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(1) Program Order Number *(to be filled in by PID)* 360D-08.6.012

(2) System Type *(machine)* 360-65

(3) Search Key . . . . . PRG, PERSPECTIVE PLOTTING OF CURVES AND SURFACES, RECTANGULAR GRID

(4) Programming Language 360OS FL4G

(5) Author's Name and Address . . . . BRUCE KUBERT

(6) Direct Inquiries to Name and Address *(if different than Author)*
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(7) Title of Program . . . . PRG, PERSPECTIVE PLOTTING ROUTINE, RECTANGULAR GRID

(8) Submitter's User Group Affiliation Code and Installation Code . . . . . S ASB

(9) Submitter's Own Program Identification and Suffix *(optional)* . . . . . PRG

(10) Primary Subject Code 08.6

(11) Secondary Subject Codes . . . . . ___.___ ___.___ ___.___ ___.___

(12) Operating or Monitor System Required . . . . . OS VERSION 15/16

(13) New or Revision Code *(if revision, show prior Program Order Number in item 1)* . . . . . N

(14) Year Completed 69

(15) Date of Submittal 08 28 69

(16) Documentation *(number of original pages submitted)* 58

(17) **Abstract** *(should contain sufficient information for a reader to determine the value of the program). Listed on the reverse side of this form are subjects which may serve as a guide for a descriptive abstract.*

CONTRIBUTED PROGRAM LIBRARY SUBMITTAL FORM

Subject Guide

a. Purpose
b. Programming Language used
c. Version and modification level or release number of IBM Programming System used, or program order number for non-IBM authored program used
d. Field of application
e. Type of routine (main program, subroutine, etc.)
f. Specific description of machine requirements
g. Engineering Changes (EC) level of equipment (if pertinent)

ABSTRACT

PRG is an OS/360 FORTRAN subroutine which generates perspective plots of curves and surfaces. The surfaces represent functions of two variables, f(x, y), which satisfy certain restrictions. The plot of a surface is constructed from two families of curves on the surface, one family having curves with fixed x coordinates, the other family having curves with fixed y coordinates. The plotting of the latter can be surpressed. The surfaces can be rotated or translated. As an option the surfaces may be taken to be opaque, in which case all hidden lines are eliminated. The input data for the surface is given in five arrays which contain the starting x and y values, the x and y increments and the z values. The input data for a curve is a set of consecutive points lying on the curve. This program replaces PRG (D003A). This subroutine is a modification of a program originally written by J. Szabo and S. Giulieri. It is compatible with FORTRAN H, however, it has only been checked out on FORTRAN G. The program was run on an IBM 360-IH65 using less than 270K.

(Please attach additional pages if necessary) . . . . . **Total pages attached** _____

Permission to Publish

"I hereby give anyone permission to reprint, reproduce, and distribute this program to anyone else."

(18) Signature of Submitter and Date Mary Barling 2/26/70

(19) Signature of Installation Addressee Edward H Wasserman

T4SF

PRG

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Deck # 2	Sample Driver Deck (1PRG001 through 1PRG141 in cc 73-80; 141.
Deck # 3	Test Data Deck (2PRG), sequence 2PRG001 through 2PRG0012 in cc 73-80; 12 cards.

Identification

PRG, Perspective Plotting Subroutine, Rectangular Grid
OS/360 FORTRAN
M. Barling,
Aerospace Corporation, San Bernardino Operations

Purpose

The purpose of this subroutine is to generate perspective plots of curves and surfaces. A given surface, say S_i, represents a function of two variables, say $z=f_i(x, y)$, which satisfies certain restrictions. A plane must exist such that the projection of S_i in it is a rectangular region, say R_i. This plane is the x-y plane associated with S_i. The input data for S_i are the mesh points of a rectangular grid whose boundary corresponds to that of R_i. The z values at the mesh points are given in a four dimensional array. The x and y values are implied by giving the starting values and increments for x and y. These are given in four one dimensional arrays. Consecutive points on each grid line are joined by straight line segments. The resulting piecewise linear curves are then plotted in perspective. The input data for a curve is a set of consecutive points lying on the curve.

Restrictions

1. PRG requires subroutine PLT 360 (Program Number D044A) which is in the S/360 Library.
2. The following named common are used in PRG and may not appear in the calling program: VECT, LN, MPAPL, ØBS, ØNE, FOUR, TRN, BØXES, MPPLI, TSAV, TR, FNP, AND DEBUG.
3. The projections of the rectangular grid in the x-y plane for each surface must satisfy the following condition:

Restrictions (con't)

The function f is defined for a rectangular grid of points, i.e.,

$$Z_{ij} = f(X_i, Y_j)$$

where

$$X_i = X_1 + (i-1)\,\delta x \qquad i = 1, \ldots M$$

$$Y_j = Y_1 + (j-1)\,\delta y \qquad j = 1, \ldots N$$

where δx, δy are positive spacings between consecutive grid lines in the x and y directions respectively. X_1 and Y_1 are the coordinate values associated with the leftmost and lowest grid lines respectively.

4. The coordinate z may assume one or more values at each mesh point. If z assumes n_ℓ values at each mesh point the surface is said to be segmented into n_ℓ levels, each z value at a particular mesh point belonging to a particular level and each level representing a contiguous portion of the surface. n_ℓ must be fixed for all mesh points of a given surface. The range of z values should not be unduly large or small compared to the range of x and y values or the resulting plot will be hardly more than a line. This is due to the procedure for scaling (see Scaling).

Method

The method is described in Reference 1.

Scaling

We wish to scale our figure in such a manner that regardless of the angles from which we view it, the picture will never fill up more than a specified area. We first find the x limits (x_{min}, x_{max}), the y limits (y_{min}, y_{max}), and the z limits (z_{min}, z_{max}) of all points to be plotted. A centroid is computed

$$B = (b_x, b_y, b_z)$$

Scaling (con't)

where

$$b_x = \frac{x_{max} + x_{min}}{2}$$

$$b_y = \frac{y_{max} + y_{min}}{2}$$

$$b_z = \frac{z_{max} + z_{min}}{2}$$

The distance R from (b_x, b_y, b_z) to $(x_{min}, y_{min}, z_{min})$ is then computed. The sphere described by

$$(x - b_x)^2 + (y - b_y)^2 + (z - b_z)^2 = R^2$$

contains the figure.

A sphere is always transformed into a figure of the same size, regardless of the angle of observation if the distance from the center to the point of observation remains fixed. Consider the projective transformation used (described in Reference 1). It can be shown that if $q > 1$ is a factor such that the observation point is at a distance of qR from point B and B is taken as the origin of the perspective plot, then the maximum and minimum x and y coordinates in the projective plane are

$$|x| \leq \frac{Rq}{\sqrt{q^2 - 1}} = x_s$$

$$|y| \leq \frac{Rq}{\sqrt{q^2 - 1}} = y_s$$

Therefore, taking our scales to be $[-x_s, x_s]$ and $[-y_s, y_s]$ assures us that the surface described by f will always be contained in this area.

Usage

It will be convenient to explain the usage of the program by describing the most general figure that can be plotted by PRG and then relating properties of the various parts of the figure to particular constants and arrays that must be input to PRG. Accordingly, let us define a basic rectangular coordinate system, R_o, to which all parts of the figure will be referred. It is required to construct a figure containing NARAYS surfaces and NCURVS space curves. A particular space curve is described by specifying the coordinates of consecutive points on the curve referred to R_o. These coordinates are stored in the three dimensional array C described below in Section B: Curve Entrance.

Let S_{NA} denote the na-th surface to be plotted and suppose that it consists of NLEVEL (NA) levels. Let a rectangular coordinate system, R_{NA}, be given in terms of which the mesh points of S_{NA} are specified. R_{NA} is related to R_o by a translation vector, Q_{NA}, giving the coordinates of the origin of R_{NA} in terms of R_o, and a rotation matrix, A_{NA}, giving direction numbers of the x and y axes of R_{NA} with respect to R_o. (See description of QC and AL in Section C: Rotation Entrance.)

Points on S_{NA} are specified as follows: $x_{i,na}$ and $y_{j,na}$ denote the x and y coordinates referred to R_{NA} of the mesh point defined as the intersection of the i^{th} x line and the j^{th} y line. $Z(I, J, K, NA) = f_K(x_{i,na}, y_{j,na})$ where K specifies the particular level.

We have

I = 1, 2, ... M(NA)

J = 1, 2, ... N(NA)

K = 1, 2, ... NLEVEL (NA)

where M(NA) and N(NA) are the number of x lines and y lines associated with S_{NA} respectively, and NLEVEL (NA) is the number of levels in S_{NA}.

There are seven entry points to PRG: a setup entrance; a curve entrance; a rotation entrance; a scaling entrance; a data entrance; a cleanup entrance; and

Usage (con't)

a tape-rewind entrance.

Before describing the various call statements, it will be convenient to define the following quantities:

MMAX	is the maximum of M(NA), NA=1, NARAYS
NMAX	is the maximum of N(NA), NA=1, NARAYS
NPMAX	is the maximum of NP(NC), NC=1, NCURVS
LMAX	is the maximum of NLEVEL(NA), NA=1, NARAYS
NR	≥ NARAYS
NL	≥ NCURVS
NXYT	is the maximum of (MMAX, NMAX, NPMAX)

The quantities M, N, NP, NLEVEL, NARAYS and NCURVS are described in Sections A and B below.

A. Setup Entrance

The Setup Entrance must be made for each series of plots of a given figure before any other entry to PRG. This is done with the following statement:

CALL PERSP0 (X0, DELTAX, Y0, DELTAY, Z, NZ1, NZ2, NZ3, M, N, NARAYS, NLEVEL, NCP, PT, XT, YT, Q, IVIS, IYPLT, LEWA, KCHECK, TEST1, TEST2, P1Z, P2Z, P3Z, IRØT, NCURVS, XMINI, XMAXI, YMINI, YMAXI, CZMINI, CZMAXI, BØX1, BØX2, BØX3, BØX4, NBØX)

where

X0	is a one dimensional array of length NR. X0(NA) contains the algebraically smallest x coordinate associated with the grid used to define S_{NA}.
DELTAX	is a one dimensional array of length NR. DELTAX(NA) contains the increment in x associated with the grid used to define S_{NA}.

Setup Entrance (con't)

Y0	is a one dimensional array of length NR. Y0(NA) contains the algebraically smallest y coordinate associated with the grid used to define S_{NA}.
DELTAY	is a one dimensional array of length NR. DELTAY(NA) contains the increment in y associated with the grid used to define S_{NA}.
Z	is a four dimensional array of dimensions (NZ1, NZ2, NZ3, NR). Z(I, J, L, NA) contains the z coordinate associated with the Lth level of S_{NA} at the mesh point defined as the intersection of the Ith x line and the Jth y line.
NZ1	≥ MMAX. (See description of the array Z.)
NZ2	≥ NMAX. (See description of the array Z.)
NZ3	≥ LMAX. (See description of the array Z.)
M	is a one dimensional array of length NR. M(NA) contains the number of x-lines associated with S_{NA}.
N	is a one dimensional array of length NR. N(NA) contains the number of y-lines associated with S_{NA}.
NARAYS	is the number of surfaces to be plotted.
NLEVEL	is a one dimensional array of length NR. NLEVEL(NA) contains the number of levels associated with S_{NA}.
NCP	is the number of characters in the plot title. The maximum number of characters is 80.
PT	is a one dimensional array containing the plot title.
XT	is a one dimensional array of length ≥ NXYT which is used to store the x values of the projected points.

Setup Entrance (con't)

YT	is a one dimensional array of length ≥ NXYT which is used to store the y values of the projected points.
Q	is the factor q described in the section on Scaling. The observation point will be a distance Q*R from the centroid B. Q must be greater than 1. A value of Q=5 is reasonable for most applications. As Q becomes smaller the perspective distortion increases. As Q→∞ the figure approaches a parallel projection.
IVIS	= 1 if the hidden parts of the figure are to be suppressed. ≠ 1 if the hidden parts of the figure are to be plotted.
IYPLT	= 1 if only the x = constant lines are to be plotted. ≠ 1 if both x = constant and y = constant lines are to be plotted.
LEWA	= a two dimensional array used by PRG for storing visibility information for each point. Dimensioned at (NZ1, NZ2).
KCHECK	= a two dimensional array used by PRG. Typed as INTEGER*2. Dimensioned at (NR, NR).
TEST1	= a one dimensional array of length NZ3.
TEST2	= a one dimensional array of length NZ3.
P1Z	= a one dimensional array of length NZ3.
P2Z	= a one dimensional array of length NZ3.
P3Z	= a one dimensional array of length NZ3.
IRØT	= 1, if at least one surface is rotated or translated. = 0, if no surfaces are rotated or translated.
NCURVS	= the numer of space curves to be plotted.

Setup Entrance (con't)

XMINI	= a one dimensional array of length NR used by PRG to store the minimum transformed x value of each array.
XMAXI	= a one dimensional array of length NR used by PRG to store the maximum transformed x value of each array.
YMINI	= a one dimensional array of length NR used by PRG to store the minimum transformed y value of each array.
YMAXI	= a one dimensional array of length NR used by PRG to store the maximum transformed y value of each array.
CZMINI	= a one dimensional array of length NR used by PRG to store the minimum distance from C, the center of projection (i.e., the eye of the observer) to each surface.
CZMAXI	= a one dimensional array of length NR used by PRG to store the maximum distance from C to each surface.
BØX1	= a one dimensional array of length NBOX.
BØX2	= a one dimensional array of length NBOX.
BØX3	= a one dimensional array of length NBOX.
BØX4	= a one dimensional array of length NBOX.
NBØX	see description of BØX1. Note: In order to obtain the most efficiency NBØX should be equal to NARAYS*(NARAYS+NCURVS) but if limited storage capacity precludes this a smaller value is acceptable.

Curve Entrance

If at least one space curve is to be plotted (i.e., NCURVS>0) the following call statement must be made prior to the scaling entrance.

CALL PERSPC (C, NC1, LCHECK, NL, NP, LEWC)

where

C — is a three dimensional array of dimensions (NC1, 3, NL). C(I, J, NC) contains the x, y, or z coordinate of the Ith point on the NCth curve as J=1, 2 or 3 respectively.

NC1 — ≥ NPMAX (see description of the array C).

LCHECK — is a two dimensional array of dimensions (NL, NR). LCHECK must be typed as INTEGER*2.

NL — ≥ NCURVS

NP — is a one dimensional array of length NL. NP(NC) contains the number of points in the NCth curve.

