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======================================================================= Spectra
                                                                        Spectra
       PROGRAM SPECTRA                                                  Spectra
       ===============                                                  Spectra
       An extension of LINEAR to linearize ALl MF=5 spectra.            Spectra
       05/28/2012 - Added MF=15 neutron induced, photon spectra.        Spectra
                                                                        Spectra
       First released in 2010 - Earlier below dates refer to LINEAR.    Spectra
                                                                        Spectra
       VERSION 74-1 (MAY 1974)                                          Spectra
       VERSION 75-1 (APRIL 1975)                                        Spectra
       VERSION 76-2 (OCTOBER 1976)                                      Spectra
       VERSION 77-1 (JANUARY 1977)                                      Spectra
       VERSION 78-1 (JULY 1978)                                         Spectra
       VERSION 79-1 (JULY 1979) CDC-7600 AND CRAY-1 VERSION.            Spectra
       VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION.               Spectra
       VERSION 80-2 (DECEMBER 1980)                                     Spectra
       VERSION 81-1 (MARCH 1981)                                        Spectra
       VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY.     Spectra
       VERSION 83-1 (JANUARY 1983) *MAJOR RE-DESIGN.                    Spectra
                              *PAGE SIZE INCREASED - 1002 TO 3006.      Spectra
                              *ELIMINATED COMPUTER DEPENDENT CODING.    Spectra
                              *NEW, MORE COMPATIBLE I/O UNIT NUMBER.     Spectra
                              *ADDED OPTION TO KEEP ALL ORIGINAL        Spectra
                               ENERGY POINTS FROM EVALUATION.           Spectra
                              *ADDED STANDARD ALLOWABLE ERROR OPTION     Spectra
                               (CURRENTLY 0.1 PER-CENT).                Spectra
       VERSION 83-2 (OCTOBER 1983) IMPROVED BASED ON USER COMMENTS.     Spectra
       VERSION 84-1 (APRIL 1984)   IMPROVED BASED ON USER COMMENTS.     Spectra
       VERSION 84-2 (JUNE 1984)   *UPDATED FOR ENDF/B-VI FORMATS.       Spectra
                              *SPECIAL I/O ROUTINES TO GUARANTEE        Spectra
                               ACCURACY OF ENERGY.                      Spectra
                              *DOUBLE PRECISION TREATMENT OF ENERGY     Spectra
                               (REQUIRED FOR NARROW RESONANCES).        Spectra
       VERSION 85-1 (AUGUST 1985) *FORTRAN-77/H VERSION                 Spectra
       VERSION 86-1 (JANUARY 1986)*ENDF/B-VI FORMAT                     Spectra
       VERSION 87-1 (JANUARY 1987)*DOUBLE PRECISION TREATMENT OF CROSS  Spectra
                               SECTION                                  Spectra
       VERSION 88-1 (JULY 1988)   *OPTION...INTERNALLY DEFINE ALL I/O   Spectra
                               FILE NAMES (SEE, SUBROUTINE FILEIO       Spectra
                               FOR DETAILS).                            Spectra
                              *IMPROVED BASED ON USER COMMENTS.         Spectra
       VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO   Spectra
                               INSURE PROGRAM WILL NOT DO ANYTHING      Spectra
                               CRAZY.                                   Spectra
                              *UPDATED TO USE NEW PROGRAM CONVERT       Spectra
                               KEYWORDS.                                Spectra
                              *ADDED LIVERMORE CIVIC COMPILER           Spectra
                               CONVENTIONS.                             Spectra
       VERSION 90-1 (JUNE 1990)   *EXTENDED TO LINEARIZE PHOTON         Spectra
                               INTERACTION DATA, MF=23 AND 27           Spectra
                              *ADDED FORTRAN SAVE OPTION                Spectra
                              *UPDATED BASED ON USER COMMENTS.          Spectra
                              *NEW MORE CONSISTENT ENERGY OUTPUT        Spectra
                               ROUTINE.                                 Spectra
                              *WARNING...INPUT PARAMETER FORMAT         Spectra
                               HAS BEEN CHANGED...SEE DESCRIPTION       Spectra
                               BELOW.                                   Spectra
       VERSION 91-1 (JULY 1991)   *ADDED INTERPOLATION LAW 6 - ONLY USED Spectra
                               FOR CHARGED PARTICLE CROSS SECTIONS      Spectra
