PL3 - A 3-Dimensional Plotting Program

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Abstract

PL3D is a UNIVAC 1110 FORTRAN V based Computer Code. It is developed to produce 3-dimensional and Contour plots from the output of the Computer Code TRANSWELL. This is accomplished using the MACC and CALCOMP plotting packages for the CALCOMP plotters. Interactive usage of the Code facilitates the choice of the desired plots. The main programming considerations have been clarity and versatility.

I. General Description

The PL3D Computer program is constructed mainly as a post processor for the TRANSWELL Computer Code.[1] This is a plotting routine that utilizes the MACC plotting packages, especially SURGEN[2] and CONTR[3] to display information from TRANSWELL as 3 dimensional and as contour plates. Interactive selection of plots with the choice of titles, angles, variables and scaling vectors are features of PL3D. The program can be equally used, with slight modifications, to furnish the same facilities to any Computer Code that generated data in a binary form, as will be described.

The data channel from TRANSWELL to PL3D is a FORTRAN binary file called unit 4. The PL3D program allows the user to select from up to 15 Z-variables* and many different combinations of X and Y values for each Z selection. After the user has finished with one Z-variable he may then go on to another. For each selection of X, Y and Z variables, an appropriate set of labels may be entered interactively. After the surface and labels have been chosen the user may select the angles that determine a view of the surface, this view is then displayed on the graphics terminal for the user to include or exclude from his plotting set. An example of such a plot for swelling in stainless steel is shown in figure 8 later in this report.

Generally the output format from TRANSWELL (or equivalent) is as follows:

(1) A block of X and Y axes variables.

(2) A 15 x 100 array of Z values.

For each surface, PL3D reads the entire data file, picking out the desired numbers. This method of data handling slightly sacrifices efficiency but it enables PL3D to be adapted easily to other Computer Systems.

*Actually there are 53 variables that can be selected but only 15 at any one time.

Obviously, the full plotting potential of each TRANSWELL run will not be realized at one terminal setting. To avoid the loss of these unrealized potential plots without incurring tremendous file charges, the data files are stored on a tape, via the TAPE UTILITIES ROUTINES for later use.

A general flow diagram of the interrelationships between PL3D, TRANSWELL Computer Code, Mass Storage System and Operating system is shown in Figure 1.

II. Program Variables

II-a. Cross Variables with TRANSWELL

The following variables are read from unit number 4 (on which TRANSWELL or equivalent code output is written) in one binary block:

1. TEMP; Irradiation Temperature, °K
2. PRØD; Point defect production rate; dpa/sec
3. DØSE; Total irradiation dose, dpa
4. TP; Pulse period (In case of pulsed irradiation), sec
5. XNV; Void density, cm^{-3}
6. XNIL; Interstitial loop density, cm^{-3}
7. BETA; $\frac{1}{kT}$, where k is Bolzman's constant and T is the temperature, ev^{-1}
8. TIME; Actual irradiation time; sec
9. TØUT; Output irradiation time (see reference (1)), sec
10. CASC; Collision cascade efficiency
11. RØDE; Deformation produced dislocation density, cm^{-2}
12. RØDO; Total initial dislocation density, cm^{-2}
13. RVLO; Initial vacancy loop radius, cm

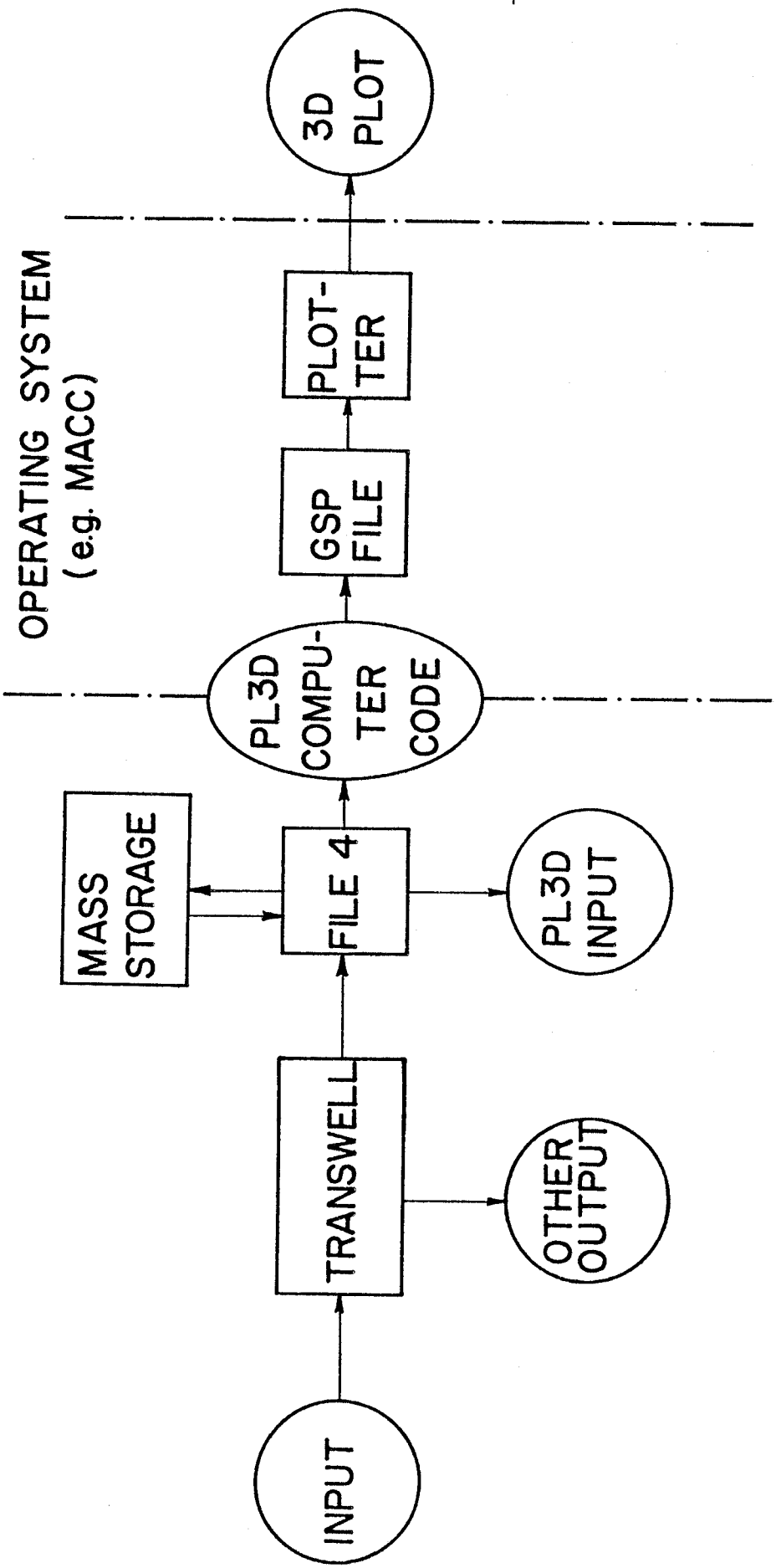


Figure 1 - Schematic of PL3D Computer Program Operation

14. GAS, Gas content of an average void; atoms/void
15. EVF, Vacancy formation energy; eV
16. EIF, Interstitial formation energy; eV
17. DVE, Vacancy diffusion coefficient preexponential; cm^2/sec
18. DIE, Interstitial diffusion coefficient preexponential; cm^2/sec
19. EVM, Vacancy migration energy; eV
20. EIM, Interstitial migration energy; eV
21. BU, Burger's vector; cm
22. GAMA, Surface energy; eV/cm^2
23. ZV, Dislocation-vacancy bias factor
24. ZI, Dislocation-interstitial bias factor
25. OMEGA, Atomic volume; cm^3
26. STACK, Stacking-fault energy; eV/cm^2
27. SHEAR, Shear modulus; $ergs/cm^3$
28. XNEW, Poisson's ratio
29. SIGMA, Applies stress; eV/cm^3
30. RVGAS, Void equilibrium radius; cm
31. GASO, Initial void gas content; atoms/void
32. RELI, Relative Interstitial relaxation volume
33. PRGAS, Gas generation rate; at/at/sec
34. CV, Vacancy concentration; at/at
35. CI, Interstitial concentration; at/at
36. FLUXV, Vacancy flux; cm^2/sec
37. FLUXI, Interstitial flux; cm^2/sec
38. XLAMI, Interstitial time constant; sec^{-1}
39. XLAMV, Vacancy time constant, sec^{-1}

The next set of variables are read also from unit 4 in one binary block. The desired Z-variable values for plotting are selected from the array,

AA (15,100) A Real* 8 array is used to hold the double precision input from TRANSWELL (or equivalent).

II-b. Local Variables

A(50) -- Real array to collect the surface to be plotted.

MASK(400,11) -- Real array to be used by MACC graphics package (SURGEN) to calculate the masking of portions of overlapping lines. This array is equivalenced to AA in order to save space.

XMAX, XMIN -- Reals used to contain the max and min values of the X-scale.