LEWC — = a one dimensional array used for visibility information. Dimensioned at (NPMAX).

Rotation Entrance

If at least one translated or rotated surface is involved (i.e., IRØT = 1) this entry must be used. This entry computes the direction cosines of the axes of the local coordinate systems with respect to the basic coordinate system and must be made prior to the scaling entrance.

CALL PERSPR (AL, ID, QC)

where

AL — is a three dimensional array of dimensions (3, 3, NR). AL (I, J, NA) is the cosine of the angle between the Ith axis of the NAth coordinate system, and the Jth axis of the basic coordinate system. The first, second and

Rotation Entrance (con't)

third coordinate axes correspond to the x, y, and z axes respectively. The user supplies direction numbers for I = 1, and 2 and the program determines the rotation matrix such that the coordinate system is right handed. For arrays which are not rotated, the user must supply the identity matrix.

ID — = a one dimensional array of length NR.
ID (NA) = 1 if the surface is rotated or translated.
≠ 1 if the surface is not rotated or translated.

QC — = a two dimensional array of dimensions (3, NR). QC (I, NA) is the x, y or z coordinate in the basic coordinate system of the origin of the NAth local coordinate system as I = 1, 2 or 3 respectively.

D. Scaling Entrance

This entry computes the centroid and does the scaling. It must be made at least once for every series of plots of a given figure. If it is desired that the scaling for plot n_p be the same as that for plot n_p-1, this call must not be made between the two pertinent calls to PERSP2.

CALL PERSP1

E. Data Entrance

This entrance which specifies the observer's position, C, causes a new plot to be initiated. The line of sight is taken to be CB where B is the centroid of the figure (see section on Scaling). There can be any number of data entrances for each setup entry. The four entries (in A-D) must be made at least once, if applicable, before this entry.

CALL PERSP2 (THETA, PHI)

where

ntrance (con't)

'HETA = the longitude, in degrees, of the observation point measured from the x axis of R'_o.
$0 \leq \theta \leq 360$

'HI = co-latitude, in degrees, of the observation point measured from the Z axis of R'_o to the line through the centroid B and the observation point, C.
$0 < \phi < 180$
R'_o is a coordinate system whose axes correspond and are parallel to those of R_o and whose origin is at B.

lean-up Entrance

his entry terminates the plotting of a figure and must be called before nitiating a new data entry (PERSP2) or setup entry (PERSP0).

ALL PERSP4

ape Rewind Entrance

his entry terminates all plotting in the run.

ALL PERSP5.

RG requires 41234 bytes.

ine and Entry Point Descriptions

0, PERSP1,
2, PERSP4,
5, PERSPC,
R — This subroutine controls the flow of the program according to the options used. It calls M1, M2, DIRC, IØUT0, IØUT1, IØUT2, NICEB, NICEL, NICER,

Subroutine and Entry Point Descriptions (con't)

PLØT0, PLØT1, PLØTC, PLØTR, TRNSF0, TRNSF1, AND PLT.

DIRC — This subroutine determines the direction cosines AL (I, J, NA), such that the coordinate system of the NAth array is right handed.

M1, M2 — The first entry transforms a point from the ith coordinate system to the basic coordinate system. The second entry transforms a point from the basic coordinate system to the ith coordinate system.

TRNSF0, TRNSF1 — This subroutine transforms a point in space to a point in the perspective plane.

IØUT0, IØUT1, IØUT2 — This subroutine determines the visibility of a point. It calls TARAY, IØF0, ZØF0, YØF0, and XØF0.

NICEB, NICEC, NICEL, NICEP, NICER — This subroutine determines the visibility of points on a line between a visible mesh point and an invisible mesh point. It calls M1, M2, IØUT1, IØUT2, TRNSF1, and PLT.

PLØT0, PLØT1, PLØTR, PLØTC — This subroutine determines the points to be plotted, transforms these points and plots them. It calls M1, TRNSF1, NICEP, NICEC, and PLT.

ZØF0 — This subroutine is used to interpolate for z at an arbitrary point between two points where the values of z are known.

YØF0 — This subroutine determines the y coordinate of the intersection of the line of sight and a specified grid line of the form x = constant.

XØF0 — This subroutine determines the x coordinate of the intersection of the line of sight and a specified grid line of the form y = constant.

Subroutine and Entry Point Descriptions (con't)

TARAY — This subroutine determines if the projection of the line of sight, CP, in the x - y plane intersects the grid formed by the projections in the x - y plane of the data points on S_{NA}. If intersections do occur the one closest to the observation point, C, is stored in (XM, YM).

IØF0 — This subroutine is used to determine the index of the x line, at on just left of XM and the index of the y line at or just below YM.

Selected Messages

1. AXES NØT PERP. STØP
   This message is written by subroutine DIRC and means that the x and y axes are not mutually perpendicular. The user should correct the AL array.
2. ILLEGAL ØBSERVATIØN PØINT .....STØP
   This message is printed by subroutine TRNSF0. The user has given PHI a value of 0° or 180°.
3. BØX TABLES WERE FILLED.
   BØX ARRAYS EXCEEDED BY ICØUNT
   This message is written by PERSP2. It is not an error message. Execution time may be decreased by increasing NBØX, the dimensions of XBØX1, XBØX2, YBØX1, and YBØX2. ICØUNT is the number of cells each of these arrays should be increased for maximum efficiency.
4. INTERSECTING ARRAYS ARE NØT LARGE ENOUGH NLEV = .
   This message is written by subroutine IØUT0 and means that the first dimension of TSAV is not large enough. The dimension should be changed to TSAV (nlev, 4) where nlev is the maximum number of levels in any surface.

Selected Messages (con't)

5. ERRØRS IN INØRØU . . . .
   This message is written by subroutine IOUT0 and means that there are inconsistencies in the boundary specifications. Execution is stopped.

