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# SIMCOMP VERSION 2.1 USER'S MANUAL AND MAINTENANCE DOCUMENT

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## ABSTRACT

The SIMCOMP version 2.1 compiler contains a basic subset of the capabilities of the SIMCOMP version 2.0 compiler. The compiler and the generated simulation programs are written in American National Standards Institute (ANSI) FORTRAN and are therefore relatively machine-independent. Section 1 of this document describes the rules for implementing flow oriented continuous system simulations. The structure and operation of the compiler and the generated simulation program are described in Section 2. An example of a simple biological simulation is given and is used throughout this document to illustrate the utilization and maintenance of the compiler.

# INTRODUCTION

SIMCOMP version 2.1 is an abbreviated version of the SIMCOMP version 2.0 continuous system simulation compiler (see Gustafson and Innis 1972, SIMCOMP Version 2.0 User's Manual). The 2.1 version provides the basic capabilities of the 2.0 compiler, but is written entirely in machine-independent American National Standards Institute (ANSI) FORTRAN with the exception of the use of FORTRAN data statements to set the values of dimensioned variables. These basic capabilities include (i) unified parameter declaration for inter-program communication, (ii) capacity of a maximum of 99 state variables and 300 flows or transfers between state variables, (iii) user-defined functions and subroutines, (iv) automatic tabular and/or graphic display of state variables, and (v) tabular display of flow rates.

# 1. USER'S GUIDE

## 1.1 Source Program Section.

The actual simulation program or source section is made up of major blocks or subdivisions. These major blocks are:

1. *STORAGE--Used for parameter declaration statements for inter-program communication.
2. *FLOW--Used for declaring and describing flows.
3. *ROUTINES--Used for declaring user-defined subprograms and functions.

Comment statements indicated by a "C" in column 1 may appear anywhere in the source section. The source section is terminated by the *END declaration.

Major block subdivisions are separated by the above major block declaration command verbs and must appear in the deck in the above order. All major block declaration command verbs must have an asterisk (*) in column 1, immediately followed by the particular verb. If a particular block is not required, that entire block may be deleted; however, the remaining blocks must appear in the above order. An example of an entire simulation program follows and is presented to illustrate each of the major blocks in a SIMCOMP 2.1 source section.

```
C...A SIMPLE HERBAGE DYNAMICS MODEL FOR AN ANDROPOGON VIRGINICUS GRASSLAND.
C     COMPARTMENT DEFINITIONS:
C        1    SOURCE PHOTOSYNTHETIC INPUT
C        2    LIVE VEGETATION TOPS
C        3    LIVE VEGETATION ROOTS
C        4    DEAD VEGETATION
C        5    MULCH
C        6    RESPIRATION SINK
C        7    ORGANIC MATTER IN SOIL
C        8    THE AMOUNT OF FLOW FROM X(1) TO X(2)
C        9    THE INTEGRATED FLOW FROM X(1) TO X(2)
C
*STORAGE
      COMMON/SPARS/PI,YEAR
      COMMON/FPARS/P12A,P12B,P12C,P12D,P23A,P23B,P23C,P23D,P24A,P24B,
     -             P26A,P36A,P36B,P36C,P36D,P45A,P45B,P56A,P56B,P56C
*FLOW
(1,2).
C...GROWTH OF LIVE PLANT TOPS.
      F=(P12A+P12B*COS(P12C+2.*PI*(TIME-1.)/YEAR))/P12D
      IF(F.LT.0.) F=0.
      X(8)=F
      X(9)=X(9)+F*DT
(2,4).
C...DEATH OF LIVE PLANT TOPS.
      F=P24A*EXP(TIME/P24B)
      F=F*X(2)
(4,5).
C...TRANSFER OF DEAD VEGETATION TO MULCH.
      F=P45A*(1.+SIN(2.*PI*(TIME-1.)/YEAR-P45B))
      F=F*X(4)
(5,7).
      F=0.
(3,7).
      F=0.
(2,3).
C...TRANSLOCATION OF ABOVE GROUND PLANTS TO ROOTS.
      F=0.
      IF(X(2).LT.20.) GO TO 5
      F=P23A+P23A*SIN(2.*PI*(TIME-1.)/YEAR-P23B)*P23C
      IF(F.LT.0.001) F=0.001
      F=F*X(2)*P23D
    5 CONTINUE
(2,6).
C...PLANT RESPIRATION.
      F=P26A
      F=F*X(6)
(4,6).
      F=0.
(5,6).
C...DECOMPOSITION OF MULCH.
      F=(P56A*(1.+SIN(2.*PI*(TIME-1.)/YEAR-P56B))*X(4)-P56C*X(5))/X(5)
      F=F*X(5)
(3,6).
C...ROOT RESPIRATION.
      TEMP=(P36A+P36B*SIN(2.*PI*(TIME-1.)/YEAR+P36C))
      IF(TIME.GT.280.) GO TO 10
      F=TEMP
      GO TO 15
   10 F=TEMP*(365.-TIME)/110.
   15 IF(F.LT.0.00036) F=0.00036
      F=F*P36D*X(3)
(2,5).
      F=0.
*ROUTINES
      SUBROUTINE START
      READ(1,100) PI,YEAR
      READ(1,100) P12A,P12B,P12C,P12D
      READ(1,100) P24A,P24B
      READ(1,100) P45A,P45B
      READ(1,100) P23A,P23B,P23C,P23D
      READ(1,100) P26A
      READ(1,100) P56A,P56B,P56C
      READ(1,100) P36A,P36B,P36C,P36D
      READ(1,100) (X(I),I=1,9)
      READ(1,100) TSTART,TEND,DT,DTPR,DTFL
  100 FORMAT(8F10.0)
      RETURN
      END
*END
```

**STORAGE block.*

The block of statements following the *STORAGE statement may contain any number of FORTRAN-labeled common statements and associated FORTRAN-type statements. These latter statements may include any of the usual FORTRAN INTEGER, REAL, or LOGICAL declaration statements.

The purpose of the storage block is to provide inter-program communication of a parameter (declared in a labeled common statement) between the routine which computes the flows and all user-declared subroutines or functions. Once a parameter has been declared in the storage block, the parameter may be considered globally defined in all of the user-defined routines and need not be declared by the user in any of his subroutines or functions. The following is an example of a storage block containing two labeled common statements.

```
*STORAGE
      COMMON/SPARS/PI,YEAR
      COMMON/FPARS/P12A,P12B,P12C,P12D,P23A,P23B,P23C,P23D,P24A,P24B,
     -             P26A,P36A,P36B,P36C,P36D,P45A,P45B,P56A,P56B,P56C
```

SIMCOMP 2.1 reserves variable names as special purpose variables and uses them to control simulation execution (Table 1).

With the exception of the state variables, any variables used in a routine, used in the computation of flows, or declared in the storage block should not begin with the letter "X." A diagnostic is not issued, but erroneous or computationally fatal results may occur. The reserved variables are automatically available for use in computation at any point in the flows or user-defined routines.

Table 1. Reserved variables.

| Variable | Default Value | Purpose |
|---|---|---|
| TIME | -- | Current value of simulated time. |
| TSTART[a/] | 0. | Starting time of simulation. |
| TEND[a/] | 1. | Ending time of simulation |
| DT[a/] | 0.1 | Time step for integration. |
| DTPR[b/] | 0. | Time step for tabular printout of state variables. |
| DTPL[c/] | -- | Time step for graphic printout of state variables. |
| DTFL[b/] | 0. | Time step for tabular printout of flows. |
| X(i)[a/] $1 \leq i \leq 99$ | 0. | Values of the state variables. |
| F | -- | Variable containing the value of each flow. |

a/ If the default value of the variable needs to be altered, it must be so altered in the user-defined subroutine START.

b/ If tabular output of state variables or flows is requested, the values of these variables must be set greater than zero in subroutine START.

c/ If graphical output of state variables is requested, DTPL is always set by the system to the maximum, either (TEND-TSTART)/99 or DT.

**FLOW block.*

All flows defined in a simulation must appear in the flow division. A flow is declared by a compiler directive in the following form:

(i,j).

.
.
.

FORTRAN TEXT

.
.
.

In the above, i and j must be integer constants in the range 1 through 99, and they may not be equal. The parenthesized pair of numbers, separated by a comma and followed by a period, may not include blanks and must begin in column 1. Anything appearing on this card after the period is treated as commentary information.

The flow declaration is followed by any legal sequence of FORTRAN executable statements which compute the value of the flow. Somewhere in the FORTRAN text, the variable "F" must be set to the value of the flow. If this is not done, the value of the flow is assumed equal to zero.

Care must be taken that a FORTRAN transfer of control statement does not transfer control to a statement which is not contained in the range of the flow declaration. The range of a flow declaration is all statements following a flow declaration and terminated by another flow declaration, a *ROUTINES card, or an *END card. The following is an example of a flow block taken from the sample simulation.

```
*FLOW
(1,2).
C...GROWTH OF LIVE PLANT TOPS.
      F=(P12A+P12B*COS(P12C+2.*PI*(TIME-1.)/YEAR))/P12D
      IF(F.LT.0.) F=0.
      X(8)=F
      X(9)=X(9)+F*DT
(2,4).
C...DEATH OF LIVE PLANT TOPS.
      F=P24A*EXP(TIME/P24B)
      F=F*X(2)
(4,5).
C...TRANSFER OF DEAD VEGETATION TO MULCH.
      F=P45A*(1.+SIN(2.*PI*(TIME-1.)/YEAR-P45B))
      F=F*X(4)
(5,7).
      F=0.
(3,7).
      F=0.
(2,3).
C...TRANSLOCATION OF ABOVE GROUND PLANTS TO ROOTS.
      F=0.
      IF(X(2).LT.20.) GO TO 5
      F=P23A+P23A*SIN(2.*PI*(TIME-1.)/YEAR-P23B)*P23C
      IF(F.LT.0.001) F=0.001
      F=F*X(2)*P23D
    5 CONTINUE
(2,6).
C...PLANT RESPIRATION.
      F=P26A
      F=F*X(6)
(4,6).
      F=0.
(5,6).
C...DECOMPOSITION OF MULCH.
      F=(P56A*(1.+SIN(2.*PI*(TIME-1.)/YEAR-P56B))*X(4)-P56C*X(5))/X(5)
      F=F*X(5)
(3,6).
C...ROOT RESPIRATION.
      TEMP=(P36A+P36B*SIN(2.*PI*(TIME-1.)/YEAR+P36C))
      IF(TIME.GT.280.) GO TO 10
      F=TEMP
      GO TO 15
   10 F=TEMP*(365.-TIME)/110.
   15 IF(F.LT.0.00036) F=0.00036
      F=F*P36D*X(3)
(2,5).
      F=0.
```

In this example, after all flows have been computed, the flow (5,6). has the effect of multiplying the value of "F" (as defined in that flow) by DT, adding it to X(6), and subtracting it from X(5) at each time step throughout the simulation.

A maximum of 300 flows may be declared in a simulation. The flows are computed in the order in which they appear in the *FLOWS block. A quantity computed in one flow may be used in the computation of a subsequent flow.

**ROUTINES block.*

The *ROUTINES block contains one or more user-defined FORTRAN subroutines or functions. If no subroutines or functions are used, the *ROUTINES block may be omitted entirely. User-defined routines are either special purpose routines called by the system at predetermined times or are general purpose routines called by the user during the computation of the flows, or called from within other routines.

The special purpose routines are named START, CYCLE, and FINIS. If provided by the user, subroutine START is called by the system prior to the simulation. This subroutine is typically used to read in initial values for variables declared in the *STORAGE block and the reserved system variables. Computations which are to be performed only once prior to simulation are to be done here. The standard SIMCOMP 2.1 system provides an input file to the user from which he may read data. This standard input file is logical unit no. 1.

Likewise, if provided by the user, subroutine CYCLE is called by the system prior to the computation of the flows at each time step during the simulation. Subroutine CYCLE is typically used to compute the values of variables declared in the *STORAGE block which are used in the computation of the flows.

Subroutine FINIS, if provided by the user, is called at the end of simulated time, i.e., TIME = TEND. This subroutine is typically used to perform calculations upon the simulated variables and to produce printed reports of these calculations just prior to the termination of the simulation.

If the user desires to print out information during the course of a simulation, in addition to the state variables which are requested for tabular output in the data section, FORTRAN write statements may be included

in any of the flows or user-defined subprograms. The standard SIMCOMP 2.1 system provides access to the system output file via logical unit no. 2.

The following example is a *ROUTINES block containing only the special purpose routine START. Also shown is the *END card used to signal the end of the source section.

```
*ROUTINES
      SUBROUTINE START
      READ(1,100) PI,YEAR
      READ(1,100) P12A,P12B,P12C,P12D
      READ(1,100) P24A,P24B
      READ(1,100) P45A,P45B
      READ(1,100) P23A,P23B,P23C,P23D
      READ(1,100) P26A
      READ(1,100) P56A,P56B,P56C
      READ(1,100) P36A,P36B,P36C,P36D
      READ(1,100) (X(I),I=1,9)
      READ(1,100) TSTART,TEND,DT,DTPR,DTFL
  100 FORMAT(8F10.0)
      RETURN
      END
*END
```

Special purpose subroutines may not have an argument list. If general purpose subroutines or functions have argument lists, they should not be so long as to require a continuation statement to specify all of the arguments. All user-defined routines have access to any of the reserved system variables or variables declared in the *STORAGE block.

## 1.2 Data Section.

The data section is made up of two parts. The first part is a set of output control directives and is terminated by a card with END. starting in column 1. If no system-generated output is requested, only the END. card should be included; but in both cases, it must be included. The second part is comprised of user's data cards to be read by FORTRAN read statements in the source section. The user's data cards immediately follow the END. card. The following is a sample data section used in conjunction with the sample source section on page 3.

```
PRINT.          1   2   3   4   5   6   7   8   9
FLOW.           1   2   2   3
PLOT.           3
                2   3   4   5
                9
                8
END.
3.14159   364.
3.0       8.6       3.1       1.4
0.00027   85.
0.00185   1.56
0.002     0.7       1.4       4.2
0.0014
0.00185   1.56      180.
0.0005    0.01      2.        1.1
100.      20.       650.      600.      180.      0.        0.        0.
0.
1.        365.      1.        10.       10.
```

*Output control directives.*

All output control directives contain the following data fields:

command. n1, n2, n3, ..., n14

The command begins in column 1, contains no imbedded blanks, and must end with a period. Legal commands are PRINT., FLOW., PLOT., and END.. The integer constants n1 through n14 are right-justified in fields of five starting in column 11. Not all 14 fields are necessarily used. The card columns of each of the fields are:

| Field | Card Columns |
|---|---|
| command. | 1-10 |
| n1 | 11-15 |
| n2 | 16-20 |
| n3 | 21-25 |
| n4 | 26-30 |
| n5 | 31-35 |
| n6 | 36-40 |
| n7 | 41-45 |
| n8 | 46-50 |
| n9 | 51-55 |
| n10 | 56-60 |
| n11 | 61-65 |
| n12 | 66-70 |
| n13 | 71-75 |
| n14 | 76-80 |

The output directives, i.e., PRINT., FLOW., and PLOT., may appear in any order in the first part of the data section.

*PRINT. directives.* Any of the 99 state variables may be requested for tabular output by PRINT. directives. The system, upon recognizing the command PRINT. in columns 1 through 6, scans the numeric fields of five columns each, starting in column no. 11 and ignoring blank fields. All constants encountered in these numeric fields are interpreted as indices of state variables to be printed. As such, the numbers must be in the range 1 through 99. As many PRINT. cards as necessary in order to specify

all of the state variables desired in the output may be included. Following is an example of a PRINT. command requesting state variables 1 through 9 to be printed.

```
PRINT.      1   2   3   4   5   6   7   8   9
```

The simulation time interval between printouts is controlled by the reserved system variable DTPR.

*FLOW. directives.* The current values for any of the flows declared in the source section may be requested for tabular output with the FLOW. command. The symbols FLOW. must appear in columns 1 through 5. Successive pairs of the numeric fields are then interpreted as the indices of flows to be printed. If any of the pairs of numbers are outside the range of 1 through 99, a diagnostic is issued. If a flow is requested for print but does not exist in the simulation, the request is ignored. Following is an example of a FLOW. command requesting the flows from X(1) to X(2) and from X(2) to X(3) be printed.

```
FLOW.       1   2   2   3
```

As many FLOW. print command cards as are necessary may be included. The simulation time step between flow printouts is controlled by DTFL.

*PLOT. directives.* Printer plots of any state variable through time may be requested with the PLOT. command. The symbols PLOT. must appear in columns 1 through 5. The first numeric field in columns 11 through 15 is interpreted as the total number of plots to be generated. A maximum of 20 plots is allowed. The indices of the state variables in each plot are specified on successive cards, one card per plot. A maximum of five state variables may be included in the first five numeric fields on each of

the successive cards after the initial PLOT. command. The command field on these cards is ignored. As many cards specifying state variables as there were number of plots requested on the initial PLOT. card must be included. The following example requests three plots. The first plot is of state variables X(2), X(3), X(4), and X(5); the second plot is of X(9); and the third plot is of X(8).

```
PLOT.       3
            2
            9
            8     3    4    5
```

*User-supplied input data.*

User-supplied data cards to be read by FORTRAN read statements in the source section may be included following the END. card which terminates the output control cards. The following example shows the data cards which are read in the user-supplied subroutine START in the sample simulation. The END. card which must precede this data is also shown.

```
END.
3.14159   364.
3.0       8.6       3.1       1.4
0.00027   85.
0.00185   1.56
0.002     0.7       1.4       4.2
0.0014
0.00185   1.56      180.
0.0005    0.01      2.        1.1
100.      20.       650.      600.      180.      0.        0.        0.
0.
1.        365.      1.        10.       10.
```

## 1.3 Sample Simulation Output.

The next few pages illustrate the output generated by the compiler and execution of the simulation. The output is comprised of



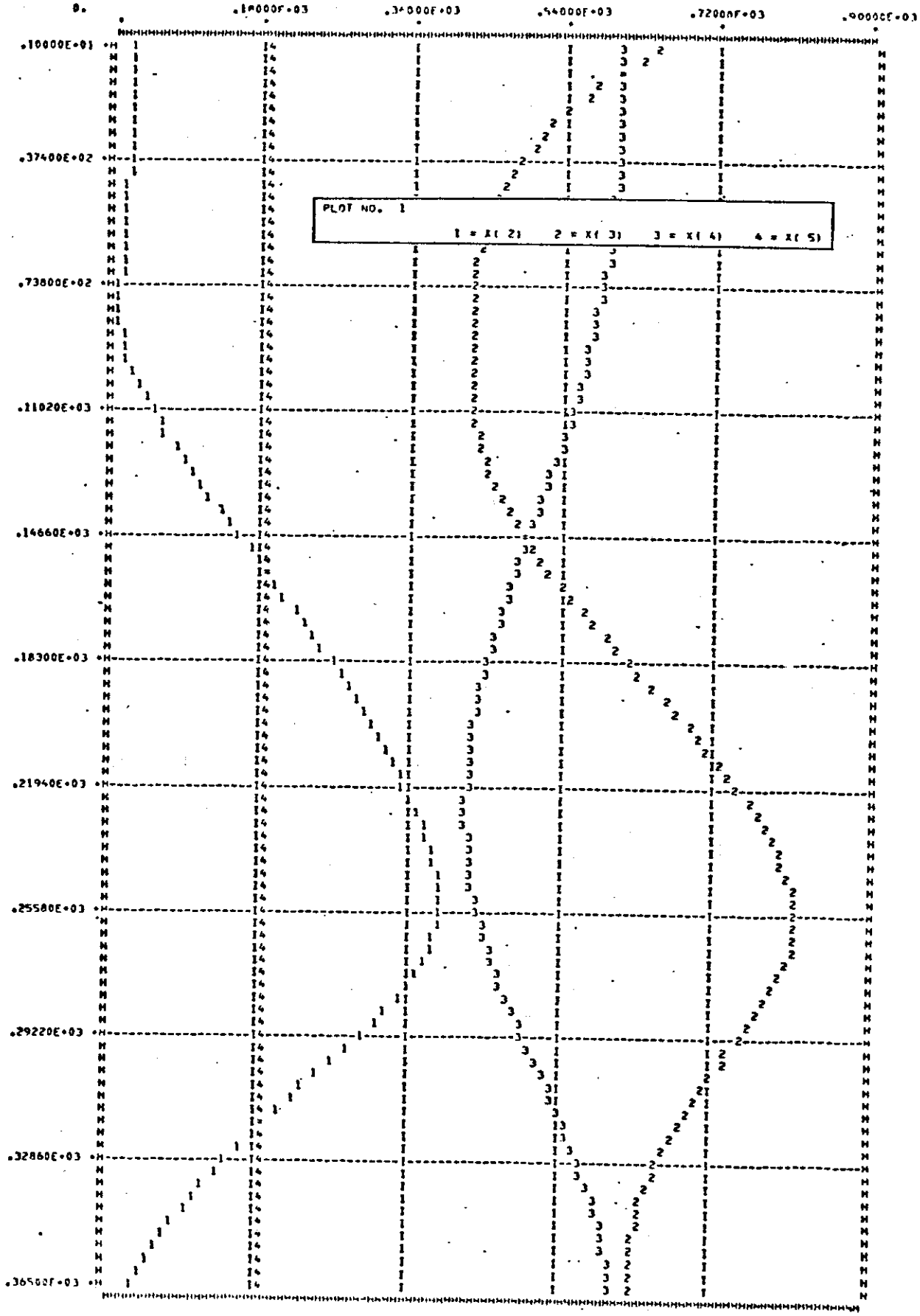
(Header information superimposed on the graphs normally appears above the graphs in the computer output, time runs down the page.)

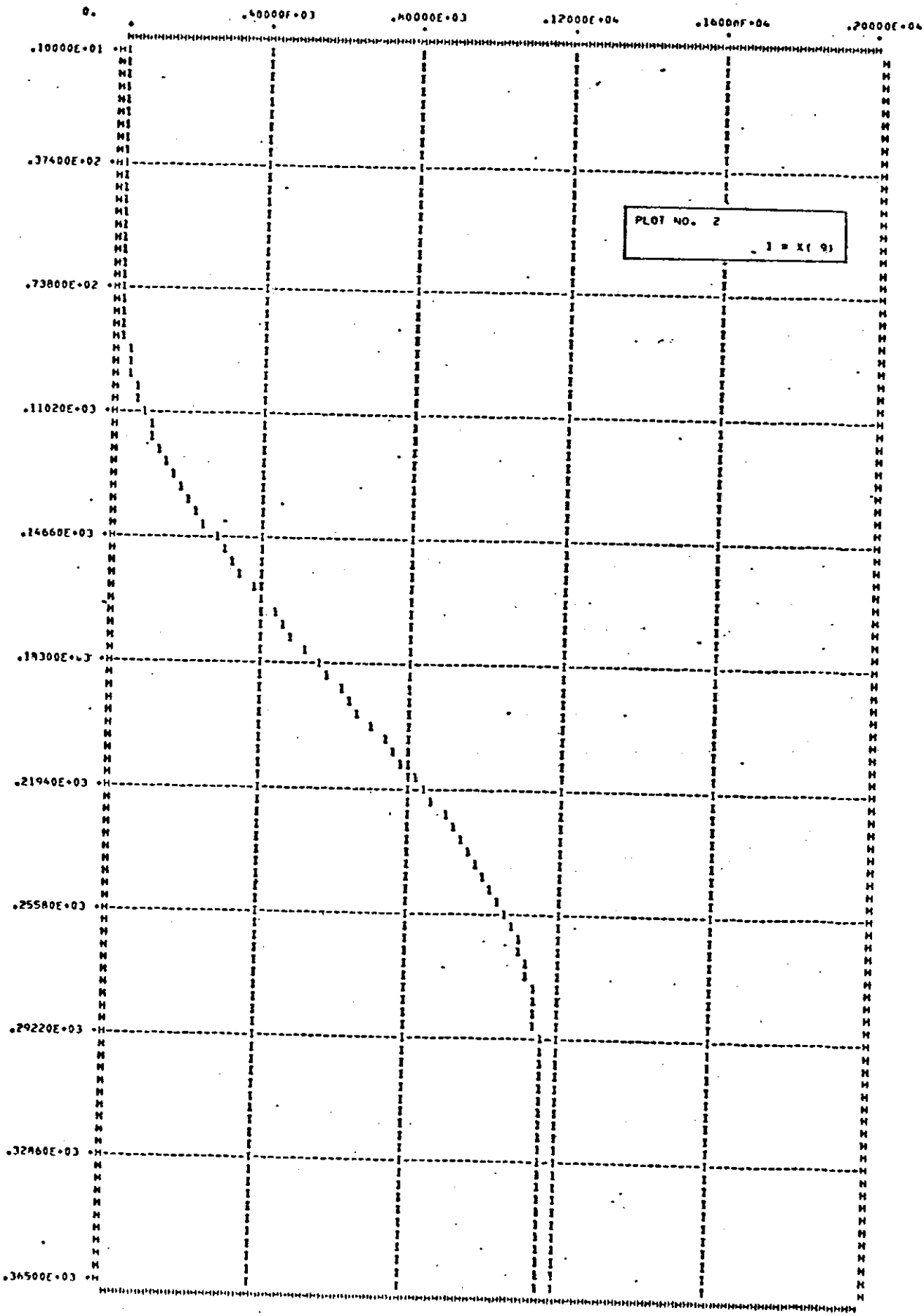
SIMCONP VERSION 2.1 SOURCE LISTING

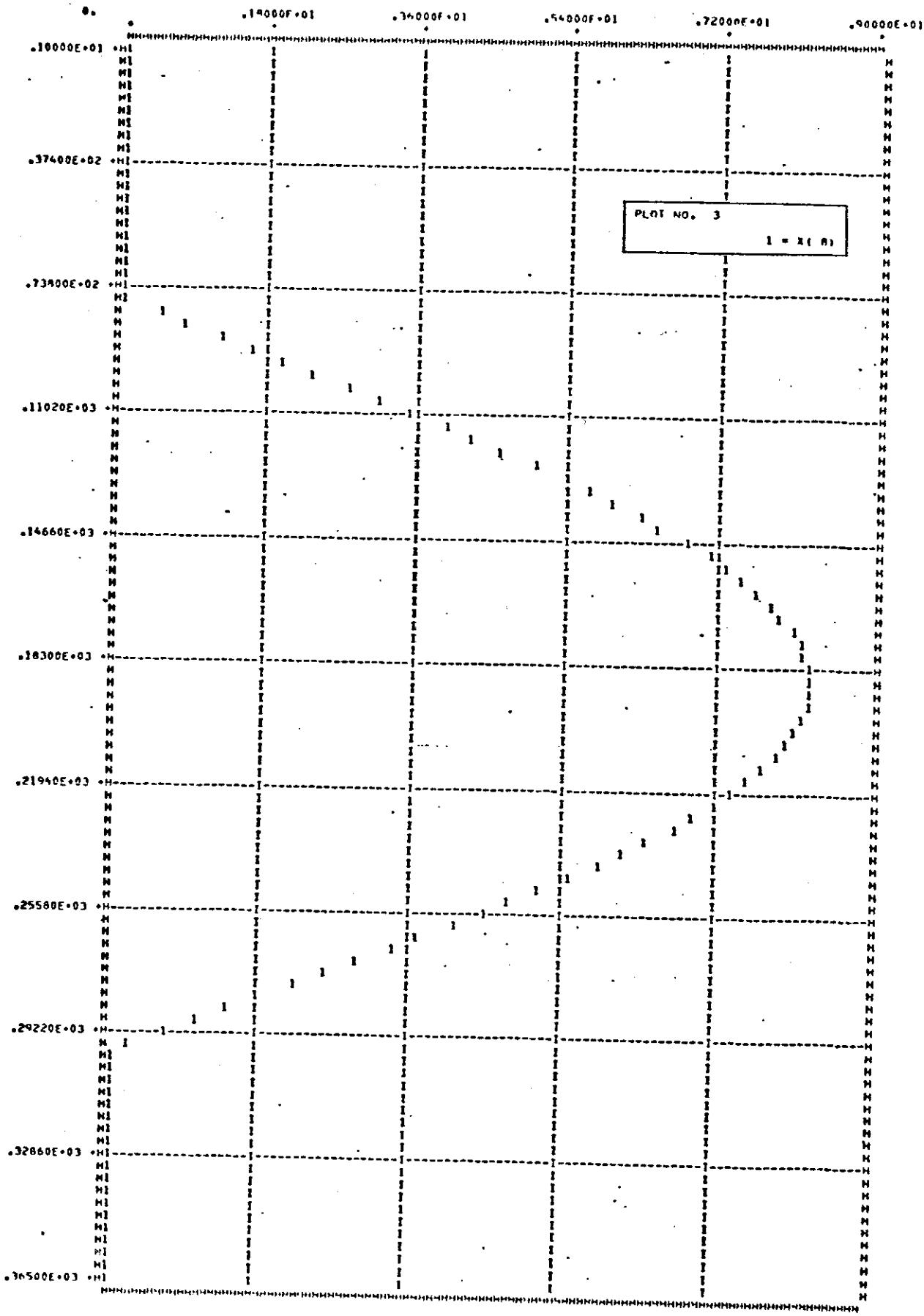
```
C...A SIMPLE HERBAGE DYNAMICS MODEL FOR AN ANDROPOGON VIRGINICUS GRASSLAND.
C     COMPARTMENT DEFINITIONS:
C        1    SOURCE PHOTOSYNTHETIC INPUT
C        2    LIVE VEGETATION TOPS
C        3    LIVE VEGETATION ROOTS
C        4    DEAD VEGETATION
C        5    MULCH
C        6    RESPIRATION SINK
C        7    ORGANIC MATTER IN SOIL
C        8    THE AMOUNT OF FLOW FROM X(1) TO X(2)
C        9    THE INTEGRATED FLOW FROM X(1) TO X(2)
C
*STORAGE
      COMMON/SPARS/PI,YEAR
      COMMON/FPARS/P12A,P12B,P12C,P12D,P23A,P23B,P23C,P23D,P24A,P24B,
     -             P26A,P36A,P36B,P36C,P36D,P45A,P45B,P56A,P56B,P56C
*FLOW
(1,2).
C...GROWTH OF LIVE PLANT TOPS.
      F=(P12A+P12B*COS(P12C+2.*PI*(TIME-1.)/YEAR))/P12D
      IF(F.LT.0.) F=0.
      X(8)=F
      X(9)=X(9)+F*DT
(2,4).
C...DEATH OF LIVE PLANT TOPS.
      F=P24A*EXP(TIME/P24B)
      F=F*X(2)
(4,5).
C...TRANSFER OF DEAD VEGETATION TO MULCH.
      F=P45A*(1.+SIN(2.*PI*(TIME-1.)/YEAR-P45B))
      F=F*X(4)
(5,7).
      F=0.
(3,7).
      F=0.
(2,3).
C...TRANSLOCATION OF ABOVE GROUND PLANTS TO ROOTS.
      F=0.
      IF(X(2).LT.20.) GO TO 5
      F=P23A+P23A*SIN(2.*PI*(TIME-1.)/YEAR-P23B)*P23C
      IF(F.LT.0.001) F=0.001
      F=F*X(2)*P23D
    5 CONTINUE
(2,6).
C...PLANT RESPIRATION.
      F=P26A
      F=F*X(6)
(4,6).
      F=0.
(5,6).
C...DECOMPOSITION OF MULCH.
      F=(P56A*(1.+SIN(2.*PI*(TIME-1.)/YEAR-P56B))*X(4)-P56C*X(5))/X(5)
      F=F*X(5)
(3,6).
C...ROOT RESPIRATION.
      TEMP=(P36A+P36B*SIN(2.*PI*(TIME-1.)/YEAR+P36C))
      IF(TIME.GT.290.) GO TO 10
      F=TEMP
      GO TO 15
   10 F=TEMP*(365.-TIME)/110.
   15 IF(F.LT.0.00036) F=0.00036
      F=F*P36D*X(3)
(2,5).
      F=0.
*ROUTINES
      SUBROUTINE START
      READ(1,100) PI,YEAR
      READ(1,100) P12A,P12B,P12C,P12D
      READ(1,100) P24A,P24B
      READ(1,100) P45A,P45B
      READ(1,100) P23A,P23B,P23C,P23D
      READ(1,100) P26A
      READ(1,100) P56A,P56B,P56C
      READ(1,100) P36A,P36B,P36C,P36D
      READ(1,100) (X(I),I=1,9)
      READ(1,100) TSTART,TEND,DT,DTPR,DTFL
  100 FORMAT(8F10.0)
      RETURN
      END
*END
```

```
SIMCOMP VERSION 2.1                INITIAL CONDITIONS

          NO. OF STATE VARIABLES..............  7
             REQUESTED FOR PRINT..............  9
             REQUESTED FOR PLOT...............  6

          NO. OF FLOWS........................  11


                TSTART..............  .10000E+01
                TEND................  .36500E+03
                DT..................  .10000E+01
                DTPR................  .10000E+02
                DTPL................  .36764E+01
                DTFL................  .10000E+02

X( 1) =   .10000E+03    X( 2) =   .20000E+02    X( 3) =   .65000E+03    X( 4) =   .60000E+03
X( 5) =   .18000E+03    X( 6) =  0.             X( 7) =  0.
```

```
SIMCOMP VERSION 2.1                    SIMULATION RESULTS

TIME =   .10000E+01
         X( 1) =   .10000E+03    X( 2) =   .20000E+02    X( 3) =   .65000E+03    X( 4) =   .60000E+03
         X( 5) =   .18000E+03    X( 6) =   0.            X( 7) =   0.            X( 8) =   0.
         X( 9) =   0.

  FLOWS     TIME =   .10000E+01   TO     .20000E+01
         ( 1, 2) =   0.
         ( 2, 3) =   .84000E-01

TIME =   .11000E+02
         X( 1) =   .10000E+03    X( 2) =   .19446E+02    X( 3) =   .58700E+03    X( 4) =   .60000E+03
         X( 5) =   .18000E+03    X( 6) =   .83550E+02    X( 7) =   0.            X( 8) =   0.
         X( 9) =   0.

  FLOWS     TIME =   .11000E+02   TO     .12000E+02
         ( 1, 2) =   0.
         ( 2, 3) =   0.

TIME =   .21000E+02
         X( 1) =   .10000E+03    X( 2) =   .18150E+02    X( 3) =   .53574E+03    X( 4) =   .59967E+03
         X( 5) =   .18000E+03    X( 6) =   .11644E+03    X( 7) =   0.            X( 8) =   0.
         X( 9) =   0.

  FLOWS     TIME =   .21000E+02   TO     .22000E+02
         ( 1, 2) =   0.
         ( 2, 3) =   0.

TIME =   .31000E+02
         X( 1) =   .10000E+03    X( 2) =   .16174E+02    X( 3) =   .49547E+03    X( 4) =   .59870E+03
         X( 5) =   .18000E+03    X( 6) =   .15966E+03    X( 7) =   0.            X( 8) =   0.
         X( 9) =   0.

  FLOWS     TIME =   .31000E+02   TO     .32000E+02
         ( 1, 2) =   0.
         ( 2, 3) =   0.

TIME =   .41000E+02
         X( 1) =   .10000E+03    X( 2) =   .13650E+02    X( 3) =   .46534E+03    X( 4) =   .59678E+03
         X( 5) =   .18000E+03    X( 6) =   .19424E+03    X( 7) =   0.            X( 8) =   0.
         X( 9) =   0.

  FLOWS     TIME =   .41000E+02   TO     .42000E+02
         ( 1, 2) =   0.
         ( 2, 3) =   0.

TIME =   .51000E+02
         X( 1) =   .10000E+03    X( 2) =   .10696E+02    X( 3) =   .44455E+03    X( 4) =   .59365E+03
         X( 5) =   .18000E+03    X( 6) =   .22110E+03    X( 7) =   0.            X( 8) =   0.
         X( 9) =   0.

  FLOWS     TIME =   .51000E+02   TO     .52000E+02
         ( 1, 2) =   0.
         ( 2, 3) =   0.

TIME =   .61000E+02
         X( 1) =   .10000E+03    X( 2) =   .74195E+01    X( 3) =   .43251E+03    X( 4) =   .58909E+03
         X( 5) =   .18000E+03    X( 6) =   .24097E+03    X( 7) =   0.            X( 8) =   0.
         X( 9) =   0.

  FLOWS     TIME =   .61000E+02   TO     .62000E+02
         ( 1, 2) =   0.
         ( 2, 3) =   0.
```


PLOT NO. 1
1 = X( 2)  2 = X( 3)  3 = X( 4)  4 = X( 5)


0.
.40000E+03
.80000E+03
.12000E+04
.16000E+04
.20000E+04
.10000E+01
.37400E+02
.73800E+02
.11020E+03
.14660E+03
.18300E+03
.21940E+03
.25580E+03
.29220E+03
.32860E+03
.36500E+03
PLOT NO. 2
1 = X( 9)


0.
.18000E+01
.36000E+01
.54000E+01
.72000E+01
.90000E+01
.10000E+01
.37400E+02
.73400E+02
.11020E+03
.14660E+03
.18300E+03
.21940E+03
.25580E+03
.29220E+03
.32860E+03
.36500E+03
PLOT NO. 3
1 = X( 8)

## 2. COMPILER AND SIMULATION PROGRAM OPERATION

The version 2.1 SIMCOMP system is a two-pass compiling system which generates a FORTRAN program that is in turn executed to produce the simulation output. The complete job sequence is diagrammed in Fig. 1 and is explained in the following steps.

