



INTERNATIONAL ATOMIC ENERGY AGENCY

# NUCLEAR DATA SERVICES

DOCUMENTATION SERIES OF THE IAEA NUCLEAR DATA SECTION

IAEA-NDS-39

(Rev. 1)

## SUMMARY OF ENDF/B PRE-PROCESSING CODES

June 1983

Enclosed is the summary documentation for the 1983 version of the ENDF/B Pre-processing Codes

LINEAR  
RECENT  
SIGMA  
GROUPIE  
EVALPLOT  
MERGER  
DICTION  
COMPLOT  
CONVERT

This summary documentation is merely a copy of the comment cards that appear at the beginning of each programme; these comment cards always reflect the latest status of input options, etc. For the latest published documentation on the methods used in these codes see UCRL-50400, Vol.17 parts A-E, Lawrence Livermore Laboratory (1979).

Please report any compiler diagnostics, conversion or operating problems to the author at,

Dermott E. Cullen  
Nuclear Data Section  
International Atomic Energy Agency  
P.O. Box 200  
A-1400 Vienna, Austria  
Europe

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IAEA NUCLEAR DATA SECTION, P.O. BOX 100, A-1400 VIENNA

All of the following programs can be used with evaluated data in any version of the ENDF/B format (e.g. ENDF/B-I, II, III, IV or V format). A brief description of the purpose of each program is as follows:

- LINEAR - Convert tabulated cross sections to linearly interpolable form.
- RECENT - Reconstruct resonance contribution, add background and output the sum in linearly interpolable form.
- SIGMA1 - Doppler broaden.
- GROUPIE - Unshielded and Bondarenko self-shielded multigroup cross sections.
- EVALPLOT - Plot cross sections, angular distributions and/or energy distributions.
- MERGER - Retrieve and merge data.
- DICTION - Create and/or update section dictionary in MF=1, MT=451.
- COMPLIT - Compare two sets of evaluated data by plotting both sets and their ratio.
- CONVERT - Convert any of the above programs for use on IBM, CDC or CRAY computers.

C		LIN0003
C	PROGRAM LINEAR	LIN0004
C	VERSION 74-1 (MAY 1974)	LIN0005
C	VERSION 75-1 (APRIL 1975)	LIN0006
C	VERSION 76-2 (OCTOBER 1976)	LIN0007
C	VERSION 77-1 (JANUARY 1977)	LIN0008
C	VERSION 78-1 (JULY 1978)	LIN0009
C	VERSION 79-1 (JULY 1979) CDC-7600 AND CRAY-1 VERSION.	LIN0010
C	VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION.	LIN0011
C	VERSION 80-2 (DECEMBER 1980)	LIN0012
C	VERSION 81-1 (MARCH 1981)	LIN0013
C	VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY.	LIN0014
C	VERSION 83-1 (JANUARY 1983) *MAJOR RE-DESIGN.	LIN0015
C	*PAGE SIZE INCREASED - 1002 TO 3006.	LIN0016
C	*ELIMINATED COMPUTER DEPENDENT CODING.	LIN0017
C	*NEW, MORE COMPATIBLE I/O UNIT NUMBER.	LIN0018
C	*ADDED OPTION TO KEEP ALL ORIGINAL	LIN0019
C	ENERGY POINTS FROM EVALUATION.	LIN0020
C	*ADDED STANDARD ALLOWABLE ERROR OPTION	LIN0021
C	(CURRENTLY 0.1 PER-CENT).	LIN0022
C		LIN0023
C	REPORT UCRL-50400, VOL.17, PART A (1979)	LIN0024
C	LAWRENCE LIVERMORE LABORATORY	LIN0025
C		LIN0026
C	WRITTEN BY DERMOTT E. CULLEN	LIN0027
C	NUCLEAR DATA SECTION	LIN0028
C	INTERNATIONAL ATOMIC ENERGY AGENCY	LIN0029
C	P.O. BOX 200	LIN0030
C	VIENNA, AUSTRIA	LIN0031
C	TELEPHONE 23-60-1719	LIN0032
C		LIN0033
C	AUTHORS MESSAGE	LIN0034
C	-----	LIN0035
C	THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION	LIN0036
C	FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED	LIN0037
C	THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE	LIN0038
C	READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION.	LIN0039
C		LIN0040
C	AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER	LIN0041
C	INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE	LIN0042
C	OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT	LIN0043
C	IT WOULD BE APPRECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY	LIN0044
C	COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO	LIN0045
C	IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF	LIN0046
C	THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR	LIN0047
C	COMPUTER.	LIN0048
C		LIN0049
C	PURPOSE	LIN0050
C	-----	LIN0051
C	THIS PROGRAM IS DESIGNED TO CONVERT ENDF/B FILE 3 CROSS SECTIONS	LIN0052
C	TO LINEAR-LINEAR INTERPOLABLE FORM. ANY SECTION THAT IS ALREADY	LIN0053
C	LINEAR-LINEAR INTERPOLABLE WILL BE THINNED.	LIN0054
C		LIN0055
C	IN THE FOLLOWING DISCUSSION FOR SIMPLICITY THE ENDF/B TERMINOLOGY	LIN0056
C	----ENDF/B TAPE----WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE	LIN0057
C	TAPE, CARDS, DISK OR ANY OTHER MEDIUM.	LIN0058
C		LIN0059
C	ENDF/B FORMAT	LIN0060
C	-----	LIN0061

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

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

#### OUTPUT FORMAT

IN THIS VERSION OF LINEAR ALL FILE 3 ENERGIES WILL BE OUTPUT IN F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN WITH UP TO 8 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN OUTPUT OPTION, HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS TO THE 8 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE TO USE THE 8 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA DUE TO TRUNCATION OF ENERGIES TO 6 DIGITS DURING OUTPUT.

#### CONTENTS OF OUTPUT

ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE LINEARIZED FILE 3 CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO INCLUDED.

#### DOCUMENTATION

THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED BY THE ADDITION OF TWO COMMENT CARDS AT THE END OF EACH HOLLERITH SECTION IN THE FORM

\*\*\*\*\* PROGRAM LINEAR (93-1) \*\*\*\*\*  
DATA LINEARIZED TO WITHIN AN ACCURACY OF 0.1 PER-CENT

THE ORDER OF SIMILAR COMMENTS (FROM RECENT, SIGMA1 AND GROUPYIE) REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON THE DATA BY THESE PROGRAMS.

THESE COMMENT CARDS ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS. I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451 IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT SHOULD BE USED TO CREATE A HOLLERITH SECTION.

#### REACTION INDEX

THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN SECTION MF=1, MT=451 OF EACH EVALUATION.

LIN00620  
LIN00630  
LIN00640  
LIN00650  
LIN00660  
LIN00670  
LIN00680  
LIN00690  
LIN00700  
LIN00710  
LIN00720  
LIN00730  
LIN00740  
LIN00750  
LIN00760  
LIN00770  
LIN00780  
LIN00790  
LIN00800  
LIN00810  
LIN00820  
LIN00830  
LIN00840  
LIN00850  
LIN00860  
LIN00870  
LIN00880  
LIN00890  
LIN00900  
LIN00910  
LIN00920  
LIN00930  
LIN00940  
LIN00950  
LIN00960  
LIN00970  
LIN00980  
LIN00990  
LIN01000  
LIN01010  
LIN01020  
LIN01030  
LIN01040  
LIN01050  
LIN01060  
LIN01070  
LIN01080  
LIN01090  
LIN01100  
LIN01110  
LIN01120  
LIN01130  
LIN01140  
LIN01150  
LIN01160  
LIN01170  
LIN01180  
LIN01190  
LIN01200

C THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451, LINO1210  
 C THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT LINO1220  
 C REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS LINO1230  
 C NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING LINO1240  
 C A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE LINO1250  
 C A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM LINO1260  
 C YOU MAY USE PROGRAM DICTION TO CREATE A CORRECT REACTION INDEX. LINO1270

#### C SECTION SIZE LINO1280

C SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT LINO1310  
 C TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS LINO1320  
 C SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS. LINO1330

C FOR ANY LINEARIZED SECTION THAT CONTAINS 6012 OR FEWER POINTS LINO1350  
 C THE ENTIRE OPERATION WILL BE PERFORMED IN CORE AND THE LINEARIZED LINO1360  
 C DATA WILL BE OUTPUT DIRECTLY TO THE ENDF/B FORMAT. FOR ANY SECTION LINO1370  
 C THAT CONTAINS MORE POINTS THE DATA WILL BE LINEARIZED A PAGE AT A LINO1380  
 C TIME (1 PAGE = 3006 POINTS) AND OUTPUT TO SCRATCH. AFTER THE LINO1390  
 C ENTIRE SECTION HAS BEEN LINEARIZED THE DATA WILL BE READ BACK FROM LINO1400  
 C SCRATCH AND OUTPUT TO THE ENDF/B FORMAT. LINO1410

#### C SELECTION OF DATA LINO1420

C THE PROGRAM SELECTS MATERIALS TO BE LINEARIZED BASED EITHER ON LINO1450  
 C MAT (ENDF/B MAT NO.) OR ZA. THE PROGRAM ALLOWS UP TO 100 MAT OR LINO1460  
 C ZA RANGES TO BE SPECIFIED. THE PROGRAM WILL ASSUME THAT THE LINO1470  
 C ENDF/B TAPE IS IN MAT ORDER, REGARDLESS OF THE CRITERIA USED LINO1480  
 C TO RETRIEVE MATERIALS. IF RETRIEVAL IS BY MAT RANGE THE PROGRAM LINO1490  
 C WILL TERMINATE WHEN A MAT IS FOUND THAT IS ABOVE ALL REQUESTED LINO1500  
 C MAT RANGES. IF RETRIEVAL IS BY ZA RANGE THE PROGRAM WILL SEARCH LINO1510  
 C THE ENTIRE ENDF/B TAPE. LINO1520

#### C PROGRAM OPERATION LINO1530

C EACH SECTION OF FILE 3 IS CONSIDERED SEPARATELY. EACH SECTION OF LINO1560  
 C ENDF/B FILE 3 CROSS SECTIONS IS REPRESENTED BY A TABLE OF ENERGY LINO1570  
 C VS. CROSS SECTION AND ANY ONE OF FIVE ALLOWABLE INTERPOLATION LAWS LINO1580  
 C BETWEEN ANY TWO TABULATED POINTS. THIS PROGRAM WILL REPLACE EACH LINO1590  
 C SECTION OF FILE 3 CROSS SECTIONS BY A NEW TABLE OF ENERGY VS. LINO1600  
 C CROSS SECTION IN WHICH THE INTERPOLATION LAW IS ALWAYS LINEAR IN LINO1610  
 C ENERGY AND CROSS SECTION BETWEEN ANY TWO TABULATED POINTS. LINO1620

C DATA IS READ AND LINEARIZED A PAGE AT A TIME (ONE PAGE CONTAINS LINO1630  
 C 3006 DATA POINTS). IF THE FINAL LINEARIZED SECTION CONTAINS TWO LINO1640  
 C PAGE OR LESS, DATA POINTS IT WILL BE ENTIRELY CORE RESIDENT LINO1650  
 C AFTER IT HAS BEEN LINEARIZED AND WILL BE WRITTEN DIRECTLY FROM LINO1660  
 C CORE TO THE OUTPUT TAPE. IF THE LINEARIZED SECTION IS LARGER THAN LINO1670  
 C TWO PAGES, AFTER EACH PAGE IS LINEARIZED IT WILL BE WRITTEN TO LINO1680  
 C SCRATCH. AFTER THE ENTIRE SECTION HAS BEEN LINEARIZED IT WILL LINO1690  
 C BE READ BACK FROM SCRATCH, TWO PAGES AT A TIME, AND WRITTEN TO LINO1700  
 C THE OUTPUT TAPE. LINO1710

#### C KEEP EVALUATED DATA POINTS LINO1720

C SOMETIMES IT IS CONVENIENT TO KEEP ALL ENERGY POINTS WHICH WERE LINO1760  
 C PRESENT IN THE ORIGINAL EVALUATION AND TO MERELY SUPPLEMENT THESE LINO1770  
 C POINTS WITH ADDITIONAL ENERGY POINTS IN ORDER TO LINEARIZE THE LINO1780  
 C CROSS SECTIONS. FOR EXAMPLE, IT IS OFTEN CONVENIENT TO KEEP THE LINO1790

THE THERMAL VALUE (AT 0.0253 EV) OR THE VALUE AT 14.1 MEV.

THE CURRENT VERSION OF THIS PROGRAM WILL ALLOW THE USER TO KEEP ALL ORIGINAL EVALUATED DATA POINTS BY SPECIFYING 1 IN COLUMNS 34-44 OF THE FIRST INPUT CARD. THIS WILL TURN OFF THE BACKWARD THINNING (SEE UCRL-50400, VOL. 17, PART A FOR EXPLANATION) AND RESULT IN ALL ORIGINAL ENERGY POINTS BEING KEPT. CAUTION SHOULD BE EXERCISED IN USING THIS OPTION SINCE IT CAN RESULT IN A CONSIDERABLE INCREASE IN THE NUMBER OF DATA POINTS OUTPUT BY THIS CODE.

FOR ALL USERS WHO ARE NOT INTERESTED IN THIS OPTIONS NO CHANGES ARE REQUIRED IN THE INPUT TO THIS PROGRAM, I. E. IF COLUMNS 34-44 ARE BLANK (AS FOR ALL PREVIOUS VERSIONS OF THIS CODE) THE PROGRAM WILL OPERATE EXACTLY AS IT DID BEFORE.

#### ALLOWABLE ERROR

ALLOWABLE ERROR MUST ALWAYS BE SPECIFIED IN THE INPUT TO THIS PROGRAM AS A FRACTION, NOT A PER-CENT. FOR EXAMPLE, INPUT THE ALLOWABLE FRACTIONAL ERROR 0.001 IN ORDER TO OBTAIN DATA THAT IS ACCURATE TO WITHIN 0.1 PER-CENT.

THE CONVERSION OF THE DATA FROM THE GENERAL INTERPOLATION FORM TO LINEARLY INTERPOLABLE FORM CANNOT BE PERFORMED EXACTLY. HOWEVER, IT CAN BE PERFORMED TO VIRTUALLY ANY REQUIRED ACCURACY AND MOST IMPORTANTLY CAN BE PERFORMED TO A TOLERANCE THAT IS SMALL COMPARED TO THE UNCERTAINTY IN THE CROSS SECTIONS THEMSELVES. AS SUCH THE CONVERSION OF CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM CAN BE PERFORMED WITH ESSENTIALLY NO LOSS OF INFORMATION.

THE ALLOWABLE ERROR MAY BE ENERGY INDEPENDENT (CONSTANT) OR ENERGY DEPENDENT. THE ALLOWABLE ERROR IS DESCRIBED BY A TABULATED FUNCTION OF UP TO 20 (ENERGY, ERROR) PAIRS AND LINEAR INTERPOLATION BETWEEN TABULATED POINTS. IF ONLY ONE TABULATED POINT IS GIVEN THE ERROR WILL BE CONSIDERED CONSTANT OVER THE ENTIRE ENERGY RANGE. WITH THIS ENERGY DEPENDENT ERROR ONE MAY OPTIMIZE THE OUTPUT FOR ANY GIVEN APPLICATION BY USING A SMALL ERROR IN THE ENERGY RANGE OF INTEREST AND A LESS STRINGENT ERROR IN OTHER ENERGY RANGES.

#### DEFAULT ALLOWABLE ERROR

IN ORDER TO INSURE CONVERGENCE OF THE LINEARIZING ALGORITHM THE ALLOWABLE ERROR MUST BE POSITIVE. IF THE USER INPUTS AN ERROR THAT IS NOT POSITIVE IT WILL AUTOMATICALLY BE SET TO THE DEFAULT VALUE (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT) AND INDICATED AS SUCH IN THE OUTPUT LISTING.

#### INPUT FILES

##### UNIT DESCRIPTION

5 INPUT CARDS (BCD - 80 CHARACTERS/RECORD)  
10 ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)

#### OUTPUT FILES

##### UNIT DESCRIPTION

LIN01800  
LIN01810  
LIN01820  
LIN01830  
LIN01840  
LIN01850  
LIN01860  
LIN01870  
LIN01880  
LIN01890  
LIN01900  
LIN01910  
LIN01920  
LIN01930  
LIN01940  
LIN01950  
LIN01960  
LIN01970  
LIN01980  
LIN01990  
LIN02000  
LIN02010  
LIN02020  
LIN02030  
LIN02040  
LIN02050  
LIN02060  
LIN02070  
LIN02080  
LIN02090  
LIN02100  
LIN02110  
LIN02120  
LIN02130  
LIN02140  
LIN02150  
LIN02160  
LIN02170  
LIN02180  
LIN02190  
LIN02200  
LIN02210  
LIN02220  
LIN02230  
LIN02240  
LIN02250  
LIN02260  
LIN02270  
LIN02280  
LIN02290  
LIN02300  
LIN02310  
LIN02320  
LIN02330  
LIN02340  
LIN02350  
LIN02360  
LIN02370  
LIN02380

C	6	OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)	LIN02390
C	11	FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)	LIN02400
C			LIN02410
C		SCRATCH FILES	LIN02420
C			LIN02430
C		UNIT DESCRIPTION	LIN02440
C			LIN02450
C	12	SCRATCH FILE (BINARY - 3006 WORDS/RECORD)	LIN02460
C			LIN02470
C		INPUT CARDS	LIN02480
C			LIN02490
C		CARD COLS. DESCRIPTION	LIN02500
C			LIN02510
C	1	1-11 SELECTION CRITERIA (0=MAT, 1=ZA)	LIN02520
C		12-22 THIS OPTION IS NO LONGER USED. THE PREVIOUS MEANING	LIN02530
C		OF THIS OPTION WAS.....	LIN02540
C		MINIMUM ENERGY SPACING SELECTOR	LIN02550
C		= 0 - 6 DIGIT MINIMUM ENERGY SPACING CALCULATIONS.	LIN02560
C		STANDARD 6 DIGIT E11.4 OUTPUT.	LIN02570
C		= 1 - 9 DIGIT MINIMUM ENERGY SPACING CALCULATIONS.	LIN02580
C		STANDARD 6 DIGIT E11.4 OUTPUT.	LIN02590
C		= 2 - 9 DIGIT MINIMUM ENERGY SPACING CALCULATIONS.	LIN02600
C		VARIABLE 8 DIGIT F FORMAT OUTPUT.	LIN02610
C		EXPERIENCE HAS DEMONSTRATED THAT FAILURE TO SET THIS	LIN02620
C		OPTION TO 3 CAN RESULT IN SIGNIFICANT ERRORS IN THE	LIN02630
C		FINAL DATA. THEREFORE INTERNALLY THIS OPTION IS	LIN02640
C		ALWAYS SET TO 2.	LIN02650
C	23-33	MINIMUM CROSS SECTION OF INTEREST (BARNS),	LIN02660
C		(IF 1.0E-10 OR LESS IS INPUT THE PROGRAM WILL	LIN02670
C		USE 1.0E-10). ENERGY INTERVALS WILL NOT BE	LIN02680
C		SUB-DIVIDED IF THE ABSOLUTE VALUE OF THE CROSS	LIN02690
C		SECTION WITHIN THE INTERVAL IS LESS THAN THIS VALUE.	LIN02700
C		AN EXCEPTION TO THIS RULE IS NEAR THRESHOLDS ENERGY	LIN02710
C		INTERVALS WILL BE SUB-DIVIDED UNTIL CONVERGENCE	LIN02720
C		REGARDLESS OF THE MAGNITUDE OF THE CROSS SECTION.	LIN02730
C	34-44	BACKWARD THINNING OPTION	LIN02740
C		= 0 - PERFORM BACKWARD THINNING.	LIN02750
C		= 1 - NO BACKWARD THINNING (KEEP ALL ORIGINAL DATA	LIN02760
C		POINTS AND ADD MORE WHERE REQUIRED FOR	LIN02770
C		LINEARIZING).	LIN02780
C	2-N	1-11 LOWER MAT OR ZA LIMIT	LIN02790
C		12-22 UPPER MAT OR ZA LIMIT	LIN02800
C		UP TO 100 MAT OR ZA RANGES MAY BE SPECIFIED, ONE	LIN02810
C		RANGE PER CARD. THE LIST OF RANGES IS TERMINATED BY	LIN02820
C		A BLANK CARD. IF THE UPPER LIMIT OF ANY REQUEST IS	LIN02830
C		LESS THAN THE LOWER LIMIT, THE UPPER LIMIT WILL BE	LIN02840
C		SET EQUAL TO THE LOWER LIMIT. IF THE FIRST REQUEST	LIN02850
C		CARD IS BLANK IT WILL TERMINATE THE REQUEST LIST	LIN02860
C		AND ALL DATA WILL BE RETRIEVED (SEE EXAMPLE INPUT).	LIN02870
C	VARY	1-11 ENERGY FOR ERROR LAW	LIN02880
C		12-22 ALLOWABLE FRACTIONAL ERROR FOR ERROR LAW.	LIN02890
C		THE ACCEPTABLE LINEARIZING ERROR MAY BE SPECIFIED TO	LIN02900
C		BE EITHER ENERGY INDEPENDENT (DEFINED BY A SINGLE	LIN02910
C		ERROR), OR ENERGY DEPENDENT (DEFINED BY UP TO 20	LIN02920
C		ENERGY, ERROR PAIRS), FOR THE ENERGY DEPENDENT CASE	LIN02930
C		LINEAR INTERPOLATION WILL BE USED TO DEFINE THE ERROR	LIN02940
C		AT ENERGIES BETWEEN THOSE AT WHICH IT IS TABULATED.	LIN02950
C		IN ALL CASES THE ERROR LAW IS TERMINATED BY A BLANK	LIN02960
C		CARD. IF ONLY ONE ENERGY, ERROR PAIR IS GIVEN THE	LIN02970

THE LAW WILL BE CONSIDERED TO BE ENERGY INDEPENDENT. IF MORE THAN ONE PAIR IS GIVEN IT WILL BE CONSIDERED TO BE ENERGY DEPENDENT (NOTE, ENERGY INDEPENDENT FORM WILL RUN FASTER THAN THE EQUIVALENT ENERGY DEPENDENT FORM). FOR AN ENERGY DEPENDENT ERROR LAW ALL ENERGIES MUST BE ASCENDING ENERGY ORDER. FOR CONVERGENCE OF THE LINEARIZING ALGORITHM ALL ERRORS MUST BE POSITIVE. IF AN ALLOWABLE ERROR IS NOT POSITIVE IT WILL BE SET EQUAL TO THE STANDARD OPTION (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT). IF THE FIRST ERROR CARD IS BLANK IT WILL TERMINATE THE ERROR LAW AND THE ERROR WILL BE TREATED AS ENERGY INDEPENDENT, EQUAL TO THE STANDARD OPTION (CURRENTLY 0.1 PER-CENT). (SEE EXAMPLE INPUT 4).

## EXAMPLE INPUT NO. 1

RETRIEVE DATA BY ZA IN ORDER TO FIND ALL URANIUM ISOTOPES AND THORIUM-232. ALL ENERGY INTERVALS IN WHICH THE CROSS SECTION IS AT LEAST 1 MICRO-BARN (1.0E-06 BARNS) WILL BE SUBDIVIDED. BACKWARD THINNING WILL BE PERFORMED. FROM 0 TO 100 EV LINEARIZE TO WITHIN 0.1 PER-CENT ACCURACY. FROM 100 EV TO 1 KEV VARY ACCURACY BETWEEN 0.1 AND 1.0 PER-CENT. ABOVE 1 KEV USE 1 PER-CENT ACCURACY.

IN THIS CASE THE FOLLOWING NINE INPUT CARDS ARE REQUIRED

```

      1          2 1.00000- 6          0
    92000      92999
    90232
                                (UPPER LIMIT AUTOMATICALLY SET TO 90232)
                                (END OF REQUEST LIST)
0.00000+ 0 1.00000-03
1.00000+ 2 1.00000-03
1.00000+ 3 1.00000-02
1.00000+ 9 1.00000-02
                                (END OF ERROR LAW)

```

## EXAMPLE INPUT NO. 2

RETRIEVE DATA BY ZA IN ORDER TO FIND ALL URANIUM ISOTOPES AND THORIUM-232. ALL ENERGY INTERVALS IN WHICH THE CROSS SECTION IS AT LEAST 1 MICRO-BARN (1.0E-06 BARNS) WILL BE SUBDIVIDED. BACKWARD THINNING WILL BE PERFORMED. LINEARIZE ALL DATA TO WITHIN THE STANDARD ACCURACY (CURRENTLY 0.1 PER-CENT).

IN THIS CASE THE FOLLOWING FIVE INPUT CARDS ARE REQUIRED

```

      1          2 1.00000- 6          0
    92000      92999
    90232
                                (UPPER LIMIT AUTOMATICALLY SET TO 90232)
                                (END OF REQUEST LIST)
                                (0.1 PER-CENT ERROR, END OF ERROR LAW)

```

## EXAMPLE INPUT NO. 3

LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO WITHIN AN ACCURACY OF 0.5 PER-CENT (0.005 AS A FRACTION).

IN THIS CASE THE FOLLOWING FOUR INPUT CARDS ARE REQUIRED

LIN02980  
LIN02990  
LIN03000  
LIN03010  
LIN03020  
LIN03030  
LIN03040  
LIN03050  
LIN03060  
LIN03070  
LIN03080  
LIN03090  
LIN03100  
LIN03110  
LIN03120  
LIN03130  
LIN03140  
LIN03150  
LIN03160  
LIN03170  
LIN03180  
LIN03190  
LIN03200  
LIN03210  
LIN03220  
LIN03230  
LIN03240  
LIN03250  
LIN03260  
LIN03270  
LIN03280  
LIN03290  
LIN03300  
LIN03310  
LIN03320  
LIN03330  
LIN03340  
LIN03350  
LIN03360  
LIN03370  
LIN03380  
LIN03390  
LIN03400  
LIN03410  
LIN03420  
LIN03430  
LIN03440  
LIN03450  
LIN03460  
LIN03470  
LIN03480  
LIN03490  
LIN03500  
LIN03510  
LIN03520  
LIN03530  
LIN03540  
LIN03550  
LIN03560





	PAGE 0001
C	REC00030
C	REC00040
C	REC00050
C	REC00060
C	REC00070
C	REC00080
C	REC00090
C	REC00100
C	REC00110
C	REC00120
C	REC00130
C	REC00140
C	REC00150
C	REC00160
C	REC00170
C	REC00180
C	REC00190
C	REC00200
C	REC00210
C	REC00220
C	REC00230
C	REC00240
C	REC00250
C	REC00260
C	REC00270
C	REC00280
C	REC00290
C	REC00300
C	REC00310
C	REC00320
C	REC00330
C	REC00340
C	REC00350
C	REC00360
C	REC00370
C	REC00380
C	REC00390
C	REC00400
C	REC00410
C	REC00420
C	REC00430
C	REC00440
C	REC00450
C	REC00460
C	REC00470
C	REC00480
C	REC00490
C	REC00500
C	REC00510
C	REC00520
C	REC00530
C	REC00540
C	REC00550
C	REC00560
C	REC00570
C	REC00580
C	REC00590
C	REC00600
C	REC00610

PROGRAM RECENT

VERSION 79-1 (OCTOBER 1979) CDC-7400 AND CRAY-1 VERSION

VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION

VERSION 80-2 (DECEMBER 1980) IMPROVED TREATMENT OF UNRESOLVED

REGION TO COMPUTE ALL REACTIONS AT THE SAME TIME.

