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THE AEROSPACE CORPORATION
El Segundo, California 90245

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Aerospace Report No.
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10 MW SOLAR THERMAL
PILOT PLANT DYNAMIC
SIMULATION

VOLUME II
COMPUTER PROGRAM
SOURCE LISTING

1 December 1978

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FOREWORD

This report is written as a partial account of work performed for the Department of Energy, on the 10 MW Solar Thermal Pilot Plant Project, under Letter Contract Number ET-78-C-03-2028.

The report is in two parts:

Volume I - Computer Program Description

Volume II - Computer Program Source Listing

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CONTENTS

Volume II

Volume II of this report consists of the actual computer source listing of Program STMPPS. Included in the listing are all routines specifically developed by The Aerospace Corporation in meeting the requirements of this Department of Energy task. Logic and analytical details on which the program is based are described in detail in Volume I.

Not included in the listing are routines associated with GASP-IV, the commercially available but proprietary simulation language employed in Program STMPPS for executive control of the simulation process. As noted in Volume I, paragraph 1.2, GASP-IV routines may be purchased at a moderate cost by the interested user.

Also not included are the general Aerospace Corporation Computer Center math and service subroutines called by Program STMPPS, which were not developed under this contract (see, for example, paragraph 3.5.3 of Volume I). It is assumed that comparable service modules are available to a User in his own computer center library.

The enclosed listing contains a generous amount of non-programmatic comment lines to aid in interpretation of program logic. It is intended that Volumes I and II taken together allow Users to fully understand and utilize Program STMPPS capabilities.

PROGRAM STMPPS(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE8,TAPE10,
1 TAPE20)

SOLAR TEN MEGAWATT (ELECTRIC) PILOT PLANT SIMULATION

THE AEROSPACE CORPORATION
2350 E. EL SEGUNDO BLVD.
EL SEGUNDO, CALIFORNIA 90245

K.F. STEFFAN - SIMULATION INTEGRATION
DECEMBER, 1977 - MAY, 1978

TAPE8 PLOT DATA OUTPUT FILE
TAPE10 ENVIRONMENTAL DATA INPUT FILE
TAPE20 SOLAR FLUX DATA INPUT FILE

EXECUTIVE AND PROGRAM CONTROL DATA

INTEGER ATIMO,ATIDAY
LOGICAL OUTFG,END,DIAG
COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1 DIAG(40)

OUTFG(I,J) OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
END END OF RUN FLAG
ATILCL LOCAL TIME (SECONDS FROM MIDNIGHT)
ATITST TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
ATIMO MONTH
ATIDAY DAY
DIAG DIAGNOSTIC PRINT FLAG ARRAY

GASP-IV SIMULATION SYSTEM DATA

DIMENSION NSET(300)
COMMON QSET(300)
COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
1NAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
2,TTCLR,TTFIN,TTTRIB(25),TTSET
COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
1,1NNEQD,1NNEQS,1NNEQT,SS(600),SSL(600),TTNEX
COMMON /GCOM3/ AAERR,DTMAX,DTMIN,DTSAB,1ITES,LLERR,LLSAV,LLSEV,RRE
1RR,TTLAS,TTSAV
COMMON /GCOM4/ DTPLT(10),HHLOW(25),HHWID(25),IICRD,IITAP(10),JJCEL
1(500),LLABC(25,2),LLABH(25,2),LLASP(11,2),LLABT(25,2),LLPHI(10),LL
2PLO(10),LLPLT,LLSUP(15),LLSYM(10),MMPTS,NNCEL(25),NNCLT,NNHIS,NNPL
3T,NNPTS(10),NNSTA,NNVAR(10),PPI(10),PPLO(10)
COMMON /GCOM5/ IIEVT,IISED(6),JJBEG,JJCLR,MMNIT,MMON,NNAME(3),NNCF
1I,NNDAY,NNPT,NNSET,NNPRJ,NNPRM,NNRNS,NNRUN,NNSTR,NNYR,SSEED(6)
COMMON /GCOM6/ EENQ(100),IINN(100),KKRNK(100),MMAXQ(100),QQTIM(100
1),SSOBV(25,5),SSTPV(25,6),VVNQ(100)
EQUIVALENCE (NSET(1),QSET(1))

FUNDAMENTAL PHYSICAL CONSTANTS

COMMON /CONSTS/ PI,ZFR,GRAV,GRAV0,SBC,GCAIR

```

C      PI          PI
C      ZFR         ZERO FAHRENHEIT (DEGREES RANKINE)
C      GRAV        LOCAL ACCELERATION DUE TO GRAVITY (FT/(SEC)**2)
C      GRAVO       GRAVITATIONAL CONSTANT (LBM FT/LBF (SEC)**2)
C      SBC         STEFAN-BOLTZMANN CONSTANT (BTU/SEC-SQ FT (DEG R)**4)
C      GCAIR       GAS CONSTANT FOR AIR (FT LBF/LBM (DEG R))
C
C
C      DATA PI,ZFR,GRAV,GRAVO,SBC,GCAIR /3.14159265,459.69,32.174,32.174,
1 4.75E-13,53.34/
C
C
C      REWIND PLOT DATA FILE
C      REWIND 8
C      REWIND ENVIRONMENTAL DATA INPUT FILE
C      REWIND 10
C      REWIND SOLAR FLUX DATA INPUT FILE
C      REWIND 20
C      INITIALIZE
C      NCRDR=5
C      NFRNT=6
C      CALL ALINIT
100  CALL INIT(1)
C      READ INPUT DATA
150  CALL INP(1)
C      PERFORM SIMULATION
250  CALL GASP
C      TEST FOR END
C      IF (END) GO TO 900
C      LOOP FOR NEXT RUN
C      GO TO 100
C      TERMINATE RUN
900  STOP 1
      END

```


FUNCTION AT(XP,YP,B,M,M1,M2)

C
C THIS ROUTINE DETERMINES THE AREA OF THE RIGHT TRIANGLE FORMED
C BY A LINE WITH A SLOPE M AND Y INTERCEPT B ($Y=MX+B$) WITH
C A POINT (XP,YP)
C THE TRIANGLE IS BOUNDED BY THE LINES $Y=MX+B$, $X=XP$, AND $Y=YP$
C $M1=-M/2$, $M2=-1/(2M)$
C

REAL M,M1,M2

C
C $AT = ABS(XP*YP - B*XP + B*YP/M + M1*XP*XP + M2*(YP*YP+B*B))$
C

RETURN
END

SUBROUTINE CFWHTR(SWIN,SPIN,SHIN,CWIN,CPIN,CHIN,FWIN,FPIN,FHIN,
1 FWOUT,FPOUT,FHOUT,CWOUT,CPOUT,CHOUT,HPARM,Q)

THIS SUBROUTINE CALCULATES THE OUTPUT
STATE FOR A CLOSED FEEDWATER HEATER

INPUTS: SWIN STEAM FLOW IN
SPIN STEAM PRESSURE IN
SHIN STEAM ENTHALPY IN
CWIN CONDENSATE FLOW IN
CPIN CONDENSATE PRESS IN
CHIN CONDENSATE ENTHALPY IN
FWIN WATER FLOW IN
FPIN WATER PRESSURE IN
FHIN WATER ENTHALPY IN
HPARM(1) TERMINAL TEMP DIFF (F)
HPARM(2) PRESSURE DROP IN WATER
ACROSS HEATER (IN)
HPARM(3) TEMP DIFF IN DRAIN
COOLER (F)
OUTPUTS: CWOUT STEAM DRAIN FLOW
CPOUT STEAM DRAIN PRESSURE
CHOUT STEAM DRAIN ENTHALPY
FWOUT WATER FLOW OUT
FPOUT WATER PRESSURE OUT
FHOUT WATER ENTHALPY OUT
Q HEAT REJECTED BY
DRAIN COOLER

COMPRESSED WATER/SUPERHEATED STEAM TABLE DATA

LOGICAL NO COMP,SATURD
REAL HE,PE,SE,TE,VE,XE
COMMON /USECOM/ HE,PE,SE,TE,VE,XE,NO COMP,SATURD

DIMENSION HPARM(3)

1) FEEDWATER OUTPUT
FLOW AND PRESSURE

FWOUT=FWIN
FPOUT=HPARM(2)*FPIN

FEEDWATER INPUT TEMPERATURE

CALL USE HP(FHIN,FPIN)
FTEMP=TE
TDRAIN=TE

TEMPERATURE OF CONDENSED STEAM

SATURD=.FALSE.
CALL USE TSAT(SPIN,DUM)
CTEMP=TE
CHOUT=HE

FEEDWATER OUTPUT TEMPERATURE

IF (SWIN.GT.0.0) FTEMP=CTEMP-HPARM(1)

FEEDWATER OUTPUT ENTHALPY

CALL USE PT(FPOUT,FTEMP)
FHOUT=HE

2) DRAIN COOLER OUTPUT
FLOW

```

C      CWOUT=SWIN+CWIN
C      TDRAIN=TDRAIN+HPARM(3)
C      TEMPERATURE
C      PRESSURE AND ENTHALPY
1  IF (CWOUT.GT.0.0) CHOUT=(FWIN*(FHIN-FHOUT)
      +CWIN*CHIN+SWIN*SHIN)/CWOUT
C      CROUT=SPIN..
C      RETURN
      END

```

SUBROUTINE CLDINT

CLOUD SIMULATION INITIALIZATION - CALL CLDINT

SETS UP ONE-TIME FUNCTIONS REQUIRING XDIR
CALLED ONCE BEFORE CALLING CLOUD

SUBROUTINE CLOUD

THIS ROUTINE SIMULATES THE PASSAGE OF A CLOUD ACROSS A
COLLECTOR FIELD REPRESENTED BY AN 11 BY 11 ARRAY OF CELLS.

THE CLOUD IS REPRESENTED BY A FRONT AND A REAR WHICH ARE
STRAIGHT LINES PERPENDICULAR TO THE CLOUD DIRECTION.
THE FRONT STARTS AT THE NEAREST CELL CORNER (OR SIDE) AT
TIME XTIST AND MOVES ACROSS THE FIELD AT A VELOCITY XVEL(M/S).
EACH TIME CLOUD IS CALLED IT SETS THE EFFICIENCY OF EACH
CELL INTERCEPTED BY THE FRONT TO THE FRACTION OF THE CELL
LEFT OPEN AND THEN PROCESSES THE CLOUD REAR.
THE REAR STARTS AT THE NEAREST CELL CORNER (OR SIDE) AT
TIME XTIEND AND MOVES ACROSS THE FIELD AT A VELOCITY XVEL.
THE EFFICIENCY OF EACH CELL INTERCEPTED BY THE REAR IS SET
TO THE FRACTION OF THE CELL LEFT OPEN.

NOTE - THE EFFICIENCY OF A CELL IS SET ONLY AFTER THE FRONT
INTERCEPTS IT (IT DECREASES) OR WHEN A REAR INTERCEPTS IT
(IT INCREASES).

RESTRICTION - THE CLOUD FRONT AND REAR ARE PROCESSED
SEQUENTIALLY. THE ROUTINE DOESNT LOOK FOR A
FRONT AND REAR IN THE SAME CELL. THE ACTION OF
THE REAR WILL DETERMINE THE FINAL RESULT.
THE START AND END TIMES SHOULD BE CHOSEN SO THAT THE
DISTANCE BETWEEN THE FRONT AND REAR EXCEEDS A CELL
DIAGONAL. A PRACTICAL GUIDE IS --

$(XTIEND - XTIST) * XVEL .GT. \sqrt{2} * HCFL / 11.0$

EXECUTIVE AND PROGRAM CONTROL DATA

INTEGER ATIMO, ATIDAY
LOGICAL OUTFG, END, DIAG
COMMON /ADATA/ OUTFG(2,10), END, ATILCL, ATITST, ATIMO, ATIDAY,
1 DIAG(40)

OUTFG(I,J) OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
END END OF RUN FLAG
ATILCL LOCAL TIME (SECONDS FROM MIDNIGHT)
ATITST TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
ATIMO MONTH
ATIDAY DAY
DIAG DIAGNOSTIC PRINT FLAG ARRAY

COLLECTOR SUBSYSTEM DATA

COMMON /HDATA/ HFLRN(20,8), HCEF(121), HREF, HCFL, XTIST, XTIEND,

```

C      1 XVAL,XDIR,XDTCS.
C
C      HFLRN      HELIOSTAT OUTPUT SOLAR ARRAY FLUX AT RECEIVER NODES
C                  (BTU/SEC)
C      HCEF      HELIOSTAT FIELD CELL EFFICIENCIES (ND)
C      HREF      HELIOSTAT REFLECTIVE EFFICIENCY (ND)
C      HCFL      COLLECTOR FIELD SIZE (FEET)
C      XTIST      START TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD FRONT INTERCEPTS CORNER OF CELL ARRAY
C      XTIEND     END TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD REAR INTERCEPTS CORNER OF CELL ARRAY
C      XVAL      CLOUD VELOCITY (MILES/HOUR)
C      XDIR      CLOUD DIRECTION (DEGREES FROM N TO S DIRECTION)
C                  (0 = N TO S, 90 = W TO E, -90 = E TO W, 180 = S TO N)
C      XDTCS     CLOUD UPDATE SCHEDULING INTERVAL (SEC)
C
C
C

```

```

REAL M,M1,M2
DIMENSION IP(4),KX(4),KY(4),XC(4),YC(4),BC(12)
DATA KX,KY /0,0,1,1,0,1,1,0/
DATA RAD/0.01745329252/

```

```

C
C      DIRECTION CATEGORY - ID
C      ID = 1  0.0 .GT. XDIR .GT. -90.0
C              = 2  -90.0 .GT. XDIR .GT. -180.0
C              = 3  90.0 .LT. XDIR .LT. 180.0
C              = 4  0.0 .LT. XDIR .LT. 90.0
C              = 5  XDIR = 0.0
C              = 6  XDIR = -90.0
C              = 7  XDIR = 180.0
C              = 8  XDIR = 90.0
C
C      SLOPE FLAG - IS = 0 - SKEW, = 1 - INFINITE, = 2 - ZERO
C
C      XVAL IN MI/HR      - - CONVERT TO M/SEC
C      XVEL = XVAL*0.447041
C      PILOT PLANT SM=1.24 HCFL = 2384.77 FT - HCFM = 726.88 M
C      CONVERT FEET TO METERS
C      HCFM = HCFL*0.3048
C      IS = 0
C      IF (XDIR .NE. -90.0) GO TO 5
C      ID = 6 $ IS = 1
C      GO TO 16
C      5 IF (XDIR .NE. 90.0) GO TO 6
C      ID = 8 $ IS = 1
C      GO TO 16
C      6 IF (XDIR .NE. 0.0) GO TO 7
C      ID = 5 $ IS = 2
C      GO TO 16
C      7 IF (XDIR .NE. 180.0) GO TO 8
C      ID = 7 $ IS = 2
C      GO TO 16
C      8 IF (XDIR .GT. -90.0) GO TO 9
C      ID = 2 $ TH = XDIR + 180.0
C      GO TO 15
C      9 IF (XDIR .GT. 0.0) GO TO 10
C      ID = 1 $ TH = XDIR
C      GO TO 15
C      10 IF (XDIR .GT. 90.0) GO TO 11
C      ID = 4 $ TH = XDIR

```

```

      GO TO 15
11 IF (XDIR .GT. 180.0) GO TO 99
      ID = 3 $ TH = XDIR - 180.0
C      FRONT (REAR) SLOPE
15 M = TAN(TH*RAD)
      M1 = -0.5*M
      M2 = -0.5/M
      STH = SIN(TH*RAD)
      CTH = COS(TH*RAD)
16 CONTINUE
C
C      FIELD DATA AND CELL BOUNDARY COORDINATES
C
      DC = HCFM/11.0
      AC = DC*DC
      XF = -5.5
      DO 17 I=1,12
      BC(I) = DC*XF
17 XF = XF + 1.0
C
C      CHECK THE TIMES
C
      IF (XVEL*(XTIEND-XTIST) .LT. 1.414214*DC) GO TO 99
C
C      START POINT COORDINATES X,Y OR SIDE X
C
      GO TO (22,22,21,21,22,22,21,21) ID
21 X = BC(1)
      GO TO 24
22 X = BC(12)
24 IF (ID .GT. 4) GO TO 27
      GO TO (26,25,25,26) ID
25 Y = BC(1)
      GO TO 27
26 Y = BC(12)
C
C      DIRECTION INDICATORS - SY, ISY, SX
C
27 GO TO (29,28,28,29,29,29,28,28) ID
C      Y INCREASING
28 SY = 1.0 $ ISY = 1
      GO TO 30
C      Y DECREASING
29 SY = -1.0 $ ISY = 2
30 GO TO (32,32,31,31,32,32,31,31) ID
C      X INCREASING
31 SX = 1.0
      GO TO 33
C      X DECREASING
32 SX = -1.0
C
C      DISTANCE LIMIT - DL
C
33 DL = HCFM*1.414214
      IF (ID .GT. 4) DL = HCFM
C
C      CALCULATE TIME INTERVAL BETWEEN SCHEDULED CALLS TO SUBROUTINE
C      CLOUD. C1 MUST BE BETWEEN 0.05 AND 5.0.
      C1=0.25
      XOTCS=(C1*HCFL/11.0)/(XVAL*1.4666667)

```



```

C      RETURN
C      ENTRY CLOUD
C
C      DEPTH OF FRONT PENETRATION
C
C      D = XVEL*(ATILCL - XTIST)
C      HAS THE FRONT REACHED THE FIELD
C      IF (D .LE. 0.0) RETURN
C
C      DEPTH OF REAR PENETRATION
C
C      DE = XVEL*(ATILCL - XTIEND)
C      HAS THE FRONT LEFT THE FIELD
C      IF (D .LT. DL) GO TO 34
C
C      YES - FIELD ENTIRELY INTERCEPTED
C      DO 97 L=1,121
C      97 HCEF(L) = 0.0
C
C      HAS THE REAR REACHED THE FIELD
C      100 IF (DE .LE. 0.0) RETURN
C      HAS THE REAR LEFT THE FIELD
C      IF (DE .LT. DL) GO TO 101
C      FIELD IS ENTIRELY OPEN
C      DO 102 L=1,121
C      102 HCEF(L) = 1.0
C      RETURN
C      INDICATE REAR PROCESSING
C      101 IPP = 1 $ FS = 1.0
C      D = DE
C      DIRECTION TYPE
C      IF (ID .GT. 4) GO TO 60
C      GO TO 35
C      INDICATE FRONT PROCESSING
C      34 IPP = 0 $ FS = 0.0
C      DIRECTION TYPE
C      IF (ID .GT. 4) GO TO 60
C
C
C      SKEW SLOPE PROCESSING ID = 1 TO 4
C      IPP = 0, FRONT, = 1, REAR
C      35 DELX = ABS(D*STH)
C      DELY = ABS(D*CTH)
C      LOCATE A POINT ON THE FRONT (REAR)
C      XP = X + SX*DELX
C      YP = Y + SY*DELY
C      Y INTERCEPT
C      B = YP - M*XP
C
C      EXAMINE EACH CELL
C
C      DO 55 L=1,121
C      I = FLOAT(L-1)/11.0 + 1.0001
C      J = L - 11*(I-1)
C      II = 12 - I
C      EXAMINE EACH CELL CORNER
C      STATUS SUM - KS
C      KS = 0
C      DO 40 K=1,4

```

```

C      IP = 0, CORNER IS NOT YET AFFECTED BY FRONT (REAR)
C      = 1, CORNER HAS BEEN INTERCEPTED
C
C      IP(K) = 0
C      CORNER COORDINATES
C      JK = J + KX(K)
C      XC(K) = BC(JK)
C      IK = II + KY(K)
C      YC(K) = BC(IK)
C      HAS THE CORNER BEEN INTERCEPTED
C      IF (ISY .EQ. 2) GO TO 42
C      IF (YC(K) .LT. (M*XC(K)+B)) IP(K)=1
C      GO TO 40
C 42 IF (YC(K) .GT. (M*XC(K)+B)) IP(K)=1
C      SUM CORNER CONDITION
C 40 KS = KS + IP(K)
C
C      CELL CLOSURE
C      IF THE CELL IS NOT INTERCEPTED DO NOT SET HCEF
C      KT = KS+1
C      GO TO (55,46,47,48,45) KT
C      CELL IS COMPLETELY INTERCEPTED
C 45 HCEF(L) = FS
C      GO TO 55
C
C      PARTIAL CLOSURE
C
C      ONE CORNER INTERCEPTED
C      FIND THE CORNER
C 46 K = KSER(1,IP,1)
C      IF (K .EQ. 0) GO TO 99
C      FIND THE AREA CLOSED (OPENED)
C      AS = AT(XC(K),YC(K),B,M,M1,M2)
C      HCEF(L) = 1.0 - AS/AC
C      IF (IPP .EQ. 1) HCEF(L)=1.0-HCEF(L)
C      GO TO 55
C      TWO CORNERS INTERCEPTED
C      LOCATE THE FIRST ONE
C 47 K = KSER(1,IP,1)
C      IF (K .EQ. 0) GO TO 99
C      AREA ENCLOSED BY THE FIRST
C      AS = AT(XC(K),YC(K),B,M,M1,M2)
C      LOCATE THE SECOND
C      K = K + 1
C      K = KSER(K,IP,1)
C      IF (K .EQ. 0) GO TO 99
C      AREA ENCLOSED BY THE SECOND
C      ASN = AT(XC(K),YC(K),B,M,M1,M2)
C      HCEF(L) = 1.0 - ABS(AS-ASN)/AC
C      IF (IPP .EQ. 1) HCEF(L)=1.0-HCEF(L)
C      GO TO 55
C      THREE CORNERS INTERCEPTED
C      LOCATE THE OPEN CORNER
C 48 K = KSER(1,IP,0)
C      IF (K .EQ. 0) GO TO 99
C      AREA NOT INTERCEPTED
C      AS = AT(XC(K),YC(K),B,M,M1,M2)
C      HCEF(L) = AS/AC
C      IF (IPP .EQ. 1) HCEF(L)=1.0-HCEF(L)
C 55 CONTINUE

```

```

C
C      ALL CELLS COMPLETED
C      GO TO 70
C
C      FRONT (REAR) SLOPE ZERO AND INFINITE PROCESSING ID= 5 TO 8
C      IPP = 0, FRONT, = 1; REAR
C
60 IK = ID - 4
C      COORDINATE OF THE FRONT (REAR)
C      DX = X + SY*D.
C      LOCATE THE CELL ROW (COLUMN) THE FRONT (REAR) IS IN
C      DO 62 K=1,12
C      IF (BC(K) .GE. DX) GO TO 63
62 CONTINUE
C      K = 12
63 KS = K - 1
C      KS IS THE INDEX OF THE ROW OR COLUMN CONTAINING THE FRONT
C      LENGTH OF CELL INTERCEPTED
C      IF (ISY .EQ. 1) DS = DX-BC(KS)
C      IF (ISY .EQ. 2) DS = BC(KS+1)-DX
C
C      RESET KS IF THE FRONT(REAR) IS DECREASING
C      IF (SY .LT. 0.0) KS = 12 - KS
C      SET THE CELLS THAT HAVE BEEN INTERCEPTED
C
C      CALL SETH(KS,IK,0,FS)
C      PROCESS THE INTERFACE CELLS
C      FS = 1.0 - DS/DC
C      IF (IPP .EQ. 1) FS=1.0-FS
C      SET THE PARTIAL CELLS
C      CALL SETH(KS,IK,1,FS)
C
C      HAS THE CLOUD REAR BEEN DONE
C
70 IF (IPP .EQ. 0) GO TO 100
C      RETURN
C
C      ERROR RETURN
C
99 RETURN
C      END

```

SUBROUTINE EDATIN

WRITTEN BY C. M. RANDALL, THE AEROSPACE CORPORATION, JANUARY 1978

THIS SUBROUTINE PROVIDES ENVIRONMENTAL DATA FROM THE DETAILED
ENVIRONMENTAL DATA BASE TAPE FOR USE IN THE PILOT PLANT
SIMULATION PROGRAM

THIS SUBROUTINE WILL PROVIDE ENVIRONMENTAL DATA FOR THE LOCAL
STANDARD TIME SPECIFIED BY THE COMBINATION OF THE FOLLOWING
3 VARIABLES, ASSUMED TO BE SET BEFORE ENTRY TO THIS SUBROUTINE

ATILCL
ATIMO
ATIDAY

THE DATA TAPE IS ASSUMED TO BE TAPE10
TAPE10 MUST HAVE ASSOCIATED WITH IT THE FOLLOWING FILE CARD
FILE(TAPE10,RT=F,BT=K,PB=96,FL=163,CM=YES,MRL=163,MBL=20000)
THE TAPE WILL BE NT,PE. A VSN WILL BE PROVIDED WHEN REQUIRED

THIS PROGRAM WILL PROVIDE A VALUE FOR EACH OF THE FOLLOWING
VARIABLES APPROPRIATE TO THE TIME SPECIFIED.

ATITST
ETEAMB
EPRAMB
EVWAMB
EINDIR
EDWAMB
ETDAMB

EXECUTIVE AND PROGRAM CONTROL DATA

INTEGER ATIMO,ATIDAY
LOGICAL OUTFG,END,DIAG
COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1 DIAG(40)

OUTFG(I,J) OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
END END OF RUN FLAG
ATILCL LOCAL TIME (SECONDS FROM MIDNIGHT)
ATITST TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
ATIMO MONTH
ATIDAY DAY
DIAG DIAGNOSTIC PRINT FLAG ARRAY