Reference

1. "Two Computer Programs for the Perspective Representation of Curves and Surfaces," Aerospace Report No. TR-0200(S9990)-1 by Bruce R. Kubert.

```
      SUBROUTINE PERSPO (XO,DELTAX,YO,DELTAY,Z, NZ1 , NZ2 ,                  D0030001
     1 NZ3 ,M,N, NARAYX ,NLEVEL,/NCP/,PT,XT,YT,/Q/,/IVIX/,                   D0030002
     2/IYPLX/,LEWA,KCHECK,TEST1,TEST2,PLZ,P2Z,P3Z,/IROX/,                    D0030003
     3/NCURVS/, XMINI,XMAXI,YMINI,YMAXI,CZMINI,CZMAXI,                       D0030004
     4XBOX1,XBOX2,YBOX1,YBOX2,/MXINOX/)                                      D0030005
C     SUBROUTINE PERSP CONTROLS THE FLOW OF THE PROGRAM ACCORDING TO THE    D0030006
C    1OPTIONS USED. IT CALLS M1,M2,DIRC,IOUTO,IOUT1,IOUT2,NICEB,NICEL,      D0030007
C    2NICER,PLOTO,PLOT1,PLOTC,PLOTR,TRNSFO,TRNSF1,AND PLT.                   D0030008
      DIMENSION XO(1),DELTAX(1),YO(1),DELTAY(1)                              D0030009
      DIMENSION TEST1(1),TEST2(1)                                            D0030010
      DIMENSION XMINI(1),XMAXI(1),YMINI(1),YMAXI(1),CZMINI(1),CZMAXI(1)      D0030011
      INTEGER*2 KCHECK                                                       D0030012
      DIMENSION XBOX1(1),XBOX2(1),YBOX1(1),YBOX2(1)                          D0030013
C     THE CARDS ABOVE WERE ADDED FOR THE FAST KCHECK MODIFICATION.           D0030014
      DIMENSION PT(1),M(1),N(1),NLEVEL(1),XT(1),YT(1)                        D0030015
      DIMENSION P1Z(1),P2Z(1),P3Z(1)                                         D0030016
      DIMENSION Z(NZ1,NZ2,NZ3,1),LEWA(NZ1,1),KCHECK(NARAYX,1)                D0030017
      DOUBLE PRECISION THETA,GAMMA,CONV,ST,CT,SG,CG                          D0030018
      COMMON /TRN/ XB,YB,ZB,CX,CY,CZ,D                                       D0030019
      COMMON /DEBUG/KBUG                                                     D0030020
      COMMON      /FNP/ X1000,DELX,DELY,SAVE(30)                             D0030021
      COMMON /VECT/ VO(3),V1(3)                                              D0030022
      COMMON /OBS/ CX1,CY1,CZ1                                               D0030023
      COMMON /ONE/ IROT                                                      D0030024
      COMMON /MPAPL/IVIS                                                     D0030025
      COMMON /FOUR/ NARAYS                                                   D0030026
      COMMON /MPPLI/IYPLT                                                    D0030027
      DATA BLANK /4H     /                                                   D0030028
      DATA SO /Z7FFFFFFF/                                                    D0030029
      DATA  CONV  /.17453292519943D-1/                                       D0030030
      DATA AXES /Z0F000000/                                                  D0030031
      KBUG = 0                                                               D0030032
      IF (KBUG .GE. 1) WRITE(6,1001)                                         D0030033
1001  FORMAT (1X,'REACHED PERSPO')                                           D0030034
      IROT = IROX                                                            D0030035
      NARAYS = NARAYX                                                        D0030036
```



```
      IVIS = IVIX                                                            D0030037
      IYPLT = IYPLX                                                          D0030038
      CALL PLOTO (XT,YT,LEWA,NZ1)                                            D0030039
      CALL IOUTO (CX1,CY1,CZ1,TEST2,TEST1)                                   D0030040
      CALL NICEB (XO,DELTAX,YO,DELTAY,Z,NZ1,NZ2,NZ3,NLEVEL,M,N,KCHECK,       D0030041
     1NARAYX,XT,YT,P1Z,P2Z,P3Z,XBOX1,XBOX2,YBOX1,YBOX2)                      D0030042
      RETURN                                                                 D0030043
      ENTRY PERSPC (C, NC1 ,LCHECK, NLC ,NP,LEWC)                            D0030044
      INTEGER*2 LCHECK                                                       D0030045
      DIMENSION NP(1),LEWC(1)                                                D0030046
      DIMENSION C(NC1,3  ,1),LCHECK(NLC,1)                                   D0030047
      CALL NICEL (LCHECK,NLC)                                                D0030048
      RETURN                                                                 D0030049
      ENTRY PERSPR (AL,ID,QC)                                                D0030050
      DIMENSION AL(3,3,1),QC(3,1),ID(1)                                      D0030051
      CALL NICER (AL,QC)                                                     D0030052
      DO 1 I=1,NARAYS                                                        D0030053
      IF (KBUG .GE. 5)                                                       D0030054
     1WRITE (6,14)  ((AL(K,L,I),K=1,3),L=1,3),((QC(K,L),K=1,3),L=1,2)        D0030055
   14 FORMAT(1X,3E13.5/)                                                     D0030056
      CALL DIRC (AL(1,1,I))                                                  D0030057
      IF (KBUG .GE. 5)                                                       D0030058
     1WRITE (6,14)  ((AL(K,L,I),K=1,3),L=1,3),((QC(K,L),K=1,3),L=1,2)        D0030059
 1    CONTINUE                                                               D0030060
      RETURN                                                                 D0030061
      ENTRY PERSP1                                                           D0030062
      XMN = SO                                                               D0030063
      XMX = -SO                                                              D0030064
      YMN = SO                                                               D0030065
      YMX = -SO                                                              D0030066
      ZMN = SO                                                               D0030067
      ZMX = -SO                                                              D0030068
      IF (NARAYS .EQ. 0) GO TO 11                                            D0030069
      DO 10 NA=1,NARAYS                                                      D0030070
      MNA = M(NA)                                                            D0030071
      NNA = N(NA)                                                            D0030072
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```
      LEV = NLEVEL(NA)                                                  D0030073
      DO 20 J=1,NNA                                                     D0030074
      VI(2) = YO(NA) + FLOAT(J-1)*DELTAY(NA)                            D0030075
      DO 21 I=1,MNA                                                     D0030076
      VI(1) = XO(NA) + FLOAT(I-1)*DELTAX(NA)                            D0030077
      DO 15 K=1,LEV                                                     D0030078
      VI(3) = Z(I,J,K,NA)                                               D0030079
      IF (IROT .EQ. 1) GO TO 16                                         D0030080
      DO 17 IS=1,3                                                      D0030081
17    VO(IS) = VI(IS)                                                   D0030082
      GO TO 18                                                          D0030083
   16 CONTINUE                                                          D0030084
      CALL M1 (AL(1,1,NA),QC(1,NA))                                     D0030085
18    IF (XMN .GT. VO(1)) XMN=VO(1)                                     D0030086
      IF (XMX .LT. VO(1)) XMX=VO(1)                                     D0030087
      IF (YMN .GT. VO(2)) YMN=VO(2)                                     D0030088
      IF (YMX .LT. VO(2)) YMX=VO(2)                                     D0030089
      IF (ZMN .GT. VO(3)) ZMN=VO(3)                                     D0030090
      IF (ZMX .LT. VO(3)) ZMX=VO(3)                                     D0030091
15    CONTINUE                                                          D0030092
21    CONTINUE                                                          D0030093
20    CONTINUE                                                          D0030094
10    CONTINUE                                                          D0030095
   11 CONTINUE                                                          D0030096
      IF (NCURVS.EQ.0) GO TO 22                                         D0030097
      DO 25 NC=1,NCURVS                                                 D0030098
      NNC = NP(NC)                                                      D0030099
      DO 26 I=1,NNC                                                     D0030100
      IF (XMN .GT. C(I,1,NC)) XMN=C(I,1,NC)                             D0030101
      IF (XMX .LT. C(I,1,NC)) XMX=C(I,1,NC)                             D0030102
      IF (YMN .GT. C(I,2,NC)) YMN=C(I,2,NC)                             D0030103
      IF (YMX .LT. C(I,2,NC)) YMX=C(I,2,NC)                             D0030104
      IF (ZMN .GT. C(I,3,NC)) ZMN=C(I,3,NC)                             D0030105
      IF (ZMX .LT. C(I,3,NC)) ZMX=C(I,3,NC)                             D0030106
26    CONTINUE                                                          D0030107
25    CONTINUE                                                          D0030108
```



```
22    CONTINUE                                                          D0030109
      XB=(XMN+XMX)/2.                                                   D0030110
      YB=(YMN+YMX)/2.                                                   D0030111
      ZB=(ZMN+ZMX)/2.                                                   D0030112
      RC=SQRT((XMX-XB)**2+(YMX-YB)**2+(ZMX-ZB)**2)                      D0030113
      D=RC*Q                                                            D0030114
      PXS=-D/SQRT(Q*Q-1.)                                               D0030115
      PXI=-PXS*0.22222222                                               D0030116
      PXS=PXS-0.5*PXI                                                   D0030117
      PYS = PXS                                                         D0030118
      RETURN                                                            D0030119
      ENTRY PERSP2 (/THETAD/,/GAMMAD/)                                  D0030120
      IF (KBUG .GE. 1) WRITE(6,27)                                      D0030121
27    FORMAT (1X, 'REACHED PERSP2')                                     D0030122
      THETA=THETAD*CONV                                                 D0030123
      GAMMA=GAMMAD*CONV                                                 D0030124
      ST = DSIN(THETA)                                                  D0030125
      CT = DCOS(THETA)                                                  D0030126
      SG = DSIN(GAMMA)                                                  D0030127
      CG = DCOS(GAMMA)                                                  D0030128
      CX=RC*SG*CT*Q+XB                                                  D0030129
      CY=RC*SG*ST*Q+YB                                                  D0030130
      CZ=RC*CG*Q+ZB                                                     D0030131
      CX1 = CX                                                          D0030132
      CY1 = CY                                                          D0030133
      CZ1 = CZ                                                          D0030134
      IF (KBUG .GE. 1) WRITE (6,802)CX,CY,CZ                            D0030135
 802  FORMAT(3E20.8)                                                    D0030136
      CALL TRNSFO                                                       D0030137
      X100D=100./PXI                                                    D0030138
      X100D=100./PXI                                                    D0030139
      NIT = 16                                                          D0030140
      CALL  PLT (1,NIT,PXS,PXI,XT,0,1,PXS,PXI,0,1,YT,NCP,PT,0,BLANK,0,  D0030141
     *BLANK)                                                            D0030142
      CALL  PLT (3,0,50,-10.,1,AXES)                                    D0030143
      CALL  PLT (3,0,50,10.,1,AXES)                                     D0030144
```

```
C     THESE CARDS ARE FOR THE FAST KCHECK MODIFICATION.                  D0030145
      ICOUNT = 0                                                         D0030146
      INDX=0                                                             D0030147
      IF (IVIS .NE. 1) GO TO 49                                          D0030148
      IF (KCHECK(1,1).EQ.-1) GO TO 49                                    D0030149
      KCHECK(1,1)= 1                                                     D0030150
      IF (NARAYS .LT. 2.AND. NCURVS .EQ. 0) GO TO 49                     D0030151
      DO 46 NA=1,NARAYS                                                  D0030152
      MNA=M(NA)                                                          D0030153
      NNA=N(NA)                                                          D0030154
      LEV=NLEVEL(NA)                                                     D0030155
      XTMIN=SO                                                           D0030156
      XTMAX=-SO                                                          D0030157
      YTMIN=SO                                                           D0030158
      YTMAX=-SO                                                          D0030159
      CZMIN=SO                                                           D0030160
      CZMAX=-SO                                                          D0030161
      DO 45 K=1,LEV                                                      D0030162
      DO 45 I=1,MNA                                                      D0030163
      DO 45 J=1,NNA                                                      D0030164
      VI(1) = XO(NA) + FLOAT(I-1)*DELTAX(NA)                             D0030165
      VI(2) = YO(NA) + FLOAT(J-1)*DELTAY(NA)                             D0030166
      VI(3)=Z(I,J,K,NA)                                                  D0030167
C     HOLES NOT CONSIDERED IN RECTANGULAR CASE                           D0030168
      IF (IROT.EQ.1) GO TO 43                                            D0030169
      DO 42 IS=1,3                                                       D0030170
42    VO(IS)=VI(IS)                                                      D0030171
      GO TO 44                                                           D0030172
43    CALL M1(AL(1,1,NA),QC(1,NA))                                       D0030173
44    CALL TRNSF1(VO(1),VO(2),VO(3),XTEST,YTEST)                         D0030174
      IF (XTEST.LT.XTMIN) XTMIN=XTEST                                    D0030175
      IF (XTEST.GT.XTMAX) XTMAX=XTEST                                    D0030176
      IF (YTEST.LT.YTMIN) YTMIN=YTEST                                    D0030177
      IF (YTEST.GT.YTMAX) YTMAX=YTEST                                    D0030178
      CZTEST=(VO(1)-CX)**2+(VO(2)-CY)**2+(VO(3)-CZ)**2                   D0030179
      IF (CZTEST.LT.CZMIN) CZMIN=CZTEST                                  D0030180
```



```
      IF (CZTEST.GT.CZMAX) CZMAX=CZTEST                                  D0030181
                                                                         D0030182
45    CONTINUE                                                           D0030183
      XMINI(NA)=XTMIN                                                    D0030184
      XMAXI(NA)=XTMAX                                                    D0030185
      YMINI(NA)=YTMIN                                                    D0030186
      YMAXI(NA)=YTMAX                                                    D0030187
      CZMINI(NA)=CZMIN                                                   D0030188
46    CZMAXI(NA)=CZMAX                                                   D0030189
      KBOX = 0                                                           D0030190
      KCHECK(NARAYS,NARAYS)=1                                            D0030191
      NARM1=NARAYS-1                                                     D0030192
      IF (NARM1.LT. 1) GO TO 49                                          D0030193
      DO 48 NA=1,NARM1                                                   D0030194
      KCHECK(NA,NA)=1                                                    D0030195
      XMINNA=XMINI(NA)                                                   D0030196
      XMAXNA=XMAXI(NA)                                                   D0030197
      YMINNA=YMINI(NA)                                                   D0030198
      YMAXNA=YMAXI(NA)                                                   D0030199
      CZMINA=CZMINI(NA)                                                  D0030200
      CZMAXA=CZMAXI(NA)                                                  D0030201
      NB1=NA+1                                                           D0030202
      DO 48 NB=NB1,NARAYS                                                D0030203
      KCK=1                                                              D0030204
      XMINNB=XMINI(NB)                                                   D0030205
      XMAXNB=XMAXI(NB)                                                   D0030206
      YMINNB=YMINI(NB)                                                   D0030207
      YMAXNB=YMAXI(NB)                                                   D0030208
      CZMINB=CZMINI(NB)                                                  D0030209
      CZMAXB=CZMAXI(NB)                                                  D0030210
      IF (XMINNA.GE.XMAXNB) KCK=0                                        D0030211
      IF (XMINNB.GE.XMAXNA) KCK=0                                        D0030212
      IF (YMINNA.GE.YMAXNB) KCK=0                                        D0030213
      IF (YMINNB.GE.YMAXNA) KCK=0                                        D0030214
      KCHECK(NB,NA)=0                                                    D0030215
      KCHECK(NA,NB)=0                                                    D0030216
      IF (KCK.EQ .0) GO TO 48
```

```
      IF (INDX.LT.MXINDX) GO TO 47                                      D0030217
      KCHECK(NB,NA)=-2                                                  D0030218
      KCHECK(NA,NB)=-2                                                  D0030219
      ICOUNT = ICOUNT + 1                                               D0030220
      IF (KBOX .EQ. 1 ) GO TO 476                                       D0030221
      KBOX = 1                                                          D0030222
      WRITE (6,473)                                                     D0030223
473   FORMAT (23HOBOX TABLES WERE FILLED )                              D0030224
      GO TO 476                                                         D0030225
47    INDX=INDX+1                                                       D0030226
      KCHECK(NB,NA)=INDX                                                D0030227
      KCHECK(NA,NB)=INDX                                                D0030228
      XBOX1(INDX)=AMAX1(XMINNA,XMINNB)                                  D0030229
      XBOX2(INDX)=AMIN1(XMAXNA,XMAXNB)                                  D0030230
      YBOX1(INDX)=AMAX1(YMINNA,YMINNB)                                  D0030231
      YBOX2(INDX)=AMIN1(YMAXNA,YMAXNB)                                  D0030232
476   IF (CZMINA.GE.CZMAXB) KCHECK(NB,NA)=0                             D0030233
      IF (CZMINB.GE.CZMAXA) KCHECK(NA,NB)=0                             D0030234
48    CONTINUE                                                          D0030235
      IF (KBUG .LT. 1) GO TO 4895                                       D0030236
      DO 485 NA1 = 1, NARAYS                                            D0030237
  485 WRITE (6,104)(KCHECK (NA1,NB1),NB1= 1,NARAYS)                     D0030238
      IJ1 = 1                                                           D0030239
      DO 489 IK =1,INDX,12                                              D0030240
      IJ2 = IJ1 + 11                                                    D0030241
      WRITE (6,487)(XBOX1(IJB),IJB=IJ1,IJ2)                             D0030242
      WRITE (6,488)(XBOX2(IJB),IJB=IJ1,IJ2)                             D0030243
      WRITE (6,488) (YBOX1(IJB),IJB=IJ1,IJ2)                            D0030244
      WRITE (6,488) (YBOX2(IJB),IJB=IJ1,IJ2)                            D0030245
487   FORMAT (1HO,12F8.2)                                               D0030246
488   FORMAT (1X, 12F8.2)                                               D0030247
489   IJ1 = IJ2 + 1                                                     D0030248
 4895 CONTINUE                                                          D0030249
   49 INSAV = INDX                                                      D0030250
      IF (ICOUNT .GT. 0 .AND. NCURVS .EQ. 0) WRITE (6,491) ICOUNT       D0030251
  491 FORMAT (1X,'BOX ARRAYS EXCEEDED BY' 1I4)                          D0030252
```



```
      IF (NARAYS.EQ.0) GO TO 371                                        D0030253
      IF (IVIS .NE. 1) GO TO 705                                        D0030254
      IF  (NCURVS .EQ. 0) GO TO 705                                     D0030255
      IF (KCHECK(1,1) .EQ. -1) GO TO 705                                D0030256
      INDX=INSAV                                                        D0030257
C     RELOCATE SO DO NOT NEED BOXES LATER                               D0030258
      DO 70 NC=1,NCURVS                                                 D0030259
      NNC=NP(NC)                                                        D0030260
      DO 70 NA=1,NARAYS                                                 D0030261
      I1=0                                                              D0030262
      I2=0                                                              D0030263
      I3=0                                                              D0030264
      I4=0                                                              D0030265
      LCHECK(NC,NA)=0                                                   D0030266
      DO 65 NPT = 1,NNC                                                 D0030267
      IFLG=1                                                            D0030268
      CXTST=C(NPT,1,NC)                                                 D0030269
      CYTST=C(NPT,2,NC)                                                 D0030270
      CZTST=C(NPT,3,NC)                                                 D0030271
      CALL TRNSF1(CXTST,CYTST,CZTST,XTEST,YTEST)                        D0030272
      IF (XTEST.GE.XMAXI(NA)) IFLG=0                                    D0030273
      IF (XTEST.LE.XMINI(NA)) IFLG=0                                    D0030274
      IF (YTEST.GE.YMAXI(NA)) IFLG=0                                    D0030275
      IF (YTEST.LE.YMINI(NA)) IFLG=0                                    D0030276
      ZTEST=(CXTST-CX)**2+(CYTST-CY)**2+(CZTST-CZ)**2                   D0030277
      IF (ZTEST.LE.CZMINI(NA)) IFLG=0                                   D0030278
      IF (IFLG.EQ.0) GO TO 63                                           D0030279
      IF (INDX .LT. MXINDX ) GO TO 605                                  D0030280
      ICOUNT = ICOUNT + 1                                               D0030281
      LCHECK (NC,NA) = - 2                                              D0030282
      IF (KBOX .EQ. 1)GO TO 70                                          D0030283
      KBOX = 1                                                          D0030284
      WRITE (6,473)                                                     D0030285
      GO TO 70                                                          D0030286
605   CONTINUE                                                          D0030287
      IF (I1.NE.0) GO TO 61                                             D0030288
```

```
      I1=NPT                                                          D0030289
      GO TO 65                                                        D0030290
   61 IF (I2.EQ.0) GO TO 65                                           D0030291
      IF (I3.NE.0) GO TO 62                                           D0030292
      I3=NPT                                                          D0030293
      GO TO 65                                                        D0030294
   62 IF (I4.EQ.0) GO TO 65                                           D0030295
      I4=NNC                                                          D0030296
      GO TO 66                                                        D0030297
   63 IF (I1.EQ.0) GO TO 65                                           D0030298
      IF (I2.NE.0) GO TO 64                                           D0030299
      I2=NPT-1                                                        D0030300
      GO TO 65                                                        D0030301
   64 IF (I3.EQ.0) GO TO 65                                           D0030302
      IF (I4.NE.0) GO TO 65                                           D0030303
      I4=NPT-1                                                        D0030304
   65 CONTINUE                                                        D0030305
   66 IF (I1.EQ.0) GO TO 70                                           D0030306
      IF (I2.NE.0) GO TO 67                                           D0030307
      I2=NNC                                                          D0030308
      GO TO 68                                                        D0030309
   67 IF (I3.EQ.0) GO TO 68                                           D0030310
      IF (I4.NE.0) GO TO 68                                           D0030311
      I4=NNC                                                          D0030312
   68 CONTINUE                                                        D0030313
      INDX=INDX+1                                                     D0030314
      LCHECK(NC,NA)=INDX                                              D0030315
      XBOX1(INDX) = I1                                                D0030316
      XBOX2(INDX) = I2                                                D0030317
      YBOX1(INDX) = I3                                                D0030318
      YBOX2(INDX) = I4                                                D0030319
   70 CONTINUE                                                        D0030320
      IF (KBUG .LT. 1) GO TO 7045                                     D0030321
      WRITE (6,704)                                                   D0030322
  704 FORMAT (1X,'LCHECK ARRAY')                                      D0030323
      DO 702 NB1 = 1,NCURVS                                           D0030324
```



```
  702 WRITE (6,703) (LCHECK(NB1,NA),NA=1,NARAYS)                      D0030325
  703 FORMAT (1X,(15I6))                                              D0030326
      IJ1 = 1                                                         D0030327
      DO 701 IK=1,INSAV,12                                            D0030328
      IJ2 = IJ1 + 11                                                  D0030329
      WRITE (6,487) (XBOX1(IJB),IJB = IJ1,IJ2)                        D0030330
      WRITE (6,488) (XBOX2(IJB),IJB = IJ1,IJ2)                        D0030331
      WRITE (6,488) (YBOX1(IJB),IJB = IJ1,IJ2)                        D0030332
      WRITE (6,488) (YBOX2(IJB),IJB = IJ1,IJ2)                        D0030333
  701 IJ1 = IJ2+1                                                     D0030334
      IJ0 = INSAV + 1                                                 D0030335
      IJ1 = IJ0                                                       D0030336
      DO 7036 IK = IJ0,INDX,12                                        D0030337
      IJ2 = IJ1 + 11                                                  D0030338
      WRITE (6,7032) IJ1,IJ2                                          D0030339
 7032 FORMAT (1H0,I4,90X,I5)                                          D0030340
      WRITE (6,487) (XBOX1(IJB),IJB = IJ1,IJ2)                        D0030341
      WRITE (6,488) (XBOX2(IJB),IJB = IJ1,IJ2)                        D0030342
      WRITE (6,488) (YBOX1(IJB),IJB = IJ1,IJ2)                        D0030343
      WRITE (6,488) (YBOX2(IJB),IJB = IJ1,IJ2)                        D0030344
 7034 FORMAT (20I5)                                                   D0030345
 7036 IJ1 = IJ2 +1                                                    D0030346
 7045 CONTINUE                                                        D0030347
      IF (ICOUNT .GT. 0) WRITE (6,491) ICOUNT                         D0030348
  705 CONTINUE                                                        D0030349
      KPRNTC = 0                                                      D0030350
      DO 50 NA=1,NARAYS                                               D0030351
      MNA = M(NA)                                                     D0030352
      NNA = N(NA)                                                     D0030353
      LEV = NLEVEL(NA)                                                D0030354
      DO 40 I=1,MNA                                                   D0030355
      DO 40 J=1,NNA                                                   D0030356
      LEWA (I,J) = 0                                                  D0030357
   40 CONTINUE                                                        D0030358
      DO 53 K=1,LEV                                                   D0030359
      IF (IVIS .NE. 1) GO TO 56                                       D0030360
```