VERSION 81-1 (MARCH 1981)

VERSION 81-2 (AUGUST 1981) ADDED MONITOR MODE, ADDED SPEED OPTION

TO BYPASS BACKWARDS THINNING IF FILE 3

ALLOWABLE ERROR = 0.0 (NOTE THIS OPTION

WILL RESULT IN ALL TABULATED POINTS

FROM THE EVALUATION BEING KEPT IN THE

OUTPUT FROM THIS PROGRAM)

VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY.

VERSION 83-1 (JANUARY 1983)\*MAJOR RE-DESIGN.

\*PAGE SIZES INCREASED.

\*ELIMINATED COMPUTER DEPENDENT CODING.

\*NEW, MORE COMPATIBLE I/O UNIT NUMBERS.

\*ADDED OPTION TO KEEP ALL RECONSTRUCTED

AND BACKGROUND ENERGY POINTS.

\*ADDED STANDARD ALLOWABLE ERROR OPTIONS

(CURRENTLY 0.1 PER-CENT RECONSTRUCTION

AND 0.0 PER-CENT THINNING).

REPORT UCRL-50400, VOL. 17, PART C (1979)

LAWRENCE LIVERMORE LABORATORY

WRITTEN BY DERMOTT E. CULLEN

NUCLEAR DATA SECTION

INTERNATIONAL ATOMIC ENERGY AGENCY

P.O. BOX 200

VIENNA, AUSTRIA

TELEPHONE 23-60-1710

AUTHOR'S MESSAGE

THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION

FOR THIS PROGRAM, HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED

THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS, PLEASE

READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY

THE COMMENTS CONCERNING MACHINE DEPENDENT CODING.

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

INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE

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

IT WOULD BE APPRECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY

COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO

IMPROVE THIS PROGRAM, HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF

THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR

COMPUTER.

PURPOSE

THIS PROGRAM IS DESIGNED TO RECONSTRUCT THE RESONANCE CONTRIBUTION

TO THE CROSS SECTION IN LINEARLY INTERPOLABLE FORM. ADD IN ANY

LINEARLY INTERPOLABLE BACKGROUND CROSS SECTION AND OUTPUT THE

RESULT IN THE ENDF/B FORMAT. THE CROSS SECTIONS OUTPUT BY THIS

PROGRAM WILL BE LINEARLY INTERPOLABLE OVER THE ENTIRE ENERGY RANGERS

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

ENDF/B FORMAT

THIS PROGRAM ONLY USES THE ENDF/B PCD OR CARD IMAGE FORMAT (AS OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION OF THE ENDF/B FORMAT (I.E., ENDF/B-1, II, III, IV OR V FORMAT).

IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS ASSUMED THAT THE MAT, MF AND MT ON EACH CARD IS CORRECT. SEQUENCE NUMBERS (COLUMNS 76-90) ARE IGNORED ON INPUT, BUT WILL BE CORRECTLY OUTPUT ON ALL CARDS. THE FORMAT OF SECTION MF=1, MT=451 AND ALL SECTIONS OF MF=2 AND 3 MUST BE CORRECT. THE PROGRAM COPIES ALL OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.

OUTPUT FORMAT

IN THIS VERSION OF RECENT ALL FILE 3 ENERGIES WILL BE OUTPUT IN F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN WITH UP TO 8 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS TO THE 8 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE TO USE THE 8 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA JUST DUE TO TRANSLATION OF THE ENERGIES TO THE ENDF/B FORMAT.

CONTENTS OF OUTPUT

ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE RECONSTRUCTED FILE 3 CROSS SECTIONS, I.E., ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO INCLUDED.

DOCUMENTATION

THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED BY THE ADDITION OF TWO COMMENT CARDS AT THE END OF EACH HOLLERITH SECTION IN THE FORM

\*\*\*\*\* RECENT (VERSION 83-1) \*\*\*\*\*  
RESONANCE CONTRIBUTION RECONSTRUCTED TO WITHIN 0.100 PER-CENT  
COMBINED DATA THINNED TO WITHIN AN ACCURACY OF 0.100 PER-CENT

THE ORDER OF ALL SIMILAR COMMENTS (FROM LINEAR, SIGMA1 AND GROUPY) REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON THE DATA.

THESE COMMENT CARDS ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS. I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451 IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND

REC00620  
REC00630  
REC00640  
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REC00660  
REC00670  
REC00680  
REC00690  
REC00700  
REC00710  
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REC00990  
REC01000  
REC01010  
REC01020  
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REC01070  
REC01080  
REC01090  
REC01100  
REC01110  
REC01120  
REC01130  
REC01140  
REC01150  
REC01160  
REC01170  
REC01180  
REC01190  
REC01200

C AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT RECO121  
 C SHOULD BE USED TO CREATE A HOLLERITH SECTION. RECO122  
 C RECO123  
 C REACTION INDEX RECO124  
 C RECO125  
 C THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN RECO126  
 C SECTION MF=1, MT=451 OF EACH EVALUATION. RECO127  
 C RECO128  
 C THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451. RECO129  
 C THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT RECO130  
 C REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS RECO131  
 C NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING RECO132  
 C A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE RECO133  
 C A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM RECO134  
 C YOU MAY USE PROGRAM DICTION TO CREATE A CORRECT REACTION INDEX. RECO135  
 C RECO136  
 C SECTION SIZE RECO137  
 C RECO138  
 C SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT RECO139  
 C TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS RECO140  
 C SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS. RECO141  
 C RECO142  
 C SELECTION OF DATA RECO143  
 C RECO144  
 C THE PROGRAM SELECTS MATERIALS TO BE PROCESSED BASED EITHER ON RECO145  
 C MAT (ENDF/B MAT NO.) OR ZA. THE PROGRAM ALLOWS UP TO 100 MAT OR RECO146  
 C ZA RANGES TO BE SPECIFIED. THE PROGRAM WILL ASSUME THAT THE RECO147  
 C ENDF/B TAPE IS IN EITHER MAT OR ZA ORDER, WHICHEVER CRITERIA IS RECO148  
 C USED TO SELECT MATERIALS, AND WILL TERMINATE WHEN A MAT OR ZA RECO149  
 C IS FOUND THAT IS ABOVE THE RANGE OF ALL REQUESTS. RECO150  
 C RECO151  
 C OUTPUT OF RESONANCE PARAMETERS RECO152  
 C RECO153  
 C A SPECIAL CONVENTION HAS BEEN INTRODUCED REGARDING RESONANCE RECO154  
 C PARAMETERS. IN ORDER TO ALLOW THE USER TO DOPPLER BROADEN AND/OR RECO155  
 C SELF-SHIELD CROSS SECTIONS THE RESONANCE PARAMETERS ARE ALSO RECO156  
 C INCLUDED IN THE OUTPUT WITH THE EVALUATION. IN ORDER TO INDICATE RECO157  
 C THAT THE RESONANCE CONTRIBUTION HAS ALREADY BEEN ADDED INTO THE RECO158  
 C FILE 3 CROSS SECTIONS, THE LRU FLAG IN EACH SECTION OF FILE 2 RECO159  
 C DATA IS CHANGED TO LRU=LRU+3. FOR EXAMPLE WHEN READING AN ENDF/B RECO160  
 C EVALUATION LRU=0 (NO RESONANCES), =1 (RESOLVED) OR =2 RECO161  
 C (UNRESOLVED) INDICATE THAT THE DATA IS IN THE ORIGINAL ENDF/B RECO162  
 C FORMAT. LRU=4 (NO RESONANCES), =5 (RESOLVED) OR =6 (UNRESOLVED) RECO163  
 C INDICATES THAT THE RESONANCE CONTRIBUTION HAS ALREADY BEEN ADDED RECO164  
 C INTO FILE 3 DATA. THIS CONVENTION INSURES THAT THIS PROGRAM WILL RECO165  
 C NOT ADD THE RESONANCE CONTRIBUTION TO FILE 3 TWICE AND ALSO RECO166  
 C ALLOWS THE USER THE OPTION OF EITHER DOPPLER BROADENING AND RECO167  
 C SELF-SHIELDING THE TABULATED CROSS SECTIONS DIRECTLY OR TO USE RECO168  
 C THE RESONANCE PARAMETERS TO DEFINE THE EFFECTS OF DOPPLER RECO169  
 C BROADENING AND SELF-SHIELDING AS THE DIFFERENCE BETWEEN THE RECO170  
 C ZERO KELVIN, INFINITELY TABULATED VALUES AND THE CROSS SECTION RECO171  
 C FOR ANY OTHER TEMPERATURE AND VALUE OF SIGMA=0. RECO172  
 C RECO173  
 C ALLOWABLE ERROR RECO174  
 C RECO175  
 C THE RECONSTRUCTION OF LINEARLY INTERPOLABLE CROSS SECTIONS FROM RECO176  
 C RESONANCE PARAMETERS CANNOT BE PERFORMED EXACTLY. HOWEVER IT CAN RECO177  
 C BE PERFORMED TO VIRTUALLY ANY REQUIRED ACCURACY AND MOST RECO178  
 C IMPORTANTLY CAN BE PERFORMED TO A TOLERANCE THAT IS SMALL COMPARED RECO179

TO THE UNCERTAINTY IN THE CROSS SECTIONS THEMSELVES, AS SUCH THE  
 CONVERSION OF CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM CAN BE  
 PERFORMED WITH ESSENTIALLY NO LOSE OF INFORMATION.

THE ALLOWABLE ERROR MAY BE ENERGY INDEPENDENT (CONSTANT) OR ENERGY  
 DEPENDENT. THE ALLOWABLE ERROR IS DESCRIBED BY A TABULATED  
 FUNCTION OF UP TO 20 (ENERGY,ERROR) PAIRS AND LINEAR INTERPOLATION  
 BETWEEN TABULATED POINTS. IF ONLY ONE TABULATED POINT IS GIVEN THE  
 ERROR WILL BE CONSIDERED CONSTANT OVER THE ENTIRE ENERGY RANGE.  
 WITH THIS ENERGY DEPENDENT ERROR ONE MAY OPTIMIZE THE OUTPUT FOR  
 ANY GIVEN APPLICATION BY USING A SMALL ERROR IN THE ENERGY RANGE  
 OF INTEREST AND A LESS STRINGENT ERROR IN OTHER ENERGY RANGES.

#### DEFAULT ALLOWABLE ERROR

IN ORDER TO INSURE CONVERGENCE OF THE RESONANCE RECONSTRUCTION THE  
 ALLOWABLE ERROR MUST BE POSITIVE. IF THE USER INPUTS AN ERROR FOR  
 RESONANCE RECONSTRUCTION THAT IS NOT POSITIVE IT WILL BE SET TO  
 THE DEFAULT VALUE (CURRENTLY 0.1 PER-CENT) AND INDICATED AS SUCH  
 IN THE OUTPUT LISTING.

#### COMMON ENERGY GRID

SOMETIMES IT IS CONVENIENT TO KEEP ALL ENERGY POINTS AT WHICH THE  
 BACKGROUND CROSS SECTION IS TABULATED AND TO MERELY ADD THE  
 RESONANCE CONTRIBUTION. FOR EXAMPLE, IT IS OFTEN CONVENIENT TO  
 KEEP THE THERMAL VALUE (AT 0.053 EV) OR THE VALUE AT 14.1 MEV.  
 SIMILARLY IT IS OFTEN CONVENIENT TO HAVE THE CONTRIBUTION OF THE  
 THE RESONANCES ALL ON THE SAME ENERGY GRID FOR ALL REACTIONS.

IN ORDER TO KEEP ALL ENERGY POINTS AT WHICH THE RESONANCE  
 CONTRIBUTION WAS RECONSTRUCTED AND TO ADD THE ENERGY POINTS AT  
 WHICH THE BACKGROUND CROSS SECTION IS GIVEN FOR EACH REACTION  
 SPECIFY ZERO (0.0) AS THE ALLOWABLE ACCURACY TO USE IN COMBINING  
 THE RESONANCE (FILE 2) AND BACKGROUND (FILE 3) CROSS SECTIONS.

CAUTION SHOULD BE EXERCISED IN USING THIS OPTION SINCE IT WILL  
 TURN OFF THE BACKWARD THINNING OF THE RESONANCE CONTRIBUTION  
 (SEE UCRL-50400, VOL. 17, PART C FOR AN EXPLANATION) AND CAN  
 RESULT IN A CONSIDERABLE INCREASE IN THE NUMBER OF DATA POINTS  
 OUTPUT BY THIS CODE.

#### INTERVAL HALVING ALGORITHM

THIS PROGRAM WILL START BY CALCULATING THE CROSS SECTIONS AT THE  
 ENERGIES CORRESPONDING TO THE PEAK OF EACH RESONANCE, AS WELL AS  
 A FIXED NUMBER OF HALF-WIDTHS ON EACH SIDE OF EACH RESONANCE.  
 STARTING FROM THIS BASIC GRID OF POINTS THE PROGRAM WILL CONTINUE  
 TO HALF EACH INTERVAL UNTIL THE CROSS SECTIONS FOR ALL REACTIONS  
 AT THE CENTER OF THE INTERVAL CAN BE DEFINED BY LINEAR  
 INTERPOLATION FROM THE ENDS OF THE INTERVAL TO WITHIN THE USER  
 SPECIFIED ACCURACY CRITERIA.

#### RESOLVED RESONANCE REGION

IN THE RESOLVED RESONANCE REGION THE RESOLVED PARAMETERS ARE  
 USED TO CALCULATE COLD (ZERO KELVIN) ENERGY DEPENDENT CROSS  
 SECTIONS. THE RESOLVED PARAMETERS MAY BE SINGLE OR MULTI-LEVEL  
 BREIT-WIGNER, OR ADLER-ADLER PARAMETERS, REICH-MOORE PARAMETERS

REC01800  
 REC01810  
 REC01820  
 REC01830  
 REC01840  
 REC01850  
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 REC01870  
 REC01880  
 REC01890  
 REC01900  
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 REC01960  
 REC01970  
 REC01980  
 REC01990  
 REC02000  
 REC02010  
 REC02020  
 REC02030  
 REC02040  
 REC02050  
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 REC02100  
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 REC02360  
 REC02370  
 REC02380

C WILL BE READ, A WARNING MESSAGE PRINTED AND THE PARAMETERS  
 C IGNORED (I.E. THIS PROGRAM DOES NOT CALCULATE CROSS SECTIONS  
 C FROM REICH-MOORE PARAMETERS). REC02310  
 C REC02320  
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 C REC02340  
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 C REC02960  
 C REC02970

C WILL BE READ, A WARNING MESSAGE PRINTED AND THE PARAMETERS  
 C IGNORED (I.E. THIS PROGRAM DOES NOT CALCULATE CROSS SECTIONS  
 C FROM REICH-MOORE PARAMETERS).

C Distant Resonance Treatment

C ALL CROSS SECTIONS AT RESONANCE PEAKS AND A FIXED NUMBER OF  
 C HALF WIDTHS FROM EACH RESONANCE PEAK WILL BE CALCULATED EXACTLY.  
 C HOWEVER, DURING THE INTERVAL HALVING ALGORITHM TO DEFINE THE  
 C CROSS SECTIONS BETWEEN THESE FIXED POINTS THE USER MAY CHOOSE  
 C TO CALCULATE THE CONTRIBUTION OF DISTANT RESONANCES EXACTLY OR TO  
 C USE AN APPROXIMATION TO DEFINE THE EFFECT OF DISTANT RESONANCES.  
 C IN THIS PROGRAM A RESONANCE IS CONSIDERED TO BE DISTANT IF IT IS  
 C MORE THAN A MINIMUM NUMBER OF RESONANCES (10 IN THIS PROGRAM) AND  
 C HALF-WIDTHS (5000 IN THIS PROGRAM) FROM THE INTERVAL BEING  
 C SUB-DIVIDED. IF THE USER DECIDES TO TREAT ALL DISTANT RESONANCES  
 C APPROXIMATELY THE EFFECT OF ALL DISTANT RESONANCES WILL BE  
 C CONSIDERED TO VARY LINEARLY OVER THE INTERVAL BEING SUB-DIVIDED.

C WARNING...WARNING...WARNING

C THE DISTANT RESONANCE TREATMENT IN THIS PROGRAM HAS BEEN TESTED  
 C IN A NUMBER OF CASES, BUT SHOULD STILL BE CONSIDERED TO BE A  
 C PROCEDURE THAT IS IN THE DEVELOPMENT STAGE. AS SUCH THE AUTHOR  
 C WOULD APPRECIATE HEARING OF ANY USER EXPERIENCE (POSITIVE OR  
 C NEGATIVE) IN USING THIS OPTION. HOWEVER, SINCE THIS OPTION IS  
 C STILL IN THE DEVELOPMENT STAGE IT IS NOT RECOMMENDED FOR USE IN  
 C ANY PRODUCTION WORK WHERE THE OUTPUT OF THIS CODE WILL ACTUALLY  
 C BE USED IN SUBSEQUENT CALCULATIONS.

C UNRESOLVED RESONANCE REGION

C IN THE UNRESOLVED RESONANCE REGION THE UNRESOLVED PARAMETERS  
 C ARE USED TO CALCULATE INFINITELY DILUTE AVERAGE CROSS SECTIONS.  
 C IN THE UNRESOLVED RESONANCE REGION THE ENDF/B CONVENTION OF  
 C INTERPOLATING CROSS SECTIONS, NOT PARAMETERS IS USED. THAT IS,  
 C INFINITELY DILUTE CROSS SECTIONS ARE CALCULATED AT THE ENERGIES  
 C AT WHICH PARAMETERS ARE GIVEN AND THE CROSS SECTIONS ARE THEN  
 C INTERPOLATED TO DEFINE THE CROSS SECTIONS AT OTHER ENERGIES.

C BACKGROUND CROSS SECTIONS

C IN ORDER TO BE COMBINED WITH THE RESONANCE CONTRIBUTION THE  
 C BACKGROUND CROSS SECTIONS MUST BE GIVEN AT 0 KELVIN TEMPERATURE  
 C AND MUST BE LINEARLY INTERPOLABLE. IF THESE CONDITIONS ARE MET  
 C THE RESONANCE AND BACKGROUND CONTRIBUTIONS WILL BE ADDED TOGETHER  
 C AND OUTPUT. IF THESE CONDITIONS ARE NOT MET THE BACKGROUND CROSS  
 C SECTION WILL BE IGNORED AND ONLY THE RESONANCE CONTRIBUTION WILL  
 C BE OUTPUT. IF THE BACKGROUND HAS NOT BEEN ADDED TO THE RESONANCE  
 C CONTRIBUTION AFTER THIS PROGRAM FINISHES THE USER CAN MAKE THE  
 C RESONANCE AND BACKGROUND CONTRIBUTIONS COMPATIBLE BY:

C (1) DOPPLER BROADENING THE RESONANCE CONTRIBUTION TO THE SAME  
 C TEMPERATURE AS THE BACKGROUND (USE PROGRAM SIGMA1), AND/OR  
 C (2) LINEARIZING THE BACKGROUND CROSS SECTION (USE PROGRAM LINEAR).

C ONCE THE RESONANCE AND BACKGROUND CONTRIBUTIONS ARE IN COMPATIBLE  
 C FORM THE TWO MAY BE ADDED TOGETHER (USE PROGRAM MIXER).

THE RECONSTRUCTION OF THE RESONANCE CONTRIBUTION TO THE CROSS SECTION CAN BE QUITE EXPENSIVE (IN TERMS OF COMPUTER TIME). SINCE THE RECONSTRUCTION IS PERFORMED BEFORE THE BACKGROUND CROSS SECTIONS ARE READ, THE ABOVE CONVENTIONS HAVE BEEN ADOPTED IN ORDER TO AVOID LOSE OF COMPUTER TIME INVOLVED IN RECONSTRUCTING THE RESONANCE CONTRIBUTION.

#### BACKGROUND CROSS SECTIONS

AFTER A ZERO KELVIN RESONANCE CONTRIBUTION HAS BEEN RECONSTRUCTED IF THERE IS A ZERO KELVIN BACKGROUND CROSS SECTION IT WILL BE ADDED TO THE RESONANCE CONTRIBUTION AND THE SUM WILL BE OUTPUT. IF THERE IS NO BACKGROUND ONLY THE RESONANCE CONTRIBUTION WILL BE OUTPUT. IF THE BACKGROUND CROSS SECTION IS NOT AT ZERO KELVIN AN ERROR MESSAGE WILL BE PRINTED OUT, THE BACKGROUND CROSS SECTION WILL BE SKIPPED (I.E. NOT ADDED TO THE RESONANCE CONTRIBUTION) AND ONLY THE RESONANCE CONTRIBUTION WILL BE OUTPUT. IN THIS CASE THE USER USE PROGRAM SIGMA1 (UCRL-50400, VOL. 17, PART C) TO DOPPLER BROADEN THE RESONANCE CONTRIBUTION TO THE SAME TEMPERATURE AS THE BACKGROUND AND THEN ADD THE RESONANCE AND BACKGROUND CONTRIBUTIONS TOGETHER USING PROGRAM MIXER.

#### PROGRAM OPERATION

ALL OF THE FILE 2 RESONANCE PARAMETERS ARE FIRST READ AND THE LINEARLY INTERPOLABLE CONTRIBUTION OF THE RESONANCE PARAMETERS TO THE TOTAL, ELASTIC, CAPTURE AND FISSION CROSS SECTIONS IS CALCULATED SIMULTANEOUSLY USING A COMMON ENERGY GRID FOR ALL FOUR REACTIONS.

AFTER THE RESONANCE CONTRIBUTION HAS BEEN RECONSTRUCTED EACH OF THE FOUR REACTIONS IS CONSIDERED SEPARATELY. IF THERE IS A ZERO KELVIN, LINEARLY INTERPOLABLE FILE 3 BACKGROUND IT WILL BE COMBINED WITH THE RESONANCE CONTRIBUTION, THE SUM THINNED AND OUTPUT. IF THERE IS NO FILE 3 BACKGROUND TO ADD (EITHER NO BACKGROUND OR INCOMPATIBLE BACKGROUND) THE CONTRIBUTION OF THE RESONANCES TO A REACTION IS THINNED AND OUTPUT.

#### INPUT FILES

##### UNIT DESCRIPTION

5 INPUT CARD (BCD - 80 CHARACTERS/RECORD)  
10 ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)

#### OUTPUT FILES

##### UNIT DESCRIPTION

6 OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)  
11 FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)

#### SCRATCH FILES

##### UNIT DESCRIPTION

12 SCRATCH FILE FOR DATA RECONSTRUCTED FROM RESONANCE PARAMETERS (BINARY - 1002 WORDS/RECORD)

REC02990  
REC03000  
REC03010  
REC03020  
REC03030  
REC03040  
REC03050  
REC03060  
REC03070  
REC03080  
REC03090  
REC03100  
REC03110  
REC03120  
REC03130  
REC03140  
REC03150  
REC03160  
REC03170  
REC03180  
REC03190  
REC03200  
REC03210  
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REC03470  
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REC03500  
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REC03540  
REC03550  
REC03560

CARD	COLS.	FORMAT	DESCRIPTION	REC
13			SCRATCH FILE FOR COMBINED FILE 2 AND 3 DATA. (BINARY - 3006 WORDS/RECORD)	REC03570
				REC03580
				REC03590
				REC03600
				REC03610
				REC03620
				REC03630
				REC03640
				REC03650
				REC03660
				REC03670
				REC03680
				REC03690
				REC03700
				REC03710
				REC03720
				REC03730
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				REC03970
				REC03980
				REC03990
				REC04000
				REC04010
				REC04020
				REC04030
				REC04040
				REC04050
				REC04060
				REC04070
				REC04080
				REC04090
				REC04100
				REC04110
				REC04120
				REC04130
				REC04140
				REC04150

THE FILE 2 OR FILE 2+3 ERROR LAW MAY BE ENERGY INDEPENDENT  
(DEFINED BY A SINGLE ERROR) OR ENERGY DEPENDENT (DEFINED BY UP



TO 20 ENERGY, ERROR PAIRS). FOR THE ENERGY DEPENDENT CASE LINEAR INTERPOLATION WILL BE USED TO DEFINE THE ERROR AT ENERGIES BETWEEN THOSE AT WHICH IT IS TABULATED. IN ALL CASES EACH ERROR LAW IS TERMINATED BY A BLANK CARD. IF ONLY ONE ENERGY ERROR PAIR IS GIVEN FOR ONE LAW THE LAW WILL BE CONSIDERED TO BE ENERGY INDEPENDENT). IF MORE THAN ONE PAIR IS GIVEN IT BE CONSIDERED TO BE ENERGY DEPENDENT (NOTE, ENERGY INDEPENDENT FORM WILL RUN FASTER THAN THE EQUIVALENT ENERGY DEPENDENT FORM). FOR AN ENERGY DEPENDENT ERROR LAW ALL ENERGIES MUST BE IN ASCENDING ORDER. FOR CONVERGENCE OF THE FILE 2 RECONSTRUCTION ALGORITHM ALL FILE 2 ERROR LAW ERRORS MUST BE POSITIVE. IF A FILE 2 ERROR IS NOT POSITIVE IT WILL BE SET EQUAL TO THE STANDARD OPTION (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT). IF A FILE 3 ERROR IS NOT POSITIVE IT WILL BE SET EQUAL TO ZERO, INDICATING NO THINNING OF THE COMBINED FILE 2+3 CONTRIBUTIONS. IF THE FIRST CARD OF EITHER ERROR LAW IS BLANK IT WILL TERMINATE THAT ERROR LAW AND THE ERROR WILL BE TREATED AS ENERGY INDEPENDENT, EQUAL TO THE STANDARD OPTION (CURRENTLY, 0.1 PER-CENT FOR FILE 2 AND 0.0 FOR FILE 2+3). (SEE EXAMPLE INPUT 4).

## EXAMPLE INPUT NO. 1

CONSIDER ALL URANIUM ISOTOPES AND TH-232. CONSIDER CROSS SECTIONS WHICH ARE LARGER THAN  $1.0E-8$  BARNs IN ABSOLUTE VALUE. USE CALCULATION MODE WITH EXACT TREATMENT OF DISTANT RESONANCES (THE ONLY RECOMMENDED CHOICE FOR THIS OPTION). FOR FILE 2 BETWEEN 0 AND 100 EV USE 0.1 PER-CENT ACCURACY. BETWEEN 100 EV AND 1 KEV VARY ACCURACY FROM 0.1 TO 1 PER-CENT. ABOVE 1 KEV USE 1 PER-CENT ACCURACY. IN COMBINING FILE 2 AND 3 THIN OUTPUT TO 0.1 PER-CENT ACCURACY AT ALL ENERGIES.

THE FOLLOWING ELEVEN INPUT CARDS ARE REQUIRED:

1	1.00000-08	0	0	0	0	
92000	92999					
90232						(UPPER LIMIT AUTOMATICALLY SET TO 90232)
						(END REQUEST LIST)
0.00000+0	1.00000-03					
1.00000+02	1.00000-03					
1.00000+03	1.00000-02					
1.00000+09	1.00000-02					(END FILE 2 ERROR LAW)
	1.00000- 3					(END FILE 2+3 ERROR LAW)

## EXAMPLE INPUT NO. 2

CONSIDER ALL URANIUM ISOTOPES AND TH-232. CONSIDER CROSS SECTIONS WHICH ARE LARGER THAN  $1.0E-8$  BARNs IN ABSOLUTE VALUE. USE CALCULATION MODE WITH EXACT TREATMENT OF DISTANT RESONANCES (THE ONLY RECOMMENDED CHOICE FOR THIS OPTION). FOR FILE 2 AND FILE 2+3 USE 0.1 PER-CENT ACCURACY. SINCE 0.1 PER-CENT IS THE STANDARD OPTION FOR FILE 2 THE FIRST CARD OF THE FILE 2 ERROR LAW MAY BE BLANK, BUT SINCE 0.1 PER-CENT IS NOT THE STANDARD OPTION FOR FILE 2+3 IT MUST BE GIVEN IN THE INPUT.