ENVIRONMENTAL DATA

COMMON /EDATA/ ETEAMB,EPRAMB,EVWAMB,EINDIR,EDWAMB,ETDAMB

ETEAMB AMBIENT TEMPERATURE (DEGREES FAHRENHEIT)
EPRAMB AMBIENT PRESSURE (LB/SQ IN ABS)
EVWAMB AMBIENT WIND VELOCITY (FT/SEC)
EINDIR DIRECT INSOLATION (KILOWATTS/SQ METER)
EDWAMB WIND DIRECTION (DEGREES AZIMUTH)
ETDAMB DEW POINT TEMPERATURE (DEGREES FAHRENHEIT)

```

C      ERROR FLAG OUT OF EDATIN ENVIRONMENTAL DATA INPUT ROUTINE. SET TO
C      ZERO OUTSIDE, WILL BE RESET IN ROUTINE ONLY IF ERROR OCCURS. 1=
C      DATA BEFORE FIRST ON TAPE, 2=DATA AFTER LAST ON TAPE, 3=PARITY
C      ERROR ON TAPE, 4=WRONG DECK OR STATION NAME ON INPUT DATA TAPE.
C      INTEGER AENERR
C      COMMON /EER/ AENERR

C
C      LINEAR INTERPOLATION BETWEEN NEAREST DATA POINTS WILL BE USED
C      EXCEPT IN THE CASE OF WIND VARIABLES, WHERE THE NEAREST
C      VALUE IN TIME WILL BE ADOPTED
C
C      NORMALLY NO OUTPUT WILL BE GENERATED BY THIS ROUTINE
C      ERROR MESSAGES -- (E.G. TIME REQUESTED OUT OF RANGE-) WILL
C      BE WRITTEN WITH FORMATTED WRITES ON TAPE6
C      AND AENERR WILL BE SET AS DEFINED IN BLOCK EER
C
C      ARRAY ENIN CONTAINS THE ENVIRONMENTAL DATA PARAMETERS FOR A GIVEN
C      DAY SPECIFIED BY IY,IM,ID
C      ENIN(I,J)
C      I IS THE 1ST TIME INTERVAL AT 15 MINUTE INTERVALS FOR THE DAY
C      I=1,CORRESPONDS TO BEGINNING MIDNIGHT
C      I=97,CORRESPONDS TO FINAL MIDNIGHT
C      IMAX IS THE MAXIMUM NUMBER OF INTERVALS IN A DAY
C      J=1 DIRECT INSOLATION (KW M**-2)
C      J=2 STATION PRESSURE (PCUNDS IN**-2)
C      J=3 DRY BULB TEMPERATURE (DEGREES F)
C      J=4 DEW POINT TEMPERATURE (DEGREES F)
C      J=5 WIND DIRECTION (DEGREES AZIMUTH)
C      J=6 WIND SPEED (FT SEC**-1)
C
C      DIMENSION ENIN(98,6)
C
C      YEAR DESIRED,ENVIRONMENTAL STATION NUMBER DESIRED
C
C      INTEGER ATIYR,AEIST
C
C      LOGICAL FLAGS
C
C      IDATIN DATA FOR DATA ARRAY FILLED
C      ILST FLAG FOR GETTING FIRST INTERVAL OF NEXT DAY
C
C      LOGICAL IDATIN,ILST
C
C      TEMPORARY ARRAY FOR INPUT FROM TAPE
C      DIMENSION IN(17)
C
C      INITIALIZATION
C
C      DATA IY/100/,NREAD/10/
C
C      MAXIMUM NUMBER OF DATA POINTS PER DAY
C
C      DATA IMAX/98/
C
C      VARIABLES INITIALIZED HERE -- BUT GOOD CANDIDATES FOR COMMON
C      BLOCKS IF SIMULATION IS RUN FOR OTHER YEARS AND LOCATIONS
C      THE YEAR IS ASSUMED TO BE 1976
C      ATIYR IS THE LAST TWO DIGITS OF THE YEAR

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C      AEIST IS THE STATION NUMBER
C      DATA ATTYR,AEIST/
C      1      76,23161/
C
C      STATEMENT FUNCTION FOR INTERPOLATION
C
C      ENTERP(I,J,X) = ENIN(I,J) + (ENIN(I+1,J)-ENIN(I,J))*X
100 CONTINUE
C
C      MAKE SURE WE HAVE DATA AVAILABLE FOR THE CORRECT DATE
C
C      YEAR FIRST
C
C      IF(IY-ATTYR) 200,105,110
110 CONTINUE
C      IF(NREAD.LE.1) GO TO 220
C      REWIND 10 $ NREAD = 0
C      GO TO 200
C
C      TEST MONTH
C
C      105 IF(IM-ATIMO) 200,115,110
C
C      TEST DAY
C
C      115 IF(ID-ATIDAY) 200,120,110
C
C      THE DATA TAPE IS NOW POSITIONED AT THE END OF THE FIRST INTERVAL
C      OF THE DESIRED DAY, WITH THE DESIRED DATA IN ARRAY IN
C      OR THE DATA ARE ALREADY IN ENIN INDICATED BY IDATIN = F OR T
C      RESPECTIVELY
C
C      TEST IDATIN -- JUMP IF DATA ARE IN TO INTERPOLATION ROUTINE
120 CONTINUE
C      IF(IDATIN) GO TO 300
C
C      FILL IN ENIN NOW
C
C      I = 0
C      ILST = .F.
C      ST = 0.0
C      BACKSPACE 10
C
C      SPECIAL CODING FOR FIRST INTERVAL ON TAPE
C
C      IF(NREAD.EQ.1) GO TO 125
C      BACKSPACE 10
130 CONTINUE
C
C      READ THE DATA TAPE
C
C      BUFFER IN (10,0) (IN(1),IN(17))
C      NREAD = NREAD + 1
C      IF(UNIT(10)) 125,205,210
125 CONTINUE
C      IF(I.LT.IMAX) I = I + 1
C      DECODE ( 30,5,IN( 2))TSHR,TSMN,STHR,STMN, ENIN(I,1)
C      5 FORMAT (5X,4F2.0,5X,F4.0,8X)
C      DECODE (30 ,6,IN(11))(ENIN(I,J),J=2,6)
C      6 FORMAT (2X,F5.2,2F4.1,F3.0,F4.1,8X)

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      IF(ILST) GO TO 142
      IF(I.LT.3) GO TO 130
      STO = ST
      ST = 3600.0*STHR + 60.0*STMN
      DELS = ST - STO
C
C      CHECK IF WE HAVE A DAYS DATA YET
C
      IF((ST+DELS).GE.86401.0) GO TO 140
      GO TO 130
C
C      ENIN IS NOW FILLED WITH ONE DAYS DATA
C
140 CONTINUE
C
C      COMPUTE SOLAR TIME OFFSET FROM LOCAL STANDARD TIME
C
      TIDSOL = 3600.0*TSHR + 60.0*TSMN - ST
      ILST = .T.
      GO TO 130
142 CONTINUE
      BACKSPACE 10
143 CONTINUE
      ILST = .F.
C
C      CONVERT UNITS FROM TAPE UNITS TO ENGLISH SIMULATION UNITS
C
      NELM = I
      DO 145 I=1,NELM
      ENIN(I,1)=ENIN(I,1)/DELS
      ENIN(I,2)=0.145039*ENIN(I,2)
      ENIN(I,3)=32.0+1.8*ENIN(I,3)
      ENIN(I,4)=32.0+1.8*ENIN(I,4)
      ENIN(I,6)=3.28084*ENIN(I,6)
145 CONTINUE
C
C      COMPUTES OFFSET IN UNITS OF THE FRACTION OF A TIME INTERVAL
C      FROM THE FIRST ELEMENT IN ENIN
C
      STO = ST/DELS + 1.5 - NELM
      IDATIN = .T.
      GO TO 100
C
C      READ DATA IN UNTIL YOU GET TO THE FIRST INTERVAL OF THE CORRECT DA
C
200 CONTINUE
      BUFFER IN (10,0) (IN(1),IN(17))
      IDATIN = .F.
      IF(UNIT(10)) 215,205,210
C
C      ENDFILE AND PARITY TESTS MESSAGES FOR TAPE10
C
205 CONTINUE
      IF(ILST) GO TO 206
      WRITE (6,1) ATYR,ATIMO,ATIDAY,*AFTER *,IY,IM,ID
1  FORMAT (* -$$-$$-DAY REQUESTED,(*,3I3,*) IS *,A6,* ONE END OF *
11 *THE DATA PERIOD (*,3I3,*)-$$-$$-*)
      AENERR = 2
      GO TO 400
206 CONTINUE

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        IF(I.LT.IMAX) I = I + 1
        DO 207 J = 1,6
        ENIN(I,J) = ENIN(I-1,J)
207 CONTINUE
        GO TO 143
210 CONTINUE
        WRITE (6,2)
        2 FORMAT (* -$$-$$-PARITY ERROR ON ENVIRONMENTAL DATA TAPE--WILL TRY
21 TO USE IT ANYWAY-$$-$$-*)
        AENERR = 3
C
C      GOOD READ OF A DATA INTERVAL
C
215 CONTINUE
        NREAD = NREAD + 1
        DECODE (30,3,IN)IDK,IST,IY,IM,ID
        3 FORMAT (I4,I5,3I2)
        IF((IDK.EQ.9724).AND.(IST.EQ.AEIST)) GO TO 100
C
C      WRONG DECK OR STATION NUMBER -- PROBABLY WRONG TAPE WAS MOUNTED
C
        WRITE (6,4) IDK,IST,AEIST
        4 FORMAT (* -$$-$$-DECK NUMBER READ (*,I4,*) NOT 9724 OR STATION NUM
41BER READ (*,I5,*) NOT DESIRED STATION NUMBER (*,I5,*)-$$-$$-*)
        AENERR = 4
        GO TO 400
C
C      DAY BEFORE THE BEGINNING OF THE DATA TAPE ERROR
C
220 CONTINUE
        WRITE (6,1) ATYR,ATIM,ATIDAY,#BEFORE#,IY,IM,ID
        AENERR = 1
        GO TO 400
C
C      INTERPOLATE WITHIN A DAY
C
300 CONTINUE
        ST = ATILCL/DELS - STO
        I = ST + 1.0
        ST = ST - I + 1
        IF(I.GT.0) GO TO 305
        ST = 0
        I=1
305 CONTINUE
        IF(I.LT.NELM) GO TO 310
        ST = 1.0
        I= NELM - 1
310 CONTINUE
        EINDIR = ENTERP(I,1,ST)
        EPRAMB = ENTERP(I,2,ST)
        ETEAMB = ENTERP(I,3,ST)
        ETDAMB = ENTERP(I,4,ST)
        IF(ST.GT.0.5) I = I + 1
        EDWAMB = ENIN(I,5)
        EVWAMB = ENIN(I,6)
        ATITST = ATILCL + TIDSOL
C
C      GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
C
400 IF (DIAG(15)) WRITE (6,405)
        1 AEIST,ATIMO,ATYR,ATIDAY,ATILCL,ATITST,EINDIR,EPRAMB,ETEAMB,

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2 ETDAMB,EDWAMB,EVWAMB
405 FORMAT(1H ,3X,14HDIAG15/EDATIN ,I7,3I4,7G10.4/(1H ,16X,9G10.4))
C
RETURN
END
```

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SUBROUTINE EPGS
C  CALCULATE STATE VARIABLE EQUATIONS FOR ELECTRICAL POWER GENERATION
C  SUBSYSTEM
C
C *****
C
C      *** COMMON DECKS ***
C
C *****
C
C  EXECUTIVE AND PROGRAM CONTROL DATA
C
C  INTEGER ATIMO,ATIDAY
C  LOGICAL OUTFG,END,DIAG
C  COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
C  1  DIAG(40)
C
C  OUTFG(I,J)  OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
C  END        END OF RUN FLAG
C  ATILCL     LOCAL TIME (SECONDS FROM MIDNIGHT)
C  ATITST     TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
C  ATIMO      MONTH
C  ATIDAY     DAY
C  DIAG       DIAGNOSTIC PRINT FLAG ARRAY
C
C  ENVIRONMENTAL DATA
C
C  COMMON /EDATA/ ETEAMB,EPRAMB,EVWAMB,EINDIR,EDWAMB,ETDAMB
C
C  ETEAMB     AMBIENT TEMPERATURE (DEGREES FAHRENHEIT)
C  EPRAMB     AMBIENT PRESSURE (LB/SQ IN ABS)
C  EVWAMB     AMBIENT WIND VELOCITY (FT/SEC)
C  EINDIR     DIRECT INSOLATION (KILOWATTS/SQ METER)
C  EDWAMB     WIND DIRECTION (DEGREES AZIMUTH)
C  ETDAMB     DEW POINT TEMPERATURE (DEGREES FAHRENHEIT)
C
C  MASTER CONTROL SUBSYSTEM DATA
C
C  INTEGER CMODE,CNMODE,CNSP,CNMV,CMVRTBL,CMVLA,CMVPA,
C  1  CMVRC,CNM,CNMVEL,CNNM
C  COMMON /CDATA/ CMODE,CNMODE,CSPTBL(7,16),CSP(16),CNSP,
C  1  CMVLTBL(6,4,7),CMVL(6,4),CNHV,CMVRTBL(7,7,4),
C  2  CMVLA(7),CMVPA(4),CMVRC(4),CNN(4),CNMVEL,CNNM
C
C  CMODE      CURRENT MODE OF OPERATION
C  CNMODE     NUMBER OF DIFFERENT MODES OF OPERATION
C  CSPTBL     SETPOINT TABLE
C  CSP        SETPOINTS FOR CURRENT MODE OF OPERATION
C  CNSP       NUMBER OF SETPOINTS
C  CMVLTBL    TABLE OF OPERATING LIMITS FOR MONITORED VARIABLES
C  CMVL       OPERATING LIMITS OF MONITORED VARIABLES FOR CURRENT
C             MODE OF OPERATION
C  CNMV       NUMBER OF MONITORED VARIABLES
C  CMVRTBL    TABLE OF MCS RESPONSES FOR MONITORED VARIABLES
C             EXCEEDING THEIR LIMITS

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C CMVLA MONITORED VARIABLE LIMIT ARGUMENT FOR RESPONSE TABLE
 C CMVPA MONITORED VARIABLE ARGUMENT FOR RESPONSE TABLE
 C CMVRC RESPONSE CODES FOR MONITORED VARIABLES CROSSING LIMITS
 C CNM POTENTIAL NEW MODES TO CORRECT MONITORED VARIABLE
 C LIMIT CROSSINGS
 C CNMVEL NUMBER OF MONITORED VARIABLES EXCEEDING LIMITS
 C AT ANY INSTANT OF TIME
 C CNNM NUMBER OF NEW MODE REQUESTS AT ANY INSTANT OF TIME

STANDARD DEFINITION OF PILOT PLANT OPERATING MODES

- 1= RECEIVER STEAM TO EPGS
- 2= RECEIVER STEAM TO EPGS AND THERMAL STORAGE
- 3= RECEIVER STEAM TO EPGS AND THERMAL STORAGE STEAM TO EPGS
- 4= RECEIVER STEAM TO THERMAL STORAGE AND THERMAL STORAGE STEAM TO EPGS
- 5= RECEIVER STEAM TO THERMAL STORAGE
- 6= THERMAL STORAGE STEAM TO EPGS
- 7= OVERNIGHT SHUTDOWN AND HOLD

ARGUMENT DEFINITIONS FOR SETPOINT ARRAY CSP(I)

- I=1,4 EPGS VALVE SETPOINTS FOR VALVES R1-R4
- I=5,6 EPGS VALVE SETPOINTS FOR VALVES T1,T2
- I=7,8 EPGS VALVE SETPOINTS FOR DRAIN VALVES
- I=9,12 EPGS VALVE SETPOINTS FOR VALVES E1-E4
- I=13 EPGS CONDENSER FAN SETPOINT
- I=14 EPGS FEED PUMP PRESSURE SETPOINT
- I=15 RECEIVER OUTLET TEMPERATURE SETPOINT
- I=16 TSS OUTLET STEAM FLOW RATE SETPOINT

CURRENT LIST OF MONITORED VARIABLES

RECEIVER OUTLET PRESSURE
 RECEIVER OUTLET TEMPERATURE
 EPGS FEEDWATER PRESSURE
 TSS THERMOCLINE LEVEL

RECEIVER SUSSYSTEM DATA

RECVR VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)

INTEGER RCVST,RAFLGC
 COMMON /RDATA/ RHISH(6),RWISH(6),RHSH,RPRSH,RTESH,RWOSH,RFMV(6),
 1 RLV(6),RHIV,RPRIV,RFRISV,RPROSV,RVIV,RHOV(6),RPROV(6),RWV(6),
 2 RWVSUM,RHF1(8),RPRF1(8),RTEF1(8),RUF1(8),RVF1(8),RHCF2(8),
 3 RHF2(8),RPRF2(8),RQF2(8),RTEF2(8),RTEFF2(8),RUF2(8),RVF2(8),
 4 RWF2(8),RHCM2(8),RHFCM2(8),RHFRM2(8),RQM2(8),RQAM2(8),RQCH2(8),
 5 RQEM2(8),RPRF3(8),RTEF3(8),RUF3(8),RVF3(8),RHCF4(8),RHNSF4(8),
 6 RHBF4(8),RHF4(8),RPRF4(8),RQF4(8),RTEF4(8),RTEFF4(8),RUF4(8),
 7 RVF4(8),RWF4(8),RHCM4(8),RHFCM4(8),RHFRM4(8),RQM4(8),RQAM4(8),
 8 RQCH4(8),RQEM4(8),RPRF5(8),RTEF5(8),RUF5(8),RVF5(8),RXF5(8),
 9 RHCF6(8),RHF6(8),RPRF6(8),RQF6(8),RTEF6(8),RTEFF6(8),RUF6(8),
 A RVF6(8),RWF6(8),RHCM6(8),RHFCM6(8),RHFRM6(8),RQM6(8),RQAM6(8),
 B RQCH6(8),RQEM6(8),RHF7(8),RPRF7(8),RTEF7(8),RUF7(8),RVF7(8),
 C RUF8(8),RVF8(8),RUVSAT(8),RVVSAT(8),RL35(8),RL57(8),RWSP(8),
 D RCVST(8),RAFLGC(6),RERRTC(6),RLPROC(6),RLSUNC(6),RTSETC

RHISH(ISP) FLUID ENTHALPY AT STEAM HEADER INLET

```

C      (BTU/LBM)
C      RWISH(ISP) FLUID MASS FLOW RATE AT STEAM HEADER INLET
C                  (LBM/SEC)
C      RSHH      FLUID ENTHALPY IN STEAM HEADER
C                  (BTU/LBM)
C      RPRSH     FLUID PRESSURE IN STEAM HEADER
C                  (PSIA)
C      RTESH     FLUID TEMPERATURE IN STEAM HEADER
C                  (DEGREES F)
C      RHOSH     FLUID MASS FLOW RATE AT STEAM HEADER OUTLET
C                  (LBM/SEC)
C      RFMV(IV)  MODIFIED FRICTION FLOW COEFFICIENT FOR FLOW
C                  CONTROL VALVE (PSI,SEC**2/LBM,CU FT)
C      RLV(IV)   STEM DISPLACEMENT OF FLOW CONTROL VALVE
C                  (PERCENT)
C      RHIV      FLUID ENTHALPY AT FLOW CONTROL VALVE INLETS
C                  (BTU/LBM)
C      RPRIV     FLUID PRESSURE AT FLOW CONTROL VALVE INLETS
C                  (PSIA)
C      RPRISV    FLUID PRESSURE AT RECEIVER SUBSYSTEM INLET
C                  (PSIA)
C      RPROSV    FLUID PRESSURE AT RECEIVER SUBSYSTEM OUTLET
C                  (PSIA)
C      RVIV      FLUID SPECIFIC VOLUME AT FLOW CONTROL VALVE INLETS
C                  (CU FT/LBM)
C      RHOV(IV)  FLUID ENTHALPY AT FLOW CONTROL VALVE OUTLET
C                  (BTU/LBM)
C      RPROV(IV) FLUID PRESSURE AT FLOW CONTROL VALVE OUTLET
C                  (PSIA)
C      RWV(IV)   FLUID MASS FLOW RATE THROUGH FLOW CONTROL VALVE
C                  (LBM/SEC)
C      RWVSUM    FLUID MASS FLOW RATE THROUGH ALL FLOW CONTROL VALVES
C                  (LBM/SEC)
C      RHF1(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 1
C                  (BTU/LBM)
C      RPRF1(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 1
C                  (PSIA)
C      RTEF1(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 1
C                  (DEGREES F)
C      RUF1(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 1
C                  (BTU/LBM)
C      RVF1(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 1
C                  (CU FT/LBM)
C      RHCF2(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C                  SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
C      RHF2(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 2
C                  (BTU/LBM)
C      RPRF2(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 2
C                  (PSIA)
C      RQF2(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
C                  SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
C      RTEF2(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C                  (DEGREES F)
C      RTEFF2(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C                  (DEGREES F)
C      RUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
C                  (BTU/LBM)
C      RVF2(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 2
C                  (CU FT/LBM)
C      RWTF2(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE

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C NUMBER 2 (LBM/SEC)
 C RHCM2(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFCM2(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFRM2(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RQM2(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQAM2(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQCM2(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQEM2(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RPRF3(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 3
 C (PSIA)
 C RTEF3(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 3
 C (DEGREES F)
 C RUF3(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RVF3(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 3
 C (CU FT/LBM)
 C RHCF4(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHN3F4(ISP) INTERNAL NUCLEATE BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFBF4(ISP) INTERNAL FILM BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHF4(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RPRF4(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 4
 C (PSIA)
 C RQF4(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RTEF4(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RTEFF4(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RUF4(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RVF4(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 4
 C (CU FT/LBM)
 C RWTF4(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 4 (LBM/SEC)
 C RHCM4(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFCM4(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFRM4(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RQM4(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQAM4(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQCM4(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQEM4(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RPRF5(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 5

C (PSIA)
 C RTEF5(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 5
 C (DEGREES F)
 C RUF5(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RVF5(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 5
 C (CU FT/LBM)
 C RXF5(ISP) FLUID QUALITY AT SUPERPANEL NODE NUMBER 5
 C (PERCENT)
 C RHCF6(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHF6(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RPRF6(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 6
 C (PSIA)
 C RGF6(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RTEF6(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RTEFF6(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RUF6(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RVF6(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 6
 C (CU FT/LBM)
 C RWF6(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 6 (LBM/SEC)
 C RHCM6(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFCM6(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFRM6(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RQM6(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQAM6(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQCM6(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQEM6(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RHF7(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RPRF7(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 7
 C (PSIA)
 C RTEF7(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 7
 C (DEGREES F)
 C RUF7(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RVF7(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 7
 C (CU FT/LBM)
 C RUFSAT(ISP) INTERNAL ENERGY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RVFSAT(ISP) SPECIFIC VOLUME OF A SATURATED LIQUID
 C (CU FT/LBM)
 C RUVSAT(ISP) INTERNAL ENERGY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RVVSAT(ISP) SPECIFIC VOLUME OF A SATURATED VAPOR
 C (CU FT/LBM)
 C RL35(ISP) LENGTH OF SUPERPANEL TWO-PHASE MIXTURE SECTION

C (FEET)
 C RL57(ISP) LENGTH OF SUPERPANEL SUPERHEATED SECTION
 C (FEET)
 C RWSP(ISP) FLUID MASS FLOW RATE THROUGH SUPERPANEL
 C (LBM/SEC)
 C RCVST(ISP) SUPERPANEL FLUID CONTROL VOLUME STATE
 C RCVST = 1 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
 C FLUID STATES ONLY
 C RCVST = 2 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
 C AND SATURATED FLUID STATES
 C RCVST = 3 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED,
 C SATURATED, AND SUPERHEATED FLUID STATES
 C RAFLGC(IC) CONTROLLER ACTIVATION FLAG
 C RAFLGC = 1 SIGNIFIES RTSENC .LT. RKTHSC
 C RAFLGC = 2 SIGNIFIES RTSENC .GT. RKTHSC
 C RERRTC(IC) CONTROLLER TEMPERATURE ERROR SIGNAL
 C (DEGREES F)
 C RLPROC(IC) CONTROLLER PROPORTIONAL SIGNAL OF VALVE STEM
 C DISPLACEMENT (PERCENT)
 C RLSUMC(IC) CONTROLLER COMMAND SIGNAL OF VALVE STEM DISPLACEMENT
 C (PERCENT)
 C RTSETC CONTROLLER SET POINT FOR RECEIVER SUBSYSTEM OUTLET
 C TEMPERATURE (DEGREES F)
 C
 C THERMAL STORAGE SUBSYSTEM DATA
 C
 C TSS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)
 C
 C COMMON /TDATA/ TP1,TP4,TH1,TH2,TH3,TH4,TH9,TW1,TW1A,TW1M,TW2,TW3,
 C 1 TW5A,TW7A,TWE,TKDSH,TKTSH,TKSG,TPPC,TPPE,TPPT,TFC,TFE,TK1,TK2,
 C 2 TK3,TK4,TCONC,TCONE,TLT,TFLAGU,TFLAGL
 C
 C TP1 PRESSURE OF STEAM INTO DESUPERHEATER,
 C AND PRESSURE OF DESUPERHEATED STEAM (PSIA)
 C TP4 PRESSURE OF WATER FROM STORAGE HEATER (PSIA)
 C TH1 ENTHALPY OF STEAM INTO DESUPERHEATER (BTU/LBM)
 C TH2 ENTHALPY OF WATER INTO DESUPERHEATER (BTU/LBM)
 C TH3 ENTHALPY OF STEAM FROM DESUPERHEATER (BTU/LBM)
 C TH4 ENTHALPY OF WATER FROM STORAGE HEATER (BTU/LBM)
 C TH9 ENTHALPY OF WATER INTO STEAM GENERATOR (BTU/LBM)
 C TW1 STEAM FLOW AVAILABLE TO DESUPERHEATER (LBM/SEC)
 C TW1A ACTUAL STEAM FLOW TO DESUPERHEATER (LBM/SEC)
 C TW1M MAXIMUM STEAM FLOW TO DESUPERHEATER (LBM/SEC)
 C TW2 WATER FLOW TO DESUPERHEATER (LBM/SEC)
 C TW3 STEAM FLOW FROM DESUPERHEATER (LBM/SEC)
 C TW5A ACTUAL OIL FLOW INTO STORAGE (LBM/SEC)
 C TW7A ACTUAL OIL FLOW FROM STORAGE (LBM/SEC)
 C TWE CONTROLLER SET POINT FOR STEAM GENERATOR STEAM FLOW
 C (LBM/SEC)
 C TKDSH FLOW RATE GAIN FACTOR OF DESUPERHEATER (RECIPROCAL
 C OF SPECIFIC ENTHALPY LOSS FACTOR) (DIMENSIONLESS)
 C TKTSH RATIO OF SPECIFIC ENTHALPY GAIN OF OIL TO SPECIFIC
 C ENTHALPY LOSS OF STEAM IN THERMAL STORAGE HEATER
 C (DIMENSIONLESS)
 C TKSG RATIO OF SPECIFIC ENTHALPY GAIN OF WATER TO
 C SPECIFIC ENTHALPY LOSS OF OIL IN STEAM GENERATOR
 C (DIMENSIONLESS)
 C TPPC CHARGING OIL PUMPING POWER (WATTS)
 C TPPE EXTRACTION OIL PUMPING POWER (WATTS)

C

```
COMMON /GCDATA/ GMVR(4),GMVT(2),GMVE(4),VRATE(12),GMVR0(4),
1  GMVT0(2),GMVE0(4),SSP(12),TZERO(3),GPSPT3,GETAT3,GLTZ3,
2  GKLC3,GPSPT1,GMCT1,GPSPT2,GETAT2,GLTZ2,GKLC2,GRIDC,
3  GRODC,GLDC,UTC,GRIS,GRISP,GLSPTG,NPORTS,IFAN,GPTE(4),
4  GTEFF,GPHRD(3,6),GWHRD(3),GTHRD(6),GEMEFF,GKEFF,GKGAIN,
5  GKINERT,GPFRSP,GFFHR,GFPR,GWFPR,GFPTR,GVFPR,GRIRC,GRORC,
6  GLRC,GRIDS,GRODS,GLDESP,GPFPSP,GLFWP,GRIFWP,GROFWP,TNOM,
7  VNOM,BPUMP(5),HFUMP(5),H1PARM(3),H2PARM(3),H4PARM(3),
8  H5PARM(3),GMCH3,GMCHW
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```

C      GMVR(4)      SETTING OFR EPGS SERVO-CONTROLLED VALVES R1-R4
C                   RANGE IS 0. TO 1.0
C      GMVT(2)      SETTING FOR EPGS SERVO-CONTROLLED VALVES T1 AND T2
C                   RANGE IS 0. TO 1.0
C      GMVE(4)      SETTING FOR EPGS SERVO-CONTROLLED VALVES E1-E4
C                   RANGE IS 0. TO 1.0
C      VRATE(10)    MAX RATE FOR VALVES TO MOVE FROM OPEN TO CLOSE
C                   POSITIONS
C      GMVR0(4)     VALVE SETTING FOR R1-R4 AT TIME TZERO(1)
C      GMVT0(2)     VALVE SETTING FOR T1-T2 AT TIME TZERO(2)
C      GMVE0(4)     VALVE SETTING FOR E1-E4 AT TIME TZERO(3)
C      TZERO(3)     LAST TIME SET POINT WAS CHANGED (SEC)
C      SSP(11)      SAVE SP(11) FROM COMMON BLOCK /CDATA/
C      GPSPT3       PRESSURE (PSIA) SET POINT FOR TANK 3 (RECVR FLASH )
C      GETAT3       SIZING CONSTANT FOR TANK 3 (MAX LEVEL DIVIDED BY
C                   MAX OUTPUT FLOW RATE)

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C GLZT3 NOMINAL WATER LEVEL (FT) FOR TANK 3
 C GKLC3 CONSTANT FOR LEVEL CONTROL IN TANK 3
 C GPSPT1 PRESSURE (PSIA) SET POINT FOR TANK 1 (TSS DRAIN SYS)
 C GMCT1 MASS (LBM) OF CONDENSATE IN TANK 1
 C GPSPT2 PRESSURE (PSIA) SET POINT FOR TANK 2 (TSS DRAIN SYS)
 C GETAT2 SIZING CONSTANT FOR TANK 2 (MAX LEVEL / MAX FLOW)
 C GLZT2 NOMINAL WATER LEVEL (FT) IN TANK 2
 C GKLC2 LEVEL CONTROL GAIN FOR TANK 2
 C GRISP INSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGs)
 C GROSP OUTSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGs)
 C GLSPTG LENGTH (FT) OF STEAM PIPE (TSS TO EPGs)
 C GRIDC INSIDE RADIUS (FT) OF DOWNCOMER
 C GRODC OUTSIDE RADIUS (FT) OF DOWNCOMER
 C GTC THERMAL CONDUCTIVITY OF DOWNCOMER INSULATION
 C (BTU/HR-FT-DEG R)
 C GLDC LENGTH OF DOWNCOMER IN FEET
 C NPORTS NUMBER OF TURBINE EXTRACTION PORTS
 C IFAN COOLING TOWER FAN CONDITIONS 1 2 FANS FULL SPEED
 C 2 1 HALF 1 FULL
 C 3 2 FANS HALF SPEED
 C GPTD(4) EXTRACTION PRESSURE (PSIA) PER UNIT OF APPARENT LP
 C FLOW (LBM/SEC)
 C GTEFF TURBINE/GENERATOR EFFICIENCY
 C GFHRD(3,6) CONDENSER PRESSURE (PSIA) AT GFHRD(3) AND GTHRD(6)
 C GFHRD(3) CONDENSER FLOW (LBM/HR) DATA AT 3 DIFFERENT VALUES
 C GTHRD(6) AMBIENT TEMP. (F) DATA AT 6 DIFFERENT VALUES
 C GNEFF ELECTRO-MECHANICAL EFFICIENCY OF RECVR FEEDPUMP
 C GKEFF FEED PUMP EFFICIENCY
 C GKGAIn FEED PUMP CONTROL GAIN
 C GKINERT FEED PUMP MOMENT OF INERTIA
 C GPFRRSP RECVR INLET PRESSURE (PSIA) SET POINT
 C GFPHR FEED PUMP RATED HEAD (FT)
 C GFPSR FEED PUMP RATED SPEED (RPM)
 C GWFFR FEED PUMP RATED FLOW (LBM/SEC)
 C GFPTR FEED PUMP RATED TORQUE (FT-LBS)
 C GVFFR SPECIFIC VOLUME (FT**3/LBM) AT RATED CONDITIONS
 C GRIRC INSIDE RADIUS (FT) OF RISER
 C GRORC OUTSIDE RADIUS (FT) OF RISER
 C GLRC LENGTH (FT) OF RISER
 C GRIDS INSIDE RADIUS (FT) OF FW PIPE FEED PUMP TO DESUPHRTR
 C GRODS OUTSIDE RADIUS (FT) FW PIPE FEED PUMP TO DESUPHRTR
 C GLDESP LENGTH (FT) OF FW PIPE FEED PUMP TO DESUPHRTR
 C GFFPSP RECVR INLET PRESSURE (PSIA) SET POINT
 C GLFWP LENGTH (FT) OF FW PIPE EPGs TO TSS STEAM GEN.
 C GRIFWP INNER RADIUS (FT) OF FW PIPE EPGs TO TSS STEAM GEN.
 C BFUMP(5) PARAMETERS FOR BOOST PUMP (SEE ROUTINE PUMPSS)
 C HPUMP(5) PARAMETERS FOR HOTWELL PUMP (SEE ROUTINE PUMPSS)
 C H1PARN(3) PARAMETERS FOR HEATER 1 (SEE ROUTINE CFWHTR)
 C H2PARN(3) PARAMETERS FOR HEATER 2 (SEE ROUTINE CFWHTR)
 C H4PARN(3) PARAMETERS FOR HEATER 4 (SEE ROUTINE CFWHTR)
 C H5PARN(3) PARAMETERS FOR HEATER 5 (SEE ROUTINE CFWHTR)
 C GMCH3 MASS OF CONDENSATE (LBM) STORED IN HEATER 3
 C GROFWP OUTER RADIUS (FT) OF FW PIPE EPGs TO TSS STEAM GEN.
 C GMCHW MASS OF CONDENSATE (LBM) STORED IN CONDENSER HOTWELL
 C TNOM NOMINAL TEMP (F) OF AIR SURROUNDING FW SYS COMPONENTS
 C VNOM NOMINAL AIR VELOCITY (FT/SEC) ABOUT FW SYS COMPONENTS
 C (NORMALLY SET TO ZERO)
 C
 C
 C
 C

```

C      COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
1      INAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
2      ,TTCLR,TTFIN,TTRIB(25),TTSET

C      COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
1      ,NNEQD,NNEQS,NNEQT,SS(600),SSL(600),TTNEX

C      DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
1      RLINTC(6),RL15(8),RHFSAT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
2      RDIUF2(8),RDL13(8),RDEM2(8),RDIHF3(8),RDEM4(8),RDEM6(8),
3      RDLINTC(6)

C      EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
1      (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
2      (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
3      (TDW5,SS(83)),(TDW7,SS(84)),(TDW8,SS(85)),
4      (TDHSU,SS(86)),(GHCOT3,SS(87)),(GHDCOT3,SS(88)),
5      (GHDCOT3,SS(89)),(GHSEDC,SS(90)),(GHSTSG,SS(91)),
6      (GHDCOT1,SS(92)),(GHDCOT2,SS(93)),(GHDCOT2,SS(94)),
7      (GHDCOT2,SS(95)),(GDFPS,SS(96)),(GHRCI,SS(97)),
8      (GHDSI,SS(98)),(GHCOH3,SS(99)),(GHCTSG,SS(100)),
9      (GHCHW,SS(101)),
A      (RL15(1),SS(102)),(RHFSAT(1),SS(110)),(RHF3(1),SS(118)),
B      (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
C      (CRFRSH,SS(151)),(CRTESH,SS(152)),(CGPFPR,SS(153)),
D      (CTLT,SS(154)),
E      (GPFFR,SS(161)),(GPDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
F      (XK3,SS(165))

C      EQUIVALENCE (RDIUF2(1),DD(1)),(RDL13(1),DD(9)),(RDEM2(1),DD(17)),
1      (RDIHF3(1),DD(25)),(RDEM4(1),DD(33)),(RDEM6(1),DD(41)),
2      (RDUSH,DD(49)),(RDVSH,DD(50)),(RDLINTC(1),DD(51)),
3      (TDW5,DD(83)),(TDW7,DD(84)),
4      (TDW8,DD(85)),(TDHSU,DD(86)),(GHDCOT3,DD(87)),
5      (GHDCOT3,DD(88)),(GHDCOT3,DD(89)),(GHSDBC,DD(90)),
6      (GHSTSG,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),
7      (GHDCOT2,DD(94)),(GHDCOT2,DD(95)),(GDFPS,DD(96)),
8      (GHRCI,DD(97)),(GHDSI,DD(98)),(GHCOH3,DD(99)),
9      (GHCTSG,DD(100)),(GHCHW,DD(101))

C      INTEGRATED STATE VARIABLES

C      RIUF2(ISP)  FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
C                  (BTU/LBM)
C      RL13(ISP)   LENGTH OF SUPERPANEL SUBCOOLED SECTION
C                  (FEET)
C      RTEM2(ISP)  METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C                  (DEGREES F)
C      RIHF3(ISP)  FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
C                  (BTU/LBM)
C      RTEM4(ISP)  METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 4
C                  (DEGREES F)
C      RTEM6(ISP)  METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 6
C                  (DEGREES F)
C      RUSH        FLUID INTERNAL ENERGY IN STEAM HEADER
C                  (BTU/LBM)
C      RVSH        FLUID SPECIFIC VOLUME IN STEAM HEADER
C                  (CU FT/LBM)
C      RLINTC(IC)  CONTROLLER INTEGRAL SIGNAL OF VALVE STEM DISPLACEMENT

