```
====================================================================== Linear
                                                                       Linear
     PROGRAM LINEAR                                                    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
```

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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
VERS. 2005-1 (JAN. 2005)    *ALWAYS KEEP ORIGINAL TABULATED       Linear
                             NU-BAR POINTS.                       Linear
VERS. 2006-1 (FEB. 2006)    *CORRECTED INT=6 NEAR THRESHOLD       Linear
                            *NO SUBDIVIDE BELOW MINIMUM XCMIN     Linear
VERS. 2007-1 (JAN. 2007)    *CHECKED AGAINST ALL ENDF/B-VII.      Linear
                            *INCREASED PAGE SIZE FROM 60,000 TO   Linear
                             600,000 POINTS                       Linear
VERS. 2007-2 (DEC. 2007)    *72 CHARACTER FILE NAMES.             Linear
VERS. 2010-1 (Apr. 2010)    *Skipped leading cross section = 0    Linear
                             up to effective start, unless keeping Linear
                             ALL original energy points.          Linear
                            *Replaced ETHRES by ESTART - it is    Linear
                             not a threshold - just a minimum     Linear
                             energy - if a section starts above   Linear
                             this energy with a positive cross    Linear
                             section, an additional point will    Linear
                             inserted with cross section = 0.     Linear
VERS. 2012-1 (Aug. 2012)    *Minor Updates based on User Feedback. Linear
                            *Added CODENAME                       Linear
                            *32 and 64 bit Compatible             Linear
                            *Added ERROR stops.                   Linear
VERS. 2012-2 (Nov. 2012)    *Never thin nu-bar.                   Linear
VERS. 2013-1 (Nov. 2013)    *Extended OUT9.                       Linear
VERS. 2015-1 (Jan. 2015)    *Allow Imaginary Anomolous Scattering Linear
                             Factor to be Negative (MF/MT=27/506). Linear
                            *Replaced ALL 3 way IF Statements.    Linear
VERS. 2016-1 (June 2016)    *Cosmetic changes based on FREUD      Linear
                             psychoanalysis.                      Linear
VERS. 2017-1 (May  2017)    *Updated based on user feedback.      Linear
                            *Inceased page size to 3,000,000.     Linear
                            *All floating input parameters changed Linear
                             to character input + IN9 conversion. Linear
VERS. 2018-1 (Jan. 2018)    *Updated based on user feedback.      Linear
                            *Added on-line output for ALL ENDERROR Linear
                                                                  Linear
OWNED, MAINTAINED AND DISTRIBUTED BY                              Linear
-----------------------------------                               Linear
THE NUCLEAR DATA SECTION                                          Linear
```

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AUTHORS MESSAGE

THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION.

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

THIS PROGRAM IS DESIGNED TO CONVERT ENDF/B FILE 3, 23 AND 27 DATA TO LINEAR-LINEAR INTERPOLABLE FORM. ANY SECTION THAT IS ALREADY LINEAR-LINEAR INTERPOLABLE WILL BE THINNED.

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

ENDF/B FORMAT

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

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

OUTPUT FORMAT

IN THIS VERSION OF LINEAR ALL ENERGIES WILL BE OUTPUT IN F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN WITH UP TO 9 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS TO THE 9 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE TO USE THE 9 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA DUE TO TRUNCATION OF ENERGIES TO 6 DIGITS DURING OUTPUT.

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 (2018-1) ***************** 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   1-72  ENDF/B INPUT DATA FILENAME                             Linear
             (STANDARD OPTION = ENDFB.IN)                           Linear
   3   1-72  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
```

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                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
```