THE FOLLOWING SEVEN INPUT CARDS ARE REQUIRED:

1	1.00000-08	0	0	0	0	
---	------------	---	---	---	---	--

C	92000	92999		REC04750	
C	90232		(UPPER LIMIT AUTOMATICALLY SET TO 90232)	REC04760	
C			(END REQUEST LIST)	REC04770	
C			(0.1 PER-CENT ERROR, END FILE 2 ERROR LAW)	REC04780	
C	1.00000-	3		REC04790	
C			(END FILE 2+3 ERROR LAW)	REC04800	
C				REC04810	
C	EXAMPLE INPUT NO. 3			REC04820	
C	-----			REC04830	
C	RECONSTRUCT ALL DATA FOR FILE 2 RECONSTRUCT DATA TO 1.0 PER-CENT			REC04840	
C	ACCURACY AND FOR FILE 2+3 DO NOT THIN THE DATA.			REC04850	
C				REC04860	
C	THE FOLLOWING FIVE INPUT CARDS ARE REQUIRED.			REC04870	
C				REC04880	
C	0 0.0	0	0	0	REC04890
C			(RETRIEVE ALL DATA, END REQUEST LIST)		REC04900
C	1.00000-	3			REC04910
C			(END FILE 2 ERROR LAW)		REC04920
C			(0.0 PER-CENT ERROR, END FILE 3 ERROR LAW)		REC04930
C					REC04940
C	EXAMPLE INPUT NO. 4			REC04950	
C	-----			REC04960	
C	RECONSTRUCT ALL DATA USING THE STANDARD OPTION FOR FILE 2			REC04970	
C	RECONSTRUCTION (CURRENTLY 0.1 PER-CENT) AND DO NOT THIN THE			REC04980	
C	COMBINED FILE 2 + 3 CROSS SECTIONS. IN THIS CASE IT IS ADEQUATE			REC04990	
C	TO INPUT A SET OF COMPLETELY BLANK INPUT CARDS WHICH WILL INVOKE			REC05000	
C	ALL OF THE STANDARD OPTIONS.			REC05010	
C				REC05020	
C	IN THIS CASE THE FOLLOWING FOUR INPUT CARDS ARE REQUIRED.			REC05030	
C	(ZEROS ARE INDICATED ON THE FIRST CARD, BELOW, ONLY TO INDICATE			REC05040	
C	WHERE THE CARD IS. THE ACTUAL INPUT CARD CAN BE COMPLETELY BLANK).			REC05050	
C				REC05060	
C	0 0.0	0	0	0	REC05070
C			(RETRIEVE ALL DATA, REQUEST LIST)		REC05080
C			(0.1 ERROR, END FILE ERROR LAW)		REC05090
C			(0.0 ERROR, END FILE 3 ERROR LAW)		REC05100
C					REC05110
C	C***** MACHINE DEPENDENT CODING *****				REC05120
C					REC05130
C	THERE IS NO COMPUTER DEPENDENT CODING IN THIS PROGRAM.				REC05140
C					REC05150
C	C***** MACHINE DEPENDENT CODING *****				REC05160

C		SIG00030
C	PROGRAM SIGNAL	SIG0004
C	VERSION 73-1 (MARCH 1973)	SIG00050
C	VERSION 74-1 (FEBRUARY 1976)	SIG00060
C	VERSION 74-2 (OCTOBER 1976)	SIG00070
C	VERSION 77-1 (JANUARY 1977)	SIG00080
C	VERSION 78-1 (JULY 1978)	SIG00090
C	VERSION 79-1 (JULY 1979) CDC-7600 AND CRAY-1 VERSION.	SIG00100
C	VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION	SIG00110
C	VERSION 80-2 (DECEMBER 1980)	SIG00120
C	VERSION 81-1 (MARCH 1981) DOUBLE PRECISION IBM VERSION	SIG00130
C	VERSION 81-2 (AUGUST 1981) IMPROVED IBM SPEED AND STABILITY	SIG00140
C	VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY	SIG00150
C	VERSION 83-1 (JANUARY 1983)*MAJOR RE-DESIGN.	SIG00160
C	*PAGE SIZE INCREASED - 1002 TO 3006.	SIG00170
C	*ELIMINATED COMPUTER DEPENDENT CODING.	SIG00180
C	*NEW, MORE COMPATIBLE I/O UNIT NUMBER.	SIG00190
C	*ADDED STANDARD ALLOWABLE ERROR OPTION	SIG00200
C	(CURRENTLY 0.1 PER-CENT).	SIG00210
C	*UNRESOLVED RESONANCE REGION COPIED.	SIG00220
C	*1/V EXTENSION OF CROSS SECTIONS	SIG00230
C	OUTSIDE OF TABULATED ENERGY RANGE AND	SIG00240
C	INTO UNRESOLVED ENERGY RANGE.	SIG00250
C		SIG00260
C	REPORT UCRL-50400, VOL. 17, PART B (1979)	SIG00270
C	LAWRENCE LIVERMORE LABORATORY	SIG00280
C		SIG00290
C	WRITTEN BY DERMOTT E. CULLEN	SIG00300
C	NUCLEAR DATA SECTION	SIG00310
C	INTERNATIONAL ATOMIC ENERGY AGENCY	SIG00320
C	P.O. BOX 200	SIG00330
C	VIENNA, AUSTRIA	SIG00340
C	TELEPHONE 23-60-1718	SIG00350
C		SIG00360
C	AUTHORS MESSAGE	SIG00370
C		SIG00380
C	THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION	SIG00390
C	FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED	SIG00400
C	THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE	SIG00410
C	READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY	SIG00420
C	THE COMMENTS CONCERNING MACHINE DEPENDENT CODING.	SIG00430
C		SIG00440
C	AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTERS	SIG00450
C	INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE	SIG00460
C	OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT	SIG00470
C	IT WOULD BE APPRECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY	SIG00480
C	COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO	SIG00490
C	IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF	SIG00500
C	THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR	SIG00510
C	COMPUTER.	SIG00520
C		SIG00530
C	PURPOSE	SIG00540
C		SIG00550
C	THIS PROGRAM IS DESIGNED TO DOPPLER BROADEN NEUTRON INDUCED	SIG00560
C	CROSS SECTIONS. EACH SECTION OF CROSS SECTIONS (FILE 3) IS READ	SIG00570
C	FROM THE ENDF/B FORMAT. THE DATA IS DOPPLER BROADENED, THINNED	SIG00580
C	AND OUTPUT IN THE ENDF/B FORMAT.	SIG00590
C		SIG00600
C	IN THE FOLLOWING DISCUSSION FOR SIMPLICITY THE ENDF/B TERMINOLOGY	SIG00610

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

#### ENDF/B FORMAT

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

IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS ASSUMED THAT THE MAT, MF AND MT ON EACH CARD IS CORRECT. SEQUENCE NUMBERS (COLUMNS 76-90) ARE IGNORED ON INPUT, BUT WILL BE CORRECTLY OUTPUT ON ALL CARDS. THE FORMAT OF SECTION MF=1, MT=451 AND ALL SECTIONS OF MF=3 MUST BE CORRECT. THE PROGRAM COPIES ALL OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.

ALL CROSS SECTIONS THAT ARE USED BY THIS PROGRAM MUST BE TABULATED AND LINEARLY INTERPOLABLE IN ENERGY AND CROSS SECTION (ENDF/B INTERPOLATION LAW 2). FILE 3 CROSS SECTIONS MAY BE MADE LINEARLY INTERPOLABLE BY USING PROGRAM LINEAR (UCRL-50400, VOL. 17, PART A). FILE 2 RESONANCE PARAMETERS MAY BE USED TO RECONSTRUCT ENERGY DEPENDENT CROSS SECTIONS AND ADD IN FILE 3 BACKGROUND CROSS SECTIONS TO DEFINE LINEARLY INTERPOLABLE CROSS SECTIONS BY USING PROGRAM RECENT (UCRL-50400, VOL. 17, PART C). IF THIS PROGRAM FINDS THAT THE FILE 3 CROSS SECTIONS ARE NOT LINEARLY INTERPOLABLE THIS PROGRAM WILL TERMINATE EXECUTION.

#### UNRESOLVED RESONANCE REGION

IN THE UNRESOLVED RESONANCE REGION IT IS NOT POSSIBLE TO EXACTLY DEFINE THE ENERGY DEPENDENCE OF THE CROSS SECTIONS. THE AVERAGE WIDTHS AND SPACINGS GIVEN IN ENDF/B ARE ONLY ADEQUATE TO DEFINE AVERAGE VALUES OF THE CROSS SECTIONS. THEREFORE ALL CROSS SECTIONS IN THE ENDF/B FORMAT FOR THE UNRESOLVED REGION ARE REALLY AVERAGE VALUES WHICH CANNOT BE DOPPLER BROADENED USING THE SIGMA1 METHOD (WHICH REQUIRES TABULATED, LINEARLY INTERPOLABLE, ENERGY DEPENDENT CROSS SECTIONS).

THEREFORE,

(1) ALL TABULATED POINTS WITHIN THE UNRESOLVED RESONANCE REGION WILL BE COPIED, WITHOUT MODIFICATION OR BROADENING. ADOPTION OF THIS CONVENTION WILL ALLOW SUBSEQUENT PROGRAMS TO PROPERLY DEFINE SELF-SHIELDED, DOPPLER BROADENED CROSS SECTIONS IN THE UNRESOLVED RESONANCE REGION.

(2) CROSS SECTIONS WILL BE EXTENDED AS  $1/V$  ABOVE THE UPPER ENERGY LIMIT OF THE RESOLVED RESONANCE REGION AND BELOW THE LOWER ENERGY LIMIT OF THE CONTINUUM REGION (I.E. INTO THE UNRESOLVED RESONANCE REGION). THIS CONVENTION WILL GUARANTEE A SMOOTH BEHAVIOR CLOSE TO THE UNRESOLVED RESONANCE REGION BOUNDARIES.

#### OUTPUT FORMAT

IN THIS VERSION OF SIGMA1 ALL FILE 3 ENERGIES WILL BE OUTPUT IN F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN WITH UP TO 8 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS

SIG00620  
SIG00630  
SIG00640  
SIG00650  
SIG00660  
SIG00670  
SIG00680  
SIG00690  
SIG00700  
SIG00710  
SIG00720  
SIG00730  
SIG00740  
SIG00750  
SIG00760  
SIG00770  
SIG00780  
SIG00790  
SIG00800  
SIG00810  
SIG00820  
SIG00830  
SIG00840  
SIG00850  
SIG00860  
SIG00870  
SIG00880  
SIG00890  
SIG00900  
SIG00910  
SIG00920  
SIG00930  
SIG00940  
SIG00950  
SIG00960  
SIG00970  
SIG00980  
SIG00990  
SIG01000  
SIG01010  
SIG01020  
SIG01030  
SIG01040  
SIG01050  
SIG01060  
SIG01070  
SIG01080  
SIG01090  
SIG01100  
SIG01110  
SIG01120  
SIG01130  
SIG01140  
SIG01150  
SIG01160  
SIG01170  
SIG01180  
SIG01190  
SIG01200

C		SIG00030
C	PROGRAM SIGNAL	SIG00040
C	VERSION 73-1 (MARCH 1973)	SIG00050
C	VERSION 74-1 (FEBRUARY 1976)	SIG00060
C	VERSION 76-2 (OCTOBER 1976)	SIG00070
C	VERSION 77-1 (JANUARY 1977)	SIG00080
C	VERSION 78-1 (JULY 1978)	SIG00090
C	VERSION 79-1 (JULY 1979) CDC-7600 AND CRAY-1 VERSION.	SIG00100
C	VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION	SIG00110
C	VERSION 80-2 (DECEMBER 1980)	SIG00120
C	VERSION 81-1 (MARCH 1981) DOUBLE PRECISION IBM VERSION	SIG00130
C	VERSION 81-2 (AUGUST 1981) IMPROVED IBM SPEED AND STABILITY	SIG00140
C	VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY	SIG00150
C	VERSION 83-1 (JANUARY 1983)*MAJOR RE-DESIGN.	SIG00160
C	*PAGE SIZE INCREASED - 1002 TO 3006.	SIG00170
C	*ELIMINATED COMPUTER DEPENDENT CODING.	SIG00180
C	*NEW, MORE COMPATIBLE I/O UNIT NUMBER.	SIG00190
C	*ADDED STANDARD ALLOWABLE ERROR OPTION	SIG00200
C	(CURRENTLY 0.1 PER-CENT).	SIG00210
C	*UNRESOLVED RESONANCE REGION COPIED.	SIG00220
C	*1/V EXTENSION OF CROSS SECTIONS	SIG00230
C	OUTSIDE OF TABULATED ENERGY RANGE AND	SIG00240
C	INTO UNRESOLVED ENERGY RANGE.	SIG00250
C		SIG00260
C	REPORT UCRL-50400, VOL. 17, PART B (1979)	SIG00270
C	LAWRENCE LIVERMORE LABORATORY	SIG00280
C		SIG00290
C	WRITTEN BY DERMOTT E. CULLEN	SIG00300
C	NUCLEAR DATA SECTION	SIG00310
C	INTERNATIONAL ATOMIC ENERGY AGENCY	SIG00320
C	P.O. BOX 200	SIG00330
C	VIENNA, AUSTRIA	SIG00340
C	TELEPHONE 23-60-1718	SIG00350
C		SIG00360
C	AUTHORS MESSAGE	SIG00370
C		SIG00380
C	THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION	SIG00390
C	FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED	SIG00400
C	THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE	SIG00410
C	READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY	SIG00420
C	THE COMMENTS CONCERNING MACHINE DEPENDENT CODING.	SIG00430
C		SIG00440
C	AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTERS	SIG00450
C	INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE	SIG00460
C	OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT	SIG00470
C	IT WOULD BE APPRECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY	SIG00480
C	COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO	SIG00490
C	IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF	SIG00500
C	THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR	SIG00510
C	COMPUTER.	SIG00520
C		SIG00530
C	PURPOSE	SIG00540
C		SIG00550
C	THIS PROGRAM IS DESIGNED TO DOPPLER BROADEN NEUTRON INDUCED	SIG00560
C	CROSS SECTIONS. EACH SECTION OF CROSS SECTIONS (FILE 3) IS READ	SIG00570
C	FROM THE ENDF/B FORMAT. THE DATA IS DOPPLER BROADENED, THINNED	SIG00580
C	AND OUTPUT IN THE ENDF/B FORMAT.	SIG00590
C		SIG00600
C	IN THE FOLLOWING DISCUSSION FOR SIMPLICITY THE ENDF/B TERMINOLOGY	SIG00610

TO THE 8 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE  
 TO USE THE 8 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA  
 JUST DUE TO TRANSLATION OF THE ENERGIES TO THE ENDF/B FORMAT.

CONTENTS OF OUTPUT

ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE BROADENED FILE 3  
 CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO  
 INCLUDED.

DOCUMENTATION

THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED  
 BY THE ADDITION OF THREE COMMENTS CARDS AT THE END OF EACH  
 HOLLERITH SECTION IN THE FORM

\*\*\*\*\* PROGRAM SIGMA1 (83-1) \*\*\*\*\*  
 DATA DOPPLER BROADENED TO 300.0 KELVIN AND  
 DATA THINNED TO WITHIN AN ACCURACY OF 0.1 PER-CENT

THE ORDER OF ALL SIMILAR COMMENTS (FROM LINEAR, RECENT AND GROUPY)  
 REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON  
 THE DATA.

THESE COMMENT CARDS ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS.  
 I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT  
 OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF  
 EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451  
 IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF  
 THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF  
 MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO  
 DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND  
 AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT  
 SHOULD BE USED TO CREATE A HOLLERITH SECTION.

REACTION INDEX

THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN  
 SECTION MF=1, MT=451 OF EACH EVALUATION.

THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451.  
 THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT  
 REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS  
 NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING  
 A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE  
 A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM  
 YOU MAY USE PROGRAM DICTION TO CREATE A CORRECT REACTION INDEX.

SECTION SIZE

SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT  
 TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS  
 SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.

SELECTION OF DATA

THE PROGRAM SELECTS MATERIALS TO BE BROADENED BASED EITHER ON  
 MAT (ENDF/B MAT NO.) OR ZA. THE PROGRAM ALLOWS UP TO 100 MAT OR  
 ZA RANGES TO BE SPECIFIED. THE PROGRAM WILL ASSUME THAT THE

ENDF/B TAPE IS IN EITHER MAT OR ZA ORDER, WHICHEVER CRITERIA IS USED TO SELECT MATERIALS, AND WILL TERMINATE WHEN A MAT OR ZA IS FOUND THAT IS ABOVE THE RANGE OF ALL REQUESTS.

#### ENERGY GRID OF BROADENED DATA

THE ENERGY GRID FOR THE DOPPLER BROADENED CROSS SECTIONS IS SELECTED TO INSURE THAT THE BROADENED DATA IS LINEAR-LINEAR INTERPOLABLE. AS SUCH THE ENERGY GRID FOR THE BROADENED DATA MAY NOT BE THE SAME AS THE ENERGY GRID FOR THE ORIGINAL UNBROADENED DATA. GENERALLY AFTER BROADENING THERE WILL BE FEWER DATA POINTS IN THE RESONANCE REGION, BUT AT LOW ENERGY THERE MAY BE MORE POINTS, DUE TO THE  $1/V$  LOW ENERGY EFFECT CREATED BY DOPPLER BROADENING.

#### EFFECTIVE TEMPERATURE INCREASE

IF THE ORIGINAL DATA IS NOT AT ZERO KELVIN THE PROGRAM WILL BROADEN THE DATA BY THE EFFECTIVE TEMPERATURE DIFFERENCE TO THE FINAL TEMPERATURE. IF THE DATA IS ALREADY AT A TEMPERATURE THAT IS HIGHER THAN THE FINAL TEMPERATURE DOPPLER BROADENING IS NATURALLY NOT PERFORMED AND THE TEMPERATURE IN THE SECTION IS LEFT AT ITS ORIGINAL VALUE.

#### MULTIPLE FINAL TEMPERATURES

THE PRESENT VERSION ONLY DOPPLER BROADENS TO ONE FINAL TEMPERATURE (IF THERE IS SUFFICIENT INTEREST EXPRESSED BY USERS FUTURE VERSION MAY BROADEN TO MULTIPLE TEMPERATURES, PLEASE CONTACT THE AUTHOR IF YOU ARE INTERESTED IN A MULTIPLE TEMPERATURE OPTION).

#### PROGRAM OPERATION

EACH SECTION OF FILE 3 DATA IS CONSIDERED SEPERATELY. THE DATA IS READ AND DOPPLER BROADENED A PAGE AT A TIME (ONE PAGE IS 2004 DATA POINTS). UP TO THREE PAGES OF DATA MAY BE IN THE CORE AT ANY GIVEN TIME, THE PAGE BEING BROADENED, THE PAGE BELOW IT IN ENERGY AND THE PAGE ABOVE IT IN ENERGY. AFTER A PAGE HAS BEEN BROADENED IT IS THINNED, IF THE ENTIRE SECTION CONTAINS ONLY ONE PAGE OR LESS, IT WILL STILL BE CORE RESIDENT AND WILL BE WRITTEN DIRECTLY FROM CORE TO THE OUTPUT TAPE. IF THE BROADENED, THINNED SECTION IS LARGER THAN A PAGE, AFTER A PAGE HAS BEEN BROADENED AND THINNED IT IS WRITTEN TO A SCRATCH FILE. AFTER THE ENTIRE SECTION HAS BEEN BROADENED AND THINNED THE DATA IS READ FROM SCRATCH TO CORE, ONE PAGE AT A TIME, THE OUTPUT TO THE OUTPUTS TAPE.

#### ALLOWABLE ERROR

AFTER DOPPLER BROADENING THE CROSS SECTION IN THE RESONANCE REGIONS WILL GENERALLY BE MUCH SMOOTHER THAN THE UNBROADENED DATA AND CAN BE REPRESENTED TO THE SAME ACCURACY BY A SMALLER NUMBER OF ENERGY POINTS. THEREFORE AFTER DOPPLER BROADENING THE DATA CAN BE THINNED WITH ESSENTIALLY NO LOSE OF INFORMATION.

THE ALLOWABLE ERROR MAY BE ENERGY INDEPENDENT (CONSTANT) OR ENERGY DEPENDENT. THE ALLOWABLE ERROR IS DESCRIBED BY A TABULATED FUNCTION OF UP TO 20 (ENERGY,ERROR) PAIRS AND LINEAR INTERPOLATIONS

SIG01800  
SIG01810  
SIG01820  
SIG01830  
SIG01840  
SIG01850  
SIG01860  
SIG01870  
SIG01880  
SIG01890  
SIG01900  
SIG01910  
SIG01920  
SIG01930  
SIG01940  
SIG01950  
SIG01960  
SIG01970  
SIG01980  
SIG01990  
SIG02000  
SIG02010  
SIG02020  
SIG02030  
SIG02040  
SIG02050  
SIG02060  
SIG02070  
SIG02080  
SIG02090  
SIG02100  
SIG02110  
SIG02120  
SIG02130  
SIG02140  
SIG02150  
SIG02160  
SIG02170  
SIG02180  
SIG02190  
SIG02200  
SIG02210  
SIG02220  
SIG02230  
SIG02240  
SIG02250  
SIG02260  
SIG02270  
SIG02280  
SIG02290  
SIG02300  
SIG02310  
SIG02320  
SIG02330  
SIG02340  
SIG02350  
SIG02360  
SIG02370  
SIG02380

BETWEEN TABULATED POINTS. IF ONLY ONE TABULATED POINT IS GIVEN THE ERROR WILL BE CONSIDERED CONSTANT OVER THE ENTIRE ENERGY RANGE. WITH THIS ENERGY DEPENDENT ERROR ONE MAY OPTIMIZE THE OUTPUT FOR ANY GIVEN APPLICATION BY USING A SMALL ERROR IN THE ENERGY RANGE OF INTEREST AND A LESS STRINGENT ERROR IN OTHER ENERGY RANGES.

#### INPUT FILES

##### UNIT DESCRIPTION

5 INPUT CARDS (BCD - 80 CHARACTERS/RECORD)  
10 ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)

#### OUTPUT FILES

##### UNIT DESCRIPTION

6 OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)  
11 FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)

#### SCRATCH FILES

##### UNIT DESCRIPTION

12 SCRATCH FILE FOR BROADENED DATA (BINARY - 2004 WORDS/RECORD)

#### INPUT CARDS

##### CARD COLS. DESCRIPTION

1	1-11	SELECTION CRITERIA (0=MAT, 1=ZA)	SIG02430
	12-22	NO LONGER USED AS AN INPUT OPTION. THE FORMER MEANING OF THIS PARAMETER WAS.....	SIG02440
		MINIMUM ENERGY SPACING SELECTOR	SIG02450
		= 0 - 4 DIGIT MINIMUM ENERGY SPACING CALCULATIONS. STANDARD 6 DIGIT E11.4 OUTPUT.	SIG02460
		= 1 - 8 DIGIT MINIMUM ENERGY SPACING CALCULATIONS. STANDARD 6 DIGIT E11.4 OUTPUT.	SIG02470
		= 2 - 8 DIGIT MINIMUM ENERGY SPACING CALCULATIONS. VARIABLE 8 DIGIT F FORMAT OUTPUT.	SIG02480
		EXPERIENCE HAS DEMONSTRATED THAT FAILURE TO USE 2 FOR THIS OPTION CAN RESULT IN SIGNIFICANT ERRORS IN THE FINAL DATA. THEREFORE INTERNALLY THIS OPTION IS ALWAYS SET TO 2.	SIG02490
	23-33	KELVIN TEMPERATURE	SIG02500
2-N	1-11	LOWER MAT OR ZA LIMIT	SIG02510
	12-22	UPPER MAT OR ZA LIMIT	SIG02520
		UP TO 100 MAT OR ZA RANGES MAY BE SPECIFIED, ONE RANGE PER CARD. THE LIST OF RANGES IS TERMINATED BY A BLANK CARD. IF THE UPPER LIMIT IS LESS THAN THE LOWER LIMIT THE UPPER LIMIT WILL BE SET EQUAL TO THE LOWER LIMIT. IF THE FIRST REQUEST CARD IS BLANK IT WILL TERMINATE THE LIST OF REQUESTS AND CAUSE ALL DATA TO BE RETRIEVED (SEE EXAMPLE INPUT).	SIG02530
VARY	1-11	ENERGY FOR ERROR LAW	SIG02540
	12-22	ERROR FOR ERROR LAW	SIG02550
		THE ACCEPTABLE LINEARIZING ERROR CAN BE GIVEN AS AN ENERGY DEPENDENT FUNCTION SPECIFIED BY UP TO 20 (ENERGY,ERROR) PAIRS AND LINEAR INTERPOLATION	SIG02560
			SIG02570
			SIG02580
			SIG02590
			SIG02600
			SIG02610
			SIG02620
			SIG02630
			SIG02640
			SIG02650
			SIG02660
			SIG02670
			SIG02680
			SIG02690
			SIG02700
			SIG02710
			SIG02720
			SIG02730
			SIG02740
			SIG02750
			SIG02760
			SIG02770
			SIG02780
			SIG02790
			SIG02800
			SIG02810
			SIG02820
			SIG02830
			SIG02840
			SIG02850
			SIG02860
			SIG02870
			SIG02880
			SIG02890
			SIG02900
			SIG02910
			SIG02920
			SIG02930
			SIG02940
			SIG02950
			SIG02960
			SIG02970