1. The SIMCOMP 2.1 compiler (or pre-processor), written in FORTRAN, is compiled by the FORTRAN compiler.
2. The compiled SIMCOMP compiler is executed with the user's source section and auxiliary source statements (file SRCST) as input. The source listing, with diagnostics if errors occur, is printed on output. The generated FORTRAN simulation source program is produced on file SIMPRG.
3. File SIMPRG is compiled by the FORTRAN compiler.
4. The compiled simulation program is executed with the user's data section as input. Tabular and/or graphic simulation results are printed on output.

On most computer systems the first step may be performed only once with the compiled SIMCOMP compiler and the auxiliary source statements remaining resident to the system via disk or tape. The SIMCOMP system is then called in for execution directly.

Likewise, after a simulation has been developed and debugged, the compiled simulation program can be saved and reexecuted with different data sections. This is especially useful if the simulation is sufficiently parameterized to allow for versatile modification of the simulation by way of altering data values. This eliminates the need to perform steps 1 through 3 above.

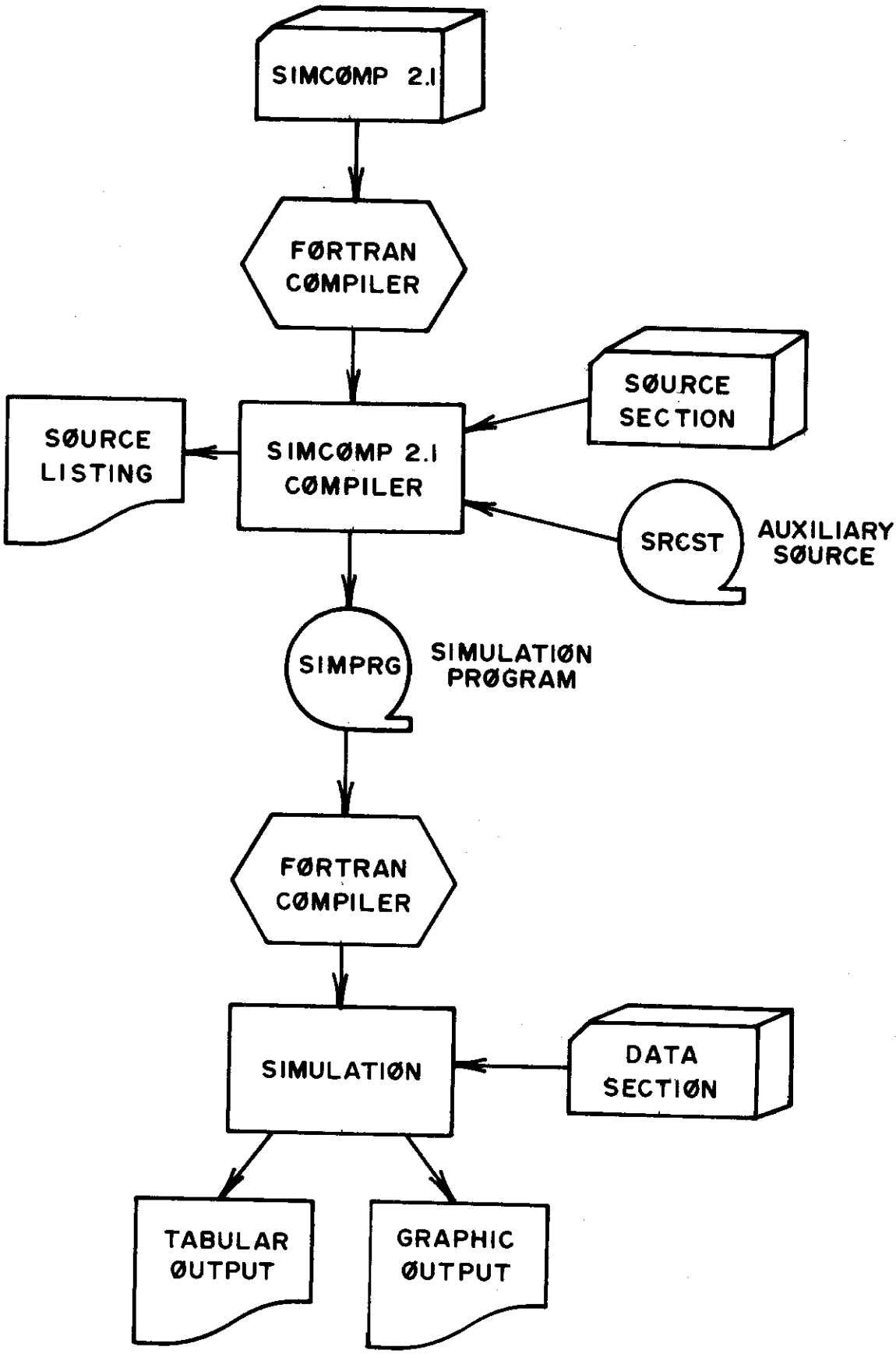



Fig. 1. Complete SIMCOMP 2.1 execution sequence.

The SIMCOMP system requires seven external files for compilation. These files include the standard input/output files and serve the following purposes:

| File Name | Purpose |
|---|---|
| INPUT | User source section input. |
| OUTPUT | Printed output file. |
| COMST | Temporary (or intermediate) storage of *STORAGE text. |
| FLOST | Temporary storage of *FLOW text. |
| TEXST | Temporary storage of *ROUTINES text. |
| SRCST | Auxiliary source statement input. |
| SIMPRG | Generated simulation program. |

The generated simulation program requires three external files for execution:

| File Name | Purpose |
|---|---|
| INPUT | Data section input. |
| OUTPUT | Printed output file. |
| PLTSV | Temporary file of generated simulation results used in plot generation. |

Time and core requirements will obviously vary for difficult machines. The central processor time requirement (seconds) and the number of central memory 60-bit words on a Control Data Corporation (CDC) 6400 computer used in each of the above four steps for the simulation described previously follow.

| Step No. | Time (sec) | Core (words, decimal) |
|---|---|---|
| 1 | 3.06 | 17,920 |
| 2 | 12.25 | 11,776 |
| 3 | 7.72 | 17,920 |
| 4 | 6.38 | 10,048 |
| TOTAL | 29.41 | 17,920 (maximum required) |

A rough estimation of the central processor time required for a CDC 6400 computer to perform a SIMCOMP compilation (step 2) is given by

$$t = 8.6 + 0.19 \cdot COM + 0.23 \cdot FLW + 0.57 \cdot SUB + 0.35 \cdot FUN$$

where

COM = number of statements in *STORAGE

FLW = number of flows

SUB = number of user-supplied subroutines

FUN = number of user-supplied functions

Although the above core requirements were stated for a 60-bit word length (10 characters internal representation per word) machine, the SIMCOMP compiler and simulation execution programs only require a machine with the capacity of four stored characters per FORTRAN-addressable word. This is, of course, ignoring subsequent loss in arithmetic precision.

## 2.1 Compiler Operation.

The primary features of execution of the SIMCOMP 2.1 compiler are presented in Fig. 2. Next, a complete listing of the compiler program is presented. The relevant code, variable definitions, and descriptions for each of the blocks shown in Fig. 2 are presented on pages 33 through 45. The procedure for generation of error messages is outlined on page 45.

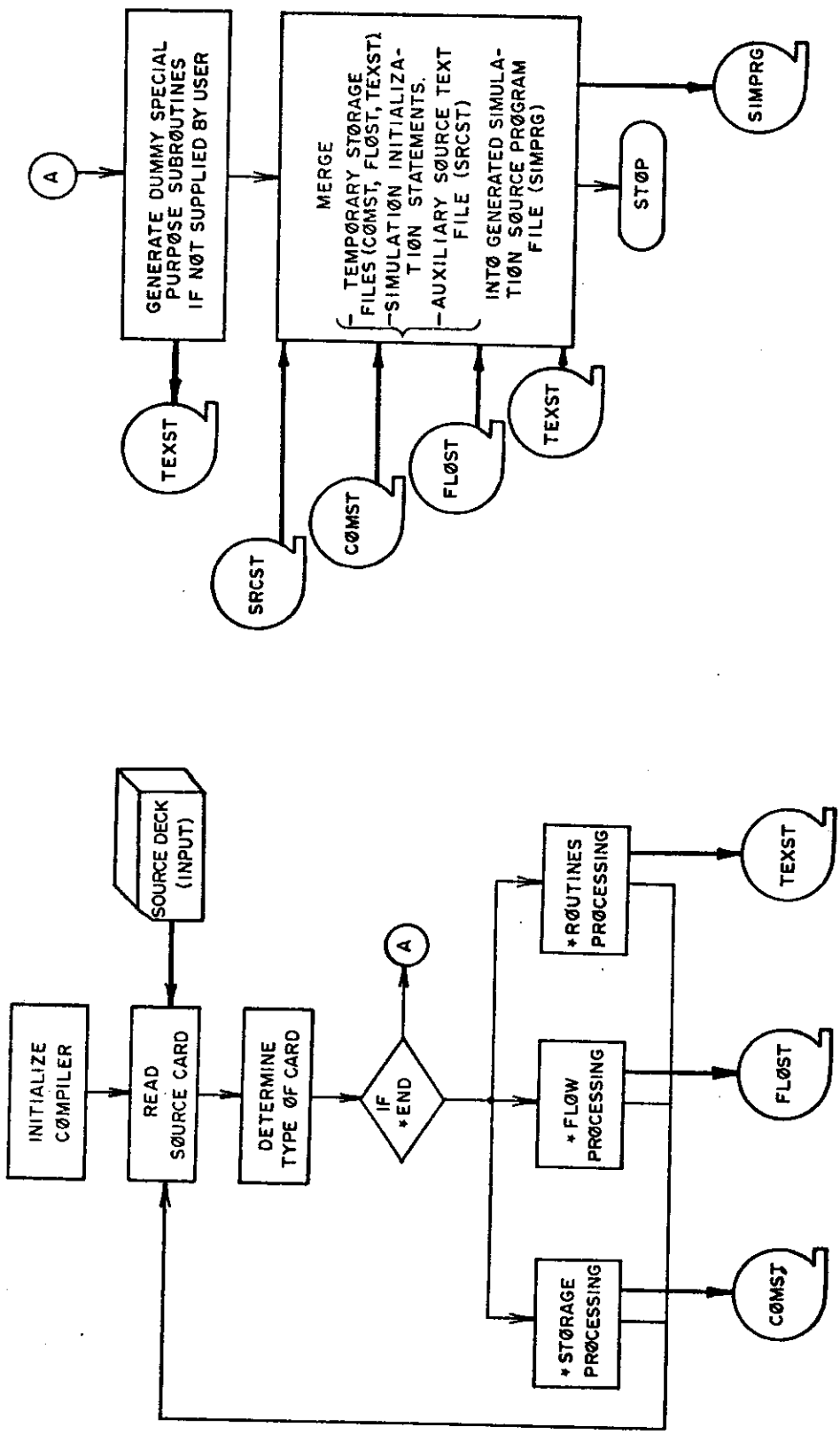



Fig. 2. Flow chart of the SIMCOMP 2.1 compiler.

*Listing of the compiler program.*

```
00001
00002            PROGRAM SCMP21(INPUT,OUTPUT,COMST,FLOST,TEXST,SRCST,SIMPRG,                SCMP21
00003           -     TAPE1=INPUT,                                                         SCMP21
00004           -     TAPE2=OUTPUT,                                                        SCMP21
00005           -     TAPE3=COMST,                                                         SCMP21
00006           -     TAPE4=FLOST,                                                         SCMP21
00007           -     TAPE5=TEXST,                                                         SCMP21
00008           -     TAPE6=SRCST,                                                         SCMP21
00009           -     TAPE7=SIMPRG)                                                        SCMP21
00010            DIMENSION KARD(80),KEY1(4),KEY2(12),KEY3(10),KEY4(5,3),KEY5(8),         SCMP21
00011           -   IFLW(300),IST(99),IVRB(10),ISUB(3),NUM(2)                            SCMP21
00012            INTEGER U1,U2,U3,U4,U5,U6,U7                                            SCMP21
00013            DATA KEY1/1HS,1HF,1HR,1HE/                                              SCMP21
00014            DATA KEY2/1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H.,1H)/              SCMP21
00015            DATA KEY3/1HS,1HU,1HB,1HP,1HO,1HU,1HT,1HI,1HN,1HE/                      SCMP21
00016            DATA KEY4/1HS,1HT,1HA,1HR,1HT,1HC,1HY,1HC,1HL,1HE,1HF,1HI,1HN,1HI,      SCMP21
00017           -   1HS/                                                                 SCMP21
00018            DATA KEY5/1HF,1HU,1HN,1HC,1HT,1HI,1HO,1HN/                              SCMP21
00019            DATA ICEEE/1HC/, ISTAR/1H*/, ILPAR/1H(/                                 SCMP21
00020      C.....S I M C O M P   V E R S I O N   2.1    -    APRIL 12, 1972               SCMP21
00021      C     FLOW-ORIENTED CONTINUOUS SYSTEM SIMULATION COMPILER. SHORTENED          SCMP21
00022      C     VERSION OF SIMCOMP VERSION 2.0 COMPILER.  WRITTEN IN ANSI (AMERICAN     SCMP21
00023      C     NATIONAL STANDARDS INSTITUTE) FORTRAN.                                  SCMP21
00024      C     (NOTE - THIS IS WITH THE EXCEPTION OF THE USE OF DATA STATEMENTS        SCMP21
00025      C     TO SET VALUES IN ARRAYS.)                                               SCMP21
00026      C           AUTHOR  -  JON D. GUSTAFSON                                       SCMP21
00027      C                      NATURAL RESOURCS ECOLOGY LABORATORY                    SCMP21
00028      C                      GRASSLANDS BIOME/U.S.I.B.P.                            SCMP21
00029      C                      COLORADO STATE UNIVERSITY                              SCMP21
00030      C                      FORT COLLINS, COLORADO                                 SCMP21
00031      C                                                                             SCMP21
00032      C...EXTERNAL LOGICAL UNIT ASSIGNMENTS.                                        SCMP21
00033      C     NO.  VARIABLE    NAME              PURPOSE                              SCMP21
00034      C      1       U1     INPUT       USER SOURCE CARD INPUT.                    SCMP21
00035      C      2       U2     OUTPUT      PRINTED OUTPUT FILE.                       SCMP21
00036      C      3       U3     COMST       TEMPORARY STORAGE OF COMMON STATEMENTS.    SCMP21
00037      C      4       U4     FLOST       TEMPORARY STORAGE OF FLOW TEXT.            SCMP21
00038      C      5       U5     TEXST       TEMPORARY USER-DEFINED SUBROUTINE AND      SCMP21
00039      C                                    FUNCTION ROUTINE STORAGE.                SCMP21
00040      C      6       U6     SRCST       SOURCE TEXT INPUT OF SIMULATION PROGRAM    SCMP21
00041      C                                    (PRIOR TO INCLUSION OF USER TEXT).       SCMP21
00042      C      7       U7     SIMPRG      COMPLETE COMPILER GENERATED SIMULATION     SCMP21
00043      C                                    PROGRAM - TO BE COMPILED AND EXECUTED.   SCMP21
00044      C                                                                             SCMP21
00045      C     NOTE - ANY OF THE ABOVE LOGICAL UNIT NO.S MAY BE ALTERED BY             SCMP21
00046      C           ALTERING THE FOLLOWING DATA ASSIGNMENTS.                          SCMP21
00047            DATA U1/1/, U2/2/, U3/3/, U4/4/, U5/5/, U6/6/, U7/7/                    SCMP21
00048      C                                                                             SCMP21
00049      C                                                                             SCMP21
00050      C...COMPILER INITIALIZATIONS.                                                 SCMP21
00051            WRITE(U2,302)                                                           SCMP21
00052            WRITE(U3,316)                                                           SCMP21
00053            KODE=1                                                                  SCMP21
00054            NFLW=0                                                                  SCMP21
00055            NST=0                                                                   SCMP21
00056            NU3=3                                                                   SCMP21
00057            NU4=0                                                                   SCMP21
00058            NU5=0                                                                   SCMP21
00059            ISUB(1)=0                                                               SCMP21
00060            ISUB(2)=0                                                               SCMP21
00061            ISUB(3)=0                                                               SCMP21
00062      C                                                                             SCMP21
00063      C                                                                             SCMP21
00064      C...READ THE SOURCE SECTION, CHECK FOR MAJOR BLOCK SUBDIVIDERS AND            SCMP21
00065      C     COMMENT STATEMENTS.                                                     SCMP21
           20 CONTINUE                                                                  SCMP21
                                                                                        SCMP21
```

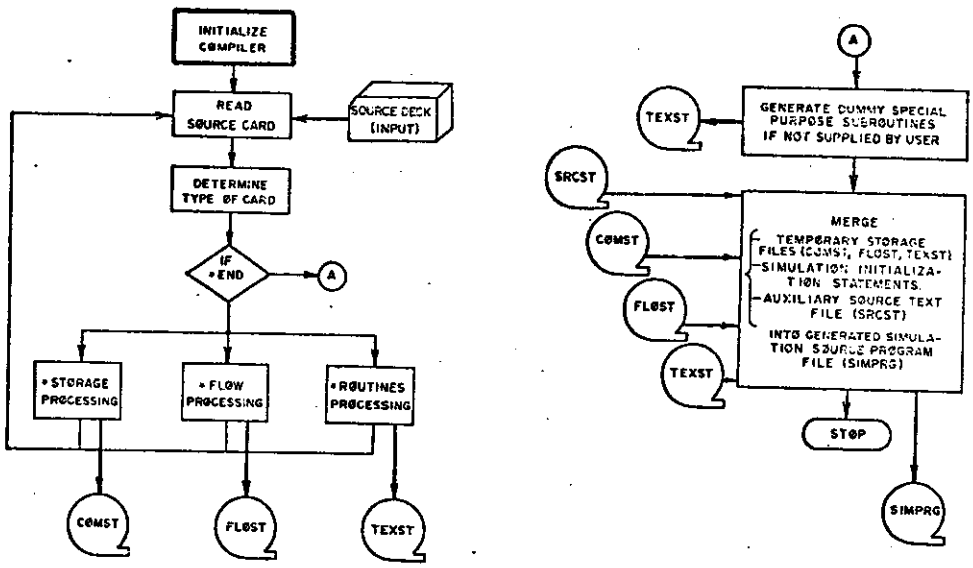
```
00066          READ(U1,300) (KARD(I),I=1,80)                                  SCMP21
00067          WRITE(U2,301) (KARD(I),I=1,80)                                 SCMP21
00068    C...COMMENT CHECK (C IN COLUMN 1).                                   SCMP21
00069          IF(KARD(1).EQ.ICEFF) GO TO 20                                  SCMP21
00070    C...MAJOR BLOCK SUBDIVIDER CHECK (* IN COLUMN 1).                    SCMP21
00071          IF(KARD(1).NE.ISTAR) GO TO 35                                  SCMP21
00072    C...CHECK COLUMN 2.                                                  SCMP21
00073    C         COL 2       INTERPRETATION     LODE                      SCMP21
00074    C           S            *STORAGE          2                       SCMP21
00075    C           F            *FLOW             3                       SCMP21
00076    C           R            *ROUTINES         4                       SCMP21
00077    C           E            *END              5                       SCMP21
00078          DO 25 I=1,4                                                    SCMP21
00079          IF(KARD(2).EQ.KEY1(I)) GO TO 30                                SCMP21
00080       25 CONTINUE                                                       SCMP21
00081          GO TO 400                                                      SCMP21
00082       30 LODE=I+1                                                       SCMP21
00083          IF(LODE.LE.KODE) GO TO 400                                     SCMP21
00084          IF(KODE.NE.3) GO TO 33                                         SCMP21
00085          NU4=NU4+1                                                      SCMP21
00086          WRITE(U4,303)                                                  SCMP21
00087       33 IF(LODE.EQ.5) GO TO 165                                        SCMP21
00088          KODE=LODE                                                      SCMP21
00089          GO TO 20                                                       SCMP21
00090    C                                                                    SCMP21
00091    C                                                                    SCMP21
00092    C...CURRENT SOURCE CARD IS NOT A BLOCK DIVIDER, BRANCH TO THE APPROPRI- SCMP21
00093    C     ATE BLOCK PROCESSOR.                                           SCMP21
00094       35 GO TO(400,40,45,120), KODE                                     SCMP21
00095    C                                                                    SCMP21
00096    C                                                                    SCMP21
00097    C...*STORAGE BLOCK PROCESSING.                                       SCMP21
00098       40 NU3=NU3+1                                                      SCMP21
00099          WRITE(U3,300) (KARD(I),I=1,80)                                 SCMP21
00100          GO TO 20                                                       SCMP21
00101    C                                                                    SCMP21
00102    C                                                                    SCMP21
00103    C...*FLOW BLOCK PROCESSING.                                          SCMP21
00104       45 IF(KARD(1).EQ.ILPAR) GO TO 50                                  SCMP21
00105          NU4=NU4+1                                                      SCMP21
00106          WRITE(U4,300) (KARD(I),I=1,80)                                 SCMP21
00107          GO TO 20                                                       SCMP21
00108    C...GENERATE FLOW TERMINATION STATEMENT IF REQUIRED.                 SCMP21
00109       50 IF(NFLW.LE.0) GO TO 53                                         SCMP21
00110          NU4=NU4+1                                                      SCMP21
00111          WRITE(U4,303)                                                  SCMP21
00112       53 CONTINUE                                                       SCMP21
00113    C...FLOW DECLARATION ENCOUNTERED, RETRIEVE FLOW INDICES.             SCMP21
00114          ICOL=1                                                         SCMP21
00115          NUM(1)=0                                                       SCMP21
00116          NUM(2)=0                                                       SCMP21
00117          K=1                                                            SCMP21
00118       55 ICOL=ICOL+1                                                    SCMP21
00119          IF(ICOL.GT.20) GO TO 401                                       SCMP21
00120          DO 60 I=1,12                                                   SCMP21
00121          IF(KARD(ICOL).EQ.KEY2(I)) GO TO 65                             SCMP21
00122       60 CONTINUE                                                       SCMP21
00123          GO TO 402                                                      SCMP21
00124       65 IF(I.GT.10) GO TO 70                                           SCMP21
00125          J=I-1                                                          SCMP21
00126          NUM(K)=NUM(K)*10+J                                             SCMP21
00127          GO TO 55                                                       SCMP21
00128       70 IF(I.GT.11) GO TO 75                                           SCMP21
00129          K=2                                                            SCMP21
00130          GO TO 55                                                       SCMP21
00131    C...CHECK FOR INDICES OUT OF RANGE.                                  SCMP21
```

```
00132          75 DO 80 I=1,2                                                  SCMP21
00133             IF(NUM(I).LE.0.OR.NUM(I).GT.99) GO TO 403                    SCMP21
00134          80 CONTINUE                                                     SCMP21
00135       C...INSERT FLOW INDICES IN FLOW REFERENCE STACK.                   SCMP21
00136             INDX=NUM(1)*100+NUM(2)                                       SCMP21
00137             IF(NFLW.LE.0) GO TO 90                                       SCMP21
00138             DO 85 I=1,NFLW                                               SCMP21
00139             IF(INDX.EQ.IFLW(I)) GO TO 404                                SCMP21
00140          85 CONTINUE                                                     SCMP21
00141          90 NFLW=NFLW+1                                                  SCMP21
00142             IFLW(NFLW)=INDX                                              SCMP21
00143       C...INSERT STATE VARIABLE INDICES IN STATE VARIABLE STACK.         SCMP21
00144             DO 105 I=1,2                                                 SCMP21
00145             N=NUM(I)                                                     SCMP21
00146             IF(NST.LE.0) GO TO 100                                       SCMP21
00147             DO 95 J=1,NST                                                SCMP21
00148             IF(N.EQ.IST(J)) GO TO 105                                    SCMP21
00149          95 CONTINUE                                                     SCMP21
00150         100 NST=NST+1                                                    SCMP21
00151             IST(NST)=N                                                   SCMP21
00152         105 CONTINUE                                                     SCMP21
00153       C...GENERATE FLOW PREFACE STATEMENTS.                              SCMP21
00154             NU4=NU4+2                                                    SCMP21
00155             WRITE(U4,304)                                                SCMP21
00156             GO TO 20                                                     SCMP21
00157       C                                                                  SCMP21
00158       C                                                                  SCMP21
00159       C...*ROUTINES BLOCK PROCESSING, CHECK FOR SUBROUTINE STATEMENT.    SCMP21
00160         120 IFLG=0                                                       SCMP21
00161             CALL GETVRB(KARD,7,10,IFIN,IVRB)                             SCMP21
00162             IF(IFIN.GT.72) GO TO 155                                     SCMP21
00163             DO 125 I=1,10                                                SCMP21
00164             IF(IVRB(I).NE.KEY3(I)) GO TO 145                             SCMP21
00165         125 CONTINUE                                                     SCMP21
00166             IFLG=1                                                       SCMP21
00167       C...DETERMINE IF SUBROUTINE IS START, CYCLE, OR FINIS.             SCMP21
00168             CALL GETVRB(KARD,IFIN+5,IF,IVRB)                             SCMP21
00169             DO 140 I=1,3                                                 SCMP21
00170             DO 130 J=1,5                                                 SCMP21
00171             IF(IVRB(J).NE.KEY4(J,I)) GO TO 140                           SCMP21
00172         130 CONTINUE                                                     SCMP21
00173             ISUB(I)=1                                                    SCMP21
00174             GO TO 155                                                    SCMP21
00175         140 CONTINUE                                                     SCMP21
00176             GO TO 155                                                    SCMP21
00177       C...CHECK FOR FUNCTION STATEMENT.                                  SCMP21
00178         145 DO 150 I=1,8                                                 SCMP21
00179             IF(IVRB(I).NE.KEY5(I)) GO TO 155                             SCMP21
00180         150 CONTINUE                                                     SCMP21
00181             IFLG=1                                                       SCMP21
00182       C...SAVE CURRENT SOURCE INPUT CARD ON THE ROUTINE TEXT FILE.       SCMP21
00183         155 NU5=NU5+1                                                    SCMP21
00184             WRITE(U5,300) (KARD(I),I=1,80)                               SCMP21
00185             IF(IFLG.LE.0) GO TO 20                                       SCMP21
00186             REWIND U3                                                    SCMP21
00187             KNT=0                                                        SCMP21
00188         160 KNT=KNT+1                                                    SCMP21
00189             IF(KNT.GT.NU3) GO TO 20                                      SCMP21
00190             READ(U3,300) (KARD(I),I=1,80)                                SCMP21
00191             NU5=NU5+1                                                    SCMP21
00192             WRITE(U5,300) (KARD(I),I=1,80)                               SCMP21
00193             GO TO 160                                                    SCMP21
00194       C                                                                  SCMP21
00195       C                                                                  SCMP21
00196       C...END OF SOURCE ENCOUNTERED.                                     SCMP21
00197       C...GENERATE SPECIAL PURPOSE DUMMY ROUTINES IF NOT SUPPLIED BY USER. SCMP21
```

```
00198          165 DO 175 I=1,3                                                SCMP21
00199              IF(ISUB(I).GE.1) GO TO 175                                  SCMP21
00200              NU5=NU5+3                                                   SCMP21
00201              WRITE(U5,305) (KEY4(J,I),J=1,5)                             SCMP21
00202          175 CONTINUE                                                    SCMP21
00203        C...MERGE FILES INTO SIMULATION PROGRAM FILE.                     SCMP21
00204          180 READ(U6,300) (KARD(I),I=1,80)                               SCMP21
00205              IF(KARD(1).EQ.ISTAR) GO TO 185                              SCMP21
00206              WRITE(U7,300) (KARD(I),I=1,80)                              SCMP21
00207              GO TO 180                                                   SCMP21
00208        C...GENERATE COMPILER-DIRECTED INITIALIZATIONS.                   SCMP21
00209          185 IF(NFLW.LE.0) GO TO 405                                     SCMP21
00210              WRITE(U7,306) NFLW                                          SCMP21
00211              DO 190 I=1,NFLW                                             SCMP21
00212          190 WRITE(U7,307) I,IFLW(I)                                     SCMP21
00213              NST1=NST-1                                                  SCMP21
00214              DO 193 I=1,NST1                                             SCMP21
00215              IJ=I+1                                                      SCMP21
00216              DO 193 J=IJ,NST                                             SCMP21
00217              IF(IST(I).LE.IST(J)) GO TO 193                              SCMP21
00218              KEEP=IST(I)                                                 SCMP21
00219              IST(I)=IST(J)                                               SCMP21
00220              IST(J)=KEEP                                                 SCMP21
00221          193 CONTINUE                                                    SCMP21
00222              WRITE(U7,308) NST                                           SCMP21
00223              DO 195 I=1,NST                                              SCMP21
00224          195 WRITE(U7,309) I,IST(I)                                      SCMP21
00225          200 READ(U6,300) (KARD(I),I=1,80)                               SCMP21
00226              IF(KARD(1).EQ.ISTAR) GO TO 205                              SCMP21
00227              WRITE(U7,300) (KARD(I),I=1,80)                              SCMP21
00228              GO TO 200                                                   SCMP21
00229        C...INSERT COMMON STORAGE IN FLOW COMPUTATION ROUTINE.            SCMP21
00230          205 KNT=0                                                       SCMP21
00231              REWIND U3                                                   SCMP21
00232          210 KNT=KNT+1                                                   SCMP21
00233              IF(KNT.GT.NU3) GO TO 215                                    SCMP21
00234              READ(U3,300) (KARD(I),I=1,80)                               SCMP21
00235              WRITE(U7,300) (KARD(I),I=1,80)                              SCMP21
00236              GO TO 210                                                   SCMP21
00237          215 READ(U6,300) (KARD(I),I=1,80)                               SCMP21
00238              IF(KARD(1).EQ.ISTAR) GO TO 220                              SCMP21
00239              WRITE(U7,300) (KARD(I),I=1,80)                              SCMP21
00240              GO TO 215                                                   SCMP21
00241        C...INSERT FLOW COMPUTATION CODE.                                 SCMP21
00242          220 KNT=0                                                       SCMP21
00243              REWIND U4                                                   SCMP21
00244          225 KNT=KNT+1                                                   SCMP21
00245              IF(KNT.GT.NU4) GO TO 230                                    SCMP21
00246              READ(U4,300) (KARD(I),I=1,80)                               SCMP21
00247              WRITE(U7,300) (KARD(I),I=1,80)                              SCMP21
00248              GO TO 225                                                   SCMP21
00249          230 READ(U6,300) (KARD(I),I=1,80)                               SCMP21
00250              IF(KARD(1).EQ.ISTAR) GO TO 235                              SCMP21
00251              WRITE(U7,300) (KARD(I),I=1,80)                              SCMP21
00252              GO TO 230                                                   SCMP21
00253        C...INSERT USER DEFINED ROUTINES.                                 SCMP21
00254          235 KNT=0                                                       SCMP21
00255              REWIND U5                                                   SCMP21
00256          240 KNT=KNT+1                                                   SCMP21
00257              IF(KNT.GT.NU5) GO TO 245                                    SCMP21
00258              READ(U5,300) (KARD(I),I=1,80)                               SCMP21
00259              WRITE(U7,300) (KARD(I),I=1,80)                              SCMP21
00260              GO TO 240                                                   SCMP21
00261          245 CONTINUE                                                    SCMP21
00262              REWIND U7                                                   SCMP21
00263              STOP                                                        SCMP21
```

```
00264          C
00265          C                                                                SCMP21
00266          C...IF ERROR OCCURED GENERATE DIAGNOSTIC.                        SCMP21
00267            400 WRITE(U2,310)                                              SCMP21
00268                CALL ESCAPE                                                SCMP21
00269            401 WRITE(U2,311)                                              SCMP21
00270                CALL ESCAPE                                                SCMP21
00271            402 WRITE(U2,312) KARD(ICOL),ICOL                              SCMP21
00272                CALL ESCAPE                                                SCMP21
00273            403 WRITE(U2,313)                                              SCMP21
00274                CALL ESCAPE                                                SCMP21
00275            404 WRITE(U2,314)                                              SCMP21
00276                CALL ESCAPE                                                SCMP21
00277            405 WRITE(U2,315)                                              SCMP21
00278                CALL ESCAPE                                                SCMP21
00279            300 FORMAT(80A1)                                               SCMP21
00280            301 FORMAT(20X,80A1)                                           SCMP21
00281            302 FORMAT(20H1SIMCOMP VERSION 2.1,20X,14HSOURCE LISTING,///)  SCMP21
00282            303 FORMAT(6X,8HXF(XN)=F,66X)                                  SCMP21
00283            304 FORMAT(6X,7HXN=XN+1,67X/6X,4HF=0.,70X)                     SCMP21
00284            305 FORMAT(6X,11HSUBROUTINE ,5A1,58X/6X,6HRETURN,68X/6X,3HEND,71X)  SCMP21
00285            306 FORMAT(6X,9HDATA XNF/,I3,1H/,61X)                          SCMP21
00286            307 FORMAT(6X,9HDATA XFR(,I3,2H)/,I4,1H/,55X)                  SCMP21
00287            308 FORMAT(6X,10HDATA XNST/,I2,1H/,61X)                        SCMP21
00288            309 FORMAT(6X,9HDATA XST(,I2,2H)/,I2,1H/,68X)                  SCMP21
00289            310 FORMAT(15X,32H*****BLOCK DIVISION VERB ILLEGAL)            SCMP21
00290            311 FORMAT(15X,32H*****FLOW DECLARATION INCOMPLETE)            SCMP21
00291            312 FORMAT(15X,15H*****CHARACTER(,A1,25H) ILLEGAL IN CARD COLUMN ,I2)  SCMP21
00292            313 FORMAT(15X,30H*****FLOW INDICES OUT OF RANGE)              SCMP21
00293            314 FORMAT(15X,33H*****THIS FLOW PREVIOUSLY DEFINED)           SCMP21
00294            315 FORMAT(15X,31H*****NO FLOWS HAVE BEEN DEFINED)             SCMP21
00295            316 FORMAT(6X,65HCOMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),  SCMP21
00296              -XNF,XF(300),,9X/5X,58H-    XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,  SCMP21
00297              -XPL(99),XNPLT,,17X/5X,25H-    XNVRS(20),XNLOC(20,5),50X)  SCMP21
00298                END                                                        SCMP21
00299                SUBROUTINE GETVRB(KARD,ISRT,NCOL,IFIN,IVRB)                SCMP21
00300                DIMENSION KARD(80),IVRB(10)                                SCMP21
00301                DATA IBLNK/1H /                                            SCMP21
00302          C...THIS ROUTINE RETRIEVES THE FIRST NCOL NON-BLANK CHARACTERS STARTING  SCMP21
00303          C     IN COLUMN ISRT FROM KARD AND STORES THEM LEFT JUSTIFIED IN IVRB,  SCMP21
00304          C     RETURNING THE LOCATION OF THE FINAL COLUMN OF KARD IN IFIN.  SCMP21
00305                ICOL=ISRT-1                                                SCMP21
00306                DO 10 I=1,10                                               SCMP21
00307            10  IVRB(I)=IBLNK                                             SCMP21
00308                JCOL=0                                                     SCMP21
00309            15  ICOL=ICOL+1                                               SCMP21
00310                IF(ICOL.GT.72) GO TO 20                                    SCMP21
00311                IF(KARD(ICOL).EQ.IBLNK) GO TO 15                           SCMP21
00312                JCOL=JCOL+1                                                SCMP21
00313                IVRB(JCOL)=KARD(ICOL)                                      SCMP21
00314                IF(JCOL.GE.NCOL) GO TO 25                                  SCMP21
00315                GO TO 15                                                   SCMP21
00316            20  IFIN=ICOL                                                 SCMP21
00317                RETURN                                                     SCMP21
00318            25  IFIN=ICOL+1                                               SCMP21
00319                RETURN                                                     SCMP21
00320                END                                                        SCMP21
00321                SUBROUTINE ESCAPE                                          SCMP21
00322          C...THIS ROUTINE IS USED TO ABORT ABNORMALLY THE COMPILATION.  AN EXIT  SCMP21
00323          C     FROM EXECUTION WHICH PREVENTS THE JOB FROM FURTHER PROCESSING (I.E.  SCMP21
00324          C     PREVENTS SUBSEQUENT COMPILATION AND EXECUTION OF FILE SIMPRG BY  SCMP21
00325          C     FORTRAN) SHOULD BE INCLUDED HERE.                          SCMP21
00326                CALL ABORT                                                 SCMP21
00327                END                                                        SCMP21
                                                                               SCMP21
```

