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TART INPUT MANUAL

MASTER

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Lawrence Livermore Laboratory

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UCID- 17026 Rev. 2

TART INPUT MANUAL

John R. Kimlinger, Ernest F. Plechaty

APRIL 1 1982

TART INPUT MANUAL

TABLE OF CONTENTS

008

T A R T   I N P U T   M A N U A L

TART INPUT MANUAL

T A R T   I N P U T   M A N U A L

ABSTRACT

This report lists all the input cards for the TART code on the CRAY and gives definitions for all input parameters. It also describes how to execute the code, the limitations of the code, and includes the input for two sample problems.

INTRODUCTION

The new TART code is a Monte Carlo neutron/photon transport code that is only on the CRAY computer. The size of the code is problem dependent. The computer algorithm that determines the code size takes into consideration the numbers of zones, time steps, isotopes, and combinations of isotopes that are given as input. The basic code limitations are listed on page 3. These constraints will be relaxed upon user request.

With the exception of the NAME and BOX cards, all input cards are field free, space delimited and may be either fixed or floating format. The cards may be in any order and any contradictions are settled in favor of the last one entered. Zone, material, and boundary numbers need not be in continuous order.

This report lists first a minumum number of input cards with which to describe a problem. Default values are given. A complete description of each card is then given under general groupings.

This report will conclude with the input for sample problems.

AVAILABILITY

This manual can be obtained by LLNL personnel and printed by:

XPORT RD .4773ØØ:TARTDOC / T V

Then:

TRIX ACIPRINT(<RJET# TARTDOC BOX#>) / T V

T A R T I N P U T M A N U A L

TART EXECUTION

TART is a public file on the CRAY and can be run from a terminal as a controllee:

TART FILE / T V ,

where FILE is the name of a file containing the input. In this mode all output goes to the high speed printer.

Extra arguments on the execution line either save the output, redirect it, or use special input:

TART FILE A B C / T V

```
Where A=Ø  Printer output goes to HSP
        =F  Printer output goes to FR8Ø (microfiche)
        =NAME  Printer output goes to a file NAME
       B=Ø  Plot of problem goes to FR8Ø
        =NAME  FR8Ø file contains plot of problem
       C=Ø  TARTND cross section library used
        =NAME  Special cross section file NAME
```

PROBLEM TERMINATION AND RESTART

At the end of each sample, the code will respond to the message END or SW1. by printing a long edit and writing a restart file. This restart file may be used to continue the problem at a later time. See RESTART, page 27.

When the problem completes normally, a restart file will also be written. This file may be used to continue a problem by changing the number of samples. See RESTART, page 27.

When a problem is interrupted because it has run out of time or the computer has dead-started, the problem should be restarted by executing the plus-file:

+TARTA / T V

CODE LIMITATIONS

ZONES 300
QUADRATIC BOUNDARY FUNCTIONS 200
PLANES 200
CENSUS TIMES 20*
MATERIALS 40
ISOTOPES 50
ENERGY GROUPS 175

CODE UNITS

TIME .... SHAKE (1.0E-8 SEC.)
LENGTH .... CENTIMETER
SPEED .... CM/SH
ENERGY .... MILLIONS OF ELECTRON VOLTS (MeV)

* This number is not a limit, but is problem dependent. With other sizes (such as number of zones) set at less than the maximum, a problem with more than 20 census times will run.

013

TART INPUT MANUAL

INPUT CARDS IN GENERAL

All cards, with the exception of the NAME, RESTART, and BOX, are field free, space delimited. With the exception of several types that are preceded by a continuation sentinel, all other cards are identified by alphanumeric mnemonics as their first entry. The other entries may be fixed or floating point type data and will be converted to the proper mode by the code. Following the last non-zero entry on a card, all fields are taken to be zero unless specifically set to default values as described below. (Zeroes must be entered if a later entry on a card is non-zero.)

For the purposes of this manual, all mention of input cards is in upper case. In actual practice, all entries are in lower case. See page 44.

SPECIAL CARDS

The first card in a problem deck is the NAME card. This card has a special format (5a8). The first six alphanumeric characters should be unique for each problem because they are used to form the name of the restart file.

The second card in the deck should be the BOX card. See page 5.

Comment cards may be inserted in any sequence in the input file. They are recognized by a space delimited * or C as the first entry.

The END card signals the end of the input. This card has only the word END on it. The END card is not necessary if the last card in the file or deck completes the problem description. Including the END card allows the user to follow it with another problem or alternate cards to be used later.

T A R T   I N P U T   M A N U A L

A MINIMUM SET OF INPUT CARDS

NAME PROBLEM NAME

Where PROBLEM NAME is a string of up to 40 alphanumeric characters to identify the problem. The first six characters should be unique for each problem because they are used to form the name of the restart file.

Example: NAME sample problem 2a

BOX ANN HSP ID

Where ANN directs output to the correct box number and HSP ID is a string of up to 24 alphanumeric characters which will be printed on the output.

Example: BOX g33 problem 2a

ZONEJB Z +B +B ...

Where Z is the number of the zone being described, B is the number of a boundary to describe that zone. The + refers to the sign j as described in the physics manual.(1) Note: The code now generates P (most probable zone) for the user. If more boundaries are needed to describe a zone than can be entered on one card, a space delimited & as the last entry in a card will signal that the next card is a continuation and contains only +B (no ASCII).

```
Example: ZONEJB 2  1 -20 21
         ZONEJB 1  -10 9 7 6 -11 12 &
         14 -3 15
```

See BJP on page 7 for another zone descriptor card.

SURF S K C Z0 X0 Y0 A B

Where S is the boundary number and the other entries are the parameters for the quadratic boundary function:

A(x-X0)**2+B(y-Y0)**2+C(z-Z0)**2=K**2

Default values for A and B are 1.0

Example: SURF 6 6.35 1.

ZPLANE B Z

Where B is the boundary number and Z is the intercept on the z axis.

Example: ZPLANE 21 .914

(1) Ernest F. Plechaty, John R Kimlinger, TARTNP: A Coupled Neutron-Photon Monte Carlo Transport Code, UCRL-50400, Vol. 14

015

```
     MATL M R   F I   F I .. ..
Where M is a material number
      R is the density of the material in g/cm**3
      F is the relative atom-fraction of the first isotope in the material
      I is the isotope (as ZZAAA).  See list of available isotopes, page 37.
```

If more pairs of fractions and isotopes are needed to describe a material than can be entered on one card, a space delimited & as the last entry in a card will signal that the next card is a continuation and contains only pairs of F I (no alphanumerics).

```
 Example: MATL 1 11.36  1 82000
          MATL 2 1.239  .003204 3006 .033863 3007 .001668 24000 .005910 26000 &
          .000903  28000  .000125  42000
```

```
     MATZ M Z1 Z2 ..
```

Where M is a material number assigned to zones Z1 Z2 .. . This material number is defined by the MATL card.

```
 Example:  MATZ 1 1 THRU 20
 Example:  MATZ 2 4 7 15
```

```
     SOURCE1 L X Y Z
```

Where L is the zone in which a point source is to be generated and X, Y, and Z are the coordinates of the point.

```
 Example:  SOURCE1 1 0. 0. 5.3
```

See other geometric sources starting on page 13.

```
     SENTL N1 V1  N2 V2 .. ..
```

Where N1 is a sentinel number associated with a code parameter. These parameters all have default values. A complete listing of sentinel numbers, parameters, and default values is given on page 29.

```
 Example:  SENTL 1 2  25 1  17 .122  3 3000
          Where a sentinel 1 = 2 requests to follow photons only
                          25 = 1 fluorescent photons followed
                          17 = .122 source energy
                           3 = 3000 sample size
```

GEOMETRY CARDS

In the following cards XØ, YØ, and ZØ are the displacement of the center, or axis of symmetry, of the surface from the coordinate origin (Ø,Ø,Ø).

BJP L B JP B JP B JP .. ..

This card describes a zone as being bounded by one or more boundaries. With each boundary is associated a sign and the most probable zone that the particle will enter when it crosses that boundary. This card is used when more than one zone is used to describe the same space. Then all zones must be described by BJP cards (no ZONEJB cards). L is the number of the zone being described, J is the sign associated with that boundary as described in UCRL-5Ø4ØØ, vol. 14, and P is the most probable zone that a particle will enter when it crosses boundary B.

Example: BJP 14 2 -1Ø 4 6 11 -8

CONE S ANG ZØ

Where S is the number of a boundary that is a right circular cone that is revolved about the z axis. ANG is the angle (in degrees) between the z axis and the surface; ZØ is the intercept on the z axis. (An alternate name for this card is ZCONE.)

Example: CONE 7 53.14 -1Ø.

CONERZ S ZØ R Z

Where S is the boundary number of a right circular cone that is revolved about the z axis at ZØ and passes through the point (R,Z).

Example: CONERZ 5 Ø 923.76 -16ØØ

CONE2P S R1 Z1 R2 Z2

Where S is the boundary number of a right circular cone that is revolved about the z axis and passes through the two points (R1,Z1) and (R2,Z2).

Example: CONE2P 7 2134.1 -161Ø. 133.38 -11Ø.

CYL S K XØ YØ

Where S is the boundary number of a right circular cylinder on the z axis of radius K, displaced XØ and YØ.

Example: CYL 1 2.5

ELLIPSE S A B D ZØ XØ YØ
Where S is the boundary number of an ellipse and the other entries are the parameters of the equation:

```
(x-XØ)**2/A**2+(y-YØ)**2/B**2+(z-ZØ)**2/D**2=1.Ø
```

That is, A, B, and D are the radii on the x, y, and z axes and the boundary is displaced XØ, YØ, and ZØ.
Example: ELLIPSE 1 3. 3. 2. 1Ø.

