**======================================================================= 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**

 **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**

 **INTERNATIONAL ATOMIC ENERGY AGENCY Linear**

 **P.O. BOX 100 Linear**

 **A-1400, VIENNA, AUSTRIA Linear**

 **EUROPE Linear**

 **Linear**

 **ORIGINALLY WRITTEN BY Linear**

 **------------------------------------ Linear**

 **Dermott E. Cullen Linear**

 **Linear**

 **PRESENT CONTACT INFORMATION Linear**

 **--------------------------- Linear**

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 **Linear**

 **AUTHORS MESSAGE Linear**

 **--------------- Linear**

 **THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION Linear**

 **FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED Linear**

 **THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE Linear**

 **READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION. Linear**

 **Linear**

 **AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER Linear**

 **INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE Linear**

 **OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT Linear**

 **IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY Linear**

 **COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO Linear**

 **IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF Linear**

 **THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR Linear**

 **COMPUTER. Linear**

 **Linear**

 **PURPOSE Linear**

 **------- Linear**

 **THIS PROGRAM IS DESIGNED TO CONVERT ENDF/B FILE 3, 23 AND 27 DATA Linear**

 **TO LINEAR-LINEAR INTERPOLABLE FORM. ANY SECTION THAT IS ALREADY Linear**

 **LINEAR-LINEAR INTERPOLABLE WILL BE THINNED. Linear**

 **Linear**

 **IN THE FOLLOWING DISCUSSION FOR SIMPLICITY THE ENDF/B TERMINOLOGY Linear**

 **---ENDF/B TAPE---WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE Linear**

 **TAPE, CARDS, DISK OR ANY OTHER MEDIUM. Linear**

 **Linear**

 **ENDF/B FORMAT Linear**

 **------------- Linear**

 **THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS Linear**

 **OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION Linear**

 **OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT). Linear**

 **Linear**

 **IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B Linear**

 **FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS Linear**

 **ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE Linear**

 **NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE Linear**

 **CORRECTLY OUTPUT ON ALL LINES. THE FORMAT OF SECTION MF=1, MT=451 Linear**

 **AND ALL SECTIONS OF MF=3 MUST BE CORRECT. THE PROGRAM COPIES ALL Linear**

 **OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO Linear**

 **THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS. Linear**

 **Linear**

 **OUTPUT FORMAT Linear**

 **------------- Linear**

 **IN THIS VERSION OF LINEAR ALL ENERGIES WILL BE OUTPUT IN Linear**

 **F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN Linear**

 **WITH UP TO 9 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN Linear**

 **OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS Linear**

 **OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS Linear**

 **TO THE 9 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE Linear**

 **TO USE THE 9 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA Linear**

 **DUE TO TRUNCATION OF ENERGIES TO 6 DIGITS DURING OUTPUT. Linear**

 **Linear**

 **CONTENTS OF OUTPUT Linear**

 **------------------ Linear**

 **ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE LINEARIZED DATA Linear**

 **CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO Linear**

 **INCLUDED. Linear**

 **Linear**

 **DOCUMENTATION Linear**

 **------------- Linear**

 **THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED Linear**

 **BY THE ADDITION OF 3 COMMENT LINES AT THE END OF EACH HOLLERITH Linear**

 **SECTION IN THE FORM Linear**

 **Linear**

 **\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* PROGRAM LINEAR (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**

 **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**