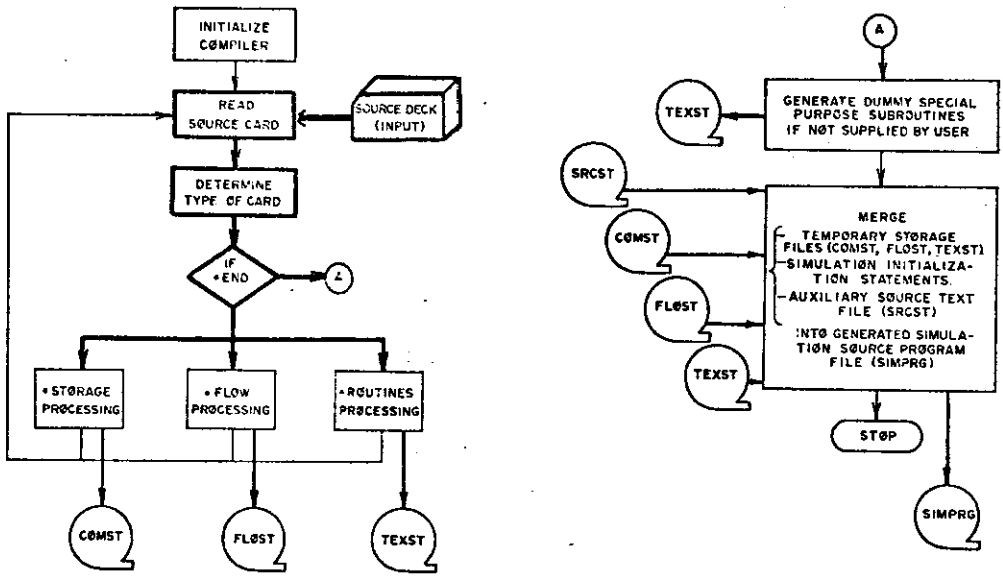
*Compiler initializations.*




```
00048          C
00049          C...COMPILER INITIALIZATIONS.                                        SCMP21
00050                WRITE(U2,302)                                                  SCMP21
00051                WRITE(U3,316)                                                  SCMP21
00052                KODE=1                                                         SCMP21
00053                NFLW=0                                                         SCMP21
00054                NST=0                                                          SCMP21
00055                NU3=3                                                          SCMP21
00056                NU4=0                                                          SCMP21
00057                NU5=0                                                          SCMP21
00058                ISUB(1)=0                                                      SCMP21
00059                ISUB(2)=0                                                      SCMP21
00060                ISUB(3)=0                                                      SCMP21
                                                                                    |
00281           302 FORMAT(20HISIMCOMP VERSION 2.1,20X,14HSOURCE LISTING,///)       SCMP21
                                                                                    |
00295           316 FORMAT(6X,65HCOMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),  SCMP21
00296              -XNF,XF(300),,9X/5X,58H-    XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,  SCMP21
00297              -XPL(99),XNPLT,,17X/5X,25H-    XNVRS(20),XNLOC(20,5),50X)        SCMP21
```

| Line Number | Comment |
|---|---|
| 50 | Listing header is written on ØUTPUT. |
| 52 | The system-supplied common block /XSYS/ containing the simulation control parameters, state variables, and flow, print, and plot system variables is written on file CØMST. |
| 53 to 54 | Number of flows (NFLW) and number of state variables (NST) initialized to zero. |
| 55 to 57 | Number of unit records (cards) written (NU3, NU4, NU5) on the temporary storage files initialized. |
| 58 to 60 | Flags used to signal if special purpose subroutines (ISUB(1) for START, ISUB(2) for CYCLE, and ISUB(3) for FINIS) have been supplied by the user and are initialized to zero (1 = user-supplied, 0 = not supplied). |

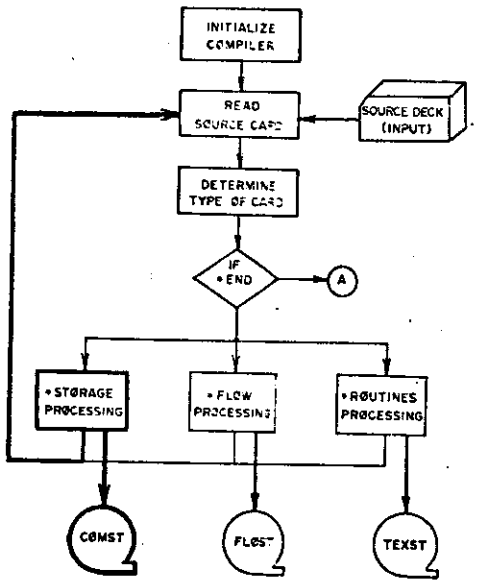
*Source card input and type checking.*

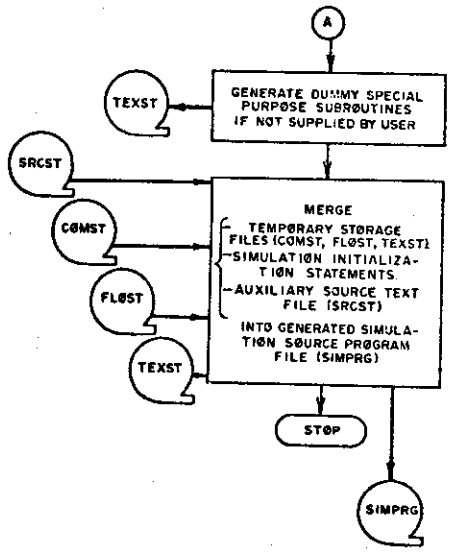



```
00012          DATA KEY1/1HS,1HF,1HR,1HE/                                    SCMP21
00018          DATA ICEEE/1HC/, ISTAR/1H*/, ILPAR/1H(/                       SCMP21
               :                                                              |
00061          C                                                             SCMP21
00062          C                                                             SCMP21
00063          C...READ THE SOURCE SECTION, CHECK FOR MAJOR BLOCK SUBDIVIDERS AND SCMP21
00064          C     COMMENT STATEMENTS.                                      SCMP21
00065             20 CONTINUE                                                 SCMP21
00066                READ(U1,300) (KARD(I),I=1,80)                            SCMP21
00067                WRITE(U2,301) (KARD(I),I=1,80)                           SCMP21
00068          C...COMMENT CHECK (C IN COLUMN 1).                             SCMP21
00069                IF(KARD(1).EQ.ICEEE) GO TO 20                            SCMP21
00070          C...MAJOR BLOCK SUBDIVIDER CHECK (* IN COLUMN 1).              SCMP21
00071                IF(KARD(1).NE.ISTAR) GO TO 35                            SCMP21
00072          C...CHECK COLUMN 2.                                            SCMP21
00073          C          COL 2       INTERPRETATION     KODE               SCMP21
00074          C            S             *STORAGE         2                 SCMP21
00075          C            F             *FLOW            3                 SCMP21
00076          C            R             *ROUTINES        4                 SCMP21
00077          C            E             *END             5                 SCMP21
00078                DO 25 I=1,4                                              SCMP21
00079                IF(KARD(2).EQ.KEY1(I)) GO TO 30                          SCMP21
00080             25 CONTINUE                                                 SCMP21
00081                GO TO 400                                                SCMP21
00082             30 KODE=I+1                                                 SCMP21
00083                IF(KODE.LE.KODE) GO TO 400                               SCMP21
00084                IF(KODE.NE.3) GO TO 33                                   SCMP21
00085                NU4=NU4+1                                                SCMP21
00086                WRITE(U4,303)                                            SCMP21
00087             33 IF(KODE.EQ.5) GO TO 165                                  SCMP21
00088                KODE=KODE                                                SCMP21
00089                GO TO 20                                                 SCMP21
00090          C                                                             SCMP21
00091          C                                                             SCMP21
00092          C...CURRENT SOURCE CARD IS NOT A BLOCK DIVIDER, BRANCH TO THE APPROPRI- SCMP21
00093          C     ATE BLOCK PROCESSOR.                                     SCMP21
00094             35 GO TO(400,40,45,120), KODE                               SCMP21
               |                                                              |
               :                                                              |
00279             300 FORMAT(80A1)                                            SCMP21
00280             301 FORMAT(20X,80A1)                                        SCMP21
00282             303 FORMAT(6X,PHXF(XN)=F,66X)                               SCMP21
```

| Line Number | Comment |
|---|---|
| 66 to 67 | Source card is read in (variable KARD(1-80)), with one character per word, left-justified with blank fill, and printed on ØUTPUT. |
| 69 | If column 1 contains a "C" the card is assumed to be a comment; branch is taken to statement 20, and the next card is read in. |
| 71 | Check is made for an asterisk in column 1. If no asterisk, the card is assumed not to be a major block subdivider. |
| 78 to 81 | Source card is assumed to be a major block subdivider, column 2 is checked for a match with S, F, R, or E. Source card produces a diagnostic if no match is found by branching to statement 400 (see page 45). |
| 82 to 83 | LØDE = branch code (line 94) for currently scanned source card.<br>KØDE = branch code for previously encountered major block subdivision. Major blocks must appear in the order *STORAGE, *FLOW, *ROUTINE, and *END. |
| 84 to 86 | If previous block was *FLOW, then the last flow stored on file FLØST requires a flow termination statement (see page 38). |
| 87 to 89 | If an *END card was encountered, branch to merge files (page 43). The current block branch code (KØDE) is reset and a branch is taken to read the next card. |
| 94 | If the source card was not a major block subdivider, then a branch to the appropriate block processor is made according to the value of KØDE. |

**STORAGE processing.*

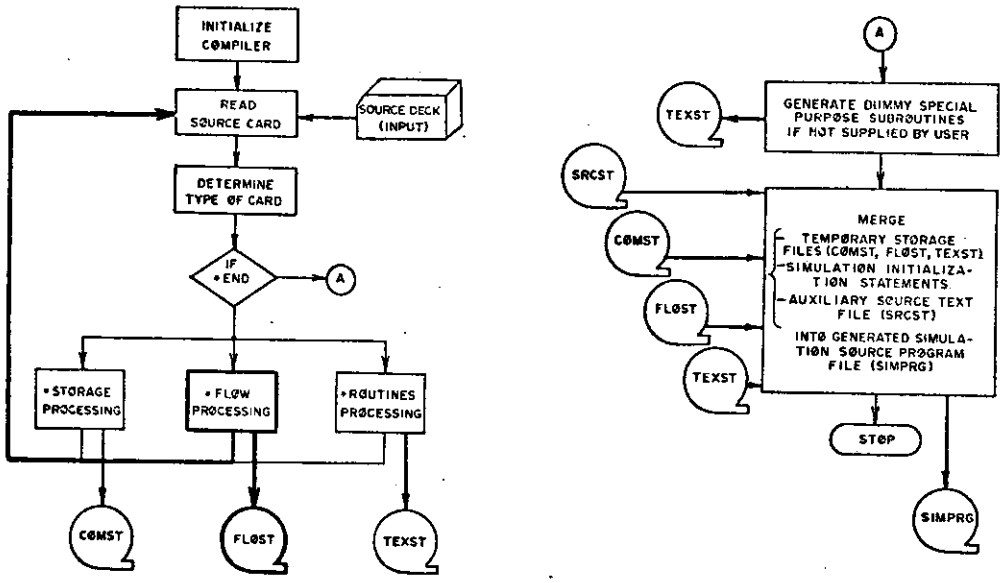



```
00095          C                                                              SCMP21
00096          C                                                              SCMP21
00097          C...*STORAGE BLOCK PROCESSING.                                 SCMP21
00098             40 NU3=NU3+1                                                SCMP21
00099                WRITE(U3,300) (KARD(I),I=1,80)                           SCMP21
00100                GO TO 20                                                 SCMP21
```

| Line Number | Comment |
|---|---|
| 98 to 100 | The current source card is contained in the *STORAGE block. The number of records written (variable NU3) on the temporary storage file for *STORAGE cards (file COMST) is incremented. The source card is written directly to COMST. A branch is taken to read in the next source card. |

**FLOW processing.*

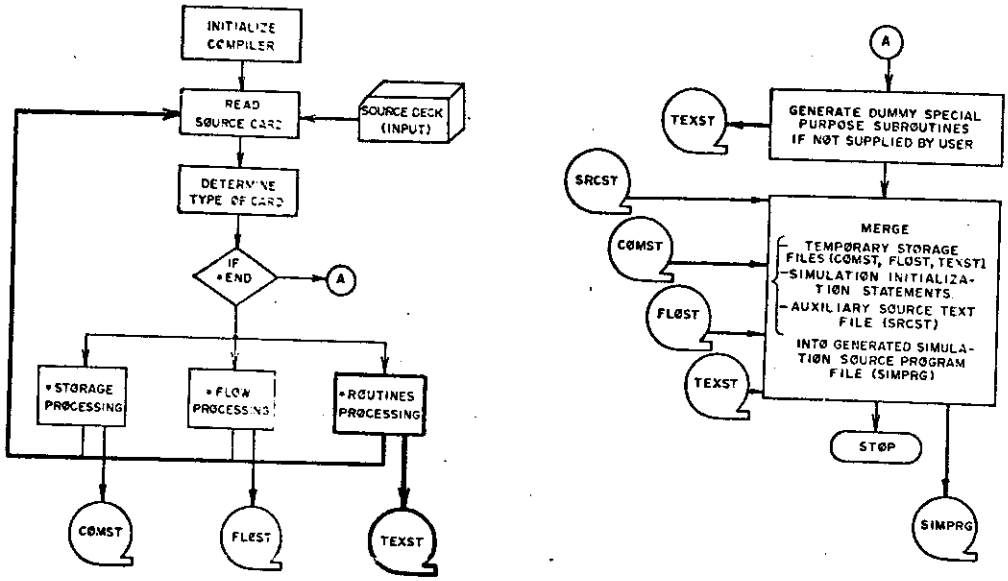



```
00013          DATA KEY2/1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H.,1H)/      SCMP21
00018          DATA ICEEE/1HC/, ISTAR/1H*/, ILPAR/1H(/                          SCMP21
                                                                                SCMP21
                                                                                SCMP21
00101       C                                                                   SCMP21
00102       C                                                                   SCMP21
00103       C...*FLOW BLOCK PROCESSING.                                         SCMP21
00104          45 IF(KARD(1).EQ.ILPAR) GO TO 50                                 SCMP21
00105             NU4=NU4+1                                                     SCMP21
00106             WRITE(U4,300) (KARD(I),I=1,80)                                SCMP21
00107             GO TO 20                                                      SCMP21
00108       C...GENERATE FLOW TERMINATION STATEMENT IF REQUIRED.                SCMP21
00109          50 IF(NFLW.LE.0) GO TO 53                                        SCMP21
00110             NU4=NU4+1                                                     SCMP21
00111             WRITE(U4,303)                                                 SCMP21
00112          53 CONTINUE                                                      SCMP21
00113       C...FLOW DECLARATION ENCOUNTERED. RETRIEVE FLOW INDICES.            SCMP21
00114             ICOL=1                                                        SCMP21
00115             NUM(1)=0                                                      SCMP21
00116             NUM(2)=0                                                      SCMP21
00117             K=1                                                           SCMP21
00118          55 ICOL=ICOL+1                                                   SCMP21
00119             IF(ICOL.GT.20) GO TO 401                                      SCMP21
00120             DO 60 I=1,12                                                  SCMP21
00121             IF(KARD(ICOL).EQ.KEY2(I)) GO TO 65                            SCMP21
00122          60 CONTINUE                                                      SCMP21
00123             GO TO 402                                                     SCMP21
00124          65 IF(I.GT.10) GO TO 70                                          SCMP21
00125             J=I-1                                                         SCMP21
00126             NUM(K)=NUM(K)*10+J                                            SCMP21
00127             GO TO 55                                                      SCMP21
00128          70 IF(I.GT.11) GO TO 75                                          SCMP21
00129             K=2                                                           SCMP21
00130             GO TO 55                                                      SCMP21
00131       C...CHECK FOR INDICES OUT OF RANGE.                                 SCMP21
```

```
00132            75 DO 80 I=1,2
00133               IF(NUM(I).LE.0.OR.NUM(I).GT.99) GO TO 403                    SCMP21
00134            80 CONTINUE                                                     SCMP21
00135          C...INSERT FLOW INDICES IN FLOW REFERENCE STACK.                  SCMP21
00136               INDX=NUM(1)*100+NUM(2)                                       SCMP21
00137               IF(NFLW.LE.0) GO TO 90                                       SCMP21
00138               DO 85 I=1,NFLW                                               SCMP21
00139               IF(INDX.EQ.IFLW(I)) GO TO 404                                SCMP21
00140            85 CONTINUE                                                     SCMP21
00141            90 NFLW=NFLW+1                                                  SCMP21
00142               IFLW(NFLW)=INDX                                              SCMP21
00143          C...INSERT STATE VARIABLE INDICES IN STATE VARIABLE STACK.        SCMP21
00144               DO 105 I=1,2                                                 SCMP21
00145               N=NUM(I)                                                     SCMP21
00146               IF(NST.LE.0) GO TO 100                                       SCMP21
00147               DO 95 J=1,NST                                                SCMP21
00148               IF(N.EQ.IST(J)) GO TO 105                                    SCMP21
00149            95 CONTINUE                                                     SCMP21
00150           100 NST=NST+1                                                    SCMP21
00151               IST(NST)=N                                                   SCMP21
00152           105 CONTINUE                                                     SCMP21
00153          C...GENERATE FLOW PREFACE STATEMENTS.                             SCMP21
00154               NU4=NU4+2                                                    SCMP21
00155               WRITE(U4,304)                                                SCMP21
00156               GO TO 20                                                     SCMP21
                                                                                SCMP21
```

| Line Number | Comment |
|---|---|
| 104 to 107 | If the first character is not a left parenthesis, the current source card is assumed to be user's flow text and is written onto file FLØST. A branch is made to read the next source card. |
| 109 to 112 | The current source card is assumed to be a flow declaration. If flows have previously been encountered, a flow termination statement is written on file FLØST. |
| 114 to 134 | The flow declaration is parsed, checking for illegal characters. The source compartment index and destination compartment index are stored in NUM(1) and NUM(2), respectively. Branches to 4XX labels produce diagnostics (see page 45). |
| 136 to 142 | The flow indices are stored in the flow stack (variable IFLW (1-300)), one flow per entry, as the sum of the source compartment index times 100 and the destination compartment index. A particular flow may not be declared more than once. NFLW is the current number of flows in the stack. |
| 144 to 152 | The compartment indices are inserted into the state variable stack (variable IST(1-99)). Replicated state variable indices are not reentered. NST is the number of indices in the stack. |
| 154 to 156 | The flow preface statement is written onto file FLØST. A branch is taken to read the next source card. The code supplied by the user in a single flow declaration is prefaced (format no. 304) and terminated (format no. 303) by system-supplied FORTRAN statements, which serves to enter the values of the flows into a flow value stack for integration. |

**ROUTINES processing.*

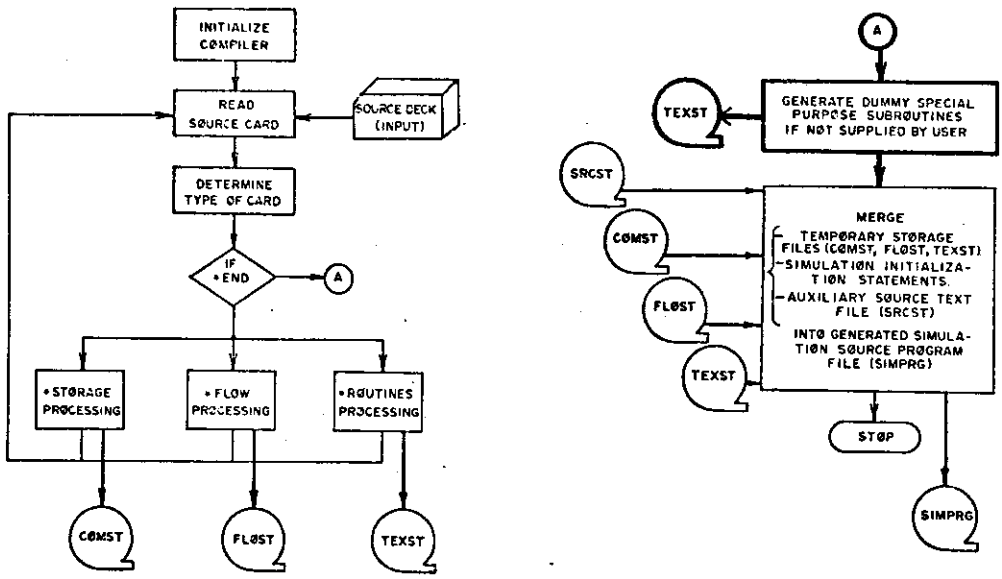



```
00014            DATA KEY3/1HS,1HU,1HB,1HR,1HO,1HU,1HT,1HI,1HN,1HE/                    SCMP21
00015            DATA KEY4/1HS,1HT,1HA,1HR,1HT,1HC,1HY,1HC,1HL,1HE,1HF,1HI,1HN,1HI,    SCMP21
00016           -   1HS/                                                               SCMP21
00017            DATA KEY5/1HF,1HU,1HN,1HC,1HT,1HI,1HO,1HN/                            SCMP21
                                                                                       SCMP21
00157       C
00158       C
00159       C...*ROUTINES BLOCK PROCESSING, CHECK FOR SUBROUTINE STATEMENT.            SCMP21
00160         12) IFLG=0                                                               SCMP21
00161             CALL GETVRB(KARD,7,10,IFIN,IVRB)                                     SCMP21
00162             IF(IFIN.GT.72) GO TO 155                                             SCMP21
00163             DO 125 I=1,10                                                        SCMP21
00164             IF(IVRB(I).NE.KEY3(I)) GO TO 145                                     SCMP21
00165           125 CONTINUE                                                           SCMP21
00166             IFLG=1                                                               SCMP21
00167       C...DETERMINE IF SUBROUTINE IS START, CYCLE, OR FINIS.                     SCMP21
00168             CALL GETVRB(KARD,IFIN,5,IF,IVRB)                                     SCMP21
00169             DO 140 I=1,3                                                         SCMP21
00170             DO 130 J=1,5                                                         SCMP21
00171             IF(IVRB(J).NE.KEY4(J,I)) GO TO 140                                   SCMP21
00172           130 CONTINUE                                                           SCMP21
00173             ISUB(I)=1                                                            SCMP21
00174             GO TO 155                                                            SCMP21
00175           140 CONTINUE                                                           SCMP21
00176             GO TO 155                                                            SCMP21
00177       C...CHECK FOR FUNCTION STATEMENT.                                          SCMP21
00178           145 DO 150 I=1,8                                                       SCMP21
00179             IF(IVRB(I).NE.KEY5(I)) GO TO 155                                     SCMP21
00180           150 CONTINUE                                                           SCMP21
00181             IFLG=1                                                               SCMP21
00182       C...SAVE CURRENT SOURCE INPUT CARD ON THE ROUTINE TEXT FILE.               SCMP21
00183           155 NU5=NU5+1                                                          SCMP21
00184             WRITE(U5,300) (KARD(I),I=1,80)                                       SCMP21
00185             IF(IFLG.LE.0) GO TO 20                                               SCMP21
00186             REWIND U3                                                            SCMP21
00187             KNT=0                                                                SCMP21
00188           160 KNT=KNT+1                                                          SCMP21
00189             IF(KNT.GT.NU3) GO TO 20                                              SCMP21
00190             READ(U3,300) (KARD(I),I=1,80)                                        SCMP21
00191             NU5=NU5+1                                                            SCMP21
00192             WRITE(U5,300) (KARD(I),I=1,80)                                       SCMP21
00193             GO TO 160                                                            SCMP21
```

```
00299                SUBROUTINE GETVRB(KARD,ISRT,NCOL,IFIN,IVRB)                    SCMP21
00300                DIMENSION KARD(80),IVRB(10)                                    SCMP21
00301                DATA IBLNK/1H /                                                SCMP21
00302          C...THIS ROUTINE RETRIEVES THE FIRST NCOL NON-BLANK CHARACTERS STARTING SCMP21
00303          C     IN COLUMN ISRT FROM KARD AND STORES THEM LEFT JUSTIFIED IN IVRB, SCMP21
00304          C     RETURNING THE LOCATION OF THE FINAL COLUMN OF KARD IN IFIN.      SCMP21
00305                ICOL=ISRT-1                                                    SCMP21
00306                DO 10 I=1,10                                                   SCMP21
00307             10 IVRB(I)=IBLNK                                                  SCMP21
00308                JCOL=0                                                         SCMP21
00309             15 ICOL=ICOL+1                                                    SCMP21
00310                IF(ICOL.GT.72) GO TO 20                                        SCMP21
00311                IF(KARD(ICOL).EQ.IBLNK) GO TO 15                               SCMP21
00312                JCOL=JCOL+1                                                    SCMP21
00313                IVRB(JCOL)=KARD(ICOL)                                          SCMP21
00314                IF(JCOL.GE.NCOL) GO TO 25                                      SCMP21
00315                GO TO 15                                                       SCMP21
00316             20 IFIN=ICOL                                                      SCMP21
00317                RETURN                                                         SCMP21
00318             25 IFIN=ICOL+1                                                    SCMP21
00319                RETURN                                                         SCMP21
00320                END                                                            SCMP21
```

| Line Number | Comment |
|---|---|
| 160 to 166 | The first 10 non-blank characters starting in column 7 are checked for a match with the characters SUBROUTINE. Variable IFLG is set to 1 if a match is found. |
| 169 to 176 | The next five non-blank characters after the characters SUBROUTINE are checked for a match with a special purpose subroutine name. If a match is found, the flag variable ISUB(I) is set to 1, where I=1 for START, I=2 for CYCLE, and I=3 for FINIS. A branch is made to statement 155. |
| 178 to 181 | If a match was not found with SUBROUTINE, a check is made for a match with the characters FUNCTION. Variable IFLG is set to 1 if a match is found. |
| 183 to 193 | The current source card is saved on the user-supplied routine text file TEXST. If the variable IFLG is non-zero, the contents of the *STORAGE block file CØMST is copied onto the routine text file TEXST immediately following the SUBROUTINE or FUNCTION statement. A branch is taken to read in the next source card. |
| 299 to 320 | Subroutine GETVRB retrieves the first NCØL non-blank characters from array KARD starting in column (word) ISRT and stores them one character per word in array IVRB. IFIN is set to the column (word) immediately following the last retrieved character, or 73 if NCØL non-blank characters were not found. |

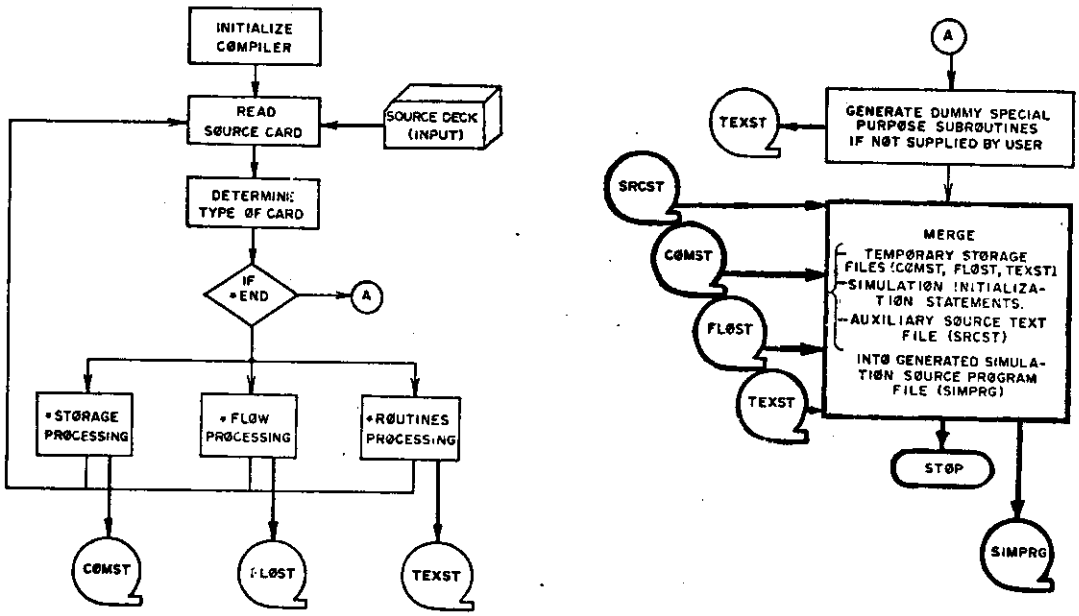
*Generation of subroutines not supplied by the user.*




```
00015              DATA KEY4/1HS,1HT,1HA,1HR,1HT,1HC,1HY,1HC,1HL,1HE,1HF,1HI,1HN,1HI,  SCMP21
00016             -   1HS/                                                             SCMP21
                                                                                       SCMP21
00194        C                                                                         SCMP21
00195        C                                                                         SCMP21
00196        C...END OF SOURCE ENCOUNTERED.                                            SCMP21
00197        C...GENERATE SPECIAL PURPOSE DUMMY ROUTINES IF NOT SUPPLIED BY USER.      SCMP21
00198          165 DO 175 I=1,3                                                        SCMP21
00199              IF(ISUB(I).GE.1) GO TO 175                                          SCMP21
00200              NUS=NUS+3                                                           SCMP21
00201              WRITE(US,305) (KEY4(J,I),J=1,5)                                     SCMP21
00202          175 CONTINUE                                                            SCMP21
                                                                                       SCMP21
00284          305 FORMAT(6X,11HSURROUTINE ,5A1,58X/6X,6HRETURN,68X/6X,3HEND,71X)      SCMP21
```

| Line Number | Comment |
|---|---|
| 198 to 202 | Any of the special purpose subroutines not supplied by the user are supplied by the system. For each such routine flagged by variable ISUB(I), a dummy routine containing only a RETURN statement is generated on file TEXST. |

*Merging of files into simulation program file.*




```
00203          C...MERGE FILES INTO SIMULATION PROGRAM FILE.                    SCMP21
00204            180 READ(U6,300) (KARD(I),I=1,80)                              SCMP21
00205                IF(KARD(1).EQ.ISTAR) GO TO 185                             SCMP21
00206                WRITE(U7,300) (KARD(I),I=1,80)                             SCMP21
00207                GO TO 180                                                  SCMP21
00208          C...GENERATE COMPILER-DIRECTED INITIALIZATIONS.                   SCMP21
00209            185 IF(NFLW.LE.0) GO TO 405                                    SCMP21
00210                WRITE(U7,306) NFLW                                         SCMP21
00211                DO 190 I=1,NFLW                                            SCMP21
00212            190 WRITE(U7,307) I,IFLW(I)                                    SCMP21
00213                NST1=NST-1                                                 SCMP21
00214                DO 193 I=1,NST1                                            SCMP21
00215                IJ=I+1                                                     SCMP21
00216                DO 193 J=IJ,NST                                            SCMP21
00217                IF(IST(I).LE.IST(J)) GO TO 193                             SCMP21
00218                KEEP=IST(I)                                                SCMP21
00219                IST(I)=IST(J)                                              SCMP21
00220                IST(J)=KEEP                                                SCMP21
00221            193 CONTINUE                                                   SCMP21
00222                WRITE(U7,308) NST                                          SCMP21
00223                DO 195 I=1,NST                                             SCMP21
00224            195 WRITE(U7,309) I,IST(I)                                     SCMP21
00225            200 READ(U6,300) (KARD(I),I=1,80)                              SCMP21
00226                IF(KARD(1).EQ.ISTAR) GO TO 205                             SCMP21
00227                WRITE(U7,300) (KARD(I),I=1,80)                             SCMP21
00228                GO TO 200                                                  SCMP21
00229          C...INSERT COMMON STORAGE IN FLOW COMPUTATION ROUTINE.           SCMP21
00230            205 KNT=0                                                      SCMP21
00231                REWIND U3                                                  SCMP21
00232            210 KNT=KNT+1                                                  SCMP21
00233                IF(KNT.GT.NU3) GO TO 215                                   SCMP21
00234                READ(U3,300) (KARD(I),I=1,80)                              SCMP21
00235                WRITE(U7,300) (KARD(I),I=1,80)                             SCMP21
00236                GO TO 210                                                  SCMP21
00237            215 READ(U6,300) (KARD(I),I=1,80)                              SCMP21
00238                IF(KARD(1).EQ.ISTAR) GO TO 220                             SCMP21
00239                WRITE(U7,300) (KARD(I),I=1,80)                             SCMP21
00240                GO TO 215                                                  SCMP21
```

```
00241          C...INSERT FLOW COMPUTATION CODE.
00242            220 KNT=0                                                  SCMP21
00243                REWIND U4                                              SCMP21
00244             225 KNT=KNT+1                                             SCMP21
00245                IF(KNT.GT.NU4) GO TO 230                               SCMP21
00246                READ(U4,300) (KARD(I),I=1,80)                          SCMP21
00247                WRITE(U7,300) (KARD(I),I=1,80)                         SCMP21
00248                GO TO 225                                              SCMP21
00249             230 READ(U6,300) (KARD(I),I=1,80)                         SCMP21
00250                IF(KARD(1).EQ.ISTAR) GO TO 235                         SCMP21
00251                WRITE(U7,300) (KARD(I),I=1,80)                         SCMP21
00252                GO TO 230                                              SCMP21
00253          C...INSERT USER DEFINED ROUTINES.                            SCMP21
00254            235 KNT=0                                                  SCMP21
00255                REWIND U5                                              SCMP21
00256             240 KNT=KNT+1                                             SCMP21
00257                IF(KNT.GT.NU5) GO TO 245                               SCMP21
00258                READ(U5,300) (KARD(I),I=1,80)                          SCMP21
00259                WRITE(U7,300) (KARD(I),I=1,80)                         SCMP21
00260                GO TO 240                                              SCMP21
00261             245 CONTINUE                                              SCMP21
00262                REWIND U7                                              SCMP21
00263                STOP                                                   SCMP21
                                                                            SCMP21

00285             306 FORMAT(6X,9HDATA XNF/,I3,1H/,61X)
00286             307 FORMAT(6X,9HDATA XFP(,I3,2H)/,I4,1H/,55X)            SCMP21
00287             308 FORMAT(6X,10HDATA XNST/,I2,1H/,61X)                  SCMP21
00288             309 FORMAT(6X,9HDATA XST(,I2,2H)/,I2,1H/,68X)            SCMP21
                                                                            SCMP21
```

| Line Number | Comment |
|---|---|
| 204 to 207<br>225 to 228<br>237 to 240<br>249 to 252 | Auxiliary source text file (SRCST) is copied to the generated simulation program file (SIMPRG) until a card is encountered on SRCST containing as asterisk in column 1. |
| 209 to 224 | Data statements which initialize system control variables in the generated program are written onto file SIMPRG. |
| 230 to 236 | Statements on file CØMST are copied to file SIMPRG. |
| 242 to 248 | Statements on file FLØST are copied to file SIMPRG. |
| 254 to 263 | Statements on file TEXST are copied to file SIMPRG. File SIMPRG is rewound and the compiler stops execution. |

*Error diagnostic generation.*

```
00264          C
00265          C                                                              SCMP21
00266          C...IF ERROR.OCCURED GENERATE DIAGNOSTIC.                      SCMP21
00267            400 WRITE(U2,310)                                            SCMP21
00268                CALL ESCAPE                                              SCMP21
00269            401 WRITE(U2,311)                                            SCMP21
00270                CALL ESCAPE                                              SCMP21
00271            402 WRITE(U2,312) KARD(ICOL),ICOL                            SCMP21
00272                CALL ESCAPE                                              SCMP21
00273            403 WRITE(U2,313)                                            SCMP21
00274                CALL ESCAPE                                              SCMP21
00275            404 WRITE(U2,314)                                            SCMP21
00276                CALL ESCAPE                                              SCMP21
00277            405 WRITE(U2,315)                                            SCMP21
00278                CALL ESCAPE                                              SCMP21
                                                                              SCMP21
00289            310 FORMAT(15X,32H*****BLOCK DIVISION VERB ILLEGAL)          SCMP21
00290            311 FORMAT(15X,32H*****FLOW DECLARATION INCOMPLETE)          SCMP21
00291            312 FORMAT(15X,15H*****CHARACTER(,A1,25H) ILLEGAL IN CARD COLUMN ,I2) SCMP21
00292            313 FORMAT(15X,30H*****FLOW INDICES OUT OF RANGE)            SCMP21
00293            314 FORMAT(15X,33H*****THIS FLOW PREVIOUSLY DEFINED)        SCMP21
00294            315 FORMAT(15X,31H*****NO FLOWS HAVE BEEN DEFINED)           SCMP21
                                                                              SCMP21
00321                SUBROUTINE ESCAPE                                        SCMP21
00322          C...THIS ROUTINE IS USED TO ABORT ABNORMALLY THE COMPILATION.  AN EXIT SCMP21
00323          C    FROM EXECUTION WHICH PREVENTS THE JOB FROM FURTHER PROCESSING (I.E. SCMP21
00324          C    PREVENTS SUBSEQUENT COMPILATION AND EXECUTION OF FILE SIMPRG BY SCMP21
00325          C    FORTRAN) SHOULD BE INCLUDED HERE.                         SCMP21
00326                CALL ABORT                                               SCMP21
00327                END                                                      SCMP21
                                                                              SCMP21
```

| Line Number | Comment |
|---|---|
| 267 to 278 | All branches in the compiler to statements 4XX write an error message on ØUTPUT immediately following the source card in error. Subroutine ESCAPE is called. |
| 321 to 327 | Subroutine ESCAPE should be replaced by a machine level routine which aborts the job abnormally. |

## 2.2 Simulation Program Operation.

A flow chart of the overall simulation program in presented in Fig. 3. Next, a complete listing of the auxiliary source statement file (SRCST) is presented on pages 48 through 57. The cards with asterisks (*) in columns 1 through 72 (line nos. 68, 208, 220, and 642) indicate the locations where compiler-generated FORTRAN statements are inserted into the text. A complete listing of the generated program including those segments of code inserted by the compiler is presented on pages 58 through 69. The simulation example used in part one were used to generate this listing. The statements *not* containing the identified SRCST along the right side are the statements generated by the compiler from the user's source sections. The relevant code, variable definitions, and operation descriptions for each of the blocks shown in Fig. 3 are presented on pages 70 through 95.