C TABULATE POINTS. ENERGIES MUST BE IN ASCENDING ORDER. SIG02980  
 C THE ERROR LAW IS TERMINATED BY A BLANK CARD. IF THE SIG02990  
 C FIRST ERROR LAW CARD IS BLANK IT WILL TERMINATE THE SIG03000  
 C ERROR LAW AND THE ERROR WILL BE TREATED AS ENERGY SIG03010  
 C INDEPENDENT, EQUAL TO ZERO, WHICH INDICATES THAT THE SIG03020  
 C BROADENED DATA SHOULD NOT BE THINNED. SIG03030  
 C SIG03040  
 C SIG03050  
 C SIG03060  
 C  
 C EXAMPLE INPUT NO. 1  
 C -----  
 C BROADEN ALL URANIUM ISOTOPES AND THORIUM-232 TO 300 KELVIN. FROM SIG03070  
 C 0 TO 100 EV THEN OUTPUT DATA TO 0.1 PER-CENT ACCURACY. FROM 100 EV SIG03080  
 C TO 1 KEV VARY THE ERROR BETWEEN 0.1 AND 1 PER-CENT; ABOVE 1 KEV SIG03090  
 C USE 1 PER-CENT ACCURACY. CALCULATIONS WILL USE 8 DIGIT MINIMUM SIG03100  
 C ENERGY SPACING FOR CALCULATIONS, AND 8 DIGIT VARIABLE F OUTPUT SIG03110  
 C FORMAT (NOTE THAT THIS IS NO LONGER AN INPUT OPTION. SEE COMMENTS SIG03120  
 C ABOVE). SIG03130  
 C SIG03140  
 C THE FOLLOWING NINE CARDS ARE REQUIRED SIG03150  
 C SIG03160  
 C 1 0 3.00000+ 2 SIG03170  
 C 92000 92999 (UPPER LIMIT WILL AUTOMATICALLY RE DEFINED) SIG03180  
 C 90232 (BLANK CARD INDICATES END OF REQUEST LIST) SIG03190  
 C  
 C 0.00000+ 0 1.00000-03 SIG03210  
 C 1.00000+ 2 1.00000-03 SIG03220  
 C 1.00000+ 3 1.00000-02 SIG03230  
 C 1.00000+ 9 1.00000-02 SIG03240  
 C (BLANK CARD INDICATES END OF ERROR LAW) SIG03250  
 C SIG03260  
 C  
 C EXAMPLE INPUT NO. 2  
 C -----  
 C BROADEN ALL DATA TO 300 KELVIN AND DO NOT THEN THE BROADEN DATA. SIG03290  
 C ALL OF THE STANDARD OPTION MAY BE INVOKED MERELY BY SPECIFYING SIG03300  
 C THE KELVIN TEMPERATURE ON THE FIRST CARD. ALL OTHER FIELDS MAY SIG03310  
 C BE LEFT BLANK. SIG03320  
 C SIG03330  
 C THE FOLLOWING THREE CARDS ARE REQUIRED SIG03340  
 C SIG03350  
 C 3.00000+ 2 (MAT RETRIEVAL, 8 DIGIT, 300 KELVIN) SIG03360  
 C (RETRIEVE ALL DATA, TERMINATE REQUEST LIST) SIG03370  
 C (0.0 ALLOWABLE ERROR, TERMINATE ERROR LAW) SIG03380  
 C SIG03390  
 C  
 C \*\*\*\*\* MACHINE DEPENDENT CODING \*\*\*\*\* SIG03400  
 C SIG03410  
 C THE ONLY MACHINE DEPENDENT CODING IN THIS PROGRAM IS IN SIG03420  
 C CONNECTION WITH THE USE OF DOUBLE PRECISION ON SHORT WORD LENGTH SIG03430  
 C COMPUTERS (E.G. IBM 32 BITS/WORD COMPUTERS). AS DISTRIBUTED THIS SIG03440  
 C PROGRAM WILL PERFORM DOUBLE PRECISION ARITHMETIC AND NEED NOT BE SIG03450  
 C MODIFIED FOR USE ON ANY COMPUTER. SIG03460  
 C SIG03470  
 C IF YOU WISH TO OPTIMIZE THIS PROGRAM FOR USE AT YOUR INSTALLATION, SIG03480  
 C IF YOU HAVE A LONGER WORD LENGTH COMPUTER (E.G. CDC 60 BITS/WORD SIG03490  
 C COMPUTERS), YOU MAY ELIMINATE THE DOUBLE PRECISION ARITHMETIC. SIG03500  
 C SIG03510  
 C \*\*\*\*\* MACHINE DEPENDENT CODING \*\*\*\*\* SIG03520

C PROGRAM GROUPIE GR000040  
 C VERSION 76-1 (NOVEMBER 1974) GR000050  
 C VERSION 79-1 (OCTOBER 1979) CDC-7600 AND CRAY-1 VERSION. GR000060  
 C VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION GR000080  
 C VERSION 81-1 (JANUARY 1981) EXTENSION TO 3000 GROUPS GR000090  
 C VERSION 81-2 (MARCH 1981) IMPROVED SPEED GR000100  
 C VERSION 81-3 (AUGUST 1981) BUILT-IN 1/E WEIGHTING SPECTRUM GR000110  
 C VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY GR000120  
 C VERSION 83-1 (JANUARY 1983)\*MAJOR RE-DESIGN. GR000130  
 C \*ELIMINATED COMPUTER DEPENDENT CODING. GR000140  
 C \*NEW, MORE COMPATIBLE I/O UNIT NUMBERS. GR000150  
 C \*NEW MULTI-BAND LIBRARY BINARY FORMAT. GR000160  
 C GR000170  
 C WRITTEN BY DERMOTT E. CULLEN GR000180  
 C NUCLEAR DATA SECTION GR000190  
 C INTERNATIONAL ATOMIC ENERGY AGENCY GR000200  
 C P.O. BOX 200 GR000210  
 C VIENNA, AUSTRIA GR000220  
 C TELEPHONE 23-60-1718 GR000230  
 C GR000240  
 C REPORT UCRL-50400, VOL. 17, PART D (1979) GR000250  
 C LAWRENCE LIVERMORE LABORATORY GR000260  
 C GR000270  
 C AUTHORS MESSAGE GR000280  
 C ----- GR000290  
 C THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION GR000300  
 C FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED GR000310  
 C THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE GR000320  
 C READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY GR000330  
 C THE COMMENTS CONCERNING MACHINE DEPENDENT CODING. GR000340  
 C GR000350  
 C AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER GR000360  
 C INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE GR000370  
 C OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT GR000380  
 C IT WOULD BE APPRECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY GR000390  
 C COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO GR000400  
 C IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF GR000410  
 C THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR GR000420  
 C COMPUTER. GR000430  
 C GR000440  
 C PURPOSE GR000450  
 C ----- GR000460  
 C THIS PROGRAM IS DESIGNED TO CALCULATE ANY COMBINATION OF GR000470  
 C THE FOLLOWING QUANTITIES FROM LINEARLY INTERPOLABLE TABULATED GR000480  
 C CROSS SECTIONS IN THE ENDF/B FORMAT GR000490  
 C GR000500  
 C (1) UNSHIELDED GROUP AVERAGED CROSS SECTIONS GR000510  
 C (2) BONDARENKO SELF-SHIELDED GROUP AVERAGED CROSS SECTIONS GR000520  
 C (3) MULTI-BAND PARAMETERS GR000530  
 C GR000540  
 C IN THE FOLLOWING FOR SIMPLICITY THE ENDF/B TERMINOLOGY--ENDF/B GR000550  
 C TAPE--WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE TAPE, CARDS, GR000560  
 C DISK OR ANY OTHER MEDIUM. GR000570  
 C GR000580  
 C ENDF/B FORMAT GR000590  
 C ----- GR000600  
 C THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS GR000610  
 C OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION GR000620

OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II, III, IV OR V FORMAT).  
 IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B  
 FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS  
 ASSUMED THAT THE MAT, MF AND MT ON EACH CARD IS CORRECT. SEQUENCE  
 NUMBERS (COLUMNS 76-90) ARE IGNORED ON INPUT, BUT WILL BE  
 CORRECTLY OUTPUT ON ALL CARDS. THE FORMAT OF SECTION MF=1, MT=451  
 AND ALL SECTIONS OF MF= 3 MUST BE CORRECT. THE PROGRAM COPIES ALL  
 OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO  
 THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.

ALL FILE 3 CROSS SECTIONS THAT ARE USED BY THIS PROGRAM MUST BE  
 LINEARLY INTERPOLABLE IN ENERGY AND CROSS SECTION (ENDF/B  
 INTERPOLATION LAW 2). FILE 3 BACKGROUND CROSS SECTIONS MAY BE MADE  
 LINEARLY INTERPOLABLE USING PROGRAM LINEAR (UCRL-50400, VOL. 17,  
 PART A). THE RESONANCE CONTRIBUTION MAY BE ADDED TO THE BACKGROUND  
 CROSS SECTIONS USING PROGRAM RECENT (UCRL-50400, VOL. 17, PART B).  
 IF THIS PROGRAM FINDS THAT THE FILE 3 CROSS SECTIONS ARE NOT  
 LINEARLY INTERPOLABLE THIS PROGRAM WILL TERMINATE EXECUTION.

#### CONTENTS OF OUTPUT

IF ENDF/B FORMATTED OUTPUT IS REQUESTED ENTIRE EVALUATIONS ARE  
 OUTPUT, NOT JUST THE MULTI-GROUPED FILE 3 CROSS SECTIONS, E.G.  
 ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO INCLUDED.

#### DOCUMENTATION

THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED  
 BY THE ADDITION OF TWO COMMENT CARDS AT THE END OF EACH HOLLERITH  
 SECTION IN THE FORM

\*\*\*\*\* PROGRAM GROUP I E (83-1) \*\*\*\*\*  
 UNSHIELDED GROUP AVERAGES USING 175 GROUPS

THE ORDER OF ALL SIMILAR COMMENTS (FROM LINEAR, RECENT AND SIGMA1)  
 REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON  
 THE DATA.

THESE COMMENT CARDS ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS.  
 I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT  
 OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF  
 EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451  
 IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF  
 THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF  
 MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO  
 DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND  
 AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT  
 SHOULD BE USED TO CREATE A HOLLERITH SECTION.

#### REACTION INDEX

THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN  
 SECTION MF=1, MT=451 OF EACH EVALUATION.

THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451.  
 THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT  
 REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS  
 NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING

C A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE GRO01230  
 C A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM GRO01240  
 C YOU MAY USE PROGRAM DICTION TO CREATE A CORRECT REACTION INDEX. GRO01250  
 C  
 C SECTION SIZE GRO01260  
 C  
 C SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT GRO01270  
 C TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS GRO01280  
 C SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS. GRO01290  
 C  
 C SELECTION OF DATA GRO01300  
 C  
 C THE PROGRAM SELECTS MATERIALS TO BE PROCESSED BASED EITHER ON GRO01310  
 C MAT (ENDF/B MAT NO.) OR ZA. THE PROGRAM ALLOWS UP TO 100 MAT OR GRO01320  
 C ZA RANGES TO BE SPECIFIED. THE PROGRAM WILL ASSUME THAT THE GRO01330  
 C ENDF/B TAPE IS IN EITHER MAT OR ZA ORDER, WHICHEVER CRITERIA IS GRO01340  
 C USED TO SELECT MATERIALS, AND WILL TERMINATE WHEN A MAT OR ZA GRO01350  
 C IS FOUND THAT IS ABOVE THE RANGE OF ALL REQUESTS. GRO01360  
 C  
 C ENERGY ORDER AND UNITS GRO01370  
 C  
 C ALL ENERGIES (FOR CROSS SECTIONS, WEIGHTING SPECTRUM OR GROUP GRO01380  
 C BOUNDARIES) MUST BE IN UNITS OF EV AND MUST BE IN ASCENDING GRO01390  
 C NUMERICAL ORDER. GRO01400  
 C  
 C ENERGY GRID GRO01410  
 C  
 C ALTHOUGH ALL REACTIONS MUST TO LINEARLY INTERPOLABLE, THEY DO NOT GRO01420  
 C ALL HAVE TO USE THE SAME ENERGY GRID. EACH REACTION CAN BE GIVEN GRO01430  
 C BY AN INDEPENDENT ENERGY GRID. THIS PROGRAM WILL PROCEED FROM GRO01440  
 C THE LOWEST TO HIGHEST ENERGY SELECTING EACH ENERGY INTERVAL OVER GRO01450  
 C WHICH ALL DATA, FOR ANY GIVEN CALCULATION, ARE ALL LINEARLY GRO01460  
 C INTERPOLABLE. GRO01470  
 C  
 C GROUP STRUCTURE GRO01480  
 C  
 C THIS PROGRAM IS DESIGNED TO USE AN ARBITRARY ENERGY GROUP GRO01490  
 C STRUCTURE WHERE THE ENERGIES ARE IN EV AND ARE IN INCREASING GRO01500  
 C ENERGY ORDER. IF ONLY UNSHIELDED AVERAGES ARE CALCULATED THIS GRO01510  
 C PROGRAM CAN HANDLE UP TO 3000 GROUPS. IF SELF-SHIELDED AVERAGES GRO01520  
 C AND/OR MULTI-BAND PARAMETERS ARE CALCULATED THIS PROGRAM CAN GRO01530  
 C HANDLE UP TO 175 GROUPS. GRO01540  
 C  
 C THE USER MAY INPUT AN ARBITRARY GROUP STRUCTURE OR THE USER MAY GRO01550  
 C USE ONE OF THE SEVEN BUILT-IN GROUP STRUCTURES. GRO01560  
 C (1) 175 GROUP (TART STRUCTURE) GRO01570  
 C (2) 50 GROUP (ORNL STRUCTURE) GRO01580  
 C (3) 126 GROUP (ORNL STRUCTURE) GRO01590  
 C (4) 171 GROUP (ORNL STRUCTURE) GRO01600  
 C (5) 620 GROUP (SAND-II STRUCTURE, UP TO 18 MEV) GRO01610  
 C (6) 640 GROUP (SAND-II STRUCTURE, UP TO 20 MEV) GRO01620  
 C (7) 69 GROUP (WIMS STRUCTURE) GRO01630  
 C (8) 68 GROUP (GAM-I STRUCTURE) GRO01640  
 C (9) 99 GROUP (GAM-II STRUCTURE) GRO01650  
 C (10) 54 GROUP (MUFT STRUCTURE) GRO01660  
 C  
 C GROUP AVERAGES GRO01670  
 C  
 C THIS PROGRAM DEFINES GROUP AVERAGED CROSS SECTIONS AS... GRO01680  
 C GRO01690  
 C GRO01700  
 C GRO01710  
 C GRO01720  
 C GRO01730  
 C GRO01740  
 C GRO01750  
 C GRO01760  
 C GRO01770  
 C GRO01780  
 C GRO01790  
 C GRO01800

$$\text{AVERAGE} = \frac{(\text{INTEGRAL E1 TO E2}) (\text{SIGMA}(E) * S(E) * \text{WT}(E) * DE)}{(\text{INTEGRAL E1 TO E2}) (S(E) * \text{WT}(E) * DE)}$$

WHERE...

AVERAGE = GROUP AVERAGED CROSS SECTION  
 E1, E2 = ENERGY LIMITS OF THE GROUP  
 SIGMA(E) = ENERGY DEPENDENT CROSS SECTION FOR ANY GIVEN REACTION  
 S(E) = ENERGY DEPENDENT WEIGHTING SPECTRUM  
 WT(E) = ENERGY DEPENDENT SELF-SHIELDING FACTOR.

#### ENERGY DEPENDENT WEIGHTING SPECTRUM

THE ENERGY DEPENDENT WEIGHTING SPECTRUM IS GIVEN BY AN ARBITRARY TABULATED LINEARLY INTERPOLABLE FUNCTION WHICH CAN BE DESCRIBED BY AN ARBITRARY NUMBER OF POINTS. THIS ALLOWS THE USER TO SPECIFY ANY DESIRED WEIGHTING SPECTRUM TO ANY GIVEN DEGREE OF ACCURACY. REMEMBER THAT THE PROGRAM WILL ASSUME THAT THE SPECTRUM IS LINEARLY INTERPOLABLE BETWEEN TABULATED POINTS. THEREFORE THE USER SHOULD USE ENOUGH POINTS TO INSURE AN ADEQUATE REPRESENTATION OF THE SPECTRUM BETWEEN TABULATED DATA POINTS.

THE PRESENT VERSION OF THE CODE HAS A BUILT IN CONSTANT AND 1/E WEIGHTING SPECTRA.

#### UNSHIELDED GROUP AVERAGES

FOR UNSHIELDED AVERAGES THE SELF-SHIELDING FACTOR (WT(E)) IS SET TO UNITY. IF ONLY UNSHIELDED AVERAGES ARE CALCULATED THIS PROGRAM ALLOWS UP TO 3000 GROUPS. UNSHIELDED AVERAGES ARE CALCULATED FOR EVERY REACTION (EVERY ENDF/B SECTION OF FILE 3).

#### SELF-SHIELDED GROUP AVERAGES

IF SELF-SHIELDED AVERAGES AND/OR MULTI-BAND PARAMETERS ARE CALCULATED THIS PROGRAM ALLOWS UP TO 175 GROUPS. SELF-SHIELDED AVERAGES AND/OR MULTI-BAND PARAMETERS ARE CALCULATED FOR THE TOTAL, ELASTIC, CAPTURE AND FISSION.

FOR THE TOTAL, ELASTIC, CAPTURE AND FISSION THE PROGRAM USES A WEIGHTING FUNCTION THAT IS A PRODUCT OF THE ENERGY DEPENDENT WEIGHTING SPECTRUM TIMES A BONDARENKO TYPE SELF-SHIELDING FACTOR.

$$\text{WT}(E) = S(E) / (\text{TOTAL}(E) + \text{SIGMA0}) ** N$$

WHERE...

S(E) - ENERGY DEPENDENT WEIGHTING SPECTRUM (DEFINED BY TABULATED VALUES AND LINEAR INTERPOLATION BETWEEN TABULATED VALUES).  
 TOTAL(E) - ENERGY DEPENDENT TOTAL CROSS SECTION FOR ONE MATERIAL (DEFINED BY TABULATED VALUES AND LINEAR INTERPOLATION BETWEEN TABULATED VALUES).  
 SIGMA0 - CROSS SECTION TO REPRESENT THE EFFECT OF ALL OTHER MATERIALS AND LEAKAGE (DEFINED WITHIN EACH GROUP TO BE A MULTIPLE OF THE UNSHIELDED TOTAL CROSS SECTION WITHIN THAT GROUP).  
 N - A POSITIVE INTEGER (0, 1, 2 OR 3).

GR001810  
 GR001820  
 GR001830  
 GR001840  
 GR001850  
 GR001860  
 GR001870  
 GR001880  
 GR001890  
 GR001900  
 GR001910  
 GR001920  
 GR001930  
 GR001940  
 GR001950  
 GR001960  
 GR001970  
 GR001980  
 GR001990  
 GR002000  
 GR002010  
 GR002020  
 GR002030  
 GR002040  
 GR002050  
 GR002060  
 GR002070  
 GR002080  
 GR002090  
 GR002100  
 GR002110  
 GR002120  
 GR002130  
 GR002140  
 GR002150  
 GR002160  
 GR002170  
 GR002180  
 GR002190  
 GR002200  
 GR002210  
 GR002220  
 GR002230  
 GR002240  
 GR002250  
 GR002260  
 GR002270  
 GR002280  
 GR002290  
 GR002300  
 GR002310  
 GR002320  
 GR002330  
 GR002340  
 GR002350  
 GR002360  
 GR002370  
 GR002380  
 GR002390

C  
 C THE PROGRAM WILL USE ONE ENERGY DEPENDENT WEIGHTING SPECTRUM S(E) GR002410  
 C AND 25 DIFFERENT BONDARENKO TYPE SELF-SHIELDING FACTORS (25 SIGMAO GR002420  
 C AND N COMBINATIONS) TO DEFINE 25 DIFFERENT AVERAGE CROSS SECTIONS, GR002430  
 C FOR EACH REACTION, WITHIN EACH GROUP. GR002440  
 C GR002450  
 C THE 25 WEIGHTING FUNCTIONS USED ARE.... GR002460  
 C (1) - UNSHIELDED CROSS SECTIONS (N=0) GR002470  
 C (2-22)- PARTIALLY SHIELDED CROSS SECTIONS (N=1, VARIOUS SIGMAO) GR002480  
 C THE VALUES OF SIGMAO THAT ARE USED VARY FROM 1024 TIMES GR002490  
 C THE UNSHIELDED TOTAL CROSS SECTIONS IN STEPS OF 1/2 GR002500  
 C DOWN TO 1/1024 TIMES THE UNSHIELDED TOTAL CROSS SECTION GR002510  
 C (A RANGE OF OVER 1 MILLION, CENTERED ON THE UNSHIELDED GR002520  
 C TOTAL CROSS SECTION WITHIN EACH GROUP). GR002530  
 C (23) - TOTALLY SHIELDED FLUX WEIGHTED CROSS SECTION GR002540  
 C (N=1, SIGMAO=0) GR002550  
 C (24) - TOTALLY SHIELDED CURRENT WEIGHTED CROSS SECTION GR002560  
 C (N=2, SIGMAO=0) GR002570  
 C (25) - TOTALLY SHIELDED COSINE SQUARED WEIGHTED CROSS SECTION GR002580  
 C (N=3, SIGMAO=0) GR002590  
 C GR002600  
 C FOR ALL OTHER REACTIONS (EXCEPT TOTAL, ELASTIC, CAPTURE AND GR002610  
 C FISSION), THE PROGRAM WILL USE THE ENERGY DEPENDENT WEIGHTING GR002620  
 C SPECTRUM S(E) TO DEFINE THE UNSHIELDED (BONDARENKO N=0) GR002630  
 C AVERAGED CROSS SECTION WITHIN EACH GROUP. GR002640  
 C GR002650  
 C RESOLVED RESONANCE REGION GR002660  
 C ----- GR002670  
 C IN THE RESOLVED RESONANCE REGION (ACTUALLY EVERYWHERE BUT IN THE GR002680  
 C UNRESOLVED RESONANCE REGION) THE CROSS SECTIONS OUTPUT BY LINEAR- GR002690  
 C RECENT-SIGMA1 WILL BE ACTUAL ENERGY DEPENDENT CROSS SECTIONS AND GR002700  
 C THE CALCULATIONS BY THIS PROGRAM WILL YIELD ACTUAL SHIELDED AND GR002710  
 C UNSHIELDED CROSS SECTIONS. GR002720  
 C GR002730  
 C UNRESOLVED RESONANCE REGION GR002740  
 C ----- GR002750  
 C IN THE UNRESOLVED RESONANCE REGION PROGRAM RECENT USES THE GR002760  
 C UNRESOLVED RESONANCE PARAMETERS TO CALCULATE INFINITELY DILUTE GR002770  
 C AVERAGE CROSS SECTIONS. THIS PROGRAM WILL MERELY READ THIS GR002780  
 C INFINITELY DILUTE DATA AS IF IT WERE ENERGY DEPENDENT DATA AND GR002790  
 C GROUP AVERAGE IT. AS SUCH THIS PROGRAM WILL PRODUCE THE CORRECT GR002800  
 C UNSHIELDED CROSS SECTION IN THE UNRESOLVED RESONANCE REGION, BUT GR002810  
 C IT WILL NOT PRODUCE THE CORRECT SELF-SHIELDING EFFECTS. GR002820  
 C GR002830  
 C ACCURACY OF RESULTS GR002840  
 C ----- GR002850  
 C ALL INTEGRALS ARE PERFORMED ANALYTICALLY, THEREFORE NO ERROR IS GR002860  
 C INTRODUCED DUE TO THE USE OF TRAPAZOIDAL OR OTHER INTEGRATION GR002870  
 C SCHEME. THE TOTAL ERROR THAT CAN BE ASSIGNED TO THE RESULTING GR002880  
 C AVERAGES IS JUST THAT DUE TO THE ERROR IN THE CROSS SECTIONS GR002890  
 C AND ENERGY DEPENDENT WEIGHTING SPECTRUM. GENERALLY SINCE THE GR002900  
 C THE ENERGY DEPENDENT WEIGHTING SPECTRUM APPEARS IN BOTH THE GR002910  
 C NUMERATOR AND THE DENOMINATOR THE AVERAGES RAPIDLY BECOME GR002920  
 C INSENSITIVE TO THE WEIGHTING SPECTRUM AS MORE GROUPS ARE USED. GR002930  
 C SINCE THE WEIGHTING SPECTRUM IS LOADED IN THE PAGING SYSTEM THE GR002940  
 C USER CAN DESCRIBE THE SPECTRUM TO ANY REQUIRED ACCURACY USING GR002950  
 C ANY NUMBER OF ENERGY VS. SPECTRUM PAIRS. GR002960  
 C GR002970  
 C MULTI-BAND PARAMETERS GR002980

MULTI-BAND PARAMETERS ARE CALCULATED FOR THE TOTAL, ELASTIC, CAPTURE AND FISSION REACTIONS. WITH THE NUMBER OF GROUPS THAT ARE NORMALLY USED (SEE BUILT IN GROUP STRUCTURES) ALL OTHER REACTIONS RESULT IN A NEGLIGIBLE AMOUNT OF SELF-SHIELDING. AS SUCH THEIR EQUIVALENT BAND CROSS SECTION WILL MERELY BE THEIR UNSHIELDED VALUE WITHIN EACH BAND.

FOR ANY GIVEN EVALUATION, WITHIN ANY GIVEN GROUP THIS PROGRAM WILL GENERATE THE MINIMUM NUMBER OF BANDS REQUIRED WITHIN THAT GROUP. AS OUTPUT TO THE COMPUTER READABLE DISK FILE THE BAND PARAMETERS FOR EACH EVALUATION WILL BE FORMATTED TO HAVE THE SAME NUMBER OF BANDS IN ALL GROUPS (WITH ZERO WEIGHT FOR SOME BANDS WITHIN ANY GROUP). THE USER MAY DECIDE TO HAVE OUTPUT EITHER WITH THE MINIMUM NUMBER OF BANDS REQUIRED FOR EACH EVALUATION (E.G. 2 BANDS FOR HYDROGEN AND 4 BANDS FOR U-233) OR THE SAME NUMBER OF BANDS FOR ALL EVALUATIONS (E.G. 4 BANDS FOR BOTH HYDROGEN AND U-233).

FOR 2 OR FEWER BANDS THE PROGRAM USES AN ANALYTIC EXPRESSION TO DEFINE ALL MULTI-BAND PARAMETERS. FOR MORE THAN 2 BANDS THE PROGRAM PERFORMS A NON-LINEAR FIT TO SELECT THE MULTI-BAND PARAMETERS THAT MINIMIZE THE MAXIMUM FRACTIONAL ERROR AT ANY POINT ALONG THE ENTIRE SELF-SHIELDING CURVE. THE NUMBER OF BANDS REQUIRED WITHIN ANY GIVEN GROUP IS DEFINED BY INSURING THAT THE MULTI-BAND PARAMETERS CAN BE USED TO ACCURATELY DEFINE SELF-SHIELDED CROSS SECTIONS ALONG THE ENTIRE SELF-SHIELDING CURVE FROM  $\Sigma_{00} = 0$  TO INFINITY. THE USER MAY DEFINE THE ACCURACY REQUIRED.

#### ENDF/B FORMATTED UNSHIELDED AVERAGES

UNSHIELDED MULTI-GROUP AVERAGED CROSS SECTIONS FOR ALL REACTIONS MAY BE OBTAINED IN THE ENDF/B FORTRAN IN EITHER HISTOGRAM (INTERPOLATION LAW 1) OR LINEARLY INTERPOLABLE (INTERPOLATION LAW 2) FORM. SEE INPUT BELOW FOR DETAILS.

