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**I2D: Code for Conversion of ISOTXS Structured
Data To DTF and ANISN Structured Tables**

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I2D: CODE FOR CONVERSION OF ISOTXS STRUCTURED
DATA TO DTF AND ANISN STRUCTURED TABLES

by

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ABSTRACT

The I2D code converts neutron cross-section data written in the standard interface file format called ISOTXS to a matrix structured format commonly called DTF tables. Several BCD and binary output options are available including FIDO (ANISN) format. The I2D code adheres to the guidelines established by the Committee on Computer Code Coordination for standardized code development. Since some machine dependency is inherent regardless of the degree of standardization, provisions have been made in the I2D code for easy implementation on either short-word machines (IBM) or on long-word machines (CDC).

I. INTRODUCTION

Current Los Alamos Scientific Laboratory (LASL) transport theory codes such as ONETRAN,¹ TWOTRAN,² and TRIDENT³ still process cross-section data in a matrix structure commonly called DTF tables. All of these codes have attached preprocessors which translate neutron cross-section data existing in the standard file structure called ISOTXS^{4,5} into the DTF tables. Occasionally, some calculations are performed with older codes which do not contain ISOTXS processing capabilities. For these situations the I2D, i.e., ISOTXS to DTF code has been written to provide cross sections in compatible input formats.

The DTF tables were so named because the first widely used code to use such tables was the DTF-IV code.⁶ (See Sec. IV.A.2.) These tables consist of matrices IGM*IHM words long where IGM is the number of cross-section groups and IHM is the DTF table length, i.e., the number of values in the vector of cross sections for any given energy group. The matrices contain pertinent cross sections including scattering, total, absorption, and nu*fission in table positions determined relative to the total cross-section position. Additional reaction cross

sections such as n,p, n, α , and n, γ can be included in the tables by expanding IHM. Separate tables exist for each isotope and every Legendre scattering order. For instance, cross sections for three isotopes with Legendre orders to P_3 consist of twelve DTF matrices (tables), i.e., P_0 , P_1 , P_2 , and P_3 tables for each isotope.

Guidelines^{7,8} for code standardization established by the Committee on Computer Code Coordination (CCCC) have been followed during the development of the I2D code. The CCCC is a group of representatives from various reactor community facilities assembled by the Energy Research and Development Administration's (ERDA) Division of Reactor Development and Demonstration (RDD) to provide a set of specifications for the development of fast reactor physics codes. The resulting specifications were devised to insure that techniques used in these standardized codes are compatible with several different machine types and thereby are easily interchanged between facilities. As part of the CCCC efforts, specifications for a set of standard interface files (ISOTXS is one) were developed. These files, particularly the ISOTXS file, have now been generally accepted as the standards for exchanging applicable fast

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reactor data between codes and, when necessary, between facilities. As a result, many facilities now have processing capabilities for reading and writing data in the ISOTXS file format. The I2D code is yet another way in which ISOTXS data may be processed.

The I2D code provides several BCD or binary output options including FIDO format.⁹ The FIDO option produces data which is compatible with codes requiring ANISN⁹ type input. Other I2D output options are included for easy interface of ISOTXS data to existing in-house LASL codes. For this reason, some of these options may not be of particular value outside of LASL.

II. DESCRIPTION OF CODE

A block diagram of the I2D code is shown in Fig. 1 and displays the basic flow of the code. Specific subroutines are discussed in Appendix A. Throughout the code, file management and all binary I/O are handled through calls to the standard subroutines SEEK, REED, and RITE. Specifications for these standard routines are briefly described in Sec. II.C and more thoroughly described in Refs. 4 and 5.

Fig. 1. Block flow diagram.

A. I2D Code Flow

The routine I2DDRV is the main code driver routine and performs three basic functions:

- (1) Calls input module (I2DINP). Initially, in I2DDRV, appropriate calls to subroutine SEEK are made to set the catalog of files maintained by SEEK. Once I2DINP is called, SEEK is again called and a logical unit number for the ISOTXS file to be processed is returned. Next, subroutine REED is called for processing the first two records on the ISOTXS file. The second of these records (1D record) contains pertinent data about the size of the file, e.g., the number of isotopes, energy groups, scattering orders, etc., which are required for allocating storage in the container array A. These data, along with the user specified data read by this routine (described in Sec. IV.A) are employed by the code to determine the storage configuration of the container array A.
- (2) Calls calculational module (IFINXS). Once container storage is allocated, computational control is passed back to I2DDRV and then to subroutine IFINXS where the remainder of the ISOTXS data and records are processed. (See Sec. II.B.) After the data are stored in DTF matrices by the IFINXS routine, control is again returned to I2DDRV.
- (3) Calls output module (I2DOUT). Finally, I2DDRV calls subroutine I2DOUT for the final disposition of the data, e.g., punched cards, tape, etc., as specified in the user control input cards. (See Sec. V.)

B. IFINXS - Inter Face Input of Cross Sections

Versions of the subroutine IFINXS have been used in several codes for converting ISOTXS data to DTF tables. The routine used in the I2D code was taken from the ONETRAN code but has since undergone extensive modifications. Basically, the IFINXS routine processes data from the ISOTXS file, rearranges those data, and fills out the DTF matrices. A logical flow diagram of the IFINXS routine is given in Fig. 2.

Coding is provided in IFINXS to find and to order selected isotopes as specified in the user card input. Relevant data and cross sections are printed by IFINXS.

C. SEEK, REED, and RITE

In keeping with the standards established by the CCCC, the three standardized subroutines SEEK, REED, and RITE are used in all file management and for data transfers between central memory and other storage facilities.

Subroutine SEEK maintains a catalog of data files and their current status. SEEK provides a

Fig. 2. Logical flow diagram of subroutine IFINXS.

means of passing file status information between codes. The main purpose of SEEK in the I2D code is to manage the logical unit numbers assigned to the ISOTXS file and to a scratch file when the binary data output option is used. The free-standing version of SEEK included with the code assigns unit 20 to ISOTXS and unit 21 to the binary data file. In I2D, REED and RITE transfer data to or from these units (sequential storage files). The standard form of the REED and RITE argument list is as follows.

REED (NREF, IREC, ARRAY(I), NWDS, MODE)

RITE (NREF, IREC, ARRAY(I), NWDS, MODE)

A call to REED transfers NWDS words in record IREC in the file on logical unit number NREF from peripheral storage to central memory beginning at core location ARRAY(I). A call to RITE performs the reverse operation. Records may be accessed in any order by REED calls since REED uses the IREC parameter to internally position a file through rewinds, backspaces, or dummy reads. Subroutine RITE however is strictly a sequential operation and records cannot be written out of sequence.

For export purposes, very unsophisticated versions of subroutines SEEK, REED, and RITE are included in the I2D code. It should be noted, however, that efficient SEEK, REED, and RITE routines are installation dependent. When possible, recoding should be effected in order to utilize unique systems routines and thus maximize the efficiency of the standard routines. Specifications for coding and/or recoding these routines are given in Refs. 4 and 5.

D. Long-Word - Short-Word Computer Conversion

Although I2D was primarily written for LASL use, it is fully exportable and compatible on short-word machines with minimal changes. At LASL the I2D code will run on both CROS and LTSS operating systems.