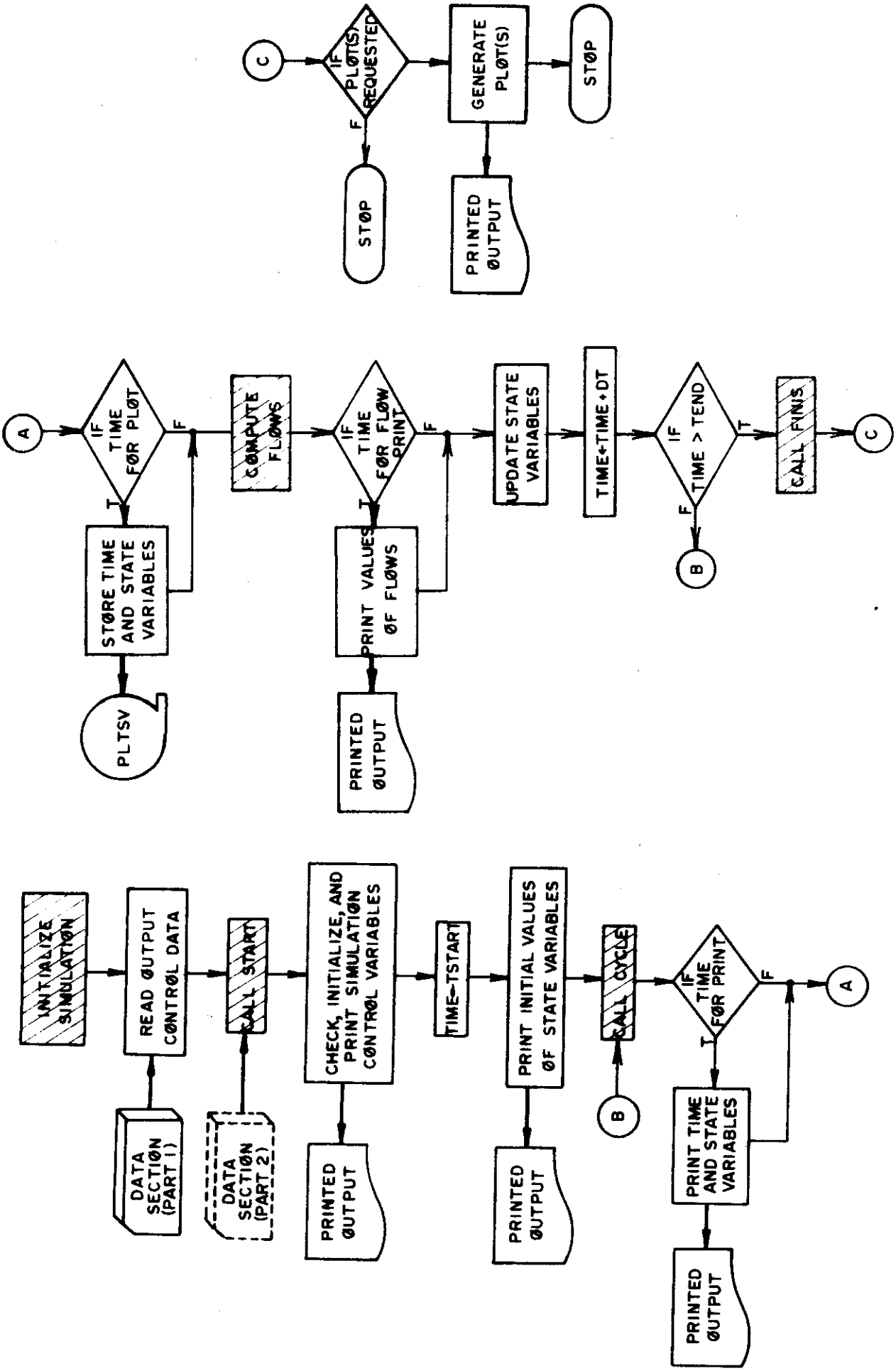



Fig. 3. Flow chart of the generated simulation program.

*Listing of auxiliary source file SRCST.*

```
00001            PROGRAM SIMEXC(INPUT,OUTPUT,PLTSV,                                  SRCST
00002           -      TAPE1=INPUT,                                                  SRCST
00003           -      TAPE2=OUTPUT,                                                 SRCST
00004           -      TAPE3=PLTSV)                                                  SRCST
00005            COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),  SRCST
00006           -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,          SRCST
00007           -   XNVRS(20),XNLOC(20,5)                                           SRCST
00008            COMMON/XUNT/U1,U2,U3                                                SRCST
00009            DIMENSION VAL(300)                                                  SRCST
00010            INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC       SRCST
00011            INTEGER U1,U2,U3                                                    SRCST
00012      C...THIS PROGRAM IS THE SIMULATION EXECUTION CONTROL ROUTINE.             SRCST
00013      C...EXTERNAL DEVISE FILE ASSIGNMENTS:                                     SRCST
00014      C     UNIT NO.  VARIABLE          PURPOSE                                 SRCST
00015      C        1         U1         DATA INPUT UNIT.                          SRCST
00016      C        2         U2         OUTPUT UNIT.                              SRCST
00017      C        3         U3         TEMPORARY MASS STORAGE DEVISE USED FOR PLOT SRCST
00018      C                               GENERATION.                               SRCST
00019      C                                                                         SRCST
00020      C     NOTE  -  ANY OF THESE EXTERNAL I/O UNITS MAY BE REASSIGNED A DIF-   SRCST
00021      C              FERENT UNIT NO. BY ALTERING THE FOLLOWING ASSIGNMENTS.     SRCST
00022            DATA U1/1/, U2/2/, U3/3/                                            SRCST
00023      C                                                                         SRCST
00024      C...SYSTEM COMMON BLOCK VARIABLE DEFINITIONS:                             SRCST
00025      C   VARIABLE    MODE          PURPOSE                                     SRCST
00026      C     TIME         R      CURRENT VALUE OF SIMULATED TIME.               SRCST
00027      C     TSTART*      R      STARTING TIME OF SIMULATION.                   SRCST
00028      C     TEND*        R      ENDING TIME OF SIMULATION.                     SRCST
00029      C     DT*          R      SOLUTION TIME STEP FOR INTEGRATION.            SRCST
00030      C     DTPR**       R      TIME STEP BETWEEN PRINT OUTS.                  SRCST
00031      C     DTFL**       R      TIME STEP BETWEEN FLOW PRINT OUTS.             SRCST
00032      C     DTPL         R      TIME STEP FOR PLOT VALUE STORAGE.              SRCST
00033      C     X(99)***     R      STATE VARIABLES (MAXIMUM OF 99).               SRCST
00034      C     XNF          I      NO. OF FLOWS DEFINED (MAXIMUM OF 300).         SRCST
00035      C     XF(300)      R      CURRENT VALUES OF FLOWS.                       SRCST
00036      C     XFR(300)     I      FLOW REFERENCE TABLE - THE COMPARTMENTAL       SRCST
00037      C                           INDICES OF THE K-TH FLOW ARE STORED IN THE    SRCST
00038      C                           K-TH ENTRY (I.E. XFR(K)) AS THE SUM OF THE    SRCST
00039      C                           FOLLOWING:                                    SRCST
00040      C                               N*10000   -   PRINT FLAG.                SRCST
00041      C                               I*100     -   SOURCE INDEX.              SRCST
00042      C                               J         -   DESTINATION INDEX.          SRCST
00043      C     XNST         I      NO. OF STATE VARIABLES USED.                   SRCST
00044      C     XST(99)      I      LIST OF STATE VARIABLE INDICES.                SRCST
00045      C     XNPR         I      NO. OF STATE VARIABLES TO BE PRINTED.          SRCST
00046      C     XPR(99)      I      LIST OF STATE VARIABLES TO BE PRINTED.         SRCST
00047      C     XNPL         I      NO. OF STATE VARIABLES TO BE PLOTTED.          SRCST
00048      C     XPL(99)      I      LIST OF STATE VARIABLES TO BE PLOTTED.         SRCST
00049      C     XNPLT        I      NO. OF PLOTS TO BE GENERATED (MAXIMUM OF 20).  SRCST
00050      C     XNVRS(20)    I      NO. OF VARIABLES PER PLOT (MAXIMUM OF 5).      SRCST
00051      C     XNLOC(20,5)  I      LOCATION IN LIST OF STATE VARIABLES TO BE      SRCST
00052      C                           PLOTTED (I.E. XPL(K)) OF EACH VARIABLE IN     SRCST
00053      C                           EACH PLOT.                                    SRCST
00054      C     VAL(300)     R      WORKING STORAGE ARRAY USED IN OUTPUT GENERATION SRCST
00055      C                                                                         SRCST
00056      C     NOTE:                                                             SRCST
00057      C       *    -   USER MUST DEFINE VALUE IN ROUTINE START.  IF VALUES NOT SRCST
00058      C                  SET IN START DEFAULT VALUES ARE:                       SRCST
00059      C                           TSTART   =   0.                               SRCST
00060      C                           TEND     =   1.                               SRCST
00061      C                           DT       =   0.1                              SRCST
00062      C       **   -   USER MUST DEFINE VALUE IN START IF PRINTING OF STATE    SRCST
00063      C                  VARIABLES OR FLOWS IS REQUESTED.                       SRCST
00064      C      ***   -   USER MUST DEFINE INITIAL VALUES FOR EACH STATE VARIABLE SRCST
00065      C                  USED. DEFAULT VALUES ARE ZERO.                         SRCST
```

```
00066          C                                                                      SRCST
00067          C...COMPILER GENERATED INITIALIZATIONS.                                SRCST
00068          ***************************************************************************SRCST
00069          C...INITIALIZE SIMULATION CONTROL VARIABLES.                           SRCST
00070                DATA TSTART/0./                                                  SRCST
00071                DATA TEND/1./                                                    SRCST
00072                DATA DT/0.1/                                                     SRCST
00073                DATA DTPR/0./                                                    SRCST
00074                DATA DTPL/0./                                                    SRCST
00075                DATA DTFL/0./                                                    SRCST
00076                DATA X/99*0./                                                    SRCST
00077                DATA XNPR/0/                                                     SRCST
00078                DATA XNPL/0/                                                     SRCST
00079                DATA XNPLT/0/                                                    SRCST
00080          C...READ OUTPUT CONTROL INFORMATION.                                   SRCST
00081                CALL XINPUT                                                      SRCST
00082          C...CALL USER CONTROL INITIALIZATION ROUTINE.                          SRCST
00083                CALL START                                                       SRCST
00084          C...CHECK AND INITIALIZE SIMULATION CONTROL VARIABLES.                 SRCST
00085                IF(TEND.LE.TSTART) GO TO 100                                     SRCST
00086                IF(DT.LE.0.) GO TO 101                                           SRCST
00087                TIME=TSTART                                                      SRCST
00088                IF(XNPR.GT.0.AND.DTPR.LE.0.) GO TO 102                           SRCST
00089                NPR=0                                                            SRCST
00090                TIMEPR=0.                                                        SRCST
00091                IF(XNPR.LE.0) GO TO 15                                           SRCST
00092                NPR=1                                                            SRCST
00093                TIMEPR=TSTART                                                    SRCST
00094             15 NPL=0                                                            SRCST
00095                TIMEPL=0.                                                        SRCST
00096                IF(XNPL.LE.0) GO TO 20                                           SRCST
00097                NPL=1                                                            SRCST
00098                TIMEPL=TSTART                                                    SRCST
00099                DTPL=(TEND-TSTART)/99.                                           SRCST
00100                IF(DTPL.LT.DT) DTPL=DT                                           SRCST
00101             20 NFL=0                                                            SRCST
00102                TIMEFL=0.                                                        SRCST
00103                IF(DTFL.LE.0.) GO TO 23                                          SRCST
00104                NFL=1                                                            SRCST
00105                TIMEFL=TIME                                                      SRCST
00106          C...OUTPUT SIMULATION CHARACTERISTS AND CONTROL VARIABLES.             SRCST
00107             23 CONTINUE                                                         SRCST
00108                WRITE(U2,200) XNST,XNPR,XNPL,XNF                                 SRCST
00109                WRITE(U2,201) TSTART,TEND,DT,DTPR,DTPL,DTFL                      SRCST
00110          C...OUTPUT INITIAL VALUES OF STATE VARIABLES.                          SRCST
00111                DO 10 I=1,XNST                                                   SRCST
00112                J=XST(I)                                                         SRCST
00113             10 VAL(I)=X(J)                                                      SRCST
00114                NLINE=XNST/4+1                                                   SRCST
00115                NKNT=MOD(XNST,4)                                                 SRCST
00116                IF(NKNT.NE.0) GO TO 11                                           SRCST
00117                NLINE=NLINE-1                                                    SRCST
00118                NKNT=4                                                           SRCST
00119             11 J1=1                                                             SRCST
00120                DO 18 I=1,NLINE                                                  SRCST
00121                IF(I.EQ.NLINE) GO TO 12                                          SRCST
00122                J2=J1+3                                                          SRCST
00123                WRITE(U2,202) (XST(J),VAL(J),J=J1,J2)                            SRCST
00124                GO TO 18                                                         SRCST
00125             12 J2=J1+NKNT-1                                                     SRCST
00126                GO TO(13,14,16,17), NKNT                                         SRCST
00127             13 WRITE(U2,212) (XST(J),VAL(J),J=J1,J2)                            SRCST
00128                GO TO 18                                                         SRCST
00129             14 WRITE(U2,211) (XST(J),VAL(J),J=J1,J2)                            SRCST
00130                GO TO 18                                                         SRCST
00131             16 WRITE(U2,210) (XST(J),VAL(J),J=J1,J2)                            SRCST
```

```
00132            GO TO 18                                                    SRCST
00133         17 WRITE(U2,202) (XST(J),VAL(J),J=J1,J2)                       SRCST
00134         18 J1=J1+4                                                     SRCST
00135            WRITE(U2,205)                                               SRCST
00136      C...ENTER THE SIMULATION LOOP.                                     SRCST
00137         25 CONTINUE                                                    SRCST
00138            CALL CYCLE                                                  SRCST
00139      C...GENERATE OUTPUT IF REQUESTED.                                  SRCST
00140            IF(NPR.LE.0.OR.TIMEPR.GT.TIME) GO TO 30                     SRCST
00141            CALL XPRINT(VAL)                                            SRCST
00142            TIMEPR=TIMEPR+DTPR                                          SRCST
00143         30 IF(NPL.LE.0.OR.TIMEPL.GT.TIME) GO TO 35                     SRCST
00144            CALL XPLOT(VAL,0)                                           SRCST
00145            TIMEPL=TIMEPL+DTPL                                          SRCST
00146      C...COMPUTE THE FLOWS.                                             SRCST
00147         35 CALL XFLWS                                                  SRCST
00148            IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 40                     SRCST
00149            TM=TIME+DT                                                  SRCST
00150            WRITE(U2,203) TIME,TM                                       SRCST
00151      C...UPDATE THE STATE VARIABLES AND PRINT FLOWS IF REQUESTED.       SRCST
00152         40 DO 45 I=1,XNF                                               SRCST
00153            INFO=XFR(I)                                                 SRCST
00154      C...RETRIEVE SOURCE (I1) AND DESTINATION (I2) COMPARTMENT INDICES, AND SRCST
00155      C     PRINT FLAG (IP) FOR THE I-TH FLOW.                           SRCST
00156            CALL XUNPAK(INFO,IP,I1,I2)                                  SRCST
00157            X(I1)=X(I1)-XF(I)*DT                                        SRCST
00158            X(I2)=X(I2)+XF(I)*DT                                        SRCST
00159            IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 45                     SRCST
00160            IF(IP.LE.0) GO TO 45                                        SRCST
00161            WRITE(U2,204) I1,I2,XF(I)                                   SRCST
00162         45 CONTINUE                                                    SRCST
00163            IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 50                     SRCST
00164            TIMEFL=TIMEFL+DTFL                                          SRCST
00165         50 TIME=TIME+DT                                                SRCST
00166            IF(TIME.GT.TEND) GO TO 55                                   SRCST
00167            GO TO 25                                                    SRCST
00168      C...SIMULATION IS COMPLETE, PREFORM END PROCESSING AND PLOT GENERATION SRCST
00169      C     IF REQUESTED.                                                SRCST
00170         55 CALL FINIS                                                  SRCST
00171            IF(NPL.LE.0) GO TO 60                                       SRCST
00172            CALL XPLOT(VAL,1)                                           SRCST
00173            CALL XPLGEN                                                 SRCST
00174         60 STOP                                                        SRCST
00175      C...GENERATE DIAGNOSTICS FOR ILLEGAL CONDITIONS.                   SRCST
00176        100 WRITE(U2,206)                                               SRCST
00177            WRITE(U2,207) TSTART,TEND                                   SRCST
00178            STOP                                                        SRCST
00179        101 WRITE(U2,206)                                               SRCST
00180            WRITE(U2,208) DT                                            SRCST
00181            STOP                                                        SRCST
00182        102 WRITE(U2,206)                                               SRCST
00183            WRITE(U2,209)                                               SRCST
00184            STOP                                                        SRCST
00185        200 FORMAT(20H1SIMCOMP VERSION 2.1,15X,18HINITIAL CONDITIONS///13X, SRCST
00186           -   37HNO. OF STATE VARIABLES.............,I2/16X,34HREQUESTED FO SRCST
00187           -R PRINT.............,I2/16X,34HREQUESTED FOR PLOT.............. SRCST
00188           -,I2//13X,37HNO. OF FLOWS.....................,I3)            SRCST
00189        201 FORMAT(///20X,20HTSTART.............,E12.5/20X,20HTEND.......... SRCST
00190           -......,E12.5/20X,20HDT.................,E12.5/20X,20HDTPR........ SRCST
00191           -.......,E12.5/20X,20HDTPL..............,E12.5/20X,20HDTFL....... SRCST
00192           -.........,E12.5//)                                          SRCST
00193        202 FORMAT(10X,4(2HX(,I2,4H) = ,E12.5,5X))                      SRCST
00194        203 FORMAT(20H0  FLOWS     TIME = ,E12.5,8H   TO   ,E12.5)      SRCST
00195        204 FORMAT(10X,1H(,I2,1H,,I2,4H) = ,E12.5)                      SRCST
00196        205 FORMAT(20H1SIMCOMP VERSION 2.1,15X,18HSIMULATION RESULTS,//) SRCST
00197        206 FORMAT(42H0*****ILLEGAL CONDITION - PARAMETER VALUES)       SRCST
```

```
00198          207 FORMAT(13H0     TSTART(,E12.5,12H) .GE. TEND(,E12.5,1H))          SRCST
00199          208 FORMAT(9H0     DT(,E12.5,9H) .LE. 0.)                             SRCST
00200          209 FORMAT(44H0     PRINT REQUESTS ENCOUNTERED WHILE DTPR(,E12.5,9H) . SRCST
00201             -LE. 0.)                                                           SRCST
00202          210 FORMAT(10X,3(2HX(,I2,4H) = ,E12.5,5X))                         SRCST
00203          211 FORMAT(10X,2(2HX(,I2,4H) = ,E12.5,5X))                         SRCST
00204          212 FORMAT(10X,2HX(,I2,4H) = ,F12.5,5X)                            SRCST
00205              END                                                            SRCST
00206              SUBROUTINE XFLWS                                               SRCST
00207              COMMON/XUNT/U1,U2,U3                                           SRCST
00208        ************************************************************************SRCST
00209              INTEGER XNF,XFR,XNPR,XPR,XNPL,XPL,XNST,XST,U1,U2,U3            SRCST
00210              INTEGER XN                                                     SRCST
00211        C...THIS SUBROUTINE COMPUTES THE VALUES OF THE FLOWS AND STORES THE  SRCST
00212        C     VALUES IN THE COMPUTED FLOW STACK.  THE COMPARTMENTAL INDICES OF SRCST
00213        C     THE K-TH FLOW IN THE COMPUTED FLOW STACK ARE STORED IN THE K-TH SRCST
00214        C     ENTRY OF THE FLOW REFENRENCE TABLE AS THE SUM OF THE FOLLOWING SRCST
00215        C     TERMS:                                                         SRCST
00216        C         N*10000          FLOW PRINT FLAG (N=0, NO PRINT - N=1, PRINT). SRCST
00217        C         I*100            INDEX OF SOURCE COMPARTMENT.            SRCST
00218        C         J                INDEX OF DESTINATION COMPARTMENT.       SRCST
00219              XN=0                                                           SRCST
00220        ************************************************************************SRCST
00221              RETURN                                                         SRCST
00222              END                                                            SRCST
00223              SUBROUTINE XINPUT                                              SRCST
00224              COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300), SRCST
00225             -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,      SRCST
00226             -   XNVRS(20),XNLOC(20,5)                                       SRCST
00227              COMMON/XUNT/U1,U2,U3                                           SRCST
00228              DIMENSION NUM(14)                                              SRCST
00229              DIMENSION KEY(5)                                               SRCST
00230              INTEGER XNF,XFR,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC,XNST,XST   SRCST
00231              INTEGER U1,U2,U3                                               SRCST
00232        C...THIS ROUTINE READS THE INPUT SECTION. EACH CARD ON INPUT IS SCANNED SRCST
00233        C     FOR A COMMAND VERB IN THE FIRST FOUR COLUMNS.  UPON RECOGNITION OF SRCST
00234        C     A COMMAND VERB THE REMAINING INFORMATION IS STORED ACCORDINGLY.  SRCST
00235        C     ON EACH CARD IN THE OUTPUT CONTROL DATA SECTION THERE IS ASSUMED TO SRCST
00236        C     EXIST 15 FIELDS (POSSIBLY BLANK):                              SRCST
00237        C       FIELD       COLS.    FORMAT        PURPOSE                   SRCST
00238        C      COMMAND       1-4       A4      COMMAND VERBS, LEFT JUSTIFIED SRCST
00239        C         1         11-15      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00240        C         2         16-20      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00241        C         3         21-25      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00242        C         4         26-30      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00243        C         5         31-35      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00244        C         6         36-40      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00245        C         7         41-45      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00246        C         8         46-50      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00247        C         9         51-55      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00248        C        10         56-60      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00249        C        11         61-65      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00250        C        12         66-70      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00251        C        13         71-75      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00252        C        14         76-80      I5      INTEGER, RIGHT JUSTIFIED      SRCST
00253              DATA KEY/4HEND,,4HPRIN,4HFLOW,4HPLOT,4H    /                   SRCST
00254           10 READ(U1,100) IVERB,(NUM(I),I=1,14)                             SRCST
00255              DO 15 I=1,5                                                    SRCST
00256              IF(IVERB.EQ.KEY(I)) GO TO 20                                   SRCST
00257           15 CONTINUE                                                       SRCST
00258              GO TO 200                                                      SRCST
00259        C...A COMMAND VERB HAS BEEN ENCOUNTERED.                             SRCST
00260           20 KODE=5                                                         SRCST
00261              IF(I.LT.5) KODE=I                                              SRCST
00262              GO TO(25,30,50,65,200), KODE                                   SRCST
00263        C...END.                                                             SRCST
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00264          25 RETURN                                                        SRCST
00265       C...PRINT.                                                          SRCST
00266       C     STORE THE INDICES OF THE STATE VARIABLES REQUESTED FOR PRINTING SRCST
00267       C     (NUM(I)) IN THE PRINT STACK (XPR(XNPR)).                      SRCST
00268          30 DO 45 I=1,14                                                  SRCST
00269       C     INDICES .LE. 0 ARE ASSUMED A BLANK AND ARE IGNORED.           SRCST
00270             IF(NUM(I).LE.0) GO TO 45                                      SRCST
00271       C     INDICES .GT. 99 PRODUCE A DIAGNOSTIC.  REPETITIOUS REQUESTS ARE SRCST
00272       C     IGNORED.                                                      SRCST
00273             IF(NUM(I).GT.99) GO TO 201                                    SRCST
00274             IF(XNPR.LE.0) GO TO 40                                        SRCST
00275             DO 35 J=1,XNPR                                                SRCST
00276             IF(NUM(I).EQ.XPR(J)) GO TO 45                                 SRCST
00277          35 CONTINUE                                                      SRCST
00278          40 XNPR=XNPR+1                                                   SRCST
00279             XPR(XNPR)=NUM(I)                                              SRCST
00280          45 CONTINUE                                                      SRCST
00281             GO TO 10                                                      SRCST
00282       C...FLOW.                                                           SRCST
00283       C     SET THE FLOW PRINT FLAG FOR THE K-TH FLOW IN THE FLOW REFERENCE SRCST
00284       C     TABLE (XFR(K)) FOR EACH PAIR OF INDICES IN THE RANGE 1 THROUGH 99 SRCST
00285       C     (NUM(I) AND NUM(J)) FOR WHICH A CORRESPONDING ENTRY EXISTS IN THE SRCST
00286       C     FLOW REFERENCE TABLE.                                         SRCST
00287          50 DO 60 I=1,13,2                                                SRCST
00288             J=I+1                                                         SRCST
00289             IF(NUM(I).LE.0.AND.NUM(J).LE.0) GO TO 60                      SRCST
00290             IF(NUM(I).LE.0.OR.NUM(I).GT.99) GO TO 201                     SRCST
00291             IF(NUM(J).LE.0.OR.NUM(J).GT.99) GO TO 201                     SRCST
00292             DO 55 K=1,XNF                                                 SRCST
00293             INFO=XFR(K)                                                   SRCST
00294             CALL XUNPAK(INFO,IP,I1,I2)                                    SRCST
00295             IF(NUM(I).NE.I1.OR.NUM(J).NE.I2) GO TO 55                     SRCST
00296             IF(IP.EQ.1) GO TO 60                                          SRCST
00297             XFR(K)=XFR(K)+10000                                           SRCST
00298             GO TO 60                                                      SRCST
00299          55 CONTINUE                                                      SRCST
00300          60 CONTINUE                                                      SRCST
00301             GO TO 10                                                      SRCST
00302       C...PLOT.                                                           SRCST
00303       C     RETRIEVE THE NUMBER OF PLOTS REQUESTED (XNPLT) FROM THE PLOT CARD, SRCST
00304       C     FIRST NUMERIC FIELD.                                          SRCST
00305          65 XNPLT=NUM(1)                                                  SRCST
00306             IF(XNPLT.LE.0.OR.XNPLT.GT.20) GO TO 202                       SRCST
00307       C     THE NEXT (XNPLT) CARDS ARE READ, ONE CARD PER PLOT, WITH THE FIRST SRCST
00308       C     FIVE NUMERIC FIELDS INTERPRETED AS THE INDICES OF UP TO FIVE STATE SRCST
00309       C     VARIABLES TO APPEAR IN EACH PLOT.                             SRCST
00310             DO 90 I=1,XNPLT                                               SRCST
00311             READ(U1,100) IVERR,(NUM(J),J=1,14)                            SRCST
00312             DO 68 J=1,3                                                   SRCST
00313             IF(IVERR.EQ.KEY(J)) GO TO 203                                 SRCST
00314          68 CONTINUE                                                      SRCST
00315             XNVRS(I)=0                                                    SRCST
00316             DO 85 J=1,5                                                   SRCST
00317             IF(NUM(J).LE.0) GO TO 85                                      SRCST
00318             IF(NUM(J).GT.99) GO TO 201                                    SRCST
00319             XNVRS(I)=XNVRS(I)+1                                           SRCST
00320             K=XNVRS(I)                                                    SRCST
00321             IF(XNPL.LE.0) GO TO 75                                        SRCST
00322             DO 70 L=1,XNPL                                                SRCST
00323             IF(NUM(J).EQ.XPL(L)) GO TO 80                                 SRCST
00324          70 CONTINUE                                                      SRCST
00325          75 XNPL=XNPL+1                                                   SRCST
00326             XPL(XNPL)=NUM(J)                                              SRCST
00327             L=XNPL                                                        SRCST
00328          80 XNLOC(I,K)=L                                                  SRCST
00329          85 CONTINUE                                                      SRCST
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00330          90 CONTINUE                                                          SRCST
00331             GO TO 10                                                          SRCST
00332       C...IF ERRORS OCCURED GENERATE A DIAGNOSTIC.                            SRCST
00333         200 WRITE(U2,102) IVERR,(NUM(I),I=1,14)                               SRCST
00334             WRITE(U2,103)                                                     SRCST
00335             STOP                                                              SRCST
00336         201 WRITE(U2,102) IVERR,(NUM(I),I=1,14)                               SRCST
00337             WRITE(U2,104)                                                     SRCST
00338             STOP                                                              SRCST
00339         202 WRITE(U2,102) IVERR,(NUM(I),I=1,14)                               SRCST
00340             WRITE(U2,105)                                                     SRCST
00341             STOP                                                              SRCST
00342         203 WRITE(U2,102) IVERR,(NUM(I),I=1,14)                               SRCST
00343             WRITE(U2,106)                                                     SRCST
00344             STOP                                                              SRCST
00345         100 FORMAT(A4,6X,14I5)                                                SRCST
00346         102 FORMAT(33H0*****ERROR IN DATA SECTION INPUT,/10X,A4,6X,14I5)       SRCST
00347         103 FORMAT(25H      ILLEGAL COMMAND VERB)                             SRCST
00348         104 FORMAT(43H      STATE VARIABLE INDEX .LE. 0 OR .GT. 99)           SRCST
00349         105 FORMAT(45H      NO. OF PLOTS REQUESTED .LE. 0 OR .GT. 20)         SRCST
00350         106 FORMAT(122H      COMMAND VERB ENCOUNTERED WHILE PROCESSING PLOT RE@ SRCST
00351            -UEST, CHECK FOR NO. OF PLOTS REQUESTED .NE. NO. OF SUBSEQUENT CARD SRCST
00352            -S)                                                               SRCST
00353             END                                                              SRCST
00354             SUBROUTINE XPRINT(VAL)                                           SRCST
00355             COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300), SRCST
00356            -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,        SRCST
00357            -   XNVRS(20),XNLOC(20,5)                                         SRCST
00358             COMMON/XUNT/U1,U2,U3                                             SRCST
00359             DIMENSION VAL(300)                                               SRCST
00360             INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC     SRCST
00361             INTEGER U1,U2,U3                                                 SRCST
00362       C...THIS ROUTINE PRODUCES PRINTED OUTPUT OF EACH STATE VARIABLE LISTED SRCST
00363       C     IN THE PRINT REQUESTS.                                           SRCST
00364       C...STORE THE VALUES OF THE STATE VARIABLES TO BE PRINTED IN THE OUTPUT SRCST
00365       C     WORKING STORAGE ARRAY.                                           SRCST
00366             DO 10 I=1,XNPR                                                   SRCST
00367             J=XPR(I)                                                         SRCST
00368          10 VAL(I)=X(J)                                                      SRCST
00369       C...FORMAT AND OUTPUT THE STATE VARIABLE NAMES AND VALUES, FOUR STATE  SRCST
00370       C     VARIABLES PER LINE.                                              SRCST
00371             WRITE(U2,200) TIME                                               SRCST
00372             NLINE=XNPR/4+1                                                   SRCST
00373             NKNT=MOD(XNPR,4)                                                 SRCST
00374             IF(NKNT.NE.0) GO TO 15                                           SRCST
00375             NLINE=NLINE-1                                                    SRCST
00376             NKNT=4                                                           SRCST
00377          15 J1=1                                                             SRCST
00378             DO 45 I=1,NLINE                                                  SRCST
00379             IF(I.EQ.NLINE) GO TO 20                                          SRCST
00380             J2=J1+3                                                          SRCST
00381             WRITE(U2,201) (XPR(J),VAL(J),J=J1,J2)                            SRCST
00382             GO TO 45                                                         SRCST
00383          20 J2=J1+NKNT-1                                                     SRCST
00384             GO TO(25,30,35,40), NKNT                                         SRCST
00385          25 WRITE(U2,202) (XPR(J),VAL(J),J=J1,J2)                            SRCST
00386             GO TO 45                                                         SRCST
00387          30 WRITE(U2,203) (XPR(J),VAL(J),J=J1,J2)                            SRCST
00388             GO TO 45                                                         SRCST
00389          35 WRITE(U2,204) (XPR(J),VAL(J),J=J1,J2)                            SRCST
00390             GO TO 45                                                         SRCST
00391          40 WRITE(U2,201) (XPR(J),VAL(J),J=J1,J2)                            SRCST
00392          45 J1=J1+4                                                          SRCST
00393             RETURN                                                           SRCST
00394         200 FORMAT(8HOTIME = ,E12.5)                                         SRCST
00395         201 FORMAT(10X,4(2HX(,I2,4H) = ,E12.5,5X))                           SRCST
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00396          202 FORMAT(10X,2HX(,I2,4H) = ,E12.5,5X)                                  SRCST
00397          203 FORMAT(10X,2(2HX(,I2,4H) = ,E12.5,5X))                               SRCST
00398          204 FORMAT(10X,3(2HX(,I2,4H) = ,E12.5,5X))                               SRCST
00399              END                                                                  SRCST
00400              SUBROUTINE XPLOT(VAL,ISTOP)                                          SRCST
00401              COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),    SRCST
00402             -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,           SRCST
00403             -   XNVRS(20),XNLOC(20,5)                                            SRCST
00404              COMMON/XUNT/U1,U2,U3                                                 SRCST
00405              DIMENSION VAL(300)                                                   SRCST
00406              INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC         SRCST
00407              INTEGER U1,U2,U3                                                     SRCST
00408          C...THIS ROUTINE GENERATES ONE RECORD OF PLOT VARIABLE VALUES ON MASS    SRCST
00409          C     STORAGE DEVICE (U3) AT EACH CALL.                                  SRCST
00410          C...STORE THE VALUES OF THE STATE VARIABLES TO BE SAVED FOR PLOTTING IN  SRCST
00411          C     THE OUTPUT WORKING STORAGE ARRAY.                                  SRCST
00412              DO 10 I=1,XNPL                                                       SRCST
00413              J=XPL(I)                                                             SRCST
00414           10 VAL(I)=X(J)                                                          SRCST
00415          C...FORMAT FOR EACH RECORD:                                              SRCST
00416          C       WORD NO.      VARIABLE          PURPOSE                          SRCST
00417          C          1           ISTOP      FLAG TO SIGNAL LAST RECORD OF STORED  SRCST
00418          C                                    VALUES (ISTOP=1 IS FINAL, ISTOP=0   SRCST
00419          C                                    OTHERWISE).                         SRCST
00420          C          2           TIME       CURRENT SIMULATED TIME.               SRCST
00421          C      3 THROUGH       VAL(I)     VALUES OF THE XNPL STATE VARIABLES TO BE SRCST
00422          C        XNPL+2                     PLOTTED.                            SRCST
00423              WRITE(U3) ISTOP,TIME,(VAL(I),I=1,XNPL)                               SRCST
00424              RETURN                                                               SRCST
00425              END                                                                  SRCST
00426              SUBROUTINE XUNPAK(IV,IP,IF,IT)                                       SRCST
00427          C...THIS SUBROUTINE UNPACKS THE INFORMATION STORED IN THE FLOW REFERENCE  SRCST
00428          C     TABLES.                                                            SRCST
00429          C         IV      -      WORD TO BE UNPACKED.                          SRCST
00430          C         IP      -      FLOW PRINT FLAG.                              SRCST
00431          C         IF      -      INDEX OF SOURCE COMPARTMENT.                  SRCST
00432          C         IT      -      INDEX OF DESTINATION COMPARTMENT.             SRCST
00433              IP=IV/10000                                                          SRCST
00434              I=IV-IP*10000                                                        SRCST
00435              IF=I/100                                                             SRCST
00436              IT=I-IF*100                                                          SRCST
00437              RETURN                                                               SRCST
00438              END                                                                  SRCST
00439              SUBROUTINE XPLGEN                                                    SRCST
00440              COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),    SRCST
00441             -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,           SRCST
00442             -   XNVRS(20),XNLOC(20,5)                                            SRCST
00443              COMMON/XUNT/U1,U2,U3                                                 SRCST
00444              DIMENSION Z(100),XLINE(11),YLINE(6)                                  SRCST
00445              INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC         SRCST
00446              INTEGER U1,U2,U3                                                     SRCST
00447          C...THIS ROUTINE GENERATES THE REQUESTED PLOTS UNDER CONTROL OF THE PLOT  SRCST
00448          C     GENERATION VARIABLES.  THE INFORMATION FOR PLOTTING IS ON THE      SRCST
00449          C     TEMPORARY MASS STORAGE DEVISE (U3).                                SRCST
00450              DO 35 II=1,XNPLT                                                     SRCST
00451              XMIN=1.E50                                                           SRCST
00452              XMAX=-XMIN                                                           SRCST
00453              YMIN=1.E50                                                           SRCST
00454              YMAX=-YMIN                                                           SRCST
00455          C...SEARCH THE PLOT DATA, DETERMINING MAX AND MIN VALUES FOR SCALING.    SRCST
00456              REWIND U3                                                            SRCST
00457           20 READ(U3) ISTOP,TIME,(Z(I),I=1,XNPL)                                  SRCST
00458              IF(ISTOP.GE.1) GO TO 27                                              SRCST
00459              XMIN=AMIN1(XMIN,TIME)                                                SRCST
00460              XMAX=AMAX1(XMAX,TIME)                                                SRCST
00461              NVARS=XNVRS(II)                                                      SRCST
                                                                                        SRCST
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00462                DO 25 I=1,NVARS
00463                LOC=XNLOC(II,I)                                          SRCST
00464                ZZ=Z(LOC)                                                SRCST
00465                YMIN=AMIN1(YMIN,ZZ)                                      SRCST
00466             25 YMAX=AMAX1(YMAX,ZZ)                                      SRCST
00467                GO TO 20                                                 SRCST
00468          C...CALCULATE GRAPHICAL SCALING VALUES.                        SRCST
00469             27 CALL XRND(YMIN,YMAX,YMIN,YMAX)                           SRCST
00470                XLINE(1)=XMIN                                            SRCST
00471                XLINE(11)=XMAX                                           SRCST
00472                XINC=(XMAX-XMIN)/10.                                     SRCST
00473                X1ST=XMIN                                                SRCST
00474                DO 30 I=2,10                                             SRCST
00475                X1ST=X1ST+XINC                                           SRCST
00476             30 XLINE(I)=X1ST                                            SRCST
00477                YLINE(1)=YMIN                                            SRCST
00478                YLINE(6)=YMAX                                            SRCST
00479                YINC=(YMAX-YMIN)/5.                                      SRCST
00480                Y1ST=YMIN                                                SRCST
00481                DO 32 I=2,5                                              SRCST
00482                Y1ST=Y1ST+YINC                                           SRCST
00483             32 YLINE(I)=Y1ST                                            SRCST
00484          C...GENERATE THE PLOT.                                         SRCST
00485                REWIND U3                                                SRCST
00486                CALL XGRAPH(II,NVARS,XNLOC,XLINE,YLINE,Z,YMIN,YMAX,XNPL,XPL)  SRCST
00487             35 CONTINUE                                                 SRCST
00488                RETURN                                                   SRCST
00489                END                                                      SRCST
00490                SUBROUTINE XGRAPH(NPL,NVR,NXLOC,XLINE,YLINE,Z,YMIN,YMAX,NN,NXPL)  SRCST
00491                COMMON/XUNT/U1,U2,U3                                     SRCST
00492                DIMENSION NXLOC(20,5),XLINE(11),YLINE(6),Z(100),IP(100),JCHAR(5)  SRCST
00493                DIMENSION NXPL(99)                                       SRCST
00494                INTEGER U1,U2,U3                                         SRCST
00495                DATA JCHAR/1H1,1H2,1H3,1H4,1H5/                          SRCST
00496                DATA IBLNK/1H /, IDASH/1H-/, IEYEE/1HI/, IQUAL/1H=/      SRCST
00497          C...THIS ROUTINE GENERATES AND OUTPUTS ONE PRINTER PLOT AT EACH CALL.  SRCST
00498                KNT=0                                                    SRCST
00499                JNT=0                                                    SRCST
00500                DO 5 I=1,NVR                                             SRCST
00501                J=NXLOC(NPL,I)                                           SRCST
00502             5 IP(I)=NXPL(J)                                             SRCST
00503                WRITE(U2,300) NPL,(I,IP(I),I=1,NVR)                      SRCST
00504                WRITE(U2,301) (YLINE(I),I=1,6)                           SRCST
00505          C...EACH PASS THROUGH THE FOLLOWING EXPLICIT LOOP (STATEMENT 10 TO  SRCST
00506          C     STATEMENT 40) GENERATES ONE LINE OF THE PRINTED GRAPH ON OUTPUT.  SRCST
00507          C...READ IN ONE TIME STEP OF PLOTTING DATA.                    SRCST
00508             10 READ(U3) ISTOP,TIME,(Z(I),I=1,NN)                        SRCST
00509                IF(ISTOP.GE.1) GO TO 40                                  SRCST
00510          C...INITIALIZE THE OUTPUT CHARACTER STRING (IP) TO CONTAIN BLANKS AND  SRCST
00511          C     GRAPHICAL REFERENCE LINES.                               SRCST
00512                KNT=KNT+1                                                SRCST
00513                ICHR=IBLNK                                               SRCST
00514                IF(MOD(KNT,10).NE.0) GO TO 15                            SRCST
00515                IF(KNT.EQ.100) GO TO 15                                  SRCST
00516                ICHR=IDASH                                               SRCST
00517             15 DO 20 I=1,100                                            SRCST
00518                IP(I)=ICHR                                               SRCST
00519                IF(MOD(I,20).NE.0) GO TO 20                              SRCST
00520                IF(I.EQ.100) GO TO 20                                    SRCST
00521                IP(I)=IEYEE                                              SRCST
00522             20 CONTINUE                                                 SRCST
00523          C...INSERT PLOTTING CHARACTERS INTO STRING WHICH REPESENTS THE PLOTTED  SRCST
00524          C     VARIABLE.                                                SRCST
00525                DO 30 I=1,NVR                                            SRCST
00526                LOC=NXLOC(NPL,I)                                         SRCST
00527                ZZ=Z(LOC)                                                SRCST
                                                                              SRCST
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00528          C...DETERMINE LOCATION OF PLOTTING CHARACTER IN STRING ACCORDING TO      SRCST
00529          C     VALUE OF DEPENDENT VARIABLE (ZZ) AND SCALING PARAMETERS.          SRCST
00530                ZI=1.+99.*(ZZ-YMIN)/(YMAX-YMIN)                                   SRCST
00531                IZ=ZI                                                             SRCST
00532                ZJ=IZ                                                             SRCST
00533                IF((ZI-ZJ).GE.0.5) IZ=IZ+1                                        SRCST
00534          C...STORE PLOTTING CHARACTER IN STRING.                                 SRCST
00535                JP=IP(IZ)                                                         SRCST
00536                ICHR=ICHAR(1)                                                     SRCST
00537                IF(JP.EQ.IBLNK) GO TO 25                                          SRCST
00538                IF(JP.EQ.IDASH) GO TO 25                                          SRCST
00539                IF(JP.EQ.IEYEE) GO TO 25                                          SRCST
00540                IF(JP.EQ.ICHR) GO TO 30                                           SRCST
00541                ICHR=IQUAL                                                        SRCST
00542             25 IP(IZ)=ICHR                                                       SRCST
00543             30 CONTINUE                                                          SRCST
00544          C...OUTPUT CHARACTER STRING.                                            SRCST
00545                IF(KNT.EQ.1.OR.MOD(KNT,10).EQ.0) GO TO 35                         SRCST
00546                WRITE(U2,302) (IP(I),I=1,100)                                     SRCST
00547                GO TO 10                                                          SRCST
00548             35 JNT=JNT+1                                                         SRCST
00549                WRITE(U2,303) XLINE(JNT),(IP(I),I=1,100)                          SRCST
00550                GO TO 10                                                          SRCST
00551             40 WRITE(U2,304)                                                     SRCST
00552                RETURN                                                            SRCST
00553            300 FORMAT(12H1  PLOT NO. ,I2//20X,5(I1,5H = X(,I2,1H),4X))          SRCST
00554            301 FORMAT(////13X,E12.5,5(8X,E12.5)/20X,1H+,18X,1H+,4(19X,1H+)/20X,  SRCST
00555              -    100(1HH))                                                     SRCST
00556            302 FORMAT(19X,1HH,100A1,1HH)                                        SRCST
00557            303 FORMAT(5X,E12.5,3H +H,100A1,1HH)                                 SRCST
00558            304 FORMAT(20X,100(1HH))                                             SRCST
00559                END                                                               SRCST
00560                SUBROUTINE XRND(ZMIN,ZMAX,RNZMIN,RNZMAX)                          SRCST
00561          C...GIVEN ZMIN AND ZMAX, THIS SUBROUTINE DETERMINES AN APPROPRIATE      SRCST
00562          C     SCALING FOR A GRAPH OF A FUNCTION WHOSE VALUES RANGE FROM ZMIN    SRCST
00563          C     TO ZMAX.                                                          SRCST
00564          C     RNZMIN AND RNZMAX ARE THE EXTREME VALUES OF THE GRAPH.            SRCST
00565          C...THE CASE WHERE ZMIN = ZMAX IS TREATED SEPARATELY.                   SRCST
00566                IF (ZMIN.NE.ZMAX) GO TO 20                                        SRCST
00567                IF (ZMAX.NE.0.) GO TO 1                                           SRCST
00568                RNZMIN = -1.                                                      SRCST
00569                RNZMAX = 1.                                                       SRCST
00570                GO TO 27                                                          SRCST
00571          C...SCALE Z UNTIL THE FIRST SIGNIFICANT DIGIT IS IN THE THOUSANDS      SRCST
00572          C     PLACE AND ROUND AT THE DECIMAL PLACE.                             SRCST
00573             1  Z = ZMAX                                                         SRCST
00574                I = 0                                                             SRCST
00575             2  IF (Z.GE.1000.) GO TO 3                                         SRCST
00576                Z = Z*10.                                                         SRCST
00577                I = I-1                                                           SRCST
00578                GO TO 2                                                           SRCST
00579             3  IF (Z.LT.10000.) GO TO 4                                        SRCST
00580                Z = Z/10.                                                         SRCST
00581                I = I+1                                                           SRCST
00582                GO TO 3                                                           SRCST
00583             4  Z = INT(Z+.5)                                                    SRCST
00584          C...DETERMINE THE NUMBER OF SIGNIFICANT DIGITS IN Z, TRUNCATE THE      SRCST
00585          C     LAST ONE, AND USE THIS NUMBER AS A BASIS FOR SETTING THE        SRCST
00586          C     GRAPH VALUES.                                                     SRCST
00587                Z = Z/10.                                                         SRCST
00588                I = I+1                                                           SRCST
00589             5  ZRND = INT(Z)                                                    SRCST
00590                IF (ZRND.NE.Z) GO TO 6                                            SRCST
00591                Z = Z/10.                                                         SRCST
00592                I = I+1                                                           SRCST
00593                GO TO 5                                                           SRCST
                                                                                      SRCST
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00594              6 IF (Z.GE.0.) RNZMIN = ZRND-1.                                    SRCST
00595                IF (Z.LT.0.) RNZMIN = ZRND-2.                                    SRCST
00596                RNZMAX = RNZMIN+3.                                               SRCST
00597           C...RESTORE THE NUMBERS TO THE ORIGINAL MAGNITUDE.                    SRCST
00598                RNZMIN = RNZMIN*10.**I                                           SRCST
00599                RNZMAX = RNZMAX*10.**I                                           SRCST
00600                GO TO 27                                                         SRCST
00601           C...IN THE GENERAL CASE THE DIFFERENCE, ZMAX-ZMIN, IS TRUNCATED TO    SRCST
00602           C      THE FIRST SIGNIFICANT DIGIT AND ENLARGED IF NECESSARY TO       SRCST
00603           C      ENCOMPASS THE ENTIRE RANGE, ZMIN TO ZMAX.                      SRCST
00604              20 VAR = ZMAX-ZMIN                                                SRCST
00605                 I = 0.                                                         SRCST
00606              21 IF (VAR.GE.1.) GO TO 22                                        SRCST
00607                 VAR = VAR*10.                                                  SRCST
00608                 I = I-1                                                        SRCST
00609                 GO TO 21                                                       SRCST
00610              22 IF (VAR.LT.10.) GO TO 23                                       SRCST
00611                 VAR = VAR/10.                                                  SRCST
00612                 I = I+1                                                        SRCST
00613                 GO TO 22                                                       SRCST
00614              23 RNVAR = INT(VAR)                                               SRCST
00615                 IF (RNVAR.EQ.VAR) GO TO 24                                     SRCST
00616                 IF (VAR.GT.0.) RNVAR=RNVAR+1.                                  SRCST
00617                 IF (VAR.LT.0.) RNVAR=RNVAR-1.                                  SRCST
00618           C...TRUNCATE ZMIN AT THE SAME DECIMAL PLACE AS THE DIFFERENCE,       SRCST
00619           C      ZMAX-ZMIN, WAS TRUNCATED AND LOWER THIS VALUE IF NECESSARY     SRCST
00620           C      TO INSURE THAT IT IS LESS THAN ZMIN. THIS VALUE IS USED FOR    SRCST
00621           C      RNZMIN AND THE TRUNCATED DIFFERENCE, RNVAR, IS ADDED TO        SRCST
00622           C      OBTAIN RNZMAX (RNVAR IS ENLARGED IF NECESSARY TO INSURE        SRCST
00623           C      INCLUSION OF THE ENTIRE INTERVAL).                             SRCST
00624              24 Z = ZMIN*10.**(-I)                                             SRCST
00625                 ZZ = ZMAX*10.**(-I)                                            SRCST
00626                 ZRND = INT(Z)                                                  SRCST
00627                 IF (VAR.LT.0) GO TO 25                                         SRCST
00628                 IF (Z.GE.0.) RNZMIN=ZRND                                       SRCST
00629                 IF (Z.LT.0.) RNZMIN=ZRND-1.                                    SRCST
00630                 IF (RNZMIN+RNVAR.LT.ZZ) RNVAR=RNVAR+1.                         SRCST
00631                 GO TO 26                                                       SRCST
00632              25 IF (Z.GT.0.) RNZMIN=ZRND+1.                                    SRCST
00633                 IF (Z.LE.0.) RNZMIN=ZRND                                       SRCST
00634                 IF (RNZMIN+RNVAR.GT.ZZ) RNVAR=RNVAR-1.                         SRCST
00635              26 RNZMAX = RNZMIN+RNVAR                                          SRCST
00636           C...RESTORE THE NUMBERS TO THE ORIGINAL MAGNITUDE                    SRCST
00637                 RNZMIN = RNZMIN*10.**I                                         SRCST
00638                 RNZMAX = RNZMAX*10.**I                                         SRCST
00639              27 CONTINUE                                                       SRCST
00640                 RETURN                                                         SRCST
00641                 END                                                            SRCST
00642           ********************************************************************* SRCST
```