#### MIXTURES OF MATERIALS AND RESONANCE OVERLAP

THE SELF-SHIELDED CROSS SECTIONS FOR THE INDIVIDUAL CONSTITUENTS OF ANY MIXTURE CAN BE CALCULATED BY THIS PROGRAM BY REALIZING THAT THIS PROGRAM ESSENTIALLY ONLY USES THE TOTAL CROSS SECTION AS A WEIGHTING FUNCTION TO ACCOUNT FOR SELF-SHIELDING EFFECTS. FOR A MIXTURE IT IS THEREFORE ONLY NECESSARY TO USE THE TOTAL CROSS SECTION FOR THE MIXTURE IN PLACE OF THE ACTUAL TOTAL CROSS SECTION FOR EACH CONSTITUENT AND TO RUN THIS PROGRAM. THIS CAN BE DONE BY FIRST RUNNING PROGRAM MIXER TO CALCULATE THE ENERGY DEPENDENT TOTAL CROSS SECTION FOR ANY COMPOSITE MIXTURE. NEXT, SUBSTITUTE THIS COMPOSITE TOTAL CROSS SECTION FOR THE ACTUAL TOTAL CROSS SECTION OF EACH CONSTITUENT (IN EACH ENDF/B FORMATTED EVALUATION). FINALLY, RUN THIS PROGRAM TO CALCULATE THE SELF-SHIELDED CROSS SECTION FOR EACH CONSTITUENT, PROPERLY ACCOUNTING FOR RESONANCE OVERLAP BETWEEN THE RESONANCES OF ALL OF THE CONSTITUENTS OF THE MIXTURE. DURING THE SAME RUN THESE SELF-SHIELDED CROSS SECTIONS CAN IN TURN BE USED TO CALCULATE FULLY CORRELATED MULT-BAND

#### INPUT FILES

#### UNIT DESCRIPTION

GRO02990  
GRO03000  
GRO03010  
GRO03020  
GRO03030  
GRO03040  
GRO03050  
GRO03060  
GRO03070  
GRO03080  
GRO03090  
GRO03100  
GRO03110  
GRO03120  
GRO03130  
GRO03140  
GRO03150  
GRO03160  
GRO03170  
GRO03180  
GRO03190  
GRO03200  
GRO03210  
GRO03220  
GRO03230  
GRO03240  
GRO03250  
GRO03260  
GRO03270  
GRO03280  
GRO03290  
GRO03300  
GRO03310  
GRO03320  
GRO03330  
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GRO03390  
GRO03400  
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GRO03420  
GRO03430  
GRO03440  
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GRO03460  
GRO03470  
GRO03480  
GRO03490  
GRO03500  
GRO03510  
GRO03520  
GRO03530  
GRO03540  
GRO03550  
GRO03560  
GRO03570

C				GR003580
C	5	INPUT DATA (BCD - 80 CHARACTERS/RECORD)		GR003590
C	10	ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)		GR003600
C				GR003610
C				GR003620
C				GR003630
C				GR003640
C				GR003650

OUTPUT FILES

C	UNIT	DESCRIPTION		
C	6	OUTPUT REPORT (BCD - 80 CHARACTERS/RECORD)		GR003660
C	11	MULTI-GROUP ENDF/B DATA - OPTIONAL (BCD - 80 CHARACTERS/RECORD)		GR003670
C	1	MULTI-BAND PARAMETERS - COMPUTER READABLE - OPTIONAL (BINARY - 4378 WORDS/RECORD)		GR003680
C	2	SELF-SHIELDED CROSS SECTION LISTING - OPTIONAL (BCD - 120 CHARACTERS/RECORD)		GR003700
C	3	MULTI-BAND PARAMETER LISTING - OPTIONAL (BCD - 120 CHARACTERS/RECORD)		GR003710
C	4	UNSHIELDED CROSS SECTION LISTING - OPTION (BCD - 120 CHARACTERS/RECORD)		GR003720
C				GR003730
C				GR003740
C				GR003750
C				GR003760
C				GR003770
C				GR003780

SCRATCH FILES

C	UNIT	FILENAME	DESCRIPTION	
C	8		ENERGY DEPENDENT WEIGHTING SPECTRUM (BINARY - 2004 WORDS/BLOCK)	GR003800
C	9		TOTAL CROSS SECTION (BINARY - 2004 WORDS/BLOCK)	GR003810
C	12		ELASTIC CROSS SECTION (BINARY - 2004 WORDS/BLOCK)	GR003820
C	13		FISSION CROSS SECTION (BINARY - 2004 WORDS/BLOCK)	GR003830
C	14		CAPTURE CROSS SECTION (BINARY - 2004 WORDS/BLOCK)	GR003840
C				GR003850
C				GR003860
C				GR003870
C				GR003880
C				GR003890
C				GR003900
C				GR003910
C				GR003920
C				GR003930
C				GR003940
C				GR003950
C				GR003960

INPUT CARDS

C	CARD	COLS.	FORMAT	DESCRIPTION	
C	1	1-11	I11	SELECTION CRITERIA (0=MAT, 1=ZA)	GR003970
C	1	12-22	I11	NUMBER OF GROUPS.	GR003980
C				= .GT.0 - ARBITRARY GROUP BOUNDARIES ARE READ	GR003990
C				FROM INPUT FILE (N GROUPS REQUIRE	GR004000
C				N+1 GROUP BOUNDARIES). CURRENT	GR004010
C				PROGRAM MAXIMUM IS 175 GROUPS (IF	GR004020
C				SHIELDED OR MULTI-BAND PARAMETERS)	GR004030
C				OR 3000 GROUPS (IF ONLY UNSHIELDED	GR004040
C				AVERAGE CROSS SECTIONS CALCULATED).	GR004050
C				BUILT-IN OPTIONS INCLUDE...	GR004060
C				= 0 - TART 175 GROUPS SEE	GR004070
C				= -1 - ORNL 50 GROUPS BLOCK	GR004080
C				= -2 - ORNL 126 GROUPS DATA	GR004090
C				= -3 - ORNL 171 GROUPS	GR004100
C				= -4 - SAND-II 620 GROUPS UP TO 18 MEV	GR004110
C				= -5 - SAND-II 640 GROUPS UP TO 20 MEV	GR004120
C				= -6 - WIMS 69 GROUPS	GR004130
C				= -7 - GAM-I 68 GROUPS	GR004140
C				= -8 - GAM-II 99 GROUPS	GR004150
C				= -9 - MUFT 54 GROUPS	GR004160



1	23-33	I11	MULTI-BAND SELECTOR	GR004170
			= 0 - NO MULTI-BAND CALCULATIONS	GR004180
			= 1 - 2 BAND. CONSERVE AV(TOT), AV(1/TOT) AND AV(1/TOT**2)	GR004190 GR004200
			= 2 - 2 BAND. CONSERVE AV(TOT), AV(1/TOT) AND AV(1/(TOT+SIGMAO)) WHERE SIGMAO = AV(TOT) IN EACH GROUP	GR004210 GR004220 GR004230
			= 3-5- MULTI-BAND FIT. CONSERVE AV(TOT) AND MINIMIZE FRACTIONAL ERROR FOR ENTIRE SELF-SHIELDING CURVE (SIGMAO = 0 TO INFINITY)	GR004240 GR004250 GR004260 GR004270
			IF THE SELECTOR IS POSITIVE (1 TO 5) THE MINIMUM NUMBER OF BANDS WILL BE OUTPUT FOR EACH ISOTOPE INDEPENDENTLY. IF THE SELECTOR IS NEGATIVE (-1 TO -5) THE SAME NUMBER OF BANDS (ABS(SELECTOR)) WILL BE OUTPUT FOR ALL ISOTOPES.	GR004280 GR004290 GR004300 GR004310 GR004320 GR004330
1	34-44	I11	NUMBER OF POINTS USED TO DESCRIBE ENERGY DEPENDENT WEIGHTING SPECTRUM S(E).	GR004340 GR004350
			= -1 - 1/E WEIGHTING SPECTRUM.	GR004360
			= 0 OR 1- ENERGY INDEPENDENT (SO CALLED FLAT) WEIGHTING SPECTRUM. NO DATA READ FROM INPUT FILE.	GR004370 GR004380 GR004390
			= .GT.1 - READ THIS MANY POINTS FROM INPUT TO DESCRIBE WEIGHTING SPECTRUM. NO LIMIT TO THE NUMBER OF POINTS USED TO DESCRIBE WEIGHTING.	GR004400 GR004410 GR004420 GR004430
1	45-55	E11.4	MULTI-BAND CONVERGENCE CRITERIA.	GR004440
			ONLY USED FOR 3 OR MORE BANDS. THE NUMBER OF BANDS IN EACH GROUPS IS SELECTED TO INSURE THAT THE ENTIRE SELF-SHIELDING CURVE CAN BE REPRODUCED TO WITHIN THIS FRACTIONAL ERROR.	GR004450 GR004460 GR004470 GR004480
			= .LT. 0.0001 - USE STANDARD 0.001 (0.1 PER-CENT)	GR004490 GR004500
			= .GE. 0.0001 - USE AS CONVERGENCE CRITERIA	GR004510
1	56-66	I11	CONSTANT CROSS SECTION IN ALL BANDS SELECTOR.	GR004520
			THIS OPTION IS ONLY USED IF ONE WISHES TO DETERMINE THE IMPORTANCE OF USING MULTI-BAND DATA COMPARED TO MULTI-GROUP DATA. THIS CAN BE ACCOMPLISHED BY RUNNING THE SAME PROBLEM USING MULTI-BAND PARAMETERS AND THEN RE-RUN USING SELF-SHIELDED MULTI-GROUP DATA.	GR004530 GR004540 GR004550 GR004560 GR004570 GR004580
			= 1-25 - USE THE SAME SELF-SHIELDED CROSS IN ALL BANDS. THE INDEX SELECTS ONE OF THE 25 CROSS SECTIONS GENERATED IN EACH GROUP (SEE ABOVE FOR DEFINITION OF 25 WEIGHTING FUNCTIONS FOR AVERAGES).	GR004590 GR004600 GR004610 GR004620 GR004630 GR004640
			= NOT 1-25 - GENERATE NORMAL MULTI-BAND PARAMETERS	GR004650 GR004660 GR004670
			THE SECOND INPUT CARD IS USED TO SELECT ALL DESIRED OUTPUT MODES. EACH OUTPUT DEVICE MAY BE TURNED OFF (0) OR ON (1). THEREFORE THEREFORE EACH OF THE FOLLOWING INPUT PARAMETERS MAY BE EITHER ZERO TO INDICATE NO OUTPUT OR NON-ZERO TO INDICATE OUTPUT.	GR004680 GR004690 GR004700 GR004710 GR004720
2	1-11	I11	* SELF-SHIELDED CROSS SECTION LISTING	GR004730
2	12-22	I11	MULTI-BAND PARAMETER LISTING	GR004740
2	23-33	I11	MULTI-BAND PARAMETERS COMPUTER READABLE	GR004750

C	2	34-44	I11	UNSHIELDED CROSS SECTIONS IN ENDF/B FORMAT	GR004760
C				= 1 - HISTOGRAM FORMAT (INTERPOLATION LAW 1)	GR004770
C				= 2 - LINEAR-LINEAR (INTERPOLATION LAW 2)	GR004780
C	2	45-55	I11	UNSHIELDED CROSS SECTIONS LISTING	GR004790
C					GR004800
C	3	1-80	20A4	LIBRARY IDENTIFICATION. ANY TEXT THAT THE	GR004810
C				USER WISHES TO IDENTIFY THE MULTI-BAND	GR004820
C				PARAMETERS. THIS LIBRARY IDENTIFICATION IS	GR004830
C				WRITTEN INTO THE COMPUTER READABLE MULTI-BAND	GR004840
C				DATA FILE.	GR004850
C					GR004860
C	4-N	1-11	I11	LOWER MAT OR ZA LIMIT	GR004870
C		12-22	I11	UPPER MAT OR ZA LIMIT	GR004880
C				UP TO 100 MAT OR ZA RANGES MAY BE SPECIFIED,	GR004890
C				ONE RANGE PER CARD. THE LIST OF RANGES IS	GR004900
C				TERMINATED BY A BLANK CARD. IF THE UPPER	GR004910
C				LIMIT IS LESS THAN THE LOWER LIMIT THE UPPER	GR004920
C				IS SET EQUAL TO THE LOWER LIMIT. IF THE FIRST	GR004930
C				REQUEST CARD IS BLANK IT WILL TERMINATE THE	GR004940
C				LIST OF RANGES AND CAUSE ALL DATA TO BE	GR004950
C				RETRIEVED (SEE EXAMPLE INPUT).	GR004960
C					GR004970
C	VARY	1-66	6E11.4	ENERGY GROUP BOUNDARIES. ONLY REQUIRED IF	GR004980
C				THE NUMBER OF GROUPS INDICATED ON THE FIRST	GR004990
C				INPUT CARD IS POSITIVE. ALL ENERGIES MUST	GR005000
C				BE IN ASCENDING ENERGY IN EV. THE PRESENT	GR005010
C				LIMITS ARE 1 TO 175 GROUPS (IF SHIELDED	GR005020
C				OR MULTI-BAND PARAMETERS ARE CALCULATED).	GR005030
C				OR 1 TO 3000 GROUPS (IF ONLY UNSHIELDED	GR005040
C				AVERAGE CROSS SECTIONS ARE CALCULATED). FOR	GR005050
C				N GROUPS N+1 BOUNDARIES WILL BE READ FROM	GR005060
C				THE INPUT FILE, E.G. IF THE FIRST INPUT CARD	GR005070
C				INDICATES 20 GROUPS. 21 ENERGY BOUNDARIES	GR005080
C				WILL BE READ FROM THE INPUT FILE.	GR005090
C					GR005100
C	VARY	1-66	6E11.4	ENERGY DEPENDENT WEIGHTING SPECTRUM. ONLY	GR005110
C				REQUIRED IF THE NUMBER OF POINTS INDICATED	GR005120
C				ON FIRST CARD IS MORE THAN ONE. DATA IS	GR005130
C				GIVEN IN (ENERGY, WEIGHT) PAIRS, UP TO 3	GR005140
C				PAIRS PER CARD, USING ANY NUMBER OF CARDS	GR005150
C				REQUIRED. ENERGIES MUST BE IN ASCENDING	GR005160
C				ORDER IN EV. THE SPECTRUM VALUES MUST BE	GR005170
C				NON-NEGATIVE. THE ENERGY RANGE OF SPECTRUM	GR005180
C				MUST AT LEAST SPAN THE ENERGY RANGE OF THE	GR005190
C				ENERGY GROUPS. SINCE SPECTRUM IS STORED IN	GR005200
C				PAGING SYSTEM THERE IS NO LIMIT TO NUMBER	GR005210
C				OF POINTS THAT CAN BE USED TO DESCRIBE THE	GR005220
C				WEIGHTING SPECTRUM.	GR005230
C					GR005240
C					GR005250
C					GR005260
C					GR005270
C					GR005280
C					GR005290
C					GR005300
C					GR005310
C					GR005320
C					GR005330
C					GR005340

EXAMPLE INPUT NO. 1

REQUEST DATA BY MAT AND PROCESS ALL DATA (ALL MAT BETWEEN 1 AND 9999). USE THE TART 175 GROUP STRUCTURE, GENERATE 3 BAND PARAMETERS (THE FOR ALL ISOTOPES) TO 0.1 PER-CENT ACCURACY IN THE SELF-SHIELDING CURVE. OUTPUT ALL LISTING, COMPUTER READABLE AND ENDF/B FORMAT GROUP AVERAGES. THE FOLLOWING FIVE INPUT CARDS ARE REQUIRED.

0 0 -3 0 1.00000-03 0

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C          1          1          1          1          1
C TART 175 GROUP, 3 BAND LIBRARY TO -0.1 PER-CENT ACCURACY
C          1          9999
C          (BLANK CARD TERMINATES REQUEST LIST)
C
C  EXAMPLE INPUT NO. 2
C -----
C  PROCESS ALL DATA. USE 1/V WEIGHTING IN ORDER TO CALCULATE
C  UNSHIELDED ONE GROUP CROSS SECTIONS OVER THE ENERGY RANGE 0.5 EV
C  TO 1 MEV (NOTE THAT THE RESULTS ARE SIMPLY PROPORTIONAL TO THE
C  RESONANCE INTEGRAL FOR EACH REACTION). OUTPUT UNSHIELDED LISTING.
C  THE FOLLOWING FIVE INPUT CARDS ARE REQUIRED.
C
C          0          0          1          -1          0
C          0          0          0          0          1
C RESONANCE INTEGRAL CALCULATION (FROM 0.5 EV TO 1 MEV)
C          (RETRIEVE ALL DATA, TERMINATE REQUEST LIST)
C 5.00000-01 1.00000+06
C
C***** MACHINE DEPENDENT CODING *****
C
C  MULTI-BAND CALCULATION
C -----
C  THERE IS MACHINE DEPENDENT CODING IN SUBROUTINE READIN AND
C  AROUND THE DUMMY SUBROUTINE ZXSSQ BECAUSE THE NON-LINEAR
C  SYSTEM SOLVER ZXSSQ IS A PROPRIETARY PIECE OF SOFTWARE WHICH
C  CANNOT BE DISTRIBUTED WITH THIS PROGRAM. THE NON-LINEAR SYSTEM
C  SOLVER IS ONLY USED TO CALCULATE MULTI-BAND PARAMETERS WITH
C  THREE OR MORE BANDS. THEREFORE THIS VERSION OF THE PROGRAM
C  WILL ONLY DO MULTI-BAND CALCULATIONS WITH UP TO TWO BANDS. IF
C  YOU HAVE ZXSSQ AVAILABLE REMOVE ALL ERROR MESSAGE AND STOPS
C  FROM SUBROUTINE ZXSSQ AND ADD TO THIS PROGRAM. FROM THIS PROGRAM
C  REMOVE THE DUMMY SUBROUTINE ZXSSQ AND THE RESTRICTION ON THE
C  NUMBER OF BANDS IN SUBROUTINE READIN (THE VARIABLE MBAND).
C  THIS WILL ALLOW YOU TO DO CALCULATIONS WITH UP TO FIVE BANDS
C  (MORE THAN IS REQUIRED IN ANY CASE NORMALLY ENCOUNTERED).
C
C  DOUBLE PRECISION CALCULATIONS
C -----
C  THERE IS ALSO MACHINE DEPENDENT CODING IN SUBROUTINE GROUPN TO
C  USE DOUBLE PRECISION ARITHMETIC ON SHORT WORD LENGTH MACHINES
C  (E.G. IBM 32 BITS/WORD MACHINES) FOR THE SELF-SHIELDING
C  CALCULATIONS. AS DISTRIBUTED THIS DOUBLE PRECISION ARITHMETIC
C  WILL WORK ON ANY MACHINE. HOWEVER IF YOU HAVE A LONGER WORD
C  LENGTH MACHINE (E.G. CDC 60 BITS/WORD MACHINE) YOU MAY OPTIMIZE
C  THIS PROGRAM FOR USE ON YOUR MACHINE BY ELIMINATING THE USE
C  OF DOUBLE PRECISION ARITHMETIC IN SUBROUTINE GROUPN.
C
C  SCRATCH I/O
C -----
C  AS DISTRIBUTED THIS PROGRAM WILL PERFORM NORMAL FORTRAN
C  BINARY I/O AND NEED NOT BE MODIFIED FOR USE ON ANY COMPUTER.
C  HOWEVER IF YOU WISH TO OPTIMIZE THIS PROGRAM FOR USE AT YOUR
C  INSTALLATION YOU MAY REPLACE THE BINARY I/O READ/WRITE IN
C  SUBROUTINES IRLCK AND ORLCK BY THE MOST EFFICIENT TYPE OF
C  I/O FOR YOUR COMPUTER.
C
C***** MACHINE DEPENDENT CODING *****

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GRO05350  
 GRO05360  
 GRO05370  
 GRO05380  
 GRO05390  
 GRO05400  
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 GRO05900  
 GRO05910  
 GRO05920

		PAGE 0001
C		EVA00030
C	PROGRAM EVALPLOT	EVA00040
C	VERSION 75-1 (AUGUST 1975)	EVA00050
C	VERSION 76-1 (JULY 1976)	EVA00060
C	VERSION 77-1 (APRIL 1977)	EVA00070
C	VERSION 78-1 (JULY 1978)	EVA00080
C	VERSION 79-1 (FEBRUARY 1979)	EVA00090
C	VERSION 80-1 (JULY 1980) IBM VERSION	EVA00100
C	VERSION 80-2 (DECEMBER 1980)	EVA00110
C	VERSION 81-1 (MARCH 1981)	EVA00120
C	VERSION 81-2 (AUGUST 1981) IMPROVED ZOOM CAPABILITY	EVA00130
C	VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY	EVA00140
C	VERSION 83-1 (JANUARY 1983) ELIMINATED COMPUTER DEPENDENT CODING.	EVA00150
C		EVA00160
C	REPORT UCRL-50400, VOL. 17, PART E (1979)	EVA00170
C	LAWRENCE LIVERMORE LABORATORY	EVA00180
C		EVA00190
C	WRITTEN BY DERMOTT E. CULLEN	EVA00200
C	NUCLEAR DATA SECTION	EVA00210
C	INTERNATIONAL ATOMIC ENERGY AGENCY	EVA00220
C	P.O. BOX 200	EVA00230
C	VIENNA, AUSTRIA	EVA00240
C	TELEPHONE 23-60-1718	EVA00250
C		EVA00260
C	AUTHORS MESSAGE	EVA00270
C		EVA00280
C	THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION	EVA00290
C	FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED	EVA00300
C	THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE	EVA00310
C	READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY	EVA00320
C	THE COMMENTS CONCERNING MACHINE DEPENDENT CODING.	EVA00330
C		EVA00340
C	AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER	EVA00350
C	INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE	EVA00360
C	OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT	EVA00370
C	IT WOULD BE APPRECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY	EVA00380
C	COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO	EVA00390
C	IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF	EVA00400
C	THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR	EVA00410
C	COMPUTER.	EVA00420
C		EVA00430
C	PURPOSE	EVA00440
C		EVA00450
C	THIS PROGRAM IS DESIGNED TO READ EVALUATED DATA FROM THE ENDF/B	EVA00460
C	FORMAT AND TO PLOT THE DATA. THE USER MAY SELECT CROSS SECTIONS,	EVA00470
C	PARAMETERS (E.G. NU-BAR, MU-BAR, ETC.), ANGULAR DISTRIBUTIONS	EVA00480
C	AND/OR ENERGY DISTRIBUTIONS TO BE PLOTTED.	EVA00490
C		EVA00500
C	IN THE FOLLOWING FOR SIMPLICITY THE ENDF/B TERMINOLOGY---ENDF/B	EVA00510
C	TAPE---WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE TAPE, CARDS,	EVA00520
C	DISK OR ANY OTHER MEDIUM.	EVA00530
C		EVA00540
C	PROGRAM IDENTIFICATION	EVA00550
C		EVA00560
C	AS DISTRIBUTED THE FIRST FRAME OF PLOTTED OUTPUT WILL DOCUMENT	EVA00570
C	THE PROGRAM NAME, VERSION AND INSTALLATION. THIS INFORMATION IS	EVA00580
C	STORED AS DATA IN THE ARRAY VERSES NEAR THE BEGINNING OF	EVA00590
C	SUBROUTINE SETPLT. IF YOU WISH TO CUSTOMIZE THE OUTPUT TO IDENTIFY	EVA00600
C	YOUR INSTALLATION CHANGE THE LAST TWO LINES OF THE ARRAY VERSES.	EVA00610

ENDF/B FORMAT

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

IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS ASSUMED THAT THE MAT, MF AND MT ON EACH CARD IS CORRECT. SEQUENCE NUMBERS (COLUMNS 76-80) ARE IGNORED. FORMAT OF SECTION MT=452, 455 OF MF=1, AND ALL SECTIONS OF MF=3, 4 AND 5 MUST BE CORRECT. ALL OTHER SECTION OF DATA ARE SKIPPED AND AS SUCH THE OPERATION OF THIS PROGRAM IS INSENSITIVE TO THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.

ALL DATA THAT IS USED BY THIS PROGRAM SHOULD BE LINEARLY INTERPOLABLE (ENDF/B INTERPOLATION LAW 2). IF THIS PROGRAM FINDS ANY DATA THAT IS NOT LINEARLY INTERPOLABLE IT WILL PRINT AN ERROR MESSAGE, BUT WILL STILL PLOT THE DATA AS IF IT WERE LINEARLY INTERPOLABLE. THE ONLY ERROR THAT WILL RESULT IN THE PLOT WILL BE IN THE CURVE FOLLOWED BETWEEN TABULATED POINTS. PROGRAM LINEAR (UCRL-50400, VOL. 17, PART A) MAY BE USED TO CONVERT CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM. PROGRAM LEGEND CAN BE USED FOR ANGULAR DISTRIBUTIONS AND PROGRAM ENERGY CAN BE USED FOR SECONDARY ENERGY DISTRIBUTIONS.

REACTION INDEX

THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN SECTION MF=1, MT=451 OF EACH EVALUATION.

SECTION SIZE

SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.

SELECTION OF DATA

IN THE BATCH MODE THE FIRST INPUT CARD SPECIFIES A ZA RANGE TO PLOT. FOR ANY ZA WITHIN THE RANGE SPECIFIED ON THE FIRST CARD PLOTS OF SPECIFIC ENERGY RANGES, AND TYPES OF DATA MAY BE REQUESTED.

IN THE INTERACTIVE MODE THE USER MUST SPECIFY A SPECIFIC PLOT OF OF A ZA, TYPE OF DATA AND ENERGY RANGE. EACH COMMAND IS EXECUTED IN TURN.