Y3D(20) -- Real array used to accumulate the values of the Y-axes.

ZMAX -- Integer initialized to "MAX" which instructs graphics package to search for the surface maximum.

AXES, ORIENT, XYGRID -- Reals used to receive the values of the graphics package pseudo-functions AXVALS, GRID3D, XYVALS respectively.

NROWS, LIMIT -- Integers which contain the number of valid rows and columns in array A (the surface to be plotted). These values are set in subroutine RDARR.

PLANE -- Integer initialized to "NONE" to instruct SURGEN not to generate a reference plane.

LINE (2) -- An interger array initialized to (1,1) which instructs SURGEN to generate every line in both the X and Y directions.

XLABEL(5), YLABEL(5), ZLABEL(5) -- Integer arrays to hold the titles for the X, Y and Z axes respectively.

TITLE(10) -- Integer array used to hold the 3-D plot title.

CTITLE(5) -- Integer array used to hold the title for the contour plot.

III. Subroutines

III-1. MAIN

This portion drives the rest of the system. Initialization of the MACC graphics package is the first thing done. Then the main production cycle is entered. This cycle consists of the following parts.

(1) Read in a new surface to plot, or terminate execution on @EOF.

(2) Read in the labels.

(3) Calculate the various max and min values.

(4) Complete the minor plot cycle.

(5) Handle the contour plot.

(6) Erase the screen and go to (1).

The minor plot cycle consists of the following:

(1) Read in the plotting angles (phi and theta).

or Exit the minor plotting cycle (on @EOF).

(2) Generate the surface on the terminal.

(3) If so instructed, send the surface to the plotter.

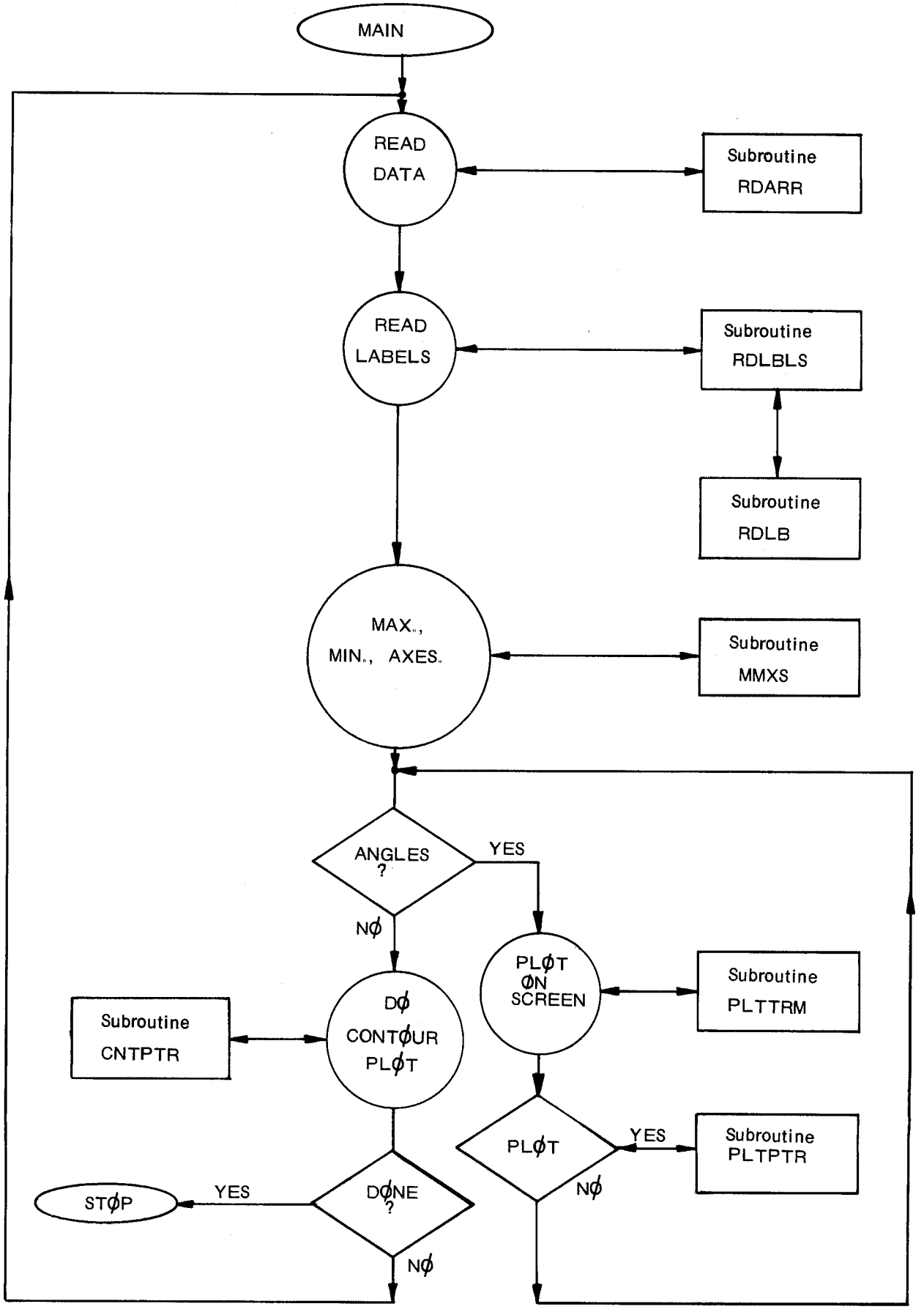
(4) Go to (1).

A flow diagram of PL3D manifesting the previous logic is shown in Figure 2.

III-2. RDARR

Read Array. This subroutine reads the data file that was created by TRANSWELL and extracts the selected data. The data selection specifications are made available to the routine thru the DAT3D namelist input. This routine

Figure (2). FLØW DIAGRAM ØF PL3D.



also is able to log scale the selected data upon command. A flow diagram of this subroutine is shown in Figure 3.

Called from: Main routine

Calls : N.A.

III-3. MMXS

Max, Min, Axes, Orient. This routine finds the max and min for the two independent variables and the min for the dependent variable. It also sets the axes specifications and the orientation specifications. A flow diagram of this subroutine is shown in Figure 4.

Called from: MAIN routine

Calls to : AXES, ØRIENT (graphics package pseudo-functions)

III-4. RDLBS

Read Labels. This routine supervises the reading of labels for plot and axes titles. A flow diagram of RDLBS is shown in Figure 5.

Called from: MAIN routine

Calls to: RDLB

III-5. RDLB

Read Label. This routine does the actual reading of the label. Currently 24 character labels are used. These 24 characters are the first 24 columns of the input line.

Called from: RDLBLS

Calls to: N.A.

III-6. PLTPTR

Plot Plotter. This routine has two entrys; PLTPTR & PLTTRM. PLTTRM sets up the window for, and makes the call to SURGEN that makes a 3-D plot

Figure (3). Flow Diagram of Subroutine RDARR.

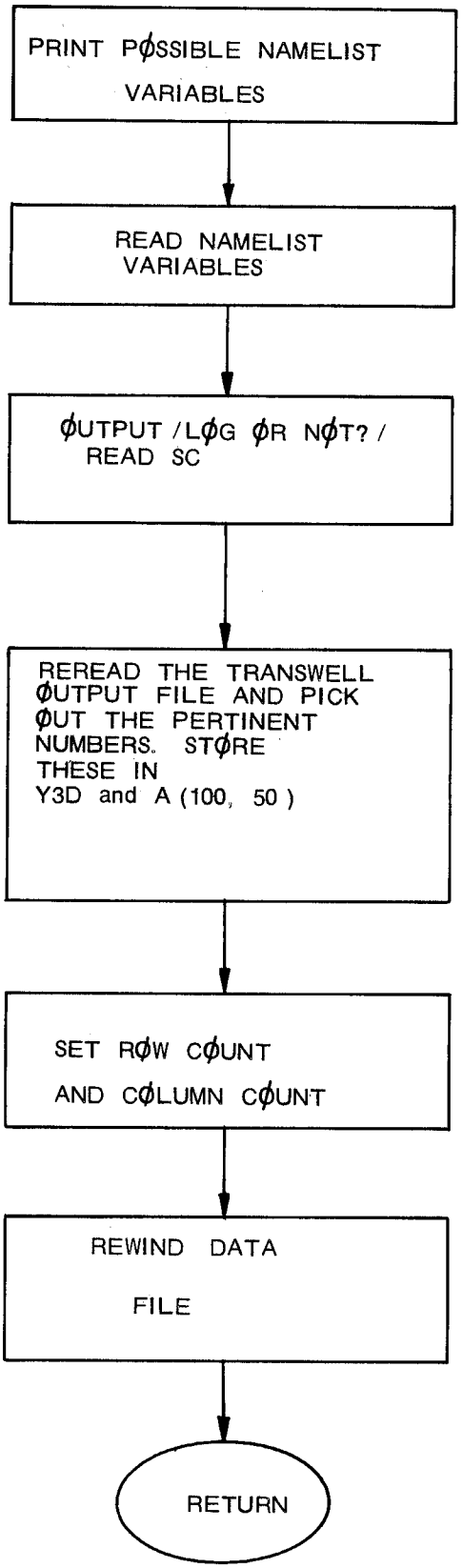


Figure (4). A Flow Diagram of Subroutine MMXS.