```

C (PERCENT)
 C
 C TW5 NOMINAL OIL FLOW INTO STORAGE (LBM/SEC)
 C TW7 NOMINAL OIL FLOW FROM STORAGE (LBM/SEC)
 C TW3 STEAM FLOW FROM STEAM GENERATOR (LBM/SEC)
 C THTSU HEAT STORED IN THERMAL STORAGE UNIT (BTU)
 C
 C GMCT3 CONDENSATE MASS (LBM) IN TANK 3 (RECVR FLASH TANK)
 C GHCOT3 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 3
 C GWCOT3 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 3
 C GHSBOC ENTHALPY (BTU/LBM) OF STEAM AT BOTTOM OF DOWNCOMER
 C GHSTSG ENTHALPY (BTU/LBM) OF ADMISSION STEAM
 C GHCOT1 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 1
 C GHCOT2 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 2
 C GMCT2 MASS (LBM) OF CONDENSATE IN TANK 2
 C GWCOT2 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 2
 C GFFS RECVR FEED PUMP SPEED (RPM)
 C GHRCI F.W. ENTHALPY (BTU/LBM) AT RECVR INLET
 C GHDSI F.W. ENTHALPY (BTU/LBM) AT DESUPERHEATER INLET
 C GHCOH3 F.W. ENTHALPY (BTU/LBM) OUT OF FW HRTR NO. 3
 C GHCTSG ENTHALPY (BTU/LBM) AT TSS STEAM GEN. INLET
 C GHCHW ENTHALPY (BTU/LBM) OF CONDENSATE IN CONDENSER HOTWELL
 C
 C ADDITIONALLY REQUIRED GASP-IV STATE VARIABLES
 C
 C RL15(ISP) COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND
 C TWO-PHASE MIXTURE SECTIONS (FEET)
 C RHFSAT(ISP) ENTHALPY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RHVSAT(ISP) ENTHALPY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RHF5(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RTSENC(IC) CONTROLLER TEMPERATURE SENSOR SIGNAL OF BOILER
 C SUPERPANEL OUTLET TEMPERATURE (DEGREES F)
 C CRPRSH FLUID PRESSURE IN RECEIVER STEAM HEADER
 C (PSIA)
 C CRTESH FLUID TEMPERATURE IN RECEIVER STEAM HEADER
 C (DEGREES F)
 C CGPFPR FLUID PRESSURE AT RECEIVER INLET
 C (PSIA)
 C CTLT POSITION OF TSS THERMOCLINE
 C (PERCENT)
 C GPFPR FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
 C GPD SI FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)
 C XK1,XK2,XK3 EFGS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND
 C PRESSURE AT RECEIVER INLET
 C
 C TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES
 C
 C RDIUF2(ISP) TIME DERIVATIVE OF RIUF2(ISP)
 C RDL13(ISP) TIME DERIVATIVE OF RL13(ISP)
 C RDTM2(ISP) TIME DERIVATIVE OF RTM2(ISP)
 C RDIHF3(ISP) TIME DERIVATIVE OF RIHF3(ISP)
 C RDTM4(ISP) TIME DERIVATIVE OF RTM4(ISP)
 C RDTM6(ISP) TIME DERIVATIVE OF RTM6(ISP)
 C RDUSH TIME DERIVATIVE OF RUSH
 C RDVSH TIME DERIVATIVE OF RVSH


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C      ROLINTC(IC) TIME DERIVATIVE OF RLINTC(IC)
C
C      TDW5      TIME DERIVATIVE OF TW5
C      TDW7      TIME DERIVATIVE OF TW7
C      TDW8      TIME DERIVATIVE OF TW8
C      TDHTSU    TIME DERIVATIVE OF THTSU
C
C      GMCDT3    TIME DERIVATIVE OF GMCT3
C      GHDCOT3   TIME DERIVATIVE OF GHCOT3
C      GWCOT3    TIME DERIVATIVE OF GWCOT3
C      GHSDBDC   TIME DERIVATIVE OF GHSBDC
C      GHSTSG    TIME DERIVATIVE OF GHSTSG
C      GHDCOT1   TIME DERIVATIVE OF GHCOT1
C      GHDCOT2   TIME DERIVATIVE OF GHCOT2
C      GMCT2     TIME DERIVATIVE OF GMCT2
C      GWCOT2    TIME DERIVATIVE OF GWCOT2
C      GDFPS     TIME DERIVATIVE OF GFPS
C      GHRCI     TIME DERIVATIVE OF GHRCI
C      GHDSI     TIME DERIVATIVE OF GHDSI
C      GHDCOH3   TIME DERIVATIVE OF GHCOH3
C      GHCTSG    TIME DERIVATIVE OF GHCTSG
C      GHCHW     TIME DERIVATIVE OF GHCHW
C
C
C      FUNDAMENTAL PHYSICAL CONSTANTS
C
C      COMMON /CONSTS/ PI,ZFR,GRAV,GRAV0,SBC,GCAIR
C
C      PI      PI
C      ZFR     ZERO FAHRENHEIT (DEGREES RANKINE)
C      GRAV    LOCAL ACCELERATION DUE TO GRAVITY (FT/(SEC)**2)
C      GRAV0   GRAVITATIONAL CONSTANT (LBM FT/LBF (SEC)**2)
C      SBC     STEFAN-BOLTZMANN CONSTANT (BTU/SEC-SQ FT (DEG R)**4)
C      GCAIR   GAS CONSTANT FOR AIR (FT LBF/LBM (DEG R))
C
C
C      COMPRESSED WATER/SUPERHEATED STEAM TABLE DATA
C
C      LOGICAL NO COMP,SATURD
C      REAL HE,PE,SE,TE,VE,XE
C      COMMON /USECOM/ HE,PE,SE,TE,VE,XE,NO COMP,SATURD
C
C
C      1) CALCULATE VALVE POSITIONS AND
C          CONTROLLER SETPOINTS
C
C      CALL MCSAUX
C
C      2) CALCULATE DOWNCOMER FLOW AND STATE
C          RECVIR STEAM FLOW TO TSS
C          RECVIR STEAM FLOW TO TURBINE
C          MAIN THROTTLE
C          RECVIR FLASH TANK OUTPUTS
C
C      200 CALL RIAUXC
C
C      3) CALCULATE FLOWS AND STATE IN TSS DRAIN
C          SYSTEM
C          FLOW AND STATE OF ADMISSION
C          STEAM TO TURBINE
C
C      300 CALL TSSIAUX
C
C      C1000 CONTINUE

```


GEPOUT=GEPOUT-TPPT/1.0E6

DIAGNOSTIC PRINT IF DESIRED

```
2000 IF (DIAG(18)) WRITE(6,1909) NPORTS,IFAN,GTEFF,GWTALP,
1      GWTEXH,GHTEXH,GPTEXH,
2      GWTEXT,GHTEXT,GPTTEXT,
3      GTPOWER,GEPOUT
1909 FORMAT(1H ,29HDIAG18/EPGS-TURBINE/CONDENSER,/,
1      19X,9H NPORTS=,I10,9H IFAN=,I10,9H GTEFF=,G10.4,
1      9H GWTALP=,G10.4,/,
2      19X,9H GWTEXH=,G10.4,9H GHTEXH=,G10.4,9H GPTEXH=,G10.4,/,
3      19X,9H GWTEXT=,4(G10.4),/,
4      19X,9H GHTEXT=,4(G10.4),/,
5      19X,9H GPTTEXT=,4(G10.4),/,
6      19X,9H GTPOWER=,G10.4,9H GEPOUT=,G10.4)
```

```
C*****
C***** EPGS FEEDWATER SECTION *****
C***** (STATEMENT LABELS 2100 - 3000) *****
C
```

```
SATURD=.FALSE.
IF (GPTEXH.LE.1.0) P=1.0
CALL USE TSAT(P,DUM)
GVCHW=VE
GHSAT=HE
```

1) HEATING STEAM FLOW AND STATE TO
FEEDWATER HEATERS

A) HEATER NO.1 (CLOSED F.W. HEATER)

STEAM FLOW (GWSH1)

```
2110 GWSH1=GWTEXT(1)+GWSTH1+GWSOT3
      GWCH12=GWSH1
      IF (GWSH1.LE.0.0) GO TO 2120
```

PRESSURE (GPSH1)
ENTHALPY (GHSH1)

```
GPSH1=(GWTEXT(1)*GPTTEXT(1)+GWSTH1*GPT1+GWSOT3*GPT3)/GWSH1
GHSH1=(GWTEXT(1)*GHTEXT(1)+GWSTH1*GHSTH1+GWSOT3*GHSOT3)/GWSH1
```

B) HEATER NO. 2 (CLOSED F.W. HEATER)

STEAM FLOW (GWSH2)

```
2120 GWSH2=GWTEXT(2)+GWSTH2
      GWCH23=GWSH2
      IF (GWSH2.LE.0.0) GO TO 2130
```

PRESSURE (GPSH2)
ENTHALPY (GHSH2)

```
GPSH2=(GWTEXT(2)*GPTTEXT(2)+GWSTH2*GPT2)/GWSH2
GHSH2=(GWTEXT(2)*GHTEXT(2)+GWSTH2*GHSTH2)/GWSH2
```

C) HEATER NO. 3 AND NO. 4 USE EXTRACTION
STEAM ONLY. HEATER NO. 5 USES
TSS DRAIN CONDENSATE ONLY.

```
2130 CONTINUE
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```
C***** FOLLOWING IS NOT OPERATIONAL *****
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2) FEEDWATER SURGE CONTROL MODEL - FLOW
THROUGH VALVE PROPORTIONAL TO SQRT OF
PRESSURE DROP ACROSS VALVE. PUMP
DISCHARGE PRESSURE A FUNCTION OF FLOW.
RELATION SOLVED ALGEBRAICALLY - SEE

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C                                MODEL DOCUMENTATION FOR DEFINITION OF
C                                TERMS NOT DEFINED THIS SECTION
C                                A) VALVE OPENING                                (GAFWV)
C2210 GAFWV=GKLH3*(GLH3-GLZH3)
C                                B) INLET PRESSURE AT HEATER 5                (GPIH5)
C2220 GPIH5=GWTEXT(3)/(HPDROP*HPDROP)
C                                C) FLOW THROUGH VALVE                        (GWCLP)
C2230 PZERO=GPTEXH+1.3*HPUMP(1)/(144.*GVCHW)
C                                PK=0.3*HPUMP(1)/(144.*GVCHW*HPUMP(3)**2)
C                                GWCLP=GKFWV*GAFWV*SQRT((FZERO-GPIH5)/(1.+GKFWV**2*GAFWV**2*PK))
C
C*****
C
C                                3) FEEDWATER FLOW RATES
C                                A) FLOW TO RECVR FEEDPUMPS                    (GWFPT)
C                                TSS TO EPGS INTERFACE
C2310 TWFP=TW2
C                                GWFPT=RWVSUM+TW2
C                                B) FLOW TO TSS STEAM GEN.                    (GWTSS)
C2320 GWTSS=TW8
C                                C) HEATER NO. 3 OUTPUT FLOW                  (GWOH3)
C2330 GWCOH3=GWFPT+GWTSS
C                                D) HEATER NO. 3 INPUT FLOW TO SURGE TANK      (GWCIH3)
C2340 GWCIH3=GWCOH3
C                                TEMPORARYLY NO SURGE CONTROL
C                                USING STEADY STATE MASS BALANCE
C                                GWCLP=GWCIH3-(GWTEXT(3)+GWCOT3+GWCTH3+GWCH23)
C                                GWCLP=AMAX1(0.0,GWCLP)
C
C                                4) FEEDWATER SYSTEM STATE EQUATIONS
C                                BEGINING WITH THE CONDENSER HOTWELL
C                                THE EQUATIONS PROCEED TO THE HP HEATERS
C                                A) CONDENSER HOTWELL
C                                INPUT CONDENSATE (TSS DRAIN SYS)
C                                FLOW                                          (GWCTC)
C                                ENTHALPY                                      (GHCOT2)
C                                INPUT STEAM (TURBINE EXHAUST)
C                                FLOW                                          (GWTEXH)
C                                ENTHALPY                                      (GWTEXH)
C                                OUTPUT CONDENSATE
C                                FLOW                                          (GWCLP)
C                                ENTHALPY                                      (GWCLP)
C                                CONDENSER PRESSURE                          (GPTEXH)
C                                FLUID MASS                                    (GWCHW)
C2400 GWCIHW=GWCTC+GWTEXH+GWTEXT(4)+GWCTH5
C                                GMDCHW=GWCIHW-GWCLP
C
C                                GHDCHW=(GWCTC*(GHCOT2-GWCHW) + GWTEXH*(GHSAT-GWCHW)
C1                                + GWTEXT(4)*(GWCH4C-GWCHW) + GWCTH5*(GWCH5C-GWCHW)
C2                                + GPTEXH*GVCHW*GMDCHW)/GMCHW
C
C                                B) HOTWELL PUMP
C                                FLOW                                          (GWCLP)
C                                OUTPUT PRESSURE                            (GPCIH5)
C                                OUTPUT ENTHALPY                            (GNCIH5)
C                                AUX POWER                                  (A)
C2410 CALL PUMPSS(GWCLP,DELP,DELH,APHP,HPUMP)
C                                GNCIH5=GWCHW+DELH

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GPCIH5=GPTEXH+DELP
GTAUXP=APHP

C
C
C
C
C
C

C) HEATER NO. 5
HEATING FLUID IS CONDENSATE, CALLS TO
CFWHTR REQUIRE STEAM HEATING
FW OUTPUT TEMP (GTCOH5)
FW OUTPUT PRESS (GPCOH5)
DRAIN ENTHALPY (GHCH5C)

2420 CALL USE HP(GHCOT2,GPT2)
GTCOH5=TE-H5PARM(1)
GPCOH5=GPCIH5*H5PARM(2)
CALL USE PT(GPCOH5,GTCOH5)
GHCOH5=HE
GHCH5C=GHCOT2
GPCH5C=GPT2
IF(GWCTH5.GT.1.0E-04)GHCH5C=GHCH5C+(GHCIH5-GHCOH5)*(GWCLP/GWCTH5)

C
C
C
C

D) HEATER NO. 4
NO CONDENSATE HEATING FLUID

2430 CWIN=0.0
CHIN=0.0
CPIN=0.0

C

CALL CFWHTR(GWTEXT(4),GPTTEXT(4),GHTEXT(4),CWIN,CPIN,CHIN,
1 GWCLP,GPCOH5,GHCOH5,GWCLP,GPCOH4,GHCOH4,
2 GWTEXT(4),GPCH4C,GHCH4C,H4PARM,Q)

C
C
C
C
C
C
C
C

FW OUTPUT FLOW IS GWCLP
DRAIN COOLER OUTPUT FLOW IS GWTEXT(4)

E) BOOST PUMP
FLOW (GWCOH3)
OUTPUT PRESSURE (GPCIH2)
OUTPUT ENTHALPY (GHCIH2)
AUX. POWER (AFBP)

2440 CALL PUMPSS(GWCOH3,DELPBP,DELHBP,APBP,BPUMP)
GHCIH2=GHCOH3+DELHBP
GPCIH2=GPTTEXT(3)+DELPBP
GTAUXP=GTAUXP+APBP

C
C
C

F) HEATER NO. 2

2450 CALL CFWHTR(GWSH2,GPSH2,GHSH2,GWCH12,GPCH12,GHCH12,
1 GWFPT,GPCIH2,GHCIH2,GWFPT,GPCOH2,GHCOH2,
2 GWCH23,GPCH23,GHCH23,H2PARM,Q)

C
C
C

G) HEATER NO. 1

2460 CALL CFWHTR(GWSH1,GPSH1,GHSH1,CWIN,CPIN,CHIN,
1 GWFPT,GPCOH2,GHCOH2,GWFPT,GPCOH1,GHCOH1,
2 GWCH12,GPCH12,GHCH12,H1PARM,Q)

C

CALL USE HP(GHCOH1,GPCOH1)
GTCOH1=TE
GHHTR1=GHCOH1
GFHTR1=GPCOH1
GTHTR1=GTCOH1


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2993 FORMAT(19X,23HHEATER NO. 3 -DEGRATOR, /
1      19X,9H  GVCH3=,G10.4,9H  GWCIH3=,G10.4,9H  GHCIH3=,G10.4,
1      /,
2      19X,9H  GWCOH3=,G10.4,9H  GHCOH3=,G10.4,9H  GHDCOH3=,G10.4,
2      /,
3      19X,9H  GTCOH3=,G10.4,9H  GWCTH3=,G10.4)
C
      WRITE(6,2994) GWCLP,GPCOH5,GHCOH5,
1      GPCOH4,GHCOH4,GPCH4C,GHCH4C
2994 FORMAT(19X,12HHEATER NO. 4, /
1      19X,9H  GWCLP=,G10.4,9H  GPCOH5=,G10.4,9H  GHCOH5=,G10.4,
1      /,
2      19X,9H  GPCOH4=,G10.4,9H  GHCOH4=,G10.4,9H  GPCH4C=,G10.4,
2      9H  GHCH4C=,G10.4)
C
      WRITE(6,2995) GPCIH5,GHCIH5,GWCTH5,
1      GPCOH5,GHCOH5,GPCH5C,GHCH5C
2995 FORMAT(19X,12HHEATER NO. 5, /
1      19X,9H  GPCIH5=,G10.4,9H  GHCIH5=,G10.4,
1      9H  GWCTH5=,G10.4,/,
2      19X,9H  GPCOH5=,G10.4,9H  GHCOH5=,G10.4,9H  GPCH5C=,G10.4,
2      9H  GHCH5C=,G10.4)
      WRITE(6,2996) GWCIHW,GMDCHW,GHCHW,GHDCHW,
1      GVCHW,GHSAT,GWCTC,GWCTH5
2996 FORMAT(19X,17HCONDENSER HOTWELL, /,
1      19X,9H  GWCIHW=,G10.4,9H  GMDCHW=,G10.4,9H  GHCHW=,G10.4,
1      9H  GHDCHW=,G10.4,/,
2      19X,9H  GVCHW=,G10.4,9H  GHSAT=,G10.4,9H  GWCTC=,G10.4,
2      9H  GWCTH5=,G10.4)
C
C
      WRITE(6,2997) DELH,DELP,APHP,DELHBP,DELPBP,APBP,GTAUXP
2997 FORMAT(19X,15HFEEDWATER PUMPS, /,
1      19X,9H  DELH=,G10.4,9H  DELP=,G10.4,9H  APHP=,G10.4,
1      /,
2      19X,9H  DELHBP=,G10.4,9H  DELPBP=,G10.4,9H  APBP=,G10.4,
2      /,
3      19X,9H  GTAUXP=,G10.4)
C
C
      RECVR FEEDPUMP ROUTINE
C
3000 CALL RECFEED(GPCOH1,GTCOH1,GHCOH1)
C*****
C*****          EPGS FEEDWATER TO TSS STEAM GENERATOR          *****
C*****          *****
C
4000 GDIFWP=2.*GRIFWP
      GDOFWP=2.*GROFWP
C
C
C          1. COMPUTE PRESSURE AT STEAM GENERATOR
C          INLET (GPCTSG)
C          REYNOLDS NUMBER (GRETSG)
C          VISCOSITY (GMUTSG)
C          FRICTIONAL PRESSURE DROP (DELPTSG)
4100 CALL USE HP(GHCIH2,GPCIH2)
      GVTSG=VE
      GTCIH2=TE
      GRETSG=AIREWA(TE,GPCIH2,GWTSS,GDIFWP)
C
      GMUTSG=AIVISC(TE,GPCIH2)

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      SUBROUTINE ERR(I)
C
C SUBROUTINE ERR PRINTS AN ERROR MESSAGE AND CAUSES AN ERROR HALT.
C I=1,2,3,4 SIGNIFIES TYPE OF ERROR.
C ERROR MESSAGES ARE --
C   1 -- TOO MANY VARIABLE/LABEL CARDS
C   2 -- TOO MANY CARDS IN A PLOT REQUEST
C   3 -- REQUESTED VARIABLE NOT IN VARIABLE TABLE
C   4 -- TOO MANY RECORDS ON TAPE 8
C
C WRITE ERROR HEADER MESSAGE
      WRITE(6,1000)
1000 FORMAT(/////* FATAL ERROR DETECTED BY PLOT ROUTINE*)
C
      IF(I.NE.1) GO TO 10
      WRITE(6,1001)
1001 FORMAT(* TOO MANY VARIABLE/LABEL CARDS*)
      GO TO 100
C
10 IF(I.NE.2) GO TO 20
      WRITE(6,1002)
1002 FORMAT(* TOO MANY CARDS IN A PLOT REQUEST*)
      GO TO 100
C
20 IF(I.NE.3) GO TO 30
      WRITE(6,1003)
1003 FORMAT(* REQUESTED VARIABLE NOT IN VARIABLE TABLE*)
      GO TO 100
C
30 WRITE(6,1004)
1004 FORMAT(* TOO MANY RECORDS ON TAPE 8*/)
C
100 STOP 2
      END

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C      SUBROUTINE EVNTS(IX)
C      SELECT APPROPRIATE EVENT
C
C
C      EXECUTIVE AND PROGRAM CONTROL DATA
C
C      INTEGER ATIMO,ATIDAY
C      LOGICAL OUTFG,END,DIAG
C      COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1  DIAG(40)
C
C      OUTFG(I,J)  OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
C      END          END OF RUN FLAG
C      ATILCL       LOCAL TIME (SECONDS FROM MIDNIGHT)
C      ATITST       TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
C      ATIMO        MONTH
C      ATIDAY       DAY
C      DIAG         DIAGNOSTIC PRINT FLAG ARRAY
C
C
C      MASTER CONTROL SUBSYSTEM DATA
C
C      INTEGER CMODE,CNMODE,CNSP,CNMV,CMVRTBL,CMVLA,CMVPA,
1  CMVRC,CNM,CNMVEL,CNNM
C      COMMON /CDATA/ CMODE,CNMODE,CSPTBL(7,16),CSP(16),CNSP,
1  CMVLTBL(6,4,7),CMVL(5,4),CNMV,CMVRTBL(7,7,4),
2  CMVLA(7),CMVPA(4),CMVRC(4),CNM(4),CNMVEL,CNNM
C
C      CMODE        CURRENT MODE OF OPERATION
C      CNMODE       NUMBER OF DIFFERENT MODES OF OPERATION
C      CSPTBL       SETPOINT TABLE
C      CSP          SETPOINTS FOR CURRENT MODE OF OPERATION
C      CNSP         NUMBER OF SETPOINTS
C      CMVLTBL      TABLE OF OPERATING LIMITS FOR MONITORED VARIABLES
C      CMVL         OPERATING LIMITS OF MONITORED VARIABLES FOR CURRENT
C                  MODE OF OPERATION
C      CNMV         NUMBER OF MONITORED VARIABLES
C      CMVRTBL      TABLE OF MCS RESPONSES FOR MONITORED VARIABLES
C                  EXCEEDING THEIR LIMITS
C      CMVLA        MONITORED VARIABLE LIMIT ARGUMENT FOR RESPONSE TABLE
C      CMVPA        MONITORED VARIABLE ARGUMENT FOR RESPONSE TABLE
C      CMVRC        RESPONSE CODES FOR MONITORED VARIABLES CROSSING LIMITS
C      CNM          POTENTIAL NEW MODES TO CORRECT MONITORED VARIABLE
C                  LIMIT CROSSINGS
C      CNMVEL       NUMBER OF MONITORED VARIABLES EXCEEDING LIMITS
C                  AT ANY INSTANT OF TIME
C      CNNM         NUMBER OF NEW MODE REQUESTS AT ANY INSTANT OF TIME
C
C      STANDARD DEFINITION OF PILOT PLANT OPERATING MODES
C
C      1= RECEIVER STEAM TO EPGS
C      2= RECEIVER STEAM TO EPGS AND THERMAL STORAGE
C      3= RECEIVER STEAM TO EPGS AND THERMAL STORAGE STEAM TO EPGS
C      4= RECEIVER STEAM TO THERMAL STORAGE AND THERMAL STORAGE
C          STEAM TO EPGS
C      5= RECEIVER STEAM TO THERMAL STORAGE
C      6= THERMAL STORAGE STEAM TO EPGS
C      7= OVERNIGHT SHUTDOWN AND HOLD
C

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C ARGUMENT DEFINITIONS FOR SETPOINT ARRAY CSP(I)
C
C I=1,4 EPGS VALVE SETPOINTS FOR VALVES R1-R4
C I=5,6 EPGS VALVE SETPOINTS FOR VALVES T1,T2
C I=7,8 EPGS VALVE SETPOINTS FOR DRAIN VALVES
C I=9,12 EPGS VALVE SETPOINTS FOR VALVES E1-E4
C I=13 EPGS CONDENSER FAN SETPOINT
C I=14 EPGS FEED PUMP PRESSURE SETPOINT
C I=15 RECEIVER OUTLET TEMPERATURE SETPOINT
C I=16 TSS OUTLET STEAM FLOW RATE SETPOINT
C
C CURRENT LIST OF MONITORED VARIABLES
C
C RECEIVER OUTLET PRESSURE
C RECEIVER OUTLET TEMPERATURE
C EPGS FEEDWATER PRESSURE
C TSS THERMOCLINE LEVEL
C
C COLLECTOR SUBSYSTEM DATA
C
C COMMON /HDATA/ HFLRN(20,8),HCEF(121),HREF,HCFL,XTIST,XTIEND,
1 XVAL,XDIR,XDTCS
C
C HFLRN HELIOSTAT OUTPUT SOLAR ARRAY FLUX AT RECEIVER NODES
C (BTU/SEC)
C HCEF HELIOSTAT FIELD CELL EFFICIENCIES (ND)
C HREF HELIOSTAT REFLECTIVE EFFICIENCY (ND)
C HCFL COLLECTOR FIELD SIZE (FEET)
C XTIST START TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C TIME CLOUD FRONT INTERCEPTS CORNER OF CELL ARRAY
C XTIEND END TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C TIME CLOUD REAR INTERCEPTS CORNER OF CELL ARRAY
C XVAL CLOUD VELOCITY (MILES/HOUR)
C XDIR CLOUD DIRECTION (DEGREES FROM N TO S DIRECTION)
C (0 = N TO S, 90 = W TO E, -90 = E TO W, 180 = S TO N)
C XDTCS CLOUD UPDATE SCHEDULING INTERVAL (SEC)
C
C RECEIVER SUBSYSTEM DATA
C
C RECVR VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)
C
C INTEGER RCVST,RAFLGC
C COMMON /RDATA/ RHISH(6),RWISH(6),RHSR,RPRSR,RTESH,RHOSH,RFMV(6),
1 RLV(6),RHIV,RPRIV,RPRISV,RPROSV,RVIV,RHOV(6),RPROV(6),RHW(6),
2 RWVSUM,RHF1(8),RPRF1(8),RTEF1(8),RUF1(8),RVF1(8),RHCF2(8),
3 RHF2(8),RPRF2(8),RQF2(8),RTEF2(8),RTEFF2(8),RUF2(8),RVF2(8),
4 RHTF2(8),RHCM2(8),RHFCM2(8),RHFRM2(8),RQM2(8),RQAM2(8),RQCM2(8),
5 RQEM2(8),RPRF3(8),RTEF3(8),RUF3(8),RVF3(8),RHCF4(8),RHNDF4(8),
6 RHFBF4(8),RHF4(8),RPRF4(8),RQF4(8),RTEF4(8),RTEFF4(8),RUF4(8),
7 RVF4(8),RWTF4(8),RHCM4(8),RHFCM4(8),RHFRM4(8),RQM4(8),RQAM4(8),
8 RQCM4(8),RQEM4(8),RPRF5(8),RTEF5(8),RUF5(8),RVF5(8),RXF5(8),
9 RHCF6(8),RHF6(8),RPRF6(8),RQF6(8),RTEF6(8),RTEFF6(8),RUF6(8),
A RVF6(8),RWTF6(8),RHCM6(8),RHFCM6(8),RHFRM6(8),RQM6(8),RQAM6(8),
B RQCM6(8),RQEM6(8),RHF7(8),RPRF7(8),RTEF7(8),RUF7(8),RVF7(8),
C RUFSAT(8),RVFSAT(8),RUVSAT(8),RVVSAT(8),RL35(8),RL57(8),RHSP(8),
D RCVST(8),RAFLGC(6),RERRTC(6),RLPROC(6),RLSUMC(6),RTSETC
C
C RHISH(ISP) FLUID ENTHALPY AT STEAM HEADER INLET