Because of compiler differences in long-word and short-word computers, especially when processing A6 Hollerith words, coding changes are necessary when running the I2D code on various machines. Coding for both IBM and CDC computers is included in I2D. Unnecessary coding for a specific system is made nonoperative by designating this coding as comment cards. For example, if a long-word version is required, double-precision references such as REAL*8 are unnecessary (and not recognized on CDC

```
Column 1
      ↓
      CIBM
      C      REAL*8
      CIBM
```

E. Memory Requirements

	<u>Octal</u>	<u>Decimal</u>
I2DDRV	146	102
I2DINP	735	477
I2DOUT	61	49
IFINXS	2 256	1 198
DTFBL	335	221
PRISOS	206	134
PUNHDR	230	152
PUNFDO	176	126
PUNDTF	247	167
FIDPUN	221	145
FLTFX	57	47
PIT	202	130
PRNTBL	346	230
SEEK	144	84
RITE	146	102
REED	166	118
ERROR	406	262

With a container array dimensioned at 30 000₁₀ words, the storage requirements of the stand-alone version is 33 744₁₀ words. These storage requirements are only those associated with the code and do not include systems routines.

The I2D code like any other code has certain conditions under which it will not execute. The following conditions, if satisfied and with proper user input (see Sec. IV), will ensure complete execution of the code.

- (1) ISOTXS input must be a SINGLE version IV binary type file input. Multiple files and BCD card image input cannot be read. Binary tape or sequential disk input is acceptable.
- (2) A total scattering matrix must be present on the file for requested isotopes if microfiche is not requested, or for all isotopes if microfiche is requested. A fatal error flag will be issued if the total scattering matrix is not present on the ISOTXS file.

- (3) Scattering orders higher than P99 cannot be processed. If MAXORD is greater than 99, a fatal error message will be issued.

IV. INPUT SPECIFICATIONS

A description of the user input control data is given in Table I for the I2D code. It is listed exactly as it should be entered into the code. All user defined data will be entered in either a I2I6 or A4 format. All user defined data are read by I2DINP. NOTE: Cards 2, 5, and 6 are included only if the specified criteria are met. A standard file description format for all I2D user input data is included in Appendix B.

1. Sample USER Input

A typical user input deck is arranged as below for a 30-isotope, 4-group problem.

Card 1 indicates tape is off, punch and microfiche are on.

Card 2 indicates DTF format punched output.

Card 3 indicates cross-section table length = 15. Position of self-scatter cross section = 13. Position of total cross section = 10.

Card 4 indicates four groups in ISOTXS. Five isotopes will be processed. P_3 scatter included.

Card 5 indicates that the 10th, 15th, 12th, 25th, and 30th isotopes of the 30 on the ISOTXS file will be processed.

Card 6 indicates that $\sigma_{n,p}$ cross section is not present, all others are in designated positions.

The sample output for this sample deck and a 30-isotope, 4-group problem is included in Appendix C.

2. Cross-Section Table Row Order

DTF cross-section format assumes that each nuclide is described by a block of cross sections of IHM rows and IGM group columns. The row position of the cross sections is specified relative to the total cross section, σ_t (row IHT), and the self-scatter cross section, $\sigma_{s,g \rightarrow g}$ (row IHS). The I2D code assumes that the row order of the cross section is as in Table II.

The symbol $\sigma_{s,g-2 \rightarrow g}$ denotes the scattering transfer probability from group g-2 to group g. The

TABLE I
USER INPUT CONTROL DATA

Number of Word on Card	Name of Variable	COMMENTS
Control Integers	(12I6)-----	-----Card 1
1	IPUN	0/1 = no/yes, punched DTF or FIDO output
2	ITAPE	0/1 = no/yes, binary output to tape, Unit 21
3	IFICHE	0/1 = no/yes, microfiche output; all isotopes
Control Hollerith	(A4)-----	-----Card 2
1	TYPE	type of punched output (.,DTF/FIDO)
Control Integers	(12I6)-----	-----Card 3
1	IHM	cross-section table length
2	IHS	position of self-scatter cross section in table
3	IHT	position of total cross section in table
Control Integers	(12I6)-----	-----Card 4
1	IGM	number of energy groups on ISOTXS file
2	MTP	number of isotopes selected
3	ISCT	Nth order anisotropic scattering
Control Integers	(12I6)-----	-----Card 5
1	MTT(1)	selected isotope number in list
2	MTT(2)	selected isotope number in list
.	MTT(3)	selected isotope number in list
.	.	.
.	.	.
.	.	selected isotope number in list
MTP	MTT(MTP)	
Control Integers	(12I6)-----	-----Card 6
		0/N = not present/present in Nth position above sigma fission cross section in table (see Table III)
1	INT	$\sigma_{n,\text{tritium}}$
2	INP	$\sigma_{n,\text{proton}}$
3	IND	$\sigma_{n,\text{deuteron}}$
4	INA	$\sigma_{n,\text{alpha}}$
5	ING	$\sigma_{n,\text{gamma}}$

TABLE II
CROSS-SECTION ROW ORDER

Row	Cross-Section Type - Group g
.	
.	
.	
.	
IHT-5	σ_f
IHT-4	$\sigma_{n,2n}$
IHT-3	σ_{tr}
IHT-2	σ_a
IHT-1	$\nu\sigma_f$
IHT	σ_t
IHT+1	$\sigma_{s,g+n+g}$
IHM	
.	
.	
.	
IHS-2	$\sigma_{s,g+2+g}$
IHS-1	$\sigma_{s,g+1+g}$
IHS	$\sigma_{s,g+g}$
IHS+1	$\sigma_{s,g-1+g}$
IHS+2	$\sigma_{s,g-2+g}$
.	
.	
.	
IHS+m	$\sigma_{s,g-m+g}$

format allows n groups of upscatter and m groups of downscatter. Both upscatter and downscatter are read from the ISOTXS file by IFINXS. All DTF format cross-section blocks created from an ISOTXS file will have constant values for IHM, IHS, and IHT. Additional partial cross sections may be added at the top of this table when IHT > 6. The position may be specified in the last card of the user input descriptions. For example, for IGM=4 let IHM=15, IHT=10, and IHS=11. The ISOTXS control data imply that the number of downscatter cross sections is four, self scatter is IHS, and there is no upscatter. IHT > 6 implies that 4 (IHT-6) additional partial cross-section positions can be specified in the last card. Suppose the last card is read as in Table III. The row order would appear as in Table IV.

B. User Input Errors

Table V describes the errors which may be encountered due to incorrect or inconsistent user

TABLE III
PARTIAL CROSS-SECTIONS TYPE AND POSITION

Cross-Section Type	Position as read (0 = not present)
$\sigma_{n,\text{tritium}}$	3
$\sigma_{n,\text{proton}}$	0
$\sigma_{n,\text{deuteron}}$	2
$\sigma_{n,\text{alpha}}$	4
$\sigma_{n,\text{gamma}}$	1

input. It is stressed that the user should be familiar with the ISOTXS file to be converted in order to ensure that the I2D code will run properly. A standard ISOTXS file description is included in Appendix C. The maximum number of upscatter and downscatter cross sections should be known so that IHM, IHS, and IHT may be set correctly. Also, NGROUP should be known as well as NISO so that IGM and MTP will be set properly.

The fatal errors fall into two categories, i.e., exit is taken by subroutine ERROR, or an end-of-file is encountered (cards missing) and a system abort results.

