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GRID-COORDINATE GENERATION PROGRAM

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Prepared in cooperation with the
Virginia State Water Control Board
Bureau of Water Control Management

Open-file report
1974
74-1018

CONTENTS

## ILLUSTRATIONS

# GRID COORDINATE GENERATION PROGRAM

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Oliver J. Cosner and Esther Horwich

## ABSTRACT

This program description of the grid-coordinate generation program is written for computer users who are familiar with digital aquifer models. The program computes the coordinates for a variable grid used in the "Pinder Model" (a finite-difference aquifer simulator), for input to the CalComp GPCP (general purpose contouring program). The program adjusts the y-value by a user-supplied constant in order to transpose the origin of the model grid from the upper left-hand corner to the lower left-hand corner of the grid. The user has the options of, (1.) choosing the boundaries of the plot, (2.) adjusting the z-values (altitudes) by a constant, (3.) deleting superfluous z-values and (4.) subtracting two simulated surfaces from each other to obtain the decline. Output of this program includes the fixed format CNTL data cards and the other data cards required for input to GPCP. The output from GPCP then is used to produce a potentiometric map or a decline map by means of the CalComp plotter.

## INTRODUCTION

This program description is written for individuals involved in the use of digital aquifer models. The grid-coordinate generation program itself is designed specifically for the "Pinder Model" (Pinder, 1970) but can be adapted to other models. The program computes the x and y coordinates of the nodes of a variable grid from an aquifer model. The output includes the data cards and parameter cards required as input into the CalComp GPCP*, a program recently acquired by the U.S. Geological Survey. The output from the GPCP is fed into the CalComp plotter to produce a contour map.

Geological Survey scientists commonly use an aquifer simulation program written by George F. Pinder, (1970) or a revised and updated version by P.C. Trescott, (1972). The model simulates the change in the potentiometric surface due to man-made stresses with the results printed on the line printer and punched on cards. When the simulation period is to be continued, this punch card deck may serve as the initial surface for the next run of the model. It is by comparing this simulated potentiometric surface with a measured surface that a model is calibrated.

*GPCP is a general purpose contouring program which contains proprietary information. Further information about GPCP can be obtained by contacting California Computer Products, Inc.

In the past it has been necessary to manually plot altitudes from the printed output and then contour them to make simulated potentiometric maps which then form the main body of a report on the model. For most models somewhere between 500 and 2,500 values have to be plotted and then contoured. By using the grid-coordinate generation program in conjunction with GPCP the hand plotting and contouring is eliminated. Thus, simulated potentiometric maps can be produced with relative ease. Figure 1 is a plotter-generated map.

## Cooperation

This program was written as part of a digital model study by the U.S. Geological Survey in cooperation with the Virginia State Water Control Board, E.T. Jensen, Jr., Executive Secretary.

## APPLICATION

Figure 2 is a sample grid from an aquifer model. The reader should refer to it for a better understanding of the discussions that follow. The grid-coordinate generation program converts grid dimensions of an aquifer model whose node reference is in the upper left-hand corner to a coordinate system whose origin is in the lower left-hand corner, (a requirement of GPCP) and generates the x and y coordinates of each node, in feet. To accomplish this, the user must supply a constant from which each y value is subtracted. Selection of this value is discussed below. Meters can be used in place of feet throughout the program, if one wishes to use the metric system.

Options are:

1. Adjusting the z-value (altitude); some models use altitudes which have been adjusted by a constant; at the time of plotting it may be desirable to remove this constant.
2. Subtracting two different sets of z-values (altitudes) from each other to obtain a decline value.
3. Specifying which rows and columns of nodes will form the boundaries of the plot, thus eliminating peripheral altitudes which are generally not wanted in the plot. (See figure 2)
4. Deleting entire rows and (or) columns within the main body of the model. (See figure 2)
5. Replacing individual node values which are needed but are wiped out by the deletion in item 4, above. (See figure 2)

6. If the user wishes to store the output as a data set on a disk, the grid-coordinate generation program offers the option of adding the parameter cards for GPCP, thus, eliminating the necessity of updating the data set before running GPCP. This feature also makes it feasible for the user to combine runs of the grid-coordinate generation program and GPCP by use of a temporary data set for the output of the grid-coordinate generation program.

After the x and y coordinates for each node are computed, the program then tests to see if the user-supplied GPCP parameter cards are to be read in. After the GPCP cards are processed the data set for input to GPCP is either punched out or written on a storage device. A flow chart and a listing of the grid-coordinate generation program are included in appendix A.

## Restrictions and Dimensions

All of the parameters used in the following discussion are diagrammatically defined on figure 2 and all are described in table 2 except YH and the GPCP parameters YMIN, YMAX, XMIN and XMAX.

