUT)                            Complot
12-14  (SCRATCH)                                                       Complot
  15   PLOT.CHR                                                        Complot
  16   (PLOTTER UNIT...USUALLY A DUMMY)                                Complot
                                                                       Complot
 INPUT PARAMETERS                                                      Complot
 ------------------------------------------------------------------- Complot
 LINE  COLUMNS  FORMAT  DESCRIPTION                                    Complot
 ----  -------  ------  -----------                                    Complot
   1     1-11    E11.4  LOWER X LIMIT OF PLOTTER                       Complot
        12-22    E11.4  UPPER X LIMIT OF PLOTTER                       Complot
        23-33    E11.4  LOWER Y LIMIT OF PLOTTER                       Complot
        34-44    E11.4  UPPER Y LIMIT OF PLOTTER                       Complot
        45-55     I11   NUMBER OF PLOTS PER FRAME IN X DIRECTION       Complot
        56-66     I11   NUMBER OF PLOTS PER FRAME IN Y DIRECTION       Complot
        67-70     F4.1  CHARACTER SIZE MULTIPLIER                      Complot
                        = 0 TO 1    - NORMAL CHARACTER SIZE            Complot
                        = OTHERWISE - CHARACTERS SCALED BY THIS        Complot
                                      FACTOR                           Complot
                                                                       Complot
                        PLOT ORIENTATION IS BASED ON THE UPPER X       Complot
                        LIMIT                                          Complot
                        = .GT.0 - X HORIZONTAL/Y VERTICAL              Complot
                        = .LT.0 - Y HORIZONTAL/X VERTICAL              Complot
                        AFTER TESTING THE UPPER X LIMIT WILL BE        Complot
                        SET TO ITS ABSOLUTE VALUE.                     Complot
   2     1-72     A60   FILENAME FOR FIRST ENDF/B DATA FILE            Complot
                        (LEAVE BLANK FOR ENDFB.IN1)                    Complot
   3     1-72     A60   FILENAME FOR SECOND ENDF/B DATA FILE           Complot
                        (LEAVE BLANK FOR ENDFB.IN2)                    Complot
   4     1-11     I11   RETRIEVAL MODE (0=MAT, 1=ZA)                   Complot
        12-22     I11   GRID (SPEED) OPTION.                          Complot
                        = 0 - TICK MARKS ON BORDER                     Complot
                        = 1 - SOLID AT COARSE INTERVALS                Complot
                        = 2 - DASHED AT COARSE INTERVALS               Complot
                        = 3 - SOLID AT COARSE AND FINE INTERVALS       Complot
                        = 4 - DASHED AT COARSE AND FINE INTERVALS      Complot
                        = 5 - SOLID COARSE/DASHED FINE INTERVALS       Complot
        23-33     I11   SHOULD BORDER BE PLOTTED AROUND EACH PLOT      Complot
                        = 0 - NO                                       Complot
                        = 1 - YES                                      Complot
        34-44     I11   LINE THICKNESS                                 Complot
                        = 0 TO  5 - LINES AND CHARACTERS               Complot
                        =-1 TO -5 - ONLY LINES                         Complot
        45-55     I11   OUTPUT MODE                                    Complot
                        =-1 - ONLY COMPARISON LISTING. NO PLOTS.       Complot
                        = 0 - CROSS SECTION OVER RATIO.                Complot
                        = 1 - CROSS SECTION OVER CROSS SECTION.        Complot
                        = 2 - TWO CROSS SECTIONS ON SAME PLOT.         Complot
                        = 3 - CROSS SECTION OVER CROSS SECTION OVER    Complot
                              RATIO.                                   Complot
                        = 4 - TWO CROSS SECTIONS ON SAME PLOT OVER     Complot
                              RATIO.                                   Complot
        56-66     I11   STARTING PLOT NUMBER                          Complot
                        = 0     - DO NOT NUMBER PLOTS                  Complot
                        = .GT.0 - NUMBER PLOTS IN LOWER LEFT HAND      Complot
                                  CORNER STARTING WITH INPUT NUMBER    Complot
        67-70     I41   BACKGROUND COLOR                               Complot
                        = 0         = BLACK                            Complot
                        = OTHERWISE = WHITE                            Complot
    5    1-11    E11.4  ALLOWABLE FRACTIONAL DIFFERENCE. USED WHEN     Complot
                        PLOTTING RATIOS. ANY REACTION WHERE THE        Complot
                        TWO EVALUATIONS DIFFER BY MORE THAN THE        Complot
                        ALLOWABLE DIFFERENCE WILL BE PLOTTED. IF       Complot
                        ZERO IS INPUT THE STANDARD ALLOWABLE           Complot
                        DIFFERENCE OF 0.001 (0.1 PER-CENT) WILL BE     Complot
```

```
                                USED.                                    Complot
          12-22      E11.4      MAXIMUM ALLOWABLE RATIO. IF RATIOS ARE   Complot
                                PLOTTED THEY WILL BE IN THE RANGE RATMAX Complot
                                TO 1/RATMAX. IF 0.0 IS INPUT THERE WILL  Complot
                                BE NO LIMIT ON THE RANGE OF THE RATIOS.  Complot
                                THIS OPTION MAY BE USED TO IGNORE LARGE  Complot
                                DIFFERENCES OVER VERY NARROW ENERGY RANGES Complot
                                (WHICH MAY BE UNIMPORTANT) AND ALLOW ONE Complot
                                TO SEE IMPORTANT, BUT SMALLER DIFFERENCES, Complot
                                OVER EXTENDED ENERGY RANGES.             Complot
        6        1-40       40A1  IDENTIFICATION FOR UPPER EVALUATIONS    Complot
        7        1-40       40A1  IDENTIFICATION FOR LOWER EVALUATIONS    Complot
                                (IDENTIFICATIONS SHOULD BE LEFT ADJUSTED Complot
                                TO START IN COLUMN 1).                   Complot
      8-N        1- 6        I6   LOWER MAT OR ZA LIMIT (SEE SELECTION MODE, Complot
                                INPUT LINE 1, COLUMNS 1-11).             Complot
                 7- 8        I2   LOWER MF LIMIT                         Complot
                 9-11        I3   LOWER MT LIMIT                         Complot
                12-22      E11.4  LOWER ENERGY LIMIT                      Complot
                23-28        I6   UPPER MAT OR ZA LIMIT (SEE SELECTION MODE, Complot
                                INPUT LINE 1, COLUMNS 1-11).             Complot
                29-30        I2   UPPER MF LIMIT                         Complot
                31-33        I3   UPPER MT LIMIT                         Complot
                34-44      E11.4  UPPER ENERGY LIMIT                      Complot
                45-55       I11   IDENTIFY EVALUATED DATA POINTS OPTION.  Complot
                                = 0 - DO NOT IDENTIFY DATA POINTS.       Complot
                                = 1 - IDENTIFY DATA POINTS (BY DRAWING A Complot
                                      SMALL BOX AROUND EACH POINT).      Complot
                56-66       I11   INTERACTIVE INPUT FLAG                  Complot
                                = 0 - NO INTERACTIVE INPUT ALLOWED       Complot
                                = 1 - INTERACTIVE INPUT ALLOWED          Complot
                               *SETTING THIS OPTION =1 WILL TURN ON THE  Complot
                                MOUSE AFTER EACH PLOT AND ALLOW YOU TO   Complot
                                INTERACTIVELY SPECIFY PLOT LIMITS.       Complot
                               *IF YOU DO NOT WISH TO INTERACT WITH A PLOT Complot
                                OR IF YOU HAVE NO INTERACTIVE CAPABILITY Complot
                                THIS OPTION SHOULD BE SET = 0.           Complot
                                                                         Complot
                               *WARNING...DATA POINTS IDENTIFIED OPTION IS Complot
                                NOT RECOMMENDED FOR PLOTS CONTAINING MANY Complot
                                (I.E. THOUSANDS) OF DATA POINTS SINCE IT Complot
                                WILL MERELY INCREASE THE RUNNING TIME OF Complot
                                THE PROGRAM AND STILL NOT ALLOW ONE TO   Complot
                                ACCURATELY SEE DATA POINTS.              Complot
                                                                         Complot
                               *UP TO 100 MAT OR ZA RANGES ARE ALLOWED.  Complot
                                THE LIST IS TERMINATED BY A BLANK LINE.  Complot
                                IF THE UPPER LIMIT IS LESS THAN THE LOWER Complot
                                LIMIT IT WILL BE SET EQUAL TO THE LOWER  Complot
                                LIMIT. IF THE FIRST RANGE LINE IS BLANK  Complot
                                ALL DATA WILL BE RETRIEVED. IF THE UPPER Complot
                                MT LIMIT IS ZERO IT WILL BE SET EQUAL TO Complot
                                999 (NO LIMIT). IF THE UPPER ENERGY LIMIT Complot
                                IS ZERO IT WILL BE INTREPRETED TO MEAN NO Complot
                                LIMIT. IF THE FIRST RANGE LINE SPECIFIES Complot
                                ZERO LOWER AND UPPER MAT OR ZA RANGE IT  Complot
                                WILL TERMINATE THE LIST BE RANGE LINES   Complot
                                (A SECOND BLANK LINE NEED NOT BE INPUT)  Complot
                                AND THE ENTIRE RANGE OF MATS WILL BE     Complot
                                COMPARED FOR THE SPECIFIED MT AND ENERGY Complot
                                RANGES.                                  Complot
                                                                         Complot
    N+1-M                       EQUIVALENCES                             Complot
                 1- 6        I6   MASTER ZA.                             Complot
                 7- 8        I2   MASTER MF.                             Complot
                 9-11        I3   MASTER MT.                             Complot
                12-17        I6   EQUIVALENT ZA FROM SECOND FILE.        Complot
                18-19        I2   EQUIVALENT MF FROM SECOND FILE.        Complot
                20-22        I3   EQUIVALENT MT FROM SECOND FILE.        Complot
                23-33      E11.4  MULTIPLICATION FACTOR. ANY EQUATED ZA,MF, Complot
                                MT DATA WILL BE MULTIPLIED BY THIS FACTOR. Complot
```

```
                        *THIS OPTION MAY BE USED TO RE-NORMALIZE     Complot
                         THE SECOND CROSS SECTION OR IF COMPARING    Complot
                         ONE CONSTITUENT OF A MIXTURE TO THE MIXED   Complot
                         CROSS SECTION THIS MAY BE USED TO CONVERT   Complot
                         THE SECOND CROSS SECTION TO BARNS PER MIXED Complot
                         ATOM BY USING A MULTIPLICATION FACTOR WHICH Complot
                         IS EQUAL TO THE NUMBER OF ATOMS OF THE ONE  Complot
                         CONSTITUENT PER ATOM OF THE MIXTURE.        Complot
                         = 0.0 - ON INPUT WILL BE INTERPRETED AS 1.0 Complot
                         (WITH THIS CONVENTION THE USER NEED ONLY    Complot
                         INPUT MULTIPLICATION FACTORS IF THEY ARE    Complot
                         NOT 1.0).                                   Complot
                        *UP TO 100 MAT OR ZA EQUIVALENCES ARE        Complot
                         ALLOWED.                                    Complot
                        *THE LIST IS TERMINATED BY A BLANK LINE.     Complot
                        *A ZERO INPUT FIELD IMPLIES ALL. TO EQUATE   Complot
                         A GIVEN MT NUMBER TO ANOTHER MT NUMBER YOU  Complot
                         NEED MERELY SPECIFY ZA=0 ON INPUT.          Complot
                        *NOTE, IN ALL CASES THE TITLE AT TOP OF PLOT Complot
                         WILL ONLY INDENTIFY MASTER (ZA,MF,MT). THE  Complot
                         USER INPUT TITLES MUST BE USED TO IDENTIFY  Complot
                         THE SECOND REACTION (SEE, EXAMPLE INPUT 4   Complot
                         BELOW).                                     Complot
                                                                     Complot
                                                                     Complot
EXAMPLE DEFINITION OF PLOTTER                                        Complot
---------------------------                                          Complot
THE FIRST INPUT LINE DEFINES THE DIMENSIONS OF THE PLOTTER BEING     Complot
USED IN ANY UNITS (INCHES, CENTIMETERS, MILLIMETERS, ANYTHING)       Complot
WHICH APPLY TO THE PLOTTER. IN ADDITION THE FIRST LINE DEFINES       Complot
HOW MANY PLOTS SHOULD APPEAR ON EACH FRAME. THE PLOTTING AREA        Complot
DEFINED ON THE FIRST INPUT LINE MAY BE SUBDIVIDED INTO ANY NUMBER    Complot
OF PLOTS IN THE X AND Y DIRECTION. FOR EXAMPLE, TO PRODUCE A         Complot
SERIES OF FRAMES EACH CONTAINING 3 PLOTS IN THE X DIRECTION AND      Complot
2 PLOTS IN THE Y DIRECTION (6 PLOTS PER FRAME) COLUMN 45-55 OF       Complot
THE FIRST INPUT LINE SHOULD BE 3 AND COLUMNS 56-66 SHOULD BE 2.      Complot
                                                                     Complot
IF THE LOCAL PLOTTER USES DIMENSIONS OF INCHES IN ORDER TO OBTAIN    Complot
10 X 10 INCH FRAMES WITH 3 X 2 PLOTS PER FRAME THE FIRST INPUT       Complot
LINE SHOULD BE,                                                      Complot
                                                                     Complot
  0.0       10.0      0.0     10.0              3          2        Complot
                                                                     Complot
IF THE LOCAL PLOTTER USES DIMENSION OF MILLIMETERS THE SAME          Complot
PHYSICAL SIZE PLOT MAY BE OBTAINED IF THE FIRST INPUT LINE IS,       Complot
                                                                     Complot
  0.0      254.0      0.0    254.0              3          2        Complot
                                                                     Complot
FOR SIMPLICITY THE FOLLOWING EXAMPLE INPUTS WILL NOT DISCUSS THE     Complot
PHYSICAL DIMENSIONS OF THE PLOTTER AND THE FIRST INPUT LINE WILL     Complot
IN ALL CASES INDICATE 10 X 10 INCH PLOTS WITH ONLY 1 PLOT PER        Complot
FRAME.                                                               Complot
                                                                     Complot
IN THE FOLLOWING EXAMPLES IN ALL CASES THESE OPTIONS WILL BE USED,   Complot
1) DASHED GRID       - COLUMNS 12-22 OF SECOND INPUT LINE =  1       Complot
2) NO BORDER         - COLUMNS 23-33 OF SECOND INPUT LINE =  0       Complot
3) LINE THICKNESS    - COLUMNS 34-44 OF SECOND INPUT LINE = -2       Complot
4) OUTPUT MODE       - COLUMNS 45-55 OF SECOND INPUT LINE =  3       Complot
5) FIRST PLOT NUMBER - COLUMNS 56-66 OF SECOND INPUT LINE =  1       Complot
                                                                     Complot
EXAMPLE INPUT 1                                                      Complot
--------------                                                       Complot
RETRIEVE MATS 1023, 1056 AND 1065 THROUGH 1072, MT = 1 AND 2         Complot
(TOTAL AND ELASTIC) FROM THE FIRST INPUT FILE AND COMPARE TO         Complot
ANY SECTION FROM THE SECOND FILE THAT HAS THE SAME ZA/MF/MT. ONLY    Complot
COMPARE DATA OVER THE ENERGY RANGE 0.1 EV TO 1 KEV. IDENTIFY         Complot
THE TWO SETS OF DATA AS ENDF/B-V AND ENDF/B-IV, RESPECTIVELY.        Complot
ONLY PLOT THOSE REACTIONS WHICH DIFFER AT ONE OR MORE ENERGIES       Complot
BY MORE THAN 1 PER-CENT (NOTE, 1 PER-CENT = 0.01 AS INPUT            Complot
FRACTION). NO EQUIVALENT REACTIONS ARE SPECIFIED. FILERNAMES         Complot
ARE STANDARD (THSE CAN EITHER BE EXPLICITLY INCLUDED, OR SIMPLY      Complot
```

```
   LEFT BLANK).                                                          Complot
                                                                         Complot
   THE FOLLOWING 12 INPUT LINES ARE REQUIRED.                            Complot
                                                                         Complot
      0.0       10.0      0.0     10.0              3          2       Complot
 ENDFB.IN1                                                               Complot
 ENDFB.IN2                                                               Complot
        0          1        0       -2              3          1       Complot
     0.01        0.0                                                    Complot
 ENDF/B-V DATA (STANDARD)                                                Complot
 ENDF/B-IV DATA                                                          Complot
 1023 3  1 0.1            3  2 1000.0               0                  Complot
 1056 3  1 0.1            3  2 1000.0               0                  Complot
 1065 3  1 0.1       1072 3  2 1000.0               0                  Complot
                                   (TERMINATES REQUEST LIST)            Complot
                                   (TERMINATES EQUIVALENCE LIST)        Complot
                                                                        Complot
   EXAMPLE INPUT 2                                                      Complot
   --------------                                                       Complot
   TO USE ALL OF THE SAME OPTIONS AS SPECIFIED IN EXAMPLE INPUT 1,      Complot
   EXCEPT TO RETRIEVE U-235, U-238 AND PU-239 THROUGH PU-242 THE        Complot
   FOLLOWING 12 INPUT LINES ARE REQUIRED.                               Complot
                                                                        Complot
      0.0       10.0      0.0     10.0              3          2       Complot
 ENDFB.IN1                                                              Complot
 ENDFB.IN2                                                              Complot
        1          1        0       -2              3          1       Complot
     0.01        0.0                                                    Complot
 ENDF/B-V DATA (STANDARD)                                               Complot
 ENDF/B-IV DATA                                                         Complot
92235 3  1 0.1            3  2 1000.0               0                  Complot
92238 3  1 0.1            3  2 1000.0               0                  Complot
94239 3  1 0.1      94242 3  2 1000.0               0                  Complot
                                   (TERMINATES REQUEST LIST)            Complot
                                   (TERMINATES EQUIVALENCE LIST)        Complot
   EXAMPLE INPUT 3                                                      Complot
   --------------                                                       Complot
   TO USE ALL OF THE SAME OPTIONS AS SPECIFIED IN EXAMPLE INPUT 1,      Complot
   EXCEPT TO RETRIEVE AND COMPARE ALL MATS THE FOLLOWING 10 INPUT       Complot
   LINES ARE REQUIRED.                                                  Complot
                                                                        Complot
     0.0       10.0      0.0     10.0              3          2       Complot
 ENDFB.IN1                                                              Complot
 ENDFB.IN2                                                              Complot
       0          1        0       -2              3          1       Complot
    0.01        0.0                                                    Complot
ENDF/B-V DATA (STANDARD)                                                Complot
ENDF/B-IV DATA                                                          Complot
   1 1  1 0.0       999999999 0.0                  0                  Complot
                                   (TERMINATES REQUEST LIST)            Complot
                                   (TERMINATES EQUIVALENCE LIST)        Complot
                                    NOTE, ZERO LOWER AND UPPER          Complot
                                    MAT LIMITS INDICATES NO LIMIT.      Complot
                                                                        Complot
   EXAMPLE INPUT 4                                                      Complot
   --------------                                                       Complot
   RETRIEVE U-235 AND EQUATE THE FISSION CROSS SECTION (MT=18) ON       Complot
   THE MASTER FILE TO CAPTURE (MT=102) ON THE SECOND FILE. PLOT         Complot
   THE CAPTURE, FISSION AND CAPTURE TO FISSION RATIO OVER THE ENERGY    Complot
   RANGE 0.0253 EV TO 1 KEV. THE FOLLOWING 11 INPUT LINES ARE           Complot
   REQUIRED.                                                            Complot
                                                                        Complot
      0.0       10.0      0.0     10.0              3          2       Complot
 ENDFB.IN1                                                              Complot
 ENDFB.IN2                                                              Complot
        1          1        0       -2              3          1       Complot
     0.01        0.0                                                    Complot
 FISSION                                                                Complot
 CAPTURE                                                                Complot
92235 3 18 0.0253   92235 3 18 1000.0               0                  Complot
                                   (TERMINATES REQUEST LIST)            Complot
```

```
92235 3 18 92235 3102                (MULTIPLICATION OF 1.0 INFERRED) Complot
                                     (TERMINATES EQUIVALENCE LIST)    Complot
                                                                      Complot
    EXAMPLE INPUT 5                                                   Complot
    --------------                                                    Complot
    IN DIFFERENT VERSIONS OF THE ENDF/B FORMAT DIFFERENT MT NUMBERS    Complot
    ARE ASSIGNED TO THE SAME REACTION. FOR EXAMPLE, IN ENDF/B-V AND    Complot
    EARLIER VERSIONS OF ENDF/B THE PHOTOELECTRIC CROSS SECTION IS      Complot
    MT=602, WHILE IN ENDF/B-VI IT IS MT=522. IN ORDER TO COMPARE       Complot
    ASSUMING THAT THE MASTER IS ENDF/B-VI AND THE OTHER ENDF/B FILE    Complot
    IS ENDF/B-V (OR EARLIER) YOU MAY EQUATE MT=522 TO 602.            Complot
                                                                      Complot
    WHEN COMPARING PHOTOELECTRIC CROSS SECTIONS WE EXPECT THERE TO BE  Complot
    LARGE DIFFERENCES NEAR EDGES, SINCE IT IS UNLIKELY THAT TWO        Complot
    INDEPENDENT EVALUATIONS USE EXACTLY THE SAME EDGE ENERGIES. FROM   Complot
    A PRACTICAL VIEWPOINT THESE DIFFERENCES ARE NOT IMPORTANT IF THEY  Complot
    ONLY OCCUR OVER NARROW ENERGY RANGES NEAR ENERGIES. HOWEVER THESE  Complot
    LARGE DIFFERENCES MAY MAKE IT DIFFICULT TO SEE DIFFERENCES OVER    Complot
    OTHER ENERGY RANGES, WHICH MAY BE IMPORTANT. IN ORDER TO BE ABLE   Complot
    TO SEE IMPORTANT DIFFERENCES IN THE FOLLOWING COMPARISON WE WILL   Complot
    CONSTRAIN THE PLOTTED RATIO TO THE RANGE ABOUT 0.9 TO 1.1 IN       Complot
    ORDER TO BE ABLE TO SEE DIFFERENCES OF UP TO 10 PER-CENT. WE WILL  Complot
    DO THIS BY SPECIFYING A MAXIMUM RATIO OF 1.1, WHICH WILL IN TURN   Complot
    DEFINE A MINIMUM RATIO OF 1/1.1, OR ABOUT 0.9.                    Complot
                                                                      Complot
    IN ORDER TO COMPARE THE PHOTOELECTRIC CROSS SECTION FOR ALL        Complot
    MATERIALS THE FOLLOWING 11 INPUT LINES ARE REQUIRED.              Complot
                                                                      Complot
      0.0       10.0      0.0     10.0              3          2       Complot
 ENDFB.IN1                                                            Complot
 ENDFB.IN2                                                            Complot
       0          1        0       -2              3          1       Complot
     0.01        1.1                                                  Complot
ENDF/B-VI                                                             Complot
ENDF/B-V                                                              Complot
   023522           999923522                     0                  Complot
                                     (TERMINATES REQUEST LIST)        Complot
   023522     023602                 (MULTIPLICATION OF 1.0 INFERRED) Complot
                                     (TERMINATES EQUIVALENCE LIST)    Complot
                                                                      Complot
    EXAMPLE INPUT 6                                                   Complot
    --------------                                                    Complot
    THE SAME EXAMPLE AS ABOVE, EXCEPT THAT DIFFERENT FILENAMES WILL    Complot
    BE USED TO READ THE DATA FROM A FILE TREE STRUCTURE. THE FOLLOWING Complot
    11 INPUT LINES ARE REQUIRED.                                      Complot
                                                                      Complot
      0.0       10.0      0.0     10.0              3          2       Complot
 /Evaluated/ENDFB6/PHOTON.IN                                          Complot
 /Evaluated/ENDFB5/PHOTON.IN                                          Complot
       0          1        0       -2              3          1       Complot
     0.01        1.1                                                  Complot
ENDF/B-VI                                                             Complot
ENDF/B-V                                                              Complot
   023522           999923522                     0                  Complot
                                     (TERMINATES REQUEST LIST)        Complot
   023522     023602                 (MULTIPLICATION OF 1.0 INFERRED) Complot
                                     (TERMINATES EQUIVALENCE LIST)    Complot
                                                                      Complot
    EXAMPLE INPUT 7                                                   Complot
    --------------                                                    Complot
    THE OUTPUT FOR ALL OF THE ABOVE EXAMPLES ARE ORIENTED WITH X       Complot
    HORIZONTAL AND Y VERTICAL. TO CHANGE THE ORIENTATION OF THE PLOTS  Complot
    YOU NEED MERELY SPECIFY A NEGATIVE UPPER X LIMIT OF THE SIZE OF    Complot
    THE PLOTS ON THE FIRST INPUT LINE.                                Complot
                                                                      Complot
    THE FOLLOWING EXAMPLE IS EXACTLY THE SAME AS THE ABOVE EXAMPLE,    Complot
    EXCEPT THAT THE ORIENTATION OF THE PLOTS HAS BEEN CHANGED. THE     Complot
    FOLLOWING 11 INPUT LINES ARE REQUIRED.                            Complot
                                                                      Complot
      0.0      -10.0      0.0     10.0              3          2       Complot
 /Evaluated/ENDFB6/PHOTON.IN                                          Complot
```

```
 /Evaluated/ENDFB5/PHOTON.IN                                          Complot
       0          1        0       -2              3          1      Complot
    0.01        1.1                                                   Complot
ENDF/B-VI                                                            Complot
ENDF/B-V                                                             Complot
   023522           999923522                     0                  Complot
                                  (TERMINATES REQUEST LIST)          Complot
   023522     023602              (MULTIPLICATION OF 1.0 INFERRED)   Complot
                                  (TERMINATES EQUIVALENCE LIST)      Complot
                                                                     Complot
===== PLOTTER/GRAPHICS TERMINAL INTERFACE ============================ Complot
                                                                     Complot
     NON-INTERACTIVE                                                 Complot
    ---------------------------------------------------------------- Complot
     THIS PROGRAM USES A SIMPLE CALCOMP LIKE INTERFACE INVOLVING     Complot
     ONLY 5 SUBROUTINES,                                             Complot
                                                                     Complot
     STARPLOT     - INITIALIZE PLOTTER                               Complot
     NEXTPLOT     - CLEAR SCREEN FOR NEXT PLOT                       Complot
     ENDPLOTS     - TERMINATE PLOTTING                               Complot
                                                                     Complot
     PLOT(X,Y,IPEN)        - DRAW OR MOVE FROM LAST LOCATION TO (X,Y), Complot
                             END OF CURRENT PLOT OR END OF PLOTTING.  Complot
           IPEN =   2 - DRAW                                         Complot
                =   3 - MOVE                                         Complot
                                                                     Complot
     PEN(IPEN)             - SELECT COLOR.                           Complot
         IPEN- COLOR = 1 TO N (N = ANY POSITIVE INTEGER)             Complot
                                                                     Complot
     BOXCOLOR(X,Y,IFILL,IBORDER) - FILL A RECTANGLE WITH COLOR       Complot
              X,Y               = DEFINE THE CORNERS OF THE BOX      Complot
                  IFILL         = COLOR TO FILL BOX WITH             Complot
                        IBORDER  = COLOR OF BORDER OF BOX            Complot
                                                                     Complot
     INTERACTIVE                                                     Complot
    ---------------------------------------------------------------- Complot
     THIS PROGRAM INCLUDES AN INTERACTIVE INTERFACE FOR USE WITH A   Complot
     MOUSE. THE INTERFACE INVOLVES 2 SUBROUTINE,                     Complot
                                                                     Complot
     INTERACT(MYACTION)             - WHETHER OR NOT INTERACTION     Complot
              MYACTION              = 0 - NO (RETURNED BY INTERACT)  Complot
                                    = 1 - YES (RETURNED BY INTERACT) Complot
                                                                     Complot
     MOUSEY(IWAY,XI,YI,IWAY1,IWAY2) - READ POSITION OF MOUSE         Complot
                             IWAY    = 0 - NO INPUT                  Complot
                                     = 1 - LEFT BUTTON               Complot
                                     = 2 - MIDDLE BUTTON             Complot
                                     = 3 - RIGHT BUTTON              Complot
                                     = 4 - KEYBOARD INPUT            Complot
                             XI      = X POSITION IN LOCAL UNITS     Complot
                             YI      = Y POSITION IN LOCAL UNITS     Complot
                             IWAY1   = MINIMUM ALLOWABLE IWAY        Complot
                             IWAY2   = MAXIMUM ALLOWABLE IWAY        Complot
                                                                     Complot
    AS USED BY THIS PROGRAM IWAY1   = 1                              Complot
                             IWAY2   = 4                             Complot
    KEYBOARD INPUT (IWAY=4) MEANS NO ZOOMED PLOT REQUESTED.          Complot
    MOUSE INPUT (IWAY=1 TO 3) MEANS A ZOOMED PLOT IS REQUESTED.      Complot
    MOUSEY WILL BE CALLED ONCE TO SEE IF A ZOOMED PLOT IS REQUESTED. Complot
    IF IT IS XI WILL BE USED TO DEFINE ONE X (E.G., ENERGY) LIMIT OF Complot
    THE ZOOMED PLOT. MOUSEY WILL THEN BE CALLED A SECOND TIME TO     Complot
    DEFINE A SECOND XI TO DEFINE THE OTHER X LIMIT OF THE ZOOMED     Complot
    PLOT.                                                            Complot
                                                                     Complot
    IF YOU DO NOT WANT INTERACTION YOU SHOULD INCLUDE THE FOLLOWING  Complot
    SUBROUTINES IN YOUR GRAPHIC INTERFACE,                           Complot
                                                                     Complot
    SUBROUTINE INTERACT(MYACTION)                                    Complot
    MYACTION=0                                                       Complot
    RETURN                                                           Complot
    END                                                              Complot
```

```
SUBROUTINE MOUSEY(IWAY,XI,YI,IWAY1,IWAY2)                          Complot
IWAY=4                                                             Complot
XI=0.0                                                             Complot
YI=0.0                                                             Complot
RETURN                                                             Complot
END                                                                Complot
                                                                   Complot
ALTERNATIVE INTERACTIVE                                            Complot
------------------------------------------------------------------ Complot
IF YOU DO NOT HAVE A MOUSE BUT WOULD STILL LIKE TO INTERACTIVE     Complot
INPUT YOU CAN REPLACE SUBROUTINE ACTION IN THIS PROGRAM.           Complot
                                                                   Complot
AS DISTRIBUTED SUBROUTINE ACTION USES A MOUSE TO DEFINE LOWER      Complot
AND UPPER ENERGY (OR X) LIMITS WHICH ARE USED TO PRODUCE THE       Complot
NEXT PLOT. A CALL TO ACTION IS OF THE FORM,                        Complot
                                                                   Complot
CALL ACTION(KACTV,XACT1,XACT2)                                     Complot
                                                                   Complot
            KACTV   = 0 - NO INTERACTIVE INPUT                     Complot
                    = 1 - INTERACTIVE INPUT                        Complot
            XACT1   = LOWER ENERGY LIMIT                           Complot
            XACT2   = UPPER ENERGY LIMIT                           Complot
                                                                   Complot
IF THERE IS NO INTERACTIVE INPUT THE PROGRAM WILL PROCEED TO THE   Complot
NEXT PLOT REQUESTED BY NON-INTERACTIVE INPUT.                      Complot
                                                                   Complot
IF THERE IS INTERACTIVE INPUT THE PROGRAM WILL USE XACT1 AND       Complot
XACT2 TO DEFINE THE ENERGY LIMITS OF THE NEXT PLOT USING THE       Complot
SAME DATA AS APPEARED ON THE LAST PLOT. AS WITH NON-INTERACTIVE    Complot
INPUT, IF YOU SELECT AN ENERGY RANGE WHERE THE MAXIMUM DIFFERENCE  Complot
IS LESS THAN THAT SPECIFIED BY INPUT NO PLOT WILL BE PRODUCED      Complot
AND THE CODE WILL PROCEED TO THE NEXT PLOT REQUESTED BY            Complot
NON-INTERACTIVE INPUT.                                             Complot
                                                                   Complot
YOU CAN REPLACE SUBROUTINE ACTION FOLLOWING THE ABOVE CONVENTIONS  Complot
TO ALLOW INTERACTION VIA DIRECT READ OF X LIMITS, LIGHTPEN OR      Complot
WHATEVER FACILITIES YOU HAVE AVAILABLE.                            Complot
                                                                   Complot
INTERFACING                                                        Complot
------------------------------------------------------------------ Complot
IN ORDER TO INTERFACE THIS PROGRAM FOR USE ON ANY PLOTTER WHICH    Complot
DOES NOT USE THE ABOVE CONVENTIONS IT IS MERELY NECESSARY FOR THE  Complot
THE USER TO WRITE 5 SUBROUTINES DESCRIBED ABOVE AND TO THEN CALL   Complot
THE LOCAL EQUIVALENT ROUTINES.                                     Complot
                                                                   Complot
COLOR PLOTS                                                        Complot
------------------------------------------------------------------ Complot
TO SELECT PLOTTING COLORS SUBROUTINE PEN (DESCRIBED ABOVE) IS USED Complot
TO SELECT ONE OF THE AVAILABLE COLORS. WHEN RUNNING ON A MAINFRAME Complot
USING AN IBM GRAPHICS TERMINAL OR ON AN IBM-PC USING A HEWLETT-    Complot
PACKARD PLOTTER THE GRAPHICS INTERFACE (DESCRIBED ABOVE) WILL      Complot
PRODUCE COLOR PLOTS.                                               Complot
                                                                   Complot
BLACK AND WHITE PLOTS                                              Complot
------------------------------------------------------------------ Complot
WHEN PRODUCING BLACK AND WHITE HARDCOPY ON A MAINFRAME THE USER    Complot
SHOULD ADD A DUMMY SUBROUTINE PEN TO THE END OF THE PROGRAM TO     Complot
IGNORE ATTEMPTS TO CHANGE COLOR. ADD THE FOLLOWING SUBROUTINE,     Complot
                                                                   Complot
SUBROUTINE PEN(IPEN)                                               Complot
RETURN                                                             Complot
END                                                                Complot
                                                                   Complot
CHARACTER SET                                                      Complot
------------------------------------------------------------------ Complot
THIS PROGRAM USES COMPUTER AND PLOTTER DEVICE INDEPENDENT SOFTWARE Complot
CHARACTERS. THIS PROGRAM COMES WITH A FILE THAT DEFINES THE PEN     Complot
STROKES REQUIRED TO DRAW ALL CHARACTERS ON AN IBM KEYBOARD (UPPER   Complot
AND LOWER CASE CHARACTERS, NUMBERS, ETC.) PLUS AN ALTERNATE SET OF Complot
ALL UPPER AND LOWER CASE GREEK CHARACTERS AND ADDITIONAL SPECIAL    Complot
SYMBOLS.                                                           Complot
```

```
                                                                      Complot
THE SOFTWARE CHARACTER TABLE CONTAINS X AND Y AND PEN POSITIONS TO Complot
DRAW EACH CHARACTER. IF YOU WISH TO DRAW ANY ADDITIONAL CHARACTERS Complot
OR TO MODIFY THE FONT OF THE EXISTING CHARACTERS YOU NEED ONLY     Complot
MODIFY THIS TABLE.                                                Complot
                                                                  Complot
CONTROL CHARACTERS                                                Complot
------------------------------------------------------------------ Complot
IN THE SOFTWARE CHARACTER TABLE ALL CHARACTERS TO BE PLOTTED WILL  Complot
HAVE PEN POSITION = 2 (DRAW) OR = 3 (MOVE). IN ADDITION THE TABLE  Complot
CURRENTLY CONTAINS 4 CONTROL CHARACTERS,                          Complot
                                                                  Complot
PEN POSITION = 0                                                  Complot
---------------                                                   Complot
SHIFT THE NEXT PRINTED CHARACTER BY X AND Y. 3 CONTROL CHARACTERS  Complot
ARE PRESENTLY INCLUDED IN THE SOFTWARE CHARACTER TABLE TO ALLOW    Complot
SHIFTING.                                                         Complot
                                                                  Complot
{   = SHIFT UP (FOR SUPERSCRIPTS.............X= 0.0, Y= 0.5)      Complot
}   = SHIFT DOWN (FOR SUBSCRIPTS.............X= 0.0, Y=-0.5)      Complot
\   = SHIFT LEFT 1 CHARACTER (FOR BACKSPACE...X=-1.0, Y= 0.0)     Complot
                                                                  Complot
PEN POSITION =-1                                                  Complot
---------------                                                   Complot
SELECT THE NEXT PRINTED CHARACTER FROM THE ALTERNATE CHARACTER     Complot
SET. AT PRESENT THIS CONTROL CHARACTER IS,                        Complot
                                                                  Complot
]   = SWITCH TO ALTERNATE CHARACTER SET                           Complot
                                                                  Complot
THESE 4 CONTROL CHARACTERS ARE ONLY DEFINED BY THE VALUE OF THE    Complot
PEN POSITION IN THE SOFTWARE CHARACTER TABLE (I.E., THEY ARE NOT   Complot
HARD WIRED INTO THIS PROGRAM). AS SUCH BY MODIFYING THE SOFTWARE   Complot
CHARACTER TABLE THE USER HAS THE OPTION OF DEFINING ANY CONTROL    Complot
CHARACTERS TO MEET SPECIFIC NEEDS.                                Complot
                                                                  Complot
THESE CHARACTERS MAY BE USED IN CHARACTER STRINGS TO PRODUCE       Complot
SPECIAL EFFECTS. FOR EXAMPLE, TO PLOT SUBSCRIPT 5, B, SUPERSCRIPT  Complot
10 USE THE STRING,                                                Complot
                                                                  Complot
}5B{1{0                                                           Complot
                                                                  Complot
TO PLOT B, SUBSCRIPT 5 AND SUPERSCRIPT 10 WITH THE 5 DIRECTLY      Complot
BELOW THE 1 OF THE 10 WE CAN USE THE BACKSPACE CHARACTER TO       Complot
POSITION THE 1 DIRECTLY ABOVE THE 5 USING THE STRING,             Complot
                                                                  Complot
B}5\{1{0                                                          Complot
                                                                  Complot
TO PLOT UPPER CASE GREEK GAMMA FOLLOWED BY THE WORD TOTAL (I.E.,   Complot
RESONANCE TOTAL WIDTH) USE THE STRING.                            Complot
                                                                  Complot
]G TOTAL                                                          Complot
                                                                  Complot
NOTE, WHEN THESE CONTROL CHARACTERS ARE USED THEY ONLY EFFECT THE  Complot
NEXT 1 PRINTED CHARACTER (SEE, ABOVE EXAMPLE OF PLOTTING SUPER-    Complot
SCRIPT 10 WHERE THE SHIFT UP CONTROL CHARACTER WAS USED BEFORE THE Complot
1 AND THEN AGAIN BEFORE THE 0 AND THE BACKSPACE AND SHIFT UP      Complot
CONTROL CHARACTERS WERE USED IN COMBINATION).                     Complot
                                                                  Complot
IF THESE 4 CONTROL CHARACTERS ARE NOT AVAILABLE ON YOUR COMPUTER   Complot
YOU CAN MODIFY THE SOFTWARE CHARACTER TABLE TO USE ANY OTHER 4     Complot
CHARACTERS THAT YOU DO NOT NORMALLY USE IN CHARACTER STRINGS (FOR  Complot
DETAILS SEE THE SOFTWARE CHARACTER TABLE).                        Complot
                                                                  Complot
STANDARD/ALTERNATE CHARACTER SETS                                 Complot
------------------------------------------------------------------ Complot
THE SOFTWARE CHARACTER TABLE CONTAINS 2 SETS OF CHARACTERS WHICH   Complot
ARE A STANDARD SET (ALL CHARACTERS ON AN IBM KEYBOARD) AND AN      Complot
ALTERNATE SET (UPPER AND LOWER CASE GREEK CHARACTERS AND SPECIAL   Complot
CHARACTERS). TO DRAW A CHARACTER FROM THE ALTERNATE CHARACTER SET  Complot
PUT A RIGHT BRACKET CHARACTER (]) BEFORE A CHARACTER (SEE THE      Complot
ABOVE EXAMPLE AND THE SOFTWARE CHARACTER TABLE FOR DETAILS). THIS  Complot
```

```
     CONTROL CHARACTER WILL ONLY EFFECT THE NEXT 1 PLOTTED CHARACTER.   Complot
                                                                        Complot
     SUB AND SUPER SCRIPTS                                              Complot
     ------------------------------------------------------------------ Complot
     TO DRAW SUBSCRIPT PRECEED A CHARACTER BY }. TO DRAW SUPERSCRIPT    Complot
     PRECEED A CHARACTER BY { (SEE THE ABOVE EXAMPLE AND THE SOFTWARE   Complot
     CHARACTER TABLE FOR DETAILS). THESE CONTROL CHARACTER WILL ONLY    Complot
     EFFECT THE NEXT 1 PLOTTED CHARACTER.                               Complot
                                                                        Complot
     BACKSPACING                                                        Complot
     ------------------------------------------------------------------ Complot
     TO BACKSPACE ONE CHARACTER PRECEED A CHARACTER BY \ (SEE, THE      Complot
     ABOVE EXAMPLE AND THE SOFTWARE CHARACTER TABLE FOR DETAILS). THIS  Complot
     CONTROL CHARACTER WILL PERFORM A TRUE BACKSPACE AND WILL EFFECT    Complot
     ALL FOLLOWING CHARACTERS IN THE SAME CHARACTER STRING.             Complot
                                                                        Complot
     PLOT DIMENSIONS                                                    Complot
     ---------------                                                    Complot
     ARE DEFINED BY USER INPUT. INTERNALLY THE PROGRAM WILL CREATE A    Complot
     PLOT IN APPROXIMATELY A4 OR 8-1/2 BY 11 INCH FORMAT. DURING        Complot
     OUTPUT THE PLOT IS TRANSFORMED TO THE UNITS (INCHES, CENTIMETERS,  Complot
     MILLIMETERS, WHATEVER) OF THE PLOTTER BEING USED AND OUTPUT.       Complot
                                                                        Complot
===== PLOTTER/GRAPHICS TERMINAL INTERFACE ============================== Complot
======================================================================== Complot
```

```
====================================================================== Convert
                                                                       Convert
     PROGRAM CONVERT                                                   Convert
     VERSION 75-1 (APRIL 1975)                                         Convert
     VERSION 78-1 (JANUARY 1978)                                       Convert
     VERSION 80-1 (AUGUST 1980)  IBM VERSION                           Convert
     VERSION 80-2 (DECEMBER 1980)                                      Convert
     VERSION 82-1 (JANUARY 1982)                                       Convert
     VERSION 83-1 (JANUARY 1983)                                       Convert
     VERSION 86-1 (JANUARY 1986)*NEW PROGRAM                           Convert
                               *FORTRAN-77/H VERSION                   Convert
                               *MULTIPLE INPUT OPTIONS                 Convert
     VERSION 88-1 (AUGUST 1988) *OPTION...INTERNALLY DEFINE ALL I/O    Convert
                                 FILE NAMES (SEE, SUBROUTINE FILEIO    Convert
                                 FOR DETAILS).                         Convert
                               *IMPROVED BASED ON USER COMMENTS.       Convert
                               *ADDED NAMES OPTION TO TURN ON/OFF      Convert
                                STANDARD FILE NAMES.                   Convert
                               *ADDED REWIND OPTION TO TURN ON/OFF     Convert
                                REWIND AT START OF PROGRAMS.           Convert
                               *DELETED HARWELL AND JAERI OPTIONS      Convert
                                (PREVIOUSLY ONLY REQUIRED FOR GRAPHIC  Convert
                                INTERFACE. NO LONGER REQUIRED).        Convert
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO    Convert
                                 INSURE PROGRAM WILL NOT DO ANYTHING   Convert
                                 CRAZY.                                Convert
                               *IMPROVED BASED ON USER COMMENTS.       Convert
                               *ADDED LIVERMORE CIVIC COMPILER         Convert
                                CONVENTIONS.                           Convert
                               *UPDATED TO USE NEW PROGRAM CONVERT     Convert
                                KEYWORDS.                              Convert
                               *ADDED ENDFILE OPTION TO OPTIONALLY     Convert
                                ALLOW END OF FILE TO BE WRITTEN        Convert
     VERSION 91-1 (JUNE 1991)   *ADDED FORTRAN SAVE OPTION             Convert
     VERSION 92-1 (JANUARY 1992)*ADDED ACTION OPTION - TO CONTROL      Convert
                                 INTERACTIVE INPUT TO CODES            Convert
                               *ADDED BLANK DELIMITED KEYWORD INPUT    Convert
                                (REPLACES EARLIER FIXED FIELD INPUT)   Convert
                               *WARNING...THE INPUT PARAMETER FORMAT   Convert
                                HAS BEEN GENERALIZED - FOR DETAILS     Convert
                                SEE BELOW.                             Convert
     VERSION 94-1 (JANUARY 1994)*VARIABLE PROGRAM FILENAMES            Convert
                                 TO ALLOW ACCESS TO FILE STRUCTURES     Convert
                                 (WARNING - INPUT PARAMETER FORMAT     Convert
                                 HAS BEEN CHANGED)                     Convert
                               *CLOSE ALL FILES BEFORE TERMINATING     Convert
                                (SEE, SUBROUTINE ENDIT)                Convert
                               *ADDED KEYWORD CLOSE.                   Convert
     VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                    Convert
                                 *IMPROVED COMPUTER INDEPENDENCE       Convert
                                 *ALL DOUBLE PRECISION                 Convert
                                 *ON SCREEN OUTPUT                     Convert
     VERSION 99-1 (MARCH 1999)   *GENERAL IMPROVEMENTS BASED ON        Convert
                                  USER FEEDBACK                        Convert
     VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON        Convert
                                  USER FEEDBACK                        Convert
     VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS            Convert
     VERS. 2004-1 (MARCH 2004)   *GENERAL UPDATE                       Convert
                                                                       Convert
     OWNED, MAINTAINED AND DISTRIBUTED BY                              Convert
     ------------------------------------                              Convert
     THE NUCLEAR DATA SECTION                                          Convert
     INTERNATIONAL ATOMIC ENERGY AGENCY                                Convert
     P.O. BOX 100                                                      Convert
     A-1400, VIENNA, AUSTRIA                                           Convert
     EUROPE                                                            Convert
                                                                       Convert
     ORIGINALLY WRITTEN BY                                             Convert
     ---------------------------------                                 Convert
     DERMOTT E. CULLEN                                                 Convert
     UNIVERSITY OF CALIFORNIA                                          Convert
```

```
LAWRENCE LIVERMORE NATIONAL LABORATORY                                  Convert
L-159                                                                   Convert
P.O. BOX 808                                                            Convert
LIVERMORE, CA 94550                                                     Convert
U.S.A.                                                                  Convert
TELEPHONE  925-423-7359                                                 Convert
E. MAIL    CULLEN1@LLNL.GOV                                             Convert
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                                  Convert
                                                                        Convert
AUTHORS MESSAGE                                                         Convert
---------------                                                         Convert
THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENATION         Convert
FOR THIS PROGRAM INCLUDING ALL RECENT IMPROVEMENTS. PLEASE READ         Convert
ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY THE           Convert
COMMENTS CONCERNING COMPUTER DEPENDENT CODING.                          Convert
                                                                        Convert
AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER      Convert
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE          Convert
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT      Convert
IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY            Convert
COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO       Convert
IMPROVE THIS PROGRAM. IN PARTICULAR IF YOUR FORTRAN COMPILER, OR        Convert
COMPUTER HAS A SET OF REQUIREMENTS THAT ARE DIFFERENT FROM THOSE        Convert
OF CDC, CRAY OR IBM PLEASE NOTIFY THE AUTHOR AND THIS PROGRAM WILL      Convert
BE MODIFIED TO CONSIDER YOUR COMPUTER SEPERATELY. HOWEVER, IN           Convert
ORDER TO PREVENT A PROLIFERATION OF CODING IT IS IMPERATIVE THAT        Convert
YOU IDENTIFY EXACTLY HOW YOUR FORTRAN COMPILER OR COMPUTER DIFFERS      Convert
FROM THOSE ALREADY CONSIDERED BY THIS PROGRAM. HOPEFULLY,IN THIS        Convert
WAY FUTURE VERSIONS OF THIS PROGRAM WILL BE COMPLETELY COMPATIBLE       Convert
FOR USE ON YOUR COMPUTER.                                               Convert
                                                                        Convert
PURPOSE                                                                 Convert
-------                                                                 Convert
THIS PROGRAM IS DESIGNED TO AUTOMATICALLY CONVERT FORTRAN PROGRAMS      Convert
FOR USE ON ANY ONE OF A VARIETY OF,                                     Convert
(1) COMPUTERS                                                           Convert
(2) COMPILERS                                                           Convert
(3) PRECISIONS (SINGLE OR DOUBLE PRECISION)                             Convert
(4) INSTALLATIONS                                                       Convert
(5) STANDARD OR NON-STANDARD FILE NAMES                                 Convert
                                                                        Convert
FORTRAN CODING CONVENTIONS                                              Convert
--------------------------                                              Convert
THIS PROGRAM MAY BE USED TO CONVERT ANY PROGRAM WHICH USES THE          Convert
FOLLOWING CONVENTIONS.                                                  Convert
                                                                        Convert
ALL FORTRAN STATEMENTS THAT DEPEND ON ANY COMBINATION OF COMPUTER,      Convert
COMPILER, PRECISION AND/OR INSTALLATION AND STANDARD FILE NAMES         Convert
SHOULD BE PRECEDED AND FOLLOWED BY A COMMENT LINE THAT CONTAINS,        Convert
                                                                        Convert
C***** DOUBLE ****** ACTIVATE DOUBLE PRECISION (DEFAULT)                Convert
C***** SINGLE ****** ACTIVATE SINGLE PRECISION                          Convert
C***** CHARACTER *** TREAT CHARACTER ARRAYS AS CHARACTERS(DEFAULT)       Convert
C***** INTEGER ***** TREAT CHARACTER ARRAYS AS INTEGERS                  Convert
C***** STOP ******** ACTIVATE STOP TO TERMINATE PROGRAM                  Convert
C***** EXIT ******** ACTIVATE EXIT TO TERMINATE PROGRAM                  Convert
C***** PROGRAM ***** ACTIVATE PROGRAM LINE AND CONTINUATIONS             Convert
C***** NAMES ******* ACTIVATE STANDARD FILENAMES                        Convert
C***** REWIND ****** ACTIVATE REWIND FILES AT START OF PROGRAM          Convert
C***** ENDFILE ***** ACTIVATE ENDFILE AT END OF PROGRAM                 Convert
C***** CIVIC ******* ACTIVATE LIVERMORE CIVIC COMPILER CONVENTIONS      Convert
C***** NOID ******** REMOVE LINE ID IN COLUMNS 73-80 (73-80=BLANK)      Convert
C***** SAVE ******** SAVE VARIABLES BETWEEN SUBROUTINE CALLS            Convert
C***** ACTION ****** ACTIVATE INTERACTIVE INPUT TO CODES                Convert
C***** CLOSE ******* ACTIVATE CLOSE ALL FILES BEFORE TERMINATING        Convert
                                                                        Convert
IF THE USER DOES NOT SELECT,                                            Convert
(1) DOUBLE OR SINGLE      - THE PROGRAM WILL ACTIVATE DOUBLE            Convert
(2) CHARACTER OR INTEGER  - THE PROGRAM WILL ACTIVATE CHARACTER         Convert
(3) STOP OR EXIT          - THE PROGRAM WILL ACTIVATE STOP              Convert
                                                                        Convert
```

```
 IF THE USER SELECTS,                                                  Convert
 (1) DOUBLE AND SINGLE     - THE PROGRAM WILL ACTIVATE DOUBLE          Convert
 (2) CHARACTER AND INTEGER - THE PROGRAM WILL ACTIVATE CHARACTER       Convert
 (3) STOP AND EXIT         - THE PROGRAM WILL ACTIVATE STOP            Convert
                                                                       Convert
 IF THE USER DOES NOT SELECT PROGRAM, NAMES, REWIND, ENDFILE,          Convert
 CIVIC, NOID, SAVE OR ACTION THESE OPTIONS WILL BE TURNED OFF.         Convert
                                                                       Convert
 WHERE CODING IS COMPUTER OR COMPILER DEPENDENT CODING WILL BE         Convert
 PRESENT FOR ALL POSSIBLE OPTIONS. THIS PROGRAM WILL ALLOW THE         Convert
 THE USER TO CONVERT PROGRAMS FOR USE WITH ANY COMBINATION OF          Convert
 OPTIONS. FOR EXAMPLES OF HOW THIS CONVENTION IS USED SEE THE          Convert
 LISTING OF THIS PROGRAM AND THE COMMENTS BELOW ON COMPUTER            Convert
 DEPENDENT CODING.                                                     Convert
                                                                       Convert
 INPUT LINES                                                           Convert
 -----------                                                           Convert
   LINE   COLS.  DESCRIPTION                                           Convert
   ----   -----  ------------------------------------                 Convert
      1   1-72   BLANK DELIMITED KEYWORDS                             Convert
      2   1-60   ENDF/B INPUT DATA FILENAME                           Convert
                 (STANDARD OPTION = ENDFB.IN)                          Convert
      3   1-60   ENDF/B OUTPUT DATA FILENAME                          Convert
                 (STANDARD OPTION = ENDFB.OUT)                         Convert
                                                                       Convert
*THE FIRST INPUT LINE IS 72 CHARACTERS.                                Convert
*KEYWORDS MAY BE LOCATED ANYWHERE WITHIN THESE 72 CHARACTERS           Convert
*THERE MAY BE ANY NUMBER OF KEYWORDS INPUT                             Convert
*EACH KEYWORD MUST BE BLANK DELIMITED, E.G., DOUBLE CHARACTER          Convert
 IS LEGAL INPUT - DOUBLECHARACTER IS NOT LEGAL INPUT.                  Convert
*THERE MUST BE ONE OR MORE BLANKS BETWEEN KEYWORDS                     Convert
                                                                       Convert
*NOTE, THIS NEW INPUT PARAMETER FORMAT (VERSION 92-1) IS COMPLETELY    Convert
 COMPATIBLE WITH THE OLDER FIXED FIELD FORMAT. SO THAT IF YOU HAVE     Convert
 INPUT THAT YOU HAVE USED IN THE PAST YOU CAN CONTINUE TO USE IT.      Convert
                                                                       Convert
 LEGAL KEYWORDS INCLUDE,                                               Convert
                                                                       Convert
 DOUBLE        ACTIVATE DOUBLE PRECISION (DEFAULT)                     Convert
 SINGLE        ACTIVATE SINGLE PRECISION                               Convert
 CHARACTER     TREAT CHARACTER ARRAYS AS CHARACTERS(DEFAULT)           Convert
 INTEGER       TREAT CHARACTER ARRAYS AS INTEGERS                      Convert
 PROGRAM       ACTIVATE PROGRAM LINE AND CONTINUATIONS                 Convert
 NAMES         ACTIVATE STANDARD FILENAMES                             Convert
 REWIND        ACTIVATE REWIND FILES AT START OF PROGRAM               Convert
 ENDFILE       ACTIVATE ENDFILE AT END OF PROGRAM                      Convert
 CIVIC         ACTIVATE LIVERMORE CIVIC COMPILER CONVENTIONS           Convert
 NOID          REMOVE LINE ID IN COLUMNS 73-80 (73-80=BLANK)           Convert
 SAVE          SAVE VARIABLES BETWEEN SUBROUTINE CALLS                 Convert
 ACTION        ACTIVATE INTERACTIVE INPUT FOR CODES                    Convert
 CLOSE         ACTIVATE CLOSE ALL FILES BEFORE TERMINATING             Convert
                                                                       Convert
 EXAMPLE INPUT NO. 1                                                   Convert
 -------------------                                                   Convert
 TO USE A PROGRAM IN SINGLE PRECISION, USE THE STANDARD FILE NAMES,    Convert
 REWIND ALL UNITS AT THE START OF THE PROGRAM AND TREAT CHARACTER      Convert
 ARRAYS AS CHARACTER (FORTRAN-77 CONVENTION).                          Convert
                                                                       Convert
 READ  \PREPRO93\RECENT\RECENT.OLD AND                                 Convert
 WRITE \PREPRO93\RECENT\RECENT.NEW                                     Convert
                                                                       Convert
 THE FOLLOWING 3 INPUT LINES ARE REQUIRED,                             Convert
                                                                       Convert
 SINGLE NAMES REWIND CHARACTER                                         Convert
 \PREPRO93\RECENT\RECENT.OLD                                           Convert
 \PREPRO93\RECENT\RECENT.NEW                                           Convert
                                                                       Convert
 NOTE, SINCE CHARACTER IS THE STANDARD OPTION THE KEYWORD CHARACTER    Convert
 NEED NOT APPEAR ON THE ABOVE INPUT LINE.                              Convert
                                                                       Convert
 EXAMPLE INPUT NO. 2                                                   Convert
```

```
------------------                                                      Convert
TO USE A PROGRAM IN DOUBLE PRECISION AND TREAT ALL CHARACTER            Convert
ARRAYS AS INTEGER (FORTRAN-H CONVENTION).                               Convert
                                                                        Convert
USE THE STANDARD FILENAMES TO READ = CONVERT.IN AND WRITE =             Convert
CONVERT.OUT (THIS CAN BE DONE BY LEAVING THE SECOND AND THIRD           Convert
INPUT LINES BLANK).                                                     Convert
                                                                        Convert
THE FOLLOWING 3 INPUT LINES ARE REQUIRED,                               Convert
                                                                        Convert
DOUBLE  INTEGER                                                         Convert
(NOTE, THIS IS A BLANK LINE)                                            Convert
(NOTE, THIS IS A BLANK LINE)                                            Convert
                                                                        Convert
NOTE, SINCE DOUBLE IS THE STANDARD OPTION THE KEYWORD DOUBLE            Convert
NEED NOT APPEAR ON THE ABOVE INPUT LINE.                                Convert
                                                                        Convert
EXAMPLE INPUT NO. 3                                                     Convert
------------------                                                      Convert
TO ACTIVATE THE PROGRAM LINE, USE DOUBLE PRECISION AND TREAT ALL        Convert
CHARACTER ARRAYS AS CHARACTER.                                          Convert
                                                                        Convert
                                                                        Convert
READ  \PREPRO93\RECENT\RECENT.OLD AND                                   Convert
WRITE THE STANDARD FILENAME = CONVERT.OUT (LEAVE THE THIRD INPUT        Convert
LINE BLANK).                                                            Convert
                                                                        Convert
THE FOLLOWING 3 INPUT LINES ARE REQUIRED,                               Convert
                                                                        Convert
PROGRAM                                                                 Convert
\PREPRO93\RECENT\RECENT.OLD                                             Convert
(NOTE, THIS IS A BLANK LINE)                                            Convert
                                                                        Convert
NOTE, SINCE DOUBLE, CHARACTER AND EXIT ARE THE STANDARD OPTIONS         Convert
THEY NEED NOT APPEAR ON THE ABOVE INPUT LINE AND IN THIS EXAMPLE        Convert
HAVE BEEN OMITTED.                                                      Convert
                                                                        Convert
WARNING                                                                 Convert
-------                                                                 Convert
(1) THE PROGRAM WILL ALWAYS ACTIVATE DOUBLE OR SINGLE, CHARACTER        Convert
OR INTEGER (AS DESCRIBED ABOVE).                                        Convert
                                                                        Convert
(2) CODING IN THE PROGRAM FOR ANY KEYWORDS THAT ARE NOT ACTIVATED       Convert
WILL BE CONVERTED TO COMMENT LINES AND AS SUCH WILL EFFECTIVELY         Convert
DISAPPEAR FROM THE PROGRAM. THEREFORE IF THE KEYWORDS PROGRAM,          Convert
NAMES, REWIND, ENDFILE, CIVIC OR NOID ARE NOT INPUT BY THE USER         Convert
THESE OPTIONS WILL BE TURNED OFF AND ANY CODING USING THESE             Convert
KEYWORDS WILL EFFECTIVELY DISAPPEAR FROM THE PROGRAM.                   Convert
                                                                        Convert
(3) THE SERIES OF CODES THAT ARE DESIGNED TO BE AUTOMATICALLY           Convert
TRANSLATED BY THIS PROGRAM REQUIRE THAT ALL CALCULATIONS BE             Convert
PERFORMED IN DOUBLE PRECISION ON SHORT WORD LENGTH COMPUTERS            Convert
(E.G., IBM COMPUTERS). THIS PROGRAM WILL ALLOW YOU TO SPECIFY           Convert
EITHER DOUBLE OR SINGLE PRECISION. HOWEVER, IF YOU SPECIFY              Convert
SINGLE PRECISION THIS PROGRAM WILL PRINT A WARNING MESSAGE THAT         Convert
THE CONVERTED PROGRAM SHOULD ONLY BE USED ON LONG WORD LENGTH           Convert
COMPUTERS (E.G., CDC COMPUTERS).                                        Convert
                                                                        Convert
PROGRAM OPERATION                                                       Convert
-----------------                                                       Convert
THE PROGRAM WILL SEARCH FOR COMMENT LINES THAT START WITH C**           Convert
IN COLUMNS 1-3 FOLLOWED BY ANY ONE OF THE ALLOWED KEYWORDS              Convert
IF THE KEYWORD IS THE SAME AS ONE OF THE KEYWORDS INPUT BY              Convert
THE USER ALL LINES UP TO THE NEXT LINE WITH C** IN COLUMNS 1-3          Convert
FOLLOWED BY THE SAME KEYWORD WILL BE SET ACTIVE BY SETTING COLUMN       Convert
1 TO BLANK. IF THE KEYWORDS DIFFERS FROM THAT INPUT BY THE USER         Convert
ALL LINES UP TO THE NEXT LINE WITH C** IN COLUMNS 1-3 FOLLOWED BY       Convert
THE SAME KEYWORD WILL BE SET INACTIVE BY SETTING COLUMN 1 TO C.         Convert
                                                                        Convert
KEYWORDS MAY NOT BE NESTED (I.E., THIS PROGRAM WILL ONLY OPERATE        Convert
PROPERLY IF KEYWORDS APPEAR IN PAIRS. ONCE A LINE IS FOUND THAT         Convert
```

```
     CONTAINS A KEYWORD, THE NEXT LINE THAT CONTAINS A KEYWORD MUST     Convert
     CONTAIN THE SAME KEYWORD).                                         Convert
                                                                        Convert
     PROGRAM LINE                                                       Convert
     ------------                                                       Convert
     THE FORTRAN FILE MAY START WITH A PROGRAM LINE AND CONTINUATIONS.  Convert
     FOR USE ON CDC-7600 OR CRAY-1 COMPUTERS THIS PROGRAM CAN ACTIVATE  Convert
     THE PROGRAM LINE AND CONTINUATION LINES. FOR USE ON OTHER TYPES OF Convert
     COMPUTERS THIS PROGRAM WILL AUTOMATICALLY DE-ACTIVATE THE PROGRAM  Convert
     LINE AND CONTINUATION LINES. THIS CONVENTIONS HAS BEEN INTRODUCED  Convert
     BECAUSE SOME CDC-7600 COMPILERS CONSIDER IT AN ERROR IF THE FIRST  Convert
     LINE IS NOT A PROGRAM LINE. PRECEEDING COMMENT LINES ARE NOT       Convert
     ALLOWED. THEREFORE THE NORMAL CONVENTION, DESCRIBED ABOVE, OF      Convert
     USING PRECEDING AND FOLLOWING COMMENT LINES, CANNOT BE USED AT     Convert
     THE BEGINNING OF THE PROGRAM.                                      Convert
                                                                        Convert
     COMMENT LINES                                                      Convert
     -------------                                                      Convert
     COMMENT LINES MAY APPEAR ON LINES BETWEEN PAIRS OF KEYWORD LINES   Convert
     ONLY IF THE COMMENT LINES CONTAINS C-- IN COLUMS 1-3. ANY LINE     Convert
     THAT CONTAINS ANYTHING ELSE IN COLUMNS 1-3 MAY BE ACTIVATED        Convert
     BY THIS PROGRAM BY SETTING COLUMN 1 BLANK AND CAN LEAD TO ERRORS   Convert
     DURING COMPILATION AND/OR EXECUTION.                               Convert
                                                                        Convert
     INPUT FILES                                                        Convert
     -----------                                                        Convert
     UNIT  DESCRIPTION                                                  Convert
     ----  -----------                                                  Convert
       2   INPUT LINE (BCD - 80 CHARACTERS/RECORD)                      Convert
      10   ORIGINAL PROGRAM (BCD - 80 CHARACTERS/RECORD)                Convert
                                                                        Convert
     OUTPUT FILES                                                       Convert
     ------------                                                       Convert
     UNIT  DESCRIPTION                                                  Convert
     ----  -----------                                                  Convert
       3   OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)                  Convert
      11   RE-FORMATTED PROGRAM (BCD - 80 CHARACTERS/RECORD)            Convert
                                                                        Convert
     OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILIO1 AND FILIO2)    Convert
     ---------------------------------------------------------------    Convert
     UNIT  FILE NAME                                                    Convert
     ----  ----------                                                   Convert
       2   CONVERT.INP                                                  Convert
       3   CONVERT.LST                                                  Convert
      10   CONVERT.IN                                                   Convert
      11   CONVERT.OUT                                                  Convert
                                                                        Convert
===========================================================================Convert
```

```
C======================================================================C Dictin
C                                                                      C Dictin
C     PROGRAM DICTIN (Renamed from DICTION to eliminate conflict with  C Dictin
C                     UNIX diction command - 12/22/02)                 C Dictin
C     ==============                                                   C Dictin
C     VERSION 81-1 (SEPTEMBER 1981)                                    C Dictin
C     VERSION 82-1 (JANUARY 1982)                                      C Dictin
C     VERSION 83-1 (JANUARY 1983)  *KEEP ORIGINAL MOD. NUMBER          C Dictin
C                                  *NEW, MORE COMPATIBLE I/O UNITS.    C Dictin
C     VERSION 84-1 (SEPTEMBER 1984)*UPDATED TO HANDLE ENDF/B-VI FORMAT.C Dictin
C                                   (PROGRAM WILL NOW WORK ON ALL      C Dictin
C                                    VERSIONS OF THE ENDF/B FORMAT).   C Dictin
C     VERSION 85-1 (AUGUST 1985)   *FORTRAN-77/H VERSION               C Dictin
C     VERSION 86-1 (JANUARY 1986)  *MAT ORDER CHECK.                   C Dictin
C                                  *IF NO HOLLERITH SECTION COPY MAT.  C Dictin
C     VERSION 88-1 (JULY 1988)     *OPTION...INTERNALLY DEFINE ALL I/O  C Dictin
C                                   FILE NAMES (SEE, SUBROUTINE FILEIO C Dictin
C                                   FOR DETAILS).                      C Dictin
C                                  *IMPROVED BASED ON USER COMMENTS.   C Dictin
C     VERSION 89-1 (JANUARY 1989)  *PSYCHOANALYZED BY PROGRAM FREUD TO C Dictin
C                                   INSURE PROGRAM WILL NOT DO ANYTHING Dictin
C                                   CRAZY.                             C Dictin
C                                  *IMPROVED BASED ON USER COMMENTS.   C Dictin
C                                  *ADDED LIVERMORE CIVIC COMPILER     C Dictin
C                                   CONVENTIONS.                       C Dictin
C                                  *UPDATED TO USE NEW PROGRAM CONVERT C Dictin
C                                   KEYWORDS.                          C Dictin
C     VERSION 92-1 (JANUARY 1992)  *UPDATED BASED ON USER COMMENTS.    C Dictin
C                                  *UP TO 6000 SECTIONS PER TAPE.      C Dictin
C                                  *CHANGED DEFAULT MOD NUMBER FOR NEW C Dictin
C                                   SECTIONS FROM 0 TO 1               C Dictin
C     VERSION 94-1 (JANUARY 1994)  *VARIABLE ENDF/B DATA FILENAMES     C Dictin
C                                   TO ALLOW ACCESS TO FILE STRUCTURES C Dictin
C                                   (WARNING - INPUT PARAMETER FORMAT  C Dictin
C                                   HAS BEEN CHANGED)                  C Dictin
C                                  *CLOSE ALL FILES BEFORE TERMINATING C Dictin
C                                   (SEE, SUBROUTINE ENDIT)            C Dictin
C                                  *ADDED FORTRAN SAVE OPTION          C Dictin
C     VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                   C Dictin
C                                 *IMPROVED COMPUTER INDEPENDENCE      C Dictin
C                                 *ALL DOUBLE PRECISION                C Dictin
C                                 *ON SCREEN OUTPUT                    C Dictin
C                                 *UNIFORM TREATMENT OF ENDF/B I/O     C Dictin
C                                 *IMPROVED OUTPUT PRECISION           C Dictin
C     VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING     C Dictin
C                                  POINT READ FOR MORE DIGITS          C Dictin
C                                 *UPDATED TEST FOR ENDF/B FORMAT      C Dictin
C                                  VERSION BASED ON RECENT FORMAT CHANGEDictin
C                                 *GENERAL IMPROVEMENTS BASED ON       C Dictin
C                                  USER FEEDBACK                       C Dictin
C     VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON       C Dictin
C                                  USER FEEDBACK                       C Dictin
C     VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS           C Dictin
C                                 *RENAMED dictin TO ELIMINATE CONFLICT C Dictin
C                                  WITH UNIX diction COMMAND.          C Dictin
C                                 *ADDED DOCUMENTATION LINE TO COMMENTS.Dictin
C     VERS. 2004-1 (JAN. 2004)    *GENERAL UPDATE BASED ON USER FEEDBACK Dictin
C                                 *UP TO 100,000 SECTIONS PER TAPE.    C Dictin
C                                                                      C Dictin
C     OWNED, MAINTAINED AND DISTRIBUTED BY                             C Dictin
C     ------------------------------------                             C Dictin
C     THE NUCLEAR DATA SECTION                                         C Dictin
C     INTERNATIONAL ATOMIC ENERGY AGENCY                               C Dictin
C     P.O. BOX 100                                                     C Dictin
C     A-1400, VIENNA, AUSTRIA                                          C Dictin
C     EUROPE                                                           C Dictin
C                                                                      C Dictin
C     ORIGINALLY WRITTEN BY                                            C Dictin
C     ---------------------------------                                C Dictin
C     DERMOTT E. CULLEN                                                C Dictin
C     UNIVERSITY OF CALIFORNIA                                         C Dictin
```

```
LAWRENCE LIVERMORE NATIONAL LABORATORY                                  Dictin
L-159                                                                   Dictin
P.O. BOX 808                                                            Dictin
LIVERMORE, CA 94550                                                     Dictin
U.S.A.                                                                  Dictin
TELEPHONE  925-423-7359                                                 Dictin
E. MAIL    CULLEN1@LLNL.GOV                                             Dictin
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                                  Dictin
                                                                        Dictin
AUTHORS MESSAGE                                                         Dictin
---------------                                                         Dictin
THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENATION         Dictin
FOR THIS PROGRAM INCLUDING ALL RECENT IMPROVEMENTS. PLEASE READ         Dictin
ALL OF THESE COMMENTS BEFORE IMPLEMENTATION.                            Dictin
                                                                        Dictin
AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER      Dictin
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE          Dictin
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT      Dictin
IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY            Dictin
COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO       Dictin
IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF         Dictin
THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR              Dictin
COMPUTER.                                                               Dictin
                                                                        Dictin
PURPOSE                                                                 Dictin
-------                                                                 Dictin
THIS PROGRAM IS DESIGNED TO CREATE A REACTION INDEX FOR EACH            Dictin
MATERIAL ON AN ENDF/B FORMATTED TAPE AND TO INSERT THIS REACTION        Dictin
INDEX IN FILE 1, SECTION 451 OF EACH MATERIAL.                          Dictin
                                                                        Dictin
IN THE DESCRIPTION THAT FOLLOWS FOR SIMPLICITY THE ENDF/B               Dictin
TERMINOLOGY---ENDF/B TAPE---WILL BE USED. IN FACT THE ACTUAL            Dictin
MEDIUM MAY BE TAPE, CARDS, DISK, OR ANY OTHER MEDIUM.                   Dictin
                                                                        Dictin
ENDF/B FORMAT                                                           Dictin
-------------                                                           Dictin
THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS          Dictin
OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION        Dictin
OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT).      Dictin
                                                                        Dictin
THIS PROGRAM WILL AUTOMATICALLY DETERMINE WHICH VERSION OF THE          Dictin
ENDF/B FORMAT EACH MAT IS IN AND WILL THEN PROPERLY REPLACE THE         Dictin
REACTION INDEX FOR EACH MAT. DIFFERENT MATS ON THE SAME TAPE MAY        Dictin
EVEN BE IN DIFFERENT VERSIONS OF THE ENDF/B FORMAT.                     Dictin
                                                                        Dictin
IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B            Dictin
FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS          Dictin
ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE       Dictin
NUMBERS (COLUMNS 76-80) NEED NOT BE PRESENT ON INPUT, BUT WILL BE       Dictin
CORRECTLY OUTPUT ON ALL LINES.                                          Dictin
                                                                        Dictin
ENDF/B FORMAT VERSION                                                   Dictin
---------------------                                                   Dictin
THE ENDF/B FORMAT CAN BE DETERMINED FROM THE SECOND LINE OF             Dictin
THE HOLLERITH SECTION (MF=1, MT=451).                                   Dictin
ENDF/B-IV = N1 - LINE COUNT (POSITIVE)                                  Dictin
ENDFB/-V  = N1 = N2 =0                                                  Dictin
ENDF/B-VI = N1 =0, N2= VERSION NUMBER (6 OR MORE)                       Dictin
                                                                        Dictin
SECTION SIZE                                                            Dictin
------------                                                            Dictin
SINCE THIS PROGRAM ONLY READS THE DATA ONE LINE AT A TIME THERE         Dictin
IS NO LIMIT TO THE SIZE OF ANY GIVEN SECTION, E.G. THE TOTAL            Dictin
CROSS SECTION MAY BE DESCRIBED BY 200,000 DATA POINTS.                  Dictin
                                                                        Dictin
NUMBER OF SECTIONS PER TAPE                                             Dictin
---------------------------                                             Dictin
IT IS ASSUMED THAT THE ENDF/B TAPE CONTAINS 100,000 OR FEWER            Dictin
SECTIONS = 100,000 OR FEWER MAT,MF,MT COMBINATIONS. IF THIS LIMIT       Dictin
IS EXCEEDED THIS PROGRAM WILL TERMINATE EXECUTION. IF NEED BE THIS      Dictin
LIMIT CAN EASILY BE CHANGED BY CHANGING THE DIMENSION STATEMENT         Dictin
```

```
    BELOW AND RE-DEFINING THE VARIABLE MAXTAB IN THE BELOW DATA        Dictin
    STATEMENT. ALTERNATIVELY THE ENDF/B TAPE MAY BE DIVIDED INTO A     Dictin
    NUMBER SMALLER TAPES EACH CONTAINING 100,000 OR FEWER SECTIONS.    Dictin
    EACH ENDF/B TAPE CAN THEN RUN THROUGH THIS PROGRAM AND THE OUTPUT  Dictin
    FOR EACH ENDF/B TAPE CAN THEN BE RE-COMBINED (I.E., MERGED BACK    Dictin
    TOGETHER).                                                         Dictin
                                                                       Dictin
    HOLLERITH SECTION                                                  Dictin
    ----------------                                                   Dictin
    IF ANY MATERIAL DOES NOT INITIALLY CONATIN A SECTION MF=1, MT=451  Dictin
    A WARNING MESSAGE WILL BE PRINTED AND THE MATERIAL WILL BE COPIED. Dictin
                                                                       Dictin
    IF ANY MATERIAL INITIALLY CONTAINS A SECTION MF=1, MT=451 A NEW    Dictin
    REACTION INDEX WILL BE CREATED AND INSERTED. THE INITIAL SECTION   Dictin
    MF=1, MT=451 MAY OR MAY NOT CONTAIN A REACTION INDEX.              Dictin
                                                                       Dictin
    IF THE MATERIAL INITIALLY CONTAINS A REACTION INDEX IT WILL BE     Dictin
    USED TO DEFINE THE MOD NUMBER FOR CORRESPONDING SECTIONS IN THE    Dictin
    NEW REACTION INDEX (I.E. IF A SECTION FROM THE ORIGINAL REACTION   Dictin
    INDEX HAS THE SAME MF/MT NUMBERS AS A SECTION IN THE NEW REACTION  Dictin
    INDEX THE MOD NUMBER FROM THE ORIGINAL REACTION INDEX WILL BE USED Dictin
    IN THE NEW REACTION INDEX). OTHERWISE THE MOD NUMBER IN THE NEW    Dictin
    REACTION INDEX WILL BE SET EQUAL TO ZERO.                          Dictin
                                                                       Dictin
    PROGRAM OPERATION                                                  Dictin
    -----------------                                                  Dictin
    THE ENTIRE ENDF/B TAPE IS FIRST READ AND A DICTIONARY ENTRY IS     Dictin
    CREATED FOR EACH SECTION OF THE TAPE. THE ENDF/B TAPE IS THEN      Dictin
    REWOUND AND READ A SECOND TIME. DURING THIS SECOND PASS THE        Dictin
    DICTIONARY OF EACH MAT IS REPLACED. THIS VERSION OF DICTIN         Dictin
    DOES NOT USE SCRATCH FILES AND IS MORE EFFICIENT THAN EARLIER      Dictin
    VERSIONS OF DICTIN.                                                Dictin
                                                                       Dictin
    INPUT LINES                                                        Dictin
    -----------                                                        Dictin
      LINE   COLS.  DESCRIPTION                                        Dictin
      ----   -----  ------------------------------                     Dictin
         1   1-60   ENDF/B INPUT DATA FILENAME                         Dictin
                    (STANDARD OPTION = ENDFB.IN)                       Dictin
         2   1-60   ENDF/B OUTPUT DATA FILENAME                        Dictin
                    (STANDARD OPTION = ENDFB.OUT)                      Dictin
                                                                       Dictin
    EXAMPLE INPUT NO. 1                                                Dictin
    -------------------                                                Dictin
    READ \ENDFB6\K300\ENDFB.IN AND WRITE \ENDFB\K300\ENDFB.OUT. THE    Dictin
    FOLLOWING 2 INPUT LINES ARE REQUIRED,                              Dictin
                                                                       Dictin
\ENDFB6\K300\ENDFB.IN                                                  Dictin
\ENDFB6\K300\ENDFB.OUT                                                 Dictin
                                                                       Dictin
    EXAMPLE INPUT NO. 2                                                Dictin
    -------------------                                                Dictin
    USE THE DEFAULT FILENAMES TO READ ENDFB.IN AND WRITE ENDFB.OUT.    Dictin
    2 BLANK INPUT LINES ARE REQUIRED                                   Dictin
                                                                       Dictin
    INPUT FILES                                                        Dictin
    -----------                                                        Dictin
    UNIT  DESCRIPTION                                                  Dictin
    ----  -----------                                                  Dictin
       2  INPUT PARAMETERS (BCD - 80 CHARACTERS/RECORD)                Dictin
      10  ORIGINAL TAPE OF ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)    Dictin
                                                                       Dictin
    OUTPUT FILES                                                       Dictin
    ------------                                                       Dictin
    UNIT  DESCRIPTION                                                  Dictin
    ----  -----------                                                  Dictin
       3  OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)                  Dictin
      11  FINAL TAPE OF ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)       Dictin
                                                                       Dictin
    OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILIO1 AND FILIO2)    Dictin
    ------------------------------------------------------------       Dictin
```