V. OUTPUT OPTIONS

There are four modes of output available to the user of the I2D code. They are printed output (always

TABLE IV
SAMPLE ROW ORDER

ROW	Cross-Section Type - Group g	Position	
IHT-9	$\sigma_{n,\alpha}$	4	
IHT-8	$\sigma_{n,\text{trit}}$	3	as
IHT-7	$\sigma_{n,d}$	2	specified
IHT-6	$\sigma_{n,\gamma}$	1	by the
IHT-5	σ_f		user
IHT-4	$\sigma_{n,2n}$		
IHT-3	σ_{tr}		
IHT-2	σ_a		
IHT-1	$\nu\sigma_f$		
IHT	σ_t		
IHS	$\sigma_{s,g+g}$		
IHS+1	$\sigma_{s,t-1+g}$		
IHS+2	$\sigma_{s,g-2+g}$		
IHS+3	$\sigma_{s,g-3+g}$		
IHS+4	$\sigma_{s,g-4+g}$		

TABLE V
USER INPUT ERRORS

<u>Error</u>	<u>Severity</u>	<u>Action</u>
TYPE not specified when IPUN or ITAPE=1	FATAL	EXIT TAKEN
IHT+MAXUP+MAXDN+1.GT.IHM	FATAL	EXIT TAKEN
IHT.GT.IHS and/or IHS.GT.IHM	FATAL	EXIT TAKEN
IHT.GT.11	FATAL	EXIT TAKEN
IGM.NE.NGRUP	FATAL	EXIT TAKEN
MTP=0	NON-FATAL	MTP=NISO
MTP.GT.NISO	FATAL	EXIT TAKEN
ISCT.GT.MAXORD	FATAL	EXIT TAKEN
MTT(I).GT.NISO	FATAL	EXIT TAKEN
MTT ARRAY (card 5) not present	FATAL	END OF FILE ENCOUNTERED
IHT.GT.6 and last card not present	FATAL	END OF FILE ENCOUNTERED
INT, INP, IND, INA, or ING.GT.IHT-6	FATAL	EXIT TAKEN

present), microfiche, punched, and binary tape output (optional). The optional output is requested from data on card 1 of the user input code parameters (see Table I). Output types are described as follows.

A. Printed Output

Printed output of the I2D code is always present and is therefore not specified as an option on Card 1 of the user input code parameters. Printed output includes an echo check of all user input, a representation of the cross-section table, and cross sections for ONLY those isotopes specified in the MTT array as user input. The number of isotopes and their cross sections printed is always MTP, unless MTP=0 whereby all isotopes and cross

an advantage in large multigroup libraries. The microfiche on/off flag IFICHE is read as the third entry of the first user input card by I2DDRV.

All data are written to the microfiche unit (unit 8) by I2DDRV, which then calls the LASL systems routine FICHEX. Assuming that FICHEX is not available to every system, the statement may be changed to meet the requirements of a particular computer.

C. Punched Output

There are two basic types of punched output available from the I2D code. The DTF punch uses a standard 6E12.5 format and punches cross sections for selected isotopes as specified by MTP and the MTT array. (See Sec. IV.A.) DTF format described below: (Note "^" denotes a blank space.)

Column 1

^+1.2345E-21^0.0^0.0^0.0^+2.7493E-13^-7.3954E+08

Column 72

sections are printed. The variable MTP is specified as user input. (See Sec. IV.A.1.)

B. Microfiche Output

Fiche output is identical in form to the printed output with the exception that regardless of the value of MTP, all isotopes and all cross-section groups are written on fiche. Fiche output may be

The FIDO punch is written in two possible formats as described below and contains a repeated zero flag. This repeated zero flag is invoked with unsigned integer "n" immediately followed by the letter "R." These fill the first 3 columns of a 12-column field. The last column of the remaining nine columns contains a zero. The integer "n" denotes the number of times a zero is repeated between two nonzero numbers.

FIDO FORMAT 1

FIDO FORMAT 2

The above FIDO format diagrams describe how +12.345678 would be punched. Zone (a) is the exponent, (b) is the sign of the exponent, and (c) is an integer composed of the number's digits. Coding for both FIDO formats exists in I2D and is bracketed by comment cards. The coding for FIDO format 1 is bracketed by CFID01 cards and for FIDO format 2, by CFID02 cards. Both FIDO formats fill a 12-column field.

A header card precedes all DTF and FIDO format data blocks. Included in the header card are the isotope name and the order of scatter. Figure 3 depicts the card order of a sample punched output deck and shows the position of the header card in the deck. The isotope identification name is read from the ISOTXS 2D record.

D. Binary Tape Output

Binary output is written to unit 21 in the LASL version of the I2D code and contains the same information as punched output would. The tape is written in binary by subroutine RITE, called by subroutine PUNHDR. Following each call to the DTF or FIDO punch subroutines, the subroutine RITE is called and two records for each isotope and scattering order, i.e., a 12-word title record and a record

of dimension IHM*IGM are written on logical unit 21. All data written on unit 21 are written sequentially. The tape output on/off flag is written by I2DINP as the second entry of the first card in user input. (See Sec. IV.A.)

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Fig. 3. Punched output deck (example).

APPENDIX A
FUNCTIONS OF I2D SUBROUTINES

Table A-I describes the names and functions of all I2D code routines and subroutines.

TABLE A-I
FUNCTIONS OF I2D SUBROUTINES

<u>Routine Name</u>	<u>Functional Descriptions</u>	<u>Calling Routine</u>
I2DDRV	Main driver program of code. Calls input, output, and calculational blocks.	-
I2DINP	Input block. Sets array pointers and reads user input.	I2DDRV
I2DOUT	Main routine of the output block. Controls output options.	I2DDRV
IFINXS	Main routine of the calculational block. Converts standard ISOTXS cross-section input to DTF-type cross-section table.	I2DDRV
DTFTBL	Prints a DTF cross-section position table.	IFINXS
PRISOS	Prints isotope material lists.	IFINXS
PUNHDR	Punches a header card for each scattering cross section and calls either DTF or FIDO punch subroutines.	I2DOUT
PUNFDO	Punches cross sections in FIDO format.	PUNHDR
PUNDTF	Punches cross sections in DTF format.	PUNHDR
FIDPUN	Determines variable formats for sub-routine PUNFDO.	PUNFDO
FLTFX	Converts floating point numbers to fixed, eight-digit integers.	FIDPUN
PIT	Prints group-ordered cross-section tables.	IFINXS
SEEK	Locates and assigns a logical unit number for ISOTXS and output files.	I2DDRV I2DINP
REED	Reads records from a sequential disk file from logical number assigned by SEEK.	I2DINP IFINXS
RITE	Writes records onto a sequential disk file to the logical unit number assigned by SEEK.	I2DOUT PUNHDR PUNFDO PUNDTF
ERROR	Prints errors assigned by IFINXS.	ALL ROUTINES

APPENDIX B
ISOTXS FILE AND I2D INPUT FILE DESCRIPTIONS

```

*****
C               REVISED 11/30/76
C
C      ISOTXS-IV
CE     MICROSCOPIC GROUP NEUTRON CROSS SECTIONS
C
C      THIS FILE PROVIDES A BASIC BROAD GROUP
CN     LIBRARY, ORDERED BY ISOTOPE
CN     FORMATS GIVEN ARE FOR FILE EXCHANGE PURPOSES
CN     ONLY,
C
*****