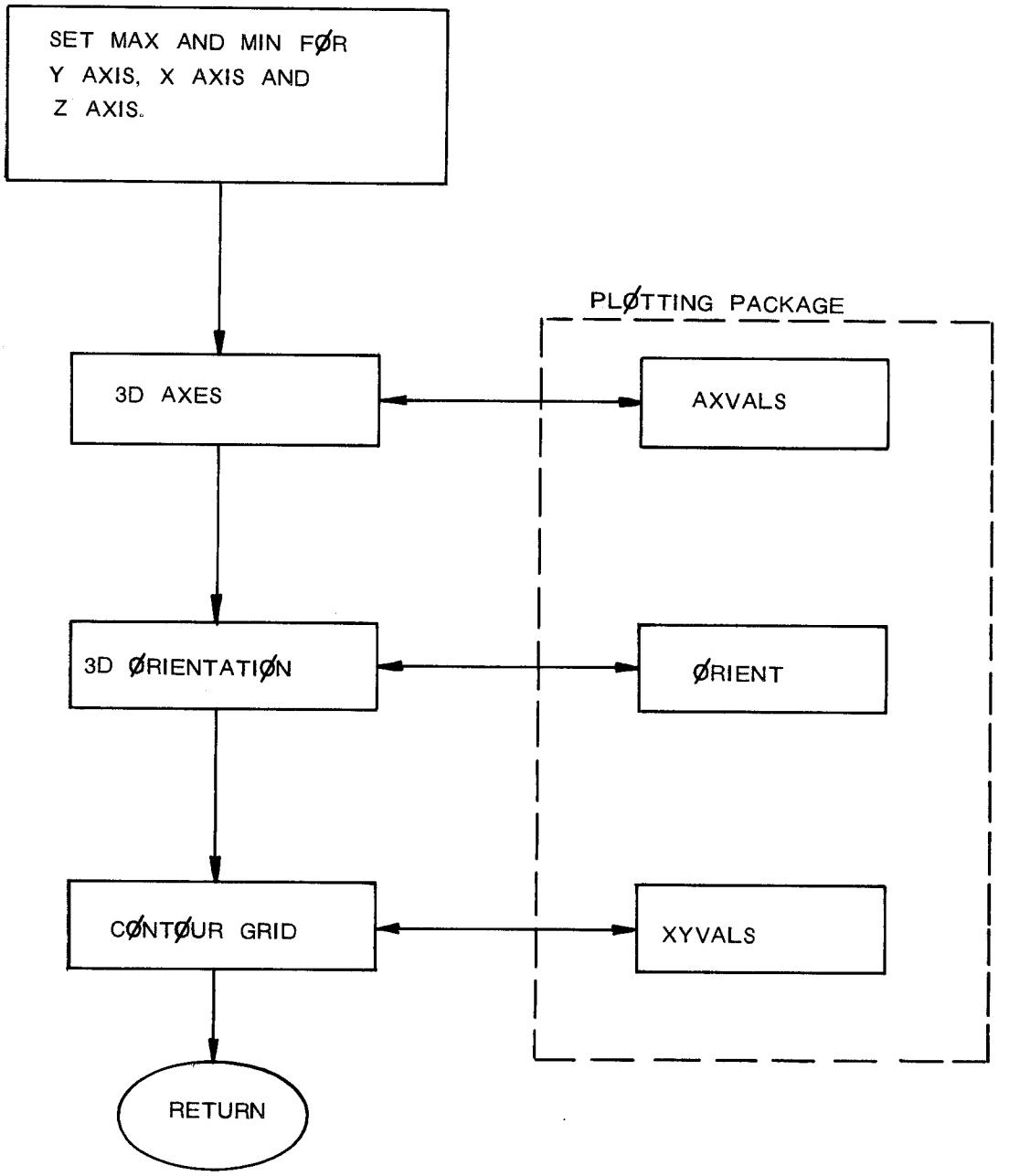
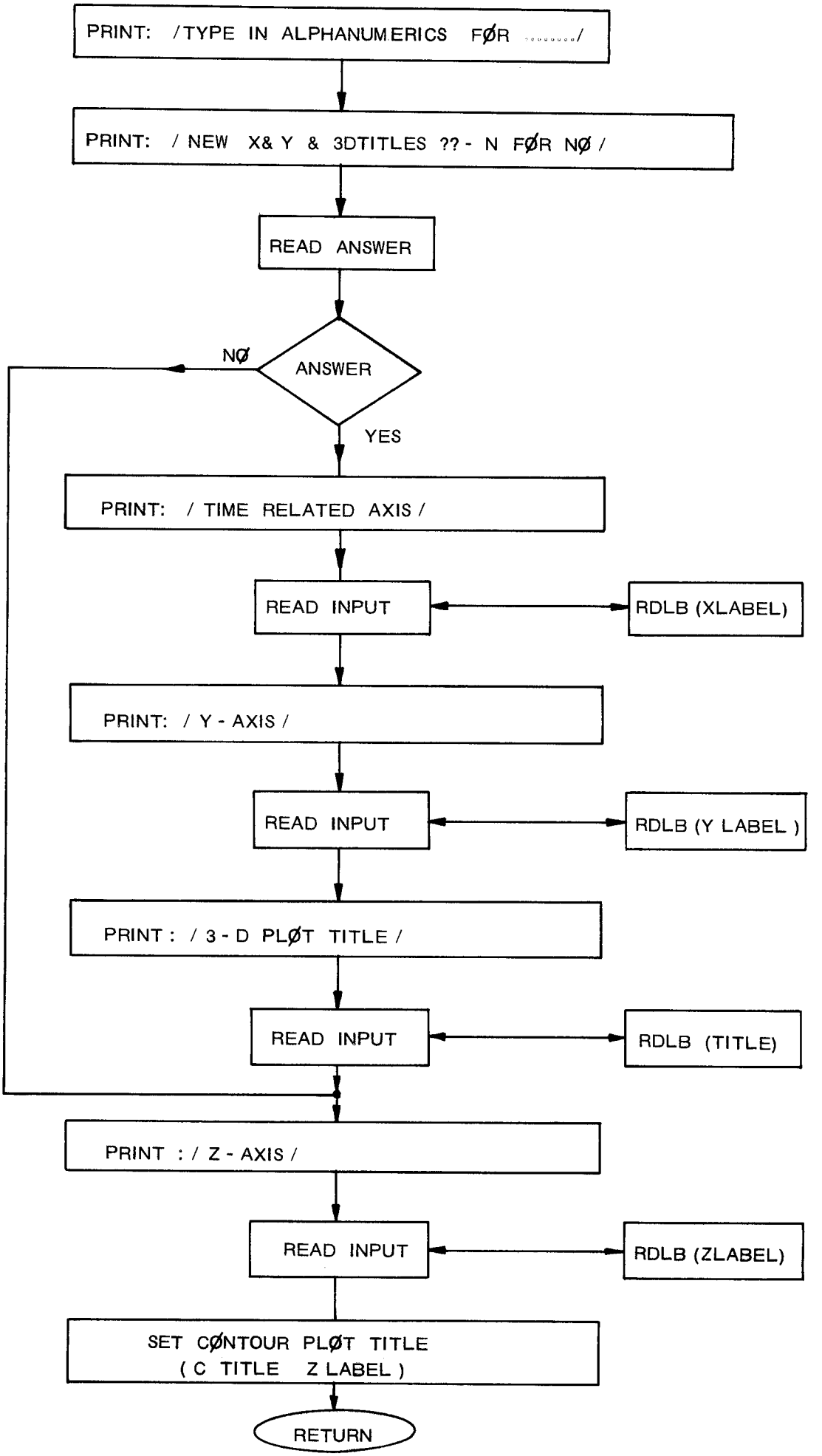


Figure (5). Flow Diagram Of Subroutine RDLBLS



on the terminal for preview purposes. PLTPTR sets up the window for and makes the call to SURGEN that sends the selected 3-D plot to the plot-file. A flow diagram of PLTPTR with the entry point is shown in Figure 6.

Called from: MAIN routine

Calls to: DEVSET, SURGEN, PURGBF (all graphics package routine).

III-7. CNTPTR

Contour Plot to Plotter. This routine has two entry points; CNTPTR & CNTTRM. These two entrys act the same as PLTTRM except that they create contour plots instead of 3-D plots. A flow diagram is shown in Figure 7.

Called from: MAIN routine

Calls to: DEVSET, CØNTR, PURGBF (all graphics package routines).

III-8. MACC Subroutines Used

a. DEVSET[4]

It provides a selection of graphic output devices which may be a plotter or a graphics terminal. The call is as follows

CALL DEVSET (IDEVIC)

where,

IDEVIC - Hollerith or equivalent INTEGER value to select output device: IDEVIC = 5HPLTTR or 1; graphic output goes to plotter. This is the default value for a batch run or a standard run.