```
     UNIT  FILE NAME                                                    Dictin
     ----  ----------                                                   Dictin
       2   DICTIN.INP                                                   Dictin
       3   DICTIN.LST                                                   Dictin
      10   ENDFB.IN                                                     Dictin
      11   ENDFB.OUT                                                    Dictin
                                                                        Dictin
==========================================================================Dictin
```

```
====================================================================== Evalplot
                                                                       Evalplot
     PROGRAM EVALPLOT                                                  Evalplot
     VERSION 75-1 (AUGUST 1975)                                        Evalplot
     VERSION 76-1 (JULY 1976)                                          Evalplot
     VERSION 77-1 (APRIL 1977)                                         Evalplot
     VERSION 78-1 (JULY 1978)                                          Evalplot
     VERSION 79-1 (FEBRUARY 1979)                                      Evalplot
     VERSION 80-1 (JULY 1980)    *IBM VERSION                          Evalplot
     VERSION 80-2 (DECEMBER 1980)                                      Evalplot
     VERSION 81-1 (MARCH 1981)                                         Evalplot
     VERSION 81-2 (AUGUST 1981)  *IMPROVED ZOOM CAPABILITY             Evalplot
     VERSION 82-1 (JANUARY 1982) *IMPROVED COMPUTER COMPATIBILITY       Evalplot
     VERSION 83-1 (JANUARY 1983) *ELIMINATED COMPUTER DEPENDENT CODING. Evalplot
     VERSION 83-2 (OCTOBER 1983) *ADDED PLOTTING OF HISTOGRAM DATA.     Evalplot
     VERSION 84-1 (DECEMBER 1984)*ADDED PLOTS OF LEGENDRE COEFFICENTS   Evalplot
                                  AS A FUNCTION OF ENERGY.             Evalplot
                                 *ADDED SMALL PLOTTING MODE.           Evalplot
     VERSION 85-1 (AUGUST 1985)  *FORTRAN-77/H VERSION                 Evalplot
     VERSION 86-1 (JANUARY 1986) *ENDF/B-VI FORMAT                     Evalplot
     VERSION 88-1 (JULY 1988)    *MAJOR REVISION TO MAKE CODE EASILY    Evalplot
                                  INTERFACEABLE TO ALMOST ANY PLOTTER.  Evalplot
                                 *WARNING...INPUT PARAMETERS FROM BEEN  Evalplot
                                  CHANGED (SEE, DESCRIPTION BELOW)     Evalplot
                                 *COMPUTER INDEPENDENT SOFTWARE         Evalplot
                                  CHARACTERS.                          Evalplot
                                 *COLOR PLOTS.                         Evalplot
                                 *MT NUMBER DEFINITIONS FROM DATA FILE  Evalplot
                                  READ BY PROGRAM                      Evalplot
                                 *FORTRAN-77 REQUIRED (FORTRAN-H NO     Evalplot
                                  SUPPORTED BY THIS PROGRAM).          Evalplot
                                 *OPTION...INTERNALLY DEFINE ALL I/O    Evalplot
                                  FILE NAMES (SEE, SUBROUTINE FILEIO   Evalplot
                                  FOR DETAILS).                        Evalplot
                                 *IMPROVED BASED ON USER COMMENTS.      Evalplot
     VERSION 89-1 (JANUARY 1989) *PSYCHOANALYZED BY PROGRAM FREUD TO    Evalplot
                                  INSURE PROGRAM WILL NOT DO ANYTHING   Evalplot
                                  CRAZY.                               Evalplot
                                 *UPDATED TO USE NEW PROGRAM CONVERT    Evalplot
                                  KEYWORDS.                            Evalplot
                                 *ADDED LIVERMORE CIVIC COMPILER        Evalplot
                                  CONVENTIONS.                         Evalplot
                                 *FORTRAN-77/FORTRAN-H COMPATIBLE       Evalplot
                                 *SPECIAL ENDF/B MATERIAL DEFINITIONS   Evalplot
                                  (ZA.LT.1000) FROM DATA FILE READ      Evalplot
                                  BY PROGRAM.                          Evalplot
     VERSION 89-2 (MARCH 1989)   *ADDED ENDF/B-V AND VI MT             Evalplot
                                  DEFINITIONS. PROGRAM WILL DETERMINE   Evalplot
                                  ENDF/B FORMAT BASED ON MF=1,          Evalplot
                                  MT=451 AND USE ASPPROPRIATE MT        Evalplot
                                  DEFINITIONS. IF NO MF=1, MT=451       Evalplot
                                  PROGRAM WILL USE ENDF/B-V             Evalplot
                                  MT DEFINITIONS.                      Evalplot
     VERSION 89-3 (JUNE 1989)    *3 CHARACTER FONTS                    Evalplot
     VERSION 92-1 (JANUARY 1992) *COMPLETE REWRITE OF CODE             Evalplot
                                 *ADDED PHOTON DATA, MF=23 AND 27       Evalplot
                                 *ADDED INCIDENT CHARGED PARTICLES      Evalplot
                                  (IDENTIFIED IN PLOT TITLES)          Evalplot
                                 *ADDED FORTRAN SAVE OPTION.            Evalplot
                                 *UPDATED BASED ON USER COMMENTS        Evalplot
                                 *ADDED RETRIEVAL BY UP TO 100          Evalplot
                                  MAT/MF/MT OR ZA/MF/MT RANGES         Evalplot
                                 *WARNING...INPUT PARAMETER FORMAT      Evalplot
                                  HAS BEEN CHANGED...SEE DESCRIPTION    Evalplot
                                  BELOW.                               Evalplot
     VERSION 92-2 (FEBRUARY 1992)*ADDED PHOTON SPECTRA, MF=15.          Evalplot
                                 *ADDED MULTIPLICATION OF DISTRIBUTIONS Evalplot
                                  IN MF=5 AND 15 BY PROBABILITY=YIELD.  Evalplot
                                 *INCREASED PAGE SIZE TO 12000 POINTS   Evalplot
     VERSION 92-3 (MAY 1992)     *CORRECTED DESCRIPTION OF INPUT        Evalplot
                                  PARAMETERS AND EXAMPLE PROBLEMS.     Evalplot
```

```
                          *CORRECTED FOR ENDF/B-VI DEFINITION OF Evalplot
                           TEMPERATURE FROM MF=1/MT=451.         Evalplot
                          *CORRECTED LOGIC SO THAT EACH REQUEST  Evalplot
                           IS TREATED SEPARATELY TO CREATE A     Evalplot
                           PLOT, UNLESS REQUESTS ARE CHAINED     Evalplot
                           TOGETHER.                             Evalplot
                          *ADDED VARIABLE CHARACTER SIZE INPUT.  Evalplot
VERSION 93-1 (MARCH 1993)  *INCREASED PAGE SIZE FROM 12000       Evalplot
                           TO 210000                             Evalplot
                          *INCREASED THE NUMBER OF ENERGIES      Evalplot
                           VS. LEGENDRE COEFFICIENTS FROM        Evalplot
                           167 TO 7000                           Evalplot
                          *UPDATED FOR ON SCREEN GRAPHICS        Evalplot
                           USING THE LAHEY FORTRAN COMPILER.     Evalplot
VERSION 94-1 (JANUARY 1994) *VARIABLE ENDF/B DATA FILENAMES      Evalplot
                           TO ALLOW ACCESS TO FILE STRUCTURES    Evalplot
                           (WARNING - INPUT PARAMETER FORMAT     Evalplot
                           HAS BEEN CHANGED)                     Evalplot
                          *CLOSE ALL FILES BEFORE TERMINATING    Evalplot
                           (SEE, SUBROUTINE ENDIT)               Evalplot
VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                   Evalplot
                          *IMPROVED COMPUTER INDEPENDENCE        Evalplot
                          *ALL DOUBLE PRECISION                  Evalplot
                          *UNIFORM TREATMENT OF ENDF/B I/O       Evalplot
                          *IMPROVED OUTPUT PRECISION             Evalplot
                          *DEFINED SCRATCH FILE NAMES            Evalplot
                          *ALL DOUBLE PRECISION                  Evalplot
VERSION 97-1 (APRIL 1997)  *INCREASED PAGE SIZE FROM 210000      Evalplot
                           TO 480,000                            Evalplot
VERSION 99-1 (MARCH 1999)  *CORRECTED CHARACTER TO FLOATING      Evalplot
                           POINT READ FOR MORE DIGITS            Evalplot
                          *UPDATED TEST FOR ENDF/B FORMAT        Evalplot
                           VERSION BASED ON RECENT FORMAT CHANGE Evalplot
                          *GENERAL IMPROVEMENTS BASED ON         Evalplot
                           USER FEEDBACK                         Evalplot
VERS. 2000-1 (FEBRUARY 2000)*ADDED MF=10, ACTIVATION CROSS       Evalplot
                           SECTION PLOTS.                        Evalplot
                          *INCREASED DIMENSIONS TO HANDLE MORE   Evalplot
                           SECTIONS - UP TO 1,000                Evalplot
                          *GENERAL IMPROVEMENTS BASED ON         Evalplot
                           USER FEEDBACK                         Evalplot
VERS. 2002-1 (Nov. 2002)   *OPTIONAL INPUT PARAMETERTS           Evalplot
                          *OPTIONAL BLACK OR WHITE BACKGROUND    Evalplot
                          *COLOR POSTSCRIPT FILES                Evalplot
VERS. 2004-1 (MARCH 2004)  *ADDED INCLUDE FOR COMMON             Evalplot
                          *INCREASED PAGE SIZE TO 600,000        Evalplot
                          *INCREASED THE NUMBER OF ENERGIES      Evalplot
                           VS. LEGENDRE COEFFICIENTS FROM        Evalplot
                           7000 TO 20000                         Evalplot
                                                                 Evalplot
OWNED, MAINTAINED AND DISTRIBUTED BY                             Evalplot
-----------------------------------                              Evalplot
THE NUCLEAR DATA SECTION                                         Evalplot
INTERNATIONAL ATOMIC ENERGY AGENCY                               Evalplot
P.O. BOX 100                                                     Evalplot
A-1400, VIENNA, AUSTRIA                                          Evalplot
EUROPE                                                           Evalplot
                                                                 Evalplot
ORIGINALLY WRITTEN BY                                            Evalplot
---------------------------------                                Evalplot
DERMOTT E. CULLEN                                                Evalplot
UNIVERSITY OF CALIFORNIA                                         Evalplot
LAWRENCE LIVERMORE NATIONAL LABORATORY                           Evalplot
L-159                                                            Evalplot
P.O. BOX 808                                                     Evalplot
LIVERMORE, CA 94550                                              Evalplot
U.S.A.                                                           Evalplot
TELEPHONE  925-423-7359                                          Evalplot
E. MAIL    CULLEN1@LLNL.GOV                                      Evalplot
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                           Evalplot
                                                                 Evalplot
```

```
AUTHORS MESSAGE                                                  Evalplot
---------------                                                  Evalplot
THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION Evalplot
FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED Evalplot
THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE Evalplot
READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY   Evalplot
THE COMMENTS CONCERNING MACHINE DEPENDENT CODING.                Evalplot
                                                                 Evalplot
AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER Evalplot
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE   Evalplot
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT Evalplot
IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY     Evalplot
COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO Evalplot
IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF  Evalplot
THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR       Evalplot
COMPUTER.                                                        Evalplot
                                                                 Evalplot
PURPOSE                                                          Evalplot
-------                                                          Evalplot
THIS PROGRAM IS DESIGNED TO READ EVALUATED DATA FROM THE ENDF/B  Evalplot
FORMAT AND TO PLOT THE DATA. THE USER MAY SELECT CROSS SECTIONS, Evalplot
PARAMETERS (E.G. NU-BAR, MU-BAR, ETC.), ANGULAR DISTRIBUTIONS    Evalplot
AND/OR ENERGY DISTRIBUTIONS TO BE PLOTTED.                       Evalplot
                                                                 Evalplot
IN THE FOLLOWING FOR SIMPLICITY THE ENDF/B TERMINOLOGY--ENDF/B   Evalplot
TAPE--WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE TAPE, CARDS, Evalplot
DISK OR ANY OTHER MEDIUM.                                        Evalplot
                                                                 Evalplot
ON WHAT COMPUTERS WILL THE PROGRAM RUN                           Evalplot
---------------------------------------------------------------- Evalplot
THE PROGRAM HAS BEEN IMPLEMENTED ON A WIDE VARIETY OF COMPUTERS  Evalplot
FROM THE ONE EXTREME OF LARGE MAINFRAME CRAY AND IBM COMPUTERS   Evalplot
TO THE OTHER EXTREME OF SUN TERMINALS AND IBM PERSONAL COMPUTERS. Evalplot
THE PROGRAM IS DESIGNED TO RUN ON VIRTUALLY ANY COMPUTER. FOR    Evalplot
SPECIAL CONSIDERATIONS SEE THE SECTIONS BELOW ON,                Evalplot
(1) COMPUTER DEPENDENT CODING                                    Evalplot
(2) PLOTTER/GRAPHICS TERMINAL INTERFACE                          Evalplot
                                                                 Evalplot
ON WHAT PLOTTERS WILL THE PROGRAM RUN                            Evalplot
---------------------------------------------------------------- Evalplot
THE PLOTTER MAY USE UNITS OF INCHES, CENTIMETERS, MILLIMETERS,   Evalplot
VIRTUALLY ANYTHING. INTERNALLY THE PROGRAM WILL DEFINE PLOTS IN  Evalplot
APPROXIMATELY A4 OR 8-1/2 BY 11 INCH FORMAT. AS PART OF THE      Evalplot
INPUT THE USER DEFINES THE ACTUAL SIZE OF THE PLOT IN THE UNITS  Evalplot
(I.E., INCHES, CENTIMETERS, MILLIMETERS, WHATEVER) OF THE REAL   Evalplot
PLOT. THE PLOT IS TRANSFORMED TO THE SIZE OF THE LOCAL PLOTTER   Evalplot
AND OUTPUT. USING THIS CONVENTION THIS PROGRAM SHOULD BE EASY    Evalplot
TO INTERFACE TO VIRTUALLY ANY PLOTTER OR GRAPHICS TERMINAL.      Evalplot
                                                                 Evalplot
GRAPHICS INTERFACE                                               Evalplot
---------------------------------------------------------------- Evalplot
THIS PROGRAM USES A SIMPLE CALCOMP LIKE GRAPHICS INTERFACE WHICH Evalplot
REQUIRES ONLY 3 SUBROUTINES...PLOTS, PLOT AND PEN (DESCRIBED IN  Evalplot
DETAIL BELOW). ALL CHARACTERS AND SYMBOLS ARE DRAWN USING TABLES  Evalplot
OF PEN STROKES (SUPPLIED WITH THIS PROGRAM). USING THIS METHOD   Evalplot
THE PROGRAM SHOULD BE SIMPLE TO INTERFACE TO VIRTUALLY ANY PLOTTER Evalplot
OR GRAPHICS TERMINAL AND THE APPEARANCE AND LAYOUT OF THE PLOTS  Evalplot
SHOULD BE INDEPENDENT OF WHICH PLOTTER IS USED.                  Evalplot
                                                                 Evalplot
PROGRAM IDENTIFICATION                                           Evalplot
----------------------                                           Evalplot
AS DISTRIBUTED THE FIRST FRAME OF PLOTTED OUTPUT WILL DOCUMENT   Evalplot
THE PROGRAM NAME, VERSION AND INSTALLATION. THIS INFORMATION IS  Evalplot
STORED AS DATA IN THE ARRAY VERSES NEAR THE BEGINNING OF         Evalplot
SUBROUTINE FRAME1. IF YOU WISH TO CUSTOMIZE THE OUTPUT TO IDENTIFY Evalplot
YOUR INSTALLATION CHANGE THE LAST TWO LINES OF THE ARRAY VERSES. Evalplot
                                                                 Evalplot
SIZE OF PLOTS                                                    Evalplot
-------------                                                    Evalplot
THE PROGRAM HAS A BUILT-IN DEFAULT SIZE TO MAKE EACH PLOT 13.50  Evalplot
BY 10.24 INCHES. THIS SIZE WAS SELECTED ASSUMING THAT THE        Evalplot
```

```
RESOLUTION OF THE PLOTTER IS 1024 RASTER POINTS PER INCH. THE      Evalplot
USER MAY CHANGE THE SIZE OF THE PLOT BY SPECIFYING ANY REQUIRED    Evalplot
SIZE ON THE FIRST INPUT LINE. IN PARTICULAR FOR USE ON ANY PLOTTER Evalplot
THAT USES CENTIMETERS INSTEAD OF INCHES THE USER MAY MERELY        Evalplot
SPECIFY THE REQUIRED SIZE OF THE PLOT IN CENTIMETERS (E.G., TO     Evalplot
OBTAIN A 13.50 BY 10.24 INCH PLOT, THE USER NEED ONLY SPECIFY      Evalplot
34.3 BY 26 ON THE FIRST INPUT LINE...ASSUMING 2.54 CENTIMETERS PER Evalplot
INCH, OR 343 BY 260 FOR MILLIMETERS..ASSUMING 25.4 MILLIMETERS     Evalplot
PER INCH).                                                         Evalplot
                                                                   Evalplot
CHARACTER SIZE                                                     Evalplot
--------------                                                     Evalplot
THE PLOT HAS A BUILT-IN CHARACTER SIZE WHICH HAS BEEN DEFINED FOR  Evalplot
COMPATIBILITY WITH THE BUILT-IN PLOT SIZE. IF THE USER SPECIFIES   Evalplot
BY INPUT A DIFFERENT PLOT SIZE, THE PROGRAM WILL AUOTMATICALLY     Evalplot
SCALE THE SIZE OF ALL CHARACTERS BY THE RATIO OF THE Y SIZE OF THE Evalplot
PLOT SPECIFIED BY THE USER TO THE BUILT-IN Y SIZE OF PLOTS (E.G.,  Evalplot
FOR PLOTS WHICH ARE ONLY 5.12 HIGH (Y DIRECTION) ALL CHARACTERS    Evalplot
WILL BE SCALED TO BE ONLY 1/2 THE CHARACTER SIZE ON PLOTS WHICH    Evalplot
ARE 10.24 HIGH (10.24 = THE BUILT-IN SIZE). NOTE, CHANGES IN THE   Evalplot
X SIZE OF THE PLOT WILL NOT HAVE ANY EFFECT ON THE CHARACTER SIZE  Evalplot
(E.G., FOR A LONG PLOT, 30 BY 10.24 THE CHARACTER SIZE WILL BE THE Evalplot
THE SAME AS ON A 13.50 BY 10.24 PLOT).                             Evalplot
                                                                   Evalplot
PLOT PER FRAME                                                     Evalplot
--------------                                                     Evalplot
BY INPUT THE USER CAN SPECIFY NOT ONLY THE ACTUAL SIZE OF THE      Evalplot
LOCAL PLOTTER, BUT ALSO HOW MANY PLOTS SHOULD APPEAR ON EACH       Evalplot
FRAME. THIS IS DONE BY SPECIFYING THE LAYOUT OF A FRAME IN TERMS   Evalplot
OF THE NUMBER OF PLOTS IN THE X AND Y DIRECTION. FOR EXAMPLE BY    Evalplot
SPECIFYING THAT EACH FRAME BE DIVIDED INTO 3 PLOTS IN THE X        Evalplot
DIRECTION AND 2 PLOTS IN THE Y DIRECTION, EACH FRAME WILL CONTAIN  Evalplot
UP TO 6 PLOTS (3 X 2). INTERNALLY EACH PLOT WILL BE GENERATED TO   Evalplot
STANDARD A4 SIZE, AS DESCRIBED ABOVE, AND THEN ON OUTPUT SCALED    Evalplot
TO THE NUMBER OF PLOTS PER FRAME SPECIFIED BY THE USER INPUT.      Evalplot
                                                                   Evalplot
ENDF/B FORMAT                                                      Evalplot
-------------                                                      Evalplot
THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS     Evalplot
OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION   Evalplot
OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT). Evalplot
                                                                   Evalplot
IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B       Evalplot
FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS     Evalplot
ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE  Evalplot
NUMBERS (COLUMNS 76-80) ARE IGNORED. FORMAT OF SECTION MT=452, 455 Evalplot
OF MF=1, AND ALL SECTIONS OF MF=3, 4 AND 5 MUST BE CORRECT. ALL    Evalplot
OTHER SECTION OF DATA ARE SKIPPED AND AS SUCH THE OPERATION OF     Evalplot
THIS PROGRAM IS INSENSITIVE TO THE CORRECTNESS OR INCORRECTNESS    Evalplot
OF ALL OTHER SECTIONS.                                             Evalplot
                                                                   Evalplot
INTERPOLATION LAW                                                  Evalplot
-----------------                                                  Evalplot
EACH TABLE OF DATA MAY USE EITHER COMPLETELY HISTOGRAM OR          Evalplot
COMPLETELY LINEAR INTERPOLATION LAW (THE TWO INTERPOLATION LAWS    Evalplot
CANNOT BE MIXED TOGETHER IN ONE TABLE). EITHER OF THESE TWO        Evalplot
REPRESENTATIONS WILL BE STORED IN CORE IN LINEARLY INTERPOLABLE    Evalplot
FORM. IF THIS PROGRAM FINDS ANY DATA THAT USES ANY OTHER           Evalplot
INTERPOLATION LAW IT WILL PRINT AN ERROR MESSAGE AND PLOT THE      Evalplot
TABLE AS IF IT WERE LINEARLY INTERPOLABLE. THE ONLY ERROR THAT     Evalplot
WILL RESULT IN THE PLOT WILL BE IN THE CURVE FOLLOWED BETWEEN      Evalplot
TABULATED POINTS. PROGRAM LINEAR (UCRL-50400, VOL. 17, PART A)     Evalplot
MAY BE USED TO CONVERT CROSS SECTIONS TO LINEARLY INTERPOLABLE     Evalplot
FORM. PROGRAM LEGEND CAN BE USED FOR ANGULAR DISTRIBUTIONS AND     Evalplot
PROGRAM ENERGY CAN BE USED FOR SECONDARY ENERGY DISTRIBUTIONS.     Evalplot
                                                                   Evalplot
REACTION INDEX                                                     Evalplot
--------------                                                     Evalplot
THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN     Evalplot
SECTION MF=1, MT=451 OF EACH EVALUATION.                           Evalplot
                                                                   Evalplot
```

```
PAGE SIZE                                                          Evalplot
---------                                                          Evalplot
ONLY ONE PAGE OF DATA = 600000 DATA POINTS - IS KEPT IN CORE AT    Evalplot
ANY GIVEN TIME. IF THERE IS MORE THAN THIS MANY POINTS THEY WILL   Evalplot
BE KEPT ON A SCRATCH FILE AND LOADED INTO CORE AS NEEDED.          Evalplot
                                                                   Evalplot
TO CHANGE THE PAGE SIZE,                                           Evalplot
                                                                   Evalplot
1) CHANGE  600000 TO THE NEW PAGE SIZE                             Evalplot
2) CHANGE 1200000 TO TWO TIMES THE NEW PAGE SIZE                   Evalplot
                                                                   Evalplot
SECTION SIZE                                                       Evalplot
------------                                                       Evalplot
SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT  Evalplot
TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS      Evalplot
SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.                 Evalplot
                                                                   Evalplot
THE ONLY EXCEPTION TO THIS RULE IS THAT EACH TABLE OF DATA WHICH   Evalplot
USES A HISTOGRAM INTERPOLATION LAW CANNOT EXCEED HALF THE SIZE     Evalplot
OF THE IN CORE PAGE (PRESENTLY 600000/2=300000) WHICH IS ADEQUATE  Evalplot
FOR ALMOST ALL HISTOGRAM (E.G. MULTIGROUP) REPRESENTATIONS OF      Evalplot
A SINGLE TABLE (E.G. REACTION).                                    Evalplot
                                                                   Evalplot
WHAT DATA CAN BE PLOTTED                                           Evalplot
------------------------                                           Evalplot
THIS CODE CAN PLOT VIRTUALLY ANY NEUTRON OR PHOTON CROSS SECTIONS  Evalplot
(MF=3 OR 23) AND ANY TABULATED ANGULAR OR ENERGY DISTRIBUTIONS OR  Evalplot
LEGENDRE COEFFICIENTS. WHAT IS ACTUALLY PLOTTED DEPENDS ON WHAT    Evalplot
DATA IS SELECTED BY THE USER.                                      Evalplot
                                                                   Evalplot
SELECTION OF DATA                                                  Evalplot
-----------------                                                  Evalplot
DATA TO BE PLOTTED IS SPECIFIED BY INPUTTING UP TO 100 MAT/MF/MT   Evalplot
RANGES OR UP TO 100 ZA/MF/MT RANGES. IN ADDITION FOR EACH RANGE    Evalplot
THE USER MAY SPECIFY AN X RANGE (USUALLY ENERGY) AND THE TYPE OF   Evalplot
DATA TO BE PLOTTED (SEE: THE DESCRIPTION OF TYPES, BELOW).         Evalplot
                                                                   Evalplot
THE X RANGE FOR MF = 1, 3, 23 AND 27 AND MF = 4 LEGENDRE           Evalplot
COEFFICIENTS WILL BE USED AS THE X LIMITS OF THE PLOTS, E.G.,      Evalplot
PLOT ENERGY DEPENDENT CROSS SECTIONS BETWEEN 1 AND 20 MEV.         Evalplot
                                                                   Evalplot
THE X RANGE FOR MF = 4 AND 5 WILL BE USED TO ONLY SELECT ANGULAR   Evalplot
AND ENERGY DISTRIBUTION FOR WHICH THE INCIDENT NEUTRON ENERGY      Evalplot
IS IN THE X RANGE. E.G., ONLY PLOT ANGULAR DISTRIBUTIONS WHERE     Evalplot
THE INCIDENT NEUTRON ENERGY IS 1 TO 20 MEV.                        Evalplot
                                                                   Evalplot
INTERACTIVE VS. BATCH MODE                                         Evalplot
--------------------------                                         Evalplot
VERSION 92-1 AND LATER VERSIONS OF THIS CODE ONLY USE A BATCH      Evalplot
MODE WHERE ALL REQUESTS ARE READ AND PROCESSED. EARLIER VERSIONS   Evalplot
OF THIS CODE HAD BOTH AN INTERACTIVE MODE (WHERE REQUESTS WHERE    Evalplot
READ AND EXECUTED ONE AT A TIME) AND A BATCH MODE. INTERACTIVE     Evalplot
MODE HAS BEEN DROPPED AND WILL NOT TO REINTRODUCED UNLESS THE      Evalplot
AUTHOR IS INFORMED BY USERS THAT THEY WERE USING THE INTERACTIVE   Evalplot
MODE.                                                              Evalplot
                                                                   Evalplot
PLOT LAYOUT                                                        Evalplot
-----------                                                        Evalplot
VERSION 92-1 AND LATER VERSIONS OF THIS CODE WILL PLOT ALL         Evalplot
CURVES ON A SINGLE PLOT. EARLIER VERSIONS OF THIS CODE ALLOWED     Evalplot
THE OPTION TO HAVE,                                                Evalplot
MULTIPLE PLOTS - INDIVIDUAL SCALING                                Evalplot
MULTIPLE PLOTS - COMMON SCALING                                    Evalplot
SINGLE PLOT                                                        Evalplot
MULTILE PLOTS PER PLOT HAVE BEEN DROPPED AND WILL NOT BE           Evalplot
REINTRODUCED UNLESS IT IS DEMONSTRATED TO THE AUTHOR THAT THEY     Evalplot
ARE OF PRACTICAL USE IN SOME APPLICATION.                          Evalplot
                                                                   Evalplot
PROCESSING OF DATA                                                 Evalplot
------------------                                                 Evalplot
IN THE CASE OF NEUTRON AND PHOTON CROSS SECTIONS (MF=3 OR 23)      Evalplot
```

```
AND PARAMETERS (MF=1 OR 27) ALL DATA IN A FILE (MF) IS READ        Evalplot
GROUPED TOGETHER BY TYPE (AS EXPLAINED BELOW) AND PLOTTED.         Evalplot
                                                                   Evalplot
IN THE CASE OF ANGULAR AND ENERGY DISTRIBUTIONS (MF=4 OR 5) ONLY   Evalplot
ONE SECTION OF DATA AT A TIME IS READ AND PLOTTED.                 Evalplot
                                                                   Evalplot
TYPES OF DATA (MF=1, 3, 23 AND 27 ONLY)                            Evalplot
-------------------------------------                              Evalplot
THESE DATA ARE DIVIDED INTO UP TO 18 TYPES AND EACH TYPE OF        Evalplot
DATA IS GROUPED TOGETHER AND PLOTTED (IF THE DATA IS ACTUALLY      Evalplot
PRESENT).                                                          Evalplot
                                                                   Evalplot
WHAT TYPE OF DATA IS ACTUALLY PLOTTED CAN BE CONTROLLED BY USER    Evalplot
INPUT EITHER BASED ON SELECTED MAT/MF/MT OR ZA/MF/MT RANGES OR     Evalplot
BY EXPLICITLY SELECTING ONLY ONE TYPE OF DATA IS TO BE PLOTTED     Evalplot
(SEE THE DESCRIPTION OF INPUT BELOW).                              Evalplot
                                                                   Evalplot
SIMPLE REQUESTS                                                    Evalplot
---------------                                                    Evalplot
GENERALLY EACH MAT/MF/MT OR ZA/MF/MT REQUESTED IS TREATED          Evalplot
SEPERATELY AND THE SPECIFIED DATA IS GROUPED BY TYPE AND PLOTTED.  Evalplot
FOR EXAMPLE, THE USER MAY SPECIFY USING ONE REQUEST THAT ALL       Evalplot
TYPES OF DATA BE PLOTTED OVER THE ENTIRE ENERGY RANGE AND USE      Evalplot
A SECOND REQUEST TO SPECIFY THAT ONE PARTICULAR TYPE OF DATA       Evalplot
BE PLOTTED OVER A SPECIFIC ENERGY RANGE.                           Evalplot
                                                                   Evalplot
CHAINED REQUESTS                                                   Evalplot
----------------                                                   Evalplot
REQUESTS MAY ALSO BE CHAINED TOGETHER (SEE, THE DESCRIPTION OF     Evalplot
INPUT BELOW), WHERE A NUMBER OF REQUESTS MAY BE USED TO SELECT     Evalplot
DATA, BUT ONLY THE LAST REQUEST IN A CHAIN WILL CAUSE ALL SELECTED Evalplot
DATA TO BE PLOTTED. CHAINED REQUESTED ARE INDICATED ON INPUT BY    Evalplot
A SERIES OF REQUESTS FOR DATA TYPE = -1, EXCEPT FOR THE LAST       Evalplot
REQUEST OF THE CHAIN, WHICH MUST SPECIFY A TYPE DATA = 0 (ALL)     Evalplot
OR A POSITIVE NUMBER. UNLIKE SIMPLE REQUESTS, WHERE EACH WILL      Evalplot
PRODUCE ONE OR MORE PLOTS, WITH CHAINED REQUESTS THE ENTIRE        Evalplot
SERIES OF CHAINED REQUESTS WILL BE TREATED AS A SINGLE REQUEST     Evalplot
AND WILL PRODUCE ONE OR MORE PLOTS.                                Evalplot
                                                                   Evalplot
FOR EXAMPLE, DATA TYPE = 1 WILL NORMALLY INCLUDE,                  Evalplot
MT =   1 - TOTAL                                                  Evalplot
   =   2 - ELASTIC                                                 Evalplot
   =   4 - TOTAL INELASTIC                                         Evalplot
   =  18 - FISSION                                                 Evalplot
   = 102 - CAPTURE                                                 Evalplot
IF YOU WISH TO EXCLUDE TOTAL INELASTIC FROM A PLOT YOU NEED ONLY    Evalplot
SPECIFY TWO CHAINED REQUESTS THE FIRST TO SELECT MT = 1 THROUGH     Evalplot
2 (TO INCLUDE TOTAL AND ELASTIC) AND A SECOND TO INCLUDE MT = 18    Evalplot
THROUGH 102. THE FIRST REQUEST SHOULD SPECIFY DATA TYPE = -1 AND    Evalplot
SECOND 1 (THIS WILL CHAIN THE 2 REQUESTS TOGETHER, SO THAT MT =1    Evalplot
THROUGH 2, AND MT = 18 THROUGH 102 ALL APPEAR ON THE SAME PLOT).    Evalplot
SINCE MT = 4 (TOTAL INELASTIC) IS NOT REQUESTED IT WILL NOT BE      Evalplot
PLOTTED.                                                           Evalplot
                                                                   Evalplot
DEFINITION OF 18 DATA TYPES                                        Evalplot
------------------------------------------------------------------ Evalplot
NEUTRONS (MF = 3)                                                  Evalplot
-----------------                                                  Evalplot
(1) TOTAL, ELASTIC, CAPTURE, FISSION AND TOTAL INELASTIC           Evalplot
(2) (N,2N), (N,3N) AND (N,N' CHARGED PARTICLE)                     Evalplot
(3) (N,CHARGED PARTICLE)                                           Evalplot
(4) PARTICLE PRODUCTION (PROTON, DEUTERON, ETC.) AND DAMAGE        Evalplot
(5) TOTAL, FIRST, SECOND, ETC. CHANCE FISSION.                     Evalplot
(6) TOTAL INELASTIC, INELASTIC DISCRETE LEVELS AND CONTINUUM       Evalplot
(7) (N,P) TOTAL AND LEVELS (ONLY IF LEVELS ARE GIVEN)              Evalplot
(8) (N,D) TOTAL AND LEVELS (ONLY IF LEVELS ARE GIVEN)              Evalplot
(9) (N,T) TOTAL AND LEVELS (ONLY IF LEVELS ARE GIVEN)              Evalplot
(10) (N,HE-3) TOTAL AND LEVELS (ONLY IF LEVELS ARE GIVEN)          Evalplot
(11) (N,ALPHA) TOTAL AND LEVELS (ONLY IF LEVELS ARE GIVEN)         Evalplot
(12) PARAMETERS MU-BAR, XI AND GAMMA                               Evalplot
(13) NU-BAR - TOTAL, PROMPT AND DELAYED                            Evalplot
```

```
                                                                      Evalplot
PHOTONS  (MF=23 AND 27)                                               Evalplot
---------------------                                                 Evalplot
(14) TOTAL, COHERENT, INCOHERENT, TOTAL PHOTOELECTRIC, TOTAL          Evalplot
     PAIR PRODUCTION                                                  Evalplot
(15) TOTAL AND SUBSHELL PHOTOELECTRIC                                 Evalplot
(16) TOTAL, NUCLEAR AND ELECTRON PAIR PRODUCTION                      Evalplot
(17) COHERENT FORM FACTOR AND INCOHERENT SCATTERING FUNCTION          Evalplot
(18) REAL AND IMAGINARY SCATTERING FACTORS                            Evalplot
                                                                      Evalplot
IDENTIFICATION OF DATA                                                Evalplot
---------------------                                                 Evalplot
ALL PLOTS IDENTIFY THE TARGET, E.G., U-238 AND UNITS OF THE X AND     Evalplot
Y AXIS, E.G., X = ENERGY (MEV) OR COSINE (LAB), ETC., Y = CROSS       Evalplot
SECTION (BARNS) OR PROBABILITY/COSINE, ETC.                           Evalplot
                                                                      Evalplot
FOR TYPES OF DATA (MF=1, 3, 23 AND 27) DIFFERENT REACTIONS (MT)       Evalplot
ARE GROUPED TOGETHER TO APPEAR ON THE SAME PLOT. THE TITLE AT         Evalplot
THE TOP OF THE PLOT WILL IDENTIFY THE TYPE OF DATA BEING PLOTTED      Evalplot
AND THE LEGEND BOX WITHIN THE PLOT WILL IDENTIFY EACH REACTION.       Evalplot
                                                                      Evalplot
FOR ANGULAR AND ENERGY DISTRIBUTIONS (MF=4 OR 5) EACH PLOT WILL       Evalplot
CONTAIN DATA FOR A SINGLE REACTION (MT) AND DIFFERENT INCIDENT        Evalplot
NEUTRON ENERGIES. THE TITLE AT THE TOP OF THE PLOT WILL IDENTIFY      Evalplot
THE REACTION AND THE LEGEND BOX WITHIN THE PLOT WILL IDENTIFY         Evalplot
THE INCIDENT ENERGY.                                                  Evalplot
                                                                      Evalplot
FOR LEGENDRE COEFFICIENT THE DATA IN ENDF/B FORMAT WILL BE            Evalplot
INVERTED IN ORDER TO PRESENT EACH LEGENDRE COEFFICIENT VERSUS         Evalplot
INCIDENT ENERGY. THE TITLE AT THE TOP OF THE PLOT WILL IDENTIFY       Evalplot
THE REACTION AND THE LEGEND BOX WITHIN THE PLOT WILL IDENTIFY         Evalplot
THE LEGENDRE ORDER.                                                   Evalplot
                                                                      Evalplot
INPUT FILES                                                           Evalplot
-----------                                                           Evalplot
UNIT  DESCRIPTION                                                     Evalplot
----  -----------                                                     Evalplot
   2   INPUT LINES (BCD - 80 CHARACTERS/RECORD)                       Evalplot
   9   MT DEFINITIONS (BCD - 80 CHARACTERS/RECORD)                    Evalplot
  10   ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)                       Evalplot
  12   SOFTWARE CHARACTERS (BCD - 80 CHARACTERS/RECORD)               Evalplot
                                                                      Evalplot
OUTPUT FILES                                                          Evalplot
------------                                                          Evalplot
UNIT  DESCRIPTION                                                     Evalplot
----  -----------                                                     Evalplot
   3   OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)                    Evalplot
  16   PLOTTING UNIT                                                  Evalplot
                                                                      Evalplot
SCRATCH FILES                                                         Evalplot
-------------                                                         Evalplot
UNIT  DESCRIPTION                                                     Evalplot
----  -----------                                                     Evalplot
  11  SCRATCH FILE (BINARY - 960000 WORDS/RECORD = 2*PAGE SIZE)       Evalplot
                                                                      Evalplot
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILIO1 AND FILIO2)       Evalplot
--------------------------------------------------------------        Evalplot
UNIT  FILE NAME                                                       Evalplot
----  ----------                                                      Evalplot
  2   EVALPLOT.INP                                                   Evalplot
  3   EVALPLOT.LST                                                   Evalplot
  9   MT.DAT                                                         Evalplot
 10   ENDFB.IN    (OR AS INPUT PARAMETER)                            Evalplot
 11   (SCRATCH)                                                      Evalplot
 12   PLOT.CHR                                                       Evalplot
 16   (PLOTTING UNIT...USUALLY A DUMMY)                              Evalplot
                                                                      Evalplot
INPUT PARAMETERS                                                      Evalplot
----------------                                                      Evalplot
LINE COLUMNS FORMAT  DESCRIPTION                                      Evalplot
---- ------- ------  -----------                                      Evalplot
```

```
   1   1-11   E11.4  LOWER X LIMIT OF PLOTTER                       Evalplot
      12-22   E11.4  UPPER X LIMIT OF PLOTTER                       Evalplot
      23-33   E11.4  LOWER Y LIMIT OF PLOTTER                       Evalplot
      34-44   E11.4  UPPER Y LIMIT OF PLOTTER                       Evalplot
      45-55    I11   NUMBER OF PLOTS PER FRAME IN X DIRECTION       Evalplot
      56-66    I11   NUMBER OF PLOTS PER FRAME IN Y DIRECTION       Evalplot
      67-70    F4.1  CHARACTER SIZE MULTIPLIER                      Evalplot
                     = 0 OR 1    - NORMAL CHARACTER SIZE           Evalplot
                     = OTHERWISE - CHARACTERS SCALED BY THIS       Evalplot
                                   FACTOR.                         Evalplot
   2   1-60    A60   ENDF/B DATA FILENAME                          Evalplot
                     (LEAVE BLANK FOR STANDARD = ENDFB.IN)         Evalplot
   3   1-11    I11   RETRIEVAL CRITERIA                            Evalplot
                     = 0 - MAT                                     Evalplot
                     = 1 - ZA                                      Evalplot
      12-22    I11   TYPE OF GRID                                  Evalplot
                     = 0 - TICK MARKS ON BORDER                    Evalplot
                     = 1 - SOLID AT COARSE INTERVALS               Evalplot
                     = 2 - DASHED AT COARSE INTERVALS              Evalplot
                     = 3 - SOLID AT FINE INTERVALS                 Evalplot
                     = 4 - DASHED AT FINE INTERVALS                Evalplot
                     = 5 - SOLID COARSE/DASHED FINE GRID           Evalplot
      23-33    I11   SHOULD BORDER BE PLOTTED ON EACH PLOT         Evalplot
                     = 0 - NO                                      Evalplot
                     = 1 - YES                                     Evalplot
      34-44    I11   LINE THICKNESS                                Evalplot
                     = 0 -  5 = BORDER/CURVES/CHARACTERS           Evalplot
                     =-1 - -5 = BORDER/CURVES (NOT CHARACTERS)     Evalplot
                              NOTE, THE GRID IS NEVER THICK.       Evalplot
      45-55    I11   SHOULD TEMPERATURE BE PLOTTED.                Evalplot
                     = 0 - YES                                     Evalplot
                     = 1 - NO                                      Evalplot
      56-66   E11.4  ALLOWABLE RATIO OF PLOT Y RANGE MAXIMUM TO    Evalplot
                     MINIMUM - IF THIS RATIO IS EXCEEDED THE Y     Evalplot
                     RANGE MINIMUM WILL BE CHANGED TO THE Y RANGE  Evalplot
                     MAXIMUM TIMES THIS RATIO.                     Evalplot
                     IF THIS RATIO IS NOT POSITIVE, IT IS          Evalplot
                     INTERPRETED TO MEAN NO LIMIT ON Y RANGE.      Evalplot
      67-70    I4    BACKGROUND COLOR                              Evalplot
                     = 0         = BLACK                           Evalplot
                     = OTHERWISE = WHITE                           Evalplot
 4-N   1- 6    I6    LOWER MAT OR ZA LIMIT                         Evalplot
       7- 8    I2    LOWER MF LIMIT                                Evalplot
       9-11    I3    LOWER MT LIMIT                                Evalplot
      11-22   E11.4  LOWER X LIMIT (USUALLY ENERGY) - EV           Evalplot
      23-28    I6    UPPER MAT OR ZA LIMIT                         Evalplot
      29-30    I2    UPPER MF LIMIT                                Evalplot
      31-33    I3    UPPER MT LIMIT                                Evalplot
      34-44   E11.4  UPPER X LIMIT (USUALLY ENERGY) - EV           Evalplot
      45-55   I11    TYPE OF DATA TO RETRIEVE AND PLOT             Evalplot
                     =  -1  - CHAIN THIS REQUEST TO THE NEXT ONE   Evalplot
                     =   0  - ALL                                  Evalplot
                     = 1-18 - TYPE AS SPECIFIED ABOVE              Evalplot
                                                                   Evalplot
THERE MAY BE UP 100 MAT/MF/MT OR ZA/MF/MT REQUEST RANGES. INPUT    Evalplot
MUST BE TERMINATED BY A BLANK LINE.                                Evalplot
                                                                   Evalplot
IF X LIMITS ARE NOT SPECIFIED (I.E., LOWER AND UPPER X LIMIT = 0)  Evalplot
THIS WILL BE INTERPRETED TO MEAN NO LIMIT AND ALL DATA WILL BE     Evalplot
PLOTTED OVER THEIR ENTIRE ENERGY RANGE, I.E., YOU NEED NOT         Evalplot
KNOW AND SPECIFY THE ACTUAL ENERGY LIMITS OF THE DATA.             Evalplot
                                                                   Evalplot
EXAMPLE DEFINITION OF PLOTTER                                      Evalplot
----------------------------                                       Evalplot
THE FIRST INPUT LINE DEFINES THE DIMENSIONS OF THE PLOTTER BEING   Evalplot
USED IN ANY UNITS (INCHES, CENTIMETERS, MILLIMETERS, ANYTHING)     Evalplot
WHICH APPLY TO THE PLOTTER. IN ADDITION THE FIRST LINE DEFINES     Evalplot
HOW MANY PLOTS SHOULD APPEAR ON EACH FRAME. THE PLOTTING AREA      Evalplot
DEFINED ON THE FIRST INPUT LINE MAY BE SUBDIVIDED INTO ANY NUMBER  Evalplot
OF PLOTS IN THE X AND Y DIRECTION. FOR EXAMPLE, TO PRODUCE A       Evalplot
SERIES OF FRAMES EACH CONTAINING 3 PLOTS IN THE X DIRECTION AND    Evalplot
```

```
    2 PLOTS IN THE Y DIRECTION (6 PLOTS PER FRAME) COLUMN 45-55 OF     Evalplot
    THE FIRST INPUT LINE SHOULD BE 3 AND COLUMNS 56-66 SHOULD BE 2.    Evalplot
                                                                       Evalplot
    IF THE LOCAL PLOTTER USES DIMENSIONS OF INCHES IN ORDER TO OBTAIN  Evalplot
    10 X 10 INCH FRAMES WITH 3 X 2 PLOTS PER FRAME THE FIRST INPUT     Evalplot
    LINE SHOULD BE,                                                    Evalplot
                                                                       Evalplot
      0.0       10.0      0.0     10.0              3          2       Evalplot
                                                                       Evalplot
    IF THE LOCAL PLOTTER USES DIMENSION OF MILLIMETERS THE SAME        Evalplot
    PHYSICAL SIZE PLOT MAY BE OBTAINED IF THE FIRST INPUT LINE IS,     Evalplot
                                                                       Evalplot
      0.0      254.0      0.0    254.0              3          2       Evalplot
                                                                       Evalplot
    FOR SIMPLICITY THE FOLLOWING EXAMPLE INPUTS WILL NOT DISCUSS THE   Evalplot
    PHYSICAL DIMENSIONS OF THE PLOTTER AND THE FIRST INPUT LINE WILL   Evalplot
    IN ALL CASES INDICATE 10 X 10 INCH PLOTS WITH ONLY 1 PLOT PER      Evalplot
    FRAME.                                                             Evalplot
                                                                       Evalplot
    ALL OF THE FOLLOWING EXAMPLE WILL USE,                             Evalplot
    1) A DASHED GRID          (SECOND LINE, COLS. 12-22 = 2)           Evalplot
    2) NO BORDER              (SECOND LINE, COLS. 23-33 = 0)           Evalplot
    3) LINE THICKNESS -2      (SECOND LINE, COLS. 34-44 =-2)           Evalplot
    4) TEMPERATURE ON PLOTS   (SECOND LINE, COLS. 45-55 = 0)           Evalplot
    5) NO Y RANGE LIMIT       (SECOND LINE, COLS. 56-66 = 0.0)         Evalplot
                                                                       Evalplot
    EXAMPLE INPUT NO. 1                                                Evalplot
    ------------------                                                 Evalplot
    FOR ALL THORIUM AND URANIUM ISOTOPES PLOT NEUTRON CROSS SECTIONS   Evalplot
    ENTIRE ENERGY RANGE. IN ADDITION PLOT TYPE 1 DATA, MAJOR NEUTRON   Evalplot
    CROSS SECTIONS OVER THE ENERGY RANGE 1 EV TO 1 KEV. USE THE        Evalplot
    STANDARD FILENAME (ENDFB.IN) FOR THE ENDF/B DATA. THE FOLLOWING    Evalplot
    6 INPUT LINES ARE REQUIRED,                                        Evalplot
                                                                       Evalplot
   0.0       10.0       0.0       10.0              3          2      Evalplot
ENDFB.IN                                                               Evalplot
          1          2         0         -2          0 0.0            Evalplot
 90000 3  0           90999 3999                    0                 Evalplot
 90000 3  0 1.00000+ 090999 3999 1.00000+ 3         1                 Evalplot
(BLANK LINE MUSE FOLLOW LAST REQUEST)                                  Evalplot
                                                                       Evalplot
    EXAMPLE INPUT NO. 2                                                Evalplot
    ------------------                                                 Evalplot
    PLOT FE-56 ELASTIC AND INELASTIC ANGULAR DISTRIBUTIONS BETWEEN     Evalplot
    1 AND 20 MEV. THE FOLLOWING 6 INPUT LINES ARE REQUIRED,            Evalplot
                                                                       Evalplot
   0.0       10.0       0.0       10.0              3          2      Evalplot
ENDFB.IN                                                               Evalplot
          1          2         0         -2          0 0.0            Evalplot
 26056 4  2 1.00000+ 626056 4  2 2.00000+ 7         0                 Evalplot
 26056 4  4 1.00000+ 626056 4  4 2.00000+ 7         0                 Evalplot
(BLANK LINE MUSE FOLLOW LAST REQUEST)                                  Evalplot
                                                                       Evalplot
    EXAMPLE INPUT NO. 3 (CHAINED INPUT)                                Evalplot
    -----------------------------------                                Evalplot
    FOR ALL THORIUM AND URANIUM ISOTOPES PLOT TOTAL, ELASTIC ,CAPTURE  Evalplot
    AND FISSION, BUT NOT INELASTIC CROSS SECTIONS OVER THERE ENTIRE     Evalplot
    ENERGY RANGE AND FROM 1 KEV TO 1 MEV. THE FOLLOWING 8 INPUT        Evalplot
    LINES ARE REQUIRED,                                                Evalplot
                                                                       Evalplot
   0.0       10.0       0.0       10.0              3          2      Evalplot
ENDFB.IN                                                               Evalplot
          1          2         0         -2          0 0.0            Evalplot
 90000 3  1           90999 3  2                   -1                 Evalplot
 90000 3 18           90999 3102                    1                 Evalplot
 90000 3  1 1.00000+ 390999 3  2 1.00000+ 6        -1                 Evalplot
 90000 3 18 1.00000+ 390999 3102 1.00000+ 6         1                 Evalplot
(BLANK LINE MUSE FOLLOW LAST REQUEST)                                  Evalplot
                                                                       Evalplot
    NOTE, THIS EXAMPLE INCLUDES 2 CHAINED REQUESTED - INPUT LINES 3    Evalplot
    AND 4 SELECTING DATA AND PRODUCING A PLOT OVER THE ENTIRE ENERGY   Evalplot
```

```
    RANGE AND INPUT LINES 5 AND 6 SELECTING THE SAME DATA AND          Evalplot
    PRODUCING A PLOT FROM 1 KEV TO 1 MEV.                              Evalplot
                                                                       Evalplot
    ANY NUMBER OF REQUEST LINES MAY TO CHAINED TOGETHER TO SELECT      Evalplot
    DATA. THE CHAIN ENDS WHERE THE TYPE OF DATA (COLS. 45-55) IS NOT   Evalplot
    NEGATIVE AND THEN THE SELECTED DATA WILL BE PLOTTED.               Evalplot
                                                                       Evalplot
    EXAMPLE INPUT NO. 4                                                Evalplot
    ------------------                                                 Evalplot
    FOR THE SAME EXAMPLE AS ABOVE, EXCEPT USE A DIFFERENT FILENAME     Evalplot
    FOR THE ENDF/B DATA TO READ FROM A FILE TREE STRUCTURE. THE        Evalplot
    FOLLOWING 8 INPUT LINES ARE REQUIRED,                              Evalplot
                                                                       Evalplot
   0.0       10.0       0.0       10.0               3          2      Evalplot
 EVALUATION/ENDFB6/THORIUM                                             Evalplot
          1          2         0         -2          0 0.0            Evalplot
  90000 3  1          90999 3  2                    -1                Evalplot
  90000 3 18          90999 3102                     1                Evalplot
  90000 3  1 1.00000+ 390999 3  2 1.00000+ 6         -1                Evalplot
  90000 3 18 1.00000+ 390999 3102 1.00000+ 6          1                Evalplot
 (BLANK LINE MUST FOLLOW LAST REQUEST)                                 Evalplot
                                                                       Evalplot
===== PLOTTER/GRAPHICS TERMINAL INTERFACE ============================= Evalplot
                                                                       Evalplot
      THIS PROGRAM USES A SIMPLE CALCOMP LIKE INTERFACE INVOLVING      Evalplot
      ONLY 6 SUBROUTINES,                                              Evalplot
                                                                       Evalplot
      STARPLOT  - INITIALIZE PLOTTER                                   Evalplot
      NEXTPLOT  - CLEAR THE SCREEN FOR THE NEXT PLOT                   Evalplot
      ENDPLOTS  - TERMINATE PLOTTING                                   Evalplot
                                                                       Evalplot
      PLOT(X,Y,IPEN)        - DRAW OR MOVE FROM LAST LOCATION TO (X,Y), Evalplot
                              END OF CURRENT PLOT OR END OF PLOTTING.   Evalplot
            IPEN =   2 - DRAW                                          Evalplot
                 =   3 - MOVE                                          Evalplot
                                                                       Evalplot
      PEN(IPEN)             - SELECT COLOR.                            Evalplot
           IPEN- COLOR = 1 TO N (N = ANY POSITIVE INTEGER)             Evalplot
                                                                       Evalplot
      BOXCOLOR(X,Y,IFILL,IBORDER) - FILL A RECTANGULAR BOX DEFINED     Evalplot
                                    BY THE X AND Y CORNERS - X(1),     Evalplot
                                    X(2), Y(1),Y(2)                    Evalplot
                  IFILL          - COLOR TO FILL BOX WITH              Evalplot
                        IBORDER  - COLOR OF BOX BORDER                 Evalplot
                                                                       Evalplot
    IN ORDER TO INTERFACE THIS PROGRAM FOR USE ON ANY PLOTTER WHICH    Evalplot
    DOES NOT USE THE ABOVE CONVENTIONS IT IS MERELY NECESSARY FOR THE  Evalplot
    THE USER TO WRITE 6 SUBROUTINES WITH THE NAMES PLOTS, PLOT AND PEN Evalplot
    WITH THE SUBROUTINE ARGUMENTS DESCRIBED ABOVE AND TO THEN CALL THE Evalplot
    LOCAL EQUIVALENT ROUTINES.                                         Evalplot
                                                                       Evalplot
    COLOR PLOTS                                                        Evalplot
    ------------------------------------------------------------------ Evalplot
    TO SELECT PLOTTING COLORS SUBROUTINE PEN (DESCRIBED ABOVE) IS USED Evalplot
    TO SELECT ONE OF THE AVAILABLE COLORS. IF YOU HAVE COLOR ON YOUR   Evalplot
    PLOTTER YOU SHOULD PROVIDE A SUBROUTINE PEN TO SELECT COLORS.      Evalplot
                                                                       Evalplot
    BLACK AND WHITE PLOTS                                              Evalplot
    ------------------------------------------------------------------ Evalplot
    WHEN PRODUCING BLACK AND WHITE PLOTS SUBROUTINE PEN NEED MERELY    Evalplot
    BE A DUMMY SUBROUTINE TO IGNORE ANY ATTEMPT TO CHANGE COLORS,      Evalplot
                                                                       Evalplot
    SUBROUTINE PEN(IPEN)                                               Evalplot
    RETURN                                                             Evalplot
    END                                                                Evalplot
                                                                       Evalplot
    SIMILAR BOXCOLOR CAN BE A DUMMY                                    Evalplot
                                                                       Evalplot
    SUBROUTINE BOXCOLOR(X,Y,IFILL,IBORDER)                             Evalplot
    RETURN                                                             Evalplot
    END                                                                Evalplot
```

```
                                                                    Evalplot
CHARACTER SET                                                       Evalplot
------------------------------------------------------------------- Evalplot
THIS PROGRAM USES COMPUTER AND PLOTTER DEVICE INDEPENDENT SOFTWARE Evalplot
CHARACTERS. THIS PROGRAM COMES WITH A FILE THAT DEFINES THE PEN    Evalplot
STROKES REQUIRED TO DRAW ALL CHARACTERS ON AN IBM KEYBOARD (UPPER  Evalplot
AND LOWER CASE CHARACTERS, NUMBERS, ETC.) PLUS AN ALTERNATE SET OF Evalplot
ALL UPPER AND LOWER CASE GREEK CHARACTERS AND ADDITIONAL SPECIAL   Evalplot
SYMBOLS.                                                           Evalplot
                                                                   Evalplot
THE SOFTWARE CHARACTER TABLE CONTAINS X AND Y AND PEN POSITIONS TO Evalplot
DRAW EACH CHARACTER. IF YOU WISH TO DRAW ANY ADDITIONAL CHARACTERS Evalplot
OR TO MODIFY THE FONT OF THE EXISTING CHARACTERS YOU NEED ONLY     Evalplot
MODIFY THIS TABLE.                                                 Evalplot
                                                                   Evalplot
ADDITIONAL FONTS                                                   Evalplot
----------------                                                   Evalplot
THIS PROGRAM COMES WITH 3 COMPLETE SETS OF THE SAME CHARACTERS     Evalplot
USING DIFFERENT FONTS. FOR SPEED IN PLOTTING IT IS RECOMMENDED     Evalplot
THAT YOU USE THE SIMPLEX FONT. FOR FINISHED PLOTS SUITABLE FOR     Evalplot
PUBLICATION, BUT REQUIRING MORE TIME TO GENERATE A PLOT, IT IS     Evalplot
RECOMMENDED THAT YOU USE THE DUPLEX OR COMPLEX FONT - YOU CAN      Evalplot
EXPERIMENT WITH ANY OF THE 3 FONTS TO DETERMINE WHICH BEST MEETS   Evalplot
YOUR NEEDS.                                                        Evalplot
                                                                   Evalplot
TO USE ANY ONE OF THE FONTS MERELY BY SURE THAT IT IS DEFINED AS   Evalplot
UNIT 12 FOR INPUT (IF USING STANDARD FILENAMES IT SHOULD BE        Evalplot
NAMED PLOT.CHR). SO THAT SWITCHING FONTS CAN BE SIMPLY DONE        Evalplot
MERELY BY COPYING THE FONT THAT YOU WANT TO THE UNIT 12 THAT       Evalplot
YOU ARE USING FOR INPUT.                                           Evalplot
                                                                   Evalplot
CONTROL CHARACTERS                                                 Evalplot
------------------------------------------------------------------ Evalplot
IN THE SOFTWARE CHARACTER TABLE ALL CHARACTERS TO BE PLOTTED WILL  Evalplot
HAVE PEN POSITION = 2 (DRAW) OR = 3 (MOVE). IN ADDITION THE TABLE  Evalplot
CURRENTLY CONTAINS 4 CONTROL CHARACTERS,                           Evalplot
                                                                   Evalplot
PEN POSITION = 0                                                   Evalplot
----------------                                                   Evalplot
SHIFT THE NEXT PRINTED CHARACTER BY X AND Y. 3 CONTROL CHARACTERS  Evalplot
ARE PRESENTLY INCLUDED IN THE SOFTWARE CHARACTER TABLE TO ALLOW    Evalplot
SHIFTING.                                                          Evalplot
                                                                   Evalplot
{   = SHIFT UP (FOR SUPERSCRIPTS.............X= 0.0, Y= 0.5)       Evalplot
}   = SHIFT DOWN (FOR SUBSCRIPTS.............X= 0.0, Y=-0.5)       Evalplot
\   = SHIFT LEFT 1 CHARACTER (FOR BACKSPACE...X=-1.0, Y= 0.0)      Evalplot
                                                                   Evalplot
PEN POSITION =-1                                                   Evalplot
----------------                                                   Evalplot
SELECT THE NEXT PRINTED CHARACTER FROM THE ALTERNATE CHARACTER     Evalplot
SET. AT PRESENT THIS CONTROL CHARACTER IS,                         Evalplot
                                                                   Evalplot
|   = SWITCH TO ALTERNATE CHARACTER SET                            Evalplot
                                                                   Evalplot
THESE 4 CONTROL CHARACTERS ARE ONLY DEFINED BY THE VALUE OF THE    Evalplot
PEN POSITION IN THE SOFTWARE CHARACTER TABLE (I.E., THEY ARE NOT   Evalplot
HARD WIRED INTO THIS PROGRAM). AS SUCH BY MODIFYING THE SOFTWARE   Evalplot
CHARACTER TABLE THE USER HAS THE OPTION OF DEFINING ANY CONTROL    Evalplot
CHARACTERS TO MEET SPECIFIC NEEDS.                                 Evalplot
                                                                   Evalplot
THESE CHARACTERS MAY BE USED IN CHARACTER STRINGS TO PRODUCE       Evalplot
SPECIAL EFFECTS. FOR EXAMPLE, TO PLOT SUBSCRIPT 5, B, SUPERSCRIPT  Evalplot
10 USE THE STRING,                                                 Evalplot
                                                                   Evalplot
}5B{1{0                                                            Evalplot
                                                                   Evalplot
TO PLOT B, SUBSCRIPT 5 AND SUPERSCRIPT 10 WITH THE 5 DIRECTLY      Evalplot
BELOW THE 1 OF THE 10 WE CAN USE THE BACKSPACE CHARACTER TO        Evalplot
POSITION THE 1 DIRECTLY ABOVE THE 5 USING THE STRING,              Evalplot
                                                                   Evalplot
B}5\{1{0                                                           Evalplot
```

```
                                                                      Evalplot
     TO PLOT UPPER CASE GREEK GAMMA FOLLOWED BY THE WORD TOTAL (I.E.,  Evalplot
     RESONANCE TOTAL WIDTH) USE THE STRING.                           Evalplot
                                                                      Evalplot
     |G TOTAL                                                        Evalplot
                                                                      Evalplot
     NOTE, WHEN THESE CONTROL CHARACTERS ARE USED THEY ONLY EFFECT THE Evalplot
     NEXT 1 PRINTED CHARACTER (SEE, ABOVE EXAMPLE OF PLOTTING SUPER-  Evalplot
     SCRIPT 10 WHERE THE SHIFT UP CONTROL CHARACTER WAS USED BEFORE THE Evalplot
     1 AND THEN AGAIN BEFORE THE 0 AND THE BACKSPACE AND SHIFT UP     Evalplot
     CONTROL CHARACTERS WERE USED IN COMBINATION).                    Evalplot
                                                                      Evalplot
     IF THESE 4 CONTROL CHARACTERS ARE NOT AVAILABLE ON YOUR COMPUTER  Evalplot
     YOU CAN MODIFY THE SOFTWARE CHARACTER TABLE TO USE ANY OTHER 4    Evalplot
     CHARACTERS THAT YOU DO NOT NORMALLY USE IN CHARACTER STRINGS (FOR Evalplot
     DETAILS SEE THE SOFTWARE CHARACTER TABLE).                       Evalplot
                                                                      Evalplot
     STANDARD/ALTERNATE CHARACTER SETS                                Evalplot
     ---------------------------------------------------------------- Evalplot
     THE SOFTWARE CHARACTER TABLE CONTAINS 2 SETS OF CHARACTERS WHICH  Evalplot
     ARE A STANDARD SET (ALL CHARACTERS ON AN IBM KEYBOARD) AND AN     Evalplot
     ALTERNATE SET (UPPER AND LOWER CASE GREEK CHARACTERS AND SPECIAL  Evalplot
     CHARACTERS). TO DRAW A CHARACTER FROM THE ALTERNATE CHARACTER SET Evalplot
     PUT A RIGHT BRACKET CHARACTER (|) BEFORE A CHARACTER (SEE THE     Evalplot
     ABOVE EXAMPLE AND THE SOFTWARE CHARACTER TABLE FOR DETAILS). THIS Evalplot
     CONTROL CHARACTER WILL ONLY EFFECT THE NEXT 1 PLOTTED CHARACTER.  Evalplot
                                                                      Evalplot
     SUB AND SUPER SCRIPTS                                            Evalplot
     ---------------------------------------------------------------- Evalplot
     TO DRAW SUBSCRIPT PRECEED A CHARACTER BY }. TO DRAW SUPERSCRIPT   Evalplot
     PRECEED A CHARACTER BY { (SEE THE ABOVE EXAMPLE AND THE SOFTWARE  Evalplot
     CHARACTER TABLE FOR DETAILS). THESE CONTROL CHARACTER WILL ONLY   Evalplot
     EFFECT THE NEXT 1 PLOTTED CHARACTER.                             Evalplot
                                                                      Evalplot
     BACKSPACING                                                      Evalplot
     ---------------------------------------------------------------- Evalplot
     TO BACKSPACE ONE CHARACTER PRECEED A CHARACTER BY \ (SEE, THE     Evalplot
     ABOVE EXAMPLE AND THE SOFTWARE CHARACTER TABLE FOR DETAILS). THIS Evalplot
     CONTROL CHARACTER WILL PERFORM A TRUE BACKSPACE AND WILL EFFECT   Evalplot
     ALL FOLLOWING CHARACTERS IN THE SAME CHARACTER STRING.            Evalplot
                                                                      Evalplot
     PLOT DIMENSIONS                                                  Evalplot
     ---------------                                                  Evalplot
     ARE DEFINED BY USER INPUT. INTERNALLY THE PROGRAM WILL CREATE A   Evalplot
     PLOT IN APPROXIMATELY A4 OR 8-1/2 BY 11 INCH FORMAT. DURING      Evalplot
     OUTPUT THE PLOT IS TRANSFORMED TO THE UNITS (INCHES, CENTIMETERS, Evalplot
     MILLIMETERS, WHATEVER) OF THE PLOTTER BEING USED AND OUTPUT.      Evalplot
                                                                      Evalplot
===== PLOTTER/GRAPHICS TERMINAL INTERFACE ============================ Evalplot
====================================================================== Evalplot
```

```
====================================================================== Fixup
                                                                       Fixup
     PROGRAM FIXUP                                                     Fixup
     VERSION 84-1 (NOVEMBER 1984)                                      Fixup
     VERSION 86-1 (JANUARY 1986) *IMPROVED BASED ON USER COMMENTS       Fixup
                                 *FORTRAN-77/H VERSION                 Fixup
     VERSION 86-2 (JUNE 1986)    *ALLOW CREATION OF SECTIONS OF CROSS   Fixup
                                  SECTIONS WHICH ARE NOT PRESENT IN    Fixup
                                  THE ORIGINAL EVALUATION              Fixup
     VERSION 88-1 (JULY 1988)    *OPTION...INTERNALLY DEFINE ALL I/O    Fixup
                                  FILE NAMES (SEE, SUBROUTINE FILEIO   Fixup
                                  FOR DETAILS).                        Fixup
                                 *IMPROVED BASED ON USER COMMENTS.     Fixup
     VERSION 89-1 (JANUARY 1989) *PSYCHOANALYZED BY PROGRAM FREUD TO    Fixup
                                  INSURE PROGRAM WILL NOT DO ANYTHING  Fixup
                                  CRAZY.                               Fixup
                                 *UPDATED TO USE NEW PROGRAM CONVERT    Fixup
                                  KEYWORDS.                            Fixup
                                 *ADDED LIVERMORE CIVIC COMPILER       Fixup
                                  CONVENTIONS.                         Fixup
     VERSION 89-2 (MARCH 1989)   *ADDED ENDF/B-VI SUMMATION RULES AND   Fixup
                                  DEFINED MF AND MT NUMBERS. PROGRAM   Fixup
                                  WILL NOW USE MF=1, MT=451 TO DEFINE  Fixup
                                  THE ENDF/B FORMAT OF THE DATA (E.G.,  Fixup
                                  ENDF/B-VI OR EARLIER) AND USE THE    Fixup
                                  CORRECT SUMMATION RULES FOR EACH     Fixup
                                  VERSION OF THE ENDF/B FORMAT. IF     Fixup
                                  MF=1, MT=451 IS NOT PRESENT PROGRAM  Fixup
                                  WILL USE ENDF/B-VI SUMMATION         Fixup
                                  CONVENTIONS AS A DEFAULT.            Fixup
     VERSION 90-1 (JUNE 1990)    *UPDATED BASED ON USER COMMENTS       Fixup
                                 *ADDED PHOTON INTERACTION, MF=23      Fixup
     VERSION 91-1 (JUNE 1991)    *ADDED FORTRAN SAVE OPTION            Fixup
                                 *NEW MORE CONSISTENT ENERGY OUTPUT    Fixup
                                  ROUTINE                              Fixup
     VERSION 92-1 (JANUARY 1992) *ADDED OPTION TO CALCULATE RATIOS,    Fixup
                                  E.G., CAPTURE/FISSION AND PRODUCTS,  Fixup
                                  NU-BAR*FISSION - AND OUTPUT THE      Fixup
                                  RESULTS IN THE ENDF/B FORMAT (SEE,   Fixup
                                  BELOW - CREATING RATIOS AND PRODUCTS) Fixup
                                 *ALLOW TOTAL NU-BAR (MF=1, MT=452) TO  Fixup
                                  BE USED IN DEFINING RATIOS OR        Fixup
                                  PRODUCTS.                            Fixup
                                 *ALLOW ALL CROSS SECTIONS TO BE PUT    Fixup
                                  ON A UNIFORM ENERGY GRID.            Fixup
                                 *NOTE, CHANGE IN INPUT FORMAT FOR      Fixup
                                  RANGES OF MT NUMBERS                 Fixup
                                 *COMPLETELY CONSISTENT I/O ROUTINES -  Fixup
                                  TO MINIMIZE COMPUTER DEPENDENCE.     Fixup
     VERSION 93-1 (JULY 1993)    *CORRECTED ALGORITHM TO CREATE UNIFORM Fixup
                                  ENERGY GRID.                         Fixup
     VERSION 94-1 (JANUARY 1993) *VARIABLE ENDF/B DATA FILENAMES       Fixup
                                  TO ALLOW ACCESS TO FILE STRUCTURES    Fixup
                                  (WARNING - INPUT PARAMETER FORMAT    Fixup
                                  HAS BEEN CHANGED)                    Fixup
                                 *INCREASED PAGE SIZE FROM 1002 TO     Fixup
                                  12000 DATA POINTS.                   Fixup
                                 *CLOSE ALL FILES BEFORE TERMINATING    Fixup
                                  (SEE, SUBROUTINE ENDIT)              Fixup
     VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                    Fixup
                                 *IMPROVED COMPUTER INDEPENDENCE       Fixup
                                 *ALL DOUBLE PRECISION                 Fixup
                                 *ON SCREEN OUTPUT                     Fixup
                                 *UNIFORM TREATMENT OF ENDF/B I/O      Fixup
                                 *IMPROVED OUTPUT PRECISION            Fixup
                                 *DEFINED SCRATCH FILE NAMES           Fixup
                                 *INCREASED PAGE SIZE FROM 12000 TO    Fixup
                                  36000 DATA POINTS.                   Fixup
     VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING      Fixup
                                  POINT READ FOR MORE DIGITS           Fixup
                                 *UPDATED TEST FOR ENDF/B FORMAT       Fixup
```

```
                            VERSION BASED ON RECENT FORMAT CHANGE Fixup
                           *GENERAL IMPROVEMENTS BASED ON         Fixup
                            USER FEEDBACK                         Fixup
VERSION 99-2 (JUNE 1999)    *ASSUME ENDF/B-VI, NOT V, IF MISSING  Fixup
                            MF=1, MT-451.                         Fixup
                           *FIXED CREATION OF SECTIONS            Fixup
VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON        Fixup
                            USER FEEDBACK                         Fixup
VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS            Fixup
                           *SUMMATION RULES ARE DEFINED BASED     Fixup
                            ON CONTENTS OF TABLES.                Fixup
VERS. 2004-1 (JAN. 2004)    *GENERAL UPDATE BASED ON USER FEEDBACK Fixup
                           *INCREASED PAGE SIZE FROM 36000 TO     Fixup
                            60000 DATA POINTS.                    Fixup
                                                                  Fixup
OWNED, MAINTAINED AND DISTRIBUTED BY                              Fixup
-----------------------------------                               Fixup
THE NUCLEAR DATA SECTION                                          Fixup
INTERNATIONAL ATOMIC ENERGY AGENCY                                Fixup
P.O. BOX 100                                                      Fixup
A-1400, VIENNA, AUSTRIA                                           Fixup
EUROPE                                                            Fixup
                                                                  Fixup
ORIGINALLY WRITTEN BY                                             Fixup
---------------------------------                                 Fixup
DERMOTT E. CULLEN                                                 Fixup
UNIVERSITY OF CALIFORNIA                                          Fixup
LAWRENCE LIVERMORE NATIONAL LABORATORY                            Fixup
L-159                                                             Fixup
P.O. BOX 808                                                      Fixup
LIVERMORE, CA 94550                                               Fixup
U.S.A.                                                            Fixup
TELEPHONE  925-423-7359                                           Fixup
E. MAIL    CULLEN1@LLNL.GOV                                       Fixup
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                            Fixup
                                                                  Fixup
PURPOSE                                                           Fixup
=======                                                           Fixup
THIS PROGRAM IS DESIGNED TO READ EVALUATED DATA IN THE ENDF/B     Fixup
FORMAT, PERFORM CORRECTIONS AND OUTPUT THE RESULT IN THE ENDF/B    Fixup
FORMAT. TWO TYPES OF CORRECTIONS ARE POSSIBLE (1) AUTOMATIC AND   Fixup
(2) OPTIONAL (BASED ON USER INPUT) CORRECTIONS.                    Fixup
                                                                  Fixup
ONE OF THE MOST IMPORTANT FUNCTIONS OF THIS PROGRAM IS TO         Fixup
RE-DEFINE ALL REDUNDANT CROSS SECTIONS (E.G. TOTAL) TO BE EXACTLY Fixup
EQUAL TO THE SUM OF ITS PARTS. THIS PROCEDURE ELIMINATES THE      Fixup
PROBLEM WITH MANY ENDF/B EVALUATIONS, WHERE DUE TO THE USE OF     Fixup
NON-LINEAR INTERPOLATION LAWS THE TOTAL MAY BE EQUAL TO THE SUM   Fixup
OF ITS PARTS AT ALL TABULATED ENERGIES, BUT BASED ON THE          Fixup
INTERPOLATION LAWS IT CAN BE QUITE DIFFERENT AT ENERGIES BETWEEN  Fixup
TABULATED ENERGIES.                                               Fixup
                                                                  Fixup
AUTOMATIC CHECKS/CORRECTIONS                                      Fixup
============================                                      Fixup
(1) CHECK THAT MAT/MF/MT DOES NOT CHANGE UNLESS A MEND/FEND/SEND  Fixup
    LINE IS READ. IF MAT/MF/MT CHANGES A WARNING MESSAGE IS       Fixup
    PRINTED BUT NO CORRECTIVE ACTION IS TAKEN.                    Fixup
(2) ALL LINES WITHIN A GIVEN MAT WILL BE SEQUENTIALLY NUMBERED    Fixup
    ON OUTPUT.                                                    Fixup
                                                                  Fixup
OPTIONAL CHECKS/CORRECTIONS                                       Fixup
===========================                                       Fixup
THE FOLLOWING NUMBERS CORRESPOND TO THE INPUT DATA OPTION COLUMNS  Fixup
(SEE THE DESCRIPTION OF THE INPUT BELOW)                          Fixup
                                                                  Fixup
(1) CORRECT ZA AND AWR IN ALL SECTIONS. CHECK TO INSURE THAT THE  Fixup
    C1 AND C2 VALUES (ZA AND AWR) ARE THE SAME IN ALL SECTIONS.   Fixup
    THE C1 AND C2 OF THE FIRST SECTION READ ARE ASSUMED TO BE     Fixup
    CORRECT AND ARE USED FOR COMPARISON. IF THE C1 AND/OR C2 OF   Fixup
    THE FIRST SECTION ARE NOT POSITIVE AN ERROR MESSAGE IS OUTPUT Fixup
    AND THE MATERIAL IS COPIED WITHOUT CHANGE.                    Fixup
```