1. DELX(I), DELY(I); Model grid up to 65 by 65 nodes (see notes on model size, pg 10).
2. NN; Number of individual nodes to be replaced in plot, up to 20.
3. NX; Number of rows to be eliminated from main body of the plot, up to 20.
4. NY; Number of columns to be eliminated from main body of the plot, up to 20.

5. YADJ; the value supplied for YADJ must be slightly greater than the height of the plot. This will place the origin of the coordinates outside of the plot. To determine a suitable value for YADJ the user should first determine the value for the height of the plot, YH on figure 2. YH can be computed as follows:

$$YH = \left( \sum_{i = IOUTL}^{i = INL} DELY_i \right) - 1/2\,(DELY_{INL} + DELY_{IOUTL})$$

The user should then pick an acceptable value for YMIN. (In the example the value of 22,500 was selected as being approximately equal to 1 inch on the plot). The value for YADJ can then be determined by the following equation:

$$YADJ = YH + YMIN + 1/2\ DELY_{(INL)}$$

6. XMIN, XMAX, YMIN and YMAX; The values for XMIN, XMAX, YMIN and YMAX can be obtained by inspection of the printed output from the grid-coordinate generation program. However, if the user wishes to write the output from the grid-coordinate generation program on a disk for use as input to GPCP, he will need to know these values beforehand. They can be obtained by the following equations:

$$XMIN = 1/2\ DELX_{INW}$$

$$XMAX = \left( \sum_{i = IOUTW}^{i = INW} DELX_i \right) - 1/2\ DELX_{IOUTW}$$

YMIN = is selected by user as described under 5 above.

$$YMAX = YADJ - 1/2\ DELY_{INL}$$

## Input Requirements for the Program

There are two parameter cards and a maximum of six data sets for the grid-coordinate generation program. The parameters to be read into the program are listed in alphabetical order in table 1 along with their format and location on the cards. The format of the two parameter cards and the data sets are listed below with an explanation of each, (see table 2).

Sample listings included in the attached tables and appendix are the input to the grid-coordinate generation program in table 3; input to the CalComp GPCP in table 4; and the grid-coordinate generation Fortran program and flow chart in appendix A.

## Some Remarks on the CalComp GPCP

The CalComp GPCP is a very comprehensive program and offers many options. Although the GPCP manual covers all of these options this manual may be a little difficult for a user to interpret at first glance.

One of the most important concepts that the user must grasp is that of the CalComp grid. The size of this grid is chosen by the user. The optimum grid size is related to the spacing of the random data set (input data points). However, economics governs the selection at the small limit and accuracy governs the selection at the large limit. The grid size is selected on the "SIZE" parameter card. It is given in the same units as the coordinates which are in feet in the example given here.

The program allows the user to select the number of units per inch (feet per inch in this case) on the plot. The user can select this parameter with a standard map scale in mind (in this case, 20,833 feet per inch for a 1 to 250,000 map scale; see SIZE card, table 4).

In the example given in table 4 two LINE cards are included. These cause the plotter to draw two lines which correspond to latitude and longitude lines on the base map, figure 1. They are used to register the plot over the base. The use of line cards is optional.

The more familiar the user is with the CalComp GPCP manual the easier it will be for him to obtain suitable plots. The use of the grid-coordinate generation program is a good starting point for mastering the use of GPCP. The sample input listing given in table 4 will help the user become familiar with GPCP.

## Notes on Problem Size

If the maximum array size in the grid-coordinate generation program, 65 by 65, is smaller than the array size of the user's model, the dimension cards (cards 650 and 660; see listing in appendix A) can be changed to fit the program.

If the user's model is much extended in the Y direction, it probably would be advisable to rotate the plot. This option is available with GPCP.

## Notes on Time

The grid-coordinate generation program when run on the 360/65 takes about 3 seconds CPU time to compile and about 8 seconds CPU time on the go step with a 1600 node problem.

The GPCP program on the 360/65 takes about 30 seconds CPU time to run a problem with 361 random data points and a 20 x 20 GPCP plot grid of 1-inch squares. Plotting time was 20 minutes.

These times will vary depending on the size of the problem and the options selected.