IDEVIC = 6HGRAPHIC or 2; graphic output goes to the PEP-801 terminal. This is the default value for a timesharing run.

IDEVIC = 5; graphic output goes to the TEKTRONIX terminal.

b. PURGBF[4]

This subroutine empties the terminal output buffer. If the buffer length

Figure (6). FLØW DIAGRAM ØF SUBRØUTINE PLTPTR

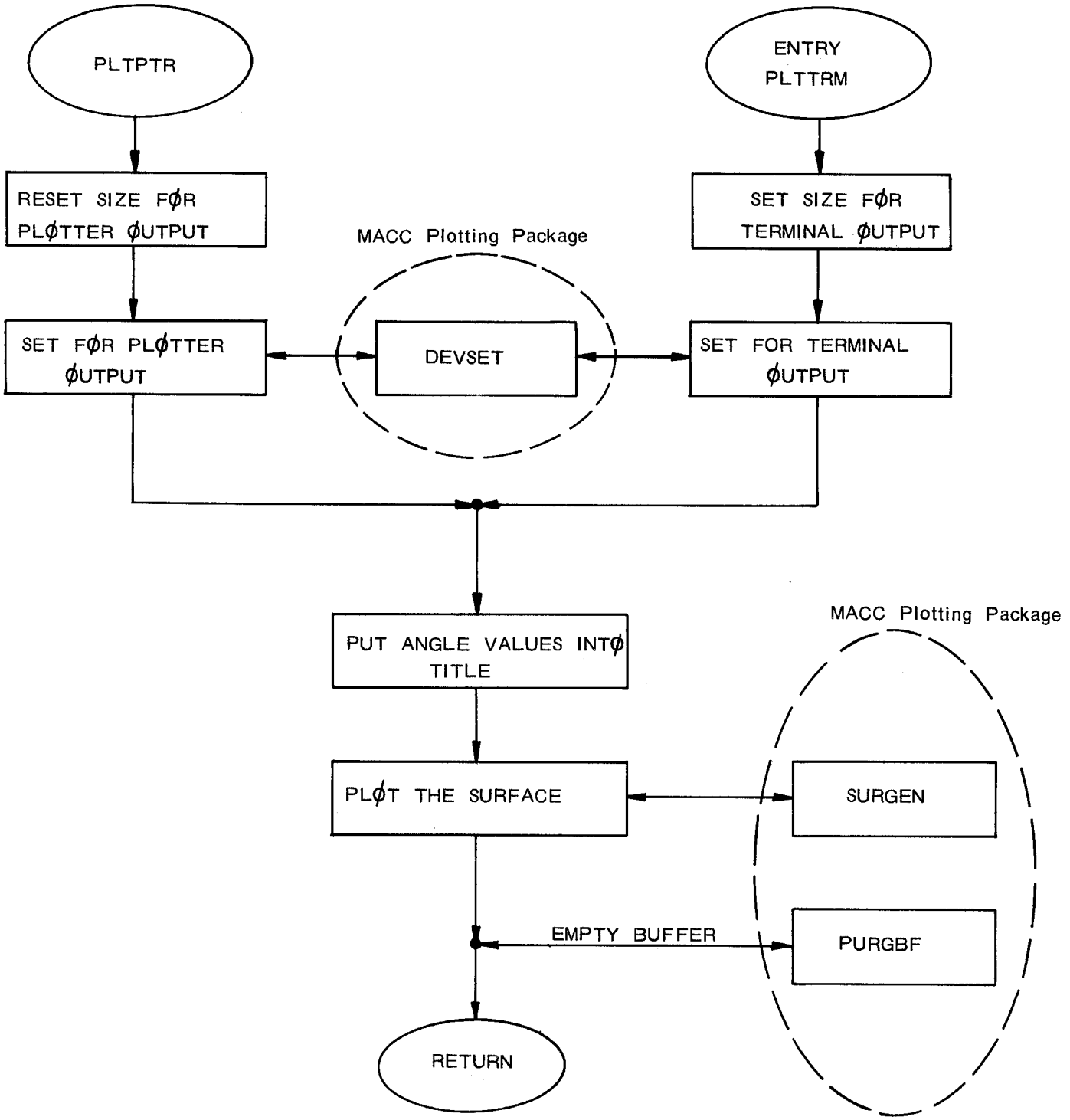
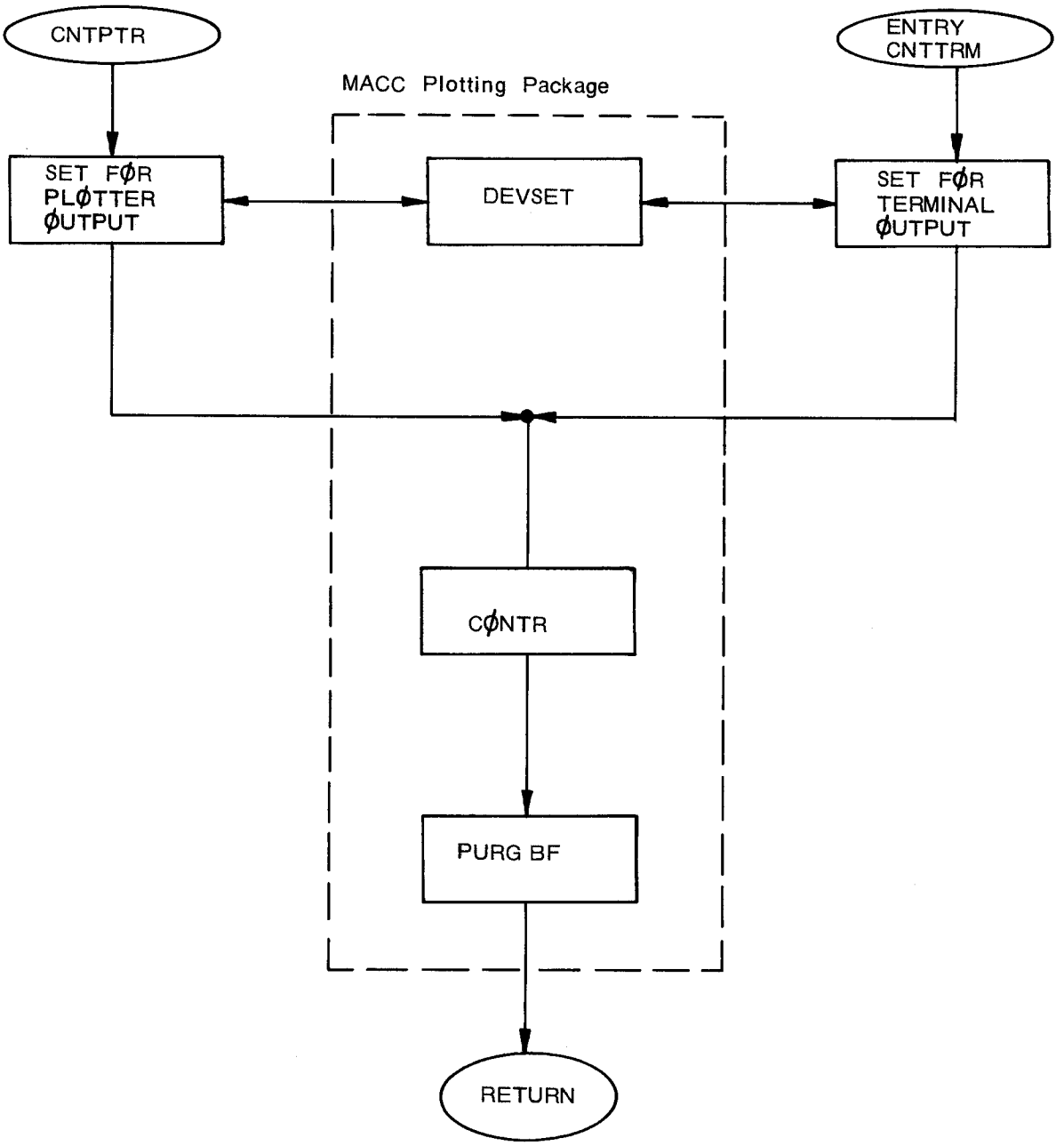


Figure (7). Flow Diagram of Subroutine CNTPTR



set by GSPSET or BUFSET is not 0, graphic output is transmitted only when the buffer gets full or when PURGBF is called; PURGBF therefore insures that displayed intems have been trasmitted even if the buffer was only partially full. The subroutine has no arguments and is called as:

```
CALL PURGBF
```

c. SURGEN[2]

This is a FØRTRAN Callable subroutine which generates a three-dimensional surface plot either from a rectangular grid of data or from the values of user-supplied function. The plot assumes that for any given (X,Y) location there is only one surface value. SURGEN can create a surface with lines parallel to the X-axis, to the Y-axis or to both axes, the latter of which produces a cross-hatched figure.