```

```

C-----
CS      FILE STRUCTURE
C
CS      RECORD TYPE                                PRESENT IF
CS      =====
CS      FILE IDENTIFICATION                        ALWAYS
CS      FILE CONTROL                              ALWAYS
CS      FILE DATA                                ALWAYS
CS      FILE-WIDE CHI DATA                        ICHIST,GT,1
CS
CS      ***** (REPEAT FOR ALL ISOTOPES)
CS      *      ISOTOPE CONTROL AND GROUP
CS      *      INDEPENDENT DATA                ALWAYS
CS      *      PRINCIPAL CROSS SECTIONS          ALWAYS
CS      *      ISOTOPE CHI DATA                ICHI,GT,1
CS      *
CS      * ***** (REPEAT TO NSCMAX SCATTERING BLOCKS)
CS      * * ***** (REPEAT FROM 1 TO NSBLOK)
CS      * * * SCATTERING SUB-BLOCK              LORD(N),GT,0
CS      *****
C
C-----

```

```

C-----
CR      FILE IDENTIFICATION
C
CL      HNAME,(HUSE(I),I=1,2),IVERS
C
CW      1+3*MULT=NUMBER OF WORDS
C
CB      FORMAT(11H 0V ISOTXS , 1H*,
CB      12A6,1h*,I6)
C
CD      HNAME      HOLLERITH FILE NAME = ISOTXS = (A6)
CD      HUSE(I)    HOLLERITH USER IDENTIFICATION (A6)
CD      IVERS      FILE VERSION NUMBER
CD      MULT       DOUBLE PRECISION PARAMETER
CD                  1= A6 WORD IS SINGLE WORD
CD                  2= A6 WORD IS DOUBLE PRECISION WORD
C
C-----

```

```

C-----
CR      FILE CONTROL (1D RECORD)
C
CL      NGROUP,NISO,MAXUP,MAXDN,MAXORD,ICHIST,NSCMAX,NSBLOK
C
CW      8=NUMBER OF WORDS
C
CB      FORMAT(4H 1D ,B16)
C
CD      NGROUP     NUMBER OF ENERGY GROUPS IN FILE
CD      NISO       NUMBER OF ISOTOPES IN FILE
CD      MAXUP      MAXIMUM NUMBER OF UPSCATTER GROUPS
CD      MAXDN      MAXIMUM NUMBER OF DOWNSCATTER GROUPS
CD      MAXORD     MAXIMUM SCATTERING ORDER (MAXIMUM VALUE OF
CD                  LEGENDRE EXPANSION INDEX USED IN FILE),
CD      ICHIST     FILE-WIDE FISSION SPECTRUM FLAG
CD                  ICHIST,EQ,0, NO FILE-WIDE SPECTRUM
CD                  ICHIST,EQ,1, FILE-WIDE CHI VECTOR
CD                  ICHIST,GT,1, FILE-WIDE CHI MATRIX
CD      NSCMAX     MAXIMUM NUMBER OF BLOCKS OF SCATTERING DATA
CD      NSBLOK     SUBBLOCKING CONTROL FOR SCATTER MATRICES, THE
CD                  SCATTERING DATA ARE SUBBLOCKED INTO NSBLOK
CD                  RECORDS(SUBBLOCKS) PER SCATTERING BLOCK,
C
C-----