ELLIP2P S ZØ R1 Z1 R2 Z2
Where S is the boundary number of a right circular ellipse revolved about the z axis, centered at ZØ, and passing through two points (R1,Z1) and (R2,Z2).
Example: ELLIP2P 1 1Ø. 2. 11.5 Ø 12.

GENPLANE S X Y Z U V W
A generalized (inclined) plane where S is the boundary number, X, Y, and Z are the coordinates of a point on the plane and U, V, and W are the direction cosines of the unit normal to the plane. An alternate name for this card is GPL.
Example: GENPLANE 5 Ø. 37.48 31.74 Ø. .5736 .8191
Surface 5 is a zy plane passing through the point x=Ø, y=37.48, z=31.74; and the plane intersects the z axis at an angle of 55 degrees (unit normal of 35 deg.).

SPHERE S K ZØ XØ YØ A sphere where S is the boundary number, K is the radius and ZØ, XØ, and YØ are the displacements on the z, x, and y axes Example: SPHERE 1 4. 1Ø.

SPHERE2P S R1 Z1 R2 Z2
A sphere where S is the boundary number of a sphere revolved about the z axis that is described by two points (R1,Z1) and (R2,Z2). R1 and R2 are the cylindric radii at Z1 and Z2.
Example: SPHERE2P 1 3.5 12 1. 6.1

SURF S K C ZØ XØ YØ A B

A surface where S is the boundary number and the other entries are the parameters for the quadratic boundary function:

A(x-XØ)**2+B(y-YØ)**2+C(z-ZØ)**2=K**2

Default values for A and B are 1.Ø

Example: SURF 2 Ø. -.Ø625 Ø . Ø .25 .111111

Boundary 2 is an elliptic cone with radii of 2 and 3 cm. at 4 cm., revolved about the z axis.

XCONE S ANG XØ

Where S is the number of a boundary that is a right circular cone that is revolved about the x axis. ANG is the angle (in degrees) between the x axis and the surface; XØ is the intercept on the x axis.

Example: XCONE 2Ø 45

XPLANE S X

Where S is the number of a boundary that is perpendicular to the x axis and X is the intercept.

Example: XPLANE 1Ø 3.4

YCONE S ANG YØ

Where S is the number of a boundary that is a right circular cone that is revolved about the y axis. ANG is the angle (in degrees) between the y axis and the surface; YØ is the intercept on the y axis.

Example: YCONE 2 3Ø

.PLANE S Y

Where S is the number of a boundary that is perpendicular to the y axis and Y is the intercept.

Example: YPLANE 1 2Ø.

ZCONE S ANG ZØ

See CONE, page 7.

019

ZONEJB Z +B +B ...
Where Z is the number of the zone, B is the number of a boundary to describe the zone. The + refers to the sign j as described in UCRL-50400, vol. 14. A blank is a +. If more boundaries are needed to describe a zone than can be entered on one card, a space delimited & as the last entry on a card will signal that the next card is a continuation and contains only +B +B (no alphanumerics). An alternate name for this card is JB.

It is important to notice that with zones described by ZONEJB cards, the code calculates P, the most probable zone that a particle will enter when it crosses a boundary. These cards should not be used when more than one zone describe the same space (overlapping zones). When overlapping zones occur BJP cards should be used for the entire problem description. See page 7.

Example: ZONEJB 14 -2 3 4 &
-11 12 13

ZPLANE S Z
Where S is the number of a boundary that is perpendicular to the z axis and Z is the intercept.

Example: ZPLANE 3 -15.6

020

ZONAL PROPERTY CARDS

All zonal property cards are of two types:

1. PROP Value Zmin THRU Zmax

Where PROP is the card mnemonic and Value is the constant that is stored in all successive zones Zmin through Zmax.

2. PROP Value Z1 Z2 Z3 ..

Where Value is stored only in zones Z1 Z2 Z3 .. .

A combination of the two types may be used. For example a combination of the three following cards:

```
WEIGHT 4.0 1 THRU 30
WEIGHT 2.0 10 8 12
WEIGHT 1.0 20
```

Zone 20 will have a weight of 1.0
Zones 8, 10, and 12 will have weights of 2.
And the remainder of the zones to number 30 will have a weight of 4.
That is, weights will be assigned according to the last card for that zone.

In the description of the zonal property cards, only the name of the card, the parameter for Value, and a Z will be listed. Each card also has the form Zmin THRU Zmax or Z1 Z2 Z3 .. . See sample problems on page 44.

EMIN E Z

Where E is the minimum energy for neutrons in zone Z. Neutrons are not allowed to fall below this energy after a collision. The default value is SENTL = 8 (or 2.51e-08 MeV if that parameter is not set). A negative value (-E) indicates that if a neutron falls below E after a collision, it will be discarded.
Example: EMIN 1.0e-04 2 THRU 10

EMING E Z

Where E is the minimum energy for photons in zone Z. The default value is SENTL = 9 (-1.0e-04). See EMIN.
Example: EMING 1.0e-4 6 8 10

ETA R Z

Where R is the relative density in zone Z. The relative density is the ratio of the density of the material in the zone to the density used in the material card. Default value is 1.0. This card allows the user to assign the same material, but with different densities, to multiple zones.

LTYPE L Z

Where L is the neutron edit indicator in zone Z. LTYPE allows each zone to have one of the tally types listed for ITN page 34. Default value is the value for SENTL = 5, page 29.

LTYPEG L Z

Where L is the photon edit indicator in zone Z. LTYPEG allows each zone to have one of the tally types listed for ITNG page 34. Default value is the value for SENTL = 33, page 31.

MATZ M Z

Where M is the number of the material assigned to zone Z.

UNITS M Z

Where M is a zone multiplier for zone Z. These constants, used with PROBM or PROBMV cards give additional output for this zone. An alternate name for this card is ZONEMULT.

WEIGHT W Z

Where W is the neutron statistical weight for zone Z. Weights other than 1.Ø are used in high-attenuation problems to force particle flow into regions of interest. Weights must be powers of 2, and ratios of weights of adjacent zones must be 1/2, 1 or 2. The product of weight and number of particles is conserved at a boundary crossing. For example, if a particle crosses from a high-weight zone into a low-weight zone, the particle is split into two particles. If a particle crosses from a low-weight zone into a high-weight zone; on the average, one half of the particles are discarded. The default value is 1.Ø. The default values for WGTGAM (photon weights) are WEIGHT.

WGTGAM W Z

Where W is the photon statistical weight for zone Z. See WEIGHT.

ZONEMULT M Z

Where M is a zone multiplier for zone Z. These constants, used with PROBM or PROBMV cards give additional output for this zone.

022

SOURCE CARDS

The primary name of each source card is for a neutron source. If SENTL = 1 (see page 29) is set to 2 for photons only or to 3 for an independent photon source, a photon source card must be used. The name of each photon source card is given immediately after the neutron source name Other entries on the card are identical.

When describing a source, users should also see the SENTL variables 4, 6,7,17,18,30,31,32,41,42,and 43 starting on page 29.

ANGLSRCE A1 A2
ANGLSRG is the name of photon source.
Where A1 and A2 are angles, between 180 and 0 degrees (A1>A2), within which the source will be generated. The azimuthal angle is uniformly distributed in the interval (0,2pi). The reference direction is the positive z axis. The source is generated with equally probable cosines in the angular interval A2 to A1.
Note: This card replaces SENTL = 6 and 7, page 29.
Example: ANGLSRCE 80.5 45
The source is uniformily distributed between 45 degrees and 80 degrees 30 minutes.
Example: ANGLSRCE 5 0 - source is distributed between 0 and 5 degrees.
Example: ANGLSRCE 180 180 - beamed down the z axis in a negative direction.
Example: ANGLSRCE 0 0 - beamed down the z axis in a positive direction.

EANGL J N(C,J) C(J) N(C,J+1) C(J+1) .. ..
EANGLG is the name of photon source.
This card in conjunction with a ENERANGL card signifies that the source will be chosen from a correlated energy-angle spectrum. N(C,J) and C(J) are pairs of consecutive points where N(C,J) is the relative number of particles generated with a cosine gamma (relative to the z axis) of C(J) for point J. N(C,J+1) and C(J+1) are the values for the next point. See ENERANGL for an example.

EDISCR N1 E1 N2 E2 .. ..
EDISCRG is the name of photon source.
This card specifies that the energy of the source will consist of more than one discrete energy. N1 is the relative number of particles at energy E1, N2 is the number of particles of energy E2, etc.
Example: EDISCR 10 1. 20 10. 20 .001 50 .1 50 .05
6.7% of this source will have an incident energy of 1 MeV, 13% 10 MeV, etc.