```
    NOTE....TO CHANGE THE ZA AND/OR AWR OF ANY MATERIAL IT IS      Fixup
    MERELY NECESSARY TO CHANGE THE ZA AND/OR AWR IN THE FIRST      Fixup
    SECTION OF THE MATERIAL AND USE THIS OPTION TO AUTOMATICALLY   Fixup
    CHANGE ALL OTHER SECTIONS.                                     Fixup
(2) CORRECT CROSS SECTION (MF=3) THRESHOLDS. THE Q-VALUE AND AWR   Fixup
    ARE USED TO DERIVE THE REACTION THRESHOLD USING THE RELATION,  Fixup
                                                                   Fixup
    E-THRESHOLD = -(Q-VALUE)*(AWRE+1.0)/AWRE                       Fixup
                                                                   Fixup
    IF THE THRESHOLD IS POSITIVE THE CROSS SECTION IS CHECKED TO   Fixup
    INSURE THAT THE FIRST TABULATED POINT IS AT THE THRESHOLD AND  Fixup
    HAS A ZERO CROSS SECTION. IF NOT, THE CROSS SECTION WILL BE    Fixup
    CHANGED.                                                       Fixup
    (A) IF THE FIRST TABULATED POINT IS ABOVE THE THRESHOLD AND    Fixup
        HAS A ZERO CROSS SECTION, THE POINT IS DELETED AND A POINT Fixup
        IS INSERTED AT THE THRESHOLD.                              Fixup
    (B) IF THE FIRST TABULATED POINT IS ABOVE THE THRESHOLD AND    Fixup
        HAS A NON-ZERO CROSS SECTION, A POINT WITH ZERO CROSS      Fixup
        SECTION IS INSERTED AT THE THRESHOLD.                      Fixup
    (C) IF THE FIRST TABULATED POINT IS BELOW THE THRESHOLD AND    Fixup
        HAS A NON-ZERO CROSS SECTION, ALL POINTS BELOW THE         Fixup
        THRESHOLD ARE DELETED AND A POINT WITH ZERO CROSS SECTION  Fixup
        IS INSERTED AT THE THRESHOLD.                              Fixup
(3) EXTEND ALL CROSS SECTIONS (MF=3) TO 20 MEV. IF THE TABULATED   Fixup
    CROSS SECTION ENDS BELOW 20 MEV IT WILL BE EXTENDED TO 20 MEV  Fixup
    AS EITHER ZERO (IMOPS(3)=1) OR CONSTANT (IMOPS(3)=2) EQUAL     Fixup
    TO THE LAST TABULATED VALUE.                                   Fixup
(4) ALLOW REACTION (MF=3, ANY MT) DELETION. ALL SPECIFIED          Fixup
    REACTIONS WILL BE DELETED WHEN THE DATA IS READ FROM THE       Fixup
    INPUT ENDF/B DATA FILE AND WILL NOT BE IN THE OUTPUT ENDF/B    Fixup
    DATA FILE. WARNING DELETED REACTIONS MAY NOT BE USED TO DEFINE Fixup
    ANY RECONSTRUCTED REACTIONS (I.E. REACTIONS DEFINED BY SUMMING Fixup
    OTHER REACTIONS). SINCE DELETED REACTIONS ARE DELETED DURING   Fixup
    READING IT IS AS IF THEY NEVER EXISTED AND IF ANY DELETED      Fixup
    REACTION IS REQUIRED LATER TO DEFINE ANY SUM AN ERROR WILL     Fixup
    RESULT. THE USER MAY SPECIFY THAT THE DELETION RULES ARE TO BE Fixup
    READ FROM INPUT (IMOPS(4)=1) OR THAT THE BUILT IN SUMMATION    Fixup
    RULES ARE TO BE USED (MOPS(4)=2). AT THE PRESENT TIME THE      Fixup
    BUILT-IN DELETION RULES ARE THAT NO SECTIONS SHOULD BE DELETED Fixup
    (THE USER MAY OVERRIDE THIS CONVENTION BY INPUT).              Fixup
(5) ALLOW REACTION (MF=3, ANY MT) RECONSTRUCTION BY SUMMING OTHER  Fixup
    REACTIONS. IN ORDER TO OPTIMIZE THE RUNNING TIME OF THIS       Fixup
    PROGRAM CARE SHOULD BE EXERCISED TO MINIMIZE THE NUMBER OF     Fixup
    TIMES THAT EACH CONTRIBUTING CROSS SECTION MUST BE USED.       Fixup
    THE USED MAY SPECIFY THAT THE SUMMATION RULES ARE TO BE READ   Fixup
    AS INPUT (IMOPS(5)=1) OR THAT THE BUILT IN SUMMATION RULES     Fixup
    ARE TO BE USED (IMOPS(5)=2). THE BUILT IN SUMMATION RULES ARE  Fixup
    DESIGNED TO USE ENDF/B CONVENTIONS AND TO MINIMIZE THE NUMBER  Fixup
    OF TIMES THAT EACH CROSS SECTION IS USED.                      Fixup
(6) INSURE THAT ALL CROSS SECTIONS ARE NON-NEGATIVE (I.E. ARE      Fixup
    ZERO OR POSITIVE). DURING READING ALL NEGATIVE CROSS SECTIONS  Fixup
    WILL BE SET EQUAL TO ZERO AND TREATED AS SUCH DURING ALL       Fixup
    SUBSEQUENT SUMMATIONS AND ENDF/B OUTPUT.                       Fixup
    NOTE...THIS OPTION SHOULD NEVER BE USED WITH DATA CONTAINING   Fixup
    BACKGROUND CROSS SECTIONS WHICH MAY BE NEGATIVE. ONLY AFTER    Fixup
    THE RESONANCE CONTRIBUTION HAS BEEN ADDED TO THE BACKGROUND    Fixup
    TO DEFINE THE ACTUAL CROSS SECTION IS IT VALID TO ELIMINATE    Fixup
    NEGATIVE CROSS SECTIONS.                                       Fixup
    NOTE...THIS OPTION MAY BE USED TO DELETE NEGATIVE ELASTIC      Fixup
    CROSS SECTIONS THAT MAY RESULT FROM RECONSTRUCTING CROSS       Fixup
    SECTIONS FROM SINGLE LEVEL BREIT-WIGNER PARAMETERS. IF THE     Fixup
    TOTAL CROSS SECTION IS THEN RECONSTRUCTED USING THE CORRECTED  Fixup
    ELASTIC CROSS SECTION THE TOTAL WILL BE POSITIVE DUE TO THE    Fixup
    CONTRIBUTIONS OF CAPTURE AND FISSION (THUS AVOIDING NUMERICAL  Fixup
    INSTABILITY PROBLEMS DURING SELF-SHIELDING CALCULATIONS).      Fixup
(7) WITHIN EACH SECTION OF CROSS SECTIONS DELETE ENERGIES THAT     Fixup
    ARE NOT IN ASCENDING ENERGY ORDER (ENERGY REPETITION IS O.K.)  Fixup
(8) WITHIN EACH SECTION OF CROSS SECTIONS ELIMINATE DUPLICATE      Fixup
    POINTS (SUCCESSIVE POINTS WITH THE SAME ENERGY-CROSS SECTION). Fixup
(9) TEST THAT ALL SECTIONS ARE IN ASCENDING MAT/MF/MT ORDER.       Fixup
    IF NOT, NO CORRECTIVE ACTION WILL BE TAKEN, ONLY AN ERROR      Fixup
```

```
     MESSAGE WILL BE OUTPUT.                                          Fixup
(10) CHECK MF/MT FOR EACH SECTION TO INSURE THAT THEY ARE DEFINED     Fixup
     IN THE ENDF/B FORMAR MANUAL. IF THEY ARE NOT DEFINED AN ERROR    Fixup
     MESSAGE IS PRINTED, BUT NO CORRECTIVE ACTION IS TAKEN.           Fixup
(11) ALLOW SECTIONS WHICH ARE NOT PRESENT IN THE ORIGINAL (INPUT)     Fixup
     EVALUATION TO BE CREATED. NORMALLY THIS PROGRAM WILL ONLY        Fixup
     RECONSTRUCT AND OUTPUT SECTIONS IF THE SECTION IS PRESENT        Fixup
     IN THE ORIGINAL EVALUATION. THIS PROCEDURE IS FOLLOWED BECAUSE   Fixup
     NORMALLY THE PROGRAM DOES NOT KNOW HOW TO DEFINE THE CONTENTS    Fixup
     OF THE FIRST TWO LINES OF THE SECTION (E.G., Q-VALUE,            Fixup
     TEMPERATURE, INITIAL AND FINAL STATES). THIS OPTION MAY BE       Fixup
     USED TO ALLOW THE PROGRAM TO READ AND SAVE A TABLE DEFINING      Fixup
     THE CONTENTS OF THE FIRST TWO LINES OF EACH SECTION TO BE        Fixup
     CREATED.                                                         Fixup
     NOTE...IF A SECTION IS PRESENT ANY COMMAND TO CREATE IT WILL     Fixup
     BE IGNORED.                                                      Fixup
 (12)ALLOW ENERGY POINTS TO BE INSERTED. THE PROGRAM CAN READ UP      Fixup
     TO 50, ENERGIES, MAT, MT AND USE LINEAR INTERPOLATION TO         Fixup
     INSERT ENERGY POINTS INTO TABLES AS THEY ARE READ, E.G.,         Fixup
     INSERT AN ENERGY POINT AT THERMAL ENERGY (0.0253 EV). IF         Fixup
     AN MAT AND/OR MT IS ZERO THIS IMPLIES = ALL - INSERT THE         Fixup
     ENERGY IN ALL TABLES.                                            Fixup
 (13)PUT ALLOW CROSS SECTIONS ON A UNIFORM ENERGY GRID = EACH         Fixup
     SECTION (MT) OF CROSS SECTIONS WILL INCLUDE ALL ENERGIES         Fixup
     WHICH APPEAR IN AT LEAST ONE SECTION OF DATA. PARAMETERS         Fixup
     (MT=251 THROUGH 255) ARE NOT INCLUDED IN THE UNIFORM ENERGY      Fixup
     GRID.                                                            Fixup
 (14)DELETE SECTION IF CROSS SECTION = 0 AT ALL ENERGIES. THIS        Fixup
     SOUNDS LIKE AN ABSURD OPTION, BUT IS REQUIRED BECAUSE SUCH       Fixup
     SECTIONS EXIST IN ENDF/B-VI.                                     Fixup
                                                                      Fixup
 CREATING RATIOS AND PRODUCTS                                         Fixup
 ============================                                         Fixup
 IN ORDER TO CREATE RATIOS AND PRODUCTS = NEW MT NUMBERS, YOU MUST    Fixup
 DO TWO THINGS,                                                       Fixup
                                                                      Fixup
 1) DEFINE EACH NEW MT NUMBER AS A RATIO OR PRODUCT OF TWO MT         Fixup
    NUMBERS.                                                          Fixup
                                                                      Fixup
 2) USE THE CREATE MT NUMBER OPTION AND INPUT THE FIRST TWO LINES     Fixup
    OF THE SECTION                                                    Fixup
                                                                      Fixup
 WARNING - UNLESS YOU DO BOTH OF THESE YOU WILL NOT OBTAIN OUTPUT     Fixup
 IN THE ENDF/B FORMAT.                                                Fixup
                                                                      Fixup
 TWO SPECIAL MT NUMBERS HAVE BEEN DEFINED BY CSEWG INVOLVING          Fixup
 RATIOS AND PRODUCTS,                                                 Fixup
                                                                      Fixup
 ALPHA (MT=254)= CAPTURE (MT=102)/FISSION (MT=18)                     Fixup
                                                                      Fixup
 ETA (MT=255)  = NU-BAR (MT=452)*FISSION (MT=18)/ABSORPTION (MT=27)   Fixup
                                                                      Fixup
 ABSORPTION (MT=27) = FISSION (MT=18) + SUM (MT=102 THROUGH 116)      Fixup
                                                                      Fixup
 AS YET THERE IS NO STANDARD DEFINITION OF MT NUMBERS FOR RATIO       Fixup
 OR PRODUCT DATA. YOU ARE FREE TO USE ANY MT NUMBERS NORMALLY NOT     Fixup
 USED IN THE ENDF/B. HOWEVER, IT WILL THEN BE YOUR RESPONSIBILITY     Fixup
 TO PROPERLY INTERPRET THE RESULTS, I.E., NOBODY ELSE WILL HAVE       Fixup
 ANY IDEA HOW TO INTERPRET A TABLE OF DATA ASSOCIATED WITH THE MT     Fixup
 NUMBERS YOU HAVE USED.                                               Fixup
                                                                      Fixup
 THIS PROGRAM CAN BE ONLY DIRECTLY DEFINE RATIOS AND PRODUCTS         Fixup
 USING TWO MT NUMBERS = BINARY OPERATIONS, E.G., DEFINE THE CAPTURE   Fixup
 TO FISSION RATIO, OR DEFINE THE PRODUCT NU-BAR*FISSION.              Fixup
                                                                      Fixup
 THIS PROGRAM CANNOT DIRECTLY DEFINE RATIO OR PRODUCT OF A SUM OF     Fixup
 SECTIONS TO THE SUM OF ANOTHER SET OF SECTIONS. HOWEVER, THIS CAN    Fixup
 BE DONE INDIRECTLY BY FIRST DEFINING A DUMMY MT NUMBER (ANY MT       Fixup
 NUMBER NOT NORMALLY USED IN ENDF/B) TO BE A SUM OF SECTIONS AND      Fixup
 A SECOND DUMMY MT NUMBER TO BE A SECOND SUM OF SECTIONS. YOU CAN     Fixup
 THEN DEFINE RATIO OR PRODUCT YOU REQUIRE TO BE THE RATIO OF THESE    Fixup
```

```
TWO DUMMY MT NUMBERS.                                                  Fixup
                                                                       Fixup
FOR EXAMPLE, TO DEFINE ETA,                                            Fixup
1) FIRST DEFINE (MT=27) = (MT=27) + (SUM OF MT=102 THROUGH 116)        Fixup
2) NEXT DEFINE (MT=333) = (MT=452)*(MT=18)                             Fixup
3) LAST DEFINE (MT=255) = (MT=333)/(MT=27)                             Fixup
DO NOT FORGET TO TURN ON THE CREATE SECTION OPTION (ON THE FIRST       Fixup
INPUT LINE) AND INPUT THE FIRST TWO LINES OF SECTION MT=255 -          Fixup
OTHERWISE YOU WILL NOT GET ANY ENDF/B FORMATTED OUTPUT.                 Fixup
                                                                       Fixup
THE ONLY SPECIAL CONVENTIONS USED BY THIS PROGRAM IN CALCULATING       Fixup
RATIOS ARE WHEN THE DENOMINATOR OF THE RATIO IS ZERO. IN THIS          Fixup
CASE IF THE NUMERATOR IS ALSO ZERO THE RATIO IS DEFINED TO BE ONE.     Fixup
IN THIS CASE IF THE NUMERATOR IS NOT ZERO THE RATIO IS DEFINED         Fixup
TO BE ZERO.                                                            Fixup
                                                                       Fixup
ENDF/B FORMAT                                                          Fixup
=============                                                          Fixup
THIS PROGRAM MAY BE USED WITH DATA IN ANY VERSION OF THE ENDF/B        Fixup
FORMAT (I.E. ENDF/B-I, II, III, IV, V OR VI FORMAT). SINCE A           Fixup
PAGING SYSTEM IS USED STORE CROSS SECTION TABLES ON SCRATCH FILES      Fixup
THERE IS NO LIMIT TO THE SIZE OF TABLES (E.G. THE TOTAL CROSS          Fixup
SECTION MAY BE REPRESENTED BY 200,000 TABULATED POINTS).               Fixup
                                                                       Fixup
WARNING                                                                Fixup
=======                                                                Fixup
(1) FOR EACH SECTION OF CROSS SECTIONS (I.E. EACH MT, MF=3) IN         Fixup
    THE ORIGINAL EVALUATION (I.E. ENDF/B DATA READ) ONE SECTION        Fixup
    OF DATA WILL BE OUTPUT, UNLESS THE SECTION HAS BEEN DELETED.       Fixup
    THIS INCLUDES ANY SECTIONS WHICH ARE NOT PRESENT IN THE            Fixup
    ORIGINAL EVALUATION, BUT THE USER INDICATES (BY INPUT) SHOULD      Fixup
    BE CREATED.                                                        Fixup
                                                                       Fixup
    THE PROGRAM WILL NOT OUTPUT ANY SECTION RECONSTRUCTED BY           Fixup
    SUMMATION UNLESS THE CORRESPONDING SECTION (MT NUMBER) IS          Fixup
    PRESENT IN THE ORIGINAL EVALUATION OR USER INPUT INDICATES         Fixup
    SHOULD BE CREATED AND OUTPUT. THIS IS (A) BECAUSE THE              Fixup
    PROGRAM CANNOT DEFINE THE PARAMETERS TO APPEAR ON THE FIRST        Fixup
    TWO LINES OF THE SECTION, (B) TO AVOID OUTPUTTING TOO MUCH         Fixup
    DATA WHICH THE USER MAY NOT BE INTERESTED IN.                      Fixup
                                                                       Fixup
(2) FOR ANY SECTIONS THAT DO NOT APPEAR IN THE ORIGINAL DATA THE       Fixup
    USER MAY SPECIFY THAT THEY BE DEFINED BY SUMMATION. ANY SUCH       Fixup
    SECTION MAY BE USED BE DEFINE SUBSEQUENT SUMS, BUT THE SECTION     Fixup
    ITSELF WILL NOT BE OUTPUT (E.G. GENERALLY MT=27 AND 101 ARE        Fixup
    NOT PRESENT IN EVALUATIONS. HOWEVER, THE BUILT-IN SUMMATION        Fixup
    RULES OF THIS PROGRAM USES THE ENDF/B SUMMATION RULES TO           Fixup
    DEFINE MT=27 AND 101, WHICH IN TURN ARE USED TO DEFINE THE         Fixup
    NON-ELASTIC CROSS SECTION, MT=3. SECTIONS MT=27 AND 101 ARE        Fixup
    NOT OUTPUT).                                                       Fixup
                                                                       Fixup
(3) ALL DATA IN FILE 3 AND 23 MUST BE LINEARLY INTERPOLABLE. IF        Fixup
    THE DATA IS NOT LINEARLY INTERPOLABLE THIS PROGRAM WILL            Fixup
    TERMINATE.                                                         Fixup
                                                                       Fixup
PROGRAM OPERATION                                                      Fixup
=================                                                      Fixup
ALL MAT NUMBER ON AN ENDF/B TAPE ARE PROCESSED. EACH MAT IS            Fixup
TREATED SEPARATELY. WITHIN EACH MAT, EACH SECTION BEFORE MF=3          Fixup
IS READ, CHECKED/CORRECTED (BASED ON INPUT OPTIONS) AND OUTPUT.        Fixup
WHEN MF=3 IS LOCATED ALL CROSS SECTIONS ARE READ, SECTIONS TO BE       Fixup
DELETED ARE DELETED, SECTIONS WHICH ARE NOT PRESENTED AND USER         Fixup
INPUT INDICATES SHOULD BE CREATED ARE CREATE, SECTIONS TO BE KEPT      Fixup
ARE CHECKED/CORRECTED (BASED ON INPUT OPTIONS) AND WRITTEN TO A        Fixup
SCRATCH FILE. NEXT, IF THE USER SPECIFIES THAT THEY SHOULD,            Fixup
SECTIONS ARE RECONSTRUCTED. FINALLY ALL CROSS SECTIONS (OLD AND        Fixup
NEW) ARE OUTPUT. WITHIN THE SAME MAT, EACH SECTION AFTER MF=3 IS       Fixup
READ, CHECKED/CORRECTED (BASED ON INPUT OPTIONS) AND OUTPUT.           Fixup
                                                                       Fixup
MF=3                                                                   Fixup
====                                                                   Fixup
```

```
THE TREATMENT OF THE CROSS SECTIONS REQUIRES UP TO 4 PASSES FOR    Fixup
CROSS SECTIONS. IN THE PROGRAM THEY CORRESPOND TO SUBROUTINES      Fixup
PASS1, PASS2, PASS3 AND PASS4. THE ORIGINAL AND FINAL ENDF/B DATA  Fixup
FILES, 5 SCRATCH FILES AND 3 IN CORE ARRAYS ARE USED. OPERATIONS   Fixup
PERFORMED DURING EACH PASS ARE,                                    Fixup
                                                                   Fixup
PASS1                                                              Fixup
=====                                                              Fixup
READ ALL CROSS SECTIONS FROM ITAPE. DELETED ANY SECTIONS. CREATE   Fixup
ANY SECTIONS. CHECK/CORRECT THEM AND WRITE THEM TO SCRATCH FILE.   Fixup
DATA IS READ INTO ARRAY A, TRANSFERRED TO ARRAY C (AFTER EDITING)  Fixup
AND OUTPUT TO ISCRC FROM ARRAY C.                                  Fixup
ITAPE  - UNIT ORIGINAL ENDF/B DATA IS READ FROM.                   Fixup
ISCRC  - SCRATCH UNIT THAT EDITED DATA IS WRITTEN ON.              Fixup
TABA   - ARRAY INTO WHICH ORIGINAL DATA IS READ.                   Fixup
TABC   - ARRAY INTO WHICH EDITED DATA IS TRANSFERRED TO AND        Fixup
         FROM WHICH IT IS WRITTEN TO ISCRC.                        Fixup
                                                                   Fixup
PASS2                                                              Fixup
=====                                                              Fixup
IF A UNIFORM ENERGY GRID IS REQUESTED IT IS CREATED DURING THIS    Fixup
PASS. FIRST ALL OF THE CROSS SECTIONS FROM PASS1 ARE READ AND A    Fixup
UNIFORM ENERGY GRID IS CREATED = ALL ENERGIES THAT ARE INCLUDED    Fixup
IN AT LEAST ONE SECTION (MT) OF CROSS SECTIONS.                    Fixup
ISCRA  - SCRATCH UNIT CONTAINING UNIFORM ENERGY GRID.              Fixup
ISCRB  - SCRATCH UNIT CONTAINING UNIFORM ENERGY GRID.              Fixup
ISCRC  - SCRATCH UNIT THAT EDITED DATA IS READ FROM.               Fixup
TABA   - ARRAY CONTAINING UNIFORM ENERGY GRID.                     Fixup
TABB   - ARRAY CONTAINING UNIFORM ENERGY GRID.                     Fixup
TABC   - ARRAY CONTAINING EDITED DATA.                             Fixup
                                                                   Fixup
THE UNIFORM ENERGY GRID ENDS UP ON ISCRB. NEXT EACH SECTION OF     Fixup
CROSS SECTIONS FROM PASS1 IS READ FROM ISCRC, INTERPOLATED TO      Fixup
THE UNIFORM ENERGY GRID AND OUTPUT TO ISCRA. FINALLY ISCRA AND     Fixup
ISCRC ARE SWITCH, SO THAT AT THE END OF THIS PASS THE DATA WILL    Fixup
AGAIN BE ON ISCRC (EXACTLY AS AT THE END OF PASS1), WITH UPDATED   Fixup
POINT COUNTS.                                                      Fixup
ISCRA  - SCRATCH UNIT THAT UNIFORM ENERGY GRID DATA IS WRITTEN ON. Fixup
ISCRB  - SCRATCH UNIT CONTAINING UNIFORM ENERGY GRID.              Fixup
ISCRC  - SCRATCH UNIT THAT EDITED DATA IS READ FROM.               Fixup
TABA   - ARRAY CONTAINING UNIFORM ENERGY GRID DATA.                Fixup
TABB   - ARRAY CONTAINING UNIFORM ENERGY GRID.                     Fixup
TABC   - ARRAY CONTAINING EDITED DATA.                             Fixup
                                                                   Fixup
PASS3                                                              Fixup
=====                                                              Fixup
SUMMATION CROSS SECTIONS ARE DEFINED BY READING DATA FROM ISCRC    Fixup
AND MERGING THEM ONTO ISCRA. THE FIRST SECTION THAT CONTRIBUTES    Fixup
TO A SUM IS MERELY COPIED FROM C TO A. IF MORE SECTIONS WILL       Fixup
CONTRIBUTE TO THE SUM THE DATA IN A IS TRANSFERRED TO B, A         Fixup
SECTION OF DATA FROM C IS ADDED TO THE DATA IN B AND STORED IN     Fixup
A. THE CYLE OF ADDED C AND B TO A, FOLLOWED BY MOVING A TO B       Fixup
IS CONTINUED UNTIL ALL CONTRIBUTING SECTIONS HAVE BEEN ADDED.      Fixup
THE SUM IS THEN COPIED FROM A TO D. IF NEWLY CONSTRUCTED SECTION   Fixup
IS REQUIRED FOR ANY LATER SUMMUATIONS IT IS ALSO COPIED TO E.      Fixup
THE CYCLE OF ADDED SECTIONS FROM C AND B TO A IS REPEATED FOR      Fixup
EACH REQUIRED SUMMATION REACTION. IN ADDITION TO SECTIONS FROM     Fixup
C, AFTER THE FIRST SUMMATION SECTIONS MAY ALSO BE ADDED TO A       Fixup
FROM E (THE CONTRIBUTION OF NEW RECONSTRUCTED CROSS SECTIONS).     Fixup
WHEN ALL REQUIRED SECTIONS HAVE BEEN RECONSTRUCTED THE NEW         Fixup
SECTIONS WILL BE ON E AND THE ORIGINAL SECTIONS ON C.              Fixup
ISCRC  - SCRATCH FILE FROM WHICH ORIGINAL DATA IS READ.            Fixup
ISCRA  - SCRATCH FILE ONTO WHICH SUM FOR ONE SECTION IS WRITTEN.   Fixup
ISCRD  - SCRATCH FILE ONTO WHICH ALL SUM CROSS SECTIONS ARE        Fixup
         WRITTEN.                                                  Fixup
ISCRE  - SCRATCH FILE ONTO WHICH ALL SUM CROSS SECTIONS WHICH      Fixup
         ARE REQUIRED FOR LATER SUMS ARE WRITTEN.                  Fixup
ISCRB  - UTILITY SCRATCH FILE USED TO CREATE SUM CROSS SECTIONS.   Fixup
TABA   - ARRAY INTO WHICH SUMS ARE WRITTEN.                        Fixup
TABB   - ARRAY INTO WHICH PARTIAL SUMS ARE WRITTEN.                Fixup
TABC   - ARRAY INTO WHICH ORIGINAL DATA IS READ.                   Fixup
```

```
                                                                      Fixup
 PASS4                                                                Fixup
 =====                                                                Fixup
 CROSS SECTIONS ARE READ FROM ISCRC (ORIGINAL) AND ISCRD (NEW)        Fixup
 AND ARE WRITTEN IN THE ENDF/B FORMAT ON OTAPE. THE BEGINNING OF      Fixup
 EACH SECTION OF ORIGINAL DATA IS READ FROM ISCRC (TO DEFINE          Fixup
 SECTION HEADER INFORMATION). IF THIS MT HAS NOT BEEN RECOSTRUCTED    Fixup
 ON ISCRD THE ORIGINAL SECTION IS OUTPUT. IF THE SECTION HAS BEEN     Fixup
 RECONSTRUCTED THE ORIGINAL SECTION IS SKIPPED AND THE NEW SECTION    Fixup
 IS OUTPUT.                                                           Fixup
 OTAPE  - OUTPUT DATA IN THE ENDF/B FORMAT.                           Fixup
 ISCRC  - SCRATCH FILE FROM WHICH ORIGINAL DATA IS READ.              Fixup
 ISCRD  - SCRATCH FILE FROM WHICH NEW DATA IS READ.                   Fixup
 TABC   - ARRAY INTO WHICH CROSS SECTIONS ARE READ FROM SCRATCH       Fixup
          AND WRITTEN TO OTAPE                                        Fixup
                                                                      Fixup
 I/O FILE DEFINITIONS                                                 Fixup
 ====================                                                 Fixup
 UNIT   DESCRIPTION                                                   Fixup
 ====   ===========                                                   Fixup
   2    INPUT PARAMETERS.                                             Fixup
   3    OUTPUT REPORT.                                                Fixup
  10    ORIGINAL DATA IN THE ENDF/B FORMAT.                           Fixup
  11    FINAL DATA IN THE ENDF/B FORMAT.                              Fixup
  12    SCRATCH FILE                                                  Fixup
  14    SCRATCH FILE                                                  Fixup
  15    SCRATCH FILE                                                  Fixup
  16    SCRATCH FILE                                                  Fixup
  17    SCRATCH FILE                                                  Fixup
                                                                      Fixup
 OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILIO1 AND FILIO2)      Fixup
 ============================================================         Fixup
 UNIT  FILE NAME   FORMAT                                             Fixup
 ====  ==========  ======                                             Fixup
   2   FIXUP.INP    BCD                                             Fixup
   3   FIXUP.LST    BCD                                             Fixup
  10   ENDFB.IN     BCD                                             Fixup
  11   ENDFB.OUT    BCD                                             Fixup
12-17  (SCRATCH)   BINARY                                           Fixup
                                                                      Fixup
 INPUT LINES                                                          Fixup
 ===========                                                          Fixup
 LINE  COLUMNS  FORMAT  DESCRIPTION                                   Fixup
 ====  =======  ======  ===========                                   Fixup
   1    1-14     14I1   INPUT OPTIONS AS DESCRIBED ABOVE.             Fixup
                        EACH COLUMN OF THE INPUT LINE CONTROLS        Fixup
                        ONE OF THE TESTS/CORRECTIONS DESCRIBED        Fixup
                        ABOVE. TESTS/CORRECTION 1-14 (NOT ALL         Fixup
                        IMPLEMENTED YET) CORRESPOND TO COLUMNS        Fixup
                        1-14 OF THIS INPUT LINE AND ARE TREATED       Fixup
                        AS FOLLOWS,                                   Fixup
                        = 0 - DO NOT PERFORM TEST/CORRECTION.         Fixup
                        = 1 - PERFORM TEST/CORRECTION.                Fixup
                        FOR MT EXCLUSION FROM THRESHOLD TESTS         Fixup
                        (COLUMN 2), DELETION (COLUMN 4), OR           Fixup
                        SUMMATION (COLUMN 5) THE INPUT OPTION         Fixup
                        MAY BE,                                       Fixup
                        = 1 - READ RULES FROM INPUT                   Fixup
                        = 2 - USE BUILT-IN RULES                      Fixup
   2    1-60      A60   ENDF/B INPUT DATA FILENAME                   Fixup
                        (STANDARD OPTION = ENDFB.IN)                  Fixup
   3    1-60      A60   ENDF/B OUTPUT DATA FILENAME                  Fixup
                        (STANDARD OPTION = ENDFB.OUT)                 Fixup
 4-M    1-5      FREE   CHARACTER (S,D,T,R,*) FOLLOWED BY BLANK OR    Fixup
                 FORM   MT NUMBER                                     Fixup
                        - THE ALLOWED CHARACTERS ARE,                 Fixup
                        - S OR BLANK = SUM (OR DIFFERENCES)           Fixup
                        - D = DELETE                                  Fixup
                        - T = NO THRESHOLD ENERGY CORRECTIONS         Fixup
                        - R = RATIO                                   Fixup
                        - * = PRODUCT                                 Fixup
```

```
6-72      FREE   UP TO 10 LOWER AND UPPER MT RANGES WHICH    Fixup
          FORM   WILL BE USED TO DEFINE THE RECONSTRUCTED    Fixup
                 CROSS SECTION OR TO DEFINE MT RANGES WHICH  Fixup
                 ARE EXCLUDED FROM THRESHOLD TESTS.          Fixup
                                                             Fixup
                 EACH MT NUMBER IS DEFINED BY A CONTINUOUS   Fixup
                 STRING OF DIGITS, POSSIBILITY PRECEEDED BY  Fixup
                 A - (MINUS SIGN). EACH MT NUMBER MUST BE    Fixup
                 BLANK OR OTHERWISE (NOT A DIGIT) DELIMITED. Fixup
                                                             Fixup
                 COLUMNS 6-72 MAY CONTAIN STRINGS OF DIGITS  Fixup
                 THE FIRST DIGIT STRING OF EACH PAIR MAY BE  Fixup
                 PRECEEDED BY A - (MINUS SIGN).              Fixup
                                                             Fixup
                 EACH LINE WILL BE INTERPRETED AS FOLLOWS,   Fixup
                                                             Fixup
                *SUMMATION (OR DIFFERENCES)                  Fixup
                 -------------------------                  Fixup
                 COLUMNS 1-5 = S OR BLANK FOLLOWED BY THE    Fixup
                 MT NUMBER TO BE DEFINED BY SUMMATION        Fixup
                                                             Fixup
                 COLUMNS 6-72 = UP TO 10 MT RANGE (PAIRS OF  Fixup
                 MT NUMBERS) TO BE USED TO DEFINED THE SUM.  Fixup
                 IF THE FIRST MT NUMBER OF A PAIR IS         Fixup
                 NEGATIVE THE RANGE OF MT NUMBERS IS         Fixup
                 SUBTRACTED - AT LEAST ONE RANGE MUST BE     Fixup
                 SPECIFIED.                                  Fixup
                                                             Fixup
                *DELETIONS                                   Fixup
                 ---------                                  Fixup
                 COLUMNS 1-5 = D FOLLOWED BY BLANKS          Fixup
                                                             Fixup
                 COLUMNS 6-72 CONTAIN UP TO 10 MT RANGE      Fixup
                 (PAIRS OF MT NUMBERS), EACH RANGE DEFINING  Fixup
                 A RANGE OF MT NUMBERS TO BE DELETED - AT    Fixup
                 LEAST ONE RANGE MUST BE SPECIFIED.          Fixup
                                                             Fixup
                *EXCLUSION FROM THRESHOLD TESTS              Fixup
                 ------------------------------             Fixup
                 COLUMNS 1=5 = T FOLLOWED BY BLANKS          Fixup
                                                             Fixup
                 COLUMNS 6-72 CONTAIN UP TO 10 MT RANGE      Fixup
                 (PAIRS OF MT NUMBERS), EACH RANGE DEFINING  Fixup
                 A RANGE OF MT NUMBERS WHOSE THRESHOLD       Fixup
                 ENERGY WILL NOT BE CHECKED - AT LEAST ONE   Fixup
                 RANGE MUST BE SPECIFIED.                    Fixup
                                                             Fixup
                *RATIO                                       Fixup
                 -----                                      Fixup
                 COLUMNS 1-5 = R FOLLOWED BY THE MT NUMBER   Fixup
                 TO BE DEFINED BY A RATIO                    Fixup
                                                             Fixup
                 COLUMNS 6-72 CONTAINS 2 MT NUMBERS TO BE    Fixup
                 USED TO DEFINE THE RATIO.                   Fixup
                                                             Fixup
                *PRODUCT                                     Fixup
                 -----                                      Fixup
                 COLUMNS 1-5 = * FOLLOWED BY THE MT NUMBER   Fixup
                 TO BE DEFINED BY A PRODUCT                  Fixup
                                                             Fixup
                 COLUMNS 6-72 CONTAINS 2 MT NUMBERS TO BE    Fixup
                 USED TO DEFINE THE PRODUCT.                 Fixup
                                                             Fixup
                 CONVENTIONS                                 Fixup
                 -----------                                 Fixup
                *UP TO 20 DELETIONS AND 20 SUMMATIONS OR     Fixup
                 RATIOS OR PRODUCTS MAY BE SPECIFIED.        Fixup
                *ONLY 1 EXCLUSION FROM THRESHOLD TESTS       Fixup
                 MAY BE SPECIFIED (THE 1 LINE MAY CONTAIN    Fixup
                 UP TO 10 MT RANGES TO EXCLUDE FROM TESTS).  Fixup
                *INPUT IS TERMINATED BY INPUTTNG 0 OR        Fixup
```

```
                          BLANK IN COLUMNS 1-72 (I.E. THE LAST        Fixup
                          INPUT LINE MUST BE BLANK).                  Fixup
                         *THE UPPER LIMIT OF EACH RANGE MUST BE AT    Fixup
                          LEAST AS BIG AS THE LOWER LIMIT (IN         Fixup
                          ABSOLUTE VALUE).                            Fixup
                         *FOR RECONSTRUCTION POSITIVE MT RANGES WILL  Fixup
                          BE ADDED TO THE SUM AND NEGATIVE MT RANGES  Fixup
                          WILL BE SUBTRACTED.                         Fixup
                         *IF INPUT OPTION 2 (FIRST INPUT LINE) IS     Fixup
                          0 THRESHOLD EXCLUSION IS NOT ALLOWED.       Fixup
                         *IF INPUT OPTION 4 (FIRST INPUT LINE) IS     Fixup
                          0 DELETIONS ARE NOT ALLOWED.                Fixup
                         *IF INPUT OPTION 5 (FIRST INPUT LINE) IS     Fixup
                          0 SUMMATIONS AND RATIOS ARE NOT ALLOWED.    Fixup
   N-K                    IF THE USER SPECIFIES THAT SECTIONS WHICH   Fixup
                          ARE NOT PRESENT IN THE ORIGINAL EVALUATION  Fixup
                          MAY BE CREATED, TWO LINES MUST BE INPUT FOR Fixup
                          EACH SECTION TO BE CREATED. THE TWO LINES   Fixup
                          DEFINE (C1, C2, L1 AND L2) FOR EACH OF THE  Fixup
                          FIRST TWO LINES OF THE SECTION TO BE        Fixup
                          CREATED. THE FIRST LINE ALSO DEFINES (MAT   Fixup
                          AND MT). (N1, N2) ARE ALWAYS ZERO ON THE    Fixup
                          FIRST LINE AND WILL BE CALCULATED BY THE    Fixup
                          PROGRAM FOR THE SECOND LINE.                Fixup
 FIRST     1-11     E11.4  ZA OF SECTION TO BE CREATED                 Fixup
 LINE     12-22     E11.4  AWRE OF SECTION TO BE CREATED               Fixup
          23-33      I11   L1 OF SECTION TO BE CREATED                 Fixup
          34-44      I11   L2 OF SECTION TO BE CREATED                 Fixup
          45-48      I4    MAT OF SECTION TO BE CREATED                Fixup
          49-51      I3    MT OF SECTION TO BE CREATED                 Fixup
SECOND     1-11     E11.4  C1 OF SECTION TO BE CREATED                 Fixup
 LINE     12-22     E11.4  C2 OF SECTION TO BE CREATED                 Fixup
          23-33      I11   L1 OF SECTION TO BE CREATED                 Fixup
          34-44      I11   L2 OF SECTION TO BE CREATED                 Fixup
                         *PAIRS OF LINES MAY BE IN ANY MAT/MT ORDER   Fixup
                          (E.G., THEY NEED NOT BE IN ASCENDING        Fixup
                           MAT/MT ORDER).                             Fixup
                         *UP TO 50 PAIRS OF LINES MAY BE USED TO      Fixup
                          DEFINE SECTIONS TO BE CREATED. THE LIST     Fixup
                          IS TERMINATED WHEN THE FIRST LINE OF A      Fixup
                          PAIR CONTAINS A ZERO (OR BLANK) MAT AND/OR  Fixup
                          MT.                                         Fixup
   M-N                    IF THE USER SPECIFIES THAT ENERGIES WHICH   Fixup
                          ARE NOT PRESENT IN THE ORIGINAL EVALUATION  Fixup
                          MAY BE INSERTED, ONE LINE MUST BE INPUT FOR Fixup
                          EACH ENERGY TO BE INSERTED.                 Fixup
           1-11    E11.4   ENERGY TO BE INSERTED                      Fixup
          12-15     I4     MAT IN WHICH TO INSERT ENERGY = 0 = ALL     Fixup
          16-18     I3     MT IN WHICH TO INSERT ENERGY = 0 = ALL      Fixup
                         *UP TO 50 (ENERGY, MAT, MT) LINES MAY BE     Fixup
                          USED. THE LIST IS TERMINATED BY A BLANK     Fixup
                          LINE.                                       Fixup
                         *INPUT MAY BE IN ANY (ENERGY, MAT, MT)       Fixup
                          ORDER.                                      Fixup
                         *ENERGY POINTS CAN ONLY BE INSERTED WITHIN   Fixup
                          THE ORIGINAL ENERGY RANGE OF A SECTION -    Fixup
                          THIS OPTION CANNOT BE USED TO EXTEND THE    Fixup
                          CROSS SECTION EITHER BELOW OR ABOVE THE     Fixup
                          ORIGINAL TABULATED ENERGY RANGE.            Fixup
                                                                      Fixup
   EXAMPLE INPUT NO. 1                                                Fixup
   ==================                                                 Fixup
   (1) USE OPTIONS 1-11 (ALL OPTIONS, EXCEPT INSERT ENERGY POINTS)    Fixup
   (2) DELETE MT=900 (FOR EXAMPLE PURPOSES ONLY)                      Fixup
   (3) DEFINE THE FOLLOWING MT NUMBERS TO BE RECONSTRUCTED,           Fixup
       (MT=  4) = THE SUM OF MT= 51 THROUGH  91                       Fixup
       (MT=103) = THE SUM OF MT=700 THROUGH 718 (NOT 719)             Fixup
       (MT=104) = THE SUM OF MT=720 THROUGH 738 (NOT 739)             Fixup
       (MT=105) = THE SUM OF MT=740 THROUGH 758 (NOT 759)             Fixup
       (MT=106) = THE SUM OF MT=760 THROUGH 778 (NOT 779)             Fixup
       (MT=107) = THE SUM OF MT=780 THROUGH 798 (NOT 799)             Fixup
```

```
     (MT=101) = THE SUM OF MT=102 THROUGH 114                          Fixup
     (MT= 18) = (MT=19) + (MT=20 AND 21) + (MT=38)                     Fixup
                (IF TOTAL FISSION, MT=18, IS NOT PRESENT, DEFINE       Fixup
                IT BY SUMMING FIRST, SECOND, ETC. CHANCE - NOTE        Fixup
                THAT THIS MUST BE DONE IN THIS ORDER, SINCE THE        Fixup
                NEXT SUM INVOLVES USING MT=18.                         Fixup
     (MT= 27) = THE SUM OF MT= 18 AND 101                              Fixup
                (MT=101 RECONSTRUCTED ABOVE USED IN SUM).              Fixup
     (MT=  3) = THE SUM OF (MT=4)+(MT=6-9)+(MT=16-17)+(MT=22-37)+      Fixup
                (MT=41-45)                                             Fixup
                (MT=4 AND 27 RECONSTRUCTED ABOVE USED IN SUM).         Fixup
     (MT= 19) = (MT=18) - (MT=20 AND 21) - (MT=38)                     Fixup
                (DEFINE FIRST CHANGE FISSION BY SUBTRACTION TO         Fixup
                ALLOW RESONANCE CONTRIBUTION FROM MT=18 TO BE          Fixup
                INCLUDED IN MT=19).                                    Fixup
     (MT=  1) = THE SUM OF MT=2 AND 3                                  Fixup
                (MT=3 RECONSTRUCTED ABOVE USED IN SUM).                Fixup
(4) THRESHOLD ENERGIES OF THE FOLLOWING MT NUMBERS WILL NOT BE         Fixup
     TESTED OR CORRECTED.                                              Fixup
     MT=1, 4, 18, 19, 91, 103 THROUGH 114.                             Fixup
(5) DEFINE MT=254 TO BE THE CAPTURE TO FISSION RATIO (MT=102/18)       Fixup
(6) CREATE MAT=1300/MT=254 - NOTE, THIS IS NECESSARY IN ORDER TO       Fixup
    HAVE THE CAPTURE TO FISSION RATIO OUTPUT IN THE ENDF/B FORMAT      Fixup
                                                                       Fixup
 NOTE, ON THE FOLLOWING INPUT LINES THE CHARACTERS = ( ) + , HAVE      Fixup
 BEEN USED ONLY TO MAKE THE INPUT MORE READABLE - THESE CHARACTERS     Fixup
 WILL BE SKIPPED BY THE PROGRAM IN READING INPUT - THE RESULTS         Fixup
 WOULD BE THE SAME IF THESE CHARACTERS WERE OMITTED, AS LONG AS        Fixup
 ALL OF THE MT NUMBERS ARE DELIMITED, I.E., THERE IS AT LEAST ONE      Fixup
 NON-DIGITAL CHARACTER BETWEEN MT NUMBERS. NOTE, THAT - (MINUS         Fixup
 SIGN) IS IMPORTANT AND IS USED DURING INPUT TO DEFINE MT RANGES       Fixup
 WHICH SHOULD BE SUBTRACTED, E.,G., SEE THE DEFINITION OF MT=19.       Fixup
                                                                       Fixup
 READ FILE /ENDFB6/K300/LEAD.IN AND WRITE /ENDFB6/K300/LEAD.OUT        Fixup
                                                                       Fixup
 THE FOLLOWING 21 INPUT LINES ARE REQUIRED.                            Fixup
                                                                       Fixup
 11111111111                                                           Fixup
 /ENDFB6/K300/LEAD.IN                                                  Fixup
 /ENDFB6/K300/LEAD.OUT                                                 Fixup
 D900                                                                  Fixup
    4=( 51, 91)                                                        Fixup
  103=(700,718)                                                        Fixup
  104=(720,738)                                                        Fixup
  105=(740,758)                                                        Fixup
  106=(760,778)                                                        Fixup
  107=(780,798)                                                        Fixup
  101=(102,114)                                                        Fixup
   18=( 19, 19)+( 20, 21)+( 38, 38)                                    Fixup
   27=( 18, 18)+(101,101)                                              Fixup
    3=(  4,  4)+(  6,  9)+( 16, 17)+( 22, 37)+( 41, 45)                Fixup
   19=( 18, 18)-( 20, 21)-( 38, 38)                                    Fixup
    1=(  2,  3)                                                        Fixup
 T    (  1,  1) (  4,  4) ( 18, 19) ( 91, 91) (103,114)                Fixup
 R254=(102/ 18)                                                        Fixup
              (BLANK LINE TO TERMINATE SUMMATION/DELETION RULES)       Fixup
  2.00400+ 3 0.00000+ 0          0          01300254                   Fixup
  0.00000+ 0 0.00000+ 0          0          0                          Fixup
              (BLANK LINE TO TERMINATE SECTION CREATION RULES)         Fixup
                                                                       Fixup
 NOTE, THE DELETION AND THRESHOLD EXCLUSION LINES MAY APPEAR IN        Fixup
 IN ANY ORDER. HOWEVER, SUMMATION AND RATIO RULES MUST APPEAR IN       Fixup
 THE ORDER IN WHICH YOU WANT THEM TO BE EXECUTED - E.G., THE           Fixup
 ABOVE INPUT WILL FIRST RECONSTRUCT MT=4, WHICH CAN THEN BE USED       Fixup
 TO CONTRIBUTE TO THE FOLLOWING SUM TO DEFINE MT=3, WHICH IN TURN      Fixup
 CAN THEN BE USED TO CONTRIBUTE TO THE FOLLOWING SUM TO DEFINE         Fixup
 MT=1. IF THE ORDER OF THE INPUT LINES IS CHANGED SUCH THAT MT=3       Fixup
 IS RECONSTRUCTED BEFORE MT=4, THE ORIGINAL MT=4 WILL BE USED IN       Fixup
 THE SUMMATION TO DEFINE MT=3. THE SAME RULES APPLY TO CALCULATING     Fixup
 RATIOS, IF EITHER THE NUMERATOR OR DENOMINATOR IS TO BE DEFINED       Fixup
 BY SUMMATION, THIS SHOULD BE DONE BEFORE DEFINING THE RATIO BY        Fixup
```

```
INPUT PARAMETERS.                                                    Fixup
                                                                     Fixup
EXAMPLE INPUT NO. 2                                                  Fixup
==================                                                   Fixup
(1) USE OPTIONS 1-11 (ALL OPTIONS, EXCEPT INSERT ENERGY POINTS)      Fixup
(2) USE BUILT-IN TABLES FOR SUMMATION/DELETION/THRESHOLD EXCLUSION   Fixup
    (THIS ONLY REQUIRES COLUMNS 2, 4 AND 5 TO BE SET =2 ON THE       Fixup
    FIRST INPUT LINE. THE BUILT-IN RULES EXACTLY CORRESPOND TO       Fixup
    THE INPUT ABOVE UNDER EXAMPLE NO. 1, EXCEPT THAT NO MT NUMBERS   Fixup
    WILL BE DELETED.                                                 Fixup
(3) IF NOT PRESENT, CREATE MAT=1300/MT=1                             Fixup
                                                                     Fixup
USE THE STANDARD FILE NAMES ENDFB.IN AND ENDFB.OUT (THIS CAN BE      Fixup
DONE BY LEAVING THE SECOND AND THIRD INPUT LINES BLANK).             Fixup
                                                                     Fixup
THE FOLLOWING 6 INPUT LINES ARE REQUIRED.                            Fixup
                                                                     Fixup
12122111111                                                          Fixup
                                                                     Fixup
                                                                     Fixup
 2.00400+ 3 0.00000+ 0          0          01300  1                  Fixup
 0.00000+ 0 0.00000+ 0          0          0                         Fixup
            (BLANK LINE TO TERMINATE SECTION CREATION RULES)         Fixup
                                                                     Fixup
EXAMPLE INPUT NO. 3                                                  Fixup
==================                                                   Fixup
(1) USE OPTIONS 1-10 (ALL OPTIONS PRESENTLY IMPLEMENTED, EXCEPT      Fixup
    DO NOT ALLOW SECTION CREATION AND INSERT ENERGY POINTS).         Fixup
(2) USE BUILT-IN TABLES FOR SUMMATION/DELETION/THRESHOLD EXCLUSION   Fixup
    (THIS ONLY REQUIRES COLUMNS 2, 4 AND 5 TO BE SET =2 ON THE       Fixup
    FIRST INPUT LINE. THE BUILT-IN RULES EXACTLY CORRESPOND TO       Fixup
    THE INPUT ABOVE UNDER EXAMPLE NO. 1, EXCEPT THAT NO MT NUMBERS   Fixup
    WILL BE DELETED.                                                 Fixup
(3) DO NOT CREATE ANY SECTIONS.                                      Fixup
                                                                     Fixup
READ FILE /ENDFB6/K300/LEAD.IN AND WRITE /ENDFB6/K300/LEAD.OUT       Fixup
                                                                     Fixup
THE FOLLOWING 3 INPUT LINES ARE REQUIRED.                            Fixup
                                                                     Fixup
1212211111                                                           Fixup
/ENDFB6/K300/LEAD.IN                                                 Fixup
/ENDFB6/K300/LEAD.OUT                                                Fixup
                                                                     Fixup
EXAMPLE INPUT NO. 4                                                  Fixup
==================                                                   Fixup
SAME AS EXAMPLE NO. 3, ABOVE, EXCEPT INSERT AN ENERGY POINT AT       Fixup
THERMAL FOR ALL REACTIONS WHICH SPAN THE THERMAL ENERGY RANGE.       Fixup
                                                                     Fixup
USE THE STANDARD FILE NAMES ENDFB.IN AND ENDFB.OUT (THIS CAN BE      Fixup
DONE BY LEAVING THE SECOND AND THIRD INPUT LINES BLANK).             Fixup
                                                                     Fixup
THE FOLLOWING 5 INPUT LINES ARE REQUIRED.                            Fixup
                                                                     Fixup
121221111101                                                         Fixup
                                                                     Fixup
                                                                     Fixup
 2.53000- 2   0  0                                                  Fixup
            (BLANK LINE TO TERMINATE ENERGY INSERTS)                 Fixup
                                                                     Fixup
WARNING                                                              Fixup
=======                                                              Fixup
ALTHOUGH THIS PROGRAM IS DESIGNED TO ALLOW REACTIONS TO BE DEFINED   Fixup
BY ADDING OR SUBTRACTING REACTIONS THE USER SHOULD ALWAYS TRY TO      Fixup
DEFINE REACTIONS BY SUMMING TO AVOID NEGATIVE CROSS SECTIONS. FOR    Fixup
EXAMPLE, IT IS POSSIBLE TO CALCULATE MT=3 AND DEFINE MT=1 AS THE     Fixup
SUM OF MT=2 AND 3 (THE RECOMMENDED APPROACH AS USED IN THE ABOVE     Fixup
INPUT). ALTERATIVELY IT IS POSSIBLE TO CALCULATE MT=1 AND DEFINE     Fixup
MT=3 AS MT=1 MINUS MT=2 (THIS APPROACH IS NOT RECOMMENDED).          Fixup
                                                                     Fixup
THE ONLY BUILT-IN SUMMATION RULE THAT USES SUBTRACTION IS THE        Fixup
CALCULATION OF THE FIRST CHANGE FISSION (MT=19) AS THE TOTAL         Fixup
```

```
     FISSION (MT=18) MINUS THE SECOND, THIRD AND FOURTH CHANGE FISSION  Fixup
     (MT=20, 21, 38). THIS HAS BEEN DONE TO ALLOW THE RESONANCE         Fixup
     CONTRIBUTION, CALCULATED BY MANY CODES AND INCLUDED IN MT=18,      Fixup
     TO BE CONSISTENTLY INCLUDED IN THE FIRST CHANCE FISSION.           Fixup
                                                                        Fixup
=============================================================================== Fixup
```

```
====================================================================== Groupie
                                                                       Groupie
     PROGRAM 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 EACHGroupie
                                 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
                                 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
                            1.0E-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
                                                                  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
UNIVERSITY OF CALIFORNIA                                          Groupie
LAWRENCE LIVERMORE NATIONAL LABORATORY                            Groupie
L-159                                                             Groupie
P.O. BOX 808                                                      Groupie
LIVERMORE, CA 94550                                               Groupie
U.S.A.                                                            Groupie
TELEPHONE  925-423-7359                                           Groupie
```

```
E. MAIL    CULLEN1@LLNL.GOV                                          Groupie
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                               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 (2004-1) ***************    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
 (8)  99 GROUP (GAM-II STRUCTURE)                                        Groupie
 (9)  54 GROUP (MUFT STRUCTURE)                                          Groupie
(10)  28 GROUP (ABBN STRUCTURE)                                          Groupie
(11) 650 GROUP (TART STRUCTURE)                                          Groupie
(12) 700 GROUP (TART STRUCTURE)                                          Groupie
(13) 665 GROUP (SAND-II STRUCTURE, 1.0e-5 eV, UP TO 18 MEV)              Groupie
(14) 685 GROUP (SAND-II STRUCTURE, 1.0e-5 eV, UP TO 20 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     = 9.65E+5                                                    Groupie
     WB     = 2.29E-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
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                            Groupie
   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     D11.4   TEMPERATURE (KELVIN)                   Groupie
          45-55    1X,10A1  HOLLERITH DESCRIPTION OF ZA            Groupie
   3       1-11     D11.4   ENERGY (EV) - GROUP BOUNDARY.          Groupie
          12-22     D11.4   TOTAL      (FIRST BAND)                Groupie
          23-33     D11.4   ELASTIC                                Groupie
          34-44     D11.4   CAPTURE                                Groupie
          35-55     D11.4   FISSION                                Groupie
   4       1-11     -----   BLANK                                  Groupie
          12-22     D11.4   TOTAL      (SECOND BAND)               Groupie
          23-33     D11.4   ELASTIC                                Groupie
          34-44     D11.4   CAPTURE                                Groupie
          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    650 GROUPS                   Groupie
                     =-12   - TART    700 GROUPS                   Groupie
                     =-13   - SAND-II 665 GROUPS TO 18 MEV         Groupie
                     =-14   - SAND-II 685 GROUPS TO 20 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
                     = -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
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    1-60    A60  ENDF/B INPUT DATA FILENAME                    Groupie
                    (STANDARD OPTION = ENDFB.IN)                  Groupie
  3    1-60    A60  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
                                                                  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  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
```

```
======================================================================= Legend
                                                                        Legend
     PROGRAM LEGEND                                                     Legend
     VERSION 80-1 (SEPTEMBER 1980)                                      Legend
     VERSION 84-1 (NOVEMBER 1984)                                       Legend
     VERSION 86-1 (JANUARY 1986) *CORRECTED BASED ON USER COMMENTS      Legend
                                 *FORTRAN-77/H VERSION                  Legend
     VERSION 87-1 (JANUARY 1987) *CORRECTED BASED ON USER COMMENTS      Legend
     VERSION 88-1 (JULY 1988)    *OPTION...INTERNALLY DEFINE ALL I/O    Legend
                                  FILE NAMES (SEE, SUBROUTINE FILEIO    Legend
                                  FOR DETAILS).                         Legend
                                 *IMPROVED BASED ON USER COMMENTS.      Legend
     VERSION 89-1 (JANUARY 1989) *PSYCHOANALYZED BY PROGRAM FREUD TO    Legend
                                  INSURE PROGRAM WILL NOT DO ANYTHING   Legend
                                  CRAZY.                                Legend
                                 *UPDATED TO USE NEW PROGRAM CONVERT    Legend
                                  KEYWORDS.                             Legend
                                 *ADDED LIVERMORE CIVIC COMPILER        Legend
                                  CONVENTIONS.                          Legend
     VERSION 92-1 (JANUARY 1992) *FOR ANGULAR DISTRIBUTIONS CALCULATED  Legend
                                  FROM LEGENDRE COEFFICIENTS, INTERVAL  Legend
                                  HALF TO CONVERGENCE.                  Legend
                                 *UPDATED BASED ON USER COMMENTS        Legend
                                 *ADDED FORTRAN SAVE OPTION             Legend
                                 *ADDED SELECTED OF DATA TO PROCESS     Legend
                                  BY MAT/MF/MT/ENERGY RANGES.           Legend
                                 *WARNING...THE INPUT PARAMETER FORMAT  Legend
                                  HAS BEEN CHANGED - FOR DETAILS SEE    Legend
                                  BELOW.                                Legend
     VERSION 92-2 (SEPT. 1992)   *CORRECTED PROCESSING OF ISOTROPIC     Legend
                                  ANGULAR DISTRIBUTIONS                 Legend
     VERSION 94-1 (JANUARY 1994) *VARIABLE ENDF/B DATA FILENAMES        Legend
                                  TO ALLOW ACCESS TO FILE STRUCTURES    Legend
                                  (WARNING - INPUT PARAMETER FORMAT     Legend
                                  HAS BEEN CHANGED)                     Legend
                                 *CLOSE ALL FILES BEFORE TERMINATING    Legend
                                  (SEE, SUBROUTINE ENDIT)               Legend
     VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                     Legend
                                 *IMPROVED COMPUTER INDEPENDENCE        Legend
                                 *ALL DOUBLE PRECISION                  Legend
                                 *ON SCREEN OUTPUT                      Legend
                                 *UNIFORM TREATMENT OF ENDF/B I/O       Legend
                                 *IMPROVED OUTPUT PRECISION             Legend
                                 *INCREASED MAX. POINTS FROM 5,000      Legend
                                  TO 20,000.                            Legend
     VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING       Legend
                                  POINT READ FOR MORE DIGITS            Legend
                                 *UPDATED TEST FOR ENDF/B FORMAT        Legend
                                  VERSION BASED ON RECENT FORMAT CHANGE Legend
                                 *GENERAL IMPROVEMENTS BASED ON         Legend
                                  USER FEEDBACK                         Legend
     VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON         Legend
                                  USER FEEDBACK                         Legend
     VERS. 2001-1 (MARCH 2001)   *UPDATED TO HANDLE COMBINATIONS OF     Legend
                                  LEGENDRE COEFFICIENTS AT LOW ENERGY   Legend
                                  AND TABULATED DATA AT HIGH ENERGY.    Legend
     VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS             Legend
     VERS. 2004-1 (MARCH 2004)   *ADDED INCLUDE FOR COMMON              Legend
                                                                        Legend
     OWNED, MAINTAINED AND DISTRIBUTED BY                               Legend
     ------------------------------------                               Legend
     THE NUCLEAR DATA SECTION                                           Legend
     INTERNATIONAL ATOMIC ENERGY AGENCY                                 Legend
     P.O. BOX 100                                                       Legend
     A-1400, VIENNA, AUSTRIA                                            Legend
     EUROPE                                                             Legend
                                                                        Legend
     ORIGINALLY WRITTEN BY                                              Legend
     ---------------------------------                                  Legend
     DERMOTT E. CULLEN                                                  Legend
     CURRENT ADDRESS                                                    Legend
```

```
UNIVERSITY OF CALIFORNIA                                                Legend
LAWRENCE LIVERMORE NATIONAL LABORATORY                                  Legend
L-159                                                                   Legend
P.O. BOX 808                                                            Legend
LIVERMORE, CA 94550                                                     Legend
U.S.A.                                                                  Legend
TELEPHONE  925-423-7359                                                 Legend
E. MAIL    CULLEN1@LLNL.GOV                                             Legend
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                                  Legend
                                                                        Legend
PURPOSE                                                                 Legend
-------                                                                 Legend
CALCULATE LINEARLY INTERPOLABLE TABULATED ANGULAR DISTRIBUTIONS          Legend
STARTING FROM DATA IN THE ENDF/B FORMAT. ANGULAR DISTRIBUTIONS          Legend
MAY BE DESCRIBED IN THE ENDF/B FORMAT IN ONE OF THREE WAYS.             Legend
FOR EACH OF THESE THREE FORMS THE USER MAY CHOOSE (SEE, INPUT           Legend
OPTIONS) TO EITHER COPY EACH TYPE OF DATA OR TO PROCESS IT AT           Legend
AS FOLLOWS,                                                             Legend
                                                                        Legend
(1) ANGULAR DISTRIBUTION IS ISOTROPIC AT ALL ENERGIES (LTT=0)           Legend
------------------------------------------------------------            Legend
IN THIS CASE THE INPUT DATA DOES NOT INCLUDE ANY ANGULAR                Legend
DISTRIBUTIONS. A SECTION MERELY CONTAINS A FLAG TO INDICATE             Legend
THE ANGULAR DISTRIBUTION IS ISOTROPIC AT ALL ENERGIES. IN THIS          Legend
CASE THE SECTION IS OUTPUT IN EXACTLY THE SAME FORM IN WHICH IT         Legend
WAS READ FROM THE INPUT.                                                Legend
                                                                        Legend
(2) ANGULAR DISTRIBUTIONS GIVEN BY LEGENDRE COEFFICIENTS (LTT=1)        Legend
----------------------------------------------------------------        Legend
LEGENDRE COEFFICIENTS ARE GIVEN AT A SERIES OF ENERGIES. AN             Legend
INTERPOLATION LAW IS GIVEN BETWEEN ENERGIES. THE INTERPOLATION          Legend
LAW BETWEEN ENERGIES IS COPIED AS INPUT (I.E., NO ATTEMPT IS            Legend
MADE TO LINEARIZE THE VARIATION WITH ENERGY). FOR EACH ENERGY AT        Legend
WHICH LEGENDRE COEFFICIENTS ARE GIVEN A LINEARLY INTERPOLABLE           Legend
ANGULAR DISITRIBUTION IS RECONSTRUCTED IN THE SYSTEM IN WHICH THE       Legend
THE COEFFICIENTS ARE GIVEN (I.E., CM OR LAB - NO ATTEMPT IS MADE        Legend
TO CONVERT FROM ONE SYSTEM TO THE OTHER). A MAXIMUM OF 50 LEGENDRE      Legend
COEFFICIENTS IS ALLOWED. REGARDLESS OF THE NUMBER OF COEFFICIENTS       Legend
INPUT THE PROGRAM WILL ONLY USE COEFFICIENTS UP TO THE LAST ORDER       Legend
AT WHICH THE COEFFICIENTS ARE NON-ZERO (E.G. IF COEFFICIENTS P1         Legend
THROUGH P12 ARE READ, BUT P9=P10=P11=P12=0.0, THE PROGRAM WILL          Legend
ONLY USE COEFFICIENTS UP TO P8). IF OVER 50 NON-ZERO COEFFICIENTS       Legend
ARE READ ONLY THE FIRST 50 WILL BE USED.                                Legend
                                                                        Legend
(2) ANGULAR DISTRIBUTIONS IS TABULATED (LTT=2)                          Legend
----------------------------------------------------------------        Legend
ANGULAR DISTRIBUTIONS ARE GIVEN AT A SERIES OF ENERGIES. AN             Legend
INTERPOLATION LAW IS GIVEN BETWEEN ENERGIES AND A SECOND                Legend
INTERPOLATION LAW IS GIVEN AT EACH ENERGY TO INTERPOLATE BETWEEN        Legend
THE POINTS IN EACH TABULATED DISTRIBUTION. AT EACH ENERGY THE           Legend
ANGULAR DISTRIBUTION WILL BE CONVERTED TO LINEARLY INTERPOLABLE         Legend
FORM. THE INTERPOLATION BETWEEN ENERGIES IS OUTPUT EXACTLY AS           Legend
INPUT. THE INTERPOLATION LAW AT EACH ENERGY IS OUTPUT TO INDICATE       Legend
THE NOW LINEARLY INTERPOLABLE ANGULAR DISTRIBUTION.                     Legend
                                                                        Legend
(3) LEGENDRE COEFFICIENTS AND TABULATED (LTT=3)                         Legend
----------------------------------------------------------------        Legend
ENDF-102 SAYS THIS SHOULD BE LTT=4, BUT ALL OF THE EVALUATIONS          Legend
IN ENDF/B-VI, RELEASE 7, USE LTT=3? THIS CODE WILL TREAT THESE          Legend
AS LTT=4 - SEE BELOW.                                                   Legend
                                                                        Legend
(4) LEGENDRE COEFFICIENTS AND TABULATED (LTT=4)                         Legend
----------------------------------------------------------------        Legend
THIS IS A COMBINATION OF (1) AND (2) DESCRIBED ABOVE. THE               Legend
LEGENDRE DATA IS ALWAYS GIVEN FIRST, FOR LOWER ENERGIES,                Legend
FOLLOWED BY TABULATED ANGULAR DISTRIBUTIONS, FOR HIGHER ENERGIES.       Legend
                                                                        Legend
THIS TYPE OF DATA CAN ONLY BE COPIED OR ALL CONVERTED TO                Legend
TABULATED (LTT=2).                                                      Legend
                                                                        Legend
POINT VALUES - NORMALIZED VS. UNNORMALIZED                              Legend
```

```
---------------------------------------------------------------- Legend
THE VALUE OF AN ANGULAR DISTRIBUTION AT ANY COSINE WILL BE       Legend
CORRECTLY CALCULATED BY THIS CODE, BASED EITHER DIRECTLY ON THE  Legend
ANGULAR DISTRIBUTION, OR ON THE SUM OF THE CONTRIBUTING LEGENDRE Legend
MOMENTS.                                                         Legend
                                                                 Legend
ENDF/B ANGULAR DISTRIBUTIONS ARE BY DEFINITION NORMALIZED WHEN   Legend
INTEGRATED OVER COSINE. THEREFORE THIS CODE WILL NORMALIZE EACH  Legend
ANGULAR DISTRIBUTION BEFORE IT IS OUTPUT. THE OUTPUT REPORT FROM Legend
THIS CODE WILL INDICATE THE NORMALIZATION FACTOR USED.           Legend
                                                                 Legend
THE REASON THAT AN ANGULAR DISTRIBUTION MAY NOT BE NORMALIZED IS Legend
DUE TO THE APPROXIMATION OF CREATING LINEARLY INTERPOLABLE       Legend
TABULATED ANGULAR DISTRIBUTIONS - THE MORE ACCURATELY THIS IS    Legend
DONE THE CLOSER THE NORMALIZATION FACTOR WILL BE TO UNITY. AS YOU Legend
DECREASE THE ALLOWABLE ERROR THE NORMALIZED VALUES WILL APPROACH Legend
THE CORRECT POINT VALUES CALCULATED BY THE CODE.                 Legend
                                                                 Legend
SINCE THE DATA IS NORMALIZED PRIOR TO OUTPUT THE RESULTS IN THE  Legend
ENDF/B FORMAT MAY DIFFER SLIGHTLY FROM VALUES REFERRED TO BE ERROR Legend
MESSAGES, ETC. PRINTED BY THE CODE DURING EXECUTION. IN ALL CASES Legend
THE VALUES PRINTED BY THE CODE IN ERROR MESSAGES, ETC. SHOULD BE Legend
CONSIDERED TO BE THE CORRECT VALUES AND THE OUTPUT TABULATED     Legend
ANGULAR DISTRIBUTIONS APPROXIMATE DUE TO THE RE-NORMALIZATION -  Legend
TO RE-ITERATE, THE OUTPUT TABULATED VALUES ARE APPROXIMATE DUE   Legend
TO THE APPROXIMATIONS USED IN CONSTRUCTING LINEAR INTERPOLABLE   Legend
ANGULAR DISTRIBUTIONS TO WITHIN SOME ALLOWABLE TOLERANCE.        Legend
                                                                 Legend
ELIMINATION OF NEGATIVE VALUES                                   Legend
------------------------------                                   Legend
THE RECONSTRUCTED ANGULAR DISTRIBUTION WILL BE TESTED AND IF IT  Legend
IS NEGATIVE AT ONE OR MORE COSINES AN ERROR MESSAGE WILL BE OUTPUT Legend
AND BASED ON THE INPUT OPTION SELECTED ONE OF THE FOLLOWING      Legend
CORRECTIVE ACTIONS WILL BE TAKEN (SEE, INPUT OPTIONS),           Legend
(1) NO CORRECTION                                                Legend
(2) CHANGE INDIVIDUAL LEGENDRE COEFFICIENTS (EACH BY LESS THAN   Legend
    1.0 PER-CENT) UNTIL THE RECONSTRUCTED ANGULAR DISTRIBUTION   Legend
    IS POSITIVE (MINIMUM MORE THAN 1 MILLI-BARN). THE ALLOWABLE  Legend
    PER-CENT CHANGE IN COEFFICIENTS AND MINIMUM CROSS SECTION CAN Legend
    BE CHANGED BY INPUT.                                         Legend
(3) CHANGE ALL LEGENDRE COEFFICIENTS TO FORCE DISTRIBUTION TO BE Legend
    POSITIVE (MINIMUM MORE THAN 1 MILLI-BARN). WITH THIS OPTION  Legend
    THERE IS NO RESTRICTION ON THE AMOUNT THAT EACH COEFFICIENT  Legend
    IS CHANGED AND AS SUCH THIS OPTION SHOULD BE USED WITH       Legend
    CAUTION AND ONLY AS A LAST RESORT IF NO OTHER APPROACH CAN   Legend
    BE USED TO MAKE THE DISTRIBUTION POSITIVE.                   Legend
                                                                 Legend
OUTPUT                                                           Legend
------                                                           Legend
THE USER MAY REQUEST OUTPUT OF EITHER,                           Legend
(1) TABULATED VALUES - POSSIBLY CORRECTED TO ELIMINATE NEGATIVE  Legend
    VALUES. THE TABULATED DISTRIBUTION WILL BE NORMALIZED BEFORE Legend
    OUTPUT.                                                      Legend
(2) LEGENDRE COEFFICIENTS - POSSIBLY CORRECTED TO ELIMINATE      Legend
    NEGATIVE VALUES AND WITHOUT HIGHER ORDER ZERO COEFFICIENTS.  Legend
    BY DEFINITION DISTRIBUTIONS DEFINED BY LEGENDRE COEFFICIENTS Legend
    ARE NORMALIZED TO UNITY.                                     Legend
                                                                 Legend
(3) ANGULAR DISTRIBUTIONS GIVEN BY A TABULATION (LTT=2)          Legend
-------------------------------------------------------          Legend
TABULATED ANGULAR DISTRIBUTIONS ARE GIVEN AT A SERIES OF ENERGIES. Legend
AN INTERPOLATION LAW IS GIVEN BETWEEN ENERGIES. THE INTERPOLATION Legend
LAW BETWEEN ENERGIES IS COPIED AS INPUT (I.E., NO ATTEMPT IS     Legend
MADE TO LINEARIZE THE VARIATION WITH ENERGY). FOR EACH ENERGY AT Legend
AT WHICH TABULATED DATA ARE GIVEN A LINEARLY INTERPOLABLE ANGULAR Legend
DISTRIBUTION IS CONSTRUCTED IN THE SYSTEM IN WHICH THE TABULATED  Legend
DATA ARE GIVEN (I.E., CM OR LAB - NO ATTEMPT IS MADE TO CONVERT  Legend
FROM ONE SYSTEM TO THE OTHER). A MAXIMUM OF 60000 POINTS IS ALLOWE Legend
TO REPRESENT THE ANGULAR DISTRIBUTION AT EACH ENERGY.            Legend
                                                                 Legend
ELIMINATION OF NEGATIVE VALUES                                   Legend
```

```
----------------------------                                        Legend
THE RECONSTRUCTED ANGULAR DISTRIBUTION WILL BE TESTED AND IF IT     Legend
IS NEGATIVE AT ONE OR MORE COSINES AN ERROR MESSAGE WILL BE OUTPUT  Legend
AND BASED ON THE INPUT OPTION SELECTED ONE OF THE FOLLOWING         Legend
CORRECTIVE ACTIONS WILL BE TAKEN (SEE, INPUT OPTIONS),              Legend
(1) NO CORRECTION                                                   Legend
(2) CHANGE ALL TABULATED VALUES TO FORCE DISTRIBUTION TO BE         Legend
    POSITIVE (MINIMUM MORE THAN 1 MILLI-BARN). THE MINIMUM VALUE    Legend
    MAY BE CHANGED BY INPUT. WITH THIS OPTION THERE IS NO           Legend
    RESTRICTION ON THE AMOUNT THAT EACH VALUE IS CHANGED AND AS     Legend
    SUCH THIS OPTION SHOULD BE USED WITH CAUTION AND ONLY AS A      Legend
    LAST RESORT IF NO OTHER APPROACH CAN BE USED TO MAKE THE        Legend
    DISTRIBUTION POSITIVE.                                          Legend
                                                                    Legend
OUTPUT                                                              Legend
------                                                              Legend
THE OUTPUT WILL BE THE LINEARIZED ANGULAR DISTRIBUTION. THE         Legend
TABULATED DISTRIBUTION WILL BE NORMALIZED TO UNITY BEFORE OUTPUT.   Legend
                                                                    Legend
CORRECTING NEGATIVE ANGULAR DISTRIBUTION                            Legend
---------------------------------------                             Legend
IF AN ANGULAR DISTRIBUTION IS NEGATIVE AN ERROR MESSAGE WILL BE     Legend
PRINTED AND THE USER MAY DECIDE (BASED ON INPUT OPTION) TO,         Legend
(1) NOT PERFORM ANY CORRECTIVE ACTION.                              Legend
(2) FOR TABULATED DISTRIBUTIONS - ADD THE SAME VALUE TO EACH POINT  Legend
    VALUE SUCH THAT WHEN THE DISTRIBUTION IS RE-NORMALIZED THE      Legend
    MINIMUM VALUE IS 0.001 (1 MILLI-BARN). THE MINIMUM VALUE CAN    Legend
    BE CHANGED BY INPUT. WARNING...EXCEPT FOR SELECTION OF THE      Legend
    MINIMUM VALUE (BY INPUT) THE USER HAS NO CONTROL OVER HOW       Legend
    MUCH THE DISTRIBUTION IS CHANGED. THEREFORE THIS OPTION SHOULD  Legend
    BE USED WITH CAUTION.                                           Legend
(3) FOR LEGENDRE COEFFICIENTS ONE OF TWO OPTIONS MAY BE SELECTED,   Legend
(A) CHANGE INDIVIDUAL COEFFICIENTS (NO ONE COEFFICIENT BY MORE      Legend
    THAN 1 PER-CENT) TO MAKE THE DISTRIBUTION POSITIVE WITH A       Legend
    MINIMUM VALUE OF 0.001 (1 MILLI-BARN). THE MAXIMUM PER-CENT     Legend
    CHANGE IN EACH COEFFICIENT AND MINIMUM VALUE MAY BE CHANGED     Legend
    BY INPUT. INPUT THE PROGRAM CANNOT MAKE THE DISTRIBUTION        Legend
    POSITIVE BY CHANGING EACH COEFFICIENT BY UP TO THE MAXIMUM      Legend
    ALLOWABLE AMOUNT, THE ORIGINAL ANGULAR DISTRIBUTION OR          Legend
    COEFFICIENTS WILL BE OUTPUT. ONLY IN THE LATTER CASE SHOULD     Legend
    ONE CONSIDER USING OPTION (B) DESCRIBED BELOW.                  Legend
(B) LOGICALLY ADD THE SAME VALUE TO EACH POINT VALUE SUCH THAT      Legend
    WHEN THE DISTRIBUTION IS RE-NORMALIZED THE MINIMUM VALUE IS     Legend
    0.001 (1 MILLI-BARN). THIS IS EQUIVALENT AT INCREASING P0       Legend
    BY A CERTAIN AMOUNT AND RE-NORMALIZATION IS EQUIVALENT TO THEN  Legend
    DIVIDING EACH COEFFICIENT BY A CERTAIN AMOUNT. THEREFORE,       Legend
    WHAT IS PHYSICALLY DONE BY THE PROGRAM IS TO DIVIDE EACH        Legend
    COEFFICIENT BY THE SAME AMOUNT. WARNING..EXCEPT FOR SELECTION   Legend
    OF THE MINIMUM VALUE (BY INPUT) THE USER HAS NO CONTROL OVER    Legend
    HOW MUCH THE DISTRIBUTION IS CHANGED. THEREFORE THIS OPTION     Legend
    SHOULD BE USED WITH CAUTION.                                    Legend
                                                                    Legend
WARNING MESSAGES FROM PROGRAM                                       Legend
-----------------------------                                       Legend
THE WARNING MESSAGES PRINTED BY THIS PROGRAM SHOULD ONLY BE         Legend
CONSIDERED TO BE EXACTLY THAT..WARNINGS..NOT AN ABSOLUTE JUDGEMENT  Legend
BY THIS PROGRAM THAT THERE IS SOMETHING WRONG WITH THE DATA. WHEN   Legend
WARNING MESSAGES ARE PRINTED EXAMINE THE DATA AND EITHER TAKE NO    Legend
ACTION (IF YOU FEEL THAT THE DATA IS O.K.) OR CORRECT THE DATA      Legend
(IF YOU FEEL THAT THE DATA IS INCORRECT AND YOU CAN CORRECT IT).    Legend
                                                                    Legend
VALIDITY OF MODIFIED DATA                                           Legend
-------------------------                                           Legend
BEFORE BELIEVING AND USING DATA WHICH HAS BEEN MODIFIED (EITHER     Legend
TABULATED ANGULAR DISTRIBUTIONS OR LEGENDRE COEFFICIENTS) THE USER  Legend
SHOULD INSURE THAT THE MODIFIED DATA IS PHYSICALLY MORE ACCEPTABLE  Legend
THAN THE ORIGINAL DATA. IN ORDER TO DO THIS ONE OR MORE OF THE      Legend
FOLLOWING METHODS SHOULD BE USED,                                   Legend
                                                                    Legend
(1) USE THE ENERGY VARIATION TESTS BUILT-IN TO THIS PROGRAM AND     Legend
    EVALPLOT TO PLOT THE ENERGY DEPENDENCE OF THE LEGENDRE          Legend
```