```

```

C-----
CR      FILE DATA      (2D RECORD)
C
CL      (HSETID(I),I=1,12),(HISONM(I),I=1,NISO),
CL      1(CHI(J),J=1,NGROUP),(VEL(J),J=1,NGROUP),
CL      2(EMAX(J),J=1,NGROUP),EMIN,(LOCA(I),I=1,NISO)
C
CW      (NISO+12)*MULT+1+NISO
CN      +NGROUP*(2+ICHIST*(2/(ICHIST+1)))=NUMBER OF WORDS
C
CB      FORMAT(4H 2D ,1H*,11A6,1H*/      HSETID,HISONM
CB      11H*,A6,1H*,9(1X,A6)/(10(1X,A6)))
CB      FORMAT(1P6E12,5)      CHI (PRESENT IF ICHIST,EQ,1)
CB      FORMAT(1P6E12,5)      VEL,EMAX,EMIN
CB      FORMAT(12I6)      LOCA
C
CD      HSETID(I)      HOLLERITH IDENTIFICATION OF FILE (A6)
CD      HISONM(I)      HOLLERITH ISOTOPE LABEL FOR ISOTOPE I (A6)
CD      CHI(J)      FILE-WIDE FISSION SPECTRUM(PRESENT IF ICHIST,EQ,1)
CD      VEL(J)      MEAN NEUTRON VELOCITY IN GROUP J (CM/SEC)
CD      EMAX(J)      MAXIMUM ENERGY BOUND OF GROUP J (EV)
CD      EMIN      MINIMUM ENERGY BOUND OF SET (EV)
CD      LOCA(I)      NUMBER OF RECORDS TO BE SKIPPED TO READ DATA FOR
CD                      ISOTOPE I. LOCA(I)=0
C
C-----

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C-----
CR      FILE-WIDE CHI DATA      (3D RECORD)
C
CC      PRESENT IF ICHIST,GT,1
C
CL      ((CHI(K,J),K=1,ICHIST),J=1,NGROUP),(ISSPEC(I),I=1,NGROUP)
C
CN      NGROUP*(ICHIST+1)=NUMBER OF WORDS
C
CB      FORMAT(4H 3D ,1P5E12,5/(6E12,5)) CHI
CB      FORMAT(12I6)      ISSPEC
C
CD      CHI(K,J)      FRACTION OF NEUTRONS EMITTED INTO GROUP J AS A
CD                      RESULT OF FISSION IN ANY GROUP,USING SPECTRUM K
CD      ISSPEC(I)      ISSPEC(I)=K IMPLIES THAT SPECTRUM K IS USED
CD                      TO CALCULATE EMISSION SPECTRUM FROM FISSION
CD                      IN GROUP I
C
C-----

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C-----
CR      ISOTOPE CONTROL AND GROUP INDEPENDENT DATA      (4D RECORD)
C
CL      HABSID,HIDENT,HMAT,AMASS,EFISS,ECAPT,1P,SIGPOT,ADENS,KBR,ICHI,
CL      1IFIS,IALF,INP,IN2N,IND,INT,LTOT,LTRN,ISTRPD,
CL      2(IDSCT(N),N=1,NSCMAX),(LORD(N),N=1,NSCMAX),
CL      3((JBAND(J,N),J=1,NGROUP),N=1,NSCMAX),
CL      4((IJJ(J,N),J=1,NGROUP),N=1,NSCMAX)
C
CW      3*MULT+17+NSCMAX*(2*NGROUP+2)=NUMBER OF WORDS
C
CB      FORMAT(4H 4D ,3(1X,A6)/1P6E12,5/
CB      1(12I6))
C
CD      HABSID      HOLLERITH ABSOLUTE ISOTOPE LABEL = SAME FOR ALL
CD                      VERSIONS OF THE SAME ISOTOPE IN FILE (A6)
CD      HIDENT      IDENTIFIER OF LIBRARY FROM WHICH BASIC DATA
CD                      CAME(E,G, ENDF/B) (A6)
CD      HMAT      ISOTOPE IDENTIFICATION (E,G, ENDF/B MAY NO,) (A6)
CD      AMASS      GRAM ATOMIC WEIGHT
CD      EFISS      TOTAL THERMAL ENERGY YIELD/FISSION (W,SEC/FISS)
CD      ECAPT      TOTAL THERMAL ENERGY YIELD/CAPTURE (W,SEC/CAPT)
CD      TEMP      ISOTOPE TEMPERATURE (DEGREES KELVIN)
CD      SIGPOT      AVERAGE EFFECTIVE POTENTIAL SCATTERING IN
CD                      RESONANCE RANGE (BARN/ATOM)
C

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CD      ADENS      DENSITY OF ISOTOPE IN MIXTURE IN WHICH ISOTOPE
CD                      CROSS SECTIONS WERE GENERATED (A/BARN=CM)
CD      KBR        ISOTOPE CLASSIFICATION
CD                      0=UNDEFINED
CD                      1=FISSILE
CD                      2=FERTILE
CD                      3=OTHER ACTINIDE
CD                      4=FISSION PRODUCT
CD                      5=STRUCTURE
CD                      6=COOLANT
CD                      7=CONTROL
CD      ICHI       ISOTOPE FISSION SPECTRUM FLAG
CD                      ICHI,EQ,0,      USE FILE-WIDE CHI
CD                      ICHI,EQ,1,      ISOTOPE CHI VECTOR
CD                      ICHI,GT,1,      ISOTOPE CHI MATRIX
CD      IFIS       (N,F) CROSS SECTION FLAG
CD                      IFIS=0, NO FISSION DATA IN PRINCIPAL CROSS
CD                      SECTION RECORD
CD                      #1, FISSION DATA PRESENT IN PRINCIPAL
CD                      CROSS SECTION RECORD
CD      IALF       (N,ALPHA) CROSS SECTION FLAG
CD                      SAME OPTIONS AS IFIS
CD      INP        (N,P) CROSS SECTION FLAG
CD                      SAME OPTIONS AS IFIS
CD      IN2N       (N,2N) CROSS SECTION FLAG
CD                      SAME OPTIONS AS IFIS
CD      IND        (N,D) CROSS SECTION FLAG
CD                      SAME OPTIONS AS IFIS
CD      INT        (N,T) CROSS SECTION FLAG
CD                      SAME OPTIONS AS IFIS
CD      LTOY       NUMBER OF MOMENTS OF TOTAL CROSS SECTION PROVIDED
CD                      IN PRINCIPAL CROSS SECTIONS RECORD
CD      LTRN       NUMBER OF MOMENTS OF TRANSPORT CROSS SECTION
CD                      PROVIDED IN PRINCIPAL CROSS SECTIONS RECORD
CD      ISTRPD     NUMBER OF COORDINATE DIRECTIONS FOR WHICH
CD                      COORDINATE DEPENDENT TRANSPORT CROSS SECTIONS
CD                      ARE GIVEN, IF ISTRPD=0, NO COORDINATE DEPENDENT
CD                      TRANSPORT CROSS SECTIONS ARE GIVEN.
CD      IDSCT(N)   SCATTERING MATRIX TYPE IDENTIFICATION FOR
CD                      SCATTERING BLOCK N, SIGNIFICANT ONLY IF
CD                      LORD(N),GT,0
CD                      IDSCT(N)=200 + NN, TOTAL SCATTERING, (SUM OF
CD                      ELASTIC, INELASTIC, AND N,2N SCATTERING
CD                      MATRIX TERMS),
CD                      =100 + NN, ELASTIC SCATTERING
CD                      =200 + NN, INELASTIC SCATTERING
CD                      =300 + NN, (N,2N) SCATTERING,----SEE
CD                      NOTE BELOW----
CD                      WHERE NN IS THE LEGENDRE EXPANSION INDEX OF THE
CD                      FIRST MATRIX IN BLOCK N
CD      LORD(N)    NUMBER OF SCATTERING ORDERS IN BLOCK N, IF
CD                      LORD(N)=0, THIS BLOCK IS NOT PRESENT FOR THIS
CD                      ISOTOPE, IF NN IS THE VALUE TAKEN FROM
CD                      IDSCT(N), THEN THE MATRICES IN THIS BLOCK
CD                      HAVE LEGENDRE EXPANSION INDICES OF NN,NN+1,
CD                      NN+2,...,NN+LORD(N)-1
CD      JBAND(J,N) NUMBER OF GROUPS THAT SCATTER INTO GROUP J,
CD                      INCLUDING SELF-SCATTER, IN SCATTERING BLOCK N,
CD                      IF JBAND(J,N)=0, NO SCATTER DATA IS PRESENT IN
CD                      BLOCK N
CD      IJJ(J,N)   POSITION OF IN-GROUP SCATTERING CROSS SECTION IN
CD                      SCATTERING DATA FOR GROUP J, SCATTERING BLOCK
CD                      N, COUNTED FROM THE FIRST WORD OF GROUP J DATA.
CD                      IF JBAND(J,N).NE.0 THEN IJJ(J,N) MUST SATISFY
CD                      THE RELATION 1,LE,IJJ(J,N),LE,JBAND(J,N)
C
CN      NOTE* FOR N,2N SCATTER, THE MATRIX CONTAINS TERMS,
CN      SCAT(J TO G), WHICH ARE EMISSION (PRODUCTION)-
CN      BASED, I.E., ARE DEFINED SUCH THAT MACROSCOPIC
CN      SCAT(J TO G) TIMES THE FLUX IN GROUP J GIVES
CN      THE RATE OF EMISSION (PRODUCTION) OF NEUTRONS
CN      INTO GROUP G.
C

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C-----
CR      PRINCIPAL CROSS SECTIONS   (50 RECORD)
C
CL      ((STRPL(J,L),J=1,NGROUP),L=1,LTRN),
CL      1((STOTPL(J,L),J=1,NGROUP),L=1,LTOT),(SNGAM(J),J=1,NGROUP),
CL      2(SFIS(J),J=1,NGROUP),(SNUTOT(J),J=1,NGROUP),
CL      3(CHISO(J),J=1,NGROUP),(SNALF(J),J=1,NGROUP),
CL      4(SNP(J),J=1,NGROUP),(SN2N(J),J=1,NGROUP),
CL      5(SND(J),J=1,NGROUP),(SNT(J),J=1,NGROUP)
CL      6((STRPD(J,I),J=1,NGROUP),I=1,ISTRPD)
C
CW      (1+LTRN+LTOT+IALF+INP+IN2N+IND+INT+ISTRPD+2*IFIS+
CW      ICHI*(2/(ICHI+1)))*NGROUP=NUMBER OF WORDS
C
CB      FORMAT(4H 50 ,1P5E12,5/(6E12,5)) LENGTH OF LIST AS ABOVE
C
CD      STRPL(J,L)    PL WEIGHTED TRANSPORT CROSS SECTION
CD                      THE FIRST ELEMENT OF ARRAY STRPL IS THE
CD                      CURRENT (P1) WEIGHTED TRANSPORT CROSS SECTION
CD                      THE LEGENDRE EXPANSION COEFFICIENT FACTOR (2L+1)
CD                      IS NOT INCLUDED IN STRPL(J,L).
CD      STOTPL(J,L)   PL WEIGHTED TOTAL CROSS SECTION
CD                      THE FIRST ELEMENT OF ARRAY STOTPL IS THE
CD                      FLUX (P0) WEIGHTED TOTAL CROSS SECTION
CD                      THE LEGENDRE EXPANSION COEFFICIENT FACTOR (2L+1)
CD                      IS NOT INCLUDED IN STOTPL(J,L).
CD      SNGAM(J)      (N,GAMMA)
CD      SFIS(J)       (N,F)          (PRESENT IF IFIS.GT.0)
CD      SNUTOT(J)     TOTAL NEUTRON YIELD/FISSION (PRESENT IF IFIS.GT.0)
CD      CHISO(J)      ISOTOPE CHI (PRESENT IF ICHI.EQ.1)
CD      SNALF(J)      (N,ALPHA)      (PRESENT IF IALF.GT.0)
CD      SNP(J)        (N,P)          (PRESENT IF INP.GT.0)
CD      SN2N(J)       (N,2N)         (PRESENT IF IN2N.GT.0) ----SEE
CD                      NOTE BELOW----
CD      SND(J)        (N,D)          (PRESENT IF IND.GT.0)
CD      SNT(J)        (N,T)          (PRESENT IF INT.GT.0)
CD      STRPD(J,I)    COORDINATE DIRECTION I TRANSPORT CROSS SECTION
CD                      (PRESENT IF ISTRPD.GT.0)
C
CN      NOTE = THE PRINCIPAL N,2N CROSS SECTION SN2N(J)
CN      IS DEFINED AS THE N,3N REACTION CROSS SECTION,
CN      I.E., SUCH THAT MACROSCOPIC SN2N(J) TIMES THE
CN      FLUX IN GROUP J GIVES THE RATE AT WHICH N,2N
CN      REACTIONS OCCUR IN GROUP J.  THUS, FOR N,2N
CN      SCATTERING, SN2N(J) = 0.5*(SUM OF SCAT(J TO G)
CN      SUMMED OVER ALL G).
C-----

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C-----
CR      ISOTOPE CHI DATA   (60 RECORD)
C
CC      PRESENT IF ICHI.GT.1
C
CL      ((CHIISO(K,J),K=1,ICHI),J=1,NGROUP),(ISOPEC(I),I=1,NGROUP)
C
CW      NGROUP*(ICHI+1)=NUMBER OF WORDS
C
CB      FORMAT(4H 60 ,1P5E12,5/(6E12,5)) CHIISO
CB      FORMAT(12I6)          ISOPEC
C
CD      CHIISO(K,J)  FRACTION OF NEUTRONS EMITTED INTO GROUP J AS A
CD                      RESULT OF FISSION IN ANY GROUP,USING SPECTRUM K
CD      ISOPEC(I)    ISOPEC(I)=K IMPLIES THAT SPECTRUM K IS USED
CD                      TO CALCULATE EMISSION SPECTRUM FROM FISSION
CD                      IN GROUP J
C-----