EHIST J N(E,J) E(J) N(E,J+1) E(J+1) .. .. Ø EMAX
EHISTG is the name of photon source.
Where N(E) and E are pairs of points to describe a source energy spectrum in histogram form. J is an index for the first point on each card and N(E)J is the number of particles between E(J) and E(J+1). The last N entry is Ø. See ESPEC, page 14, for a description of the output.

```
 Example: EHIST 1 Ø.Ø1433 6.7743 Ø.Ø1Ø1Ø 7.5479 Ø.ØØ7873  8.3633
          EHIST 4 Ø.ØØ42Ø4  9.22Ø5  Ø.ØØ6741  1Ø.12Ø  Ø.ØØ2363  11.Ø6Ø
          EHIST 7 Ø.ØØ3448  11.547  Ø.ØØ3121  12.Ø43  Ø.ØØ4434  12.55Ø
          EHIST 1Ø Ø.Ø245Ø  13.Ø68  Ø.Ø2234  13.863  Ø.Ø26Ø9  14.134
          EHIST 13 Ø.Ø1429  14.4Ø7  Ø.Ø  15.242
```

ENERANGL J E(J) C(J) E(J+1) C(J+1) E(J+1) C(J+1) E(J+2) ..
ENRANGLG is the name of photon source.
This card in conjunction with a EANGL card signifies that the source will be chosen from a correlated energy-angle spectrum. E(J) is the energy of the source for particles generated with a cosine gamma of C(J). E(J+1) C(J+1), E(J+2) C(J+2) are the values for consecutively following points.

```
 Example: EANGL 1  1.     1.    .996   .93969  .98455  .766Ø4
          EANGL 4  .9672  .5    .94622 .17365  .924278 -.17365
          EANGL 7  .9Ø4ØØ6  -.5  .887732   -.766Ø4 .877232 -.93969
          EANGL 1Ø  .8736  -1.Ø
          ENERANGL 1  15.1Ø6 1.Ø  15.Ø45  .93969 14.859  .766Ø4
          ENERANGL 4  14.6Ø5  .5  14.286  .17365 13.955  -.17365
          ENERANGL 7  13.651 -.5  13.5Ø7  -.766Ø4   13.251  -.93969
          ENERANGL 1Ø  13.197 -1.Ø
```

ESPEC J N(E,J) E(J) N(E,J+1) E(J+1) .. ..
ESPECG is the name of photon source.
Where J is an index and N(E) E are pairs of consecutive points to describe an energy spectrum from which the source particles will be randomly generated. The code will integrate the function between points and divide it up into 1ØØ1 equally probable energies. N(E) is the number of particles per unit energy at energy E (in MeV) at point J. N(E,J+1) and E(J+1) describe point J+1. The code assumes that the consecutive pairs of points are connected by a straight line of the form AE + B and integrates over energy to obtain the number of neutrons in each interval.

```
 Example: ESPEC 1 Ø.1822   Ø.75Ø  Ø.1936   1.Ø245   Ø.1867   1.3381
          ESPEC 4 Ø.15ØØ  1.6936  Ø.1339  2.Ø9Ø8  Ø.1ØØ9  2.5299
          ESPEC 7  Ø.Ø7593   3.Ø1Ø8  Ø.ØØ26Ø   3.5335  Ø.Ø5219   4.Ø
```


024

FSPEC J F(E,J) E(J)   F(E,J+1) E(J+1)   .. ..
FSPECG is the name of photon source.

This card signifies the source energy will be generated from a spectrum made of pairs of consecutive points F(E,J) and E(J). The N(E,J) as described in ESPEC is defined as N(E,J) = F(E,J) / E(J) .

Example: FSPEC 1 Ø .Ø1 .Ø6 .1 .18 .26 .25 .34 .39 .56 .36 .74
FSPEC 7 .27 1.16 .2Ø 1.18 .14 2.3 .Ø49 3.3 .Ø48 3.7 .Ø25 4.4
FSPEC 13 .Ø11 5.5 .ØØ53 6.6 Ø 8.Ø1

MAEC I W C1 C2 T1 T2
MAECG is the name of photon source.

This card, in conjunction with a MAEE card (or cards), signifies that the source will be generated from multiple angle-energy spectra. I is a spectrum number which is identical to I on the MAEE cards. W is the relative number of particles to generate from this spectrum. C1 and C2 are the cosines with respect to the z axis between which the particles will be generated. If SOURCE6 (page 17) is used, the reference direction for the cosines is determined by that card. T1 and T2 are starting times between which the particles will be generated. See MAEE for an example. Also see SOURCE13, page 19, for another use of C1 and C2.

MAEE I J N(E,J) E(J)   N(E,J+1) E(J+1) ..
MAEEG is the name of photon source.

This card, in conjunction with a MAEC card, signifies that the source will be generated from multiple angle-energy spectra. The spectrum number I is identical to the I on the MAEC card. J is an index and N(E,J) is the number of particles at energy E(J). See ESPEC, page 14.

Example: MAEC 1 167 1. .9
MAEE 1 1 3.Ø8e-Ø7 3.316e-Ø2 9.26e-Ø7 6.74e-Ø2 5.86e-Ø6 9.6e-Ø2
MAEE 1 4 2.56e-Ø6 .135 8.27e-Ø5 .318 2.4e-Ø4 .76
MAEE 1 7 2.19e-Ø4 2.Ø2 5.46e-Ø5 5.2 3.Ø8e-Ø7 1Ø.5
MAEC 2 753 .9 .866
MAEE 2 1 6.17e-Ø7 4.73e-Ø2 4.6e-Ø6 7.8e-Ø2 1.Ø4e-Ø5 .1
MAEE 2 4 1.99e-Ø4 .18 6.2e-Ø4 .42 1.Ø1e-Ø3 1.
MAEE 2 7 5.6e-Ø4 2.8 1.6e-Ø4 9.5

MAEEH I J N(E<J) E(J) N(E,J+1) E(J+1) .. ..Ø EMAX

MAEEHG is the name of photon source.

This card is identical to MAEE with the exception that the input spectrum is in histogram form. See EHIST, page 14.

```
Example: MAEC  1  177 -.86 -.9
         MAEEH 1  1  3.Ø8e-Ø7 .Ø33  3.Øe-Ø7 .Ø47  1.23e-Ø4 .56  2.42e-Ø4 .75
         MAEEH 1  5  2.41e-Ø4  1.  2.42e-Ø4  1.4  3.7e-Ø5  6.5  5.8e-Ø6  8.3
         MAEEH 1  9  3.Ø864Øe-Ø7 1Ø.  Ø. 13.
         MAEC  2  743 -.9 -1.Ø
         MAEEH 2  1  3.Ø8e-Ø7 .Ø33  6.17e-Ø7 .Ø47  5.Ø6e-Ø5 .11  1.14e-Ø4 .13
         MAEEH 2  5  1.99e-Ø4  .18  2.85e-Ø4  .24 2.8e-Ø4  4.1  1.99e-Ø4  5.1
         MAEEH 2  9  1.5926Øe-Ø4  6.6  3.179ØØe-Ø5  8.  Ø. 1Ø.
```

SOURCE1 L X Y Z

S1G is the name of photon source.

Where L is the zone in which a point source is to be generated and X, Y, and Z are the coordinates of the point.

Example: SOURCE1 1Ø Ø Ø -23.1

This source is generated in zone 1Ø with coordinates x=Ø., y=Ø., and z=-23.1.

SOURCE2 L Ri Ro ZØ LEN XØ YØ

S2G is the name of photon source.

Where Ri and Ro are the inner radius and and outer radius of a source uniformly distributed in a cylindrical volume. The cylinder is rotated about the z axis and is of length LEN, starting with z=ZØ. It is in zone L and is displaced on th x and y axes by XØ and YØ. Note: If LEN=Ø, the source is a disk at z=ZØ. See page 31, SENTL = 3Ø, to exchange the axis.

Example: SOURCE2 1Ø Ø 5. -4Ø. 1ØØ.

This is a cylindrical source of radius 5.Ø , between z=-4Ø.Ø and 6Ø.

SOURCE3 L Ri Ro ZØ XØ YØ A1 A2

S3G is the name of photon source.

This source in zone L is uniformly distributed throughout a spherical shell or a segment of a spherical shell with inner radius Ri and outer radius Ro, centered at XØ, YØ, and ZØ. The segment of the shell extends from angle A1 to A2. The defaults for A1 and A2 are 18Ø and Ø degrees, which define the source as being generated over a complete sphere.

Example: SOURCE3 5 16ØØ 17ØØ Ø Ø Ø 9Ø Ø

The source is generated throughout the positive half (9Ø to Ø degrees) of a spherical shell with inner radius 16ØØ. and outer radius 17ØØ. centered at the origin.

SOURCE4 L R ZØ XØ YØ A1 A2

S4G is the name of photon source.

This source in zone L is uniformily distributed on a segment of a spherical surface. The surface is centered at XØ, YØ, and ZØ, with a radius of R. The segment of the surface is defined by A1 and A2 as described in SOURCE3.

Example: SOURCE4 1 1Ø. Ø Ø Ø 18Ø 9Ø

This source is generated in zone 1 over the surface of the negative hemisphere (18Ø to 9Ø degrees) of radius 1Ø.Ø centered at the origin.

SOURCE5 L ZØ ZLEN XØ XLEN YØ YLEN

S5G is the name of photon source.

Where this source is equally distributed over, or throughout a line, plane, or a rectangular volume in zone L. Space for the source is described as:

x=XØ+XLEN
y=YØ+YLEN
z=ZØ+ZLEN

with all extensions in a positive direction.

Example: SOURCE5 1 -1ØØ. 2ØØ. -1ØØ. 2ØØ. -1ØØ. 2ØØ.

SOURCE6 L X1 Y1 Z1 X2 Y2 Z2

S6G is the name of photon source.

Where L is the zone in which a point source is generated at the coordinates X1, Y1, and Z1 with the reference direction for its angular distribution defined by the line joining the source point and the point (X2,Y2,Z2). This angular distribution is provided for in ANGLSRCE, page 13.

Example: SOURCE6 1 -1. Ø -1.

SOURCE9 L W RI RO ZØ XØ YØ T

S9G is the name of photon source.

This source consists of particles uniformily d :ributed throughout the volume of more than one sprerical shell. (One SOURCE9 card per shell.) The shell is in zone L, of relative number W, with an inner rarius RI and outer radius RO, displaced from the origin by ZØ, XØ, and YØ. It will have a starting time coordinate T.

Example: SOURCE9 1 5Ø Ø 1.
SOURCE9 4 1Ø 3. 4.
SOURCE9 7 2Ø 6. 7.

SOURCE1Ø L W RI RO ZI LEN XØ YØ T

S1ØG is the name of photon source.

This source consists of particles uniformly distributed throughout the volume of more than one cylindric shell rotated about the z axis. (One SOURCE1Ø card per shell.) The shell has an inner radius of RI, outer radius RO, and a length of LEN starting at z=ZI. It is displaced by XØ and YØ and has a starting time of T.

```
 Example: SOURCE1Ø 4 1Ø 3. 4. -1. 2.
          SOURCE1Ø 7 2Ø 6. 7. -1. 2.
          SOURCE1Ø 1Ø 1Ø 9. 1Ø. -1. 2.
```

S9OR1ØE I J N(E,J) E(J)   N(E,J+1) E(J+1) .. ..