```
       COEFFICIENTS IN ORDER TO IDENTIFY AND CORRECT (BY HAND...NOT   Legend
       BY THIS PROGRAM) ANY COEFFICIENTS WHICH HAVE UNREALISTIC       Legend
       ENERGY AND L ORDER VARIATIONS. THIS SHOULD ALWAYS BE DONE      Legend
       FIRST TO ELIMINATE MAJOR PROBLEMS BEFORE USING THIS PROGRAM    Legend
       TO AUTOMATICALLY MAKE MINOR CORRECTIONS.                       Legend
   (1) OUTPUT AND PLOT THE UNCORRECTED AND CORRECTED ANGULAR          Legend
       DISTRIBUTIONS. COMPARE THE PLOTS TO INSURE THAT THE CORRECTED  Legend
       DATA DOES NOT SERIOUSLY CHANGE THE ENERGY DEPENDENCE OF THE    Legend
       ANGULAR DISTRIBUTION.                                          Legend
   (2) IF PLOTTING CAPABILITY IS NOT AVAIALABLE, USE THE PRINTED OUT  Legend
       OF THIS PROGRAM TO DETERMINE HOW MUCH THE TABULATED ANGULAR    Legend
       DISTRIBUTION OR LEGENDRE COEFFICIENTS HAVE BEEN MODIFIED.      Legend
       GENERALLY IF ONE COEFFICIENT HAS BEEN ONLY SLIGHTLY MODIFIED   Legend
       THE DISTRIBUTION WILL BE ACCEPTABLE. HOWEVER IF MANY           Legend
       COEFFICIENTS HAVE BEEN MODIFIED THE RESULT WILL NOT BE         Legend
       RELIABLE.                                                      Legend
                                                                      Legend
   SEEING ANGULAR DISTRIBUTIONS AND LEGENDRE COEFFICIENTS             Legend
   ---------------------------------------------------                Legend
   PROGRAM EVALPLOT CAN BE USED TO PLOT ANGULAR DISTRIBUTION AND      Legend
   LEGENDRE COEFFICIENTS - WHEN IT COMES TO CHECKING THIS TYPE OF     Legend
   DATA THERE IS NO SUBSTITUTE FOR PLOTS OF THE DATA TO MAKE THE      Legend
   JOB EASY AND STRAIGHTFORWARD.                                      Legend
                                                                      Legend
   FOR LEGENDRE COEFFICIENTS EVALPLOT CAN BE USED TO SEE THE ENERGY   Legend
   DEPENDENCE OF EACH COEFFICIENT - THIS IS AN EXTREMELY EASY AND     Legend
   USEFUL WAY TO CHECK FOR ERRORS IN THE BASIC DATA.                  Legend
                                                                      Legend
   FOR ANGULAR DISTRIBUTION EVALPLOT CAN BE USED TO PLOT THEM AT      Legend
   EACH ENERGY THAT THEY ARE TABULATED - THIS IS ALSO AN EASY AND     Legend
   USEFUL WAY TO CHECK FOR ERRORS.                                    Legend
                                                                      Legend
   I/O UNIT DEFINITIONS                                               Legend
   --------------------                                               Legend
   UNIT  DESCRIPTION                                                  Legend
   ----  -----------                                                  Legend
     2   INPUT CARDS                                                  Legend
     3   OUTPUT REPORT                                                Legend
    10   ORIGINAL DATA IN ENDF/B FORMAT                               Legend
    11   FINAL DATA IN ENDF/B FORMAT                                  Legend
                                                                      Legend
   OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILIO1 AND FILIO2)    Legend
   ---------------------------------------------------------------    Legend
   UNIT  FILE NAME                                                    Legend
   ----  ----------                                                   Legend
     2   LEGEND.INP                                                   Legend
     3   LEGEND.LST                                                   Legend
    10   ENDFB.IN                                                     Legend
    11   ENDFB.OUT                                                    Legend
                                                                      Legend
   INPUT CARD                                                         Legend
   ----------                                                         Legend
CARD COLS.  FORMAT  DESCRIPTION                                       Legend
---- -----  ------ -----------                                       Legend
 1    1-11   E11.4 FRACTIONAL THINNING CRITERIA                       Legend
     12-22   I11   MAXIMUM NUMBER OF POINTS IN ANGULAR DISTRIBUTION   Legend
                   RECONSTRUCTED FROM LEGENDRE COEFFICIENTS (PRESENT  Legend
                   LIMITS ARE 11 TO 60000 POINTS)                     Legend
                  *THIS OPTION CAN BE USED TO RUN QUICK, BUT NOT      Legend
                   NECESSARILY SO ACCURATE CALCULATIONS - TO ROUGHLY  Legend
                   SEE WHAT THE ANGULAR DISTRIBUTIONS LOOK LIKE.      Legend
                  *IT IS RECOMMENDED THAT YOU USE 0 AS INPUT - IN     Legend
                   WHICH CASE THE PROGRAM WILL USE THE MAXIMUM        Legend
                   ALLOWABLE NUMBER OF POINTS = 60000.                Legend
     23-33   I11   TABULATED ANGULAR DISTRIBUTION TREATMENT           Legend
                   = 0 - COPY TABLES                                  Legend
                   = 1 - LINEARIZE TABLES (OUTPUT TABLES)             Legend
                   = 2 - LINEARIZE AND THIN TABLES (OUTPUT TABLES)    Legend
     34-44   I11   LEGENDRE COEFFICIENT TREATMENT                     Legend
                   = 0 - COPY LEGENDRE COEFFICIENTS                   Legend
                   = 1 - RECONSTRUCT TABULATED ANGULAR DISTRIBUTION.  Legend
```

```
                        (OUTPUT TABLES).                                  Legend
                    = 2 - RECONSTRUCT TABULATED ANGULAR DISTRIBUTION.     Legend
                        (OUTPUT LEGENDRE COEFFICIENTS).                   Legend
     45-55   I11    NEGATIVE ANGULAR DISTRIBUTION TREATMENT.               Legend
                    = 0 - NO CORRECTION                                   Legend
                    = 1 - TABULATE DATA - NO CORRECTION.                  Legend
                        - LEGENDRE DATA - CHANGE COEFFICIENTS             Legend
                        (NONE BY MORE THAN 1.0 PER-CENT - CAN BE          Legend
                        CHANGED BY INPUT).                                Legend
                    = 2 - FORCE DISTRIBUTIONS TO BE POSITIVE              Legend
                        (TABULATED OR LEGENDRE DATA).                     Legend
     56-66   I11    LEGENDRE COEFFICIENT VARIATION TEST FLAG.             Legend
                    = 0 - TEST TESTS.                                     Legend
                    = 1 - PERFORM TESTS,                                  Legend
                        (A) LEGENDRE ORDER INCREASES WITH ENERGY.         Legend
                        (C) MONOTONIC VARIATION OF COEFFICIENTS           Legend
                            AS A FUNCTION OF ENERGY.                      Legend
                        (C) COEFFICIENTS DECREASE AS A FUNCTION OF        Legend
                            LEGENDRE ORDER.                               Legend
  2   1-60   60A1   ENDF/B INPUT DATA FILENAME                            Legend
                    (STANDARD OPTION = ENDFB.IN)                          Legend
  3   1-60   60A1   ENDF/B OUTPUT DATA FILENAME                           Legend
                    (STANDARD OPTION = ENDFB.OUT)                         Legend
4-N   1- 6    I6    LOWER MAT LIMIT                                       Legend
      7- 8    I2    LOWER MF LIMIT                                        Legend
      9-11    I3    LOWER MT LIMIT                                        Legend
     12-17    I6    UPPER MAT LIMIT                                       Legend
     18-19    I2    UPPER MF LIMIT                                        Legend
     20-22    I3    UPPER MT LIMIT                                        Legend
     23-33  E11.4   LOWER ENERGY LIMIT                                    Legend
     34-44  E11.4   UPPER ENERGY LIMIT                                    Legend
     45-55  E11.4   MINIMUM ALLOWABLE VALUE OF ANGULAR DISTRIBUTION       Legend
     56-66  E11.4   ALLOWABLE FRACTION (NOT PER-CENT) CHANGE IN ANY       Legend
                    ONE LEGENDRE COEFFICIENT TO MAKE THE ANGULAR          Legend
                    DISTRIBUTION POSITIVE (AND AT LEAST EQUAL TO THE      Legend
                    INPUT MINIMUM ALLOWABLE VALUE).                       Legend
                                                                          Legend
    *UP TO 100 MAT/MT/E RANGES MAY BE INPUT, EACH SPECIFYING AN           Legend
     ALLOWABLE MINIMUM SIGMA AND MAXIMUM CHANGE IN COEFFICIENTS.          Legend
    *INPUT IS TERMINATED BY A BLANK CARD.                                 Legend
    *ALL MAY/MT/E RANGES NOT SPECIFIED BY INPUT WILL BE TREATED BY        Legend
     ALLOWING A MINIMUM SIGMA OF 0.001 (1 MILLI-BARN) AND A CHANGE        Legend
     IN EACH COEFFICIENT BY UP TO 0.01 (1 PER-CENT).                      Legend
    *THESE MAT/MT/E RANGES ARE NOT USED TO CORRECT ALL ANGULAR            Legend
     DISTRIBUTIONS WHERE SIGMA IS LESS THAN THE MINIMUM. THEY ARE         Legend
     ONLY USED TO CORRECT DISTRIBUTION THAT ARE NEGATIVE AND TO           Legend
     INSURE THAT THE CROSS SECTION AT THE COSINES WHERE THE ANGULAR       Legend
     DISTRIBUTION ARE INITIALLY NEGATIVE ARE CORRECTED TO BE POSITIVE     Legend
     AND AT LEAST AS LARGE AS THE MINIMUM ALLOWABLE SIGMA (SPECIFIED      Legend
     BY INPUT).                                                           Legend
                                                                          Legend
    EXAMPLE INPUT NO. 1                                                   Legend
    ------------------                                                    Legend
    PROCESS BOTH LEGENDRE COEFFICIENTS AND TABULATED DATA TO OBTAIN       Legend
    ANGULAR DISTRIBUTION WHICH ARE ACCURATE TO WITHIN 0.1 PER-CENT        Legend
    AND OUTPUT UNCORRECTED TABULATED ANGULAR DISTRIBUTION USING           Legend
    A MAXIMUM OF 501 POINTS IN EACH TABULATED ANGULAR DISTRIBUTION.       Legend
    SINCE LEGENDRE COEFFICIENTS WILL NOT BE CORRECTED THE INPUT NEED      Legend
    NOT SPECIFY MAT/MT/E RANGES.                                          Legend
                                                                          Legend
    READ /ENDFB6/K300/LEAD.IN AND WRITE /ENDFB6/K300/LEAD.OUT             Legend
                                                                          Legend
    THE FOLLOWING 4 INPUT LINES ARE REQUIRED,                             Legend
                                                                          Legend
1.00000- 3        501          2          1          0                   Legend
/ENDFB6/K300/LEAD.IN                                                      Legend
/ENDFB6/K300/LEAD.OUT                                                     Legend
    (BLANK CARD TERMINATED INPUT)                                         Legend
                                                                          Legend
    EXAMPLE INPUT NO. 2                                                   Legend
    ------------------                                                    Legend
```

```
    PROCESS BOTH LEGENDRE COEFFICIENTS AND TABULATED DATA TO OBTAIN    Legend
    ANGULAR DISTRIBUTION WHICH ARE ACCURATE TO WITHIN 0.1 PER-CENT     Legend
    AND OUTPUT CORRECTED TABULATED ANGULAR DISTRIBUTION (ONLY THOSE    Legend
    RE-CONSTRUCTED FROM LEGENDRE COEFFICIENTS WILL BE CORRECTED).      Legend
    FOR ALL MAT/MT/E CORRECT NEGATIVE ANGULAR DISTRIBUTION TO A VALUE  Legend
    OF 0.01 (10 MILLI-BARNS) AND ALLOW LEGENDRE COEFFICIENTS TO BE     Legend
    CHANGED BY UP TO 0.02 (2 PER-CENT).                                Legend
                                                                       Legend
    USE THE DEFAULT FILENAMES ENDFB.IN AND ENDFB.OUT (THIS CAN BE      Legend
    DONE BY LEAVING THE SECOND AND THIRD INPUT LINES BLANK).           Legend
                                                                       Legend
    THE FOLLOWING 5 INPUT LINES ARE REQUIRED,                          Legend
                                                                       Legend
1.00000- 3        501          2          1          1                Legend
                                                                       Legend
                                                                       Legend
    1 1  1  999999999 0.00000+ 0 3.00000+ 7 1.00000- 2 2.00000- 2      Legend
    (BLANK CARD TERMINATED INPUT)                                      Legend
                                                                       Legend
    EXAMPLE INPUT NO. 3                                                Legend
    -------------------                                                Legend
    PROCESS BOTH LEGENDRE COEFFICIENTS AND TABULATED DATA TO OBTAIN    Legend
    ANGULAR DISTRIBUTION WHICH ARE ACCURATE TO WITHIN 0.1 PER-CENT     Legend
    AND OUTPUT CORRECTED LEGENDRE COEFFICIENTS AND UNCORRECTED         Legend
    TABULATED ANGULAR DISTRIBUTIONS. FOR MAT=1800, MT=2 CORRECT        Legend
    NEGATIVE ANGULAR DISTRIBUTIONS TO INSURE THE MINIMUM IS 0.01       Legend
    (10 MILLI-BARNS) ALLOWING EACH LEGENDRE COEFFICIENT TO CHANGE BY   Legend
    UP TO 0.02 (2 PER-CENT). ALL OTHER MAT/MT/E WILL BE CORRECTED      Legend
    TO A MINIMUM OF 0.001 (1 MILLI-BARN) ALLOWING A 0.01 (1 PER-CENT)  Legend
    CHANGE (BUILT-IN OPTION).                                          Legend
                                                                       Legend
    READ /ENDFB6/K300/LEAD.IN AND WRITE /ENDFB6/K300/LEAD.OUT          Legend
                                                                       Legend
    THE FOLLOWING 5 INPUT LINES ARE REQUIRED,                          Legend
                                                                       Legend
1.00000- 3        501          2          2          1                Legend
/ENDFB6/K300/LEAD.IN                                                   Legend
/ENDFB6/K300/LEAD.OUT                                                  Legend
 1800 4  2  1800 4  2 0.00000+ 0 3.00000+ 7 1.00000- 2 2.00000- 2      Legend
    (BLANK CARD TERMINATED INPUT)                                      Legend
                                                                       Legend
    EXAMPLE INPUT NO. 4                                                Legend
    -------------------                                                Legend
    TO COPY TABULATED ANGULAR DISTRIBUTION AND CONVERT LEGENDRE        Legend
    COEFFICIENTS TO UNCORRECTED TABULAR DISTRIBUTIONS.                 Legend
                                                                       Legend
    USE THE DEFAULT FILENAMES ENDFB.IN AND ENDFB.OUT (THIS CAN BE      Legend
    DONE BY LEAVING THE SECOND AND THIRD INPUT LINES BLANK).           Legend
                                                                       Legend
    THE FOLLOWING 4 INPUT LINES ARE REQUIRED,                          Legend
                                                                       Legend
1.00000- 3        501          0          1          0                Legend
                                                                       Legend
                                                                       Legend
    (BLANK CARD TERMINATED INPUT)                                      Legend
                                                                       Legend
========================================================================Legend
```

```
====================================================================== Linear
                                                                       Linear
     PROGRAM LINEAR                                                    Linear
     VERSION 74-1 (MAY 1974)                                           Linear
     VERSION 75-1 (APRIL 1975)                                         Linear
     VERSION 76-2 (OCTOBER 1976)                                       Linear
     VERSION 77-1 (JANUARY 1977)                                       Linear
     VERSION 78-1 (JULY 1978)                                          Linear
     VERSION 79-1 (JULY 1979) CDC-7600 AND CRAY-1 VERSION.             Linear
     VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION.                Linear
     VERSION 80-2 (DECEMBER 1980)                                      Linear
     VERSION 81-1 (MARCH 1981)                                         Linear
     VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY.      Linear
     VERSION 83-1 (JANUARY 1983) *MAJOR RE-DESIGN.                     Linear
                                 *PAGE SIZE INCREASED - 1002 TO 3006.  Linear
                                 *ELIMINATED COMPUTER DEPENDENT CODING. Linear
                                 *NEW, MORE COMPATIBLE I/O UNIT NUMBER. Linear
                                 *ADDED OPTION TO KEEP ALL ORIGINAL    Linear
                                  ENERGY POINTS FROM EVALUATION.       Linear
                                 *ADDED STANDARD ALLOWABLE ERROR OPTION Linear
                                  (CURRENTLY 0.1 PER-CENT).            Linear
     VERSION 83-2 (OCTOBER 1983) IMPROVED BASED ON USER COMMENTS.      Linear
     VERSION 84-1 (APRIL 1984)   IMPROVED BASED ON USER COMMENTS.      Linear
     VERSION 84-2 (JUNE 1984)   *UPDATED FOR ENDF/B-VI FORMATS.       Linear
                                *SPECIAL I/O ROUTINES TO GUARANTEE     Linear
                                 ACCURACY OF ENERGY.                   Linear
                                *DOUBLE PRECISION TREATMENT OF ENERGY  Linear
                                 (REQUIRED FOR NARROW RESONANCES).     Linear
     VERSION 85-1 (AUGUST 1985) *FORTRAN-77/H VERSION                  Linear
     VERSION 86-1 (JANUARY 1986)*ENDF/B-VI FORMAT                      Linear
     VERSION 87-1 (JANUARY 1987)*DOUBLE PRECISION TREATMENT OF CROSS   Linear
                                 SECTION                               Linear
     VERSION 88-1 (JULY 1988)   *OPTION...INTERNALLY DEFINE ALL I/O    Linear
                                 FILE NAMES (SEE, SUBROUTINE FILEIO    Linear
                                 FOR DETAILS).                         Linear
                                *IMPROVED BASED ON USER COMMENTS.      Linear
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO    Linear
                                 INSURE PROGRAM WILL NOT DO ANYTHING   Linear
                                 CRAZY.                                Linear
                                *UPDATED TO USE NEW PROGRAM CONVERT    Linear
                                 KEYWORDS.                             Linear
                                *ADDED LIVERMORE CIVIC COMPILER        Linear
                                 CONVENTIONS.                          Linear
     VERSION 90-1 (JUNE 1990)   *EXTENDED TO LINEARIZE PHOTON          Linear
                                 INTERACTION DATA, MF=23 AND 27        Linear
                                *ADDED FORTRAN SAVE OPTION             Linear
                                *UPDATED BASED ON USER COMMENTS.       Linear
                                *NEW MORE CONSISTENT ENERGY OUTPUT     Linear
                                 ROUTINE.                              Linear
                                *WARNING...INPUT PARAMETER FORMAT      Linear
                                 HAS BEEN CHANGED...SEE DESCRIPTION    Linear
                                 BELOW.                                Linear
     VERSION 91-1 (JULY 1991)   *ADDED INTERPOLATION LAW 6 - ONLY USED Linear
                                 FOR CHARGED PARTICLE CROSS SECTIONS   Linear
                                 FOR COULOMB PENETRABILITIES.          Linear
     VERSION 92-1 (JANUARY 1992)*ADDED NU-BAR (TOTAL, DELAYED, PROMPT) Linear
                                 POLYNOMIAL OR TABULATED ALL CONVERTED Linear
                                 TO LINEARLY INTERPOLABLE              Linear
                                *INCREASED PAGE SIZE FROM 3006 TO 5010 Linear
                                 POINTS.                               Linear
                                *ALL ENERGIES INTERNALLY ROUNDED PRIOR Linear
                                 TO CALCULATIONS.                      Linear
                                *COMPLETELY CONSISTENT I/O AND ROUNDING Linear
                                 ROUTINES - TO MINIMIZE COMPUTER       Linear
                                 DEPENDENCE.                           Linear
     VERSION 92-2 (JULY 1992)   *CORRECTED CONVERSION OF NU-BAR FROM   Linear
                                 POLYNOMIAL TO TABULATED - COPY        Linear
                                 SPONTANEOUS NU-BAR (BY DEFINITION     Linear
                                 THE SPONTANEOUS NU-BAR IS NOT AN      Linear
                                 ENERGY DEPENDENT QUANTITY).           Linear
     VERSION 93-1 (MARCH 1993)  *UPDATED FOR USE WITH LAHEY COMPILER   Linear
```

```
                          ON IBM-PCS.                                Linear
                         *INCREASED PAGE SIZE FROM 5010 TO           Linear
                          30000 POINTS                               Linear
VERSION 94-1 (JANUARY 1994)*VARIABLE ENDF/B DATA FILENAMES           Linear
                          TO ALLOW ACCESS TO FILE STRUCTURES         Linear
                          (WARNING - INPUT PARAMETER FORMAT          Linear
                          HAS BEEN CHANGED)                          Linear
                         *CLOSE ALL FILES BEFORE TERMINATING         Linear
                          (SEE, SUBROUTINE ENDIT)                    Linear
VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                       Linear
                          *IMPROVED COMPUTER INDEPENDENCE            Linear
                          *ALL DOUBLE PRECISION                      Linear
                          *ON SCREEN OUTPUT                          Linear
                          *UNIFORM TREATMENT OF ENDF/B I/O           Linear
                          *IMPROVED OUTPUT PRECISION                 Linear
                          *DEFINED SCRATCH FILE NAMES                Linear
                          *ALWAYS INCLUDE THERMAL VALUE              Linear
                          *INCREASED PAGE SIZE FROM 30000 TO         Linear
                           60000 POINTS                              Linear
VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING         Linear
                           POINT READ FOR MORE DIGITS                Linear
                          *UPDATED TEST FOR ENDF/B FORMAT            Linear
                           VERSION BASED ON RECENT FORMAT CHANGE     Linear
                          *GENERAL IMPROVEMENTS BASED ON             Linear
                           USER FEEDBACK                             Linear
VERSION 99-2 (JUNE 1999)    *ASSUME ENDF/B-VI, NOT V, IF MISSING     Linear
                           MF=1, MT-451.                             Linear
VERS. 2000-1 (FEBRUARY 2000)*ADDED MF = 9 AND 10 LINEARIZATION       Linear
                          *GENERAL IMPROVEMENTS BASED ON             Linear
                           USER FEEDBACK                             Linear
VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS               Linear
VERS. 2004-1 (JAN. 2004)    *GENERAL UPDATE BASED ON USER FEEDBACK   Linear
                                                                     Linear
OWNED, MAINTAINED AND DISTRIBUTED BY                                 Linear
-----------------------------------                                  Linear
THE NUCLEAR DATA SECTION                                             Linear
INTERNATIONAL ATOMIC ENERGY AGENCY                                   Linear
P.O. BOX 100                                                         Linear
A-1400, VIENNA, AUSTRIA                                              Linear
EUROPE                                                               Linear
                                                                     Linear
ORIGINALLY WRITTEN BY                                                Linear
---------------------------------                                    Linear
DERMOTT E. CULLEN                                                    Linear
UNIVERSITY OF CALIFORNIA                                             Linear
LAWRENCE LIVERMORE NATIONAL LABORATORY                               Linear
L-159                                                                Linear
P.O. BOX 808                                                         Linear
LIVERMORE, CA 94550                                                  Linear
U.S.A.                                                               Linear
TELEPHONE  925-423-7359                                              Linear
E. MAIL    CULLEN1@LLNL.GOV                                          Linear
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                               Linear
                                                                     Linear
AUTHORS MESSAGE                                                      Linear
---------------                                                      Linear
THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION     Linear
FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED   Linear
THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE   Linear
READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION.                    Linear
                                                                     Linear
AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER   Linear
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE       Linear
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT   Linear
IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY         Linear
COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO    Linear
IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF      Linear
THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR           Linear
COMPUTER.                                                            Linear
                                                                     Linear
PURPOSE                                                              Linear
```

```
-------                                                                 Linear
THIS PROGRAM IS DESIGNED TO CONVERT ENDF/B FILE 3, 23 AND 27 DATA       Linear
TO LINEAR-LINEAR INTERPOLABLE FORM. ANY SECTION THAT IS ALREADY         Linear
LINEAR-LINEAR INTERPOLABLE WILL BE THINNED.                             Linear
                                                                        Linear
IN THE FOLLOWING DISCUSSION FOR SIMPLICITY THE ENDF/B TERMINOLOGY       Linear
---ENDF/B TAPE---WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE         Linear
TAPE, CARDS, DISK OR ANY OTHER MEDIUM.                                  Linear
                                                                        Linear
ENDF/B FORMAT                                                           Linear
-------------                                                           Linear
THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS          Linear
OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION        Linear
OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT).      Linear
                                                                        Linear
IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B            Linear
FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS          Linear
ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE       Linear
NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE               Linear
CORRECTLY OUTPUT ON ALL LINES. THE FORMAT OF SECTION MF=1, MT=451       Linear
AND ALL SECTIONS OF MF=3 MUST BE CORRECT. THE PROGRAM COPIES ALL        Linear
OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO        Linear
THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.                  Linear
                                                                        Linear
OUTPUT FORMAT                                                           Linear
-------------                                                           Linear
IN THIS VERSION OF LINEAR ALL ENERGIES WILL BE OUTPUT IN                Linear
F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN        Linear
WITH UP TO 9 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN       Linear
OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS        Linear
OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS         Linear
TO THE 9 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE       Linear
TO USE THE 9 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA          Linear
DUE TO TRUNCATION OF ENERGIES TO 6 DIGITS DURING OUTPUT.                Linear
                                                                        Linear
CONTENTS OF OUTPUT                                                      Linear
------------------                                                      Linear
ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE LINEARIZED DATA             Linear
CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO          Linear
INCLUDED.                                                               Linear
                                                                        Linear
DOCUMENTATION                                                           Linear
-------------                                                           Linear
THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED       Linear
BY THE ADDITION OF 3 COMMENT LINES AT THE END OF EACH HOLLERITH         Linear
SECTION IN THE FORM                                                     Linear
                                                                        Linear
***************** PROGRAM LINEAR (2004-1) ***************             Linear
FOR ALL DATA GREATER THAN 1.00000-10 IN ABSOLUTE VALUE                  Linear
DATA LINEARIZED TO WITHIN AN ACCURACY OF  0.1  PER-CENT                 Linear
                                                                        Linear
THE ORDER OF SIMILAR COMMENTS (FROM RECENT, SIGMA1 AND GROUPIE)         Linear
REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON            Linear
THE DATA BY THESE PROGRAMS.                                             Linear
                                                                        Linear
THESE COMMENT LINES ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS,      Linear
I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT      Linear
OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF           Linear
EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451         Linear
IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF           Linear
THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF           Linear
MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO               Linear
DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND        Linear
AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT       Linear
SHOULD BE USED TO CREATE A HOLLERITH SECTION.                           Linear
                                                                        Linear
REACTION INDEX                                                          Linear
--------------                                                          Linear
THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN          Linear
SECTION MF=1, MT=451 OF EACH EVALUATION.                                Linear
                                                                        Linear
```

```
THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451.   Linear
THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT         Linear
REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS Linear
NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING  Linear
A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE  Linear
A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM Linear
YOU MAY USE PROGRAM DICTIN TO CREATE A CORRECT REACTION INDEX.     Linear
                                                                   Linear
SECTION SIZE                                                       Linear
------------                                                       Linear
SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT  Linear
TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS      Linear
SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.                 Linear
                                                                   Linear
FOR ANY LINEARIZED SECTION THAT CONTAINS 60000 OR FEWER POINTS     Linear
THE ENTIRE OPERATION WILL BE PERFORMED IN CORE AND THE LINEARIZED  Linear
DATA WILL BE OUTPUT DIRECTLY TO THE ENDF/B FORMAT. FOR ANY SECTION Linear
THAT CONTAINS MORE POINTS THE DATA WILL BE LINEARIZED A PAGE AT A  Linear
TIME (1 PAGE = 60000 POINTS) AND OUTPUT TO SCRATCH. AFTER THE      Linear
ENTIRE SECTION HAS BEEN LINEARIZED THE DATA WILL BE READ BACK FROM Linear
SCRATCH AND OUTPUT TO THE ENDF/B FORMAT.                           Linear
                                                                   Linear
SELECTION OF DATA                                                  Linear
-----------------                                                  Linear
THE PROGRAM SELECTS DATA TO BE LINEARIZED BASED EITHER ON EITHER   Linear
MAT (ENDF/B MAT NO.) OR ZA AS WELL AS MF AND MT NUMBERS. THIS      Linear
PROGRAM ALLOWS UP TO 100 MAT/MF/MT OR ZA/MF/MT RANGES TO BE        Linear
SPECIFIED BY INPUT PARAMETERS. THE PROGRAM WILL ASSUME THAT THE    Linear
ENDF/B TAPE IS IN MAT ORDER, REGARDLESS OF THE CRITERIA USED       Linear
TO RETRIEVE MATERIALS. IF RETRIEVAL IS BY MAT RANGE THE PROGRAM    Linear
WILL TERMINATE WHEN A MAT IS FOUND THAT IS ABOVE ALL REQUESTED     Linear
MAT RANGES. IF RETRIEVAL IS BY ZA RANGE THE PROGRAM WILL SEARCH    Linear
THE ENTIRE ENDF/B TAPE.                                            Linear
                                                                   Linear
PROGRAM OPERATION                                                  Linear
-----------------                                                  Linear
EACH SECTION OF DATA IS CONSIDERED SEPARATELY. EACH SECTION OF     Linear
ENDF/B DATA TO LINEARIZE IS REPRESENTED BY A TABLE OF ENERGY       Linear
VS. CROSS SECTION AND ANY ONE OF FIVE ALLOWABLE INTERPOLATION LAWS Linear
BETWEEN ANY TWO TABULATED POINTS. THIS PROGRAM WILL REPLACE EACH   Linear
SECTION OF DATA CROSS SECTIONS BY A NEW TABLE OF ENERGY VS.        Linear
CROSS SECTION IN WHICH THE INTERPOLATION LAW IS ALWAYS LINEAR IN   Linear
ENERGY AND CROSS SECTION BETWEEN ANY TWO TABULATED POINTS.         Linear
                                                                   Linear
DATA IS READ AND LINEARIZED A PAGE AT A TIME (ONE PAGE CONTAINS    Linear
60000 DATA POINTS). IF THE FINAL LINEARIZED SECTION CONTAINS TWO   Linear
PAGES OR LESS, DATA POINTS IT WILL BE ENTIRELY CORE RESIDENT       Linear
AFTER IT HAS BEEN LINEARIZED AND WILL BE WRITTEN DIRECTLY FROM     Linear
CORE TO THE OUTPUT TAPE. IF THE LINEARIZED SECTION IS LARGER THAN  Linear
TWO PAGES, AFTER EACH PAGE IS LINEARIZED IT WILL BE WRITTEN TO     Linear
SCRATCH. AFTER THE ENTIRE SECTION HAS BEEN LINEARIZED IT WILL      Linear
BE READ BACK FROM SCRATCH, TWO PAGES AT A TIME, AND WRITTEN TO     Linear
THE OUTPUT TAPE.                                                   Linear
                                                                   Linear
KEEP EVALUATED DATA POINTS                                         Linear
--------------------------                                         Linear
SOMETIMES IT IS CONVENIENT TO KEEP ALL ENERGY POINTS WHICH WERE    Linear
PRESENT IN THE ORIGINAL EVALUATION AND TO MERELY SUPPLEMENT THESE  Linear
POINTS WITH ADDITIONAL ENERGY POINTS IN ORDER TO LINEARIZE THE     Linear
CROSS SECTIONS. FOR EXAMPLE, IT IS OFTEN CONVENIENT TO KEEP THE    Linear
THERMAL VALUE (AT 0.0253 EV) OR THE VALUE AT 14.1 MEV.             Linear
                                                                   Linear
THE CURRENT VERSION OF THIS PROGRAM WILL ALLOW THE USER TO KEEP    Linear
ALL ORIGINAL EVALUATED DATA POINTS BY SPECIFYING 1 IN COLUMNS      Linear
34-44 OF THE FIRST INPUT LINE. THIS WILL TURN OFF THE BACKWARD     Linear
THINNING (SEE UCRL-50400, VOL. 17, PART A FOR EXPLANATION) AND     Linear
RESULT IN ALL ORIGINAL ENERGY POINTS BEING KEPT. CAUTION SHOULD    Linear
BE EXERCISED IN USING THIS OPTION SINCE IT CAN RESULT IN A         Linear
CONSIDERABLE INCREASE IN THE NUMBER OF DATA POINTS OUTPUT BY       Linear
THIS CODE.                                                         Linear
                                                                   Linear
```

```
FOR ALL USERS WHO ARE NOT INTERESTED IN THIS OPTIONS NO CHANGES    Linear
ARE REQUIRED IN THE INPUT TO THIS PROGRAM, I. E. IF COLUMNS        Linear
34-44 ARE BLANK (AS FOR ALL PREVIOUS VERSIONS OF THIS CODE) THE    Linear
PROGRAM WILL OPERATE EXACTLY AS IT DID BEFORE.                     Linear
                                                                   Linear
ALLOWABLE ERROR                                                    Linear
--------------                                                     Linear
ALLOWABLE ERROR MUST ALWAYS BE SPECIFIED IN THE INPUT TO THIS      Linear
PROGRAM AS A FRACTION, NOT A PER-CENT. FOR EXAMPLE, INPUT THE      Linear
ALLOWABLE FRACTIONAL ERROR 0.001 IN ORDER TO OBTAIN DATA THAT IS   Linear
ACCURATE TO WITHIN 0.1 PER-CENT.                                   Linear
                                                                   Linear
THE CONVERSION OF THE DATA FROM THE GENERAL INTERPOLATION FORM TO  Linear
LINARLY INTERPOLABLE FORM CANNOT BE PERFORMED EXACTLY. HOWEVER, IT Linear
CAN BE PERFORMED TO VIRTUALLY ANY REQUIRED ACCURACY AND MOST       Linear
IMPORTANTLY CAN BE PERFORMED TO A TOLERANCE THAT IS SMALL COMPARED Linear
TO THE UNCERTAINTY IN THE CROSS SECTIONS THEMSELVES. AS SUCH THE   Linear
CONVERSION OF CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM CAN BE  Linear
PERFORMED WITH ESSENTIALLY NO LOSE OF INFORMATION.                 Linear
                                                                   Linear
THE ALLOWABLE ERROR MAY BE ENERGY INDEPENDENT (CONSTANT) OR ENERGY Linear
DEPENDENT. THE ALLOWABLE ERROR IS DESCRIBED BY A TABULATED         Linear
FUNCTION OF UP TO 20 (ENERGY,ERROR) PAIRS AND LINEAR INTERPOLATION Linear
BETWEEN TABULATED POINTS. IF ONLY ONE TABULATED POINT IS GIVEN THE Linear
ERROR WILL BE CONSIDERED CONSTANT OVER THE ENTIRE ENERGY RANGE.    Linear
WITH THIS ENERGY DEPENDENT ERROR ONE MAY OPTIMIZE THE OUTPUT FOR   Linear
ANY GIVEN APPLICATION BY USING A SMALL ERROR IN THE ENERGY RANGE   Linear
OF INTEREST AND A LESS STRINGENT ERROR IN OTHER ENERGY RANGES.     Linear
                                                                   Linear
DEFAULT ALLOWABLE ERROR                                            Linear
----------------------                                             Linear
IN ORDER TO INSURE CONVERGENCE OF THE LINEARIZING ALGORITHM THE    Linear
ALLOWABLE ERROR MUST BE POSITIVE. IF THE USER INPUTS AN ERROR      Linear
THAT IS NOT POSITIVE IT WILL AUTOMATICALLY BE SET TO THE DEFAULT   Linear
VALUE (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT) AND         Linear
INDICATED AS SUCH IN THE OUTPUT LISTING.                           Linear
                                                                   Linear
COULOMB PENETRABILITY (INTERPOLATION LAW = 6)                      Linear
-------------------------------------------                        Linear
INTRODUCED FOR ENDF/B-VI. THIS IS DEFINED AS,                      Linear
                                                                   Linear
SIG(E) = C1*EXP(-C2/SQRT(E - T))                                   Linear
                                                                   Linear
THIS PROGRAM ONLY CONSIDERS EXOTHERMIC REACTIONS - T = 0           Linear
                                                                   Linear
SIG(E) = C1*EXP(-C2/SQRT(E))                                       Linear
                                                                   Linear
WARNING...THIS INTERPOLATION LAW SHOULD ONLY BE USED FOR REACTIONS Linear
          WHICH HAVE A POSITIVE Q-VALUE (EXOTHERMIC REACTIONS),    Linear
          SINCE HERE WE ONLY CONSIDER T = 0.0 IN THE FORMALISM.    Linear
          IN ALL OTHER CASES A WARNING MESSAGE WILL BE PRINTED.    Linear
                                                                   Linear
INPUT FILES                                                        Linear
-----------                                                        Linear
UNIT  DESCRIPTION                                                  Linear
----  -----------                                                  Linear
   2  INPUT LINES (BCD - 80 CHARACTERS/RECORD)                     Linear
  10  ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)            Linear
                                                                   Linear
OUTPUT FILES                                                       Linear
------------                                                       Linear
UNIT  DESCRIPTION                                                  Linear
----  -----------                                                  Linear
   3  OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)                  Linear
  11  FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)               Linear
                                                                   Linear
SCRATCH FILES                                                      Linear
-------------                                                      Linear
UNIT  DESCRIPTION                                                  Linear
----  -----------                                                  Linear
  12  SCRATCH FILE (BINARY - 180000 WORDS/RECORD                   Linear
```

```
                                                                    Linear
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILEIO)                Linear
-------------------------------------------------                   Linear
UNIT  FILE NAME                                                     Linear
----  ----------                                                    Linear
  2   LINEAR.INP                                                    Linear
  3   LINEAR.LST                                                    Linear
 10   ENDFB.IN                                                      Linear
 11   ENDFB.OUT                                                     Linear
 12   (SCRATCH)                                                     Linear
                                                                    Linear
                                                                    Linear
INPUT PARAMETERS                                                    Linear
---------------                                                     Linear
FOR VERSIONS EARLIER THAN 90-1 THIS PROGRAM ONLY ALLOWED THE USER   Linear
TO SPECIFY BY INPUT PARAMETERS WHICH MATERIALS (MAT) TO PROCESS.     Linear
FOR EACH REQUESTED MATERIAL NEUTRON INTERACTION CROSS SECTIONS      Linear
(MF=3) WOULD BE LINEARIZED AND THE REMAINDER OF THE MATERIAL        Linear
WOULD BE COPIED.                                                    Linear
                                                                    Linear
FOR VERSIONS 90-1 AND LATER THIS PROGRAM WILL ALLOW THE USER TO     Linear
TO SPECIFY BY INPUT PARAMETERS EXACTLY WHAT SECTIONS OF DATA        Linear
TO PROCESS. FOR EACH SECTION OF DATA, SPECIFIED BY MAT, MF, MT      Linear
RANGES, SECTIONS OF MF=3, 23 AND 27 WILL BE LINEARIZED AND ALL      Linear
OTHER REQUESTED SECTIONS WILL BE COPIED. ALL SECTIONS WHICH ARE     Linear
NOT EXPLICITLY REQUESTED WILL BE SKIPPED AND WILL NOT APPEAR ON     Linear
ENDF/B FILE OUTPUT BY THIS PROGRAM.                                 Linear
                                                                    Linear
WITH THIS NEW PROCEDURE YOU CAN MINIMIZE THE SIZE OF THE ENDF/B     Linear
FILE OUTPUT BY THIS PROGRAM, E.G., IF YOU ONLY WANT NEUTRON         Linear
CROSS SECTIONS FOR SUBSEQUENT PROCESSING YOU NEED ONLY REQUEST      Linear
ONLY MF=3 DATA.                                                     Linear
                                                                    Linear
HOWEVER, YOU MUST UNDERSTAND THAT ONLY THOSE SECTIONS WHICH YOU     Linear
EXPLICITLY REQUEST WILL APPEAR ON THE ENDF/B FILE OUTPUT BY         Linear
THIS PROGRAM. FOR EXAMPLE, IF YOU WISH TO DOCUMENT EXACTLY          Linear
HOW YOU LINEARIZED THE DATA BY INCLUDING COMMENTS IN MF=1, MT=451   Linear
THEN YOU MUST EXPLICITLY REQUEST THAT MF=1, MT=451 BE PROCESSED     Linear
FOR EACH MATERIAL THAT YOU REQUEST. SIMILAR IF YOU WANT THE         Linear
ENTIRE EVALUATION YOU MUST REQUEST ALL MF AND MT TO BE OUTPUT.      Linear
                                                                    Linear
LINE  COLS.  DESCRIPTION                                            Linear
----  -----  -----------                                            Linear
   1   1-11  SELECTION CRITERIA (0=MAT, 1=ZA)                       Linear
      12-22  MONITOR MODE SELECTOR                                  Linear
             = 0 - NORMAL OPERATION                                 Linear
             = 1 - MONITOR PROGRESS OF LINEARIZING OF THE DATA.     Linear
                   EACH TIME A PAGE OF DATA POINTS IS WRITTEN TO    Linear
                   THE SCRATCH FILE PRINT OUT THE TOTAL NUMBER OF   Linear
                   POINTS ON SCRATCH AND THE LOWER AND UPPER        Linear
                   ENERGY LIMITS OF THE PAGE (THIS OPTION MAY BE    Linear
                   USED IN ORDER TO MONITOR THE EXECUTION SPEED     Linear
                   OF LONG RUNNING JOBS).                           Linear
      23-33  MINIMUM CROSS SECTION OF INTEREST (BARNS).              Linear
             (IF 0.0 OR LESS IS INPUT THE PROGRAM WILL              Linear
             USE 1.0E-10). ENERGY INTERVALS WILL NOT BE             Linear
             SUB-DIVIDED IF THE ABSOLUTE VALUE OF THE CROSS         Linear
             SECTION WITHIN THE INTERVAL IS LESS THAN THIS VALUE.   Linear
             AN EXCEPTION TO THIS RULE IS NEAR THRESHOLDS ENERGY    Linear
             INTERVALS WILL BE SUB-DIVIDED UNTIL CONVERGENCE        Linear
             REGARDLESS OF THE MAGNITUDE OF THE CROSS SECTION.      Linear
      34-44  KEEP ORIGINAL EVALUATED DATA POINTS.                   Linear
             = 0 - NO.                                              Linear
             = 1 - YES - ADDITIONAL POINTS MAY BE ADDED IN ORDER    Linear
                         TO LINEARIZE DATA, BUT ALL ORIGINAL        Linear
                         DATA POINTS WILL BE INCLUDED IN THE        Linear
                         RESULTS.                                   Linear
   2   1-60  ENDF/B INPUT DATA FILENAME                             Linear
             (STANDARD OPTION = ENDFB.IN)                           Linear
   3   1-60  ENDF/B OUTPUT DATA FILENAME                            Linear
             (STANDARD OPTION = ENDFB.OUT)                          Linear
```

```
 4-N   1- 6  LOWER MAT OR ZA LIMIT                                  Linear
       7- 8  LOWER MF LIMIT                                         Linear
       9-11  LOWER MT LIMIT                                         Linear
      12-17  UPPER MAT OR ZA LIMIT                                  Linear
      18-19  UPPER MF LIMIT                                         Linear
      20-22  UPPER MT LIMIT                                         Linear
             UP TO 100 RANGES MAY BE SPECIFIED, ONLY ONE RANGE     Linear
             PER LINE. THE LIST OF RANGES IS TERMINATED BY A       Linear
             BLANK LINE. IF THE UPPER MAT LIMIT OF ANY REQUEST     Linear
             IS LESS THAN THE LOW LIMIT IT WILL BE SET EQUAL TO    Linear
             THE LOWER LIMIT. IF THE UPPER LIMIT IS STILL ZERO     Linear
             IT WILL BE SET EQUAL TO 999999. IF THE UPPER MF OR    Linear
             MT LIMIT IS ZERO IT WILL BE SET TO 99 OR 999          Linear
             RESPECTIVELY.                                         Linear
 VARY  1-11  ENERGY FOR ERROR LAW                                  Linear
      12-22  ALLOWABLE FRACTIONAL ERROR FOR ERROR LAW.              Linear
             THE ACCEPTABLE LINEARIZING ERROR MAY BE SPECIFIED TO  Linear
             BE EITHER ENERGY INDEPENDENT (DEFINED BY A SINGLE     Linear
             ERROR), OR ENERGY DEPENDENT (DEFINED BY UP TO 20      Linear
             ENERGY, ERROR PAIRS). FOR THE ENERGY DEPENDENT CASE   Linear
             LINEAR INTERPOLATION WILL BE USED TO DEFINE THE ERROR Linear
             AT ENERGIES BETWEEN THOSE AT WHICH IT IS TABULATED.   Linear
             IN ALL CASES THE ERROR LAW IS TERMINATED BY A BLANK   Linear
             LINE. IF ONLY ONE ENERGY, ERROR PAIR IS GIVEN THE     Linear
             THE LAW WILL BE CONSIDERED TO BE ENERGY INDEPENDENT.  Linear
             IF MORE THAN ONE PAIR IS GIVEN IT WILL BE CONSIDERED  Linear
             TO BE ENERGY DEPENDENT (NOTE, ENERGY INDEPENDENT      Linear
             FORM WILL RUN FASTER THAN THE EQUIVALENT ENERGY       Linear
             DEPENDENT FORM). FOR AN ENERGY DEPENDENT ERROR LAW    Linear
             ALL ENERGIES MUST BE ASCENDING ENERGY ORDER. FOR      Linear
             CONVERGENCE OF THE LINEARIZING ALGORITHM ALL ERRORS   Linear
             MUST BE POSITIVE. IF AN ALLOWABLE ERROR IS NOT        Linear
             POSITIVE IT WILL BE SET EQUAL TO THE STANDARD OPTION  Linear
             (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT).     Linear
             IF THE FIRST ERROR LINE IS BLANK IT WILL TERMINATE    Linear
             THE ERROR LAW AND THE ERROR WILL BE TREATED AS        Linear
             ENERGY INDEPENDENT, EQUAL TO THE STANDARD OPTION      Linear
             (CURRENTLY 0.1 PER-CENT). (SEE EXAMPLE INPUT 4).      Linear
                                                                   Linear
    EXAMPLE INPUT NO. 1                                            Linear
    ------------------                                             Linear
    RETRIEVE DATA BY ZA IN ORDER TO FIND ALL URANIUM ISOTOPES AND  Linear
    THORIUM 232. RETRIEVE ALL NEUTRON INTERACTION CROSS SECTIONS   Linear
    (MF=3). ALL ENERGY INTERVALS IN WHICH THE CROSS SECTION IS     Linear
    AT LEAST 1 MICRO-BARN (1.0E-06 BARNS) WILL BE SUBDIVIDED.      Linear
    BACKWARD THINNING WILL BE PERFORMED. FROM 0 TO 100 EV LINEARIZE Linear
    TO WITHIN 0.1 PER-CENT ACCURACY. FROM 100 EV TO 1 KEV VARY     Linear
    ACCURACY BETWEEN 0.1 AND 1.0 PER-CENT. ABOVE 1 KEV USE 1       Linear
    PER-CENT ACCURACY.                                             Linear
                                                                   Linear
    EXPLICITLY SPECIFY THE STANDARD FILENAMES.                     Linear
                                                                   Linear
    IN THIS CASE THE FOLLOWING 11 INPUT LINES ARE REQUIRED         Linear
                                                                   Linear
        1          0 1.00000- 6          0                       Linear
ENDFB.IN                                                           Linear
ENDFB.OUT                                                          Linear
92000 3  0 92999 3999                                              Linear
90232 3  0     0 3  0    (UPPER LIMIT AUTOMATICALLY SET TO 90232 3999) Linear
                         (END OF REQUEST LIST)                     Linear
0.00000+ 0 1.00000-03                                              Linear
1.00000+ 2 1.00000-03                                              Linear
1.00000+ 3 1.00000-02                                              Linear
1.00000+ 9 1.00000-02                                              Linear
                         (END OF ERROR LAW)                        Linear
                                                                   Linear
    EXAMPLE INPUT NO. 2                                            Linear
    ------------------                                             Linear
    SAME AS THE ABOVE CASE, EXCEPT LINEARIZE ALL DATA TO WITHIN THE Linear
    STANDARD ACCURACY (CURRENTLY 0.1 PER-CENT). IN ORDER TO USE THE Linear
    STANDARD ACCURACY YOU NEED NOT SPECIFY ANY ERROR LAW AT ALL. IN Linear
```

```
    THIS CASE INCLUDE THE HOLLERITH SECTION, MF=1, MT=451, FOR EACH    Linear
    MATERIAL.                                                          Linear
                                                                       Linear
    LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL     Linear
    THEN USE STANDARD FILENAMES.                                       Linear
                                                                       Linear
    IN THIS CASE THE FOLLOWING 9 INPUT LINES ARE REQUIRED              Linear
                                                                       Linear
         1          0 1.00000- 6          0                          Linear
                        (USE DEFAULT FILENAME = ENDFB.IN)              Linear
                        (USE DEFAULT FILENAME = ENDFB.OUT)             Linear
 92000 1451 92999 1451                                                 Linear
 92000 3  0 92999 3999                                                 Linear
 90232 1451     0 1451                                                 Linear
 90232 3  0     0 3  0    (UPPER LIMIT AUTOMATICALLY SET TO 90232 3999) Linear
                        (END OF REQUEST LIST)                          Linear
                        (0.1 PER-CENT ERROR, END OF ERROR LAW)         Linear
                                                                       Linear
    EXAMPLE INPUT NO. 3                                                Linear
    ------------------                                                 Linear
    LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO WITHIN AN ACCURACY    Linear
    OF 0.5 PER-CENT (0.005 AS A FRACTION). IN THIS CASE YOU NEED NOT   Linear
    SPECIFY THE MAT, MF, MT RANGES.                                    Linear
                                                                       Linear
    READ THE ENDF/B DATA FROM \ENDFB6\ZA092238 AND WRITE THE ENDF/B    Linear
    DATA TO \ENDFB6\LINEAR\ZA092238.                                   Linear
                                                                       Linear
    IN THIS CASE THE FOLLOWING 6 INPUT LINES ARE REQUIRED              Linear
                                                                       Linear
                                          (MAT, 1.0E-10 BARNS, THIN)   Linear
 \ENDFB6\ZA092238                                                      Linear
 \ENDFB6\LINEAR\ZA092238                                               Linear
                        (RETRIEVE ALL DATA, END REQUEST LIST)          Linear
           5.00000-03                                                  Linear
                        (END OF ERROR LAW)                             Linear
                                                                       Linear
    NOTE THAT IN THIS CASE IF THE INPUT HAD SPECIFIED AN EQUIVALENT    Linear
    ENERGY DEPENDENT ERROR LAW BY GIVING A NUMBER OF ENERGY POINTS     Linear
    AT EACH OF WHICH THE ERROR IS 0.5 PER-CENT THE PROGRAM WOULD TAKE  Linear
    LONGER TO RUN (I.E., ONLY USE AN ENERGY DEPENDENT ERROR LAW WHEN   Linear
    IT IS NECESSARY).                                                  Linear
                                                                       Linear
    EXAMPLE INPUT NO. 4                                                Linear
    ------------------                                                 Linear
    IN ORDER TO LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO THE       Linear
    STANDARD OPTION OF 0.1 PER-CENT IT IS ADEQUATE TO INPUT A SET      Linear
    OF COMPLETELY BLANK LINES WHICH WILL AUTOMATICALLY INVOKE ALL      Linear
    OF THE STANDARD OPTIONS.                                           Linear
                                                                       Linear
    LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL     Linear
    THEN USE STANDARD FILENAMES.                                       Linear
                                                                       Linear
    IN THIS CASE THE FOLLOWING THREE INPUT LINES ARE REQUIRED          Linear
                                                                       Linear
                                          (MAT, 1.0E-10 BARNS, THIN)   Linear
                        (USE DEFAULT FILENAME = ENDFB.IN)              Linear
                        (USE DEFAULT FILENAME = ENDFB.OUT)             Linear
                        (RETRIEVE ALL DATA, END REQUEST LIST)          Linear
                        (0.1 PER-CENT ERROR, END OF ERROR LAW)         Linear
                                                                       Linear
======================================================================= Linear
```

```
======================================================================= Merger
                                                                        Merger
     PROGRAM MERGER                                                     Merger
     VERSION 80-1 (JANUARY 1980)                                        Merger
     VERSION 80-2 (DECEMBER 1980)                                       Merger
     VERSION 82-1 (JANUARY 1982)                                        Merger
     VERSION 83-1 (JANUARY 1983)*NEW, MORE COMPATIBLE I/O UNIT NUMBERS. Merger
     VERSION 85-1 (AUGUST 1985) *FORTRAN-77/H VERSION                   Merger
     VERSION 86-1 (JANUARY 1986)*ENDF/B-VI FORMATS                      Merger
     VERSION 88-1 (JULY 1988)   *OPTION...INTERNALLY DEFINE ALL I/O     Merger
                                 FILE NAMES (SEE, SUBROUTINES FILIO1    Merger
                                 AND FILIO2 FOR DETAILS).               Merger
                                *IMPROVED BASED ON USER COMMENTS.       Merger
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO     Merger
                                 INSURE PROGRAM WILL NOT DO ANYTHING    Merger
                                 CRAZY.                                 Merger
                                *UPDATED TO USE NEW PROGRAM CONVERT     Merger
                                 KEYWORDS.                              Merger
                                *ADDED LIVERMORE CIVIC COMPILER         Merger
                                 CONVENTIONS.                           Merger
     VERSION 92-1 (JANUARY 1992)*UPDATED BASED ON USER COMMENTS         Merger
                                *ADDED FORTRAN SAVE OPTION              Merger
     VERSION 92-2 (JULY 1992)   *ALLOW UP TO 99 ENDF/B DATA FILES.      Merger
                                 (TO ALLOW MANAGEMENT OF THE ENTIRE     Merger
                                  ENDF/B SYSTEM).                       Merger
     VERSION 94-1 (JANUARY 1994)*VARIABLE ENDF/B DATA FILENAMES         Merger
                                 TO ALLOW ACCESS TO FILE STRUCTURES     Merger
                                 (WARNING - INPUT PARAMETER FORMAT      Merger
                                 HAS BEEN CHANGED)                      Merger
                                *ONLY SPECIFY FILENAMES - NO UNIT       Merger
                                 NUMBERS ON INPUT (WARNING - INPUT      Merger
                                 PARAMETERS FORMAT HAS BEEN CHANGED)    Merger
                                *CLOSE ALL FILES BEFORE TERMINATING     Merger
                                 (SEE, SUBROUTINE ENDIT)                Merger
                                *REQUEST LOG DELETED                    Merger
     VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                     Merger
                                 *IMPROVED COMPUTER INDEPENDENCE        Merger
                                 *ALL DOUBLE PRECISION                  Merger
                                 *ON SCREEN OUTPUT                      Merger
                                 *UNIFORM TREATMENT OF ENDF/B I/O       Merger
                                 *IMPROVED OUTPUT PRECISION             Merger
     VERSION 99-1 (MARCH 1999)   *GENERAL IMPROVEMENTS BASED ON         Merger
                                  USER FEEDBACK                         Merger
     VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON         Merger
                                  USER FEEDBACK                         Merger
     VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS             Merger
     VERS. 2004-1 (MERCH 2004)   *ADDED INCLUDE TO DEFINE COMMON        Merger
                                 *ADDED TEND LINE IF NO DATA RETRIEVED  Merger
                                                                        Merger
     OWNED, MAINTAINED AND DISTRIBUTED BY                               Merger
     ------------------------------------                               Merger
     THE NUCLEAR DATA SECTION                                           Merger
     INTERNATIONAL ATOMIC ENERGY AGENCY                                 Merger
     P.O. BOX 100                                                       Merger
     A-1400, VIENNA, AUSTRIA                                            Merger
     EUROPE                                                             Merger
                                                                        Merger
     ORIGINALLY WRITTEN BY                                              Merger
     ---------------------------------                                  Merger
     DERMOTT E. CULLEN                                                  Merger
     UNIVERSITY OF CALIFORNIA                                           Merger
     LAWRENCE LIVERMORE NATIONAL LABORATORY                             Merger
     L-159                                                              Merger
     P.O. BOX 808                                                       Merger
     LIVERMORE, CA 94550                                                Merger
     U.S.A.                                                             Merger
     TELEPHONE  925-423-7359                                            Merger
     E. MAIL    CULLEN1@LLNL.GOV                                        Merger
     WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                             Merger
                                                                        Merger
     AUTHORS MESSAGE                                                    Merger
```

```
--------------                                                      Merger
THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENTATION    Merger
FOR THIS PROGRAM INCLUDING ALL RECENT IMPROVEMENTS. PLEASE READ     Merger
ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY THE       Merger
COMMENTS CONCERNING MACHINE DEPENDENT CODING.                       Merger
                                                                    Merger
AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER  Merger
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE      Merger
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT  Merger
IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY        Merger
COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO   Merger
IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF     Merger
THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR          Merger
COMPUTER.                                                           Merger
                                                                    Merger
PURPOSE                                                             Merger
-------                                                             Merger
THIS PROGRAM IS DESIGNED TO SELECTIVELY RETRIEVE DATA OFF OF FROM   Merger
1 TO 10 ENDF/B DATA TAPES AND TO MERGE THE SELECTED DATA INTO A     Merger
SINGLE MAT/MF/MT ORDERED FINAL OUTPUT FILE.                         Merger
                                                                    Merger
IN THE DISCUSSION THAT FOLLOWS FOR SIMPLICITY THE ENDF/B            Merger
TERMINOLOGY---ENDF/B TAPE---WILL BE USED. IN FACT THE ACTUAL        Merger
MEDIUM USED MAY BE TAPE, CARD, DISK OR ANY OTHER MEDIUM.            Merger
                                                                    Merger
ENDF/B FORMAT                                                       Merger
-------------                                                       Merger
THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS      Merger
OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION    Merger
OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV OR V FORMAT).      Merger
                                                                    Merger
THE ONLY NUMERICAL DATA THAT THIS PROGRAM READS IS THE ZA FROM THE  Merger
FIRST CARD OF EACH SECTION AND THE MAT/MF/MT FROM EACH CARD.        Merger
SEQUENCE NUMBERS ARE IGNORED ON INPUT AND ALL OTHER FIELDS ARE      Merger
READ AS HOLLERITH. AS SUCH THIS PROGRAM NEED NOT DISTINGUISH        Merger
BETWEEN DIFFERENT VERSIONS OF THE ENDF/B FORMAT.                    Merger
                                                                    Merger
IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B        Merger
FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS      Merger
ASSUMED THAT THE MAT, MF AND MT ON EACH CARD IS CORRECT. SEQUENCE   Merger
NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE           Merger
CORRECTLY OUTPUT ON ALL CARDS.                                      Merger
                                                                    Merger
SECTION SIZE                                                        Merger
------------                                                        Merger
SINCE THIS PROGRAM ONLY READS THE DATA ONE CARD AT A TIME THERE     Merger
IS NO LIMIT TO THE SIZE OF ANY GIVEN SECTION, E.G. THE TOTAL        Merger
CROSS SECTION MAY BE DESCRIBED BY 200,000 DATA POINTS.              Merger
                                                                    Merger
SELECTION OF DATA                                                   Merger
-----------------                                                   Merger
THE USER MAY CHOOSE TO MERGE ALL DATA OR THE USER MAY SPECIFY       Merger
THAT ONLY CERTAIN DATA SHOULD BE SELECTED. THE DATA TO BE           Merger
SELECTED IS DEFINED BY SPECIFYING UP TO 100 MAT/MF/MT OR            Merger
ZA/MF/MT RANGES. EACH RANGE IS DEFINED BY LOWER AND UPPER LIMITS    Merger
OF MAT/MF/MT OR ZA/MF/MT.                                           Merger
                                                                    Merger
REQUEST LIMITS                                                      Merger
--------------                                                      Merger
IN ORDER TO SIMPLIFY THE INPUT OF SELECTION REQUESTS THE FOLLOWING  Merger
CONVENTIONS HAVE BEEN INTRODUCED IN ORDER TO DEFINE THE UPPER       Merger
LIMITS OF REQUESTS IF THEY ARE NOT DEFINED BY INPUT (I.E., IF THEY  Merger
ARE ZERO).                                                          Merger
                                                                    Merger
(1) MAT OR ZA - IF THE UPPER LIMIT IS ZERO IT IS SET EQUAL TO THE   Merger
                LOWER LIMIT.                                        Merger
(2) MF OR MT  - IF THE UPPER LIMIT IS ZERO IT IS SET EQUAL TO THE   Merger
                MAXIMUM POSSIBLE VALUE, 99 OR 999 RESPECTIVELY.     Merger
                                                                    Merger
WITH THESE CONVENTIONS AN ENTIRE EVALUATION MAY BE SELECTED BY      Merger
MERELY SPECIFYING THE LOWER LIMIT OF MAT OR ZA. THE UPPER MAT OR    Merger
```

```
ZA LIMIT WILL BE SET EQUAL TO THE LOWER LIMIT, THE LOWER LIMITS OF Merger
MF/MT WILL BE 0/0 AND THE UPPER LIMITS OF MF/MT WILL BE SET TO     Merger
99/999. THIS WILL CAUSE ALL SECTIONS OF A SINGLE EVALUATION TO BE  Merger
SELECTED.                                                          Merger
                                                                   Merger
SATISFYING SELECTION CRITERIA                                      Merger
----------------------------                                       Merger
IN ORDER FOR A SECTION TO MEET THE SELECTION CRITERIA SPECIFIED    Merger
BY ONE OF THE RETRIEVAL REQUESTS, EACH OF THE THREE FIELDS (       Merger
MAT/MF/MT OR ZA/MF/MT) MUST INDIVIDUALLY SATISFY THE CORRESPONDING Merger
LIMITS OF THE REQUEST. IT IS NOT SUFFICIENT THAT THE MAT OF A      Merger
SECTION LIE BETWEEN THE MINIMUM AND MAXIMUM MATS OF A REQUEST. THE Merger
MF AND MT WILL ALSO BE INDIVIDUALLY COMPARED TO THE MF AND MT      Merger
LIMITS OF THE REQUEST. FOR EXAMPLE, A SECTION WITH MAT/MF/MT=      Merger
2500/3/2 DOES NOT SATISFY A REQUEST THAT SPECIFIES A REQUEST USING Merger
THE RANGE 2000/3/1 THROUGH 3000/3/1. THIS REQUEST SPECIFIES ALL    Merger
MATERIALS WITH MAT BETWEEN 2000 AND 3000, BUT ONLY THOSE SECTIONS  Merger
WITH MF/MT=3/1. SIMILARLY A REQUEST FOR 2000/3/1 THROUGH 3000/99/  Merger
999 WILL NOT SELECT ANY SECTIONS WITH MF=1 OR 2, SINCE THE         Merger
REQUEST SPECIFIES ALL MATERIALS WITH MAT BETWEEN 2000 AND 3000,    Merger
BUT ONLY THOSE SECTIONS WITH MF= 3, OR MORE.                       Merger
                                                                   Merger
DUPLICATE SECTIONS                                                 Merger
------------------                                                 Merger
IF TWO OR MORE SECTIONS WITH THE SAME MAT/MF/MT ARE FOUND EITHER   Merger
ON THE SAME OR DIFFERENT TAPES, THE SECTION FROM THE TAPE DEFINED  Merger
EARLIEST IN THE INPUT CARDS WILL BE COPIED TO THE FINAL TAPE AND   Merger
ALL OTHER SECTIONS WITH THE SAME MAT/MF/MT WILL BE SKIPPED. THE    Merger
OUTPUT REPORT WILL INDICATE WHICH SECTIONS WERE COPIED FROM WHICH  Merger
TAPES, AS WELL AS WHICH SECTIONS ARE DUPLICATE AND WERE SKIPPED.   Merger
                                                                   Merger
REACTION INDEX                                                     Merger
--------------                                                     Merger
THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451.   Merger
FOR EACH MATERIAL THE PROGRAM WILL FOLLOW THE CONVENTIONS          Merger
DEFINED ABOVE AND ONLY COPY ONE SECTION MF=1, MT=451 AND SKIP      Merger
ALL OTHERS (IF MORE THAN ONE). THIS CONVENTION HAS BEEN ADOPTED    Merger
BECAUSE MOST USERS DO NOT REQUIRE A CORRECT REACTION INDEX FOR     Merger
THERE APPLICATIONS AND IT WAS NOT CONSIDERED WORTHWHILE TO INCLUDE Merger
THE OVERHEAD OF CONSTRUCTING A CORRECT REACTION INDEX IN THIS      Merger
PROGRAM. HOWEVER, IF YOU REQUIRE A REACTION INDEX FOR YOUR         Merger
APPLICATION AFTER RUNNING THIS PROGRAM YOU MAY USE PROGRAM         Merger
DICTIN TO CREATE ONE.                                              Merger
                                                                   Merger
RETRIEVAL STATISTICS                                               Merger
--------------------                                               Merger
THERE WILL ALWAYS BE AN OUTPUT REPORT LISTING INDICATING WHICH     Merger
SECTIONS WHERE SELECTED, WHICH DUPLICATE SECTIONS WERE SKIPPED,    Merger
WHICH TAPE THE SECTION WAS ON, WHICH REQUEST (MAT/MF/MT OR         Merger
ZA/MF/MT RANGE) CAUSED THE SECTION TO BE SELECTED AND HOW MANY     Merger
CARDS WERE IN THE SECTION. IN ADDITION THE USER MAY OPTIONALLY     Merger
OBTAIN A FILE CONTAINING THE SAME INFORMATION. THIS FILE MAY BE    Merger
COMBINED WITH OTHER SIMILAR FILES OUTPUT BY THIS PROGRAM IN ORDER  Merger
TO ACCUMULATE RETRIEVAL STATISTICS OVER A PERIOD OF TIME. IF       Merger
SPECIFIED THIS FILE WILL CONTAIN THE FOLLOWING INFORMATION IN      Merger
6I7 FORMAT.                                                        Merger
                                                                   Merger
(1) ZA                                                             Merger
(2) MAT                                                            Merger
(3) MF                                                             Merger
(4) MT                                                             Merger
(5) NUMBER OF CARDS IN SECTION                                     Merger
(6) REQUEST NUMBER THAT CAUSED SECTION TO BE SELECTED              Merger
                                                                   Merger
INPUT FILES                                                        Merger
-----------                                                        Merger
UNIT  DESCRIPTION                                                  Merger
----  -----------                                                  Merger
  2   INPUT CARDS (BCD - 80 CHARACTERS/RECORD)                     Merger
VARY  FROM 1 TO 99 ENDF/B DATA FILES (BCD - 80 CHARACTERS/RECORD)  Merger
                                                                   Merger
```

```
OUTPUT FILES                                                          Merger
------------                                                          Merger
UNIT  DESCRIPTION                                                     Merger
----  -----------                                                     Merger
  3   OUTPUT REPORT LISTING (BCD - 120 CHARACTERS/RECORD)             Merger
 10   MERGED ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)                 Merger
                                                                      Merger
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINES FILIO1 AND FILIO2)      Merger
-------------------------------------------------------------------   Merger
UNIT  FILE NAME   DESCRIPTION                                         Merger
----  ----------  -----------                                         Merger
  2   MERGER.INP  INPUT PARAMETERS                                    Merger
  3   MERGER.LST  OUTPUT LISTING                                      Merger
 11   ENDFB.OUT   RETRIEVED ENDF/B DATA                               Merger
 12   ENDFB.IN1   ENDF/B DATA TO READ...FILENAMES WILL BE DEFINED     Merger
 13   ENDFB.IN2   IN THE ORDER ENDFB.IN1, ENDFB.IN2,...ENDFB.I99      Merger
 14   ENDFB.IN3   CORRESPONDING TO THE FIRST, SECOND,...99-TH         Merger
 15   ENDFB.IN4   ENDF/B DATA FILE TO READ.                           Merger
 16   ENDFB.IN5                                                       Merger
 17   ENDFB.IN6                                                       Merger
 18   ENDFB.IN7                                                       Merger
        .                                                             Merger
        .                                                             Merger
110   ENDFB.I99                                                       Merger
                                                                      Merger
 INPUT CARDS                                                          Merger
 -----------                                                          Merger
 CARD  COLUMNS  FORMAT  DESCRIPTION                                   Merger
 ----  -------  ------  -----------                                   Merger
   1     1-60    A60    FILENAME FOR MERGED OUTPUT.                   Merger
                        (LEAVE BLANK FOR STANDARD = ENDFB.OUT)        Merger
   2     1-66  16A4,A2  MERGED FILE LABEL                             Merger
                        IF BLANK - LABEL FROM FIRST FILE READ WILL    Merger
                        BE OUTPUT                                     Merger
        67-70    I4     MERGED FILE ENDF/B NUMBER                    Merger
                        IF ZERO - NUMBER OF FIRST FILE READ WILL      Merger
                        BE OUTPUT.                                    Merger
        71-72    I2     RETRIEVAL CRITERIA                           Merger
                        = 0 - MAT/MF/MT RANGES                        Merger
                        = 1 - ZA/MF/MT RANGES                         Merger
 3-N    1-60    A60    FILENAME FOR FILE TO RETRIEVE DATA FROM       Merger
                        (LEAVE BLANK FOR STANDARD..ENDFB.IN1,ETC.)    Merger
                        TERMINATE LIST OF FILES WITH A LINE THAT      Merger
                        SAYS END OR end                               Merger
 VARY    1- 6    I6     LOWER PRIMARY LIMIT (MAT OR ZA)              Merger
         7- 8    I2     LOWER MF LIMIT                               Merger
         9-11    I3     LOWER MT LIMIT                               Merger
        12-17    I6     UPPER PRIMARY LIMIT (MAT OR ZA)              Merger
        18-19    I2     UPPER MF LIMIT                               Merger
        20-22    I3     UPPER MT LIMIT                               Merger
                        RANGES OF MAT/MF/MT OR ZA/MF/MT TO BE        Merger
                        RETRIEVED ARE SPECIFIED BY DEFINING          Merger
                        ONE RANGE (LOWER AND UPPER LIMITS) PER       Merger
                        CARD. THE USER MAY SPECIFY 0 TO 100          Merger
                        RANGES AND THE LIST OF REQUEST RANGES        Merger
                        IS TERMINATED BY A BLANK CARD. IF            Merger
                        THE FIRST CARD IS BLANK (0 REQUESTS)         Merger
                        ALL DATA WILL BE RETRIEVED. IF THE UPPER     Merger
                        PRIMARY CRITERIA (MAT OR ZA) IS LESS THAN    Merger
                        THE LOWER PRIMARY CRITERIA, THE UPPER        Merger
                        PRIMARY CRITERIA WILL BE SET EQUAL TO        Merger
                        THE LOWER PRIMARY CRITERIA. IF THE UPPER     Merger
                        MF OR MT LIMIT IS ZERO, OR BLANK, IT         Merger
                        WILL BE SET TO THE MAXIMUM POSSIBLE          Merger
                        VALUE, I.E. MF=99 OR MT=999 (SEE             Merger
                        EXAMPLE INPUT).                              Merger
                                                                     Merger
 EXAMPLE INPUT NO. 1                                                 Merger
 ------------------                                                  Merger
 MERGE ENDF/B DATA ONTO UNIT 10 FROM UNITS 11, 12, 13 AND 14.        Merger
 RETRIEVE DATA BY MAT NUMBER. RETRIEVE MATS 1103, 1106, ALL MATS     Merger
```

```
 BETWEEN 1204 AND 1215, MF=1, 3, 4 AND 5 OF MAT 1219 AND MF=3,     Merger
 MT=1 OF MAT 1304. USE STANDARD FILENAMES.                         Merger
                                                                   Merger
 THE FOLLOWING 13 INPUT CARDS ARE REQUIRED.                        Merger
                                                                   Merger
ENDFB.OUT                                                          Merger
EXAMPLE FILE LABEL FOR MERGER                                  0 0 Merger
ENDFB.IN1                                                          Merger
ENDFB.IN2                                                          Merger
ENDFB.IN3                                                          Merger
ENDFB.IN4                                                          Merger
END                                                                Merger
  1103                    4317  (UPPER LIMIT SET TO 1103/99/999) Merger
  1106                    4317  (UPPER LIMIT SET TO 1106/99/999) Merger
  1204       1215         4317  (UPPER LIMIT SET TO 1215/99/999) Merger
  1219 1     1219 1       4317  (UPPER LIMIT SET TO 1219/ 1/999) Merger
  1219 3     1219 5       4317  (UPPER LIMIT SET TO 1219/ 5/999) Merger
  1304 3  1  1304 3  1    4317  (UPPER LIMIT COMPLETELY DEFINED) Merger
                                 (BLANK CARD TERMINATES REQUESTS) Merger
                                                                   Merger
 EXAMPLE INPUT NO. 2                                               Merger
 ------------------                                                Merger
 THE SAME AS EXAMPLE 1, EXCEPT SPECIFY FILENAMES                   Merger
                                                                   Merger
\ENDFB6\MERGED.LIB                                                 Merger
EXAMPLE FILE LABEL FOR MERGER                                  0 0 Merger
ENDFB6.PART1                                                       Merger
ENDFB6.PART2                                                       Merger
ENDFB6.PART3                                                       Merger
ENDFB6.PART4                                                       Merger
END                                                                Merger
  1103                    4317  (UPPER LIMIT SET TO 1103/99/999) Merger
  1106                    4317  (UPPER LIMIT SET TO 1106/99/999) Merger
  1204       1215         4317  (UPPER LIMIT SET TO 1215/99/999) Merger
  1219 1     1219 1       4317  (UPPER LIMIT SET TO 1219/ 1/999) Merger
  1219 3     1219 5       4317  (UPPER LIMIT SET TO 1219/ 5/999) Merger
  1304 3  1  1304 3  1    4317  (UPPER LIMIT COMPLETELY DEFINED) Merger
                                 (BLANK CARD TERMINATES REQUESTS) Merger
                                                                   Merger
==================================================================== Merger
```

```
====================================================================== Mixer
                                                                       Mixer
     PROGRAM MIXER                                                     Mixer
                                                                       Mixer
     VERSION 76-1 (NOVEMBER 1976)                                      Mixer
     VERSION 81-1 (APRIL 1981)  *IBM VERSION                           Mixer
     VERSION 82-1 (AUGUST 1982) *COMPUTER INDEPENDENT VERSION          Mixer
     VERSION 84-1 (JUNE 1984)   *SPECIAL I/O ROUTINES TO GUARANTEE     Mixer
                                 ACCURACY OF ENERGY.                   Mixer
                                *DOUBLE PRECISION TREATMENT OF ENERGY  Mixer
                                 (REQUIRED FOR NARROW RESONANCES).     Mixer
     VERSION 86-1 (JANUARY 1986)*FORTRAN-77/H VERSION                  Mixer
     VERSION 88-1 (JULY 1988)   *OPTION...INTERNALLY DEFINE ALL I/O    Mixer
                                 FILE NAMES (SEE, SUBROUTINE FILIO1    Mixer
                                 AND FILIO2 FOR DETAILS).              Mixer
                                *IMPROVED BASED ON USER COMMENTS.      Mixer
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO    Mixer
                                 INSURE PROGRAM WILL NOT DO ANYTHING   Mixer
                                 CRAZY.                                Mixer
                                *UPDATED TO USE NEW PROGRAM CONVERT    Mixer
                                 KEYWORDS.                             Mixer
                                *ADDED LIVERMORE CIVIC COMPILER        Mixer
                                 CONVENTIONS.                          Mixer
     VERSION 92-1 (JANUARY 1992)*UPDATED BASED ON USER COMMENTS        Mixer
                                *ADDED PHOTON CROSS SECTIONS           Mixer
                                *ADDED FORTRAN SAVE OPTION             Mixer
                                *OUTPUT IN ENDF/B-VI FORMAT            Mixer
                                *COMPLETELY CONSISTENT I/O ROUTINES -  Mixer
                                 TO MINIMIZE COMPUTER DEPENDENCE.      Mixer
                                *NOTE, CHANGE IN INPUT PARAMETER       Mixer
                                 FORMAT.                               Mixer
     VERSION 94-1 (JANUARY 1994)*VARIABLE ENDF/B DATA FILENAMES        Mixer
                                 TO ALLOW ACCESS TO FILE STRUCTURES    Mixer
                                 (WARNING - INPUT PARAMETER FORMAT     Mixer
                                 HAS BEEN CHANGED)                     Mixer
                                *CLOSE ALL FILES BEFORE TERMINATING    Mixer
                                 (SEE, SUBROUTINE ENDIT)               Mixer
                                *INCREASED INCORE PAGE SIZE FROM       Mixer
                                 1002 TO 4008.                         Mixer
     VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                    Mixer
                                 *IMPROVED COMPUTER INDEPENDENCE       Mixer
                                 *ALL DOUBLE PRECISION                 Mixer
                                 *ON SCREEN OUTPUT                     Mixer
                                 *UNIFORM TREATMENT OF ENDF/B I/O      Mixer
                                 *IMPROVED OUTPUT PRECISION            Mixer
                                 *DEFINED SCRATCH FILE NAMES           Mixer
                                 *INCREASED INCORE PAGE SIZE FROM      Mixer
                                  4008 TO 12000.                       Mixer
     VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING      Mixer
                                  POINT READ FOR MORE DIGITS           Mixer
                                 *UPDATED TEST FOR ENDF/B FORMAT       Mixer
                                  VERSION BASED ON RECENT FORMAT CHANGE Mixer
                                 *GENERAL IMPROVEMENTS BASED ON        Mixer
                                  USER FEEDBACK                        Mixer
     VERSION 99-2 (JUNE 1999)    *ASSUME ENDF/B-VI, NOT V, IF MISSING  Mixer
                                  MF=1, MT-451.                        Mixer
     VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON        Mixer
                                  USER FEEDBACK                        Mixer
     VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS            Mixer
     VERS. 2004-1 (MARCH 2004)   *ADDED INCLUDE FOR COMMON             Mixer
                                 *INCREASED INCORE PAGE SIZE FROM      Mixer
                                  12000 TO 60000.                      Mixer
                                                                       Mixer
     OWNED, MAINTAINED AND DISTRIBUTED BY                              Mixer
     ------------------------------------                              Mixer
     THE NUCLEAR DATA SECTION                                          Mixer
     INTERNATIONAL ATOMIC ENERGY AGENCY                                Mixer
     P.O. BOX 100                                                      Mixer
     A-1400, VIENNA, AUSTRIA                                           Mixer
     EUROPE                                                            Mixer
                                                                       Mixer
```