*Listing of generated simulation program.*

```
00001            PROGRAM SIMEXC(INPUT,OUTPUT,PLTSV,                                    SRCST
00002           -     TAPE1=INPUT,                                                     SRCST
00003           -     TAPE2=OUTPUT,                                                    SRCST
00004           -     TAPE3=PLTSV)                                                     SRCST
00005            COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),   SRCST
00006           -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,           SRCST
00007           -   XNVRS(20),XNLOC(20,5)                                            SRCST
00008            COMMON/XUNT/U1,U2,U3                                                 SRCST
00009            DIMENSION VAL(300)                                                   SRCST
00010            INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC        SRCST
00011            INTEGER U1,U2,U3                                                     SRCST
00012      C...THIS PROGRAM IS THE SIMULATION EXECUTION CONTROL ROUTINE.              SRCST
00013      C...EXTERNAL DEVISE FILE ASSIGNMENTS:                                      SRCST
00014      C     UNIT NO.  VARIABLE          PURPOSE                                  SRCST
00015      C        1.         U1        DATA INPUT UNIT.                           SRCST
00016      C        2          U2        OUTPUT UNIT.                               SRCST
00017      C        3          U3        TEMPORARY MASS STORAGE DEVISE USED FOR PLOT SRCST
00018      C                               GENERATION.                               SRCST
00019      C                                                                         SRCST
00020      C     NOTE  -  ANY OF THESE EXTERNAL I/O UNITS MAY BE REASSIGNED A DIF-   SRCST
00021      C              FERENT UNIT NO. BY ALTERING THE FOLLOWING ASSIGNMENTS.     SRCST
00022            DATA U1/1/, U2/2/, U3/3/                                            SRCST
00023      C                                                                         SRCST
00024      C...SYSTEM COMMON BLOCK VARIABLE DEFINITIONS:                             SRCST
00025      C   VARIABLE     MODE          PURPOSE                                    SRCST
00026      C     TIME         R       CURRENT VALUE OF SIMULATED TIME.              SRCST
00027      C     TSTART*      R       STARTING TIME OF SIMULATION.                  SRCST
00028      C     TEND*        R       ENDING TIME OF SIMULATION.                    SRCST
00029      C     DT*          R       SOLUTION TIME STEP FOR INTEGRATION.           SRCST
00030      C     DTPR**       R       TIME STEP BETWEEN PRINT OUTS.                 SRCST
00031      C     DTFL**       R       TIME STEP BETWEEN FLOW PRINT OUTS.            SRCST
00032      C     DTPL         R       TIME STEP FOR PLOT VALUE STORAGE.             SRCST
00033      C     X(99)***     R       STATE VARIABLES (MAXIMUM OF 99).              SRCST
00034      C     XNF          I       NO. OF FLOWS DEFINED (MAXIMUM OF 300).        SRCST
00035      C     XF(300)      R       CURRENT VALUES OF FLOWS.                      SRCST
00036      C     XFR(300)     I       FLOW REFERENCE TABLE - THE COMPARTMENTAL       SRCST
00037      C                            INDICES OF THE K-TH FLOW ARE STORED IN THE  SRCST
00038      C                            K-TH ENTRY (I.E. XFR(K)) AS THE SUM OF THE  SRCST
00039      C                            FOLLOWING:                                  SRCST
00040      C                                N*10000   -   PRINT FLAG.               SRCST
00041      C                                I*100     -   SOURCE INDEX.             SRCST
00042      C                                J         -   DESTINATION INDEX.         SRCST
00043      C     XNST         I       NO. OF STATE VARIABLES USED.                  SRCST
00044      C     XST(99)      I       LIST OF STATE VARIABLE INDICES.               SRCST
00045      C     XNPR         I       NO. OF STATE VARIABLES TO BE PRINTED.         SRCST
00046      C     XPR(99)      I       LIST OF STATE VARIABLES TO BE PRINTED.        SRCST
00047      C     XNPL         I       NO. OF STATE VARIABLES TO BE PLOTTED.         SRCST
00048      C     XPL(99)      I       LIST OF STATE VARIABLES TO BE PLOTTED.        SRCST
00049      C     XNPLT        I       NO. OF PLOTS TO BE GENERATED (MAXIMUM OF 20). SRCST
00050      C     XNVPS(20)    I       NO. OF VARIABLES PER PLOT (MAXIMUM OF 5).     SRCST
00051      C     XNLOC(20,5)  I       LOCATION IN LIST OF STATE VARIABLES TO BE     SRCST
00052      C                            PLOTTED (I.E. XPL(K)) OF EACH VARIABLE IN   SRCST
00053      C                            EACH PLOT.                                  SRCST
00054      C     VAL(300)     R       WORKING STORAGE ARRAY USED IN OUTPUT GENERATION SRCST
00055      C                                                                         SRCST
00056      C     NOTE:                                                               SRCST
00057      C       *    -   USER MUST DEFINE VALUE IN ROUTINE START.  IF VALUES NOT  SRCST
00058      C                  SET IN START DEFAULT VALUES ARE:                       SRCST
00059      C                           TSTART   =   0.                               SRCST
00060      C                           TEND     =   1.                               SRCST
00061      C                           DT       =   0.1                              SRCST
00062      C       **   -   USER MUST DEFINE VALUE IN START IF PRINTING OF STATE     SRCST
00063      C                  VARIABLES OR FLOWS IS REQUESTED.                       SRCST
00064      C      ***   -   USER MUST DEFINE INITIAL VALUES FOR EACH STATE VARIABLE  SRCST
00065      C                  USED, DEFAULT VALUES ARE ZERO.                         SRCST
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00066          C
00067          C...COMPILER GENERATED INITIALIZATIONS.                          SRCST
00068                DATA XNF/ 11/                                             SRCST
00069                DATA XFR(  1)/ 102/
00070                DATA XFR(  2)/ 204/
00071                DATA XFR(  3)/ 405/
00072                DATA XFR(  4)/ 507/
00073                DATA XFR(  5)/ 307/
00074                DATA XFR(  6)/ 203/
00075                DATA XFR(  7)/ 206/
00076                DATA XFR(  8)/ 406/
00077                DATA XFR(  9)/ 506/
00078                DATA XFR( 10)/ 306/
00079                DATA XFR( 11)/ 205/
00080                DATA XNST/ 7/
00081                DATA XST(  1)/ 1/
00082                DATA XST(  2)/ 2/
00083                DATA XST(  3)/ 3/
00084                DATA XST(  4)/ 4/
00085                DATA XST(  5)/ 5/
00086                DATA XST(  6)/ 6/
00087                DATA XST(  7)/ 7/
00088          C...INITIALIZE SIMULATION CONTROL VARIABLES.                     SRCST
00089                DATA TSTART/0./                                           SRCST
00090                DATA TEND/1./                                             SRCST
00091                DATA DT/0.1/                                              SRCST
00092                DATA DTPR/0./                                             SRCST
00093                DATA DTPL/0./                                             SRCST
00094                DATA DTFL/0./                                             SRCST
00095                DATA X/99*0./                                             SRCST
00096                DATA XNPR/0/                                              SRCST
00097                DATA XNPL/0/                                              SRCST
00098                DATA XNPLT/0/                                             SRCST
00099          C...READ OUTPUT CONTROL INFORMATION.                             SRCST
00100                CALL XINPUT                                               SRCST
00101          C...CALL USER CONTROL INITIALIZATION ROUTINE.                    SRCST
00102                CALL START                                                SRCST
00103          C...CHECK AND INITIALIZE SIMULATION CONTROL VARIABLES.           SRCST
00104                IF(TEND.LE.TSTART) GO TO 100                              SRCST
00105                IF(DT.LE.0.) GO TO 101                                    SRCST
00106                TIME=TSTART                                               SRCST
00107                IF(XNPR.GT.0.AND.DTPR.LE.0.) GO TO 102                    SRCST
00108                NPR=0                                                     SRCST
00109                TIMEPR=0.                                                 SRCST
00110                IF(XNPR.LE.0) GO TO 15                                    SRCST
00111                NPR=1                                                     SRCST
00112                TIMEPR=TSTART                                             SRCST
00113             15 NPL=0                                                     SRCST
00114                TIMEPL=0.                                                 SRCST
00115                IF(XNPL.LE.0) GO TO 20                                    SRCST
00116                NPL=1                                                     SRCST
00117                TIMEPL=TSTART                                             SRCST
00118                DTPL=(TEND-TSTART)/99.                                    SRCST
00119                IF(DTPL.LT.DT) DTPL=DT                                    SRCST
00120             20 NFL=0                                                     SRCST
00121                TIMEFL=0.                                                 SRCST
00122                IF(DTFL.LE.0.) GO TO 23                                   SRCST
00123                NFL=1                                                     SRCST
00124                TIMEFL=TIME                                               SRCST
00125          C...OUTPUT SIMULATION CHARACTERISTS AND CONTROL VARIABLES.       SRCST
00126             23 CONTINUE                                                  SRCST
00127                WRITE(U2,200) XNST,XNPR,XNPL,XNF                          SRCST
00128                WRITE(U2,201) TSTART,TEND,DT,DTPR,DTPL,DTFL               SRCST
00129          C...OUTPUT INITIAL VALUES OF STATE VARIABLES.                    SRCST
00130                DO 10 I=1,XNST                                            SRCST
00131                J=XST(I)                                                  SRCST
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00132          10 VAL(I)=X(J)
00133             NLINE=XNST/4+1                                                    SRCST
00134             NKNT=MOD(XNST,4)                                                  SRCST
00135             IF(NKNT.NE.0) GO TO 11                                            SRCST
00136             NLINE=NLINE-1                                                     SRCST
00137             NKNT=4                                                            SRCST
00138          11 J1=1                                                              SRCST
00139             DO 18 I=1,NLINE                                                   SRCST
00140             IF(I.EQ.NLINE) GO TO 12                                           SRCST
00141             J2=J1+3                                                           SRCST
00142             WRITE(U2,202) (XST(J),VAL(J),J=J1,J2)                             SRCST
00143             GO TO 18                                                          SRCST
00144          12 J2=J1+NKNT-1                                                      SRCST
00145             GO TO(13,14,16,17), NKNT                                          SRCST
00146          13 WRITE(U2,212) (XST(J),VAL(J),J=J1,J2)                             SRCST
00147             GO TO 18                                                          SRCST
00148          14 WRITE(U2,211) (XST(J),VAL(J),J=J1,J2)                             SRCST
00149             GO TO 18                                                          SRCST
00150          16 WRITE(U2,210) (XST(J),VAL(J),J=J1,J2)                             SRCST
00151             GO TO 18                                                          SRCST
00152          17 WRITE(U2,202) (XST(J),VAL(J),J=J1,J2)                             SRCST
00153          18 J1=J1+4                                                           SRCST
00154             WRITE(U2,205)                                                     SRCST
00155       C...ENTER THE SIMULATION LOOP.                                          SRCST
00156          25 CONTINUE                                                          SRCST
00157             CALL CYCLE                                                        SRCST
00158       C...GENERATE OUTPUT IF REQUESTED.                                       SRCST
00159             IF(NPR.LE.0.OR.TIMEPR.GT.TIME) GO TO 30                           SRCST
00160             CALL XPRINT(VAL)                                                  SRCST
00161             TIMEPR=TIMEPR+DTPR                                                SRCST
00162          30 IF(NPL.LE.0.OR.TIMEPL.GT.TIME) GO TO 35                           SRCST
00163             CALL XPLOT(VAL,0)                                                 SRCST
00164             TIMEPL=TIMEPL+DTPL                                                SRCST
00165       C...COMPUTE THE FLOWS.                                                  SRCST
00166          35 CALL XFLWS                                                        SRCST
00167             IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 40                           SRCST
00168             TM=TIME+DT                                                        SRCST
00169             WRITE(U2,203) TIME,TM                                             SRCST
00170       C...UPDATE THE STATE VARIABLES AND PRINT FLOWS IF REQUESTED.            SRCST
00171          40 DO 45 I=1,XNF                                                     SRCST
00172             INFO=XFR(I)                                                       SRCST
00173       C...RETRIEVE SOURCE (I1) AND DESTINATION (I2) COMPARTMENT INDICES, AND  SRCST
00174       C     PRINT FLAG (IP) FOR THE I-TH FLOW.                                SRCST
00175             CALL XUNPAK(INFO,IP,I1,I2)                                        SRCST
00176             X(I1)=X(I1)-XF(I)*DT                                              SRCST
00177             X(I2)=X(I2)+XF(I)*DT                                              SRCST
00178             IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 45                           SRCST
00179             IF(IP.LE.0) GO TO 45                                              SRCST
00180             WRITE(U2,204) I1,I2,XF(I)                                         SRCST
00181          45 CONTINUE                                                          SRCST
00182             IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 50                           SRCST
00183             TIMEFL=TIMEFL+DTFL                                                SRCST
00184          50 TIME=TIME+DT                                                      SRCST
00185             IF(TIME.GT.TEND) GO TO 55                                         SRCST
00186             GO TO 25                                                          SRCST
00187       C...SIMULATION IS COMPLETE, PREFORM END PROCESSING AND PLOT GENERATION  SRCST
00188       C     IF REQUESTED.                                                     SRCST
00189          55 CALL FINIS                                                        SRCST
00190             IF(NPL.LE.0) GO TO 60                                             SRCST
00191             CALL XPLOT(VAL,1)                                                 SRCST
00192             CALL XPLGEN                                                       SRCST
00193          60 STOP                                                             SRCST
00194       C...GENERATE DIAGNOSTICS FOR ILLEGAL CONDITIONS.                        SRCST
00195         100 WRITE(U2,206)                                                     SRCST
00196             WRITE(U2,207) TSTART,TEND                                         SRCST
00197             STOP                                                              SRCST
                                                                                    SRCST
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00198          101 WRITE(U2,206)
00199              WRITE(U2,208) DT                                                    SRCST
00200              STOP                                                                SRCST
00201          102 WRITE(U2,206)                                                       SRCST
00202              WRITE(U2,209)                                                       SRCST
00203              STOP                                                                SRCST
00204          200 FORMAT(20H1SIMCOMP VERSION 2.1,15X,18HINITIAL CONDITIONS///13X,     SRCST
00205             -   37HNO. OF STATE VARIABLES.............,I2/16X,34HREQUESTED FO   SRCST
00206             -R PRINT.............I2/16X,34HREQUESTED FOR PLOT.............      SRCST
00207             -,I2//13X,37HNO. OF FLOWS.....................,I3)                 SRCST
00208          201 FORMAT(///20X,20HTSTART.............,E12.5/20X,20HTEND.....       SRCST
00209             -.....,E12.5/20X,20HDT.................,E12.5/20X,20HDTPR.....     SRCST
00210             -.....,E12.5/20X,20HDTPL.............,E12.5/20X,20HDTFL.....      SRCST
00211             -.....,E12.5//)                                                     SRCST
00212          202 FORMAT(10X,4(2HX(,I2,4H) = ,E12.5,5X))                             SRCST
00213          203 FORMAT(20H0  FLOWS      TIME = ,E12.5,8H   TO   ,E12.5)            SRCST
00214          204 FORMAT(10X,1H(,I2,1H,,I2,4H) = ,E12.5)                             SRCST
00215          205 FORMAT(20H1SIMCOMP VERSION 2.1,15X,18HSIMULATION RESULTS,//)       SRCST
00216          206 FORMAT(42H0*****ILLEGAL CONDITION - PARAMETER VALUES)              SRCST
00217          207 FORMAT(13H0      TSTART(,E12.5,12H) .GE. TEND(,E12.5,1H))          SRCST
00218          208 FORMAT(9H0      DT(,E12.5,9H) .LE. 0.)                             SRCST
00219          209 FORMAT(44H0      PRINT REQUESTS ENCOUNTERED WHILE DTPR(,E12.5,9H) . SRCST
00220             -LE. 0.)                                                            SRCST
00221          210 FORMAT(10X,3(2HX(,I2,4H) = ,E12.5,5X))                             SRCST
00222          211 FORMAT(10X,2(2HX(,I2,4H) = ,E12.5,5X))                             SRCST
00223          212 FORMAT(10X,2HX(,I2,4H) = ,E12.5,5X)                                SRCST
00224              END                                                                 SRCST
00225              SUBROUTINE XFLWS                                                    SRCST
00226              COMMON/XUNT/U1,U2,U3                                                SRCST
00227              COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),   SRCST
00228             -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,
00229             -   XNVRS(20),XNLOC(20,5)
00230              COMMON/SPARS/PI,YEAR
00231              COMMON/FPARS/P12A,P12B,P12C,P12D,P23A,P23B,P23C,P23D,P24A,P24B,
00232             -            P26A,P36A,P36B,P36C,P36D,P45A,P45B,P56A,P56B,P56C
00233              INTEGER XNF,XFR,XNPR,XPR,XNPL,XPL,XNST,XST,U1,U2,U3
00234              INTEGER XN                                                          SRCST
00235          C...THIS SUBROUTINE COMPUTES THE VALUES OF THE FLOWS AND STORES THE     SRCST
00236          C     VALUES IN THE COMPUTED FLOW STACK.  THE COMPARTMENTAL INDICES OF  SRCST
00237          C     THE K-TH FLOW IN THE COMPUTED FLOW STACK ARE STORED IN THE K-TH   SRCST
00238          C     ENTRY OF THE FLOW REFENRENCE TABLE AS THE SUM OF THE FOLLOWING    SRCST
00239          C     TERMS:                                                            SRCST
00240          C         N*10000          FLOW PRINT FLAG (N=0, NO PRINT - N=1, PRINT).  SRCST
00241          C         I*100            INDEX OF SOURCE COMPARTMENT.               SRCST
00242          C         J                INDEX OF DESTINATION COMPARTMENT.          SRCST
00243              XN=0                                                                SRCST
00244              XN=XN+1                                                             SRCST
00245              F=0.
00246              F=(P12A+P12B*COS(P12C+2.*PI*(TIME-1.)/YEAR))/P12D
00247              IF(F.LT.0.) F=0.
00248              X(8)=F
00249              X(9)=X(9)+F*DT
00250              XF(XN)=F
00251              XN=XN+1
00252              F=0.
00253              F=P24A*EXP(TIME/P24B)
00254              F=F*X(2)
00255              XF(XN)=F
00256              XN=XN+1
00257              F=0.
00258              F=P45A*(1.+SIN(2.*PI*(TIME-1.)/YEAR-P45B))
00259              F=F*X(4)
00260              XF(XN)=F
00261              XN=XN+1
00262              F=0.
00263              F=0.
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00264                XF(XN)=F
00265                XN=XN+1
00266                F=0.
00267                F=0.
00268                XF(XN)=F
00269                XN=XN+1
00270                F=0.
00271                F=0.
00272                IF(X(2).LT.20.) GO TO 5
00273                F=P23A+P23A*SIN(2.*PI*(TIME-1.)/YEAR-P23B)*P23C
00274                IF(F.LT.0.001) F=0.001
00275                F=F*X(2)*P23D
00276              5 CONTINUE
00277                XF(XN)=F
00278                XN=XN+1
00279                F=0.
00280                F=P26A
00281                F=F*X(6)
00282                XF(XN)=F
00283                XN=XN+1
00284                F=0.
00285                F=0.
00286                XF(XN)=F
00287                XN=XN+1
00288                F=0.
00289                F=(P56A*(1.+SIN(2.*PI*(TIME-1.)/YEAR-P56B))*X(4)-P56C+X(5))/X(5)
00290                F=F*X(5)
00291                XF(XN)=F
00292                XN=XN+1
00293                F=0.
00294                TEMP=(P36A+P36B*SIN(2.*PI*(TIME-1.)/YEAR+P36C))
00295                IF(TIME.GT.280.) GO TO 10
00296                F=TEMP
00297                GO TO 15
00298             10 F=TEMP*(365.-TIME)/110.
00299             15 IF(F.LT.0.00036) F=0.00036
00300                F=F*P36D*X(3)
00301                XF(XN)=F
00302                XN=XN+1
00303                F=0.
00304                F=0.
00305                XF(XN)=F
00306                RETURN
00307                END                                                                    SRCST
00308                SUBROUTINE XINPUT                                                      SRCST
00309                COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),      SRCST
00310               -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,             SRCST
00311               -   XNVRS(20),XNLOC(20,5)                                             SRCST
00312                COMMON/XUNT/U1,U2,U3                                                   SRCST
00313                DIMENSION NUM(14)                                                      SRCST
00314                DIMENSION KEY(5)                                                       SRCST
00315                INTEGER XNF,XFR,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC,XNST,XST           SRCST
00316                INTEGER U1,U2,U3                                                       SRCST
00317      C...THIS ROUTINE READS THE INPUT SECTION. EACH CARD ON INPUT IS SCANNED          SRCST
00318      C    FOR A COMMAND VERB IN THE FIRST FOUR COLUMNS.  UPON RECOGNITION OF        SRCST
00319      C    A COMMAND VERB THE REMAINING INFORMATION IS STORED ACCORDINGLY.           SRCST
00320      C    ON EACH CARD IN THE OUTPUT CONTROL DATA SECTION THERE IS ASSUMED TO        SRCST
00321      C    EXIST 15 FIELDS (POSSIBLY BLANK):                                         SRCST
00322      C      FIELD       COLS.    FORMAT          PURPOSE                           SRCST
00323      C     COMMAND       1-4       A4       COMMAND VERBS, LEFT JUSTIFIED         SRCST
00324      C        1         11-15      I5       INTEGER, RIGHT JUSTIFIED              SRCST
00325      C        2         16-20      I5       INTEGER, RIGHT JUSTIFIED              SRCST
00326      C        3         21-25      I5       INTEGER, RIGHT JUSTIFIED              SRCST
00327      C        4         26-30      I5       INTEGER, RIGHT JUSTIFIED              SRCST
00328      C        5         31-35      I5       INTEGER, RIGHT JUSTIFIED              SRCST
00329      C        6         36-40      I5       INTEGER, RIGHT JUSTIFIED              SRCST
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00330          C         7          41-45      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
00331          C         8          46-50      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
00332          C         9          51-55      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
00333          C        10          56-60      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
00334          C        11          61-65      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
00335          C        12          66-70      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
00336          C        13          71-75      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
00337          C        14          76-80      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
00338                DATA KEY/4HEND,,4HPRIN,4HFLOW,4HPLOT,4H    /                                   SRCST
00339             10 READ(U1,100) IVERB,(NUM(I),I=1,14)                                           SRCST
00340                DO 15 I=1,5                                                                  SRCST
00341                IF(IVERB.EQ.KEY(I)) GO TO 20                                                 SRCST
00342             15 CONTINUE                                                                     SRCST
00343                GO TO 200                                                                    SRCST
00344          C...A COMMAND VERB HAS BEEN ENCOUNTERED.                                          SRCST
00345             20 KODE=5                                                                       SRCST
00346                IF(I.LT.5) KODE=I                                                            SRCST
00347                GO TO(25,30,50,65,200), KODE                                                 SRCST
00348          C...END.                                                                          SRCST
00349             25 RETURN                                                                       SRCST
00350          C...PRINT.                                                                        SRCST
00351          C     STORE THE INDICES OF THE STATE VARIABLES REQUESTED FOR PRINTING             SRCST
00352          C     (NUM(I)) IN THE PRINT STACK (XPR(XNPR)).                                    SRCST
00353             30 DO 45 I=1,14                                                                 SRCST
00354          C     INDICES .LE. 0 ARE ASSUMED A BLANK AND ARE IGNORED.                         SRCST
00355                IF(NUM(I).LE.0) GO TO 45                                                     SRCST
00356          C     INDICES .GT. 99 PRODUCE A DIAGNOSTIC.  REPETITIOUS REQUESTS ARE             SRCST
00357          C     IGNORED.                                                                    SRCST
00358                IF(NUM(I).GT.99) GO TO 201                                                   SRCST
00359                IF(XNPR.LE.0) GO TO 40                                                       SRCST
00360                DO 35 J=1,XNPR                                                               SRCST
00361                IF(NUM(I).EQ.XPR(J)) GO TO 45                                                SRCST
00362             35 CONTINUE                                                                     SRCST
00363             40 XNPR=XNPR+1                                                                  SRCST
00364                XPR(XNPR)=NUM(I)                                                             SRCST
00365             45 CONTINUE                                                                     SRCST
00366                GO TO 10                                                                     SRCST
00367          C...FLOW.                                                                         SRCST
00368          C     SET THE FLOW PRINT FLAG FOR THE K-TH FLOW IN THE FLOW REFERENCE             SRCST
00369          C     TABLE (XFR(K)) FOR EACH PAIR OF INDICES IN THE RANGE 1 THROUGH 99           SRCST
00370          C     (NUM(I) AND NUM(J)) FOR WHICH A CORRESPONDING ENTRY EXISTS IN THE           SRCST
00371          C     FLOW REFERENCE TABLE.                                                       SRCST
00372             50 DO 60 I=1,13,2                                                               SRCST
00373                J=I+1                                                                        SRCST
00374                IF(NUM(I).LE.0.AND.NUM(J).LE.0) GO TO 60                                     SRCST
00375                IF(NUM(I).LE.0.OR.NUM(I).GT.99) GO TO 201                                    SRCST
00376                IF(NUM(J).LE.0.OR.NUM(J).GT.99) GO TO 201                                    SRCST
00377                DO 55 K=1,XNF                                                                SRCST
00378                INFO=XFR(K)                                                                  SRCST
00379                CALL XUNPAK(INFO,IP,I1,I2)                                                   SRCST
00380                IF(NUM(I).NE.I1.OR.NUM(J).NE.I2) GO TO 55                                    SRCST
00381                IF(IP.EQ.1) GO TO 60                                                         SRCST
00382                XFR(K)=XFR(K)+10000                                                          SRCST
00383                GO TO 60                                                                     SRCST
00384             55 CONTINUE                                                                     SRCST
00385             60 CONTINUE                                                                     SRCST
00386                GO TO 10                                                                     SRCST
00387          C...PLOT.                                                                         SRCST
00388          C     RETRIEVE THE NUMBER OF PLOTS REQUESTED (XNPLT) FROM THE PLOT CARD,          SRCST
00389          C     FIRST NUMERIC FIELD.                                                        SRCST
00390             65 XNPLT=NUM(1)                                                                 SRCST
00391                IF(XNPLT.LE.0.OR.XNPLT.GT.20) GO TO 202                                      SRCST
00392          C     THE NEXT (XNPLT) CARDS ARE READ, ONE CARD PER PLOT, WITH THE FIRST          SRCST
00393          C     FIVE NUMERIC FIELDS INTERPRETED AS THE INDICES OF UP TO FIVE STATE          SRCST
00394          C     VARIABLES TO APPEAR IN EACH PLOT.                                           SRCST
00395                DO 90 I=1,XNPLT                                                              SRCST
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00396            READ(U1,100) IVERB,(NUM(J),J=1,14)
00397            DO 68 J=1,3                                                    SRCST
00398            IF(IVERB.EQ.KEY(J)) GO TO 203                                  SRCST
00399         68 CONTINUE                                                       SRCST
00400            XNVRS(I)=0                                                     SRCST
00401            DO 85 J=1,5                                                    SRCST
00402            IF(NUM(J).LE.0) GO TO 85                                       SRCST
00403            IF(NUM(J).GT.99) GO TO 201                                     SRCST
00404            XNVRS(I)=XNVRS(I)+1                                            SRCST
00405            K=XNVRS(I)                                                     SRCST
00406            IF(XNPL.LE.0) GO TO 75                                         SRCST
00407            DO 70 L=1,XNPL                                                 SRCST
00408            IF(NUM(J).EQ.XPL(L)) GO TO 80                                  SRCST
00409         70 CONTINUE                                                       SRCST
00410         75 XNPL=XNPL+1                                                    SRCST
00411            XPL(XNPL)=NUM(J)                                               SRCST
00412            L=XNPL                                                         SRCST
00413         80 XNLOC(I,K)=L                                                   SRCST
00414         85 CONTINUE                                                       SRCST
00415         90 CONTINUE                                                       SRCST
00416            GO TO 10                                                       SRCST
00417      C...IF ERRORS OCCURED GENERATE A DIAGNOSTIC.                         SRCST
00418        200 WRITE(U2,102) IVERB,(NUM(I),I=1,14)                            SRCST
00419            WRITE(U2,103)                                                  SRCST
00420            STOP                                                           SRCST
00421        201 WRITE(U2,102) IVERB,(NUM(I),I=1,14)                            SRCST
00422            WRITE(U2,104)                                                  SRCST
00423            STOP                                                           SRCST
00424        202 WRITE(U2,102) IVERB,(NUM(I),I=1,14)                            SRCST
00425            WRITE(U2,105)                                                  SRCST
00426            STOP                                                           SRCST
00427        203 WRITE(U2,102) IVERB,(NUM(I),I=1,14)                            SRCST
00428            WRITE(U2,106)                                                  SRCST
00429            STOP                                                           SRCST
00430        100 FORMAT(A4,6X,14I5)                                             SRCST
00431        102 FORMAT(33H0*****ERROR IN DATA SECTION INPUT,/10X,A4,6X,14I5)   SRCST
00432        103 FORMAT(25H      ILLEGAL COMMAND VERB)                          SRCST
00433        104 FORMAT(43H      STATE VARIABLE INDEX .LE. 0 OR .GT. 99)        SRCST
00434        105 FORMAT(45H      NO. OF PLOTS REQUESTED .LE. 0 OR .GT. 20)      SRCST
00435        106 FORMAT(122H      COMMAND VERB ENCOUNTERED WHILE PROCESSING PLOT RE@ SRCST
00436           -UEST. CHECK FOR NO. OF PLOTS REQUESTED .NE. NO. OF SUBSEQUENT CARD SRCST
00437           -S)                                                             SRCST
00438            END                                                            SRCST
00439            SUBROUTINE XPRINT(VAL)                                         SRCST
00440            COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300), SRCST
00441           -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,      SRCST
00442           -   XNVRS(20),XNLOC(20,5)                                       SRCST
00443            COMMON/XUNT/U1,U2,U3                                           SRCST
00444            DIMENSION VAL(300)                                             SRCST
00445            INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC   SRCST
00446            INTEGER U1,U2,U3                                               SRCST
00447      C...THIS ROUTINE PRODUCES PRINTED OUTPUT OF EACH STATE VARIABLE LISTED SRCST
00448      C     IN THE PRINT REQUESTS.                                         SRCST
00449      C...STORE THE VALUES OF THE STATE VARIABLES TO BE PRINTED IN THE OUTPUT SRCST
00450      C     WORKING STORAGE ARRAY.                                         SRCST
00451            DO 10 I=1,XNPR                                                 SRCST
00452            J=XPR(I)                                                       SRCST
00453         10 VAL(I)=X(J)                                                    SRCST
00454      C...FORMAT AND OUTPUT THE STATE VARIABLE NAMES AND VALUES, FOUR STATE SRCST
00455      C     VARIABLES PER LINE.                                            SRCST
00456            WRITE(U2,200) TIME                                             SRCST
00457            NLINE=XNPR/4+1                                                 SRCST
00458            NKNT=MOD(XNPR,4)                                               SRCST
00459            IF(NKNT.NE.0) GO TO 15                                         SRCST
00460            NLINE=NLINE-1                                                  SRCST
00461            NKNT=4                                                         SRCST
                                                                                SRCST
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00462          15 J1=1                                                          SRCST
00463             DO 45 I=1,NLINE                                               SRCST
00464             IF(I.EQ.NLINE) GO TO 20                                       SRCST
00465             J2=J1+3                                                       SRCST
00466             WRITE(U2,201) (XPR(J),VAL(J),J=J1,J2)                         SRCST
00467             GO TO 45                                                      SRCST
00468          20 J2=J1+NKNT-1                                                  SRCST
00469             GO TO(25,30,35,40), NKNT                                      SRCST
00470          25 WRITE(U2,202) (XPR(J),VAL(J),J=J1,J2)                         SRCST
00471             GO TO 45                                                      SRCST
00472          30 WRITE(U2,203) (XPR(J),VAL(J),J=J1,J2)                         SRCST
00473             GO TO 45                                                      SRCST
00474          35 WRITE(U2,204) (XPR(J),VAL(J),J=J1,J2)                         SRCST
00475             GO TO 45                                                      SRCST
00476          40 WRITE(U2,201) (XPR(J),VAL(J),J=J1,J2)                         SRCST
00477          45 J1=J1+4                                                       SRCST
00478             RETURN                                                        SRCST
00479         200 FORMAT(8HOTIME = ,E12.5)                                      SRCST
00480         201 FORMAT(10X,4(2HX(,I2,4H) = ,E12.5,5X))                        SRCST
00481         202 FORMAT(10X,2HX(,I2,4H) = ,E12.5,5X)                           SRCST
00482         203 FORMAT(10X,2(2HX(,I2,4H) = ,E12.5,5X))                        SRCST
00483         204 FORMAT(10X,3(2HX(,I2,4H) = ,E12.5,5X))                        SRCST
00484             END                                                           SRCST
00485             SUBROUTINE XPLOT(VAL,ISTOP)                                   SRCST
00486             COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),  SRCST
00487            -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,     SRCST
00488            -   XNVRS(20),XNLOC(20,5)                                      SRCST
00489             COMMON/XUNT/U1,U2,U3                                          SRCST
00490             DIMENSION VAL(300)                                            SRCST
00491             INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC  SRCST
00492             INTEGER U1,U2,U3                                              SRCST
00493      C...THIS ROUTINE GENERATES ONE RECORD OF PLOT VARIABLE VALUES ON MASS SRCST
00494      C    STORAGE DEVICE (U3) AT EACH CALL.                                SRCST
00495      C...STORE THE VALUES OF THE STATE VARIABLES TO BE SAVED FOR PLOTTING IN SRCST
00496      C    THE OUTPUT WORKING STORAGE ARRAY.                                SRCST
00497             DO 10 I=1,XNPL                                                SRCST
00498             J=XPL(I)                                                      SRCST
00499          10 VAL(I)=X(J)                                                   SRCST
00500      C...FORMAT FOR EACH RECORD:                                          SRCST
00501      C       WORD NO.      VARIABLE          PURPOSE                      SRCST
00502      C          1            ISTOP      FLAG TO SIGNAL LAST RECORD OF STORED  SRCST
00503      C                                     VALUES (ISTOP=1 IS FINAL, ISTOP=0  SRCST
00504      C                                     OTHERWISE).                    SRCST
00505      C          2            TIME       CURRENT SIMULATED TIME.          SRCST
00506      C       3 THROUGH       VAL(I)     VALUES OF THE XNPL STATE VARIABLES TO BE  SRCST
00507      C         XNPL+2                     PLOTTED.                       SRCST
00508             WRITE(U3) ISTOP,TIME,(VAL(I),I=1,XNPL)                        SRCST
00509             RETURN                                                        SRCST
00510             END                                                           SRCST
00511             SUBROUTINE XUNPAK(IV,IP,IF,IT)                                SRCST
00512      C...THIS SUBROUTINE UNPACKS THE INFORMATION STORED IN THE FLOW REFERENCE  SRCST
00513      C    TABLES.                                                          SRCST
00514      C        IV      -      WORD TO BE UNPACKED.                         SRCST
00515      C        IP      -      FLOW PRINT FLAG.                             SRCST
00516      C        IF      -      INDEX OF SOURCE COMPARTMENT.                 SRCST
00517      C        IT      -      INDEX OF DESTINATION COMPARTMENT.            SRCST
00518             IP=IV/10000                                                   SRCST
00519             I=IV-IP*10000                                                 SRCST
00520             IF=I/100                                                      SRCST
00521             IT=I-IF*100                                                   SRCST
00522             RETURN                                                        SRCST
00523             END                                                           SRCST
00524             SUBROUTINE XPLGEN                                             SRCST
00525             COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),  SRCST
00526            -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,     SRCST
00527            -   XNVRS(20),XNLOC(20,5)                                      SRCST
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00528          COMMON/XUNT/U1,U2,U3
00529          DIMENSION Z(100),XLINE(11),YLINE(6)                                SRCST
00530          INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC       SRCST
00531          INTEGER U1,U2,U3                                                   SRCST
00532       C...THIS ROUTINE GENERATES THE REQUESTED PLOTS UNDER CONTROL OF THE PLOT SRCST
00533       C     GENERATION VARIABLES.  THE INFORMATION FOR PLOTTING IS ON THE   SRCST
00534       C     TEMPORARY MASS STORAGE DEVISE (U3).                            SRCST
00535          DO 35 II=1,XNPLT                                                   SRCST
00536          XMIN=1.E50                                                         SRCST
00537          XMAX=-XMIN                                                         SRCST
00538          YMIN=1.E50                                                         SRCST
00539          YMAX=-YMIN                                                         SRCST
00540       C...SEARCH THE PLOT DATA, DETERMINING MAX AND MIN VALUES FOR SCALING. SRCST
00541          REWIND U3                                                          SRCST
00542       20 READ(U3) ISTOP,TIME,(Z(I),I=1,XNPL)                                SRCST
00543          IF(ISTOP.GE.1) GO TO 27                                            SRCST
00544          XMIN=AMIN1(XMIN,TIME)                                              SRCST
00545          XMAX=AMAX1(XMAX,TIME)                                              SRCST
00546          NVARS=XNVRS(II)                                                    SRCST
00547          DO 25 I=1,NVARS                                                    SRCST
00548          LOC=XNLOC(II,I)                                                    SRCST
00549          ZZ=Z(LOC)                                                          SRCST
00550          YMIN=AMIN1(YMIN,ZZ)                                                SRCST
00551       25 YMAX=AMAX1(YMAX,ZZ)                                                SRCST
00552          GO TO 20                                                           SRCST
00553       C...CALCULATE GRAPHICAL SCALING VALUES.                               SRCST
00554       27 CALL XRND(YMIN,YMAX,YMIN,YMAX)                                     SRCST
00555          XLINE(1)=XMIN                                                      SRCST
00556          XLINE(11)=XMAX                                                     SRCST
00557          XINC=(XMAX-XMIN)/10.                                               SRCST
00558          X1ST=XMIN                                                          SRCST
00559          DO 30 I=2,10                                                       SRCST
00560          X1ST=X1ST+XINC                                                     SRCST
00561       30 XLINE(I)=X1ST                                                      SRCST
00562          YLINE(1)=YMIN                                                      SRCST
00563          YLINE(6)=YMAX                                                      SRCST
00564          YINC=(YMAX-YMIN)/5.                                                SRCST
00565          Y1ST=YMIN                                                          SRCST
00566          DO 32 I=2,5                                                        SRCST
00567          Y1ST=Y1ST+YINC                                                     SRCST
00568       32 YLINE(I)=Y1ST                                                      SRCST
00569       C...GENERATE THE PLOT.                                                SRCST
00570          REWIND U3                                                          SRCST
00571          CALL XGRAPH(II,NVARS,XNLOC,XLINE,YLINE,Z,YMIN,YMAX,XNPL,XPL)       SRCST
00572       35 CONTINUE                                                           SRCST
00573          RETURN                                                             SRCST
00574          END                                                                SRCST
00575          SUBROUTINE XGRAPH(NPL,NVR,NXLOC,XLINE,YLINE,Z,YMIN,YMAX,NN,NXPL)   SRCST
00576          COMMON/XUNT/U1,U2,U3                                               SRCST
00577          DIMENSION NXLOC(20,5),XLINE(11),YLINE(6),Z(100),IP(100),JCHAR(5)   SRCST
00578          DIMENSION NXPL(99)                                                 SRCST
00579          INTEGER U1,U2,U3                                                   SRCST
00580          DATA JCHAR/1H1,1H2,1H3,1H4,1H5/                                    SRCST
00581          DATA IBLNK/1H /, IDASH/1H-/, IEYEE/1HI/, IQUAL/1H=/                SRCST
00582       C...THIS ROUTINE GENERATES AND OUTPUTS ONE PRINTER PLOT AT EACH CALL. SRCST
00583          KNT=0                                                              SRCST
00584          JNT=0                                                              SRCST
00585          DO 5 I=1,NVR                                                       SRCST
00586          J=NXLOC(NPL,I)                                                     SRCST
00587       5  IP(I)=NXPL(J)                                                     SRCST
00588          WRITE(U2,300) NPL,(I,IP(I),I=1,NVR)                                SRCST
00589          WRITE(U2,301) (YLINE(I),I=1,6)                                     SRCST
00590       C...EACH PASS THROUGH THE FOLLOWING EXPLICIT LOOP (STATEMENT 10 TO    SRCST
00591       C     STATEMENT 40) GENERATES ONE LINE OF THE PRINTED GRAPH ON OUTPUT. SRCST
00592       C...READ IN ONE TIME STEP OF PLOTTING DATA.                           SRCST
00593       10 READ(U3) ISTOP,TIME,(Z(I),I=1,NN)                                  SRCST
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00594                 IF(ISTOP.GE.1) GO TO 40                                    SRCST
00595           C...INITIALIZE THE OUTPUT CHARACTER STRING (IP) TO CONTAIN BLANKS AND  SRCST
00596           C     GRAPHICAL REFERENCE LINES.                                   SRCST
00597                 KNT=KNT+1                                                  SRCST
00598                 ICHR=IBLNK                                                 SRCST
00599                 IF(MOD(KNT,10).NE.0) GO TO 15                              SRCST
00600                 IF(KNT.EQ.100) GO TO 15                                    SRCST
00601                 ICHR=IDASH                                                 SRCST
00602              15 DO 20 I=1,100                                              SRCST
00603                 IP(I)=ICHR                                                 SRCST
00604                 IF(MOD(I,20).NE.0) GO TO 20                                SRCST
00605                 IF(I.EQ.100) GO TO 20                                      SRCST
00606                 IP(I)=IEYEE                                                SRCST
00607              20 CONTINUE                                                   SRCST
00608           C...INSERT PLOTTING CHARACTERS INTO STRING WHICH REPESENTS THE PLOTTED  SRCST
00609           C     VARIABLE.                                                  SRCST
00610                 DO 30 I=1,NVR                                              SRCST
00611                 LOC=NXLOC(NPL,I)                                           SRCST
00612                 ZZ=Z(LOC)                                                  SRCST
00613           C...DETERMINE LOCATION OF PLOTTING CHARACTER IN STRING ACCORDING TO    SRCST
00614           C     VALUE OF DEPENDENT VARIABLE (ZZ) AND SCALING PARAMETERS.     SRCST
00615                 ZI=1.+99.*(ZZ-YMIN)/(YMAX-YMIN)                            SRCST
00616                 IZ=ZI                                                      SRCST
00617                 ZJ=IZ                                                      SRCST
00618                 IF((ZI-ZJ).GE.0.5) IZ=IZ+1                                 SRCST
00619           C...STORE PLOTTING CHARACTER IN STRING.                          SRCST
00620                 JP=IP(IZ)                                                  SRCST
00621                 ICHR=JCHAR(I)                                              SRCST
00622                 IF(JP.EQ.IBLNK) GO TO 25                                   SRCST
00623                 IF(JP.EQ.IDASH) GO TO 25                                   SRCST
00624                 IF(JP.EQ.IEYEE) GO TO 25                                   SRCST
00625                 IF(JP.EQ.ICHR) GO TO 30                                    SRCST
00626                 ICHR=IQUAL                                                 SRCST
00627              25 IP(IZ)=ICHR                                                SRCST
00628              30 CONTINUE                                                   SRCST
00629           C...OUTPUT CHARACTER STRING.                                     SRCST
00630                 IF(KNT.EQ.1.OR.MOD(KNT,10).EQ.0) GO TO 35                  SRCST
00631                 WRITE(U2,302) (IP(I),I=1,100)                              SRCST
00632                 GO TO 10                                                   SRCST
00633              35 JNT=JNT+1                                                  SRCST
00634                 WRITE(U2,303) XLINE(JNT),(IP(I),I=1,100)                   SRCST
00635                 GO TO 10                                                   SRCST
00636              40 WRITE(U2,304)                                              SRCST
00637                 RETURN                                                     SRCST
00638             300 FORMAT(12H1  PLOT NO. ,I2//20X,5(I1,5H = X(,I2,1H),4X))    SRCST
00639             301 FORMAT(////13X,E12.5,5(8X,E12.5)/20X,1H+,18X,1H+,4(19X,1H+)/20X,  SRCST
00640                -   100(1HH))                                               SRCST
00641             302 FORMAT(19X,1HH,100A1,1HH)                                  SRCST
00642             303 FORMAT(5X,E12.5,3H +H,100A1,1HH)                           SRCST
00643             304 FORMAT(20X,100(1HH))                                       SRCST
00644                 END                                                        SRCST
00645                 SUBROUTINE XRND(ZMIN,ZMAX,RNZMIN,RNZMAX)                   SRCST
00646           C...GIVEN ZMIN AND ZMAX, THIS SUBROUTINE DETERMINES AN APPROPRIATE  SRCST
00647           C     SCALING FOR A GRAPH OF A FUNCTION WHOSE VALUES RANGE FROM ZMIN  SRCST
00648           C     TO ZMAX.                                                   SRCST
00649           C     RNZMIN AND RNZMAX ARE THE EXTREME VALUES OF THE GRAPH.     SRCST
00650           C...THE CASE WHERE ZMIN = ZMAX IS TREATED SEPARATELY.            SRCST
00651                 IF (ZMIN.NE.ZMAX) GO TO 20                                 SRCST
00652                 IF (ZMAX.NE.0.) GO TO 1                                    SRCST
00653                 RNZMIN = -1.                                               SRCST
00654                 RNZMAX = 1.                                                SRCST
00655                 GO TO 27                                                   SRCST
00656           C...SCALE Z UNTIL THE FIRST SIGNIFICANT DIGIT IS IN THE THOUSANDS  SRCST
00657           C     PLACE AND ROUND AT THE DECIMAL PLACE.                      SRCST
00658              1  Z = ZMAX                                                   SRCST
00659                 I = 0                                                      SRCST
                                                                                 SRCST
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00660          2 IF (Z.GE.1000.) GO TO 3                                        SRCST
00661            Z = Z*10.                                                      SRCST
00662            I = I-1                                                        SRCST
00663            GO TO 2                                                        SRCST
00664          3 IF (Z.LT.10000.) GO TO 4                                       SRCST
00665            Z = Z/10.                                                      SRCST
00666            I = I+1                                                        SRCST
00667            GO TO 3                                                        SRCST
00668          4 Z = INT(Z+.5)                                                  SRCST
00669       C...DETERMINE THE NUMBER OF SIGNIFICANT DIGITS IN Z, TRUNCATE THE   SRCST
00670       C     LAST ONE, AND USE THIS NUMBER AS A BASIS FOR SETTING THE      SRCST
00671       C     GRAPH VALUES.                                                SRCST
00672            Z = Z/10.                                                      SRCST
00673            I = I+1                                                        SRCST
00674          5 ZRND = INT(Z)                                                  SRCST
00675            IF (ZRND.NE.Z) GO TO 6                                         SRCST
00676            Z = Z/10.                                                      SRCST
00677            I = I+1                                                        SRCST
00678            GO TO 5                                                        SRCST
00679          6 IF (Z.GE.0.) RNZMIN = ZRND-1.                                  SRCST
00680            IF (Z.LT.0.) RNZMIN = ZRND-2.                                  SRCST
00681            RNZMAX = RNZMIN+3.                                             SRCST
00682       C...RESTORE THE NUMBERS TO THE ORIGINAL MAGNITUDE.                   SRCST
00683            RNZMIN = RNZMIN*10.**I                                         SRCST
00684            RNZMAX = RNZMAX*10.**I                                         SRCST
00685            GO TO 27                                                       SRCST
00686       C...IN THE GENERAL CASE THE DIFFERENCE, ZMAX-ZMIN, IS TRUNCATED TO   SRCST
00687       C     THE FIRST SIGNIFICANT DIGIT AND ENLARGED IF NECESSARY TO     SRCST
00688       C     ENCOMPASS THE ENTIRE RANGE, ZMIN TO ZMAX.                    SRCST
00689         20 VAR = ZMAX-ZMIN                                               SRCST
00690            I = 0.                                                         SRCST
00691         21 IF (VAR.GE.1.) GO TO 22                                       SRCST
00692            VAR = VAR*10.                                                  SRCST
00693            I = I-1                                                        SRCST
00694            GO TO 21                                                       SRCST
00695         22 IF (VAR.LT.10.) GO TO 23                                      SRCST
00696            VAR = VAR/10.                                                  SRCST
00697            I = I+1                                                        SRCST
00698            GO TO 22                                                       SRCST
00699         23 RNVAR = INT(VAR)                                              SRCST
00700            IF (RNVAR.EQ.VAR) GO TO 24                                     SRCST
00701            IF (VAR.GT.0.) RNVAR=RNVAR+1.                                  SRCST
00702            IF (VAR.LT.0.) RNVAR=RNVAR-1.                                  SRCST
00703       C...TRUNCATE ZMIN AT THE SAME DECIMAL PLACE AS THE DIFFERENCE,       SRCST
00704       C     ZMAX-ZMIN, WAS TRUNCATED AND LOWER THIS VALUE IF NECESSARY   SRCST
00705       C     TO INSURE THAT IT IS LESS THAN ZMIN. THIS VALUE IS USED FOR   SRCST
00706       C     RNZMIN AND THE TRUNCATED DIFFERENCE, RNVAR, IS ADDED TO      SRCST
00707       C     OBTAIN RNZMAX (RNVAR IS ENLARGED IF NECESSARY TO INSURE      SRCST
00708       C     INCLUSION OF THE ENTIRE INTERVAL).                           SRCST
00709         24 Z = ZMIN*10.**(-I)                                            SRCST
00710            ZZ = ZMAX*10.**(-I)                                            SRCST
00711            ZRND = INT(Z)                                                  SRCST
00712            IF (VAR.LT.0) GO TO 25                                         SRCST
00713            IF (Z.GE.0.) RNZMIN=ZRND                                       SRCST
00714            IF (Z.LT.0.) RNZMIN=ZRND-1.                                    SRCST
00715            IF (RNZMIN+RNVAR.LT.ZZ) RNVAR=RNVAR+1.                         SRCST
00716            GO TO 26                                                       SRCST
00717         25 IF (Z.GT.0.) RNZMIN=ZRND+1.                                   SRCST
00718            IF (Z.LE.0.) RNZMIN=ZRND                                       SRCST
00719            IF (RNZMIN+RNVAR.GT.ZZ) RNVAR=RNVAR-1.                         SRCST
00720         26 RNZMAX = RNZMIN+RNVAR                                         SRCST
00721       C...RESTORE THE NUMBERS TO THE ORIGINAL MAGNITUDE                    SRCST
00722            RNZMIN = RNZMIN*10.**I                                         SRCST
00723            RNZMAX = RNZMAX*10.**I                                         SRCST
00724         27 CONTINUE                                                      SRCST
00725            RETURN                                                         SRCST
```
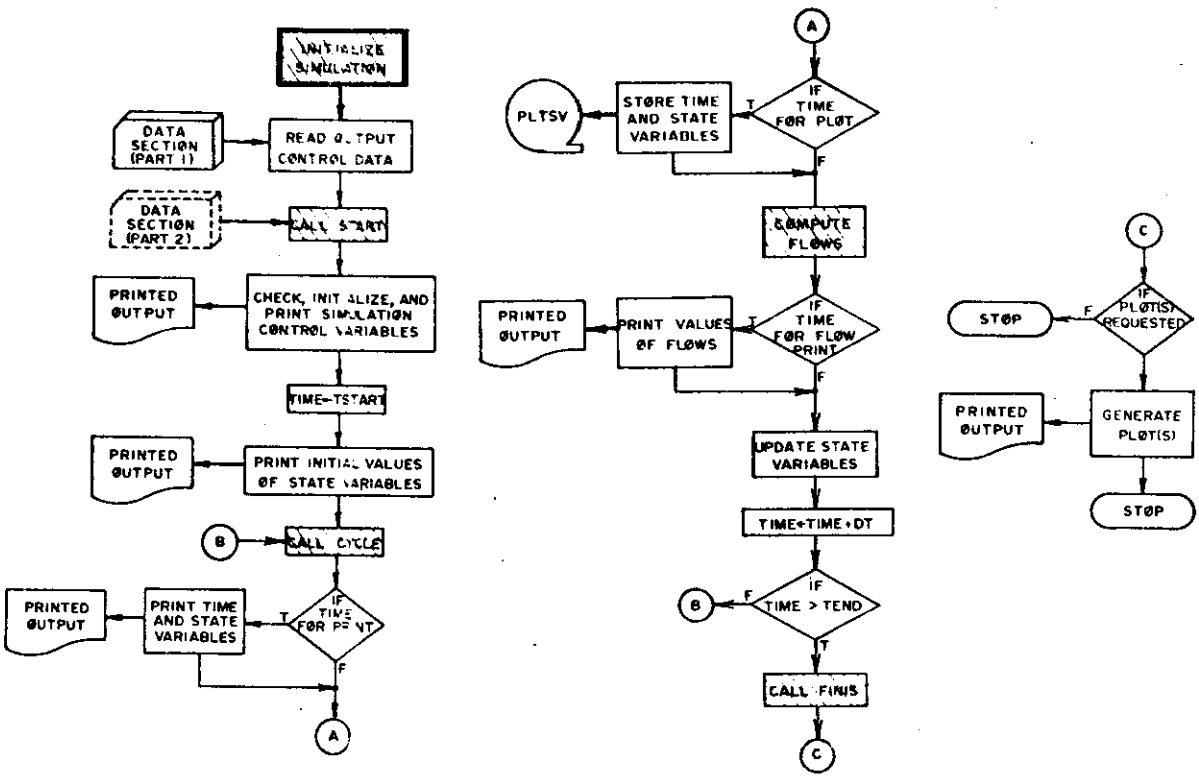

```
00726                 END                                                                    SRCST
00727                 SUBROUTINE START
00728                 COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),
00729                -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,
00730                -   XNVRS(20),XNLOC(20,5)
00731                 COMMON/SPARS/PI,YEAR
00732                 COMMON/FPARS/P12A,P12B,P12C,P12D,P23A,P23B,P23C,P23D,P24A,P24B,
00733                -             P26A,P36A,P36B,P36C,P36D,P45A,P45B,P56A,P56B,P56C
00734                 READ(1,100) PI,YEAR
00735                 READ(1,100) P12A,P12B,P12C,P12D
00736                 READ(1,100) P24A,P24B
00737                 READ(1,100) P45A,P45B
00738                 READ(1,100) P23A,P23B,P23C,P23D
00739                 READ(1,100) P26A
00740                 READ(1,100) P56A,P56B,P56C
00741                 READ(1,100) P36A,P36B,P36C,P36D
00742                 READ(1,100) (X(I),I=1,9)
00743                 READ(1,100) TSTART,TEND,DT,DTPR,DTFL
00744           100   FORMAT(8F10.0)
00745                 RETURN
00746                 END
00747                 SUBROUTINE CYCLE
00748                 RETURN
00749                 END
00750                 SUBROUTINE FINIS
00751                 RETURN
00752                 END
```