                               FOR COULOMB PENETRABILITIES.             Spectra
       VERSION 92-1 (JANUARY 1992)*ADDED NU-BAR (TOTAL, DELAYED, PROMPT) Spectra
                               POLYNOMIAL OR TABULATED ALL CONVERTED    Spectra
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                                  TO LINEARLY INTERPOLABLE               Spectra
                                 *INCREASED PAGE SIZE FROM 3006 TO 5010  Spectra
                                  POINTS.                                Spectra
                                 *ALL ENERGIES INTERNALLY ROUNDED PRIOR  Spectra
                                  TO CALCULATIONS.                       Spectra
                                 *COMPLETELY CONSISTENT I/O AND ROUNDING Spectra
                                  ROUTINES - TO MINIMIZE COMPUTER        Spectra
                                  DEPENDENCE.                            Spectra
        VERSION 92-2 (JULY 1992) *CORRECTED CONVERSION OF NU-BAR FROM    Spectra
                                  POLYNOMIAL TO TABULATED - COPY         Spectra
                                  SPONTANEOUS NU-BAR (BY DEFINITION      Spectra
                                  THE SPONTANEOUS NU-BAR IS NOT AN        Spectra
                                  ENERGY DEPENDENT QUANTITY).            Spectra
      VERSION 93-1 (MARCH 1993)  *UPDATED FOR USE WITH LAHEY COMPILER    Spectra
                                  ON IBM-PCS.                            Spectra
                                 *INCREASED PAGE SIZE FROM 5010 TO       Spectra
                                  30000 POINTS                           Spectra
   VERSION 94-1 (JANUARY 1994)*VARIABLE ENDF/B DATA FILENAMES           Spectra
                                  TO ALLOW ACCESS TO FILE STRUCTURES     Spectra
                                  (WARNING - INPUT PARAMETER FORMAT      Spectra
                                  HAS BEEN CHANGED)                      Spectra
                                 *CLOSE ALL FILES BEFORE TERMINATING     Spectra
                                  (SEE, SUBROUTINE ENDIT)                Spectra
   VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                       Spectra
                                 *IMPROVED COMPUTER INDEPENDENCE         Spectra
                                 *ALL DOUBLE PRECISION                   Spectra
                                 *ON SCREEN OUTPUT                       Spectra
                                 *UNIFORM TREATMENT OF ENDF/B I/O        Spectra
                                 *IMPROVED OUTPUT PRECISION              Spectra
                                 *DEFINED SCRATCH FILE NAMES             Spectra
                                 *ALWAYS INCLUDE THERMAL VALUE           Spectra
                                 *INCREASED PAGE SIZE FROM 30000 TO      Spectra
                                  60000 POINTS                           Spectra
      VERSION 99-1 (MARCH 1999)  *CORRECTED CHARACTER TO FLOATING       Spectra
                                  POINT READ FOR MORE DIGITS             Spectra
                                 *UPDATED TEST FOR ENDF/B FORMAT         Spectra
                                  VERSION BASED ON RECENT FORMAT CHANGE  Spectra
                                 *GENERAL IMPROVEMENTS BASED ON          Spectra
                                  USER FEEDBACK                          Spectra
       VERSION 99-2 (JUNE 1999)  *ASSUME ENDF/B-VI, NOT V, IF MISSING    Spectra
                                  MF=1, MT-451.                          Spectra
   VERS. 2000-1 (FEBRUARY 2000)*ADDED MF = 9 AND 10 LINEARIZATION       Spectra
                                 *GENERAL IMPROVEMENTS BASED ON          Spectra
                                  USER FEEDBACK                          Spectra
    VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS               Spectra
    VERS. 2004-1 (JAN. 2004)    *GENERAL UPDATE BASED ON USER FEEDBACK  Spectra
    VERS. 2005-1 (JAN. 2005)    *ALWAYS KEEP ORIGINAL TABULATED         Spectra
                                  NU-BAR POINTS.                         Spectra
    VERS. 2006-1 (FEB. 2006)    *CORRECTED INT=6 NEAR THRESHOLD         Spectra
                                 *NO SUBDIVIDE BELOW MINIMUM XCMIN       Spectra
    VERS. 2007-1 (JAN. 2007)    *CHECKED AGAINST ALL ENDF/B-VII.        Spectra
                                 *INCREASED PAGE SIZE FROM 60,000 TO     Spectra
                                  600,000 POINTS                         Spectra
    VERS. 2010-1 (JUNE 2010)    *ADDED MF = 5 - MF = 6 STILL PLANNED.   Spectra
                                 *72 CHARACTER FILE NAMES.               Spectra
                                 *ONLY PROCESS MF=5 - SKIP ALL OTHERS    Spectra
