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====================================================================== Spectra
                                                                       Spectra
     PROGRAM SPECTRA                                                   Spectra
     ===============                                                   Spectra
     An extension of LINEAR to linearize ALl MF=5 spectra.             Spectra
     2012/05/28 - Added MF=15 neutron induced, photon spectra.         Spectra
     2019/01/03 - MF=6 Still NOT Implemented                           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
                                 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
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                          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
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
VERS. 2018-1 (Jan. 2018)   *On-line output for ALL ENDERROR            Spectra
VERS. 2019-1 (June 2019)   *Additional Interpolation Law Tests         Spectra
                           *Check Maximum Tabulated Energy to          Spectra
                            insure it is the same for all MTs -        Spectra
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                            if not, print WARNING messages.       Spectra
                           *Corrected END Histogram linearized -  Spectra
                            Previously deleted last point - ERROR Spectra
                            to assume this has Y=0 - now keep     Spectra
                            point, but insure Y = 0.              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 (2019-1) ***************** 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 SPECIFIED BY INPUT PARAMETERS. THE PROGRAM WILL ASSUME THAT THE ENDF/B TAPE IS IN MAT ORDER, REGARDLESS OF THE CRITERIA USED TO RETRIEVE MATERIALS. IF RETRIEVAL IS BY MAT RANGE THE PROGRAM WILL TERMINATE WHEN A MAT IS FOUND THAT IS ABOVE ALL REQUESTED MAT RANGES. IF RETRIEVAL IS BY ZA RANGE THE PROGRAM WILL SEARCH THE ENTIRE ENDF/B TAPE.

PROGRAM OPERATION

EACH SECTION OF DATA IS CONSIDERED SEPARATELY. EACH SECTION OF ENDF/B DATA TO LINEARIZE IS REPRESENTED BY A TABLE OF ENERGY VS. CROSS SECTION AND ANY ONE OF FIVE ALLOWABLE INTERPOLATION LAWS BETWEEN ANY TWO TABULATED POINTS. THIS PROGRAM WILL REPLACE EACH SECTION OF DATA CROSS SECTIONS BY A NEW TABLE OF ENERGY VS. CROSS SECTION IN WHICH THE INTERPOLATION LAW IS ALWAYS LINEAR IN ENERGY AND CROSS SECTION BETWEEN ANY TWO TABULATED POINTS.

DATA IS READ AND LINEARIZED A PAGE AT A TIME (ONE PAGE CONTAINS 60000 DATA POINTS). IF THE FINAL LINEARIZED SECTION CONTAINS TWO PAGES OR LESS, DATA POINTS IT WILL BE ENTIRELY CORE RESIDENT AFTER IT HAS BEEN LINEARIZED AND WILL BE WRITTEN DIRECTLY FROM CORE TO THE OUTPUT TAPE. IF THE LINEARIZED SECTION IS LARGER THAN TWO PAGES, AFTER EACH PAGE IS LINEARIZED IT WILL BE WRITTEN TO SCRATCH. AFTER THE ENTIRE SECTION HAS BEEN LINEARIZED IT WILL BE READ BACK FROM SCRATCH, TWO PAGES AT A TIME, AND WRITTEN TO THE OUTPUT TAPE.

KEEP EVALUATED DATA POINTS

SOMETIMES IT IS CONVENIENT TO KEEP ALL ENERGY POINTS WHICH WERE PRESENT IN THE ORIGINAL EVALUATION AND TO MERELY SUPPLEMENT THESE POINTS WITH ADDITIONAL ENERGY POINTS IN ORDER TO LINEARIZE THE CROSS SECTIONS. FOR EXAMPLE, IT IS OFTEN CONVENIENT TO KEEP THE THERMAL VALUE (AT 0.0253 EV) OR THE VALUE AT 14.1 MEV.

THE CURRENT VERSION OF THIS PROGRAM WILL ALLOW THE USER TO KEEP ALL ORIGINAL EVALUATED DATA POINTS BY SPECIFYING 1 IN COLUMNS 34-44 OF THE FIRST INPUT LINE. THIS WILL TURN OFF THE BACKWARD THINNING (SEE UCRL-50400, VOL. 17, PART A FOR EXPLANATION) AND RESULT IN ALL ORIGINAL ENERGY POINTS BEING KEPT. CAUTION SHOULD BE EXERCISED IN USING THIS OPTION SINCE IT CAN RESULT IN A CONSIDERABLE INCREASE IN THE NUMBER OF DATA POINTS OUTPUT BY THIS CODE.