A brief description of the subroutine argument is given here, while the interested reader is referred to the original document.[2]

Calling Sequence:

CALL SURGEN (A, NRDIMA, NROWS, NCOLS, ORIENT, PHI, THETA, XSIZE, YSIZE, XORY, NLINE, PLANE, AXES, MASK, TITLE)

In brief, a call to SURGEN requires specification of:

A - a two-dimensional array or a user-supplied function from which the data values to be projected are obtained.

NRDIMA - row dimension of the array or an indicator specifying that A is a function.

NROWS - number of rows in the array, or number of X points to be calculated by the function.

NCOLS - number of columns in the array, or number of Y points to be calculated by the function.

ORIENT - an indicator for orientation of the array.

PHI - a rotation angle about the Z-axis.

THETA - a rotation angle about the X-axis

XSIZE - page size in the X-direction

YSIZE - page size in the Y-direction

XORY - indicator whether lines parallel to the X-axis, to the Y-axis, or to both axes are to be drawn.

NLINE - indicator for specifying which rows or columns out of the array or function are to be drawn.

PLANE - indicator if reference plane or frame is desired.

AXES - indicator for either suppressing or plotting any of these three axes and their labels.

MASK - scratch array for the hidden line mask.

TITLE - title for the three-dimensional surface.

The orginal axes system, XYZ, is assumed to be oriented as follows: Z runs up and down the paper, X runs horizontal with the positive X pointing to your right and positive Y goes into the paper, while negative Y comes straight out of the paper. The resultant projection is based on two rotation angles which were explained before.

d. CØNTR[3]

CØNTR is a FØRTRAN V Callable subroutine which produces a contour plot on the CalComp plotter of a rectangular grid of data or of the values of a user supplied function.

The contour plot drawn is based on a pair of rectangular Cartesian axes. The axes themselves may or may not actually be plotted. The subroutine is designed to minimize the user's programming efforts. A brief description of the calling sequence is given below:

Calling Sequences for CONTR and CONTRA:

The calling sequences for producing a contour plot are identical for both plotter and line printer versions. Only the subroutine names are different. This feature is designed to facilitate switching between out-put media.

Plotter Version

```
CALL CONTR (VALUES, NRDIM, NROWS, NCOLS, ZLVES, ZLEVID, ZMISS, XYGRID,
            IGRID, IXLABL, IYLABL, ITITLE, PGWID, PGHITE)
```

Line Printer Version

```
CALL CONTRA (VALUES, NRDIM, NROWS, NCOLS, ZLEVS, ZLEVID, ZMISS, XYGRID,
             IGRID, IXLABL, IYLABL, ITITLE, PGWID, PGHITE)
```

In brief, a call to CONTR OR CONTRA requires specification of:

VALUES - A 2-dimensional array or a user-supplied function from which the data values to be contoured are obtained.

NRDIM - row dimension of the array or any indicator specifying that VALUES is a function.

NROWS - number of rows in the array.

NCOLS - number of columns in the array.

ZLEVS - control for establishing the contour levels.

ZLEVID - control for identifying the contour levels on the plot.

ZMISS - indicator for missing data.

XYGRID - control for the orientation of the grid on which the contour is plotted.

IGRID - control designating either suppression or plotting of the grid axes.

IXLABL - label for X-axis.

IYLABL - label for Y-axis.

ITITLE - title for the contour plot.

PGWID - page width.

PGHITE - page height.

IV. PL3D User's Guide

IV-A. Implementing the PL3D Code

PL3D Computer Code was developed on a UNIVAC 1110 using the FØRTRAN V Compiler. It contains approximately 323 cards and needs approximately 58000 decimal words on a UNIVAC 1110 computer.

The 3-dimensional and contour plotting were kept separate from the TRANSWELL code for the following reasons:

(1) Plotting Routines occupy a large CORE space which increase the charges and handling difficulties.

(2) Every time the plotting is changed the large Code (e.g. TRANSWELL) must be changed and remapped.

(3) Any changes in the large Code (TRANSWELL) would mean mapping of all Plotting Routines.

(4) Finding a good plot is sometimes an iterative process. If plotting is a part of the Code, the entire Code must be rerun to produce the same data (i.e. to get a different view of the same data) for each iteration.

(5) Plotting Routines are not transportable.

IV-B. Using the PL3D Code

There are three steps involved in setting up a PL3D Run: First, setting up the data file; second, initializing the plotter and third, interacting with PL3D.

(1) The Data File

Suppose TRANSWELL (or equivalent) has dumped its binary data into a file named PL*DATA, then the following sequence of EXEC 8 Commands will prepare this file for use by PL3D.

```
@USE 4, PL*DATA.
@ASG,AX 4.
```

The reason for this is that PL3D takes its binary input from logical unit 4. PL3D takes care of all file reading and rewinding internally.

(2) The Plotter

Use of the CalComp plotter at MACC requires a call to the @GSP processor preceeding the execution of the plot producer. For all the graphic details of MACC's plotting package, the plotting manuals should be consulted. However, the following example should demonstrate a "standard" or "normal" run.

```
@GSP,P
PLØTTER PEN/LIQ
@XQT   PLØT*3D.PL3D
```

The last EXEC 8 Control Card starts the execution of the absolute element (PL3D) in the public file (PLØT*3D.).

(3) Plot Selection

Plot selection is a two-question process. First, the user is asked to select a PHI-THETA angular pair. The view of the surface determined by this pair is then displayed on the terminal, and the user is asked the second question - whether to plot this view or not?. If one decides to choose a particular plot, it is immediately sent to the CalComp plotter file for later plotting. Then the question about the angular pair is repeated. again. To transfer to another variable for plotting, the user types in an @EOF.

At this point, a contour plot of the surface is sent to the CalComp plot file, and the NAMELIST input is again encountered. An @EOF entered here gracefully terminates the execution of PL3D.

IV-C. NAMELIST Variables and INPUT Description

The program contains only one namelist; DAT3D. The numeric input is read in via the NAMELIST first, then followed by alphanumeric input, numeric input and alphanumeric input as described below;

i. NAMELIST/DAT3D/Variables

(1) IXWANT Default = 1

Integer determining whether one wants time or dose to be the x-variable. For IXWANT = 1, the x-variable is the dose in DPA, while for IXWANT = 2 the x-variable is the irradiation time in seconds.

(2) IYWANT Default = 1

Integer determining the y-variable with the following values:

IYWANT = 1; for the temperature in °K

IYWANT = 2; for the log of point defect production rate in at/at/sec.

IYWANT = 3; for vacancy migration energy in eV.

IYWANT = 4; for interstitial migration energy in eV.

IYWANT = 5; for vacancy formation energy in eV.

IYWANT = 6; for surface energy in ergs/cm^2.

IYWANT = 7; for applied stress in eV/cm^3.

IYWANT = 8; for initial void gas content

IYWANT = 9; for the log of gas production rate in at/at/sec.

(3) NSKIP Default = 4

Integer determining the number of rows skipped (x-axis) before a line is plotted.

(4) IVAR Default = N.A.

Integer determining the variable plotted on the z=axis. It is the serial number of the variable in a 15 x 100 array of points. IVAR assumes a value from 1 to 15.

(5) TRMNL Default = 5;"TEKTRONIX"

Integer determining the terminal available for output plots. The default terminal is the TEKTRONIX type. For others, consult subroutine DEVSET.

(6) XSIZE Default = 11"

Real determining the horizontal length of plot in inches.

(7) YSIZE Default = 8.5"

Real determining the vertical length of plot in inches.

(8) XSTART Default = 1

Integer determining the number of rows (on x-axis) to be skipped before plotting the first y-curve (i.e. a simple translation of origin on the x-axis).

ii. Alphanumeric Input

Here one needs 5 card images of input:

(1) SC ; an A4 format variable determining the Z-variable scale. It assumes the values: LØGb or NØTb, where b is a blank.

(2) INST ; an A6 format variable determining whether one wants new titles or not. It assumes the values: YESbbb or Nbbbbb.

(3) XLABEL(5); a 5A6 format string of alphanumeric variables for the x-axis label.

(4) YLABEL(5); a 5A6 format string of alphanumeric variables for the y-axis label.

(5) TITLE(0) ; a 10A6 format string of alphanumeric variables for the figure caption. TITLE(7) is reserved for the value of angle ϕ and TITLE(9) is reserved for angle θ.

iii. Numeric Input

One card is needed for the values of ϕ and θ; the angles rotating around z-axis and x-axis respectively. The input is free format anywhere on the card.

iv. Alphanumeric Input

This is the last card in one plotting cycle. It reads the variable INST with A6 format. It assumes the values: PLØTbb or NØtbbb, to get a CalComp plotter plot or not respectively.