```

```

C-----
CR          SCATTERING SUB-BLOCK   (7D RECORD)
C
CC          PRESENT IF LORD(N),GT,0
C
CL          ((SCAT(K,L),K=1,KMAX),L=1,LORDN)
C
CC          KMAX=SUM OVER J OF JBAND(J,N) WITHIN THE J=GROUP RANGE OF THIS
CC          SUB-BLOCK.  IF M IS THE INDEX OF THE SUB-BLOCK, THE J=GROUP
CC          RANGE CONTAINED WITHIN THIS SUB-BLOCK IS
CC          JL=(M-1)*((NGROUP-1)/NSBLOCK+1)+1 TO JUMIN0(NGROUP,JUP),
CC          WHERE JUP=M*((NGROUP-1)/NSBLOCK+1).
C
CC          LORDN=LORD(N)
CC          N IS THE INDEX FOR THE LOOP OVER NSCMAX (SEE FILE STRUCTURE)
C
CW          KMAX=LORDN=NUMBER OF WORDS
C
CB          FORMAT(4H 7D ,1P5E12,5/(6E12,5))
C
CD          SCAT(K,L)      SCATTERING MATRIX OF SCATTERING ORDER L, FOR
CC                          REACTION TYPE IDENTIFIED BY IDSCT(N) FOR THIS
CC                          BLOCK.  JBAND(J,N) VALUES FOR SCATTERING INTO
CC                          GROUP J ARE STORED AT LOCATIONS K=SUM FROM 1
CC                          TO (J-1) OF JBAND(J,N) PLUS 1 TO K=1+JBAND(J,N).
CC                          THE SUM IS ZERO WHEN J=1.  J=TO=J SCATTER IS
CC                          THE IJJ(J,N)TH ENTRY IN THE RANGE JBAND(J,N).
CC                          VALUES ARE STORED IN THE ORDER (J+JUP),
CC                          (J+JUP+1),...,(J+1),J,(J+1),...,(J+JDN),
CC                          WHERE JUP=IJJ(J,N)+1 AND JDN=JBAND(J,N)-IJJ(J,N).
C-----

```

CEOF

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C*****
C          REVISED 5/17/77
C
CF          STANDARD INPUT FILE DESCRIPTION FOR
CE          ISOTXS TO DTF FORMAT CONVERTER CODE (120)
C
C*****

```

```

C-----
CS          INPUT STRUCTURE
C
CS          RECORD TYPE          PRESENT IF
CS          =====
CS          I2D OUTPUT OPTIONS    ALWAYS
CS          PUNCH TYPE            IPUN OR ITAPE,NE,0
CS          DTF TABLE CONTROL    ALWAYS
CS          CODE DATA            ALWAYS
CS          SELECTED ISOTOPES     MTP,NE,0 OR NISO
CS          CROSS SECTION TYPES   IMT,GT,6
C
C-----

```

```

C-----
CR          I2D OUTPUT OPTIONS
C
CL          IPUN,ITAPE,IFICHE
C
CW          3=NUMBER OF WORDS
C
CB          3I6
C
CD          IPUN      0/1=NO/YES    PUNCHED OUTPUT
CD          ITAPE     0/1=NO/YES    BINARY TAPE OUTPUT
CD          IFICHE     0/1=NO/YES    MICROFICHE OUTPUT
C
C-----

```

```

C-----
CR          PUNCH TYPE
C
CC PRESENT IF IPUN,NE,0,OR,ITAPE,NE,0
C
CL TYPE
C
CB 1 WORD = A4
C
CD TYPE      DTF/FIDO  PUNCHED OUTPUT FORMAT
C-----

```

```

C-----
CR          DTF TABLE CONTROL
C
CL  IMM,IHS,IHT
C
CM 3NUMBER OF WORDS
C
CB 316
C
CD IMM      CROSS SECTION TABLE LENGTH.
CD IHS      POSITION OF SELF-SCATTER CROSS SECTION
CD          IN CROSS SECTION TABLE
CD IHT      POSITION OF TOTAL CROSS SECTION
CD          IN CROSS SECTION TABLE.
C-----

```

```

C-----
CR          CODE DATA
C
CL  IGM,MTP,ISCT
C
CM 3NUMBER OF WORDS
C
CB 316
C
CD IGM      NUMBER OF GROUPS ON ISOTXS FILE
CD          (A PRECAUTIONARY CHECK)
CD MTP      NUMBER OF ISOTOPES FROM
CD          ISOTXS LIBRARY TO BE PRINTED
CD          MTP=0 OR NISO IMPLIES THAT AL.
CD          ISOTOPES WILL BE PRINTED.
CD          MAXIMUM SCATTERING ORDER FOR
CD          ALL ISOTOPES.
C-----

```