FOR ALL USERS WHO ARE NOT INTERESTED IN THIS OPTIONS NO CHANGES ARE REQUIRED IN THE INPUT TO THIS PROGRAM, I. E. IF COLUMNS 34-44 ARE BLANK (AS FOR ALL PREVIOUS VERSIONS OF THIS CODE) THE PROGRAM WILL OPERATE EXACTLY AS IT DID BEFORE.

ALLOWABLE ERROR

ALLOWABLE ERROR MUST ALWAYS BE SPECIFIED IN THE INPUT TO THIS PROGRAM AS A FRACTION, NOT A PER-CENT. FOR EXAMPLE, INPUT THE ALLOWABLE FRACTIONAL ERROR 0.001 IN ORDER TO OBTAIN DATA THAT IS ACCURATE TO WITHIN 0.1 PER-CENT.

THE CONVERSION OF THE DATA FROM THE GENERAL INTERPOLATION FORM TO LINARLY INTERPOLABLE FORM CANNOT BE PERFORMED EXACTLY. HOWEVER, IT CAN BE PERFORMED TO VIRTUALLY ANY REQUIRED ACCURACY AND MOST IMPORTANTLY CAN BE PERFORMED TO A TOLERANCE THAT IS SMALL COMPARED TO THE UNCERTAINTY IN THE CROSS SECTIONS THEMSELVES. AS SUCH THE CONVERSION OF CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM CAN BE PERFORMED WITH ESSENTIALLY NO LOSE OF INFORMATION.

THE ALLOWABLE ERROR MAY BE ENERGY INDEPENDENT (CONSTANT) OR ENERGY DEPENDENT. THE ALLOWABLE ERROR IS DESCRIBED BY A TABULATED FUNCTION OF UP TO 20 (ENERGY,ERROR) PAIRS AND LINEAR INTERPOLATION BETWEEN TABULATED POINTS. IF ONLY ONE TABULATED POINT IS GIVEN THE ERROR WILL BE CONSIDERED CONSTANT OVER THE ENTIRE ENERGY RANGE. WITH THIS ENERGY DEPENDENT ERROR ONE MAY OPTIMIZE THE OUTPUT FOR

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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
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
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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
                    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
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                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
    (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
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                                                                      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
                                                                      Spectra
    NOTE THAT IN THIS CASE IF THE INPUT HAD SPECIFIED AN EQUIVALENT   Spectra
    ENERGY DEPENDENT ERROR LAW BY GIVING A NUMBER OF ENERGY POINTS    Spectra
    AT EACH OF WHICH THE ERROR IS 0.5 PER-CENT THE PROGRAM WOULD TAKE  Spectra
    LONGER TO RUN (I.E., ONLY USE AN ENERGY DEPENDENT ERROR LAW WHEN  Spectra
    IT IS NECESSARY).                                                 Spectra
                                                                      Spectra
    EXAMPLE INPUT NO. 4                                               Spectra
    -------------------                                               Spectra
    IN ORDER TO LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO THE      Spectra
    STANDARD OPTION OF 0.1 PER-CENT IT IS ADEQUATE TO INPUT A SET     Spectra
    OF COMPLETELY BLANK LINES WHICH WILL AUTOMATICALLY INVOKE ALL     Spectra
    OF THE STANDARD OPTIONS.                                          Spectra
                                                                      Spectra
    LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL    Spectra
    THEN USE STANDARD FILENAMES.                                      Spectra
                                                                      Spectra
    IN THIS CASE THE FOLLOWING THREE INPUT LINES ARE REQUIRED         Spectra
                                                                      Spectra
                                          (MAT, 1.0E-10 BARNS, THIN)  Spectra
                        (USE DEFAULT FILENAME = ENDFB.IN)             Spectra
                        (USE DEFAULT FILENAME = ENDFB.OUT)            Spectra
                        (RETRIEVE ALL DATA, END REQUEST LIST)         Spectra
                        (0.1 PER-CENT ERROR, END OF ERROR LAW)        Spectra
                                                                      Spectra
====================================================================== Spectra
```