V. Example Problem

The following example illustrates a "dialogue" example between a user and the TEKTRONIX terminal. It is assumed that the numeric data from TRANSWELL exists on file PL*DATA. We will also suppose that the swelling of stainless steel is the z-variable to be plotted against dose-temperature axes. The sequence number of swelling is assumed to be IVAR = 13. U stands for user and T for terminal.

```
 U   : UWGT
 T   : MACC 33, 15      TTY U02008
 U   : @RUN, 11162, 9000151622, $20.00, 1000
 T   : RUNID: Y57021 DATE: 082577 Time 094947
 T   : PASSWORD PLEASE
TU   : XXXXXX
 T   : CONTINUE
 U   :@USE 4., PL*DATA.
 T   : READY
 U   :@ASG, AX 4.
 T   : READY
 U   :@GSP, P
 T   : GRAPHICS SYSTEM PROCESSOR V67
 U   : PLOTTER PEN/LIQ
 U   :@XQT PLØT*3D.PL3D
```

```
T    :  READ IN NAMELIST DAT3D:
        (1) IXWANT --- X VARIABLE
        (2) IYWANT --- Y VARIABLE
        (3) NSKIP  --- SKIP N ROWS
        (4) IVAR   --- VARIABLE TO PLOT
        (5) TRMNL  --- DFLT=   TKTTNX=5
        (6) XSIZE  --- HOT LNGTH OF PLT IN INCHS
        (7) YSIZE  --- VERT LNGTH DFLT 11x8.5
        (8) XSTART --- START THE X'S ON THIS COL
U    : $DAT3D   IVAR = 13,    $END
T    :
          TYPE in ALPHANUMERICS FØR - - -
          NEW X & Y 3D TITLES ?? - N FØR NØ
U    : YES
T    :   TIME RELATED AXIS TITLE
U    : DØSE (DPA)
T    :   Y-AXIS
U    : TEMP (K)
T    : 3-D PLØT TITLE
U    : ION IRRAD SS (EPS = 0.001)
T    : Z-AXIS
U    : SWELLING %
T    : ENTER THE ANGLES PHI, THETA
U    :    45    20
```

```
T   :       PLØT AS IN FIGURE (8)

T   :  PLØT ØR NØT?
U   :  PLØT
T   :  ENTER THE ANGLES PHI, THETA
U   :      225       15


T   :       PLØT AS IN FIGURE (9)

T   : PLØT OR NØT
U   : PLØT
T   : ENTER THE ANGLES PHI, THETA
U   : @EØF
T   :          READ IN NAMELIST DAT3D:
          (1) IXWANT --- X VARIABLE
          (2) IYWANT --- Y VAR
          (3) NSKIP  --- SKIP N ROWS
          (4) IVAR   --- VARIABLE TO PLOT
          (5) TRMNL  --- DFLT=   TKTRNX=5
          (6) XSIZE  --- HOR LNGTH of PLT IN INCHS
          (7) YSIZE  --- VERT LNGTH DFLT 11x8.5"
          (8) XSTART --- START the X'S ON THIS COL
U   : @EØF
T   : STØP DØNE
U   : @FIN
```

It is to be noted that Figure 10 is obtained from the CalComp plotter directly. A complete listing of PL3D is given in the Appendix.

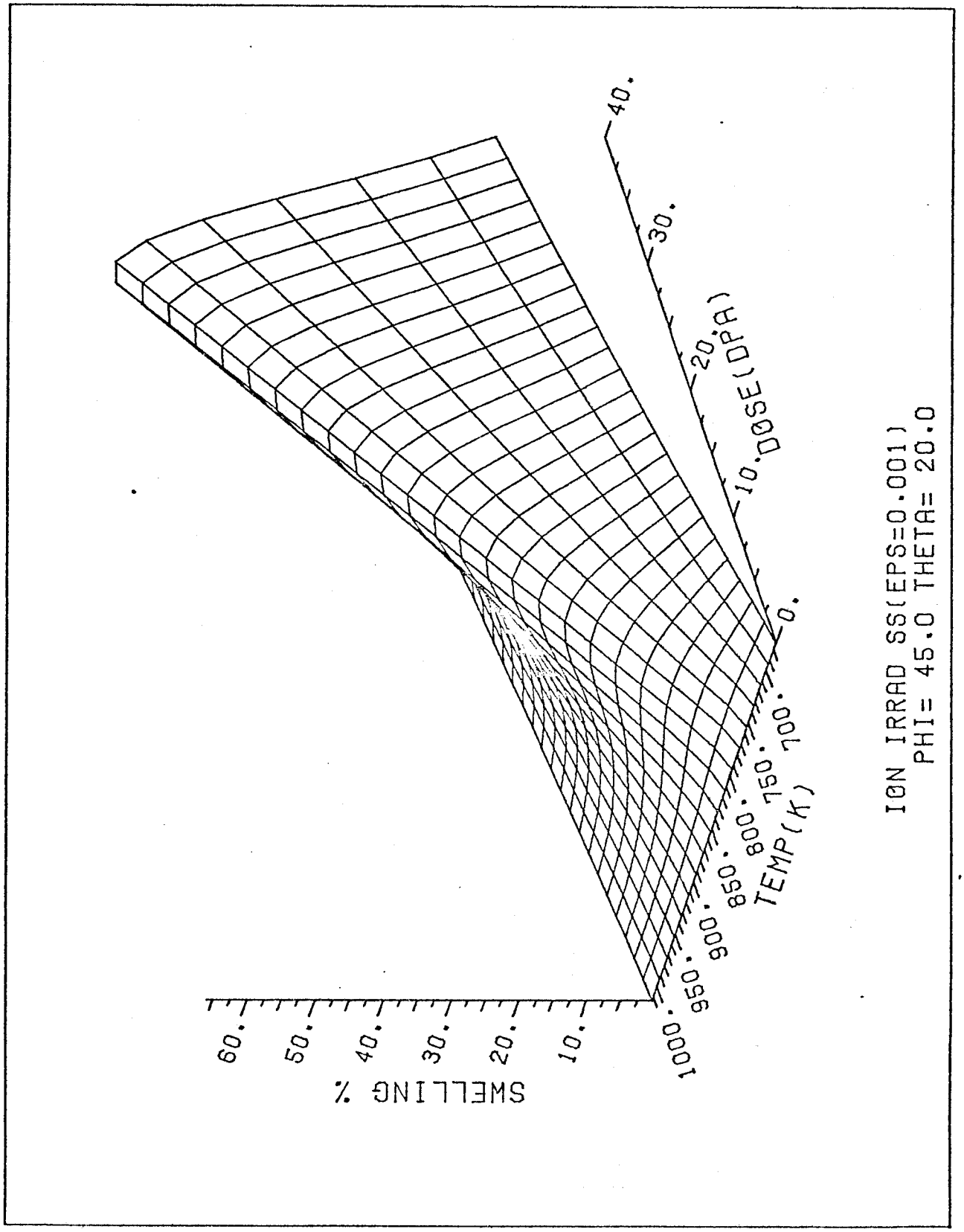

ION IRRAD SS(EPS=0.001)
PHI= 45.0 THETA= 20.0
SWELLING %
60.
50.
40.
30.
20.
10.
TEMP(K)
1000.
950.
900.
850.
800.
750.
700.
DOSE(DPA)
0.
10.
20.
30.
40.

Figure (8)