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C      (BTU/LBM)
C      RWISH(ISP) FLUID MASS FLOW RATE AT STEAM HEADER INLET
C                  (LBM/SEC)
C      RSHH      FLUID ENTHALPY IN STEAM HEADER
C                  (BTU/LBM)
C      RPRSH     FLUID PRESSURE IN STEAM HEADER
C                  (PSIA)
C      RTESH     FLUID TEMPERATURE IN STEAM HEADER
C                  (DEGREES F)
C      RWOSH     FLUID MASS FLOW RATE AT STEAM HEADER OUTLET
C                  (LBM/SEC)
C      RFMV(IV)  MODIFIED FRICTION FLOW COEFFICIENT FOR FLOW
C                  CONTROL VALVE (PSI,SEC**2/LBM,CU FT)
C      RLV(IV)   STEM DISPLACEMENT OF FLOW CONTROL VALVE
C                  (PERCENT)
C      RHIV      FLUID ENTHALPY AT FLOW CONTROL VALVE INLETS
C                  (BTU/LBM)
C      RPRIV     FLUID PRESSURE AT FLOW CONTROL VALVE INLETS
C                  (PSIA)
C      RPRISV    FLUID PRESSURE AT RECEIVER SUBSYSTEM INLET
C                  (PSIA)
C      RPROSV    FLUID PRESSURE AT RECEIVER SUBSYSTEM OUTLET
C                  (PSIA)
C      RVIV      FLUID SPECIFIC VOLUME AT FLOW CONTROL VALVE INLETS
C                  (CU FT/LBM)
C      RHOV(IV)  FLUID ENTHALPY AT FLOW CONTROL VALVE OUTLET
C                  (BTU/LBM)
C      RPROV(IV) FLUID PRESSURE AT FLOW CONTROL VALVE OUTLET
C                  (PSIA)
C      RWV(IV)   FLUID MASS FLOW RATE THROUGH FLOW CONTROL VALVE
C                  (LBM/SEC)
C      RWVSUM    FLUID MASS FLOW RATE THROUGH ALL FLOW CONTROL VALVES
C                  (LBM/SEC)
C      RHF1(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 1
C                  (BTU/LBM)
C      RPRF1(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 1
C                  (PSIA)
C      RTEF1(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 1
C                  (DEGREES F)
C      RUF1(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 1
C                  (BTU/LBM)
C      RVF1(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 1
C                  (CU FT/LBM)
C      RHCF2(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C                  SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
C      RHF2(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 2
C                  (BTU/LBM)
C      RPRF2(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 2
C                  (PSIA)
C      RQF2(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
C                  SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
C      RTEF2(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C                  (DEGREES F)
C      RTEFF2(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C                  (DEGREES F)
C      RUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
C                  (BTU/LBM)
C      RVF2(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 2
C                  (CU FT/LBM)
C      RUTF2(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE

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C NUMBER 2 (LBM/SEC)
 C RHCM2(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFCM2(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFRM2(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RQM2(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQAM2(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQCM2(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQEM2(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RPRF3(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 3
 C (PSIA)
 C RTEF3(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 3
 C (DEGREES F)
 C RUF3(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RVF3(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 3
 C (CU FT/LBM)
 C RHCF4(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHNB4(ISP) INTERNAL NUCLEATE BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFB4(ISP) INTERNAL FILM BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHF4(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RPRF4(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 4
 C (PSIA)
 C RQF4(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RTEF4(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RTEFF4(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RUF4(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RVF4(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 4
 C (CU FT/LBM)
 C RWF4(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 4 (LBM/SEC)
 C RHCM4(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFCM4(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFRM4(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RQM4(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQAM4(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQCM4(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQEM4(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RPRF5(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 5

C (PSIA)
 C RTEF5(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 5
 C (DEGREES F)
 C RUF5(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RVF5(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 5
 C (CU FT/LBM)
 C RXF5(ISP) FLUID QUALITY AT SUPERPANEL NODE NUMBER 5
 C (PERCENT)
 C RHCF6(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHF6(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RPRF6(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 6
 C (PSIA)
 C RQF6(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RTEF6(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RTEFF6(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RUF6(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RVF6(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 6
 C (CU FT/LBM)
 C RHTF6(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 6 (LBM/SEC)
 C RHCM6(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFCM6(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFRM6(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RQM6(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQAM6(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQCM6(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQEM6(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RHF7(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RPRF7(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 7
 C (PSIA)
 C RTEF7(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 7
 C (DEGREES F)
 C RUF7(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RVF7(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 7
 C (CU FT/LBM)
 C RUF\$AT(ISP) INTERNAL ENERGY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RVFSAT(ISP) SPECIFIC VOLUME OF A SATURATED LIQUID
 C (CU FT/LBM)
 C RUVSAT(ISP) INTERNAL ENERGY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RVVSAT(ISP) SPECIFIC VOLUME OF A SATURATED VAPOR
 C (CU FT/LBM)
 C RL35(ISP) LENGTH OF SUPERPANEL TWO-PHASE MIXTURE SECTION


```

C   RKNBSP      NUMBER OF BOILER SUPERPANELS
C               (ND)
C   RKFF2       FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 2
C               (PSI,SEC**2/LBM,CU FT)
C   RKFF4       FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 4
C               (PSI,SEC**2/LBM,CU FT)
C   RKFF6       FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 6
C               (PSI,SEC**2/LBM,CU FT)
C   RKFFV(IV)   FLUID FLOW COEFFICIENT OF FLOW CONTROL VALVE
C               (PSI,SEC**2/LBM,CU FT)
C   RKAHV(IV)   PERCENT SUBSYSTEM PRESSURE DROP ACROSS
C               FLOW CONTROL VALVE (PERCENT)
C   RKVSH       VOLUME OF STEAM HEADER
C               (CU FT)
C   RKINTC(IC)  CONTROLLER INTEGRAL GAIN CONSTANT
C               (PERCENT,SEC/F)
C   RKPROC(IC)  CONTROLLER PROPORTIONAL GAIN CONSTANT
C               (PERCENT/F)
C   RKTHSC      CONTROLLER ACTIVATION TEMPERATURE THRESHOLD
C               (DEGREES F)
C
C   GASP-IV SIMULATION SYSTEM DATA
C
C   COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
1  INAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
2  ,TTCLR,TTFIN,TRIB(25),TTSET
C
C   COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
1  ,NNEQD,NNEQS,NNEQT,SS(600),SSL(600),TTNEX
C
C   DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
1  RLINTC(6),RL15(8),RHFSAT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
2  RDIUF2(8),RDL13(8),RDTM2(8),RDIHF3(8),RDEM4(8),RDEM6(8),
3  RDLINTC(6)
C
C   EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
1  (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
2  (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
3  (TWS,SS(83)),(TW7,SS(84)),(TWS,SS(85)),
4  (THTSU,SS(86)),(GMCT3,SS(87)),(GHCOT3,SS(88)),
5  (GHCOT3,SS(89)),(GHSDC,SS(90)),(GHSTSG,SS(91)),
6  (GHCOT1,SS(92)),(GHCOT2,SS(93)),(GMCT2,SS(94)),
7  (GHCOT2,SS(95)),(GFPS,SS(96)),(GHRCI,SS(97)),
8  (GHDSI,SS(98)),(GHCDH3,SS(99)),(GHCTSG,SS(100)),
9  (GHCHW,SS(101)),
A  (RL15(1),SS(102)),(RHFSAT(1),SS(110)),(RHF3(1),SS(113)),
B  (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
C  (CRPSSH,SS(151)),(CRTESH,SS(152)),(CGPFPR,SS(153)),
D  (CTLT,SS(154)),
E  (GPFP,SS(161)),(GPDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
F  (XK3,SS(165))
C
C   EQUIVALENCE (RDIUF2(1),DD(1)),(RDL13(1),DD(9)),(RDEM2(1),DD(17)),
1  (RDIHF3(1),DD(25)),(RDEM4(1),DD(33)),(RDEM6(1),DD(41)),
2  (RUSH,DD(49)),(RVSH,DD(50)),(RDLINTC(1),DD(51)),
3  (TDWS,DD(83)),(TDW7,DD(84)),
4  (TDW8,DD(85)),(TDHTSU,DD(86)),(GMCDT3,DD(87)),
5  (GHDCOT3,DD(88)),(GHDCOT3,DD(89)),(GHSDC,DD(90)),
6  (GHSTSG,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),
7  (GHSTSG,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),

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INTEGRATED STATE VARIABLES	
RIUF2(ISP)	FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2 (BTU/LBM)
RL13(ISP)	LENGTH OF SUPERPANEL SUBCOOLED SECTION (FEET)
RTEM2(ISP)	METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 2 (DEGREES F)
RIHF3(ISP)	FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3 (BTU/LBM)
RTEM4(ISP)	METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 4 (DEGREES F)
RTEM6(ISP)	METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 6 (DEGREES F)
RUSH	FLUID INTERNAL ENERGY IN STEAM HEADER (BTU/LBM)
RVSH	FLUID SPECIFIC VOLUME IN STEAM HEADER (CU FT/LBM)
RLINTC(IC)	CONTROLLER INTEGRAL SIGNAL OF VALVE STEM DISPLACEMENT (PERCENT)
TW5	NOMINAL OIL FLOW INTO STORAGE (LBM/SEC)
TW7	NOMINAL OIL FLOW FROM STORAGE (LBM/SEC)
TW3	STEAM FLOW FROM STEAM GENERATOR (LBM/SEC)
THTSU	HEAT STORED IN THERMAL STORAGE UNIT (BTU)
GMCT3	CONDENSATE MASS (LBM) IN TANK 3 (RECVR FLASH TANK)
GHCOT3	ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 3
GHCOT3	FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 3
GHSEDC	ENTHALPY (BTU/LBM) OF STEAM AT BOTTOM OF DOWNCOMER
GHSTSG	ENTHALPY (BTU/LBM) OF ADMISSION STEAM
GHCOT1	ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 1
GHCOT2	ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 2
GMCT2	MASS (LBM) OF CONDENSATE IN TANK 2
GHCOT2	FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 2
GFPS	RECVR FEED PUMP SPEED (RPM)
GHRCI	F.W. ENTHALPY (BTU/LBM) AT RECVR INLET
GHDSI	F.W. ENTHALPY (BTU/LBM) AT DESUPERHTR INLET
GHCH3	F.W. ENTHALPY (BTU/LBM) OUT OF FW HRTR NO. 3
GHCTSG	ENTHALPY (BTU/LBM) AT TSS STEAM GEN. INLET
GHCHW	ENTHALPY (BTU/LBM) OF CONDENSATE IN CONDENSER HOTWELL
ADDITIONALLY REQUIRED GASP-IV STATE VARIABLES	
RL15(ISP)	COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND TWO-PHASE MIXTURE SECTIONS (FEET)
RHFSAT(ISP)	ENTHALPY OF A SATURATED LIQUID (BTU/LBM)
RHF3(ISP)	FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3 (BTU/LBM)
RHVSAT(ISP)	ENTHALPY OF A SATURATED VAPOR (BTU/LBM)
RHF5(ISP)	FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5 (BTU/LBM)
RTSENC(IC)	CONTROLLER TEMPERATURE SENSOR SIGNAL OF BOILER SUPERPANEL OUTLET TEMPERATURE (DEGREES F)

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C   CRPRSH      FLUID PRESSURE IN RECEIVER STEAM HEADER
C               (PSIA)
C   CRTESH      FLUID TEMPERATURE IN RECEIVER STEAM HEADER
C               (DEGREES F)
C   CGPFPR      FLUID PRESSURE AT RECEIVER INLET
C               (PSIA)
C   CTLT        POSITION OF TSS THERMOCLINE
C               (PERCENT)
C   GPFPR       FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
C   GFDSI       FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)
C   XK1,XK2,XK3 EFSS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND
C               PRESSURE AT RECEIVER INLET
C
C   TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES
C
C   RDIUF2(ISP) TIME DERIVATIVE OF RIUF2(ISP)
C   RDL13(ISP)  TIME DERIVATIVE OF RL13(ISP)
C   RTEM2(ISP)  TIME DERIVATIVE OF RTEM2(ISP)
C   ROIHF3(ISP) TIME DERIVATIVE OF RIHF3(ISP)
C   RTEM4(ISP)  TIME DERIVATIVE OF RTEM4(ISP)
C   RTEM6(ISP)  TIME DERIVATIVE OF RTEM6(ISP)
C   ROUSH       TIME DERIVATIVE OF RUSH
C   RDVSH       TIME DERIVATIVE OF RVSH
C   RLINTC(IC)  TIME DERIVATIVE OF RLINTC(IC)
C
C   TDW5        TIME DERIVATIVE OF TW5
C   TDW7        TIME DERIVATIVE OF TW7
C   TDW8        TIME DERIVATIVE OF TW8
C   TDHTSU      TIME DERIVATIVE OF THTSU
C
C   GMDCT3      TIME DERIVATIVE OF GMCT3
C   GHDCOT3     TIME DERIVATIVE OF GMDCT3
C   GHDCOT3     TIME DERIVATIVE OF GMDCT3
C   GHSDSDC     TIME DERIVATIVE OF GHSDC
C   GHSTSG      TIME DERIVATIVE OF GHSTSG
C   GHDCOT1     TIME DERIVATIVE OF GMDCT1
C   GHDCOT2     TIME DERIVATIVE OF GMDCT2
C   GMDCT2      TIME DERIVATIVE OF GMCT2
C   GHDCOT2     TIME DERIVATIVE OF GMDCT2
C   GFPS        TIME DERIVATIVE OF GFPS
C   GHRCI       TIME DERIVATIVE OF GHRCI
C   GHDSI       TIME DERIVATIVE OF GHDSI
C   GHDCOH3     TIME DERIVATIVE OF GHCOH3
C   GHDCOTSG    TIME DERIVATIVE OF GHCTSG
C   GHCHW       TIME DERIVATIVE OF GHCHW
C
C   DIMENSION J1(15)
C
C   DATA EPSLN /0.01/
C   EPSLN      SMALL LENGTH INCREMENT
C
C   TEST EVENT TYPE
C   GO TO (300,1200,1300,1400), IX
C
C *****RECEIVER SUBSYSTEM STATE EVENTS*****
C

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C      SEARCH FOR STATE EVENT IN EACH SUPERPANEL
300  NSP=RKNPSP+RKNBSP
    DO 400 ISP=1,NSP
C      DECODE 3 BIT TRANSITION FLAGS IN LFLAG
    J2=LFLAG(ISP)
    IF (J2.EQ.0) GO TO 400
    DO 320 I1=1,15
    J3=J2/8
    J1(I1)=J2-8*J3
320  J2=J3
C
C      LFLAG IS DIVIDED INTO FIFTEEN 3 BIT CELLS (NUMBERED FROM RIGHT END
C      OF WORD) WHICH CONTAIN STATE VARIABLE TRANSITION INFORMATION AS
C      SHOWN BELOW.
C      CELL          CROSSING VAR.          CROSSED VAR.
C      1             RL13                   0.0
C      2             RL15                   RKL17
C      3             RL13                   RKL17
C      4             RHF3                   RHFSAT
C      5             RHF5                   RHVSAT
C      6             RTSENC                 RKTHSC
C      7-15          RESERVED
C      WITHIN EACH CELL, THE VALUE IS INTERPRETED AS FOLLOWS.
C      VALUE          MEANING
C      0              NO CROSSING
C      1              POSITIVE CROSSING
C      2              NEGATIVE CROSSING
C      ALL OTHERS     UNDEFINED
C
C      TEST FOR TRANSITION TO 1 FLUID CONTROL VOLUME
    IF (.NOT.(J1(3).EQ.1.OR.J1(4).EQ.2)) GO TO 370
    RCVST(ISP)=1
    RL15(ISP)=RKL17
    RL13(ISP)=RL15(ISP)
    GO TO 400
C      TEST FOR TRANSITION TO 2 FLUID CONTROL VOLUMES
370  IF (.NOT.(J1(2).EQ.1.OR.J1(3).EQ.2.OR.J1(4).EQ.1.OR.J1(5).EQ.
1  2)) GO TO 380
    RCVST(ISP)=2
    RL15(ISP)=RKL17
    GO TO 400
C      TEST FOR TRANSITION TO 3 FLUID CONTROL VOLUMES
380  IF (.NOT.(J1(2).EQ.2.OR.J1(5).EQ.1)) GO TO 400
    RCVST(ISP)=3
    RTEF7(ISP)=RTEF5(ISP)
    RVF7(ISP)=RVF5(ISP)
400  CONTINUE
C
C      SEARCH FOR STATE EVENT IN EACH TEMPERATURE CONTROLLER
    DO 450 IC=1,RKNBSP
C      TEST FOR FLOW CONTROLLER ACTIVATION OR DEACTIVATION
    IF (J1(6).EQ.0) GO TO 450
    IF (J1(6).EQ.1) RAFLGC(IC)=2
    IF (J1(6).EQ.2) RAFLGC(IC)=1
450  CONTINUE
C
C      GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
    DO 700 ISP=1,NSP
    IF (ISP.LE.RKNBSP) IC=ISP
    IF (DIAG(10).AND.LFLAG(ISP).NE.0) WRITE(6,685)

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1  ISP,LFLAG(ISP),J1,RCVST(ISP),RAFLGC(IC),
2  RL13(ISP),RL15(ISP),EPSLN,
3  RTEF7(ISP),RVF7(ISP)
685  FORMAT(1H ,3X,13HDIAG10/EVNTS ,I4,I16,17I3,9X,G10.4/
1  (1H ,16X,9G10.4))
C
700  CONTINUE
C
C
C*****MASTER CONTROL SUBSYSTEM STATE EVENTS*****
C
C
C      MASTER CONTROL REACTION TO MONITORED VARIABLES EXCEEDING
C      THEIR LIMITS
C
C
C      DETERMINE THE NUMBER OF MONITORED VARIABLES WHICH HAVE EXCEEDED
C      THEIR LIMITS AT THIS INSTANT AND THE RESPONSE TABLE LIMIT AND
C      POSITION ARGUMENTS OF THESE VARIABLES
C
C      CNMVEL=0
C      DO 710 I=1,CNMV
C      IFLGMV=8+I
C
C      IF (DIAG(27).AND.LFLAG(IFLGMV).NE.0) PRINT *,#DIAG(27)      #,
1  #TROW = #,TROW,# LFLAG(#,IFLGMV,#) = #,LFLAG(IFLGMV)
C
C      IF (LFLAG(IFLGMV).EQ.0) GO TO 710
C      CNMVEL=CNMVEL+1
C      CMVLA(CNMVEL)=LFLAG(IFLGMV)+4
C      CMVPA(CNMVEL)=I
C
C      IF (DIAG(27).AND.LFLAG(IFLGMV).NE.0) PRINT *,#      #,
1  #CNMVEL = #,CNMVEL,# CMVLA = #,CMVLA(CNMVEL),# CMVPA = #,
2  CMVPA(CNMVEL)
C
710  CONTINUE
C      IF (CNMVEL.EQ.0) GO TO 900
C
C      OBTAIN MCS RESPONSE CODES FOR THE MONITORED VARIABLES WHICH
C      HAVE EXCEEDED THEIR LIMITS
C
C      CNNM=0
C      DO 720 I=1,CNMVEL
C      CMVRC(I)=CMVRTBL(CMVLA(I),CMODE,CMVPA(I))
C
C      IF (DIAG(27)) PRINT *,#      CMVRC(#,I,#) = #,CMVRC(I),
1  # CMODE = #,CMODE
C
C      IF (CMVRC(I).GT.CNM) GO TO 720
C      CNNM=CNNM+1
C      CNM(CNM)=CMVRC(I)
C
C      IF (DIAG(27)) PRINT *,#      CNNM = #,CNM,# CNM = #,
1  CNM(CNM)
C
720  CONTINUE
C      IF (CNM.EQ.0) GO TO 750
C
C

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```

C      SET NEW MCS OPERATING MODE
C
C
C      IF SEVERAL NEW OPERATING MODES HAVE BEEN AUTHORIZED, SET
C      THE NEW OPERATING MODE TO THE AUTHORIZED MODE OF HIGHEST
C      PRIORITY
C
C      LCMODE=CMODE
C      DO 740 I=1,CNNM
C      DO 730 J=1,CNNM
C      IF (CNM(I).GE.CNM(J)) CMODE=CNM(I)
C
C      IF (DIAG(27)) PRINT *,*          CNM = *,CNM(I),* CMODE = *,
1      CMODE
C
C      730 CONTINUE
C      740 CONTINUE
C      IF (LCMODE.EQ.CMODE) GO TO 746
C
C      PRINT *,*OPERATION HAS BEEN SWITCHED FROM MODE *,LCMODE,
1      * TO MODE *,CMODE,* WITH THE FOLLOWING NEW SETPOINTS AND*,
2      * MONITORED VARIABLE LIMITS:*
C
C      DO 742 I=1,CNSP
C      CSP(I)=CSPTBL(CMODE,I)
C
C      742 PRINT *,*          CSP(*,I,*) = *,CSP(I)
C
C      DO 748 J=1,CNMV
C      DO 747 I=1,6
C      747 CMVL(I,J)=CMVLTBL(I,J,CMODE)
C
C      748 PRINT *,*          CMVL(I,*,J,*) = *,(CMVL(I,J),I=1,6)
C
C      IF(CMODE.NE.6.OR.CMODE.NE.7) GO TO 900
C      DO 744 K=1,121
C      744 HCEF(K)=0.0*HCEF(K)
C      CALL FLUX
C
C      PRINT *,*COLLECTOR EFFICIENCY IS ZERO FOR THIS MODE*
C
C      GO TO 900
C
C      746 PRINT *,*OPERATION REMAINS IN MODE *,CMODE
C
C      GO TO 900
C
C
C      ADJUST COLLECTOR FIELD OR SUBSYSTEM SETPOINTS
C
C      750 DO 800 I=1,CNMVEL
C      GO TO (760,770,780,790) CMVRC(I)-CMODE
C
C      DEFOCUS THE COLLECTOR FIELD BY 10 PERCENT
C
C
C      760 DO 761 J=1,121
C      761 HCEF(J)=0.9*HCEF(J)
C      CALL FLUX
C      WRITE(6,762)
C      762 FORMAT(/5X,*COLLECTOR EFFICIENCY WILL BE REDUCED BY 10 PERCENT *,

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1  *FROM ITS PREVIOUS VALUE*/
GO TO 800
C
C      ADJUST RECEIVER SUBSYSTEM SETPOINTS
C
770 CONTINUE
WRITE(6,772)
772 FORMAT(/5X,*RECEIVER SUBSYSTEM SETPOINTS HAVE BEEN ADJUSTED*/)
GO TO 800
C
C      ADJUST EPGS SETPOINTS
C
780 CONTINUE
WRITE(6,782)
782 FORMAT(/5X,*EPGS SETPOINTS HAVE BEEN ADJUSTED*/)
GO TO 800
C
C      ADJUST TSS SETPOINTS
C
790 CONTINUE
WRITE(6,792)
792 FORMAT(/5X,*TSS SETPOINTS HAVE BEEN ADJUSTED*/)
GO TO 800
C
800 CONTINUE
900 CONTINUE
C
RETURN
C
C      ENVIRONMENTAL DATA UPDATE
1200 ATILCL=TNOW
CALL EDATIN
ATIB(1)=TNOW+500.0
ATIB(2)=2.0
CALL FILEM(1)
GO TO 2000
C
C      SOLAR FLUX DATA UPDATE
1300 ATILCL=TNOW
CALL FLUX
ATIB(1)=TNOW+500.0
ATIB(2)=3.0
CALL FILEM(1)
GO TO 2000
C
C      CLOUD DATA UPDATE
1400 ATILCL=TNOW
CALL CLOUD
CALL FLUX
IF (TNOW.GT.(XTIEND+10.96423652*HCFL/XVAL)) GO TO 2000
ATIB(1)=TNOW+XDTC5
ATIB(2)=4.0
CALL FILEM(1)
GO TO 2000
C
C      GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
2000 IF (DIAG(10)) WRITE (6,2010)
1 TNOW,ATIB(1),ATIB(2)
2010 FORMAT(1H ,3X,13HDIAG10/EVNTS ,12HTIME EVENT ,2F11.3,F6.1)
C
RETURN
END

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SUBROUTINE FLUX

AEROSPACE CORPORATION, JAN 1978, C. L. LAURENCE

THIS ROUTINE READS FLUX DATA FROM FILE 20 FOR INCREMENTS IN SOLAR TIME FROM SUNRISE TO SUNSET.
THE DATA IS FOR THE FLUX (WATTS) ON 160 RECEIVER NODES FROM EACH OF 121 CELLS OF HELIOSTATS IN THE COLLECTOR FIELD.
THERE ARE 20 VERTICAL NODES EVENLY SPACED ON 8 SUPERPANELS.
THE DATA FILES ARE PRODUCED BY PROGRAM CONCEN AND NORMALIZED TO 1.0 KW/SQ M INSOLATION, 1.0 HELIOSTAT REFLECTIVE EFFICIENCY AND TO 0.95 NORMAL INCIDENCE RECEIVER ABSORPTIVITY.

THIS ROUTINE MULTIPLIES BY THE CURRENT OPERATING EFFICIENCY OF EACH HELIOSTAT FIELD CELL, SUMS OVER CELLS TO GET THE TOTAL FLUX INTO EACH NODE, INTERPOLATES (LINEAR) IN TIME, AND MULTIPLIES BY THE CURRENT VALUE OF INSOLATION AND HELIOSTAT REFLECTIVITY.

EXECUTIVE AND PROGRAM CONTROL DATA

INTEGER ATIMO,ATIDAY
LOGICAL OUTFG,END,DIAG
COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1 DIAG(40)

OUTFG(I,J) OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
END END OF RUN FLAG
ATILCL LOCAL TIME (SECONDS FROM MIDNIGHT)
ATITST TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
ATIMO MONTH
ATIDAY DAY
DIAG DIAGNOSTIC PRINT FLAG ARRAY

ENVIRONMENTAL DATA

COMMON /EDATA/ ETEAMB,EPRAMB,EVWAMB,EINDIR,EDWAMB,ETDAMB
ETEAMB AMBIENT TEMPERATURE (DEGREES FAHRENHEIT)
EPRAMB AMBIENT PRESSURE (LB/SQ IN ABS)
EVWAMB AMBIENT WIND VELOCITY (FT/SEC)
EINDIR DIRECT INSOLATION (KILOWATTS/SQ METER)
EDWAMB WIND DIRECTION (DEGREES AZIMUTH)
ETDAMB DEW POINT TEMPERATURE (DEGREES FAHRENHEIT)

COLLECTOR SUBSYSTEM DATA

COMMON /HDATA/ HFLRN(20,8),HCEF(121),HREF,HCFL,XTIST,XTIEND,
1 XVAL,XDIR,XDTCS

HFLRN HELIOSTAT OUTPUT SOLAR ARRAY FLUX AT RECEIVER NODES (BTU/SEC)
HCEF HELIOSTAT FIELD CELL EFFICIENCIES (ND)
HREF HELIOSTAT REFLECTIVE EFFICIENCY (ND)
HCFL COLLECTOR FIELD SIZE (FEET)
XTIST START TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)

```

C      TIME CLOUD FRONT INTERCEPTS CORNER OF CELL ARRAY
C      XTIEND  END TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C      TIME CLOUD REAR INTERCEPTS CORNER OF CELL ARRAY
C      XVAL    CLOUD VELOCITY (MILES/HOUR)
C      XDIR    CLOUD DIRECTION (DEGREES FROM N TO S DIRECTION)
C              (0 = N TO S, 90 = W TO E, -90 = E TO W, 180 = S TO N)
C      XDTCS   CLOUD UPDATE SCHEDULING INTERVAL (SEC)
C
C      LEVEL 2,SFA,SFB
C      COMMON SFA,SFB
C      DIMENSION SFA(20,8,121),SFB(20,8,121),HA(20,8),HB(20,8)
C
C      DATA NR/0/
C
C      HAS ANY DATA BEEN READ
C      IF (NR .NE. 0) GO TO 15
C
C      NR = 1
C      READ (20) TA,(((SFA(I,J,L),I=1,20),J=1,8),L=1,121)
C      RECCRD CONTROL
12 NR = NR + 1
C      READ (20) TB,(((SFB(I,J,L),I=1,20),J=1,8),L=1,121)
C
C      EOF CONTROL
C      IF (EOF(20)) 97,15
C
C      FORM THE SOLAR TIME IN HOURS FROM MIDNIGHT
15 TM = ATITST/3600.0
C      IS IT LESS THAN THE EARLY TIME
C      IF (TM .LT. TA) GO TO 99
C      IS IT LESS THAN THE LATE TIME
C      IF (TM .LE. TB) GO TO 20
C
C      TIME HAS EXCEEDED THE DATA
C
C      PLACE THE LATE TIME IN THE EARLY TIME
C      TA = TB
C      DO 17 L=1,19360
17 SFA(L) = SFB(L)
C      GO READ THE NEXT TIME POINT
C      GO TO 12
C
C      MAIN PROCESSING (TA .LE. TM .LE. TB)
C
C      MULTIPLY BY THE FIELD CELL EFFICIENCY
C      AND SUM OVER THE CELLS
C
20 DO 24 I=1,20 $ DO 24 J=1,8
C      HA(I,J) = 0.0 $ HB(I,J) = 0.0
C      DO 24 L=1,121
C      HA(I,J) = HA(I,J) + SFA(I,J,L)*HCEF(L)
24 HB(I,J) = HB(I,J) + SFB(I,J,L)*HCEF(L)
C
C      INTERPOLATE
C
C      TX = (TM-TA)/(TB-TA)
C
C      INSOLATION, REFLECTIVITY, ABSORPTIVITY
C

```



```

      EF = EINDIR*HREF
C      CONVERT TO BTU/SECOND
      EF=EF*0.948047E-3
C
      DO 22 I=1,20    $ DO 22 J=1,8
22     HFLRN(I,J) = EF*(TX*(HB(I,J) - HA(I,J)) + HA(I,J))
      GO TO 100
C
C      ASORTION TERMINATION
C
      97 NR = 0
      99 DO 98 K=1,160
      98 HFLRN(K) = 0.0
C
C      GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
100    IF (DIAG(16)) WRITE (6,115)
      1  ATITST,TM,TA,TB,TX,EINDIR,HREF,EF,HFLRN
115    FORMAT(1H ,3X,13HDIAG16/FLUX ,9G10.4/(1H ,16X,9G10.4))
C
      RETURN
C
      END

```

[illegible]

THE ROUTINE WILL BE USED TO COMPUTE LOSSES
IN THE PIPING TO THE DESUPERHEATER, TO THE
RECEIVER, AND FROM THE RECEIVER.

00000000

COMMON /CONSTS/ PI,ZFR,GRAV,GRAVO,SBC,GCAIR

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THE EXPRESSION ABOVE IS A CURVE FIT
TO A MOODY CHART

CONVERT TO FORCE PER SQUARE INCH

54

SUBROUTINE FTANK(GPIN,GPSP,GWIN,GHIN,GHCIN,GWCIN,GHSOUT,GWSOUT,
1 GPT)

THIS ROUTINE CALCULATES THE OUTPUT STATE
OF STEAM AND THE STATE OF CONDENSATE
INPUT TO THE TANK.

GPIN - PRESSURE OF STEAM COMING IN
GPSP - TANK PRESSURE SET POINT
GWIN - STEAM INPUT FLOW RATE
GHIN - ENTHALPY OF STEAM INPUT
GHCIN - ENTHALPY OF CONDENSATE INPUT TO
THE TANK
GWCIN - FLOW RATE OF CONDENSATE INPUT TO
THE TANK
GHSOUT- ENTHALPY OF STEAM OUTPUT
GWSOUT- FLOW RATE OF STEAM OUTPUT
GPT - TANK PRESSURE

COMPRESSED WATER/SUPERHEATED STEAM TABLE DATA

LOGICAL NO COMP,SATURD
REAL HE,PE,SE,TE,VE,XE
COMMON /USECOM/ HE,PE,SE,TE,VE,XE,NO COMP,SATURD

- 1) CALCULATE ENTHALPY OF SATURATED LIQUID
AT PRESSURE SET POINT (GHSL)
- 2) CALCULATE HEAT OF VAPORIZATION AT
PRESSURE SET POINT (GHV)

SATURD=.TRUE.
CALL USE TSAT(GPSP,DUM)
HSAT=HE
SATURD=.FALSE.
CALL USE TSAT(GPSP,DUM)
GHSL=HE
GHV=HSAT-HE

- 3) CALCULATE PERCENT FLASHED TO THE TANK
(PCF)

$PCF = (GHIN - GHSL) / GHV$

- 4) CALCULATE STATE OF OUTPUT STEAM FROM
THE TANK AND THE STATE OF CONDENSATE
INPUTED TO THE TANK.

A) PCF SHOULD BE BETWEEN 0 AND 1.

IF (PCF .GT. 1) PCF=1.
IF (PCF .LT. 0) PCF=0.

B) CHECK INLET PRESSURE AGAINST
PRESSURE SET POINT. IF INLET
PRESSURE LE PRESSURE SET POINT,
THAT MEANS NO STEAM OUTPUT, AND
THE STATE OF THE CONDENSATE IS THE
SAME AS IN INPUT STATE.