*Initialize simulation.*

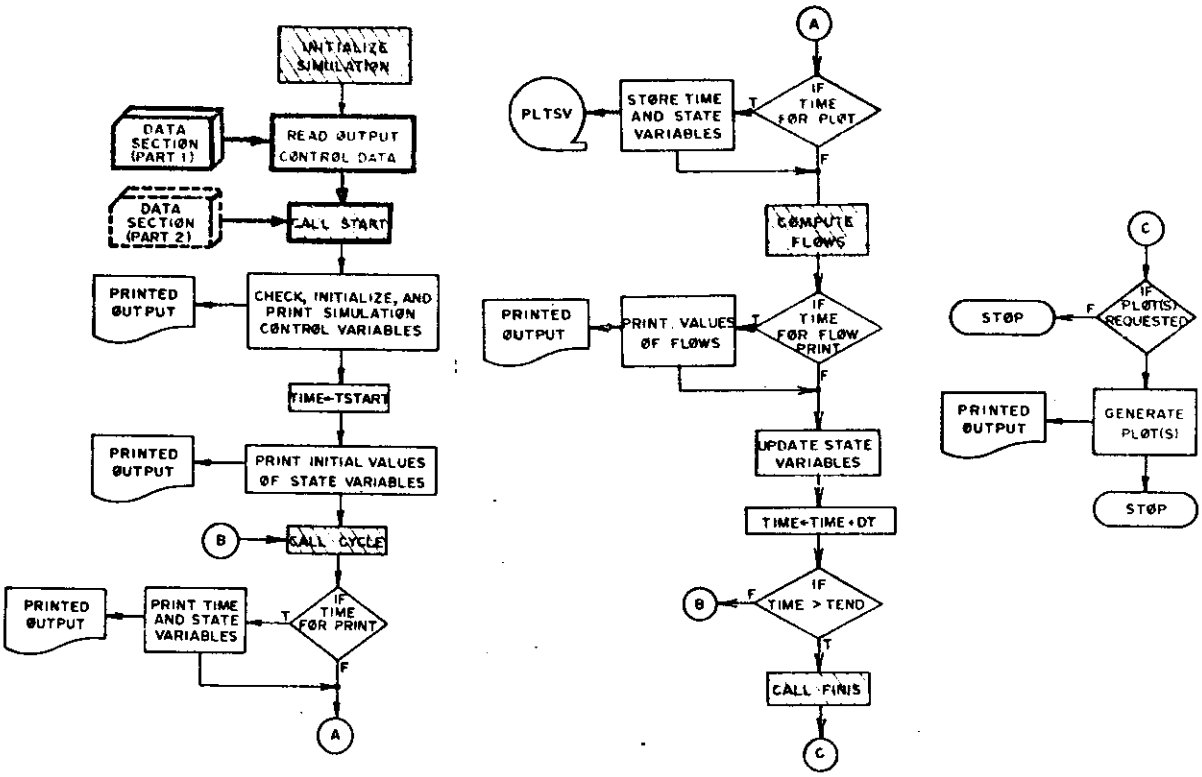



```
00005            COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),    SRCST
00006           -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,             SRCST
00007           -   XNVRS(20),XNLOC(20,5)                                              SRCST

00010            INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC          SRCST
```

```
00066          C
00067          C...COMPILER GENERATED INITIALIZATIONS.                          SRCST
00068                DATA XNF/ 11/                                              SRCST
00069                DATA XFR(  1)/ 102/
00070                DATA XFR(  2)/ 204/
00071                DATA XFR(  3)/ 405/
00072                DATA XFR(  4)/ 507/
00073                DATA XFR(  5)/ 307/
00074                DATA XFR(  6)/ 203/
00075                DATA XFR(  7)/ 206/
00076                DATA XFR(  8)/ 406/
00077                DATA XFR(  9)/ 506/
00078                DATA XFR( 10)/ 306/
00079                DATA XFR( 11)/ 205/
00080                DATA XNST/ 7/
00081                DATA XST( 1)/ 1/
00082                DATA XST( 2)/ 2/
00083                DATA XST( 3)/ 3/
00084                DATA XST( 4)/ 4/
00085                DATA XST( 5)/ 5/
00086                DATA XST( 6)/ 6/
00087                DATA XST( 7)/ 7/
00088          C...INITIALIZE SIMULATION CONTROL VARIABLES.
00089                DATA TSTART/0./                                            SRCST
00090                DATA TEND/1./                                              SRCST
00091                DATA DT/0.1/                                               SRCST
00092                DATA DTPR/0./                                              SRCST
00093                DATA DTPL/0./                                              SRCST
00094                DATA DTFL/0./                                              SRCST
00095                DATA X/99*0./                                              SRCST
00096                DATA XNPR/0/                                               SRCST
00097                DATA XNPL/0/                                               SRCST
00098                DATA XNPLT/0/                                              SRCST
```

| Line Number | Comment |
|---|---|
| 68 to 79 | XNF is the number of flows defined. Each element of array XFR(I) contains the quantity 100 • M + N where<br>M = source compartment index<br>N = destination compartment index<br>Line 73 contains the information that the fifth row is from X(3) to X(7). |
| 80 to 87 | XNST is the number of state variables referred to in flow declarations. XST(I) contains the index of the I--the state variable. In general if no state variables are used, they need not be state variable indices 1 through n. |
| 89 to 95 | The system-defined variables are assigned their default values. These values may be altered by reading in new values in subroutine START. |
| 96 to 98 | The number of state variables to be printed and plotted, and the number of requested plots are initialized to zero. |