S9OR1ØEG is the name of photon source.

This card, in conjunction with a previous SOURCE9 or SOURCE1Ø card, assigns a set of one or more discreet energies to be used as the initial energy for each geometric shell previously described. I is the number of the shell and J is an index. N(E,J) and E(J) are the relative number of particles at energy E.

```
 Example: S9OR1ØE 1 1 5Ø .1  5Ø .Ø5
          S9OR1ØE 2 1 33.3 .Ø4  33.3 .Ø3  33.4 .Ø2
          S9OR1ØE 3 1 5Ø .Ø1  1Ø .ØØ8  2Ø .ØØ6  2Ø .ØØ4
```

S11CONE L W ZØ Z1 Z2 A1 XØ YØ

S11CONEG is the name of photon source.

This source is uniformily distributed on the surface of a right circular cone that is revolved parallel to the z axis and is directed inward with a cosine distribution. The source may also include S11SPH, S11CYL, and S11DSK cards. The source is in zone L and W is the relative number of particles. The source is between Z1 and Z2 with an angle of A1 degrees as measured from the z axis. The surface is displaced on the x and y axes by XØ and YØ.

```
 Example:  S11CONE 7 2Ø Ø 1595 16Ø5 3Ø.Ø5
```

S11CYL L W R Z1 LEN XØ YØ

S11CYLG is the name of photon source.

This source is uniformily distributed on the surface of a cylinder rotated about the z axis and is directed inward with a cosine distribution. The source may also include S11CONE, S11SPH, and S11DSK cards. The source is in zone L and of relative strength W. The surface has a radius of R and is of length LEN starting at the z intercept Z1 and is displaced by XØ and YØ.

```
 Example:  S11CYL 18 1ØØ 136Ø. -14ØØ. 1ØØ.
```

S11DSK L W RI RO ZØ D XØ YØ
S11DSKG is the name of photon source.
This source is uniformly distributed on the surface of a disk that is perpendicular to the z axis and is directed away with a cosine distribution. The source may also include S11CONE, S11CYL, and S11SPH cards. The source is in zone L and of relative strength W with radii RI and RO. The disk is at ZØ displaced by XØ and YØ. D is +1 or -1 indicating the direction of the normal to the surface. (-1 indicates a source beamed in the positive direction.)
Example: S11DSK 18 1ØØ 12ØØ 125Ø -124Ø 1

S11SPH L W R ZØ XØ YØ A1 A2
S11SPHG is the name of photon source.
This source is uniformily distributed on a segment of a spherical surface and is directed inward with a cosine distribution. The source may also include S11CONE, S11CYL, and S11DSK cards. The source is in zone L and of relative strength W. The surface is centered at XØ, YØ, and ZØ with a radius of R. The segment of the surface is defined by A1 and A2 as described in SOURCE3, page 16.
Example: S11SPH 7 2Ø 17Ø1 Ø Ø Ø 42.8 3Ø

SOURCE12 FILE
This source is read from a file or files written by a previous problem using tally type 12. Particles will be read from files named cordØ,cord1,etc. FILE is the name of the last source file.
Example: SOURCE12 CORD2

SOURCE13 L R ZØ XØ YØ A1 A2
S13G is the name of photon source.
This source uses cards MAEC and MAEE (or MAEEH) to generate multiple angle-energy spectra. The cosines described on card MAEC will be generated relative to the normal of the spherical surface described here. L is the zone of generation. The surface is centered at XØ, YØ, and ZØ and has a radius R. The segment of the surface is defined by A1 and A2 as described in SOURCE3, page 16.
Example: SOURCE13 1 4.

TIMDIST J T(J) T(J+1) T(J+2) ...
TIMDISTG is the name of photon source.

This card signifies that the time coordinate of the source particles will be chosen from the equally probable entries T(J). The time coordinate is sampled in such a way that the initial time coordinate is chosen with equal probability from each interval and is chosen uniformly within the interval. Time is in shakes (1.Øe-Ø8 sec.). T(J) is the lower time entry for interval J. T(J+1) T(J+2) ... are the entries for consecutively following intervals.

Example: TIMDIST 1 Ø. 1.ØEØ4 1.ØEØ6 1.ØEØ8

TIMSPEC J N(T,J) T(J) N(T,J+1) T(J+1) .. ..
TIMSPECG is the name of photon source.

This card signifies that the time coordinate of the source particles will be chosen from a time spectrum made of consecutive pairs of points N(T) and T. N(T,J) is the relative number of particles per shake at time T(J) for point J. The code assumes that consecutive pairs of points are connected by a straight line of the form at+b; and it integrates over time to obtain the number of particles in each interval.

Example: TIMSPEC 1 4716. Ø. 431Ø. .Ø345 2852. .Ø597 3652. .1Ø42
TIMSPEC 5 656 .2795 7Ø.22 .5921 25.8 3.Ø46

030

MISCELLANEOUS CARDS

ANGG J I(J) I(J+1) I(J+2) ...

This card provides a way to change the photon energy tally group limits for tally types 7, 8, 9, and 10. (These types have a special edit of angular distribution by energy.) See the default set of 13 limits on page 41. I(J) is the number of the photon tally group assigned as the lower boundary to group J for the angular distribution edit and I(J+1) is the upper limit. I(J+2) is the number of the upper limit for group J+1. The maximum number of limits that can be entered is 25.

```
 Example: ANGG 1 1 3 6 9 12 14 17 18 20 22 24 26 28
          ANGG 14 29 30 31 34 36 37 38 40 42 45 47 51
```

ANGN J I(J) I(J+1) I(J+2) ...

This card provides a way to change the neutron energy tally group limits for tally types 7, 8, 9, and 10. See ANGG for a description.

```
 Example: ANGN 1 1 2 3 4 5 6 9 15 19 21 24 26
          ANGN 13 29 31 34 35 38 41 43 46 49 50 51
```

CENTIM T1 T2 ...

Where T1 T2 .. are the times (in shakes) at which various output quantities in their respective time interval are accumulated and edited. The default value for T1 is 1.0e+08. If more times are needed than can be entered on one card, a space delimited & as the last entry on a card will signal that the next card is a continuation and contains only times.

```
 Example:  CENTIM 500 1.0e6
```

CHEGP J I(J) I(J+1) ...

This card signifies that fewer than the standard 175 neutron energy groups will be used for tracking the neutrons. See page 38 for the standard group limits. I(J) is the group number from that set that will be the lower limit for group J. I(J+1) I(J+2) ... are the lower limits for consecutively following energy groups. The set of new limits must include the following: 1, 7, 25, 92, 114, and 176.

This card allows the user to change the group energy bounds and consequently, the group averaged cross sections, to a sub-set of the standard 175 groups. This option is not recommended. When the CHEGP option is used, CNEUTAL cards must also be used to select tally limits from the sub-set of the collapsed group structure.

```
 Example: CHEGP 1 1 7 25 67 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93
          CHEGP 22 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110
          CHEGP 39 111 112 113 114 115 116 117 118 130 140 158 160 162 164 176
```

CNANG J C(J) C(J+1) C(J+2) ...

This card provides a method of changing the values of the cosines used as the bin limits for neutron tally types 7, 8, 9, and 1Ø. The default set is given on page 41. C(J) is the cosine value assigned to the angular distribution group J. C(J+1) is the next succesive (increasing or decreasing) cosine for group J+1. The maximun number of cosines that can be entered is 2Ø. The values are truncated to the least one-hundredth (e.g., Ø.989=Ø.98).

```
Example: CNANG 1 1. .98 .96 .94 .92 .9 .88 .8 .7 .6 .5 Ø -.3
         CNANG 14 -.5 -.8 -.9 -.94 -.96 -.98 -1.
```

CPANG J C(J) C(J+1) C(J+2) ...

This card provides a method of changing the values of the cosines used as the bin limits for photon tally types 7, 8, 9, and 1Ø. See CNANG for a description.

```
Example: CPANG 1 -1. -.98 -.95 -.9 -.8 -.6 -.4 Ø .4 .5 .6
         CPANG 12 .7 .8 .88 .92 .94 .96 .98 1.
```

CNEUTAL J I(J) I(J+1) I(J+2) ..

This card signifies that the energy limits on the standard 5Ø neutron tally groups will be changed. See page 4Ø for the list of default values. I(J) is the group number from the standard set that will be the lower limit for group J. I(J+1) I(J+2) .. are the lower limits for consecutively following tally groups.

```
Example: CNEUTAL 1 1 3 5 12 16 19 21 23 26 32 38 41 46 56 67 74 81 84
         CNEUTAL 19 89 91 94 96 99 1Ø1 1Ø2 1Ø3 1Ø4 1Ø! 1Ø7 1Ø9 111 112 113 114
         CNEUTAL 35 117 119 121 123 124 126 126 128 132 133 137 141 143 15Ø
         CNEUTAL 49 157 166 176
```


032

CPHOTAL J I(J) I(J+1) I(J+2) ..

This card signifies that a special set of photon tally groups will be used. I(J) is the number of the photon energy group assigned as the lower boundary for tally group J and I(J+1) is the upper limit. I(J+2) is the upper limit for tally group J+1 (or lower limit for group J+2). As default, the code uses a basic set of 50 tally groups (51 limits) for output. See page 40.

Example: See sample problem, page 44.

CRITCALC J N STAT DELT

This card signifies that a reactivity calculation will be called instead of the transport code. If the DELT variable is included on the card, the calculation will be the decay constant (alpha) and the dynamic reactivity (k). Otherwise it will be static reactivity (k). J is the number of settle cycles to follow before starting the calculation. N is the number of replications of the calculation (default is 1). STAT is the cutoff percentage on the value of the calculation (default is 10). DELT is the time step to be used in the dynamic calculation. SENTL = 2 (nsors-number of samples to follow) and SENTL = 3 (nsamp- sample size) are important inputs for reactivity calculations. Nsors is a maximum number of batches to follow before stopping the calculation. (The normal method is when STAT is reached.) Nsamp should be in the range 300 - 1000 to keep the problem size within a reasonable range.

