**======================================================================= Legend**

 **Legend**

 **PROGRAM LEGEND Legend**

 **============== Legend**

 **VERSION 80-1 (SEPTEMBER 1980) Legend**

 **VERSION 84-1 (NOVEMBER 1984) Legend**

 **VERSION 86-1 (JANUARY 1986) \*CORRECTED BASED ON USER COMMENTS Legend**

 **\*FORTRAN-77/H VERSION Legend**

 **VERSION 87-1 (JANUARY 1987) \*CORRECTED BASED ON USER COMMENTS Legend**

 **VERSION 88-1 (JULY 1988) \*OPTION...INTERNALLY DEFINE ALL I/O Legend**

 **FILE NAMES (SEE, SUBROUTINE FILEIO Legend**

 **FOR DETAILS). Legend**

 **\*IMPROVED BASED ON USER COMMENTS. Legend**

 **VERSION 89-1 (JANUARY 1989) \*PSYCHOANALYZED BY PROGRAM FREUD TO Legend**

 **INSURE PROGRAM WILL NOT DO ANYTHING Legend**

 **CRAZY. Legend**

 **\*UPDATED TO USE NEW PROGRAM CONVERT Legend**

 **KEYWORDS. Legend**

 **\*ADDED LIVERMORE CIVIC COMPILER Legend**

 **CONVENTIONS. Legend**

 **VERSION 92-1 (JANUARY 1992) \*FOR ANGULAR DISTRIBUTIONS CALCULATED Legend**

 **FROM LEGENDRE COEFFICIENTS, INTERVAL Legend**

 **HALF TO CONVERGENCE. Legend**

 **\*UPDATED BASED ON USER COMMENTS Legend**

 **\*ADDED FORTRAN SAVE OPTION Legend**

 **\*ADDED SELECTED OF DATA TO PROCESS Legend**

 **BY MAT/MF/MT/ENERGY RANGES. Legend**

 **\*WARNING...THE INPUT PARAMETER FORMAT Legend**

 **HAS BEEN CHANGED - FOR DETAILS SEE Legend**

 **BELOW. Legend**

 **VERSION 92-2 (SEPT. 1992) \*CORRECTED PROCESSING OF ISOTROPIC Legend**

 **ANGULAR DISTRIBUTIONS Legend**

 **VERSION 94-1 (JANUARY 1994) \*VARIABLE ENDF/B DATA FILENAMES Legend**

 **TO ALLOW ACCESS TO FILE STRUCTURES Legend**

 **(WARNING - INPUT PARAMETER FORMAT Legend**

 **HAS BEEN CHANGED) Legend**

 **\*CLOSE ALL FILES BEFORE TERMINATING Legend**

 **(SEE, SUBROUTINE ENDIT) Legend**

 **VERSION 96-1 (JANUARY 1996) \*COMPLETE RE-WRITE Legend**

 **\*IMPROVED COMPUTER INDEPENDENCE Legend**

 **\*ALL DOUBLE PRECISION Legend**

 **\*ON SCREEN OUTPUT Legend**

 **\*UNIFORM TREATMENT OF ENDF/B I/O Legend**

 **\*IMPROVED OUTPUT PRECISION Legend**

 **\*INCREASED MAX. POINTS FROM 5,000 Legend**

 **TO 20,000. Legend**

 **VERSION 99-1 (MARCH 1999) \*CORRECTED CHARACTER TO FLOATING Legend**

 **POINT READ FOR MORE DIGITS Legend**

 **\*UPDATED TEST FOR ENDF/B FORMAT Legend**

 **VERSION BASED ON RECENT FORMAT CHANGE Legend**

 **\*GENERAL IMPROVEMENTS BASED ON Legend**

 **USER FEEDBACK Legend**

 **VERS. 2000-1 (FEBRUARY 2000)\*GENERAL IMPROVEMENTS BASED ON Legend**

 **USER FEEDBACK Legend**

 **VERS. 2001-1 (MARCH 2001) \*UPDATED TO HANDLE COMBINATIONS OF Legend**

 **LEGENDRE COEFFICIENTS AT LOW ENERGY Legend**

 **AND TABULATED DATA AT HIGH ENERGY. Legend**

 **VERS. 2002-1 (MAY 2002) \*OPTIONAL INPUT PARAMETERS Legend**

 **VERS. 2004-1 (MARCH 2004) \*ADDED INCLUDE FOR COMMON Legend**

 **\*ZERO ANGULAR DISTRIBUTIONS ARE O.K. Legend**

 **(PREVIOUSLY ZERO OR NEGATIVE WAS Legend**

 **TREATED AS AN ERROR - ZERO IS O.K. Legend**

 **FOR SOME REACTIONS OVER SOME COSINE Legend**

 **RANGES) Legend**

 **VERS. 2006-1 (MARCH 2006) \*INCREASED MAXIMUM NUMBER OF LEGENDRE Legend**

 **COEFFICIENTS FROM 50 TO 500. Legend**

 **WARNING - THE RECURSION RELATIONSHIP Legend**

 **FOR LEGENDRE POLYNOMIALS BECOMES Legend**

 **UNSTABLE IN HIGHER ORDER POLYTNOMIALS Legend**

 **EVEN USING DOUBLE PRECISION. Legend**

 **VERS. 2007-1 (JAN. 2007) \*CHECKED AGAINST ALL ENDF/B=VII. Legend**

 **\*INCREASED MAX. POINTS FROM 60,000 Legend**

 **TO 240,000. Legend**

 **VERS. 2007-2 (MAY 2007) \*CORRECTED SIZE OF XMUBASE IN ANGLEN Legend**

 **FOR INCREASED NUMBER OF COEFFICIENTS. Legend**

 **VERS. 2010-1 (Apr. 2010) \*General update based on user feedback Legend**

 **VERS. 2012-1 (Aug. 2012) \*added CODENAME Legend**

 **\*32 and 64 bit Compatible Legend**

 **\*Added ERROR stop Legend**

 **VERS. 2015-1 (Jan. 2015) \*Extended OUT9 Legend**

 **\*Replaced ALL 3 way IF Statements. Legend**

 **VERS. 2015-2 (Oct. 2015) \*OPEN optional LEGEND.INP after Legend**

 **OPENING LEGEND.LST. Legend**

 **\*Coefficient checks are turned OFF Legend**

 **if LEGEND.INP is missing = this Legend**

 **agrees with BEST INPUT. Legend**

 **\*Switched from LISTO to LISTO9 Legend**

 **(no 10 digit output) Legend**

 **VERS. 2016-1 (May 2016) \*Changed multiple IF statement to Legend**

 **accommodate compiler optimizer Legend**

 **\*Increased Maximum allowed points per Legend**

 **angular distribution from 900 to Legend**

 **MAXPOINT (currently 240,000) Legend**

 **VERS. 2017-1 (May 2017) \*More tests. Expanded to handle new Legend**

 **R-M (LRF=7) detailed angular Legend**

 **distributions. Legend**

 **\*Max. points increased to 3,000,000. Legend**

 **\*All floating input parameters changed Legend**

 **to characte input + IN9 conversion. Legend**

 **\*If near COS=0 - set = 0 Legend**

 **\*Default changed to negative fixes. Legend**

 **\*At end print tallies for, Legend**

 **1-Number of negative distributions. Legend**

 **2-Number of duplicate or out-of-order Legend**

 **Ehnergies Legend**

 **VERS. 2018-1 (Jan. 2018) \*Added on-line output for ALL ENDERROR Legend**

 **VERS. 2019-1 (June 2019) \*Additional Interpolation Law Tests Legend**

 **\*Checked Maximum Tabulated Energy to Legend**

 **insure it is the same for all MTs - Legend**

 **if not, print WARNING messages. Legend**

 **\*Corrected END Histogram linearized - Legend**

 **Previously assumed Y = 0 and deleted Legend**

 **Now output whatever the Y value. Legend**

 **Legend**

 **OWNED, MAINTAINED AND DISTRIBUTED BY Legend**

 **------------------------------------ Legend**

 **THE NUCLEAR DATA SECTION Legend**

 **INTERNATIONAL ATOMIC ENERGY AGENCY Legend**

 **P.O. BOX 100 Legend**

 **A-1400, VIENNA, AUSTRIA Legend**

 **EUROPE Legend**

 **Legend**

 **ORIGINALLY WRITTEN BY Legend**

 **------------------------------------ Legend**

 **Dermott E. Cullen Legend**

 **Legend**

 **PRESENT CONTACT INFORMATION Legend**

 **--------------------------- Legend**

 **Dermott E. Cullen Legend**

 **1466 Hudson Way Legend**

 **Livermore, CA 94550 Legend**

 **U.S.A. Legend**

 **Telephone 925-443-1911 Legend**

 **E. Mail RedCullen1@Comcast.net Legend**

 **Website RedCullen1.net/HOMEPAGE.NEW Legend**

 **Legend**

 **PURPOSE Legend**

 **------- Legend**

 **CALCULATE LINEARLY INTERPOLABLE TABULATED ANGULAR DISTRIBUTIONS Legend**

 **STARTING FROM DATA IN THE ENDF/B FORMAT. ANGULAR DISTRIBUTIONS Legend**

 **MAY BE DESCRIBED IN THE ENDF/B FORMAT IN ONE OF THREE WAYS. Legend**

 **FOR EACH OF THESE THREE FORMS THE USER MAY CHOOSE (SEE, INPUT Legend**

 **OPTIONS) TO EITHER COPY EACH TYPE OF DATA OR TO PROCESS IT AT Legend**

 **AS FOLLOWS, Legend**

 **Legend**

 **(1) ANGULAR DISTRIBUTION IS ISOTROPIC AT ALL ENERGIES (LTT=0) Legend**

 **------------------------------------------------------------- Legend**

 **IN THIS CASE THE INPUT DATA DOES NOT INCLUDE ANY ANGULAR Legend**

 **DISTRIBUTIONS. A SECTION MERELY CONTAINS A FLAG TO INDICATE Legend**

 **THE ANGULAR DISTRIBUTION IS ISOTROPIC AT ALL ENERGIES. IN THIS Legend**

 **CASE THE SECTION IS OUTPUT IN EXACTLY THE SAME FORM IN WHICH IT Legend**

 **WAS READ FROM THE INPUT. Legend**

 **Legend**

 **(2) ANGULAR DISTRIBUTIONS GIVEN BY LEGENDRE COEFFICIENTS (LTT=1) Legend**

 **---------------------------------------------------------------- Legend**

 **LEGENDRE COEFFICIENTS ARE GIVEN AT A SERIES OF ENERGIES. AN Legend**

 **INTERPOLATION LAW IS GIVEN BETWEEN ENERGIES. THE INTERPOLATION Legend**

 **LAW BETWEEN ENERGIES IS COPIED AS INPUT (I.E., NO ATTEMPT IS Legend**

 **MADE TO LINEARIZE THE VARIATION WITH ENERGY). FOR EACH ENERGY AT Legend**

 **WHICH LEGENDRE COEFFICIENTS ARE GIVEN A LINEARLY INTERPOLABLE Legend**

 **ANGULAR DISITRIBUTION IS RECONSTRUCTED IN THE SYSTEM IN WHICH THE Legend**

 **THE COEFFICIENTS ARE GIVEN (I.E., CM OR LAB - NO ATTEMPT IS MADE Legend**

 **TO CONVERT FROM ONE SYSTEM TO THE OTHER). A MAXIMUM OF 50 LEGENDRE Legend**

 **COEFFICIENTS IS ALLOWED. REGARDLESS OF THE NUMBER OF COEFFICIENTS Legend**

 **INPUT THE PROGRAM WILL ONLY USE COEFFICIENTS UP TO THE LAST ORDER Legend**

 **AT WHICH THE COEFFICIENTS ARE NON-ZERO (E.G. IF COEFFICIENTS P1 Legend**

 **THROUGH P12 ARE READ, BUT P9=P10=P11=P12=0.0, THE PROGRAM WILL Legend**

 **ONLY USE COEFFICIENTS UP TO P8). IF OVER 50 NON-ZERO COEFFICIENTS Legend**

 **ARE READ ONLY THE FIRST 50 WILL BE USED. Legend**

 **Legend**

 **(2) ANGULAR DISTRIBUTIONS IS TABULATED (LTT=2) Legend**

 **---------------------------------------------------------------- Legend**

 **ANGULAR DISTRIBUTIONS ARE GIVEN AT A SERIES OF ENERGIES. AN Legend**

 **INTERPOLATION LAW IS GIVEN BETWEEN ENERGIES AND A SECOND Legend**

 **INTERPOLATION LAW IS GIVEN AT EACH ENERGY TO INTERPOLATE BETWEEN Legend**

 **THE POINTS IN EACH TABULATED DISTRIBUTION. AT EACH ENERGY THE Legend**

 **ANGULAR DISTRIBUTION WILL BE CONVERTED TO LINEARLY INTERPOLABLE Legend**

 **FORM. THE INTERPOLATION BETWEEN ENERGIES IS OUTPUT EXACTLY AS Legend**

 **INPUT. THE INTERPOLATION LAW AT EACH ENERGY IS OUTPUT TO INDICATE Legend**

 **THE NOW LINEARLY INTERPOLABLE ANGULAR DISTRIBUTION. Legend**

 **Legend**

 **(3) LEGENDRE COEFFICIENTS AND TABULATED (LTT=3) Legend**

 **---------------------------------------------------------------- Legend**

 **ENDF-102 SAYS THIS SHOULD BE LTT=4, BUT ALL OF THE EVALUATIONS Legend**

 **IN ENDF/B-VI, RELEASE 7, USE LTT=3? THIS CODE WILL TREAT THESE Legend**

 **AS LTT=4 - SEE BELOW. Legend**

 **Legend**

 **(4) LEGENDRE COEFFICIENTS AND TABULATED (LTT=4) Legend**

 **---------------------------------------------------------------- Legend**

 **THIS IS A COMBINATION OF (1) AND (2) DESCRIBED ABOVE. THE Legend**

 **LEGENDRE DATA IS ALWAYS GIVEN FIRST, FOR LOWER ENERGIES, Legend**

 **FOLLOWED BY TABULATED ANGULAR DISTRIBUTIONS, FOR HIGHER ENERGIES. Legend**

 **Legend**

 **THIS TYPE OF DATA CAN ONLY BE COPIED OR ALL CONVERTED TO Legend**

 **TABULATED (LTT=2). Legend**

 **Legend**

 **POINT VALUES - NORMALIZED VS. UNNORMALIZED Legend**

 **------------------------------------------------------------------ Legend**

 **THE VALUE OF AN ANGULAR DISTRIBUTION AT ANY COSINE WILL BE Legend**

 **CORRECTLY CALCULATED BY THIS CODE, BASED EITHER DIRECTLY ON THE Legend**

 **ANGULAR DISTRIBUTION, OR ON THE SUM OF THE CONTRIBUTING LEGENDRE Legend**

 **MOMENTS. Legend**

 **Legend**

 **ENDF/B ANGULAR DISTRIBUTIONS ARE BY DEFINITION NORMALIZED WHEN Legend**

 **INTEGRATED OVER COSINE. THEREFORE THIS CODE WILL NORMALIZE EACH Legend**

 **ANGULAR DISTRIBUTION BEFORE IT IS OUTPUT. THE OUTPUT REPORT FROM Legend**

 **THIS CODE WILL INDICATE THE NORMALIZATION FACTOR USED. Legend**

 **Legend**

 **THE REASON THAT AN ANGULAR DISTRIBUTION MAY NOT BE NORMALIZED IS