```

IF (GPIN .GT. GPSP) GO TO 110
GHSOUT=0.
GHSOUT=0.
GWCIN=GWIN
GHCIN=GHIN
GPT=GPIN
RETURN

```

C
C
C
C

C) CALCULATE STEAM OUT FLOW RATE
(GWSOUT)

```

110 CONTINUE
GWSOUT=PCF*GWIN

```

C
C
C
C

D) CALCULATE CONDENSATE IN FLOW RATE TO
THE TANK (GWCIN)

```

GWCIN=(1-PCF)*GWIN

```

C
C
C

E) CALCULATE TANK PRESSURE (GPT)

```

GPT=GPSP

```

C
C
C
C

F) CALCULATE OUTPUT STEAM ENTHALPY
(GHSOUT)

```

GHSOUT=GHSI+GHV
IF (PCF .EQ. 1) GHSOUT=GHIN

```

C
C
C

G) CALCULATE INPUT ENTHALPY TO THE TANK
(GHCIN)

```

GHCIN=GHSI
IF (PCF .EQ. 0) GHCIN=SHIN
RETURN
END

```

FUNCTION H(PX)

THIS FUNCTION CONTAINS THE TURBINE STATE
CURVE IN THE FORM OF ENTHALPY VS PRESSURE
FOR STEAM ENTERING FROM THE RECEIVER THRU
THE MAIN THROTTLE

P - INTERNAL TURBINE PRESSURE
(PSIA)

GHMAIN - CORRESPONDING ENTHALPY
(BTU/LBM)

RANGE FOR P IS SET AT 1050 TO 0.5 PSIA

DATA SOURCE MDAC PRELIMINARY DESIGN REPORT
VOLUME VI

ENTRY GHMAIN

P=PX

IF (P.GT.1050.0) P=1050.0

IF (P.LT.0.5) P=0.5

PLN=ALOG(P)

H=998.53944+37.04293*PLN+3.78244*PLN*PLN

RETURN

ENTRY GHADD

P=PX

TURBINE STATE CURVE FOR STEAM ENTERING
FROM TSS THRU THE ADMISSION PORT

RANGE FOR P IS SET AT 1050 TO 0.5 PSIA

IF (P.GT.280.) P=280.0

IF (P.LT.0.5) P=0.5

PLN=ALOG(P)

H= 949.17168+41.40087*PLN+1.05530*PLN*PLN+0.17865*PLN**3

RETURN

END

SUBROUTINE HRSYS(BP,TEXHW,ETEAMB)

HEAT REJECTION SYSTEM SUBROUTINE: 4/1/78 J THACKER

THIS SUBROUTINE CALCULATES THE CONDENSER PRESSURE (BP) IN PSIA FOR A GIVEN TURBINE EXHAUST FLOW RATE (TEXHW) IN LBM/SEC. THE CONDENSER PERFORMANCE CHARACTERISTICS ARE TAKEN FROM THE HONEYWELL PRELIMINARY DESIGN REPORT (EPGS VOLUME). THE NUMERICAL METHOD EMPLOYED IS INTERPOLATION OF TWO-D DATA BY BI-CUBIC SPLINES, SINCE THE CONDENSER PRESSURE IS ALSO A FUNCTION OF THE AMBIENT WET BULB TEMPERATURE (ETEAMB) IN DEGREES FAHRENHEIT.

EPGS CONSTANTS

COMMON /GC DATA/ GMVR(4),GMVT(2),GMVE(4),VRATE(12),GMVRO(4),
 1 GMVT0(2),GMVE0(4),SSP(12),TZERO(3),GPSPT3,GETAT3,GLZT3,
 2 GKLC23,GPSPT1,GMCT1,GPSPT2,GETAT2,GLZT2,GKLC22,GRIDC,
 3 GRODC,GLDC,GTG,GRISP,GROSP,GLSPTG,NPORTS,IFAN,GPTED(4),
 4 GTEFF,GPHRD(3,6),GWHRD(3),GTHRD(6),GMEFF,GKEFF,GKGAIN,
 5 GKINERT,GPFERSP,GFPHR,GFPRS,GWFFR,GFPTG,GVFPR,GRIRC,GRORC,
 6 GLRC,GRIDS,GRODS,GLDESP,GPFPS,GLFNP,GRIFWP,GROFNP,TNOM,
 7 VNOM,BFUMP(5),HFUMP(5),H1PARM(3),H2PARM(3),H4PARM(3),
 8 H5PARM(3),GMCH3,GMCHW

GMVR(4) SETTING OFR EPGS SERVO-CONTROLLED VALVES R1-R4
 RANGE IS 0. TO 1.0
 GMVT(2) SETTING FOR EPGS SERVO-CONTROLLED VALVES T1 AND T2
 RANGE IS 0. TO 1.0
 GMVE(4) SETTING FOR EPGS SERVO-CONTROLLED VALVES E1-E4
 RANGE IS 0. TO 1.0
 VRATE(10) MAX RATE FOR VALVES TO MOVE FROM OPEN TO CLOSE
 POSITIONS
 GMVRO(4) VALVE SETTING FOR R1-R4 AT TIME TZERO(1)
 GMVT0(2) VALVE SETTING FOR T1-T2 AT TIME TZERO(2)
 GMVE0(4) VALVE SETTING FOR E1-E4 AT TIME TZERO(3)
 TZERO(3) LAST TIME SET POINT WAS CHANGED (SEC)
 SSP(11) SAVE SP(11) FROM COMMON BLOCK /C DATA/
 GPSPT3 PRESSURE (PSIA) SET POINT FOR TANK 3 (RECVR FLASH)
 GETAT3 SIZING CONSTANT FOR TANK 3 (MAX LEVEL DIVIDED BY
 MAX OUTPUT FLOW RATE)
 GLZT3 NOMINAL WATER LEVEL (FT) FOR TANK 3
 GKLC23 CONSTANT FOR LEVEL CONTROL IN TANK 3
 GPSPT1 PRESSURE (PSIA) SET POINT FOR TANK 1 (TSS DRAIN SYS)
 GMCT1 MASS(LBM) OF CONDENSATE IN TANK 1
 GPSPT2 PRESSURE (PSIA) SET POINT FOR TANK 2 (TSS DRAIN SYS)
 GETAT2 SIZING CONSTANT FOR TANK 2 (MAX LEVEL / MAX FLOW)
 GLZT2 NOMINAL WATER LEVEL (FT) IN TANK 2
 GKLC22 LEVEL CONTROL GAIN FOR TANK 2
 GRISP INSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
 GROSP OUTSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
 GLSPTG LENGTH (FT) OF STEAM PIPE (TSS TO EPGS)
 GRIDC INSIDE RADIUS (FT) OF DOWNCOMER
 GRODC OUTSIDE RADIUS (FT) OF DOWNCOMER

C GTC THERMAL CONDUCTIVITY OF DOWNCOMER INSULATION
 C (BTU/HR-FT-DEG R)
 C GLDC LENGTH OF DOWNCOMER IN FEET
 C NPORTS NUMBER OF TURBINE EXTRACTION PORTS
 C IFAN COOLING TOWER FAN CONDITIONS 1 2 FANS FULL SPEED
 C 2 1 HALF 1 FULL
 C 3 2 FANS HALF SPEED
 C GPTED(4) EXTRACTION PRESSURE (PSIA) PER UNIT OF APPARENT LP
 C FLOW (LBM/SEC)
 C GTEFF TURBINE/GENERATOR EFFICIENCY
 C GPHRD(3,6) CONDENSER PRESSURE (PSIA) AT GWHRD(3) AND GTHRD(6)
 C GWHRD(3) CONDENSER FLOW (LBM/HR) DATA AT 3 DIFFERENT VALUES
 C GTHRD(6) AMBIENT TEMP. (F) DATA AT 6 DIFFERENT VALUES
 C GMEFF ELECTRO-MECHANICAL EFFICIENCY OF RECVR FEEDPUMP
 C GKEFF FEED PUMP EFFICIENCY
 C GKGAIN FEED PUMP CONTROL GAIN
 C GKINERT FEED PUMP MOMENT OF INERTIA
 C GPFRSP RECVR INLET PRESSURE (PSIA) SET POINT
 C GFPHR FEED PUMP RATED HEAD (FT)
 C GFPSR FEED PUMP RATED SPEED (RPM)
 C GNFR FEED PUMP RATED FLOW (LBM/SEC)
 C GFPTR FEED PUMP RATED TORQUE (FT-LBS)
 C GVFR SPECIFIC VOLUME (FT**3/LBM) AT RATED CONDITIONS
 C GRIRC INSIDE RADIUS (FT) OF RISER
 C GRORC OUTSIDE RADIUS (FT) OF RISER
 C GLRC LENGTH (FT) OF RISER
 C GRIDS INSIDE RADIUS (FT) OF FW PIPE FEED PUMP TO DESUPHRTR
 C GRODS OUTSIDE RADIUS (FT) FW PIPE FEED PUMP TO DESUPHRTR
 C GLDESP LENGTH (FT) OF FW PIPE FEED PUMP TO DESUPERHRTR
 C GFFPSP RECVR INLET PRESSURE (PSIA) SET POINT
 C GLFWP LENGHT (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
 C GRIFWP INNER RADIUS (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
 C BPUMP(5) PARAMETERS FOR BOOST PUMP (SEE ROUTINE PUMPSS)
 C HFUMP(5) PARAMETERS FOR HOTWELL PUMP (SEE ROUTINE PUMPSS)
 C H1PARM(3) PARAMETERS FOR HEATER 1 (SEE ROUTINE CFWHTR)
 C H2PARM(3) PARAMETERS FOR HEATER 2 (SEE ROUTINE CFWHTR)
 C H4PARM(3) PARAMETERS FOR HEATER 4 (SEE ROUTINE CFWHTR)
 C H5PARM(3) PARAMETERS FOR HEATER 5 (SEE ROUTINE CFWHTR)
 C GNCH3 MASS OF CONDENSATE (LBM) STORED IN HEATER 3
 C GROFWP OUTER RADIUS (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
 C GNCHW MASS OF CONDENSATE (LBM) STORED IN CONDENSER HOTWELL
 C TNOM NOMINAL TEMP (F) OF AIR SURROUNDING FW SYS COMPONENTS
 C VNOM NOMINAL AIR VELOCITY (FT/SEC) ABOUT FW SYS COMPONENTS
 C (NORMALLY SET TO ZERO)

C
 C
 C DIMENSION WL(1),TL(1),PL(1,6),WK(21)

C
 C
 C CHECK FOR COOLING TOWER SYSTEM OFF

C BP=1.225
 C IF (IFAN.EQ.4) RETURN

C CHCK FOR TEMPERATURE OUT OF RANGE

C TEMP=ETEAMB
 C IF (TEMP.GT.GTHRD(6)) TEMP=GTHRD(6)
 C IF (TEMP.LT.GTHRD(1)) TEMP=GTHRD(1)

C
 C
 C INITIALIZATIONS MAX MIN FLOWS

```

      WMAX=GWHRD(3)
      WMIN=GWHRD(1)
C
C      CONVERT FLOW RATE TO LBM/HR AND SCALE
      TO HONEYWELL CHARACTERISTIC
      WCOND=TEXHW*3600.
      DELP=0.0
      IF (WCOND.LE.WMAX) GO TO 10
      DELP=9.94E-06*(WCOND-WMAX)
      WCOND=WMAX
      GO TO 20
10  IF (WCOND.GE.WMIN) GO TO 20
      DELP=9.15E-06*(WCOND-WMIN)
      WCOND=WMIN
C
C      PERFORM THE INTERPOLATION
20  CONTINUE
      IHRO=3
      NW=3
      NT=6
      NWL=1
      NTL=1
      WL(1)=WCOND
      TL(1)=TEMP
      IPL=1
      IERR=0
      CALL IBCIEU(GPHRD,IHRO,GWHRD,NW,GTHRD,NT,WL,NWL,TL,NTL,
1      PL,IPL,WK,IERR)
C
C      CORRECT FOR MDAC AND SCE DESIGN POINTS
C
      BP=PL(1) +0.5+DELP
C      ADJUST FOR FAN CONDITION (1,.5)
      IF (IFAN.EQ.2) BP=BP+.3
C      ADJUST FOR FAN CONDITION (.5,.5)
      IF (IFAN.EQ.3) BP=BP+.75
C      CHANGE FROM INCHES OF HG TO PSIA
      BP=.49*BP
C      ERROR MESSAGE
      IF (IERR.NE.0) WRITE(6,9) IERR,BP
9  FORMAT(75H ERROR CONDITION: SUBROUTINE IBCIEU CALLED IN SUBROUTINE
1  HRSYS: ERROR CODE=,I3,/,
2      50H, EXECUTION CONTINUING WITH TURBINE BACK
2-PRESSURE= ,G10.4,6H, PSIA)
C
      RETURN
      END

```



```

C      SUBROUTINE INIT(IMODE)
C      INITIALIZATION SUBROUTINE
C
C      INITIALIZES PLANT PARAMETERS FOR SIMULATION
C
C      EXECUTIVE AND PROGRAM CONTROL DATA
C
C      INTEGER ATIMO,ATIDAY
C      LOGICAL OUTFG,END,DIAG
C      COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1  DIAG(40)
C
C      OUTFG(I,J)  OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
C      END        END OF RUN FLAG
C      ATILCL     LOCAL TIME (SECONDS FROM MIDNIGHT)
C      ATITST     TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
C      ATIMO      MONTH
C      ATIDAY     DAY
C      DIAG       DIAGNOSTIC PRINT FLAG ARRAY
C
C      ENVIRONMENTAL DATA
C
C      COMMON /EDATA/ ETEAMB,EPRAMB,EVWAMB,EINDIR,EDWAMB,ETDAMB
C
C      ETEAMB     AMBIENT TEMPERATURE (DEGREES FAHRENHEIT)
C      EPRAMB     AMBIENT PRESSURE (LB/SQ IN ABS)
C      EVWAMB     AMBIENT WIND VELOCITY (FT/SEC)
C      EINDIR     DIRECT INSOLATION (KILOWATTS/SQ METER)
C      EDWAMB     WIND DIRECTION (DEGREES AZIMUTH)
C      ETDAMB     DEW POINT TEMPERATURE (DEGREES FAHRENHEIT)
C
C      COLLECTOR SUBSYSTEM DATA
C
C      COMMON /HDATA/ HFLRN(20,8),HCEF(121),HREF,HCFL,XTIST,XTIEND,
1  XVAL,XDIR,XDTCS
C
C      HFLRN      HELIOSTAT OUTPUT SOLAR ARRAY FLUX AT RECEIVER NODES
C                  (BTU/SEC)
C      HCEF       HELIOSTAT FIELD CELL EFFICIENCIES (ND)
C      HREF       HELIOSTAT REFLECTIVE EFFICIENCY (ND)
C      HCFL       COLLECTOR FIELD SIZE (FEET)
C      XTIST      START TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD FRONT INTERCEPTS CORNER OF CELL ARRAY
C      XTIEND     END TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD REAR INTERCEPTS CORNER OF CELL ARRAY
C      XVAL       CLOUD VELOCITY (MILES/HOUR)
C      XDIR       CLOUD DIRECTION (DEGREES FROM N TO S DIRECTION)
C                  (0 = N TO S, 90 = W TO E, -90 = E TO W, 180 = S TO N)
C      XDTCS      CLOUD UPDATE SCHEDULING INTERVAL (SEC)
C
C      RECVR CONSTANTS
C
C      INTEGER RKNB,RKNPSP,RKNBSP
C      COMMON /RCDATA/ RKCM,RKDNM,RKCSP,RKEESP,RKHFC,RKHFR,RKIDTB,
1  RKCDTB,RKHSP,RKL17,RKASP,RKSSP,RKNB,RKNPSP,RKNBSP,RKFF2,

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2  RKFF4,RKFF6,RKFV(6),RKAHV(6),RKVSH,RKINTC(6),RKPROC(6),RKTHSC
C
C  R KCM      HEAT CAPACITY OF SUPERPANEL TUBE METAL
C              (BTU/LBM,F)
C  R KDNM     DENSITY OF SUPERPANEL TUBE METAL
C              (LBM/CU FT)
C  R KCSP     HEAT CAPACITY OF A SUPERPANEL PER UNIT LENGTH
C              (BTU/FT,F)
C  R KEESP    EMISSIVITY OF EXTERNAL SUPERPANEL COATING
C              (ND)
C  R KHFC     EXTERNAL FORCED CONVECTION HEAT TRANSFER CONSTANT
C              ( )
C  R KHFR     EXTERNAL FREE CONVECTION HEAT TRANSFER CONSTANT
C              ( )
C  R KIOTB    INSIDE DIAMETER OF A SUPERPANEL TUBE
C              (FEET)
C  R KODTB    OUTSIDE DIAMETER OF A SUPERPANEL TUBE
C              (FEET)
C  R KWSP     WIDTH OF A SUPERPANEL
C              (FEET)
C  R KLI7     INSULATION EXPOSED LENGTH OF A SUPERPANEL
C              (FEET)
C  R KASP     FLOW CROSS SECTIONAL AREA OF A SUPERPANEL
C              (SQ FT)
C  R KSSP     INSIDE SURFACE AREA PER UNIT LENGTH OF A SUPERPANEL
C              (FEET)
C  R KNTB     NUMBER OF TUBES COMPOSING A SUPERPANEL
C              (ND)
C  R KNPS    NUMBER OF PREHEATER SUPERPANELS
C              (ND)
C  R KNBS    NUMBER OF BOILER SUPERPANELS
C              (ND)
C  R KFF2     FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 2
C              (PSI,SEC**2/LBM,CU FT)
C  R KFF4     FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 4
C              (PSI,SEC**2/LBM,CU FT)
C  R KFF6     FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 6
C              (PSI,SEC**2/LBM,CU FT)
C  R KVF(IV)  FLUID FLOW COEFFICIENT OF FLOW CONTROL VALVE
C              (PSI,SEC**2/LBM,CU FT)
C  R KAAV(IV) PERCENT SUBSYSTEM PRESSURE DROP ACROSS
C              FLOW CONTROL VALVE (PERCENT)
C  R KVSH     VOLUME OF STEAM HEADER
C              (CU FT)
C  R KINTC(IC) CONTROLLER INTEGRAL GAIN CONSTANT
C              (PERCENT,SEC/F)
C  R KPROC(IC) CONTROLLER PROPORTIONAL GAIN CONSTANT
C              (PERCENT/F)
C  R KTHSC    CONTROLLER ACTIVATION TEMPERATURE THRESHOLD
C              (DEGREES F)
C
C
C  TSS CONSTANTS
C
C  COMMON /TCDATA/ TT3,TT4,TT5,TT6,TT8,TP8,TH8,TPDTS,TC5,TC6,TW5M,
1  TW5MF,TW7M,TW7MF,TKHC,TKTMTSH,TKTHSG,TKTNECS,TKG,TPPA,TPPCM,
2  TPPM,TPL1,TPL2,TPL3,TAK1,TBK1,TCK1,TOK1,TAK2,TBK2,TCK2,TOK2,
3  TAK3,TBK3,TAK4,TBK4,TK5,TK6,THTSUM,TLTU1,TLTU2,TLTL1,TLTL2,
4  TTSC,TTSE
C

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C	TT3	TEMPERATURE OF DESUPERHEATED STEAM (DEG. F)
C	TT4	TEMPERATURE OF WATER FROM STORAGE HEATER (DEG. F)
C	TT5	TEMPERATURE OF OIL FROM STORAGE HEATER (DEG. F)
C	TT6	TEMPERATURE OF OIL INTO STORAGE HEATER (DEG. F)
C	TT8	TEMPERATURE OF STEAM FROM STEAM GENERATOR (DEG. F)
C	TP8	PRESSURE OF STEAM FROM STEAM GENERATOR (PSIA)
C	TH8	ENTHALPY OF STEAM FROM STEAM GENERATOR (BTU/LBM)
C	TFDTS	PRESSURE DROP THROUGH THERMAL STORAGE HEATER (PSIA)
C	TC5	HEAT CAPACITY OF OIL INTO STORAGE (BTU/LBM DEG. F)
C	TC6	HEAT CAPACITY OF OIL FROM STORAGE (BTU/LBM DEG. F)
C	TW5M	MAXIMUM OIL FLOW INTO STORAGE (LBM/SEC)
C	TW5HF	MINIMUM NON-ZERO OIL FLOW INTO STORAGE (LBM/SEC)
C	TW7M	MAXIMUM OIL FLOW FROM STORAGE (LBM/SEC)
C	TW7HF	MINIMUM NON-ZERO OIL FLOW FROM STORAGE (LBM/SEC)
C	TKHC	SPECIFIC ENTHALPY GAIN OF OIL IN THERMAL STORAGE HEATER OR LOSS IN STEAM GENERATOR (BTU/LBM)
C	TKTMTSH	TIME CONSTANT OF THERMAL STORAGE HEATER (SEC)
C	TKTHSG	TIME CONSTANT OF STEAM GENERATOR (SEC)
C	TKTMECS	TIME CONSTANT OF EXTRACTION CONTROL SYSTEM (SEC)
C		(RESPONSE OF OIL FLOW TO ERROR IN OUTPUT STEAM FLOW)
C	TKG	GAIN OF EXTRACTION CONTROL SYSTEM (DIMENSIONLESS)
C		(REQUESTED OIL FLOW/ERROR IN OUTPUT STEAM FLOW)
C	TPPA	AUXILIARY PUMPING POWER (WATTS)
C	TPPCM	MAXIMUM CHARGING OIL PUMPING POWER (WATTS)
C	TPPEM	MAXIMUM EXTRACTION OIL PUMPING POWER (WATTS)
C	TPL1	UPPER LIMIT OF TFC FOR ONE PUMP, LOW SPEED (DIMENSIONLESS)
C	TPL2	LOWER LIMIT OF TFC FOR TWO PUMPS, HIGH SPEED (DIMENSIONLESS)
C	TPL3	LOWER LIMIT OF TFE FOR TWO PUMPS (DIMENSIONLESS)
C	TAK1	TK1 FOR ONE PUMP AT LOW SPEED (WATTS)
C	TBK1	TK1 FOR TWO PUMPS AT LOW SPEED (WATTS)
C	TCK1	TK1 FOR ONE PUMP AT HIGH SPEED (WATTS)
C	TDK1	TK1 FOR TWO PUMPS AT HIGH SPEED (WATTS)
C	TAK2	TK2 FOR ONE PUMP AT LOW SPEED (WATTS/LBM/SEC)
C	TBK2	TK2 FOR TWO PUMPS AT LOW SPEED (WATTS/LBM/SEC)
C	TCK2	TK2 FOR ONE PUMP AT HIGH SPEED (WATTS/LBM/SEC)
C	TDK2	TK2 FOR TWO PUMPS AT HIGH SPEED (WATTS/LBM/SEC)
C	TAK3	TK3 FOR ONE PUMP (WATTS)
C	TBK3	TK3 FOR TWO PUMPS (WATTS)
C	TAK4	TK4 FOR ONE PUMP (WATTS/LBM/SEC)
C	TBK4	TK4 FOR TWO PUMPS (WATTS/LBM/SEC)
C	TK5	HEAT LOSS FROM STORAGE UNIT WITH THERMOCLINE AT TOP (BTU/SEC)
C	TK6	ADDITIONAL HEAT LOSS FROM STORAGE UNIT WITH THERMOCLINE AT BOTTOM (BTU/SEC)
C	THTSUM	CAPACITY OF THERMAL STORAGE UNIT (BTU)
C	TLTU1	TFLAGU=0 WHEN TLT.GT.TLTU1, 1 OR 2 WHEN TLT.LE.TLTU1
C	TLTU2	TFLAGU=2 WHEN TLT.LT.TLTU2, 1 OR 0 WHEN TLT.GE.TLTU2
C	TLTL1	TFLAGL=0 WHEN TLT.LT.TLTL1, 1 OR 2 WHEN TLT.GE.TLTL1
C	TLTL2	TFLAGL=2 WHEN TLT.GT.TLTL2, 1 OR 0 WHEN TLT.LE.TLTL2
C	TTSC	0 FOR HOT START CHARGE, 1 FOR STEADY STATE
C	TTSE	0 FOR HOT START EXTRACTION, 1 FOR STEADY STATE

EPGS CONSTANTS

COMMON /GCDATA/ GMVR(4),GMVT(2),GMVE(4),VRATE(12),GMVR0(4),
 1 GHVT0(2),GMVE0(4),SSP(12),TZERO(3),GPSPT3,GETAT3,GLZT3,
 2 GKLC2,GPSPT1,GMCT1,GPSPT2,GETAT2,GLZT2,GKLC2,GRIDC,

3 GRODC, GLDC, GTC, GRISP, GROSP, GLSPTG, NPORTS, IFAN, GPTED(4),
 4 GTEFF, GFHRD(3,6), GWHRD(3), GTHRD(6), GMEFF, GKEFF, GKAIN,
 5 GKINERT, GPFRSP, GFPHR, GFPSR, GWFFR, GFPT, GVFFR, GRIRC, GRORC,
 6 GLRC, GRIDS, GRODS, G_DESP, GPFPS, GLFWP, GRIFWP, GROFWP, TNOM,
 7 VNOM, BPUMP(5), HFUMP(5), H1PARM(3), H2PARM(3), H4PARM(3),
 8 H5PARM(3), GMCH3, GMCHW