                                  TO PREVENT CONFLICT WITH LINEAR        Spectra
                                  THINNING.                              Spectra
    VERS. 2012-1 (Aug. 2012)    *Added MF=15, neutron induced photon    Spectra
                                  spectra.                               Spectra
                                 *Added CODENAME                         Spectra
                                 *32 and 64 bit Compatible               Spectra
                                 *Added ERROR stop                       Spectra
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VERS. 2015-1 (Jan. 2015)     *Extended OUT9.                     Spectra
                             *Replaced ALL 3 way IF Statements.  Spectra
                             *Corrected MF=15 Data - it was adding  Spectra
                              SEND between sub-sections.          Spectra
                             *Deleted unused parts, e.g., NUBAR.  Spectra
VERS. 2017-1 (May  2017)     *Increased page size to 3,000,000   Spectra
                             *Updated based on user feedback      Spectra
                             *Changed DGAMMA to REDGAMMA to avoid  Spectra
                              conflict with possble RESERVED NAME  Spectra
                             *All floating input parameters changed Spectra
                              to character input + IN9 conversion.  Spectra
                                                                 Spectra
OWNED, MAINTAINED AND DISTRIBUTED BY                             Spectra
------------------------------------                             Spectra
THE NUCLEAR DATA SECTION                                         Spectra
INTERNATIONAL ATOMIC ENERGY AGENCY                               Spectra
P.O. BOX 100                                                     Spectra
A-1400, VIENNA, AUSTRIA                                          Spectra
EUROPE                                                           Spectra
                                                                 Spectra
ORIGINALLY WRITTEN BY                                            Spectra
-----------------------------------                             Spectra
Dermott E. Cullen                                               Spectra
                                                                 Spectra
PRESENT CONTACT INFORMATION                                      Spectra
---------------------------                                      Spectra
Dermott E. Cullen                                               Spectra
1466 Hudson Way                                                 Spectra
Livermore, CA 94550                                            Spectra
U.S.A.                                                          Spectra
Telephone  925-443-1911                                        Spectra
E. Mail    RedCullen1@Comcast.net                              Spectra
Website    RedCullen1.net/HOMEPAGE.NEW                         Spectra
                                                                 Spectra
AUTHORS MESSAGE                                                 Spectra
--------------                                                 Spectra
THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION  Spectra
FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED Spectra
THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE Spectra
READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION.               Spectra
                                                                 Spectra
AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER Spectra
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE  Spectra
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT Spectra
IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY    Spectra
COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO Spectra
IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF Spectra
THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR      Spectra
COMPUTER.                                                       Spectra
                                                                 Spectra
PURPOSE                                                          Spectra
-------                                                          Spectra
THIS PROGRAM IS DESIGNED TO CONVERT ENDF/B FILE 3, 23 AND 27 DATA Spectra
TO LINEAR-LINEAR INTERPOLABLE FORM. ANY SECTION THAT IS ALREADY Spectra
LINEAR-LINEAR INTERPOLABLE WILL BE THINNED.                     Spectra
                                                                 Spectra
IN THE FOLLOWING DISCUSSION FOR SIMPLICITY THE ENDF/B TERMINOLOGY Spectra
---ENDF/B TAPE---WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE Spectra
TAPE, CARDS, DISK OR ANY OTHER MEDIUM.                          Spectra