Table-1. Alphabetical list of Parameters for grid-coordinate generation program

| DATA or PARAMETER NAME | DATA SET NUMBER PARAMETER CARD | FORMAT | CARD COLUMNS |
|---|---|---|---|
| A, B | Data Set 2 | 20I3 | 1-60 |
| ALTADJ | Parameter Card 2 | F10.0 | 20-29 |
| C, D | Data Set 3 | 2I3 | 1-3, 4-6 |
| DECL | Parameter Card 2 | F10.0 | 30-39 |
| DELX, DELY | Data Set 1 | 8F10.0 | 1-80 |
| GPCRD | Data Set 6 | 20A4 | 1-80 |
| INL | Parameter Card 1 | I10 | 41-50 |
| INW | Parameter Card 1 | I10 | 21-30 |
| IOUTL | Parameter Card 1 | I10 | 51-60 |
| IOUTW | Parameter Card 1 | I10 | 31-40 |
| IPARAI | Parameter Card 2 | I2 | 42-43 |
| IPARA2 | Parameter Card 2 | I2 | 44-45 |
| LIML | Parameter Card 1 | I10 | 11-20 |
| LIMW | Parameter Card 1 | I10 | 1-10 |
| NFILE | Parameter Card 2 | I2 | 40-41 |
| NN | Parameter Card 2 | I3 | 1-3 |
| NX | Parameter Card 2 | I3 | 4-6 |
| NY | Parameter Card 2 | I3 | 7-9 |
| PHI | Data Set 4 | 8F10.4 | 1-80 |
| PHI1 | Data Set 5 | 8F10.4 | 1-80 |
| YADJ | Parameter Card 2 | F10.0 | 10-19 |

Table 2. Explanation of the parameters for grid-coordinate generation program

| Columns | Format | Comment |
|---|---|---|
| | | CARD 1 |
| 1-10 | (I10) | LIMW - Number of nodes in row of the model grid. Limited to 65 values. |
| 11-20 | (I10) | LIML - Number of nodes in column of the model grid. Limited to 65 values. |
| 21-30 | (I10) | INW - Column number, (J), of the model grid which is to be the left-hand border of plot. |
| 31-40 | (I10) | IOUTW - Column number, (J), of the model grid which is to be the right-hand border of plot. |
| 41-50 | (I10) | INL - Row number, (I), of the model grid which is to be the upper border of plot. |
| 51-60 | (I10) | IOUTL - Row number, (I), of the model grid which is to be the lower border of plot. |
| | | CARD 2 |
| 1-3 | (I3) | NN - Number of individual nodes to be added to plot. Limited to 20. |
| 4-6 | (I3) | NX - Number of entire rows to be eliminated from main body of the plot. Limited to 20. |
| 7-9 | (I3) | NY - Number of entire columns to be eliminated from the main body of the plot. Limited to 20. Note: To save individual nodes of the rows or columns deleted see data set 3 below. |
| 10-19 | (F10.0) | YADJ - Variable with a value greater than the height of the plot (see figure 1). Its function is to transpose the origin of the plot. |

Table 2 Cont.

| Columns | Format | Comment |
|---|---|---|
| 20-29 | (F10.0) | ALTADJ - Constant supplied by user to be subtracted from the altitude at each point. See DECL. |
| 30-39 | (F10.0) | DECL - Test parameter. If it is equal to zero, the job is standard output. If it has any numeric value, the program will read in another surface and subtract it from the first. IF ALTADJ has a given value, it will be subtracted from the second surface also. |
| 40-41 | (I2) | NFILE - File number for punched output. Usually = 7 for punched cards. |
| 42-43 | (I2) | IPARA1 - Number of GPCP parameter cards to precede the type 2 CNTL cards. |
| 44-45 | (I2) | IPARA2 - Number of GPCP parameter cards to follow the type 2 CNTL cards. |
| | | DATA SET 1 |
| 1-80 | (8F10.0) | DELX - Grid dimensions of the model grid in the x direction. There must be LIMW values. |
| 1-80 | (8F10.0) | DELY - Grid dimensions of the model grid in the y direction. There must be LIML values. |
| | | DATA SET 2 |
| 1-60 | (20I3) | A - Individual row numbers (I's) to be deleted. There should be NX entries. (See note below). |

Table 2 Cont.

| Columns | Format | Comment |
|---|---|---|
| 1-60 | (20I3) | B - Individual column numbers (J's) to be deleted. There should be NY entries. |
| | | Note: If either NX = 0 or NY = 0 that part of data set 2 should be omitted. |
| | | DATA SET 3 |
| 1-3 | (I3) | C - Row number (I) for replaced individual node. |
| 4-6 | (I3) | D - Column number (J) for replaced individual node. Include one card for each node. If NN=0 data set 3 is not included. |
| | | DATA SET 4 |
| 1-80 | (8F10.4) | PHI(I,J) - Value of hydraulic head in aquifer at node I,J. (This data set is the punched output from the "Pinder Model"). The entire deck should be included as the program reads all values whether inside of plot or not. |
| | | DATA SET 5 |
| 1-80 | (8F10.4) | PHIL (I,J) - Data set to be subtracted from PHI (I,J). (This data set is also the punched output from the "Pinder Model"). |
| | | DATA SET 6 |
| 1-80 | (20A4) | GPCRD - The GPCP parameter cards are placed here in the order they will appear for input to the GPCP program. |

Table 3. Sample input to grid-coordinate generation program.