CATEGORIES OF DATA

CROSS SECTIONS ARE DIVIDED INTO SIX CATEGORIES

- (1) TOTAL, ELASTIC, CAPTURE, FISSION AND TOTAL INELASTIC
- (2) TOTAL INELASTIC, INELASTIC DISCRETE LEVELS AND CONTINUUM
- (3) (N,2N), (N,3N) AND (N,N' CHARGED PARTICLE)
- (4) (N,CHARGED PARTICLE)
- (5) PARTICLE PRODUCTION (PROTON, DEUTERON, ETC.) AND DAMAGE
- (6) PARAMETERS NU-BAR, NU-BAR, XI AND GAMMA

EVA00620  
EVA00630  
EVA00640  
EVA00650  
EVA00660  
EVA00670  
EVA00680  
EVA00690  
EVA00700  
EVA00710  
EVA00720  
EVA00730  
EVA00740  
EVA00750  
EVA00760  
EVA00770  
EVA00780  
EVA00790  
EVA00800  
EVA00810  
EVA00820  
EVA00830  
EVA00840  
EVA00850  
EVA00860  
EVA00870  
EVA00880  
EVA00890  
EVA00900  
EVA00910  
EVA00920  
EVA00930  
EVA00940  
EVA00950  
EVA00960  
EVA00970  
EVA00980  
EVA00990  
EVA01000  
EVA01010  
EVA01020  
EVA01030  
EVA01040  
EVA01050  
EVA01060  
EVA01070  
EVA01080  
EVA01090  
EVA01100  
EVA01110  
EVA01120  
EVA01130  
EVA01140  
EVA01150  
EVA01160  
EVA01170  
EVA01180  
EVA01190  
EVA01200

C  
 C MASTER PLOTS EVA01210  
 C EVA01220  
 C EVA01230  
 C IF THE USER REQUESTS MASTER PLOTS, A PLOT OF EACH CATEGORY OF DATA EVA01240  
 C IS FIRST PLOTTED OVER THE ENERGY RANGE FROM 0.01 EV (OR USER EVA01250  
 C SPECIFIED LOWER ENERGY LIMIT) OR THE LOWEST THRESHOLD (WHICHEVER EVA01260  
 C IS HIGHER) UP TO THE HIGHEST TABULATED ENERGY. EVA01270  
 C EVA01280  
 C ZOOM COMMANDS EVA01290  
 C EVA01300  
 C IN ADDITION TO THE MASTER PLOTS THE USER MAY REQUEST MORE DETAILED EVA01310  
 C PLOTS OF ANY CATEGORY OF DATA, OVER ANY ENERGY RANGE BY USING ZOOM EVA01320  
 C COMMANDS. ZOOM COMMANDS SPECIFY EVA01330  
 C (1) A ZA RANGE EVA01340  
 C (2) ONE OF THE SIX CATEGORIES OUTLINED ABOVE EVA01350  
 C (3) AN ENERGY RANGE EVA01360  
 C (4) A CROSS SECTION RANGE (OPTIONAL) EVA01370  
 C (5) ONE OF THREE PLOTTING MODES (SEE UCKL30400, VOL. 17, PART E) EVA01380  
 C EVA01390  
 C EVA01400  
 C IDENTIFICATION OF DATA EVA01410  
 C EVA01420  
 C FOR CROSS SECTIONS CURVES FOR UP TO 12 REACTIONS MAY APPEAR ON A EVA01430  
 C SINGLE PLOT. REACTION REACTION IS IDENTIFIED BY A DIFFERENT LINE EVA01440  
 C TYPE AND A NAME. FOR INELASTIC DATA LEVELS ARE IDENTIFIED BY EVA01450  
 C LEVEL ENERGY (IN NO CASE IS ENDF/B JARGON USED, SUCH AS MT=56). EVA01460  
 C FOR ANGULAR OR ENERGY DISTRIBUTIONS EACH PLOT WILL ONLY CONTAIN EVA01470  
 C DATA FOR A SINGLE REACTION, BUT MAY CONTAIN CURVES FOR UP TO 5 EVA01480  
 C INCIDENT NEUTRON ENERGIES. REACTIONS ARE IDENTIFIED BY NAME AND EVA01490  
 C EACH CURVE IS IDENTIFIED BY INCIDENT NEUTRON ENERGY. FOR ANY TYPE EVA01500  
 C OF DATA IF THERE ARE MORE CURVES TO PLOT THEN WILL FIT ON A SINGLE EVA01510  
 C PLOT, THEY WILL BE DIVIDED INTO A SERIES OF PLOTS. EVA01520  
 C EVA01530  
 C BATCH MODE EVA01540  
 C EVA01550  
 C IN THE BATCH MODE THIS PROGRAM WILL READ ALL ZOOM COMMAND AT THE EVA01560  
 C BEGINNING OF THE PROGRAM AND PROCEED TO EXECUTE ALL COMMANDS EVA01570  
 C WITHOUT FURTHER INSTRUCTIONS FROM THE USER. IN THE BATCH MODE THE EVA01580  
 C ZA RANGE SPECIFIED ON THE FIRST INPUT CARD IS USED TO DEFINE WHICHEVA01590  
 C EVALUATIONS TO PLOT. PLOTTING MAY BE SPECIFIED WITH OR WITHOUT EVA01600  
 C MASTER PLOTS, AND WITH OR WITHOUT ZOOM COMMANDS. ZOOM COMMANDS MAY EVA01610  
 C BE INPUT IN ANY ORDER, I.E., THEY NEED NOT BE IN THE ORDER IN EVA01620  
 C WHICH THEY WILL BE EXECUTED. IF MASTER PLOTS ARE REQUESTED DATA EVA01630  
 C FOR EACH OF THE DEFINED SIX CATEGORIES WILL IN TURN BE PLOTTED. EVA01640  
 C IF ONE OR MORE ZOOM COMMANDS ARE SPECIFIED FOR A GIVEN CATEGORY OF EVA01650  
 C DATA, THE ZOOM PLOTS WILL IMMEDIATELY FOLLOW THE MASTER PLOT OF EVA01660  
 C THE SAME CATEGORY OF DATA. IF MASTER PLOTS ARE NOT REQUESTED ONLY EVA01670  
 C ZOOM PLOTS WILL BE PRODUCED. IN ALL CASES PLOTS WILL BE PRODUCED EVA01680  
 C IN THE ORDER IN WHICH THE EVALUATIONS APPEAR ON THE TAPE, AND EVA01690  
 C WITHIN EACH ZA PLOTS WILL BE PRODUCED IN CATEGORY 1 THROUGH 6 EVA01700  
 C ORDER. EVA01710  
 C EVA01720  
 C INTERACTIVE MODE EVA01730  
 C EVA01740  
 C IN THE INTERACTIVE MODE THIS PROGRAM WILL READ ONE ZOOM COMMAND AT EVA01750  
 C A TIME AND EXECUTE THE ZOOM COMMAND. IN THE INTERACTIVE MODE THE EVA01760  
 C ZA RANGE SPECIFIED ON THE FIRST INPUT CARD IS IGNORED AND THE NEXT EVA01770  
 C EVALUATION TO BE PLOTTED IS DEFINED ONLY BY THE LOWER ZA LIMIT EVA01780  
 C SPECIFIED WITH THE ZOOM COMMAND. EACH ZOOM COMMAND CAN ONLY EVA01790

SPECIFY A SINGLE ZA, DEFINED BY THE LOWER ZA LIMIT OF THE ZOOM COMMAND, AND THE UPPER ZA LIMIT OF THE ZOOM COMMAND IS IGNORED. IN THE INTERACTIVE MODE THERE ARE NO MASTER PLOTS AND ONLY ZOOM COMMANDS ARE EXECUTED. ZOOM COMMANDS MUST BE INPUT IN THE ORDER THAT THEY ARE TO BE EXECUTED AND THE END OF A RUN IS INDICATED BY THE END OF THE LIST OF ZOOM COMMANDS (I.E., A ZOOM COMMAND WITH A LOWER ZA LIMIT OF ZERO). AFTER READING A ZOOM COMMAND THE PROGRAM WILL SEARCH TO FIND THE REQUESTED ZA, IMMEDIATELY GENERATE THE REQUESTED ZOOM PLOT AND THEN PAUSE. WHEN THE PROGRAM PROCEEDS FROM THE PAUSE IT WILL TRY TO READ THE NEXT ZOOM COMMAND. HOW TO PAUSE IF MACHINE DEPENDENT AND A STANDARD INTERFACE HAS BEEN BUILT FOR THIS PROGRAM. IN THE INTERACTIVE MODE, AFTER GENERATING A PLOT THIS PROGRAM WILL CALL SUBROUTINE WAITER, AS DISTRIBUTED WITH THIS PROGRAM SUBROUTINE WAITER WILL MERELY IMMEDIATELY RETURN. IF THE USER WISHES TO REALLY IMPLEMENT THE INTERACTIVE MODE OF THIS PROGRAM INSERT THE CODING IN SUBROUTINE WAITER TO PAUSE WHEN SUBROUTINE WAITER IS CALLED.

#### INPUT FILES

##### UNIT DESCRIPTION

5 INPUT CARDS (BCD - 80 CHARACTERS/RECORD)  
10 ENH/B DATA (BCD - 80 CHARACTERS/RECORD)

#### OUTPUT FILES

##### UNIT DESCRIPTION

6 OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)  
13 PLOTTING TAPE

#### SCRATCH FILES

##### UNIT DESCRIPTION

12 SCRATCH FILE (BINARY -10020 WORDS/RECORD)

#### INPUT CARDS

CARD	COLS.	FORMAT	DESCRIPTION
1	1-5	I5	NO LONGER USED
	6-10	I5	PLOT FILE 3 (0=NO, 1=YES)
	11-15	I5	PLOT FILE 4 (0=NO, 1=YES)
	16-20	I5	PLOT FILE 5 (0=NO, 1=YES)
	21-25	I5	ORDERED DATA FLAG = 0 - DATA IS NOT ORDERED (SEARCH ENTIRE FILE). = 1 - DATA IS ZA ORDERED (COLUMNS 26-35 DEFINE THE ZA RANGE TO PLOT). =-1 - DATA IS MAT ORDERED (COLUMNS 26-35 DEFINE THE MAT RANGE TO PLOT).
	26-30	I5	MASTER LOWER ZA OR MAT LIMIT FOR PLOTS
	31-35	I5	MASTER UPPER ZA OR MAT LIMIT FOR PLOTS
	36-40	I5	FLAG FOR TEMPERATURE IN PLOTS = 0 - TEMPERATURE ON PLOTS. = 1 - NO TEMPERATURE ON PLOTS
	41-45	I5	= 0 - ANY REACTION WHOSE MAXIMUM CROSS

C				IS LESS THAN 1 MILLIBARN WILL BE	EVA02390
C				IGNORED.	EVA02400
C				= 1 - ALL REACTIONS WILL BE PLOTTED	EVA02410
C				REGARDLESS OF THE MAGNITUDE OF	EVA02420
C				THE CROSS SECTION.	EVA02430
C	46-55	E10.3		X LENGTH OF PLOT.	EVA02440
C				= 0.0 - STANDARD 10.24 INCHES USED.	EVA02450
C				= .GT. 0.0 - USED AS X LENGTH OF PLOT.	EVA02460
C	56-65	E10.3		Y LENGTH OF PLOT.	EVA02470
C				= 0.0 - STANDARD 10.24 INCHES USED.	EVA02480
C				= .GT. 0.0 - USED AS Y LENGTH OF PLOT.	EVA02490
C				NORMALLY EACH PLOT IS PLOTTED WITHIN	EVA02500
C				IN A SQUARE AREA THAT IS 10.24 BY	EVA02510
C				10.24 INCHES. HOWEVER THE ABOVE INPUT	EVA02520
C				PARAMETERS MAY BE USED TO DEFINE ANY SIZE	EVA02530
C				FOR THE PLOTS (E.G. TO OBTAIN A DETAILED	EVA02540
C				PLOT OF A RESONANCE REGION INPUT 100.0 FOR	EVA02550
C				THE X LENGTH TO OBTAIN A 100.0 BY 10.24	EVA02560
C				INCH PLOT).	EVA02570
C	66-70	I5		OPERATING MODE	EVA02580
C				= 0 - BATCH WITH MASTER PLOTS.	EVA02590
C				= 1 - BATCH WITHOUT MASTER PLOTS.	EVA02600
C				= 2 - INTERACTIVE WITHOUT MASTER PLOTS.	EVA02610
C				* BATCH MODE = ALL ZOOM REQUESTS ARE READ AT	EVA02620
C				THE BEGINNING OF THE PROGRAM AND MAY BE IN	EVA02630
C				ANY ORDER. EACH MATERIAL WITH A ZA BETWEEN	EVA02640
C				THE LOW AND HIGH LIMITS (SPECIFIED ON THE	EVA02650
C				FIRST INPUT CARD) WILL BE PLOTTED.	EVA02660
C				* WITH MASTER PLOTS = AS EACH NEW MATERIAL IS	EVA02670
C				READ A MASTER PLOT OF EACH TYPE WILL BE	EVA02680
C				GENERATED BEFORE GENERATING ANY ZOOMED PLOT	EVA02690
C				OF THE SAME MATERIAL AND TYPE.	EVA02700
C				* WITHOUT MASTER PLOTS = ONLY ZOOMED PLOTS	EVA02710
C				WILL BE GENERATED.	EVA02720
C				* INTERACTIVE MODE = ZOOM REQUESTS ARE READ	EVA02730
C				ONE AT A TIME AND MUST BE IN THE SAME ORDER	EVA02740
C				AS THE MATERIALS ON THE ENDF/B TAPE. THE	EVA02750
C				LOW ZA LIMIT OF THE ZOOM REQUEST WILL BE USED	EVA02760
C				TO DEFINE WHICH MATERIAL TO PLOT NEXT. THE	EVA02770
C				UPPER LIMIT OF THE ZOOM REQUEST AND THE	EVA02780
C				LOW AND HIGH ZA LIMITS (SPECIFIED ON THE	EVA02790
C				FIRST INPUT CARD) WILL BE IGNORED.	EVA02800
C	2-N	1-5	I5	ZOOM LOWER ZA LIMIT	EVA02810
C		6-10	I5	ZOOM UPPER ZA LIMIT	EVA02820
C		11-15	I5	DATA CATEGORY (1 TO 6)	EVA02830
C				1 = TOTAL, ELASTIC, CAPTURE, FISSION	EVA02840
C				AND TOTAL INELASTIC	EVA02850
C				2 = TOTAL INELASTIC, DISCRETE LEVELS	EVA02860
C				AND CONTINUUM	EVA02870
C				3 = (N,2N), (N,3N), (N,4N), (N,N*X)	EVA02880
C				4 = (N,CHARGED PARTICLE)	EVA02890
C				5 = PARTICLE PRODUCTION AND DAMAGE	EVA02900
C				6 = NU BAR, XI AND GAMMA	EVA02910
C	16-25	E10.3		ZOOM LOWER ENERGY LIMIT (EV)	EVA02920
C	26-35	E10.3		ZOOM UPPER ENERGY LIMIT (EV)	EVA02930
C	36-45	E10.3		ZOOM LOWER CROSS SECTION LIMIT (BARNS)	EVA02940
C	46-55	E10.3		ZOOM UPPER CROSS SECTION LIMIT (BARNS)	EVA02950
C	56-60	I5		ZOOM PLOT MODE (SEE UCRL50400, VOL. 17, PART E)	EVA02960
C				0 = MULTIPLE PLOTS - INDIVIDUAL SCALING	EVA02970



C 1 = MULTIPLE PLOTS - COMMON SCALING EVA02980  
 C 2 = SINGLE PLOT EVA02990  
 C THERE MAY BE UP TO 100 ZOOM COMMANDS IN THE BATCH EVA03000  
 C MODE AND THERE IS NO LIMIT TO THE NUMBER OF ZOOM EVA03010  
 C COMMANDS IN THE INTERACTIVE MODE. THE END OF THE ZOOM EVA03020  
 C COMMANDS IS INDICATED BY A BLANK CARD FOLLOWING THE LAST EVA03030  
 C ZOOM COMMAND. EVA03040  
 C EVA03050  
 C EVA03060  
 C CROSS SECTION LIMITS OF ZOOMED PLOTS MAY BE USED TO SELECT ANY EVA03070  
 C RANGE OF CROSS SECTION REQUIRED. IF NOT SUPPLIED (I.E. LOWER = EVA03080  
 C UPPER = 0.0) ZOOMED PLOTS WILL BE AUTOMATICALLY SCALED IN CROSS EVA03090  
 C SECTION SO THAT THE PLOT CONTAINS THE ENTIRE CROSS SECTION EVA03100  
 C RANGE OVER THE ENERGY RANGE OF INTEREST. EVA03110  
 C EVA03120  
 C THE MASTER ZA LIMITS ARE USED TO DEFINE WHICH ZA VALUES TO SELECT EVA03130  
 C FOR PLOTTING. OF THOSE ZA VALUES SELECTED FOR PLOTTING THE ZOOM ZA EVA03140  
 C LIMITS SPECIFY WHICH ZA VALUES TO PLOT ON AN EXPANDED ENERGY SCALE EVA03150  
 C EVA03160  
 C THE ZA ORDERED DATA FLAG ON CARD 1, COLS. 21-25 IS MERELY USED TO EVA03170  
 C MINIMIZE RUNNING TIME BY ALLOWING THE PROGRAM TO TERMINATE ONCE IT EVA03180  
 C HAS PLOTTED ALL REQUESTED DATA, WITHOUT SEARCHING THE REMAINDER OF EVA03190  
 C THE ENDF/B FORMAT FILE. ONCE A ZA LARGER THAN THE MASTER UPPER ZA EVA03200  
 C LIMIT IS FOUND, IF THE ZA ORDERED DATA FLAG IS ON THE PROGRAM CAN EVA03210  
 C IMMEDIATELY TERMINATE. OTHERWISE THE PROGRAM MUST SEARCH ALL THE EVA03220  
 C WAY TO THE END OF THE DATA (I.E. UP TO THE TEND CARD) TO INSURE EVA03230  
 C THAT ALL DATA IN THE REQUESTED ZA RANGE HAS BEEN PLOTTED. EVA03240  
 C EVA03250  
 C EXAMPLE INPUT EVA03260  
 C \_\_\_\_\_ EVA03270  
 C PLOT ALL THORIUM AND URANIUM ISOTOPES FROM A ZA ORDERED FILE. EVA03280  
 C TO PRODUCE ZOOMED PLOTS OF CATEGORY 1 DATA (TOTAL, ELASTIC, CAPTURE, EVA03290  
 C FISSION AND TOTAL INELASTIC DATA) FOR THORIUM-232 FROM 10 EV TO EVA03300  
 C 1 KEV AND FOR URANIUM-238 FROM 100 KEV TO 20 MEV THE FOLLOWING 4 EVA03310  
 C INPUT CARDS ARE REQUIRED.... EVA03320  
 C EVA03330  
 C 0 1 1 1 19000092999 0 EVA03340  
 C 9023290232 1 1.0000+01 1.0000+03 1 EVA03350  
 C 9223892238 1 1.0000+05 2.0000+07 3 EVA03360  
 C (BLANK CARD FOLLOWING LAST ZOOM COMMAND) EVA03370  
 C EVA03380  
 C SEE UCRL-50400, VOL. 17, PART E FOR EXAMPLE OUTPUT PLOTS THAT EVA03390  
 C CORRESPOND TO THE ABOVE INPUT PARAMETERS. EVA03400  
 C EVA03410  
 C \*\*\*\*\* MACHINE DEPENDENT CODING \*\*\*\*\* EVA03420  
 C EVA03430  
 C CHARACTER PLOTTING EVA03440  
 C \_\_\_\_\_ EVA03450  
 C THE ONLY MACHINE DEPENDENT PORTION OF THE GRAPHICS INTERFACE IS EVA03460  
 C INVOLVED WITH PLOTTING STRINGS OF CHARACTERS. ALL CHARACTERS ARE EVA03470  
 C STORED IN THIS PROGRAM FOUR PER WORD. ALL PLOTTING OF CHARACTER EVA03480  
 C STRINGS IS PERFORMED WITH SUBROUTINE SYMBL4, WHICH ASSUMES FOUR EVA03490  
 C CHARACTERS PER WORD AND PASSES THE CHARACTER STRINGS ON TO THE EVA03500  
 C NORMAL CALCOMP-LIKE CHARACTER PLOTTING SUBROUTINE SYMPL. FOR USE EVA03510  
 C ON COMPUTERS WITH MORE THAN FOUR CHARACTERS PER WORD SUBROUTINE EVA03520  
 C SYMBL4 CONTAINS CODING TO PLOT ONE WORD OF CHARACTERS AT A TIME, EVA03530  
 C ADVANCING IN THE X OR Y DIRECTION (AS APPROPRIATE) BETWEEN WORDS. EVA03540  
 C BY ACTIVATING THIS CODING THIS PROGRAM MAY BE USED ON MACHINES EVA03550  
 C WITH MORE THAN FOUR CHARACTERS PER WORD. EVA03560

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C
C
C          PAUSE BETWEEN PLOTS
C          -----
C          AFTER GENERATING A PLOT THIS PROGRAM WILL CALL SUBROUTINE WAITER
C          BEFORE PROCEEDING TO THE NEXT PLOT. AS DISTRIBUTED IN THIS PROGRAM
C          SUBROUTINE WAITER WILL MERELY IMMEDIATELY RETURN. IF THE USER
C          WISHES TO IMPLEMENT THE INTERACTIVE MODE OF THIS PROGRAM INSERT
C          CODING IN SUBROUTINE WAITER TO PAUSE WHEN SUBROUTINE WAITER IS
C          CALLED.
C
C***** MACHINE DEPENDENT CODING *****
C***** PLOTTER INTERFACE *****
C
C          THIS PROGRAM USES A CALCOMP-LIKE PLOTTER INTERFACE CONSISTING OF
C          ONLY FOUR SUBROUTINES WHICH ARE DEFINED AS FOLLOWS..
C
C          PLOTS(BUF,NBUF,NTAPE) - INITIALIZE PLOTTER. DEFINE BUFFER FOR
C          PLOTTER (BUF), SIZE OF BUFFER IN WORDS (NBUF) AND UNIT NUMBER OF PLOTTING TAPE
C          (NTAPE). THIS ROUTINE IS ONLY CALLED ONCE WITH PLOTS(BUF,1000,10).
C
C          PLOT(X,Y,IPEN) - MOVE PEN FROM CURRENT POSITION TO THE COORDINATES (X,Y) OR
C          TERMINATE PLOTTING DEPENDING ON THE VALUE OF IPEN..
C          = 2 - MOVE AND DRAW LINE (BEAM ON)
C          = 3 - MOVE ONLY (BEAM OFF)
C          = -3 - ADVANCE TO NEXT FRAME
C          = 999 - TERMINATE PLOTTING
C
C          SYMBOL(X,Y,H,BCD,A,NBCD) - PLOT CHARACTERS STARTING AT THE COORDINATES (X,Y)
C          AND MOVING AT AN ANGLE (A) WITH RESPECT TO THE POSITIVE X AXIS (IN THIS CODE
C          A= 0.0 OR 90.0). THE CHARACTERS ARE STORED IN (BCD) AND (NBCD) DEFINES THE
C          NUMBER OF CHARACTER SEQUENCE TO PLOT. EACH CHARACTER WILL BE (H) IN
C          HEIGHT.
C
C          NUMBER(X,Y,H,Z,A,NZ) - PLOT A FLOATING POINT NUMBER STARTING AT THE
C          COORDINATES (X,Y) AND MOVING AT AN ANGLE (A) WITH RESPECT TO THE POSITIVE
C          X AXIS (IN THIS CODE A=0.0 OR 90.0). THE NUMBER IS (Z) AND (NZ) IS THE
C          NUMBER OF DECIMAL DIGITS TO PLOT AFTER THE DECIMAL POINT (0=END NUMBER
C          WITH DECIMAL POINT, -1=WRITE NUMBER AS AN INTEGER WITH NO FOLLOWING
C          DECIMAL POINT). EACH CHARACTER WILL BE (H) IN HEIGHT.
C
C          IN ADDITION THE PLOTTER INTERFACE USING THE FOLLOWING CONVENTIONS.
C
C          PLOTTING AREA
C          -----
C          THE DEFAULT PLOTTING AREA ASSUMED BY THIS PROGRAM IS A SQUARE 10.24 BY
C          10.24 INCHES AND IS COMPOSED A SET OF 1024 BY 1024 RASTER POINTS
C          (RASTER POINT SPACING IS 0.01 INCHES IN X OR Y). THIS PLOTTING AREA IS
C          DEFINED BY THE ARRAY (XYEIGE) IN BLOCK DATA (THE LOWER AND UPPER X
C          LIMITS FOLLOWED BY THE LOWER AND UPPER Y LIMITS ARE GIVEN). THE
C          RASTER POINT SPACING IS GIVEN BY THE ARRAY (RASTER) IN BLOCK DATA
C          (THE RASTER POINT SPACING IS GIVEN FOR THE

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X AND Y DIRECTIONS), THE PLOTTING AREA MAY BE RE-DEFINED BY THE USER BY USING INPUT CARDS, BUT THE RASTER SPACING WILL STILL REMAIN THE SAME (E.G. IF THE USER DEFINES A 20.0 BY 10.0 PLOT THE PLOTTING AREA WILL LOGICALLY BE COMPOSED BY 2000 BY 1000 RASTER POINTS).

CHARACTER SIZE

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THE RATIO OF WIDTH TO HEIGHT OF CHARACTERS OR NUMBERS IS ASSUMED TO BE 6/7. ALL CHARACTERS WILL BE 14 RASTER POINTS HIGH AND 12 RASTER POINTS WIDE. THE HEIGHT AND WIDTH OF CHARACTERS ARE DEFINED IN UNITS OF RASTER SPACINGS IN BLOCK DATA BY THE ARRAYS (HEIGHT) AND (WIDTH). TWO POSSIBLE CHARACTER SIZES ARE DEFINED, BUT IN THIS VERSION OF THE CODE BOTH ARE THE SAME SIZE.

\*\*\*\*\* PLOTTER INTERFACE \*\*\*\*\*

EVA04160  
EVA04170  
EVA04180  
EVA04190  
EVA04200  
EVA04210  
EVA04220  
EVA04230  
EVA04240  
EVA04250  
EVA04260  
EVA04270  
EVA04280  
EVA04290  
EVA04300  
EVA04310

		PAGE 0001
C		MER00040
C	PROGRAM MERGER	MER00050
C	VERSION 80-1 (JANUARY 1980)	MER00060
C	VERSION 80-2 (DECEMBER 1980)	MER00070
C	VERSION 82-1 (JANUARY 1982)	MER00080
C	VERSION 83-1 (JANUARY 1983) NEW, MORE COMPATIBLE I/O UNIT NUMBERS.	MER00090
C		MER00100
C	WRITTEN BY DERMOTT E. CULLEN	MER00110
C	NUCLEAR DATA SECTION	MER00120
C	INTERNATIONAL ATOMIC ENERGY AGENCY	MER00130
C	P.O. BOX 200	MER00140
C	VIENNA, AUSTRIA	MER00150
C	TELEPHONE 23-60-1718	MER00160
C		MER00170
C	AUTHORS MESSAGE	MER00180
C	-----	MER00190
C	THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENTATION	MER00200
C	FOR THIS PROGRAM INCLUDING ALL RECENT IMPROVEMENTS, PLEASE READ	MER00210
C	ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY THE	MER00220
C	COMMENTS CONCERNING MACHINE DEPENDENT CODING.	MER00230
C		MER00240
C	AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER	MER00250
C	INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE	MER00260
C	OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT	MER00270
C	IT WOULD BE APPRECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY	MER00280
C	COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO	MER00290
C	IMPROVE THIS PROGRAM, HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF	MER00300
C	THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR	MER00310
C	COMPUTER.	MER00320
C		MER00330
C	PURPOSE	MER00340
C	-----	MER00350
C	THIS PROGRAM IS DESIGNED TO SELECTIVELY RETRIEVE DATA OFF OF FROM	MER00360
C	1 TO 10 ENDF/B DATA TAPES AND TO MERGE THE SELECTED DATA INTO A	MER00370
C	SINGLE MAT/MF/MT ORDERED FINAL OUTPUT FILE.	MER00380
C		MER00390
C	IN THE DISCUSSION THAT FOLLOWS FOR SIMPLICITY THE ENDF/B	MER00400
C	TERMINOLOGY---ENDF/B TAPE---WILL BE USED. IN FACT THE ACTUAL	MER00410
C	MEDIUM USED MAY BE TAPE, CARD, DISK OR ANY OTHER MEDIUM.	MER00420
C		MER00430
C	ENDF/B FORMAT	MER00440
C	-----	MER00450
C	THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS	MER00460
C	OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION	MER00470
C	OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II, III, IV OR V FORMAT).	MER00480
C		MER00490
C	THE ONLY NUMERICAL DATA THAT THIS PROGRAM READS IS THE ZA FROM THE	MER00500
C	FIRST CARD OF EACH SECTION AND THE MAT/MF/MT FROM EACH CARD.	MER00510
C	SEQUENCE NUMBERS ARE IGNORED ON INPUT AND ALL OTHER FIELDS ARE	MER00520
C	READ AS HOLLERITH. AS SUCH THIS PROGRAM NEED NOT DISTINGUISH	MER00530
C	BETWEEN DIFFERENT VERSIONS OF THE ENDF/B FORMAT.	MER00540
C		MER00550
C	IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B	MER00560
C	FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS	MER00570
C	ASSUMED THAT THE MAT, MF AND MT ON EACH CARD IS CORRECT. SEQUENCE	MER00580
C	NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE	MER00590
C	CORRECTLY OUTPUT ON ALL CARDS.	MER00600
C		MER00610
C	SECTION SIZE	MER00620

SINCE THIS PROGRAM ONLY READS THE DATA ONE CARD AT A TIME THERE IS NO LIMIT TO THE SIZE OF ANY GIVEN SECTION, E.G. THE TOTAL CROSS SECTION MAY BE DESCRIBED BY 200,000 DATA POINTS.

#### SELECTION OF DATA

THE USER MAY CHOOSE TO MERGE ALL DATA OR THE USER MAY SPECIFY THAT ONLY CERTAIN DATA SHOULD BE SELECTED. THE DATA TO BE SELECTED IS DEFINED BY SPECIFYING UP TO 100 MAT/MF/MT OR ZA/MF/MT RANGES. EACH RANGE IS DEFINED BY LOWER AND UPPER LIMITS OF MAT/MF/MT OR ZA/MF/MT.

#### REQUEST LIMITS

IN ORDER TO SIMPLIFY THE INPUT OF SELECTION REQUESTS THE FOLLOWING CONVENTIONS HAVE BEEN INTRODUCED IN ORDER TO DEFINE THE UPPER LIMITS OF REQUESTS IF THEY ARE NOT DEFINED BY INPUT (I.E., IF THEY ARE ZERO).

- (1) MAT OR ZA - IF THE UPPER LIMIT IS ZERO IT IS SET EQUAL TO THE LOWER LIMIT.
- (2) MF OR MT - IF THE UPPER LIMIT IS ZERO IT IS SET EQUAL TO THE MAXIMUM POSSIBLE VALUE, 99 OR 999 RESPECTIVELY.