C
 C GMVR(4) SETTING OFR EPGS SERVO-CONTROLLED VALVES R1-R4
 C RANGE IS 0. TO 1.0
 C GMVT(2) SETTING FOR EPGS SERVO-CONTROLLED VALVES T1 AND T2
 C RANGE IS 0. TO 1.0
 C GMVE(4) SETTING FOR EPGS SERVO-CONTROLLED VALVES E1-E4
 C RANGE IS 0. TO 1.0
 C VRATE(10) MAX RATE FOR VALVES TO MOVE FROM OPEN TO CLOSE
 C POSITIONS
 C GMVR0(4) VALVE SETTING FOR R1-R4 AT TIME TZERO(1)
 C GMVT0(2) VALVE SETTING FOR T1-T2 AT TIME TZERO(2)
 C GMVE0(4) VALVE SETTING FOR E1-E4 AT TIME TZERO(3)
 C TZERO(3) LAST TIME SET POINT WAS CHANGED (SEC)
 C SSP(11) SAVE SP(11) FROM COMMON BLOCK /C/DATA/
 C GPSPT3 PRESSURE (PSIA) SET POINT FOR TANK 3 (RECVR FLASH)
 C GETAT3 SIZING CONSTANT FOR TANK 3 (MAX LEVEL DIVIDED BY
 C MAX OUTPUT FLOW RATE)
 C GLZT3 NOMINAL WATER LEVEL (FT) FOR TANK 3
 C GKLC3 CONSTANT FOR LEVEL CONTROL IN TANK 3
 C GPSPT1 PRESSURE (PSIA) SET POINT FOR TANK 1 (TSS DRAIN SYS)
 C GMCT1 MASS(LBM) OF CONDENSATE IN TANK 1
 C GPSPT2 PRESSURE (PSIA) SET POINT FOR TANK 2 (TSS DRAIN SYS)
 C GETAT2 SIZING CONSTANT FOR TANK 2 (MAX LEVEL / MAX FLOW)
 C GLZT2 NOMINAL WATER LEVEL (FT) IN TANK 2
 C GKLC2 LEVEL CONTROL GAIN FOR TANK 2
 C GRISP INSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
 C GROSP OUTSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
 C GLSPTG LENGTH (FT) OF STEAM PIPE (TSS TO EPGS)
 C GRIDC INSIDE RADIUS (FT) OF DOWNCOMER
 C GRODC OUTSIDE RADIUS (FT) OF DOWNCOMER
 C GTC THERMAL CONDUCTIVITY OF DOWNCOMER INSULATION
 C (BTU/HR-FT-DEG R)
 C GLDC LENGTH OF DOWNCOMER IN FEET
 C NPORTS NUMBER OF TURBINE EXTRACTION PORTS
 C IFAN COOLING TOWER FAN CONDITIONS 1 2 FANS FULL SPEED
 C 2 1 HALF 1 FULL
 C 3 2 FANS HALF SPEED
 C GPTED(4) EXTRACTION PRESSURE (PSIA) PER UNIT OF APPARENT LP
 C FLOW (LBM/SEC)
 C GTEFF TURBINE/GENERATOR EFFICIENCY
 C GFHRD(3,6) CONDENSER PRESSURE (PSIA) AT GWHRD(3) AND GTHRD(6)
 C GWHRD(3) CONDENSER FLOW (LBM/HR) DATA AT 3 DIFFERENT VALUES
 C GTHRD(6) AMBIENT TEMP. (F) DATA AT 6 DIFFERENT VALUES
 C GMEFF ELECTRO-MECHANICAL EFFICIENCY OF RECVR FEEDPUMP
 C GKEFF FEED PUMP EFFICIENCY
 C GKAIN FEED PUMP CONTROL GAIN
 C GKINERT FEED PUMP MOMENT OF INERTIA
 C GPFRSP RECVR INLET PRESSURE (PSIA) SET POINT
 C GFPHR FEED PUMP RATED HEAD (FT)
 C GFPSR FEED PUMP RATED SPEED (RPM)
 C GWFFR FEED PUMP RATED FLOW (LBM/SEC)
 C GFPTR FEED PUMP RATED TORQUE (FT-LBS)
 C GVFFR SPECIFIC VOLUME (FT**3/LBM) AT RATED CONDITIONS
 C GRIRC INSIDE RADIUS (FT) OF RISER

C GRORC OUTSIDE RADIUS (FT) OF RISER
 C GLRC LENGTH (FT) OF RISER
 C GRIDS INSIDE RADIUS (FT) OF FW PIPE FEED PUMP TO DESUPHRTR
 C GRCOS OUTSIDE RADIUS (FT) FW PIPE FEED PUMP TO DESUPHRTR
 C GLDESP LENGTH (FT) OF FW PIPE FEED PUMP TO DESUPERHRTR
 C GPFPSP RECVR INLET PRESSURE (PSIA) SET POINT
 C GLFWP LENGHT (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
 C GRIFWP INNER RADIUS (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
 C BPUMP(5) PARAMETERS FOR BOOST PUMP (SEE ROUTINE PUMPSS)
 C HPUMP(5) PARAMETERS FOR HOTWELL PUMP (SEE ROUTINE PUMPSS)
 C H1PARM(3) PARAMETERS FOR HEATER 1 (SEE ROUTINE CFWHTR)
 C H2PARM(3) PARAMETERS FOR HEATER 2 (SEE ROUTINE CFWHTR)
 C H4PARM(3) PARAMETERS FOR HEATER 4 (SEE ROUTINE CFWHTR)
 C H5PARM(3) PARAMETERS FOR HEATER 5 (SEE ROUTINE CFWHTR)
 C GMCH3 MASS OF CONDENSATE (LBM) STORED IN HEATER 3
 C GROFWP OUTER RADIUS (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
 C GMCHW MASS OF CONDENSATE (LBM) STORED IN CONDENSER HOTWELL
 C TNOM NOMINAL TEMP (F) OF AIR SURROUNDING FW SYS COMPONENTS
 C VNOM NOMINAL AIR VELOCITY (FT/SEC) ABOUT FW SYS COMPONENTS
 C (NORMALLY SET TO ZERO)
 C
 C
 C

INITIALIZE EXECUTIVE AND PROGRAM CONTROL DATA

DO 110 I1=1,2
 DO 110 I2=1,10
 110 OUTFG(I1,I2)=.FALSE.
 END=.FALSE.
 ATILCL=0.0
 ATITST=0.0
 ATIMO=3
 ATIDAY=21
 DO 120 I1=1,40
 120 DIAG(I1)=.FALSE.
 C
 C

INITIALIZE ENVIRONMENTAL DATA

ETEAMB=70.0
 EPRAMB=14.7
 EVWAMS=1.0
 EINDIR=1.0
 EDWAMB=0.0
 ETDAMB=50.0
 C
 C

INITIALIZE HELIOSTAT/COLLECTOR SUBSYSTEM DATA

DO 310 I1=1,160
 310 HFLRN(I1)=213.3
 DO 320 I1=1,121
 320 HCEF(I1)=1.0
 HREF=0.88
 HCFL=2699.4
 XTIST=-1.0
 XTIEND=-1.0
 XVAL=0.0001
 XDIR=20.0
 C
 C

INITIALIZE RECEIVER SUBSYSTEM PHYSICAL PARAMETERS

RKCM=0.134
 RKDN=496.0
 RKEESP=0.90
 RKHFC=9.296E-5
 RKHFR=5.278E-5

RKIDTB=0.0224
 RKODTB=0.0417
 RKWSP=9.378
 RKL17=42.64
 RKNBTB=219
 RKNBSP=2
 RKNBSP=6
 RKFF2=1.6
 RKFF4=1.6
 RKFF6=0.3
 DO 330 IV=1,RKNBSP
 RKEV(IV)=210.132
 330 RKAIV(IV)=0.95
 RKVSH=45.0
 DO 340 IC=1,RKNBSP
 RKINTC(IC)=0.001
 340 RKPROC(IC)=0.0
 RKTHSC=500.0

C
 C
 C
 C
 C
 C
 C
 C
 C

INITIALIZE THERMAL STORAGE SUBSYSTEM PARAMETERS

C OPERATING TEMPERATURES, OUTPUT STEAM PRESSURE, AND PRESSURE DROP
 C THROUGH THERMAL STORAGE HEATER

TT3=650.0
 TT4=475.0
 TT5=575.0
 TT6=425.0
 TT8=530.0
 TP8=400.0
 TPDTS=65.0

C
 C
 C
 C
 C
 C
 C
 C
 C

C MAXIMUM OIL PUMPING POWER (WATTS) FOR CHARGING (TPPCM) AND
 C EXTRACTION (TPPEM), AUXILIARY PUMPING POWER (TPPA - ASSUMED
 C CONSTANT), AND MAXIMUM AND MINIMUM OIL FLOW RATES FOR CHARGING
 C (TW5M,TW5MF) AND EXTRACTION (TW7M,TW7MF)

TPPCM=119360.0
 TPPEM=104440.0
 TPPA=7460.0
 TW5M=282.0
 TW5MF=14.1
 TW7M=310.0
 TW7MF=15.5

C
 C
 C
 C
 C
 C

C TIME CONSTANT (TKTHECS) AND GAIN (TKG) OF EXTRACTION CONTROL, TIME
 C CONSTANTS OF STORAGE HEATER (TKTMTSH) AND STEAM GENERATOR (TKTMSG),
 C AND CAPACITY (THTSUM) OF THERMAL STORAGE UNIT

TKTHECS=5.0
 TKG=12.0
 TKTMTSH=200.0
 TKTMSG=200.0
 THTSUM=455600000.0

C

C CURVE FIT CONSTANTS FOR CHARGING PUMP POWER AS FUNCTION OF OIL
 C FLOW. A = 1 PUMP LOW SPEED (TFC.LE.TPL1), B = 2 PUMPS LOW SPEED
 C (TFC BETWEEN TPL1 AND TPL2 AND TCONC=2), C = 1 PUMP HIGH SPEED

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C (TFC BETWEEN TPL1 AND .5 AND TCONC=1), D = 2 PUMPS HIGH SPEED
C (TFC.GT.TPL2); 1 = Y INTERCEPT, 2 = SLOPE
C
    TAK1=0.07
    TAK2=0.22
    TBK1=0.13
    TBK2=0.22
    TCK1=0.28
    TCK2=0.38
    TDK1=0.40
    TDK2=0.60
    TPL1=0.20
    TPL2=0.66
C
C CURVE FIT CONSTANTS FOR EXTRACTION PUMP POWER AS FUNCTION OF
C OIL FLOW. A = 1 PUMP (TFE.LT.TPL3 OR TCONE=1), B = 2 PUMPS
C (TFE.GT..5 OR TCONE=2); 3 = Y INTERCEPT, 4 = SLOPE
C
    TAK3=0.28
    TAK4=0.40
    TBK3=0.40
    TBK4=0.60
    TPL3=0.20
C
C CONSTANTS FOR LINEAR HEAT LOSS FROM THERMAL STORAGE UNIT
C (LOSS=TK5+TK6*TLT, WHERE TLT IS FRACTIONAL THERMOCLINE POSITION),
C
    TK5=100.0
    TK6=100.0
C
C LIMITS ON TLT (NO CHARGING FOR TLT.GT.TLTU1, NO START OR RESTART
C OF CHARGING FOR TLT.GE.TLTU2, LIMITED EXTRACTION FOR TLT.LT.
C TLTL1, LIMITING MAINTAINED, OR STARTING EXTRACTION LIMITED,
C WHILE TLT.LE.TLTL2)
C
    TLTU1=0.985
    TLTU2=0.9848
    TLTL1=0.05
    TLTL2=0.0502
C
C FLAGS TO INDICATE HOT START OR INITIAL STEADY STATE FOR CHARGING
C (TTSC) AND FOR EXTRACTION (TTSE) (DEFAULT=STEADY STATE FOR BOTH)
    TTSC=1.0
    TTSE=1.0
C
C INITIALIZE ELECTRICAL POWER GENERATION SUBSYSTEM
C PHYSICAL PARAMETERS
    DO 130 I=1,12
    SSP(I)=0.0
130 CONTINUE
    DO 140 I=1,12
    VRATE(I)=240.
140 CONTINUE
    GPSPT3=315.
    GETAT3=5.28E-2
    GLZT3=2.
    GKLCT3=30.
    GRIDC=0.25
    GRODC=8./12.
    GTC=5.83E-2

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GLDC=315.
GRISP=.25
GROSP=8./12.
GLSPTG=150.
GPSPT1=310.
GPSPT2=150.
GKLCT2=30.
GLZT2=2.
GETAT2=0.0528
GMCT1=10900.0
NPORTS=4
IFAN=1
GPTED(1)=.00274
GPTED(2)=.00115
GPTED(3)=.000377
GPTED(4)=.0000983
GTEFF=0.65
GPHRD(1,1)=.5625
GPHRD(1,2)=.7200
GPHRD(1,3)=.9375
GPHRD(1,4)=1.1563
GPHRD(1,5)=1.375
GPHRD(1,6)=1.656
GPHRD(2,1)=.9375
GPHRD(2,2)=1.0938
GPHRD(2,3)=1.325
GPHRD(2,4)=1.594
GPHRD(2,5)=1.906
GPHRD(2,6)=2.219
GPHRD(3,1)=1.125
GPHRD(3,2)=1.313
GPHRD(3,3)=1.594
GPHRD(3,4)=1.875
GPHRD(3,5)=2.203
GPHRD(3,6)=2.500
GMHRD(1)=54665.
GMHRD(2)=109332.
GMHRD(3)=134479.
GTHRD(1)=30.
GTHRD(2)=40.
GTHRD(3)=50.
GTHRD(4)=60.
GTHRD(5)=70.
GTHRD(6)=80.
GRIRC=0.25
GRCRC=8./12.
GRIDS=0.25
GRODS=8./12.
GENEFF=0.85
GFFHR=4670.
GFPSR=3465.
GFPTR=4858.
GVFFR=165000./3600.
GVFFR=1.0/53.7634
GKEFF=.85
GLRC=315.
GKGAIN=1000.
GKINERT=1.0
GLDESP=150.
GRIFWP=0.25


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GROFWP=8./12.  
GLFWP=150.  
TNOM=75.  
VNOM=0.0  
GMCH3=11000.  
GMCHW=11000.  
H1PARM(1)=5.0  
H1PARM(2)=0.9  
H1PARM(3)=10.0  
DO 150 I=1,3  
H2PARM(I)=H1PARM(I)  
H4PARM(I)=H1PARM(I)  
H5PARM(I)=H1PARM(I)
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```
150 CONTINUE
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BFUMP(1)=1066.  
BFUMP(2)=46.  
BFUMP(3)=3600.  
BFUMP(4)=1950.  
BFUMP(5)=0.85  
HFUMP(1)=310.  
HFUMP(2)=42.  
HFUMP(3)=3600.  
HFUMP(4)=418.  
HFUMP(5)=0.85
```

```
C  
C
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```
RETURN  
END
```

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C      SUBROUTINE INP(IMODE)
C      SIMULATION INPUT SUBROUTINE
C
C      EXECUTIVE AND PROGRAM CONTROL DATA
C
C      INTEGER ATIMO,ATIDAY
C      LOGICAL OUTFG,END,DIAG
C      COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1  DIAG(40)
C
C      OUTFG(I,J)  OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
C      END          END OF RUN FLAG
C      ATILCL       LOCAL TIME (SECONDS FROM MIDNIGHT)
C      ATITST       TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
C      ATIMO        MONTH
C      ATIDAY       DAY
C      DIAG         DIAGNOSTIC PRINT FLAG ARRAY
C
C      ENVIRONMENTAL DATA
C
C      COMMON /EDATA/ ETEAMB,EPRAMB,EVWAMB,EINDIR,EDWAMB,ETDAMB
C
C      ETEAMB       AMBIENT TEMPERATURE (DEGREES FAHRENHEIT)
C      EPRAMB       AMBIENT PRESSURE (LB/SQ IN ABS)
C      EVWAMB       AMBIENT WIND VELOCITY (FT/SEC)
C      EINDIR       DIRECT INSOLATION (KILOWATTS/SQ METER)
C      EDWAMB       WIND DIRECTION (DEGREES AZIMUTH)
C      ETDAMB       DEW POINT TEMPERATURE (DEGREES FAHRENHEIT)
C
C      COLLECTOR SUBSYSTEM DATA
C
C      COMMON /HDATA/ HFLRN(20,8),HCEF(121),HREF,HCFL,XTIST,XTIEND,
1  XVAL,XDIR,XDTCS
C
C      HFLRN        HELIOSTAT OUTPUT SOLAR ARRAY FLUX AT RECEIVER NODES
C                   (BTU/SEC)
C      HCEF         HELIOSTAT FIELD CELL EFFICIENCIES (ND)
C      HREF         HELIOSTAT REFLECTIVE EFFICIENCY (ND)
C      HCFL         COLLECTOR FIELD SIZE (FEET)
C      XTIST        START TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                   TIME CLOUD FRONT INTERCEPTS CORNER OF CELL ARRAY
C      XTIEND       END TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                   TIME CLOUD REAR INTERCEPTS CORNER OF CELL ARRAY
C      XVAL         CLOUD VELOCITY (MILES/HOUR)
C      XDIR         CLOUD DIRECTION (DEGREES FROM N TO S DIRECTION)
C                   (0 = N TO S, 90 = W TO E, -90 = E TO W, 180 = S TO N)
C      XDTCS        CLOUD UPDATE SCHEDULING INTERVAL (SEC)
C
C      RECVR CONSTANTS
C
C      INTEGER RKNTB,RKNPSP,RKNBSP
C      COMMON /RCDATA/ RKCM,RKDNM,RKCSP,RKEESP,RKHFC,RKHFR,RKIOTB,
1  RKCOTB,RKHSP,RKLI7,RKASP,RKSSP,RKNTB,RKNPSP,RKNBSP,RKFF2,
2  RKFF4,RKFF6,RKFV(6),RKAHV(6),RKVSH,RKINTC(6),RKPROC(6),RKTHSC
C

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C R K C M H E A T C A P A C I T Y O F S U P E R P A N E L T U B E M E T A L
 C (B T U / L B M , F)
 C R K D N M D E N S I T Y O F S U P E R P A N E L T U B E M E T A L
 C (L B M / C U F T)
 C R K C S P H E A T C A P A C I T Y O F A S U P E R P A N E L P E R U N I T L E N G T H
 C (B T U / F T , F)
 C R K E E S P E M I S S I V I T Y O F E X T E R N A L S U P E R P A N E L C O A T I N G
 C (N D)
 C R K H F C E X T E R N A L F O R C E D C O N V E C T I O N H E A T T R A N S F E R C O N S T A N T
 C ()
 C R K H F R E X T E R N A L F R E E C O N V E C T I O N H E A T T R A N S F E R C O N S T A N T
 C ()
 C R K I D T B I N S I D E D I A M E T E R O F A S U P E R P A N E L T U B E
 C (F E E T)
 C R K O D T B O U T S I D E D I A M E T E R O F A S U P E R P A N E L T U B E
 C (F E E T)
 C R K W S P W I D T H O F A S U P E R P A N E L
 C (F E E T)
 C R K L I 7 I N S O L A T I O N E X P O S E D L E N G T H O F A S U P E R P A N E L
 C (F E E T)
 C R K A S P F L O W C R O S S S E C T I O N A L A R E A O F A S U P E R P A N E L
 C (S Q F T)
 C R K S S P I N S I D E S U R F A C E A R E A P E R U N I T L E N G T H O F A S U P E R P A N E L
 C (F E E T)
 C R K N T B N U M B E R O F T U B E S C O M P O S I N G A S U P E R P A N E L
 C (N D)
 C R K N P S P N U M B E R O F P R E H E A T E R S U P E R P A N E L S
 C (N D)
 C R K N B S P N U M B E R O F B O I L E R S U P E R P A N E L S
 C (N D)
 C R K F F 2 F L U I D F L O W C O E F F I C I E N T A T S U P E R P A N E L N O D E N U M B E R 2
 C (P S I , S E C ** 2 / L B M , C U F T)
 C R K F F 4 F L U I D F L O W C O E F F I C I E N T A T S U P E R P A N E L N O D E N U M B E R 4
 C (P S I , S E C ** 2 / L B M , C U F T)
 C R K F F 6 F L U I D F L O W C O E F F I C I E N T A T S U P E R P A N E L N O D E N U M B E R 6
 C (P S I , S E C ** 2 / L B M , C U F T)
 C R K F V (I V) F L U I D F L O W C O E F F I C I E N T O F F L O W C O N T R O L V A L V E
 C (P S I , S E C ** 2 / L B M , C U F T)
 C R K A A V (I V) P E R C E N T S U B S Y S T E M P R E S S U R E D R O P A C R O S S
 C F L O W C O N T R O L V A L V E (P E R C E N T)
 C R K V S H V O L U M E O F S T E A M H E A D E R
 C (C U F T)
 C R K I N T C (I C) C O N T R O L L E R I N T E G R A L G A I N C O N S T A N T
 C (P E R C E N T , S E C / F)
 C R K P R O C (I C) C O N T R O L L E R P R O P O R T I O N A L G A I N C O N S T A N T
 C (P E R C E N T / F)
 C R K T H S C C O N T R O L L E R A C T I V A T I O N T E M P E R A T U R E T H R E S H O L D
 C (D E G R E E S F)

TSS CONSTANTS

C C O M M O N / T C D A T A / T T 3 , T T 4 , T T 5 , T T 6 , T T 8 , T P 8 , T H 8 , T P D T S H , T C 5 , T C 6 , T W 5 M ,
 1 T W 5 H F , T W 7 M , T W 7 M F , T K H C , T K T M T S H , T K T M S G , T K T M E C S , T K G , T P P A , T P P C M ,
 2 T P P E M , T P L 1 , T P L 2 , T P L 3 , T A K 1 , T B K 1 , T C K 1 , T D K 1 , T A K 2 , T E K 2 , T C K 2 , T D K 2 ,
 3 T A K 3 , T B K 3 , T A K 4 , T B K 4 , T K 5 , T K 6 , T H T S U M , T L T U 1 , T L T U 2 , T L T L 1 , T L T L 2 ,
 4 T T S C , T T S E

C T T 3 T E M P E R A T U R E O F D E S U P E R H E A T E D S T E A M (D E G . F)
 C T T 4 T E M P E R A T U R E O F W A T E R F R O M S T O R A G E H E A T E R (D E G . F)

C TT5 TEMPERATURE OF OIL FROM STORAGE HEATER (DEG. F)
 C TT6 TEMPERATURE OF OIL INTO STORAGE HEATER (DEG. F)
 C TT8 TEMPERATURE OF STEAM FROM STEAM GENERATOR (DEG. F)
 C TP8 PRESSURE OF STEAM FROM STEAM GENERATOR (PSIA)
 C TH8 ENTHALPY OF STEAM FROM STEAM GENERATOR (BTU/LBM)
 C TPDTSH PRESSURE DROP THROUGH THERMAL STORAGE HEATER (PSIA)
 C TC5 HEAT CAPACITY OF OIL INTO STORAGE (BTU/LBM DEG. F)
 C TC6 HEAT CAPACITY OF OIL FROM STORAGE (BTU/LBM DEG. F)
 C TH5M MAXIMUM OIL FLOW INTO STORAGE (LBM/SEC)
 C TW5MF MINIMUM NON-ZERO OIL FLOW INTO STORAGE (LBM/SEC)
 C TH7M MAXIMUM OIL FLOW FROM STORAGE (LBM/SEC)
 C TW7MF MINIMUM NON-ZERO OIL FLOW FROM STORAGE (LBM/SEC)
 C TKHC SPECIFIC ENTHALPY GAIN OF OIL IN THERMAL STORAGE
 C HEATER OR LOSS IN STEAM GENERATOR (BTU/LBM)
 C TKTMTSH TIME CONSTANT OF THERMAL STORAGE HEATER (SEC)
 C TKTMSG TIME CONSTANT OF STEAM GENERATOR (SEC)
 C TKIMECS TIME CONSTANT OF EXTRACTION CONTROL SYSTEM (SEC)
 C (RESPONSE OF OIL FLOW TO ERROR IN OUTPUT STEAM FLOW)
 C TKG GAIN OF EXTRACTION CONTROL SYSTEM (DIMENSIONLESS)
 C (REQUESTED OIL FLOW/ERROR IN OUTPUT STEAM FLOW)
 C TPPA AUXILIARY PUMPING POWER (WATTS)
 C TPFCM MAXIMUM CHARGING OIL PUMPING POWER (WATTS)
 C TPPEM MAXIMUM EXTRACTION OIL PUMPING POWER (WATTS)
 C TPL1 UPPER LIMIT OF TFC FOR ONE PUMP, LOW SPEED
 C (DIMENSIONLESS)
 C TPL2 LOWER LIMIT OF TFC FOR TWO PUMPS, HIGH SPEED
 C (DIMENSIONLESS)
 C TPL3 LOWER LIMIT OF TFE FOR TWO PUMPS (DIMENSIONLESS)
 C TAK1 TK1 FOR ONE PUMP AT LOW SPEED (WATTS)
 C TBK1 TK1 FOR TWO PUMPS AT LOW SPEED (WATTS)
 C TCK1 TK1 FOR ONE PUMP AT HIGH SPEED (WATTS)
 C TDK1 TK1 FOR TWO PUMPS AT HIGH SPEED (WATTS)
 C TAK2 TK2 FOR ONE PUMP AT LOW SPEED (WATTS/LBM/SEC)
 C TBK2 TK2 FOR TWO PUMPS AT LOW SPEED (WATTS/LBM/SEC)
 C TCK2 TK2 FOR ONE PUMP AT HIGH SPEED (WATTS/LBM/SEC)
 C TDK2 TK2 FOR TWO PUMPS AT HIGH SPEED (WATTS/LBM/SEC)
 C TAK3 TK3 FOR ONE PUMP (WATTS)
 C TBK3 TK3 FOR TWO PUMPS (WATTS)
 C TAK4 TK4 FOR ONE PUMP (WATTS/LBM/SEC)
 C TBK4 TK4 FOR TWO PUMPS (WATTS/LBM/SEC)
 C TK5 HEAT LOSS FROM STORAGE UNIT WITH THERMOCLINE AT
 C TOP (BTU/SEC)
 C TK6 ADDITIONAL HEAT LOSS FROM STORAGE UNIT WITH
 C THERMOCLINE AT BOTTOM (BTU/SEC)
 C THTSUM CAPACITY OF THERMAL STORAGE UNIT (BTU)
 C TLTU1 TFLAGU=0 WHEN TLT.GT.TLTU1, 1 OR 2 WHEN TLT.LE.TLTU1
 C TLTU2 TFLAGU=2 WHEN TLT.LT.TLTU2, 1 OR 0 WHEN TLT.GE.TLTU2
 C TLTL1 TFLAGL=0 WHEN TLT.LT.TLTL1, 1 OR 2 WHEN TLT.GE.TLTL1
 C TLTL2 TFLAGL=2 WHEN TLT.GT.TLTL2, 1 OR 0 WHEN TLT.LE.TLTL2
 C TTSC 0 FOR HOT START CHARGE, 1 FOR STEADY STATE
 C TTSE 0 FOR HOT START EXTRACTION, 1 FOR STEADY STATE

EPGS CONSTANTS

COMMON /GCDATA/ GMVR(4),GMVT(2),GMVE(4),VRATE(12),GMVRO(4),
 1 GMVTO(2),GMVEO(4),SSP(12),TZERO(3),GPSPT3,GETAT3,GLZT3,
 2 GKLC3,GPSPT1,GMCT1,GPSPT2,GETAT2,GLZT2,GKLC2,GRIDC,
 3 GRODC,GLDC,UTC,GRISP,GROSP,GLSPTG,NPORTS,IFAN,GPTED(4),
 4 GTEFF,GPHRD(3,6),GWHRD(3),GTHRD(6),GMEFF,GKEFF,GKGAIN,

5 GKINERT,GPFRSP,GFPHR,GFPSR,GWFPR,GFPTR,GVFPR,GRIRC,GRORC,
 6 GLRC,GRIDS,GRODS,GLDESP,GPFPSP,GLFWP,GRIFWP,GROFWP,TNOM,
 7 VNOM,BFUMP(5),HFUMP(5),H1PARM(3),H2PARM(3),H4PARM(3),
 8 H5PARM(3),GMCH3,GMCHW

C
 C GMVR(4) SETTINGS OFR EPGS SERVO-CONTROLLED VALVES R1-R4
 C RANGE IS 0. TO 1.0
 C GMVT(2) SETTING FOR EPGS SERVO-CONTROLLED VALVES T1 AND T2
 C RANGE IS 0. TO 1.0
 C GMVE(4) SETTING FOR EPGS SERVO-CONTROLLED VALVES E1-E4
 C RANGE IS 0. TO 1.0
 C VRATE(10) MAX RATE FOR VALVES TO MOVE FROM OPEN TO CLOSE
 C POSITONS
 C GMVRO(4) VALVE SETTING FOR R1-R4 AT TIME TZERO(1)
 C GMVTO(2) VALVE SETTING FOR T1-T2 AT TIME TZERO(2)
 C GMVEO(4) VALVE SETTING FOR E1-E4 AT TIME TZERO(3)
 C TZERO(3) LAST TIME SET POINT WAS CHANGED (SEC)
 C SSP(11) SAVE SP(11) FROM COMMON BLOCK /CDA/
 C GPSPT3 PRESSURE (PSIA) SET POINT FOR TANK 3 (RECVR FLASH)
 C GETAT3 SIZING CONSTANT FOR TANK 3 (MAX LEVEL DIVIDED BY
 C MAX OUTPUT FLOW RATE)
 C GLZT3 NOMINAL WATER LEVEL (FT) FOR TANK 3
 C GKLC3 CONSTANT FOR LEVEL CONTROL IN TANK 3
 C GPSPT1 PRESSURE (PSIA) SET POINT FOR TANK 1 (TSS DRAIN SYS)
 C GMCT1 MASS(LBM) OF CONDENSATE IN TANK 1
 C GPSPT2 PRESSURE (PSIA) SET POINT FOR TANK 2 (TSS DRAIN SYS)
 C GETAT2 SIZING CONSTANT FOR TANK 2 (MAX LEVEL / MAX FLOW)
 C GLZT2 NOMINAL WATER LEVEL (FT) IN TANK 2
 C GKLC2 LEVEL CONTROL GAIN FOR TANK 2
 C GRISP INSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
 C GROSP OUTSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
 C GLSPTG LENGTH (FT) OF STEAM PIPE (TSS TO EPGS)
 C GRIDC INSIDE RADIUS (FT) OF DOWNCOMER
 C GRODC OUTSIDE RADIUS (FT) OF DOWNCOMER
 C GTC THERMAL CONDUCTIVITY OF DOWNCOMER INSULATION
 C (BTU/HR-FT-DEG R)
 C GLDC LENGTH OF DOWNCOMER IN FEET
 C NPORTS NUMBER OF TURBINE EXTRACTION PORTS
 C IFAN COOLING TOWER FAN CONDITIONS 1 2 FANS FULL SPEED
 C 2 1 HALF 1 FULL
 C 3 2 FANS HALF SPEED
 C GPTD(4) EXTRACTION PRESSURE (PSIA) PER UNIT OF APPARENT LP
 C FLOW (LBM/SEC)
 C GTEFF TURBINE/GENERATOR EFFICIENCY
 C GPHRD(3,6) CONDENSER PRESSURE (PSIA) AT GWHRD(3) AND GTHRD(6)
 C GWHRD(3) CONDENSER FLOW (LBM/HR) DATA AT 3 DIFFERENT VALUES
 C GTHRD(6) AMBIENT TEMP. (F) DATA AT 6 DIFFERENT VALUES
 C GEMEFF ELECTRO-MECHANICAL EFFICIENCY OF RECVR FEEDPUMP
 C GKEFF FEED PUMP EFFICIENCY
 C GKGAİN FEED PUMP CONTROL GAIN
 C GKINERT FEED PUMP MOMENT OF INERTIA
 C GPFRSP RECVR INLET PRESSURE (PSIA) SET POINT
 C GFPHR FEED PUMP RATED HEAD (FT)
 C GFPSR FEED PUMP RATED SPEED (RPM)
 C GWFPR FEED PUMP RATED FLOW (LBM/SEC)
 C GFPTR FEED PUMP RATED TORQUE (FT-LBS)
 C GVFPR SPECIFIC VOLUME (FT**3/LBM) AT RATED CONDITIONS
 C GRIRC INSIDE RADIUS (FT) OF RISER
 C GRORC OUTSIDE RADIUS (FT) OF RISER
 C GLRC LENGTH (FT) OF RISER