                                                                 Spectra
ENDF/B FORMAT                                                    Spectra
------------                                                    Spectra
THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS  Spectra
```

OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION   Spectra
OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT).   Spectra
                                                                     Spectra
IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B   Spectra
FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS   Spectra
ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE   Spectra
NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE   Spectra
CORRECTLY OUTPUT ON ALL LINES. THE FORMAT OF SECTION MF=1, MT=451   Spectra
AND ALL SECTIONS OF MF=3 MUST BE CORRECT. THE PROGRAM COPIES ALL   Spectra
OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO   Spectra
THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.   Spectra
                                                                     Spectra
OUTPUT FORMAT   Spectra
-------------   Spectra
IN THIS VERSION OF LINEAR ALL ENERGIES WILL BE OUTPUT IN   Spectra
F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN   Spectra
WITH UP TO 9 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN   Spectra
OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS   Spectra
OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS   Spectra
TO THE 9 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE   Spectra
TO USE THE 9 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA   Spectra
DUE TO TRUNCATION OF ENERGIES TO 6 DIGITS DURING OUTPUT.   Spectra
                                                                     Spectra
CONTENTS OF OUTPUT   Spectra
------------------   Spectra
ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE LINEARIZED DATA   Spectra
CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO   Spectra
INCLUDED.   Spectra
                                                                     Spectra
DOCUMENTATION   Spectra
-------------   Spectra
THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED   Spectra
BY THE ADDITION OF 3 COMMENT LINES AT THE END OF EACH HOLLERITH   Spectra
SECTION IN THE FORM   Spectra
                                                                     Spectra
***************** PROGRAM SPECTRA (2017-1) ****************   Spectra
FOR ALL DATA GREATER THAN 1.00000-10 IN ABSOLUTE VALUE   Spectra
DATA LINEARIZED TO WITHIN AN ACCURACY OF 0.1 PER-CENT   Spectra
                                                                     Spectra
THE ORDER OF SIMILAR COMMENTS (FROM RECENT, SIGMA1 AND GROUPIE)   Spectra
REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON   Spectra
THE DATA BY THESE PROGRAMS.   Spectra
                                                                     Spectra
THESE COMMENT LINES ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS,   Spectra
I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT   Spectra
OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF   Spectra
EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451   Spectra
IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF   Spectra
THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF   Spectra
MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO   Spectra
DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND   Spectra
AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT   Spectra
SHOULD BE USED TO CREATE A HOLLERITH SECTION.   Spectra
                                                                     Spectra
REACTION INDEX   Spectra
-------------   Spectra
THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN   Spectra
SECTION MF=1, MT=451 OF EACH EVALUATION.   Spectra
                                                                     Spectra
THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451.   Spectra
THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT   Spectra
REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS   Spectra
NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING   Spectra

A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE   Spectra
A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM Spectra
YOU MAY USE PROGRAM DICTIN TO CREATE A CORRECT REACTION INDEX.   Spectra
                                                                    Spectra
SECTION SIZE   Spectra
------------   Spectra
SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT   Spectra
TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS   Spectra
SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.   Spectra
                                                                    Spectra
FOR ANY LINEARIZED SECTION THAT CONTAINS 60000 OR FEWER POINTS   Spectra