Parameter card 1.

```
45    49    8    41    7    40
```

Parameter card 2.

```
3 12 12 437500.00    800.00    0.0 7 5 8
```

Data set 1.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 200000. | 150000. | 100000. | 67000. | 45000. | 30000. | 20000. | 20000. |
| 20000. | 20000. | 15000. | 10000. | 10000. | 10000. | 10000. | 10000. |
| 10000. | 7500 | 5000. | 5000. | 5000. | 5000. | 5000. | 5000. |
| 5000. | 5000. | 5000. | 7500. | 10000. | 10000. | 10000. | 10000. |
| 10000. | 10000. | 15000. | 20000. | 20000. | 20000. | 20000. | 30000. |
| 45000. | 67000. | 100000. | 150000. | 200000. | . | . | . |
| 450000. | 300000. | 200000. | 150000. | 100000. | 67000. | 45000. | 30000. |
| 20000. | 20000. | 20000. | 20000. | 15000. | 10000. | 10000. | 10000. |
| 10000. | 10000. | 10000. | 7500. | 5000. | 5000. | 5000. | 5000. |
| 5000. | 5000. | 5000. | 5000. | 5000. | 7500. | 10000. | 10000. |
| 10000. | 10000. | 10000. | 10000. | 15000. | 20000. | 20000. | 20000. |
| 20000. | 30000. | 45000. | 67000. | 100000. | 150000. | 200000. | 300000. |
| 450000. | . | . | . | . | . | . | . |

Data set 2.

```
12 14 16 18 20 22 24 26 28 30 32 34

14 16 18 20 22 24 26 28 30 32 34 36
```

Data set 3

```
12 29
14 30
15 18
```

Table 3 cont'd.

Data set 4.

```
   0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
   0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
   0.0        0.0        0.0        0.0        0.0        0.0        0.0   817.0000
818.0000   818.0000   818.0000   817.0000   817.0000   817.0000   817.0000   817.0000
816.0000   816.0000   816.0000   816.0000   815.0000   814.0000   812.0000   810.0000
810.0000   810.0000   810.0000   810.0000   810.0000
////////////////////////////////////////////////////////////////////////////////
             The central bulk of this data set is left out.
////////////////////////////////////////////////////////////////////////////////
850.0000   849.0000   849.0000   849.0000   847.0000   846.0000   845.0000   838.0000
836.0000   833.0000   833.0000   833.0000   833.0000
```

Data set 5.

Data set #5 is not used in this example.

Data set 6.

```
JOB  SIMULATED POTENTIOMETRIC SURFACE FOR 2000 WITH 1.625 x 1972 PUMPAGE. JOB 63
FLEX
FCTR   1.
SIZE 2083320833   1.   1.    10000.15000   402500.    22500.15000    415000.
CNTL   .05   .1    1    2
BEND
PRNT
BLNK
BLEV   20.
BRDR
LINE     010.18  1.0 2.4419.84                      1
LINE     0   1.0 6.6519.8414.37                     1
STOP
```

Table 4. Sample output from grid generation program. This is the input to the CalComp GPCP program.

```
JOB  SIMULATED POTENTIOMETRIC SURFACE FOR 2000 WITH 1.625 X 1972 PUMPAGE. JOB 63
FLEX
FCTR    1.
SIZE 2083320833   1.   1.    1000C.15000   402500.    22500.15000   415000.
CNTL   .05   .1    1    2                                               6    6
CNTL    10000.   415000.    -22.76
CNTL    30000.   415000.    -40.24
CNTL    50000.   415000.    -59.16
CNTL    67500.   415000.    -75.79
CNTL    90000.   415000.    -91.24
CNTL   110000.   415000.   -100.37
CNTL   130000.   415000.   -111.01
CNTL   145000.   415000.   -122.45
CNTL   155000.   415000.   -130.56
CNTL   165000.   415000.   -139.55
CNTL   175000.   415000.   -152.29
CNTL   185000.   415000.   -136.73
CNTL   200000.   415000.   -119.58
CNTL   220000.   415000.   -104.31
CNTL   240000.   415000.    -93.54

CNTL   280000.    22500.    -50.59
CNTL   300000.    22500.    -47.91
CNTL   320000.    22500.    -45.02
CNTL   340000.    22500.    -41.82
CNTL   365000.    22500.    -37.40
CNTL   402500.    22500.    -30.59
HEND
PRNT
BLNK
BLEV   20.
BKOR
LINE     010.18  1.0 2.4419.84                        1
LINE     0   1.0 6.6519.8414.37                       1
STOP
```

## Selected References


California Computer Products, Inc., 1971, A general purpose contouring program (GPCP): User's manual, California Computer Products report.