*Read output control cards and call START.*




```
00099          C...READ OUTPUT CONTROL INFORMATION.                                    SRCST
00100                CALL XINPUT                                                       SRCST
00101          C...CALL USER CONTROL INITIALIZATION ROUTINE.                           SRCST
00102                CALL STAPT                                                        SRCST


00308                SUBROUTINE XINPUT                                                 SRCST
00309                COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300), SRCST
00310               -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,         SRCST
00311               -   XNVRS(20),XNLOC(20,5)                                          SRCST
00312                COMMON/XUNT/U1,U2,U3                                              SRCST
00313                DIMENSION NUM(14)                                                 SRCST
00314                DIMENSION KEY(5)                                                  SRCST
00315                INTEGER XNF,XFR,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC,XNST,XST      SRCST
00316                INTEGER U1,U2,U3                                                  SRCST
00317          C...THIS ROUTINE READS THE INPUT SECTION. EACH CARD ON INPUT IS SCANNED SRCST
00318          C    FOR A COMMAND VERB IN THE FIRST FOUR COLUMNS.  UPON RECOGNITION OF SRCST
00319          C    A COMMAND VERB THE REMAINING INFORMATION IS STORED ACCORDINGLY.    SRCST
00320          C    ON EACH CARD IN THE OUTPUT CONTROL DATA SECTION THERE IS ASSUMED TO SRCST
00321          C    EXIST 15 FIELDS (POSSIBLY BLANK):                                 SRCST
00322          C      FIELD       COLS.    FORMAT        PURPOSE                      SRCST
00323          C     COMMAND       1-4       A4      COMMAND VERBS, LEFT JUSTIFIED   SRCST
00324          C       1          11-15      I5      INTEGER, RIGHT JUSTIFIED        SRCST
00325          C       2          16-20      I5      INTEGER, RIGHT JUSTIFIED        SRCST
00326          C       3          21-25      I5      INTEGER, RIGHT JUSTIFIED        SRCST
00327          C       4          26-30      I5      INTEGER, RIGHT JUSTIFIED        SRCST
00328          C       5          31-35      I5      INTEGER, RIGHT JUSTIFIED        SRCST
00329          C       6          36-40      I5      INTEGER, RIGHT JUSTIFIED        SRCST
```

```
C         7         41-45      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
C         8         46-50      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
C         9         51-55      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
C        10         56-60      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
C        11         61-65      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
C        12         66-70      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
C        13         71-75      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
C        14         76-80      I5      INTEGER, RIGHT JUSTIFIED                    SRCST
      DATA KEY/4HEND,,4HPRIN,4HFLOW,4HPLOT,4H    /                                SRCST
   10 READ(U1,100) IVERB,(NUM(I),I=1,14)                                          SRCST
      DO 15 I=1,5                                                                 SRCST
      IF(IVERB.EQ.KEY(I)) GO TO 20                                                SRCST
   15 CONTINUE                                                                    SRCST
      GO TO 200                                                                   SRCST
C...A COMMAND VERB HAS BEEN ENCOUNTERED.                                          SRCST
   20 KODE=5                                                                      SRCST
      IF(I.LT.5) KODE=I                                                           SRCST
      GO TO(25,30,50,65,200), KODE                                                SRCST
C...END.                                                                          SRCST
   25 RETURN                                                                      SRCST
C...PRINT.                                                                        SRCST
C    STORE THE INDICES OF THE STATE VARIABLES REQUESTED FOR PRINTING              SRCST
C    (NUM(I)) IN THE PRINT STACK (XPR(XNPR)).                                     SRCST
   30 DO 45 I=1,14                                                                SRCST
C    INDICES .LE. 0 ARE ASSUMED A BLANK AND ARE IGNORED.                          SRCST
      IF(NUM(I).LE.0) GO TO 45                                                    SRCST
C    INDICES .GT. 99 PRODUCE A DIAGNOSTIC.  REPETITIOUS REQUESTS ARE              SRCST
C    IGNORED.                                                                     SRCST
      IF(NUM(I).GT.99) GO TO 201                                                  SRCST
      IF(XNPR.LE.0) GO TO 40                                                      SRCST
      DO 35 J=1,XNPR                                                              SRCST
      IF(NUM(I).EQ.XPR(J)) GO TO 45                                               SRCST
   35 CONTINUE                                                                    SRCST
   40 XNPR=XNPR+1                                                                 SRCST
      XPR(XNPR)=NUM(I)                                                            SRCST
   45 CONTINUE                                                                    SRCST
      GO TO 10                                                                    SRCST
C...FLOW.                                                                         SRCST
C    SET THE FLOW PRINT FLAG FOR THE K-TH FLOW IN THE FLOW REFERENCE              SRCST
C    TABLE (XFR(K)) FOR EACH PAIR OF INDICES IN THE RANGE 1 THROUGH 99            SRCST
C    (NUM(I) AND NUM(J)) FOR WHICH A CORRESPONDING ENTRY EXISTS IN THE            SRCST
C    FLOW REFERENCE TABLE.                                                        SRCST
   50 DO 60 I=1,13,2                                                              SRCST
      J=I+1                                                                       SRCST
      IF(NUM(I).LE.0.AND.NUM(J).LE.0) GO TO 60                                    SRCST
      IF(NUM(I).LE.0.OR.NUM(I).GT.99) GO TO 201                                   SRCST
      IF(NUM(J).LE.0.OR.NUM(J).GT.99) GO TO 201                                   SRCST
      DO 55 K=1,XNF                                                               SRCST
      INFO=XFR(K)                                                                 SRCST
      CALL XUNPAK(INFO,IP,I1,I2)                                                  SRCST
      IF(NUM(I).NE.I1.OR.NUM(J).NE.I2) GO TO 55                                   SRCST
      IF(IP.EQ.1) GO TO 60                                                        SRCST
      XFR(K)=XFR(K)+10000                                                         SRCST
      GO TO 60                                                                    SRCST
   55 CONTINUE                                                                    SRCST
   60 CONTINUE                                                                    SRCST
      GO TO 10                                                                    SRCST
C...PLOT.                                                                         SRCST
C    RETRIEVE THE NUMBER OF PLOTS REQUESTED (XNPLT) FROM THE PLOT CARD,           SRCST
C    FIRST NUMERIC FIELD.                                                         SRCST
   65 XNPLT=NUM(1)                                                                SRCST
      IF(XNPLT.LE.0.OR.XNPLT.GT.20) GO TO 202                                     SRCST
C    THE NEXT (XNPLT) CARDS ARE READ, ONE CARD PER PLOT, WITH THE FIRST           SRCST
C    FIVE NUMERIC FIELDS INTERPRETED AS THE INDICES OF UP TO FIVE STATE           SRCST
C    VARIABLES TO APPEAR IN EACH PLOT.                                            SRCST
      DO 90 I=1,XNPLT                                                             SRCST
      READ(U1,100) IVERB,(NUM(J),J=1,14)                                          SRCST
      DO 68 J=1,3                                                                 SRCST
      IF(IVERB.EQ.KEY(J)) GO TO 203                                               SRCST
                                                                                  SRCST
```

```
00399          68 CONTINUE                                                    SRCST
00400             XNVRS(I)=0                                                  SRCST
00401             DO 85 J=1,5                                                 SRCST
00402             IF(NUM(J).LE.0) GO TO 85                                    SRCST
00403             IF(NUM(J).GT.99) GO TO 201                                  SRCST
00404             XNVRS(I)=XNVRS(I)+1                                         SRCST
00405             K=XNVRS(I)                                                  SRCST
00406             IF(XNPL.LE.0) GO TO 75                                      SRCST
00407             DO 70 L=1,XNPL                                              SRCST
00408             IF(NUM(J).EQ.XPL(L)) GO TO 80                               SRCST
00409          70 CONTINUE                                                    SRCST
00410          75 XNPL=XNPL+1                                                 SRCST
00411             XPL(XNPL)=NUM(J)                                            SRCST
00412             L=XNPL                                                      SRCST
00413          80 XNLOC(I,K)=L                                                SRCST
00414          85 CONTINUE                                                    SRCST
00415          90 CONTINUE                                                    SRCST
00416             GO TO 10                                                    SRCST
00417       C...IF ERRORS OCCURED GENERATE A DIAGNOSTIC.                      SRCST
00418         200 WRITE(U2,102) IVERB,(NUM(I),I=1,14)                         SRCST
00419             WRITE(U2,103)                                               SRCST
00420             STOP                                                        SRCST
00421         201 WRITE(U2,102) IVERB,(NUM(I),I=1,14)                         SRCST
00422             WRITE(U2,104)                                               SRCST
00423             STOP                                                        SRCST
00424         202 WRITE(U2,102) IVERB,(NUM(I),I=1,14)                         SRCST
00425             WRITE(U2,105)                                               SRCST
00426             STOP                                                        SRCST
00427         203 WRITE(U2,102) IVERB,(NUM(I),I=1,14)                         SRCST
00428             WRITE(U2,106)                                               SRCST
00429             STOP                                                        SRCST
00430         100 FORMAT(A4,6X,14I5)                                          SRCST
00431         102 FORMAT(33H0*****ERROR IN DATA SECTION INPUT,/10X,A4,6X,14I5) SRCST
00432         103 FORMAT(25H      ILLEGAL COMMAND VERB)                       SRCST
00433         104 FORMAT(43H      STATE VARIABLE INDEX .LE. 0 OR .GT. 99)     SRCST
00434         105 FORMAT(45H      NO. OF PLOTS REQUESTED .LE. 0 OR .GT. 20)   SRCST
00435         106 FORMAT(122H      COMMAND VERB ENCOUNTERED WHILE PROCESSING PLOT REQ SRCST
00436            -UEST. CHECK FOR NO. OF PLOTS REQUESTED .NE. NO. OF SUBSEQUENT CARD SRCST
00437            -S)                                                         SRCST
00438             END                                                        SRCST
                                                                            SRCST

00511             SUBROUTINE XUNPAK(IV,IP,IF,IT)                            SRCST
00512       C...THIS SUBROUTINE UNPACKS THE INFORMATION STORED IN THE FLOW REFERENCE SRCST
00513       C     TABLES.                                                   SRCST
00514       C         IV      -      WORD TO BE UNPACKED.                   SRCST
00515       C         IP      -      FLOW PRINT FLAG.                       SRCST
00516       C         IF      -      INDEX OF SOURCE COMPARTMENT.           SRCST
00517       C         IT      -      INDEX OF DESTINATION COMPARTMENT.      SRCST
00518             IP=IV/10000                                               SRCST
00519             I=IV-IP*10000                                             SRCST
00520             IF=I/100                                                  SRCST
00521             IT=I-IF*100                                               SRCST
00522             RETURN                                                    SRCST
00523             END                                                       SRCST
                                                                            SRCST

00727             SUBROUTINE START
00728             COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),
00729            -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,
00730            -   XNVRS(20),XNLOC(20,5)
00731             COMMON/SPARS/PI,YEAR
00732             COMMON/FPARS/P12A,P12B,P12C,P12D,P23A,P23B,P23C,P23D,P24A,P24B,
00733            -            P26A,P36A,P36B,P36C,P36D,P45A,P45B,P56A,P56B,P56C
00734             READ(1,100) PI,YEAR
00735             READ(1,100) P12A,P12B,P12C,P12D
00736             READ(1,100) P24A,P24B
00737             READ(1,100) P45A,P45B
00738             READ(1,100) P23A,P23B,P23C,P23D
00739             READ(1,100) P26A
00740             READ(1,100) P56A,P56B,P56C
00741             READ(1,100) P36A,P36B,P36C,P36D
00742             READ(1,100) (X(I),I=1,9)
00743             READ(1,100) TSTART,TEND,DT,DTPR,DTFL
00744         100 FORMAT(8F10.0)
00745             RETURN
00746             END
```

| Line Number | Comment |
|---|---|
| 100<br>339 to 343<br>418 to 420 | The command verb and 14 numeric fields are read in. The command verb is checked for a match with the list of legal command verbs and I is set as an index to the command verb encountered. |

| IVERB | I |
|---|---|
| END. | 1 |
| PRINT. | 2 |
| FLØW. | 3 |
| PLØT. | 4 |
| blank | 5 (illegal) |
| other | illegal |

Only the first four characters are checked. If a non-existent or blank command is encountered a diagnostic is issued and the program is terminated.

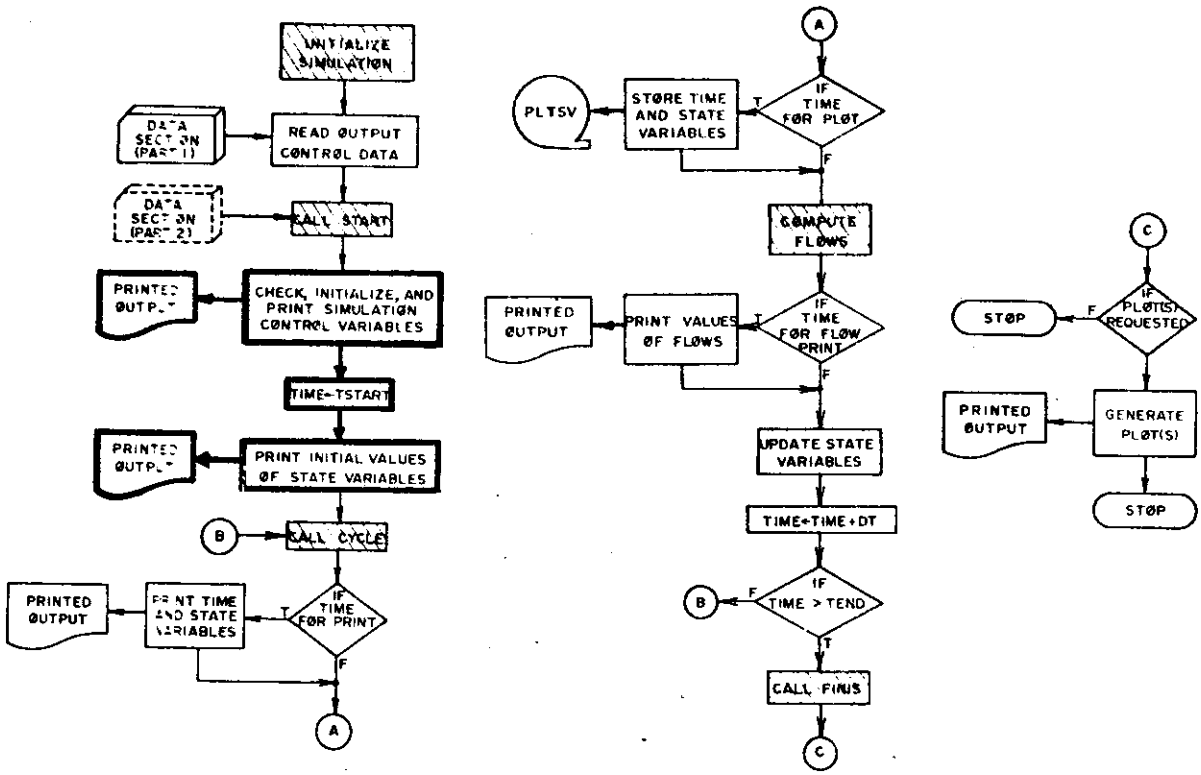
| | |
|---|---|
| 345 to 347 | KØDE is set to I and control is transferred to the section of the subroutine responsible for the particular verb encountered. |
| 349 | An END. command signals the end of output control commands and control is returned to the main program. |
| 353 to 366 | All values for the numeric fields NUM(I), I = 1 ,..., 14 within the range $1 \leq NUM(I) \leq 99$ are inserted in the state variable print stack XPR. The stated number of state variables requested for printing is XNPR. |
| 372 to 386<br>511 to 523 | Each of the 7 consecutive pairs of values for NUM are checked to be in the range 1 through 99. Each pair of values in NUM are checked for a match with the flow indices contained in array XFR which are retrieved for the check by routine XUNPAK. If a match is found a print indicator flag of 1000 is added to the value of XFR(I). For example is the flow (3-7) declared in the source program was requested for printing then XFR(5) would contain $10000 + 100 \cdot 3 + 7 = 10307$. |
| 390 to 391 | The first numeric field on the PLØT request is assumed to contain the number of plots requested and must be in the range $1 \leq XNPLT \leq 20$. |

| Line Number | Comment |
|---|---|
| 395 to 416 | The next XNPLT data cards are read in and processed one at a time. The command verb portion of the cards must not contain the recognizable commands END., PRINT., or FLØW. This feature alerts the user if the number of cards following the PLØT. card is less than the number of plots requested on the plot card. The first five numeric fields on each card are checked to be in the range 1 through 99. Values less than or equal to zero are assumed blank and are ignored. The following variable definitions pertain to the operation of the 85 loop (line nos. 401 to 414). |

| Variable | Description |
|---|---|
| NUM(J) | Value of the Jth numerics field. |
| XNVRS(I) | The number of variables to be plotted in the Ith graph. |
| XNPL | The total number of different state-variables to be plotted in all graphs. |
| XPL(L) | The index of the Lth state variable to be plotted. |
| XNLØC(I,K) | The location in array XPL containing the index of the Kth state variable to be plotted in the Ith graph. |

| | |
|---|---|
| 102<br>727 to 746 | Subroutine START was written by the user and included in the generated program by the compiler. The three common blocks were inserted into the routine by the compiler. The common blocks SPARS and FPARS were provided by the user in the *STØRAGE block in the source program. The purpose of subroutine START is to read in values of the user's parameters, the initial values of the state variables X(1) through X(9), and to change the values of the reserved system control variables from their default values. If subroutine START had not been provided by the user a dummy START routine would have been supplied by the compiler. |

*Check and output initialized system variables.*

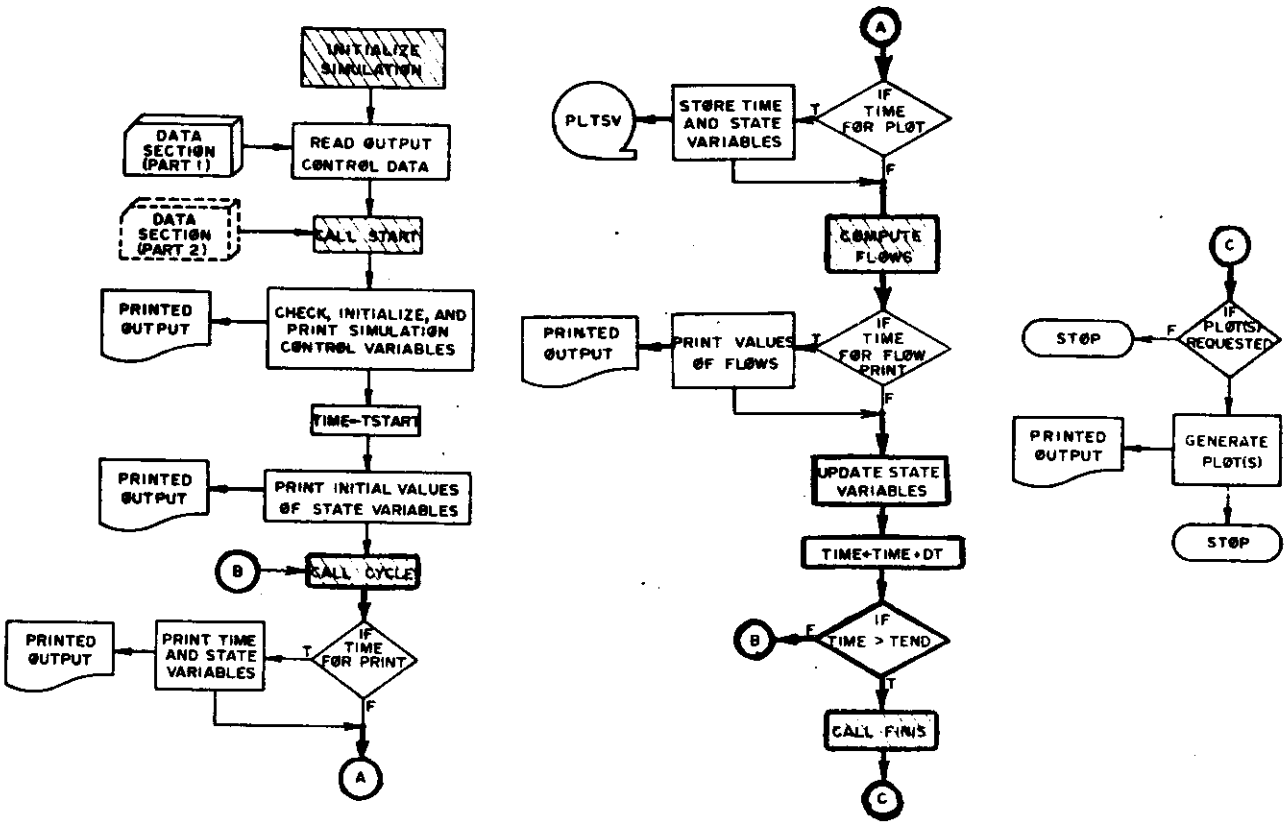



```
00005          COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),     SRCST
00006         -    XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,            SRCST
00007         -    XNVRS(20),XNLOC(20,5)                                             SRCST
00008          COMMON/XUNT/U1,U2,U3                                                  SRCST
00009          DIMENSION VAL(300)                                                    SRCST
00010          INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC          SRCST
00011          INTEGER U1,U2,U3                                                      SRCST
               .                                                                     SRCST
00103       C...CHECK AND INITIALIZE SIMULATION CONTROL VARIABLES.
00104            IF(TEND.LE.TSTART) GO TO 100                                       SRCST
00105            IF(DT.LE.0.) GO TO 101                                             SRCST
00106            TIME=TSTART                                                        SRCST
00107            IF(XNPR.GT.0.AND.DTPR.LE.0.) GO TO 102                             SRCST
00108            NPR=0                                                              SRCST
00109            TIMEPR=0.                                                          SRCST
00110            IF(XNPR.LE.0) GO TO 15                                             SRCST
00111            NPR=1                                                              SRCST
00112            TIMEPR=TSTART                                                      SRCST
00113         15 NPL=0                                                              SRCST
00114            TIMEPL=0.                                                          SRCST
00115            IF(XNPL.LE.0) GO TO 20                                             SRCST
00116            NPL=1                                                              SRCST
00117            TIMEPL=TSTART                                                      SRCST
00118            DTPL=(TEND-TSTART)/99.                                             SRCST
00119            IF(DTPL.LT.DT) DTPL=DT                                             SRCST
00120         20 NFL=0                                                              SRCST
00121            TIMEFL=0.                                                          SRCST
00122            IF(DTFL.LE.0.) GO TO 23                                            SRCST
00123            NFL=1                                                              SRCST
00124            TIMEFL=TIME                                                        SRCST
               .                                                                     SRCST
```

```
00125          C...OUTPUT SIMULATION CHARACTERISTS AND CONTROL VARIABLES.
00126             23 CONTINUE                                                    SRCST
00127                WRITE(U2,200) XNST,XNPR,XNPL,XNF                            SRCST
00128                WRITE(U2,201) TSTART,TEND,DT,DTPR,DTPL,DTFL                 SRCST
00129          C...OUTPUT INITIAL VALUES OF STATE VARIABLES.                     SRCST
00130                DO 10 I=1,XNST                                              SRCST
00131                J=XST(I)                                                    SRCST
00132             10 VAL(I)=X(J)                                                 SRCST
00133                NLINE=XNST/4+1                                              SRCST
00134                NKNT=MOD(XNST,4)                                            SRCST
00135                IF(NKNT.NE.0) GO TO 11                                      SRCST
00136                NLINE=NLINE-1                                               SRCST
00137                NKNT=4                                                      SRCST
00138             11 J1=1                                                        SRCST
00139                DO 18 I=1,NLINE                                             SRCST
00140                IF(I.EQ.NLINE) GO TO 12                                     SRCST
00141                J2=J1+3                                                     SRCST
00142                WRITE(U2,202) (XST(J),VAL(J),J=J1,J2)                       SRCST
00143                GO TO 18                                                    SRCST
00144             12 J2=J1+NKNT-1                                                SRCST
00145                GO TO(13,14,16,17), NKNT                                    SRCST
00146             13 WRITE(U2,212) (XST(J),VAL(J),J=J1,J2)                       SRCST
00147                GO TO 18                                                    SRCST
00148             14 WRITE(U2,211) (XST(J),VAL(J),J=J1,J2)                       SRCST
00149                GO TO 18                                                    SRCST
00150             16 WRITE(U2,210) (XST(J),VAL(J),J=J1,J2)                       SRCST
00151                GO TO 18                                                    SRCST
00152             17 WRITE(U2,202) (XST(J),VAL(J),J=J1,J2)                       SRCST
00153             18 J1=J1+4                                                     SRCST
00154                WRITE(U2,205)                                               SRCST
                                                                               SRCST

00194          C...GENERATE DIAGNOSTICS FOR ILLEGAL CONDITIONS.
00195            100 WRITE(U2,206)                                              SRCST
00196                WRITE(U2,207) TSTART,TEND                                   SRCST
00197                STOP                                                        SRCST
00198            101 WRITE(U2,206)                                              SRCST
00199                WRITE(U2,208) DT                                            SRCST
00200                STOP                                                        SRCST
00201            102 WRITE(U2,206)                                              SRCST
00202                WRITE(U2,209)                                               SRCST
00203                STOP                                                        SRCST
00204            200 FORMAT(20H1SIMCOMP VERSION 2.1,15X,18HINITIAL CONDITIONS///13X,SRCST
00205               -   37HNO. OF STATE VARIABLES.................,I2/16X,34HREQUESTED FO SRCST
00206               -R PRINT.................,I2/16X,34HREQUESTED FOR PLOT.............. SRCST
00207               -,I2//13X,37HNO. OF FLOWS.............................,I3)        SRCST
00208            201 FORMAT(///20X,20HTSTART.............,E12.5/20X,20HTEND.......... SRCST
00209               -......,E12.5/20X,20HDT.................,E12.5/20X,20HDTPR........ SRCST
00210               -........,E12.5/20X,20HDTPL.............,E12.5/20X,20HDTFL....... SRCST
00211               -.........,E12.5//)                                         SRCST
00212            202 FORMAT(10X,4(2HX(,I2,4H) = ,E12.5,5X))                     SRCST
                                                                               SRCST

00215            205 FORMAT(20H1SIMCOMP VERSION 2.1,15X,18HSIMULATION RESULTS,//)   SRCST
00216            206 FORMAT(42H0*****ILLEGAL CONDITION - PARAMETER VALUES)      SRCST
00217            207 FORMAT(13H0      TSTART(,E12.5,12H) .GE. TEND(,E12.5,1H))  SRCST
00218            208 FORMAT(9H0      DT(,E12.5,9H) .LE. 0.)                     SRCST
00219            209 FORMAT(44H0      PRINT REQUESTS ENCOUNTERED WHILE DTPR(,E12.5,9H) . SRCST
00220               -LE. 0.)                                                    SRCST
00221            210 FORMAT(10X,3(2HX(,I2,4H) = ,E12.5,5X))                     SRCST
00222            211 FORMAT(10X,2(2HX(,I2,4H) = ,E12.5,5X))                     SRCST
00223            212 FORMAT(10X,2HX(,I2,4H) = ,E12.5,5X)                        SRCST
                                                                               SRCST
```

| Line Number | Comment |
|---|---|
| 104 to 107 | The system control variables TSTART, TEND, DT, and DTPR are checked for legal values. An illegal condition generates a diagnostic and terminates the program. TIME is set equal to TSTART. |
| 108 to 112 | If PRINT. requests were processes and DTPR > 0 then the print flag NPR is set to one and the time of first print, TIMEPR is set to TSTART. |
| 113 to 119 | If PLØT. requests were processed then the plot flag NPL is set to one and the time for the first record of state variables to be plotted, TIMEPL is set to TSTART. DTPL is set to the maximum of (TEND - TSTART)/99 and DT. |
| 120 to 124 | If FLØW. printing requests were processed, then set the flow print flag NFL to one and set the time of flow printing TIMEFL to TSTART. |
| 126 to 154 | The values of the system control variables and the initial values of the state variables are printed on output. |

*Solve system of flow equations.*




The collection of highlighted blocks in the above flow charts are the the parts of the program directly related to the computation of the flows and the solution of the continuous system of difference or differential equations. The three conditional branches which have been passed over at this time provide for (i) the printing of tabular output, (ii) sowing of values for plotting, and (iii) the printing of values of the flows. These segments are treated separately on pages 85, 87, and 89.

```
00005          COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),    SRCST
00006         -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,           SRCST
00007         -   XNVRS(20),XNLOC(20,5)                                            SRCST
00008          COMMON/XUNIT/U1,U2,U3                                               SRCST
00009          DIMENSION VAL(300)                                                  SRCST
00010          INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC        SRCST
00011          INTEGER U1,U2,U3                                                    SRCST
```

```
00155          C...ENTER THE SIMULATION LOOP.
00156             25 CONTINUE                                                    SRCST
00157                CALL CYCLE                                                  SRCST
00158          C...GENERATE OUTPUT IF REQUESTED.                                 SRCST
00159                IF(NPR.LE.0.OR.TIMEPR.GT.TIME) GO TO 30                     SRCST
00160                CALL XPRINT(VAL)                                            SRCST
00161                TIMEPR=TIMEPR+DTPR                                          SRCST
00162             30 IF(NPL.LE.0.OR.TIMEPL.GT.TIME) GO TO 35                     SRCST
00163                CALL XPLOT(VAL,0)                                           SRCST
00164                TIMEPL=TIMEPL+DTPL                                          SRCST
00165          C...COMPUTE THE FLOWS.                                            SRCST
00166             35 CALL XFLWS                                                  SRCST
00167                IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 40                     SRCST
00168                TM=TIME+DT                                                  SRCST
00169                WRITE(U2,203) TIME,TM                                       SRCST
00170          C...UPDATE THE STATE VARIABLES AND PRINT FLOWS IF REQUESTED.      SRCST
00171             40 DO 45 I=1,XNF                                               SRCST
00172                INFO=XFR(I)                                                 SRCST
00173          C...RETRIEVE SOURCE (I1) AND DESTINATION (I2) COMPARTMENT INDICES, AND SRCST
00174          C     PRINT FLAG (IP) FOR THE I-TH FLOW.                          SRCST
00175                CALL XUNPAK(INFO,IP,I1,I2)                                  SRCST
00176                X(I1)=X(I1)-XF(I)*DT                                        SRCST
00177                X(I2)=X(I2)+XF(I)*DT                                        SRCST
00178                IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 45                     SRCST
00179                IF(IP.LE.0) GO TO 45                                        SRCST
00180                WRITE(U2,204) I1,I2,XF(I)                                   SRCST
00181             45 CONTINUE                                                    SRCST
00182                IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 50                     SRCST
00183                TIMEFL=TIMEFL+DTFL                                          SRCST
00184             50 TIME=TIME+DT                                                SRCST
00185                IF(TIME.GT.TEND) GO TO 55                                   SRCST
00186                GO TO 25                                                    SRCST
00187          C...SIMULATION IS COMPLETE, PREFORM END PROCESSING AND PLOT GENERATION SRCST
00188          C     IF REQUESTED.                                               SRCST
00189             55 CALL FINIS                                                  SRCST
                                                                                 SRCST

00747                SUBROUTINE CYCLE
00748                RETURN
00749                END

00225                SUBROUTINE XFLWS
00226                COMMON/XUNT/U1,U2,U3                                        SRCST
00227                COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300), SRCST
00228             -     XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,
00229             -     XNVRS(20),XNLOC(20,5)
00230                COMMON/SPARS/PI,YEAR
00231                COMMON/FPARS/P12A,P12B,P12C,P12D,P23A,P23B,P23C,P23D,P24A,P24B,
00232             -                  P26A,P36A,P36B,P36C,P36D,P45A,P45B,P56A,P56B,P56C
00233                INTEGER XNF,XFR,XNPR,XPR,XNPL,XPL,XNST,XST,U1,U2,U3
00234                INTEGER XN
00235          C...THIS SUBROUTINE COMPUTES THE VALUES OF THE FLOWS AND STORES THE SRCST
00236          C     VALUES IN THE COMPUTED FLOW STACK.  THE COMPARTMENTAL INDICES OF SRCST
00237          C     THE K-TH FLOW IN THE COMPUTED FLOW STACK ARE STORED IN THE K-TH SRCST
00238          C     ENTRY OF THE FLOW REFERENCE TABLE AS THE SUM OF THE FOLLOWING SRCST
00239          C     TERMS:                                                      SRCST
00240          C          N*10000          FLOW PRINT FLAG (N=0, NO PRINT - N=1, PRINT). SRCST
00241          C          I*100            INDEX OF SOURCE COMPARTMENT.        SRCST
00242          C          J                INDEX OF DESTINATION COMPARTMENT.   SRCST
00243                XN=0                                                      SRCST
00244                XN=XN+1                                                   SRCST
00245                F=0.
00246                F=(P12A+P12B*COS(P12C*2.*PI*(TIME-1.)/YEAR))/P12D
00247                IF(F.LT.0.) F=0.
00248                X(8)=F
00249                X(9)=X(9)+F*DT
00250                XF(XN)=F
00251                XN=XN+1
00252                F=0.
00253                F=P24A*EXP(TIME/P24B)
00254                F=F*X(2)
00255                XF(XN)=F
```

```
00256              XN=XN+1
00257              F=0.
00258              F=P45A*(1.+SIN(2.*PI*(TIME-1.)/YEAR-P45B))
00259              F=F*X(4)
00260              XF(XN)=F
00261              XN=XN+1
00262              F=0.
00263              F=0.
00264              XF(XN)=F
00265              XN=XN+1
00266              F=0.
00267              F=0.
00268              XF(XN)=F
00269              XN=XN+1
00270              F=0.
00271              F=0.
00272              IF(X(2).LT.20.) GO TO 5
00273              F=P23A+P23A*SIN(2.*PI*(TIME-1.)/YEAR-P23B)*P23C
00274              IF(F.LT.0.001) F=0.001
00275              F=F*X(2)*P23D
00276            5 CONTINUE
00277              XF(XN)=F
00278              XN=XN+1
00279              F=0.
00280              F=P26A
00281              F=F*X(6)
00282              XF(XN)=F
00283              XN=XN+1
00284              F=0.
00285              F=0.
00286              XF(XN)=F
00287              XN=XN+1
00288              F=0.
00289              F=(P56A*(1.+SIN(2.*PI*(TIME-1.)/YEAR-P56B))*X(4)-P56C*X(5))/X(5)
00290              F=F*X(5)
00291              XF(XN)=F
00292              XN=XN+1
00293              F=0.
00294              TEMP=(P36A+P36B*SIN(2.*PI*(TIME-1.)/YEAR+P36C))
00295              IF(TIME.GT.280.) GO TO 10
00296              F=TEMP
00297              GO TO 15
00298           10 F=TEMP*(365.-TIME)/110.
00299           15 IF(F.LT.0.00036) F=0.00036
00300              F=F*P36D*X(3)
00301              XF(XN)=F
00302              XN=XN+1
00303              F=0.
00304              F=0.
00305              XF(XN)=F
00306              RETURN
00307              END                                                          SRCST
                                                                               SRCST

00511              SUBROUTINE XUNPAK(IV,IP,IF,IT)                               SRCST
00512     C...THIS SUBROUTINE UNPACKS THE INFORMATION STORED IN THE FLOW REFERENCE SRCST
00513     C    TABLES.                                                         SRCST
00514     C         IV      -     WORD TO BE UNPACKED.                        SRCST
00515     C         IP      -     FLOW PRINT FLAG.                            SRCST
00516     C         IF      -     INDEX OF SOURCE COMPARTMENT.                SRCST
00517     C         IT      -     INDEX OF DESTINATION COMPARTMENT.           SRCST
00518              IP=IV/10000                                                  SRCST
00519              I=IV-IP*10000                                                SRCST
00520              IF=I/100                                                     SRCST
00521              IT=I-IF*100                                                  SRCST
00522              RETURN                                                       SRCST
00523              END                                                          SRCST
                                                                               SRCST

00750              SUBROUTINE FINIS
00751              RETURN
00752              END
```

| Line Number | Comment |
|---|---|
| 157<br>747 to 749 | Subroutine CYCLE is called prior to each execution of the simulation loop. The simulation loop is executed once for each time step DT from TSTART to TEND. Subroutine CYCLE in general is provided by the user in the *ROUTINES block. Since our example did not include the use of cycle the compiler provided a dummy routine to satisfy the call statement at line 157. |
| 166<br>225 to 307 | The values of the flows are computed in routine XFLWS. Most of the coding in XFLWS was generated by the compiler using the flow definitions provided by the user in the *FLØW block. A specific example how a single flow is computed and stored follows. |
| 269 to 277 | The sixth flow contained in the source program is represented by the coding in lines 269 through 277. The original source statements follow. |

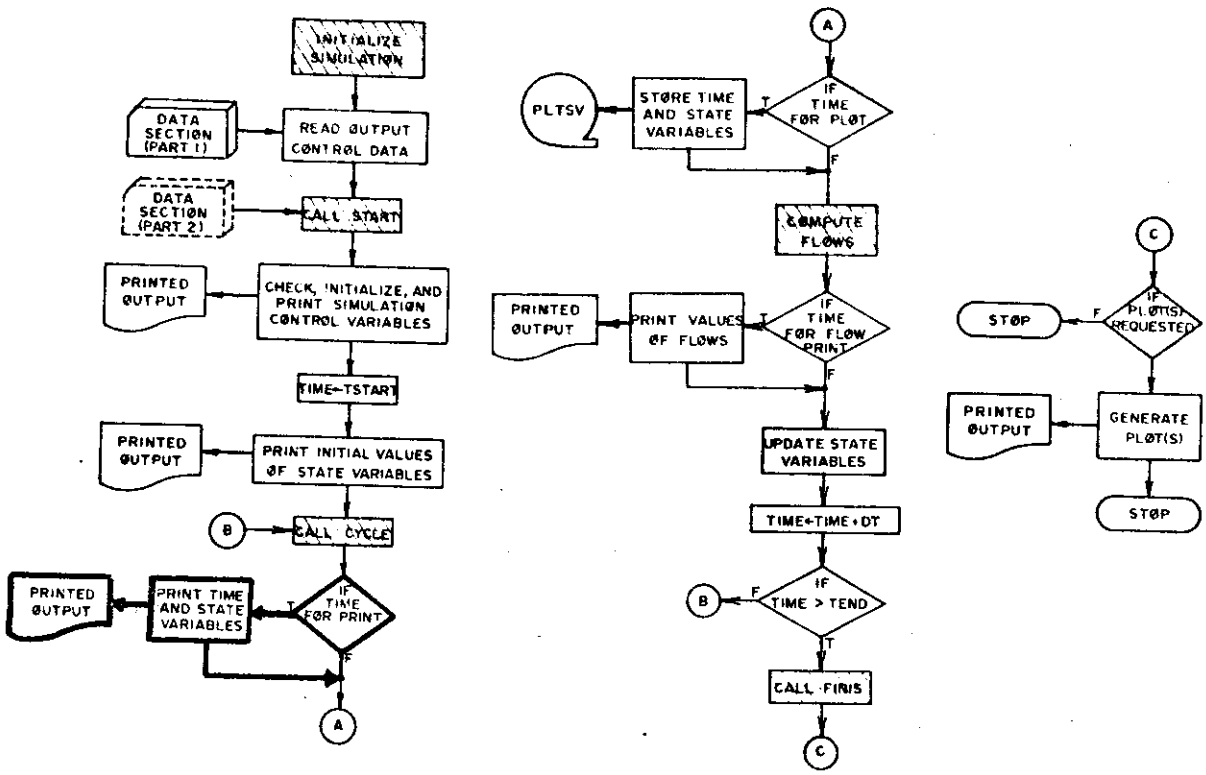
```
(2,3).
C...TRANSLOCATION OF ABOVE GROUND PLANTS TO ROOTS.
      F=0.
      IF(X(2).LT.20.) GO TO 5
      F=P23A+P23A*SIN(2.*PI*(TIME-1.)/YEAR-P23B)*P23C
      IF(F.LT.0.001) F=0.001
      F=F*X(2)*P23D
    5 CONTINUE
```