THE ENTIRE OPERATION WILL BE PERFORMED IN CORE AND THE LINEARIZED   Spectra
DATA WILL BE OUTPUT DIRECTLY TO THE ENDF/B FORMAT. FOR ANY SECTION Spectra
THAT CONTAINS MORE POINTS THE DATA WILL BE LINEARIZED A PAGE AT A   Spectra
TIME (1 PAGE = 60000 POINTS) AND OUTPUT TO SCRATCH. AFTER THE   Spectra
ENTIRE SECTION HAS BEEN LINEARIZED THE DATA WILL BE READ BACK FROM Spectra
SCRATCH AND OUTPUT TO THE ENDF/B FORMAT.   Spectra
                                                                    Spectra
SELECTION OF DATA   Spectra
-----------------   Spectra
THE PROGRAM SELECTS DATA TO BE LINEARIZED BASED EITHER ON EITHER   Spectra
MAT (ENDF/B MAT NO.) OR ZA AS WELL AS MF AND MT NUMBERS. THIS   Spectra
PROGRAM ALLOWS UP TO 100 MAT/MF/MT OR ZA/MF/MT RANGES TO BE   Spectra
SPECIFIED BY INPUT PARAMETERS. THE PROGRAM WILL ASSUME THAT THE   Spectra
ENDF/B TAPE IS IN MAT ORDER, REGARDLESS OF THE CRITERIA USED   Spectra
TO RETRIEVE MATERIALS. IF RETRIEVAL IS BY MAT RANGE THE PROGRAM   Spectra
WILL TERMINATE WHEN A MAT IS FOUND THAT IS ABOVE ALL REQUESTED   Spectra
MAT RANGES. IF RETRIEVAL IS BY ZA RANGE THE PROGRAM WILL SEARCH   Spectra
THE ENTIRE ENDF/B TAPE.   Spectra
                                                                    Spectra
PROGRAM OPERATION   Spectra
-----------------   Spectra
EACH SECTION OF DATA IS CONSIDERED SEPARATELY. EACH SECTION OF   Spectra
ENDF/B DATA TO LINEARIZE IS REPRESENTED BY A TABLE OF ENERGY   Spectra
VS. CROSS SECTION AND ANY ONE OF FIVE ALLOWABLE INTERPOLATION LAWS Spectra
BETWEEN ANY TWO TABULATED POINTS. THIS PROGRAM WILL REPLACE EACH   Spectra
SECTION OF DATA CROSS SECTIONS BY A NEW TABLE OF ENERGY VS.   Spectra
CROSS SECTION IN WHICH THE INTERPOLATION LAW IS ALWAYS LINEAR IN   Spectra
ENERGY AND CROSS SECTION BETWEEN ANY TWO TABULATED POINTS.   Spectra
                                                                    Spectra
DATA IS READ AND LINEARIZED A PAGE AT A TIME (ONE PAGE CONTAINS   Spectra
60000 DATA POINTS). IF THE FINAL LINEARIZED SECTION CONTAINS TWO   Spectra
PAGES OR LESS, DATA POINTS IT WILL BE ENTIRELY CORE RESIDENT   Spectra
AFTER IT HAS BEEN LINEARIZED AND WILL BE WRITTEN DIRECTLY FROM   Spectra
CORE TO THE OUTPUT TAPE. IF THE LINEARIZED SECTION IS LARGER THAN   Spectra
TWO PAGES, AFTER EACH PAGE IS LINEARIZED IT WILL BE WRITTEN TO   Spectra
SCRATCH. AFTER THE ENTIRE SECTION HAS BEEN LINEARIZED IT WILL   Spectra
BE READ BACK FROM SCRATCH, TWO PAGES AT A TIME, AND WRITTEN TO   Spectra
THE OUTPUT TAPE.   Spectra
                                                                    Spectra
KEEP EVALUATED DATA POINTS   Spectra
-------------------------   Spectra
SOMETIMES IT IS CONVENIENT TO KEEP ALL ENERGY POINTS WHICH WERE   Spectra
PRESENT IN THE ORIGINAL EVALUATION AND TO MERELY SUPPLEMENT THESE   Spectra
POINTS WITH ADDITIONAL ENERGY POINTS IN ORDER TO LINEARIZE THE   Spectra
CROSS SECTIONS. FOR EXAMPLE, IT IS OFTEN CONVENIENT TO KEEP THE   Spectra
THERMAL VALUE (AT 0.0253 EV) OR THE VALUE AT 14.1 MEV.   Spectra
                                                                    Spectra
THE CURRENT VERSION OF THIS PROGRAM WILL ALLOW THE USER TO KEEP   Spectra
ALL ORIGINAL EVALUATED DATA POINTS BY SPECIFYING 1 IN COLUMNS   Spectra
34-44 OF THE FIRST INPUT LINE. THIS WILL TURN OFF THE BACKWARD   Spectra
THINNING (SEE UCRL-50400, VOL. 17, PART A FOR EXPLANATION) AND   Spectra
RESULT IN ALL ORIGINAL ENERGY POINTS BEING KEPT. CAUTION SHOULD   Spectra

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

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OUTPUT FILES                                                     Spectra
------------                                                     Spectra
UNIT  DESCRIPTION                                                Spectra
----  -----------                                               Spectra
   3  OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)                Spectra
  11  FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)             Spectra
                                                                 Spectra
SCRATCH FILES                                                    Spectra
-------------                                                    Spectra
UNIT  DESCRIPTION                                                Spectra
----  -----------                                               Spectra
  12  SCRATCH FILE (BINARY - 180000 WORDS/RECORD                 Spectra
                                                                 Spectra
OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILEIO)             Spectra
----------------------------------------------------            Spectra
UNIT  FILE NAME                                                  Spectra
----  ----------                                                Spectra