Example: CRITCALC 10 2 2 .30

EDIF J E(J) E(J+1) E(J+2) ..

Where E(J) is a neutron tally multiplier for tally group J and E(J+1) E(J+2) are the multipliers for consecutively following groups. This card sets SENTL = 28 to 2.

Example:
```
EDIF 1 4.00e-11  2.20e-11  8.00e-12  4.20e-12  2.30e-12  1.90e-12
EDIF 7 1.60e-12  1.30e-12  1.20e-12  1.10e-12  1.10e-12  1.10e-12
EDIF 13 1.20e-12  1.30e-12  1.70e-12  2.70e-12  4.40e-12  7.00e-12
EDIF 19 1.00e-11  1.40e-11  2.20e-11  3.10e-11  4.60e-11  6.40e-11
EDIF 25 8.40e-11  1.20e-10  1.70e-10  2.30e-10  3.20e-10  4.40e-10
EDIF 31 5.40e-10  6.00e-10  7.00e-10  9.20e-10  1.15e-09  1.30e-09
EDIF 37 1.50e-09  1.65e-09  1.80e-09  2.00e-09  2.30e-09  2.70e-09
EDIF 43 3.00e-09  3.30e-09  4.00e-09  4.10e-09  4.40e-09  5.00e-09
EDIF 49 6.00e-09  6.90e-09
```

EDIFG J E(J) E(J+1) E(J+2) ..

Where E(J) is a photon tally multiplier for tally group J and E(J+1) E(J+2) are the multipliers for consecutively following groups. This card sets SENTL = 29 to 2.

MATL M R F I F I .. ..

Where M is a material number

R is the density of the material in g/cm**3

F is the relative atom-fraction of the first isotope in the material

Note: F need not be normalized

I is the isotope (as ZZAAA). See list of available isotopes, page 37.

If more pairs of fractions and isotopes are needed to describe a material than can be entered on one card, a space delimited & as the last entry in a card will signal that the next card is a continuation and contains only pairs of F I (no ASCII).

Example: MATL 2 1.5 .32 1ØØ1 .25 6Ø12 .2 7Ø14 .2 8Ø16

MATLWP M R F I F I ..

Where all parameters are the same as for MATL except that F is the weight fraction of the isotope.

Example: MATLWP 1. .Ø775 1ØØ1 .9225 6Ø12

MCVDISK FRAC RI RO I SMAX XØ YØ AXIS ZCHECK

This card provides a method to statistically calculate the volumes of zones that are bounded by three-dimensional boundaries. An additional option checks whether or not all space within a certain volume is described correctly. The procedure is that at input generation time, some particles are beamed down an axis in a positive direction with a record being kept of each zone they traverse. FRAC is the number of particles per square centimeter to follow. The area of generation is a circular disk described by the radii RI and RO. I is the intercept on the axis where this special source originates. SMAX is some maximum distance that can be traversed in the problem. XØ and YØ are displacements of the source on the x and y axes. If AXIS is Ø, the source will be beamed down the z axis (1=x axis, 2=y). If ZCHECK is set to 1, the zone and space check option is turned on. With this option, the geometry input is searched to find duplicate mapping as well as parts of the problem that are not described.

Example: MCVDISK 1Ø. Ø. 6.4 -7. 8 Ø Ø Ø 1

MCVPLANE FRAC X1 X2 Y1 Y2 I SMAX AXIS ZCHECK

This card provides the same options as MCVDISK with the difference being that the source is generated over a rectangle defined by the points (X1, X2, Y1, Y2). When AXIS = 1, X1 and X2 are the points (Z1,Z2). When AXIS = 2, Y1 and Y2 are the points (Z1,Z2).

Example: MCVPLANE 1ØØ. -6.4 6.4 -6.4 6.4 -7. 8. Ø 1

C34

PLOTZR ZMIN ZMAX RMIN RMAX
Where ZMIN and ZMAX define that portion of the problem which the user wants to plot. To define a rectangle off the z axis, RMIN and RMAX are also required.
Example: PLOTZR -2Ø. 2Ø.

PROBM P1 P2 ..
Where P1 P2 .. are problem multipliers. The energy deposited and fissions by zone and time step (expressed in MeV/g) are multiplied by these conversion factors. See SENTL = 35,36 (page 32) for another use of PROBM.
Example: PROBM 8.52E+Ø4 48.5Ø

PROBMV P1 P2 ..
Where P1 P2 .. are as in PROBM except the output is in MeV/cm3.

REACTED L I1 I2 ..
Where L is the number of the zone in which the individual neutron reactions of isotopes I1, I2 ... are to be tallied. If I1 I2 .. are not listed, all the reactions of all the isotopes in zone L will be edited. In addition, a zone must have LTYPE = 1 (expected collisions) or LTYPE = 2Ø (Monte Carlo collisions) to be edited. If neither of these options is selected, the code will set the LTYPE for zone L to 1. When reaction edits are requested the number of neutron tally groups is changed from 5Ø to 175. To print the totals only and suppress printing the entire array by energy , set SENTL = 23 to 1 (See page 31).
Example: REACTED 4 3ØØ6

035

A note about the next five cards:

The code uses specular reflection to reflect neutrons and photons off a boundary when a zone is labeled as a reflection zone. For this type of reflection the code calculates the normal to the surface that the incident particle crossed entering the reflection zone and derives the direction cosines such that the incident particle, the surface normal, and the reflected particle are co-planar.

REFLX L1 L2 ..
Where L1 L2 .. are the zones from which particles that enter will be reflected by changing the sign of the direction cosine with respect to the x axis. These zones are only described by one boundary, an XPLANE.
Example: REFLX 10

REFLY L1 L2 L3 ..
Where L1 L2 .. are the zones from which particles that enter will be reflected back into the problem by changing the sign of the direction cosine with respect to the y axis. These zones need only be described by one boundary, a YPLANE.
Example: REFLY 5 9

REFLZ L1 L2 ..
This card signifies that particles that enter zones L1 L2 .. will be reflected back into the problem by changing the sign of the direction cosine with respect to the z axis. These zones need only be described by a ZPLANE.
Example: REFLZ 10 2

REFLQ L1 L2 ..
Where L1 L2 .. are zones from which particles that enter will be reflected back into the problem as if they reflected from a surface described by the quadratic equation in SURF, page 9. These zones need only be described by one quadratic boundary.
Example: REFLQ 2 49 11

REFLGP L1 L2 L3 ..
This card signifies that particles that enter zones L1 L2 L3 .. will be reflected back into the problem as if they reflected from a generalized plane. See GENPLANE page 8. These zones need only be described by one GENPLANE boundary.
Example: REFLGP 50 60

RESTART FILE

Where FILE is the name of a restart file. This card specifies that no other cards are following and that the code is to continue a problem from the specified restart file. If no file is given, the code forms the name of the restart file from the NAME card. When restarting a problem, only BOX, NAME, and SENTL cards will be recognized. The only SENTL values that can be changed are SENTL = 2, 11, 21, and 23.

Example: RESTART T+OFFSET

T1819 L R Z N L1

This card provides necessary input for any zones that are assigned tally types 18 or 19 which collect particles in those zones, move them to a surface, and then redirect along the z axis. If the collection surface is a disk, this card is sufficient to describe the input. Otherwise, a following T18SPH or T18DPL card is necessary. L is the zone number in which the collection surface is located. R is the radius of the disk or spherical surface. Z is the z-coordinate of the disk or the displacement on the z axis of the spherical surface. N is the number of times each particle is to be replicated (default value is 1.Ø). The output from zones numbered L1 or greater will be normalized by N. The default for L1 is L.

Example: T1819 1Ø3 .1 2Ø.

T18SPH A1 A2 XØ YØ

This card, in conjunction with a T1819 card, describes the spherical surface used as a collector surface for zones with tally types 18 or 19. The segment of the surface extends from angle A1 to A2 (A1>A2) and the surface is displaced on the x and y axes by XØ and YØ.

Example: T18SPH 4.12

T18DPL A1 A2 XØ YØ X1 Y1 Z1

This card, in conjunction with a T1819 card, describes a displaced spherical surface used as the collector surface for zones with tally types 18 or 19. The segment of the surface extends from angle A1 to A2 (A1>A2) and the surface is displaced on the x and y axes by XØ and YØ. The origin of the surface is displaced on the x, y, and z axes by X1, Y1, and Z1.

Example: T18DPL Ø.12 Ø Ø Ø .Ø6

XSEC I R J S(J) S(J+1) S(J+2) ...