Legend**

 **DUE TO THE APPROXIMATION OF CREATING LINEARLY INTERPOLABLE Legend**

 **TABULATED ANGULAR DISTRIBUTIONS - THE MORE ACCURATELY THIS IS Legend**

 **DONE THE CLOSER THE NORMALIZATION FACTOR WILL BE TO UNITY. AS YOU Legend**

 **DECREASE THE ALLOWABLE ERROR THE NORMALIZED VALUES WILL APPROACH Legend**

 **THE CORRECT POINT VALUES CALCULATED BY THE CODE. Legend**

 **Legend**

 **SINCE THE DATA IS NORMALIZED PRIOR TO OUTPUT THE RESULTS IN THE Legend**

 **ENDF/B FORMAT MAY DIFFER SLIGHTLY FROM VALUES REFERRED TO BE ERROR Legend**

 **MESSAGES, ETC. PRINTED BY THE CODE DURING EXECUTION. IN ALL CASES Legend**

 **THE VALUES PRINTED BY THE CODE IN ERROR MESSAGES, ETC. SHOULD BE Legend**

 **CONSIDERED TO BE THE CORRECT VALUES AND THE OUTPUT TABULATED Legend**

 **ANGULAR DISTRIBUTIONS APPROXIMATE DUE TO THE RE-NORMALIZATION - Legend**

 **TO RE-ITERATE, THE OUTPUT TABULATED VALUES ARE APPROXIMATE DUE Legend**

 **TO THE APPROXIMATIONS USED IN CONSTRUCTING LINEAR INTERPOLABLE Legend**

 **ANGULAR DISTRIBUTIONS TO WITHIN SOME ALLOWABLE TOLERANCE. Legend**

 **Legend**

 **ELIMINATION OF NEGATIVE VALUES Legend**

 **------------------------------ Legend**

 **THE RECONSTRUCTED ANGULAR DISTRIBUTION WILL BE TESTED AND IF IT Legend**

 **IS NEGATIVE AT ONE OR MORE COSINES AN ERROR MESSAGE WILL BE OUTPUT Legend**

 **AND BASED ON THE INPUT OPTION SELECTED ONE OF THE FOLLOWING Legend**

 **CORRECTIVE ACTIONS WILL BE TAKEN (SEE, INPUT OPTIONS), Legend**

 **(1) NO CORRECTION Legend**

 **(2) CHANGE INDIVIDUAL LEGENDRE COEFFICIENTS (EACH BY LESS THAN Legend**

 **1.0 PER-CENT) UNTIL THE RECONSTRUCTED ANGULAR DISTRIBUTION Legend**

 **IS POSITIVE (MINIMUM MORE THAN 1 MILLI-BARN). THE ALLOWABLE Legend**

 **PER-CENT CHANGE IN COEFFICIENTS AND MINIMUM CROSS SECTION CAN Legend**

 **BE CHANGED BY INPUT. Legend**

 **(3) CHANGE ALL LEGENDRE COEFFICIENTS TO FORCE DISTRIBUTION TO BE Legend**

 **POSITIVE (MINIMUM MORE THAN 1 MILLI-BARN). WITH THIS OPTION Legend**

 **THERE IS NO RESTRICTION ON THE AMOUNT THAT EACH COEFFICIENT Legend**

 **IS CHANGED AND AS SUCH THIS OPTION SHOULD BE USED WITH Legend**

 **CAUTION AND ONLY AS A LAST RESORT IF NO OTHER APPROACH CAN Legend**

 **BE USED TO MAKE THE DISTRIBUTION POSITIVE. Legend**

 **Legend**

 **OUTPUT Legend**

 **------ Legend**

 **THE USER MAY REQUEST OUTPUT OF EITHER, Legend**

 **(1) TABULATED VALUES - POSSIBLY CORRECTED TO ELIMINATE NEGATIVE Legend**

 **VALUES. THE TABULATED DISTRIBUTION WILL BE NORMALIZED BEFORE Legend**

 **OUTPUT. Legend**

 **(2) LEGENDRE COEFFICIENTS - POSSIBLY CORRECTED TO ELIMINATE Legend**

 **NEGATIVE VALUES AND WITHOUT HIGHER ORDER ZERO COEFFICIENTS. Legend**

 **BY DEFINITION DISTRIBUTIONS DEFINED BY LEGENDRE COEFFICIENTS Legend**

 **ARE NORMALIZED TO UNITY. Legend**

 **Legend**

 **(3) ANGULAR DISTRIBUTIONS GIVEN BY A TABULATION (LTT=2) Legend**

 **------------------------------------------------------- Legend**

 **TABULATED ANGULAR DISTRIBUTIONS ARE GIVEN AT A SERIES OF ENERGIES. Legend**

 **AN INTERPOLATION LAW IS GIVEN BETWEEN ENERGIES. THE INTERPOLATION Legend**

 **LAW BETWEEN ENERGIES IS COPIED AS INPUT (I.E., NO ATTEMPT IS Legend**

 **MADE TO LINEARIZE THE VARIATION WITH ENERGY). FOR EACH ENERGY AT Legend**

 **AT WHICH TABULATED DATA ARE GIVEN A LINEARLY INTERPOLABLE ANGULAR Legend**

 **DISTRIBUTION IS CONSTRUCTED IN THE SYSTEM IN WHICH THE TABULATED Legend**

 **DATA ARE GIVEN (I.E., CM OR LAB - NO ATTEMPT IS MADE TO CONVERT Legend**

 **FROM ONE SYSTEM TO THE OTHER). A MAXIMUM OF 60000 POINTS IS ALLOWE Legend**

 **TO REPRESENT THE