The compiler upon encountering the flow declaration (2,3). generated an entry into the array XFR(6) = 203 at line 74 of the generated program.
Lines 269, 270, and 277 were generated by the compiler. XN is incremented by one. Since this is the sixth flow XN = 6. F is set to zero. Lines 271 through 276 were copies from the source statements and are the code which the user used to compute the value of F, the sixth flow. At line 277 the most recent value of F is entered into the array of computed flows XF(6). The above procedure is performed for each flow declared by the user. Therefore, at the completion of routine XFLWS the first 11 elements of array XF contains the values of the 11 flows defined by the user.

| | |
|---|---|
| 171 to 181<br>511 to 523 | The DO loop beginning at line no. 171 is executed XNF times, where XNF is the number of flows in the simulation. XFR(I) contains the packed indices of the source and destination compartments of the Ith flow. Subroutine XUNPAK retrieves the indices of the two state variables as I1 and I2. IP is the flow print flag used to determine if the Ith flow had been requested for printing. The description of flow printing is on page 89. Since I1 is the source compartment, the value of the Ith flow XF(I) is multiplied by DT and the product is subtracted iteratively from X(I1). Similarly this product is added iteratively to X(I2). |

| Line Number | Comment |
|---|---|
| 184 to 186 | TIME is updated by the increment DT. If TIME is greater than TEND an exit is taken from the simulation loop. Otherwise, control is transferred to statement 25 and the simulation loop is reexecuted. |

*Print state variables.*



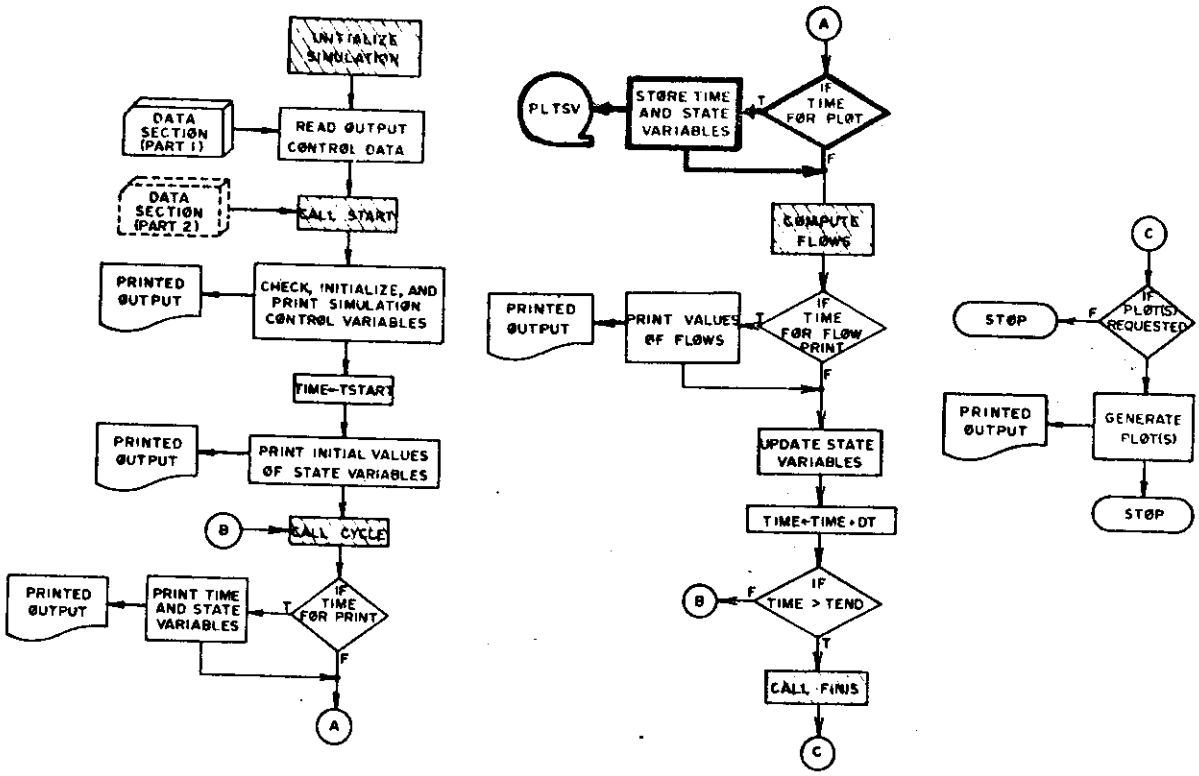

Lines 158 through 161 are contained within the simulation loop which is explained on page 80. The entire simulation loop is physically located in the main program.

```
00158         C...GENERATE OUTPUT IF REQUESTED.                                  SRCST
00159               IF(NPR.LE.0.OR.TIMEPR.GT.TIME) GO TO 30                      SRCST
00160               CALL XPRINT(VAL)                                             SRCST
00161               TIMEPR=TIMEPR+DTPR                                           SRCST
                                                                                 SRCST

00439               SUBROUTINE XPRINT(VAL)
00440               COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),  SRCST
00441           -      XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,   SRCST
00442           -      XNVRS(20),XNLOC(20,5)                                     SRCST
00443               COMMON/XUNT/U1,U2,U3                                         SRCST
00444               DIMENSION VAL(300)                                           SRCST
00445               INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC SRCST
00446               INTEGER U1,U2,U3                                             SRCST
00447         C...THIS ROUTINE PRODUCES PRINTED OUTPUT OF EACH STATE VARIABLE LISTED  SRCST
00448         C     IN THE PRINT REQUESTS.                                       SRCST
00449         C...STORE THE VALUES OF THE STATE VARIABLES TO BE PRINTED IN THE OUTPUT  SRCST
00450         C     WORKING STORAGE ARRAY.                                       SRCST
00451               DO 10 I=1,XNPR                                               SRCST
00452               J=XPR(I)                                                     SRCST
                                                                                 SRCST
```

```
00453            10 VAL(I)=X(J)
00454          C...FORMAT AND OUTPUT THE STATE VARIABLE NAMES AND VALUES. FOUR STATE      SRCST
00455          C     VARIABLES PER LINE.                                                  SRCST
00456                WRITE(U2,200) TIME                                                   SRCST
00457                NLINE=XNPR/4+1                                                       SRCST
00458                NKNT=MOD(XNPR,4)                                                     SRCST
00459                IF(NKNT.NE.0) GO TO 15                                               SRCST
00460                NLINE=NLINE-1                                                        SRCST
00461                NKNT=4                                                               SRCST
00462             15 J1=1                                                               SRCST
00463                DO 45 I=1,NLINE                                                      SRCST
00464                IF(I.EQ.NLINE) GO TO 20                                              SRCST
00465                J2=J1+3                                                              SRCST
00466                WRITE(U2,201) (XPR(J),VAL(J),J=J1,J2)                                SRCST
00467                GO TO 45                                                             SRCST
00468             20 J2=J1+NKNT-1                                                       SRCST
00469                GO TO(25,30,35,40), NKNT                                             SRCST
00470             25 WRITE(U2,202) (XPR(J),VAL(J),J=J1,J2)                              SRCST
00471                GO TO 45                                                             SRCST
00472             30 WRITE(U2,203) (XPR(J),VAL(J),J=J1,J2)                              SRCST
00473                GO TO 45                                                             SRCST
00474             35 WRITE(U2,204) (XPR(J),VAL(J),J=J1,J2)                              SRCST
00475                GO TO 45                                                             SRCST
00476             40 WRITE(U2,201) (XPR(J),VAL(J),J=J1,J2)                              SRCST
00477             45 J1=J1+4                                                            SRCST
00478                RETURN                                                               SRCST
00479            200 FORMAT(1HOTIME = ,E12.5)                                           SRCST
00480            201 FORMAT(10X,4(2HX(,I2,4H) = ,E12.5,5X))                             SRCST
00481            202 FORMAT(10X,2HX(,I2,4H) = ,E12.5,5X)                                SRCST
00482            203 FORMAT(10X,2(2HX(,I2,4H) = ,E12.5,5X))                             SRCST
00483            204 FORMAT(10X,3(2HX(,I2,4H) = ,E12.5,5X))                             SRCST
00484                END                                                                SRCST
```

| Line Number | Comment |
|---|---|
| 159 to 161 | If the print request flag NPR is set and TIME is greater than or equal to TIMEPR then the routine to print the requested state variables, XPRINT, is called. The time for the next printing of state variables, TIMEPR is updated by DTPR. |
| 451 to 453 | Array XPR contains the indices of XNPR in number state variables which were requested for printing on PRINT. output command cards. The values of these requested state variables are stored in the output working storage array VAL. |
| 456 | The current value of TIME is printed on a header line. |
| 457 to 462 | The number of lines required NLINE to print the XNPR values four to a line is computed. NKNT is the number of values ($1 \leq NKNT \leq 4$) to be printed in the last line. |
| 463 to 477 | Each of the NLINE lines of output are printed. The final line of output is printed by the appropriate format contingent upon the value of NKNT. |

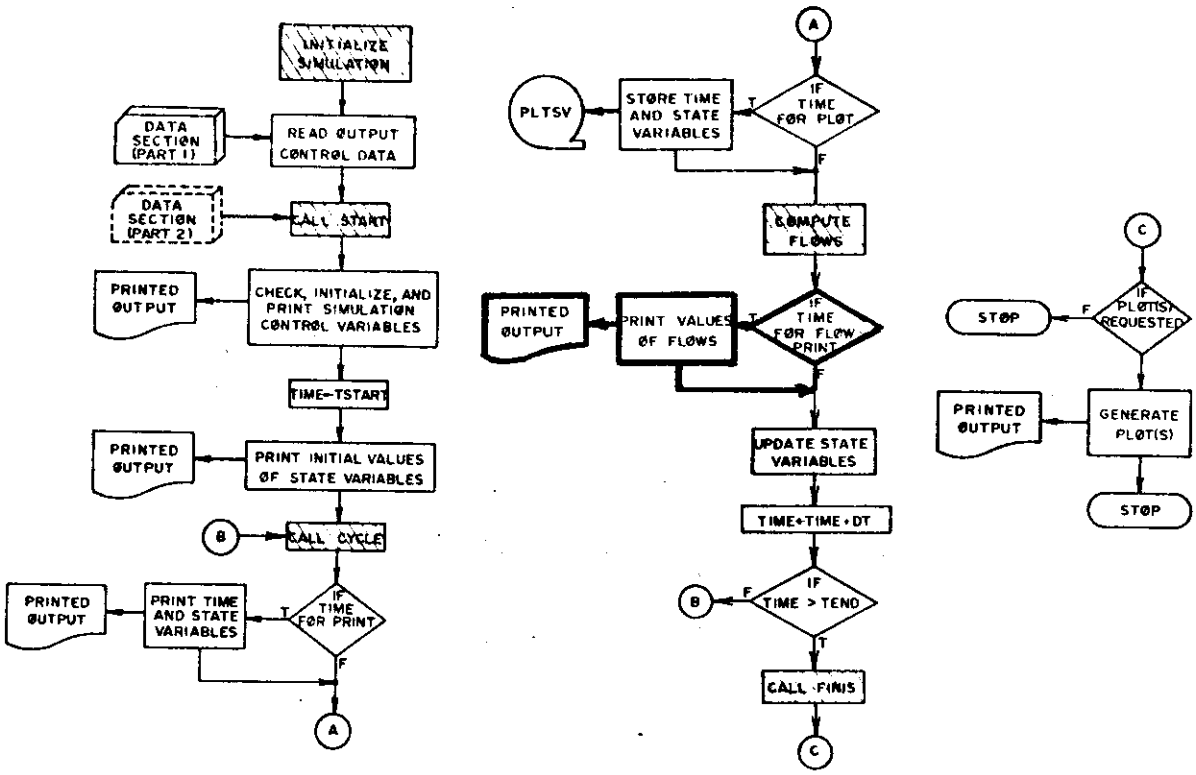
*Save values of state variables for plotting.*




```
00162          30 IF(NPL.LE.0.OR.TIMEPL.GT.TIME) GO TO 35                          SRCST
00163             CALL XPLOT(VAL,0)                                                SRCST
00164             TIMEPL=TIMEPL+DTPL                                               SRCST

00485             SUBROUTINE XPLOT(VAL,ISTOP)
00486             COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),  SRCST
00487            -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,        SRCST
00488            -   XNVRS(20),XNLOC(20,5)                                         SRCST
00489             COMMON/XUNT/U1,U2,U3                                             SRCST
00490             DIMENSION VAL(300)                                               SRCST
00491             INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC     SRCST
00492             INTEGER U1,U2,U3                                                 SRCST
00493          C...THIS ROUTINE GENERATES ONE RECORD OF PLOT VARIABLE VALUES ON MASS.  SRCST
00494          C     STORAGE DEVICE (U3) AT EACH CALL.                             SRCST
00495          C...STORE THE VALUES OF THE STATE VARIABLES TO BE SAVED FOR PLOTTING IN  SRCST
00496          C     THE OUTPUT WORKING STORAGE ARRAY.                             SRCST
00497             DO 10 I=1,XNPL                                                   SRCST
00498             J=XPL(I)                                                         SRCST
00499          10 VAL(I)=X(J)                                                      SRCST
00500          C...FORMAT FOR EACH RECORD:                                         SRCST
00501          C       WORD NO.      VARIABLE          PURPOSE                     SRCST
00502          C          1           ISTOP      FLAG TO SIGNAL LAST RECORD OF STORED  SRCST
00503          C                                    VALUES (ISTOP=1 IS FINAL, ISTOP=0  SRCST
00504          C                                    OTHERWISE).                   SRCST
00505          C          2           TIME       CURRENT SIMULATED TIME.         SRCST
00506          C       3 THROUGH      VAL(I)     VALUES OF THE XNPL STATE VARIABLES TO BE  SRCST
00507          C         XNPL+2                    PLOTTED.                      SRCST
00508             WRITE(U3) ISTOP,TIME,(VAL(I),I=1,XNPL)                           SRCST
00509             RETURN                                                           SRCST
00510             END                                                              SRCST
```

| Line Number | Comment |
|---|---|
| 162 to 164 | If the plot request flag NPL is set and TIME is greater than or equal to TIMEPL then the routine which stores the requested values for later plotting, XPLØT, is called. The next time for the storing of plot value TIMEPL is updated by DTPL. |
| 497 to 499 | Array XPL contains the indices of the XNPL in number state variables which were requested for plotting. VAL(I) contains the value of the Ith state variable to be plotted. |
| 508 | One unformatted record of information XNPL + 2 words long is written onto file PLTSV which is logical unit number U3. The value of ISTØP is normally zero. The last set of values written is flagged by setting ISTØP to one in the last call to XPLØT. |

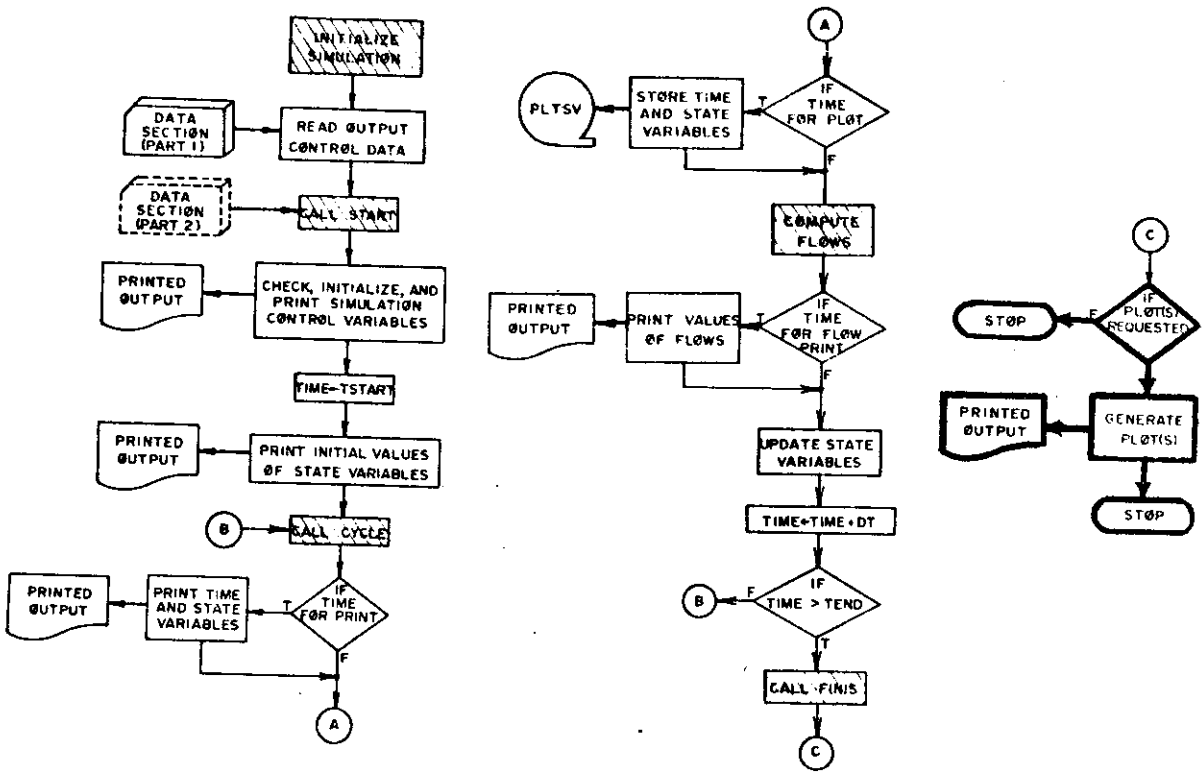
*Print values of flows.*




```
00165          C...COMPUTE THE FLOWS.                                          SRCST
00166             35 CALL XFLWS                                                SRCST
00167                IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 40                   SRCST
00168                TM=TIME+DT                                                SRCST
00169                WRITE(U2,203) TIME,TM                                     SRCST
00170          C...UPDATE THE STATE VARIABLES AND PRINT FLOWS IF REQUESTED.    SRCST
00171             40 DO 45 I=1,XNF                                             SRCST
00172                INFO=XFR(I)                                               SRCST
00173          C...RETRIEVE SOURCE (I1) AND DESTINATION (I2) COMPARTMENT INDICES, AND SRCST
00174          C     PRINT FLAG (IP) FOR THE I-TH FLOW.                        SRCST
00175                CALL XUNPAK(INFO,IP,I1,I2)                                SRCST
00176                X(I1)=X(I1)-XF(I)*DT                                      SRCST
00177                X(I2)=X(I2)+XF(I)*DT                                      SRCST
00178                IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 45                   SRCST
00179                IF(IP.LE.0) GO TO 45                                      SRCST
00180                WRITE(U2,204) I1,I2,XF(I)                                 SRCST
00181             45 CONTINUE                                                  SRCST
00182                IF(NFL.LE.0.OR.TIMEFL.GT.TIME) GO TO 50                   SRCST
00183                TIMEFL=TIMEFL+DTFL                                        SRCST
```

| Line Number | Comment |
|---|---|
| 167 to 169 | If the flow print request flag NFL is greater than zero and TIME is greater than or equal to TIMEFL, then a time header for the flow information to be printed is written. |
| 175<br>178 to 180 | The indices of the state variables (I1 and I2) of the Ith flow are unpacked. The flow print request indicator IP is also unpacked by routine XUNPAK. If flow printing has been requested (NFL > 0), the time for printing has been reached (TIME ≤ TIMEPL), and the Ith flow was requested for printing (IP > 0) then the Ith flow is printed on output. |
| 182 to 183 | If flow printing occurred the next time of flow printing TIMEFL is updated by DTFL. |

*Generate plots if requested.*




```
00190            IF(NPL.LE.0) GO TO 60                                          SRCST
00191            CALL XPLOT(VAL,1)                                              SRCST
00192            CALL XPLGEN                                                    SRCST
00193         60 STOP                                                           SRCST

00524            SUBROUTINE XPLGEN
00525            COMMON/XSYS/TIME,TSTART,TEND,DT,DTPR,DTPL,DTFL,X(99),XNF,XF(300),  SRCST
00526           -   XFR(300),XNST,XST(99),XNPR,XPR(99),XNPL,XPL(99),XNPLT,      SRCST
00527           -   XNVRS(20),XNLOC(20,5)                                       SRCST
00528            COMMON/XUNT/U1,U2,U3                                           SRCST
00529            DIMENSION Z(100),XLINE(11),YLINE(6)                            SRCST
00530            INTEGER XNF,XFR,XNST,XST,XNPR,XPR,XNPL,XPL,XNPLT,XNVRS,XNLOC   SRCST
00531            INTEGER U1,U2,U3                                               SRCST
00532         C...THIS ROUTINE GENERATES THE REQUESTED PLOTS UNDER CONTROL OF THE PLOT  SRCST
00533         C     GENERATION VARIABLES.  THE INFORMATION FOR PLOTTING IS ON THE  SRCST
00534         C     TEMPORARY MASS STORAGE DEVISE (U3).                          SRCST
00535            DO 35 II=1,XNPLT                                               SRCST
00536            XMIN=1.E50                                                     SRCST
00537            XMAX=-XMIN                                                     SRCST
00538            YMIN=1.E50                                                     SRCST
00539            YMAX=-YMIN                                                     SRCST
00540         C...SEARCH THE PLOT DATA, DETERMINING MAX AND MIN VALUES FOR SCALING.  SRCST
00541            REWIND U3                                                      SRCST
00542         20 READ(U3) ISTOP,TIME,(Z(I),I=1,XNPL)                            SRCST
00543            IF(ISTOP.GE.1) GO TO 27                                        SRCST
00544            XMIN=AMIN1(XMIN,TIME)                                          SRCST
00545            XMAX=AMAX1(XMAX,TIME)                                          SRCST
00546            NVARS=XNVRS(II)                                                SRCST
00547            DO 25 I=1,NVARS                                                SRCST
00548            LOC=XNLOC(II,I)                                                SRCST
00549            ZZ=Z(LOC)                                                      SRCST
00550            YMIN=AMIN1(YMIN,ZZ)                                            SRCST
```

```
00551          25 YMAX=AMAX1(YMAX,ZZ)                                          SRCST
00552             GO TO 20                                                     SRCST
00553       C...CALCULATE GRAPHICAL SCALING VALUES.                            SRCST
00554          27 CALL XRND(YMIN,YMAX,YMIN,YMAX)                               SRCST
00555             XLINE(1)=XMIN                                                SRCST
00556             XLINE(11)=XMAX                                               SRCST
00557             XINC=(XMAX-XMIN)/10.                                         SRCST
00558             XIST=XMIN                                                    SRCST
00559             DO 30 I=2,10                                                 SRCST
00560             XIST=XIST+XINC                                               SRCST
00561          30 XLINE(I)=XIST                                                SRCST
00562             YLINE(1)=YMIN                                                SRCST
00563             YLINE(6)=YMAX                                                SRCST
00564             YINC=(YMAX-YMIN)/5.                                          SRCST
00565             YIST=YMIN                                                    SRCST
00566             DO 32 I=2,5                                                  SRCST
00567             YIST=YIST+YINC                                               SRCST
00568          32 YLINE(I)=YIST                                                SRCST
00569       C...GENERATE THE PLOT.                                             SRCST
00570             REWIND U3                                                    SRCST
00571             CALL XGRAPH(II,NVARS,XNLOC,XLINE,YLINE,Z,YMIN,YMAX,XNPL,XPL) SRCST
00572          35 CONTINUE                                                     SRCST
00573             RETURN                                                       SRCST
00574             END                                                          SRCST
                                                                               SRCST
00575             SUBROUTINE XGRAPH(NPL,NVR,NXLOC,XLINE,YLINE,Z,YMIN,YMAX,NN,NXPL)  SRCST
00576             COMMON/XUNT/U1,U2,U3                                         SRCST
00577             DIMENSION NXLOC(20,5),XLINE(11),YLINE(6),Z(100),IP(100),JCHAR(5)  SRCST
00578             DIMENSION NXPL(99)                                           SRCST
00579             INTEGER U1,U2,U3                                             SRCST
00580             DATA JCHAR/1H1,1H2,1H3,1H4,1H5/                              SRCST
00581             DATA IBLNK/1H /, IDASH/1H-/, IEYEE/1HI/, IQUAL/1H=/          SRCST
00582       C...THIS ROUTINE GENERATES AND OUTPUTS ONE PRINTER PLOT AT EACH CALL.  SRCST
00583             KNT=0                                                        SRCST
00584             JNT=0                                                        SRCST
00585             DO 5 I=1,NVR                                                 SRCST
00586             J=NXLOC(NPL,I)                                               SRCST
00587          5 IP(I)=NXPL(J)                                                 SRCST
00588             WRITE(U2,300) NPL,(I,IP(I),I=1,NVR)                          SRCST
00589             WRITE(U2,301) (YLINE(I),I=1,6)                               SRCST
00590       C...EACH PASS THROUGH THE FOLLOWING EXPLICIT LOOP (STATEMENT 10 TO SRCST
00591       C     STATEMENT 40) GENERATES ONE LINE OF THE PRINTED GRAPH ON OUTPUT.  SRCST
00592       C...READ IN ONE TIME STEP OF PLOTTING DATA.                        SRCST
00593          10 READ(U3) ISTOP,TIME,(Z(I),I=1,NN)                            SRCST
00594             IF(ISTOP.GE.1) GO TO 40                                      SRCST
00595       C...INITIALIZE THE OUTPUT CHARACTER STRING (IP) TO CONTAIN BLANKS AND  SRCST
00596       C     GRAPHICAL REFERENCE LINES.                                   SRCST
00597             KNT=KNT+1                                                    SRCST
00598             ICHR=IBLNK                                                   SRCST
00599             IF(MOD(KNT,10).NE.0) GO TO 15                                SRCST
00600             IF(KNT.EQ.100) GO TO 15                                      SRCST
00601             ICHR=IDASH                                                   SRCST
00602          15 DO 20 I=1,100                                                SRCST
00603             IP(I)=ICHR                                                   SRCST
00604             IF(MOD(I,20).NE.0) GO TO 20                                  SRCST
00605             IF(I.EQ.100) GO TO 20                                        SRCST
00606             IP(I)=IEYEE                                                  SRCST
00607          20 CONTINUE                                                     SRCST
00608       C...INSERT PLOTTING CHARACTERS INTO STRING WHICH REPESENTS THE PLOTTED  SRCST
00609       C     VARIABLE.                                                    SRCST
00610             DO 30 I=1,NVR                                                SRCST
00611             LOC=NXLOC(NPL,I)                                             SRCST
00612             ZZ=Z(LOC)                                                    SRCST
00613       C...DETERMINE LOCATION OF PLOTTING CHARACTER IN STRING ACCORDING TO  SRCST
00614       C     VALUE OF DEPENDENT VARIABLE (ZZ) AND SCALING PARAMETERS.     SRCST
00615             ZI=1.+99.*(ZZ-YMIN)/(YMAX-YMIN)                              SRCST
00616             IZ=ZI                                                        SRCST
00617             ZJ=IZ                                                        SRCST
00618             IF((ZI-ZJ).GE.0.5) IZ=IZ+1                                   SRCST
                                                                               SRCST
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```
00619          C...STORE PLOTTING CHARACTER IN STRING.                                  SRCST
00620                JP=IP(IZ)                                                          SRCST
00621                ICHR=JCHAR(I)                                                      SRCST
00622                IF(JP.EQ.IBLNK) GO TO 25                                           SRCST
00623                IF(JP.EQ.IDASH) GO TO 25                                           SRCST
00624                IF(JP.EQ.IEYEE) GO TO 25                                           SRCST
00625                IF(JP.EQ.ICHR) GO TO 30                                            SRCST
00626                ICHR=IQUAL                                                         SRCST
00627             25 IP(IZ)=ICHR                                                        SRCST
00628             30 CONTINUE                                                           SRCST
00629          C...OUTPUT CHARACTER STRING.                                             SRCST
00630                IF(KNT.EQ.1.OR.MOD(KNT,10).EQ.0) GO TO 35                          SRCST
00631                WRITE(U2,302) (IP(I),I=1,100)                                      SRCST
00632                GO TO 10                                                           SRCST
00633             35 JNT=JNT+1                                                          SRCST
00634                WRITE(U2,303) XLINE(JNT),(IP(I),I=1,100)                           SRCST
00635                GO TO 10                                                           SRCST
00636             40 WRITE(U2,304)                                                      SRCST
00637                RETURN                                                             SRCST
00638            300 FORMAT(12H1  PLOT NO. ,I2//20X,5(I1,5H = X(,I2,1H),4X))          SRCST
00639            301 FORMAT(////13X,E12.5,5(8X,E12.5)/20X,1H*,18X,1H*,4(19X,1H*)/20X,  SRCST
00640              -    100(1HH))                                                      SRCST
00641            302 FORMAT(19X,1HH,100A1,1HH)                                         SRCST
00642            303 FORMAT(5X,E12.5,3H +H,100A1,1HH)                                  SRCST
00643            304 FORMAT(20X,100(1HH))                                              SRCST
00644                END                                                               SRCST

00645                SUBROUTINE XRND(ZMIN,ZMAX,RNZMIN,RNZMAX)                          SRCST
00646          C...GIVEN ZMIN AND ZMAX, THIS SUBROUTINE DETERMINES AN APPROPRIATE      SRCST
00647          C     SCALING FOR A GRAPH OF A FUNCTION WHOSE VALUES RANGE FROM ZMIN    SRCST
00648          C     TO ZMAX.                                                          SRCST
00649          C     RNZMIN AND RNZMAX ARE THE EXTREME VALUES OF THE GRAPH.            SRCST
00650          C...THE CASE WHERE ZMIN = ZMAX IS TREATED SEPARATELY.                   SRCST
00651                IF (ZMIN.NE.ZMAX) GO TO 20                                        SRCST
00652                IF (ZMAX.NE.0.) GO TO 1                                           SRCST
00653                RNZMIN = -1.                                                      SRCST
00654                RNZMAX = 1.                                                       SRCST
00655                GO TO 27                                                          SRCST
00656          C...SCALE Z UNTIL THE FIRST SIGNIFICANT DIGIT IS IN THE THOUSANDS      SRCST
00657          C     PLACE AND ROUND AT THE DECIMAL PLACE.                             SRCST
00658             1 Z = ZMAX                                                           SRCST
00659               I = 0                                                              SRCST
00660             2 IF (Z.GE.1000.) GO TO 3                                            SRCST
00661               Z = Z*10.                                                          SRCST
00662               I = I-1                                                            SRCST
00663               GO TO 2                                                            SRCST
00664             3 IF (Z.LT.10000.) GO TO 4                                           SRCST
00665               Z = Z/10.                                                          SRCST
00666               I = I+1                                                            SRCST
00667               GO TO 3                                                            SRCST
00668             4 Z = INT(Z+.5)                                                      SRCST
00669          C...DETERMINE THE NUMBER OF SIGNIFICANT DIGITS IN Z, TRUNCATE THE      SRCST
00670          C     LAST ONE, AND USE THIS NUMBER AS A BASIS FOR SETTING THE          SRCST
00671          C     GRAPH VALUES.                                                     SRCST
00672               Z = Z/10.                                                          SRCST
00673               I = I+1                                                            SRCST
00674             5 ZRND = INT(Z)                                                      SRCST
00675               IF (ZRND.NE.Z) GO TO 6                                           SRCST
00676               Z = Z/10.                                                          SRCST
00677               I = I+1                                                            SRCST
00678               GO TO 5                                                          SRCST
00679             6 IF (Z.GE.0.) RNZMIN = ZRND-1.                                    SRCST
00680               IF (Z.LT.0.) RNZMIN = ZRND-2.                                    SRCST
00681               RNZMAX = RNZMIN+3.                                               SRCST
00682          C...RESTORE THE NUMBERS TO THE ORIGINAL MAGNITUDE.                     SRCST
00683               RNZMIN = RNZMIN*10.**I                                           SRCST
00684               RNZMAX = RNZMAX*10.**I                                           SRCST
00685               GO TO 27                                                         SRCST
                                                                                     SRCST
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```
00686          C...IN THE GENERAL CASE THE DIFFERENCE, ZMAX-ZMIN, IS TRUNCATED TO                SRCST
00687          C     THE FIRST SIGNIFICANT DIGIT AND ENLARGED IF NECESSARY TO                    SRCST
00688          C     ENCOMPASS THE ENTIRE RANGE, ZMIN TO ZMAX.                                   SRCST
00689             20 VAR = ZMAX-ZMIN                                                             SRCST
00690                I = 0.                                                                      SRCST
00691             21 IF (VAR.GE.1.) GO TO 22                                                     SRCST
00692                VAR = VAR*10.                                                               SRCST
00693                I = I-1                                                                     SRCST
00694                GO TO 21                                                                    SRCST
00695             22 IF (VAR.LT.10.) GO TO 23                                                    SRCST
00696                VAR = VAR/10.                                                               SRCST
00697                I = I+1                                                                     SRCST
00698                GO TO 22                                                                    SRCST
00699             23 RNVAR = INT(VAR)                                                            SRCST
00700                IF (RNVAR.EQ.VAR) GO TO 24                                                  SRCST
00701                IF (VAR.GT.0.) RNVAR=RNVAR+1.                                               SRCST
00702                IF (VAR.LT.0.) RNVAR=RNVAR-1.                                               SRCST
00703          C...TRUNCATE ZMIN AT THE SAME DECIMAL PLACE AS THE DIFFERENCE,                    SRCST
00704          C     ZMAX-ZMIN, WAS TRUNCATED AND LOWER THIS VALUE IF NECESSARY                  SRCST
00705          C     TO INSURE THAT IT IS LESS THAN ZMIN. THIS VALUE IS USED FOR                 SRCST
00706          C     RNZMIN AND THE TRUNCATED DIFFERENCE, RNVAR, IS ADDED TO                     SRCST
00707          C     OBTAIN RNZMAX (RNVAR IS ENLARGED IF NECESSARY TO INSURE                     SRCST
00708          C     INCLUSION OF THE ENTIRE INTERVAL).                                          SRCST
00709             24 Z = ZMIN*10.**(-I)                                                          SRCST
00710                ZZ = ZMAX*10.**(-I)                                                         SRCST
00711                ZRND = INT(Z)                                                               SRCST
00712                IF (VAR.LT.0) GO TO 25                                                      SRCST
00713                IF (Z.GE.0.) RNZMIN=ZRND                                                    SRCST
00714                IF (Z.LT.0.) RNZMIN=ZRND-1.                                                 SRCST
00715                IF (RNZMIN+RNVAR.LT.ZZ) RNVAR=RNVAR+1.                                      SRCST
00716                GO TO 26                                                                    SRCST
00717             25 IF (Z.GT.0.) RNZMIN=ZRND+1.                                                 SRCST
00718                IF (Z.LE.0.) RNZMIN=ZRND                                                    SRCST
00719                IF (RNZMIN+RNVAR.GT.ZZ) RNVAR=RNVAR-1.                                      SRCST
00720             26 RNZMAX = RNZMIN+RNVAR                                                       SRCST
00721          C...RESTORE THE NUMBERS TO THE ORIGINAL MAGNITUDE                                 SRCST
00722                RNZMIN = RNZMIN*10.**I                                                      SRCST
00723                RNZMAX = RNZMAX*10.**I                                                      SRCST
00724             27 CONTINUE                                                                    SRCST
00725                RETURN                                                                      SRCST
                                                                                                SRCST
```

| Line Number | Comment |
|---|---|
| 535 to 572 | The DØ loop starting at line 535 is executed once for each plot requested. II is the number of the current plot. For each plot the data is read in two passes. The first pass on lines 542 through 552 scans the data to determine the minimum and maximum values for all variables in the IIth plot. The values to be written out at each grid reference line are computed in lines 554 through 568. The second pass through the data is made within routine XGRAPH which is called once for each plot to be generated from line 571. |

| Line Number | Comment |
|---|---|
| 554<br>645 to 725 | Routine XRND is called which, when given the minimum and maximum values of the dependent variables returns appropriately rounded values for minimum and maximum suitable for use as the extreme values for the plot. |
| 585 to 589 | An index of the state variables plotted in the NPLth plot and the character which represents each state variable in the plot is written. IP(I) currently contains the index of the Ith state variable to be plotted and is only used here has temporary working storage. |
| 593 to 594 | One record of data is read in. If ISTØP is greater than or equal to one, the currently read record is the last and an exit from the graphing loop is taken. Each pass through the loop reads in one time-record of data and produces one printed line of graphical output. The independent variable, TIME, runs down the printed paper. |
| 597 to 607 | The graphical output line IP is initialized to contain blanks and graphical reference lines. KNT is the current output line number. Every tenth line down the page is a reference line and is filled with dashes. Every 20th character in the line is a reference line and contains an "I." |
| 610 to 628 | The DO 30 loop inserts into the output line the appropriate character at the appropriate location in the line for each of the NVR variables to be plotted in the current graph. NXLØC(NPL,I) is the location in the data record Z of the value of the Ith variable in the NPLth plot. The value of the variable ZZ is scaled to produce a character position in the output line IZ. Grid lines and blanks are replaced by the character. If two or more different characters representing plotted variables is stored, then an equal sign is inserted in the line. |
| 630 to 635 | The graphical output line is printed. If the current line is a reference line. The value of the reference line is printed in the left hand margin. |

## LITERATURE CITED

Gustafson, J. D., and G. Innis. 1972. SIMCOMP version 2.0 user's manual. U.S. IBP Grassland Biome Tech. Rep. No. 138. Colorado State Univ., Fort Collins. 62 p.