   2  SPECTRA.INP                                                Spectra
   3  SPECTRA.LST                                                Spectra
  10  ENDFB.IN                                                   Spectra
  11  ENDFB.OUT                                                  Spectra
  12  (SCRATCH)                                                  Spectra
                                                                 Spectra
                                                                 Spectra
INPUT PARAMETERS                                                 Spectra
----------------                                                 Spectra
FOR VERSIONS EARLIER THAN 90-1 THIS PROGRAM ONLY ALLOWED THE USER Spectra
TO SPECIFY BY INPUT PARAMETERS WHICH MATERIALS (MAT) TO PROCESS. Spectra
FOR EACH REQUESTED MATERIAL NEUTRON INTERACTION CROSS SECTIONS   Spectra
(MF=3) WOULD BE LINEARIZED AND THE REMAINDER OF THE MATERIAL     Spectra
WOULD BE COPIED.                                                 Spectra
                                                                 Spectra
FOR VERSIONS 90-1 AND LATER THIS PROGRAM WILL ALLOW THE USER TO  Spectra
TO SPECIFY BY INPUT PARAMETERS EXACTLY WHAT SECTIONS OF DATA     Spectra
TO PROCESS. FOR EACH SECTION OF DATA, SPECIFIED BY MAT, MF, MT   Spectra
RANGES, SECTIONS OF MF=3, 23 AND 27 WILL BE LINEARIZED AND ALL   Spectra
OTHER REQUESTED SECTIONS WILL BE COPIED. ALL SECTIONS WHICH ARE  Spectra
NOT EXPLICITLY REQUESTED WILL BE SKIPPED AND WILL NOT APPEAR ON  Spectra
ENDF/B FILE OUTPUT BY THIS PROGRAM.                              Spectra
                                                                 Spectra
WITH THIS NEW PROCEDURE YOU CAN MINIMIZE THE SIZE OF THE ENDF/B  Spectra
FILE OUTPUT BY THIS PROGRAM, E.G., IF YOU ONLY WANT NEUTRON      Spectra
CROSS SECTIONS FOR SUBSEQUENT PROCESSING YOU NEED ONLY REQUEST   Spectra
ONLY MF=3 DATA.                                                  Spectra
                                                                 Spectra
HOWEVER, YOU MUST UNDERSTAND THAT ONLY THOSE SECTIONS WHICH YOU  Spectra
EXPLICITLY REQUEST WILL APPEAR ON THE ENDF/B FILE OUTPUT BY      Spectra
THIS PROGRAM. FOR EXAMPLE, IF YOU WISH TO DOCUMENT EXACTLY       Spectra
HOW YOU LINEARIZED THE DATA BY INCLUDING COMMENTS IN MF=1, MT=451 Spectra
THEN YOU MUST EXPLICITLY REQUEST THAT MF=1, MT=451 BE PROCESSED  Spectra
FOR EACH MATERIAL THAT YOU REQUEST. SIMILAR IF YOU WANT THE      Spectra
ENTIRE EVALUATION YOU MUST REQUEST ALL MF AND MT TO BE OUTPUT.   Spectra
                                                                 Spectra
LINE  COLS.  DESCRIPTION                                         Spectra
----  -----  -----------                                         Spectra
   1  1-11   SELECTION CRITERIA (0=MAT, 1=ZA)                    Spectra
      12-22  MONITOR MODE SELECTOR                               Spectra
             = 0 - NORMAL OPERATION                              Spectra
             = 1 - MONITOR PROGRESS OF LINEARIZING OF THE DATA.  Spectra
                   EACH TIME A PAGE OF DATA POINTS IS WRITTEN TO Spectra
                   THE SCRATCH FILE PRINT OUT THE TOTAL NUMBER OF Spectra
                   POINTS ON SCRATCH AND THE LOWER AND UPPER     Spectra
                   ENERGY LIMITS OF THE PAGE (THIS OPTION MAY BE Spectra
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                    USED IN ORDER TO MONITOR THE EXECUTION SPEED       Spectra
                    OF LONG RUNNING JOBS).                             Spectra
        23-33   MINIMUM CROSS SECTION OF INTEREST (BARNS).             Spectra
                    (IF 0.0 OR LESS IS INPUT THE PROGRAM WILL          Spectra
                    USE 1.0E-10). ENERGY INTERVALS WILL NOT BE         Spectra
                    SUB-DIVIDED IF THE ABSOLUTE VALUE OF THE CROSS     Spectra
                    SECTION WITHIN THE INTERVAL IS LESS THAN THIS VALUE. Spectra
                    AN EXCEPTION TO THIS RULE IS NEAR THRESHOLDS ENERGY Spectra
                    INTERVALS WILL BE SUB-DIVIDED UNTIL CONVERGENCE    Spectra
                    REGARDLESS OF THE MAGNITUDE OF THE CROSS SECTION.  Spectra
        34-44   KEEP ORIGINAL EVALUATED DATA POINTS.                   Spectra
                    = 0 - NO.                                          Spectra
                    = 1 - YES - ADDITIONAL POINTS MAY BE ADDED IN ORDER Spectra
                            TO LINEARIZE DATA, BUT ALL ORIGINAL        Spectra
                            DATA POINTS WILL BE INCLUDED IN THE        Spectra
                            RESULTS.                                   Spectra
   2    1-72   ENDF/B INPUT DATA FILENAME                              Spectra
                    (STANDARD OPTION = ENDFB.IN)                       Spectra