ANGULAR DISTRIBUTION AT EACH ENERGY. Legend**

 **Legend**

 **ELIMINATION OF NEGATIVE VALUES Legend**

 **------------------------------ Legend**

 **THE RECONSTRUCTED ANGULAR DISTRIBUTION WILL BE TESTED AND IF IT Legend**

 **IS NEGATIVE AT ONE OR MORE COSINES AN ERROR MESSAGE WILL BE OUTPUT Legend**

 **AND BASED ON THE INPUT OPTION SELECTED ONE OF THE FOLLOWING Legend**

 **CORRECTIVE ACTIONS WILL BE TAKEN (SEE, INPUT OPTIONS), Legend**

 **(1) NO CORRECTION Legend**

 **(2) CHANGE ALL TABULATED VALUES TO FORCE DISTRIBUTION TO BE Legend**

 **POSITIVE (MINIMUM MORE THAN 1 MILLI-BARN). THE MINIMUM VALUE Legend**

 **MAY BE CHANGED BY INPUT. WITH THIS OPTION THERE IS NO Legend**

 **RESTRICTION ON THE AMOUNT THAT EACH VALUE IS CHANGED AND AS Legend**

 **SUCH THIS OPTION SHOULD BE USED WITH CAUTION AND ONLY AS A Legend**

 **LAST RESORT IF NO OTHER APPROACH CAN BE USED TO MAKE THE Legend**

 **DISTRIBUTION POSITIVE. Legend**

 **Legend**

 **OUTPUT Legend**

 **------ Legend**

 **THE OUTPUT WILL BE THE LINEARIZED ANGULAR DISTRIBUTION. THE Legend**

 **TABULATED DISTRIBUTION WILL BE NORMALIZED TO UNITY BEFORE OUTPUT. Legend**

 **Legend**

 **CORRECTING NEGATIVE ANGULAR DISTRIBUTION Legend**

 **---------------------------------------- Legend**

 **IF AN ANGULAR DISTRIBUTION IS NEGATIVE AN ERROR MESSAGE WILL BE Legend**

 **PRINTED AND THE USER MAY DECIDE (BASED ON INPUT OPTION) TO, Legend**

 **(1) NOT PERFORM ANY CORRECTIVE ACTION. Legend**

 **(2) FOR TABULATED DISTRIBUTIONS - ADD THE SAME VALUE TO EACH POINT Legend**

 **VALUE SUCH THAT WHEN THE DISTRIBUTION IS RE-NORMALIZED THE Legend**

 **MINIMUM VALUE IS 0.001 (1 MILLI-BARN). THE MINIMUM VALUE CAN Legend**

 **BE CHANGED BY INPUT. WARNING...EXCEPT FOR SELECTION OF THE Legend**

 **MINIMUM VALUE (BY INPUT) THE USER HAS NO CONTROL OVER HOW Legend**

 **MUCH THE DISTRIBUTION IS CHANGED. THEREFORE THIS OPTION SHOULD Legend**

 **BE USED WITH CAUTION. Legend**

 **(3) FOR LEGENDRE COEFFICIENTS ONE OF TWO OPTIONS MAY BE SELECTED, Legend**

 **(A) CHANGE INDIVIDUAL COEFFICIENTS (NO ONE COEFFICIENT BY MORE Legend**

 **THAN 1 PER-CENT) TO MAKE THE DISTRIBUTION POSITIVE WITH A Legend**

 **MINIMUM VALUE OF 0.001 (1 MILLI-BARN). THE MAXIMUM PER-CENT Legend**

 **CHANGE IN EACH COEFFICIENT AND MINIMUM VALUE MAY BE CHANGED Legend**

 **BY INPUT. INPUT THE PROGRAM CANNOT MAKE THE DISTRIBUTION Legend**

 **POSITIVE BY CHANGING EACH COEFFICIENT BY UP TO THE MAXIMUM Legend**

 **ALLOWABLE AMOUNT, THE ORIGINAL ANGULAR DISTRIBUTION OR Legend**

 **COEFFICIENTS WILL BE OUTPUT. ONLY IN THE LATTER CASE SHOULD Legend**

 **ONE CONSIDER USING OPTION (B) DESCRIBED BELOW. Legend**

 **(B) LOGICALLY ADD THE SAME VALUE TO EACH POINT VALUE SUCH THAT Legend**

 **WHEN THE DISTRIBUTION IS RE-NORMALIZED THE MINIMUM VALUE IS Legend**

 **0.001 (1 MILLI-BARN). THIS IS EQUIVALENT AT INCREASING P0 Legend**

 **BY A CERTAIN AMOUNT AND RE-NORMALIZATION IS EQUIVALENT TO THEN Legend**

 **DIVIDING EACH COEFFICIENT BY A CERTAIN AMOUNT. THEREFORE, Legend**

 **WHAT IS PHYSICALLY DONE BY THE PROGRAM IS TO DIVIDE EACH Legend**

 **COEFFICIENT BY THE SAME AMOUNT. WARNING..EXCEPT FOR SELECTION Legend**

 **OF THE MINIMUM VALUE (BY INPUT) THE USER HAS NO CONTROL OVER Legend**

 **HOW MUCH THE DISTRIBUTION IS CHANGED. THEREFORE THIS OPTION Legend**

 **SHOULD BE USED WITH CAUTION. Legend**

 **Legend**

 **WARNING MESSAGES FROM PROGRAM Legend**

 **----------------------------- Legend**

 **THE WARNING MESSAGES PRINTED BY THIS PROGRAM SHOULD ONLY BE Legend**

 **CONSIDERED TO BE EXACTLY THAT..WARNINGS..NOT