```
ORIGINALLY WRITTEN BY                                                  Mixer
-----------------------------------                                    Mixer
DERMOTT E. CULLEN                                                      Mixer
UNIVERSITY OF CALIFORNIA                                               Mixer
LAWRENCE LIVERMORE NATIONAL LABORATORY                                 Mixer
L-159                                                                  Mixer
P.O. BOX 808                                                           Mixer
LIVERMORE, CA 94550                                                    Mixer
U.S.A.                                                                 Mixer
TELEPHONE  925-423-7359                                                Mixer
E. MAIL    CULLEN1@LLNL.GOV                                            Mixer
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                                 Mixer
                                                                       Mixer
PURPOSE                                                                Mixer
-------                                                                Mixer
THIS PROGRAM IS DESIGNED TO CALCULATE THE ENERGY DEPENDENT CROSS       Mixer
SECTION FOR A COMPOSITE MIXTURE OF UP TO 10 DIFFERENT MATERIALS.       Mixer
                                                                       Mixer
THE PRESENT VERSION WILL ONLY CALCULATE THE CROSS SECTION FOR ONE      Mixer
FINAL REACTION (ENDF/B SECTION), E.G. TOTAL CROSS SECTION, BUT NOT     Mixer
ANY OTHER REACTION.                                                    Mixer
                                                                       Mixer
NOTE, THIS PROGRAM WILL NOT COMBINE ALL REACTIONS FOR A MIXTURE        Mixer
OF MATERIALS DURING A SINGLE RUN - ONLY ONE REACTION WILL BE           Mixer
CREATED PER RUN.                                                       Mixer
                                                                       Mixer
EVALUATED DATA FORMAT                                                  Mixer
---------------------                                                  Mixer
THE CROSS SECTIONS ARE READ FROM THE ENDF/B FORMAT AND THE             Mixer
COMPOSITE CROSS SECTION IS CONVERTED TO AN EQUIVALENT BARNS/ATOM       Mixer
FORM AND OUTPUT IN THE ENDF/B FORMAT WITH AN EQUIVALENT ATOMIC         Mixer
WEIGHT. THE USER MUST SPECIFY THE COMPOSITION BY GIVING THE ZA,        Mixer
MT AND GRAMS/CC OF EACH CONSTITUENT. IN ADDITION THE USER MUST         Mixer
IDENTIFY THE COMPOSITE CROSS SECTION BY SPECIFYING THE ZA, MAT         Mixer
AND MT TO BE USED IN THE ENDF/B FORMATTED OUTPUT.                      Mixer
                                                                       Mixer
SINCE ONLY THE CROSS SECTIONS IN FILE 3 AND 23 ARE USED, AND THE       Mixer
FORMAT FOR FILE 3/23 IS THE SAME IN ALL VERSIONS ON ENDF/B, THIS       Mixer
PROGRAM MAY BE USED WITH ANY VERSION OF ENDF/B DATA (I.E.,             Mixer
ENDF/B-I, II, III, IV, V OR VI). DURING A SINGLE RUN IT MAY EVEN       Mixer
BE USED TO READ AND COMBINE EVALUATIONS WHICH ARE IN DIFFERENT         Mixer
VERSIONS OF THE ENDF/B FORMAT.                                         Mixer
                                                                       Mixer
ENDF/B FORMATTED OUTPUT WILL BE IN THE ENDF/B-VI FORMAT REGARDLESS     Mixer
OF THE FORMAT OF THE INPUT ENDF/B DATA. THIS WILL ONLY EFFECT THE      Mixer
HOLLERITH SECTION (MF=1, MT=451). THE FORMAT OF CROSS SECTIONS         Mixer
(MF=3) IS THE SAME IN ALL VERSION OF THE ENDF/B FORMAT.                Mixer
                                                                       Mixer
IN ORDER TO GUARANTEE PROPER OPERATION OF THIS PROGRAM THE DATA        Mixer
MUST BE PROPERLY CODED IN THE ENDF/B FORMAT. NO ERROR CHECKING IS      Mixer
PERFORMED. IT IS PARTICULARLY IMPORTANT THAT THE FOLLOWING DATA        Mixer
BE CORRECT                                                             Mixer
                                                                       Mixer
(1) ZA, MF, MT - MUST BE CORRECT IN ORDER TO ALLOW PROGRAM TO          Mixer
    SELECT THE APPROPRIATE SECTIONS TO BE COMBINED.                    Mixer
(2) AWRE - ATOMIC WEIGHT RATIO MUST BE CORRECT TO ALLOW PROGRAM        Mixer
    TO CONVERT THE USER SPECIFIED GRAMS/CC INTO ATOMS/CC FOR           Mixer
    PROPER ATOM RATIO MIXING.                                          Mixer
(3) (ENERGIES, CROSS SECTIONS) - MUST BE CORRECT, LINEARLY             Mixer
                                                  ========             Mixer
    INTERPOLABLE, IN ASCENDING ENERGY ORDER OF (E, BARNS).             Mixer
    ============                                                       Mixer
                                                                       Mixer
    TO CONVERT ENDF/B FORMATTED DATA TO THE REQUIRED INPUT FORM        Mixer
    THE FOLLOWING PROGRAMS MAY BE USED,                                Mixer
    LINEAR - CONVERT TABULATED CROSS SECTIONS TO LINEARLY              Mixer
             INTERPOLABLE FORM.                                        Mixer
    RECENT - RECONSTRUCT RESONANCE CONTRIBUTION, ADD TO BACKGROUND     Mixer
             CROSS SECTION AND OUTPUT THE COMBINATION IN LINEARLY      Mixer
             INTERPOLABLE FORM.                                        Mixer
    SIGMA1 - DOPPLER BROADEN CROSS SECTIONS TO ANY TEMPERATURE AND     Mixer
```

```
            OUTPUT THE RESULT IN LINEARLY INTERPOLABLE FORM.      Mixer
                                                                  Mixer
DOCUMENTATION                                                     Mixer
------------                                                      Mixer
THE FACT THAT THIS PROGRAM HAS COMBINED THE DATA IS DOCUMENTED    Mixer
IN THE OUTPUT ENDF/B FORMAT IN THE HOLLERITH SECTION BY FIRST     Mixer
IDENTIFYING THE VERSION OF THIS PROGRAM THAT WAS USED, IN THE FORM Mixer
                                                                  Mixer
********************( PROGRAM MIXER 2004-1) ********************** Mixer
                                                                  Mixer
THIS IS FOLLOWED BY THE TWO LINE IDENTIFICATION INPUT BY THE USER. Mixer
THIS IS FOLLOWED BY COMPOSITION INPUT BY THE USER.                Mixer
                                                                  Mixer
NEUTRON OR PHOTON DATA                                            Mixer
----------------------                                            Mixer
THIS PROGRAM WILL ALLOW YOU TO PROCESS EITHER NEUTRON OR PHOTON   Mixer
CROSS SECTIONS - BUT YOU CANNOT MIX THE TWO TYPES TOGETHER. BY    Mixer
INPUT YOU CAN SPECIFY THE OUTPUT MF = 3 (NEUTRONS) OR 23 (PHOTONS) Mixer
WHATEVER TYPE YOU SPECIFIED FOR OUTPUT IS THE ONLY TYPE OF DATA   Mixer
WHICH WILL BE PROCESSED BY THIS PROGRAM.                          Mixer
                                                                  Mixer
DEFINING THE COMPOSITION                                          Mixer
------------------------                                          Mixer
THE USER MAY SPECIFY UP TO 10 DIFFERENT SECTIONS OF DATA TO BE    Mixer
COMBINED, EACH SECTION IDENTIFIED BY ZA AND MT NUMBER. THE        Mixer
AMOUNT OF EACH MATERIAL IS SPECIFIED BY DEFINING THE NUMBER OF    Mixer
GRAMS/CC OF EACH MATERIAL IN THE COMPOSITE MIXTURE. THIS CAN BE   Mixer
DERIVED FROM THE VOLUME FRACTION SIMPLY BY MULTIPLYING THE STP    Mixer
DENSITY OF EACH MATERIAL BY ITS VOLUME FRACTION. NOTE, DO NOT     Mixer
INPUT ATOM FRACTIONS.                                             Mixer
                                                                  Mixer
THE LIST OF SECTIONS TO BE COMBINED MAY BE SPECIFIED IN ANY       Mixer
ORDER, I.E. THEY NEED NOT BE IN ZA ORDER OR THE ORDER THAT THE    Mixer
EVALUATED DATA APPEARS ON THE ENDF/B FORMATTED TAPE.              Mixer
                                                                  Mixer
IF ANY REQUESTED SECTION OF DATA IS NOT FOUND ON THE ORIGINAL     Mixer
ENDF/B FORMATTED FILE, THE PROGRAM WILL PRINT A LIST OF THE       Mixer
MISSING SECTIONS AND TERMINATE. IF ALL REQUESTED SECTIONS ARE     Mixer
FOUND THE PROGRAM WILL PRODUCE A COMPOSITE SECTION USING THE      Mixer
UNION OF ALL ENERGIES FOUND IN ANY SECTION. THE COMPOSITE SECTION Mixer
WILL NOT BE THINNED.                                              Mixer
                                                                  Mixer
PRIOR TO LATER USE IN ANY APPLICATION THE NUMBER OF ENERGY POINTS Mixer
IN THE COMPOSITE CROSS SECTION MAY BE MINIMIZED BY USING PROGRAM  Mixer
LINEAR, UCRL-50400, VOL. 17, PART B TO THIN THE DATA.             Mixer
                                                                  Mixer
ONLY LINEARLY INTERPOLABLE DATA                                   Mixer
-------------------------------                                   Mixer
THE CROSS SECTIONS TO BE COMBINED MUST BE IN LINEARLY INTERPOLABLE Mixer
TABULATED FORM (I. E., FILE 3 OR 23, INTERPOLATION LAW 2).        Mixer
                                                                  Mixer
TO CONVERT TABULATED CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM  Mixer
SEE, PROGRAM LINEAR, UCRL-50400, VOL. 17, PART A.                 Mixer
                                                                  Mixer
TO CONVERT RESONANCE PARAMETERS TO LINEARLY INTERPOLABLE FORM SEE, Mixer
PROGRAM RECENT, UCRL-50400, VOL. 17, PART C.                      Mixer
                                                                  Mixer
TO DOPPLER BROADEN LINEARLY INTERPOLABLE DATA TO ANY TEMPERATURE   Mixer
SEE PROGRAM SIGMA1, UCRL-50400, VOL. 17, PART B.                  Mixer
                                                                  Mixer
PAGING SYSTEM                                                     Mixer
-------------                                                     Mixer
THERE IS NO LIMIT TO THE THE NUMBER OF DATA POINTS IN EACH OF THE  Mixer
SECTIONS TO BE COMBINED, NOR IS THERE A LIMIT TO THE NUMBER OF     Mixer
DATA POINTS IN THE COMPOSITE MIXTURE CROSS SECTION.               Mixer
                                                                  Mixer
ALL REQUIRED SECTIONS OF DATA ARE READ FROM THE ORIGINAL ENDF/B    Mixer
FORMATTED FILE. ANY SECTION OF 60000 OR FEWER POINTS WILL BE       Mixer
TOTALLY CORE RESIDENT. LARGER SECTIONS ARE LOADED INTO A PAGING    Mixer
SYSTEM USING A SCRATCH FILE WITH ONLY 60000 POINTS PER SECTION     Mixer
CORE RESIDENT AT ANY ONE TIME. SIMILARLY THE COMPOSITE SECTION     Mixer
```

```
WILL BE TOTALLY CORE RESIDENT IF IT CONTAINS 60000 OR FEWER POINTS Mixer
AND LARGER COMPOSITE SECTIONS WILL BE LOADED INTO A PAGING         Mixer
SYSTEM WHERE ONLY 60000 POINTS ARE CORE RESIDENT AT ANY TIME. SINC Mixer
A PAGING SYSTEM MAY BE USED BY ANY SECTION OF DATA THERE IS NO     Mixer
LIMIT TO THE SIZE OF EITHER THE ORIGINAL SECTIONS, NOR TO THE      Mixer
COMPOSITE SECTION, E.G. A SECTION MAY CONTAIN 100,000 ENERGIES     Mixer
AND CROSS SECTIONS TO DESCRIBE A GIVEN REACTION.                   Mixer
                                                                   Mixer
PAGE SIZE                                                          Mixer
---------                                                          Mixer
THE PAGE SIZE USED IN THIS PROGRAM IS DEFINED BY THE PARAMETER     Mixer
NPAGE AND THE DIMENSIONS OF THE ARRAYS XTAB AND YTAB. IN ORDER     Mixer
TO ADAPT THIS PROGRAM FOR USE ON ANY COMPUTER THE PAGE SIZE MAY    Mixer
BE INCREASED OR DECREASED BUT THE FOLLOWING RULES MUST BE FOLLOWED Mixer
                                                  ====             Mixer
                                                                   Mixer
(1) NPAGE - MUST BE A MULTIPLE OF 3 IN ORDER TO ALLOW THE PROGRAM  Mixer
    TO READ FULL CARDS OF ENDF/B DATA (3 POINTS PER LINE). FAILURE Mixer
    TO FOLLOW THIS RULE CAN LEAD TO LOSS OF DATA AND/OR PROGRAM    Mixer
    ERRORS DURING EXECUTION.                                       Mixer
(3) YTAB  - THE DIMENSION OF YTAB MUST BE (NPAGE,11).              Mixer
(4) XTAB  - THE DIMENSION OF XTAB MUST BE (NPAGE,11).              Mixer
                                                                   Mixer
DOPPLER BROADENING                                                 Mixer
------------------                                                 Mixer
THE COMPOSITE CROSS SECTION OUTPUT FROM THIS PROGRAM SHOULD NOT    Mixer
BE DOPPLER BROADENED USING PROGRAM SIGMA1, OR THE EQUIVALENT. THE  Mixer
ATOMIC WEIGHT USED TO IDENTIFY THE COMPOSITE MIXTURE IS BASED ON   Mixer
THE ATOM FRACTION OF EACH CONSTITUENT AND CANNOT BE USED TO        Mixer
CHARACTERIZE THE BROADENING OF ANY GIVEN RESONANCE IN THE MIXTURE  Mixer
DUE TO THE CONTRIBUTION OF ONE CONSTITUENT. IN ORDER TO CONSIDER   Mixer
DOPPLER BROADENING FIRST USE PROGRAM SIGMA1 TO BROADEN THE CROSS   Mixer
SECTION FOR EACH OF THE CONSTITUENTS AND THEN COMBINE THE          Mixer
BROADENED DATA USING PROGRAM MIXER.                                Mixer
                                                                   Mixer
EXAMPLE USE                                                        Mixer
-----------                                                        Mixer
THE OUTPUT FROM THIS PROGRAM HAS BEEN FOUND TO BE EXTREMELY        Mixer
USEFUL IN THE FOLLOWING APPLICATIONS...                            Mixer
                                                                   Mixer
(1) CALCULATE A COMPOSITE TOTAL CROSS SECTON FOR LATER USE AS      Mixer
    A WEIGHTING FUNCTION IN SELF-SHIELDING THE CROSS SECTIONS      Mixer
    OF EACH CONSTITUENT OF THE MIXTURE SEPARATELY.                 Mixer
                                                                   Mixer
    PROGRAM GROUPIE CAN USE THE CALCULATED COMPOSITE TOTAL CROSS   Mixer
    SECTION AS THE TOTAL CROSS SECTION FOR EACH CONSTITUENT OF     Mixer
    THE MIXTURE IN ORDER TO CALCULATE  SELF-SHIELDED CROSS SECTION Mixer
    FOR EACH CONSTITUENT OF THE MIXTURE.                           Mixer
                                                                   Mixer
(2) CALCULATE COMPOSITE TOTAL AND FISSION CROSS SECTIONS IN        Mixer
    ORDER TO CALCULATE THE TRANSMISSION AND SELF-INDICATION        Mixer
    THROUGH COMPOSITE MATERIALS. GENERALLY IN THIS CASE THE        Mixer
    TOTAL CROSS SECTION WILL BE CALCULATED FOR THE COMPOSITION     Mixer
    OF THE SAMPLE AND THE FISSION CROSS SECTION WILL BE            Mixer
    CALCULATED FOR THE COMPOSITION OF THE FISSION CHAMBER          Mixer
    (WHICH GENERALLY WILL HAVE A DIFFERENT COMPOSITION THAN THE    Mixer
    SAMPLE).                                                       Mixer
                                                                   Mixer
    PROGRAM VIRGIN CAN USE THE OUTPUT FROM THIS PROGRAM TO         Mixer
    PERFORM TRANSMISSION AND SELF-INDICATION CALCULATIONS.         Mixer
    PROGRAM VIRGIN WILL ANALYTICALLY CALCULATE THE UNCOLLIDED      Mixer
    (I.E. VIRGIN) FLUX TRANSMITTED AND REACTION RATE DUE TO ANY    Mixer
    TABULATED LINEARLY INTERPOLABLE INCIDENT SPECTRUM. RESULTS     Mixer
    WILL BE PRESENTLY FOR UP TO 10 DIFFERENT SAMPLE THICKNESSES    Mixer
    AND BINNED INTO ENERGY GROUPS IN ORDER TO SIMULATE AN          Mixer
    EXPERIMENTAL MEASUREMENT.                                      Mixer
                                                                   Mixer
(3) THE OUTPUT FROM THIS PROGRAM IS VERY USEFUL TO PLOT IN ORDER   Mixer
    TO SEE THE IMPORTANCE OF SPECIFIC CROSS SECTION FEATURES IN    Mixer
    THE COMPOSITE CROSS SECTION.                                   Mixer
                                                                   Mixer
```

```
    PROGRAM COMPLOT CAN BE USED TO PLOT THE OUTPUT FROM THIS       Mixer
    PROGRAM AND IF REQUIRED EXAMINE ANY PARTICULAR ENERGY RANGE    Mixer
    IN DETAIL. IN ORDER TO DO THIS THE (ZA, MT) EQUIVALENCE OPTION Mixer
    OF PROGRAM COMPLOT SHOULD BE USED. TO COMPARE ANY CONSTITUENT  Mixer
    CROSS SECTION TO THE COMPOSITE CROSS SECTION THE INPUT TO      Mixer
    COMPLOT SHOULD EQUATE THE (ZA,MT) OF THE COMPOSITE TO THE      Mixer
    (ZA,MT) OF ONE CONSTITUENT AND THE MULTIPLIER INPUT TO         Mixer
    COMPLOT SHOULD BE THE ATOM FRACTION FOR THE CONSTITUENT (THE   Mixer
    ATOM FRACTIONS ARE DEFINED IN THE OUTPUT LISTING FROM PROGRAM  Mixer
    MIXER).                                                        Mixer
                                                                   Mixer
 INPUT FILES                                                       Mixer
 -----------                                                       Mixer
 UNIT  DESCRIPTION                                                 Mixer
 ----  -----------                                                 Mixer
   2   INPUT CARDS (BCD - 80 CHARACTERS/RECORD)                    Mixer
  10   ORIGINAL EVALUATED DATA IN ENDF/B FORMAT                    Mixer
                  (BCD - 80 CHARACTERS/RECORD)                     Mixer
                                                                   Mixer
 OUTPUT FILES                                                      Mixer
 ------------                                                      Mixer
 UNIT  DESCRIPTION                                                 Mixer
 ----  -----------                                                 Mixer
   3   OUTPUT LISTING (BCD - 120 CHARACTERS/RECORD)                Mixer
  11   COMPOSITE EVALUATED DATA IN ENDF/B FORMAT                   Mixer
               (BCD - 80 CHARACTERS/RECORD)                        Mixer
                                                                   Mixer
 SCRATCH FILES                                                     Mixer
 -------------                                                     Mixer
 UNIT  DESCRIPTION                                                 Mixer
 ----  -----------                                                 Mixer
  12   SCRATCH FILE FOR EACH OF THE 10 SECTIONS WHICH              Mixer
  13   WILL BE ADDED TOGETHER TO DEFINE THE FINAL                  Mixer
   .   SECTION (BINARY - 60000 AND 480000 WORDS/RECORD)           Mixer
   . .                                                           Mixer
   . .                                                           Mixer
  20 .                                                           Mixer
  21 .                                                           Mixer
  22   SCRATCH FILE FOR COMBINED SECTION.                          Mixer
       (BINARY - 2004 WORDS/RECORD)                                Mixer
                                                                   Mixer
 STANDARD FILE NAMES (SEE SUBROUTINES FILIO1 AND FILIO2)           Mixer
 ---------------------------------------------------------------   Mixer
 UNIT  FILE NAME                                                   Mixer
 ----  ----------                                                  Mixer
   2   MIXER.INP                                                   Mixer
   3   MIXER.LST                                                   Mixer
  10   ENDFB.IN                                                    Mixer
  11   ENDFB.OUT                                                   Mixer
12-22  (SCRATCH)                                                   Mixer
                                                                   Mixer
 INPUT CARDS                                                       Mixer
 -----------                                                       Mixer
 LINE  COLS.  FORMAT  NAME    DESCRIPTION                          Mixer
 ----  -----  ------  ------- ----------                           Mixer
  1-2   1-66 16A4,A2  TITLE   TWO LINE TITLE DESCRIBING PROBLEM    Mixer
                              (THIS TITLE IS USED TO IDENTIFY THE  Mixer
                              OUTPUT LISTING AND IS ALSO WRITTEN   Mixer
                              IN MF=1, MT=451 (HOLLERITH SECTION)  Mixer
                              OF THE ENDF/B FORMATTED OUTPUT TO    Mixer
                              IDENTIFY THE COMPOSITE MIXTURE).     Mixer
    3   1-60                  ENDF/B INPUT DATA FILENAME           Mixer
                              (STANDARD OPTION = ENDFB.IN)         Mixer
    4   1-60                  ENDF/B OUTPUT DATA FILENAME          Mixer
                              (STANDARD OPTION = ENDFB.OUT)        Mixer
    5   1-11    I11   IZAOUT  ZA IDENTIFICATION FOR COMBINATION    Mixer
    5  12-17    I6    MATOUT  MAT IDENTIFICATION FOR COMBINATION   Mixer
    5  18-19    I2    MFOUT   MF IDENTIFICATION FOR COMBINATION    Mixer
    5  20-22    I3    MTOUT   MT IDENTIFICATION FOR COMBINATION    Mixer
  6-N   1-11    I11   IZAGET  ZA (1000*Z+A) OF MATERIAL            Mixer
  6-N  12-22    I11   MTGET   MT OF REACTION                       Mixer
```

```
 6-N  23-33  E11.4   DENSE   DENSITY OF MATERIAL (GRAMS/CC)        Mixer
                                                                  Mixer
THE SIXTH LINE IS REPEATED FOR EACH SECTION (FROM 2 TO 10).       Mixer
SINCE THE ENDF/B FORMATTED OUTPUT IS IN BARNS/ATOM FORM A MINIMUM  Mixer
OF TWO SECTIONS MUST BE COMBINED (I.E., IF ONLY ONE SECTION IS    Mixer
SPECIFIED THE OUTPUT WOULD BE IDENTICAL TO THE INPUT AND AS SUCH  Mixer
THE PROGRAM WILL CONSIDER THIS TO BE AN ERROR AND NOT PERFORM THE  Mixer
CALCULATION). THE LIST OF SECTIONS IS TERMINATED BY A BLANK LINE.  Mixer
                                                                  Mixer
THE LIST OF SECTIONS TO BE COMBINED MAY BE SPECIFIED IN ANY       Mixer
ORDER, I.E. THEY NEED NOT BE IN ZA ORDER OR THE ORDER THAT THE    Mixer
EVALUATED DATA APPEARS ON THE ENDF/B FORMATTED TAPE.              Mixer
                                                                  Mixer
EXAMPLE INPUT NO. 1                                               Mixer
------------------                                                Mixer
CREATE THE TOTAL CROSS SECTION (MT=1) FOR STAINLESS STEEL AND     Mixer
IDENTIFY THE COMBINED MATERIAL WITH ZA=26800 AND MAT=4000,        Mixer
THE COMPOSITION BY VOLUME OF THE STEEL WILL BE...                 Mixer
                                                                  Mixer
THE DATA FROM \ENDFB6\K300\LIBRARY.DAT AND WRITE DATA TO          Mixer
\MIXER\STEEL.DAT                                                  Mixer
                                                                  Mixer
IRON      - 74.8 PER-CENT                                         Mixer
CHROMIUM  - 16.0                                                  Mixer
NICKEL    -  6.0                                                  Mixer
MANGANESE -  2.0                                                  Mixer
SILICON   -  1.0                                                  Mixer
CARBON    -  0.2                                                  Mixer
                                                                  Mixer
THE INPUT MUST SPECIFY THE COMPOSITION BY GRAMS/CC. THIS IS       Mixer
DEFINED AS THE PRODUCT OF THE STANDARD DENSITY (GRAMS/CC)         Mixer
TIMES THE VOLUME FRACTION. NOTE, DO NOT USE ATOM FRACTIONS.       Mixer
FOR THIS EXAMPLE THE FOLLOWING 12 INPUT CARDS ARE REQUIRED....    Mixer
                                                                  Mixer
STAINLESS STEEL. COMPOSITION BY PER-CENT VOLUME IS 74.8-IRON,     Mixer
16-CHROME, 6-NICKEL, 2-MANGANESE, 1-SILICON, 0.2-CARBON           Mixer
\ENDFB6\K300\LIBRARY.DAT                                          Mixer
\MIXER\STEEL.DAT                                                  Mixer
     26800  4000 3  1                                            Mixer
     26000          1 5.88676    (NOTE, GRAMS/CC INPUT FOR EACH   Mixer
     24000          1 1.150448    CONSTITUENT, E.G. FOR IRON THE  Mixer
     28000          1 0.533928    STP DENSITY IS 7.87 GRAMS/CC.   Mixer
     25055          1 0.1486      THE INPUT VALUE OF 5.88676 IS   Mixer
     14000          1 0.0233      0.748 X 7.87,I.E.  VOLUME       Mixer
      6012          1 0.0044958   FRACTION TIMES STP DENSITY).    Mixer
                                (BLANK LINE TERMINATES INPUT LIST) Mixer
                                                                  Mixer
EXAMPLE INPUT NO. 2                                               Mixer
------------------                                                Mixer
THE SAME EXAMPLE AS THE ABOVE PROBLEM, ONLY USE THE STANDARD      Mixer
ENDF/B DATA FILENAMES - ENDFB.IN AND ENDFB.OUT (THIS CAN BE       Mixer
DONE BY LEAVING THE THIRD AND FOURTH INPUT LINES BLANK).          Mixer
FOR THIS EXAMPLE THE FOLLOWING 12 INPUT CARDS ARE REQUIRED....    Mixer
                                                                  Mixer
STAINLESS STEEL. COMPOSITION BY PER-CENT VOLUME IS 74.8-IRON,     Mixer
16-CHROME, 6-NICKEL, 2-MANGANESE, 1-SILICON, 0.2-CARBON           Mixer
(NOTE - THIS LINE IS REALLY BLANK)                                Mixer
(NOTE - THIS LINE IS REALLY BLANK)                                Mixer
     26800  4000 3  1                                            Mixer
     26000          1 5.88676    (NOTE, GRAMS/CC INPUT FOR EACH   Mixer
     24000          1 1.150448    CONSTITUENT, E.G. FOR IRON THE  Mixer
     28000          1 0.533928    STP DENSITY IS 7.87 GRAMS/CC.   Mixer
     25055          1 0.1486      THE INPUT VALUE OF 5.88676 IS   Mixer
     14000          1 0.0233      0.748 X 7.87,I.E.  VOLUME       Mixer
      6012          1 0.0044958   FRACTION TIMES STP DENSITY).    Mixer
                                (BLANK LINE TERMINATES INPUT LIST) Mixer
                                                                  Mixer
================================================================== Mixer
```

```
====================================================================== Recent
                                                                       Recent
     PROGRAM RECENT                                                    Recent
     VERSION 79-1 (OCTOBER 1979)  CDC-7600                             Recent
     VERSION 80-1 (MAY 1980)      IBM, CDC AND CRAY VERSION            Recent
     VERSION 80-2 (DECEMBER 1980) IMPROVED TREATMENT OF UNRESOLVED     Recent
                                  REGION TO COMPUTE ALL REACTIONS AT   Recent
                                  THE SAME TIME.                       Recent
     VERSION 81-1 (MARCH 1981)  IMPROVED BASED ON USER COMMENTS.       Recent
     VERSION 81-2 (AUGUST 1981) ADDED MONITOR MODE. ADDED SPEED OPTION Recent
                                TO BYPASS BACKWARDS THINNING IF FILE 3 Recent
                                ALLOWABLE ERROR = 0.0 (NOTE THIS OPTION Recent
                                WILL RESULT IN ALL TABULATED POINTS    Recent
                                FROM THE EVALUATION BEING KEPT IN THE  Recent
                                OUTPUT FROM THIS PROGRAM).             Recent
     VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY.      Recent
     VERSION 83-1 (JANUARY 1983)*MAJOR RE-DESIGN.                      Recent
                                *PAGE SIZES INCREASED.                 Recent
                                *ELIMINATED COMPUTER DEPENDENT CODING. Recent
                                *NEW, MORE COMPATIBLE I/O UNIT NUMBERS. Recent
                                *ADDED OPTION TO KEEP ALL RECONSTRUCTED Recent
                                 AND BACKGROUND ENERGY POINTS.         Recent
                                *ADDED STANDARD ALLOWABLE ERROR OPTIONS Recent
                                 (CURRENTLY 0.1 PER-CENT RECONSTRUCTION Recent
                                 AND 0.0 PER-CENT THINNING).           Recent
     VERSION 83-2 (OCTOBER 1983) IMPROVED BASED ON USER COMMENTS.      Recent
     VERSION 84-1 (JANUARY 1984) IMPROVED INTERVAL HALFING CONVERGENCE. Recent
     VERSION 85-1 (APRIL 1985)  *A BRAND NEW PROGRAM WHICH COMPLETELY  Recent
                                 SUPERCEDES ALL PREVIOUS VERSIONS OF   Recent
                                 THIS PROGRAM.                         Recent
                                *UPDATED FOR ENDF/B-VI FORMATS.        Recent
                                *ADDED GENERAL REICH-MOORE FORMALISM   Recent
                                 (WITH TWO FISSION CHANNELS).          Recent
                                *DECREASED RUNNING TIME.               Recent
                                *SPECIAL I/O ROUTINES TO GUARANTEE     Recent
                                 ACCURACY OF ENERGY.                   Recent
                                *DOUBLE PRECISION TREATMENT OF ENERGY  Recent
                                 (REQUIRED FOR NARROW RESONANCES).     Recent
     VERSION 85-2 (AUGUST 1985) *FORTRAN-77/H VERSION                  Recent
     VERSION 86-1 (JANUARY 1986)*ENERGY DEPENDENT SCATTERING RADIUS    Recent
     VERSION 86-2 (JUNE 1986)   *IF FIRST CHANCE FISSION (MT=19)       Recent
                                 BACKGROUND IS PRESENT ADD RESONANCE   Recent
                                 CONTRIBUTION OF FISSION TO IT.        Recent
     VERSION 86-3 (OCTOBER 1986)*MULTI-LEVEL OR REICH-MOORE..CORRECT   Recent
                                 POTENTIAL SCATTERING CROSS SECTION FOR Recent
                                 MISSING AND/OR FICTICIOUS (L,J)       Recent
                                 SEQUENCES.                            Recent
     VERSION 87-1 (JANUARY 1987)*IMPROVED COMBINING FILE 2+3           Recent
     VERSION 87-2 (MARCH 1987)  *CORRECTED ADLER-ADLER CALCULATIONS.   Recent
     VERSION 88-1 (JULY 1988)   *UPDATED REICH-MOORE ENDF/B-VI FORMAT  Recent
                                 TO BE THE SAME AS REICH-MOORE FORMAT  Recent
                                 IN EARLIER VERSIONS OF ENDF/B FORMAT. Recent
                                *CHECK FOR PRELIMINARY ENDF/B-VI       Recent
                                 REICH-MOORE FORMAT (NOW ABANDONED)    Recent
                                 AND TERMINATE EXECUTION IF DATA IS    Recent
                                 IN THIS FORMAT.                       Recent
                                *CALCULATE CHANNEL RADIUS OR SET IT    Recent
                                 EQUAL TO THE SCATTERING RADIUS.       Recent
                                *IMPLEMENTED HYBRID R-FUNCTION WITH THE Recent
                                 FOLLOWING RESTRICTIONS                Recent
                                 - ONLY INELASTIC COMPETITION (NO      Recent
                                   CHARGED PARTICLES)                  Recent
                                 - NO TABULATED FILE 2 BACKGROUND      Recent
                                 - NO TABULATED OPTICAL MODEL PHASE    Recent
                                   SHIFT                               Recent
                                *PROGRAM EXIT IF GENERAL R-MATRIX IN   Recent
                                 THE EVALUATION (THIS FORMALISM WILL   Recent
                                 BE IMPLEMENTED ONLY AFTER THE AUTHOR  Recent
                                 RECEIVES REAL EVALUATIONS WHICH USE   Recent
                                 THIS FORMALISM...UNTIL THEN IT IS     Recent
                                 IMPOSSIBLE TO ADEQUATELY TEST THAT    Recent
```

```
                          THE CODING FOR THIS FORMALISM IS       Recent
                          CORRECT).                              Recent
                         *INCREASED MAXIMUM NUMBER OF RESONANCES Recent
                          FROM 1002 TO 4008.                     Recent
                         *DOUBLE PRECISION RESONANCE REGION      Recent
                          LIMITS.                                Recent
                         *FILE 2 AND FILE 3 ENERGIES WHICH ARE   Recent
                          NEARLY EQUAL ARE TREATED AS EQUAL      Recent
                          (I.E., SAME TO ABOUT 9 DIGITS).        Recent
                         *CHECK FILE 3 BACKGROUND CROSS SECTIONS Recent
                          IN EDIT MODE.                          Recent
                         *OPTION...INTERNALLY DEFINE FILENAMES   Recent
                          (SEE SUBROUTINE FILEIO FOR DETAILS).   Recent
VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO   Recent
                          INSURE PROGRAM WILL NOT DO ANYTHING    Recent
                          CRAZY.                                 Recent
                         *UPDATED TO USE NEW PROGRAM CONVERT     Recent
                          KEYWORDS.                              Recent
                         *CORRECTED MULTILEVEL, REICH-MOORE AND  Recent
                          HYBRID R-FUNCTION POTENTIAL SCATTER    Recent
                          TO ACCOUNT FOR REPEATED J-VALUES FOR   Recent
                          THE SAME TARGET SPIN AND L-VALUE.      Recent
                         *ADDED LIVERMORE CIVIC COMPILER         Recent
                          CONVENTIONS.                           Recent
                         *UPDATED TO USE NEW ENDF/B-VI           Recent
                          CONVENTION TO ALLOW UNRESOLVED         Recent
                          RESONANCE CONTRIBUTION TO ALREADY      Recent
                          BE INCLUDED IN THE FILE 3 CROSS        Recent
                          SECTIONS (INFINITELY DIULUTE           Recent
                          CONTRIBUTION).                         Recent
VERSION 90-1 (JUNE 1990)  *UPDATED BASED ON USER COMMENTS        Recent
                         *ADDED FORTRAN SAVE OPTION              Recent
                         *NEW MORE CONSISTENT ENERGY OUTPUT      Recent
                          ROUTINE                                Recent
VERSION 91-1 (JULY 1991)  *NEW UNIFORM TREATMENT OF ALL RESONANCE Recent
                          FORMALISMS (SEE, COMMENTS BELOW)       Recent
                         *NEW REICH-MOORE ALGORITHM              Recent
                         *MORE EXTENSIVE ERROR CHECKING AND      Recent
                          ERROR MESSAGE EXPLANATIONS             Recent
VERSION 92-1 (JANUARY 1992)*MAJOR RESTRUCTING TO IMPROVE ACCURACY Recent
                          AND COMPUTER INDEPENDENCE.             Recent
                         *INCREASED ENERGY POINT PAGE SIZE FROM  Recent
                          1002 TO 4008.                          Recent
                         *NO MORE THAN 2 ENERGY POINTS WHERE     Recent
                          CROSS SECTION IS ZERO AT BEGINNING     Recent
                          OF A SECTION FOR EACH REACTION,E.G.,   Recent
                          THRESHOLD FISSION.                     Recent
                         *PROCESS ONLY A PORTION OF RESONANCE    Recent
                          REGION - SEE EXPLANATION BELOW         Recent
                         *ALL ENERGIES INTERNALLY ROUNDED PRIOR  Recent
                          TO CALCULATIONS.                       Recent
                         *COMPLETELY CONSISTENT I/O AND ROUNDING Recent
                          ROUTINES - TO MINIMIZE COMPUTER        Recent
                          DEPENDENCE.                            Recent
VERSION 93-1 (MARCH 1993) *UPDATED REICH-MOORE TREATMENT TO USE  Recent
                          L DEPENDENT SCATTERING RADIUS (APL)    Recent
                          RATHER THAN SCATTERING RADIUS (AP)     Recent
                          (SEE, ENDF/B-VI FORMATS AND            Recent
                           PROCEDURES MANUAL, PAGE 2.6)          Recent
                         *INCREASED PAGE SIZE FROM 4008 TO       Recent
                          20040 DATA POINTS.                     Recent
                         *INCREASED MAXIMUM NUMBER OF RESONANCES Recent
                          FROM 4008 TO 20040.                    Recent
VERSION 94-1 (JANUARY 1994)*VARIABLE ENDF/B DATA FILENAMES       Recent
                          TO ALLOW ACCESS TO FILE STRUCTURES     Recent
                          (WARNING - INPUT PARAMETER FORMAT      Recent
                          HAS BEEN CHANGED).                     Recent
                         *CLOSE ALL FILES BEFORE TERMINATING     Recent
                          (SEE, SUBROUTINE ENDIT)                Recent
VERSION 94-2 (AUGUST 1994) *CORRECTED ADDJ FOR ENERGY DEPENDENT  Recent
                          (TABULATED) SCATTERING RADIUS CASE.    Recent
```

```
VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                      Recent
                            *IMPROVED COMPUTER INDEPENDENCE         Recent
                            *ALL DOUBLE PRECISION                   Recent
                            *ON SCREEN OUTPUT                       Recent
                            *UNIFORM TREATMENT OF ENDF/B I/O        Recent
                            *IMPROVED OUTPUT PRECISION              Recent
                            *ALWAYS INCLUDE THERMAL VALUE           Recent
                            *DEFINED SCRATCH FILE NAMES             Recent
VERSION 97-1 (APRIL 1997)   *OPTIONAL MAKE NEGATIVE CROSS           Recent
                             SECTION = 0 FOR OUTPUT                 Recent
                           *INCREASED PAGE SIZE FROM 20040 TO       Recent
                            120000 DATA POINTS.                     Recent
                           *INCREASED MAXIMUM NUMBER OF RESONANCES  Recent
                            FROM 20040 TO 120000.                   Recent
VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING        Recent
                             POINT READ FOR MORE DIGITS             Recent
                            *UPDATED TEST FOR ENDF/B FORMAT         Recent
                             VERSION BASED ON RECENT FORMAT CHANGE  Recent
                            *UPDATED CONSTANTS BASED ON CSEWG       Recent
                             SUBCOMMITTEE RECOMMENDATIONS           Recent
                            *GENERAL IMPROVEMENTS BASED ON          Recent
                             USER FEEDBACK                          Recent
VERSION 99-2 (JUNE 1999)    *IMPLEMENTED NEW REICH-MOORE FORMALISM  Recent
                             TO ALLOW DEFINITION OF (L,J,S) FOR     Recent
                             EACH SEQUENCE.                         Recent
                            *ASSUME ENDF/B-VI, NOT V, IF MISSING    Recent
                             MF=1, MT-451.                          Recent
VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON          Recent
                             USER FEEDBACK                          Recent
VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS              Recent
             (SEPT. 2002)   *OUTPUT RESONANCE WITH 9 DIGITS         Recent
                            *TO BE C AND C++ COMPATIBLE OUTPUT      Recent
VERS. 2004-1 (JAN. 2004)    *ADDED INCLUDE 'recent.h'               Recent
                            *MADE ENDF/B-VII READY                  Recent
                            *UPDATED FOR NEW REICH-MOORE LRF=7      Recent
                             PARAMETERS WITH COMPETITION            Recent
                            *ADDED COULOMB PENETRATION FACTORS FOR  Recent
                             LRF=7 COMPETITIVE CHANNELS.            Recent
                            *EXTENDED DEFINITIONS OF PENETRATION    Recent
                             FACTOR, LEVEL SHIFT FACTOR, AND        Recent
                             POTENTIAL SCATTERING PHASE SHIFT       Recent
                             ABOVE L = 5 TO INFINITY.               Recent
                            *ADDED QUICK CALCULATION - IF THE       Recent
                             INPUT ALLOWABLE ERROR IS 1.0 OR MORE   Recent
                             (100 % OR MORE) THERE IS NO ITERATION  Recent
                             TO CONVERGENCE - CROSS SECTION ARE     Recent
                             QUICKLY CALCULATED ONLY AT A FIXED     Recent
                             SET OF ENERGY POINTS, BASED ON THE     Recent
                             ENERGY AND WIDTH OF ALL RESONANCES.    Recent
                             THIS CAN BE USED TO QUICKLY "SEE"      Recent
                             NEW EVALUATIONS THAT MAY CONTAIN       Recent
                             ERRORS, THAT WOULD OTHERWISE CAUSE     Recent
                             THIS CODE TO RUN FOR AN EXCESSIVELY    Recent
                             LONG TIME.                             Recent
                                                                    Recent
OWNED, MAINTAINED AND DISTRIBUTED BY                                Recent
-----------------------------------                                 Recent
THE NUCLEAR DATA SECTION                                            Recent
INTERNATIONAL ATOMIC ENERGY AGENCY                                  Recent
P.O. BOX 100                                                        Recent
A-1400, VIENNA, AUSTRIA                                             Recent
EUROPE                                                              Recent
                                                                    Recent
ORIGINALLY WRITTEN BY                                               Recent
---------------------------------                                   Recent
DERMOTT E. CULLEN                                                   Recent
UNIVERSITY OF CALIFORNIA                                            Recent
LAWRENCE LIVERMORE NATIONAL LABORATORY                              Recent
L-159                                                               Recent
P.O. BOX 808                                                        Recent
LIVERMORE, CA 94550                                                 Recent
```

```
U.S.A.                                                          Recent
TELEPHONE  925-423-7359                                         Recent
E. MAIL    CULLEN1@LLNL.GOV                                     Recent
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                          Recent
                                                                Recent
Acknowledgement (Version 2004-1)                                Recent
================================================================ Recent
The author thanks Nancy Larson, ORNL, for providing her SAMRML  Recent
code for comparison to RECENT output for Reich-Moore evaluations, Recent
in particular to verify results for the new LFR=7 evaluations. I Recent
also thank her for providing guidance to help me understand and Recent
implement this new teatment for Reich-Moore parameters.         Recent
                                                                Recent
ACKNOWLEDGEMENT (VERSION 92-1)                                  Recent
================================================================ Recent
THE AUTHOR THANKS SOL PEARLSTEIN (BROOKHAVEN NATIONAL LAB) FOR  Recent
SIGNIFICANTLY CONTRIBUTING TOWARD IMPROVING THE ACCURACY AND     Recent
COMPUTER INDEPENDENCE OF THIS CODE - THANKS, SOL                Recent
================================================================ Recent
                                                                Recent
AUTHORS MESSAGE                                                 Recent
================================================================ Recent
THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION Recent
FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED Recent
THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE Recent
READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY  Recent
THE COMMENTS CONCERNING MACHINE DEPENDENT CODING.               Recent
                                                                Recent
AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER Recent
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE  Recent
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT Recent
IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY    Recent
COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO Recent
IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF Recent
THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR      Recent
COMPUTER.                                                       Recent
                                                                Recent
PURPOSE                                                         Recent
================================================================ Recent
THIS PROGRAM IS DESIGNED TO RECONSTRUCT THE RESONANCE CONTRIBUTION Recent
TO THE CROSS SECTION IN LINEARLY INTERPOLABLE FORM, ADD IN ANY  Recent
LINEARLY INTERPOLABLE BACKGROUND CROSS SECTION AND OUTPUT THE   Recent
RESULT IN THE ENDF/B FORMAT. THE CROSS SECTIONS OUTPUT BY THIS  Recent
PROGRAM WILL BE LINEARLY INTERPOLABLE OVER THE ENTIRE ENERGY RANGE Recent
                                                                Recent
THE RESONANCE CONTRIBUTION IS CALCULATED FOR TOTAL (MT=1),      Recent
ELASTIC (MT=2), CAPTURE (MT=102) AND FISSION (MT=18), ADDED     Recent
TO THE BACKGROUND (IF ANY) AND OUTPUT. IN ADDITION, IF THERE    Recent
IS A FIRST CHANCE FISSION (MT=19) BACKGROUND PRESENT THE RESONANCE Recent
CONTRIBUTION OF FISSION WILL BE ADDED TO THE BACKGROUND AND     Recent
OUTPUT. IF THERE IS NO FIRST CHANCE FISSION (MT=19) BACKGROUND  Recent
PRESENT THE PROGRAM WILL NOT OUTPUT MT=19.                      Recent
                                                                Recent
IN THE FOLLOWING FOR SIMPLICITY THE ENDF/B TERMINOLOGY--ENDF/B  Recent
TAPE--WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE TAPE, CARDS, Recent
DISK OR ANY OTHER MEDIUM.                                       Recent
                                                                Recent
PROCESSING DATA IN THE ENDF/B-VI FORMAT                         Recent
================================================================ Recent
IT HAS NOW BEEN CONFIRMED (PRIVATE COMMUNICATION, CHARLES DUNFORD, Recent
APRIL, 1991) THAT THE PROPER PROCEDURE TO FOLLOW WHEN THERE ARE Recent
MISSING OR DUPLICATE J VALUES IS TO IN ALL CASES ADD A SEQUENCE Recent
WITH NO RESONANCES TO ACCOUNT FOR THE CONTRIBUTION OF THE SEQUENCE Recent
TO THE POTENTIAL SCATTERING CROSS SECTION.                      Recent
                                                                Recent
THIS IS THE PROCEDURE WHICH WAS FOLLOWED BY ALL VERSIONS OF RECENT Recent
SINCE 86-3 AND WILL CONTINUE TO BE THE PROCEDURE.               Recent
                                                                Recent
INPUT ENDF/B FORMAT AND CONVENTIONS                             Recent
================================================================ Recent
ENDF/B FORMAT                                                   Recent
```

```
------------                                                      Recent
THIS PROGRAM ONLY USES THE ENDF/B BCD OR LINE IMAGE FORMAT (AS    Recent
OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION  Recent
OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT). Recent
                                                                  Recent
IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B      Recent
FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS    Recent
ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE Recent
NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE         Recent
CORRECTLY OUTPUT ON ALL CARDS. THE FORMAT OF SECTION MF=1, MT=451 Recent
AND ALL SECTIONS OF MF=2 AND 3 MUST BE CORRECT. THE PROGRAM COPIES Recent
ALL OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE Recent
TO THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.         Recent
                                                                  Recent
ENDF/B FORMAT VERSION                                             Recent
--------------------                                              Recent
THE FORMATS AND CONVENTIONS FOR READING AND INTERPRETING THE DATA Recent
VARIES FROM ONE VERSION OF ENDF/B TO THE NEXT. HOWEVER, IF THE    Recent
HOLLERITH SECTION (MF=1, MT=451) IS PRESENT IT IS POSSIBLE FOR    Recent
THIS PROGRAM TO DISTINGUISH BETWEEN DATA IN THE ENDF/B-IV, V AND  Recent
VI FORMATS AND TO USE THE APPROPRIATE CONVENTIONS FOR EACH         Recent
ENDF/B VERSION (SEE, SUBROUTINE FILE1 FOR A DESCRIPTION OF HOW    Recent
THIS IS DONE). IF THE HOLLERITH SECTION IS NOT PRESENT THE         Recent
PROGRAM WILL ASSUME THE DATA IS IN THE ENDF/B-VI FORMAT AND USE    Recent
ALL CONVENTIONS APPROPRIATE TO ENDF/B-V. USERS ARE ENCOURAGED TO   Recent
INSURE THAT THE HOLLERITH SECTION (MF=1, MT=451) IS PRESENT IN     Recent
ALL EVALUATIONS.                                                  Recent
                                                                  Recent
INPUT OF ENERGIES                                                 Recent
-----------------                                                 Recent
ALL ENERGIES ARE READ IN DOUBLE PRECISION (BY SPECIAL FORTRAN I/O  Recent
ROUTINES) AND ARE TREATED IN DOUBLE PRECISION IN ALL CALCULATIONS. Recent
                                                                  Recent
OUTPUT ENDF/B FORMAT AND CONVENTIONS                              Recent
================================================================= Recent
CONTENTS OF OUTPUT                                                Recent
------------------                                                Recent
ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE RECONSTRUCTED FILE     Recent
3 CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE       Recent
ALSO INCLUDED.                                                    Recent
                                                                  Recent
DOCUMENTATION                                                     Recent
-------------                                                     Recent
THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED  Recent
BY THE ADDITION OF COMMENT CARDS AT THE END OF EACH HOLLERITH      Recent
SECTION IN THE FORM                                               Recent
                                                                  Recent
***************** RECENT (VERSION 2004-1) ***************         Recent
RESONANCE CONTRIBUTION RECONSTRUCTED TO WITHIN   0.100 PER-CENT   Recent
COMBINED DATA NOT THINNED (ALL RESONANCE + BACKGROUND DATA KEPT)  Recent
                                                                  Recent
THE ORDER OF ALL SIMILAR COMMENTS (FROM LINEAR, SIGMA1 AND GROUPY) Recent
REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON       Recent
THE DATA, INCLUDING WHICH VERSION OF EACH PROGRAM WAS USED.       Recent
                                                                  Recent
THESE COMMENT CARDS ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS, Recent
I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT Recent
OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF      Recent
EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451    Recent
IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF      Recent
THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF      Recent
MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO          Recent
DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND   Recent
AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT  Recent
SHOULD BE USED TO CREATE A HOLLERITH SECTION.                      Recent
                                                                  Recent
REACTION INDEX                                                    Recent
--------------                                                    Recent
THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN     Recent
SECTION MF=1, MT=451 OF EACH EVALUATION.                          Recent
                                                                  Recent
```

```
THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451.   Recent
THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT         Recent
REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS Recent
NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING  Recent
A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE  Recent
A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM Recent
YOU MAY USE PROGRAM DICTIN TO CREATE A CORRECT REACTION INDEX.     Recent
                                                                   Recent
OUTPUT FORMAT OF ENERGIES                                          Recent
-------------------------                                          Recent
IN THIS VERSION OF RECENT ALL FILE 3 ENERGIES WILL BE OUTPUT IN    Recent
F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN   Recent
WITH UP TO 9 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN  Recent
OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS   Recent
OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS    Recent
TO THE 9 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE  Recent
TO USE THE 9 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA     Recent
JUST DUE TO TRANSLATION OF ENERGIES FROM THEIR INTERNAL (BINARY)   Recent
REPRESENTATION TO THE ENDF/B FORMAT.                               Recent
                                                                   Recent
ACCURACY OF ENERGY                                                 Recent
------------------                                                 Recent
IN ORDER TO ALLOW ENERGIES TO BE ACCURATELY OUTPUT TO 9 DIGITS     Recent
ON SHORT WORD LENGTH COMPUTERS (E.G. IBM) ALL ENERGIES AND         Recent
ENERGY DEPENDENT TERMS ARE READ AND TREATED IN DOUBLE PRECISION.   Recent
                                                                   Recent
OUTPUT OF RESONANCE PARAMETERS                                     Recent
------------------------------                                     Recent
A SPECIAL CONVENTION HAS BEEN INTRODUCED REGARDING RESONANCE       Recent
PARAMETERS. IN ORDER TO ALLOW THE USER TO DOPPLER BROADEN AND/OR   Recent
SELF-SHIELD CROSS SECTIONS THE RESONANCE PARAMETERS ARE ALSO       Recent
INCLUDED IN THE OUTPUT WITH THE EVALUATION. IN ORDER TO AVOID THE  Recent
POSSIBILITY OF ADDING THE RESONANCE CONTRIBUTION A SECOND TIME     Recent
TWO CONVENTIONS HAVE BEEN ADOPTED TO INDICATE THAT THE RESONANCE   Recent
CONTRIBUTION HAS ALREADY BEEN ADDED TO THE FILE 3 CROSS SECTIONS,  Recent
                                                                   Recent
(1) WHEN THE DATA IS PROCESSED BY THIS PROGRAM LRP (IN MF=1,       Recent
MT=451) IS SET EQUAL TO 2. THIS IS A CONVENTION WHICH HAS BEEN     Recent
ADOPTED AS A STANDARD CONVENTION IN ENDF/B-VI, BUT IS ONLY TO BE   Recent
USED FOR PROCESSED DATA, AS OPPOSED TO THE ORIGINAL EVALUATIONS.   Recent
IN EVALUATIONS WHICH CONTAIN MF=1, MT=451 LRP CAN BE USED TO       Recent
DETERMINE IF THE MATERIAL HAS BEEN PROCESSED.                      Recent
                                                                   Recent
(2) THE LRU FLAG IN EACH SECTION OF FILE 2 DATA IS CHANGED TO      Recent
LRU=LRU+3. FOR EXAMPLE WHEN READING AN ENDF/B EVALUATION LRU=0     Recent
(NO RESONANCES), =1 (RESOLVED) OR =2 (UNRESOLVED) INDICATES THAT   Recent
THE DATA IS IN THE ORIGINAL ENDF/B FORM. LRU=3 (NO RESONANCES),    Recent
=4 (RESOLVED) OR =5 (UNRESOLVED) INDICATES THAT THE RESONANCE      Recent
CONTRIBUTION HAS ALREADY BEEN ADDED TO THE FILE 3 DATA. THIS       Recent
SECOND CONVENTION HAS BEEN ADOPTED AS INSURANCE THAT THE RESONANCE Recent
CONTRIBUTION WILL NOT BE ADDED TWICE, EVEN FOR EVALUATIONS WHICH   Recent
DO NOT CONTAIN MF=1, MT=451 (EVALUATIONS WHICH CONTAIN MF=1,       Recent
MT=451 ARE COVERED BY CONVENTION (1), DESCRIBED ABOVE).            Recent
                                                                   Recent
UNIFORM TREATMENT OF RESONANCE FORMALISMS                          Recent
================================================================== Recent
NORMALIZATION                                                      Recent
=============                                                      Recent
ALL OF THE RESONANCE FORMALISMS INCLUDE A FACTOR OF,               Recent
                                                                   Recent
PI*(FRACTIONAL ABUNDANCE)/(K**2)                                   Recent
                                                                   Recent
THIS FACTOR HAS BEEN REMOVED FROM THE CALCULATION OF EACH TYPE     Recent
OF RESONANCE FORMALISM AND IS APPLIED AS A FINAL NORMALIZATION     Recent
AFTER THE CALCULATION, ONLY ONE PLACE IN THIS PROGRAM.             Recent
                                                                   Recent
FOR SIMPLICITY THIS TERM IS NOT INCLUDED IN THE FOLLOWING          Recent
DERIVATIONS - IN ALL CASES THE ACTUAL CROSS SECTION IS A PRODUCT   Recent
OF THE ABOVE FACTOR TIMES THE RESULTS PRESENTED BELOW.             Recent
                                                                   Recent
SIMILARITIES                                                       Recent
```

```
============                                                        Recent
FOR THE RESOLVED RESONANCE REGION, EXCEPT FOR SINGLE LEVEL BREIT    Recent
WIGNER, PARAMETERS ALL OF THE FORMALISMS DEFINE THE CROSS SECTIONS  Recent
IN AN EQUIVALENT FORM,                                              Recent
                                                                    Recent
TOTAL    = 2*GJ*REAL(1 - U)                                         Recent
         = 2*GJ*(1 - REAL(U))                                       Recent
ELASTIC  =   GJ*(1 - U)**2                                          Recent
         =   GJ*((1 - 2*REAL(U)) + (REAL(U)**2 + IM(U)**2))         Recent
         = 2*GJ*(1 - REAL(U)) - GJ*(1 - (REAL(U)**2 + IM(U)**2))    Recent
                                                                    Recent
SINCE THE FIRST TERM IS THE TOTAL, THE SECOND TERM MUST BE          Recent
ABSORPTION. SO WE FIND,                                             Recent
                                                                    Recent
ABSORPTION = GJ*(1 - (REAL(U)**2 + IM(U)**2))                       Recent
                                                                    Recent
IN ALL CASES U IS DEFINED IN THE FORM,                              Recent
                                                                    Recent
U        = EXP(-I*2*PS)*((1-X) - I*Y)                               Recent
                                                                    Recent
WHERE (X) AND (Y) ARE RELATED TO THE SYMMETRIC AND ANTI-SYMMETRIC   Recent
CONTRIBUTIONS OF THE RESONANCES, RESPECTIVELY. ONLY THE DEFINITION  Recent
OF (X) AND (Y) WILL BE DIFFERENT FOR EACH RESONANCE FORMALISM.      Recent
BELOW WE WILL SHOW THAT WHAT MIGHT APPEAR TO BE A STRANGE CHOICE    Recent
OF DEFINITION OF THE SIGN OF (X) AND(Y) HAS BEEN SELECTED SO THAT   Recent
FOR BREIT-WIGNER PARAMETERS (X) AND (Y) CORRESPOND EXACTLY TO THE   Recent
SYMMETRIC AND ANTI-SYMMETRIC CONTRIBUTION OF THE RESONANCES.        Recent
                                                                    Recent
U        = (COS(2*PS) - I*SIN(2*PS))*((1-X) - I*Y)                  Recent
         =   ((1-X)*COS(2*PS) - Y*SIN(2*PS))                        Recent
         =-I*((1-X)*SIN(2*PS) + Y*COS(2*PS))                        Recent
                                                                    Recent
REAL(U)  = ((1-X)*COS(2*PS) - Y*SIN(2*PS))                          Recent
IM(U)    =-((1-X)*SIN(2*PS) + Y*COS(2*PS))                          Recent
                                                                    Recent
R(U)**2  =((1-X)*COS(2*PS))**2 + (Y*SIN(2*PS))**2                   Recent
          -2*(1-X)*Y*COS(2*PS)*SIN(2*PS)                            Recent
I(U)**2  =((1-X)*SIN(2*PS))**2 + (Y*COS(2*PS))**2                   Recent
          +2*(1-X)*Y*COS(2*PS)*SIN(2*PS)                            Recent
                                                                    Recent
THE TERMS 2*(1-X)*Y*COS(2*PS)*SIN(2*PS) CANCEL AND UPON USING       Recent
THE IDENTITY COS(2*PS)**2 + SIN(2*PS)**2 = 1,                       Recent
                                                                    Recent
SUM      = (1-X)**2 + (Y)**2                                        Recent
                                                                    Recent
WE NOW HAVE ALL THE QUANTITIES THAT WE NEED TO DEFINE THE CROSS     Recent
SECTIONS,                                                           Recent
                                                                    Recent
ELASTIC                                                             Recent
=======                                                             Recent
ELASTIC  =GJ*(1 - 2*REAL(U) + (REAL(U)**2 + IM(U)**2))              Recent
         =GJ*(1 - 2*((1-X)*COS(2*PS)-Y*SIN(2*PS))+(1-X)**2+(Y)**2)  Recent
                                                                    Recent
THIS CAN BE WRITTEN AS A SUM OF 2 SQUARES,                          Recent
                                                                    Recent
ELASTIC  =GJ*(COS(2*PS) - (1-X))**2 + (SIN(2*PS) + Y)**2            Recent
                                                                    Recent
         =GJ*((COS(2*PS))**2 - 2*(1-X)*COS(2*PS) + (1-X)**2) +      Recent
              (SIN(2*PS))**2 + 2*Y*SIN(2*PS)    + (Y)**2)           Recent
                                                                    Recent
AGAIN USING THE IDENTITY COS(2*PS)**2 + SIN(2*PS)**2 = 1, WE CAN    Recent
SEE THAT THE DEFINITION AS THE SUM OF 2 SQUARES IS IDENTICAL TO     Recent
THE PRECEDING DEFINITION OF THE ELASTIC.                            Recent
                                                                    Recent
ELASTIC  =GJ*(COS(2*PS) - (1-X))**2 + (SIN(2*PS) + Y)**2            Recent
         =GJ*((COS(2*PS)-1) + X)**2 + (SIN(2*PS) + Y)**2            Recent
                                                                    Recent
USING THE IDENTITY (1 - COS(2*PS))) = 2*SIN(PS)**2, WE OBTAIN       Recent
THE FINAL FORM FOR THE ELASTIC,                                     Recent
                                                                    Recent
ELASTIC =GJ*(2*SIN(PS)**2 - X)**2 + (SIN(2*PS) + Y)**2              Recent
```

```
                                                                      Recent
ABSORPTION                                                            Recent
==========                                                            Recent
ABSORPTION = GJ*(1 - (REAL(U)**2 + IM(U)**2))                         Recent
           = GJ*(1 - ((1-X)**2   + (Y)**2)                            Recent
           = GJ*(1 - (1 - 2*X + (X)**2 + (Y)**2)                      Recent
           = GJ*(2*X - (X)**2 + (Y)**2)                               Recent
                                                                      Recent
SINCE PHYSICALLY THE ABSORPTION CANNOT BE NEGATIVE WE CAN SEE         Recent
THAT (X) MUST BE POSITIVE AND 2*X MUST BE GREATER THAN                Recent
(X)**2 + (Y)**2, FOR ALL OF THE FORMALISMS.                           Recent
                                                                      Recent
TOTAL                                                                 Recent
=====                                                                 Recent
IN THIS PROGRAM THE TOTAL CROSS SECTION IS ALWAYS DEFINED TO BE       Recent
THE SUM OF ITS PARTS - SO THE ABOVE DEFINITION IS NEVER EXPLICITLY    Recent
USED. HOWEVER, WE CAN LEARN SOMETHING BY EXAMINING THE DEFINITION,    Recent
                                                                      Recent
TOTAL    = 2*GJ*REAL(1 - U)                                           Recent
         = 2*GJ*(1 - (((1-X)*COS(2*PS) - Y*SIN(2*PS)))                Recent
         = 2*GJ*((1 - COS(2*PS))*(1-X) - (1-X) + Y*SIN(2*PS))         Recent
         = 2*GJ*(2*SIN(PS)**2*(1-X)    - (1-X) + Y*SIN(2*PS))         Recent
                                                                      Recent
         = 4*GJ*SIN(PS)**2 +                                          Recent
           2*GJ*((X-1) - 2*X*SIN(PS)**2 +  Y*SIN(2*PS))               Recent
                                                                      Recent
THE IMPORTANT POINT TO NOTE IS THAT THE DEFINITION OF THE TOTAL       Recent
DOES NOT EXPLICITLY CONTAIN ANY DEPENDENCE ON X**2 AND Y**2 -         Recent
THE LEVEL-LEVEL INTERFERENCE TERMS.                                   Recent
                                                                      Recent
THIS IMPLIES THAT IF A GIVEN SET OF RESONANCE PARAMETERS ARE USED     Recent
WITH THIS DEFINITION THEY WILL PRODUCE EXACTLY THE SAME TOTAL         Recent
CROSS SECTION - WHETHER WE CLAIM THE PARAMETERS HAVE BEEN             Recent
PRODUCED USING A SINGLE OR MULTI-LEVEL FIT. THIS RESULT COULD         Recent
BE VERY MISLEADING, IF THIS RESULT FOR THE TOTAL IS IMPLIED TO        Recent
MEAN THAT ONE INTERPRETATION OR THE OTHER WILL NOT HAVE ANY           Recent
EFFECT ON THE INDIVIDUAL CROSS SECTIONS.                              Recent
                                                                      Recent
STARTING FROM EXACTLY THE SAME RESONANCE PARAMETERS, RELATIVE TO      Recent
THE RESULTS OBTAINED USING THE SINGLE LEVEL FORMULA, MULTI-LEVEL      Recent
RESULTS WILL TEND TO ALWAYS DECREASE THE ABSORPTION AND INCREASE      Recent
THE ELASTIC. THIS CAN BE IMMEDIATELY SEEN FROM OUR GENERAL            Recent
MULTI-LEVEL DEFINITION OF ABSORPTION,                                 Recent
                                                                      Recent
ABSORPTION =GJ*(2*X - ((X)**2 + (Y)**2))                              Recent
                                                                      Recent
THE SINGLE LEVEL ABSORPTION IS,                                       Recent
                                                                      Recent
ABSORPTION =GJ*(2*X)                                                  Recent
                                                                      Recent
THE DIFFERENCE BETWEEN THE TWO IS -2*GJ*(X**2 + Y**2), SO THAT        Recent
REGARDLESS OF HOW WE DEFINE (X) AND (Y) THE INCLUSION OF THIS         Recent
TERM WILL ALWAYS DECREASE ABSORPTION. SINCE THE TOTAL CROSS           Recent
SECTION IS THE SAME IN BOTH CASE, THIS MEANS THAT THE ELASTIC         Recent
HAS BEEN INCREASED BY THIS AMOUNT.                                    Recent
                                                                      Recent
AGAIN, THESE RESULTS ARE BASED ON STARTING FROM EXACTLY THE SAME      Recent
PARAMETERS - IN ANY ACTUAL CASE THE PARAMETERS BASED ON A SINGLE      Recent
OR MULTI-LEVEL FIT WILL BE QUITE DIFFERENT - THE POINT THAT WE        Recent
WANT TO STRESS HERE IS THAT YOU SHOULD NEVER USE PARAMETERS           Recent
WHICH HAVE BEEN DEFINED BY A FIT USING ONE FORMALISM - IN THE         Recent
EQUATIONS FOR A DIFFERENT FORMALISM - AND ASSUME THAT THE RESULTS     Recent
WILL BE CONSISTENT - AND NEVER USE THE TOTAL CROSS SECTION TO         Recent
SEE WHETHER OR NOT A SET OF SINGLE LEVEL PARAMETERS CAN BE USED       Recent
WITH A MULTI-LEVEL FORMALISM.                                         Recent
                                                                      Recent
POTENTIAL CROSS SECTION                                               Recent
=======================                                               Recent
FAR FROM RESONANCES (X) AND (Y) WILL BE SMALL AND THE ELASTIC         Recent
CROSS SECTION REDUCES TO,                                             Recent
                                                                      Recent
```

```
ELASTIC =GJ*(2*SIN(PS)**2)**2     + (SIN(2*PS))**2                Recent
        =GJ*4*(SIN(PS)**4         + SIN(2*PS)**2                  Recent
                                                                  Recent
USING THE IDENTITY SIN(2*PS) = 2*SIN(PS)*COS(PS)                  Recent
                                                                  Recent
        =4*GJ*(SIN(PS)**4         + (SIN(PS)*COS(PS))**2)         Recent
        =4*GJ*SIN(PS)**2*(SIN(PS)**2 + COS(PS)**2)                Recent
        =4*GJ*SIN(PS)**2                                          Recent
                                                                  Recent
WHICH IS THE POTENTIAL CROSS SECTION. NOTE THAT THIS RESULT IS    Recent
INDEPENDENT OF THE FORMALISM USED, AS IT MUST PHYSICALLY BE,      Recent
AND AS SUCH ALTHOUGH AS YET WE HAVE NOT DEFINED IT, WE CAN        Recent
NOW SEE THAT IN ALL CASES (PS) MUST BE THE PHASE SHIFT AND FOR    Recent
CONSISTENCY IT MUST BE DEFINED USING EXACTLY THE SAME DEFINITION  Recent
IN ALL CASES.                                                     Recent
                                                                  Recent
IN ADDITION SINCE PHYSICALLY FOR EACH L VALUE WE EXPECT TO OBTAIN Recent
A POTENTIAL CROSS SECTION,                                        Recent
                                                                  Recent
4*(2*L+1)*SIN(PS)**2                                              Recent
                                                                  Recent
OBVIOUSLY FOR CONSISTENCY WE MUST HAVE,                           Recent
                                                                  Recent
(2*L+1) = (SUM OVER J) GJ                                         Recent
                                                                  Recent
ONLY IN THIS CASE WILL THE RESULTS BE CONSISTENT - THIS POINT WILL Recent
BE DISCUSSED IN DETAIL BELOW.                                     Recent
                                                                  Recent
WHAT ARE THIS TERMS (X) AND (Y)                                   Recent
==============================                                    Recent
(X) AND (Y) CAN BE EASILY IDENTIFIED BY CONSIDERING THE SINGLE    Recent
AND MULTI-LEVEL BREIT WIGNER FORMALISMS. IN THESE CASES WE WILL   Recent
FIND THAT,                                                        Recent
                                                                  Recent
X       = GAM(N)*GAM(T)/2/DEN                                     Recent
Y       = GAM(N)*(E-ER)/DEN                                       Recent
DEN     = ((E-ER)**2 + (GAM(T)/2)**2)                             Recent
                                                                  Recent
EXTREME CARE HAS TO BE USED TO PROPERLY DEFINE (Y) SUCH THAT IT   Recent
IS NEGATIVE FOR E LESS THAN ER AND POSITIVE FOR E GREATER THAN     Recent
ER. I WILL MERELY MENTION THAT THE EQUATIONS FOR ALL FORMALISMS   Recent
IN ENDF-102 DO NOT CONSISTENTLY USE (E - ER) - IN SOME CASES      Recent
THIS IS WRITTEN AS (ER - E), WHICH CAN LEAD TO AN INCORRECT       Recent
SIGN IN THE DEFINITION OF THE (Y) THAT WE REQUIRE.                Recent
                                                                  Recent
THE INTERFERENCE TERMS CAN BE WRITTEN IN TERMS OF,                Recent
1) LEVEL-SELF INTERFERENCE  = THE CONTRIBUTION OF EACH LEVEL      Recent
                              INTERFERRING WITH ITSELF            Recent
2) LEVEL-LEVEL INTERFERENCE = THE CONTRIBUTION OF EACH LEVEL      Recent
                              INTERFERRRING WITH ALL OTHER LEVELS Recent
                                                                  Recent
WE WILL REFER TO THESE TWO AS (L-S) AND (L-L),                    Recent
                                                                  Recent
X**2    = (GAM(N)*(GAM(T)/2)**2/(DEN)**2      + (L-L)             Recent
        = (GAM(N)**2*((GAM(T)/2)**2)/(DEN)**2 + (L-L)             Recent
Y**2    = (GAM(N))**2*((E-ER))**2/(DEN)**2    + (L-L)             Recent
                                                                  Recent
X**2+Y**2= GAM(N)**2*DEN/(DEN)**2 = GAM(N)**2/DEN + (L-L)         Recent
                                                                  Recent
TO SEE THE EFFECT OF INCLUDING MULTI-LEVEL INTERFERENCE WE CAN    Recent
CONSIDER OUR GENERAL EXPRESSION FOR ABSORPTION,                   Recent
                                                                  Recent
ABSORPTION =GJ*(2*X - ((X)**2 + (Y)**2))                          Recent
                                                                  Recent
AND NOTE THAT FOR BOTH SINGLE AND MULTI-LEVEL BREIT WIGNER THE    Recent
ENDF-102 SAYS TO TREAT ABSORPTION IN A SINGLE LEVEL APPROXIMATION Recent
I.E., IGNORE LEVEL-LEVEL INTERFERENCE. IF ALL INTERFERENCE IS     Recent
IGNORED THIS IS EQUIVALENT TO COMPLETELY IGNORING X**2 + Y**2 AND Recent
DEFINING,                                                         Recent
                                                                  Recent
ABSORPTION =GJ*2*X                                                Recent
```

```
          =2*GJ*GAM(N)*GAM(T)/DEN                                    Recent
                                                                     Recent
WHICH IS INCORRECT - SINCE THIS SEEMS TO INDICATE EVERYTHING IS      Recent
ABSORBED. IN ORDER TO OBTAIN THE CORRECT EXPRESSION WE CANNOT        Recent
COMPLETELY IGNORE INTERFERENCE - WE CAN IGNORE LEVEL-LEVEL           Recent
INTERFERENCE, BUT WE MUST INCLUDE LEVEL-SELF INTERFERENCE,           Recent
                                                                     Recent
X**2+Y**2= GAM(N)**2/DEN                                             Recent
                                                                     Recent
ABSORPTION =GJ*(2*X - ((X)**2 + (Y)**2))                             Recent
           =GJ*GAM(N)*(GAM(T)-GAM(N))/DEN                            Recent
           =GJ*GAM(N)*GAM(A)/DEN                                     Recent
                                                                     Recent
SUMMARY                                                              Recent
=======                                                              Recent
AN IMPORTANT POINT TO NOTE IS THE DEFINITION OF (X) AND (Y)          Recent
WHICH IN ALL CASES WILL CORRESPOND TO THE SYMMETRIC AND              Recent
ANTI-SYMMETRIC CONTRIBUTION OF THE RESONANCES. IN PARTICULAR         Recent
DEFINING (U) IN TERMS OF (1-X) INSTEAD OF (X) IS EXTREMELY           Recent
IMPORTANT. NOTE, THAT THE DEFINITION OF THE ELASTIC AND              Recent
ABSORPTION ONLY INVOLVE (X), NOT (1-X). FAR FROM RESONANCES          Recent
(X) CAN BE EXTREMELY SMALL, THEREFORE (1-X) WILL BE VERY CLOSE       Recent
TO (1). IF THE CALCULATION PROCEEDS BY FIRST CALCULATING (1-X)       Recent
AND THEN DEFINING (X) BY SUBTRACTING (1), EXTREME ROUND-OFF          Recent
PROBLEMS CAN RESULT. THESE PROBLEMS CAN BE AVOIDED BY IN ALL         Recent
CASES DEFINING (X) DIRECTLY, WITHOUT ANY DIFFERENCES.                Recent
                                                                     Recent
IN EACH FORMALISM THE DEFINITION OF (X) AND (Y) MAY BE DIFFERENT     Recent
BUT ONCE WE HAVE DEFINED (X) AND (Y) WE CAN IMMEDIATELY WRITE        Recent
THE CROSS SECTIONS USING A UNIFORM DEFINITION,                       Recent
                                                                     Recent
ELASTIC =GJ*(2*SIN(PS)**2 - X)**2 + (SIN(2*PS) + Y)**2)              Recent
                                                                     Recent
ABSORPTION =-GJ*(2*X + (X)**2 + (Y)**2)                              Recent
                                                                     Recent
AND DEFINE THE TOTAL AS THE SUM OF THESE 2 PARTS.                    Recent
                                                                     Recent
RELATIONSHIP TO SINGLE LEVEL                                         Recent
===========================                                          Recent
HOW DO THE SINGLE AND MULTI-LEVEL FORMALISMS COMPARE. TO SEE,        Recent
STARTING FROM OUR GENERAL DEFINITION OF THE ELASTIC IN THE FORM,     Recent
                                                                     Recent
ELASTIC =GJ*(2*SIN(PS)**2 + X)**2 + (SIN(2*PS) + Y)**2)              Recent
        =GJ*(4*SIN(PS)**4 - 4*X*SIN(PS)**2 + X**2                    Recent
           + SIN(2*PS)**2 + 2*Y*SIN(2*PS)  + Y**2)                   Recent
                                                                     Recent
        =4*GJ*SIN(PS)**2 +                                           Recent
           GJ*(X**2 + Y**2                                           Recent
              -4*X*SIN(PS)**2                                        Recent
              +2*Y*SIN(2*PS))                                        Recent
                                                                     Recent
AND OUR SPECIFIC DEFINITIONS OF (X) AND (Y) FOR MULTI-LEVEL BREIT-   Recent
WIGNER PARAMETERS,                                                   Recent
                                                                     Recent
X        = GAM(N)*GAM(T)/2/DEN                                       Recent
Y        = GAM(N)*(E-ER)/DEN                                         Recent
DEN      = ((E-ER)**2 + (GAM(T)/2)**2)                               Recent
                                                                     Recent
X**2+Y**2= GAM(N)**2/DEN + (L-L)                                     Recent
                                                                     Recent
WE CAN RECOGNIZE X**2 AND Y**2 AS THE INTERFERENCE - (L-S) + (L-L)   Recent
TERMS IN THE MULTI-LEVEL FORMALISM. IN ORDER TO OBTAIN THE SINGLE    Recent
LEVEL EQUATION WE CAN ASSUME THAT EACH LEVEL DOES NOT INTERFERE      Recent
WITH ANY OTHER LEVEL - THEREFORE THE (L-L) CONTRIBUTION IS ZERO.     Recent
                                                                     Recent
ELASTIC =4*GJ*SIN(PS)**2 +                                           Recent
           GJ*GAM(N)*(GAM(N)                                         Recent
                     -2*GAM(T)*SIN(PS)**2                            Recent
                     +2*(E-ER)*SIN(2*PS))/DEN                        Recent
                                                                     Recent
WHICH IS THE FORM THAT IT APPEARS IN ENDF-102, EXCEPT FOR TWO        Recent
```