Pinder, George F., 1970, An iterative digital model for aquifer evaluation: U.S. Geol. Survey open-file report.

Trescott, P.C., 1972, Iterative digital model for aquifer evaluation, U.S. Geol. Survey open-file report.

## APPENDIX A

## Flow Chart and Source Listing

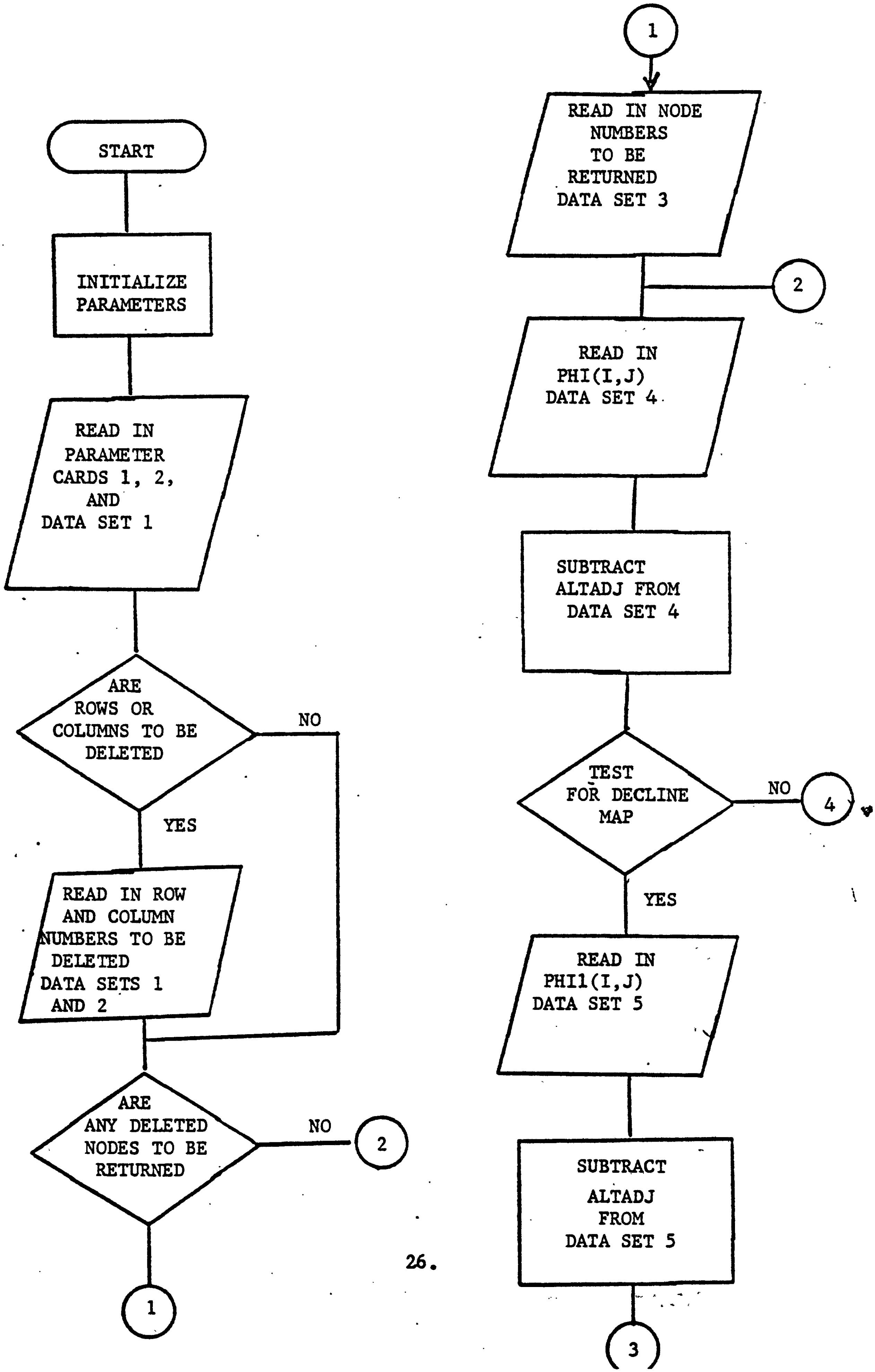
## of

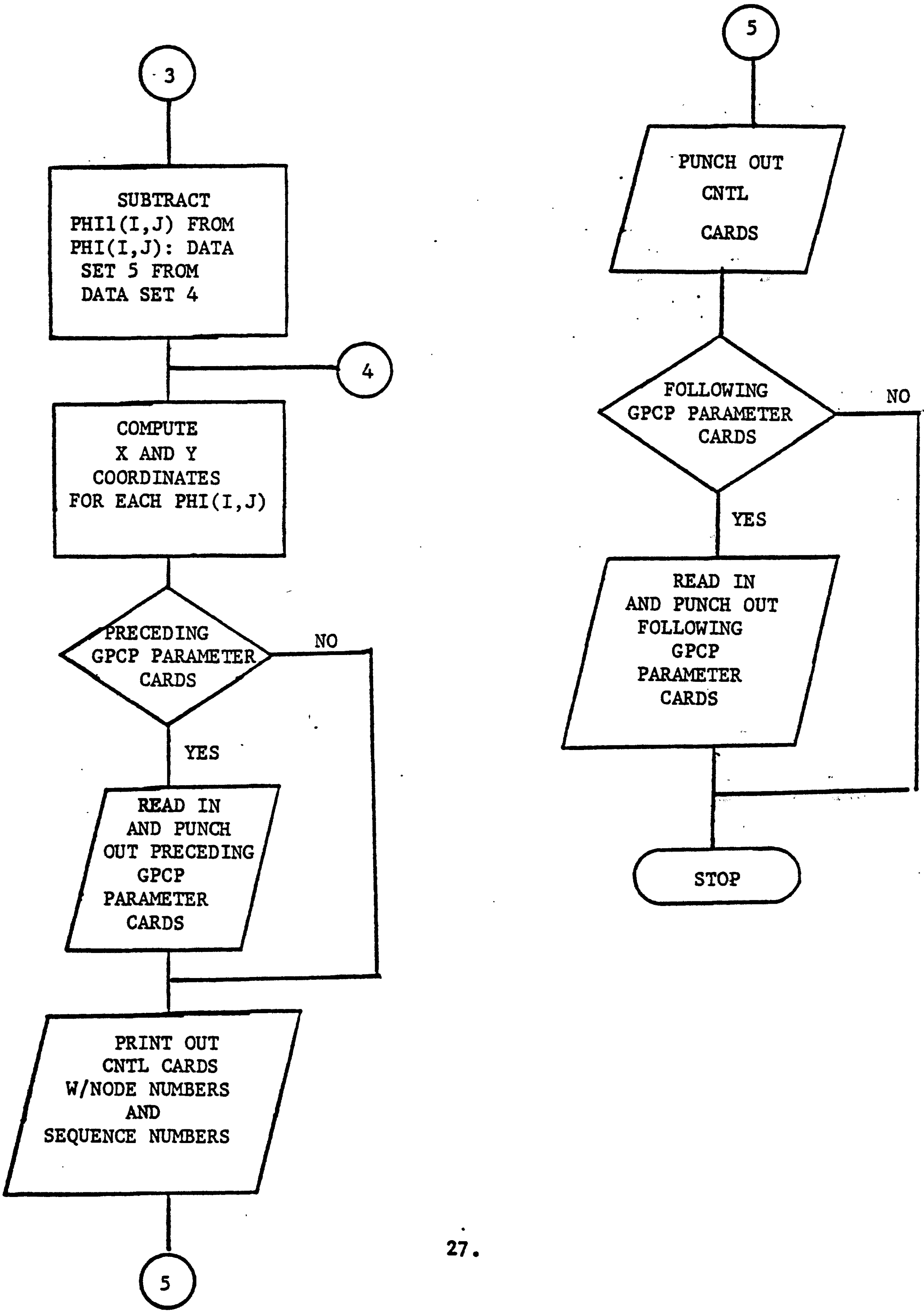
## Grid-Coordinate Generation Program

```
C                       GRID COORDINATE GENERATICN PROGRAM
C      PROGRAMED BY O.J. COSNER AND ESTER HORWICH,  JUNE, 1973.
C      ****************************************************************
C      PURPOSE
C      TO COMPUTE THE  GRID CCCRDINATES FCR AN EXPANCING GRIC SUCH AS IS
C      IN THE 'PINDER MODEL,' FOR THE CALCCMP CONTOURING ROUTINE AND TO
C      PUNCH OUT DATA CARDS FCR INPUT.
C      ****************************************************************
C      ****************************************************************
C      DESCRIPTION OF PARAMETERS
C      PARAMETER CARC #1.
C      LIMW = NUMBER OF NODES IN A ROW IN THE MCDEL GRID
C      LIML = NUMBER OF NODES IN A COLUMN IN THE MODEL GRID
C      INW = THE COLUMN NUMBER IN THE MODEL GRID THAT IS TC BE THE LEFT
C      HAND BORDER OF PLOT
C      IOUTW = THE COLUMN NUMBER IN THE MODEL GRID THAT IS TO BE THE
C      RIGHT HAND BORDER OF PLOT
C      INL = THE ROW NUMBER IN THE MODEL GRID THAT IS TO BE THE UPPER
C      BORDER OF PLOT
C      IOUTL = THE ROW NUMBER IN THE MCDEL GRID THAT IS TO BE THE LOWER
C      BORDER OF PLOT
C      PARAMETER CARD #2.
C      NN = NUMBER OF INDIVIDUAL NODES TO BE LEFT IN THE PLOT
C      NX = NUMBER OF ROWS AND COLUMNS TO BE ELIMINATED FRCM THE MAIN
C      BODY OF THE PLOT.
C      YADJ = VARIABLE SUPPLIED BY USER TO TRANSPOSE ORIGIN OF PLOT
C      ALTADJ = CONSTANT TO BE SUPPLIED BY USER TO BE SUBTRACTED FROM
C      THE ALTITUDE AT EACH NODE.
C      DECL IS A TEST PARAMETER.  IF = TO 0.0 JOB IS STANDARD OUTPUT.
C      IF DECL HAS ANY NUMERIC VALUE, THE PROGRAM WILL READ IN