WITH THESE CONVENTIONS AN ENTIRE EVALUATION MAY BE SELECTED BY MERELY SPECIFYING THE LOWER LIMIT OF MAT OR ZA. THE UPPER MAT OR ZA LIMIT WILL BE SET EQUAL TO THE LOWER LIMIT. THE LOWER LIMITS OF MF/MT WILL BE 0/0 AND THE UPPER LIMITS OF MF/MT WILL BE SET TO 99/999. THIS WILL CAUSE ALL SECTIONS OF A SINGLE EVALUATION TO BE SELECTED.

#### SATISFYING SELECTION CRITERIA

IN ORDER FOR A SECTION TO MEET THE SELECTION CRITERIA SPECIFIED BY ONE OF THE RETRIEVAL REQUESTS, EACH OF THE THREE FIELDS (MAT/MF/MT OR ZA/MF/MT) MUST INDIVIDUALLY SATISFY THE CORRESPONDING LIMITS OF THE REQUEST. IT IS NOT SUFFICIENT THAT THE MAT OF A SECTION LIE BETWEEN THE MINIMUM AND MAXIMUM MATS OF A REQUEST. THE MF AND MT WILL ALSO BE INDIVIDUALLY COMPARED TO THE MF AND MT LIMITS OF THE REQUEST. FOR EXAMPLE, A SECTION WITH MAT/MF/MT= 2500/3/2 DOES NOT SATISFY A REQUEST THAT SPECIFIES A REQUEST USING THE RANGE 2000/3/1 THROUGH 3000/3/1. THIS REQUEST SPECIFIES ALL MATERIALS WITH MAT BETWEEN 2000 AND 3000, BUT ONLY THOSE SECTIONS WITH MF/MT=3/1. SIMILARLY A REQUEST FOR 2000/3/1 THROUGH 3000/99/999 WILL NOT SELECT ANY SECTIONS WITH MF=1 OR 2, SINCE THE REQUEST SPECIFIES ALL MATERIALS WITH MAT BETWEEN 2000 AND 3000, BUT ONLY THOSE SECTIONS WITH MF= 3, OR MORE.

#### DUPLICATE SECTIONS

IF TWO OR MORE SECTIONS WITH THE SAME MAT/MF/MT ARE FOUND EITHER ON THE SAME OR DIFFERENT TAPES, THE SECTION FROM THE TAPE DEFINED EARLIEST IN THE INPUT CARDS WILL BE COPIED TO THE FINAL TAPE AND ALL OTHER SECTIONS WITH THE SAME MAT/MF/MT WILL BE SKIPPED. THE OUTPUT REPORT WILL INDICATE WHICH SECTIONS WERE COPIED FROM WHICH TAPES, AS WELL AS WHICH SECTIONS ARE DUPLICATE AND WERE SKIPPED.

#### REACTION INDEX

MER00630  
 MER00640  
 MER00650  
 MER00660  
 MER00670  
 MER00680  
 MER00690  
 MER00700  
 MER00710  
 MER00720  
 MER00730  
 MER00740  
 MER00750  
 MER00760  
 MER00770  
 MER00780  
 MER00790  
 MER00800  
 MER00810  
 MER00820  
 MER00830  
 MER00840  
 MER00850  
 MER00860  
 MER00870  
 MER00880  
 MER00890  
 MER00900  
 MER00910  
 MER00920  
 MER00930  
 MER00940  
 MER00950  
 MER00960  
 MER00970  
 MER00980  
 MER00990  
 MER01000  
 MER01010  
 MER01020  
 MER01030  
 MER01040  
 MER01050  
 MER01060  
 MER01070  
 MER01080  
 MER01090  
 MER01100  
 MER01110  
 MER01120  
 MER01130  
 MER01140  
 MER01150  
 MER01160  
 MER01170  
 MER01180  
 MER01190  
 MER01200  
 MER01210

C  
 C THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451.  
 C FOR EACH MATERIAL. THE PROGRAM WILL FOLLOW THE CONVENTIONS  
 C DEFINED ABOVE AND ONLY COPY ONE SECTION MF=1, MT=451 AND SKIP  
 C ALL OTHERS (IF MORE THAN ONE). THIS CONVENTION HAS BEEN ADOPTED  
 C BECAUSE MOST USERS DO NOT REQUIRE A CORRECT REACTION INDEX FOR  
 C THERE APPLICATIONS AND IT WAS NOT CONSIDERED WORTHWHILE TO INCLUDE  
 C THE OVERHEAD OF CONSTRUCTING A CORRECT REACTION INDEX IN THIS  
 C PROGRAM. HOWEVER, IF YOU REQUIRE A REACTION INDEX FOR YOUR  
 C APPLICATION AFTER RUNNING THIS PROGRAM YOU MAY USE PROGRAM  
 C DITION TO CREATE ONE.

#### RETRIEVAL STATISTICS

C  
 C THERE WILL ALWAYS BE AN OUTPUT REPORT LISTING INDICATING WHICH  
 C SECTIONS WERE SELECTED, WHICH DUPLICATE SECTIONS WERE SKIPPED,  
 C WHICH TAPE THE SECTION WAS ON, WHICH REQUEST (MAT/MF/MT OR  
 C ZA/MF/MT RANGE) CAUSED THE SECTION TO BE SELECTED AND HOW MANY  
 C CARDS WERE IN THE SECTION. IN ADDITION THE USER MAY OPTIONALLY  
 C OBTAIN A FILE CONTAINING THE SAME INFORMATION. THIS FILE MAY BE  
 C COMBINED WITH OTHER SIMILAR FILES OUTPUT BY THIS PROGRAM IN ORDER  
 C TO ACCUMULATE RETRIEVAL STATISTICS OVER A PERIOD OF TIME. IF  
 C SPECIFIED THIS FILE WILL CONTAIN THE FOLLOWING INFORMATION IN  
 C 617 FORMAT.

- (1) ZA
- (2) MAT
- (3) MF
- (4) MT
- (5) NUMBER OF CARDS IN SECTION
- (6) REQUEST NUMBER THAT CAUSED SECTION TO BE SELECTED

#### INPUT FILES

##### UNIT DESCRIPTION

C  
 C 5 INPUT CARDS (BCD - 90 CHARACTERS/RECORD)  
 C VARY FROM 1 TO 10 ENDF/B DATA FILES (BCD - 80 CHARACTERS/RECORD)

#### OUTPUT FILES

##### UNIT DESCRIPTION

C  
 C 6 OUTPUT REPORT LISTING (BCD - 120 CHARACTERS/RECORD)  
 C VARY MERGED ENDF/B DATA (BCD - 90 CHARACTERS/RECORD)  
 C VARY RETRIEVAL STATISTICS FILE (BCD - 80 CHARACTERS/RECORD)

#### INPUT CARDS

CARD	COLUMNS	FORMAT	DESCRIPTION
1	1-11	I11	MERGED TAPE UNIT NUMBER.
	12-22	I11	PRIMARY RETRIEVAL CRITERIA = 0 - MAT = 1 - ZA
	23-33	I11	RETRIEVAL REPORT UNIT NUMBER (OPTIONAL) =.LE.0 - REPORT WILL NOT BE WRITTEN =.GT.0 - REPORT OF EACH SECTION RETRIEVED WILL BE WRITTEN ON THIS UNIT

2	1-66	16A, A2	MERGED TAPE LABEL	MER01810
	67-70	I4	MERGED TAPE ENDF/B NUMBER	MER01820
3-N	1-11	I11	UNIT NUMBER(S) OF TAPE(S) TO MERGE.	MER01830
			TAPES TO MERGE ARE DEFINED ONE PER	MER01840
			CARD. THE USER MUST SPECIFY 1 TO 10	MER01850
			TAPES AND THE LIST IS TERMINATED BY A	MER01860
			BLANK CARD.	MER01870
VARY	1- 6	I6	LOWER PRIMARY LIMIT (MAT OR ZA)	MER01880
	7- 8	I2	LOWER MF LIMIT	MER01890
	9-11	I3	LOWER MT LIMIT	MER01900
	12-17	I6	UPPER PRIMARY LIMIT (MAT OR ZA)	MER01910
	18-19	I2	UPPER MF LIMIT	MER01920
	20-22	I3	UPPER MT LIMIT	MER01930
			RANGES OF MAT/MF/MT OR ZA/MF/MT TO BE	MER01940
			RETRIEVED ARE SPECIFIED BY DEFINING	MER01950
			ONE RANGE (LOWER AND UPPER LIMITS) PER	MER01960
			CARD. THE USER MAY SPECIFY 0 TO 100	MER01970
			RANGES AND THE LIST OF REQUEST RANGES	MER01980
			IS TERMINATED BY A BLANK CARD. IF	MER01990
			THE FIRST CARD IS BLANK (0 REQUESTS)	MER02000
			ALL DATA WILL BE RETRIEVED. IF THE UPPER	MER02010
			PRIMARY CRITERIA (MAT OR ZA) IS LESS THAN	MER02020
			THE LOWER PRIMARY CRITERIA, THE UPPER	MER02030
			PRIMARY CRITERIA WILL BE SET EQUAL TO	MER02040
			THE LOWER PRIMARY CRITERIA. IF THE UPPER	MER02050
			MF OR MT LIMIT IS ZERO, OR BLANK, IT	MER02060
			WILL BE SET TO THE MAXIMUM POSSIBLE	MER02070
			VALUE, I.E. MF=99 OR MT=999 (SEE	MER02080
			EXAMPLE INPUT).	MER02090
23-33		I11	ASSIGNED REQUEST NUMBER. IF NOT SPECIFIED	MER02100
			THE PROGRAM WILL ASSUME THAT EACH REQUEST	MER02110
			LINE IS INDEPENDENT AND REQUESTS ARE	MER02120
			NUMBERED 1, 2, 3, 4, ETC. REQUEST NUMBERS	MER02130
			NEED ONLY BE SPECIFIED IF THE USER WISHES	MER02140
			TO EITHER GROUP A NUMBER OF RANGES	MER02150
			TOGETHER FOR THE OUTPUT REPORT, AND/OR IF	MER02160
			THE USER WISHES TO ACCUMULATE RETRIEVAL	MER02170
			INFORMATION USING THE OPTIONAL OUTPUT	MER02180
			REPORT FILE.	MER02190

## EXAMPLE INPUT

MERGE ENDF/B DATA ONTO UNIT 10 FROM UNITS 11, 12, 13 AND 14.  
 RETRIEVE DATA BY MAT NUMBER. WRITE RETRIEVAL STATISTICS ON  
 UNIT 15. THE RETRIEVAL WILL BE MATS 1103, 1106, ALL MATS  
 BETWEEN 1204 AND 1215, MF=1, 3, 4 AND 5 OF MAT 1219 AND MF=3,  
 MT=1 OF MAT 1304. ALL OF THESE RANGES WILL BE TREATED AS PARTS  
 OF REQUEST NUMBER 4317.

THE FOLLOWING 14 INPUT CARDS ARE REQUIRED.

EXAMPLE TAPE LABEL FOR MERGER

```

10          0          15
11
12
13
14

```

(BLANK CARD TERMINATES TAPE LIST)

1103

4317 (UPPER LIMIT SET TO 1103/99/999)

MER02200  
 MER02210  
 MER02220  
 MER02230  
 MER02240  
 MER02250  
 MER02260  
 MER02270  
 MER02280  
 MER02290  
 MER02300  
 MER02310  
 MER02320  
 MER02330  
 MER02340  
 MER02350  
 MER02360  
 MER02370  
 MER02380  
 MER02390

PAGE 0005

C	1106		4317	(UPPER LIMIT SET TO 1106/99/999)	MERO2400			
C	1204	1215	4317	(UPPER LIMIT SET TO 1215/99/999)	MERO2410			
C	1219	1	1219	1	4317 (UPPER LIMIT SET TO 1219/ 1/999)	MERO2420		
C	1219	3	1219	5	4317 (UPPER LIMIT SET TO 1219/ 5/999)	MERO2430		
C	1304	3	1	1304	3	1	4317 (UPPER LIMIT COMPLETELY DEFINED)	MERO2440
C							(BLANK CARD TERMINATES REQUESTS)	MERO2450
C								MERO2460
C	***** MACHINE DEPENDENT CODING *****							MERO2470
C								MERO2480
C	THERE SHOULD NOT BE ANY MACHINE DEPENDENT CODING IN THIS PROGRAM.							MERO2490
C								MERO2500
C	***** MACHINE DEPENDENT CODING *****							MERO2510



		PAGE 0001
C	PROGRAM DICTION(OUTPUT,TAPE6=OUTPUT,TAPE10,TAPE11)	00010000
C		00020000
C	PROGRAM DICTION	00030000
C	VERSION 81-1 (SEPTEMBER 1981)	00040000
C	VERSION 82-1 (JANUARY 1982)	00050000
C	VERSION 83-1 (JANUARY 1983)*KEEP ORIGINAL MOD. NUMBER	00060000
C	*NEW, MORE COMPATIBLE I/O UNIT NUMBERS.	00070000
C		00080000
C	WRITTEN BY DERMOTT E. CULLEN	00090000
C	NUCLEAR DATA SECTION	00100000
C	INTERNATIONAL ATOMIC ENERGY AGENCY	00110000
C	P.O. BOX 200	00120000
C	A-1400, VIENNA, AUSTRIA	00130000
C	TELEPHONE 23-60-1718	00140000
C		00150000
C	AUTHORS MESSAGE	00160000
C	-----	00170000
C	THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENTATION	00180000
C	FOR THIS PROGRAM INCLUDING ALL RECENT IMPROVEMENTS. PLEASE READ	00190000
C	ALL OF THESE COMMENTS BEFORE IMPLEMENTATION.	00200000
C		00210000
C	AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER	00220000
C	INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE	00230000
C	OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT	00240000
C	IT WOULD BE APPRECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY	00250000
C	COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO	00260000
C	IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF	00270000
C	THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR	00280000
C	COMPUTER.	00290000
C		00300000
C	PURPOSE	00310000
C	-----	00320000
C	THIS PROGRAM IS DESIGNED TO CREATE A REACTION INDEX FOR EACH	00330000
C	MATERIAL ON AN ENDF/B FORMATTED TAPE AND TO INSERT THIS REACTION	00340000
C	INDEX IN FILE 1, SECTION 451 OF EACH MATERIAL.	00350000
C		00360000
C	IN THE DESCRIPTION THAT FOLLOWS FOR SIMPLICITY THE ENDF/B	00370000
C	TERMINOLOGY-----ENDF/B TAPE-----WILL BE USED. IN FACT THE ACTUAL	00380000
C	MEDIUM MAY BE TAPE, CARDS, DISK, OR ANY OTHER MEDIUM.	00390000
C		00400000
C	ENDF/B FORMAT	00410000
C	-----	00420000
C	THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS	00430000
C	OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION	00440000
C	OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II, III, IV OR V FORMAT).	00450000
C		00460000
C	THIS PROGRAM WILL AUTOMATICALLY DETERMINE WHICH VERSION OF THE	00470000
C	ENDF/B FORMAT EACH MAT IS IN AND WILL THEN PROPERLY REPLACE THE	00480000
C	REACTION INDEX FOR EACH MAT. DIFFERENT MATS ON THE SAME TAPE MAY	00490000
C	EVEN BE IN DIFFERENT VERSIONS OF THE ENDF/B FORMAT.	00500000
C		00510000
C	IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B	00520000
C	FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS	00530000
C	ASSUMED THAT THE MAT, MF AND MT ON EACH CARD IS CORRECT. SEQUENCE	00540000
C	NUMBERS (COLUMNS 76-90) NEED NOT BE PRESENT ON INPUT, BUT WILL BE	00550000
C	CORRECTLY OUTPUT ON ALL CARDS.	00560000
C		00570000
C	IN ORDER TO DISTINGUISH BETWEEN DATA IN THE ENDF/B-V AND EARLIER	00580000
C	VERSIONS OF THE ENDF/B FORMAT, FOR ALL DATA IN THE ENDF/B-V	00590000

FORMAT, ON THE SECOND CARD OF SECTION MF=1, MT=451 THE N1 FIELD  
MUST BE ZERO. IN EARLIER VERSIONS OF THE ENDF/B FORMAT THIS N1  
DEFINED THE NUMBER OF COMMENT CARDS IN THE SECTION, WHICH IS  
ALWAYS POSITIVE. THEREFORE BY SIMPLY TESTING THIS N1 FIELD IT  
IS POSSIBLE TO DISTINGUISH BETWEEN DATA IN THE ENDF/B-V AND  
EARLIER VERSIONS OF THE ENDF/B FORMAT.

#### SECTION SIZE

SINCE THIS PROGRAM ONLY READS THE DATA ONE CARD AT A TIME THERE  
IS NO LIMIT TO THE SIZE OF ANY GIVEN SECTION, E.G. THE TOTAL  
CROSS SECTION MAY BE DESCRIBED BY 200,000 DATA POINTS.

#### NUMBER OF SECTIONS PER TAPE

IT IS ASSUMED THAT THE ENTIRE ENDF/B TAPE CONTAINS 3000 OR FEWER  
SECTIONS, I.E. 3000 OR FEWER MAT,MF,MT COMBINATIONS. IF THIS LIMIT  
IS EXCEEDED THIS PROGRAM WILL TERMINATE EXECUTION. IF NEED BE THIS  
LIMIT CAN EASILY BE CHANGED BY CHANGING THE DIMENSION STATEMENT  
BELOW AND RE-DEFINING THE VARIABLE MAXIE IN THE BELOW DATA  
STATEMENT.

#### HOLLERITH SECTION

EACH MAT MUST INITIALLY CONTAIN A SECTION MF=1, MT=451, ALTHOUGH  
THE SECTION MAY OR MAY NOT INITIALLY CONTAIN A REACTION INDEX. IF  
ANY MATERIAL DOES NOT CONTAIN A SECTION MF=1, MT=451 THIS PROGRAM  
WILL TERMINATE EXECUTION. THIS CONVENTION HAS BEEN ADOPTED BECAUSE  
IT IS IMPOSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF  
THE ENDF/B FORMAT THE DATA IS CODED IN WITHOUT FIRST READING MF=1,  
MT=451. THEREFORE WITHOUT AN INITIAL SECTION MF=1, MT=451 THE  
PROGRAM CANNOT DETERMINE HOW TO PROPERLY OUTPUT MF=1, MT=451.

IF THE MATERIAL INITIALLY CONTAINS A REACTION INDEX IT WILL BE  
USED TO DEFINE THE MOD NUMBER FOR CORRESPONDING SECTIONS IN THE  
NEW REACTION INDEX (I.E. IF A SECTION FROM THE ORIGINAL REACTION  
INDEX HAS THE SAME MF/MT NUMBERS AS A SECTION IN THE NEW REACTION  
INDEX THE MOD NUMBER FROM THE ORIGINAL REACTION INDEX WILL BE USED  
IN THE NEW REACTION INDEX). OTHERWISE THE MOD NUMBER IN THE NEW  
REACTION INDEX WILL BE SET EQUAL TO ZERO.

#### PROGRAM OPERATION

THE ENTIRE ENDF/B TAPE IS FIRST READ AND A DICTIONARY ENTRY IS  
CREATED FOR EACH SECTION OF THE TAPE. THE ENDF/B TAPE IS THEN  
REWOUND AND READ A SECOND TIME. DURING THIS SECOND PASS THE  
DICTIONARY OF EACH MAT IS REPLACED. THIS VERSION OF DICTION  
DOES NOT USE SCRATCH FILES AND IS MORE EFFICIENT THAN EARLIER  
VERSIONS OF DICTION.

#### INPUT CARDS

NONE

#### INPUT FILES

#### UNIT DESCRIPTION

10 ORIGINAL TAPE OF ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)

		PAGE 0003
C		01190000
C	OUTPUT FILES	01200000
C	-----	01210000
C	UNIT DESCRIPTION	01220000
C	-----	01230000
C	6 OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)	01240000
C	11 FINAL TAPE OF ENDF/R DATA (BCD - 80 CHARACTERS/RECORD)	01250000
C		01260000
C	***** MACHINE DEPENDENT CODING *****	01270000
C		01280000
C	THERE SHOULD NOT BE ANY MACHINE DEPENDENT CODING IN THIS PROGRAM.	01290000
C		01300000
C	***** MACHINE DEPENDENT CODING *****	01310000

C		CDM00030
C	PROGRAM COMPILOT	CDM00040
C	VERSION 83-1 (FEBRUARY, 1983)	CDM00050
C	VERSION 83-2 (MAY, 1983)	CDM00060
C		CDM00070
C	WRITTEN BY DERMOTT E. CULLEN	CDM00080
C	NUCLEAR DATA SECTION	CDM00090
C	INTERNATIONAL ATOMIC ENERGY AGENCY	CDM00100
C	VIENNA, AUSTRIA	CDM00110
C	TELEPHONE 23-60-1718	CDM00120
C		CDM00130
C		CDM00140
C	AUTHORS MESSAGE	CDM00150
C	-----	CDM00160
C	THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENTATION	CDM00170
C	ALL RECENT IMPROVEMENTS. PLEASE READ ALL OF THESE COMMENTS BEFORE	CDM00180
C	PARTICULARLY THE COMMENTS CONCERNING MACHINE DEPENDENT CODING.	CDM00190
C		CDM00200
C	AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER	CDM00210
C	INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE	CDM00220
C	OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT	CDM00230
C	IT WOULD BE APPRECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY	CDM00240
C	COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO	CDM00250
C	IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF	CDM00260
C	THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR	CDM00270
C	COMPUTER.	CDM00280
C		CDM00290
C	PURPOSE	CDM00300
C	-----	CDM00310
C	COMPARE ENDF/B FORMATTED DATA FROM TWO SEPERATE INPUT TAPES.	CDM00320
C	REACTIONS ARE CONSIDERED TO BE COMPARABLE IF THEY HAVE THE SAME	CDM00330
C	(ZA,MT). RESULTS ARE PRESENTED IN GRAPHICAL FORM.	CDM00340
C		CDM00350
C	IN THE FOLLOWING FOR SIMPLICITY THE ENDF/B TERMINOLOGY---ENDF/B	CDM00360
C	TAPE---WILL BE USED, IN FACT THE ACTUAL MEDIUM MAY BE TAPE, CARDS,	CDM00370
C	DISK OR ANY OTHER MEDIUM.	CDM00380
C		CDM00390
C	PROGRAM IDENTIFICATION	CDM00400
C	-----	CDM00410
C	AS DISTRIBUTED THE FIRST FRAME OF PLOTTED OUTPUT WILL DOCUMENT	CDM00420
C	THE PROGRAM NAME, VERSION AND INSTALLATION. THIS INFORMATION IS	CDM00430
C	STORED AS DATA IN THE ARRAY VERSES NEAR THE BEGINNING OF	CDM00440
C	SUBROUTINE SETPLT. IF YOU WISH TO CUSTOMIZE THE OUTPUT TO IDENTIFY	CDM00450
C	YOUR INSTALLATION CHANGE THE LAST TWO LINES OF THE ARRAY VERSES.	CDM00460
C		CDM00470
C	ENDF/B FORMAT	CDM00480
C	-----	CDM00490
C	THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS	CDM00500
C	OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION	CDM00510
C	OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II, III, IV OR V FORMAT).	CDM00520
C		CDM00530
C	- BOTH SETS OF EVALUATED DATA MUST BE IN THE ENDF/B FORMAT. ONLY	CDM00540
C	SECTIONS OF FILE 2 (RESONANCE PARAMETERS) AND FILE 3 (TABULATED	CDM00550
C	CROSS SECTIONS) WILL BE READ AND ALL OTHER SECTIONS WILL BE	CDM00560
C	SKIPPED. IN FILE 2 THE ONLY IMPORTANT INFORMATION IS THE ENERGY	CDM00570
C	LIMITS OF THE RESOLVED AND UNRESOLVED RESONANCE REGION WHICH IS	CDM00580
C	LOCATED IN THE SAME FIELDS IN ALL VERSIONS OF THE ENDF/B FORMAT.	CDM00590
C	SIMILARLY THE FORMAT OF FILE 3 IS THE SAME IN ALL VERSIONS OF	CDM00600
C	ENDF/B. THEREFORE THIS PROGRAM CAN BE USED WITH DATA IN ANY OF	CDM00610

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

#### CROSS SECTION INTERPOLATION

CROSS SECTIONS MUST BE IN EITHER HISTOGRAM (I.E., INTERPOLATION LAW 1) OR LINEARLY INTERPOLABLE (I.E. INTERPOLATION LAW 2) FORM. IF THEY ARE NOT A WARNING MESSAGE WILL BE PRINTED AND EXECUTION WILL BE TERMINATED. SEE INSTRUCTIONS BELOW ON HOW TO CONVERT DATA TO HISTOGRAM OR LINEARLY INTERPOLABLE FORM.

#### REACTION INDEX

THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN SECTION MF=1, MT=451 OF EACH EVALUATION.

#### SECTION SIZE

SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.

#### WHICH REACTIONS WILL BE PLOTTED

THOSE REACTIONS WITH THE SAME (ZA, MT) WILL BE COMPARED, BUT ONLY THOSE REACTIONS WHICH DIFFER BY A USER SPECIFIED ALLOWABLE DIFFERENCE WILL BE PLOTTED. IN ORDER TO FORCE ALL COMPARABLE REACTIONS TO BE PLOTTED THE USER NEED ONLY SPECIFY AN ALLOWABLE DIFFERENCE OF ZERO.

#### PLOT FORMATS

THE TWO CROSS SECTIONS ARE CONSIDERED TO BE A STANDARD (THE FIRST CROSS SECTION) AND A CROSS SECTION TO BE COMPARED TO THE STANDARD (THE SECOND CROSS SECTION). THE OUTPUT FROM THIS PROGRAM IS A SERIES OF PLOTS. EACH PLOT WILL CONTAIN THE STANDARD CROSS SECTION AND IN ADDITION THE USER MAY SPECIFY THAT EACH PLOT ALSO CONTAIN THE SECOND CROSS SECTION AND/OR THE RATIO OF THE SECOND CROSS SECTION TO THE FIRST CROSS SECTION.

THE USER MAY SELECT ONE OF THE FOLLOWING FIVE PLOT FORMATS (THE NUMBER PRECEDING THE OPTION IS THE VALUE OF THE PLOT MODE SELECTOR THAT THE USER SHOULD SPECIFY AS INPUT ON THE FIRST CARD).

(0) THE STANDARD CROSS SECTION (I.E. FIRST EVALUATION) AND THE RATIO OF THE SECOND EVALUATION TO THE FIRST EVALUATION. THE DATA WILL BE PRESENTED AS TWO SUB-PLOTS PER PLOT WITH THE STANDARD CROSS SECTION IN THE UPPER HALF OF THE PLOT AND THE RATIO IN THE LOWER HALF OF THE PLOT.

(1) THE STANDARD CROSS SECTION (I.E. FIRST EVALUATION) AND THE SECOND EVALUATION. THE DATA WILL BE PRESENTED AS TWO SUB-PLOTS PER PLOT WITH THE STANDARD CROSS SECTION ON THE UPPER HALF OF THE PLOT AND THE SECOND CROSS SECTION IN THE LOWER HALF OF THE PLOT.