```
TYPOGRAPHICAL ERRORS IN THE SECOND TERM,                                 Recent
                                                                         Recent
-2*GAM(T)*SIN(PS)**2                                                     Recent
                                                                         Recent
WHICH IN ENDF-102 IS WRITTEN,                                            Recent
                                                                         Recent
-2*(GAM(T)-GAM(N))*SIN(2*PS)**2                                          Recent
                                                                         Recent
PROGRAM CONVENTIONS                                                      Recent
================================================================         Recent
MINIMUM INPUT DATA                                                       Recent
------------------                                                       Recent
FOR EACH MATERIAL TO BE PROCESSED THE MINIMUM INPUT DATA ARE THE         Recent
RESONANCE PARAMETERS IN FILE 2. IF THERE ARE NO FILE 2 PARAMETERS        Recent
IN A GIVEN MATERIAL THE ENTIRE MATERIAL WILL SIMPLY BE COPIED.           Recent
NEITHER THE HOLLERITH SECTION (MF=1, MT=451) NOR THE BACKGROUND          Recent
CROSS SECTION (SECTIONS OF MF=3) NEED BE PRESENT FOR THIS PROGRAM        Recent
TO EXECUTE PROPERLY. HOWEVER, SINCE THE CONVENTIONS USED IN              Recent
INTERPRETING THE RESONANCE PARAMETERS DEPENDS ON ENDF/B VERSION          Recent
USERS ARE STRONGLY RECOMMENDED TO INSURE THAT MF=1, MT=451 IS            Recent
PRESENT IN EACH MATERIAL TO ALLOW THE PROGRAM TO DETERMINE THE           Recent
ENDF/B FORMAT VERSION.                                                   Recent
                                                                         Recent
RESONANCE PARAMETERS                                                     Recent
--------------------                                                     Recent
RESONANCE PARAMETERS MAY BE REPRESENTED USING ANY COMBINATION            Recent
OF THE REPRESENTATIONS ALLOWED IN ENDF/B,                                Recent
(1) RESOLVED DATA                                                        Recent
    (A) SINGLE LEVEL BREIT-WIGNER                                        Recent
    (B) MULTI-LEVEL BREIT-WIGNER                                         Recent
    (C) ADLER-ADLER                                                      Recent
    (D) REICH-MOORE                                                      Recent
    (E) HYBRID R-FUNCTION                                                Recent
(2) UNRESOLVED DATA                                                      Recent
    (A) ALL PARAMETERS ENERGY INDEPENDENT                                Recent
    (B) FISSION PARAMETERS ENERGY DEPENDENT                              Recent
    (C) ALL PARAMETERS ENERGY DEPENDENT                                  Recent
                                                                         Recent
THE FOLLOWING RESOLVED DATA FORMALISMS ARE NOT TREATED BY THIS           Recent
VERSION OF THE CODE AND WILL ONLY BE IMPLEMENTED AFTER EVALUATIONS       Recent
USING THESE FORMALISMS ARE AVAILABLE TO THE AUTHOR OF THIS CODE          Recent
FOR TESTING IN ORDER TO INSURE THAT THEY CAN BE HANDLED PROPERLY         Recent
    (A) GENERAL R-MATRIX                                                 Recent
                                                                         Recent
CALCULATED CROSS SECTIONS                                                Recent
-------------------------                                                Recent
THIS PROGRAM WILL USE THE RESONANCE PARAMETERS TO CALCULATE THE          Recent
TOTAL, ELASTIC, CAPTURE AND POSSIBLY FISSION CROSS SECTIONS. THE         Recent
COMPETITIVE WIDTH WILL BE USED IN THESE CALCULATIONS, BUT THE            Recent
COMPETITIVE CROSS SECTION ITSELF WILL NOT BE CALCULATED. THE             Recent
ENDF/B CONVENTION IS THAT ALTHOUGH A COMPETITIVE WIDTH MAY BE            Recent
GIVEN, THE COMPETITIVE CROSS SECTION MUST BE SEPARATELY TABULATED        Recent
AS A SECTION OF FILE 3 DATA.                                             Recent
                                                                         Recent
RESOLVED REGION                                                          Recent
---------------                                                          Recent
IN THE RESOLVED REGION THE RESOLVED PARAMETERS ARE USED TO               Recent
CALCULATE COLD (0 KELVIN), LINEARLY INTERPOLABLE, ENERGY DEPENDENT       Recent
CROSS SECTIONS.                                                          Recent
                                                                         Recent
SCATTERING RADIUS                                                        Recent
-----------------                                                        Recent
FOR SINGLE OR MULTI LEVEL BREIT-WIGNER PARAMETERS THE SCATTERING         Recent
RADIUS MAY BE SPECIFIED IN EITHER ENERGY INDEPENDENT (CONSTANT)          Recent
OR ENERGY DEPENDENT FORM (A TABLE OF ENERGY VS. RADIUS AND AN            Recent
ASSOCIATED INTERPOLATION LAW). IN ALL OTHER CASE ONLY AN ENERGY          Recent
INDEPENDENT SCATTERING RADIUS IS ALLOWED.                                Recent
                                                                         Recent
FOR ANY ONE MATERIAL (I.E. MAT) IF ENERGY DEPENDENT SCATTERING           Recent
RADII ARE GIVEN THE TOTAL NUMBER OF INTERPOLATION REGIONS AND            Recent
TABULATED VALUES FOR THE ENTIRE MATERIAL CANNOT EXCEED,                  Recent
```

```
200 - INTERPOLATION REGIONS                                          Recent
500 - TABULATED VALUES                                               Recent
IF THESE LIMITS ARE EXCEEDED THE PROGRAM WILL PRINT AN ERROR         Recent
MESSAGE AND TERMINATE.                                               Recent
                                                                     Recent
IF YOU REQUIRE A LARGER NUMBER OF INTERPOLATION REGION AND/OR        Recent
TABULATED VALUES,                                                    Recent
(1) INTERPOLATION REGIONS - INCREASE THE DIMENSION OF NBTRHO AND     Recent
INTRHO IN COMMON/TABRHO/ THROUGHOUT THE PROGRAM AND CHANGE MAXSEC    Recent
IN SUBROUTINE RDAP (MAXSEC = MAXIMUM NUMBER OF INTERPOLATION         Recent
REGIONS).                                                            Recent
(2) TABULATED VALUES - INCREASE THE DIMENSION OF ERHOTB, RHOTAB      Recent
AND APTAB IN COMMON/TABRHO/ THROUGHOUT THE PROGRAM AND CHANGE        Recent
MAXRHO IN SUBROUTINE RDAP (MAXRHO = MAXIMUM NUMBER OF TABULATED      Recent
VALUES).                                                             Recent
                                                                     Recent
RESOLVED REICH-MOORE AND MULTI-LEVEL BREIT-WIGNER PARAMETERS         Recent
-----------------------------------------------------------          Recent
CROSS SECTIONS FOR REICH-MOORE PARAMETERS ARE CALCULATED ACCORDING    Recent
TO THE EQUATION (1) - (8) OF SECTION D.1.3 OF ENDF-102. IN ORDER     Recent
TO CALCULATE CROSS SECTIONS FROM MULTI-LEVEL PARAMETERS IN A         Recent
REASONABLE AMOUNT OF TIME THIS PROGRAM EXPRESSES THE CROSS SECTION   Recent
IN TERMS OF A SINGLE SUM OVER RESONANCES (SEE, ENDF-102, SECTION     Recent
D.1.2, EQUATIONS 6-7), RATHER THAN AS A DOUBLE SUM (SEE, ENDF-102    Recent
SECTION D.1.2, EQUATION 1-2). IN ORDER FOR THE ENDF-102 EQUATIONS    Recent
TO BE CORRECT THE PARAMETERS MUST MEET THE FOLLOWING CONDITIONS,     Recent
                                                                     Recent
(1) FOR EACH L STATE ALL PHYSICALLY POSSIBLE J SEQUENCES MUST BE     Recent
    PRESENT. ONLY IN THIS CASE WILL THE CONTRIBUTIONS OF THE         Recent
    INDIVIDUAL J SEQUENCES ADD UP TO PRODUCE THE CORRECT POTENTIAL   Recent
    SCATTERING CONTRIBUTION FOR THE L STATE (SEE, ENDF-102,          Recent
    SECTION D.1.2, EQUATIONS 6-7). IF ANY J SEQUENCE IS MISSING      Recent
    THE PROGRAM WILL PRINT A WARNING AND ADD THE J SEQUENCE WITH     Recent
    NO RESONANCE PARAMETERS IN ORDER TO ALLOW THE POTENTIAL          Recent
    SCATTERING TO BE CALCULATED CORRECTLY (THIS IS EQUIVALENT TO     Recent
    ASSUMING THAT THE EVALUATOR REALIZES THAT ALL J SEQUENCES MUST   Recent
    BE AND ARE PRESENT AND THAT THE EVALUATION STATES THAT THERE     Recent
    ARE NO RESONANCES WITH CERTAIN PHYSICALLY POSSIBLE J VALUES...   Recent
    IN THIS CASE POTENTIAL CONTRIBUTION MUST STILL BE CONSIDERED).   Recent
                                                                     Recent
    EXAMPLE                                                          Recent
    =======                                                          Recent
    AN EXAMPLE OF WHERE THIS OCCURS AND IS IMPORTANT TO CONSIDER     Recent
    IS U-238 IN ENDF/B-IV AND V LIBRARIES WHERE FOR L=1 THERE IS     Recent
    ONLY A J=1/2 SEQUENCE. NOT INCLUDING THE J=3/2 SEQUENCE LEADS    Recent
    TO UNDERESTIMATING THE POTENTIAL SCATTERING AND PRODUCES          Recent
    MINIMA IN THE ELASTIC CROSS SECTION WHICH ARE AN ORDER OF        Recent
    MAGNITUDE LOWER THAN THE CROSS SECTIONS OBTAINED BE INCLUDING    Recent
    THE J=3/2 SEQUENCE.                                              Recent
                                                                     Recent
(2) FOR A GIVEN TARGET SPIN AND L VALUE THERE MAY BE 2 POSSIBLE      Recent
    MEANS OF OBTAINING THE SAME J VALUE. WHEN THIS OCCURS IN         Recent
    ORDER TO CALCULATE THE CORRECT POTENTIAL SCATTERING CROSS         Recent
    SECTION IT IS IMPORTANT TO INCLUDE THE EFFECT OF BOTH            Recent
    POSSIBLE J SEQUENCES, EVEN THOUGH FROM THE ENDF/B DATA IT IS     Recent
    NOT POSSIBLE TO DETERMINE WHICH OF THE 2 POSSIBLE SEQUENCES      Recent
    ANY GIVEN RESONANCE BELONGS TO. IN THIS CASE THIS PROGRAM        Recent
    TREAT ALL RESONANCES WITH THE SAME J VALUE AS BELONGING TO       Recent
    THE SAME J SEQUENCE (TO ALLOW INTERFERENCE) AND WILL ADD AN      Recent
    ADDITIONAL J SEQUENCE WITH NO RESONANCES IN ORDER TO ALLOW       Recent
    THE POTENTIAL CROSS SECTION TO BE CALCULATED CORRECTLY. WHEN     Recent
    THIS OCCURS A WARNING MESSAGE IS PRINTED, BUT BASED ON THE       Recent
    ENDF/B DATA THERE IS NOTHING WRONG WITH THE DATA AND THERE IS    Recent
    NOTHING THAT THE USER CAN DO TO CORRECT OR IN ANY WAY MODIFY     Recent
    THE DATA TO ELIMINATE THE PROBLEM.                               Recent
                                                                     Recent
    EXAMPLE                                                          Recent
    =======                                                          Recent
    FOR A TARGET SPIN =1 AND L=1 THE 2 RANGES OF PHYSICALLY          Recent
    POSSIBLE J ARE 1/2, 3/2, 5/2 AND 1/2, 3/2. BY CHECKING THE       Recent
    ENDF/B DATA IT IS POSSIBLE TO INSURE THAT THE 3 POSSIBLE         Recent
```

```
    J VALUES (1/2, 3/2, 5/2) ARE PRESENT AND TO INCLUDE ALL 3      Recent
    J SEQUENCES IN THE CALCULATIONS. HOWEVER, UNLESS ALL 5         Recent
    POSSIBLE J SEQUENCES ARE INCLUDED THE STATISTICAL WEIGHTS      Recent
    OF THE J SEQUENCES WILL NOT SUM UP TO 2*L+1 AND THE            Recent
    POTENTIAL CROSS SECTION WILL BE UNDERESTIMATED. IN THIS        Recent
    EXAMPLE THE SUM OF THE 3 J SEQUENCES 1/2, 3/2, 5/2 IS 2,       Recent
    RATHER THAN 3 AS IT SHOULD BE FOR L=1, AND THE CONTRIBUTION    Recent
    OF THE L=1 RESONANCES TO THE POTENTIAL SCATTERING CROSS         Recent
    SECTION WILL ONLY BE 2/3 OF WHAT IT SHOULD BE, UNLESS THE      Recent
    OTHER 2 J SEQUENCES (WITH DUPLICATE J VALUES) ARE INCLUDED     Recent
    IN THE CALCULATION.                                            Recent
                                                                   Recent
(3) EACH RESONANCE MUST HAVE AN ASSIGNED, PHYSICALLY POSSIBLE      Recent
    J VALUE. PHYSICALLY IMPOSSIBLE OR AVERAGE J VALUES CANNOT BE   Recent
    UNIQUELY INTERPRETED USING THE EQUATIONS IN ENDF-102 AND        Recent
    THEIR USE WILL USUALLY RESULT IN PHYSICALLY UNRELIABLE CROSS   Recent
    SECTIONS. THIS PROGRAM WILL CHECK ALL J VALUES AND IF ANY ARE  Recent
    ARE FOUND TO BE PHYSICALLY IMPOSSIBLE (BASED ON TARGET SPIN    Recent
    AND L VALUE) AN ERROR MESSAGE WILL BE PRINTED TO INDICATE THAT Recent
    THE RECONSTRUCTED CROSS SECTIONS WILL BE UNRELIABLE AND THE    Recent
    PROGRAM WILL CONTINUE. IN AN ATTEMPT TO CALCULATE THE CORRECT  Recent
    POTENTIAL SCATTERING CROSS SECTION THIS PROGRAM WILL SUBTRACT   Recent
    THE POTENTIAL SCATTERING CONTRIBUTION DUE TO ALL FICTICIOUS J  Recent
    SEQUENCES AND ADD THE CONTRIBUTION OF ALL PHYSICALLY POSSIBLE  Recent
    J SEQUENCES (AS DESCRIBED ABOVE).                              Recent
                                                                   Recent
    WARNING (LET THE USER BEWARE)                                  Recent
    ============================                                   Recent
    (A) IT CANNOT BE STRESSED ENOUGH THAT CROSS SECTIONS OBTAINED  Recent
        USING PHYSICALLY IMPOSSIBLE J VALUES FOR REICH-MOORE AND   Recent
        MULTI-LEVEL BREIT-WIGNER RESONANCE PARAMETERS WILL RESULT  Recent
        IN UNRELIABLE CROSS SECTIONS. THE DECISION TO HAVE THIS    Recent
        PROGRAM CONTINUE TO PROCESS WHEN THIS CONDITION IS FOUND   Recent
        IS BASED ON AN ATTEMPT TO ALLOW THE USER TO AT LEAST HAVE  Recent
        SOME RESULTS (HOWEVER BAD THEY MAY BE) IF THERE IS NO      Recent
        OTHER EVALUATED DATA AVAILABLE.                            Recent
    (B) EVEN THOUGH THE REICH-MOORE AND MULTI-LEVEL EQUATIONS ARE  Recent
        DEFINED AS ABSOLUTE OR SQUARED CONTRIBUTIONS WHICH MUST    Recent
        ALL BE PHYSICALLY POSSIBLE, ATTEMPTING TO CORRECT THE      Recent
        POTENTIAL CROSS SECTION (AS DESCRIBED ABOVE) CAN LEAD TO   Recent
        NEGATIVE ELASTIC CROSS SECTIONS. THIS IS BECAUSE BASED ON  Recent
        THE INFORMATION AVAILABLE IN THE EVALUATION IT IS NOT      Recent
        NOT POSSIBLE TO CORRECTLY ACCOUNT FOR THE INTERFERENCE     Recent
        BETWEEN THE RESONANCE AND POTENTIAL CONTRIBUTIONS FOR EACH Recent
        J SEQUENCE.                                                Recent
                                                                   Recent
UNRESOLVED RESONANCE REGION                                        Recent
---------------------------                                        Recent
IN THE UNRESOLVED RESONANCE REGION THE UNRESOLVED PARAMETERS       Recent
ARE USED TO CALCULATE INFINITELY DILUTE AVERAGE CROSS SECTIONS.    Recent
NOTE, IT IS IMPORTANT TO UNDERSTAND THAT FROM THE DEFINITION OF    Recent
THE UNRESOLVED PARAMETERS IT IS NOT POSSIBLE TO UNIQUELY CALCULATE Recent
ENERGY DEPENDENT CROSS SECTIONS. ONLY AVERAGES OR DISTRIBUTIONS    Recent
MAY BE CALCULATED.                                                 Recent
                                                                   Recent
UNRESOLVED INTERPOLATION                                           Recent
------------------------                                           Recent
IN THE UNRESOLVED RESONANCE REGION CROSS SECTIONS AT EACH ENERGY   Recent
ARE CALCULATED BY INTERPOLATING PARAMETERS. THIS IS THE CONVENTION Recent
USED IN ENDF/B-IV AND EARLIER VERSIONS OF ENDF/B. THE ENDF/B-V     Recent
CONVENTION OF INTERPOLATING CROSS SECTIONS, NOT PARAMETERS, HAS    Recent
BEEN ABANDONED AS IMPRACTICAL SINCE IT CAN LEAD TO THE SITUATION   Recent
WHERE EXACTLY THE SAME PHYSICAL DATA CAN LEAD TO DIFFERENT RESULTS Recent
DEPENDING ON WHICH OF THE THREE ENDF/B UNRESOLVED PARAMTER FORMATS Recent
IS USED. FOR EXAMPLE, GIVEN A SET OF ENERGY INDEPENDENT UNRESOLVED Recent
PARAMETERS IT IS POSSIBLE TO CODE THESE PARAMETERS IN EACH OF THE  Recent
THREE ENDF/B UNRESOLVED PARAMETER FORMATS. SINCE PHYSICALLY WE     Recent
ONLY HAVE ONE SET OF PARAMETERS WE WOULD EXPECT THE RESULTS TO BE  Recent
INDEPENDENT OF HOW THEY ARE REPRESENTED IN ENDF/B. UNFORTUNATELY   Recent
USING THE ENDF/B-V CONVENTION TO INTERPOLATE CROSS SECTIONS CAN    Recent
LEAD TO THREE COMPLETELY DIFFERENT RESULTS. IN CONTRAST USING THE  Recent
```

```
ENDF/B-IV AND EARLIER CONVENTION OF INTERPOLATING PARAMETERS LEADS Recent
TO COMPLETELY CONSISTENT RESULTS.                                 Recent
                                                                  Recent
INTERNAL REPRESENTATION OF UNRESOLVED PARAMETERS                  Recent
-----------------------------------------------                   Recent
ANY OF THE THREE POSSIBLE REPRESENTATIONS OF UNRESOLVED PARAMETERS Recent
CAN BE UNIQUELY REPRESENTED IN THE ALL PARAMETERS ENERGY DEPENDENT Recent
REPRESENTATIONS WITH THE APPROPRIATE (ENDF/B VERSION DEPENDENT)   Recent
INTERPOLATION LAW. THIS IS DONE BY THE PROGRAM WHILE READING THE  Recent
UNRESOLVED PARAMETERS AND ALL SUBSEQUENT CALCULATIONS NEED ONLY   Recent
CONSIDER THE ALL PARAMETERS ENERGY DEPENDENT REPRESENTATION.      Recent
                                                                  Recent
RESONANCE RECONSTRUCTION STARTING ENERGY GRID                     Recent
---------------------------------------------                     Recent
AS IN ANY ITERATIVE METHOD THE WAY TO SPEED CONVERGENCE IS TO TRY  Recent
TO START CLOSE TO THE ANSWER. THIS PROGRAM ATTEMPTS TO DO THIS BY  Recent
STARTING FROM AN ENERGY GRID WHICH IS A GOOD APPROXIMATION TO A    Recent
SIMPLE BREIT-WIGNER LINE SHAPE,                                   Recent
                                                                  Recent
SIGMA(X)=1.0/(1.0+X*X)                                            Recent
                                                                  Recent
WHERE X IS THE DISTANCE FROM THE PEAK IN HALF-WIDTHS              Recent
                                                                  Recent
SUBROUTINE SUBINT HAS A BUILT-IN TABLE OF NODES WHICH ARE THE      Recent
HALF-WIDTH MULTIPLES TO APPROXIMATE THE SIMPLE BREIT-LINE SHAPE    Recent
TO WITHIN 1 PER-CENT OVER THE ENTIRE INTERVAL 0 TO 500 HALF-WIDTHS Recent
                                                                  Recent
BETWEEN ANY TWO RESOLVED RESONANCES THE STARTING GRID IS BASED ON  Recent
THE HALF-WIDTHS OF THE TWO RESONANCES. FROM THE LOWER ENERGY       Recent
RESONANCE UP TO THE MID-POINT BETWEEN THE RESONANCES (MID-POINT    Recent
IS DEFINED HERE AS AN EQUAL NUMBER OF HALF-WIDTHS FROM EACH        Recent
RESONANCE) THE HALF-WIDTH OF THE LOWER ENERGY RESONANCE IS USED.   Recent
FROM THE MID-POINT UP TO THE HIGHER ENERGY RESONANCE THE HALF-     Recent
WIDTH OF THE UPPER ENERGY RESONANCE IS USED.                       Recent
                                                                  Recent
WITH THIS ALOGORITHM CLOSELY SPACED RESONANCES WILL HAVE ONLY      Recent
A FEW STARTING NODES PER RESONANCE (E.G. U-235). WIDELY SPACED     Recent
RESONANCES WILL HAVE MORE NODES PER RESONANCE (E.G. U-238). FOR    Recent
A MIX OF S, P, D ETC. RESONANCES THIS ALOGORITHM GUARANTEES AN     Recent
ADEQUTE DESCRIPTION OF THE PROFILE OF EVEN EXTREMELY NARROW        Recent
RESONANCES (WHICH MAY IMMEDIATELY CONVERGENCE TO THE ACCURACY      Recent
REQUESTED, THUS MINIMIZING ITERATION).                            Recent
                                                                  Recent
BACKGROUND CROSS SECTIONS                                         Recent
-------------------------                                         Recent
THE PROGRAM WILL SEARCH FOR BACKGROUND CROSS SECTIONS FOR TOTAL    Recent
(MT=1), ELASTIC (MT=2), FISSION (MT=18), FIRST CHANCE FISSION      Recent
(MT=19) AND CAPTURE (MT=102).                                     Recent
                                                                  Recent
(1) THE BACKGROUND CROSS SECTIONS (FILE 3) CAN BE PRESENT OR NOT   Recent
    PRESENT FOR EACH REACTION.                                    Recent
(2) IF FOR A GIVEN REACTION THE BACKGROUND CROSS SECTION IS        Recent
    PRESENT, IT WILL BE ADDED TO THE RESONANCE CONTRIBUTION AND    Recent
    THE RESULT WILL BE OUTPUT.                                    Recent
(3) IF FOR A GIVEN REACTION THE BACKGROUND IS NOT PRESENT THE      Recent
    PROGRAM WILL,                                                 Recent
    (A) IF THE INPUT TO THE PROGRAM SPECIFIES NO OUTPUT FOR        Recent
        REACTIONS WITH NO BACKGROUND THERE WILL BE NO OUTPUT.      Recent
    (B) IF THE INPUT TO THE PROGRAM SPECIFIES OUTPUT FOR REACTIONS Recent
        WITH NO BACKGROUND,                                       Recent
        (I) THE RESONANCE CONTRIBUTION TO TOTAL, ELASTIC OR        Recent
            CAPTURE WILL BE OUTPUT.                               Recent
        (II) IF ALL FISSION RESONANCE PARAMETERS ARE ZERO THE      Recent
             FISSION CROSS SECTION (MT=18) WILL NOT BE OUTPUT.     Recent
             OTHERWISE THE RESONANCE CONTRIBUTION OF THE FISSION   Recent
             (MT=18) WILL BE OUTPUT.                              Recent
        (III) THERE WILL BE NO OUTPUT FOR FIRST CHANCE FISSION     Recent
              (MT=19).                                            Recent
                                                                  Recent
COMBINING RESONANCES AND BACKGROUND CROSS SECTIONS                Recent
--------------------------------------------------                Recent
```

```
IN ORDER TO BE COMBINED WITH THE RESONANCE CONTRIBUTION THE        Recent
BACKGROUND CROSS SECTIONS MUST BE GIVEN AT 0 KELVIN TEMPERATURE    Recent
AND MUST BE LINEARLY INTERPOLABLE. IF THESE CONDITIONS ARE MET     Recent
THE RESONANCE AND BACKGROUND CONTRIBUTIONS WILL BE ADDED TOGETHER  Recent
AND OUTPUT. IF THESE CONDITIONS ARE NOT MET THE BACKGROUND CROSS   Recent
SECTION WILL BE IGNORED AND ONLY THE RESONANCE CONTRIBUTION WILL   Recent
BE OUTPUT. IF THE BACKGROUND HAS NOT BEEN ADDED TO THE RESONANCE   Recent
CONTRIBUTION AFTER THIS PROGRAM FINISHES THE USER CAN MAKE THE     Recent
RESONANCE AND BACKGROUND CONTRIBUTIONS COMPATIBLE BY,              Recent
                                                                   Recent
(1) IF THE BACKGROUND IS NOT LINEARLY INTERPOABLE, LINEARIZE THE   Recent
    BACKGROUND (E.G., USE PROGRAM LINEAR).                         Recent
(2) IF THE BACKGROUND IS NOT GIVEN AT 0 KELVIN, DOPPLER BROADEN    Recent
    THE RESONANCE (NOT BACKGROUND) CONTRIBUTION TO THE SAME        Recent
    TEMPERATURE AS THE BACKGROUND (E.G., USE PROGRAM SIGMA1).      Recent
                                                                   Recent
ONCE THE RESONANCE AND BACKGROUND CONTRIBUTIONS HAVE BEEN MADE     Recent
COMPATIBLE THEY CAN BE ADDED TOGETHER (E.G., USE PROGRAM MIXER).   Recent
                                                                   Recent
THE RECONSTRUCTION OF THE RESONANCE CONTRIBUTION TO THE CROSS      Recent
SECTION CAN BE QUITE EXPENSIVE (IN TERMS OF COMPUTER TIME). SINCE  Recent
THE RECONSTRUCTION IS PERFORMED BEFORE THE BACKGROUND CROSS        Recent
SECTIONS ARE READ, THE ABOVE CONVENTIONS HAVE BEEN ADOPTED IN      Recent
ORDER TO AVOID LOSE OF COMPUTER TIME INVOLVED IN RECONSTRUCTING    Recent
THE RESONANCE CONTRIBUTION.                                        Recent
                                                                   Recent
COMMON ENERGY GRID                                                 Recent
------------------                                                 Recent
THIS PROGRAM WILL RECONSTRUCT THE RESONANCE CONTRIBUTION TO THE    Recent
TOTAL, ELASTIC, FISSION AND CAPTURE CROSS SECTIONS ALL ON THE      Recent
SAME ENERGY GRID. EACH REACTION WILL THEN BE COMBINED WITH ITS     Recent
BACKGROUND CROSS SECTION (IF ANY) AND OUTPUT WITHOUT ANY FURTHER   Recent
THINNING. IF THERE ARE NO BACKGROUND CROSS SECTIONS, OR IF THE     Recent
BACKGROUND CROSS SECTION FOR ALL FOUR REACTIONS ARE GIVEN ON A     Recent
COMMON ENERGY GRID, THE OUTPUT FROM THIS PROGRAM WILL BE ON A      Recent
COMMON ENERGY GRID FOR ALL FOUR REACTIONS.                         Recent
                                                                   Recent
THERMAL ENERGY                                                     Recent
--------------                                                     Recent
IF THE RESONANCE REGION SPANS THERMAL ENERGY (0.0253 EV) THIS      Recent
POINT IS ALWAYS INCLUDED IN THE COMMON ENERGY GRID USED FOR ALL    Recent
REACTIONS AND WILL ALWAYS APPEAR IN THE OUTPUT DATA.               Recent
                                                                   Recent
SECTION SIZE                                                       Recent
------------                                                       Recent
SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT  Recent
TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS      Recent
SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.                 Recent
                                                                   Recent
SELECTION OF DATA                                                  Recent
-----------------                                                  Recent
THE PROGRAM SELECTS MATERIALS TO BE PROCESSED BASED EITHER ON      Recent
MAT (ENDF/B MAT NO.) OR ZA. THE PROGRAM ALLOWS UP TO 100 MAT OR    Recent
ZA RANGES TO BE SPECIFIED. THE PROGRAM WILL ASSUME THAT THE        Recent
ENDF/B TAPE IS IN EITHER MAT OR ZA ORDER, WHICHEVER CRITERIA IS    Recent
USED TO SELECT MATERIALS, AND WILL TERMINATE WHEN A MAT OR ZA      Recent
IS FOUND THAT IS ABOVE THE RANGE OF ALL REQUESTS.                  Recent
                                                                   Recent
ALLOWABLE ERROR                                                    Recent
---------------                                                    Recent
THE RECONSTRUCTION OF LINEARLY INTERPOLABLE CROSS SECTIONS FROM    Recent
RESONANCE PARAMETERS CANNOT BE PERFORMED EXACTLY. HOWEVER IT CAN   Recent
BE PERFORMED TO VIRTUALLY ANY REQUIRED ACCURACY AND MOST           Recent
IMPORTANTLY CAN BE PERFORMED TO A TOLERANCE THAT IS SMALL COMPARED Recent
TO THE UNCERTAINTY IN THE CROSS SECTIONS THEMSELVES. AS SUCH THE   Recent
CONVERSION OF CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM CAN BE  Recent
PERFORMED WITH ESSENTIALLY NO LOSS OF INFORMATION.                 Recent
                                                                   Recent
THE ALLOWABLE ERROR MAY BE ENERGY INDEPENDENT (CONSTANT) OR ENERGY Recent
DEPENDENT. THE ALLOWABLE ERROR IS DESCRIBED BY A TABULATED         Recent
FUNCTION OF UP TO 20 (ENERGY,ERROR) PAIRS AND LINEAR INTERPOLATION Recent
```

```
BETWEEN TABULATED POINTS. IF ONLY ONE TABULATED POINT IS GIVEN THE Recent
ERROR WILL BE CONSIDERED CONSTANT OVER THE ENTIRE ENERGY RANGE.    Recent
WITH THIS ENERGY DEPENDENT ERROR ONE MAY OPTIMIZE THE OUTPUT FOR   Recent
ANY GIVEN APPLICATION BY USING A SMALL ERROR IN THE ENERGY RANGE   Recent
OF INTEREST AND A LESS STRINGENT ERROR IN OTHER ENERGY RANGES,     Recent
E.G., 0.1 PER-CENT FROM 0 UP TO THE LOW EV RANGE AND A LESS        Recent
STRINGENT TOLERANCE AT HIGHER ENERGIES.                            Recent
                                                                   Recent
DEFAULT ALLOWABLE ERROR                                            Recent
----------------------                                             Recent
IN ORDER TO INSURE CONVERENCE OF THE RESONANCE RECONSTRUCTION THE  Recent
ALLOWABLE ERROR MUST BE POSITIVE. IF THE USER INPUTS AN ERROR FOR  Recent
RESONANCE RECONSTRUCTION THAT IS NOT POSITIVE IT WILL BE SET TO    Recent
THE DEFAULT VALUE (CURRENTLY 0.1 PER-CENT) AND INDICATED AS SUCH   Recent
IN THE OUTPUT LISTING.                                             Recent
                                                                   Recent
INTERVAL HALVING ALGORITHM                                         Recent
------------------------                                           Recent
THIS PROGRAM WILL START BY CALCULATING THE CROSS SECTIONS AT THE   Recent
ENERGIES CORRESPONDING TO THE PEAK OF EACH RESONANCE, AS WELL AS   Recent
A FIXED NUMBER OF HALF-WIDTHS ON EACH SIDE OF EACH RESONANCE.      Recent
STARTING FROM THIS BASIC GRID OF POINTS THE PROGRAM WILL CONTINUE  Recent
TO HALF EACH INTERVAL UNTIL THE CROSS SECTIONS FOR ALL REACTIONS   Recent
AT THE CENTER OF THE INTERVAL CAN BE DEFINED BY LINEAR             Recent
INTERPOLATION FROM THE ENDS OF THE INTERVAL TO WITHIN THE USER     Recent
SPECIFIED ACCURACY CRITERIA.                                       Recent
                                                                   Recent
DISTANT RESONANCE TREATMENT                                        Recent
---------------------------                                        Recent
THE OPTION TO TREAT DISTANT RESONANCES, WHICH WAS AVAILABLE IN     Recent
EARLIER VERSIONS OF THIS PROGRAM, IS NO LONGER AVAILABLE, BECAUSE  Recent
IT WAS FOUND TO PRODUCE UNRELIABLE RESULTS. IN THIS VERSION OF     Recent
THE PROGRAM ALL RESONANCES ARE TREATED EXACTLY.                    Recent
                                                                   Recent
PROGRAM OPERATION                                                  Recent
================================================================== Recent
EDIT MODE                                                          Recent
---------                                                          Recent
IT IS SUGGESTED THAT BEFORE RUNNING THIS PROGRAM TO RECONSTRUCT    Recent
CROSS SECTIONS FROM RESONANCE PARAMETERS (WHICH CAN BE QUITE       Recent
EXPENSIVE) THE USER FIRST RUN THE PROGRAM IN THE EDIT MODE (SEE,   Recent
DESCRIPTION OF INPUT PARAMETERS BELOW). IN THE EDIT MODE THE       Recent
PROGRAM WILL READ, LIST AND EXTENSIVELY CHECK THE CONSISTENCY OF   Recent
ALL RESONANCE PARAMETERS AND ENDF/B DEFINED RESONANCE FLAGS. THIS  Recent
IS A VERY INEXPENSIVE MEANS OF CHECKING ALL DATA BEFORE INVESTING  Recent
A LARGE AMOUNT OF MONEY IN RECONSTRUCTING CROSS SECTIONS. ANY AND  Recent
ALL DIGNOSTICS RECEIVED FROM THE EDIT WILL SUGGEST HOW TO CORRECT  Recent
THE EVALUATED DATA TO MAKE IT CONSISTENT BEFORE RECONSTRUCTING     Recent
CROSS SECTIONS. IN ORDER TO OBTAIN MEANINGFUL RESULTS FROM THE     Recent
RECONSTRUCTION ALL SUGGESTED CHANGES TO THE EVALUATION SHOULD BE   Recent
PERFORMED BEFORE TRYING RECONSTRUCTION (OTHERWISE THE RESULT OF    Recent
RECONSTRUCTION WILL NOT BE RELIABLE).                              Recent
                                                                   Recent
RECONSTRUCTION MODE                                                Recent
-------------------                                                Recent
FOR EACH REQUESTED MATERIAL                                        Recent
---------------------------                                        Recent
IF SECTION MF=1, MT=451 IS PRESENT COMMENTS WILL BE ADD TO         Recent
DOCUMENT THAT THE MATERIAL HAS BEEN PROCESSED. MF=1, MT=451 WILL   Recent
ALSO BE USED TO DETERMINE THE VERSION OF THE ENDF/B FORMAT WHICH   Recent
WILL ALLOW THE PROGRAM TO USE THE APPROPRIATE CONVENTIONS.         Recent
                                                                   Recent
ALL OF THE FILE 2 RESONANCE PARAMETERS ARE FIRST READ AND THE      Recent
LINEARLY INTERPOLABLE CONTRIBUTION OF THE RESONANCE PARAMETERS     Recent
TO THE TOTAL, ELASTIC, CAPTURE AND FISSION CROSS SECTIONS IS       Recent
CALCULATED SIMULTANEOUSLY USING A COMMON ENERGY GRID FOR ALL       Recent
FOUR REACTIONS.                                                    Recent
                                                                   Recent
AFTER THE RESONANCE CONTRIBUTION HAS BEEN RECONSTRUCTED EACH OF    Recent
THE FIVE REACTIONS (MT=1, 2, 18, 19, 102) IS CONSIDERED SEPARATELY Recent
FOR COMBINATION WILL THE BACKGROUND CROSS SECTION, IF ANY, AS      Recent
```

```
DESCRIBED ABOVE.                                                        Recent
                                                                        Recent
OUTPUT WILL INCLUDE THE ENTIRE EVALUATION, INCLUDING RESONANCES         Recent
PARAMETERS WITH LRU MODIFIED (AS DESCRIBED ABOVE) TO INDICATE           Recent
THAT THE RESONANCE CONTRIBUTION HAS ALREADY BEEN ADDED TO THE           Recent
FILE 3 CROSS SECTIONS.                                                  Recent
                                                                        Recent
THE CYCLE OF RECONSTRUCTING THE RESONANCE CONTRIBUTION AND ADDING       Recent
THE BACKGROUND WILL BE REPEATED FOR EACH MATERIAL REQUESTED.            Recent
                                                                        Recent
PROCESS ONLY A PORTION OF RESONANCE REGION                              Recent
================================================================        Recent
MODERN EVALUATIONS MAY BE EXTREMELY LARGE AND IT MAY NOT BE             Recent
POSSIBLE TO PROCESS AN ENTIRE EVALUATION (I.E., ADD THE RESONANCE       Recent
CONTRIBUTION) DURING A SINGLE COMPUTER RUN.                             Recent
                                                                        Recent
ALSO IN THE CASE WHERE YOU ARE ONLY INTERESTED IN THE CROSS             Recent
SECTIONS OVER A SMALL ENERGY RANGE, YOU MAY NOT WANT TO PROCESS         Recent
AN ENTIRE EVALUATION, E.G., IF YOU ONLY WANT TO KNOW WHAT THE           Recent
CROSS SECTIONS ARE NEAR THERMAL ENERGY, 0.0253 EV.                      Recent
                                                                        Recent
IN ORDER TO ALLOW AN EVALUATION TO BE PROCESSED USING A NUMBER OF       Recent
SHORTER COMPUTER RUNS AN OPTION HAS BEEN ADDED TO THIS PROGRAM TO       Recent
ALLOW THE USER TO SPECIFY THE ENERGY RANGE TO BE PROCESSED.             Recent
                                                                        Recent
USING THIS OPTION YOU MAY START AT THE LOWEST ENERGY (ZERO UP TO        Recent
SOME ENERGY) AND USE THE RESULTS OF THIS RUN AS INPUT TO THE            Recent
NEXT RUN, WHERE YOU CAN SPECIFY THE NEXT ENERGY RANGE. THIS             Recent
CYCLE CAN BE REPEATED UNTIL YOU HAVE PROCESSED THE ENTIRE               Recent
EVALUATION.                                                             Recent
                                                                        Recent
WARNING - THIS OPTION SHOULD BE USED WITH EXTREME CARE - THIS           Recent
OPTION HAS BEEN RELUCTANTLY ADDED - RELUCTANTLY BECAUSE IT CAN          Recent
BE EXTREMELY DANGEROUS TO USE THIS OPTION UNLESS YOU CAREFULLY          Recent
CHECKED WHAT YOU ARE DOING.                                             Recent
                                                                        Recent
THE OPTION SHOULD ONLY BE USED AS FOLLOWS,                              Recent
1) YOU MUST PROCESS USING ENERGY RANGES STARTING AT LOW ENERGY          Recent
   AND WORKING YOUR WAY TOWARD HIGH ENERGY, E.G.,                       Recent
    0.0   TO  3.0+3                                                     Recent
    3.0+3 TO 10.0+3                                                     Recent
   10.0+3 TO 80.0+3, ETC.                                               Recent
2) FOR THE LAST ENERGY RANGE THE LOWER ENERGY LIMIT MUST BE             Recent
   NON-ZERO (WHERE TO START) AND THE UPPER ENERGY LIMIT MUST             Recent
   BE ZERO (NO LIMIT)                                                   Recent
   80.0+3 TO  0.0                                                       Recent
                                                                        Recent
IF YOU ARE ONLY INTERESTED IN THE CROSS SECTION OVER A NARROW           Recent
ENERGY INTERVAL AND DO NOT INTENT TO MAKE ANY OTHER USE OF THE          Recent
RESULTS, YOU CAN IGNORE THESE WARNINGS AND MERELY SPECIFY ANY           Recent
ENERGY INTERVAL OVER WHICH YOU WISH CALCULATIONS TO BE                  Recent
PERFORMED.                                                              Recent
                                                                        Recent
NORMALLY WHEN THIS PROGRAM PROCESSES AN EVALUATION IT WILL SET          Recent
FLAGS IN THE EVALUATION TO PREVENT THE SAME RESONANCE                   Recent
CONTRIBUTION FROM BEING ADDED TO THE CROSS SECTION MORE THAN            Recent
ONCE, SHOULD YOU USE THE OUTPUT FROM THIS PROGRAM AS INPUT TO           Recent
THE PROGRAM.                                                            Recent
                                                                        Recent
WHEN PROCESSING ONLY PORTIONS OF THE RESONANCE REGION THIS              Recent
PROGRAM CANNOT SET THESE FLAGS TO PROTECT AGAINST ADDING THE            Recent
RESONANCE CONTRIBUTION MORE THAN ONCE - WHICH MAKES USE OF              Recent
THIS OPTION EXTREMELY DANGEROUS.                                        Recent
                                                                        Recent
ONLY YOU CAN CHECK TO MAKE SURE THAT YOU HAVE CORRECTLY                 Recent
INCLUDED EACH ENERGY RANGE ONLY ONCE - SEE THE COMMENT LINES            Recent
AT THE END OF SECTION, MF=1, MT=451, FOR A COMPLETE RECORD              Recent
OF EACH RUN USING THIS PROGRAM. THIS SECTION WILL CONTAIN               Recent
LINES OF THE FORM                                                       Recent
                                                                        Recent
***************** PROGRAM RECENT (VERSION 2004-1) *************         Recent
```

```
ONLY PROCESS  0.00000+ 0 TO  3.00000+ 3 EV                          Recent
***************** PROGRAM RECENT (VERSION 2004-1) *************    Recent
ONLY PROCESS  3.00000+ 3 TO  1.00000+ 4 EV                          Recent
***************** PROGRAM RECENT (VERSION 2004-1) *************    Recent
ONLY PROCESS  1.00000+ 4 TO  8.00000+ 4 EV                          Recent
***************** PROGRAM RECENT (VERSION 2004-1) *************    Recent
ONLY PROCESS  8.00000+ 4 TO  2.00000+ 7 EV                          Recent
                                                                    Recent
YOU SHOULD CHECK TO INSURE THAT THERE ARE NO OVERLAPPING ENERGY      Recent
RANGES OR MISSING ENERGY RANGES.                                    Recent
                                                                    Recent
WHEN YOU INDICATE BY INPUT THAT YOU ARE ABOUT TO PROCESS THE        Recent
LAST ENERGY RANGE (SEE ABOVE, LOWER ENERGY LIMIT = NON-ZERO,        Recent
UPPER ENERGY LIMIT = ZERO), THIS PROGRAM WILL ASSUME THAT           Recent
YOU HAVE NOW COMPLETED ALL PROCESSING - AND ONLY THEN WILL          Recent
IT SET FLAGS IN THE EVALUATION TO PREVENT THE RESONANCE             Recent
CONTRIBUTION FROM BEING ADDED MORE THAN ONCE. FOR THIS REASON       Recent
YOU CANNOT PROCESS STARTING WITH ENERGY INTERVALS AT HIGH            Recent
ENERGY AND WORKING TOWARD LOW ENERGY - YOU MUST START AT LOW        Recent
ENERGY AND WORK TOWARD HIGH ENERGY.                                 Recent
                                                                    Recent
I/O FILES                                                           Recent
=================================================================== Recent
INPUT FILES                                                         Recent
-----------                                                         Recent
UNIT  DESCRIPTION                                                   Recent
----  -----------                                                   Recent
  2   INPUT LINE (BCD - 80 CHARACTERS/RECORD)                       Recent
 10   ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)             Recent
                                                                    Recent
OUTPUT FILES                                                        Recent
------------                                                        Recent
UNIT  DESCRIPTION                                                   Recent
----  -----------                                                   Recent
  3   OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)                   Recent
 11   FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)                Recent
                                                                    Recent
SCRATCH FILES                                                       Recent
-------------                                                       Recent
UNIT  DESCRIPTION                                                   Recent
----  -----------                                                   Recent
 12   SCRATCH FILE FOR DATA RECONSTRUCTED FROM RESONANCE            Recent
      PARAMETERS (BINARY - 100200 WORDS/RECORD)                     Recent
 14   SCRATCH FILE FOR COMBINED FILE 2 AND 3 DATA                   Recent
      (BINARY - 40080 WORDS/RECORD)                                 Recent
                                                                    Recent
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILEIO)                Recent
=================================================================== Recent
UNIT  FILE NAME                                                     Recent
----  ----------                                                    Recent
  2   RECENT.INP                                                    Recent
  3   RECENT.LST                                                    Recent
 10   ENDFB.IN                                                      Recent
 11   ENDFB.OUT                                                     Recent
 12   (SCRATCH)                                                     Recent
 14   (SCRATCH)                                                     Recent
                                                                    Recent
INPUT CARDS                                                         Recent
=================================================================== Recent
LINE  COLS.  FORMAT  DESCRIPTION                                    Recent
----  -----  ------  -----------                                    Recent
  1    1-11    I11   RETRIEVAL CRITERIA (0=MAT, 1=ZA)              Recent
                     THIS OPTION DEFINED WHETHER COLUMNS 1-22 OF    Recent
                     SUBSEQUENT INPUT CARDS SHOULD BE INTERPRETED   Recent
                     TO BE MAT OR ZA RANGES.                        Recent
      12-22   E11.4  FILE 2 MINIMUM ABSOLUTE CROSS SECTION          Recent
                     (IF 1.0E-10 OR LESS IS INPUT THE PROGRAM       Recent
                     WILL USE 1.0E-10)                              Recent
      23-33    I11   TREATMENT OF REACTIONS FOR WHICH BACKGROUND    Recent
                     CROSS SECTION IS NOT GIVEN.                    Recent
                     = 0 - IGNOR (I.E. NO OUTPUT)                   Recent
```

```
                    = 1 - OUTPUT RESONANCE CONTRIBUTION.          Recent
                    THIS OPTION IS USEFUL WITH PARTIAL EVALUATION Recent
                    (E.G. ENDF/B-V DOSIMETRY LIBRARY) WHERE ONLY  Recent
                    ONE OR MORE OF THE REACTIONS ARE OF ACTUAL    Recent
                    INTEREST.                                     Recent
                    WARNING...THE USE OF THIS FIELD HAS BEEN      Recent
                    CHANGED. THIS FIELD WAS PREVIOUSLY USED TO    Recent
                    DEFINE THE PRECISION OF THE CALCULATION AND   Recent
                    OUTPUT. THE FORMER DEFINITION OF THIS FIELD   Recent
                    WAS...                                        Recent
                    MINIMUM ENERGY SPACING FLAG                   Recent
                    = 0 - 6 DIGIT MINIMUM ENERGY SPACING.         Recent
                          STANDARD 6 DIGIT E11.4 OUTPUT.          Recent
                    = 1 - 9 DIGIT MINIMUM ENERGY SPACING.         Recent
                          STANDARD 6 DIGIT E11.4 OUTPUT.          Recent
                    = 2 - 9 DIGIT MINIMUM ENERGY SPACING.         Recent
                          VARIABLE 9 DIGIT F FORMAT OUTPUT.       Recent
                    FROM EXPERIENCE IT HAS BEEN FOUND THAT        Recent
                    FAILURE TO SET THIS OPTION TO 2 CAN RESULT    Recent
                    IN LARGE ERRORS IN THE FINAL DATA. THEREFORE  Recent
                    INTERNALLY THIS OPTION IS SET TO 2.           Recent
          34-44     I11   OPERATING MODE                          Recent
                    = 0 - CACULATE. MINIMUM OUTPUT LISTING        Recent
                    = 1 - CACULATE. LIST ALL RESONANCE PARAMETERS Recent
                    = 2 - EDIT MODE. NO CALCULATION. LIST ALL     Recent
                          RESONANCE PARAMETERS.                   Recent
                    NOTE, THE EDIT MODE (=2) IS THE SUGGESTED     Recent
                    MODE TO FIRST TEST THE CONSISTENCY OF THE     Recent
                    EVALUATED DATA, BEFORE RECONSTRUCTING CROSS   Recent
                    SECTIONS (SEE, COMMENTS ABOVE).               Recent
          45-55     I11   THIS OPTION IS NO LONGER USED. THE PREVIOUS Recent
                    DEFINITION OF THIS OPTION WAS---DISTANT       Recent
                    RESONANCE TREATMENT.                          Recent
                    = 0 - EXACT                                   Recent
                    = 1 - LINEAR RATIO OVER SUBINTERVAL           Recent
                    = 2 - LINEAR RATIO OVER INTERVAL              Recent
                    ALL RESONANCES ARE TREATED EXACTLY IN THIS    Recent
                    VERSION OF THE CODE.                          Recent
          56-66     I11   MONITOR MODE SELECTOR                   Recent
                    = 0 - NORMAL OPERATION                        Recent
                    = 1 - MONITOR PROGRESS OF RECONSTRUCTION OF   Recent
                          FILE 2 DATA AND COMBINING FILE 2 AND    Recent
                          FILE 3 DATA. EACH TIME A PAGE OF DATA   Recent
                          POINTS IS WRITTEN TO A SCRATCH FILE     Recent
                          PRINT OUT THE TOTAL NUMBER OF POINTS    Recent
                          ON SCRATCH AND THE LOWER AND UPPER      Recent
                          ENERGY LIMITS OF THE PAGE (THIS OPTION  Recent
                          MAY BE USED IN ORDER TO MONITOR THE     Recent
                          EXECUTION SPEED OF LONG RUNNING JOBS).  Recent
       2     1-60     A60   ENDF/B INPUT DATA FILENAME            Recent
                            (STANDARD OPTION = ENDFB.IN)          Recent
       3     1-60     A60   ENDF/B OUTPUT DATA FILENAME           Recent
                            (STANDARD OPTION = ENDFB.OUT)         Recent
     4-N     1-11     I11   MINIMUM MAT OR ZA (SEE COLS. 1-11, LINE 1) Recent
          12-22     I11   MAXIMUM MAT OR ZA (SEE COLS. 1-11, LINE 1) Recent
                    UP TO 100 MAT OR ZA RANGES MAY BE SPECIFIED,  Recent
                    ONE RANGE PER LINE. THE LIST IS TERMINATED    Recent
                    BY A BLANK LINE. IF THE THE UPPER LIMIT OF    Recent
                    ANY REQUEST IS LESS THAN THE LOWER LIMIT THE  Recent
                    UPPER LIMIT WILL BE SET EQUAL TO THE LOWER    Recent
                    LIMIT. IF THE FIRST REQUEST LINE IS BLANK IT  Recent
                    WILL TERMINATE THE REQUEST LIST AND CAUSE ALL Recent
                    DATA TO BE RETRIEVED (SEE EXAMPLE INPUT).     Recent
          23-33   E11.4  LOWER ENERGY LIMIT FOR PROCESSING.       Recent
          34-44   E11.4  UPPER ENERGY LIMIT FOR PROCESSING.       Recent
                   *THE LOWER AND UPPER ENERGY LIMITS MUST BE     Recent
                    ZERO, OR BLANK, UNLESS YOU WISH TO ONLY       Recent
                    PROCESS A PORTION OF RESONANCE REGIONS.       Recent
                   *THESE ENERGY LIMITS ARE ONLY READ FROM THE    Recent
                    FIRST MAT/ZA REQUEST LINE                     Recent
                   *IF BOTH ARE ZERO (OR BLANK) THE ENTIRE        Recent
```

```
                        RESONANCE REGION FOR EACH MATERIAL WILL BE    Recent
                        PROCESSED                                     Recent
                       *IF LIMITS ARE INPUT ONLY THAT PORTION OF THE  Recent
                        RESONANCE REGION FOR EACH MATERIAL WHICH      Recent
                        LIES BETWEEN THESE LIMITS WILL BE PROCESSED   Recent
                       *SEE INSTRUCTIONS ABOVE BEFORE USING THIS      Recent
                        OPTION.                                       Recent
    VARY   1-11   E11.4  ENERGY FOR FILE 2 ERROR LAW     (  SEE   )    Recent
          12-22   E11.4  ERROR FOR FILE 2 ERROR LAW      (COMMENTS)    Recent
                                                        ( BELOW  )    Recent
                                                                      Recent
    NOTE, THIS VERSION OF THE PROGRAM DOES NOT THIN THE COMBINED FILE  Recent
    FILE 2 + 3 DATA. AS SUCH THE ERROR LAW FOR COMBINING FILE 2 + 3    Recent
    WHICH WAS REQUIRED IN EARLIER VERSIONS OF THIS CODE ARE NO LONGER  Recent
    REQUIRED.                                                         Recent
                                                                      Recent
    THE FILE 2 ERROR LAW MAY BE ENERGY INDEPENDENT (DEFINED BY A       Recent
    SINGLE ERROR) OR ENERGY DEPENDENT (DEFINED BY UP TO 20 ENERGY,     Recent
    ERROR PAIRS). FOR THE ENERGY DEPENDENT CASE LINEAR INTERPOLATION   Recent
    WILL BE USED TO DEFINE THE ERROR AT ENERGIES BETWEEN THOSE AT      Recent
    WHICH THE ERROR IS TABULATED. THE ERROR LAW IS TERMINATED BY A     Recent
    BLANK LINE. IF ONLY ONE ENERGY, ERROR PAIR IS GIVEN THE LAW WILL   Recent
    BE CONSIDERED TO BE ENERGY INDEPENDENT. IF MORE THAN ONE PAIR      Recent
    IS GIVEN IT BE CONSIDERED TO BE ENERGY DEPENDENT (NOTE, THAT       Recent
    FOR A CONSTANT ERROR THE ENERGY INDEPENDENT FORM WILL RUN FASTER.  Recent
    HOWEVER, FOR SPECIFIC APPLICATIONS AN ENERGY DEPENDENT ERROR MAY   Recent
    BY USED TO MAKE THE PROGRAM RUN CONSIDERABLE FASTER).              Recent
                                                                      Recent
    ALL ENERGIES MUST BE IN ASCENDING ENERGY ORDER. FOR CONVERGENCE    Recent
    OF THE FILE 2 RECONSTRUCTION ALGORITHM ALL THE ERRORS MUST BE      Recent
    POSITIVE. IF ERROR IS NOT POSITIVE IT WILL BE SET EQUAL TO THE     Recent
    STANDARD OPTION (CURRENTLY 0.001, CORRRESPONDING TO 0.1 PER-CENT). Recent
    IF THE FIRST LINE OF THE ERROR LAW IS BLANK IT WILL TERMINATE THE   Recent
    ERROR LAW AND THE ERROR WILL BE TREATED AS ENERGY INDEPENDENT,      Recent
    EQUAL TO THE STANDARD OPTION (CURRENTLY, 0.1 PER-CENT). SEE,       Recent
    EXAMPLE INPUT 4.                                                  Recent
                                                                      Recent
    EXAMPLE INPUT NO. 1                                               Recent
    ------------------                                                Recent
    CONSIDER ALL URANIUM ISOTOPES AND TH-232. CONSIDER CROSS SECTIONS  Recent
    WHICH ARE LARGER THAN 1.0E-8 BARNS IN ABSOLUTE VALUE. ONLY OUTPUT  Recent
    REACTIONS FOR WHICH A BACKGROUND IS GIVEN. LIST ALL PARAMETERS AND Recent
    CALCULATE CROSS SECTIONS. MONITOR THE EXECUTION PROGRESS OF THE    Recent
    PROGRAM. BETWEEN 0 AND 100 EV USE 0.1 PER-CENT ACCURACY. BETWEEN   Recent
    100 EV AND 1 KEV VARY THE ACCURACY FROM 0.1 TO 1 PER-CENT. ABOVE   Recent
    1 KEV USE 1 PER-CENT ACCURACY.                                    Recent
                                                                      Recent
    EXPLICITLY SPECIFY THE STANDARD FILENAMES.                        Recent
                                                                      Recent
    THE FOLLOWING 11 INPUT CARDS ARE REQUIRED.                        Recent
                                                                      Recent
         1 1.00000-08          0          1          0         1      Recent
ENDFB.IN                                                              Recent
ENDFB.OUT                                                             Recent
     92000      92999                                                 Recent
     90232                  (UPPER LIMIT AUTOMATICALLY SET TO 90232)   Recent
                            (END REQUEST LIST)                        Recent
0.00000+ 0 1.00000-03                                                 Recent
1.00000+02 1.00000-03                                                 Recent
1.00000+03 1.00000-02                                                 Recent
1.00000+09 1.00000-02                                                 Recent
                            (END FILE 2 ERROR LAW)                    Recent
                                                                      Recent
    EXAMPLE INPUT NO. 2                                               Recent
    ------------------                                                Recent
    CONSIDER ALL URANIUM ISOTOPES AND TH-232. CONSIDER CROSS SECTIONS  Recent
    WHICH ARE LARGER THAN 1.0E-8 BARNS IN ABSOLUTE VALUE. ONLY OUTPUT  Recent
    REACTIONS FOR WHICH A BACKGROUND IS GIVEN. CROSS SECTIONS WILL BE  Recent
    CALCULATED, BUT PARAMETERS WILL NOT BE LISTED. THE PROGRESS OF THE Recent
    PROGRAM WILL NOT BE MONITORED. USE 0.1 PER-CENT ACCURACY FOR ALL   Recent
    ENERGIES. SINCE 0.1 PER-CENT IS THE STANDARD OPTION FOR THE ERROR  Recent
```

```
    LAW THE FIRST ERROR LAW LINE MAY BE LEFT BLANK.                     Recent
                                                                        Recent
    LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL      Recent
    THEN USE THE STANDARD FILENAMES.                                    Recent
                                                                        Recent
    THE FOLLOWING 7 INPUT CARDS ARE REQUIRED.                           Recent
                                                                        Recent
         1 1.00000-08          0          0          0         0       Recent
                                                                        Recent
                                                                        Recent
     92000      92999                                                   Recent
     90232                  (UPPER LIMIT AUTOMATICALLY SET TO 90232)    Recent
                            (END REQUEST LIST)                          Recent
                            (USE STANDARD OPTION FOR ERROR LAW)         Recent
                                                                        Recent
    EXAMPLE INPUT NO. 3                                                 Recent
    ------------------                                                  Recent
    THE SAME AS EXAMPLE INPUT NO. 2, ONLY IN THIS CASE ONLY CALCULATE   Recent
    CROSS SECTIONS OVER THE ENERGY RANGE 0.01 TO 0.1 EV - ACROSS THE    Recent
    THERMAL ENERGY RANGE. NOTE, THE ONLY DIFFERENCE BETWEEN THE INPUT   Recent
    PARAMETERS IN THIS CASE AND IN EXAMPLE NO. 2, IS THAT ON THE        Recent
    SECOND INPUT LINE WE HAVE ADDED THE ENERGY RANGE 0.01 TO 0.1 EV.    Recent
    USE \PREPRO94\LINEAR\ENDFB.OUT AS INPUT AND ENDFB.OUT AS OUTPUT -   Recent
    SINCE ENDFB.OUT IS THE STANDARD OUTPUT FILENAME THE NAME CAN BE     Recent
    EITHER INCLUDED IN THE INPUT OR LEFT BLANK.                         Recent
                                                                        Recent
    THE FOLLOWING 7 INPUT CARDS ARE REQUIRED.                           Recent
                                                                        Recent
         1 1.00000-08          0          0          0         0       Recent
\PREPRO94\LINEAR\ENDFB.OUT                                              Recent
ENDFB.OUT                                                               Recent
     92000      92999 1.00000- 2 1.00000- 1                             Recent
     90232                  (UPPER LIMIT AUTOMATICALLY SET TO 90232)    Recent
                            (END REQUEST LIST)                          Recent
                            (USE STANDARD OPTION FOR ERROR LAW)         Recent
                                                                        Recent
    EXAMPLE INPUT NO. 4                                                 Recent
    ------------------                                                  Recent
    RECONSTRUCT ALL DATA. OUTPUT ALL REACTIONS, REGARDING OF WHETHER    Recent
    OR NOT THERE IS A BACKGROUND CROSS SECTION. DO NOT MONITOR THE      Recent
    PROGRESS OF THE PROGRAM. RECONSTRUCT CROSS SECTIONS TO 1 PER-CENT   Recent
    ACCURACY. USE \ENDFB6\LINEAR\ZA092238 AS INPUT AND                  Recent
    \ENDFB6\RECENT\ZA092238 AS OUTPUT.                                  Recent
                                                                        Recent
    THE FOLLOWING 6 INPUT CARDS ARE REQUIRED.                           Recent
                                                                        Recent
         0 0.0                 1          0          0         0       Recent
\ENDFB6\ZA092238                                                        Recent
\ENDFB6\RECENT\ZA092238                                                 Recent
                   (RETRIEVE ALL DATA, END REQUEST LIST)                Recent
           1.00000- 2                                                   Recent
                   (END FILE 2 ERROR LAW)                               Recent
                                                                        Recent
    EXAMPLE INPUT NO. 5                                                 Recent
    ------------------                                                  Recent
    RECONSTRUCT ALL DATA. ONLY OUTPUT REACTIONS FOR WHICH A BACKGROUND  Recent
    CROSS SECTION IS GIVEN. DO NOT MONITOR THE PROGRESS OF THE PROGRAM  Recent
    RECONSTRUCT CROSS SECTIONS TO 0.1 PER-CENT ACCURACY. USE ENDFB.IN   Recent
    AS INPUT AND ENDFB.OUT AS OUTPUT.                                   Recent
                                                                        Recent
    THIS CORRESPONDS TO USING ALL OF THE STANDARD OPTONS BUILT-IN TO    Recent
    THE PROGRAM AND ALL INPUT CARDS MAY BE BLANK.                       Recent
                                                                        Recent
    IN THIS CASE THE FOLLOWING 5 INPUT CARDS ARE REQUIRED.              Recent
    (ZEROES ARE INDICATED ON THE FIRST LINE, BELOW, ONLY TO INDICATE    Recent
    WHERE THE LINE IS. THE ACTUAL INPUT LINE CAN BE COMPLETELY BLANK).  Recent
                                                                        Recent
         0 0.0                 0          0          0         0       Recent
                   (USE STANDARD INPUT FILENAME = ENDFB.IN)             Recent
                   (USE STANDARD OUTPUT FILENAME = ENDFB.OUT)           Recent
                   (RETRIEVE ALL DATA, END REQUEST LIST)                Recent
```

```
                    (0.1 ERROR, END FILE 2 ERROR LAW)               Recent
                                                                    Recent
====================================================================== Recent
```

```
====================================================================== Relabel
                                                                       Relabel
     PROGRAM RELABEL                                                   Relabel
     VERSION 69-1 (APRIL 1969)                                         Relabel
     VERSION 73-1 (JUNE 1973)                                          Relabel
     VERSION 77-1 (SEPTEMBER 1977)                                     Relabel
     VERSION 80-1 (AUGUST 1980) IBM VERSION                            Relabel
     VERSION 83-1 (JANUARY 1983) COMBINED STATEMENT NUMBER SEQUENCE    Relabel
                                 AND LINE I.D. INTO ONE PROGRAM.       Relabel
     VERSION 86-1 (JANUARY 1986) FORTRAN-77/H VERSION                  Relabel
     VERSION 88-1 (JULY 1988)   *OPTION...INTERNALLY DEFINE ALL I/O    Relabel
                                 FILE NAMES (SEE, SUBROUTINES FILIO1   Relabel
                                 AND FILIO2 FOR DETAILS).              Relabel
                                *IMPROVED BASED ON USER COMMENTS.      Relabel
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO    Relabel
                                 INSURE PROGRAM WILL NOT DO ANYTHING   Relabel
                                 CRAZY.                                Relabel
                                *UPDATED TO USE NEW PROGRAM CONVERT    Relabel
                                 KEYWORDS.                             Relabel
                                *ADDED LIVERMORE CIVIC COMPILER        Relabel
                                 CONVENTIONS.                          Relabel
     VERSION 92-1 (JANUARY 1992)*ADDED FORTRAN SAVE OPTION             Relabel
     VERSION 94-1 (JANUARY 1994)*COMPLETE RE-WRITE                     Relabel
                                *OUTPUT MINIMUM NON-BLANK LENGTH FOR   Relabel
                                 EACH LINE - NO SEQUENCE NUMBERS.      Relabel
                                *INCREASED MAXIMUM NUMBER OF LABELS    Relabel
                                 PER ROUTINE FROM 1000 TO 50,000       Relabel
                                *CAN NOW PROCESS UPPER OR LOWER CASE   Relabel
                                 CODING.                               Relabel
                                *SKIP IMBEDDED BLANKS IN KEYWORDS.     Relabel
                                *ADDED WRITE(XX,XX,ERR=YYY,END=ZZZ)    Relabel
                                *ADDED OPEN(XX,ERR=YYY,END=ZZZ)        Relabel
                                *ADDED CLOSE(XX,ERR=YYY,END=ZZZ)       Relabel
                                *INTEGER INSTEAD OF CHARACTERS IS NO   Relabel
                                 LONGER SUPPORTED - ALL CHARACTERS     Relabel
                                 MUST BE IDENTIFIED AS CHARACTERS.     Relabel
                                *VARIABLE FILENAMES TO ALLOW ACCESS    Relabel
                                 FILE STRUCTURES                       Relabel
                                 (WARNING - INPUT PARAMETER FORMAT     Relabel
                                 HAS BEEN CHANGED)                     Relabel
                                *CLOSE ALL FILES BEFORE TERMINATING    Relabel
                                 (SEE, SUBROUTINE ENDIT)               Relabel
     VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                    Relabel
                                 *IMPROVED COMPUTER INDEPENDENCE       Relabel
                                 *ALL DOUBLE PRECISION                 Relabel
                                 *ON SCREEN OUTPUT                     Relabel
                                 *IMPROVED OUTPUT PRECISION            Relabel
                                 *DEFINED SCRATCH FILE NAMES           Relabel
                                 *INCREASED THE NUMBER OF LABELS       Relabel
                                  IN A ROUTINE FOR 5,000 TO 50,000     Relabel
     VERSION 99-1 (MARCH 1999)   *GENERAL IMPROVEMENTS BASED ON        Relabel
                                  USER FEEDBACK                        Relabel
     VERS. 2000-1 (FEBRUARY 2000)*UPDATED TO IGNORE ( AND ) IN QUOTES  Relabel
                                 *GENERAL IMPROVEMENTS BASED ON        Relabel
                                  USER FEEDBACK                        Relabel
     VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS            Relabel
                                 *CORRECTED END=, ERR=, WHEN I/O UNIT  Relabel
                                  NUMBER IS DIMENSIONED                Relabel
     VERS. 2004-1 (MARCH 2004)   *ADDED INCLUDE FOR COMMON             Relabel
                                 *INCREASED THE NUMBER OF LABELS IN    Relabel
                                  A ROUTINE FOR 50,000 TO 100,000      Relabel
                                                                       Relabel
     OWNED, MAINTAINED AND DISTRIBUTED BY                              Relabel
     ------------------------------------                              Relabel
     THE NUCLEAR DATA SECTION                                          Relabel
     INTERNATIONAL ATOMIC ENERGY AGENCY                                Relabel
     P.O. BOX 100                                                      Relabel
     A-1400, VIENNA, AUSTRIA                                           Relabel
     EUROPE                                                            Relabel
                                                                       Relabel
     ORIGINALLY WRITTEN BY                                             Relabel
```

```
----------------------------------                                  Relabel
DERMOTT E. CULLEN                                                   Relabel
UNIVERSITY OF CALIFORNIA                                            Relabel
LAWRENCE LIVERMORE NATIONAL LABORATORY                              Relabel
L-159                                                               Relabel
P.O. BOX 808                                                        Relabel
LIVERMORE, CA 94550                                                 Relabel
U.S.A.                                                              Relabel
TELEPHONE  925-423-7359                                             Relabel
E. MAIL    CULLEN1@LLNL.GOV                                         Relabel
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                              Relabel
                                                                    Relabel
PURPOSE                                                             Relabel
-------                                                             Relabel
THIS PROGRAM IS DESIGNED TO RE-LABEL A FORTRAN PROGRAM SO THAT      Relabel
STATEMENT LABELS ARE IN INCREASING ORDER IN INCREMENTS OF 10        Relabel
WITHIN EACH ROUTINE.                                                Relabel
                                                                    Relabel
THE FOLLOWING TYPES OF FORTRAN STATEMENTS ARE CONSIDERED,           Relabel
                                                                    Relabel
GO TO NN                                                            Relabel
GO TO (NN,MM,.....,JJ,KK),LL (MULTI LINE O.K.)                      Relabel
DO NN                                                               Relabel
IF(......) NN,MM,...JJ,KK                                           Relabel
IF(......) GO TO NN                                                 Relabel
IF(......) GO TO (NN,MM,.....,JJ,KK),LL (MULTI LINE O.K.)           Relabel
IF(......) READ(.....,END=NN,ERR=MM)                                Relabel
IF(......) WRITE(.....,END=NN,ERR=MM)                               Relabel
READ(......,END=NN,ERR=MM)                                          Relabel
OPEN(......,END=NN,ERR=MM)                                          Relabel
                                                                    Relabel
GO TO STATEMENTS MAY APPEAR IN THE FORM 'GO TO' OR 'GOTO'. IF       Relabel
THERE IS ROOM ON THE LINE 'GOTO' WILL BE CONVERTED TO 'GO TO'.      Relabel
WHETHER OR NOT 'GOTO' IS CONVERTED TO 'GO TO' IT WILL BE TREATED    Relabel
AS IDENTICAL TO 'GO TO' FOR SUBSEQUENT PROCESSING AND RELACEMENT    Relabel
OF STATEMENT NUMBERS.                                               Relabel
                                                                    Relabel
ALL OTHER STATEMENT TYPES ARE NOT CHANGED. IN PARTICULAR ALL I/O    Relabel
STATEMENTS AND ASSOCIATED FORMAT STATEMENTS ARE NOT CONVERTED.      Relabel
                                                                    Relabel
WARNING                                                             Relabel
-------                                                             Relabel
THIS PROGRAM IS ONLY DESIGNED TO MAINTAIN ENDF/B PRE-PROCESSING     Relabel
PROGRAMS, WHICH ONLY USE A RESTRICTED SET OF FORTRAN STATEMENT      Relabel
TYPES THAT CAN BE USED ON A VARIETY OF DIFFERENT TYPES OF           Relabel
COMPUTERS. THIS PROGRAM IS NOT DESIGNED TO HANDLE ALL POSSIBLE      Relabel
TYPES OF FORTRAN STATEMENTS.                                        Relabel
                                                                    Relabel
THE FORTRAN STATEMENTS DESCRIBED ABOVE AND TREATED BY THIS PROGRAM  Relabel
DO NOT INCLUDE ALL POSSIBLE FORTRAN STATEMENTS. AS SUCH THIS        Relabel
PROGRAM IS NOT COMPLETELY GENERAL AND SHOULD ONLY BE USED WITH      Relabel
PROGRAMS THAT ONLY USE THE FORTRAN STATEMENTS DESCRIBED ABOVE.      Relabel
                                                                    Relabel
FAILURE TO FOLLOW THESE INSTRUCTIONS CAN LEAD TO ERROR IN PROGRAMS  Relabel
                                                                    Relabel
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINES FILIO1 AND FILIO2)    Relabel
-----------------------------------------------------------------   Relabel
UNIT  FILE NAME    DESCRIPTION                                      Relabel
----  ----------   -----------                                      Relabel
  2   RELABEL.INP  INPUT PARAMETERS                                 Relabel
  3   RELABEL.LST  OUTPUT REPORT                                    Relabel
 10   RELABEL.IN   PROGRAM TO READ                                  Relabel
 11   RELABEL.OUT  PROGRAM TO WRITE                                 Relabel
 12   (SCRATCH)                                                     Relabel
                                                                    Relabel
INPUT CARDS                                                         Relabel
-----------                                                         Relabel
LINE  COLUMNS  DEFINITION                                           Relabel
----  -------  ----------                                           Relabel
   1   1-60    INPUT PROGRAM FILENAME                               Relabel
               (STANDARD OPTION = RELABEL.IN)                       Relabel
```

```
   2   1-60    OUTPUT PROGRAM FILENAME                                Relabel
               (STANDARD OPTION = RELABEL.OUT)                        Relabel
                                                                      Relabel
LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL        Relabel
THEN USE STANDARD FILENAMES.                                          Relabel
                                                                      Relabel
EXAMPLE INPUT NO. 1                                                   Relabel
------------------                                                    Relabel
TO READ \PREPRO94\RECENT\RECENT.FOR AND                               Relabel
WRITE   \PREPRO94\RECENT\RECENT.NEW THE FOLLOWING 2 INPUT LINES       Relabel
ARE REQUIRED,                                                         Relabel
                                                                      Relabel
\PREPRO94\RECENT\RECENT.FOR                                           Relabel
                                                                      Relabel
EXAMPLE INPUT NO. 2                                                   Relabel
------------------                                                    Relabel
TO READ RELABEL.IN AND WRITE RELABEL.OUT THE FOLOWING 2 INPUT         Relabel
LINES ARE REQUIRED,                                                   Relabel
                                                                      Relabel
RELABEL.IN                                                            Relabel
RELABEL.OUT                                                           Relabel
                                                                      Relabel
EXAMPLE INPUT NO. 3                                                   Relabel
------------------                                                    Relabel
TO READ RELABEL.IN AND WRITE RELABEL.OUT, SINCE THESE ARE THE         Relabel
STANDARD OPTIONS THE 2 INPUT LINES CAN BE COMPLETELY BLANK.           Relabel
                                                                      Relabel
====================================================================== Relabel
```

```
====================================================================== Sigma1
                                                                       Sigma1
     PROGRAM SIGMA1                                                    Sigma1
     ==============                                                    Sigma1
     VERSION 73-1 (MARCH 1973)                                         Sigma1
     VERSION 76-1 (FEBRUARY 1976)                                      Sigma1
     VERSION 76-2 (OCTOBER 1976)                                       Sigma1
     VERSION 77-1 (JANUARY 1977)                                       Sigma1
     VERSION 78-1 (JULY 1978)                                          Sigma1
     VERSION 79-1 (JULY 1979)    CDC-7600 AND CRAY-1 VERSION.          Sigma1
     VERSION 80-1 (MAY 1980)     IBM, CDC AND CRAY VERSION             Sigma1
     VERSION 80-2 (DECEMBER 1980)IMPROVED BASED ON USER COMMENTS.      Sigma1
     VERSION 81-1 (MARCH 1981)   DOUBLE PRECISION IBM VERSION          Sigma1
     VERSION 81-2 (AUGUST 1981)  IMPROVED IBM SPEED AND STABILITY      Sigma1
     VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY       Sigma1
     VERSION 83-1 (JANUARY 1983)*MAJOR RE-DESIGN.                      Sigma1
                                *PAGE SIZE INCREASED - 1002 TO 2004.   Sigma1
                                *ELIMINATED COMPUTER DEPENDENT CODING. Sigma1
                                *NEW, MORE COMPATIBLE I/O UNIT NUMBER. Sigma1
                                *ADDED STANDARD ALLOWABLE ERROR OPTION Sigma1
                                 (CURRENTLY 0.1 PER-CENT).             Sigma1
                                *UNRESOLVED RESONANCE REGION COPIED.   Sigma1
                                *1/V EXTENSION OF CROSS SECTIONS       Sigma1
                                 OUTSIDE OF TABULATED ENERGY RANGE AND Sigma1
                                 INTO UNRESOLVED ENERGY RANGE.         Sigma1
     VERSION 83-2 (OCTOBER 1983)*IMPROVED BASED ON USER COMMENTS.      Sigma1
     VERSION 84-1 (APRIL 1984)  *IMPROVED NUMERICAL STABILITY.         Sigma1
                                *PARTIAL EVALUATION TREATMENT.         Sigma1
     VERSION 85-1 (APRIL 1985)  *ITERATE TO CONVERGENCE (USING THE SAME Sigma1
                                 ENERGY GRID FOR HOT CROSS SECTION AS  Sigma1
                                 COLD CROSS SECTIONS WAS FOUND TO BE   Sigma1
                                 INACCURATE).                          Sigma1
                                *NEW FASTER HIGH ENERGY BROADENING.    Sigma1
                                *UPDATED FOR ENDF/B-VI FORMATS.        Sigma1
                                *SPECIAL I/O ROUTINES TO GUARANTEE     Sigma1
                                 ACCURACY OF ENERGY.                   Sigma1
                                *DOUBLE PRECISION TREATMENT OF ENERGY  Sigma1
                                 (REQUIRED FOR NARROW RESONANCES).     Sigma1
     VERSION 85-2 (AUGUST 1985) *FORTRAN-77/H VERSION                  Sigma1
     VERSION 86-1 (JANUARY 1986)*ENERGY DEPENDENT SCATTERING RADIUS    Sigma1
     VERSION 88-1 (JULY 1988)   *OPTION...INTERNALLY DEFINE ALL I/O    Sigma1
                                 FILE NAMES (SEE, SUBROUTINE FILEIO    Sigma1
                                 FOR DETAILS).                         Sigma1
                                *IMPROVED BASED ON USER COMMENTS.      Sigma1
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO    Sigma1
                                 INSURE PROGRAM WILL NOT DO ANYTHING   Sigma1
                                 CRAZY.                                Sigma1
                                *UPDATED TO USE NEW PROGRAM CONVERT    Sigma1
                                 KEYWORDS.                             Sigma1
                                *ADDED LIVERMORE CIVIC COMPILER        Sigma1
                                 CONVENTIONS.                          Sigma1
     VERSION 90-1 (JUNE 1990)   *UPDATED BASED ON USER COMMENTS        Sigma1
                                *ADDED FORTRAN SAVE OPTION             Sigma1
                                *NEW MORE CONSISTENT ENERGY OUTPUT     Sigma1
                                 ROUTINES                              Sigma1
     VERSION 91-1 (JULY 1991)   *WARNING...INPUT PARAMETER FORMAT      Sigma1
                                 HAS BEEN CHANGED - SEE BELOW FOR      Sigma1
                                 DETAILS.                              Sigma1
                                *ADDED CHARGED PARTICLE PROJECTILES    Sigma1
                                *OUTPUT ENERGY RANGE IS ALWAYS AT      Sigma1
                                 LEAST AS LARGE AS INPUT ENERGY RANGE. Sigma1
                                *NO 1/V EXTENSION OF CROSS SECTIONS    Sigma1
                                 FROM UNRESOLVED ENERGY RANGE.         Sigma1
     VERSION 92-1 (JANUARY 1992)*INSURE MINIMUM AND MAXIMUM CROSS      Sigma1
                                 SECTIONS ARE ALWAYS KEPT (NOT THINNED) Sigma1
                                *MT=19 (FIRST CHANCE FISSION) TREATED  Sigma1
                                 THE SAME AS FISSION.                  Sigma1
                                *VARIABLE MINIMUM CROSS SECTION OF     Sigma1
                                 INTEREST - TO ALLOW SMALL CROSS       Sigma1
                                 SECTIONS NEAR THRESHOLDS TO BE        Sigma1
                                 TREATED PROPERLY.                     Sigma1
```

