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

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                                                                      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
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                          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
```