This card signifies that the group averaged neutron cross sections for isotope I, reaction R, starting with energy index J will be replaced by S(J), S(J+1), S(J+2) ... are the replacements for consecutively following groups. If more changes are needed than can be entered on one card, a space delimited & as the last entry on a card will signal that the next card is a continuation and contains only values of S (no alphanumerics). See page 42 for a list of possible reactions. The utility routine LREACT will list the reactions for each isotope (see page 43).

```
Example: XSEC 92238 46000  19  3.51740e+00  6.02480e+00  6.45440e+00  &
         4.39040e-01 9.68330e-02 2.06120e-01 3.94500e-01 1.96470e+00   &
         3.91950e+00 5.43470e+00 4.20760e+00
```

SENTL INPUT

SENTL	Variable	Default	Explanation and optional inputs
1	ineut	Ø	Transport sentinel If =Ø follow neutrons and neutron induced photons =1 follow neutrons only =2 follow photons only =3 follow neutrons and neutron induced photons plus an independent photon source
2	nsors	2Ø	Number of samples to follow
3	nsamp	5ØØØ	Sample size
4	vn	Ø	Neutron source energy in MeV Ø= fission spectrum
5	itn	3	Neutron edit indicator (neutron tally type) Itn is the default neutron tally type for any zone which does not have an LTYPE card. Itn=3 is neutrons entering a zone. See page 34 for list of optional values.
6	s6	2.Ø	Angular distribution of neutron source The angular distribution of the source is such that the cosine of the angle between the particle and a reference direction is uniformly distributed in the interval (s7,s6+s7); that is, the cosine is computed from s6*r+s7, where r is a random number between Ø. and 1. The azimuthal angle is uniformly distributed in the interval (Ø,2pi). The reference direction is the positive z axis. An isotropic source is obtained from the default values of 2.Ø for s6 and -1.Ø for s7. A source beamed in the positive direction down the z axis is obtained by setting s6 to Ø. and s7 to 1.Ø. Also see card ANGLSRCE page 13 .
7	s7	-1.Ø	See previous entry
8	emin	2.51e-Ø8	Minimum energy in MeV for neutrons. A negative value indicates that if a neutron is below that energy it will be discarded.
9	eming	-1.Øe-Ø4	Minimum energy in MeV for photons. Negative value indicates that if a photon is below that energy it will be discarded.
1Ø	fudge	.ØØØ5	This is the amount added to the distance a particle is advanced to ensure that it will be in a new zone.

039

SENTL	Variable	Default	Explanation and optional inputs
11	jq	0	Alphanumeric name of output file to be created in which special input and output is stored. The contents of this file is given on page 35.
12	jr	0	Initial random number sentinel If =0 use regular initial random number =1-5 use different initial random numbers =6 use 7600 random number sequence >6 use random initial random number
13	s13	2.5e-08	Minimum energy cutoff for writing neutrons into zones with tally types 11 and 12.
14	s13g	1.0e-04	Minimum energy cutoff for writing photons into zones with tally types 11 and 12.
15	s16g	20.0	Maximum energy cutoff for writing photons into zones with tally types 11 and 12.
16	s16	20.0	Maximum energy cutoff for writing neutrons into zones with tally types 11 and 12.
17	vng	0	Photon source energy in MeV. 0= fission spectrum
18	gpn	0	Number of source photons per neutron. Gpn is the number of source photons to follow for each source neutron when SENTL = 1 is set to 3. This variable must be set when following neutrons and an independent photon source, or the problem will terminate after following only one neutron sample.
19-20	not used		
21	is21	20	Number of samples to skip before long edit The code automatically will give a full edit for the first and last sample . This input parameter allows the user to receive only short edits for the remainder of the samples. An entry of -1 will give a long edit for every sample.
22	mfps	0	Print mean free path sentinel An entry of 1 will inhibit printing the mean free paths, cross section probabilities, and energy deposits in the generator part of the code.

SENTL	Variable	Default	Explanation and optional inputs
23	irs	Ø	Print reaction edit sentinel This sentinel allows the user, when requesting reaction edits with a REACTED card, to inhibit the printing of reaction edits for each energy group. An entry of 1 will print only the total of each reaction edit for each zone requested.
24	nx	Ø	Next problem sentinel An entry of 1 signals that another problem immediately follows the END card of this problem.
25	ia13	Ø	Photon fluorescence sentinel An entry of 1 signals that fluorescent photons will be followed.
26	ia7	Ø	Collision sentinel =Ø emission neutronics =1 reaction neutronics
27	ia3	32	Anisotropic angular distribution intervals Optional input is 16, 8, or 4
28	edif	Ø	Neutron energy-difference edit indicator If =1 the output tallies for each zone by energy and time will be repeated with each tally divided by the difference in energy for each tally group. If =2 the output will be multiplied by an input constant for each tally group. This input will be read in on cards EDIF.
29	igsent	Ø	Photon energy-difference edit indicator =1 and 2 as neutron edits in previous entry
3Ø	jm	Ø	Switch spacial coordinates in neutron source If 1 set y=z and z=y If 2 set x=z and z=x If 3 set y=-z and z=y If 4 set x=-z and z=x If 5 set z=-z
31	tn	Ø.Ø	Set initial neutron time coordinate to tn
32	s2	Ø	Switch direction cosines in neutron source If 1 set v=w If 2 set u=w If 3 set v=-w If 4 set u=-w If 5 set w=-w Where u, v, and w are the direction co_ines on the x, y, and z axes.

041

SENTL	Variable	Default	Explanation and optional inputs.
33	itng	3	Photon edit indicator (photon tally type) See page 34 for optional values.
34	s14	1.29	Maxwellian distribution temperature for input energy spectrum.
35	ia23	0	Sentinel for extra distribution-by-energy edits This option allows for additional edits that are tallied by tally type over zone, time step, and energy tally group. If =1 the output will be multiplied by each problem multiplier entered on a PROBM or PROBMV card. If =2 the output will be divided by the volume of each zone. There will also be an edit per volume multiplied by each problem multiplier. If =3 the output will be modified by the zone multipliers entered on UNITS cards. There will also be an edit for each problem multiplier times the zone multiplier. If =4 the output will be as ia23=3, but will also be divided by the volume of each zone. If =5 as ia23=3, but in addition, the output will be multiplied by energy group multipliers read in by EDIF cards or the output will be divided by the difference in energy for each group when SENTL 28 = ?. If =6 as ia23=2, but the output will be divided by the mass of each zone. If =7 as ia23=3, but the output will be divided by the mass of each zone.
36	ia24	0	Sentinel for extra angular distribution edits This option allows for additional edits that are tallied by angle and energy for zones with tally types 7, 8, 9, or 10. The input options are identical to Sentl = 35.
37	ia27	0	Sentinel to list the neutron cross sections If =1 the generator will list the neutron cross sections for each isotope in the problem by reaction type and energy.
38	nu	0	Sentinel to set nu for fission to zero
39	itherm	0	Probability table method sentinel

042

SENTL	Variable	Default	Explanation and optional inputs
4Ø	olf	Ø	Create file in old input format Input is the alphanumeric name of an output file into which the input will be converted to the old format.
41	s6g	2.Ø	Angular distribution of photon source The angular distribution of the source is such that the cosine of the angle between the particle and a reference direction is uniformly distributed in the interval (s7g,s6g+s7g); that is, the cosine is computed from s6g*r+s7g, where r is a random number between Ø. and 1. The azimuthal angle is uniformly distributed in the interval (Ø,2pi). The reference direction is the positive z axis. An isotropic source is obtained from the default values of 2.Ø for s6g and -1.Ø for s7g. A source beamed in the positive direction down the z axis is obtained by setting s6g to Ø. and s7g to 1.Ø. Also see card ANGLSRG page 13 .
42	s7g	-1.Ø	See previous entry
43	jmg	Ø	Switch spacial coordinates in photon source If 1 set y=z and z=y If 2 set x=z and z=x If 3 set y=-z and z=y If 4 set x=-z and z=x If 5 set z=-z
44	tng	Ø.Ø	Set initial photon time coordinate to tng
45	s2g	Ø	Switch direction cosines in photon source If 1 set v=w If 2 set u=w If 3 set v=-w If 4 set u=-w If 5 set w=-w Where u is the direction cosine on the x axis v is the direction cosine on the y axis and w is the direction cosine on the z axis

043

OPTIONAL VALUES FOR ITN AND ITNG

NEUTRON AND PHOTON TALLY TYPES

1 Expected collisions. This option must be used to get reaction edits.
2 Path length in centimeters.
3 Number of particles transported into a zone.
4 Energy transported into a zone.
5 Number flux entering a a zone (1/cos theta).
6 Energy flux entering a zone
7 Same as option 3 with an angular distribution added
8 Same as option 5 with an angular distribution added
9 Same as option 4 with an angular distribution added
10 Same as option 6 with an angular distribution added
11 Writes a disk file
12 Writes a disk file
Tally types 11 and 12 write a disk file (or files) of coordinates of particles entering the zone. Type 11 saves four coordinates (x**2+y**2, z, v, and t) , while type 12 saves eight (x, y, z, u, v, w, vel, and, t) coordinates. Routines to examine these files are available from the author.
13 Expected energy deposited per collision (photons only).
14 Actual energy deposited per collision (photons only).
15 Not used
16 Write a disk file when entering the zone
17 Write a disk file after every collision in the zone
The type 16 file contains the path length swept out in the zone, the time it enters, its energy, zone number, sample number, and number of collisions it had.
The type 17 file contains the time of, and energy lost in a collision. Routines to read these files are available.
18 Collect particles that enter this zone and move to the z axis.
19 Collect particles that enter this zone and beam them down the z axis.
20 Number of Monte Carlo collisions.