```
                          *ALL ENERGIES INTERNALLY ROUNDED PRIOR  Sigma1
                           TO CALCULATIONS.                       Sigma1
                          *COMPLETELY CONSISTENT I/O AND ROUNDING Sigma1
                           ROUTINES - TO MINIMIZE COMPUTER        Sigma1
                           DEPENDENCE.                            Sigma1
VERSION 92-2 (JULY 1992)   *CORRECTED BUG ASSOCIATED WITH         Sigma1
                           THRESHOLD REACTIONS.                   Sigma1
                          *UNRESOLVED REGION COPIED WITHOUT       Sigma1
                           THINNING (IT SHOULD BE EXACTLY THE     Sigma1
                           SAME AT ALL TEMPERATURES).             Sigma1
                          *NO THINNING OF REACTIONS (MT) THAT     Sigma1
                           WERE NOT BROADENED.                    Sigma1
VERSION 93-1 (APRIL 1993)  *INCREASED PAGE SIZE FROM 2004         Sigma1
                           TO 24000 ENERGY PONTS.                 Sigma1
VERSION 94-1 (JANUARY 1994)*VARIABLE ENDF/B DATA FILENAMES        Sigma1
                           TO ALLOW ACCESS TO FILE STRUCTURES     Sigma1
                           (WARNING - INPUT PARAMETER FORMAT      Sigma1
                           HAS BEEN CHANGED)                      Sigma1
                          *CLOSE ALL FILES BEFORE TERMINATING     Sigma1
                           (SEE, SUBROUTINE ENDIT)                Sigma1
VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                    Sigma1
                            *IMPROVED COMPUTER INDEPENDENCE       Sigma1
                            *ALL DOUBLE PRECISION                 Sigma1
                            *ON SCREEN OUTPUT                     Sigma1
                            *UNIFORM TREATMENT OF ENDF/B I/O      Sigma1
                            *IMPROVED OUTPUT PRECISION            Sigma1
                            *DEFINED SCRATCH FILE NAMES           Sigma1
                            *ALWAYS INCLUDE THERMAL VALUE         Sigma1
VERSION 97-1 (APRIL 1997)   *OPTIONALLY SET NEGATIVE CROSS        Sigma1
                             SECTIONS = 0 ON INPUT AND            Sigma1
                             OUTPUT.                              Sigma1
                            *INCREASED PAGE SIZE FROM 24000       Sigma1
                             TO 60000 ENERGY POINTS.              Sigma1
VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING      Sigma1
                             POINT READ FOR MORE DIGITS           Sigma1
                            *UPDATED TEST FOR ENDF/B FORMAT       Sigma1
                             VERSION BASED ON RECENT FORMAT CHANGE Sigma1
                            *TREAT LOW ENERGY INITIAL CROSS       Sigma1
                             SECTIONS AS LOG-LOG INTERPOLABLE     Sigma1
                            *CONSTANT (RATHER THAN 1/V) EXTENSION Sigma1
                             TO HIGHER ENERGY.                    Sigma1
                            *UPDATED CONSTANTS BASED ON CSEWG     Sigma1
                             SUBCOMMITTEE RECOMMENDATIONS         Sigma1
                            *GENERAL IMPROVEMENTS BASED ON        Sigma1
                             USER FEEDBACK                        Sigma1
VERSION 99-2 (JUNE 1999)    *EXTENDED RANGE OF INTEGRALS FROM 4   Sigma1
                             TO 5 UNITS ON EACH SIDE OF ENERGY    Sigma1
                             POINT TO ALLOW FOR LARGER VARIATION  Sigma1
                             IN THE LOCAL CROSS SECTION           Sigma1
                            *ASSUME ENDF/B-VI, NOT V, IF MISSING  Sigma1
                             MF=1, MT-451.                        Sigma1
VERSION 99-3 (OCTOBER 1999))*IMPROVED ERFC FUNCTION DEFINITION.   Sigma1
                             I THANK BOB MACFARLANE (LANL) FOR    Sigma1
                             SUPPLYING A MORE ACCURATE ERFC       Sigma1
                             FUNCTION.                            Sigma1
VERS. 2000-1 (FEBRUARY 2000)*CORRECTED LOW ENERGY INTERPOLATION   Sigma1
                             FOR NON-POSITIVE CROSS SECTIONS      Sigma1
                            *GENERAL IMPROVEMENTS BASED ON        Sigma1
                             USER FEEDBACK                        Sigma1
VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS            Sigma1
VERS. 2004-1 (JAN. 2004)    *OPTIONALLY IGNORE UNRESOLVED REGION  Sigma1
                            *CORRECTED PROBLEM AT THE RESOLVED/   Sigma1
                             UNRESOLVED ENERGY BOUNDARY.          Sigma1
                            *CORRECTED HIGH ENERGY CONSTANT CROSS Sigma1
                             SECTION EXTENSION.                   Sigma1
                            *TIGHTER CRITERIA FOR INITIAL ENERGY  Sigma1
                             POINT SPACING                        Sigma1
                            *TEMPERATURE DEPENDENT ENERGY POINT   Sigma1
                             SPACING.                             Sigma1
                            *ADDED NEW REICH-MOORE (LRF=7) TO     Sigma1
                             FILE2 TO ALLOW COPY TO FIND ANY      Sigma1
```

```
                          FOLLOWING UNRESOLVED PARAMETERS       Sigma1
                                                                Sigma1
Acknowledgement 2004                                            Sigma1
-------------------                                             Sigma1
Currently almost all improvements to this code are based upon   Sigma1
feedback from code users who report problems. This feedback     Sigma1
benefits ALL users of this code, and ALL users are encouraged   Sigma1
to report problems.                                             Sigma1
                                                                Sigma1
Improvements on the 2004 version of this code based on user     Sigma1
feedback including,                                             Sigma1
1) Bret Beck  - reported a problem at the resolved/unresolved   Sigma1
                energy boundary.                                Sigma1
2) S. Ganesan - reported a problem for small temperature changes. Sigma1
                                                                Sigma1
OWNED, MAINTAINED AND DISTRIBUTED BY                            Sigma1
------------------------------------                            Sigma1
THE NUCLEAR DATA SECTION                                        Sigma1
INTERNATIONAL ATOMIC ENERGY AGENCY                              Sigma1
P.O. BOX 100                                                    Sigma1
A-1400, VIENNA, AUSTRIA                                         Sigma1
EUROPE                                                          Sigma1
                                                                Sigma1
ORIGINALLY WRITTEN BY                                           Sigma1
---------------------------------                               Sigma1
DERMOTT E. CULLEN                                               Sigma1
UNIVERSITY OF CALIFORNIA                                        Sigma1
LAWRENCE LIVERMORE NATIONAL LABORATORY                          Sigma1
L-159                                                           Sigma1
P.O. BOX 808                                                    Sigma1
LIVERMORE, CA 94550                                             Sigma1
U.S.A.                                                          Sigma1
TELEPHONE  925-423-7359                                         Sigma1
E. MAIL    CULLEN1@LLNL.GOV                                     Sigma1
WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                          Sigma1
                                                                Sigma1
AUTHORS MESSAGE                                                 Sigma1
---------------                                                 Sigma1
THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION Sigma1
FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED Sigma1
THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE Sigma1
READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY  Sigma1
THE COMMENTS CONCERNING MACHINE DEPENDENT CODING.               Sigma1
                                                                Sigma1
AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER Sigma1
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE  Sigma1
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT Sigma1
IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY    Sigma1
COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO Sigma1
IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF Sigma1
THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR      Sigma1
COMPUTER.                                                       Sigma1
                                                                Sigma1
PURPOSE                                                         Sigma1
-------                                                         Sigma1
THIS PROGRAM IS DESIGNED TO DOPPLER BROADEN NEUTRON INDUCED     Sigma1
CROSS SECTIONS. EACH SECTION OF CROSS SECTIONS (FILE 3) IS READ Sigma1
FROM THE ENDF/B FORMAT. THE DATA IS DOPPLER BROADENED, THINNED  Sigma1
AND OUTPUT IN THE ENDF/B FORMAT.                                Sigma1
                                                                Sigma1
IN THE FOLLOWING DISCUSSION FOR SIMPLICITY THE ENDF/B TERMINOLOGY Sigma1
---ENDF/B TAPE---WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE Sigma1
TAPE, CARDS, DISK OR ANY OTHER MEDIUM.                          Sigma1
                                                                Sigma1
ENDF/B FORMAT                                                   Sigma1
-------------                                                   Sigma1
THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS  Sigma1
OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION Sigma1
OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II, III, IV OR V FORMAT). Sigma1
                                                                Sigma1
IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B    Sigma1
```

```
FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS     Sigma1
ASSUMED THAT THE MAT, MF AND MT ON EACH CARD IS CORRECT. SEQUENCE  Sigma1
NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE          Sigma1
CORRECTLY OUTPUT ON ALL CARDS. THE FORMAT OF SECTION MF=1, MT=451  Sigma1
AND ALL SECTIONS OF MF=3 MUST BE CORRECT. THE PROGRAM COPIES ALL   Sigma1
OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO   Sigma1
THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.            Sigma1
                                                                   Sigma1
ALL CROSS SECTIONS THAT ARE USED BY THIS PROGRAM MUST BE TABULATED Sigma1
AND LINEARLY INTERPOLABLE IN ENERGY AND CROSS SECTION (ENDF/B      Sigma1
INTERPOLATION LAW 2). FILE 3 CROSS SECTIONS MAY BE MADE LINEARLY   Sigma1
INTERPOLABLE BY USING PROGRAM LINEAR (UCRL-50400, VOL.17, PART A). Sigma1
FILE 2 RESONANCE PARAMETERS MAY BE USED TO RECONSTRUCT ENERGY      Sigma1
DEPENDENT CROSS SECTIONS AND ADD IN FILE 3 BACKGROUND CROSS        Sigma1
SECTIONS TO DEFINE LINEARLY INTERPOLABLE CROSS SECTIONS BY USING   Sigma1
PROGRAM RECENT (UCRL-50400, VOL. 17, PART C). IF THIS PROGRAM      Sigma1
FINDS THAT THE FILE 3 CROSS SECTIONS ARE NOT LINEARLY INTERPOLABLE Sigma1
THIS PROGRAM WILL TERMINATE EXECUTION.                             Sigma1
                                                                   Sigma1
UNRESOLVED RESONANCE REGION                                        Sigma1
---------------------------                                        Sigma1
IN THE UNRESOLVED RESONANCE REGION IT IS NOT POSSIBLE TO EXACTLY   Sigma1
DEFINE THE ENERGY DEPENDENCE OF THE CROSS SECTIONS. THE AVERAGE    Sigma1
WIDTHS AND SPACINGS GIVEN IN ENDF/B ARE ONLY ADEQUATE TO DEFINE    Sigma1
AVERAGE VALUES OF THE CROSS SECTIONS. THEREFORE ALL CROSS SECTIONS Sigma1
IN THE ENDF/B FORMAT FOR THE UNRESOLVED REGION ARE REALLY AVERAGE  Sigma1
VALUES WHICH CANNOT BE DOPPLER BROADENED USING THE SIGMA1 METHOD   Sigma1
(WHICH REQUIRES TABULATED, LINEARLY INTERPOLABLE, ENERGY DEPENDENT Sigma1
CROSS SECTIONS.                                                    Sigma1
                                                                   Sigma1
THEREFORE,                                                         Sigma1
(1) ALL TABULATED POINTS WITHIN THE UNRESOLVED RESONANCE REGION    Sigma1
WILL BE COPIED, WITHOUT MODIFICATION OR BROADENING. ADOPTION OF    Sigma1
THIS CONVENTION WILL ALLOW SUBSEQUENT PROGRAMS TO PROPERLY DEFINE  Sigma1
SELF-SHIELDED, DOPPLER BROADENED CROSS SECTIONS IN THE UNRESOLVED  Sigma1
RESONANCE REGION.                                                  Sigma1
(2) CROSS SECTIONS WILL BE EXTENDED AS 1/V ABOVE THE UPPER ENERGY  Sigma1
LIMIT OF THE RESOLVED RESONANCE REGION AND BELOW THE LOWER ENERGY  Sigma1
LIMIT OF THE CONTINUUUM REGION (I.E. INTO THE UNRESOLVED           Sigma1
RESONANCE REGION). THIS CONVENTION WILL GUARANTEE A SMOOTH         Sigma1
BEHAVIOR CLOSE TO THE UNRESOLVED RESONANCE REGION BOUNDARIES.      Sigma1
                                                                   Sigma1
OUTPUT FORMAT                                                      Sigma1
-------------                                                      Sigma1
IN THIS VERSION OF SIGMA1 ALL FILE 3 ENERGIES WILL BE OUTPUT IN    Sigma1
F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN   Sigma1
WITH UP TO 9 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN  Sigma1
OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS   Sigma1
OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS    Sigma1
TO THE 9 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE  Sigma1
TO USE THE 9 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA     Sigma1
JUST DUE TO TRANSLATION OF THE ENERGIES TO THE ENDF/B FORMAT.      Sigma1
                                                                   Sigma1
CONTENTS OF OUTPUT                                                 Sigma1
------------------                                                 Sigma1
ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE BROADENED FILE 3       Sigma1
CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO     Sigma1
INCLUDED.                                                          Sigma1
                                                                   Sigma1
DOCUMENTATION                                                      Sigma1
-------------                                                      Sigma1
THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED  Sigma1
BY THE ADDITION OF THREE COMMENTS CARDS AT THE END OF EACH         Sigma1
HOLLERITH SECTION IN THE FORM                                      Sigma1
                                                                   Sigma1
***************** PROGRAM SIGMA1 (2004-1) ***************         Sigma1
DATA DOPPLER BROADENED TO 300.0   KELVIN AND                      Sigma1
DATA THINNED TO WITHIN AN ACCURACY OF  0.1 PER-CENT                Sigma1
                                                                   Sigma1
THE ORDER OF ALL SIMILAR COMMENTS (FROM LINEAR,RECENT AND GROUPY)  Sigma1
REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON        Sigma1
```

```
THE DATA.                                                          Sigma1
                                                                   Sigma1
THESE COMMENT CARDS ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS, Sigma1
I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT Sigma1
OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF      Sigma1
EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451    Sigma1
IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF      Sigma1
THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF      Sigma1
MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO          Sigma1
DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND   Sigma1
AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT  Sigma1
SHOULD BE USED TO CREATE A HOLLERITH SECTION.                      Sigma1
                                                                   Sigma1
REACTION INDEX                                                     Sigma1
--------------                                                     Sigma1
THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN     Sigma1
SECTION MF=1, MT=451 OF EACH EVALUATION.                           Sigma1
                                                                   Sigma1
THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451.   Sigma1
THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT         Sigma1
REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS Sigma1
NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING  Sigma1
A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE  Sigma1
A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM Sigma1
YOU MAY USE PROGRAM DICTIN TO CREATE A CORRECT REACTION INDEX.     Sigma1
                                                                   Sigma1
SECTION SIZE                                                       Sigma1
------------                                                       Sigma1
SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT  Sigma1
TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS      Sigma1
SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.                 Sigma1
                                                                   Sigma1
SELECTION OF DATA                                                  Sigma1
-----------------                                                  Sigma1
THE PROGRAM SELECTS MATERIALS TO BE BROADENED BASED EITHER ON      Sigma1
MAT (ENDF/B MAT NO.) OR ZA. THE PROGRAM ALLOWS UP TO 100 MAT OR    Sigma1
ZA RANGES TO BE SPECIFIED. THE PROGRAM WILL ASSUME THAT THE        Sigma1
ENDF/B TAPE IS IN EITHER MAT OR ZA ORDER, WHICHEVER CRITERIA IS    Sigma1
USED TO SELECT MATERIALS, AND WILL TERMINATE WHEN A MAT OR ZA      Sigma1
IS FOUND THAT IS ABOVE THE RANGE OF ALL REQUESTS.                  Sigma1
                                                                   Sigma1
ENERGY GRID OF BROADENED DATA                                      Sigma1
-----------------------------                                      Sigma1
THE ENERGY GRID FOR THE DOPPLER BROADENED CROSS SECTIONS IS        Sigma1
SELECTED TO INSURE THAT THE BROADENED DATA IS LINEAR-LINEAR        Sigma1
INTERPOLABLE. AS SUCH THE ENERGY GRID FOR THE BROADENED DATA       Sigma1
MAY NOT BE THE SAME AS THE ENERGY GRID FOR THE ORIGINAL            Sigma1
UNBROADENED DATA. GENERALLY AFTER BROADENING THERE WILL BE         Sigma1
FEWER DATA POINTS IN THE RESONANCE REGION, BUT AT LOW ENERGY       Sigma1
THERE MAY BE MORE POINTS, DUE TO THE 1/V LOW ENERGY EFFECT         Sigma1
CREATED BY DOPPLER BROADENING.                                     Sigma1
                                                                   Sigma1
EFFECTIVE TEMERATURE INCREASE                                      Sigma1
-----------------------------                                      Sigma1
IF THE ORIGINAL DATA IS NOT AT ZERO KELVIN THE PROGRAM WILL        Sigma1
BROADEN THE DATA BY THE EFFECTIVE TEMPERATURE DIFFENCE TO THE      Sigma1
FINAL TEMPERATURE. IF THE DATA IS ALREADY AT A TEMPERATURE THAT    Sigma1
IS HIGHER THAN THE FINAL TEMPERATURE DOPPLER BROADENING IS         Sigma1
NATURALLY NOT PERFORMED AND THE TEMPERATURE IN THE SECTION IS LEFT Sigma1
AT ITS ORIGINAL VALUE.                                             Sigma1
                                                                   Sigma1
MULTIPLE FINAL TEMPERATURES                                        Sigma1
---------------------------                                        Sigma1
THE PRESENT VERSION ONLY DOPPLER BROADENS TO ONE FINAL TEMPERATURE Sigma1
(IF THERE IS SUFFICIENT INTEREST EXPRESSED BY USERS FUTURE         Sigma1
VERSION MAY BROADEN TO MULTIPLE TEMPERATURES. PLEASE               Sigma1
CONTACT THE AUTHOR IF YOU ARE INTERESTED IN A MULTIPLE             Sigma1
TEMPERATURE OPTION).                                               Sigma1
                                                                   Sigma1
PROGRAM OPERATION                                                  Sigma1
-----------------                                                  Sigma1
```

```
EACH SECTION OF FILE 3 DATA IS CONSIDERED SEPERATELY. THE DATA     Sigma1
IS READ AND DOPPLER BROADENED A PAGE AT A TIME (ONE PAGE IS        Sigma1
60000 DATA POINTS). UP TO THREE PAGES OF DATA MAY BE IN THE CORE   Sigma1
AT ANY GIVEN TIME, THE PAGE BEING BROADENED, THE PAGE BELOW IT     Sigma1
IN ENERGY AND THE PAGE ABOVE IT IN ENERGY. AFTER A PAGE HAS BEEN   Sigma1
BROADENED IT IS THINNED, IF THE ENTIRE SECTION CONTAINS ONLY       Sigma1
ONE PAGE OR LESS, IT WILL STILL BE CORE RESIDENT AND WILL BE       Sigma1
WRITTEN DIRECTLY FROM CORE TO THE OUTPUT TAPE. IF THE BROADENED,   Sigma1
THINNED SECTION IS LARGER THAN A PAGE, AFTER A PAGE HAS BEEN       Sigma1
BROADENED AND THINNED IT IS WRITTEN TO A SCRATCH FILE. AFTER THE   Sigma1
ENTIRE SECTION HAS BEEN BROADENED AND THINNED THE DATA IS READ     Sigma1
FROM SCRATCH TO CORE, ONE PAGE AT A TIME, THE OUTPUT TO THE OUTPUT Sigma1
TAPE.                                                              Sigma1
                                                                   Sigma1
ALLOWABLE ERROR                                                    Sigma1
--------------                                                     Sigma1
AFTER DOPPLER BROADENING THE CROSS SECTION IN THE RESONANCE REGION Sigma1
WILL GENERALLY BE MUCH SMOOTHER THAN THE UNBROADENED DATA AND CAN  Sigma1
BE REPRESENTED TO THE SAME ACCURACY BY A SMALLER NUMBER OF ENERGY  Sigma1
POINTS. THEREFORE AFTER DOPPLER BROADENING THE DATA CAN BE THINNED Sigma1
WITH ESSENTIALLY NO LOSE OF INFORMATION.                           Sigma1
                                                                   Sigma1
THE ALLOWABLE ERROR MAY BE ENERGY INDEPENDENT (CONSTANT) OR ENERGY Sigma1
DEPENDENT. THE ALLOWABLE ERROR IS DESCRIBED BY A TABULATED         Sigma1
FUNCTION OF UP TO 20 (ENERGY,ERROR) PAIRS AND LINEAR INTERPOLATION Sigma1
BETWEEN TABULATED POINTS. IF ONLY ONE TABULATED POINT IS GIVEN THE Sigma1
ERROR WILL BE CONSIDERED CONSTANT OVER THE ENTIRE ENERGY RANGE.    Sigma1
WITH THIS ENERGY DEPENDENT ERROR ONE MAY OPTIMIZE THE OUTPUT FOR   Sigma1
ANY GIVEN APPLICATION BY USING A SMALL ERROR IN THE ENERGY RANGE   Sigma1
OF INTEREST AND A LESS STRINGENT ERROR IN OTHER ENERGY RANGES.     Sigma1
                                                                   Sigma1
INPUT FILES                                                        Sigma1
-----------                                                        Sigma1
UNIT  DESCRIPTION                                                  Sigma1
----  -----------                                                  Sigma1
   2  INPUT CARDS (BCD - 80 CHARACTERS/RECORD)                     Sigma1
  10  ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)            Sigma1
                                                                   Sigma1
OUTPUT FILES                                                       Sigma1
------------                                                       Sigma1
UNIT  DESCRIPTION                                                  Sigma1
----  -----------                                                  Sigma1
   3  OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)                  Sigma1
  11  FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)               Sigma1
                                                                   Sigma1
SCRATCH FILES                                                      Sigma1
-------------                                                      Sigma1
UNIT  DESCRIPTION                                                  Sigma1
----  -----------                                                  Sigma1
  12  SCRATCH FILE FOR BROADENED DATA                              Sigma1
      (BINARY - 180000 WORDS/RECORD - DOUBLE PRECISION/            Sigma1
                 42000 WORDS/RECORD - SINLGE PRECISION)            Sigma1
                                                                   Sigma1
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILEIO)               Sigma1
----------------------------------------------------               Sigma1
UNIT  FILE NAME                                                    Sigma1
----  ----------                                                   Sigma1
  2   SIGMA1.INP                                                   Sigma1
  3   SIGMA1.LST                                                   Sigma1
 10   ENDFB.IN                                                     Sigma1
 11   ENDFB.OUT                                                    Sigma1
 12   (SCRATCH)                                                    Sigma1
                                                                   Sigma1
INPUT CARDS                                                        Sigma1
-----------                                                        Sigma1
CARD  COLS.  DESCRIPTION                                           Sigma1
----  -----  -----------                                           Sigma1
   1   1-11  SELECTION CRITERIA (0=MAT, 1=ZA)                       Sigma1
      12-22  MONITOR MODE SELECTOR                                 Sigma1
             = 0 - NORMAL OPERATION                                Sigma1
             = 1 - MONITOR PROGRESS OF DOPPLER BROADENING OF DATA. Sigma1
```

```
                    EACH TIME A PAGE OF DATA POINTS IS WRITTEN TO   Sigma1
                    THE SCRATCH FILE PRINT OUT THE TOTAL NUMBER OF  Sigma1
                    POINTS ON SCRATCH AND THE LOWER AND UPPER       Sigma1
                    ENERGY LIMITS OF THE PAGE (THIS OPTION MAY BE   Sigma1
                    USED IN ORDER TO MONITOR THE EXECUTION SPEED    Sigma1
                    OF LONG RUNNING JOBS).                          Sigma1
         23-33  KELVIN TEMPERATURE                                  Sigma1
         34-44  MINIMUM CROSS SECTION OF INTEREST                   Sigma1
                (DEFAULT VALUE = 1.0E-10 BARNS).                    Sigma1
         45-55  NEGATIVE CROSS SECTION TREATMENT                    Sigma1
                = 0 - O.K.                                          Sigma1
                = 1 - SET = 0                                       Sigma1
         56-66  UNRESOLVED RESONANCE REGION TREATMENT               Sigma1
                = 0 - COPY (NO BROADENING)                          Sigma1
                = 1 - IGNORE (BROADEN)                              Sigma1
      2   1-60  ENDF/B INPUT DATA FILENAME                          Sigma1
                (STANDARD OPTION = ENDFB.IN)                        Sigma1
      3   1-60  ENDF/B OUTPUT DATA FILENAME                         Sigma1
                (STANDARD OPTION = ENDFB.OUT)                       Sigma1
    4-N   1-11  LOWER MAT OR ZA LIMIT                               Sigma1
         12-22  UPPER MAT OR ZA LIMIT                               Sigma1
                UP TO 100 MAT OR ZA RANGES MAY BE SPECIFIED, ONE    Sigma1
                RANGE PER CARD. THE LIST OF RANGES IS TERMINATED BY Sigma1
                A BLANK CARD. IF THE UPPER LIMIT IS LESS THAN THE   Sigma1
                LOWER LIMIT THE UPPER LIMIT WILL BE SET EQUAL TO THE Sigma1
                LOWER LIMIT. IF THE FIRST REQUEST CARD IS BLANK IT  Sigma1
                WILL TERMINATE THE LIST OF REQUESTS AND CAUSE ALL   Sigma1
                DATA TO BE RETRIEVED (SEE EXAMPLE INPUT).           Sigma1
    VARY  1-11  ENERGY FOR ERROR LAW                                Sigma1
         12-22  ERROR FOR ERROR LAW                                 Sigma1
                THE ACCEPTABLE LINEARIZING ERROR CAN BE GIVEN AS AN Sigma1
                ENERGY DEPENDENT FUNCTION SPECIFIED BY UP TO 20     Sigma1
                (ENERGY,ERROR) PAIRS AND LINEAR INTERPOLATION       Sigma1
                TABULATE POINTS. ENERGIES MUST BE IN ASCENDING ORDER. Sigma1
                THE ERROR LAW IS TERMINATED BY A BLANK CARD. IF THE Sigma1
                FIRST ERROR LAW CARD IS BLANK IT WILL TERMINATE THE Sigma1
                ERROR LAW AND THE ERROR WILL BE TREATED AS ENERGY   Sigma1
                INDEPENDENT, EQUAL TO ZERO, WHICH INDICATES THAT THE Sigma1
                BROADENED DATA SHOULD NOT BE THINNED.               Sigma1
                                                                    Sigma1
    EXAMPLE INPUT NO. 1                                             Sigma1
    ------------------                                              Sigma1
    BROADEN ALL URANIUM ISOTOPES AND THORIUM-232 TO 300 KELVIN. FROM Sigma1
    0 TO 100 EV THIN OUTPUT DATA TO 0.1 PER-CENT ACCURACY. FROM 100 EV Sigma1
    TO 1 KEV VARY THE ERROR BETWEEN 0.1 AND 1 PER-CENT. ABOVE 1 KEV Sigma1
    USE 1 PER-CENT ACCURACY.                                        Sigma1
                                                                    Sigma1
    EXPLICITLY SPECIFY THE STANDARD FILENAMES.                      Sigma1
                                                                    Sigma1
    THE FOLLOWING 11 CARDS ARE REQUIRED                             Sigma1
                                                                    Sigma1
        1          0 3.00000+ 2                                     Sigma1
ENDFB.IN                                                            Sigma1
ENDFB.OUT                                                           Sigma1
     92000      92999                                               Sigma1
     90232               (UPPER LIMIT WILL AUTOMATICALLY BE DEFINED) Sigma1
                         (BLANK CARD INDICATES END OF REQUEST LIST)  Sigma1
0.00000+ 0 1.00000-03                                               Sigma1
1.00000+ 2 1.00000-03                                               Sigma1
1.00000+ 3 1.00000-02                                               Sigma1
1.00000+ 9 1.00000-02                                               Sigma1
                         (BLANK CARD INDICATES END OF ERROR LAW)    Sigma1
                                                                    Sigma1
    EXAMPLE INPUT NO. 2                                             Sigma1
    ------------------                                              Sigma1
    BROADEN ALL DATA TO 300 KELVIN AND DO NOT THIN THE BROADEN DATA. Sigma1
    ALL OF THE STANDARD OPTION MAY BE INVOKED MERELY BY SPECIFYING  Sigma1
    THE KELVIN TEMPERATURE ON THE FIRST CARD. ALL OTHER FIELDS MAY  Sigma1
    BE LEFT BLANK.                                                  Sigma1
                                                                    Sigma1
    LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL  Sigma1
```

```
    THEN USE STANDARD FILENAMES.                                          Sigma1
                                                                          Sigma1
    THE FOLLOWING 5 CARDS ARE REQUIRED                                    Sigma1
                                                                          Sigma1
                     3.00000+ 2                                           Sigma1
                     (USE STANDARD FILENAME = ENDFB.IN)                   Sigma1
                     (USE STANDARD FILENAME = ENDFB.OUT)                  Sigma1
                     (RETRIEVE ALL DATA, TERMINATE REQUEST LIST)          Sigma1
                     (0.0 ALLOWABLE ERROR, TERMINATE ERROR LAW)           Sigma1
                                                                          Sigma1
    EXAMPLE INPUT NO. 3                                                   Sigma1
    ------------------                                                    Sigma1
    THE SAME AS ABOVE, ONLY DEFINE THE MINIMUM CROSS SECTION OF           Sigma1
    INTEREST TO BE 1.0E-30 BARNS (INSTEAD OF THE DEFAULT VALUE OF         Sigma1
    1.0E-10).                                                             Sigma1
                                                                          Sigma1
    READ ENDF/B DATA FROM \ENDFB6\RECENT\ZA092238 AND WRITE ENDF/B        Sigma1
    DATA TO \ENDFB\SIGMA1\ZA092238                                        Sigma1
                                                                          Sigma1
    THE FOLLOWING 5 CARDS ARE REQUIRED                                    Sigma1
                                                                          Sigma1
                     3.00000+ 2 1.00000-30                                Sigma1
 \ENDFB6\RECENT\ZA092238                                                  Sigma1
 \ENDFB6\SIGMA1\ZA092238                                                  Sigma1
                     (RETRIEVE ALL DATA, TERMINATE REQUEST LIST)          Sigma1
                     (0.0 ALLOWABLE ERROR, TERMINATE ERROR LAW)           Sigma1
                                                                          Sigma1
========================================================================= Sigma1
```

```
====================================================================== Sixpak
                                                                       Sixpak
     PROGRAM SIXPAK                                                    Sixpak
     ================================================================= Sixpak
     VERSION 92-1 (JANUARY 1992)                                       Sixpak
     VERSION 92-2 (FEBRUARY 1992)*INCREASED CORE ALLOCATION TO         Sixpak
                                  ACCOMMODATE JEF AND EFF EVALUATIONS. Sixpak
     VERSION 92-3 (APRIL 1992)   *ADDED ADDITIONAL DATA TESTS.         Sixpak
     VERSION 92-4 (SEPT. 1992)   *CORRECTED KALBACH-MANN CALCULATIONS. Sixpak
                                 *FOR PHOTON PRODUCTION OUTPUT MF=12   Sixpak
                                  (MULTIPLICITY), MF=14 (ISOTROPIC     Sixpak
                                  ANGULAR DISTRIBUTIONS) AND MF=15     Sixpak
                                  (SPECTRA) - PREVIOUSLY ONLY MF=15.   Sixpak
                                 *FIRST ORDER CORRECTIONS TRANSFORMING Sixpak
                                  CENTER-OF-MASS SPECTRA TO LAB SYSTEM Sixpak
                                  FOR OUTPUT IN MF=5                   Sixpak
                                 *CORRECTED ISOTROPIC ANGULAR          Sixpak
                                  DISTRIBUTION FLAG (LI)               Sixpak
     VERSION 94-1 (JANUARY 1994) *VARIABLE ENDF/B INPUT DATA FILENAME  Sixpak
                                  TO ALLOW ACCESS TO FILE STRUCTURES    Sixpak
                                  (WARNING - INPUT PARAMETER FORMAT     Sixpak
                                  HAS BEEN CHANGED)                    Sixpak
                                 *CLOSE ALL FILES BEFORE TERMINATING    Sixpak
                                  (SEE, SUBROUTINE ENDIT)              Sixpak
                                 *INCREASED MAXIMUM TABLE SIZE FROM     Sixpak
                                  2000 TO 6000.                        Sixpak
     VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                    Sixpak
                                 *IMPROVED COMPUTER INDEPENDENCE       Sixpak
                                 *ALL DOUBLE PRECISION                 Sixpak
                                 *ON SCREEN OUTPUT                     Sixpak
                                 *UNIFORM TREATMENT OF ENDF/B I/O      Sixpak
                                 *IMPROVED OUTPUT PRECISION            Sixpak
     VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING      Sixpak
                                  POINT READ FOR MORE DIGITS           Sixpak
                                 *UPDATED TEST FOR ENDF/B FORMAT       Sixpak
                                  VERSION BASED ON RECENT FORMAT CHANGE Sixpak
                                 *GENERAL IMPROVEMENTS BASED ON        Sixpak
                                  USER FEEDBACK                        Sixpak
     VERSION 99-2 (JUNE 1999)    *ASSUME ENDF/B-VI, NOT V, IF MISSING  Sixpak
                                  MF=1, MT-451.                        Sixpak
     VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON        Sixpak
                                  USER FEEDBACK                        Sixpak
     VERS. 2002-1 (JANUARY 2002) *CORRECTED ANGULAR DISTRIBUTION (MF=4) Sixpak
                                  OUTPUT TO INSURE USED FIELDS ARE 0   Sixpak
                  (MAY 2002)     *OPTIONAL INPUT PARAMETERS            Sixpak
                  (NOV. 2002)    *EXTENDED TO ALLOW CHARGED PARTICLE   Sixpak
                                  ANGULAR DISTRIBUTION IN MF=4 -       Sixpak
                                  WARNING - STRICTLY SPEAKING THIS IS  Sixpak
                                  NOT LEGAL, SINCE MF=4 IS SUPPOSED TO Sixpak
                                  BE USED ONLY FOR NEUTRON ANGULAR     Sixpak
                                  DISTRIBUTIONS - BUT WHERE MT MAKES   Sixpak
                                  IT OBVIOUS THAT THE OUTGOING PARTICLE Sixpak
                                  IS NOT A NEUTRON HOPEFULLY IT WILL   Sixpak
                                  NOT CAUSE A PROBLEM IF MF=4 IS USED  Sixpak
                                  FOR CHARGED PARTICLES.               Sixpak
     VERS. 2004-1 (MARCH 2004)   *ADDED INCLUDE FOR COMMON            Sixpak
                                 *INCREASED MAXIMUM TABLE SIZE FROM    Sixpak
                                  6,000 TO 12,000.                     Sixpak
                                  *ADDED DUMMY A FOR ELEMENTS          Sixpak
                                  *CORRECTED OUTPUT INTERPOLATON LAWS  Sixpak
                                                                       Sixpak
     OWNED, MAINTAINED AND DISTRIBUTED BY                              Sixpak
     ------------------------------------                              Sixpak
     THE NUCLEAR DATA SECTION                                          Sixpak
     INTERNATIONAL ATOMIC ENERGY AGENCY                                Sixpak
     P.O. BOX 100                                                      Sixpak
     A-1400, VIENNA, AUSTRIA                                           Sixpak
     EUROPE                                                            Sixpak
                                                                       Sixpak
     ORIGINALLY WRITTEN BY                                             Sixpak
     ------------------------------------                              Sixpak
```

DERMOTT E. CULLEN Sixpak
UNIVERSITY OF CALIFORNIA Sixpak
LAWRENCE LIVERMORE NATIONAL LABORATORY Sixpak
L-159 Sixpak
P.O. BOX 808 Sixpak
LIVERMORE, CA 94550 Sixpak
U.S.A. Sixpak
TELEPHONE 925-423-7359 Sixpak
E. MAIL CULLEN1@LLNL.GOV Sixpak
WEBSITE HTTP://WWW.LLNL.GOV/CULLEN1 Sixpak
Sixpak

COLLABORATION Sixpak
================================================================ Sixpak
DEVELOPED IN COLLABORATION WITH, Sixpak
Sixpak
*THE NATIONAL NUCLEAR DATA CENTER, BROOKHAVEN NATIONAL LAB Sixpak
Sixpak
*THE NUCLEAR DATA SECTION, IAEA, VIENNA, AUSTRIA Sixpak
Sixpak
*CENTRO TECNICO AEROSPACIAL, SAO JOSE DOS CAMPOS, BRAZIL Sixpak
Sixpak
AS A PART OF AN INTERNATIONAL PROJECT ON THE EXCHANGE OF Sixpak
NUCLEAR DATA Sixpak
Sixpak
ACKNOWLEDGEMENT (VERSION 92-1) Sixpak
================================================================ Sixpak
THE AUTHOR THANKS SOL PEARLSTEIN (BROOKHAVEN NATIONAL LAB) FOR Sixpak
SIGNIFICANTLY CONTRIBUTING TOWARD IMPROVING THE ACCURACY AND Sixpak
COMPUTER INDEPENDENCE OF THIS CODE - THANKS, SOL Sixpak
Sixpak
ACKNOWLEDGEMENT (VERSION 92-4) Sixpak
================================================================ Sixpak
THE AUTHOR THANKS BOB MACFARLANE (LOS ALAMOS) FOR SUGGESTING HOW Sixpak
TO PROPERLY OUTPUT THE PHOTON PRODUCTION DATA TO PUT IT INTO Sixpak
EXACTLY THE FORM NEEDED FOR USE IN PROCESSING CODES. Sixpak
Sixpak
THE AUTHOR THANKS CHRIS DEAN (WINFRITH) FOR POINTING OUT ERRORS Sixpak
IN THE EARLIER TREATMENT OF THE KALBACH-MANN FORMALISM AND IN Sixpak
THE DEFINITION OF THE ISOTROPIC ANGULAR DISTRIBUTION FLAG (LI). Sixpak
Sixpak
AUTHORS MESSAGE Sixpak
================================================================ Sixpak
THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENTATION Sixpak
INCLUDING ALL RECENT IMPROVEMENTS. PLEASE READ ALL OF THESE Sixpak
COMMENTS BEFORE IMPLEMENTING AND USING THESE CODES. Sixpak
Sixpak
AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER Sixpak
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE Sixpak
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT Sixpak
IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY Sixpak
COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO Sixpak
IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF Sixpak
THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR Sixpak
COMPUTER. Sixpak
Sixpak
PURPOSE Sixpak
================================================================ Sixpak
1) CHECK ALL DOUBLE-DIFFERENTIAL DATA (MF=6) Sixpak
Sixpak
2) OUTPUT EQUIVALENT MF = 4, 5, 12, 14 AND 15 DATA. Sixpak
Sixpak
DATA CHECKING Sixpak
================================================================ Sixpak
ALL OF THE ENDF/B-VI MF=6 DATA IS CHECKED - FOR DETAILS SEE BELOW. Sixpak
Sixpak
THE MF=6 DATA IS NOT CORRECTED AND OUTPUT IN THE ENDF/B FORMAT. Sixpak
IT IS MERELY CHECKED. IF ERRORS ARE FOUND IT IS UP TO THE USER Sixpak
TO TAKE CORRECTIVE ACTION ON THE MF=6 DATA. Sixpak
Sixpak
IN CONTRAST WHEN PROBLEMS ARE FOUND IN DATA WHICH WILL BE OUTPUT Sixpak
IN THE ENDF/B FORMAT (MF=4, 5, 12, 14 AND 15), WHENEVER POSSIBLE Sixpak

```
CORRECTIVE ACTION WILL BE TAKEN.                                    Sixpak
                                                                    Sixpak
FURTHER CHECKS AND CORRECTIONS                                      Sixpak
================================================================== Sixpak
ONCE THE DATA HAS BEEN OUTPUT IN MF = 4, 5, 12, 14 AND 15 FORMATS  Sixpak
FURTHER CORRECTIVE ACTION CAN BE TAKEN AS FOLLOWS,                  Sixpak
                                                                    Sixpak
PROGRAM LEGEND                                                      Sixpak
==============                                                      Sixpak
CAN BE USED TO CORRECT ANGULAR DISTRIBUTIONS WHICH ARE NEGATIVE,    Sixpak
TO CONVERT FROM LEGENDRE COEFFICIENTS TO TABULATED ANGULAR          Sixpak
DISTRIBUTIONS AND GENERALLY PERFORM MORE EXTENSIVE TESTS OF         Sixpak
ALL MF=4 DATA.                                                      Sixpak
                                                                    Sixpak
PROGRAM EVALPLOT                                                    Sixpak
================                                                    Sixpak
VERSION 92-1 AND LATER VERSIONS CAN PLOT ALL OF THE MF=4, 5 AND 15 Sixpak
DATA OUTPUT BY THIS CODE. EARLIER VERSIONS CAN PLOT MF=4 AND 5.     Sixpak
GRAPHICS IS AN EXCELLENT WAY TO CHECK THIS DATA.                    Sixpak
                                                                    Sixpak
PROGRAM PLOTTAB                                                     Sixpak
===============                                                     Sixpak
THIS IS A GENERAL PLOTTING PROGRAM AND THERE IS AN INTERFACE IN     Sixpak
THIS CODE TO PRODUCE OUTPUT FOR ANY MF=6 DATA IN THE PLOTTAB        Sixpak
INPUT FORMAT. THIS PROGRAM CAN BE USED TO CHECK ALL OF THE MF=6     Sixpak
DATA AS WELL AS THE EQUIVALENT MF=4, 5, 12, 14 AND 15 DATA - AS     Sixpak
WELL AS COMPARING THE ORIGINAL MF=6 AND EQUIVALENT DATA.            Sixpak
                                                                    Sixpak
DATA OUTPUT                                                         Sixpak
================================================================== Sixpak
THE ENDF/B MF=4, 5, 12, 14 AND 15 FORMATS ONLY ALLOW FOR NEUTRONS   Sixpak
INCIDENTS                                                           Sixpak
                                                                    Sixpak
THE ENDF/B MF=4 AND 5 FORMATS ONLY ALLOW FOR NEUTRONS OUTGOING.     Sixpak
                                                                    Sixpak
THE ENDF/B MF=12, 14 AND 15 ONLY ALLOWS FOR PHOTONS OUTGOING.       Sixpak
                                                                    Sixpak
THESE ARE THE ONLY COMBINATIONS OF DATA OUTPUT BY THIS CODE.        Sixpak
                                                                    Sixpak
ALL OTHER COMBINATIONS OF INCIDENT AND OUTGOING PARTICLES ARE       Sixpak
CHECKED, BUT THE RESULTS CANNOT BE OUTPUT IN THE ENDF/B FORMAT.     Sixpak
HOWEVER, USING THE PLOTTAB INTERFACE BUILT INTO THIS CODE THIS      Sixpak
DATA CAN, AND HAS BEEN, OUTPUT AND CHECKED.                         Sixpak
                                                                    Sixpak
THE NEUTRON DATA IN MF=4 CAN BE IN THE FORM OF EITHER TABULATED     Sixpak
ANGULAR DISTRIBUTIONS OR LEGENDRE COEFFICIENTS.                     Sixpak
                                                                    Sixpak
THE NEUTRON (MF=5) OR PHOTON (MF=15) SPECTRA ARE BOTH IN EXACTLY    Sixpak
THE SAME FORMAT = ARBITRARY TABULATED FUNCTIONS - ENDF/B OPTION     Sixpak
LF=1.                                                               Sixpak
                                                                    Sixpak
ENDF/B DATA OUTPUT ORDER                                            Sixpak
================================================================== Sixpak
ENDF/B DATA IS OUTPUT IN ASCENDING MAT, MF, MT ORDER. IN ORDER TO   Sixpak
ALLOW THIS PROGRAM TO PRODUCE ALL OUTPUT IN A SINGLE PASS THROUGH   Sixpak
THE MF=6 DATA, OUTPUT FOR EACH (MAT, MT) IS OUTPUT TO SEPERATE      Sixpak
FILES FOR MF=4, 5, 12, 14 AND 15.                                   Sixpak
                                                                    Sixpak
FOR SUBSEQUENT USE THE ENDF/B FORMATTED DATA OUTPUT BY THIS CODE    Sixpak
CAN BE MERGED TOGETHER USING PROGRAM MERGER (CONTAIN THE AUTHOR     Sixpak
OF THIS CODE FOR A COPY OF MERGER), E.G., MERGE MF=12, 14 AND 15    Sixpak
DATA IN ORDER TO THEN CALCULATE PHOTON PRODUCTION DATA OR MF=4      Sixpak
AND 5 CAN BE MERGED TOGETHER TO CALCULATE NEUTRON TRANSFER - OR     Sixpak
ALL OF THEM CAN BE MERGED TOGETHER TO PERFORM NEUTRON AND PHOTON    Sixpak
CALCULATIONS.                                                       Sixpak
                                                                    Sixpak
CORRELATED (MF=6) VS. UNCORRELATED (MF=4 AND 5) DATA                Sixpak
================================================================== Sixpak
THE ENDF/B DOUBLE DIFFERENTAL = CORRELATED - DATA IN MF=6           Sixpak
REPRESENTS DATA IN THE FORM,                                        Sixpak
                                                                    Sixpak
```

```
F(E,EP,COS) = SIG(E)*Y(E)*G0(E,EP)*F(E,EP,COS)                    Sixpak
                                                                 Sixpak
SIG(E)      = MF=3 CROSS SECTIONS                                Sixpak
Y(E)        = YIELD (MULTIPLICITY)                               Sixpak
G0(E,EP)    = ENERGY SPECTRUM                                    Sixpak
F(E,EP,COS) = ANGULAR DISTRIBUTION                               Sixpak
                                                                 Sixpak
IN A SITUATION WHERE YOU HAVE MONOENERGETIC AND MONODIRECTIONAL  Sixpak
NEUTRONS INCIDENT YOU WILL BE ABLE TO OBSERVE CORRELATION EFFECTS Sixpak
IN THE NEUTRON SPECTRUM AND ANGULAR DISTRIBUTION.                Sixpak
                                                                 Sixpak
EVEN IN SITUATIONS WHERE YOU HAVE A NARROW SPECTRUM OF NEUTRONS  Sixpak
THAT ARE HIGHLY DIRECTIONALLY ORIENTED YOU MAY BE ABLE TO OBSERVE Sixpak
THESE CORRELATION EFFECTS, E.G., A NARROW 14 MEV FUSION SOURCE   Sixpak
INCIDENT ON THE FIRST WALL OF A CTR DEVICE.                      Sixpak
                                                                 Sixpak
FOR SUCH SITUATIONS USE OF THE CORRELATED (MF=6) DATA IS REQUIRED Sixpak
IN CALCULATIONS.                                                 Sixpak
                                                                 Sixpak
HOWEVER, IN MANY APPLICATIONS WHERE THERE IS A BROAD SPECTRUM OF  Sixpak
NEUTRONS AND THE NEUTRON FLUX IS NOT HIGHLY DIRECTIONALLY        Sixpak
ORIENTED, THE NEUTRON MULTIPLICATION, SPECTRUM AND ORIENTATION   Sixpak
CAN BE FAIRLY ACCURATELY CALCULATED WITHOUT CONSIDERING          Sixpak
CORRELATION EFFECTS.                                             Sixpak
                                                                 Sixpak
THE UNCORRELATED DATA PRODUCED BY THIS CODE REPLACES THE         Sixpak
CORRELATED DATA,                                                 Sixpak
                                                                 Sixpak
F(E,EP,COS) = SIG(E)*Y(E)*G0(E,EP)*F(E,EP,COS)                   Sixpak
                                                                 Sixpak
BY THE UNCORRELATED DATA,                                        Sixpak
                                                                 Sixpak
F(E,EP,COS) = SIG(E)*Y(E)*G0(E,EP)*F0(E,COS)                     Sixpak
                                                                 Sixpak
BY INTEGRATING G0(E,EP)*F(E,EP,COS) OVER SECONDARY ENERGY (EP)   Sixpak
TO DEFINE AN AVERAGE ANGULAR DISTRIBUTION, F0(E,COS).            Sixpak
                                                                 Sixpak
WHAT IS LOST IN THIS PROCESS IS THE CORRELATION BETWEEN EP AND COS Sixpak
SO THAT IN A TRANSPORT CALCULATION ALL MOMENTS OF THE FLUX WILL  Sixpak
HAVE THE SAME SPECTRUM, G0(E,EP) AND EACH WILL BE EFFECTED BY THE Sixpak
AVERAGE ANGULAR DISTRIBUTION.                                    Sixpak
                                                                 Sixpak
FOR APPLICATIONS TO HIGH ENERGY FUSION APPLICATIONS CORRELATED   Sixpak
DATA SHOULD BE USED. HOWEVER, FOR LOWER ENERGY APPLICATIONS,     Sixpak
SUCH AS FISSION REACTORS, IT SHOULD BE ADEQUATE TO USE THE       Sixpak
UNCORRELATED DATA - IN THIS CASE THE MOST IMPORTANT EFFECT       Sixpak
WILL BE THE OVERALL NEUTRON MULTIPLICATION AND SPECTRUM.         Sixpak
                                                                 Sixpak
AN IMPORTANT CONSIDERATION IN DESIGNING THIS PROGRAM IS THAT     Sixpak
MANY COMPUTER CODES - DATA PROCESSING AND TRANSPORT CODES -      Sixpak
CANNOT USE THE CORRELATED (MF=6) DATA - NOR ARE THEY INTENDED    Sixpak
FOR HIGH ENERGY USE. FOR THESE CODES THE UNCORRELATED DATA       Sixpak
PRODUCED BY THIS CODE SHOULD BE ADEQUATE TO MEET THEIR NEEDS.    Sixpak
                                                                 Sixpak
WARNING - IT CANNOT BE STRESSED ENOUGH THAT THE OUTPUT OF THIS   Sixpak
CODE SHOULD ONLY BE USED FOR LOW ENERGY APPLICATIONS - FAILURE   Sixpak
TO HEED THIS WARNING CAN LEAD TO COMPLETELY UNRELIABLE RESULTS.  Sixpak
                                                                 Sixpak
ENDF/B FORMAT                                                    Sixpak
================================================================ Sixpak
THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS   Sixpak
OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION Sixpak
OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT). Sixpak
                                                                 Sixpak
IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B     Sixpak
FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS   Sixpak
ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE Sixpak
NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE        Sixpak
CORRECTLY OUTPUT ON ALL LINES. THE FORMAT OF SECTION MF=1, MT=451 Sixpak
AND ALL SECTIONS OF MF=6 MUST BE CORRECT. THE PROGRAM SKIPS ALL  Sixpak
OTHER SECTIONS OF DATA AND AS SUCH IS INSENSITIVE TO THE FORMAT  Sixpak
```

```
OF ALL OTHER SECTIONS.                                                  Sixpak
                                                                        Sixpak
CONTENTS OF OUTPUT                                                      Sixpak
================================================================        Sixpak
5 ENDF/B FORMATTED OUTPUT FILES ARE PRODUCED FOR NEUTRON INCIDENT       Sixpak
DATA,                                                                   Sixpak
                                                                        Sixpak
1) ENDFB.MF4 - ANGULAR DISTRIBUTIONS AND LEGENDRE COEFFICIENTS          Sixpak
               FOR NEUTRONS                                             Sixpak
2) ENDFB.MF5 - TABULATED NEUTRON ENERGY SPECTRA                         Sixpak
3) ENDFB.M12 - PHOTON EMISSION MULTIPLICITY                             Sixpak
4) ENDFB.M14 - PHOTON EMISSION ANGULAR DISTRIBUTIONS (ALWAYS            Sixpak
               ISOTROPIC)                                               Sixpak
5) ENDFB.M15 - TABULATED PHOTON EMISSION SPECTRA                        Sixpak
                                                                        Sixpak
EMITTED PARTICLE YIELD                                                  Sixpak
================================================================        Sixpak
NEUTRONS                                                                Sixpak
========                                                                Sixpak
IN MF=6 THE YIELD FOR EACH REACTION IS THE ACTUAL MULTIPLICITY OF       Sixpak
THE REACTION, E.G., (N,2N) = 2. IN USING MF=4 AND 5 DATA THE            Sixpak
ENDF/B CONVENTION IS THAT THE MULTIPLICITY IS IMPLIED BY THE            Sixpak
MT NUMBER, E.G., MT=16 = (N,2N) = 2.                                    Sixpak
                                                                        Sixpak
THE ONLY EXCEPT IN ENDF/B-VI IS MT=201 = TOTAL NEUTRON PRODUCTION       Sixpak
WHERE AN ACTUAL ENERGY DEPENDENT YIELD IS INCLUDED IN MF=6.             Sixpak
HOWEVER, IN THIS CASE THE MF=3 CROSS SECTION INCLUDES THE               Sixpak
MULTIPLICITY (S. PEARLSTEIN, PRIVATE COMMUNICATION, JAN. 1992),         Sixpak
SIG(MT=201) = 2*SIG(N,2N)+3*SIG(N,3N).....ETC.                          Sixpak
                                                                        Sixpak
SO THAT FOR ALL ENDF/B-VI DATA AS OF JANUARY 1992 THE MF=4 AND 5        Sixpak
DATA OUTPUT BY THIS CODE CAN BE USED IN CONJUNCTION WITH THE MF=3       Sixpak
CROSS SECTIONS - WITHOUT ANY REFERENCE TO THE MF=6 YIELD.               Sixpak
                                                                        Sixpak
PHOTONS                                                                 Sixpak
=======                                                                 Sixpak
UNLIKE THE NEUTRONS WHERE WITH ONLY ONE EXCEPTION (MT=201) THE          Sixpak
MF=6 YIELD IS ENERGY INDEPENDENT, IN THE CASE OF PHOTON EMISSION        Sixpak
ALMOST ALL OF THE PHOTONS HAVE AN ENERGY DEPENDENT YIELD.               Sixpak
                                                                        Sixpak
THIS PROGRAM WILL OUTPUT THE PHOTON MULTIPLICITY IN MF=12 AND           Sixpak
INDICATE THAT THERE IS A NORMALIZED DISTRIBUTION IN MF=15               Sixpak
(LF=1 IN MF=12).                                                        Sixpak
                                                                        Sixpak
THIS PROGRAM WILL OUTPUT THE NORMALIZED PHOTON SPECTRA IN MF=15.        Sixpak
CONTINUOUS ENERGY SPECTRA AND DISCRETE PHOTONS WILL ALL BE OUTPUT       Sixpak
AS NORMALIZED SPECTRA.                                                  Sixpak
                                                                        Sixpak
THIS PROGRAM WILL ALSO OUTPUT MF=14 PHOTON ANGULAR DISTRIBUTION         Sixpak
DATA, ALWAYS USING THE ISOTROPIC FLAG TO MINIMIZE OUTPUT.               Sixpak
                                                                        Sixpak
WARNING OF ENERGY DEPENDENT YIELD                                       Sixpak
=================================                                       Sixpak
THIS PROGRAM WILL PRINT A WARNING MESSAGE IF A SECTION OF DATA          Sixpak
BEING OUTPUT IN THE ENDF/B FORMAT HAS AN ENERGY DEPENDENT MF=6          Sixpak
YIELD AND THE EMITTED PARTICLE IS A NEUTRON - SINCE THE ENDF/B          Sixpak
CONVENTION IS THAT FOR EACH MT NUMBER THE MULTIPLICITY IS IMPLIED       Sixpak
WE DO NOT EXPECT AN ENERGY DEPENDENT MULTIPLICITY FOR NEUTRON           Sixpak
EMISSION.                                                               Sixpak
                                                                        Sixpak
USING THE OUTPUT                                                        Sixpak
================================================================        Sixpak
NOTE, THAT IN USING THIS DATA, STARTING FROM THE RELATIONSHIP,          Sixpak
                                                                        Sixpak
F(E,EP,COS) = SIG(E)*Y(E)*G0(E,EP)*F0(E,COS)                            Sixpak
                                                                        Sixpak
USING THE ENDF/B CONVENTION THAT THE MULTIPLICITY IS EITHER             Sixpak
IMPLIED BY THE MT NUMBER (E.G., MT=16 = N,2N - MULTIPLICITY = 2)        Sixpak
OR INCLUDED IN THE CROSS SECTION (E.G., MT=201 = TOTAL NEUTRON          Sixpak
PRODUCTION) ALL THE INFORMATION REQUIRED FOR A CALCULATION IS           Sixpak
AVAILABLE IN,                                                           Sixpak
```

```
                                                                      Sixpak
MF=3       - SIG(E)                                                   Sixpak
MF=4       - F0(E,COS) - FOR OUTGOING NEUTRONS                        Sixpak
MF=5       - G0(E,EP)  - FOR OUTGOING NEUTRONS                        Sixpak
MF=12      - Y(E)      - FOR OUTGOING PHOTONS                         Sixpak
MF=14      - F0(E,COS) - FOR OUTGOING PHOTONS (ALWAYS ISOTROPIC)      Sixpak
MF=15      - G0(E,EP)  - FOR OUTGOING PHOTONS                         Sixpak
                                                                      Sixpak
DOCUMENTATION                                                         Sixpak
===================================================================== Sixpak
ONLY SECTIONS OF MF=4, 5, 12, 14, 15 ARE OUTPUT ON A ENDF/B FILE.     Sixpak
THE ONLY DOCUMENTATION IS THE ENDF/B TAPE LABEL (FIRST RECORD OF      Sixpak
EACH FILE) WHICH IDENTIFIES THE DATA AS SIXPAK OUTPUT.                Sixpak
                                                                      Sixpak
REACTION INDEX                                                        Sixpak
===================================================================== Sixpak
THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN        Sixpak
SECTION MF=1, MT=451 OF EACH EVALUATION.                              Sixpak
                                                                      Sixpak
SECTION SIZE                                                          Sixpak
===================================================================== Sixpak
ALL OF THE DATA IN ENDF/B-VI, MF=6 ARE QUITE SMALL TABLES. AS SUCH    Sixpak
THIS PROGRAM ONLY ALLOWS TABLES OF UP TO 12000 POINTS (12,000 X,      Sixpak
Y VALUES). THIS SIZE IS MORE THAN ADEQUATE TO HANDLE ALL OF THE       Sixpak
CURRENT ENDF/B-VI DATA, AND IT CAN BE EASILY INCREASED TO HANDLE      Sixpak
ANY NEWER DATA AS IT BECOMES AVAILABLE.                               Sixpak
                                                                      Sixpak
PLEASE CONTACT THE AUTHOR IF YOU HAVE AN EVALUATION WHICH EXCEEDS     Sixpak
THIS LIMIT.                                                           Sixpak
                                                                      Sixpak
SELECTION OF DATA                                                     Sixpak
===================================================================== Sixpak
THE PROGRAM SELECTS DATA TO BE PROCESSED BASED ON MAT/MT RANGES       Sixpak
(MF=6 ASSUMED). THIS PROGRAM ALLOWS UP TO 100 MAT/MT RANGES TO BE     Sixpak
SPECIFIED BY INPUT PARAMETERS. THE PROGRAM WILL ASSUME THAT THE       Sixpak
ENDF/B TAPE IS IN MAT ORDER. THE PROGRAM WILL TERMINATE EXECUTION     Sixpak
WHEN A MAT IS FOUND THAT IS ABOVE ALL REQUESTED MAT RANGES.           Sixpak
                                                                      Sixpak
PROGRAM OPERATION                                                     Sixpak
===================================================================== Sixpak
EACH SECTION (MT) OF MF=6 DATA IS SUBDIVIDED INTO SUBSECTIONS -       Sixpak
ONE SUBSECTION FOR EACH EMITTED PARTICLE.                             Sixpak
                                                                      Sixpak
EACH SUBSECTION OF DATA IS CONSIDERED SEPARATELY. EACH SUBSECTION     Sixpak
OF ENDF/B MF=6 DATA TO PROCESS IS IN THE FORM,                        Sixpak
                                                                      Sixpak
F(E,EP,COS) = SIG(E)*Y(E)*G0(E,EP)*F(E,EP,COS)                        Sixpak
                                                                      Sixpak
SIG(E)      = MF=3 CROSS SECTIONS                                     Sixpak
Y(E)        = YIELD (MULTIPLICITY)                                    Sixpak
G0(E,EP)    = ENERGY SPECTRUM                                         Sixpak
F(E,EP,COS) = ANGULAR DISTRIBUTION                                    Sixpak
                                                                      Sixpak
G0(E,EP) = 1 WHEN INTEGRATED OVER EP (SECONDARY ENERGY)               Sixpak
G0(E,EP)*F(E,EP,COS) = 1 WHEN INTEGRATED OVER EP AND COS              Sixpak
                                                                      Sixpak
THIS PROGRAM WILL DEFINE THE ZEROTH ORDER MOMENTS OF THE              Sixpak
ENERGY AND ANGULAR DISTRIBUTIONS,                                     Sixpak
                                                                      Sixpak
G0(E,EP)  = G0(E,EP)*F(E,EP,COS) INTEGRATED OVER COS                  Sixpak
F0(E,COS) = G0(E,EP)*F(E,EP,COS) INTEGRATED OVER EP                   Sixpak
                                                                      Sixpak
FOR NEUTRON INDUCED REACTIONS THE ENDF/B FORMATTED OUTPUT WILL BE     Sixpak
                                                                      Sixpak
F0(E,COS)- IN ENDFB.MF4 FOR NEUTRONS OUT OF A REACTION                Sixpak
G0(E,EP) - IN ENDFB.MF5 FOR NEUTRONS OUT OF A REACTION                Sixpak
         - IN ENDFB.M15 FOR PHOTONS OUT OF A REACTION                 Sixpak
                                                                      Sixpak
FOR NEUTRONS INCIDENT AND NEUTRONS EMITTED THIS DATA WILL BE          Sixpak
OUTPUT IN MF=4 AND 5 FORMATS.                                         Sixpak
                                                                      Sixpak
```

```
FOR NEUTRONS INCIDENT AND PHOTONS EMITTED THIS DATA WILL BE        Sixpak
OUTPUT IN MF=15 FORMAT - THE SPECTRA ARE OUTPUT AND THE            Sixpak
ANGULAR DISTRIBUTION IS IGNORED.                                   Sixpak
                                                                   Sixpak
ALL PHOTON EMISSION IN THE ENDF/B-VI LIBRARY AS OF JANUARY 1992    Sixpak
IS ISOTROPIC AND AS SUCH NO DISTRIBUTION OF PHOTON ANGULAR         Sixpak
DISTRIBUTIONS NEED BE OUTPUT - IT IS ALWAYS ISOTROPIC.             Sixpak
                                                                   Sixpak
FOR ALL OTHER COMBINATIONS INCIDENT AND EMITTED PARTICLES          Sixpak
THERE WILL BE NO ENDF/B FORMATTED OUTPUT.                          Sixpak
                                                                   Sixpak
VARIATIONS FROM ENDF/B MANUAL                                      Sixpak
================================================================== Sixpak
LAW=1, LANG=2 = KALBACH-MANN                                       Sixpak
============================                                       Sixpak
FOR THE DISTRIBUTIONS,                                             Sixpak
                                                                   Sixpak
F(MU,E,EP) = G0(E,EP)*A*(COSH(MU*A)+R(E,EP)*SINH(MU*A))            Sixpak
                                                                   Sixpak
G0(E,EP) = 1 - WHEN INTEGRATED OVER EP.                            Sixpak
                                                                   Sixpak
A*(COSH(MU*A)+R(E,EP)*SINH(MU*A)) = 2 - WHEN INTEGRATD OVER MU     Sixpak
                                                                   Sixpak
THIS MEANS AS DEFINED IN THE ENDF/B MANUAL THE DISTRIBUTIONS       Sixpak
ARE NORMALIZED TO 2, INSTEAD OF 1. IN ORDER TO OBTAIN CORRECTLY    Sixpak
NORMALIZED DISTRIBUTIONS THE DISTRIBUTION SHOULD BE DEFINED        Sixpak
TO INCLUDE A FACTOR OF 1/2 MULTIPLYING THE ANGULAR PART OF         Sixpak
THE DISTRIBUTION.                                                  Sixpak
                                                                   Sixpak
F(MU,E,EP) = G0(E,EP)*0.5*A*(COSH(MU*A)+R(E,EP)*SINH(MU*A))        Sixpak
                                                                   Sixpak
THIS IS THE FORM USED IN THIS CODE                                 Sixpak
                                                                   Sixpak
LAW=1, ND NOT 0 = DISCRETE SECONDARY ENERGY DISTRIBUTION           Sixpak
========================================================           Sixpak
THE ENDF/B MANUAL SAYS THESE ARE FLAGGED WITH NEGATIVE ENERGIES.   Sixpak
IN ENDF/B-VI ALL OF THESE HAVE POSITIVE ENERGY. THIS CODE DOES     Sixpak
NOT CONSIDER THE ENDF/B-VI DATA TO BE IN ERROR.                    Sixpak
                                                                   Sixpak
WITH THE CONVENTION ACTUALLY USED IN ENDF/B-VI ALL SECONDARY       Sixpak
ENERGIES SHOULD BE NON-NEGATIVE AND IN ASCENDING ENERGY ORDER      Sixpak
FOR EACH INCIDENT ENERGY.                                          Sixpak
                                                                   Sixpak
FROM THE ENDF/B MANUAL IT IS NOT OBVIOUS WHAT G0(E,EP) SHOULD BE   Sixpak
FOR DISCRETE PHOTONS - PHYSICALLY THIS IS A DELTA FUNCTION. IN     Sixpak
ENDF/B-VI IT IS ENTERED AS 1.0 = INTERPRETING IT AS INTEGRATED     Sixpak
OVER SECONDARY ENERGY - IN WHICH CASE THE DELTA FUNCTION = 1.0.    Sixpak
                                                                   Sixpak
LIMITATIONS                                                        Sixpak
================================================================== Sixpak
CHECKING DATA                                                      Sixpak
================================================================== Sixpak
THIS PROGRAM CHECKS ALL ENDF/B-VI MF=6 DATA. THE FOLLOWING CHECKS  Sixpak
ARE PERFORMED.                                                     Sixpak
                                                                   Sixpak
PARAMETERS                                                         Sixpak
==========                                                         Sixpak
ALL PARAMETERS ARE CHECKED FOR CONSISTENCY. IF PARAMETERS ARE      Sixpak
NOT CONSISTENT THE PROGRAM MAY NOT BE ABLE TO PERFORM THE          Sixpak
FOLLOWING TESTS AND WILL MERELY SKIP A SECTION OF DATA.            Sixpak
                                                                   Sixpak
INTERPOLATION LAWS                                                 Sixpak
==================                                                 Sixpak
ALL INTEGRATIONS ARE PERFORMED USING THE INTERPOLATION LAW GIVEN   Sixpak
FOR SECONDARY ENERGY AND/OR COSINE. INTEGRATIONS ARE NOT           Sixpak
PERFORMED OVER INCIDENT - ONLY INTEGRATION OVER SECONDARY ENERGY   Sixpak
AND/OR COSINE ARE PERFORMED AT EACH INCIDENT ENERGY. THEREFORE     Sixpak
THE INTERPOLATION LAW FOR INCIDENT ENERGY IS NOT USED BY THIS      Sixpak
CODE.                                                              Sixpak
                                                                   Sixpak
ALL INTERPOLATION LAWS ARE CHECKED. ALL DATA ASSOCIATED WITH       Sixpak
```

```
INTERPOLATION LAWS ARE CHECKED, E.G., NO NON-NEGATIVE VALUES       Sixpak
REQUIRING LOG INTERPOLATION. IN ORDER TO PERFORM REQUIRED          Sixpak
INTEGRALS OVER COS AND EP IT IS IMPERATIVE THAT THE INTERPOLATION  Sixpak
LAWS BE COMPATIBLE WITH THE DATA.                                  Sixpak
                                                                   Sixpak
ENDF/B-VI ALLOWS NEW INTERPOLATION LAWS FOR CORRESPONDING POINT    Sixpak
AND UNIT BASE TRANSFORMATION INTERPOLATION. NONE OF THESE NEW      Sixpak
INTERPOLATION LAWS ARE USED IN THE ENDF/B-VI LIBRARY AS OF         Sixpak
JANUARY 1992 TO INTERPOLATE IN SECONDARY ENERGY OR COSINE.         Sixpak
THEREFORE THIS PROGRAM CAN PERFORM ALL OF THE REQUIRED INTEGRALS   Sixpak
OVER SECONDARY ENERGY AND/OR COSINE USING ONLY THE OLDER           Sixpak
INTERPOLATION CODES. THIS PROGRAM ONLY PERFORMS INTEGRALS FOR      Sixpak
EACH INCIDENT ENERGY, SO THAT INTERPOLATION IN INCIDENT ENERGY     Sixpak
IS NOT PERFORMED BY THIS PROGRAM.                                  Sixpak
                                                                   Sixpak
NEW INTERPOLATION SCHEMES ARE USED FOR INCIDENT ENERGY - FOR       Sixpak
EXAMPLE, CORRESPONDING POINT INTERPOLATION IS SPECIFIED TO ALLOW   Sixpak
INTERPOLATION IN G0(E,EP) TO SIMULATE CASES WHERE THE INPUT ENERGY Sixpak
LIMIT IS DEFINED BY E-EP = A DIAGONAL CURVE ACROSS (E,EP) SPACE.   Sixpak
THIS INTERPOLATION CODE CANNOT BE SPECIFIED IN THE MF=5 OUTPUT     Sixpak
OF THIS CODE - MF=5 ONLY ALLOWS THE OLDER INTERPOLATION LAWS       Sixpak
INT=1 THROUGH 5. THEREFORE THIS PROGRAM WILL USE THE CLOSEST       Sixpak
CORRESPONDING INTERPOLATION CODE FOR OUTPUT TO MF=5. FOR USE       Sixpak
WHERE THE OUTPUT OF THIS CODE = LOW ENERGY APPLICATIONS - THIS     Sixpak
SHOULD HAVE LITTLE EFFECT ON RESULTS.                              Sixpak
                                                                   Sixpak
FOR CONSISTENCY WITH EARLIER VERSIONS OF ENDF/B IN CREATING THE    Sixpak
ENDF/B OUTPUT, IF ANY INPUT INTERPOLATION LAW IS NOT IN THE        Sixpak
RANGE 1-5, IT WILL FIRST BE TESTED TO SEE IF MOD(10) IT IS         Sixpak
IN THIS RANGE, FINALLY IF EVEN THIS DOESN'T WORK IT IS SET         Sixpak
EQUAL TO 2 (LINEARLY INTERPOLATION). THIS METHOD WILL EFFECTIVELY  Sixpak
REPLACE CORRESPONDING POINT AND UNIT BASE TRANSFORMATION BY THE    Sixpak
CLOSEST RELATED INTERPOLATION LAW 1 THROUGH 5 - AGAIN NOTE, AS     Sixpak
OF JANUARY 1992 NONE OF THESE NEW LAWS ARE USED IN ENDF/B-VI. IF   Sixpak
THIS MUST BE DONE FOR INTERPOLATION IN SECONDARY ENERGY OR COSINE  Sixpak
AN ERROR MESSAGE WILL BE PRINTED - SINCE THIS WOULD EFFECT THE     Sixpak
ACCURACY OF THE INTEGRALS PERFORMED BY THIS PROGRAM. IF THIS MUST  Sixpak
BE DONE FOR INCIDENT ENERGY NO MESSAGE IS PRINTED - SINCE THIS     Sixpak
WILL NOT EFFECT THE ACCURACY OF THE INTEGRALS PERFORMED BY THIS    Sixpak
PROGRAM.                                                           Sixpak
                                                                   Sixpak
SPECTRA AND ANGULAR DISTRIBUTIONS                                  Sixpak
================================                                   Sixpak
ALL SPECTRA AND ANGULAR DISTRIBUTIONS ARE CHECKED TO INSURE        Sixpak
THEY ARE NORMALIZED AND DO NOT INCLUDE ANY NEGATIVE VALUES.        Sixpak
                                                                   Sixpak
LEGENDRE COEFFICIENTS                                              Sixpak
=====================                                              Sixpak
THE NORMALIZATION, F0, CANNOT BE NEGATIVE.                         Sixpak
                                                                   Sixpak
LEGENDRE COEFFICIENTS IN NORMAL FORM ARE CHECKED TO INSURE         Sixpak
THEY ARE IN THE RANGE -1 TO +1 = THE LEGENDRE EXPANSION OF A       Sixpak
DELTA FUNCTION AT COS=+1 OR -1 - COEFFICIENTS SHOULD NOT           Sixpak
EXCEED WHAT YOU GET FROM A DELTA FUNCTION.                         Sixpak
                                                                   Sixpak
ANGULAR DISTRIBUTIONS ARE CHECKED AT COS = -1, 0 AND +1.           Sixpak
                                                                   Sixpak
CREATING ENDF/B OUTPUT                                             Sixpak
=====================================================================Sixpak
THIS PROGRAM CAN CREATE EQUIVALENT MF =4, 5, 12, 14, 15 DATA FOR   Sixpak
ALL OF THE DATA INCLUDED IN ENDF/B-VI AS OF JANUARY 1992, EXCEPT   Sixpak
FOR 1 SECTION OF LAW=6 DATA (SEE DETAILS BELOW).                   Sixpak
                                                                   Sixpak
THIS PROGRAM HAS NOT BEEN TESTED ON OTHER DATA LIBRARIES, E.G.,    Sixpak
JEF, JENDL, ETC.                                                   Sixpak
                                                                   Sixpak
THE PROGRAM HAS THE FOLLOWING LIMITATION AS FAR AS CREATING        Sixpak
ENDF/B FORMATTED OUTPUT.                                           Sixpak
                                                                   Sixpak
ISOTROPIC PHOTON EMISSION                                          Sixpak
=========================                                          Sixpak
```