(2) THE STANDARD CROSS SECTION (I.E. FIRST EVALUATION) AND THE SECOND EVALUATION. THE DATA WILL BE PRESENTED AS ONE PLOT CONTAINING BOTH THE STANDARD AND SECOND CROSS SECTION. THE STANDARD CROSS SECTION WILL BE PRESENTED AS A SOLID LINE AND

CDM00620  
CDM00630  
CDM00640  
CDM00650  
CDM00660  
CDM00670  
CDM00680  
CDM00690  
CDM00700  
CDM00710  
CDM00720  
CDM00730  
CDM00740  
CDM00750  
CDM00760  
CDM00770  
CDM00780  
CDM00790  
CDM00800  
CDM00810  
CDM00820  
CDM00830  
CDM00840  
CDM00850  
CDM00860  
CDM00870  
CDM00880  
CDM00890  
CDM00900  
CDM00910  
CDM00920  
CDM00930  
CDM00940  
CDM00950  
CDM00960  
CDM00970  
CDM00980  
CDM00990  
CDM01000  
CDM01010  
CDM01020  
CDM01030  
CDM01040  
CDM01050  
CDM01060  
CDM01070  
CDM01080  
CDM01090  
CDM01100  
CDM01110  
CDM01120  
CDM01130  
CDM01140  
CDM01150  
CDM01160  
CDM01170  
CDM01180  
CDM01190  
CDM01200

C THE SECOND CROSS SECTION WILL BE PRESENTED AS A DASHED LINE. COM01210  
 C COM01220  
 C (3) THE STANDARD CROSS SECTION, SECOND CROSS SECTION AND RATIO OF COM01230  
 C THE SECOND CROSS SECTION TO THE SECOND CROSS SECTION. THE DATA COM01240  
 C WILL BE PRESENTED AS THREE SUB-PLOTS PER PLOT WITH THE COM01250  
 C STANDARD CROSS SECTION IN THE UPPER THIRD OF THE PLOT. THE COM01260  
 C SECOND CROSS SECTION IN THE MIDDLE THIRD AND THE RATIO OF THE COM01270  
 C TWO IN THE LOWER THIRD OF THE PLOT. COM01280  
 C COM01290  
 C (4) THE STANDARD CROSS SECTION, SECOND CROSS SECTION AND RATIO OF COM01300  
 C THE SECOND CROSS SECTION TO THE SECOND CROSS SECTION. THE DATA COM01310  
 C WILL BE PRESENTED AS TWO SUB-PLOTS PER PLOT WITH THE STANDARD COM01320  
 C AND SECOND CROSS SECTION ON THE SAME SUB-PLOT IN THE UPPER COM01330  
 C TWO THIRDS OF THE PLOT AND THE RATIO OF THE TWO IN THE LOWER COM01340  
 C THIRD OF THE PLOT. THE STANDARD CROSS SECTION WILL BE COM01350  
 C PRESENTED AS A SOLID LINE AND THE SECOND CROSS SECTION WILL BE COM01360  
 C PRESENTED AS A DASHED LINE. COM01370  
 C COM01380  
 C COM01390

#### ADDITIONAL PLOT FEATURES

C IN ADDITION TO THE CROSS SECTIONS OR RATIO THE FOLLOWING COM01400  
 C INFORMATIONS WILL BE INCLUDED ON EACH PLOT. COM01410  
 C COM01420  
 C (1) AN IDENTIFICATION FOR EACH SET OF CROSS SECTIONS (UP TO 30 COM01430  
 C CHARACTERS FOR EACH SET). COM01440  
 C COM01450  
 C (2) THE MAXIMUM NEGATIVE AND POSITIVE PER-CENT DIFFERENCE BETWEEN COM01460  
 C THE TWO CROSS SECTIONS. COM01470  
 C COM01480  
 C (3) ARROWS INDICATING THE ENERGY AT WHICH THE MAXIMUM DIFFERENCES COM01490  
 C (MINIMUM AND MAXIMUM RATIO) OCCUR. COM01500  
 C COM01510  
 C (4) THE ENERGY LIMITS OF THE RESOLVED AND UNRESOLVED RESONANCE COM01520  
 C REGION (IF THEY FALL WITHIN THE ENERGY LIMITS OF THE PLOT). COM01530  
 C COM01540  
 C COM01550

#### RATIO DATA

C IF RATIO OUTPUT IS REQUESTED THE RATIO WILL BE DEFINED AT EACH COM01560  
 C ENERGY THAT APPEARS IN EITHER EVALUATION. BETWEEN THESE ENERGIES COM01570  
 C THE RATIO WILL BE PLOTTED ASSUMING LINEAR DEPENDENCE BETWEEN COM01580  
 C TABULATED VALUES. FOR HISTOGRAM OR LINEARLY INTERPOLABLE CROSS COM01590  
 C SECTIONS THIS REPRESENTATION WILL POINT OUT ALL EXTREMA OF THE COM01600  
 C RATIO, BUT NOT NECESSARILY THE ENERGY DEPENDENCE BETWEEN TABULATED COM01610  
 C VALUES. COM01620  
 C COM01630  
 C IF THE EVALUATED DATA IS NOT IN EITHER HISTOGRAM OR LINEARLY COM01640  
 C INTERPOLABLE FORM THE RATIO MAY NOT EVEN FIND ALL EXTREMA. FOR COM01650  
 C EXAMPLE, IF ONE EVALUATION IS LINEARLY INTERPOLABLE AND THE COM01660  
 C OTHER NON-LINEAR, BUT BOTH AGREE AT ALL TABULATED ENERGIES THE COM01670  
 C RATIO WILL APPEAR TO BE EQUAL TO UNITY AT ALL ENERGIES, BUT IN COM01680  
 C FACT THE CROSS SECTION BETWEEN TABULATED ENERGIES MAY BE QUITE COM01690  
 C DIFFERENT USING LINEAR VS. NON-LINEAR INTERPOLATION. FOR THIS COM01700  
 C REASON ONLY LINEARLY INTERPOLABLE OR HISTOGRAM DATA IS ALLOWED COM01710  
 C AS INPUT TO THIS PROGRAM. COM01720  
 C COM01730  
 C COM01740  
 C COM01750  
 C COM01760  
 C COM01770

#### LINEAR INTERPOLABLE

C ALL CROSS SECTIONS MAY BE CONVERTED TO LINEARLY INTERPOLABLE FORM COM01780  
 C BE USING PROGRAM LINEAR (UCRL-50400, VOL. 17, PART A). COM01790

HISTOGRAM

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ALL LINEARLY INTERPOLABLE CROSS SECTION MAY BE CONVERTED TO HISTOGRAM (I.E. MULTIGROUP) FORM BY USING PROGRAM GROUPIE ( UCRL-50400, VOL. 17, PART D).

INPUT UNITS

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UNIT DESCRIPTION

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5 INPUT CARD  
 10 FIRST ENDF/B FORMATTED EVALUATION (STANDARD).  
 11 SECOND ENDF/B FORMATTED EVALUATION.

OUTPUT UNITS

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UNIT DESCRIPTION

---

6 OUTPUT REPORT

SCRATCH UNITS

---

UNIT DESCRIPTION

---

12 SCRATCH UNIT FOR FIRST EVALUATION  
 13 SCRATCH UNIT FOR SECOND EVALUATION  
 14 SCRATCH UNIT FOR RATIO (ONLY USED IF RATIOS REQUESTED).

INPUT CARDS

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CARD COLUMNS FORMAT DESCRIPTION

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1	1-11	I11	RETRIEVAL MODE (0=MAT, 1=ZA)	COM01800
1	12-22	I11	OUTPUT MODE = 0 - CROSS SECTION OVER RATIO. = 1 - CROSS SECTION OVER CROSS SECTION. = 2 - TWO CROSS SECTIONS ON SAME PLOT. = 3 - CROSS SECTION OVER CROSS SECTION OVER RATIO. = 4 - TWO CROSS SECTIONS ON SAME PLOT OVER RATIO.	COM01810 COM01820 COM01830 COM01840 COM01850 COM01860 COM01870 COM01880 COM01890 COM01900 COM01910 COM01920 COM01930 COM01940 COM01950 COM01960 COM01970 COM01980 COM01990 COM02000 COM02010 COM02020 COM02030 COM02040 COM02050 COM02060 COM02070 COM02080 COM02090 COM02100 COM02110 COM02120 COM02130 COM02140 COM02150 COM02160 COM02170 COM02180 COM02190 COM02200 COM02210 COM02220 COM02230 COM02240 COM02250 COM02260 COM02270 COM02280 COM02290 COM02300 COM02310 COM02320 COM02330 COM02340 COM02350 COM02360 COM02370 COM02380
	23-33	E11,4	ALLOWABLE FRACTIONAL DIFFERENCE, USED WHEN PLOTTING RATIOS. ANY REACTION WHERE THE TWO EVALUATIONS DIFFER BY MORE THAN THE ALLOWABLE DIFFERENCE WILL BE PLOTTED. IF ZERO IS INPUT THE STANDARD ALLOWABLE DIFFERENCE OF 0.005 (0.5 PER-CENT) WILL BE USED.	
	34-44	E11,4	X DIMENSION OF PLOT (IF ZERO IS INPUT PROGRAM WILL USE STANDARD OPTION, CURRENTLY 13.50).	
	45-55	E11,4	Y DIMENSION OF PLOT (IF ZERO IS INPUT PROGRAM WILL USE STANDARD OPTION, CURRENTLY 10.24).	
2	1-30	A30	IDENTIFICATION FOR UPPER EVALUATIONS	
3	1-30	A30	IDENTIFICATION FOR LOWER EVALUATIONS (IDENTIFICATIONS SHOULD BE LEFT ADJUSTED TO START IN COLUMN 1).	

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C      4-N      1-11      I11      LOWER MAT OR ZA LIMIT      COM02390
C      12-22      I11      UPPER MAT OR ZA LIMIT      COM02400
C      UP TO 100 MAT OR ZA RANGES ARE ALLOWED.      COM02410
C      THE LIST IS TERMINATED BY A BLANK CARD.      COM02420
C      IF THE UPPER LIMIT IS LESS THAN THE LOWER      COM02430
C      LIMIT IT WILL BE SET EQUAL TO THE LOWER      COM02440
C      LIMIT. IF THE FIRST RANGE CARD IS BLANK      COM02450
C      ALL DATA WILL BE RETRIEVED.      COM02460
C      COM02470
C      COM02480
C      COM02490
C      EXAMPLE INPUT      COM02500
C      _____      COM02510
C      RETRIEVE MATS 1023, 1056 AND 1065 THROUGH 1072. IDENTIFY THE      COM02520
C      DATA AS FROM ENDF/B-V AND ENDF/B-IV. PLOT THE ENDF/B-V DATA,      COM02530
C      THE ENDF/B-IV DATA AND THE RATIO (MODE 3) USING ENDF/B-V AS      COM02540
C      THE STANDARD OR DENOMINATOR OF THE RATIO (SINCE IT IS SPECIFIED      COM02550
C      AS THE FIRST OF THE TWO DATA SET). ONLY PLOT THOSE REACTIONS      COM02560
C      WHICH DIFFER AT ONE OR MORE ENERGIES BY 1 PER-CENT OR MORE      COM02570
C      (NOTE, 1 PER-CENT = 0.01 AS A FRACTION). MAKE THE DIMENSIONS OF      COM02580
C      THE PLOT 20 BY 10 (X BY Y) INCHES.      COM02590
C      THE FOLLOWING SEVEN INPUT CARDS ARE REQUIRED.      COM02600
C      COM02610
C      3      0 0.01      20.0      10.0      COM02620
C      ENDF/B-V DATA (STANDARD)      COM02630
C      ENDF/B-IV DATA      COM02640
C      1023      COM02650
C      1056      COM02660
C      1065      1072      COM02670
C      (BLANK CARD TERMINATES REQUEST LIST)      COM02680
C      COM02690
C      ***** MACHINE DEPENDENT CODING *****      COM02700
C      CHARACTER PLOTTING      COM02710
C      _____      COM02720
C      THE ONLY MACHINE DEPENDENT PORTION OF THE GRAPHICS INTERFACE IS      COM02730
C      INVOLVED WITH PLOTTING STRINGS OF CHARACTERS. ALL CHARACTERS ARE      COM02740
C      STORED IN THIS PROGRAM FOUR PER WORD. ALL PLOTTING OF CHARACTER      COM02750
C      STRINGS IS PERFORMED WITH SUBROUTINE SYMBL4, WHICH ASSUMES FOUR      COM02760
C      CHARACTERS PER WORD AND PASSES THE CHARACTER STRINGS ON TO THE      COM02770
C      NORMAL CALCOMP-LIKE CHARACTER PLOTTING SUBROUTINE SYMBOL. FOR USE      COM02780
C      ON COMPUTERS WITH MORE THAN FOUR CHARACTERS PER WORD SUBROUTINE      COM02790
C      SYMBL4 CONTAINS CODING TO PLOT ONE WORD OF CHARACTERS AT A TIME,      COM02800
C      ADVANCING IN THE X OR Y DIRECTION (AS APPROPRIATE) BETWEEN WORDS.      COM02810
C      BY ACTIVATING THIS CODING THIS PROGRAM MAY BE USED ON MACHINES      COM02820
C      WITH MORE THAN FOUR CHARACTERS PER WORD.      COM02830
C      COM02840
C      ***** MACHINE DEPENDENT CODING *****      COM02850
C      ***** PLOTTER INTERFACE *****      COM02860
C      THIS PROGRAM USES A CALCOMP-LIKE PLOTTER INTERFACE CONSISTING OF      COM02870
C      ONLY FOUR SUBROUTINES WHICH ARE DEFINED AS FOLLOWS...      COM02880
C      COM02890
C      PLOTS(BUF,NBUF,NTAPE) - INITIALIZE PLOTTER. DEFINE BUFFER FOR      COM02900
C      PLOTTER (BUF), SIZE OF BUFFER IN WORDS      COM02910
C      (NBUF) AND UNIT NUMBER OF PLOTTING TAPE      COM02920
C      (NTAPE). THIS ROUTINE IS ONLY CALLED      COM02930
C      CALLED ONCE WITH PLOTS(BUF,1000,10).      COM02940
C      PLOT(X,Y,IPEN) - MOVE PEN FROM CURRENT POSITION TO THE      COM02950
C      COORDINATES (X,Y) OR TERMINATE PLOTTING      COM02960
C      DEPENDING ON THE VALUE OF IPEN..      COM02970

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= 2 - MOVE AND DRAW LINE (BEAM ON) COM02980  
 = 3 - MOVE ONLY (BEAM OFF) COM02990  
 = -3 - ADVANCE TO NEXT FRAME COM03000  
 = 999 - TERMINATE PLOTTING COM03010

SYMBOL(X,Y,H,BCD,A,NBCD) - PLOT CHARACTERS STARTING AT THE COM03020  
 COORDINATES (X,Y) AND MOVING AT AN COM03030  
 ANGLE (A) WITH RESPECT TO THE POSITIVE COM03040  
 X AXIS (IN THIS CODE A= 0.0 OR 90.0). COM03050  
 THE CHARACTERS ARE STORED IN (BCD) AND COM03060  
 (NBCD) DEFINES THE NUMBER OF CHARACTERS COM03070  
 TO PLOT. EACH CHARACTER WILL BE (H) IN COM03080  
 HEIGHT. COM03090

NUMBER(X,Y,H,Z,A,NZ) - PLOT A FLOATING POINT NUMBER STARTING COM03100  
 AT THE COORDINATES (X,Y) AND MOVING AT COM03110  
 AN ANGLE (A) WITH RESPECT TO THE COM03120  
 POSITIVE X AXIS (IN THIS CODE A=0.0 OR COM03130  
 90.0). THE NUMBER IS (Z) AND (NZ) IS COM03140  
 THE NUMBER OF DECIMAL DIGITS TO PLOT COM03150  
 AFTER THE DECIMAL POINT ( 0=END NUMBER COM03160  
 WITH DECIMAL POINT; -1=WRITE NUMBER AS COM03170  
 AN INTEGER WITH NO FOLLOWING DECIMAL COM03180  
 POINT). EACH CHARACTER WILL BE (H) IN COM03190  
 HEIGHT. COM03200

IN ADDITION THE PLOTTER INTERFACE USING THE FOLLOWING CONVENTIONS. COM03220

#### PLOTTING AREA

THE DEFAULT PLOTTING AREA ASSUMED BY THIS PROGRAM IS A RECTANGLE COM03260  
 13.50 BY 10.24 INCHES AND IS COMPOSED A SET OF 1350 BY 1024 COM03270  
 RASTER POINTS (RASTER POINT SPACING IS 0.01 INCHES IN X OR Y). COM03280  
 THIS PLOTTING AREA IS DEFINED BY THE ARRAY (XYEDGE) IN BLOCK DATA COM03290  
 (THE LOWER AND UPPER X LIMITS FOLLOWED BY THE LOWER AND UPPER Y COM03300  
 LIMITS ARE GIVEN). THE RASTER POINT SPACING IS GIVEN BY THE ARRAY COM03310  
 (RASTER) IN BLOCK DATA (THE RASTER POINT SPACING IS GIVEN FOR THE COM03320  
 X AND Y DIRECTIONS). THE PLOTTING AREA MAY BE RE-DEFINED BY THE COM03330  
 USER BY USING INPUT CARDS, BUT THE RASTER SPACING WILL STILL COM03340  
 REMAIN THE SAME (E.G. IF THE USER DEFINES A 20.0 BY 10.0 PLOT THE COM03350  
 PLOTTING AREA WILL LOGICALLY BE COMPOSED BY 2000 BY 1000 RASTER COM03360  
 POINTS). COM03370

#### CHARACTER SIZE

THE RATIO OF WIDTH TO HEIGHT OF CHARACTERS OR NUMBERS IS ASSUMED COM03410  
 TO BE 6/7. ALL CHARACTERS WILL BE 14 RASTER POINTS HIGH AND 12 COM03420  
 RASTER POINTS WIDE OR 7 RASTER POINTS HIGH AND 6 RASTER POINTS COM03430  
 WIDE. THE HEIGHT AND WIDTH OF CHARACTERS ARE DEFINED IN UNITS OF COM03440  
 RASTER SPACINGS IN BLOCK DATA BY THE ARRAYS (HEIGHT) AND (WIDTH) COM03450  
 COM03460  
 COM03470

\*\*\*\*\* PLOTTER INTERFACE \*\*\*\*\*

C		CON00030
C	PROGRAM CONVERT	CON00040
C	VERSION 75-1 (APRIL 1975)	CON00050
C	VERSION 78-1 (JANUARY 1978)	CON00060
C	VERSION 80-1 (AUGUST 1980) IBM VERSION	CON00070
C	VERSION 80-2 (DECEMBER 1980)	CON00080
C	VERSION 82-1 (JANUARY 1982)	CON00090
C	VERSION 83-1 (JANUARY 1983)	CON00100
C		CON00110
C	WRITTEN BY DERMOTT E. CULLEN	CON00120
C	NUCLEAR DATA SECTION	CON00130
C	INTERNATIONAL ATOMIC ENERGY AGENCY	CON00140
C	P.O. BOX 200	CON00150
C	VIENNA, AUSTRIA	CON00160
C	TELEPHONE 23-60-1718	CON00170
C		CON00180
C	AUTHORS MESSAGE	CON00190
C	-----	CON00200
C	THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENTATION	CON00210
C	FOR THIS PROGRAM INCLUDING ALL RECENT IMPROVEMENTS. PLEASE READ	CON00220
C	ALL OF THESE COMMENTS BEFORE IMPLEMENTATION; PARTICULARLY THE	CON00230
C	COMMENTS CONCERNING MACHINE DEPENDENT CODING.	CON00240
C		CON00250
C	AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER	CON00260
C	INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE	CON00270
C	OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT	CON00280
C	IT WOULD BE APPRECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY	CON00290
C	COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO	CON00300
C	IMPROVE THIS PROGRAM. IN PARTICULAR IF YOUR FORTRAN COMPILER, OR	CON00310
C	COMPUTER HAS A SET OF REQUIREMENTS THAT ARE DIFFERENT FROM THOSE	CON00320
C	OF CDC, CRAY OR IBM PLEASE NOTIFY THE AUTHOR AND THIS PROGRAM WILL	CON00330
C	BE MODIFIED TO CONSIDER YOUR COMPUTER SEPERATELY. HOWEVER, IN	CON00340
C	ORDER TO PREVENT A PROLIFERATION OF CODING IT IS IMPERATIVE THAT	CON00350
C	YOU IDENTIFY EXACTLY HOW YOUR FORTRAN COMPILER OR COMPUTER DIFFERS	CON00360
C	FROM THOSE ALREADY CONSIDERED BY THIS PROGRAM. HOPEFULLY, IN THIS	CON00370
C	WAY FUTURE VERSIONS OF THIS PROGRAM WILL BE COMPLETELY COMPATIBLE	CON00380
C	FOR USE ON YOUR COMPUTER.	CON00390
C		CON00400
C	PURPOSE	CON00410
C	-----	CON00420
C	THIS PROGRAM IS DESIGNED TO AUTOMATICALLY CONVERT FORTRAN PROGRAMS	CON00430
C	FOR USE ON ANY ONE OF A VARIETY OF COMPUTERS.	CON00440
C		CON00450
C	FORTRAN CODING CONVENTIONS	CON00460
C	-----	CON00470
C	ALL FORTRAN STATEMENTS THAT ARE COMPUTER DEPENDENT AND SHOULD ONLY	CON00480
C	BE USED ON ONE TYPE OF COMPUTER SHOULD BE PRECEDED AND FOLLOWED BY	CON00490
C	A COMMENT CARD THAT SAYS	CON00500
C		CON00510
C	C***** CDC-7600 ***** INDICATING CARDS ONLY FOR USE ON CDC-7600	CON00520
C	C***** CRAY-1 ***** INDICATING CARDS ONLY FOR USE ON CRAY-1	CON00530
C	C***** EXPORT ***** INDICATING STANDARD FORTRAN	CON00540
C		CON00550
C	IN MOST CASES FORTRAN STATEMENTS WILL BE PRESENT FOR ALL THREE	CON00560
C	POSSIBILITIES, ONE WILL BE ACTIVE AND THE OTHER TWO WILL APPEAR	CON00570
C	AS COMMENT CARDS. THIS PROGRAM WILL ALLOW THE USER TO CONVERT	CON00580
C	PROGRAMS BACK AND FORTH BETWEEN ANY OF THESE MACHINES (INSTEAD	CON00590
C	OF DOING THE CHANGES BY HAND). FOR EXAMPLES OF HOW THIS CONVENTION	CON00600
C	IS USED SEE THE LISTING OF THIS PROGRAM AND THE COMMENTS BELOW	CON00610

ON MACHINE DEPENDENT CODING.

PAGE 0002

OPERATING INSTRUCTIONS

THE USER INPUTS A SINGLE WORD, LEFT ADJUSTED, IN COLUMNS 1-8 OF THE SINGLE INPUT CARD. THIS SINGLE INPUT CARD MAY CONTAIN ONE OF THE FOLLOWING THREE WORDS.

CDC-7600  
CRAY-1  
EXPORT

PROGRAM OPERATION

THE PROGRAM WILL THEN SEARCH FOR COMMENT CARDS THAT START WITH C\*\* IN COLUMNS 1-3 FOLLOWED BY ANY ONE OF THE THREE KEYWORDS (CDC-7600, CRAY-1 OR EXPORT). IF THE KEYWORD IS THE SAME AS THE ONE INPUT BY THE USER ALL CARDS UP TO THE NEXT CARD WITH C\*\* IN COLUMNS 1-3 FOLLOWED BY THE SAME KEYWORD WILL BE SET ACTIVE BY SETTING COLUMN 1 TO BLANK. IF THE KEYWORD DIFFERS FROM THAT INPUT BY THE USER ALL CARDS UP TO THE NEXT CARD WITH C\*\* IN COLUMNS 1-3 FOLLOWED BY THE SAME KEYWORD WILL BE SET INACTIVE BY SETTING COLUMN 1 TO C. KEYWORDS MAY NOT BE NESTED (I.E., THIS PROGRAM WILL ONLY OPERATE PROPERLY IF KEYWORDS APPEAR IN PAIRS. ONCE A CARD IS FOUND THAT CONTAINS A KEYWORD, THE NEXT CARD THAT CONTAINS A KEYWORD MUST CONTAIN THE SAME KEYWORD).

PROGRAM CARD

THIS PROGRAM WILL ASSUME THAT THE FORTRAN PROGRAM STARTS WITH A PROGRAM CARD AND POSSIBLE CONTINUATIONS OF THE PROGRAM CARD. FOR USE ON CDC OR CRAY COMPUTERS THIS PROGRAM WILL AUTOMATICALLY ACTIVATE THE PROGRAM CARD AND CONTINUATION CARDS. FOR USE ON OTHER COMPUTERS THIS PROGRAM WILL AUTOMATICALLY DE-ACTIVATE THE PROGRAM CARD AND CONTINUATION CARDS. THIS CONVENTION HAS BEEN INTRODUCED BECAUSE SOME CDC COMPILERS CONSIDER IT AN ERROR IF THE FIRST CARD IS NOT A PROGRAM CARD. PRECEDING COMMENT CARDS ARE NOT ALLOWED. THEREFORE THE NORMAL CONVENTION, DESCRIBED ABOVE, OF USING PRECEDING AND FOLLOWING COMMENT CARDS, CANNOT BE USED AT THE BEGINNING OF THE PROGRAM.

COMMENT CARDS

COMMENT CARDS MAY APPEAR ON CARDS BETWEEN PAIRS OF KEYWORD CARDS ONLY IF THE COMMENT CARDS CONTAINS C----- IN COLUMNS 1-6. ANY CARD THAT CONTAINS ANYTHING ELSE IN COLUMNS 1-6 MAY BE ACTIVATED BY THIS PROGRAM BY SETTING COLUMN 1 BLANK AND CAN LEAD TO ERRORS DURING COMPILATION AND/OR EXECUTION.

INPUT FILES

UNIT DESCRIPTION

5 INPUT CARD (BCD - 80 CHARACTERS/RECORD)  
10 ORIGINAL PROGRAM (BCD - 80 CHARACTERS/RECORD)

OUTPUT FILES

UNIT DESCRIPTION

CON00620  
CON00630  
CON00640  
CON00650  
CON00660  
CON00670  
CON00680  
CON00690  
CON00700  
CON00710  
CON00720  
CON00730  
CON00740  
CON00750  
CON00760  
CON00770  
CON00780  
CON00790  
CON00800  
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CON01130  
CON01140  
CON01150  
CON01160  
CON01170  
CON01180  
CON01190  
CON01200

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C      6  OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)          CON01210
C      11 RE-FORMATTED PROGRAM (BCD - 80 CHARACTERS/RECORD)   CON01220
C                                                                CON01230
C  INPUT CARDS                                                  CON01240
C  -----                                                    CON01250
C  A SINGLE INPUT CARD IS READ.                                CON01260
C                                                                CON01270
C  COLUMNS  FORMAT  DESCRIPTION                               CON01280
C  -----  -----  -----                               CON01290
C      1- 8      2A4  KEYWORD, LEFT ADJUSTED TO START IN COLUMN 1, CON01300
C                      THE KEYWORD MAY BE ONE OF THE FOLLOWING THREE CON01310
C                      WORDS.                                     CON01320
C                      CDC-7600                                CON01330
C                      CRAY-1  OR                               CON01340
C                      EXPORT                                    CON01350
C                                                                CON01360
C ***** MACHINE DEPENDENT CODING *****                    CON01370
C                                                                CON01380
C  THE ONLY MACHINE DEPENDENT CODING IN THIS PROGRAM IS ASSOCIATED CON01390
C  WITH HOW AN END OF FILE IS SENSED IN FORTRAN ON DIFFERENT CON01400
C  COMPUTERS. AS DISTRIBUTED THIS PROGRAM CONTAINS THE IBM CONVENTION CON01410
C  OF ,END= DIRECTLY IN THE READ STATEMENT, AS WELL AS THE CONVENTION CON01420
C  USED ON THE LIVERMORE CDC-7600 AND CRAY-1. FOR USE WITH ANY OTHER CON01430
C  COMPUTER MERELY REPLACE THE READS AND TESTS FOR END OF FILE AT CON01440
C  THE TWO INDICATED POINTS IN THE PROGRAM.                   CON01450
C                                                                CON01460
C ***** MACHINE DEPENDENT CODING *****                    CON01470

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