CONTENTS OF DATA FILE OBTAINED WHEN SETTING SENTL = 11

The file contains a 1ØØ word directory which includes the values of some variables and the addresses of all the arrays in the file.

contents of disc address:

```
 Ø 8h    data
 1  ineut   = 1  problem was run following neutrons and photons
            = 2  neutrons only
            = 3  photons only
 2  ng or l   number of zones
 3  im  number of time steps
 4  m   number of materials
 5  ltypeg  number of zones with photon angular distributions
 6  ial4g  number of photon angular distribution energy groups
 7  ltypen  number of zones with neutron angular distributions
 8  ial4   neutron angular distribution energy groups
 9  iall   number of neutron tally groups
```

disc addresses that are common to all problems:
(e.g. at disc location 21 is the fwa of head)
location and dimension

```
21  head(12)   problem name
22  mass(l)  the inverse of mass or volume per zone
23  nmat(l)    material in a zone
24  eta(l)     relative density per zone
25  tct(im)    census times
26  rho(m)     material densities
27  units(l)   zone multipliers
28  probm(5)   problem multipliers
29  spe(1ØØ1)  input energy spectrum
```

disc addresses for photon arrays

location and dimension

```
4Ø  hist(im*l*5Ø)  output tally by time step,zone,and energy tally group
41  wlg(175*m)  photon macroscopic cross section by energy group and mat
42  dv(175)     photon energy group limits
43  itapg(51)   photon energy tally group indicies
44  ltypg(l)    photon tally type per zone
45  h(l)        expected value photon energy deposition per zone
```


045

46 hg(1) standard deviation of the energy deposition
47 aflug(ltypeg*19*ial4g) flux by zone,angle, and energy tally group
48 ang(20) angles for angular distribution
49 ilapg(25) energy group limits for angular distributions
50 jikg(ltypeg) zones for angular distributions
51 edig(50) photon energy tally group multipliers
52 ph(im*l) expected value photon energy deposition by time and zone
53 gos(1) photon tally type totals*energy group multipliers

disc addresses for neutron arrays
location and dimension
60 dist(im*l*iall) output tally by time step,zone,and energy tally group
61 xl(176 *m) neutron macroscopic cross section by energy group and mat
62 hl(176) neutron energy group limits
63 itap(iall+1) neutron energy tally group indicies
64 ltype(l) neutron tally type per zone
65 pel(iall*m) elastic probabilities per material and tally group
66 pin(iall*m) inelastic probabilities
67 pfis(iall*m) fission probabilities
68 pcap(iall*m) capture probabilities
69 hn(l) local expected energy deposition per zone.
70 he(l) standard deviation of local energy deposition
71 sg(l) total energy deposition per zone
72 hgn(l) standard deviation of the total energy deposition
73 phn(im*l) expected value neutron energy deposition by time and zone. if neutrons and photons followed, phn is total energy deposited
74 aflux(ltypen*19*ial4) flux by zone,angle, and energy tally group
75 angl1(20) angles for angular distribution
76 ilap(25) energy group limits for angular distributions
77 jike(ltypen) zones for angular distributions
78 edif(iall) neutron energy tally group multipliers
79 got(l) neutron tally type totals*energy group multipliers

LIST OF AVAILABLE ISOTOPES

1	0-nu-1	26000	26-fe-nat	92236	92-u -236
1001	1-h -1	27059	27-co-59	92237	92-u -237
1002	1-h -2	28000	28-ni-nat	92238	92-u -238
1003	1-h -3	28058	28-ni-58	92239	92-u -239
2003	2-he-3	29000	29-cu-nat	92240	92-u -240
2004	2-he-4	31000	31-ga-nat	93237	93-np-237
3006	3-li-6	40000	40-zr-nat	94238	94-pu-238
3007	3-li-7	41093	41-nb-93	94239	94-pu-239
4007	4-be-7	42000	42-mo-nat	94240	94-pu-240
4009	4-be-9	47107	47-ag-107	94241	94-pu-241
5010	5-b -10	47109	47-ag-109	94242	94-pu-242
5011	5-b -11	48000	48-cd-nat	94243	94-pu-243
6012	6-c -12	50000	50-sn-nat	95241	95-am-241
7014	7-n -14	56138	56-ba-138	95242	95-am-242
8016	8-o -16	63000	63-eu-nat	95243	95-am-243
9019	9-f -19	64000	64-gd-nat	96242	96-cm-242
11023	11-na-23	67165	67-ho-165	96243	96-cm-243
12000	12-mg-nat	73181	73-ta-181	96244	96-cm-244
13027	13-al-27	74000	74-w -nat	96245	96-cm-245
14000	14-si-nat	75185	75-re-185	96246	96-cm-246
15031	15-p -31	75187	75-re-187	96247	96-cm-247
16032	16-s -32	78000	78-pt-nat	96248	96-cm-248
17000	17-cl-nat	79197	79-au-197	97249	97-bk-249
18000	18-ar-nat	82000	82-pb-nat	98249	98-cf-249
19000	19-k -nat	90231	90-th-231	98250	98-cf-250
20000	20-ca-nat	90232	90-th-232	98251	98-cf-251
22000	22-ti-nat	90233	90-th-233	98252	98-cf-252
23051	23-v -51	92233	92-u -233	99120	fission products
24000	24-cr-nat	92234	92-u -234		
25055	25-mn-55	92235	92-u -235		

Where nat indicates the naturally occurring element.

047

NEUTRON ENERGY GROUPS

1	1.307e-09	36	2.940e-05	71	1.338e-04	106	2.646e-02	141	4.069e+00
2	5.227e-09	37	3.099e-05	72	1.406e-04	107	3.267e-02	142	4.396e+00
3	2.091e-08	38	3.345e-05	73	1.511e-04	108	3.953e-02	143	4.704e+00
4	3.267e-08	39	3.601e-05	74	1.601e-04	109	4.704e-02	144	4.991e+00
5	4.704e-08	40	3.866e-05	75	1.694e-04	110	5.761e-02	145	5.353e+00
6	8.322e-08	41	4.048e-05	76	1.789e-04	111	7.002e-02	146	5.658e+00
7	1.307e-07	42	4.234e-05	77	1.887e-04	112	8.322e-02	147	6.042e+00
8	1.882e-07	43	4.329e-05	78	1.988e-04	113	9.891e-02	148	6.367e+00
9	2.561e-07	44	4.619e-05	79	2.091e-04	114	1.307e-01	149	6.737e+00
10	3.345e-07	45	4.717e-05	80	2.741e-04	115	1.820e-01	160	7.156e+00
11	4.234e-07	46	4.918e-05	81	3.267e-04	116	2.075e-01	161	7.548e+00
12	5.123e-07	47	5.123e-05	82	3.811e-04	117	2.417e-01	152	7.910e+00
13	7.527e-07	48	5.332e-05	83	4.704e-04	118	2.710e-01	163	8.322e+00
14	1.176e-06	49	5.654e-05	84	4.991e-04	119	2.940e-01	164	8.787e+00
16	1.511e-06	50	5.763e-05	85	5.658e-04	120	3.345e-01	155	9.177e+00
16	2.091e-06	51	6.097e-05	86	6.042e-04	121	3.777e-01	156	9.665e+00
17	2.741e-06	52	6.325e-05	87	6.367e-04	122	4.234e-01	157	1.012e+01
18	3.533e-06	53	6.557e-05	88	7.156e-04	123	5.123e-01	158	1.058e+01
19	4.704e-06	54	6.674e-05	89	8.322e-04	124	6.325e-01	159	1.101e+01
20	5.658e-06	55	7.034e-05	90	9.177e-04	125	7.527e-01	160	1.155e+01
21	6.737e-06	56	7.155e-05	91	1.058e-03	126	8.834e-01	161	1.199e+01
22	8.322e-06	57	7.527e-05	92	1.307e-03	127	1.025e+00	162	1.250e+01
23	9.620e-06	58	7.780e-05	93	1.581e-03	128	1.176e+00	163	1.307e+01
24	1.101e-05	59	7.908e-05	94	1.882e-03	129	1.338e+00	164	1.354e+01
25	1.307e-05	60	8.167e-05	95	2.208e-03	130	1.511e+00	165	1.386e+01
26	1.468e-05	61	8.431e-05	96	2.561e-03	131	1.694e+00	166	1.413e+01
27	1.581e-05	62	8.834e-05	97	2.940e-03	132	1.887e+00	167	1.441e+01
28	1.758e-05	63	9.108e-05	98	3.345e-03	133	2.091e+00	168	1.468e+01
29	1.882e-05	64	9.386e-05	99	3.777e-03	134	2.305e+00	169	1.519e+01
30	2.075e-05	65	9.668e-05	100	4.234e-03	135	2.530e+00	170	1.575e+01
31	2.277e-05	66	9.811e-05	101	5.763e-03	136	2.741e+00	171	1.633e+01
32	2.417e-06	67	1.025e-04	102	7.527e-03	137	3.011e+00	172	1.692e+01
33	2.561e-05	68	1.099e-04	103	1.025e-02	138	3.267e+00	173	1.752e+01
34	2.710e-05	69	1.176e-04	104	1.511e-02	139	3.533e+00	174	1.813e+01
35	2.862e-05	70	1.256e-04	105	2.091e-02	140	3.811e+00	175	1.875e+01
									2.000e+01