```

5 GRODS, GLDESP, GPFPS, GLFWP, GRIFWP, GROFWP, TNOM, VNOM, BPUMP, HPUMP,
6 H1PARM, H2PARM, H4PARM, H5PARM, GMCH3, GMCHW

```

``` READ SIMULATION INPUT DATA ```

```

      READ (5, PROG)
      READ (5, ENVIR)
      READ (5, HELIO)
      READ (5, RECEVR)
      READ (5, THSTOR)
      READ (5, EPGS)

```

``` CALCULATE SIMULATION MODEL CONSTANTS BASED ON INPUT DATA ```

``` CALCULATE RECEIVER MODEL PARAMETERS ```

```

      CALCULATE SUPERPANEL HEAT CAPACITY PER UNIT LENGTH
      RKCS=RKNTB*PKCH*PKDNN*PI*(RKODTB*RKODTB-RKIDTB*RKIDTB)/4.0
      CALCULATE SUPERPANEL CROSS-SECTIONAL AREA
      RKAS=RKNTB*PI*RKIDTB*RKIDTB/4.0
      CALCULATE SUPERPANEL INTERNAL SURFACE AREA PER UNIT LENGTH
      RKSS=RKNTB*PI*RKIDTB

```

``` CALCULATE THERMAL STORAGE MODEL PARAMETERS ```

```

      CALCULATE SPECIFIC ENTHALPY AND HEAT CAPACITIES
      CALL USE PT(TP8, TT8)
      TH8=HE
      TC5=0.5+0.0005*(TT5-200.0)
      TC6=0.5+0.0005*(TT6-200.0)
      COMPUTE SP. ENTH. GAIN (TKHC) OF OIL IN STORAGE HEATER
      TKHC=0.5*(TC5+TC6)*(TT5-TT6)

```

``` GENERATE DIAGNOSTIC PRINT (IF REQUESTED) ```

``` PRINT INITIAL PROGRAM CONTROL INPUT DATA (IF REQUESTED) ```

```

      IF (DIAG(4)) WRITE (6, 200)
1  OUTFG, ATIMO, ATIDAY, DIAG, ATILCL, ATITST, END
200 FORMAT(1H, 3X, 37HINITIAL PROGRAM CONTROL INPUT DATA- ,
1  6HOUTFG=, 20L2, 8H ATIMO=, I2, 9H ATIDAY=, I3/1H, 40X, 6HDIAG= ,
2  30L2/1H, 40X, 10L2, 10H ATILCL= , G10.4, 10H ATITST= , G10.4,
3  6H END=, L2)

```

``` PRINT INITIAL ENVIRONMENTAL INPUT DATA (IF REQUESTED) ```

```

      IF (DIAG(4)) WRITE (6, 210)
1  ETEAMB, EPRAMB, EVWAMB, EINDIR, EDWAMB, ETDAMB
210 FORMAT(1H, 3X, 37HINITIAL ENVIRONMENTAL INPUT DATA- ,
1  7HETEAMB=, G10.4, 9H EPRAMB=, G10.4, 9H EVWAMB=, G10.4/1H, 40X,
2  7HEINDIR=, G10.4, 9H EDWAMB=, G10.4, 9H ETDAMB=, G10.4)

```

``` EJECT PAGE IF PRINT OUTPUT REQUESTED ```

```

      IF (OUTFG(1,1)) WRITE (6, 310)
310 FORMAT(1H1)

```

```

      RETURN
      END

```

SUBROUTINE INTLC
INITIALIZE NON-GASP-IV VARIABLES, STATE VARIABLES, AND TIME EVENTS

CALL MASTER CONTROL TO MAKE INITIAL PLANT SETTINGS
CALL MASTER

RETURN
END

FUNCTION KSER(KS,IP,KC)

SEARCH IP STARTING AT IP(KS) TO LOCATE CONDITION KC,
SET THE POINTER TO KSER IF NOT FOUND KSER=0

DIMENSION IP(4)

DO 1 K=KS,4
IF (IP(K) .EQ. KC) GO TO 2

1 CONTINUE

K = 0

2 KSER = K

RETURN
END


```

C      SUBROUTINE MASTER
C      CALCULATE PLANT MASTER CONTROL SETTINGS
C
C
C      EXECUTIVE AND PROGRAM CONTROL DATA
C
C      INTEGER ATIMO,ATIDAY
C      LOGICAL OUTFG,END,DIAG
C      COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1  DIAG(40)
C
C      OUTFG(I,J)  OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
C      END          END OF RUN FLAG
C      ATILCL       LOCAL TIME (SECONDS FROM MIDNIGHT)
C      ATITST       TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
C      ATIMO        MONTH
C      ATIDAY       DAY
C      DIAG         DIAGNOSTIC PRINT FLAG ARRAY
C
C
C      MASTER CONTROL SUBSYSTEM DATA
C
C      INTEGER CMODE,CNMODE,CNSP,CNMV,CMVRTBL,CHVLA,CMVPA,
1  CMVRC,CNM,CNMVEL,CNNM
C      COMMON /CDATA/ CMODE,CNMODE,CSPTBL(7,16),CSP(16),CNSP,
1  CMVLTBL(6,4,7),CMVL(6,4),CNMV,CMVRTBL(7,7,4),
2  CHVLA(7),CMVPA(4),CMVRC(4),CNN(4),CNMVEL,CNNM
C
C      CMODE        CURRENT MODE OF OPERATION
C      CNMODE       NUMBER OF DIFFERENT MODES OF OPERATION
C      CSPTBL       SETPOINT TABLE
C      CSP          SETPOINTS FOR CURRENT MODE OF OPERATION
C      CNSP         NUMBER OF SETPOINTS
C      CMVLTBL      TABLE OF OPERATING LIMITS FOR MONITORED VARIABLES
C      CMVL         OPERATING LIMITS OF MONITORED VARIABLES FOR CURRENT
C                  MODE OF OPERATION
C      CNMV         NUMBER OF MONITORED VARIABLES
C      CMVRTBL      TABLE OF MCS RESPONSES FOR MONITORED VARIABLES
C                  EXCEEDING THEIR LIMITS
C      CHVLA        MONITORED VARIABLE LIMIT ARGUMENT FOR RESPONSE TABLE
C      CMVPA        MONITORED VARIABLE ARGUMENT FOR RESPONSE TABLE
C      CMVRC        RESPONSE CODES FOR MONITORED VARIABLES CROSSING LIMITS
C      CNM          POTENTIAL NEW MODES TO CORRECT MONITORED VARIABLE
C                  LIMIT CROSSINGS
C      CNMVEL       NUMBER OF MONITORED VARIABLES EXCEEDING LIMITS
C                  AT ANY INSTANT OF TIME
C      CNNM         NUMBER OF NEW MODE REQUESTS AT ANY INSTANT OF TIME
C
C      STANDARD DEFINITION OF PILOT PLANT OPERATING MODES
C
C      1=  RECEIVER STEAM TO EPGS
C      2=  RECEIVER STEAM TO EPGS AND THERMAL STORAGE
C      3=  RECEIVER STEAM TO EPGS AND THERMAL STORAGE STEAM TO EPGS
C      4=  RECEIVER STEAM TO THERMAL STORAGE AND THERMAL STORAGE
C          STEAM TO EPGS
C      5=  RECEIVER STEAM TO THERMAL STORAGE
C      6=  THERMAL STORAGE STEAM TO EPGS
C      7=  OVERNIGHT SHUTDOWN AND HOLD
C

```

```

C      ARGUMENT DEFINITIONS FOR SETPOINT ARRAY CSP(I)
C
C      I=1,4  EPGS VALVE SETPOINTS FOR VALVES R1-R4
C      I=5,6  EPGS VALVE SETPOINTS FOR VALVES T1,T2
C      I=7,8  EPGS VALVE SETPOINTS FOR DRAIN VALVES
C      I=9,12 EPGS VALVE SETPOINTS FOR VALVES E1-E4
C      I=13   EPGS CONDENSER FAN SETPOINT
C      I=14   EPGS FEED PLMP PRESSURE SETPOINT
C      I=15   RECEIVER OUTLET TEMPERATURE SETPOINT
C      I=16   TSS OUTLET STEAM FLOW RATE SETPOINT
C
C      CURRENT LIST OF MONITORED VARIABLES
C
C      RECEIVER OUTLET PRESSURE
C      RECEIVER OUTLET TEMPERATURE
C      EPGS FEEDWATER PRESSURE
C      TSS THERMOCLINE LEVEL
C
C      COLLECTOR SUBSYSTEM DATA
C
C      COMMON /HDATA/ HFLRN(20,8),HCEF(121),HREF,HCFL,XTIST,XTIEND,
1  XVAL,XDIR,XDTC
C
C      HFLRN      HELIOSTAT OUTPUT SOLAR ARRAY FLUX AT RECEIVER NODES
C                  (BTU/SEC)
C      HCEF      HELIOSTAT FIELD CELL EFFICIENCIES (ND)
C      HREF      HELIOSTAT REFLECTIVE EFFICIENCY (ND)
C      HCFL      COLLECTOR FIELD SIZE (FEET)
C      XTIST      START TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD FRONT INTERCEPTS CORNER OF CELL ARRAY
C      XTIEND     END TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD REAR INTERCEPTS CORNER OF CELL ARRAY
C      XVAL       CLOUD VELOCITY (MILES/HOUR)
C      XDIR       CLOUD DIRECTION (DEGREES FROM N TO S DIRECTION)
C                  (0 = N TO S, 90 = W TO E, -90 = E TO W, 180 = S TO N)
C      XDTC       CLOUD UPDATE SCHEDULING INTERVAL (SEC)
C
C      RECEIVER SUBSYSTEM DATA
C
C      RECVR VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)
C
C      INTEGER RCVST,RAFLGC
C      COMMON /RDATA/ RHISH(6),RWISH(6),RHSR,RPRSR,RTESH,RWOSH,RFMV(6),
1  RLV(6),RHIV,RPRIV,RFRISV,RPROSV,RVIV,PHOV(6),RPROV(6),RNV(6),
2  RWSUM,RHF1(8),RPRF1(8),RTEF1(8),RUF1(8),RVF1(8),RRCF2(8),
3  RHF2(8),RPRF2(8),RQF2(8),RTEF2(8),RTEFF2(8),RUF2(8),RVF2(8),
4  RHTF2(8),RHCN2(8),RHFCN2(8),RHFRN2(8),RCN2(8),RQAM2(8),RQCM2(8),
5  RQEN2(8),RPRF3(8),RTEF3(8),RUF3(8),RVF3(8),RRCF4(8),RHSBF4(8),
6  RHBF4(8),RHF4(8),RPRF4(8),RQF4(8),RTEF4(8),RTEFF4(8),RUF4(8),
7  RVF4(8),RHTF4(8),RHCN4(8),RHFCN4(8),RHFRN4(8),RCN4(8),RQAM4(8),
8  RQCM4(8),RQEN4(8),RPRF5(8),RTEF5(8),RUF5(8),RVF5(8),RXF5(8),
9  RRCF6(8),RHF6(8),RPRF6(8),RQF6(8),RTEF6(8),RTEFF6(8),RUF6(8),
A  RVF6(8),RHTF6(8),RHCN6(8),RHFCN6(8),RHFRN6(8),RCN6(8),RQAM6(8),
B  RQCM6(8),RQEN6(8),RPRF7(8),RTEF7(8),RUF7(8),RVF7(8),
C  RUF8(8),RVF8(8),RUV8(8),RVVSAT(8),RL35(8),RL57(8),RWSP(8),
D  RCVST(8),RAFLGC(6),FEERRC(6),RLPROC(6),RLSUNC(6),RTSETC
C
C      RHISH(ISP) FLUID ENTHALPY AT STEAM HEADER INLET

```

C (BTU/LBM)
 C RWISH(ISP) FLUID MASS FLOW RATE AT STEAM HEADER INLET
 C (LBM/SEC)
 C RSH FLUID ENTHALPY IN STEAM HEADER
 C (BTU/LBM)
 C RPRSH FLUID PRESSURE IN STEAM HEADER
 C (PSIA)
 C RTESH FLUID TEMPERATURE IN STEAM HEADER
 C (DEGREES F)
 C RWOSH FLUID MASS FLOW RATE AT STEAM HEADER OUTLET
 C (LBM/SEC)
 C RFMV(IV) MODIFIED FRICTION FLOW COEFFICIENT FOR FLOW
 C CONTROL VALVE (PSI, SEC**2/LBM, CU FT)
 C RLV(IV) STEM DISPLACEMENT OF FLOW CONTROL VALVE
 C (PERCENT)
 C RHIV FLUID ENTHALPY AT FLOW CONTROL VALVE INLETS
 C (BTU/LBM)
 C RPRIV FLUID PRESSURE AT FLOW CONTROL VALVE INLETS
 C (PSIA)
 C RPRISV FLUID PRESSURE AT RECEIVER SUBSYSTEM INLET
 C (PSIA)
 C RPROSV FLUID PRESSURE AT RECEIVER SUBSYSTEM OUTLET
 C (PSIA)
 C RVIV FLUID SPECIFIC VOLUME AT FLOW CONTROL VALVE INLETS
 C (CU FT/LBM)
 C RHOV(IV) FLUID ENTHALPY AT FLOW CONTROL VALVE OUTLET
 C (BTU/LBM)
 C RPROV(IV) FLUID PRESSURE AT FLOW CONTROL VALVE OUTLET
 C (PSIA)
 C RWV(IV) FLUID MASS FLOW RATE THROUGH FLOW CONTROL VALVE
 C (LBM/SEC)
 C RWVSUM FLUID MASS FLOW RATE THROUGH ALL FLOW CONTROL VALVES
 C (LBM/SEC)
 C RHF1(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 1
 C (BTU/LBM)
 C RPRF1(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 1
 C (PSIA)
 C RTEF1(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 1
 C (DEGREES F)
 C RUF1(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 1
 C (BTU/LBM)
 C RVF1(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 1
 C (CU FT/LBM)
 C RHCF2(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 2 (BTU/SEC, SQ FT, F)
 C RHF2(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 2
 C (BTU/LBM)
 C RPRF2(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 2
 C (PSIA)
 C RQF2(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RTEF2(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 C (DEGREES F)
 C RTEFF2(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 C (DEGREES F)
 C RUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
 C (BTU/LBM)
 C RVF2(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 2
 C (CU FT/LBM)
 C RWF2(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE

C NUMBER 2 (LBM/SEC)
 C RHCM2(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFCM2(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFRM2(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RQM2(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQAM2(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQCM2(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQEM2(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RPRF3(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 3
 C (PSIA)
 C RTEF3(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 3
 C (DEGREES F)
 C RUF3(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RVF3(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 3
 C (CU FT/LBM)
 C RHCF4(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHNBF4(ISP) INTERNAL NUCLEATE BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFBF4(ISP) INTERNAL FILM BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHF4(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RPRF4(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 4
 C (PSIA)
 C RQF4(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RTEF4(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RTEFF4(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RUF4(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RVF4(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 4
 C (CU FT/LBM)
 C RWTf4(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 4 (LBM/SEC)
 C RHCM4(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFCM4(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFRM4(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RQM4(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQAM4(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQCM4(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQEM4(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RPRF5(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 5

C (PSIA)
 C RTEF5(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 5
 C (DEGREES F)
 C RUF5(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RVF5(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 5
 C (CU FT/LBM)
 C RXF5(ISP) FLUID QUALITY AT SUPERPANEL NODE NUMBER 5
 C (PERCENT)
 C RHCF6(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHF6(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RFRF6(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 6
 C (PSIA)
 C RQF6(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RTEF6(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RTEFF6(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RUF6(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RVF6(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 6
 C (CU FT/LBM)
 C RWTF6(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 6 (LBM/SEC)
 C RHCM6(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFCM6(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFRM6(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RQM6(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQAM6(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQCM6(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQEM6(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RHF7(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RPRF7(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 7
 C (PSIA)
 C RTEF7(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 7
 C (DEGREES F)
 C RUF7(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RVF7(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 7
 C (CU FT/LBM)
 C RUFSAT(ISP) INTERNAL ENERGY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RVFSAT(ISP) SPECIFIC VOLUME OF A SATURATED LIQUID
 C (CU FT/LBM)
 C RUVSAT(ISP) INTERNAL ENERGY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RVVSAT(ISP) SPECIFIC VOLUME OF A SATURATED VAPOR
 C (CU FT/LBM)
 C RL35(ISP) LENGTH OF SUPERPANEL TWO-PHASE MIXTURE SECTION

C RKNBSP NUMBER OF BOILER SUPERPANELS
 C (ND)
 C RKFF2 FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 2
 C (PSI,SEC**2/LBM,CU FT)
 C RKFF4 FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 4
 C (PSI,SEC**2/LBM,CU FT)
 C RKFF6 FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 6
 C (PSI,SEC**2/LBM,CU FT)
 C RKFV(IV) FLUID FLOW COEFFICIENT OF FLOW CONTROL VALVE
 C (PSI,SEC**2/LBM,CU FT)
 C RKAIV(IV) PERCENT SUBSYSTEM PRESSURE DROP ACROSS
 C FLOW CONTROL VALVE (PERCENT)
 C RKVSH VOLUME OF STEAM HEADER
 C (CU FT)
 C RKINTC(IC) CONTROLLER INTEGRAL GAIN CONSTANT
 C (PERCENT,SEC/F)
 C RKPROC(IC) CONTROLLER PROPORTIONAL GAIN CONSTANT
 C (PERCENT/F)
 C RKTHSC CONTROLLER ACTIVATION TEMPERATURE THRESHOLD
 C (DEGREES F)
 C
 C THERMAL STORAGE SUBSYSTEM DATA
 C
 C TSS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)
 C
 C COMMON /TDATA/ TP1,TP4,TH1,TH2,TH3,TH4,TH9,TW1,TW1A,TW1M,TW2,TW3,
 C 1 TH5A,TW7A,TWE,TKDSH,TKTSH,TKSG,TPPC,TPPE,TPPT,TFC,TFE,TK1,TK2,
 C 2 TK3,TK4,TCONC,TCONC,TLT,TFLAGU,TFLAGL
 C
 C TP1 PRESSURE OF STEAM INTO DESUPERHEATER,
 C AND PRESSURE OF DESUPERHEATED STEAM (PSIA)
 C TP4 PRESSURE OF WATER FROM STORAGE HEATER (PSIA)
 C TH1 ENTHALPY OF STEAM INTO DESUPERHEATER (BTU/LBM)
 C TH2 ENTHALPY OF WATER INTO DESUPERHEATER (BTU/LBM)
 C TH3 ENTHALPY OF STEAM FROM DESUPERHEATER (BTU/LBM)
 C TH4 ENTHALPY OF WATER FROM STORAGE HEATER (BTU/LBM)
 C TH9 ENTHALPY OF WATER INTO STEAM GENERATOR (BTU/LBM)
 C TW1 STEAM FLOW AVAILABLE TO DESUPERHEATER (LBM/SEC)
 C TH1A ACTUAL STEAM FLOW TO DESUPERHEATER (LBM/SEC)
 C TW1M MAXIMUM STEAM FLOW TO DESUPERHEATER (LBM/SEC)
 C TH2 WATER FLOW TO DESUPERHEATER (LBM/SEC)
 C TH3 STEAM FLOW FROM DESUPERHEATER (LBM/SEC)
 C TH5A ACTUAL OIL FLOW INTO STORAGE (LBM/SEC)
 C TH7A ACTUAL OIL FLOW FROM STORAGE (LBM/SEC)
 C TWE CONTROLLER SET POINT FOR STEAM GENERATOR STEAM FLOW
 C (LBM/SEC)
 C TKDSH FLOW RATE GAIN FACTOR OF DESUPERHEATER (RECIPROCAL
 C OF SPECIFIC ENTHALPY LOSS FACTOR) (DIMENSIONLESS)
 C TKTSH RATIO OF SPECIFIC ENTHALPY GAIN OF OIL TO SPECIFIC
 C ENTHALPY LOSS OF STEAM IN THERMAL STORAGE HEATER
 C (DIMENSIONLESS)
 C TKSG RATIO OF SPECIFIC ENTHALPY GAIN OF WATER TO
 C SPECIFIC ENTHALPY LOSS OF OIL IN STEAM GENERATOR
 C (DIMENSIONLESS)
 C TPPC CHARGING OIL PUMPING POWER (WATTS)
 C TPPE EXTRACTION OIL PUMPING POWER (WATTS)
 C TPPT THERMAL STORAGE SUBSYSTEM TOTAL PUMPING POWER (WATTS)
 C TFC FRACTION OF MAX. CHARGING OIL FLOW (DIMENSIONLESS)
 C TFE FRACTION OF MAX. EXTRACTION OIL FLOW (DIMENSIONLESS)

C TK2 TK2 FOR TWO PUMPS AT HIGH SPEED (WATTS/LBM/SEC)
 C TAK3 TK3 FOR ONE PUMP (WATTS)
 C TBK3 TK3 FOR TWO PUMPS (WATTS)
 C TAK4 TK4 FOR ONE PUMP (WATTS/LBM/SEC)
 C TEK4 TK4 FOR TWO PUMPS (WATTS/LBM/SEC)
 C TK5 HEAT LOSS FROM STORAGE UNIT WITH THERMOCLINE AT
 C TOP (BTU/SEC)
 C TK6 ADDITIONAL HEAT LOSS FROM STORAGE UNIT WITH
 C THERMOCLINE AT BOTTOM (BTU/SEC)
 C THTSUM CAPACITY OF THERMAL STORAGE UNIT (BTU)
 C TLTU1 TFLAGU=0 WHEN TLT.GT.TLTU1, 1 OR 2 WHEN TLT.LE.TLTU1
 C TLTU2 TFLAGU=2 WHEN TLT.LT.TLTU2, 1 OR 0 WHEN TLT.GE.TLTU2
 C TLTL1 TFLAGL=0 WHEN TLT.LT.TLTL1, 1 OR 2 WHEN TLT.GE.TLTL1
 C TLTL2 TFLAGL=2 WHEN TLT.GT.TLTL2, 1 OR 0 WHEN TLT.LE.TLTL2
 C TTSC 0 FOR HOT START CHARGE, 1 FOR STEADY STATE
 C TTSE 0 FOR HOT START EXTRACTION, 1 FOR STEADY STATE

ELECTRICAL POWER GENERATION SUBSYSTEM DATA

EPGS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)

COMMON /GDATA/ GPT3, GLT3, GHSOT3, GHSOT3, GHSBDC, GPSBDC, GTSBDC,
 1 GHLOSSD, GHSRG, GWSRT, GWSTSG, GPSTSG, GTSTSG, GPT1, GHSTH1, GHSTH1,
 2 GPT2, GHSTH2, GHSTH2, GHCIT2, GLT2, GHCTC, GHCTH3, GHCTH5, GWTALP,
 3 GWTEXH, GPTEXH, GWTEXH, GWTEXT(4), GPTEXT(4), GWTEXT(4), GTPCWER,
 4 GEPOUT, GHLOSSR, GTFPR, GPCUT, GHOUTP, GFPAUX, GWFPT, GFPH, GFPT, GTDSI,
 5 GPCTSG, CTCTSG, GHLOSSD, GHLOTSG, GTAUXP, APSP, AFHP, GHNTR1, GFHTR1,
 6 GTHTR1, GPSH1, GHSH1, GPSH2, GHSH2, GHCH4C, GHCH5C, GHCH23, GHCH12

C GPT3 PRESSURE (PSIA) IN TANK 3 (RECVR FLASH TANK)
 C GLT3 CONDENSATE LEVEL (FT.) IN TANK 3
 C GHSOT3 FLOW (LBM/SEC) OF STEAM OUT OF TANK 3
 C GHSOT3 ENTHALPY (BTU/LBM) OF STEAM OUT OF TANK 3
 C GHSBDC FLOW (LBM/SEC) OF STEAM AT BOTTOM OF DOWNCOMER
 C GPSBDC PRESSURE (PSIA) OF STEAM AT BOTTOM OF DOWNCOMER
 C GTSBDC TEMPERATURE (F) OF STEAM AT BOTTOM OF DOWNCOMER
 C GHLOSSD HEAT LOSS (BTU/HR) FROM DOWNCOMER
 C GHSRG FLOW (LBM/SEC) OF RECVR STEAM TO TURBINE MAIN THROTTLE
 C GWSRT FLOW (LBM/SEC) OF RECVR STEAM TO THERMAL STORAGE
 C GWSTSG STEAM FLOW (LBM/SEC) AT TURBINE ADMISSION PORT
 C GPSTSG PRESSURE (PSIA) STEAM AT TURBINE ADMISSION PORT
 C GTSTSG TEMP (F) STEAM AT TURBINE ADMISSION PORT
 C GPT1 PRESSURE (PSIA) IN TANK 1 (TSS DRAIN SYS)
 C GHSTH1 STEAM FLOW (LBM/SEC) TO F.W. HEATER 1 FROM TSS DRAIN
 C GHSTH1 ENTHALPY (BTU/LBM) TO F.W. HEATER 1 FROM TSS DRAIN
 C GPT2 PRESSURE (PSIA) IN TANK 2 (TSS DRAIN SYS)
 C GHSTH2 STEAM FLOW (LBM/SEC) TO F.W. HEATER 2 FROM TSS DRAIN
 C GHSTH2 ENTHALPY (BTU/LBM) TO F.W. HEATER 2 FROM TSS DRAIN
 C GHCIT2 ENTHALPY (BTU/LBM) CONDENSATE INTO TANK 2
 C GLT2 CONDENSATE LEVEL (FT) IN TANK 2
 C GHCTC CONDENSATE FLOW (LBM/SEC) TO CONDENSER FROM TSS DRAIN
 C GHCTH3 CONDENSATE FLOW (LBM/SEC) TO F.W. HEATER 3 FROM TSS
 C GHCTH5 CONDENSATE FLOW (LBM/SEC) TO F.W. HEATER 5 FROM TSS
 C GWTALP TURBINE APPARENT LP STEAM FLOW (LBM/SEC)
 C GWTEXH TURBINE EXHAUST FLOW (LBM/SEC)
 C GPTEXH TURBINE EXHAUST PRESSURE (PSIA)
 C GWTEXH TURBINE EXHAUST ENTHALPY (BTU/LBM)
 C GWTEXT(4) TURBINE EXTRACTION FLOWS (LBM/SEC)
 C GPTEXT(4) TURBINE EXTRACTION PRESSURES (PSIA)

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C   GHTEXT(4)   TURBINE EXTRACTION ENTHALPIES (BTU/LBM)
C   GTPOWER     THERMAL AVAILABILITY (BTU/SEC)
C   GEPOUT      ELECTRICAL POWER (MEGA-WATTS)
C   GHLOSSR     RISER HEAT LOSSES (BTU/HR)
C   GTFPR       RECVR INLET TEMPERATURE (F)
C   GPOUT       RECVR FEED PUMP OUTPUT PRESSURE (PSIA)
C   GHOUTP      RECVR FEED PUMP OUTPUT ENTHALPY (BTU/LBM)
C   GFPAUX      RECVR FEED PUMP AUX POWER (KW)
C   GWFPT       TOTAL RECVR FEED PUMP FLOW (LBM/SEC)
C   GFPH        RECVR FEED PUMP HEAD (FT)
C   GFPT        RECVR FEED PUMP TORQUE (FT-LBS)
C   GTDSI       F.W. TEMPERATURE (F) AT DESUPERHRTR INLET
C   GFCTSG      PRESSURE (PSIA) AT TSS STEAM GENERATOR INLET
C   GTCTSG      TEMPERATURE (F) AT TSS STEAM GENERATOR INLET
C   GHLOSSDS    HEAT LOSS (BTU/HR) IN DESUPERHEATER FW PIPE
C   GHLOTS      HEAT LOSS (BTU/HR) IN TSS STEAM GENERATOR FW PIPE
C   GTAUXP      TOTAL AUX POWER (KW) REQUIRED BY FEEDWATER PUMPS
C   APBP        AUX POWER (KW) REQUIRED BY BOOST PUMP
C   APHP        AUX POWER (KW) REQUIRED BY HOTWELL PUMP
C   GHHTRI      ENTHALPY (BTU/LBM) OF WATER IN HEATER 1
C   GFHTRI      PRESSURE (PSIA) OF WATER IN HEATER 1
C   GHTRI       TEMPERATURE (F) OF WATER IN HEATER 1
C   GPSH1       PRESSURE (PSIA) OF STEAM TO HEATER 1
C   GHSH1       ENTHALPY (BTU/LBM) OF STEAM TO HEATER 1
C   GFSH2       PRESSURE (PSIA) OF STEAM TO HEATER 2
C   GHSH2       ENTHALPY (BTU/LBM) OF STEAM TO HEATER 2
C   GHCH4C      ENTHALPY (BTU/LBM) OF HEATER 4 CONDENSATE DRAIN
C   GHCH5C      ENTHALPY (BTU/LBM) OF HEATER 5 CONDENSATE DRAIN
C   GHCH23      ENTHALPY (BTU/LBM) OF HEATER 2 CONDENSATE DRAIN
C   GHCH12      ENTHALPY (BTU/LBM) OF HEATER 1 CONDENSATE DRAIN

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EPGS CONSTANTS

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C   COMMON /GCDATA/ GMVR(4),GMVT(2),GMVE(4),VRATE(12),GMVR0(4),
1  GMVT0(2),GMVE0(4),SSP(12),TZERO(3),GPSPT3,GETAT3,GLZT3,
2  GKLC3,GPSPT1,GMCT1,GFSP2,GETAT2,GLZT2,GKLC2,GRIDC,
3  GRODC,GLDC,GTG,GRISP,GROSP,GLSPTG,NPORTS,IFAN,GPTED(4),
4  GTEFF,GFHRD(3,6),GMHRD(3),GTHRD(6),GMEFF,GKEFF,GKGAIN,
5  GKINERT,GFERSP,GFHR,GFPSR,GWFPR,GFPT,GVFPR,GRIRC,GRCRC,
6  GLRC,GRIDS,GRODS,GLDESP,GPFSP,GLFHP,GRIFWP,GRCFWP,TNOM,
7  VNCH,BFUMP(5),HPUMP(5),H1PARM(3),H2PARM(3),H4PARM(3),
8  H5PARM(3),GMCH3,GMCHW

C   GMVR(4)      SETTING OFR EPGS SERVO-CONTROLLED VALVES R1-R4
C                 RANGE IS 0. TO 1.0
C   GMVT(2)      SETTING FOR EPGS SERVO-CONTROLLED VALVES T1 AND T2
C                 RANGE IS 0. TO 1.0
C   GMVE(4)      SETTING FOR EPGS SERVO-CONTROLLED VALVES E1-E4
C                 RANGE IS 0. TO 1.0
C   VRATE(10)    MAX RATE FOR VALVES TO MOVE FROM OPEN TO CLOSE
C                 POSITIONS
C   GMVR0(4)     VALVE SETTING FOR R1-R4 AT TIME TZERO(1)
C   GMVT0(2)     VALVE SETTING FOR T1-T2 AT TIME TZERO(2)
C   GMVE0(4)     VALVE SETTING FOR E1-E4 AT TIME TZERO(3)
C   TZERO(3)     LAST TIME SET POINT WAS CHANGED (SEC)
C   SSP(11)      SAVE SP(11) FROM COMMON BLOCK /CADATA/
C   GPSPT3       PRESSURE (PSIA) SET POINT FOR TANK 3 (RECVR FLASH )
C   GETAT3       SIZING CONSTANT FOR TANK 3 (MAX LEVEL DIVIDED BY
C                 MAX OUTPUT FLOW RATE)

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C GLZT3 NOMINAL WATER LEVEL (FT) FOR TANK 3
 C GKLC3 CONSTANT FOR LEVEL CONTROL IN TANK 3
 C GPSPT1 PRESSURE (PSIA) SET POINT FOR TANK 1 (TSS DRAIN SYS)
 C GMCT1 MASS(LBM) OF CONDENSATE IN TANK 1
 C GPSPT2 PRESSURE (PSIA) SET POINT FOR TANK 2 (TSS DRAIN SYS)
 C GETAT2 SIZING CONSTANT FOR TANK 2 (MAX LEVEL / MAX FLOW)
 C GLZT2 NOMINAL WATER LEVEL (FT) IN TANK 2
 C GKLC2 LEVEL CONTROL GAIN FOR TANK 2
 C GRISP INSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
 C GROSP OUTSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
 C GLSPT6 LENGTH (FT) OF STEAM PIPE (TSS TO EPGS)
 C GRIDC INSIDE RADIUS (FT) OF DOWNCOMER
 C GRCDC OUTSIDE RADIUS (FT) OF DOWNCOMER
 C GTC THERMAL CONDUCTIVITY OF DOWNCOMER INSULATION
 C (BTU/HR-FT-DEG R)
 C GLDC LENGTH OF DOWNCOMER IN FEET
 C NPORTS NUMBER OF TURBINE EXTRACTION PORTS
 C IFAN COOLING TOWER FAN CONDITIONS 1 2 FANS FULL SPEED
 C 2 1 HALF 1 FULL
 C 3 2 FANS HALF SPEED
 C GPTED(4) EXTRACTION PRESSURE (PSIA) PER UNIT OF APPARENT LP
 C FLOW (LBM/SEC)
 C GTEFF TURBINE/GENERATOR EFFICIENCY
 C GPHRD(3,6) CONDENSER PRESSURE (PSIA) AT GWHRD(3) AND GTHRD(6)
 C GWHRD(3) CONDENSER FLOW (LBM/HR) DATA AT 3 DIFFERENT VALUES
 C GTHRD(6) AMBIENT TEMP. (F) DATA AT 6 DIFFERENT VALUES
 C GENEFF ELECTRO-MECHANICAL EFFICIENCY OF RECVR FEEDPUMP
 C GKEFF FEED PUMP EFFICIENCY
 C GKGAIN FEED PUMP CONTROL GAIN
 C GKINERT FEED PUMP MOMENT OF INERTIA
 C GPFRRP RECVR INLET PRESSURE (PSIA) SET POINT
 C GPFRR FEED PUMP RATED HEAD (FT)
 C GPFRR FEED PUMP RATED SPEED (RPM)
 C GWFRR FEED PUMP RATED FLOW (LBM/SEC)
 C GFPTR FEED PUMP RATED TORQUE (FT-LBS)
 C GVFFR SPECIFIC VOLUME (FT**3/LBM) AT RATED CONDITIONS
 C GRIRC INSIDE RADIUS (FT) OF RISER
 C GRORC OUTSIDE RADIUS (FT) OF RISER
 C GLRC LENGTH (FT) OF RISER
 C GRIDS INSIDE RADIUS (FT) OF FW PIPE FEED PUMP TO DESUPHRTTR
 C GRCDS OUTSIDE RADIUS (FT) FW PIPE FEED PUMP TO DESUPHRTTR
 C GLDESP LENGTH (FT) OF FW PIPE FEED PUMP TO DESUPHRTTR
 C GPFPPSP RECVR INLET PRESSURE (PSIA) SET POINT
 C GLFWP LENGTH (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
 C GRIFWP INNER RADIUS (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
 C BPUMP(5) PARAMETERS FOR BOOST PUMP (SEE ROUTINE PUMPSS)
 C HPUMP(5) PARAMETERS FOR HOTWELL PUMP (SEE ROUTINE PUMPSS)
 C H1PARM(3) PARAMETERS FOR HEATER 1 (SEE ROUTINE CFWHTR)
 C H2PARM(3) PARAMETERS FOR HEATER 2 (SEE ROUTINE CFWHTR)
 C H4PARM(3) PARAMETERS FOR HEATER 4 (SEE ROUTINE CFWHTR)
 C H5PARM(3) PARAMETERS FOR HEATER 5 (SEE ROUTINE CFWHTR)
 C GMCH3 MASS OF CONDENSATE (LBM) STORED IN HEATER 3
 C GROFWP OUTER RADIUS (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
 C GMCHW MASS OF CONDENSATE (LBM) STORED IN CONDENSER HOTWELL
 C THOM NOMINAL TEMP (F) OF AIR SURROUNDING FW SYS COMPONENTS
 C VNOM NOMINAL AIR VELOCITY (FT/SEC) ABOUT FW SYS COMPONENTS
 C (NORMALLY SET TO ZERO)
 C
 C
 C GASP-IV SIMULATION SYSTEM DATA

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C      COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
      1NAPQ,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
      2,TTCLR,TTFIN,TTRIB(25),TSET

C      COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
      1,NNEQD,NNEQS,NNEQT,SS(600),SSL(600),TTNEX

C      DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
      1 RLINTC(6),RL15(8),RHFSAT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
      2 RDIUF2(8),RDL13(8),RDTEM2(8),RDIHF3(8),RDTEM4(8),RDTEM6(8),
      3 RDLINTC(6)

C      EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
      1 (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
      2 (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
      4 (TW5,SS(83)),(TW7,SS(84)),(TW8,SS(85)),
      5 (THTSU,SS(86)),(GMCT3,SS(87)),(GHCOT3,SS(88)),
      6 (GHCOT3,SS(89)),(GHSBDC,SS(90)),(GHSTSG,SS(91)),
      7 (GHCOT1,SS(92)),(GHCOT2,SS(93)),(GMCT2,SS(94)),
      8 (GHCOT2,SS(95)),(GFPS,SS(96)),(GHRCI,SS(97)),
      9 (GHDSI,SS(98)),(GHCOH3,SS(99)),(GHCTSG,SS(100)),
      A (GHCHW,SS(101)),
      B (RL15(1),SS(102)),(RHFSAT(1),SS(110)),(RHF3(1),SS(118)),
      C (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
      D (CRPRSH,SS(151)),(CRTESH,SS(152)),(CGPFPR,SS(153)),
      E (CTL7,SS(154)),
      F (GPFPR,SS(161)),(GPDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
      G (XK3,SS(165))

C      EQUIVALENCE (RDIUF2(1),DD(1)),(RDL13(1),DD(9)),(RDTEM2(1),DD(17)),
      1 (RDIHF3(1),DD(25)),(RDTEM4(1),DD(33)),(RDTEM6(1),DD(41)),
      2 (RDUSH,DD(49)),(RDVSH,DD(50)),(RDLINTC(1),DD(51)),
      3 (TDW5,DD(83)),(TDW7,DD(84)),
      5 (TDW8,DD(85)),(TDHTSU,DD(86)),(GMCDT3,DD(87)),
      6 (GHDCOT3,DD(88)),(GHDCOT3,DD(89)),(GHSBDC,DD(90)),
      7 (GHDCOT3,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),
      8 (GHDCOT2,DD(94)),(GHDCOT2,DD(95)),(GDFPS,DD(96)),
      9 (GHDCOT2,DD(97)),(GHDCOT2,DD(98)),(GHDCOT3,DD(99)),
      A (GHDCOT3,DD(100)),(GHDCOT3,DD(101))

C      INTEGRATED STATE VARIABLES

C      RIUF2(ISP)  FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
C                  (BTU/LBM)
C      RL13(ISP)   LENGTH OF SUPERPANEL SUBCOOLED SECTION
C                  (FEET)
C      RTEM2(ISP)  METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C                  (DEGREES F)
C      RIHF3(ISP)  FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
C                  (BTU/LBM)
C      RTEM4(ISP)  METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 4
C                  (DEGREES F)
C      RTEM6(ISP)  METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 6
C                  (DEGREES F)
C      RUSH        FLUID INTERNAL ENERGY IN STEAM HEADER
C                  (BTU/LBM)
C      RVSH        FLUID SPECIFIC VOLUME IN STEAM HEADER
C                  (CU FT/LBM)
C      RLINTC(IC)  CONTROLLER INTEGRAL SIGNAL OF VALVE STEM DISPLACEMENT

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	(PERCENT)
TW5	NOMINAL OIL FLOW INTO STORAGE (LBM/SEC)
TW7	NOMINAL OIL FLOW FROM STORAGE (LBM/SEC)
TW8	STEAM FLOW FROM STEAM GENERATOR (LBM/SEC)
THTSU	HEAT STORED IN THERMAL STORAGE UNIT (BTU)
GMCT3	CONDENSTAE MASS (LBM) IN TANK 3 (RECVR FLASH TANK)
GHCOT3	ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 3
GWCOT3	FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 3
GHSEDC	ENTHALPY (BTU/LBM) OF STEAM AT BOTTOM OF DOWNCOMER
GHSTSG	ENTHALPY (BTU/LBM) OF ADMISSION STEAM
GHCOT1	ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 1
GHCOT2	ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 2
GMCT2	MASS (LBM) OF CONDENSATE IN TANK 2
GWCOT2	FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 2
GFPS	RECVR FEED PUMP SPEED (RPM)
GHRCI	F.W. ENTHALPY (BTU/LBM) AT RECVR INLET
GHDSI	F.W. ENTHALPY (BTU/LBM) AT DESUPERHRTR INLET
GHCOH3	F.W. ENTHALPY (BTU/LBM) OUT OF FW HRTR NO. 3
GHCTSG	ENTHAPLY (BTU/LBM) AT TSS STEAM GEN. INLET
GHCHW	ENTHALPY (BTU/LBM) OF CONDENSATE IN CONDENSER HOTWELL
ADDITIONALLY REQUIRED GASP-IV STATE VARIABLES	
RL15(ISP)	COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND TWO-PHASE MIXTURE SECTIONS (FEET)
RHFSAT(ISP)	ENTHALPY OF A SATURATED LIQUID (BTU/LBM)
RHF3(ISP)	FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3 (BTU/LBM)
RHVSAT(ISP)	ENTHALPY OF A SATURATED VAPOR (BTU/LBM)
RHF5(ISP)	FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5 (BTU/LBM)
RTSENC(IC)	CONTROLLER TEMPERATURE SENSOR SIGNAL OF BOILER SUPERPANEL OUTLET TEMPERATURE (DEGREES F)
CRFRSH	FLUID PRESSURE IN RECEIVER STEAM HEADER (PSIA)
CRTESH	FLUID TEMPERATURE IN RECEIVER STEAM HEADER (DEGREES F)
CGPFPR	FLUID PRESSURE AT RECEIVER INLET (PSIA)
CTLT	POSITION OF TSS THERMOCLINE (PERCENT)
GPFPFR	FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
GPDSI	FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)
XK1,XK2,XK3	EPGS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND PRESSURE AT RECEIVER INLET
TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES	
RDIUF2(ISP)	TIME DERIVATIVE OF RIUF2(ISP)
RDL13(ISP)	TIME DERIVATIVE OF RL13(ISP)
RDEM2(ISP)	TIME DERIVATIVE OF RTEM2(ISP)
ROIHF3(ISP)	TIME DERIVATIVE OF RIHF3(ISP)
RDEM4(ISP)	TIME DERIVATIVE OF RTEM4(ISP)
RDEM6(ISP)	TIME DERIVATIVE OF RTEM6(ISP)
RDUSH	TIME DERIVATIVE OF RUSH
RDVSH	TIME DERIVATIVE OF RVSH

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C      RDLINTC(IC) TIME DERIVATIVE OF RLINTC(IC)
C
C      TDW5      TIME DERIVATIVE OF TW5
C      TDW7      TIME DERIVATIVE OF TW7
C      TDW8      TIME DERIVATIVE OF TW8
C      TDHTSU    TIME DERIVATIVE OF THTSU
C
C      GMDCT3    TIME DERIVATIVE OF GMCT3
C      GHDCOT3   TIME DERIVATIVE OF GHCOT3
C      GHDCOT3   TIME DERIVATIVE OF GHCOT3
C      GHSDSDC   TIME DERIVATIVE OF GHSEDC
C      GHSTSG    TIME DERIVATIVE OF GHSTSG
C      GHDCOT1   TIME DERIVATIVE OF GHCOT1
C      GHDCOT2   TIME DERIVATIVE OF GHCOT2
C      GMDCT2    TIME DERIVATIVE OF GMCT2
C      GHDCOT2   TIME DERIVATIVE OF GHCOT2
C      GDFPS     TIME DERIVATIVE OF GFPS
C      GHDRCI    TIME DERIVATIVE OF GHRCI
C      GHDDSI    TIME DERIVATIVE OF GHDSI
C      GHDCOH3   TIME DERIVATIVE OF GHCOH3
C      GHDCOTSG  TIME DERIVATIVE OF GHCTSG
C      GHDCWH    TIME DERIVATIVE OF GHCHW
C
C
C      COMPRESSED WATER/SUPERHEATED STEAM TABLE DATA
C
C      LOGICAL NO COMP,SATURD
C      REAL HE,PE,SE,TE,VE,XE
C      COMMON /USECOM/ HE,PE,SE,TE,VE,XE,NO COMP,SATURD
C
C
C      INITIALIZE NUMBER OF MODES, SETPOINTS, AND MONITORED VARIABLES
C
C      DATA CNMODE,CNSP,CNMV /7,16,4/
C
C
C      INITIALIZE SETPOINT TABLE
C
C      DATA ((CSPTBL(I,J),I=1,7),J=1,16) /
1      1.0, 1.0, 1.0, 1.0, 1.0, 0.0, 0.0,
2      0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0,
3      0.0, 0.26, 0.0, 1.0, 1.0, 0.0, 0.0,
4      1.0, 0.74, 1.0, 0.0, 0.0, 0.0, 0.0,
5      0.0, 0.0, 1.0, 1.0, 0.0, 1.0, 0.0,
6      0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,
7      0.0, 0.4, 0.0, 0.5, 0.0, 0.0, 0.4,
8      0.0, 0.6, 0.0, 0.5, 0.6, 0.0, 0.6,
9      .0737, .0754, .0561, 0.0, 0.0, 0.0, 0.0,
10     .0623, .0596, .0474, 0.0, 0.0, 0.0, 0.0,
11     .0579, .0588, .0610, .0657, 0.0, .0733, 0.0,
12     .0675, .0359, .0710, .0466, 0.0, .0816, 0.0,
13     1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 4.0,
14     2000.0, 2000.0, 2000.0, 2000.0, 2000.0, 0.0, 0.0,
15     950.0, 950.0, 950.0, 950.0, 660.0, 400.0, 400.0,
16     0.0, 0.0, 7.917, 29.167, 0.0, 29.167, 0.0/
C
C
C      INITIALIZE TABLE OF OPERATING LIMITS FOR MONITORED VARIABLES
C
C      DATA (((CMVLTBL(I,J,K),I=1,6),J=1,4),K=1,4) /

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11      0.0,      0.0,      1310.0,      1610.0,      1760.0,      1E10,
12      0.0,      0.0,      855.0,      1045.0,      1140.0,      1E10,
13      0.0,      0.0,      1800.0,      2200.0,      2400.0,      1E10,
14      0.0,      .0500,      .0502,      .9848,      .9850,      1E10,
21      0.0,      0.0,      1310.0,      1610.0,      1760.0,      1E10,
22      0.0,      0.0,      855.0,      1045.0,      1140.0,      1E10,
23      0.0,      0.0,      1800.0,      2200.0,      2400.0,      1E10,
24      0.0,      .0500,      .0502,      .9848,      .9850,      1E10,
31      0.0,      0.0,      1310.0,      1610.0,      1760.0,      1E10,
32      0.0,      0.0,      855.0,      1045.0,      1140.0,      1E10,
33      0.0,      0.0,      1800.0,      2200.0,      2400.0,      1E10,
34      0.0,      .0500,      .0502,      .9848,      .9850,      1E10,
41      0.0,      0.0,      1310.0,      1610.0,      1760.0,      1E10,
42      0.0,      0.0,      855.0,      1045.0,      1140.0,      1E10,
43      0.0,      0.0,      1800.0,      2200.0,      2400.0,      1E10,
44      0.0,      .0500,      .0502,      .9848,      .9850,      1E10/
DATA (((CHVLTBL(I,J,K),I=1,6),J=1,4),K=5,7) /
51      0.0,      0.0,      1310.0,      1610.0,      1760.0,      1E10,
52      0.0,      0.0,      855.0,      1045.0,      1140.0,      1E10,
53      0.0,      0.0,      1800.0,      2200.0,      2400.0,      1E10,
54      0.0,      .0500,      .0502,      .9848,      .9850,      1E10,
61      0.0,      0.0,      1310.0,      1610.0,      1760.0,      1E10,
62      0.0,      0.0,      855.0,      1045.0,      1140.0,      1E10,
63      0.0,      0.0,      1800.0,      2200.0,      2400.0,      1E10,
64      0.0,      .0500,      .0502,      .9848,      .9850,      1E10,
71      0.0,      0.0,      1310.0,      1610.0,      1760.0,      1E10,
72      0.0,      0.0,      855.0,      1045.0,      1140.0,      1E10,
73      0.0,      0.0,      1800.0,      2200.0,      2400.0,      1E10,
74      0.0,      .0500,      .0502,      .9848,      .9850,      1E10/