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      DO 51 I=1,MNA                                                    D0030361
      DO 52 J=1,MNA                                                    D0030362
      DO 57 LVS=1,LEV                                                  D0030363
      P3Z(LVS) = Z(I,J,LVS,NA)                                         D0030364
 57   CONTINUE                                                         D0030365
      PX = XO(NA) + FLOAT(I-1)*DELTAX(NA)                              D0030366
      PY = YO(NA) + FLOAT(J-1)*DELTAY(NA)                              D0030367
      IF (IROT .NE. 1) CALL IOUT1 (PX,PY,P3Z,LEW,K)                    D0030368
      VI(1) = XO(NA) + FLOAT(I-1)*DELTAX(NA)                           D0030369
      VI(2) = YO(NA) + FLOAT(J-1)*DELTAY(NA)                           D0030370
      VI(3)=P3Z(K)                                                     D0030371
      IF (IROT.EQ.1) GO TO 577                                         D0030372
      DO 576 IS=1,3                                                    D0030373
576   VO(IS)=VI(IS)                                                    D0030374
      GO TO 578                                                        D0030375
577   CALL M1(AL(1,1,NA),QC(1,NA))                                     D0030376
578   CALL TRNSF1(VO(1),VO(2),VO(3),XTEST,YTEST)                       D0030377
      IF (KBUG .GE. 1) WRITE(6,579) NA,I,J,VI(1),VI(2),VI(3),VO(1),VO(2)D0030378
     1,VO(3),XTEST,YTEST                                               D0030379
579   FORMAT (1X, 3I4, 2X, 8E13.5)                                     D0030380
      DO 55 NB=1,NARAYS                                                D0030381
      TEMP = P3Z(K)                                                    D0030382
      DELX = DELTAX(NB)                                                D0030383
      DELY = DELTAY(NB)                                                D0030384
      ISAM = 0                                                         D0030385
      IF (NA .EQ. NB) ISAM=1                                           D0030386
      KCK=KCHECK(NA,NB)                                                D0030387
      IF (KCK.EQ.0) GO TO 55                                           D0030388
      IF (KCK.LT.0) GO TO 58                                           D0030389
      IF (ISAM.EQ.1) GO TO 58                                          D0030390
      INDX=KCHECK(NA,NB)                                               D0030391
         IF (XTEST.LT.XBOX1(INDX)) GO TO 55                            D0030392
      IF (XTEST.GT.XBOX2(INDX)) GO TO 55                               D0030393
      IF (YTEST.LT.YBOX1(INDX)) GO TO 55                               D0030394
      IF (YTEST.GT.YBOX2(INDX)) GO TO 55                               D0030395
   58 CONTINUE                                                         D0030396
```