PHOTON ENERGY GROUPS

1	1.000e-04	36	1.559e-03	71	8.180e-03	106	4.200e-02	141	3.505e-01
2	1.089e-04	37	1.700e-03	72	8.383e-03	107	4.736e-02	142	3.855e-01
3	1.103e-04	38	1.838e-03	73	8.600e-03	108	4.851e-02	143	4.241e-01
4	1.466e-04	39	1.910e-03	74	8.982e-03	109	5.023e-02	144	4.665e-01
5	1.500e-04	40	2.142e-03	75	9.200e-03	110	5.500e-02	145	5.132e-01
6	2.000e-04	41	2.240e-03	76	9.400e-03	111	6.100e-02	146	5.645e-01
7	2.168e-04	42	2.410e-03	77	9.560e-03	112	6.745e-02	147	6.209e-01
8	2.172e-04	43	2.470e-03	78	9.660e-03	113	6.746e-02	148	6.830e-01
9	2.501e-04	44	2.630e-03	79	9.800e-03	114	6.951e-02	149	7.513e-01
10	2.515e-04	45	2.750e-03	80	1.001e-02	115	7.350e-02	150	8.264e-01
11	3.000e-04	46	2.820e-03	81	1.039e-02	116	7.835e-02	151	9.091e-01
12	3.244e-04	47	2.960e-03	82	1.075e-02	117	8.067e-02	152	1.000e+00
13	3.847e-04	48	3.180e-03	83	1.114e-02	118	8.552e-02	153	1.125e+00
14	3.881e-04	49	3.547e-03	84	1.192e-02	11.	8.795e-02	154	1.266e+00
15	4.000e-04	50	3.606e-03	85	1.265e-02	120	9.054e-02	155	1.424e+00
16	4.374e-04	51	3.700e-03	86	1.303e-02	121	9.230e-02	156	1.602e+00
17	4.390e-04	52	3.828e-03	87	1.386e-02	122	9.600e-02	157	1.802e+00
18	5.000e-04	53	4.030e-03	88	1.470e-02	123	1.000e-01	158	2.027e+00
19	5.500e-04	54	4.150e-03	89	1.520e-02	124	1.050e-01	159	2.281e+00
20	5.943e-04	55	4.300e-03	90	1.571e-02	125	1.097e-01	160	2.566e+00
21	5.947e-04	56	4.496e-03	91	1.639e-02	126	1.098e-01	161	2.887e+00
22	6.000e-04	57	4.810e-03	92	1.700e-02	127	1.149e-01	162	3.247e+00
23	6.836e-04	58	5.163e-03	93	1.716e-02	128	1.150e-01	163	3.653e+00
24	6.850e-04	59	5.467e-03	94	1.806e-02	129	1.211e-01	164	4.110e+00
25	7.000e-04	60	5.546e-03	95	1.898e-02	130	1.212e-01	165	4.624e+00
26	7.541e-04	61	5.934e-03	96	1.967e-02	131	1.351e-01	166	5.202e+00
27	7.555e-04	62	5.980e-03	97	2.010e-02	132	1.486e-01	167	5.852e+00
28	8.000e-04	63	6.250e-03	98	2.096e-02	133	1.635e-01	168	6.583e+00
29	8.197e-04	64	6.543e-03	99	2.175e-02	134	1.799e-01	169	7.406e+00
30	8.211e-04	65	6.750e-03	100	2.225e-02	135	1.978e-01	170	8.332e+00
31	9.000e-04	66	6.980e-03	101	2.312e-02	136	2.176e-01	171	9.373e+00
32	1.000e-03	67	7.113e-03	102	2.553e-02	137	2.394e-01	172	1.055e+01
33	1.080e-03	68	7.251e-03	103	2.918e-02	138	2.633e-01	173	1.186e+01
34	1.140e-03	69	7.713e-03	104	3.316e-02	139	2.897e-01	174	1.335e+01
35	1.360e-03	70	7.942e-03	105	3.750e-02	140	3.186e-01	175	2.000e+01

TALLY GROUP LIMITS FOR NEUTRONS (DEFAULT SET)

1	1.307e-09	11	6.097e-05	21	5.763e-03	31	2.091e+00	41	8.322e+00
2	8.322e-08	12	7.155e-05	22	2.646e-02	32	2.530e+00	42	9.177e+00
3	4.234e-07	13	8.431e-05	23	7.002e-02	33	3.011e+00	43	1.012e+01
4	2.091e-06	14	9.811e-05	24	2.075e-01	34	3.533e+00	44	1.101e+01
5	6.737e-06	15	1.338e-04	25	3.777e-01	35	4.069e+00	45	1.199e+01
6	1.468e-05	16	1.789e-04	26	5.123e-01	36	4.704e+00	46	1.307e+01
7	2.277e-05	17	3.267e-04	27	7.527e-01	37	5.353e+00	47	1.386e+01
8	2.940e-05	18	6.042e-04	28	1.025e+00	38	6.042e+00	48	1.413e+01
9	4.048e-05	19	1.058e-03	29	1.338e+00	39	6.737e+00	49	1.441e+01
10	4.918e-05	20	2.561e-03	30	1.694e+00	40	7.548e+00	50	1.519e+01
									2.000e+01

TALLY GROUP LIMITS FOR PHOTONS (DEFAULT SET)

1	1.000e-04	11	5.980e-03	21	1.700e-02	31	9.600e-02	41	1.000e+00
2	1.360e-03	12	6.750e-03	22	1.898e-02	32	1.097e-01	42	1.424e+00
3	1.838e-03	13	7.251e-03	23	2.095e-02	33	1.150e-01	43	2.027e+00
4	2.240e-03	14	8.180e-03	24	2.312e-02	34	1.351e-01	44	2.887e+00
5	2.630e-03	15	8.982e-03	25	3.316e-02	35	1.799e-01	45	4.110e+00
6	2.960e-03	16	9.560e-03	26	4.736e-02	36	2.394e-01	46	5.202e+00
7	3.606e-03	17	1.001e-02	27	5.500e-02	37	3.186e-01	47	6.583e+00
8	4.030e-03	18	1.114e-02	28	6.746e-02	38	4.241e-01	48	8.332e+00
9	4.496e-03	19	1.303e-02	29	7.835e-02	39	5.645e-01	49	1.055e+01
10	5.467e-03	20	1.520e-02	30	8.795e-02	40	7.513e-01	50	1.335e+01
									2.000e+01

050

COSINES OF ANGULAR DISTRIBUTION LIMITS FOR TALLY TYPES 7,8,9, AND 10

1	1.0	5	0.82	9	0.20	13	-0.40	17	-0.90
2	0.98	6	0.72	10	0.05	14	-0.60	18	-0.95
3	0.95	7	0.60	11	-0.05	15	-0.72	19	-0.98
4	0.90	8	0.40	12	-0.20	16	-0.82		-1.00

PHOTON ENERGY TALLY GROUP LIMITS FOR TALLY TYPES 7, 8, 9, AND 10

1	1.00e-04	5	2.31e-02	9	7.51e-01
2	2.62e-03	6	6.75e-02	10	2.03e+00
3	8.98e-03	7	1.15e-01	11	4.11e+00
4	1.30e-02	8	3.19e-01	12	8.33e+00
					2.00e+01

NEUTRON ENERGY TALLY GROUP LIMITS FOR TALLY TYPES 7, 8, 9, AND 10

1	1.31e-09	5	2.07e-01	9	7.55e+00
2	6.74e-06	6	1.02e+00	10	1.01e+01
3	1.34e-04	7	3.01e+00	11	1.20e+01
4	1.06e-03	8	5.35e+00	12	1.41e+01
					2.00e+01

ISOTOPE REACTION NUMBERS

100000	elastic
110000	n,n'g
110001	n,n'g from a level
120000	n,2ng
120001	n,2ng from a level
120008	n,2ng completely coordinated reaction
120010	n,2ng from a wide level
130000	n,3ng
140000	n,4ng
150000	n,fission
150700	nu bar
200000	n,n'pg
230000	n,n'd2ag
240000	n,n'tg
260000	n,n'ag
270000	n,n'3ag
270001	n,n'3ag from a level
290000	n,2np
400000	n,pg
410000	n,dg
420000	n,tg
420001	n,tg from a level
430000	n,t2ag
450000	n,ag
460000	n,g

AVAILABLE UTILITY ROUTINES

The following utility routines are available by:

XPORT RD .477300:Filename / T V

LREACT - List the reactions for each isotope in the neutron cross section library.

OLDTONU - Change an input deck from TARTNP format to TART.

PLOTF7 - Plot some arrays from data written into a file which was created by setting SENTL = 11.

TNPRD - Read all arrays from the file written by setting SENTL = 11.

TY12F - Read the files written by setting the tally type to 12 in a zone.

053

INPUT FOR SAMPLE PROBLEMS

```
name godiva    sample 1
box g33 godiv
critcalc 5 1 3
zonejb 1 1
zonejb 2 -1
sphere 1 8.74Ø7
matz 1 1
sourcel 1
sentl 2 2ØØ  3 8ØØ   1Ø 1.Øe-Ø5
matl 1 18.74 .ØØØ492 92234 .Ø44999 92235 .ØØ25 92238
end

name  offset  pb  old experiment
box t69 kim
zonejb 1 -2 7 2Ø
zonejb 2 1 -2Ø 21
zonejb 8 -7
zonejb 3 7 -1 -2Ø 21
surf 1 1.83
surf 6 6.35 1.
* surf 1 could be: cyl 1 1.83
* surf 6 could be:  sphere 6 6.35
zplane 2Ø Ø.
zplane 21 .914
sphere 7 6.4
sphere 2 2.516 -4.5 4.5
sphere 3 1.887 -4.5 4.5
sphere 4 1.258 -4.5 4.5
sphere 5 .629 -4.5 4.5
zonejb 4 2 -3 6
zonejb 5 3 -4 6
zonejb 6 4 -5 6
zonejb 7 5 6
zonejb 9 -21
zonejb 14 7 -6 2 -3
zonejb 15 7 -6 3 -4
zonejb 16 7 -6 4 -5
 zonejb 13 7 -6 5
c zones 1Ø 11 and 12 do not exist
matz 1 1 thru 16
matz Ø 8 9
```


054

```
eta 1.Øe-8  1 thru 16
eta 1.Ø 2
sentl 1 2     25 1  17 .122   1Ø 5.e-6
sentl 21 1Ø 2 1Ø   3 3ØØØØ
cphotal 1 1 39 47 52 57 62 66 72 8Ø 86 91 92 93 94 95 96 97 98
cphotal 19 99 1ØØ 1Ø1 1Ø2 1Ø3 1Ø4 1Ø5 1Ø6 1Ø7 1Ø8 1Ø9 11Ø 111 112 113 114 115
cphotal 36 116 117 118 119 12Ø 121 122 123 124 125 126 127 128 129 13Ø 131
matl 1 11.36 1. 82ØØØ
s6g 1 -1. Ø. -1.
mcvdisk 1ØØØ. Ø. 6.5  -7.  16.
anglsrg Ø. Ø.
end
 offset is a 3d photon sample problem
extra cards
mcvdisk 1ØØØ. Ø. 6.5  -7.  16. Ø. Ø.  Ø.  1
mcvplane 1ØØØ. -7. 7. -7. 7. -7. 16.
sentl 1 2    6 Ø. 7 1.Ø 25 1  4 .122   1Ø 5.e-6
plotzr -7.Ø 2.Ø
plotzr -4. 2.  1. 7.
```


055