C      ANOTHER SURFACE AND SUBTRACT IT FRCM THE FIRST. IF ALTADJ HAS
C      A GIVEN VALUE IT WILL BE SUBTRACTED FRCM THE SECOND SURFACE ALSO.
C      NFILE = FILE NUMBER FOR WRITE STATEMENTS FCR PUNCHED OUTPUT.
C      IPARA1 = THE NUMBER OF GPCP PARAMETER CARCS THAT
C      PRECEDE CNTL TYPE#2 CARDS.
C      IPARA2 = THE NUMBER CF GPCP PARAMETER CARDS THAT
C      FOLLOW CNTL TYPE#2 CARDS.
C      DATA SET #1.
C      DELX = GRID DIMENSIONS OF THE MCDEL GRID IN THE X DIRECTION
C      DELY = GRID DIMENSIONS OF THE MODEL GRID IN THE Y DIRECTICN
C      DATA SET #2.
C      A = INDIVIDUAL ROW NUMBERS (I'S) TO BE DELETED.
C      B= INDIVIDUAL COLUMN NUMBERS (J'S) TO BE DELETED.
C      DATA SET #3.
C      C =THE ROW (I) NUMBER FOR THE INDIVIDUAL NODE TO BE REPLACED.
C      D = THE COLUMN (J) NUMBER FOR THE INDIVIDUAL NODE TO BE REPLACED.
C      DATA SET 3 REQUIRES ONE CARD FOR EACH NODE LISTED.
C      DATA SET #4.
C      PHI(I,J)= VALUE OF HYDRAULIC HEAD IN AQUIFER AT NODE (I,J)
C      IN THE MODEL GRID
C      DATA SET #5.
C      PHI1(I,J)=VALUE OF HYDRAULIC HEAD IN AQUIFER AT NCDE (I,J)
C      IN THE MODEL GRID. THIS DATA SET IS SUBTRACTED FROM PHI(I,J).
C      DATA SET #6.
C      GPCP = GPCP PARAMETER CARDS. THEY GO IN THIS DATA SET IN THE
C      ORDER IN WHICH THEY WILL APPEAR IN THE INPUT TO GPCP.
C      ****************************************************************
C      THE FOLLOWING ARE COMPUTED IN THE PROGRAM.
C      AX(I)=COORDINATE IN THE X DIRECTION
C      AY(Y) =COORDINATE IN THE Y DIRECTION
C      (I) (J) KOUNT = NODE NUMBERS IN THE MODEL GRID AND SEQUENCE
C      NUMBER IN RANDOM DATA SET RESPECTIVELY
C      ****************************************************************
```

```
C     ***************************************************************
      DIMENSION DELX(65),DELY(65),PHI(65,65),X(65),Y(65),AX(65),AY(65)
      DIMENSION A(20),B(20),C(20),D(20),PHI1(65,65)
      INTEGER GPCRD(20),A,B,C,D
      A(1)=0
      B(1)=0
      C(1)=0
      D(1)=0
      KOUNT=0