   3    1-72   ENDF/B OUTPUT DATA FILENAME                             Spectra
                    (STANDARD OPTION = ENDFB.OUT)                      Spectra
 4-N    1- 6   LOWER MAT OR ZA LIMIT                                   Spectra
        7- 8   LOWER MF LIMIT                                          Spectra
        9-11   LOWER MT LIMIT                                          Spectra
       12-17   UPPER MAT OR ZA LIMIT                                   Spectra
       18-19   UPPER MF LIMIT                                          Spectra
       20-22   UPPER MT LIMIT                                          Spectra
                    UP TO 100 RANGES MAY BE SPECIFIED, ONLY ONE RANGE  Spectra
                    PER LINE. THE LIST OF RANGES IS TERMINATED BY A    Spectra
                    BLANK LINE. IF THE UPPER MAT LIMIT OF ANY REQUEST  Spectra
                    IS LESS THAN THE LOW LIMIT IT WILL BE SET EQUAL TO Spectra
                    THE LOWER LIMIT. IF THE UPPER LIMIT IS STILL ZERO  Spectra
                    IT WILL BE SET EQUAL TO 999999. IF THE UPPER MF OR Spectra
                    MT LIMIT IS ZERO IT WILL BE SET TO 99 OR 999       Spectra
                    RESPECTIVELY.                                      Spectra
 VARY   1-11   ENERGY FOR ERROR LAW                                    Spectra
       12-22   ALLOWABLE FRACTIONAL ERROR FOR ERROR LAW.              Spectra
                    THE ACCEPTABLE LINEARIZING ERROR MAY BE SPECIFIED TO Spectra
                    BE EITHER ENERGY INDEPENDENT (DEFINED BY A SINGLE  Spectra
                    ERROR), OR ENERGY DEPENDENT (DEFINED BY UP TO 20   Spectra
                    ENERGY, ERROR PAIRS). FOR THE ENERGY DEPENDENT CASE Spectra
                    LINEAR INTERPOLATION WILL BE USED TO DEFINE THE ERROR Spectra
                    AT ENERGIES BETWEEN THOSE AT WHICH IT IS TABULATED. Spectra
                    IN ALL CASES THE ERROR LAW IS TERMINATED BY A BLANK Spectra
                    LINE. IF ONLY ONE ENERGY, ERROR PAIR IS GIVEN THE  Spectra
                    THE LAW WILL BE CONSIDERED TO BE ENERGY INDEPENDENT. Spectra
                    IF MORE THAN ONE PAIR IS GIVEN IT WILL BE CONSIDERED Spectra
                    TO BE ENERGY DEPENDENT (NOTE, ENERGY INDEPENDENT   Spectra
                    FORM WILL RUN FASTER THAN THE EQUIVALENT ENERGY    Spectra
                    DEPENDENT FORM). FOR AN ENERGY DEPENDENT ERROR LAW Spectra
                    ALL ENERGIES MUST BE ASCENDING ENERGY ORDER. FOR   Spectra
                    CONVERGENCE OF THE LINEARIZING ALGORITHM ALL ERRORS Spectra
                    MUST BE POSITIVE. IF AN ALLOWABLE ERROR IS NOT     Spectra
                    POSITIVE IT WILL BE SET EQUAL TO THE STANDARD OPTION Spectra
                    (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT).  Spectra
                    IF THE FIRST ERROR LINE IS BLANK IT WILL TERMINATE Spectra
                    THE ERROR LAW AND THE ERROR WILL BE TREATED AS     Spectra
                    ENERGY INDEPENDENT, EQUAL TO THE STANDARD OPTION   Spectra
                    (CURRENTLY 0.1 PER-CENT). (SEE EXAMPLE INPUT 4).   Spectra
                                                                       Spectra
EXAMPLE INPUT NO. 1                                                    Spectra
-------------------                                                    Spectra
RETRIEVE DATA BY ZA IN ORDER TO FIND ALL URANIUM ISOTOPES AND          Spectra
THORIUM 232. RETRIEVE ALL NEUTRON INTERACTION CROSS SECTIONS           Spectra
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      (MF=3). ALL ENERGY INTERVALS IN WHICH THE CROSS SECTION IS        Spectra
      AT LEAST 1 MICRO-BARN (1.0E-06 BARNS) WILL BE SUBDIVIDED.          Spectra
      BACKWARD THINNING WILL BE PERFORMED. FROM 0 TO 100 EV LINEARIZE    Spectra
      TO WITHIN 0.1 PER-CENT ACCURACY. FROM 100 EV TO 1 KEV VARY         Spectra
      ACCURACY BETWEEN 0.1 AND 1.0 PER-CENT. ABOVE 1 KEV USE 1           Spectra
      PER-CENT ACCURACY.                                                 Spectra
                                                                         Spectra
      EXPLICITLY SPECIFY THE STANDARD FILENAMES.                         Spectra
                                                                         Spectra
      IN THIS CASE THE FOLLOWING 11 INPUT LINES ARE REQUIRED            Spectra
                                                                         Spectra
          1           0 1.00000- 6            0                          Spectra
ENDFB.IN                                                                 Spectra
ENDFB.OUT                                                                Spectra
92000 3  0 92999 3999                                                    Spectra
90232 3  0     0 3  0    (UPPER LIMIT AUTOMATICALLY SET TO 90232 3999)   Spectra