AN ABSOLUTE JUDGEMENT Legend**

 **BY THIS PROGRAM THAT THERE IS SOMETHING WRONG WITH THE DATA. WHEN Legend**

 **WARNING MESSAGES ARE PRINTED EXAMINE THE DATA AND EITHER TAKE NO Legend**

 **ACTION (IF YOU FEEL THAT THE DATA IS O.K.) OR CORRECT THE DATA Legend**

 **(IF YOU FEEL THAT THE DATA IS INCORRECT AND YOU CAN CORRECT IT). Legend**

 **Legend**

 **VALIDITY OF MODIFIED DATA Legend**

 **------------------------- Legend**

 **BEFORE BELIEVING AND USING DATA WHICH HAS BEEN MODIFIED (EITHER Legend**

 **TABULATED ANGULAR DISTRIBUTIONS OR LEGENDRE COEFFICIENTS) THE USER Legend**

 **SHOULD INSURE THAT THE MODIFIED DATA IS PHYSICALLY MORE ACCEPTABLE Legend**

 **THAN THE ORIGINAL DATA. IN ORDER TO DO THIS ONE OR MORE OF THE Legend**

 **FOLLOWING METHODS SHOULD BE USED, Legend**

 **Legend**

 **(1) USE THE ENERGY VARIATION TESTS BUILT-IN TO THIS PROGRAM AND Legend**

 **EVALPLOT TO PLOT THE ENERGY DEPENDENCE OF THE LEGENDRE Legend**

 **COEFFICIENTS IN ORDER TO IDENTIFY AND CORRECT (BY HAND...NOT Legend**

 **BY THIS PROGRAM) ANY COEFFICIENTS WHICH HAVE UNREALISTIC Legend**

 **ENERGY AND L ORDER VARIATIONS. THIS SHOULD ALWAYS BE DONE Legend**

 **FIRST TO ELIMINATE MAJOR PROBLEMS BEFORE USING THIS PROGRAM Legend**

 **TO AUTOMATICALLY MAKE MINOR CORRECTIONS. Legend**

 **(1) OUTPUT AND PLOT THE UNCORRECTED AND CORRECTED ANGULAR Legend**

 **DISTRIBUTIONS. COMPARE THE PLOTS TO INSURE THAT THE CORRECTED Legend**

 **DATA DOES NOT SERIOUSLY CHANGE THE ENERGY DEPENDENCE OF THE Legend**

 **ANGULAR DISTRIBUTION. Legend**

 **(2) IF PLOTTING CAPABILITY IS NOT AVAIALABLE, USE THE PRINTED OUT Legend**

 **OF THIS PROGRAM TO DETERMINE HOW MUCH THE TABULATED ANGULAR Legend**

 **DISTRIBUTION OR LEGENDRE COEFFICIENTS HAVE BEEN MODIFIED. Legend**

 **GENERALLY IF ONE COEFFICIENT HAS BEEN ONLY SLIGHTLY MODIFIED Legend**

 **THE DISTRIBUTION WILL BE ACCEPTABLE. HOWEVER IF MANY Legend**

 **COEFFICIENTS HAVE BEEN MODIFIED THE RESULT WILL NOT BE Legend**

 **RELIABLE. Legend**

 **Legend**

 **SEEING ANGULAR DISTRIBUTIONS AND LEGENDRE COEFFICIENTS Legend**

 **------------------------------------------------------ Legend**

 **PROGRAM EVALPLOT CAN BE USED TO PLOT ANGULAR DISTRIBUTION AND Legend**

 **LEGENDRE COEFFICIENTS - WHEN IT COMES TO CHECKING THIS TYPE OF Legend**

 **DATA THERE IS NO SUBSTITUTE FOR PLOTS OF THE DATA TO MAKE THE Legend**

 **JOB EASY AND STRAIGHTFORWARD. Legend**

 **Legend**

 **FOR LEGENDRE COEFFICIENTS EVALPLOT CAN BE USED TO SEE THE ENERGY Legend**

 **DEPENDENCE OF EACH COEFFICIENT - THIS IS AN EXTREMELY EASY AND Legend**

 **USEFUL WAY TO CHECK FOR ERRORS IN THE BASIC DATA. Legend**

 **Legend**

 **FOR ANGULAR DISTRIBUTION EVALPLOT CAN BE USED TO PLOT THEM AT Legend**

 **EACH ENERGY THAT THEY ARE TABULATED - THIS IS ALSO AN EASY AND Legend**

 **USEFUL WAY TO CHECK FOR ERRORS. Legend**

 **Legend**

 **I/O UNIT DEFINITIONS Legend**

 **-------------------- Legend**

 **UNIT DESCRIPTION Legend**

 **---- ----------- Legend**

 **2 INPUT CARDS Legend**

 **3 OUTPUT REPORT Legend**

 **10 ORIGINAL DATA IN ENDF/B FORMAT Legend**

 **11 FINAL DATA IN ENDF/B FORMAT Legend**

 **Legend**

 **OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILIO1 AND FILIO2) Legend**

 **--------------------------------------------------------------- Legend**

 **UNIT FILE NAME Legend**

 **---- ---------- Legend**

 **2 LEGEND.INP Legend**

 **3 LEGEND.LST Legend**

 **10 ENDFB.IN Legend**

 **11 ENDFB.OUT Legend**

 **Legend**

 **INPUT CARD Legend**

 **---------- Legend**

 **CARD COLS. FORMAT DESCRIPTION Legend**

 **---- ----- ------ ----------- Legend**

 **1 1-11 E11.4 FRACTIONAL THINNING CRITERIA Legend**

 **12-22 I11 MAXIMUM NUMBER OF POINTS IN ANGULAR DISTRIBUTION Legend**

 **RECONSTRUCTED FROM LEGENDRE COEFFICIENTS (PRESENT Legend**

 **LIMITS ARE 11 TO 60000 POINTS) Legend**

 **\*THIS OPTION CAN BE USED TO RUN QUICK, BUT NOT Legend**

 **NECESSARILY SO ACCURATE CALCULATIONS - TO ROUGHLY Legend**

 **SEE WHAT THE ANGULAR DISTRIBUTIONS LOOK LIKE. Legend**

 **\*IT IS RECOMMENDED THAT YOU USE 0 AS INPUT - IN Legend**

 **WHICH CASE THE PROGRAM WILL USE THE MAXIMUM Legend**

 **ALLOWABLE NUMBER OF POINTS = 60000. Legend**

 **23-33 I11 TABULATED ANGULAR DISTRIBUTION TREATMENT Legend**

 **= 0 - COPY TABLES Legend**

 **= 1 - LINEARIZE TABLES (OUTPUT TABLES) Legend**

 **= 2 - LINEARIZE AND THIN TABLES (OUTPUT TABLES) Legend**

 **34-44 I11 LEGENDRE COEFFICIENT TREATMENT Legend**

 **= 0 - COPY LEGENDRE COEFFICIENTS Legend**

 **= 1 - RECONSTRUCT TABULATED ANGULAR DISTRIBUTION. Legend**

 **(OUTPUT TABLES). Legend**

 **= 2 - RECONSTRUCT TABULATED ANGULAR DISTRIBUTION. Legend**

 **(OUTPUT LEGENDRE COEFFICIENTS). Legend**

 **45-55 I11 NEGATIVE ANGULAR DISTRIBUTION TREATMENT. Legend**

 **= 0 - NO CORRECTION Legend**

 **= 1 - TABULATE DATA - NO CORRECTION. Legend**

 **- LEGENDRE DATA - CHANGE COEFFICIENTS Legend**

 **(NONE BY MORE THAN 1.0 PER-CENT - CAN BE Legend**

 **CHANGED BY INPUT). Legend**

 **= 2 - FORCE DISTRIBUTIONS TO BE POSITIVE Legend**

 **(TABULATED OR LEGENDRE DATA). Legend**

 **56-66 I11 LEGENDRE COEFFICIENT VARIATION TEST FLAG. Legend**

 **= 0 - TEST TESTS. Legend**

 **= 1 - PERFORM TESTS, Legend**

 **(A) LEGENDRE ORDER INCREASES WITH ENERGY. Legend**

 **(C) MONOTONIC VARIATION OF COEFFICIENTS Legend**

 **AS A FUNCTION OF ENERGY. Legend**

 **(C) COEFFICIENTS DECREASE AS A FUNCTION OF Legend**

 **LEGENDRE ORDER. Legend**

 **2 1-60 60A1 ENDF/B INPUT DATA FILENAME Legend**

 **(STANDARD OPTION = ENDFB.IN) Legend**

 **3 1-60 60A1 ENDF/B OUTPUT DATA FILENAME Legend**

 **(STANDARD OPTION = ENDFB.OUT) Legend**

 **4-N 1- 6 I6 LOWER MAT LIMIT Legend**

 **7- 8 I2 LOWER MF LIMIT Legend**

 **9-11 I3 LOWER MT LIMIT Legend**

 **12-17 I6 UPPER MAT LIMIT Legend**

 **18-19 I2 UPPER MF LIMIT Legend**

 **20-22 I3 UPPER MT LIMIT Legend**

 **23-33 E11.4 LOWER ENERGY LIMIT Legend**

 **34-44 E11.4 UPPER ENERGY LIMIT Legend**

 **45-55 E11.4 MINIMUM ALLOWABLE VALUE OF ANGULAR DISTRIBUTION Legend**

 **56-66 E11.4 ALLOWABLE FRACTION (NOT PER-CENT) CHANGE IN ANY Legend**

 **ONE LEGENDRE COEFFICIENT TO MAKE THE ANGULAR Legend**

 **DISTRIBUTION POSITIVE (AND AT LEAST EQUAL TO THE Legend**

 **INPUT MINIMUM ALLOWABLE VALUE). Legend**

 **Legend**

 **\*UP TO 100 MAT/MT/E RANGES MAY BE INPUT, EACH SPECIFYING AN Legend**

 **ALLOWABLE MINIMUM SIGMA AND MAXIMUM CHANGE IN COEFFICIENTS. Legend**

 **\*INPUT IS TERMINATED BY A BLANK CARD. Legend**

 **\*ALL MAY/MT/E RANGES NOT SPECIFIED BY INPUT WILL BE TREATED BY Legend**

 **ALLOWING A MINIMUM SIGMA OF 0.001 (1 MILLI-BARN) AND A CHANGE Legend**

 **IN EACH COEFFICIENT BY UP TO 0.01 (1 PER-CENT). Legend**

 **\*THESE MAT/MT/E RANGES ARE NOT USED TO CORRECT ALL ANGULAR Legend**

 **DISTRIBUTIONS WHERE SIGMA IS LESS THAN THE MINIMUM. THEY ARE Legend**

 **ONLY USED TO CORRECT DISTRIBUTION THAT ARE NEGATIVE AND TO Legend**

 **INSURE THAT THE CROSS SECTION AT THE COSINES WHERE THE ANGULAR Legend**

 **DISTRIBUTION ARE INITIALLY NEGATIVE ARE CORRECTED TO BE POSITIVE Legend**

 **AND AT LEAST AS LARGE AS THE MINIMUM ALLOWABLE SIGMA (SPECIFIED Legend**

 **BY INPUT). Legend**

 **Legend**

 **EXAMPLE INPUT NO. 1 Legend**

 **------------------- Legend**

 **PROCESS BOTH LEGENDRE COEFFICIENTS AND TABULATED DATA TO OBTAIN Legend**

 **ANGULAR DISTRIBUTION WHICH ARE ACCURATE TO WITHIN 0.1 PER-CENT Legend**

 **AND OUTPUT UNCORRECTED TABULATED ANGULAR DISTRIBUTION USING Legend**

 **A MAXIMUM OF 501 POINTS IN EACH TABULATED ANGULAR DISTRIBUTION. Legend**

 **SINCE LEGENDRE COEFFICIENTS WILL NOT BE CORRECTED THE INPUT NEED Legend**

 **NOT SPECIFY MAT/MT/E RANGES. Legend**

 **Legend**

 **READ /ENDFB6/K300/LEAD.IN AND WRITE /ENDFB6/K300/LEAD.OUT Legend**

 **Legend**

 **THE FOLLOWING 4 INPUT LINES ARE REQUIRED, Legend**

 **Legend**

 **1.00000- 3 501 2 1 0 Legend**

 **/ENDFB6/K300/LEAD.IN Legend**

 **/ENDFB6/K300/LEAD.OUT Legend**

 **(BLANK CARD TERMINATED INPUT) Legend**

 **Legend**

 **EXAMPLE INPUT NO. 2 Legend**

 **------------------- Legend**

 **PROCESS BOTH LEGENDRE COEFFICIENTS AND TABULATED DATA TO OBTAIN Legend**

 **ANGULAR DISTRIBUTION WHICH ARE ACCURATE TO WITHIN 0.1 PER-CENT Legend**

 **AND OUTPUT CORRECTED TABULATED ANGULAR DISTRIBUTION (ONLY THOSE Legend**

 **RE-CONSTRUCTED FROM LEGENDRE COEFFICIENTS WILL BE CORRECTED). Legend**

 **FOR ALL MAT/MT/E CORRECT NEGATIVE ANGULAR DISTRIBUTION TO A VALUE Legend**

 **OF 0.01 (10 MILLI-BARNS) AND ALLOW LEGENDRE COEFFICIENTS TO BE Legend**

 **CHANGED BY UP TO 0.02 (2 PER-CENT). Legend**

 **Legend**

 **USE THE DEFAULT FILENAMES ENDFB.IN AND ENDFB.OUT (THIS CAN BE Legend**

 **DONE BY LEAVING THE SECOND AND THIRD INPUT LINES BLANK). Legend**

 **Legend**

 **THE FOLLOWING 5 INPUT LINES ARE REQUIRED, Legend**

 **Legend**

 **1.00000- 3 501 2 1 1 Legend**

 **Legend**

 **Legend**

 **1 1 1 999999999 0.00000+ 0 3.00000+ 7 1.00000- 2 2.00000- 2 Legend**

 **(BLANK CARD TERMINATED INPUT) Legend**

 **Legend**

 **EXAMPLE INPUT NO. 3 Legend**

 **------------------- Legend**

 **PROCESS BOTH LEGENDRE COEFFICIENTS AND TABULATED DATA TO OBTAIN Legend**

 **ANGULAR DISTRIBUTION WHICH ARE ACCURATE TO WITHIN 0.1 PER-CENT Legend**

 **AND OUTPUT CORRECTED LEGENDRE COEFFICIENTS AND UNCORRECTED Legend**

 **TABULATED ANGULAR DISTRIBUTIONS. FOR MAT=1800, MT=2 CORRECT Legend**

 **NEGATIVE ANGULAR DISTRIBUTIONS TO INSURE THE MINIMUM IS 0.01 Legend**

 **(10 MILLI-BARNS) ALLOWING EACH LEGENDRE COEFFICIENT TO CHANGE BY Legend**

 **UP TO 0.02 (2 PER-CENT). ALL OTHER MAT/MT/E WILL BE CORRECTED Legend**

 **TO A MINIMUM OF 0.001 (1 MILLI-BARN) ALLOWING A 0.01 (1 PER-CENT) Legend**

 **CHANGE (BUILT-IN OPTION). Legend**

 **Legend**

 **READ /ENDFB6/K300/LEAD.IN AND WRITE /ENDFB6/K300/LEAD.OUT Legend**

 **Legend**

 **THE FOLLOWING 5 INPUT LINES ARE REQUIRED, Legend**

 **Legend**

 **1.00000- 3 501 2 2 1 Legend**

 **/ENDFB6/K300/LEAD.IN Legend**

 **/ENDFB6/K300/LEAD.OUT Legend**

 **1800 4 2 1800 4 2 0.00000+ 0 3.00000+ 7 1.00000- 2 2.00000- 2 Legend**

 **(BLANK CARD TERMINATED INPUT) Legend**

 **Legend**

 **EXAMPLE INPUT NO. 4 Legend**

 **------------------- Legend**

 **TO COPY TABULATED ANGULAR DISTRIBUTION AND CONVERT LEGENDRE Legend**

 **COEFFICIENTS TO UNCORRECTED TABULAR DISTRIBUTIONS. Legend**

 **Legend**

 **USE THE DEFAULT FILENAMES ENDFB.IN AND ENDFB.OUT (THIS CAN BE Legend**

 **DONE BY LEAVING THE SECOND AND THIRD INPUT LINES BLANK). Legend**

 **Legend**

 **THE FOLLOWING 4 INPUT LINES ARE REQUIRED, Legend**

 **Legend**

 **1.00000- 3 501 0 1 0 Legend**

 **Legend**

 **Legend**

 **(BLANK CARD TERMINATED INPUT) Legend**

 **Legend**

 **======================================================================= Legend**