      READ(5,140)LIMW,LIML,INW,IOUTW,INL,IOUTL
      READ(5,205) NN,NX,NY,YADJ,ALTADJ,DECL,NFILE,IPARA1,IPARA2
      READ(5,120)(DELX(J),J=1,LIMW)
      READ(5,120)(DELY(I),I=1,LIML)
      IF (NX.EQ.0) GO TO 4
      READ (5,210) (A(I),I=1,NX)
    4 IF (NY.EQ.0) GO TO 5
      READ (5,210) (B(I),I=1,NY)
    5 IF (NN.EQ.0) GO TO 6
      DO 12 I=1,NN
   12 READ(5,220) C(I),D(I)
    6 DO 11 I=1,LIML
      READ(5,130)(PHI(I,J),J=1,LIMW)
      DO 11 J=1,LIMW
   11 PHI(I,J)=PHI(I,J)- ALTADJ
      IF (DECL.EQ.0.0) GO TO 15
      DO 14 I=1,LIML
      READ (5,130) (PHI1(I,J),J=1,LIMW)
      DO 14 J=1,LIMW
      PHI1(I,J)=PHI1(I,J)-ALTADJ
   14 PHI(I,J)=PHI(I,J)-PHI1(I,J)
   15 X(INW)=0.5*DELX(INW)
      I1=INW+1
      DO 10 I=I1,IOUTW
   10 X(I)=X(I-1)+0.5*(DELX(I-1)+DELX(I))
      Y(INL)=0.5*DELY(INL)
      I1=INL+1
      DO 20 I=I1,IOUTL
   20 Y(I)=Y(I-1)+0.5*(DELY(I-1)+DELY(I))
      DO 50 I=INW,IOUTW
   50 AX(I)=X(I)
      DO 60 I=INL,IOUTL
   60 AY(I)=YADJ-Y(I)
      IF  (IPARA1.EQ.0) GO TO 65
      DO 61 I=1,IPARA1
      READ (5,110) (GPCRD(K),K=1,20)
   61 WRITE (NFILE,110)  (GPCRD(K),K=1,20)
   65 CONTINUE
      WRITE (6,200)
      DO 85 I=INL,IOUTL
      DO 85 J=INW,IOUTW
      DO 70 K=1, NN
      NC=C(K)
      NC=D(K)
      IF (I.EQ.NC.AND.J.EQ.ND) GO TO 80
   70 CONTINUE
      DO 75 K=1,NX
      NA=A(K)
      NB=B(K)
      IF (I.EQ.NA.OR.J.EQ.NB) GO TO 85
   75 CONTINUE
   80 KOUNT=KOUNT+1
      WRITE (6,160) AX(J),AY(I),PHI(I,J),I,J,KOUNT
      WRITE (NFILE,175) AX(J),AY(I),PHI(I,J)
   85 CONTINUE
```

```
      IF (IPARA2.EQ.C) GO TO 95
      DO 90 I=1,IPARA2
      READ (5,110) (GPCRD(K),K=1,20)
   90 WRITE (NFILE,11C) (GPCRC(K),K=1,20)
   95 CONTINUE
  110 FORMAT (20A4)
  120 FORMAT(8F1C.0)
  130 FORMAT(8F10.4)
  140 FORMAT (6I1C)
  160 FORMAT (1H ,'CNTL',2F10.C,F1C.2,34X,2I3,I4)
  175 FORMAT('CNTL',2F10.0,F10.2)
  200 FORMAT (1H1,//8X,'X CORC',5X,'Y CORD',3X,'ALT.OR.DEC',33X,'I',2X
     *'J',1X,'COUNT')
  205 FORMAT (3I3,3F10.0,3I2)
  210 FORMAT (20I3)
  220 FORMAT (2I3)
      STOP
```