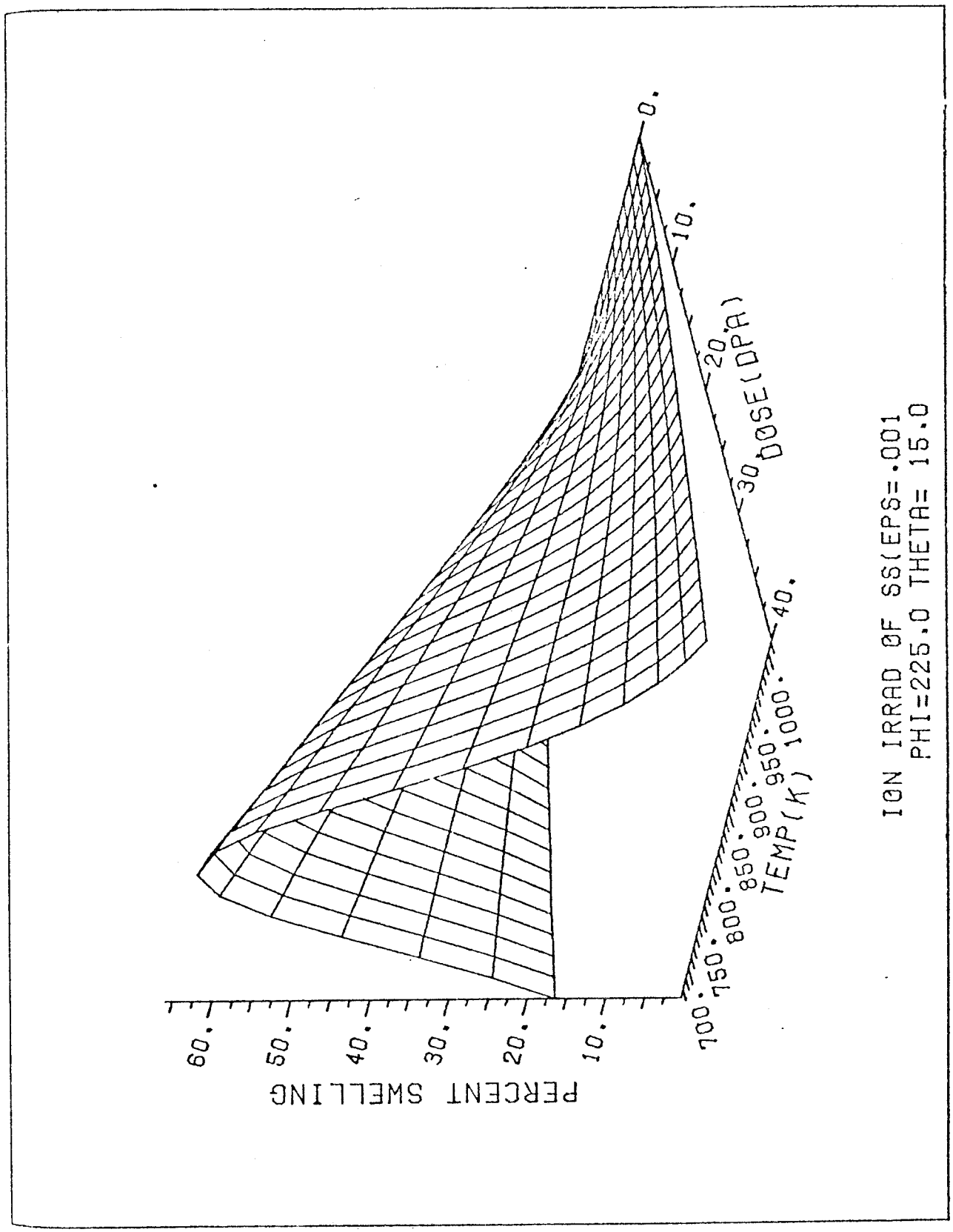

ION IRRAD OF SS(EPS=.001
PHI=225.0 THETA= 15.0
PERCENT SWELLING
60.
50.
40.
30.
20.
10.
TEMP(K)
700.
750.
800.
850.
900.
950.
1000.
DOSE(DPA)
0.
10.
20.
30.
40.

Figure (9)

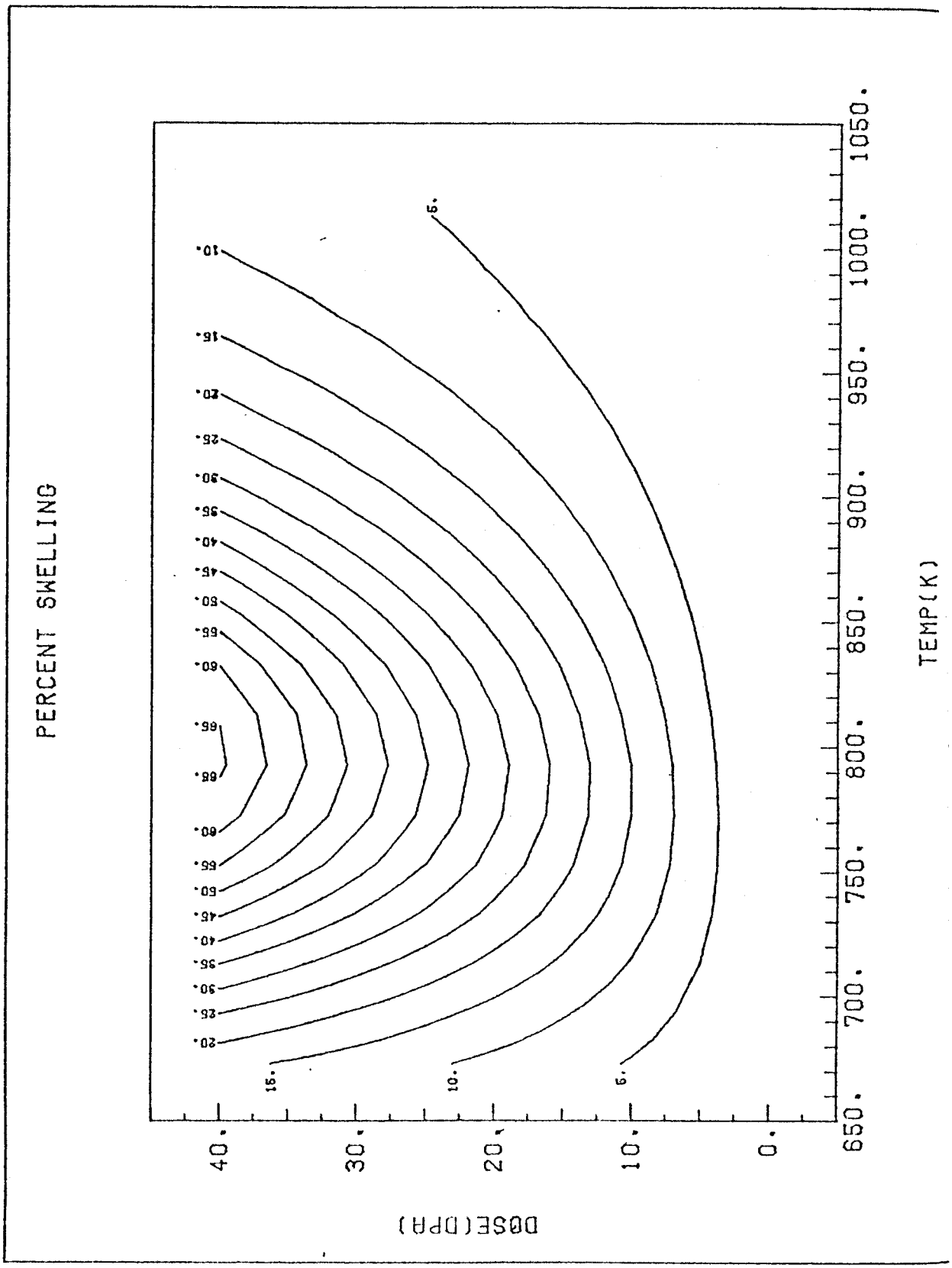

PERCENT SWELLING
DOSE(DPA)
TEMP(K)
650.
700.
750.
800.
850.
900.
950.
1000.
1050.
0.
10.
20.
30.
40.
5.
10.
15.
20.
25.
30.
35.
40.
45.
50.
55.
60.
65.
68.
66.
60.
55.
50.
45.
40.
35.
30.
25.
20.
15.
10.
5.

Figure (10)

References

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2. K. Dwelle, SURGEN: Three-Dimensional Surface Generator, Graphics Routines Series, User Manual for UNIVAC 1110 Series Computer, (1976).

3. K. Dwelle and T. Wolfe, CONTR and CONTRA, Contour Graphing Routines, Graphics Routines Series, Reference Manual for the 1110, (1974).