```
C     END OF CARDS FOR FAST KCHECK MODIFICATION                        D0030397
      IF (IROT .NE. 1) GO TO 102                                       D0030398
      VO(1) = CX                                                       D0030399
      VO(2) = CY                                                       D0030400
      VO(3) = CZ                                                       D0030401
      CALL M2 (AL(1,1,NB),QC(1,NB))                                    D0030402
      CX1 = VI(1)                                                      D0030403
      CY1 = VI(2)                                                      D0030404
      CZ1 = VI(3)                                                      D0030405
      VI(1) = XO(NA) + FLOAT(I-1)*DELTAX(NA)                           D0030406
      VI(2) = YO(NA) + FLOAT(J-1)*DELTAY(NA)                           D0030407
      IF (ISAM .EQ. 1) GO TO 101                                       D0030408
      VI(3) = P3Z(K)                                                   D0030409
      CALL M1 (AL(1,1,NA),QC(1,NA))                                    D0030410
      CALL M2 (AL(1,1,NB),QC(1,NB))                                    D0030411
      P3Z(K) = VI(3)                                                   D0030412
 101  CALL IOUT1 (VI(1),VI(2),P3Z,LEW,K)                               D0030413
 102  CONTINUE                                                         D0030414
      CALL IOUT2 (XO(NB),DELTAX(NB),YO(NB),DELTAY(NB),Z(1,1,1,NB),NZ1, D0030415
     1NZ2,NLEVEL(NB),M(NB),N(NB),ISAM,&54)                             D0030416
      P3Z(K) = TEMP                                                    D0030417
 55   CONTINUE                                                         D0030418
 54   LEWA(I,J) = LEW                                                  D0030419
 52   CONTINUE                                                         D0030420
      IF (KBUG .LT. 1) GO TO 525                                       D0030421
      WRITE (6,104) (LEWA(I,J),J =1,NNA)                               D0030422
104   FORMAT (1H0/(1516))                                              D0030423
  525 CONTINUE                                                         D0030424
 51   CONTINUE                                                         D0030425
 56   IF (IROT .NE. 1) GO TO 103                                       D0030426
      CALL PLOT1 (AL(1,1,NA),QC(1,NA))                                 D0030427
  103 CONTINUE                                                         D0030428
      CALL PLOTR (XO(NA),DELTAX(NA),YO(NA),DELTAY(NA),Z(1,1,K,NA),NZ1, D0030429
     1M(NA),N(NA),NA,K)                                                D0030430
 53   CONTINUE                                                         D0030431
 50   CONTINUE                                                         D0030432
```

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 71 CONTINUE                                                              D0030433
    IF (NCURVS.EQ.0) GO TO 81                                             D0030434
371 CONTINUE                                                              D0030435
    IF (KBUG .GE. 1) WRITE(6,376)                                         D0030436
376 FORMAT ('1CURVES')                                                    D0030437
    DO 80 NC = 1,NCURVS                                                   D0030438
    NNC=NP(NC)                                                            D0030439
    LEV=1                                                                 D0030440
    DO 715 I = 1,NNC                                                      D0030441
715 LEWC(I) = 0                                                           D0030442
    DO 77 I=1,NNC                                                         D0030443
    LEW = 0                                                               D0030444
    CXTST=C(I,1,NC)                                                       D0030445
    CYTST=C(I,2,NC)                                                       D0030446
    CZTST=C(I,3,NC)                                                       D0030447
    IF (IVIS.NE.1) GO TO 78                                               D0030448
    IF (KBUG .GE. 1) WRITE(6,717) NC,I,CXTST,CYTST,CZTST                  D0030449
717 FORMAT (1X,215,3F10.4)                                                D0030450
    DO 75 NB=1,NARAYS                                                     D0030451
    KCK=LCHECK(NC,NB)                                                     D0030452
    IF (KCK.EQ.0) GO TO 75                                                D0030453
    IF (KCK.LT.0) GO TO 72                                                D0030454
    I = I                                                                 D0030455
    IF (XBOX1 (KCK) .LE. I .AND. I .LE. XBOX2(KCK)) GO TO 72              D0030456
    IF (YBOX1(KCK) .LE. I  .AND. I .LE. YBOX2(KCK)) GO TO 72              D0030457
    GO TO 75                                                              D0030458
72  ISAM=0                                                                D0030459
    DELX = DELTAX(NB)                                                     D0030460
    DELY = DELTAY(NB)                                                     D0030461
    IF (IROT.NE.1) GO TO 725                                              D0030462
    IF (ID(NB).EQ.1) GO TO 73                                             D0030463
725 CX1=CX                                                                D0030464
    CY1=CY                                                                D0030465
    CZ1=CZ                                                                D0030466
    VI(1)=CXTST                                                           D0030467
    VI(2)=CYTST                                                           D0030468
```



```
    VI(3)=CZTST                                                           D0030469
    GO TO 74                                                              D0030470
73  VO(1)=CX                                                              D0030471
    VO(2)=CY                                                              D0030472
    VO(3)=CZ                                                              D0030473
    CALL M2(AL(1,1,NB),QC(1,NB))                                          D0030474
    CX1=VI(1)                                                             D0030475
    CY1=VI(2)                                                             D0030476
    CZ1=VI(3)                                                             D0030477
    VO(1)=CXTST                                                           D0030478
    VO(2)=CYTST                                                           D0030479
    VO(3)=CZTST                                                           D0030480
    CALL M2(AL(1,1,NB),QC(1,NB))                                          D0030481
74  P3Z(1)=VI(3)                                                          D0030482
    TEMP=P3Z(1)                                                           D0030483
    CALL IOUT1 (VI(1),VI(2),P3Z,LEW,LEV)                                  D0030484
    CALL IOUT2 (XO(NB),DELTAX(NB),YO(NB),DELTAY(NB),Z(1,1,1,NB),NZ1,      D0030485
   1NZ2,NLEVEL(NB),M(NB),N(NB),ISAM,676)                                  D0030486
75  CONTINUE                                                              D0030487
    P3Z(1)=TEMP                                                           D0030488
76  LEWC(I)=LEW                                                           D0030489
77  CONTINUE                                                              D0030490
78  CALL PLOTC(C(1,1,NC),NC1,LEWC,NNC,NC)                                 D0030491
    IF (KBUG .GE. 1) WRITE(6,104) (LEWC(I),I=1,NNC)                       D0030492
 80 CONTINUE                                                              D0030493
81  CONTINUE                                                              D0030494
    RETURN                                                                D0030495
    ENTRY PERSP4                                                          D0030496
    CALL  PLT (5,IL,PLIM)                                                 D0030497
    RETURN                                                                D0030498
    ENTRY PERSP5                                                          D0030499
    CALL  PLT (6)                                                         D0030500
    RETURN                                                                D0030501
    END                                                                   D0030502
    SUBROUTINE M1(AI,QI)                                                  D0030503
C   M1 TRANSFORMS A POINT IN THE I COORDINATE SYSTEM TO THE BASIC         D0030504
```

```
C     1COORDINATE SYSTEM.                                                    D0030505
      COMMON /VECT/ V0(3),VI(3)                                              D0030506
      COMMON /DEBUG/KBUG                                                     D0030507
      DIMENSION AI(3,1),QI(1)                                                D0030508
      DO 10 I=1,3                                                            D0030509
      SUM = 0.                                                               D0030510
      DO 15 J=1,3                                                            D0030511
      SUM = SUM + AI(J,I)*VI(J)                                              D0030512
      IF (KBUG .GE. 5)                                                       D0030513
     1WRITE (6,13) SUM,AI(J,I),VI(J),I,J                                     D0030514
   13 FORMAT (1X,'M1',10X,3E13.5,2I5)                                        D0030515
   15 CONTINUE                                                               D0030516
      V0(I) = SUM + QI(I)                                                    D0030517
      IF (KBUG .GE. 5)                                                       D0030518
     1WRITE (6,14) V0(I),SUM,QI(I)                                           D0030519
   14 FORMAT((1X,3E13.5/))                                                   D0030520
   10 CONTINUE                                                               D0030521
      RETURN                                                                 D0030522
      ENTRY M2 (AJ,QJ)                                                       D0030523
C     M2 TRANSFORMS A POINT IN THE BASIC COORDINATE SYSTEM TO THE  I          D0030524
C     1COORDINATE SYSTEM.                                                    D0030525
      DIMENSION AJ(3,1),QJ(1)                                                D0030526
      DO 20 I=1,3                                                            D0030527
      SUM = 0.                                                               D0030528
      DO 25 J=1,3                                                            D0030529
      SUM =  SUM + AJ(I,J) * (V0(J)-QJ(J))                                   D0030530
      IF (KBUG .GE. 5)                                                       D0030531
     1WRITE (6,24) SUM,AJ(I,J),V0(J),QJ(J),I,J                               D0030532
   24 FORMAT (1X, 'M2',5X,4E13.5,2I5)                                        D0030533
   25 CONTINUE                                                               D0030534
      VI(I) = SUM                                                            D0030535
      IF (KBUG .GE. 5)                                                       D0030536
     1WRITE(6,14) VI(I),SUM                                                  D0030537
   20 CONTINUE                                                               D0030538
      RETURN                                                                 D0030539
      END                                                                    D0030540
```



```
      SUBROUTINE NICE8 (XO,DELTAX,YO,DELTAY,Z, NZ1 , NZ2 ,                   D0030541
     1 NZ3 ,NLEVEL,M,N,KCHECK, NK ,XT,YT,P1Z,P2Z,P3Z,                         D0030542
     2XBOX1,XBOX2,YBOX1,YBOX2)                                               D0030543
      DIMENSION XO(1),DELTAX(1),YO(1),DELTAY(1)                              D0030544
C     NICE DETERMINES THE VISIBILITY OF POINTS ON A LINE BETWEEN A           D0030545
C     1VISIBLE MESH POINT AND AN INVISIBLE MESH POINT. IT CALLS M1,MZ,       D0030546
C     2IOUT1,IOUT2,TRNSF1,AND PLT.                                           D0030547
      DIMENSION P1Z(1),P2Z(1),M(1),N(1),P3Z(1),NLEVEL(1)                     D0030548
      DIMENSION XT(1),YT(1)                                                  D0030549
      INTEGER*2 KCHECK,LCHECK                                                D0030550
      DIMENSION Z(NZ1,NZ2,NZ3,1),KCHECK(NK,1)                                D0030551
      DIMENSION XBOX1(1),XBOX2(1),YBOX1(1),YBOX2(1)                          D0030552
      COMMON /TRN/ XB,YB,ZB,CX,CY,CZ,D                                       D0030553
      COMMON /VECT/ V0(3),VI(3)                                              D0030554
      COMMON /FOUR/ NARAYS                                                   D0030555
      COMMON /OBS/ CX1,CY1,CZ1                                               D0030556
      COMMON /DEBUG/KBUG                                                     D0030557
      COMMON /ONE/IROT                                                       D0030558
      COMMON       /FNP/ X100D,DELX,DELY,SAVE(30)                            D0030559
      DATA  AL2    /0.69314718/                                              D0030560
      DATA  CHECK /1.0E38/                                                   D0030561
      RETURN                                                                 D0030562
      ENTRY NICEL (LCHECK, NL )                                              D0030563
      DIMENSION LCHECK(NL,1)                                                 D0030564
      RETURN                                                                 D0030565
      ENTRY NICER (AL,QC)                                                    D0030566
      DIMENSION AL(3,3,1),QC(3,1)                                            D0030567
      DO 1 I=1,NARAYS                                                        D0030568
      IF (KBUG .GE. 5)                                                       D0030569
     1WRITE (6,14)  ((AL(K,L,I),K=1,3),L=1,3),((QC(K,L),K=1,3),L=1,3)        D0030570
   14 FORMAT((1X,3E13.5/))                                                   D0030571
    1 CONTINUE                                                               D0030572
      RETURN                                                                 D0030573
      ENTRY NICEP (/I1/,/J1/,/I2/,/J2/,/NA/,/ILEV/)                          D0030574
      P1X = XO(NA) + FLOAT(I1-1)*DELTAX(NA)                                  D0030575
      P1Y = YO(NA) + FLOAT(J1-1)*DELTAY(NA)                                  D0030576
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      P2X = XO(NA) + FLOAT(I2-1)*DELTAX(NA)                          D0030577
      P2Y = YO(NA) + FLOAT(J2-1)*DELTAY(NA)                          D0030578
      NLV = NLEVEL(NA)                                               D0030579
      DO 5 K=1,NLV                                                   D0030580
      P1Z(K) = Z(I1,J1,K,NA)                                         D0030581
      P2Z(K)=Z(I2,J2,K,NA)                                           D0030582
 5    CONTINUE                                                       D0030583
      ICRV = 0                                                       D0030584
      LEV = ILEV                                                     D0030585
      VI(1) = P1X                                                    D0030586
      VI(2) = P1Y                                                    D0030587
      VI(3) = P1Z(LEV)                                               D0030588
      IF (IROT .EQ. 1) GO TO 200                                     D0030589
      DO 201 IS=1,3                                                  D0030590
 201  VO(IS) = VI(IS)                                                D0030591
      GO TO 202                                                      D0030592
 200  CALL M1 (AL(1,1,NA),QC(1,NA))                                  D0030593
 202  CALL TRNSF1 (VO(1),VO(2),VO(3),XT(1),YT(1))                    D0030594
      VI(1) = P2X                                                    D0030595
      VI(2) = P2Y                                                    D0030596
      VI(3) = P2Z(LEV)                                               D0030597
      IF (IROT .EQ. 1) GO TO 210                                     D0030598
      DO 211 IS=1,3                                                  D0030599
 211  VO(IS) = VI(IS)                                                D0030600
      GO TO 212                                                      D0030601
 210  CALL M1 (AL(1,1,NA),QC(1,NA))                                  D0030602
 212  CALL TRNSF1 (VO(1),VO(2),VO(3),XT(2),YT(2))                    D0030603
      GO TO 6                                                        D0030604
      ENTRY NICEC (/PX1/,/PY1/,/PZ1/,/PX2/,/PY2/,/PZ2/,/NC/)         D0030605
      P1X = PX1                                                      D0030606
      P1Y = PY1                                                      D0030607
      P1Z(1) = PZ1                                                   D0030608
      P2X = PX2                                                      D0030609
      P2Y = PY2                                                      D0030610
      P2Z(1) = PZ2                                                   D0030611
      LEV = 1                                                        D0030612
```



```
      NLV = 1                                                        D0030613
      ICRV = 1                                                       D0030614
      CALL TRNSF1 (P1X,P1Y,P1Z(1),XT(1),YT(1))                       D0030615
      CALL TRNSF1 (P2X,P2Y,P2Z(1),XT(2),YT(2))                       D0030616
 6    CONTINUE                                                       D0030617
      DS= SQRT ((XT(1)-XT(2))**2+(YT(1)-YT(2))**2)                   D0030618
      ISTOP=ALOG(X100D*DS)/AL2                                       D0030619
      ISTOP=ISTOP+1                                                  D0030620
      ICUT=1                                                         D0030621
      IK=0                                                           D0030622
      PXVIS=CHECK                                                    D0030623
20    CONTINUE                                                       D0030624
      ICUT=ICUT+1                                                    D0030625
      P3X=(P1X+P2X)/2.                                               D0030626
      P3Y=(P1Y+P2Y)/2.                                               D0030627
      DO 21 K=1,NLV                                                  D0030628
 21   P3Z(K) = (P1Z(K)+P2Z(K))/2.                                    D0030629
      VI (1) = P3X                                                   D0030630
      VI (2) = P3Y                                                   D0030631
      VI(3) = P3Z(LEV)                                               D0030632
      IF (ICRV .EQ. 1) GO TO 213                                     D0030633
      IF (IROT .EQ. 1) GO TO 216                                     D0030634
213   CONTINUE                                                       D0030635
      DO 214 IS = 1,3                                                D0030636
 214  VO(IS) = VI(IS)                                                D0030637
      GO TO 218                                                      D0030638
 216  CALL M1 (AL(1,1,NA),QC(1,NA))                                  D0030639
 218  CALL TRNSF1 (VO(1),VO(2),VO(3),XTEST,YTEST)                    D0030640
      IF (IROT .EQ. 1 .AND. ICRV .EQ. 0) GO TO 219                   D0030641
                        CALL IOUT1 (P3X,P3Y,P3Z,LEW,LEV)             D0030642
219   CONTINUE                                                       D0030643
      DO 55 NB=1,NARAYS                                              D0030644
      IF (K80G .GE. 2)                                               D0030645
     *WRITE (6,22) NA, NB, NARAYS,ICRV,KCHECK (NA,NB)                D0030646
     1,XTEST,YTEST                                                   D0030647
22    FORMAT (1X, 'NICEP', 5I5,2E13.5)                               D0030648
```

```
      ISAM = 0                                                          D0030649
      IF (NA .EQ. NB) ISAM=1                                            D0030650
      IF (ICRV .EQ. 1) ISAM = 0                                         D0030651
      DELX = DELTAX(NB)                                                 D0030652
      DELY = DELTAY(NB)                                                 D0030653
      TEMP = P3Z(LEV)                                                   D0030654
      IF (ICRV .EQ. 0) GO TO 23                                         D0030655
      IF (LCHECK(NC,NB) .EQ. 0) GO TO 55                                D0030656
      GO TO 58                                                          D0030657
 23   CONTINUE                                                          D0030658
      KCK = KCHECK(NA,NB)                                               D0030659
      IF (KCK .EQ. 0) GO TO 55                                          D0030660
      IF (KCK .LT. 0) GO TO 58                                          D0030661
      IF (ISAM .EQ. 1) GO TO 58                                         D0030662
      INDX = KCK                                                        D0030663
      IF (XTEST .LT. XBOX1(INDX)) GO TO 55                              D0030664
      IF (XTEST .GT. XBOX2(INDX)) GO TO 55                              D0030665
      IF (YTEST .LT. YBOX1(INDX)) GO TO 55                              D0030666
      IF (YTEST .GT. YBOX2(INDX)) GO TO 55                              D0030667
   58 CONTINUE                                                          D0030668
      IF (IROT .NE. 1) GO TO 302                                        D0030669
      VO(1) = CX                                                        D0030670
      VO(2) = CY                                                        D0030671
      VO(3) = CZ                                                        D0030672
      CALL M2 (AL(1,1,NB),QC(1,NB))                                     D0030673
      CX1 = VI(1)                                                       D0030674
      CY1 = VI(2)                                                       D0030675
      CZ1 = VI(3)                                                       D0030676
      VI(1) = P3X                                                       D0030677
      VI(2) = P3Y                                                       D0030678
      IF (ISAM .EQ. 1) GO TO 101                                        D0030679
      VI(3) = P3Z(LEV)                                                  D0030680
      CALL M1 (AL(1,1,NA),QC(1,NA))                                     D0030681
      CALL M2 (AL(1,1,NB),QC(1,NB))                                     D0030682
      P3Z(LEV) = VI(3)                                                  D0030683
 101  CALL IOUT1 (VI(1),VI(2),P3Z,LEW,LEV)                              D0030684
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      GO TO 53                                                          D0030685
C     ADD  CHANGES FOR CURVES - KCHECK                                  D0030686
 53   CONTINUE                                                          D0030687
 302  CONTINUE                                                          D0030688
      CALL IOUT2 (XO(NB),DELTAX(NB),YO(NB),DELTAY(NB),Z(1,1,1,NB),NZ1,  D0030689
     1NZ2,NLEVEL(NB),M(NB),N(NB),ISAM,C54)                              D0030690
      P3Z(LEV) = TEMP                                                   D0030691
 55   CONTINUE                                                          D0030692
 54   P3Z(LEV) = TEMP                                                   D0030693
      IF (LEW .EQ. 0) GO TO 25                                          D0030694
15    P2X=P3X                                                           D0030695
      P2Y=P3Y                                                           D0030696
      DO 16 K=1,NLV                                                     D0030697
 16   P2Z(K) = P3Z(K)                                                   D0030698
      IF  (ICUT.LT.ISTOP)  GO  TO  20                                   D0030699
      IF  (PXVIS.EQ.CHECK)  RETURN                                      D0030700
      IF  (IK.EQ.1)  GO  TO  30                                         D0030701
      IK=IK+1                                                           D0030702
      GO  TO  20                                                        D0030703
25    IF  (ICUT.GE.ISTOP)  GO  TO  35                                   D0030704
      P1X=P3X                                                           D0030705
      P1Y=P3Y                                                           D0030706
      DO 26 K=1,NLV                                                     D0030707
 26   P1Z(K) = P3Z(K)                                                   D0030708
      PXVIS=P1X                                                         D0030709
      PYVIS=P1Y                                                         D0030710
      PZVIS = P1Z(LEV)                                                  D0030711
      GO  TO  20                                                        D0030712
30    P3X=PXVIS                                                         D0030713
      P3Y=PYVIS                                                         D0030714
      P3Z(LEV) = PZVIS                                                  D0030715
 35   CONTINUE                                                          D0030716
      VI(1) = P3X                                                       D0030717
      VI(2) = P3Y                                                       D0030718
      VI(3) = P3Z(LEV)                                                  D0030719
      IF (IROT .EQ. 1) GO TO 36                                         D0030720
```