```

C-----
CR          SELECTED ISOTOPE NUMBERS
C
CC PRESENT IF MTP,NE,0 OR NISO
C
CL (MT(I),I=1,MTP)
C
CM MTP=NUMBER OF WORDS
C
CB 1216
C
CD MT(I)     ISOTOPE NUMBER SELECTED FROM
CD          ISOTXS TABLE.
C-----

```



```

C-----
CR      CROSS SECTION TYPE
C
CC      PRESENT IF IMT,GT,6
C
CL      INT,INP,IND,INA,ING
C
CW      S=NUMBER OF WORDS
C
CN      516
C
CD      INT      N,TRITIUM CROSS SECTION  0/N=NOT PRESENT/POSITION
CD      INP      N,PROTON  CROSS SECTION  0/N=NOT PRESENT/POSITION
CD      IND      N,DEUTERON CROSS SECTION  0/N=NOT PRESENT/POSITION
CD      INA      N,ALPHA   CROSS SECTION  0/N=NOT PRESENT/POSITION
CD      ING      N,GAMMA   CROSS SECTION  0/N=NOT PRESENT/POSITION
CD      ***NOTE*** POSITION NUMBER MUST BE ,LT, IMT=6
C
C-----
CEOF

```

APPENDIX C
SAMPLE OUTPUT

*****USER INPUT*****

PUNCH IS ON WRITTEN TO FSET7
PICHE IS ON WRITTEN TO FSET8
TAPE IS OFF WRITTEN TO BINARY

PUNCHED AND/OR TAPE OUTPUT WILL BE DTF TYPE.

DTF TABLE CONTROL

IMM= 15
IMS= 13
IMT= 10

GROUP AND ISOTOPE INFORMATION

IGM= 4
MTP= 5
ISCT= 3

ISOTOPE NUMBERS IN ISOTOPE TABLE TO BE PRINTED. (,LE,NISO)

10 15 12 25 30

SCATTERING ORDER IN CROSS SECTION TABLE AFTER SIGMA FISSION. 0=>NOT REQUESTED

TRITIUM	PROTON	DEUTERON	ALPHA	GAMMA
3	0	2	4	1

*****END OF USER INPUT*****

ROW CROSS SECTION TYPE GROUP G TABLE LENGTH= 15

IMT= 9	N,ALPH
IMT= 8	N,TRIT
IMT= 7	N,DEUT
IMT= 6	N,GAMA
IMT= 5	FISIO.
IMT= 4	N,2N
IMT= 3	TRNSPT
IMT= 2	ARSHPT
IMT= 1	NU FIS
IMT	TOTAL
IMS= 2	SCAT,G= 2->G
IMS= 1	SCAT,G= 1->G
IMS	SCAT,G->G
IMS+ 1	SCAT,G= 1->G
IMS+ 2	SCAT,G= 2->G

INTERFACE FILE ISOTXS IS USED TO OBTAIN INPUT CROSS SECTIONS

ISOTXS FILE NAME
 LASIP USER IDENTIFICATION
 - 111

1 VERSION
 4 NGROUP
 30 NISO
 0 MAXUP
 4 MAXD
 3 MAXOMU
 1 ICHIST
 1 NSCHAX
 4 NSBLUK

*****MATERIAL LIST*****

NUMBER	POSITN	ISOTPE	NUMBER	POSITN	ISOTPF	NUMBER	POSITN	ISOTPE	NUMBER	POSITN	ISOTPE
1	1	MAT 10	2	2	MAT 11	3	3	MAT 12	4	4	MAT 13
5	5	MAT 14	6	6	MAT 15	7	7	MAT 16	8	8	MAT 17
9	9	MAT 40	10	10	MAT 44	11	11	MAT 50	12	12	MAT 28
13	13	MAT 60	14	14	MAT 88	15	15	MAT 112	16	16	MAT 56
17	17	MAT 138	18	18	MAT 139	19	19	MAT 160	20	20	MAT 135
21	21	MAT 142	22	22	MAT 174	23	23	MAT 224	24	24	MAT 141
25	25	MAT 239	26	26	MAT 240	27	27	MAT 242	28	28	MAT 238
29	29	MAT 338	30	30	MAT 352						MAT 335

*****SELECTED MATERIAL LIST IN ORDER SPECIFIED IN OUTPUT FILE*****

NUMBER	POSITN	ISOTPE	NUMBER	POSITN	ISOTPE	NUMBER	POSITN	ISOTPE
1	10	MAT 44	3	12	MAT 56	4	25	MAT 239
5	30	MAT 352						

LARGE CORE X-SECTIONS

ISOTOPE	ABSOLUTE	TEMPERATURE	NO. SCATTER	MAX GROUPS	MAX GROUPS	ISOTROPIC NUCLE
LABEL	LABEL	(DEG K)	TERMS	OF UPSCATTER	OF DOWNSCATTER	POSITION IN TABLE
MAT 44	2600	7.54100E+02	4	0	2	1

---CROSS SECTIONS--- P 0 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 3	ALL ZERO							
4	7.36585E+03		6.45551E+03		1.38873E+02		9.58798E+02	
5 TO 5	ALL ZERO							
6	1.00434E+04		0.		0.		0.	
7	3.07214E+00		3.69899E+00		7.85133E+00		9.45486E+00	
8	7.26542E+03		6.45551E+03		1.38873E+02		9.58798E+02	
9 TO 9	ALL ZERO							
10	3.07214E+00		3.69899E+00		7.85133E+00		9.45486E+00	
11 TO 12	ALL ZERO							
13	2.64793E+00		3.63332E+00		7.79648E+00		9.35898E+00	
14	0.		4.13103E+01		5.92151E+02		4.09641E+02	
15	0.		0.		3.86137E+03		0.	

---CROSS SECTIONS--- P 1 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	2.59397E+00		8.96494E+01		4.19812E+01		6.46574E+01	
14	0.		-6.91871E+02		-5.08390E+02		-2.85095E+03	
15 TO 15	ALL ZERO							

---CROSS SECTIONS--- P 2 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	3.62538E+00		6.83597E+01		1.26474E+02		1.17629E+02	
14	0.		4.21347E+02		-2.29025E+03		-9.39413E+05	
15 TO 15	ALL ZERO							

---CROSS SECTIONS--- P 3 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	2.73682E+00		5.55666E+02		7.22608E+03		1.62822E+03	
14	0.		-4.99861E+02		-7.36560E+05		2.03428E+06	
15 TO 15	ALL ZERO							

ISOTOPE LABEL	ABSOLUTE LABEL	TEMPERATURE (DEG K)	NO. SCATTER TERMS	MAX GROUPS OF UPSCATTER	MAX GROUPS OF DOWNSCATTER	ISOTROPIC NUCLEIDE POSITION IN TABLE
MAT 56	1100	7.33001E+02	4	6	2	9

---CROSS SECTIONS--- P 0 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 3	ALL ZERO							
4	2.50659E-03		1.02756E-03		5.91149E-03		1.15346E-02	
5 TO 5	ALL ZERO							
6	2.78311E-06	0.		0.		0.		
7	2.79934E+00		4.16738E+00		8.75648E+00		4.80573E+00	
8	2.50381E-03		1.02756E-03		5.91149E-03		1.15346E-02	
9 TO 9	ALL ZERO							
10	2.79934E+00		4.16738E+00		8.75648E+00		4.80573E+00	
11 TO 12	ALL ZERO							
13	2.26824E+00		4.02037E+00		8.43387E+00		4.79420E+00	
14	0.		5.28590E-01		1.45983E-01		3.16701E-01	
15	0.		0.		4.36968E-07		0.	

---CROSS SECTIONS--- P 1 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	2.63137E+00		1.23539E+00		7.88954E-01		4.38588E-01	