START
INITIALIZE PARAMETERS
READ IN PARAMETER CARDS 1, 2, AND DATA SET 1
ARE ROWS OR COLUMNS TO BE DELETED
NO
YES
READ IN ROW AND COLUMN NUMBERS TO BE DELETED DATA SETS 1 AND 2
ARE ANY DELETED NODES TO BE RETURNED
NO
2
1
1
READ IN NODE NUMBERS TO BE RETURNED DATA SET 3
2
READ IN PHI(I,J) DATA SET 4
SUBTRACT ALTADJ FROM DATA SET 4
TEST FOR DECLINE MAP
NO
4
YES
READ IN PHI1(I,J) DATA SET 5
SUBTRACT ALTADJ FROM DATA SET 5
3



3
SUBTRACT PHI1(I,J) FROM PHI(I,J): DATA SET 5 FROM DATA SET 4
4
COMPUTE X AND Y COORDINATES FOR EACH PHI(I,J)
PRECEDING GPCP PARAMETER CARDS
NO
YES
READ IN AND PUNCH OUT PRECEDING GPCP PARAMETER CARDS
PRINT OUT CNTL CARDS W/NODE NUMBERS AND SEQUENCE NUMBERS
5
5
PUNCH OUT CNTL CARDS
FOLLOWING GPCP PARAMETER CARDS
NO
YES
READ IN AND PUNCH OUT FOLLOWING GPCP PARAMETER CARDS
STOP