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      DO 37 IS=1,3                                                      D0030721
      VO(IS) = VI(IS)                                                   D0030722
   37 GO TO 38                                                          D0030723
      CALL MI (AL(1,1,NA),QC(1,NA))                                     D0030724
   36 CALL TRNSFI (VO(1),VO(2),VO(3),XT(2),YT(2))                       D0030725
   38 CALL PLT (2,2,1)                                                  D0030726
      RETURN                                                            D0030727
      END                                                               D0030728
      SUBROUTINE IOUTO (/CX/,/CY/,/CZ/,TEST2,TEST1)                     D0030729
C     IOUT DETERMINES THE VISIBILITY OF A POINT. IT CALLS TARAY,IOFO,   D0030730
C    1ZOFO,YOFO,AND XOFO.                                               D0030731
      DIMENSION TEST1(1),TEST2(1)                                       D0030732
      DIMENSION TSAV (5, 4),XSAV(4),YSAV(4),DX(4)                       D0030733
      DIMENSION T(4,6)                                                  D0030734
      DOUBLE PRECISION D1,A,B                                           D0030735
      COMMON /DEBUG/KBUG                                                D0030736
      COMMON/TSAV/T                                                     D0030737
      COMMON /MPPLI/IYPLT                                               D0030738
      COMMON /LN/ A,B                                                   D0030739
      COMMON /ENP/ X100D,DELX,DELY,SAVE(30)                             D0030740
      DATA BIG/1.E+38/                                                  D0030741
      IF (KBUG .GE. 1) WRITE(6,10)                                      D0030742
   10 FORMAT (1X,'REACHED IOUTO')                                       D0030743
      RETURN                                                            D0030744
      ENTRY IOUT1 (/PX/,/PY/,PZL,/LEW/,/LEV/)                           D0030745
      DIMENSION PZL(1)                                                  D0030746
      PZ = PZL(LEV)                                                     D0030747
      LEW = 0                                                           D0030748
      D1 = (CX-PX)**2 + (CY-PY)**2                                      D0030749
      A = (CY-PY)/(CX-PX)                                               D0030750
      B = CY - A*CX                                                     D0030751
      IF (KBUG .GE. 1) WRITE(6,15)                                      D0030752
   15 FORMAT (1X, 'REACHED IOUT1')                                      D0030753
      RETURN                                                            D0030754
      ENTRY IOUT2 (/XO/,/DELTAX/,/YO/,/DELTAY/,Z, NZ1 , NZ2 ,/NLEV/,/M/,D0030755
     1/N/,/ISAM/,*)                                                     D0030756
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      DIMENSION          Z(NZ1,NZ2,1)                                   D0030757
      IF (KBUG .GE. 1) WRITE(6,20) PX,PY,PZ,XO,DELTAX,YO,DELTAY,Z(1,1,1)D0030758
                                                                        D0030759
   20 FORMAT (1X,'IOUT2',8F10.3)                                        D0030760
      IF (NLEV .GT. 5) WRITE (6,17) NLEV                                D0030761
   17 FORMAT (1X,'INTERSECTING ARRAYS ARE NOT LARGE ENOUGH. NLEV = ',I4)D0030762
      CALL TARAY (XO,DELTAX,YO,DELTAY,CX,CY,CZ,M,N,D2,ISS,IC,630)       D0030763
      GO TO 36                                                          D0030764
   30 IF (IC .EQ. 0) RETURN                                             D0030765
      WRITE (6,33) CX,CY,CZ,PX,PY,PZ,IC,((T(I,J),J=1,6),I=1,4)          D0030766
   33 FORMAT( 17HO ERROR IN INOROU  // 22H OBSERVATION POINT IS  3E20.8 D0030767
     1 // 22H POINT OBSERVED IS      3E20.8 // 29H NO. OF SIDE INTERSECTD0030768
     2IONS IS I6  // 11H T ARRAY IS  // (6E17.8))                      D0030769
      STOP                                                              D0030770
   36 CONTINUE                                                          D0030771
      IF (ISAM .EQ. 1) GO TO 37                                         D0030772
      IF (D2 .GE. D1) RETURN                                            D0030773
   37 CONTINUE                                                          D0030774
      IN = (-1)**(ISS+1)                                                D0030775
C     IN = +1 IF ISS IS ODD WHICH CORRESPONDS TO BEGINNING (I.E.1) SIDE.D0030776
C     IN = -1 IF ISS IS EVEN WHICH CORRESPONDS TO END (I.E.M OR N) SIDE.D0030777
      IF  (ISS.GT.2)  GO  TO  40                                        D0030778
      IFX=0                                                             D0030779
      IFY=1                                                             D0030780
      XM = XO                                                           D0030781
      YM = T(1,1)                                                       D0030782
C     (XM,YM) = POINT CLOSEST TO C AT WHICH CP CROSSES ARRAY BOUNDARY.  D0030783
      I1=1                                                              D0030784
C     I1 = INDEX OF XM                                                  D0030785
      IF  (IN .GT.0)  GO  TO  38                                        D0030786
      XM = XO + FLOAT(M-1)*DELTAX                                       D0030787
      YM=T(2,1)                                                         D0030788
      I1=M                                                              D0030789
   38 CONTINUE                                                          D0030790
      CALL IOFO (YM,YO,DELY,I2)                                         D0030791
C     I2 = INDEX OF Y LINE AT OR JUST BELOW YM (I1 = 1 OR M)            D0030792
      GO  TO  42
```

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   40 IFX = 1                                                          D0030793
      IFY=0                                                            D0030794
      YM = YO                                                          D0030795
      XM=T(3,1)                                                        D0030796
C     (XM,YM) = POINT CLOSEST TO C AT WHICH GP CROSSES ARRAY BOUNDARY. D0030797
      I2=1                                                             D0030798
C     I2 = INDEX OF YM                                                 D0030799
      IF  (IN .GT.0)  GO  TO  41                                       D0030800
      YM = YO + FLOAT(N-1)*DELTAY                                      D0030801
      XM=T(4,1)                                                        D0030802
      I2=N                                                             D0030803
   41 CONTINUE                                                         D0030804
      CALL IOFO (XM,XO,DELX,I1)                                        D0030805
C     I1 = INDEX OF X LINE AT OR JUST LEFT OF XM (I2 = 1 OR N)         D0030806
42    INX=1                                                            D0030807
C     INX = X INDEX INCREMENT (+1,-1,OR0)                              D0030808
C     INX = 1 IF THE INDEX OF X INCREASES FROM XM TO PX                D0030809
      IF ((PX - XM)*DELX .LT. 0.) INX = -INX                           D0030810
C     INX = -1 IF THE INDEX OF X DECREASES FROM XM TO PX               D0030811
      INX1=INX                                                         D0030812
      IF  (ABS(XM-PX).LE.ABS(DELX+.001*DELX))INX=0                     D0030813
      INY=1                                                            D0030814
C     INY = Y INDEX INCREMENT (+1,-1,OR0)                              D0030815
      IF  ((PY-YM)*DELY.LT.0.)  INY=-INY                               D0030816
      INY1=INY                                                         D0030817
      IF (ABS(YM-PY).LE.ABS(DELY+.001*DELY))INY=0                      D0030818
      IXS=I1                                                           D0030819
      IYS=I2                                                           D0030820
C     IXS,IYS = INDICES OF (XM,YM)                                     D0030821
      IF  (CX.EQ.PX)  GO  TO  46                                       D0030822
      CALL ZOFO (XM,CX,CZ,PX,PZ,TEST)                                  D0030823
C     TEST = Z(LINE) AT (XM,YM)                                        D0030824
      GO  TO  47                                                       D0030825
   46 CALL ZOFO (YM,CY,CZ,PY,PZ,TEST)                                  D0030826
 47   I3 = I1 + IFX                                                    D0030827
      I4 = I2 + IFY                                                    D0030828
```



```
      DO 70 K=1,NLEV                                                   D0030829
      IF (I1 .EQ. I3) GO TO 48                                         D0030830
 39   CONTINUE                                                         D0030831
      XI1 = XO + FLOAT(I1-1)*DELTAX                                    D0030832
      XI3 = XO + FLOAT(I3-1)*DELTAX                                    D0030833
      CALL ZOFO (XM,XI1,Z(I1,I2,K),XI3,Z(I3,I4,K),ZM)                  D0030834
      GO TO 49                                                         D0030835
   48 CONTINUE                                                         D0030836
      YI2 = YO + FLOAT(I2-1)*DELTAY                                    D0030837
      YI4 = YO + FLOAT(I4-1)*DELTAY                                    D0030838
      CALL ZOFO (YM,YI2,Z(I1,I2,K),YI4,Z(I3,I4,K),ZM)                  D0030839
 49   CONTINUE                                                         D0030840
      TEST1(K) = TEST - ZM                                             D0030841
      TSAV(K,1) = TEST1(K)                                             D0030842
      TSAV(K,3) = TEST1(K)                                             D0030843
      IF (INX .EQ. 0 .AND. INY .EQ. 0) GO TO 70                        D0030844
      IF (TEST1(K) .EQ. 0. .AND. IYPLT .NE. 1) GO TO 67                D0030845
 70   CONTINUE                                                         D0030846
 43   CONTINUE                                                         D0030847
      XSAV(1) = XM                                                     D0030848
      YSAV(1) = YM                                                     D0030849
      XSAV(3) = XM                                                     D0030850
      YSAV(3) = YM                                                     D0030851
      IF  (INX.EQ.0 .AND.ISAM .EQ. 1) GO TO 49                         D0030852
      INDX1 = IXS                                                      D0030853
      XO=XM-PX                                                         D0030854
      XL=DELX*DELX*0.001                                               D0030855
      IFLG = 0                                                         D0030856
      IF (KBUG .GE. 2) WRITE (6,435) IXS,IYS,INZ,INY,XM,YM,TEST1(1),   D0030857
     1TEST2(1),XO,XM,YO,YM                                             D0030858
435   FORMAT (1X, 4I4,8E13.5)                                          D0030859
 50   CONTINUE                                                         D0030860
      INDX = INDX1                                                     D0030861
C *** IF (ISAM .EQ. 1) GO TO 51                                        D0030862
C ****IF (INDX.EQ.0) INDX=1                                           D0030863
C **** F (INDX.EQ.M+1) INDX=M                                          D0030864
```

```
51    CONTINUE                                                          D0030865
      IF (INDX .LT. 1 .OR. INDX .GT. M) GO TO 60                        D0030866
      XINDX = XO + FLOAT(INDX-1)*DELTAX                                 D0030867
      XN = XINDX - PX                                                   D0030868
      IF (KBUG .GE. 2) WRITE (6,515) INDX,ISAM,XO,XN,XL                 D0030869
  515 FORMAT (1X, 2I2, 3E13.5 , 'LOOP 1 ')                              D0030870
      CALL YOFO(XINDX,YTRY)                                             D0030871
      YN = YO + FLOAT(N-1)*DELTAY                                       D0030872
      IF (YTRY .GT. YN .OR. YTRY .LT. YO) GO TO 60                      D0030873
      IF (XN*XO .GT. XL) GO TO 52                                       D0030874
      IF (ISAM .EQ. 1) GO TO 60                                         D0030875
      IFLG = 1                                                          D0030876
   52 XO = XN                                                           D0030877
      CALL ZOFO (XINDX,CX,CZ,PX,PZ,TEST)                                D0030878
      CALL IOFO (YTRY,YO,DELY,I1)                                       D0030879
      I2=I1+1                                                           D0030880
      DO 75 K=1,NLEV                                                    D0030881
   76 CONTINUE                                                          D0030882
      YI1 = YO + FLOAT(I1-1)*DELTAY                                     D0030883
      YI2 = YO + FLOAT(I2-1)*DELTAY                                     D0030884
      CALL ZOFO (YTRY,YI1,Z(INDX,I1,K),YI2,Z(INDX,I2,K),Z2)             D0030885
      TEST2(K) = TEST-Z2                                                D0030886
      IF (KBUG .GE. 2) WRITE (6,761) PX,PY,XINDX,YTRY,TEST,Z2,TEST2(K), D0030887
     1I1,K,IFLG                                                         D0030888
  761 FORMAT (1X, 'X LOOP2',7E13.5,1X, 3I4)                             D0030889
      IF (IFLG .EQ. 1) GO TO 75                                         D0030890
      TSAV(K,1) = TEST2(K)                                              D0030891
   59 IF (TEST1(K)*TEST2(K) .LE. 0.) GO TO 67                           D0030892
   75 CONTINUE                                                          D0030893
      XINDX = XO + FLOAT(INDX-1)*DELTAX                                 D0030894
      IF (IFLG .EQ. 1) GO TO 595                                        D0030895
      XSAV(1) = XINDX                                                   D0030896
      YSAV(1) = YTRY                                                    D0030897
      INDX1=INDX1+INX1                                                  D0030898
      GO TO 50                                                          D0030899
  595 CONTINUE                                                          D0030900
```



```
      XSAV(2) = XINDX                                                   D0030901
      YSAV(2) = YTRY                                                    D0030902
      DO 596 K=1,NLEV                                                   D0030903
  596 TSAV(K,2) = TEST2(K)                                              D0030904
   60 IF (INY .EQ.0 .AND. ISAM .EQ. 1) GO TO 90                         D0030905
      IF (IYPLT .EQ. 1) GO TO 90                                        D0030906
      INDX1 = IYS                                                       D0030907
      YO=YM-PY                                                          D0030908
      YL=DELY*DELY*0.001                                                D0030909
      IFLG = 0                                                          D0030910
   61 CONTINUE                                                          D0030911
      INDX = INDX1                                                      D0030912
C *** IF (ISAM .EQ. 1) GO TO 63                                         D0030913
C *** IF (INDX.EQ.0) INDX=1                                             D0030914
C *** IF (INDX.EQ.N+1) INDX=N                                           D0030915
   63 CONTINUE                                                          D0030916
      IF (INDX .LT. 1 .OR. INDX .GT. N) GO TO 90                        D0030917
      YINDX = YO + FLOAT(INDX-1)*DELTAY                                 D0030918
      YN = YINDX - PY                                                   D0030919
      IF (KBUG .GE. 2) WRITE (6,631) INDX,ISAM,YO,YN,YL                 D0030920
  631 FORMAT (1X, 'Y LOOP1',2I4,3E13.5)                                 D0030921
      CALL XOFO (YINDX,XTRY)                                            D0030922
      XM = XO + FLOAT(M-1)*DELTAX                                       D0030923
      IF (XTRY .GT. XM .OR. XTRY .LT. XO) GO TO 90                      D0030924
   62 CONTINUE                                                          D0030925
      CALL ZOFO (YINDX,CY,CZ,PY,PZ,TEST)                                D0030926
      IF (YN*YO .GT. YL) GO TO 64                                       D0030927
      IF (ISAM .EQ. 1) GO TO 90                                         D0030928
      IFLG = 1                                                          D0030929
   64 YO = YN                                                           D0030930
      CALL IOFO (XTRY,XO,DELX,I1)                                       D0030931
      I2=I1+1                                                           D0030932
      DO 80 K=1,NLEV                                                    D0030933
      XI1 = XO + FLOAT(I1-1)*DELTAX                                     D0030934
      XI2 = XO + FLOAT(I2-1)*DELTAX                                     D0030935
      CALL ZOFO (XTRY,XI1,Z(I1,INDX,K),XI2,Z(I2,INDX,K),Z2)             D0030936
```

```
      TEST2(K) = TEST - Z2                                                    D0030937
      IF (KBUG .GE. 2) WRITE (6,621) PX,PY,YINDX,XTRY,TEST,Z2,TEST2(K),       D0030938
     1II,K,IFLG                                                               D0030939
621   FORMAT (1X, 'Y LOOP2',7E13.5,1X, 3I4)                                   D0030940
      IF (IFLG .EQ. 1) GO TO 80                                               D0030941
      TSAV(K,3) = TEST2(K)                                                    D0030942
 89   IF (TEST1(K)*TEST2(K) .LE. 0.) GO TO 67                                 D0030943
 80   CONTINUE                                                                D0030944
      YINDX = Y0 + FLOAT(INDX-1)*DELTAY                                       D0030945
      IF (IFLG .EQ. 1) GO TO 81                                               D0030946
      XSAV(3) = XTRY                                                          D0030947
      YSAV(3) = YINDX                                                         D0030948
      INDX1=INDX1+INY1                                                        D0030949
      GO TO 61                                                                D0030950
   81 XSAV(4) = XTRY                                                          D0030951
      YSAV(4) = YINDX                                                         D0030952
      DO 82 K=1,NLEV                                                          D0030953
   82 TSAV(K,4) = TEST2(K)                                                    D0030954
   90 CONTINUE                                                                D0030955
      IF (ISAM .EQ. 1 ) GO TO 910                                             D0030956
      IF (IFLG .EQ. 0) GO TO 910                                              D0030957
      XO=BIG                                                                  D0030958
      XN=-BIG                                                                 D0030959
      DO 901 I=1,4                                                            D0030960
      DX(I)=PX-XSAV(I)                                                        D0030961
      IF (DX(I).EQ.0) GO TO 902                                               D0030962
901   CONTINUE                                                                D0030963
      GO TO 904                                                               D0030964
902   DO 903 I=1,4                                                            D0030965
903   DX(I)=PY-YSAV(I)                                                        D0030966
904   DO 906 I=1,4                                                            D0030967
      IF (DX(I).LT.0.) GO TO 905                                              D0030968
      IF (DX(I).GT.XO) GO TO 906                                              D0030969
      XO=DX(I)                                                                D0030970
      I1=I                                                                    D0030971
      GO TO 906                                                               D0030972
```



```
905   IF (DX(I).LT.XN) GO TO 906                                              D0030973
      XN=DX(I)                                                                D0030974
      I2=I                                                                    D0030975
906   CONTINUE                                                                D0030976
      DO 909 K= 1,NLEV                                                        D0030977
      IF (XSAV(I1) .EQ. XSAV(I2)) GO TO 907                                   D0030978
      CALL ZOFO (PX,XSAV(I1),TSAV(K,I1),XSAV(I2),TSAV(K,I2),TEST)             D0030979
      GO TO 908                                                               D0030980
  907 CALL ZOFO (PY,YSAV(I1),TSAV(K,I1),YSAV(I2),TSAV(K,I2),TEST)             D0030981
  908 CONTINUE                                                                D0030982
      IF (KBUG .GE. 2) WRITE (6,9061) XSAV(I1),YSAV(I1),TSAV(K,I1),           D0030983
     1XSAV(I2),YSAV(I2),TSAV(K,I2),I1,I2,K,TEST                               D0030984
9061  FORMAT (1X, '900 LOOP', 6E13.5,3I5,1E13.5)                              D0030985
      IF (TEST*TEST1(K).LE. 0) GO TO 67                                       D0030986
  909 CONTINUE                                                                D0030987
910   CONTINUE                                                                D0030988
      IF (KBUG .GE. 2) WRITE (6,911)                                          D0030989
911   FORMAT (2X, 'REACHED 910')                                              D0030990
      IF (ISAM .NE. 1) RETURN                                                 D0030991
      IF (NLEV .EQ. 1) RETURN                                                 D0030992
      DO 91 K=1,NLEV                                                          D0030993
      IF (K .EQ. LEV) GO TO 91                                                D0030994
      TEST2(K) = PZ - PZL(K)                                                  D0030995
      ITST = 1                                                                D0030996
      IF (TEST2(K) .EQ. 0.) GO TO 91                                          D0030997
      IF (TEST1(K)*TEST2(K) .LE. 0.)GO TO 67                                  D0030998
 91   CONTINUE                                                                D0030999
      RETURN                                                                  D0031000
 67   LEW = 1                                                                 D0031001
      IF (KBUG .GE. 2) WRITE (6,68)                                           D0031002
   68 FORMAT (1X,'LEW = 1')                                                   D0031003
      RETURN 1                                                                D0031004
      END                                                                     D0031005
      SUBROUTINE PLOTO(XT,YT,LEWA, NL )                                       D0031006
C     PLOT DETERMINES THE POINTS TO BE PLOTTED,TRANSFORMS THESE POINTS        D0031007
C    1AND PLOTS THEM.                                                         D0031008
```

```
      DIMENSION XT(1),YT(1)                                              D0031009
      COMMON /ONE/IROT                                                   D0031010
      COMMON /MPAPL/IVIS                                                 D0031011
      COMMON /DEBUG/KBUG                                                 D0031012
      COMMON /MPPLI/IYPLT                                                D0031013
      COMMON /VLCT/ VO(3),VI(3)                                          D0031014
      DIMENSION LEWA (NL,1)                                              D0031015
      RETURN                                                             D0031016
      ENTRY PLOT1 (AL,QC)                                                D0031017
      DIMENSION AL(3,1),QC(1)                                            D0031018
      RETURN                                                             D0031019
      ENTRY PLOTR (/XO/,/DELTAX/,/YO/,/DELTAY/,Z, NZ1 ,/M/,/N/,/NA/,/K/)D0031020
      DIMENSION          Z(NZ1,1)                                        D0031021
      DO 440 I=1,M                                                       D0031022
      KPLOT = 0                                                          D0031023
      I1 = I                                                             D0031024
      I2 = I                                                             D0031025
      JQ = 1                                                             D0031026
      DO 430 J=1,N                                                       D0031027
      J1 = J-1                                                           D0031028
      J2 = J                                                             D0031029
  441 IF (IVIS .NE. 1) GO TO 4289                                        D0031030
      IF (LEWA(I,J) .EQ. 0) GO TO 4288                                   D0031031
      IF (KPLOT .GT. 1) CALL PLT (2,KPLOT,1)                             D0031032
      IF (KPLOT .GE. 1) CALL NICEP (I1,J1,I2,J2,NA,K)                    D0031033
      KPLOT = 0                                                          D0031034
      GO TO 430                                                          D0031035
 4288 IF (KPLOT .EQ. 0 .AND. J.NE.JQ) CALL NICEP (I1,J2,I2,J1,NA,K)      D0031036
 4289 KPLOT = KPLOT+1                                                    D0031037
      VI(1)= XO + FLOAT(I-1)*DELTAX                                      D0031038
      VI(2)= YO + FLOAT(J-1)*DELTAY                                      D0031039
      VI(3) = Z(I,J)                                                     D0031040
      IF (IROT .EQ. 1) GO TO 10                                          D0031041
      DO 11 IS=1,3                                                       D0031042