14	0.		-8.26657E-02		-9.65361E-02		-2.22687E-01	
15	0.		0.		-1.16271E-04		0.	

---CROSS SECTIONS--- P 2 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	1.79949E+00		7.17516E-01		-1.76155E-02		-1.86456E-02	
14	0.		-9.98742E-02		-4.79706E-03		-1.22208E-02	
15 TO 15	ALL ZERO							

---CROSS SECTIONS--- P 3 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	8.68069E-01		1.49176E-01		5.86585E-02		4.31936E-02	
14	0.		-4.27545E-02		2.44869E-03		8.92225E-03	
15 TO 15	ALL ZERO							

ISOTOPE	ABSOLUTE	TEMPERATURE	NO. SCATTER	MAX GROUPS	MAX GROUPS	ISOTROPIC NUCLIDE
LABEL	LABEL	(DEG K)	TERMS	OF UPSCATTER	OF DOWNSCATTER	POSITION IN TABLE
MAT112	1100	7.33000E+02	4	0	2	5

---CROSS SECTIONS--- P 0 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 3	ALL ZERO							
4	2.38604E-03		8.45860E-04		3.31712E-03		1.33330E-02	
5 TO 5	ALL ZERO							
6	2.75148E-06		0.		0.		0.	
7	2.80455E+00		4.04965E+00		6.28268E+00		5.74576E+00	
8	2.38329E-03		8.45860E-04		3.31712E-03		1.33330E-02	
9 TO 9	ALL ZERO							
10	2.80455E+00		4.04965E+00		6.28268E+00		5.74576E+00	
11 TO 12	ALL ZERO							
13	2.37685E+00		3.94767E+00		6.13216E+00		5.73243E+00	
14	0.		4.25317E-01		1.01135E-01		1.47209E-01	
15	0.		0.		4.28348E-07		0.	

---CROSS SECTIONS--- P 1 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	2.63881E+00		1.20343E+00		4.49817E-01		5.20398E-01	
14	0.		-6.89963E-02		-6.71384E-02		-6.35929E-02	
15	0.		0.		-1.08653E-04		0.	

---CROSS SECTIONS--- P 2 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	1.77877E+00		7.06622E-01		-2.25754E-02		-1.54741E-02	
14	0.		-8.39994E-02		-3.33658E-03		-7.23829E-03	
15 TO 15	ALL ZERO							

---CROSS SECTIONS--- P 3 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	8.42538E-01		1.37096E-01		5.89132E-02		4.35453E-02	
14	0.		-3.59587E-02		1.70318E-03		3.68673E-03	
15 TO 15	ALL ZERO							

ISOTOPE LABEL	ABSOLUTE LABEL	TEMPERATURE (DEG K)	NO. SCATTER TERMS	MAX GROUPS OF UPSCATTER	MAX GROUPS OF DOWNSCATTER	ISOTROPIC NUCLIDE POSITION IN TABLE
MAT239	9439	1.29240E+03	4	0	2	13

---CROSS SECTIONS--- P 0 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 3	ALL ZERO							
4	1.15952E-02		2.01419E-01		1.04271E+00		4.73989E+00	
5 TO 5	ALL ZERO							
6	2.36028E-03		0.		0.		2.98023E-07	
7	7.38411E+00		1.04586E+01		1.45144E+01		2.25069E+01	
8	1.90630E+00		1.79223E+00		3.00231E+00		1.02672E+01	
9	6.05232E+00		4.64511E+00		5.64798E+00		1.59194E+01	
10	7.38411E+00		1.04586E+01		1.45144E+01		2.25069E+01	
11 TO 12	ALL ZERO							
13	4.68850E+00		8.62007E+00		1.14846E+01		1.22397E+01	
14	0.		7.83536E-01		4.57164E-02		2.75043E-02	
15	0.		0.		5.76496E-03		1.72659E-05	

---CROSS SECTIONS--- P 1 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	7.52637E+00		5.62511E+00		8.80571E-01		2.64953E-01	
14	0.		1.45421E-03		-1.34561E-02		-8.49332E-04	
15 TO 15	ALL ZERO							

---CROSS SECTIONS--- P 2 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	9.56303E+00		3.20386E+00		1.53925E-01		3.02304E-03	
14	0.		4.47477E-04		-1.63724E-03		-2.86192E-06	
15 TO 15	ALL ZERO							

---CROSS SECTIONS--- P 3 SCATTER

POSITN	GROUP	1	GROUP	2	GROUP	3	GROUP	4
1 TO 12	ALL ZERO							
13	9.84932E+00		1.29650E+00		-3.43937E-04		-2.77827E-03	
14	0.		-4.61238E-03		-3.96843E-04		4.95013E-07	
15 TO 15	ALL ZERO							

ISOTOPE	ABSOLUTE	TEMPERATURE	NO. SCATTER	MAX GROUPS	MAX GROUPS	ISOTROPIC NUCLEIDE
LABEL	LABEL	(DEG K)	TERMS	OF UPSCATTER	OF DOWNSCATTER	POSITION IN TABLE
4AT352	2600	7.54100E+02	4	0	2	17

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---CROSS SECTIONS--- P 0 SCATTER
  POSITN  GROUP 1  GROUP 2  GROUP 3  GROUP 4
  1 TO 3  ALL ZERO
  4 7.11246E-03 6.23925E-03 1.32693E-02 7.89989E-02
  5 TO 5  ALL ZERO
  6 9.64467E-05 0. 0. 0.
  7 3.03635E+00 3.31385E+00 6.71439E+00 9.14454E+00
  8 7.01601E-03 6.23925E-03 1.32693E-02 7.89989E-02
  9 TO 9  ALL ZERO
  10 3.03635E+00 3.31385E+00 6.71439E+00 9.14454E+00
  11 TO 12 ALL ZERO
  13 2.64596E+00 3.26114E+00 6.66580E+00 9.06554E+00
  14 0. 3.79213E-01 4.64676E-02 3.53218E-02
  15 0. 0. 4.16895E-03 0.

---CROSS SECTIONS--- P 1 SCATTER
  POSITN  GROUP 1  GROUP 2  GROUP 3  GROUP 4
  1 TO 12 ALL ZERO
  13 2.48192E+00 8.46621E-01 3.27900E-01 6.39369E-01
  14 0. -5.89365E-02 -4.02697E-02 -1.33154E-03
  15 TO 15 ALL ZERO

---CROSS SECTIONS--- P 2 SCATTER
  POSITN  GROUP 1  GROUP 2  GROUP 3  GROUP 4
  1 TO 12 ALL ZERO
  13 3.50995E+00 6.17087E-01 1.23960E-02 1.16337E-02
  14 0. 3.58922E-02 -1.81411E-03 -4.32747E-05
  15 TO 15 ALL ZERO

---CROSS SECTIONS--- P 3 SCATTER
  POSITN  GROUP 1  GROUP 2  GROUP 3  GROUP 4
  1 TO 12 ALL ZERO
  13 2.56246E+00 4.73187E-02 8.15362E-03 1.92270E-03
  14 0. -4.25803E-02 -5.83432E-05 9.50090E-07
  15 TO 15 ALL ZERO

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END OF EXECUTION.