**=======================================================================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 CHANGELEGEND**

**\*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 POLYTNOMIALSLEGEND**

**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 feedbackLEGEND**

**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 changedLEGEND**

**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-orderLEGEND**

**Ehnergies LEGEND**

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

**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**

**VERS. 2020-1 (Feb. 2020) \*Identical to 2019-1. LEGEND**

**VERS. 2021-1 (Jan. 2021) \*Updated for FORTRAN 2018 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**

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**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 LEGENDRELEGEND**

**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 ERRORLEGEND**

**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 OUTPUTLEGEND**

**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 ALLOWELEGEND**

**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 OUTPUTLEGEND**

**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 POINTLEGEND**

**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 SHOULDLEGEND**

**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 THENLEGEND**

**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 JUDGEMENTLEGEND**

**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 USERLEGEND**

**SHOULD INSURE THAT THE MODIFIED DATA IS PHYSICALLY MORE ACCEPTABLELEGEND**

**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**