                         (END OF REQUEST LIST)                           Spectra
0.00000+ 0 1.00000-03                                                    Spectra
1.00000+ 2 1.00000-03                                                    Spectra
1.00000+ 3 1.00000-02                                                    Spectra
1.00000+ 9 1.00000-02                                                    Spectra
                         (END OF ERROR LAW)                              Spectra
                                                                         Spectra
      EXAMPLE INPUT NO. 2                                                Spectra
      -------------------                                                Spectra
      SAME AS THE ABOVE CASE, EXCEPT LINEARIZE ALL DATA TO WITHIN THE    Spectra
      STANDARD ACCURACY (CURRENTLY 0.1 PER-CENT). IN ORDER TO USE THE    Spectra
      STANDARD ACCURACY YOU NEED NOT SPECIFY ANY ERROR LAW AT ALL. IN    Spectra
      THIS CASE INCLUDE THE HOLLERITH SECTION, MF=1, MT=451, FOR EACH    Spectra
      MATERIAL.                                                          Spectra
                                                                         Spectra
      LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL     Spectra
      THEN USE STANDARD FILENAMES.                                       Spectra
                                                                         Spectra
      IN THIS CASE THE FOLLOWING 9 INPUT LINES ARE REQUIRED             Spectra
                                                                         Spectra
          1           0 1.00000- 6            0                          Spectra
                         (USE DEFAULT FILENAME = ENDFB.IN)               Spectra
                         (USE DEFAULT FILENAME = ENDFB.OUT)              Spectra
92000 1451 92999 1451                                                    Spectra
92000 3  0 92999 3999                                                    Spectra
90232 1451     0 1451                                                    Spectra
90232 3  0     0 3  0    (UPPER LIMIT AUTOMATICALLY SET TO 90232 3999)   Spectra
                         (END OF REQUEST LIST)                           Spectra
                         (0.1 PER-CENT ERROR, END OF ERROR LAW)          Spectra
                                                                         Spectra
      EXAMPLE INPUT NO. 3                                                Spectra
      -------------------                                                Spectra
      LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO WITHIN AN ACCURACY    Spectra
      OF 0.5 PER-CENT (0.005 AS A FRACTION). IN THIS CASE YOU NEED NOT   Spectra
      SPECIFY THE MAT, MF, MT RANGES.                                    Spectra
                                                                         Spectra
      READ THE ENDF/B DATA FROM \ENDFB6\ZA092238 AND WRITE THE ENDF/B    Spectra
      DATA TO \ENDFB6\LINEAR\ZA092238.                                   Spectra
                                                                         Spectra
      IN THIS CASE THE FOLLOWING 6 INPUT LINES ARE REQUIRED             Spectra
                                                                         Spectra
                                          (MAT, 1.0E-10 BARNS, THIN)     Spectra
\ENDFB6\ZA092238                                                         Spectra
\ENDFB6\LINEAR\ZA092238                                                  Spectra
                         (RETRIEVE ALL DATA, END REQUEST LIST)           Spectra
          5.00000-03                                                     Spectra
                         (END OF ERROR LAW)                              Spectra
```

NOTE THAT IN THIS CASE IF THE INPUT HAD SPECIFIED AN EQUIVALENT
ENERGY DEPENDENT ERROR LAW BY GIVING A NUMBER OF ENERGY POINTS
AT EACH OF WHICH THE ERROR IS 0.5 PER-CENT THE PROGRAM WOULD TAKE
LONGER TO RUN (I.E., ONLY USE AN ENERGY DEPENDENT ERROR LAW WHEN
IT IS NECESSARY).
EXAMPLE INPUT NO. 4

IN ORDER TO LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO THE
STANDARD OPTION OF 0.1 PER-CENT IT IS ADEQUATE TO INPUT A SET
OF COMPLETELY BLANK LINES WHICH WILL AUTOMATICALLY INVOKE ALL
OF THE STANDARD OPTIONS.
LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL
THEN USE STANDARD FILENAMES.
IN THIS CASE THE FOLLOWING THREE INPUT LINES ARE REQUIRED
                                    (MAT, 1.0E-10 BARNS, THIN)
                    (USE DEFAULT FILENAME = ENDFB.IN)
                    (USE DEFAULT FILENAME = ENDFB.OUT)
                    (RETRIEVE ALL DATA, END REQUEST LIST)
                    (0.1 PER-CENT ERROR, END OF ERROR LAW)
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