4. Graphics Handbook, User Manual for UNIVAC 1100 Series Computers, (1976).

Appendix: Listing of PL3D

```
      C
      C
            REAL*8    AA(15,100)
            REAL*4      XMIN,XMAX
            REAL*8  TEMP,PROD,DOSE,TP,XNV,XNIL,BETA,
           .  TIME,TOUT,CASC,RODE,RODO,RVLO,RILO,RVO,GAS,
           .  EVF,EIF,DVE,DIE,EVM,EIM,BU,GAMA,ZV,ZI,OMEGA,
           .  STACK,SHEAR,XNEW,SIGMA,RVGAS,GASO,RELI,PRGAS,
           .  CV,CI,FLUXV,FLUXI,XLAMI,XLAMV,EMIT
            REAL *4    AXES,ORIENT,XYGRID
      C
            REAL*4 A(100,50)
            REAL*4  MASK(400,11)
            EQUIVALENCE (AA,MASK)
            INTEGER TITLE(10)/4*'       '  ,' $/$',' PHI=',' ','THETA=',' ',
           .     '$$'/
            INTEGER   NROWS,LIMIT,PLANE/'NONE'/
            INTEGER     XSTART/1/
            INTEGER NLINE(2)/1,1/
            REAL*4   Y3D(20)
            REAL*4 PHI/45./  THETA/45./   XSIZE/11./  YSIZE/8.5/
            INTEGER   ZMAX/'MAX'/
            INTEGER  XLABEL(5)/4*'       '  ,'  $$  '  /
           .       YLABEL(5)/ 4*'       '  ,' $$'/
           .        ZLABEL(5)/     4*'       '  ,'$$  '/
           .        CTITLE(5)/    4*'       ','$$'/
            INTEGER   IVAR,IXWANT/1/,IYWANT/1/,NSKIP/4/   TRMNL/5/
            NAMELIST /DAT3D/ IXWANT,IYWANT,NSKIP,XSIZE,YSIZE,TRMNL,IVAR,
           .          XSTART
      C
      C
            CALL INITPL(DUMMY,10.8)
            CALL BUFSET(120)
      C
      C     ********
      C
      C
      C
      23    CONTINUE
      C
      C
      C      READ IN THE DATA
            CALL RDARR
      C
      C     READ IN THE LABELS
            CALL RDLBLS
      C
      C     MAX MIN ,SET AXES ECT
            CALL MMXS
      44    CONTINUE
      C
            PRINT 1
      1     FORMAT(' ','ENTER THE ANGLES PHI, THETA')
            READ(-, -,END=97) PHI, THETA
      C
            CALL  PLTTRM
      C
            PRINT 12
      12    FORMAT(' ',/,' ','PLOT OR NOT?')
            READ 13,INST
      13    FORMAT(A6)
            IF (INST .EQ. 'PLOT') CALL PLTPTR
```

```
63              GO TO 44
64        C
65        C
66        C
67        97    CONTINUE
68
69        C     DO THE CONTOUR PLOT
70        C      CALL CNTTRM
71
72        C      PRINT 12
73        C      READ 13,INST
74        C      IF (INST .EQ. 'PLOT') CALL CNTPTR
75              CALL CNTPTR
76
77        C     START OVER
78              CALL DEVSET(TRMNL)
79              CALL ERASGT
80              GO TO 23
81        C
82        C********************  SUBROUTINES   ***************
83        C
84        C
85        C
86                          SUBROUTINE  RDARR
87        C
88        C     FIND OUT WHICH VARIABLE TO PLOT AND READ IN THE DATA
89        C
90        1111  CONTINUE
91              PRINT 1212
92         1212 FORMAT('          ',/,'    READ IN NAMELIST DAT3D :',/
93             .           '       1)IXWANT  ---    X VARIABLE',/
94             .           '       2)IYWANT  ---    Y VAR',/
95             .           '       3)NSKIP   ----  SKIP N ROWS',/
96             .           '       4)IVAR    ----   VARIABLE TO PLOT',/
97             .           '       5)TRMNL   ----    DFLT=     TKTRNX=5',/
98             .           '       6)XSIZE   ---  HOR LNGTH OF PLT IN INCHS',/
99             .           '       7)YSIZE   ---  VERT LNGTH  DFLT  11X8.5',/
100            .           '       8)XSTART  ----    START THE X''S ON THIS COL')
101             READ (5,DAT3D,ERR=800,END=98)
102       C
103             PRINT  1313
104        1313 FORMAT('            LOG OR NOT?',//)
105             READ(5,1314)SC
106        1314 FORMAT(A4)
107       C     READ IN   THE ARRAY
108       C
109             XMIN=1.E30
110             LIMIT=(100-XSTART)/NSKIP  -  1
111       C
112             DO 100 NROWS=1,51
113       C     REALIZE NROWS
114             NR=NROWS
```

```
115       C
116               READ(4,ERR=803,END=99) AA
117               READ(4,ERR=803)  TEMP,PROD,DOSE,TP,XNV,XNIL,BETA,
118              .  TIME,TOUT,CASC,RODE,RODO,RVLO,RILO,RVO,GAS,
119              .  EVF,EIF,DVE,DIE,EVM,EIM,BU,GAMA,ZV,ZI,OMEGA,
120              .  STACK,SHEAR,XNEW,SIGMA,RVGAS,GASO,RELI,PRGAS,
121              .  CV,CI,FLUXV,FLUXI,XLAMI,XLAMV,EMIT
122       C
123       C
124               IF(IYWANT.EQ.1)   Y3D(NROWS)=TEMP
125               IF(IYWANT.EQ.2)Y3D(NROWS)=ALOG10(PROD)
126               IF(IYWANT.EQ.3)Y3D(NROWS)=EVM
127               IF(IYWANT.EQ.4)Y3D(NROWS)=EIM
128               IF(IYWANT.EQ.5)Y3D(NROWS)=EVF
129               IF(IYWANT.EQ.6)Y3D(NROWS)=GAMA/6.2415E11
130               IF(IYWANT.EQ.7)Y3D(NROWS)=SIGMA
131               IF(IYWANT.EQ.8)Y3D(NROWS)=GASO
132               IF(IYWANT.EQ.9)Y3D(NROWS)=ALOG10(PRGAS)
133       C
134               A(1,NROWS)=AA(IVAR,XSTART)
135               IF(SC.EQ.'LOG') A(1,NROWS)=ALOG10(AA(IVAR,XSTART))
136       C
137               DO 200 JJ=1,LIMIT
138               JJJ=NSKIP*JJ + XSTART
139               JJI=JJ+1
140               A(JJI,NROWS)=AA(IVAR,JJJ)
141               IF(SC.EQ.'LOG')A(JJI,NROWS)=ALOG10(AA(IVAR,JJJ))
142       200     CONTINUE
143       C
144       100     CONTINUE
145       C
146       C       ERROR CONDITION
147       C        STOP GT 50R
148       C
149       99      CONTINUE
150               NROWS=NR-1
151       C       RESET LIMIT FOR USE IN SURGEN CALL
152               LIMIT=LIMIT+1
153       C
154               REWIND 4
155       C
156       C
157               RETURN
158         803 PRINT 804
159         804  FORMAT(//,'     ERROR IN THE (A) MATRIX...',/)
160               GO TO 99
161       98      STOP DONE
162         800  PRINT  801
163         801  FORMAT( '        ',/,'        ERROR IN NAMELIST -- TRY AGAIN',/)
164               GO TO 1111
165       C
166       C
```

```
C       *******
C
C
                          SUBROUTINE MMXS
C       DEFINE THE MAX MIN AND SET THE AXES
C
C
C
              YMIN=Y3D(1)
              YMAX=Y3D(NROWS)
C
              XMAX=DOSE
              IF (IXWANT .EQ. 2) XMAX=TOUT
              XMIN=DOSE/100.*(XSTART-1)
C
              ZMIN=A(1,1)
C
C
              AXES=AXVALS
             . ( XMIN,XMAX,'AUTO',XLABEL,
             .   YMIN,YMAX,'AUTO',YLABEL,
             .   'MIN',ZMAX,'AUTO',ZLABEL)
C
C
              ORIENT=GRID3D
             .    ('X=ROWS',   'LOWER',    'EQUAL',     'EQUAL')
C
C       CONTOUR VALUES
              XYGRID=XYVALS(YMIN,YMAX,XMIN,XMAX)
              RETURN
C
C
C       *********
C
C
C
                       SUBROUTINE PLTPTR
C
C       PLOT THE PLOT ON THE CHOSEN DEVICE
              CALL DEVSET('PLTTR')
              XSZ=XSIZE
              YSZ=YSIZE
              GO TO 45
C
              ENTRY PLTTRM
              CALL DEVSET(TRMNL)
              XSZ=8.
              YSZ=6.
C
```

```
C
C
45      CONTINUE
C
        ENCODE(TITLE(7),300) PHI
        ENCODE(TITLE(9),300) THETA
300     FORMAT(F5.1)
        CALL SURGEN
     .   (A,100,LIMIT,NROWS,
     .     ORIENT,PHI,THETA,
     .      XSZ,YSZ,'CROSS',
     .      NLINE,PLANE,AXES,
     .      MASK,TITLE)
C
        CALL PURGBF
C
        RETURN
C
C
C       ********
C
C
C                       SUBROUTINE RDLBLS
C
C       READ IN  THE LABELS
C
        PRINT 1
1       FORMAT(' ',/,' ',  'TYPE IN ALPHANUMERICS FOR ---')
C
        PRINT 100
100     FORMAT('  NEW X&Y&3DTITLES?? -  N FOR NO')
        READ 200,INST
200     FORMAT (A6)

        IF (INST .EQ. 'N') GO TO 10


        PRINT 2
2       FORMAT(' ','TIME RELATED AXIS TITLE')
        CALL RDLB(XLABEL)
C
        PRINT 3
3       FORMAT (' ','Y-AXIS')
        CALL RDLB(YLABEL)
C
        PRINT 5
5       FORMAT (' ','3-D PLOT TITLE')
        CALL RDLB(TITLE)
C
10      CONTINUE
        PRINT 4
4       FORMAT(' ','Z-AXIS')
        CALL RDLB(ZLABEL)

```

```
      C        PRINT 6
      C6       FORMAT (' ','CONTOUR PLOT TITLE')
      C        CALL RDLB(CTITLE)
      C
               DO 2000 INST=1,4
               CTITLE(INST)=ZLABEL(INST)
      2000     CONTINUE


               RETURN
      C
      C        ******
      C
      C
                        SUBROUTINE RDLB(ILAB)
               INTEGER ILAB(4)
      C
      C        READ IN A LABEL
      C
               READ 3,  ILAB
      3        FORMAT(4A6)
      C
               RETURN
      C
      C
      C        ********
      C
                          SUBROUTINE CNTPTR
      C        MAKE A CONTOUR PLOT

               CALL DEVSET('PLTTR')
               GO TO 45

               ENTRY CNTTRM
               CALL DEVSET(TRMNL)

      45       CONTINUE

               CALL CONTR(
              .  A,100,LIMIT,NROWS,
              .  'LINEAR','STD','OFF',
              .   XYGRID,'NORMAL',
              .   YLABEL,XLABEL,CTITLE,
              .   'FULL','TRNSP')

               CALL PURGBF
               RETURN


      C        **************
      C
      C
               END
```