```
FOR PHOTON EMISSION THE DISTRIBUTIONS ARE ASSUMED TO BE ISOTROPIC  Sixpak
AND ONLY THE MULTIPLICITY IS OUTPUT IN MF=12, ISOTROPIC ANGULAR    Sixpak
DISTRIBUTIONS IN MF=14 AND THE SPECTRA IN MF=15. ALL ENDF/B-VI     Sixpak
MF=6 DATA AS OF JANUARY 1992 INCLUDE ONLY ISOTROPIC PHOTON         Sixpak
EMISSION - SO THAT THIS IS NOT A LIMITATION ON TRANSLATING         Sixpak
ENDF/B-VI DATA.                                                    Sixpak
                                                                   Sixpak
EITHER TABULATED OR LEGENDRE COEFFICIENTS                          Sixpak
========================================                           Sixpak
FOR LAW=2 THE REPRESENTATION, EITHER TABULATED OR LEGENDRE         Sixpak
COEFFICIENTS, CAN BE SPECIFIED FOR EACH INCIDENT ENERGY.           Sixpak
                                                                   Sixpak
IN ORDER TO OBTAIN CORRECT ENDF/B OUTPUT THE REPRESENTATION        Sixpak
MUST BE THE SAME FOR ALL INCIDENT ENERGIES = MF=4 DATA CAN ONLY     Sixpak
BE TABULATED OR LEGENDRE OVER THE ENTIRE ENERGY RANGE.             Sixpak
                                                                   Sixpak
YIELD AND OUTPUT NORMALIZATION                                     Sixpak
==============================                                     Sixpak
THE YIELD INCLUDED WITH EACH SECTION OF DATA IS NOT USED FOR       Sixpak
OUTPUT FOR NEUTRONS, BUT IS INCLUDED IN THE OUTPUT FOR PHOTONS.    Sixpak
IN ALL CASES THE ANGULAR DISTRIBUTIONS AND SPECTRA OUTPUT ARE      Sixpak
NORMALIZED TO UNITY.                                               Sixpak
                                                                   Sixpak
LAW=0                                                              Sixpak
=====                                                              Sixpak
NO OUTPUT - INCIDENT NEUTRON - EMITTED PHOTON OR NEUTRON           Sixpak
            REACTIONS ARE NOT EXPECTED.                            Sixpak
                                                                   Sixpak
LAW=1                                                              Sixpak
=====                                                              Sixpak
FOR EACH INCIDENT ENERGY DISCRETE AND CONTINUOUS EMISSION SPECTRA  Sixpak
CANNOT BE MIXED TOGETHER - THEY MUST BE ALL EITHER DISCRETE OR     Sixpak
CONTINUOUS. IF DISCRETE EMISSION IS GIVEN ONLY 1 SECONDARY         Sixpak
ENERGY (NEP=1) MAY BE GIVEN = A NORMALIZED DISTRIBUTION FOR A      Sixpak
SINGLE DISCRETE EMISSION ENERGY. ALL OF THE ENDF/B-VI DATA AS      Sixpak
OF JANUARY 1992 CONFORM TO THESE LIMITATIONS.                      Sixpak
                                                                   Sixpak
SINCE THE FLAG NA, TO INDICATE ISOTROPIC DISTRIBUTIONS, IS ONLY    Sixpak
GIVEN FOR EACH SECONDARY ENERGY (EP) THE PROGRAM CANNOT DECIDE     Sixpak
IN ADVANCE WHETHER OR NOT THE DISTRIBUTION WILL BE ISOTROPIC       Sixpak
AT ALL INCIDENT ENERGIES. THEREFORE ISOTROPIC DISTRIBUTIONS        Sixpak
WILL BE OUTPUT EITHER: LANG = 1 - AS 1 LEGENDRE COEFFICIENT = 0.0  Sixpak
OR LANG = NOT 1 - AS A 2 POINT ANGULAR DISTRIBUTION AT COS = -1.0  Sixpak
AND +1.0 WITH BOTH VALUES EQUAL TO 0.5 (A NORMALIZED ISOTROPIC     Sixpak
DISTRIBUTION).                                                     Sixpak
                                                                   Sixpak
DISCRETE PHOTONS ARE OUTPUT IN MF=15 AS 3 POINT DISTRIBUTIONS      Sixpak
WITH SECONDARY ENERGY POINTS AT EP-DEP, EP, EP+DEP, WHERE          Sixpak
DEP=0.001*EP. THE VALUES AT EP-DEP AND EP+DEP ARE 0.0, AND         Sixpak
AT EP THE VALUE IS 1000.0/EP TO NORMALIZE THE DISTRIBUTION.        Sixpak
                                                                   Sixpak
LAW=2                                                              Sixpak
=====                                                              Sixpak
NO LIMITATION ON REPRESENTATIONS.                                  Sixpak
                                                                   Sixpak
LAW=3                                                              Sixpak
=====                                                              Sixpak
NO LIMITATION ON REPRESENTATIONS.                                  Sixpak
                                                                   Sixpak
LAW=4                                                              Sixpak
=====                                                              Sixpak
NO OUTPUT - INCIDENT NEUTRON - EMITTED PHOTON OR NEUTRON           Sixpak
            REACTIONS ARE NOT EXPECTED.                            Sixpak
                                                                   Sixpak
LAW=5                                                              Sixpak
=====                                                              Sixpak
NO OUTPUT - INCIDENT NEUTRON - EMITTED PHOTON OR NEUTRON           Sixpak
            REACTIONS ARE NOT EXPECTED.                            Sixpak
                                                                   Sixpak
LAW=6                                                              Sixpak
=====                                                              Sixpak
```

```
NO OUTPUT - ENDF/B-VI ONLY INCLUDES 1 SECTION OF THIS TYPE OF DATA Sixpak
            FOR (N,D) 2N,P.                                       Sixpak
                                                                  Sixpak
LAW=7                                                             Sixpak
=====                                                             Sixpak
FOR EACH INCIDENT ENERGY THE REPRESENTATION MUST BE EITHER,       Sixpak
                                                                  Sixpak
1) SQUARE = FOR EACH INCIDENT COSINE EXACTLY THE SAME SECONDARY   Sixpak
            ENERGIES.                                             Sixpak
                                                                  Sixpak
2) LINEAR = FOR EACH INCIDENT COSINE THE INTERPOLATION LAW        Sixpak
            BETWEEN SECONDARY ENERGIES MUST BE LINEAR.            Sixpak
                                                                  Sixpak
THESE 2 PRESENTATIONS ARE THE ONLY ONES PRESENTED IN ENDF/B-VI    Sixpak
AS OF JANUARY 1992 - SO THIS PROGRAM CAN TRANSLATED ALL LAW=7     Sixpak
DATA FOR ENDF/B-VI.                                               Sixpak
                                                                  Sixpak
LABORATORY VS. CENTER-OF-MASS SYSTEM                              Sixpak
================================================================= Sixpak
IN MANY CASES PEOPLE ASSUME THAT FOR HEAVY (HIGH ATOMIC WEIGHT)   Sixpak
MATERIALS THE CENTER-OF-MASS AND LAB SYSTEMS ARE ALMOST IDENTICAL,Sixpak
SINCE IN THIS CASE THE CENTER-OF-MASS ENERGY WILL BE MUCH SMALLER Sixpak
THAN THE INCIDENT ENERGY. FOR A PROCESS SUCH AS ELASTIC SCATTERING Sixpak
WHERE FOR HEAVY MATERIALS THE SECONDARY ENERGY, EP, WILL ALWAYS   Sixpak
BE A LARGE FRACTION OF THE INCIDENT ENERGY, THIS ASSUMPTION IS    Sixpak
VALID. HOWEVER, FOR THE TYPICAL REACTIONS INCLUDED IN MF=6 THIS   Sixpak
IS NOT ALWAYS TRUE - IN MANY OF THESE CASES THE SECONDARY ENERGY  Sixpak
CAN EXTEND ALL THE WAY DOWN TO ZERO, AND IN PARTICULAR IT CAN     Sixpak
BE SMALL COMPARED TO THE CENTER-OF-MASS ENERGY - WHICH MAKES THE  Sixpak
TRANSFORMATION FROM CENTER-OF-MASS TO LAB IMPORTANT. THEREFORE    Sixpak
GENERALLY TO TREAT MF=6 DATA WE MUST CONSIDER THIS TRANSFORMATION. Sixpak
                                                                  Sixpak
THE FOLLOWING DISCUSSING ONLY APPLIES TO SPECTRA THAT MAY BE      Sixpak
OUTPUT IN MF=5 = ONLY DATA FOR NEUTRONS INCIDENT AND EMITTED -    Sixpak
IN PARTICULAR THE FOLLOWING DEFINITIONS ARE NOT GENERAL - THEY    Sixpak
ARE ONLY VALID FOR INCIDENT AND EMITTED NEUTRONS.                 Sixpak
                                                                  Sixpak
DOUBLE DIFFERENTIAL DATA IN MF=6 MAY BE GIVEN IN EITHER THE LAB   Sixpak
OR C.M. SYSTEM. SIMILARLY ANGULAR DISTRIBUTIONS IN MF=4 MAY BE    Sixpak
GIVEN IN EITHER THE LAB OR C.M. SYSTEM. IN CONTRAST ENERGY        Sixpak
SPECTRA IN MF=5 CAN ONLY BE GIVEN IN THE LABORATORY SYSTEM.       Sixpak
                                                                  Sixpak
THE ANGULAR DISTRIBUTIONS OUTPUT BY THIS CODE IN MF=4 ARE IN THE  Sixpak
SAME SYSTEM IN WHICH THEY ARE GIVEN IN MF=6 - EITHER LAB OR       Sixpak
CENTER-OF-MASS SYSTEM.                                            Sixpak
                                                                  Sixpak
THE ENERGY SPECTRA OUTPUT BY THIS CODE IN MF=5 MUST BE IN THE LAB Sixpak
SYSTEM - THIS IS THE ONLY ALLOWED FORM FOR MF=5 DATA.             Sixpak
                                                                  Sixpak
FOR MF=6 SPECTRA GIVEN IN THE LAB SYSTEM THIS MERELY REQUIRES     Sixpak
COPYING THE GIVEN SPECTRA TO MF=5 OUTPUT.                         Sixpak
                                                                  Sixpak
FOR MF=6 SPECTRA GIVEN IN THE CENTER-OF-MASS SYSTEM ONLY FIRST    Sixpak
ORDER CORRECTIONS IN THE SPECTRA AND USED AND THEY ARE THEN       Sixpak
OUTPUT IN MF=5 AS IN THE LAB SYSTEM - THE FIRST ORDER CORRECTIONS Sixpak
ARE DESCRIBED BELOW.                                              Sixpak
                                                                  Sixpak
DEFINING,                                                         Sixpak
MM      = CENTER OF MASS MOTION                                   Sixpak
CM      = OUTGOING (EMITTED) PARTICLE IN CENTER OF MASS           Sixpak
LAB     = OUTGOING (EMITTED) PARTICLE IN LAB                      Sixpak
THETA   = CM SCATTERING ANGLE RELATIVE TO INCIDENT DIRECTION      Sixpak
COS(CM) = COSINE OF THE CM SCATTERING ANGLE                       Sixpak
                                                                  Sixpak
FOR NEUTRONS INCIDENT WITH AN ENERGY, E, AND THEREFORE A SPEED,   Sixpak
                                                                  Sixpak
VN(E) = 2*SQRT(E)/MASS(IN)                                        Sixpak
                                                                  Sixpak
THE CENTER-OF-MASS SPEED IS GIVEN BY,                             Sixpak
                                                                  Sixpak
V(MM) = VN(E)/(1 + A)                                             Sixpak
```

```
                                                                      Sixpak
AND THE CENTER OF MASS ENERGY BY,                                     Sixpak
                                                                      Sixpak
E(MM) = 1/2*MASS(IN)*V(MM)**2                                         Sixpak
      = 1/2*MASS(IN)*VN(E)**2/(1 + A)**2                              Sixpak
      = E/(1 + A)**2                                                  Sixpak
                                                                      Sixpak
FOR DISTRIBUTIONS GIVEN IN MF=6 IN THE CM, THE SPEED, V(CM),          Sixpak
SHOULD BE VECTORIALLY ADDED TO THAT OF OUTGOING PARTICLES TO          Sixpak
DEFINE THE OUTGOING PARTICLES LAB VELOCITY, AND IN TURN IT'S          Sixpak
ENERGY,                                                               Sixpak
                                                                      Sixpak
V(LAB)*COS(LAB) = V(MM) + V(CM)*COS(CM)                               Sixpak
V(LAB)*SIN(LAB) =         V(CM)*SIN(CM)                               Sixpak
                                                                      Sixpak
V(LAB)**2 = V(MM)**2 + V(CM)**2 + 2*COS(CM)*V(MM)*V(CM)               Sixpak
                                                                      Sixpak
EP(LAB)   = 0.5*MASS(OUT)*V(LAB)**2                                   Sixpak
                                                                      Sixpak
          = E(MM) + EP(CM) + 2*COS(CM)*SQRT(E(MM)*EP(CM))             Sixpak
                                                                      Sixpak
WE CAN ALSO DEFINE THE REVERSE TRANSFORMATION USING,                  Sixpak
                                                                      Sixpak
V(CM)*COS(CM) = V(LAB)*COS(LAB) - V(MM)                               Sixpak
V(CM)*SIN(CM) = V(LAB)*SIN(LAB)                                       Sixpak
                                                                      Sixpak
V(CM)**2 = V(MM)**2 + V(LAB)**2 - 2*COS(LAB)*V(MM)*V(LAB)             Sixpak
                                                                      Sixpak
EP(CM)   = 0.5*MASS(OUT)*V(CM)**2                                     Sixpak
                                                                      Sixpak
          = E(MM) + EP(LAB) - 2*COS(LAB)*SQRT(E(MM)*EP(LAB))          Sixpak
                                                                      Sixpak
WE CAN DEFINE COS(LAB) FROM THE RELATIONSHIP,                         Sixpak
                                                                      Sixpak
V(LAB)*COS(LAB) = V(MM) + V(CM)*COS(CM)                               Sixpak
                                                                      Sixpak
COS(LAB)        =[V(MM) + V(CM)*COS(CM)]/V(LAB)                       Sixpak
                                                                      Sixpak
                 [V(MM) + V(CM)*COS(CM)]                              Sixpak
COS(LAB)        =-------------------------------------------          Sixpak
                 SQRT[V(MM)**2+V(CM)**2+2*COS(CM)*V(MM)*V(CM)]        Sixpak
                                                                      Sixpak
OR COS(CM) FROM THE RELATIONSHIP,                                     Sixpak
                                                                      Sixpak
V(CM)*COS(CM)  = V(LAB)*COS(LAB) - V(MM)                              Sixpak
                                                                      Sixpak
COS(CM)         =[V(LAB)*COS(LAB) - V(MM)]/V(CM)                      Sixpak
                                                                      Sixpak
                 [V(LAB)*COS(LAB) - V(MM)]                            Sixpak
COS(CM)         =-------------------------------------------          Sixpak
                 SQRT[V(LAB)**2+V(CM)**2-2*COS(LAB)*V(LAB)*V(MM)]     Sixpak
                                                                      Sixpak
THE JACOBIAN CAN BE DEFINED FROM,                                     Sixpak
                                                                      Sixpak
V(LAB)*COS(LAB) = V(MM) + V(CM)*COS(CM)                               Sixpak
                                                                      Sixpak
J = D[COS(CM)]/D[COS(LAB)] = V(LAB)/V(CM)                             Sixpak
                           = SQRT[EP(LAB)/EP(CM)]                     Sixpak
                                                                      Sixpak
WITH THESE DEFINITIONS OF EP(LAB) AND COS(LAB) IN TERMS OF E(MM),     Sixpak
EP(CM) AND COS(CM) IT IS POSSIBLE TO PERFORM A POINT-BY-POINT         Sixpak
TRANSFORMATION OF DISTRIBUTIONS FROM THE CM TO LAB SYSTEM USING       Sixpak
THESE DEFINITIONS - OR IF WE WISHED WE COULD PERFORM THE REVERSE      Sixpak
TRANSFORMATION USING THE ABOVE RELATIONSHIPS AND THE IDENTITY,        Sixpak
                                                                      Sixpak
F(E,EP(LAB),COS(LAB))*D(COS(LAB))=F(E,EP(CM),COS(CM))*D(COS(CM))      Sixpak
                                                                      Sixpak
THIS IS NOT WHAT WILL BE DONE HERE, SINCE WE WILL ONLY BE             Sixpak
INTERESTED IN THE ZEROTH ORDER MOMENTS OF THESE DISTRIBUTIONS,        Sixpak
BUT WE WILL BE INTERESTED IN DEFINING THOSE MOMENTS IN THE            Sixpak
LAB SYSTEM IN TERMS OF MF=6 SPECTRA GIVEN IN THE CM SYSTEM USING,     Sixpak
```

```
                                                                      Sixpak
F(E,EP(LAB),COS(LAB)) = F(E,EP(CM),COS(CM))*J                         Sixpak
                                                                      Sixpak
THE LIMITS OF EP(LAB) ARE DEFINED BY SETTING COS(CM) = +1 OR -1,      Sixpak
                                                                      Sixpak
EP(LAB)   = (SQRT(EP(CM)) + SQRT(E(MM)))**2  FOR COS(CM) = +1         Sixpak
          = (SQRT(EP(CM)) - SQRT(E(MM)))**2  FOR COS(CM) = -1         Sixpak
                                                                      Sixpak
IN THIS FORM WE CAN SEE THAT AS LONG AS THE SECONDARY ENERGY IN       Sixpak
THE CENTER-OF-MASS SYSTEM, EP(CM), IS MUCH LARGER THAN THE            Sixpak
ENERGY OF THE CENTER-OF-MASS, E(MM), THE CENTER-OF-MASS AND LAB       Sixpak
ENERGIES WILL BE ALMOST EQUAL - SIMILARLY FOR THE COSINE, IN          Sixpak
THIS CASE COS(LAB) AND COS(CM) WILL BE ALMOST EQUAL - HOWEVER,        Sixpak
FOR THE MF=6 DATA WE CANNOT ASSUME THAT THIS IS TRUE.                 Sixpak
                                                                      Sixpak
TO FIRST ORDER THE ANGULAR DEPENDENCE CAN BE IGNORED,                 Sixpak
                                                                      Sixpak
EP(LAB)   = E(MM) + EP(CM)                                            Sixpak
                                                                      Sixpak
ALL THIS SAYS IS THAT TO FIRST ORDER THE EFFECT OF TRANSFORMING       Sixpak
FROM THE CM TO LAB SYSTEM IS TO INCREASE THE ENERGY OF THE            Sixpak
EMITTED PARTICLE IN THE CENTER-OF-MASS SYSTEM BY THE ENERGY OF        Sixpak
THE CENTER-OF-MASS TO DEFINE THE LAB ENERGY.                          Sixpak
                                                                      Sixpak
NOT ONLY THE ENERGY, BUT ALSO THE SPECTRA MUST BE TRANSFORMED.        Sixpak
STARTING FROM THE DOUBLE DIFFERENTIAL DATA IN THE LAB SYSTEM,         Sixpak
F(E,EP,COS(LAB)), WE CAN DEFINE THE LAB SCALAR SPECTRUM AS,           Sixpak
                                                                      Sixpak
G0(E,EP) = INTEGRAL F(E,EP,COS(LAB))*D(COS(LAB))                      Sixpak
                                                                      Sixpak
THIS IS THE NORMAL CALCULATION DEFINED ABOVE AND USED FOR DATA        Sixpak
GIVEN IN THE LAB SYSTEM.                                              Sixpak
                                                                      Sixpak
STARTING FROM DATA IN THE CENTER OF MASS SYSTEM F(E,EP,COS(CM)),      Sixpak
WE CAN USE THE RELATIONSHIP,                                          Sixpak
                                                                      Sixpak
F(E,EP,COS(LAB))*D(COS(LAB)) = F(E,EP,COS(CM))*J*D(COS(LAB))          Sixpak
                                                                      Sixpak
J         = SQRT(EP(LAB)/EP(CM)) - THE JACOBIAN                       Sixpak
                                                                      Sixpak
          = E(MM)/EP(CM) + 1 + 2*COS(CM)*SQRT(E(MM)/EP(CM))           Sixpak
                                                                      Sixpak
AS IN THE CASE OF THE ENERGY, IN THIS FORM WE CAN SEE THAT AS         Sixpak
LONG AS THE SECONDARY ENERGY IN THE CENTER-OF-MASS SYSTEM,            Sixpak
EP(CM), IS LARGE COMPARED TO THE CENTER-OF-MASS ENERGY, E(MM),        Sixpak
THE JACOBIAN IS ESSENTIALLY UNITY AND THE CENTER-OF-MASS AND LAB      Sixpak
SPECTRA WILL BE VERY SIMILAR - AGAIN, GENERALLY WE CANNOT             Sixpak
ASSUME THAT THIS IS TRUE FOR THE MF=6 SPECTRA.                        Sixpak
                                                                      Sixpak
THEREFORE WE CAN ALSO DEFINE THE LAB SCALAR SPECTRUM IN TERMS OF      Sixpak
THE CM SPECTRUM IN THE FORM,                                          Sixpak
                                                                      Sixpak
G0(E,EP) = INTEGRAL F(E,EP,COS(CM))*J*D(COS(LAB))                     Sixpak
                                                                      Sixpak
CONSISTENT WITH THE ABOVE ASSUMPTION THAT THE ANGULAR DEPENDENCE      Sixpak
OF EP(LAB) CAN BE IGNORED THE JACOBIAN WILL NOT BE USED IN            Sixpak
PERFORMING THESE INTEGRALS - IN WHICH CASE THE INTEGRAL REDUCES       Sixpak
TO EXACTLY THE SAME FORM AS IF THE DATA WERE IN THE LAB SYSTEM.       Sixpak
                                                                      Sixpak
IT SHOULD BE NOTED THAT SINCE IN THIS CASE THE MF=4 ANGULAR           Sixpak
DISTRIBUTIONS ARE GIVEN IN THE CM SYSTEM AND WHEN USED IN ANY         Sixpak
APPLICATION THEY WILL BE TRANSFORMED TO THE LAB SYSTEM - WHEN         Sixpak
THIS IS DONE THE JACOBIAN WILL BE APPLIED.                            Sixpak
                                                                      Sixpak
IN THIS CODE WHERE WE ARE MOSTLY CONCERNED WITH CONSERVING THE        Sixpak
NUMBER OF EMITTED PARTICLES AND AVERAGE ENERGIES THE NEUTRON          Sixpak
SPECTRA OUTPUT IN MF=5 WILL NOT BE COMPLETELY CONVERTED TO THE        Sixpak
LAB SYSTEM - ONLY FIRST ORDER CORRECTIONS WILL BE INCLUDED BY         Sixpak
INCREASING THE EMITTED PARTICLE ENERGY BY THE CENTER OF MASS          Sixpak
ENERGY, I.E., FOR A CENTER OF MASS SPECTRUM TABULATED AT CENTER       Sixpak
OF MASS ENERGIES EP(CM) THESE WILL ALL BE UNIFORMLY INCREASED         Sixpak
```

```
BY E(MM) TO ACCOUNT FOR THE CENTER OF MASS MOTION - THE SPECTRA    Sixpak
WILL NOT BE MODIFIED BY THE JACOBIAN FACTOR SQRT(EP(LAB)/EP(CM))   Sixpak
SINCE THIS WOULD REQUIRE A DETAILED TRANSFORMATION IN ENERGY AND   Sixpak
COS(THETA) SPACE - WHICH IS JUDGED NOT TO BE WORTH PERFORMING      Sixpak
WITHIN THE LIMITS OF WHERE THE OUTPUT FROM THIS CODE IS INTENDED   Sixpak
TO BE USED.                                                        Sixpak
                                                                   Sixpak
SINCE THE ANGULAR DISTRIBUTION IS ALWAYS OUTPUT IN THE SAME        Sixpak
SYSTEM AS WHICH IT IS GIVEN IN MF=6, NO TRANSFORMATION IS          Sixpak
REQUIRED FOR THE MF=4 OUTPUT.                                      Sixpak
                                                                   Sixpak
WHEN USED IN LOW ENERGY APPLICATIONS (E.G., FISSION REACTORS) THE  Sixpak
HIGH ENERGY SPECTRA PRESENTED IN MF=6 WILL BE MOSTLY IMPORTANT     Sixpak
SIMPLY IN CONSERVING PARTICLES, (E.G., AS IN (N,2N)) AND ENERGY    Sixpak
AND THE DETAILS OF THE CORRELATION AND GROSS ENERGY SPECTRA WILL   Sixpak
NOTE PLAY THAT IMPORTANT A ROLE. IN THIS CASE THE SPECTRA OUTPUT   Sixpak
BY THIS PROGRAM IN MF=5 SHOULD BE ADEQUATE.                        Sixpak
                                                                   Sixpak
PLOTTAB FORMATTED OUTPUT                                           Sixpak
================================================================== Sixpak
THIS PROGRAM CONTAINS ROUTINES TO PRODUCE OUTPUT THAT CAN BE USED  Sixpak
AS INPUT TO THE PLOTTAB CODE TO OBTAIN GRAPHIC RESULTS.            Sixpak
                                                                   Sixpak
THESE ROUTINES ARE DESIGNED ONLY FOR USE BY THE AUTHOR TO CHECK    Sixpak
THIS CODE. USERS ARE ASKED NOT TO ACTIVATE OR TRY TO USE THESE     Sixpak
ROUTINES. UNLESS YOU COMPLETELY UNDERSTAND THIS CODE THE RESULTS   Sixpak
CAN BE UNRELIABLE IF YOU ACTIVATE THESE ROUTINES.                  Sixpak
                                                                   Sixpak
INPUT FILES                                                        Sixpak
================================================================== Sixpak
UNIT  DESCRIPTION                                                  Sixpak
----  -----------                                                  Sixpak
   2  INPUT LINES (BCD - 80 CHARACTERS/RECORD)                     Sixpak
  10  ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)            Sixpak
                                                                   Sixpak
OUTPUT FILES                                                       Sixpak
================================================================== Sixpak
UNIT  DESCRIPTION                                                  Sixpak
----  -----------                                                  Sixpak
   3  OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)                  Sixpak
  11  ENDF/B DATA MF=4 (BCD - 80 CHARACTERS/RECORD)                Sixpak
  12  ENDF/B DATA MF=5 (BCD - 80 CHARACTERS/RECORD)                Sixpak
  14  ENDF/B DATA MF=15 (BCD - 80 CHARACTERS/RECORD)               Sixpak
  17  ENDF/B DATA MF=12 (BCD - 80 CHARACTERS/RECORD)               Sixpak
  18  ENDF/B DATA MF=14 (BCD - 80 CHARACTERS/RECORD)               Sixpak
  15  PLOTTAB INPUT PARAMETERS (BCD - 80 CHARACTERS/RECORD)        Sixpak
  16  PLOTTAB FORMATTED OUTPUT (BCD - 80 CHARACTERS/RECORD)        Sixpak
                                                                   Sixpak
SCRATCH FILES                                                      Sixpak
================================================================== Sixpak
NONE                                                               Sixpak
                                                                   Sixpak
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILIO1 AND FILIO2)    Sixpak
================================================================== Sixpak
UNIT  FILE NAME                                                    Sixpak
----  ----------                                                   Sixpak
  2   SIXPAK.INP                                                   Sixpak
  3   SIXPAK.LST                                                   Sixpak
 10   ENDFB.IN                                                     Sixpak
 11   ENDFB.MF4                                                    Sixpak
 12   ENDFB.MF5                                                    Sixpak
 14   ENDFB.M15                                                    Sixpak
 17   ENDFB.M12                                                    Sixpak
 18   ENDFB.M14                                                    Sixpak
 15   PLOTTAB.INP                                                  Sixpak
 16   PLOTTAB.CUR                                                  Sixpak
                                                                   Sixpak
                                                                   Sixpak
INPUT PARAMETERS                                                   Sixpak
================================================================== Sixpak
LINE  COLS.  DESCRIPTION                                           Sixpak
```

```
----  -----  -----------                                              Sixpak
   1   1-60  ENDF/B INPUT DATA FILENAME                               Sixpak
             (STANDARD OPTION = ENDFB.IN)                             Sixpak
 2-N   1-6   MINIMUM MAT FOR REQUESTED RANGE                         Sixpak
       9-11  MINIMUM MT FOR REQUESTED RANGE                          Sixpak
      12-17  MAXIMUM MAT FOR REQUESTED RANGE                         Sixpak
      20-22  MAXIMUM MT FOR REQUESTED RANGE                          Sixpak
                                                                      Sixpak
LEAVE THE DEFINITION OF THE FILENAME BLANK - THE PROGRAM WILL         Sixpak
THEN USE THE STANDARD FILENAME (ENDFB.IN).                            Sixpak
                                                                      Sixpak
UP TO 100 MAT/MT RANGES MAY BE SPECIFIED. THE LIST OF RANGES IS       Sixpak
TERMINATED BY A BLANK LINE. IF THE FIRST INPUT LINE IS COMPLETELY     Sixpak
BLANK ALL DATA WILL BE PROCESSED.                                     Sixpak
                                                                      Sixpak
EXAMPLE INPUT NO. 1                                                   Sixpak
------------------                                                    Sixpak
PROCESS ALL MF=6 DATA ON AN ENDF/B TAPE. USE THE STANDARD INPUT       Sixpak
DATA FILENAME ENDFB.IN IN THIS CASE THE USER CAN EITHER EXPLICITLY    Sixpak
SPECIFY THE FILENAME AND MAT/MT RANGE BY THE FOLLOWING  2 INPUT       Sixpak
LINES,                                                                Sixpak
                                                                      Sixpak
ENDFB.IN                                                              Sixpak
     1    1  9999  999                                               Sixpak
                      (BLANK LINE, TERMINATES REQUEST LIST)           Sixpak
                                                                      Sixpak
OR BY INPUTTING 2 BLANK LINE = PROCESS EVERYTHING.                    Sixpak
                                                                      Sixpak
EXAMPLE INPUT NO. 2                                                   Sixpak
------------------                                                    Sixpak
PROCESS BE-9, MAT=425, MT=16. READ THE DATA FROM ENDFB6\BE9.          Sixpak
IN THIS CASE THE FOLLOWING 3 INPUT LINES ARE REQUIRED,                Sixpak
                                                                      Sixpak
ENDFBB6\BE9                                                           Sixpak
   425   16   425   16                                               Sixpak
                      (BLANK LINE, TERMINATES REQUEST LIST)           Sixpak
                                                                      Sixpak
EXAMPLE INPUT NO. 3                                                   Sixpak
------------------                                                    Sixpak
PROCESS ALL MT=16 (N,2N) DATA. THIS CAN BE DONE BY SPECIFYING THE     Sixpak
MAXIMUM MAT RANGE = 1 TO 9999, AND MT=16 FOR THE MINIMUM AND          Sixpak
MAXIMUM MT RANGE. READ THE DATA FROM ENDFB6\K300. IN THIS CASE        Sixpak
CASE THE FOLLOWING 3 INPUT LINES ARE REQUIRED,                        Sixpak
                                                                      Sixpak
ENDFB6\K300                                                           Sixpak
     1   16  9999   16                                               Sixpak
                      (BLANK LINE, TERMINATES REQUEST LIST)           Sixpak
                                                                      Sixpak
====================================================================== Sixpak
```

```
====================================================================== Virgin
                                                                       Virgin
     PROGRAM VIRGIN                                                    Virgin
     VERSION 76-1 (NOVEMBER 1976)                                      Virgin
     VERSION 84-1 (JUNE 1984)   *DOUBLE PRECISION ENERGY               Virgin
     VERSION 86-1 (JANUARY 1986)*FORTRAN-77/H VERSION                  Virgin
     VERSION 88-1 (JULY 1988)   *OPTION...INTERNALLY DEFINE ALL I/O     Virgin
                                 FILE NAMES (SEE, SUBROUTINE FILEIO    Virgin
                                 FOR DETAILS).                         Virgin
                                *IMPROVED BASED ON USER COMMENTS.      Virgin
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO     Virgin
                                 INSURE PROGRAM WILL NOT DO ANYTHING   Virgin
                                 CRAZY.                                Virgin
                                *UPDATED TO USE NEW PROGRAM CONVERT    Virgin
                                 KEYWORDS.                             Virgin
                                *ADDED LIVERMORE CIVIC COMPILER        Virgin
                                 CONVENTIONS.                          Virgin
     VERSION 92-1 (JANUARY 1992)*COMPLETE RE-WRITE                     Virgin
                                *OUTPUT IN PLOTTAB FORMAT              Virgin
                                *UP TO 2000 THICKNESSES                Virgin
                                *INCREASED INCORE PAGE SIZE TO 6000    Virgin
                                 CROSS SECTION POINTS                  Virgin
                                *ADDED PHOTON CALCULATIONS             Virgin
                                *ADDED BLACKBODY SPECTRUM              Virgin
                                *ADDED MULTIPLE LAYERS                 Virgin
                                *ADDED SPATIALLY DEPENDENT DENSITY     Virgin
                                *ADDED FORTRAN SAVE OPTION             Virgin
                                *COMPLETELY CONSISTENT I/O ROUTINES -  Virgin
                                 TO MINIMIZE COMPUTER DEPENDENCE.      Virgin
     VERSION 92-2 (MAY 1992)    *CORRECTED TO HANDLE MULTIGROUP CROSS  Virgin
                                 SECTIONS AS INPUT IN ENDF/B FORMAT.   Virgin
     VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                    Virgin
                                 *IMPROVED COMPUTER INDEPENDENCE       Virgin
                                 *ALL DOUBLE PRECISION                 Virgin
                                 *ON SCREEN OUTPUT                     Virgin
                                 *UNIFORM TREATMENT OF ENDF/B I/O      Virgin
                                 *IMPROVED OUTPUT PRECISION            Virgin
                                 *DEFINED SCRATCH FILE NAMES           Virgin
     VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING      Virgin
                                  POINT READ FOR MORE DIGITS           Virgin
                                 *UPDATED TEST FOR ENDF/B FORMAT       Virgin
                                  VERSION BASED ON RECENT FORMAT CHANGE Virgin
                                 *GENERAL IMPROVEMENTS BASED ON        Virgin
                                  USER FEEDBACK                        Virgin
     VERS. 2000-1 (FEBRUARY 2000)*GENERAL IMPROVEMENTS BASED ON        Virgin
                                  USER FEEDBACK                        Virgin
     VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS            Virgin
     VERS. 2004-1 (MARCH 2004)   *ADDED INCLUDE FOR COMMON             Virgin
                                 *UP TO 2000 THICKNESSES               Virgin
                                 *INCREASED INCORE PAGE SIZE TO 12,000 Virgin
                                                                       Virgin
     OWNED, MAINTAINED AND DISTRIBUTED BY                              Virgin
     ------------------------------------                              Virgin
     THE NUCLEAR DATA SECTION                                          Virgin
     INTERNATIONAL ATOMIC ENERGY AGENCY                                Virgin
     P.O. BOX 100                                                      Virgin
     A-1400, VIENNA, AUSTRIA                                           Virgin
     EUROPE                                                            Virgin
                                                                       Virgin
     ORIGINALLY WRITTEN BY                                             Virgin
     ------------------------------------                              Virgin
     DERMOTT E. CULLEN                                                 Virgin
     UNIVERSITY OF CALIFORNIA                                          Virgin
     LAWRENCE LIVERMORE NATIONAL LABORATORY                            Virgin
     L-159                                                             Virgin
     P.O. BOX 808                                                      Virgin
     LIVERMORE, CA 94550                                               Virgin
     U.S.A.                                                            Virgin
     TELEPHONE  925-423-7359                                           Virgin
     E. MAIL    CULLEN1@LLNL.GOV                                       Virgin
     WEBSITE    HTTP://WWW.LLNL.GOV/CULLEN1                            Virgin
```

```
                                                                    Virgin
PURPOSE                                                             Virgin
-------                                                             Virgin
THIS PROGRAM IS DESIGNED TO CALCULATE UNCOLLIDED (I.E. VIRGIN)      Virgin
FLUX AND REACTIONS DUE TO TRANSMISSION OF A MONODIRECTIONAL         Virgin
BEAM OF NEUTRONS THROUGH ANY THICKNESS OF MATERIAL. IN ORDER        Virgin
TO SIMULATE AN EXPERIMENTAL MEASUREMENT THE RESULTS ARE GIVEN       Virgin
AS INTEGRALS OVER ENERGY TALLY GROUPS (AS OPPOSED TO POINTWISE      Virgin
IN ENERGY). BY TAKING THE RATIO OF REACTIONS TO FLUX IN EACH        Virgin
GROUP AN EQUIVALENT SPATIALLY DEPENDENT GROUP AVERAGED CROSS        Virgin
SECTION IS CALCULATED BY THE PROGRAM.                               Virgin
                                                                    Virgin
EVALUATED DATA                                                      Virgin
--------------                                                      Virgin
THE EVALUATED DATA MUST BE IN THE ENDF/B FORMAT. HOWEVER IT         Virgin
MUST BE LINEAR-LINEAR INTERPOLABLE IN ENERGY-CROSS SECTION          Virgin
BETWEEN TABULATED POINTS. SINCE ONLY CROSS SECTIONS (FILE 3 OR 23) Virgin
ARE USED, THIS PROGRAM WILL WORK ON ANY VERSION OF ENDF/B           Virgin
(I.E. ENDF/B-I, II, III, IV, V OR VI).                              Virgin
                                                                    Virgin
RELATED COMPUTER CODES                                              Virgin
----------------------                                              Virgin
IN ORDER TO CONVERT ENDF/B DATA TO THE FORM REQUIRED BY THIS CODE   Virgin
THE FOLLOWING COMPUTER CODES MAY BE USED,                           Virgin
                                                                    Virgin
LINEAR  - CONVERT FROM GENERAL ENDF/B INTERPOLATION TO LINEAR-      Virgin
          LINEAR INTERPOLATION.                                     Virgin
RECENT  - ADD THE RESONANCE CONTRIBUTION TO TABULATED BACKGROUND    Virgin
          CROSS SECTIONS TO OBTAIN LINEAR-LINEAR INTERPOLABLE       Virgin
          RESULTS.                                                  Virgin
SIGMA1  - DOPPLER BROADEN CROSS SECTION TO OBTAIN LINEAR-LINEAR     Virgin
          INTERPOLABLE RESULTS.                                     Virgin
MIXER   - MIX INDIVIDUAL MATERIALS TOGETHER TO DEFINE COMPOSITE     Virgin
          MIXTURES, E.G., COMBINE MATERIALS TO DEFINE STAINLESS     Virgin
          STELL.                                                    Virgin
                                                                    Virgin
IN ORDER TO PLOT THE OUTPUT RESULTS OF THIS CODE USE PROGRAM        Virgin
PLOTTAB.                                                            Virgin
                                                                    Virgin
COPIES OF ANY OR ALL OF THESE CODES MAY BE OBTAINED FROM D.E.       Virgin
CULLEN AT THE ABOVE ADDRESS.                                        Virgin
                                                                    Virgin
OUTPUT FORMAT                                                       Virgin
-------------                                                       Virgin
FOR ALL VERSIONS OF THIS PROGRAM PRIOR TO VERSION 92-1 OUTPUT WAS   Virgin
IN TABULAR FORM.                                                    Virgin
                                                                    Virgin
FOR VERSION 92-1 AND LATER VERSIONS OF THIS CODE ALL OUTPUT IS IN   Virgin
THE PROGRAM PLOTTAB FORMAT TO ALLOW RESULTS TO BE EASILY PLOTTED.   Virgin
FOR A COPY OF PROGRAM PLOTTAB CONTACT D.E. CULLEN AT THE ABOVE      Virgin
ADDRESS.                                                            Virgin
                                                                    Virgin
TALLY GROUPS                                                        Virgin
------------                                                        Virgin
THE TALLY GROUP STRUCTURE MAY BE ANY SET OF MONONTONICALLY          Virgin
INCREASING ENERGY BOUNDARIES. THERE MAY BE UP TO 2000 TALLY         Virgin
GROUPS. BY USING THE INPUT PARAMETERS THE USER MAY SPECIFY ANY      Virgin
ARBITRARY TALLY GROUP STRUCTURE OR SELECT ONE OF THE FOLLOWING      Virgin
BUILT-IN GROUP STRUCTURES.                                          Virgin
                                                                    Virgin
 (1) TART 175 GROUPS (INPUT  0)                                     Virgin
 (2) ORNL  50 GROUPS (INPUT -1)                                     Virgin
 (3) ORNL 126 GROUPS (INPUT -2)                                     Virgin
 (4) ORNL 171 GROUPS (INPUT -3)                                     Virgin
 (5) SAND-II 620 GROUPS...UP TO 18 MEV (INPUT -4)                   Virgin
 (6) SAND-II 640 GROUPS...UP TO 20 MEV (INPUT -5)                   Virgin
 (7) WIMS 69 GROUPS (INPUT -6)                                      Virgin
 (8) GAM-I 68 GROUPS (INPUT -7)                                     Virgin
 (9) GAM-II 99 GROUPS (INPUT -8)                                    Virgin
(10) MUFT 54 GROUPS (INPUT -9)                                      Virgin
(11) ABBN 28 GROUPS (INPUT -10)                                     Virgin
```

```
                                                                    Virgin
INCIDENT SPECTRUM                                                   Virgin
----------------                                                    Virgin
THE INCIDENT SPECTRUM MAY BE ANY TABULATED FUNCTION THAT IS         Virgin
GIVEN BY A SET OF POINTS THAT IS MONOTONICALLY INCREASING IN        Virgin
ENERGY AND LINEAR-LINEAR INTERPOLABLE IN ENERGY-SPECTRUM            Virgin
BETWEEN TABULATED POINTS. THERE IS NO LIMIT TO THE NUMBER OF        Virgin
POINTS USED TO DESCRIBE THE SPECTRUM. THERE ARE FIVE BUILT-IN       Virgin
OPTIONS FOR THE SPECTRUM.                                           Virgin
                                                                    Virgin
(1) CONSTANT...ENERGY INDEPENDENT (INPUT 0)                         Virgin
(2) 1/E (INPUT 1)                                                   Virgin
(3) BLACKBODY - PHOTON SPECTRUM                                     Virgin
(4) BLACKBODY - ENERGY SPECTRUM (E TIMES THE PHOTON SPECTRUM)       Virgin
(5) TRANSMITTED SPECTRUM FROM PREVIOUS CASE                         Virgin
                                                                    Virgin
NORMALIZATION OF SPECTRUM                                           Virgin
-------------------------                                           Virgin
ANY INCIDENT SPECTRUM, EITHER READ AS INPUT OR ONE OF THE           Virgin
BUILT-IN SPECTRA, WILL BE NORMALIZED TO UNITY WHEN INTEGRATED       Virgin
OVER THEIR ENTIRE ENERGY RANGE.                                     Virgin
                                                                    Virgin
TRANSMITTED SPECTRA WILL NOT BE RE-NORMALIZED, SINCE IT ALREADY     Virgin
INCLUDES THE NORMALIZATION OF THE INCIDENT SPECTRUM.                Virgin
                                                                    Virgin
NOTE, INCIDENT SPECTRA IS NORMALIZED TO UNITY OVER THEIR ENTIRE     Virgin
ENERGY RANGE - NOT OVER THE ENERGY RANGE OF THE GROUPS. IF THE      Virgin
ENERGY RANGE OF THE GROUPS IS LESS THAN THAT OF THE SPECTRUM        Virgin
ONLY THAT PORTION OF THE SPECTRUM WILL BE USED AND THIS WILL        Virgin
NOT BE RE-NORMALIZED TO UNITY.                                      Virgin
                                                                    Virgin
COMPOSITION OF A LAYER                                              Virgin
----------------------                                              Virgin
YOU MAY RUN PROBLEMS INVOLVING                                      Virgin
1) A LAYER OF UNIFORM DENSITY - DENSITY FOR ATTENUATION IS THAT     Virgin
   OF THE TOTAL. DENSITY FOR REACTIONS IS THAT OF THE REACTION.     Virgin
2) A LAYER OF UNIFORM DENSITY - DENSITY IS THE SUM OF THE TOTAL     Virgin
   AND REACTION DENSITIES - THE SUM OF THE CROSS SECTIONS IS        Virgin
   USED FOR ATTENUATION AND REACTIONS.                              Virgin
3) A LAYER OF VARYING DENSITY BASED ON A UNIFORM TOTAL DENSITY      Virgin
   PLUS A VARIATION BETWEEN 0 AND A MAXIMUM BASED ON THE            Virgin
   REACTION DENSITY - 0 AT 0 THICKNESS AND MAXIMUM AT MAXIMUM       Virgin
   THICKNESS. IN THIS CASE THE AVERAGE REACTION DENSITY IS EQUAL    Virgin
   TO THE INPUT REACTION DENSITY. THE VARIATION IN REACTION         Virgin
   DENSITY CAN BE LINEAR, SQUARE OR CUBIC.                          Virgin
4) A LAYER OF VARYING DENSITY BASED ON A TOTAL DENSITY WHICH        Virgin
   VARYING FROM MAXIMUM AT 0 THICKNESS TO 0 AT MAXIMUM THICKNESS    Virgin
   PLUS A REACTION DENSITY WHICH VARIES FROM 0 AT 0 THICKNESS       Virgin
   TO MAXIMUM AT MAXIMUM THICKNESS. IN THIS CASE THE AVERAGE        Virgin
   DENSITY OF THE TOTAL AND REACTION WILL BOTH BE EQUAL TO THE      Virgin
   INPUT TOTAL AND REACTION DENSITIES. THE VARIATION IN TOTAL       Virgin
   AND REACTION DENSITY CAN BE LINEAR, SQUARE OR CUBIC.             Virgin
                                                                    Virgin
IN THE FIRST CASE THE TWO REQUESTED CROSS SECTIONS ARE CONSIDERED   Virgin
TO BE INDEPENDENT - THE TOTAL CROSS SECTION IS USED TO CALCULATE    Virgin
ATTENUATION AND THE REACTION CROSS SECTION IS USED TO CALCULATE     Virgin
REACTIONS, E.G., TRANSMISSION THROUGH NATURAL URANIUM (THE TOTAL    Virgin
CROSS SECTION SHOULD BE THAT OF NATURAL URANIUM) AND REACTIONS      Virgin
IN A U-235 DETECTOR (THE REACTION CROSS SECTION SHOULD BE THAT OF   Virgin
U-235).                                                             Virgin
                                                                    Virgin
IN THE OTHER THREE CASES THE TWO REQUESTED CROSS SECTIONS ARE       Virgin
TREATED AS TWO CONSTITUENTS OF A MIXTURE OF TWO MATERIALS AND       Virgin
THE TWO CROSS SECTIONS ARE USED BOTH TO DEFINE A TOTAL CROSS        Virgin
SECTION FOR ATTENUATION AND A REACTION CROSS SECTION TO DEFINE      Virgin
REACTIONS. IN THESE CASES THE MIXTURE WILL VARY CONTINUOUSLY,       Virgin
E.G., IN CASE 4) HALF WAY THROUGH THE LAYER THE COMPOSITION WILL    Virgin
BE 1/2 THE MATERIAL DEFINED BY THE TOTAL AND 1/2 THE MATERIAL       Virgin
BASED ON THE REACTION. IN THESE CASES RATHER THAN THINKING OF       Virgin
THE TWO CROSS SECTIONS AS A TOTAL AND REACTION CROSS SECTION,       Virgin
IT IS BETTER TO THINK OF THEM AS THE TOTAL CROSS SECTIONS FOR       Virgin
```

```
MATERIALS A AND B AND THE CALCULATED REACTIONS WILL BE BASED       Virgin
ON THESE TWO TOTAL CROSS SECTIONS.                                 Virgin
                                                                   Virgin
MULTIPLE LAYERS                                                    Virgin
--------------                                                     Virgin
THIS CODE MAY BE USED TO RUN EITHER A NUMBER OF INDEPENDENT        Virgin
PROBLEMS, EACH INVOLVING TRANSMISSION THROUGH A SINGLE LAYER OF    Virgin
MATERIAL, OR TRANSMISSION THROUGH A NUMBER OF LAYERS ONE AFTER     Virgin
THE OTHER.                                                         Virgin
                                                                   Virgin
IN THE CASE OF MULTIPLE LAYERS, ONE LAYER AFTER ANOTHER, THE       Virgin
TRANSMITTED ENERGY DEPENDENT SPECTRUM IS USED AS THE INCIDENT      Virgin
SPECTRUM FOR THE NEXT LAYER. THERE IS NO LIMIT TO THE NUMBER       Virgin
OF LAYERS WHICH MAY BE USED - EACH LAYER IS TREATED AS A           Virgin
COMPLETELY INDEPENDENT PROBLEM WITH A DEFINED INCIDENT SOURCE,     Virgin
AND AS SUCH THE CYCLE OF TRANSMISSION THROUGH EACH LAYER AND       Virgin
USING THE TRANSMITTED SPECTRUM AS THE INCIDENT SPECTRUM FOR THE    Virgin
NEXT LAYER MAY BE REPEATED ANY NUMBER OF TIMES.                    Virgin
                                                                   Virgin
REMEMBER - THE INCIDENT SPECTRUM IS ASSUMED TO BE LINEARLY         Virgin
INTERPOLABLE IN ENERGY AND SPECTRUM BETWEEN THE ENERGIES AT        Virgin
WHICH IT IS TABULATED. THE TRANSMITTED SPECTRUM WILL BE TABULATED  Virgin
AT THE UNION OF ALL ENERGIES OF THE INCIDENT SPECTRUM AND CROSS     Virgin
SECTIONS (TOTAL AND REACTION). IN ORDER TO INSURE THE ACCURACY     Virgin
OF THE RESULT WHEN PERFORMING MULTIPLE LAYER CALCULATION BE SURE   Virgin
TO SPECIFY THE INCIDENT SPECTRUM ON THE FIRST LAYER TO SUFFICIENT  Virgin
DETAIL (ENOUGH ENERGY POINTS CLOSELY SPACED TOGETHER) IN ORDER TO  Virgin
ALLOW THE TRANSMITTED SPECTRUM TO BE ACCURATELY REPRESENTED BY     Virgin
LINEAR INTERPOLATION BETWEEN SUCCESSIVE ENERGY POINTS - THERE IS   Virgin
NO LIMIT TO THE NUMBER OF POINTS ALLOWED IN THE INCIDENT SPECTRUM, Virgin
SO IF YOU ARE IN DOUBT, SIMPLY USE MORE ENERGY POINTS TO SPECIFY   Virgin
THE INCIDENT SPECTRUM.                                             Virgin
                                                                   Virgin
RESULT OUTPUT UNITS                                                Virgin
------------------                                                 Virgin
FLUX      = EXACTLY AS CALCULATED                                  Virgin
REACTIONS = 1/CM OR 1/GRAM                                         Virgin
AVERAGE   = 1/CM - MACROSCOPIC UNITS                               Virgin
CROSS                                                              Virgin
SECTION                                                            Virgin
                                                                   Virgin
THICKNESS AND DENSITY                                              Virgin
--------------------                                               Virgin
THE UNCOLLIDED CALCULATION ONLY DEPENDS ON THE PRODUCT OF          Virgin
THICKNESS AND DENSITY (I.E. GRAMS PER CM SQUARED). THIS FACT       Virgin
MAY BE USED TO SIMPLIFY INPUT BY ALLOWING THE THICKNESS AND        Virgin
DENSITY TO BE GIVEN EITHER AS CM AND GRAMS/CC RESPECTIVELY         Virgin
OR ELSE TO GIVE THICKNESS IN GRAMS/(CM*CM) AND INPUT A             Virgin
DENSITY OF 1.0 - OR IN ANY OTHER CONVENIENT UNITS AS LONG AS       Virgin
THE PRODUCT OF THICKNESS AND DENSITY IS IN THE CORRECT GRAMS       Virgin
PER CENTIMETER SQUARED.                                            Virgin
                                                                   Virgin
GRAMS/(CM*CM) ARE RELATED TO ATOMS/BARN THROUGH THE RELATIONSHIP   Virgin
                                                                   Virgin
GRAMS/(CM*CM)=(ATOMS/BARN)*(GRAMS/MOLE)*(MOLE/ATOM)                Virgin
                                                                   Virgin
OR...                                                              Virgin
                                                                   Virgin
GRAMS/(CM*CM)=(ATOMS/BARN)*(ATOMIC WEIGHT)/0.602                   Virgin
                                                                   Virgin
CROSS SECTIONS AT A SPACE POINT AND OPTICAL THICKNESS              Virgin
----------------------------------------------------               Virgin
THIS PROGRAM ALLOWS LAYERS OF EITHER UNIFORM DENSITY OR            Virgin
CONTINUOUSLY VARYING DENSITY. THE DENSITY CAN BE ONE OF THE        Virgin
FOLLOWING FORMS,                                                   Virgin
1) C                  = UNIFORM DENSITY                            Virgin
2) C*2*(X/T)          = LINEAR VARIATION FROM 0 TO C               Virgin
3) C*(2-2*(X/T))      = LINEAR VARIATION FROM C TO 0               Virgin
4) C*3*(X/T)**2       = SQUARE VARIATION FROM 0 TO C               Virgin
5) C*(3-3*(X/T)**2)/2 = SQUARE VARIATION FROM C TO 0               Virgin
6) C*4*(X/T)**3       = CUBIC VARIATION FROM 0 TO C                Virgin
```

```
7) C*(4-4*(X/T)**3)/3  = CUBIC VARIATION FROM C TO 0                Virgin
                                                                    Virgin
IN ORDER TO CALCULATE REACTIONS AT A POINT THE MICROSCOPIC          Virgin
REACTION CROSS SECTION NEED MERELY BE SCALED BY THESE DENSITIES.    Virgin
                                                                    Virgin
IN ORDER TO CALCULATE TRANSMISSION WE MUST DEFINE THE OPTICAL       Virgin
PATH LENGTH WHICH MAY BE DEFINED BY INTEGRATING EACH OF THE         Virgin
ABOVE DENSITY FORMS TO FIND,                                        Virgin
1) C*X                                                              Virgin
2) C*X*(X/T)                                                        Virgin
3) C*X*(2-(X/T))                                                    Virgin
4) C*X*(X/T)**2                                                     Virgin
5) C*X*(3-(X/T)**2)/2                                               Virgin
6) C*X*(X/T)**3                                                     Virgin
7) C*X*(4-(X/T)**3))/3                                              Virgin
                                                                    Virgin
IN ORDER TO CALCULATE TRANSMISSION TO A POINT THE MICROSCOPIC       Virgin
TOTAL CROSS SECTION NEED MERELY BE SCALED BY THESE DENSITIES        Virgin
TO DEFINE THE OPTICAL PATH LENGTH.                                  Virgin
                                                                    Virgin
THE VARIATION OF THE DENSITY THROUGH THE LAYER MAY BE DEFINED       Virgin
BY SETTING X = 0 OR X = T TO FIND,                                  Virgin
   X = 0      X = T                                                 Virgin
   -----      -----                                                 Virgin
1) C          C                                                     Virgin
2) 0          2*C                                                   Virgin
3) 2*C        0                                                     Virgin
4) 0          3*C                                                   Virgin
5) 3*C/2      0                                                     Virgin
6) 0          4*C                                                   Virgin
7) 4*C/3      0                                                     Virgin
                                                                    Virgin
THE OPTICAL PATH THROUGH A LAYER OF THICKNESS T MAY BE DEFINED      Virgin
FROM THE ABOVE EXPRESSIONS BY SETTING X=T TO FIND THAT IN ALL       Virgin
CASES THE ANSWER WILL BY C*T. THE CONSTANTS IN THE ABOVE            Virgin
EXPRESSIONS HAVE BEEN INTRODUCED IN ORDER TO FORCE THIS RESULT.     Virgin
WITH THESE FACTORS THE OPTICAL PATH LENGTH THROUGH THE LAYER        Virgin
WILL EXACTLY CORRESPOND TO AN AVERAGE DENSITY CORRESPONDING TO      Virgin
THAT INPUT FOR THE TOTAL AND/OR REACTION, I.E., C CORRESPONDS       Virgin
TO THE INPUT DENSITY.                                               Virgin
                                                                    Virgin
NOTE - FOR THE SAME OPTICAL PATH LENGTHS THROUGH THE LAYER THE      Virgin
TRANSMISSION WILL BE EXACTLY THE SAME. HOWEVER, VARYING THE         Virgin
DENSITY WILL ALLOW YOU TO MODIFY THE REACTION RATES AT SPECIFIC     Virgin
DEPTHS INTO THE LAYER.                                              Virgin
                                                                    Virgin
COMPUTATION OF INTEGRALS                                            Virgin
------------------------                                            Virgin
STARTING FROM TOTAL CROSS SECTIONS, REACTION CROSS SECTIONS AND     Virgin
A SOURCE SPECTRUM ALL OF WHICH ARE GIVEN IN TABULAR FORM WITH       Virgin
LINEAR INTERPOLATION BETWEEN TABULATED POINTS ALL REQUIRED          Virgin
INTEGRALS CAN BE DEFINED BY ANALYTICAL EXPRESSIONS INVOLVING        Virgin
NOTHING MORE COMPLICATED THAN EXPONENTIALS. THE INTEGRALS THAT      Virgin
MUST BE EVALUATED ARE OF THE FORM...                                Virgin
                                                                    Virgin
FLUX                                                                Virgin
----                                                                Virgin
(INTEGRAL EK TO EK+1) (S(E)* EXP(-XCT(E)*Z)*DE)                     Virgin
                                                                    Virgin
REACTIONS                                                           Virgin
---------                                                           Virgin
(INTEGRAL EK TO EK+1) (S(E)*XCR(E)*EXP(-XCT(E)*Z)*DE)               Virgin
                                                                    Virgin
WHERE..                                                             Virgin
EK TO EK+1 = LONGEST ENERGY INTERVAL OVER WHICH S(E), XCT(E) AND    Virgin
             XCR(E) ARE ALL LINEARLY INTERPOLABLE.                  Virgin
S(E)       = ENERGY DEPENDENT WEIGHTING SPECTRUM                    Virgin
XCR(E)     = REACTION CROSS SECTION                                 Virgin
XCT(E)     = OPTICAL PATH LENGTH (BASED ON TOTAL CROSS SECTION)     Virgin
Z          = MATERIAL THICKNESS                                     Virgin
                                                                    Virgin
```

```
S(E), XCR(E) AND XCT(E) ARE ALL ASSUMED TO BE GIVEN IN TABULAR     Virgin
FORM WITH LINEAR INTERPOLATION USED BETWEEN TABULATED POINTS.      Virgin
IN OTHER WORDS BETWEEN TABULATED POINTS EACH OF THESE THREE IS     Virgin
DEFINED BY A FUNCTION OF THE FORM...                               Virgin
                                                                   Virgin
F(E)=((E - EK)*FK+1 + (EK+1 - E)*FK)/(EK+1 - EK)                   Virgin
                                                                   Virgin
EACH OF THESE THREE CAN BE CONVERTED TO NORMAL FORM BY THE         Virgin
CHANGE OF VARIABLES....                                            Virgin
                                                                   Virgin
X=(E - 0.5*(EK+1 + EK))/(EK+1 - EK)                                Virgin
                                                                   Virgin
IN WHICH CASE X WILL VARY FROM -1 (AT EK) TO +1 (AT EK+1) AND      Virgin
EACH FUNCTION REDUCES TO THE NORMAL FORM...                        Virgin
                                                                   Virgin
F(X)=0.5*(FK*(1 - X) + FK+1*(1 + X))                               Virgin
    =0.5*(FK+1 + FK) + 0.5*(FK+1 - FK)*X                           Virgin
                                                                   Virgin
BY DEFINING THE AVERAGE VALUE AND 1/2 THE CHANGE ACROSS THE        Virgin
INTERVAL.                                                          Virgin
                                                                   Virgin
AVF=0.5*(FK+1 + FK)                                                Virgin
DF= 0.5*(FK+1 - FK)                                                Virgin
DE= 0.5*(EK+1 - EK)                                                Virgin
                                                                   Virgin
EACH OF THE THREE FUNCTIONS REDUCES TO THE SIMPLE FORM...          Virgin
                                                                   Virgin
F(X)=AVF+DF*X                                                      Virgin
                                                                   Virgin
AND THE TWO REQUIRED INTEGRALS REDUCE TO...                        Virgin
                                                                   Virgin
FLUX                                                               Virgin
----                                                               Virgin
DE*EXP(-AVXCT*Z) * (INTEGRAL -1 TO +1)                             Virgin
((AVS+DS*X)*EXP(-DXCT*Z*X)*DX)                                     Virgin
                                                                   Virgin
REACTION                                                           Virgin
--------                                                           Virgin
DE*EXP(-AVXCT*Z) * (INTEGRAL -1 TO +1)                             Virgin
((AVS*AVXCR+(AVS*DXCR+AVXCR*DS)*X+DS*DXCR*X*X)*EXP(-DXCT*Z*X)*DX)  Virgin
                                                                   Virgin
WHERE                                                              Virgin
                                                                   Virgin
AVXCT   = AVERAGE VALUE OF THE TOTAL CROSS SECTION                 Virgin
AVXCR   = AVERAGE VALUE OF THE REACTION CROSS SECTION              Virgin
AVS     = AVERAGE VALUE OF THE SOURCE                              Virgin
DXCT    = 1/2 THE CHANGE IN THE TOTAL CROSS SECTION                Virgin
DXCR    = 1/2 THE CHANGE IN THE REACTION CROSS SECTION             Virgin
DS      = 1/2 THE CHANGE IN THE SOURCE                             Virgin
DE      = 1/2 THE CHANGE IN THE ENERGY                             Virgin
                                                                   Virgin
NOTE THAT IN THIS FORM THE ENERGY ONLY APPEARS IN FRONT OF THE     Virgin
INTEGRALS AND THE INTEGRALS ARE EXPRESSED ONLY IN TERMS OF THE     Virgin
TABULATED VALUES OF S(E), XCT(E) AND XCR(E). IN PARTICULAR NO      Virgin
DERIVATIVES ARE USED, SO THAT THERE ARE NO NUMERICAL INSTABILITY   Virgin
PROBLEMS IN THE VACINITY OF DISCONTINUITIES IN S(E), XCT(E) OR     Virgin
XCR(E). INDEED, SINCE (EK+1 - EK) APPEARS IN FRONT OF THE INTEGRAL Virgin
POINTS OF DISCONTINUITY AUTOMATICALLY MAKE ZERO CONTRIBUTION TO    Virgin
THE INTEGRALS.                                                     Virgin
                                                                   Virgin
THE REQUIRED INTEGRALS CAN BE EXPRESSED IN TERMS OF THE THREE      Virgin
INTEGRALS IN NORMAL FORM....                                       Virgin
                                                                   Virgin
F(A,N) = (INTEGRAL -1 TO 1) (X**N*EXP(-A*X)*DX), N=0,1 AND 2.      Virgin
                                                                   Virgin
THESE THREE INTEGRALS CAN BE EVALUATED TO FIND...                  Virgin
                                                                   Virgin
N=0                                                                Virgin
---                                                                Virgin
F(A,0) = (EXP(A)-EXP(-A))/A                                        Virgin
                                                                   Virgin
```

```
N=1                                                                 Virgin
---                                                                 Virgin
F(A,1) = ((1-A)*EXP(A)-(1+A)*EXP(-A))/(A*A)                         Virgin
                                                                    Virgin
N=2                                                                 Virgin
---                                                                 Virgin
F(A,2) = ((2-2*A+A*A)*EXP(A)-(2+2*A+A*A)*EXP(-A))/(A*A*A)           Virgin
                                                                    Virgin
HOWEVER THESE EXPRESSIONS ARE NUMERICALLY UNSTABLE FOR SMALL        Virgin
VALUES OF A. THEREFORE FOR SMALL A THE EXPONENTIAL IN THE           Virgin
INTEGRALS ARE EXPANDED IN A POWER SERIES...                         Virgin
                                                                    Virgin
EXP(-AX)=1.0-(AX)+(AX)**2/2-(AX)**3/6+(AX)**4/24-.....              Virgin
        =(SUM K=0 TO INFINITY) (-AX)**K/(K FACTORIAL)               Virgin
                                                                    Virgin
AND THE INTEGRAL REDUCES TO THE FORM....                            Virgin
                                                                    Virgin
(SUM K=0 TO INFINITY) ((-A)**K/(K FACTORIAL)) *                     Virgin
(INTEGRAL -1 TO 1) (X**(N+K))*DX                                    Virgin
                                                                    Virgin
WHICH CAN BE ANALYTICALLY EVAULATED TO FIND....                     Virgin
(K(N) = K FACTORIAL)                                                Virgin
                                                                    Virgin
N=0                                                                 Virgin
---                                                                 Virgin
F(A,0) = 2*(1+(A**2)/K(3)+(A**4)/K(5)+(A**6)/K(7)+....              Virgin
                                                                    Virgin
N=1                                                                 Virgin
---                                                                 Virgin
F(A,1) = -2*A*(2/K(3)+4*(A**2)/K(5)+6*(A**4)/K(7)+8*(A**6)/K(9)+.. Virgin
                                                                    Virgin
N=2                                                                 Virgin
---                                                                 Virgin
F(A,2) = 2*(2/K(3)+3*4*(A**2)/K(5)+5*6*(A**4)/K(7)+                 Virgin
         7*8*(A**6)/K(9)+....                                       Virgin
                                                                    Virgin
THESE EXPANSIONS ARE USED WHEN THE ABSOLUTE VALUE OF A IS LESS      Virgin
THAN 0.1. BY TRUNCATING THE ABOVE SERIES BEFORE A**8 THE ERROR      Virgin
RELATIVE TO THE LEADING TERM OF THE SERIES WILL BE 10**(-10),       Virgin
YIELDING 10 DIGIT ACCURACY.                                         Virgin
                                                                    Virgin
AFTER EVALUATING THE ABOVE FUNCTIONS, EITHER DIRECTLY OR BY USING   Virgin
THE EXPANSION THE TWO REQUIRED INTEGRALS CAN BE WRITTEN AS...       Virgin
                                                                    Virgin
FLUX                                                                Virgin
----                                                                Virgin
DE*EXP(-AVXCT*Z)*(AVS*F(A,0) + DS*F(A,1))                           Virgin
                                                                    Virgin
REACTIONS                                                           Virgin
---------                                                           Virgin
DE*EXP(-AVXCT*Z)*                                                   Virgin
(AVS*AVXCR*F(A,0) + (AVS*DXCR+AVXCR*DS)*F(A,1) + DS*DXCR*F(A,2))    Virgin
                                                                    Virgin
INPUT FILES                                                         Virgin
-----------                                                         Virgin
FILENAME  UNIT  DESCRIPTION                                         Virgin
--------  ----  -----------                                         Virgin
INPUT       2   INPUT LINES                                         Virgin
ENDFIN     10   EVALUATED DATA IN ENDF/B FORMAT                     Virgin
                                                                    Virgin
OUTPUT FILES                                                        Virgin
------------                                                        Virgin
FILENAME  UNIT  DESCRIPTION                                         Virgin
--------  ----  -----------                                         Virgin
OUTPUT      3   OUTPUT LISTING                                      Virgin
                                                                    Virgin
SCRATCH FILES                                                       Virgin
-------------                                                       Virgin
FILENAME  UNIT  DESCRIPTION                                         Virgin
--------  ----  -----------                                         Virgin
SCR1       12   REACTION, FLUX AND CROSS SECTION RESULTS (BCD)      Virgin
```

```
                (SORTED AT END OF RUN AND OUTPUT SEPARATELY)      Virgin
 SCR2       13   TALLY GROUP ENERGY BOUNDARIES (BINARY)            Virgin
 SCR3       14   SOURCE SPECTRUM (BINARY)                          Virgin
 SCR4       15   TOTAL CROSS SECTION (BINARY)                      Virgin
 SCR5       16   REACTION CROSS SECTION (BINARY)                   Virgin
                                                                   Virgin
 OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILIO1 AND FILEIO2)  Virgin
 ----------------------------------------------------------------  Virgin
 UNIT  FILE NAME   FORMAT                                          Virgin
 ----  ----------  ------                                          Virgin
   2   VIRGIN.INP   BCD                                          Virgin
   3   VIRGIN.LST   BCD                                          Virgin
  10   ENDFB.IN     BCD                                          Virgin
11-15  (SCRATCH)   BINARY                                        Virgin
  16   PLOTTAB.CUR PLOTTAB OUTPUT FORMAT DATA                    Virgin
                                                                   Virgin
 INPUT LINES                                                       Virgin
 -----------                                                       Virgin
 ANY NUMBER OF CASES MAY BE RUN ONE AFTER THE OTHER. AFTER THE     Virgin
 FIRST CASE HAS BEEN RUN THE FOLLOWING CASES MAY USE THE SAME      Virgin
 THICKNESSES, GROUP STRUCTURE AND SPECTRUM AS THE PRECEDING CASE.  Virgin
 IN ADDITION THE TRANSMITTED SPECTRUM FROM ONE CASE MAY BE USED    Virgin
 AS THE INCIDENT SPECTRUM IN THE NEXT CASE, TO ALLOW MULTIPLE      Virgin
 LAYERS OF DIFFERENT MATERIALS.                                    Virgin
                                                                   Virgin
 LINE  COLS.  FORMAT  DESCRIPTION                                  Virgin
 ----  -----  ------  ----------                                  Virgin
    1   1-60   ENDF/B INPUT DATA FILENAME                         Virgin
              (STANDARD OPTION = ENDFB.IN)                         Virgin
                                                                   Virgin
 LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL    Virgin
 THEN USE STANDARD FILENAMES.                                      Virgin
                                                                   Virgin
  2-3   1-72   18A4   TWO LINE TITLE DESCRIBING PROBLEM           Virgin
    4   1- 6    I6    ZA (1000*Z+A) OF TARGET FOR TOTAL           Virgin
        7-11    I5    MT OF TOTAL                                 Virgin
       12-22   E11.4  DENSITY FOR TOTAL                          Virgin
       23-28    I6    ZA (1000*Z+A) OF TARGET FOR REACTION        Virgin
       29-33    I5    MT OF REACTION                              Virgin
                      = 0 - NO REACTION CALCULATION (ONLY FLUX).  Virgin
                      = GREATER THAN 0 - CALCULATE REACTIONS.     Virgin
       34-44   E11.4  DENSITY FOR REACTION                       Virgin
       45-50    I6    NUMBER OF TARGET THICKNESSES                Virgin
                      = GREATER THAN 0 = READ FROM INPUT          Virgin
                        (1 TO 2000 ALLOWED)                       Virgin
                      =  0 = SAME AS LAST CASE                    Virgin
       51-55    I5    NUMBER OF TALLY GROUPS                      Virgin
                      (REMEMBER NUMBER OF GROUP BOUNDARIES        Virgin
                      IS ONE MORE THAN THE NUMBER OF GROUPS)      Virgin
                      UP TO 2000 GROUPS ARE ALLOWED               Virgin
                      BUILT-IN GROUP STRUCTURES.                  Virgin
                      = GREATER THAN 0 = READ FROM INPUT          Virgin
                      =  0 SAME AS LAST CASE                      Virgin
                      = -1 TART 175 GROUPS                        Virgin
                      = -2 ORNL  50 GROUPS                        Virgin
                      = -3 ORNL 126 GROUPS                        Virgin
                      = -4 ORNL 171 GROUPS                        Virgin
                      = -5 SAND-II 620 GROUPS..UP TO 18 MEV.      Virgin
                      = -6 SAND-II 640 GROUPS..UP TO 20 MEV.      Virgin
                      = -7 WIMS 69 GROUPS                         Virgin
                      = -8 GAM-I 68 GROUPS                        Virgin
                      = -9 GAM-II 99 GROUPS                       Virgin
                      =-10 MUFT 54 GROUPS                         Virgin
                      =-11 ABBN 28 GROUPS                         Virgin
       56-60    I5    NUMBER OF POINTS IN SOURCE SPECTRUM         Virgin
                      (MUST BE AT LEAST TWO POINTS)               Virgin
                      = GREATER THAN 1 = READ FROM INPUT          Virgin
                      =  0 = SAME AS LAST CASE                    Virgin
                      = -1 = CONSTANT (ENERGY INDEPENDENT)        Virgin
                      = -2 = 1/E                                  Virgin
                      = -3 = BLACKBODY - PHOTON SPECTRUM          Virgin
```

```
                    = -4 = BLACKBODY - ENERGY SPECTRUM            Virgin
                    = -5 = TRANSMITTED SPECTRUM FROM LAST CASE    Virgin
                    NOTE, ALL SPECTRA, EXCEPT THE TRANSMITTED     Virgin
                    SPECTRUM FROM THE LAST CASE, WILL BE          Virgin
                    NORMALIZED SUCH THAT ITS INTEGRAL OVER        Virgin
                    ENERGY WILL BE UNITY.                         Virgin
      61-64  1X,3I1  SPATIALLY DEPENDENT OUTOUT                   Virgin
                    = 0 = NO                                      Virgin
                    = 1 = YES                                     Virgin
                    FOR THE 3 QUANTITIES                          Virgin
                    COLUMN 67 FLUX                                Virgin
                           68 REACTIONS                           Virgin
                           69 AVERAGE CROSS SECTION               Virgin
      65-65    I1    ENERGY DEPENDENT OUTOUT                      Virgin
                    = 0 = NONE                                    Virgin
                    = 1 = INCIDENT SPECTRUM                       Virgin
                    = 2 = TRANSMITTED SPECTRUM                    Virgin
                    = 3 = INCIDENT REACTIONS                      Virgin
                    = 4 = TRANSMIITED REACTIONS                   Virgin
                    = 5 = TOTAL CROSS SECTION                     Virgin
                    = 6 = REACTION CROSS SECTION                  Virgin
   5   1-11   E11.4  BLACKBODY TEMPERATURE IN EV                   Virgin
      12-22   E11.4  FLUX NORMALIZATION                           Virgin
      23-33   E11.4  REACTION NORMALIZATION                       Virgin
                    CALCULATIONS WILL BE BASED ON THE SPECTRUM    Virgin
                    AND CROSS SECTIONS AS READ. AT OUTPUT THE     Virgin
                    RESULTS WILL BE MULTIPLIED BY THESE           Virgin
                    NORMALIZATION FACTORS.                        Virgin
      34-44    I11   DENSITY PROFILE                              Virgin
                    = 0 - UNIFORM - BASED ON TOTAL DENSITY        Virgin
                    = 1 - UNIFORM - TOTAL + REACTION DENSITY      Virgin
                    = 2 - TOTAL + LINEAR REACTION                 Virgin
                    = 3 - LINEAR (TOTAL + REACTION)               Virgin
                    = 4 - TOTAL + SQUARE REACTION                 Virgin
                    = 5 - SQUARE (TOTAL + REACTION)               Virgin
                    = 6 - TOTAL + CUBIC REACTION                  Virgin
                    = 7 - CUBIC (TOTAL + REACTION)                Virgin
 6-N   1-66  6E11.4  TARGET THICKNESSES IN CM                      Virgin
                    IF SAME AS LAST CASE THIS SECTION IS NOT      Virgin
                    INCLUDED IN THE INPUT.                        Virgin
VARY   1-66  6E11.4  TALLY GROUP ENERGY BOUNDARIES                Virgin
                    (NUMBER OF BOUNDARIES IS ONE MORE THAN        Virgin
                    THE NUMBER OF TALLY GROUPS)                   Virgin
                    IF THE STANDARD OPTION (-11 TO 0) IS          Virgin
                    SELECTED THIS SECTION IS NOT INCLUDED         Virgin
                    IN THE INPUT                                  Virgin
VARY   1-66  6E11.4  SOURCE SPECTRUM IN ENERGY (EV)-SOURCE PAIRS  Virgin
                    (MUST BE AT LEAST TWO POINTS)                 Virgin
                    IF STANDARD OPTION (-5 TO 0) IS SELECTED THIS Virgin
                    SECTION IS NOT INCLUDED IN THE INPUT          Virgin
                                                                  Virgin
ANY NUMBER OF CASES MAY BE RUN ONE AFTER ANOTHER.                 Virgin
                                                                  Virgin
EXAMPLE INPUT NO. 1                                               Virgin
------------------                                                Virgin
CALCULATE THE UNCOLLIDED FLUX AND CAPTURE (MT=102) THROUGH        Virgin
30 CM OF IRON (DENSITY 7.87 G/CC). TALLY THE RESULTS USING        Virgin
THE TART 175 GROUP STRUCTURE. THE SOURCE WILL BE CONSTANT         Virgin
FROM 1 KEV TO 20 MEV. USE THE STANDARD ENDF/B INPUT DATA          Virgin
FILENAME.                                                         Virgin
                                                                  Virgin
ENDFB.IN                                                          Virgin
IRON 0 TO 30 CM THICK.                                            Virgin
CONSTANT SOURCE FROM 1 KEV TO 20 MEV.                             Virgin
 26000    1 7.87000+ 0 26000  102 7.87000+ 0     2    0    2 1100  Virgin
 0.00000+ 0 1.00000+ 0 1.00000+ 0          0 0.00000+00           Virgin
 0.00000+00 3.00000+01                                            Virgin
 1.0000E+03 1.0000E+00 2.0000E+07 1.0000E+00                      Virgin
                                                                  Virgin
EXAMPLE INPUT NO. 2                                               Virgin
------------------                                                Virgin
```

```
     CALCULATE THE UNCOLLIDED PHOTON FLUX THROUGH A MIXTURE OF SILICON  Virgin
     AND IRON FOR 100 MEV PHOTONS INCIDENT. THE TRANSMISSION WILL BE    Virgin
     CALCULATED FOR 21 THICKNESSES VARYING BETWEEN 0 AND 1 CM. THERE    Virgin
     WILL BE ONLY 1 TALLY GROUP SPANNING A VERY NARROW ENERGY RANGE     Virgin
     NEAR 100 MEV, AND THE SOURCE SPECTRUM WILL BE CONSTANT OVER THE    Virgin
     SAME ENERGY RANGE. USE THE STANDARD ENDF/B INPUT DATA FILENAME     Virgin
     BY LEAVING THE FIRST INPUT LINE BLANK.                             Virgin
                                                                        Virgin
     (THIS IS A BLANK LINE TO USE THE STANDARD INPUT FILENAME)          Virgin
     100 MEV PHOTONS                                                    Virgin
     SILICON + 5 % IRON                                                 Virgin
      14000  521 2.30000+ 0 26000  521 1.15000- 1    21    1    2 1000  Virgin
      0.00000+ 0 1.00000+ 0 1.00000+ 0          1 0.00000+00            Virgin
      0.00000+00 5.00000-01 1.00000+00 1.50000+00 2.00000+00 2.50000+00 Virgin
      3.00000+00 3.50000+00 4.00000+00 4.50000+00 5.00000+00 5.50000+00 Virgin
      6.00000+00 6.50000+00 7.00000+00 7.50000+00 8.00000+00 8.50000+00 Virgin
      9.00000+00 9.50000+00 1.00000+01                                  Virgin
      9.99000+ 7 1.00100+ 8                                             Virgin
      9.99000+ 7 1.00000+ 4 1.00100+ 8 1.00000+ 4                       Virgin
                                                                        Virgin
=========================================================================== Virgin
```