   11 VO(IS) = VI(IS)                                                    D0031043
      GO TO 15                                                           D0031044
```



```
   10 CALL M1 (AL,QC)                                                    D0031045
   15 CALL TRNSF1 (VO(1),VO(2),VO(3),XT(KPLOT),YT(KPLOT))                D0031046
  430 CONTINUE                                                           D0031047
      IF (KPLOT .GT. 1) CALL PLT (2,KPLOT,1)                             D0031048
  440 CONTINUE                                                           D0031049
      IF (IYPLT .EQ. 1) RETURN                                           D0031050
      DO 460 J=1,N                                                       D0031051
      J1 = J                                                             D0031052
      J2 = J                                                             D0031053
      KPLOT = 0                                                          D0031054
      IQ = 1                                                             D0031055
      DO 450 I=1,M                                                       D0031056
      I1 = I-1                                                           D0031057
      I2 = I                                                             D0031058
  461 IF (IVIS .NE. 1) GO TO 4489                                        D0031059
      IF (LEWA(I,J).EQ.0) GO TO 4488                                     D0031060
      IF (KPLOT .GT. 1) CALL PLT (2,KPLOT,1)                             D0031061
      IF (KPLOT .GE. 1) CALL NICEP (I1,J1,I2,J2,NA,K)                    D0031062
      KPLOT = 0                                                          D0031063
      GO TO 450                                                          D0031064
 4488 IF (KPLOT .EQ. 0 .AND. I.NE.IQ) CALL NICEP (I2,J1,I1,J2,NA,K)      D0031065
 4489 KPLOT = KPLOT+1                                                    D0031066
      VI(1)= XO + FLOAT(I-1)*DELTAX                                      D0031067
      VI(2)= YO + FLOAT(J-1)*DELTAY                                      D0031068
      VI(3) = Z(I,J)                                                     D0031069
      IF (IROT .EQ. 1) GO TO 110                                         D0031070
      DO 111 IS=1,3                                                      D0031071
  111 VO(IS) = VI(IS)                                                    D0031072
      GO TO 115                                                          D0031073
  110 CALL M1 (AL,QC)                                                    D0031074
  115 CALL TRNSF1 (VO(1),VO(2),VO(3),XT(KPLOT),YT(KPLOT))                D0031075
  450 CONTINUE                                                           D0031076
      IF (KPLOT .GT. 1) CALL PLT (2,KPLOT,1)                             D0031077
  460 CONTINUE                                                           D0031078
      RETURN                                                             D0031079
      ENTRY PLOTC (C,NCC,LEW,/NP/,/NC/)                                  D0031080
```

```
      DIMENSION C(NCC,1),LEW(1)                                          D0031081
      KPLOT = 0                                                          D0031082
      DO 540 I=1,NP                                                      D0031083
      IF (IVIS .NE. 1) GO TO 4589                                        D0031084
      IF (LEW(I) .EQ. 0) GO TO 4588                                      D0031085
      IF (KPLOT .GT. 1) CALL PLT (2,KPLOT,1)                             D0031086
      IF (KPLOT .GE. 1) CALL NICEC (C(I-1,1),C(I-1,2),C(I-1,3),C(I,1),   D0031087
     1 C(I,2),C(I,3),NC)                                                 D0031088
      KPLOT = 0                                                          D0031089
      GO TO 540                                                          D0031090
 4588 IF (KPLOT.EQ.0 .AND. I.NE.1) CALL NICEC (C(I,1),C(I,2),C(I,3),     D0031091
     1 C(I-1,1),C(I-1,2),C(I-1,3),NC)                                    D0031092
 4589 KPLOT = KPLOT + 1                                                  D0031093
      CALL TRNSF1 (C(I,1),C(I,2),C(I,3),XT(KPLOT),YT(KPLOT))            D0031094
      IF (KBUG .GE. 2)                                                   D0031095
     1WRITE (6,579) C(I,1),C(I,2),C(I,3),XT(KPLOT),YT(KPLOT),KPLOT,I    D0031096
  579 FORMAT (1X,5E13.5, 2I5,'PLOTC')                                    D0031097
  540 CONTINUE                                                           D0031098
      IF (KPLOT .GT. 1) CALL PLT (2,KPLOT,1)                             D0031099
      RETURN                                                             D0031100
      END                                                                D0031101
      SUBROUTINE TARAY (/XO/,/DELTAX/,/YO/,/DELTAY/,/CX/,/CY/,/CZ/,/M/,  D0031102
     1/N/,/D2/,/ISS/,/IC/,*)                                             D0031103
C     TARAY DETERMINES IF THE LINE THROUGH C AND P PASSES THROUGH AN     D0031104
C     1ARRAY. THE NUMBER OF TIMES THE LINE INTERSECTS THE BOUNDARY AS    D0031105
C     2WELL AS WHICH ONE (XM,YM) OF THE INTERSECTIONS IS CLOSEST TO C.   D0031106
      DIMENSION          T(4,6),DT(2),IT(2)                              D0031107
      DOUBLE PRECISION A,B                                               D0031108
      COMMON/TSAV/T                                                      D0031109
      COMMON /LN/ A,B                                                    D0031110
      COMMON /FNP/ X100D,DELX,DELY,SAVE(30)                              D0031111
      DATA  E /.0001/                                                    D0031112
      INTEGER ITW /2/                                                    D0031113
      YN = YO + FLOAT(N-1)*DELTAY                                        D0031114
      EY = E* (YN-YO)                                                    D0031115
      XM = XO + FLOAT(M-1)*DELTAX                                        D0031116
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      EX = E *(XM-XO)                                                    D0031117
      CALL YOFO (XO,T(1,1))                                              D0031118
      T(1,2) = YN + EY                                                   D0031119
      T(1,3) = YO - EY                                                   D0031120
      T(1,4) = XO                                                        D0031121
      T(1,5) = CX                                                        D0031122
      T(1,6) = CY                                                        D0031123
      CALL YOFO(XM,T(2,1))                                               D0031124
      T(2,2) = YN + EY                                                   D0031125
      T(2,3) = YO - EY                                                   D0031126
      T(2,4) = XM                                                        D0031127
      T(2,5) = CX                                                        D0031128
      T(2,6) = CY                                                        D0031129
      CALL XOFO (YO,T(3,1))                                              D0031130
      T(3,2) = XM + EX                                                   D0031131
      T(3,3) = XO - EX                                                   D0031132
      T(3,4) = YO                                                        D0031133
      T(3,5) = CY                                                        D0031134
      T(3,6) = CX                                                        D0031135
      CALL XOFO (YN,T(4,1))                                              D0031136
      T(4,2) = XM + EX                                                   D0031137
      T(4,3) = XO - EX                                                   D0031138
      T(4,4) = YN                                                        D0031139
      T(4,5) = CY                                                        D0031140
      T(4,6) = CX                                                        D0031141
      IC = 0                                                             D0031142
   21 CONTINUE                                                           D0031143
      DO 30 I=1,4                                                        D0031144
      IF ((T(I,1)-T(I,2))*(T(I,1)-T(I,3)) .GT. 0.) GO TO 30              D0031145
      D2 = ((T(I,5)-T(I,4))**2 + (T(I,6) - T(I,1))**2)                   D0031146
      IC = IC+1                                                          D0031147
      DT(IC) = D2                                                        D0031148
      IT(IC) = I                                                         D0031149
      IF (IC-ITW)                          30,99,99                      D0031150
   99 CONTINUE                                                           D0031151
      D2 = AMIN1(DT(1),DT(2))                                            D0031152
```

```
      IF (D2 .EQ. DT(1)) GO TO 40                                          D0031153
      GO TO 50                                                             D0031154
 40   ISS = IT(1)                                                          D0031155
      GO TO 60                                                             D0031156
   50 ISS = IT(2)                                                          D0031157
60    CONTINUE                                                             D0031158
      RETURN                                                               D0031159
 30   CONTINUE                                                             D0031160
      RETURN 1                                                             D0031161
      END                                                                  D0031162
      SUBROUTINE XOFO (/Y/,/XOF/)                                          D0031163
C     XOF APPROXIMATES X AT A KNOWN Y.                                     D0031164
      DOUBLE PRECISION A,B                                                 D0031165
      COMMON /LN/ A,B                                                      D0031166
      XOF=(Y-B)/A                                                          D0031167
      RETURN                                                               D0031168
      END                                                                  D0031169
      SUBROUTINE YOFO (/X/,/YOF/)                                          D0031170
C     YOF APPROXIMATES Y AT A KNOWN X.                                     D0031171
      DOUBLE PRECISION A,B                                                 D0031172
      COMMON /LN/ A,B                                                      D0031173
      YOF=A*X+B                                                            D0031174
      RETURN                                                               D0031175
      END                                                                  D0031176
      SUBROUTINE IOFO (/X/,/X1/,/DELX/,/IOF/)                              D0031177
C     IOF DETERMINES THE INDEX OF THE X LINE, AT OR JUST LEFT OF XM AND    D0031178
C    1THE INDEX OF THE Y LINE AT OR JUST BELOW YM.                         D0031179
      DOUBLE PRECISION SMALL,T                                             D0031180
      DATA  SMALL /1.0E-05/                                                D0031181
      T=DELX*SMALL                                                         D0031182
      IOF = (X - X1)/DELX + DMAX1 (T,SMALL)                                D0031183
      IOF=IOF+1                                                            D0031184
      RETURN                                                               D0031185
      END                                                                  D0031186
      SUBROUTINE ZOFO (/X/,/X1/,/Z1/,/X0/,/Z0/,/ZOF/)                      D0031187
C     ZOF INTERPOLATES FOR Z AT AN ARBITRARY POINT BETWEEN TWO POINTS      D0031188
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C    1WHERE THE VALUES OF Z ARE KNOWN.                                     D0031189
      ZOF=Z0+(X-X0)*(Z1-Z0)/(X1-X0)                                        D0031190
      RETURN                                                               D0031191
      END                                                                  D0031192
      SUBROUTINE TRNSFO                                                    D0031193
C     TRNSF TRANSFORMS A POINT IN SPACE TO APOINT IN THE PERSPECTIVE       D0031194
C    1PLANE.                                                               D0031195
      COMMON /TRN/ XB,YB,ZB,CX,CY,CZ,D                                     D0031196
      COMMON /TR/ CTHETA,STHETA,THTA                                       D0031197
      CALPHA=(XB-CX)/D                                                     D0031198
      CBETA =(YB-CY)/D                                                     D0031199
      CGAMMA=(ZB-CZ)/D                                                     D0031200
      SGAMMA=SQRT(1.0-CGAMMA*CGAMMA)                                       D0031201
      IF  (SGAMMA.EQ.0.)  GO  TO  20                                       D0031202
      DEN = SQRT(CALPHA**2 + CBETA**2)                                     D0031203
      CTHETA = CALPHA/DEN                                                  D0031204
      STHETA = CBETA/DEN                                                   D0031205
      THTA = ATAN2(STHETA,CTHETA)                                          D0031206
      IF (KBUG .GE. 1) WRITE (6,600) CTHETA,STHETA,THTA,CALPHA,CBETA       D0031207
 600  FORMAT(7E15.7)                                                       D0031208
      RETURN                                                               D0031209
      ENTRY TRNSF1 (/X/,/Y/,/Z/,/XCAP/,/YCAP/)                             D0031210
      XK=D/((X-CX)*CALPHA+(Y-CY)*CBETA+(Z-CZ)*CGAMMA)                      D0031211
      A=CX+XK*(X-CX)                                                       D0031212
      B=CY+XK*(Y-CY)                                                       D0031213
      C=CZ+XK*(Z-CZ)                                                       D0031214
      XCAP=((A-XB)*CBETA-(B-YB)*CALPHA)/SGAMMA                             D0031215
      YCAP=(C-ZB)/SGAMMA                                                   D0031216
      RETURN                                                               D0031217
20    WRITE  (6,25)                                                        D0031218
25    FORMAT  (36HO ILLEGAL OBSERVATION POINT...  STOP)                    D0031219
      STOP                                                                 D0031220
      END                                                                  D0031221
      SUBROUTINE DIRC(A)                                                   D0031222
C     SUBROUTINE DIRC DETERMINES THE DIRECTION COSINES AL(3,J,NA),SUCH     D0031223
C    1THAT THE COORDINATE SYSTEM OF THE  NA ARRAY IS RIGHT HANDED.         D0031224
```

```
      DIMENSION A( 3,1)                                                 D0031225
      DATA  E / 1.E-06 /                                                D0031226
      SUM = 0.                                                          D0031227
      DO 10 J=1,3                                                       D0031228
10    SUM = SUM + A(1,J)*A(2,J)                                         D0031229
      IF (ABS(SUM) .GT. E) GO TO 100                                    D0031230
      DO 15 I=1,2                                                       D0031231
      DIV = 0.                                                          D0031232
      DO 16 J=1,3                                                       D0031233
      DIV = DIV + A(I,J)**2                                             D0031234
16    CONTINUE                                                          D0031235
      DIV = SQRT(DIV)                                                   D0031236
      DO 17 J=1,3                                                       D0031237
      A(I,J) = A(I,J)/DIV                                               D0031238
17    CONTINUE                                                          D0031239
15    CONTINUE                                                          D0031240
      DO 18 J=1,3                                                       D0031241
      GO TO (19,20,21),J                                                D0031242
19    J1 = 2                                                            D0031243
      J2 = 3                                                            D0031244
      GO TO 22                                                          D0031245
20    J1 = 3                                                            D0031246
      J2 = 1                                                            D0031247
      GO TO 22                                                          D0031248
21    J1 = 1                                                            D0031249
      J2 = 2                                                            D0031250
22    A(3,J) = A(1,J1)*A(2,J2) - A(1,J2)*A(2,J1)                        D0031251
18    CONTINUE                                                          D0031252
      RETURN                                                            D0031253
100   WRITE (6,600)                                                     D0031254
600   FORMAT(1H1 20H AXES NOT PERP. STOP)                               D0031255
      STOP                                                              D0031256
      END                                                               D0031257
```



```
      DIMENSION DELTAX(2),X0(2),Y0(2),DELTAY(2)                         1PRG0001
      DIMENSION AL(3,3,2),QC(3,2),ID(2)                                 1PRG0002
      DIMENSION XMINI(2),XMAXI(2),YMINI(2),YMAXI(2),CZMINI(2),CZMAXI(2) 1PRG0003
      INTEGER*2 KCHECK,LCHECK                                           1PRG0004
      DIMENSION X(10,2),Y(10,2),Z(10,10,2,2)                            1PRG0005
      DIMENSION LEWA(10,10),KCHECK(2,2)                                 1PRG0006
      DIMENSION XS(2),YS(10),XB(2),YB(2),DLX(2),DLY(2)                  1PRG0007
      DIMENSION E(20),D(20),S(100),T(100),PT(20)                        1PRG0008
      DIMENSION M(2),N(2),NLEVEL(2),          WP(2),WDP(2),TEST1(2)     1PRG0009
     1,TEST2(2),PIZ(2),P2Z(2),P3Z(2)                                    1PRG0010
      DIMENSION C(361,3,10),LCHECK(10,2),NP(10),LEWC(361)               1PRG0011
      DIMENSION XT(361),YT(361)                                         1PRG0012
      DIMENSION BOX1(12),BOX2(12),BOX3(12),BOX4(12)                     1PRG0013
      COMMON /DEBUG/KBUG                                                1PRG0014
      DATA  R1,R2 / 1.35,2.25/                                          1PRG0015
      DATA  END /4HEND   /                                              1PRG0016
      DATA R1,R2/1.35,2.25/                                             1PRG0017
      KBUG = 0                                                          1PRG0018
      IROT = 1                                                          1PRG0019
      ID(1) = 1                                                         1PRG0020
      ID(2) = 0                                                         1PRG0021
 10   READ  (5,15) PT                                                   1PRG0022
      IF(PT(1).EQ.END) GO TO 80                                         1PRG0023
      READ  (5,15) E                                                    1PRG0024
      READ  (5,15) D                                                    1PRG0025
 15   FORMAT(20A4)                                                      1PRG0026
      READ  (5,20) NARAYS                                               1PRG0027
 20   FORMAT(I6)                                                        1PRG0028
      DO 52 NA = 1,NARAYS                                               1PRG0029
      DO 53 I = 1,3                                                     1PRG0030
      QC (I,NA) = 0.                                                    1PRG0031
   53 CONTINUE                                                          1PRG0032
   52 CONTINUE                                                          1PRG0033
      DO 54 I = 1,2                                                     1PRG0034
      DO 51 J = 1,3                                                     1PRG0035
      AL(I,J,1) = 0.                                                    1PRG0036
```

```
      AL(I,J,2) = 0.                                                    1PRG0037
   51 CONTINUE                                                          1PRG0038
   54 CONTINUE                                                          1PRG0039
      AL(1,1,1) = 1.                                                    1PRG0040
      AL(1,1,2) = 1.                                                    1PRG0041
      AL(2,2,2) = 1.                                                    1PRG0042
      AL(2,3,1)= 1.                                                     1PRG0043
      NCP = 80                                                          1PRG0044
      READ (5,210) (M(NA),N(NA),NLEVEL (NA),NA=1,NARAYS)                1PRG0045
210   FORMAT ((3I6))                                                    1PRG0046
      READ  (5,25) (XS(NA),YS(NA),XB(NA),YB(NA),NA=1,NARAYS)            1PRG0047
 25   FORMAT(4E12.8)                                                    1PRG0048
      READ  (5,25) Q                                                    1PRG0049
      READ (5,21) IVIS,IYPLT,NVIEW                                      1PRG0050
   21 FORMAT (3I6)                                                      1PRG0051
      READ (5,22) THETAD,GAMMAD,DU,DV,DT,NC                             1PRG0052
22    FORMAT (5F10.0,I5)                                                1PRG0053
      DR = (R2 - R1)/ FLOAT(NC-1)                                       1PRG0054
      NPTS = 360.1/DT + 1                                               1PRG0055
      DT = .0174533*DT                                                  1PRG0056
      DO 44 J=1,NC                                                      1PRG0057
      R=R1+FLOAT(J-1)*DR                                                1PRG0058
      DO 42 I=1,NPTS                                                    1PRG0059
      TH=FLOAT(I-1)*DT                                                  1PRG0060
      C(I,1,J)=R*COS(TH)                                                1PRG0061
      C(I,2,J)=R*SIN(TH)                                                1PRG0062
      C(I,3,J)=0.                                                       1PRG0063
42    CONTINUE                                                          1PRG0064
44    NP(J)=NPTS                                                        1PRG0065
      DO 30 NA=1,NARAYS                                                 1PRG0066
      DLX(NA) = (XB(NA)-XS(NA))/FLOAT(M(NA)-1)                          1PRG0067
      DLY(NA) = (YB(NA)-YS(NA))/FLOAT(N(NA)-1)                          1PRG0068
 30   CONTINUE                                                          1PRG0069
      CALL PLT (1,16,-5.0,1.,S,0,1,-3.0,1.,0,0,T,NCP,PT,NCP,E,NCP,D)    1PRG0070
      DO 35 NA=1,NARAYS                                                 1PRG0071
      MNA = M(NA)                                                       1PRG0072
```



```
      NNA = N(NA)                                                       1PRG0073
      DO 26 I=1,MNA                                                     1PRG0074
26    XT(I) = XS(NA) + FLOAT (I-1)*DLX(NA)                              1PRG0075
      DO 27 J=1,NNA                                                     1PRG0076
27    YT(J) = YS(NA) + FLOAT (J-1)*DLY(NA)                              1PRG0077
      LEV = NLEVEL(NA)                                                  1PRG0078
      JN = NNA                                                          1PRG0079
      K = 1                                                             1PRG0080
      DO 40 I=1,MNA                                                     1PRG0081
      DO 41 J=1,JN                                                      1PRG0082
      CALL FUNCT (XT(I),YT(J),X(I,NA),Y(J,NA),Z(I,J,K,NA),K,NA)         1PRG0083
      IF (LEV .GT. 1) Z(I,J,2,NA)=-Z(I,J,K,NA)                          1PRG0084
 41   CONTINUE                                                          1PRG0085
 40   CONTINUE                                                          1PRG0086
      DO 33 I = 1,MNA                                                   1PRG0087
      DO 32 J = 1,JN                                                    1PRG0088
      S(J) = X(I,NA)                                                    1PRG0089
      T(J) = Y(J,NA)                                                    1PRG0090
   32 CONTINUE                                                          1PRG0091
      CALL PLT (2,JN,1)                                                 1PRG0092
   33 CONTINUE                                                          1PRG0093
      DO 331 J = 1,JN                                                   1PRG0094
      DO 332 I = 1,MNA                                                  1PRG0095
      S(I) = X(I,NA)                                                    1PRG0096
      T(I) = Y(J,NA)                                                    1PRG0097
  332 CONTINUE                                                          1PRG0098
      CALL PLT (2,MNA,1)                                                1PRG0099
  331 CONTINUE                                                          1PRG0100
      XO(NA) = X(1,NA)                                                  1PRG0101
      YO(NA) = Y(1,NA)                                                  1PRG0102
      DELTAX(NA) = X(2,NA) - X(1,NA)                                    1PRG0103
      DELTAY(NA) = Y(2,NA) - Y(1,NA)                                    1PRG0104
 35   CONTINUE                                                          1PRG0105
      CALL PLT (5,IL,PLIM)                                              1PRG0106
      NCURVS = NC                                                       1PRG0107
      NL = 10                                                           1PRG0108
```

D003B, PRG SAMPLE DRIVER LISTING 13 MAY 69

```
      NK = 2                                                                    1PRG0109
      NZ1 = 10                                                                  1PRG0110
      NZ2 = 10                                                                  1PRG0111
      NZ3 = 2                                                                   1PRG0112
      NBOX = 12                                                                 1PRG0113
      CALL PERSPO (XO,DELTAX,YO,DELTAY,Z,NZ1,NZ2,NZ3,M,N,NARAYS,NLEVEL,         1PRG0114
     1NCP,PT,XT,YT,Q,IVIS,IYPLT,LEWA,KCHECK,TEST1,TEST2,P1Z,P2Z,P3Z,            1PRG0115
     2IROT,NCURVS,XMINI,XMAXI,YMINI,YMAXI,CZMINI,CZMAXI,BOX1,BOX2,BOX3,        1PRG0116
     3BOX4,NBOX)                                                                1PRG0117
      CALL PERSPR (AL,ID,QC)                                                    1PRG0118
      CALL PERSPC (C,361,  LCHECK,NL,NP,LEWC)                                   1PRG0119
      CALL PERSP1                                                               1PRG0120
      CALL PERSP2 (THETAD,GAMMAD)                                               1PRG0121
      CALL PERSP4                                                               1PRG0122
 1002 CONTINUE                                                                  1PRG0123
  333 CONTINUE                                                                  1PRG0124
   38 CONTINUE                                                                  1PRG0125
      GO TO 10                                                                  1PRG0126
   80 CALL PERSP5                                                               1PRG0127
      STOP                                                                      1PRG0128
      END                                                                       1PRG0129
      SUBROUTINE FUNCT (/U/,/V/,/X/,/Y/,/Z/,/K/,/NA/)                           1PRG0130
      X = U                                                                     1PRG0131
      Y = V                                                                     1PRG0132
      IF (NA .EQ. 2) GO TO 20                                                   1PRG0133
      ZSQ = 1. - X**2                                                           1PRG0134
      GO TO 30                                                                  1PRG0135
   20 ZSQ = 1. - Y**2                                                           1PRG0136
   30 IF (ZSQ .LT. 0.) ZSQ=0.                                                   1PRG0137
      Z = SQRT(ZSQ)                                                             1PRG0138
      IF (NA .EQ. 2) Z=-Z                                                       1PRG0139
      RETURN                                                                    1PRG0140
      END                                                                       1PRG0141
```


D003B, PRG TEST LISTING 13 MAY 69

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    CURVES,ROTATION AND INTERSECTIONS WITH PRG      DEC. 20, 1967     2PRG0001
                                                                      2PRG0002
     2                                                                2PRG0003
    10    10     2                                                   2PRG0004
    10    10     2                                                   2PRG0005
-1.         -2.          1.          2.                             2PRG0006
0.          -1.          4.          1.                             2PRG0007
 10.                                                                  2PRG0008
    1     0     1                                                   2PRG0009
20.        70.        10.        20.        10.          4          2PRG0010
END                                                                   2PRG0011
                                                                      2PRG0012
```