```

C
C
C
C

INITIALIZE TABLE OF RESPONSE CODES FOR MONITORED VARIABLES

```

DATA (((CMVRTBL(I,J,K),I=1,7),J=1,7),K=1,2) /
11      7, 7, 7, 1, 8, 7, 7,
12      7, 7, 7, 2, 8, 7, 7,
13      7, 7, 7, 3, 8, 7, 7,
14      7, 7, 7, 4, 8, 7, 7,
15      7, 7, 7, 5, 8, 7, 7,
16      6, 6, 6, 6, 6, 6, 6,
17      7, 7, 7, 7, 7, 7, 7,
21      7, 7, 7, 1, 8, 7, 7,
22      7, 7, 7, 2, 8, 7, 7,
23      7, 7, 7, 3, 8, 7, 7,
24      7, 7, 7, 4, 8, 7, 7,
25      7, 7, 7, 5, 8, 7, 7,
26      6, 6, 6, 6, 6, 6, 6,
27      7, 7, 7, 7, 7, 7, 7/
DATA (((CMVRTBL(I,J,K),I=1,7),J=1,7),K=3,4) /
31      7, 7, 7, 1, 7, 7, 7,
32      7, 7, 7, 2, 7, 7, 7,
33      7, 7, 7, 3, 7, 7, 7,
34      7, 7, 7, 4, 7, 7, 7,
35      7, 7, 7, 5, 7, 7, 7,
36      6, 6, 6, 6, 6, 6, 6,
37      7, 7, 7, 7, 7, 7, 7,
41      1, 1, 1, 1, 1, 1, 1,
42      5, 5, 5, 2, 8, 7, 7,
43      7, 7, 7, 3, 6, 6, 6,
44      5, 5, 5, 4, 8, 7, 7,

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```

45 5, 5, 5, 5, 8, 7, 7,
46 7, 7, 7, 6, 7, 7, 7,
47 4, 4, 4, 7, 7, 7, 7/
C
IF (DIAG(27)) PRINT *,#DIAG(27) CSPTBL = #,CSPTBL
IF (DIAG(27)) PRINT *,#DIAG(27) CMVLTBL = #,CMVLTBL
IF (DIAG(27)) PRINT *,#DIAG(27) CMVRTBL = #,CMVRTBL
C
C
C PERFORM INITIALIZATION CALL TO OBTAIN ENVIRONMENTAL
C AND SOLAR FLUX DATA
ATILCL=TNOW
CALL EDATIN
ATIB(1)=TNOW
ATIB(2)=2.0
CALL FILEM(1)
CALL FLUX
ATIB(1)=TNOW
ATIB(2)=3.0
CALL FILEM(1)
C DETERMINE IF CLOUD SIMULATION IS REQUESTED AND INITIALIZE
C CLOUD SIMULATION IF NEEDED
IF (XTIST.LT.0.0) GO TO 125
CALL CLDINT
CALL CLOUD
ATIB(1)=XTIST
ATIB(2)=4.0
CALL FILEM(1)
125 CONTINUE
C
C
C SET INITIAL OPERATING MODE
C
CMODE = 2
C
C
C DEFINE SUBSYSTEM SETPOINTS FOR INITIAL OPERATING MODE
C
DO 250 I=1,CHSP
250 CSP(I) = CSPTBL(CMODE,I)
C
IF (DIAG(27)) PRINT *,#DIAG(27) CSP = #,CSP
C
C
C DEFINE LIMITS OF MONITORED VARIABLES FOR INITIAL
C OPERATING MODE
C
DO 252 J=1,CHMV
DO 251 I=1,6
251 CHVL(I,J) = CMVLTBL(I,J,CMODE)
252 CONTINUE
C
IF (DIAG(27)) PRINT *,#DIAG(27) CMVL = #,CMVL
C
C
C INITIALIZE THE RECEIVER, EFGS, AND TSS SUBSYSTEM INTEGRATED
C (AND REQUIRED ALGEBRAIC) VARIABLES TO VALUES CONSISTENT WITH
C THE INITIAL OPERATING MODE AND THE INITIAL TIME OF DAY
C INITIALIZE PREHEATER SUPERPANELS
C

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C
C      INITIALIZE RECVR VARIABLES
C
      RIUF2(1)=322.0
      RIUF2(2)=474.0
      RL13(1)=RKL17
      RL13(2)=RKL17
      RTEM2(1)=358.0
      RTEM2(2)=497.0
      RIHF3(1)=398.0
      RIHF3(2)=550.0
C      INITIALIZE BOILER SUPERPANELS AND CONTROLLERS
      DO 200 IC=1,RKNBSP
      ISP=IC+RKNPSP
      RL13(ISP)=6.1
      RTEM2(ISP)=591.0
      RTEM4(ISP)=650.0
      RTEM6(ISP)=820.0
200  RLINTC(IC)=0.70
C      INITIALIZE STEAM HEADER
      RUSH=1321.0
      RVSH=0.5145
C      INITIALIZE RECEIVER ALGEBRAIC VARIABLES ASSOCIATED
C      WITH ITERATIVE LOOPS
      DO 220 IC=1,RKNBSP
      ISP=IC+RKNPSP
      RUF2(ISP)=579.0
      RTEF7(ISP)=950.0
220  RLSUMC(IC)=RLINTC(IC)
      RPRSH=1515.0
C      INITIALIZE RECEIVER LOGICAL VARIABLES
C      INITIALIZE THE SUPERPANEL FLUID CONTROL VOLUME STATE
      NSP=RKNPSP+RKNBSP
      DO 240 ISP=1,NSP
      RCVST(ISP)=3
240  IF (RL13(ISP).GE.RKL17) RCVST(ISP)=1
C      INITIALIZE THE CONTROLLER ACTIVATION FLAG
      DO 245 IC=1,RKNBSP
      ISP=IC+RKNPSP
      RAFLGC(IC)=1
245  IF (RTEF7(ISP).GE.RKTHSC) RAFLGC(IC)=2
C
C      INITIALIZE TSS VARIABLES
C
50  TP1=1465.
      TH1=1461.
      TH2=391.
      TH9=233.6
      TH1=8.5
      TWE=0.
      TPPT=0.
      TLT=0.2
C      SET THERMOCLINE FLAGS TO NORMAL
      TFLAGU=TFLAGL=2.
C      IS THERMOCLINE TOO HIGH TO START CHARGING
      IF (TLT.LT.TLTU2) GO TO 60
      TFLAGU=TTSC=0.
C      IS THERMOCLINE TOO LOW TO START EXTRACTION
60  IF (TLT.GT.TLTU2) GO TO 70
      TFLAGL=TTSE=0.

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70 CONTINUE
C      COMPUTE SPECIFIC ENTHALPIES AND HEAT CAPACITIES
      CALL USE PT(TP1,TT3)
      TH3=HE
      TP4=TP1-TPDTS
      CALL USE PT(TP4,TT4)
      TH4=HE
C      COMPUTE FLOW RATE GAIN FACTOR OF DESUPERHEATER
      TKDSH=(TH1-TH2)/(TH3-TH2)
C      COMPUTE SP. ENTH. GAIN/LOSS RATIO OF STORAGE HEATER
      TKTSH=(TH3-TH4)/TKHC
C      COMPUTE SP. ENTH. GAIN/LOSS RATIO OF STEAM GENERATOR
      TKSG=TKHC/(TH8-TH9)
C      COMPUTE MAXIMUM ALLOWABLE INPUT STEAM FLOW; LIMIT ACTUAL FLOW
      TW1M=TW5M/(TKDSH*TKTSH)
      TW1A=AMIN1(TW1,TW1M)
C      IF HOT START CHARGE (TTSC.EQ.0), SET INITIAL OIL FLOW TO ZERO
98 IF(TTSC.EQ.1.) GO TO 100
      TW5=0.
      GO TO 195
C      COMPUTE STEAM AND OIL FLOWS THROUGH STORAGE HEATER
100 TW3=TW1A*TKDSH
      TW2=TW3-TW1A
      TW5=TKTSH*TW3
C      COMPUTE FRACTION OF MAXIMUM CHARGING OIL FLOW
195 TFC=TW5/TW5M
C      INITIALIZE FLAG TO INDICATE 1 OR 2 CHARGING PUMPS
      TCONC=1.
      IF(TFC.GE..5) TCONC=2.
C      COMPUTE EXTRACTION OIL FLOW TO MATCH REQUESTED STEAM FLOW
      TW7=TWE/TKSG
C      LIMIT ACTUAL OIL FLOW
      TW7A=AMIN1(TW7M,AMAX1(TW7,0.))
C      IF HOT START EXTRACTION (TTSE.EQ.0), SET INITIAL OIL FLOW AND
      RESULTING STEAM FLOW (TW8) TO ZERO
C      446 IF(TTSE.EQ.1.) GO TO 448
      TW7=0.
      TW7A=0.
      TW3=0.
      GO TO 450
C      COMPUTE INITIAL OUTPUT STEAM FLOW (TW8)
448 TW8=TW7A*TKSG
C      COMPUTE FRACTION OF MAXIMUM EXTRACTION OIL FLOW
450 TFE=TW7A/TW7M
C      INITIALIZE FLAG TO INDICATE 1 OR 2 EXTRACTION PUMPS
      TCONE=1.
      IF(TFE.GE..5) TCONE=2.
C      INITIALIZE HEAT CONTENT OF STORAGE UNIT (THTSU)
      THTSU=TLT*THTSUM
C
C      INITIALIZE EPGS VARIABLES
C
      GMCT3=250.
      GHCOT3=397.4
      GNCOT3=0.
      GHSSDC=1461.2
      GHSTSG=1206.0
      GHCOT1=397.4
      GHCOT2=330.75
      GMCT2=10900.0

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GWCOT2=0.
GFFS=3220.0
GHRCI=376.6
GHDSI=376.6
GHCOH3=233.6
GHCTSG=233.6
GHCHW=76.7

C INITIALIZE INTERFACE VARIABLES

GPFP=2000.
XK1=2100.
XK2=XK3=0.
GPT3=310.
GLT3=2.
GWSOT3=1204.1
GHSOT3=170.
GFSBDC=1465.
GTSDC=950.
GHSRT=0.
GHSTH2=1194.9
GHCTI2=330.75
GHTEXH=0.
DO 310 I=1,4
310 GHTEXT(I)=170.
GFSH1=275.
GHSH1=1317.5
GPSH2=116.
GHSH2=1250.
GHCH4C=139.2
GHCH5C=87.1
GHCH23=243.8
GHCH12=310.

C INITIALIZE TIME ZERO (FOR EPGs VALVE TRANSITION CALCULATIONS)
C TO TSTART

DO 320 I = 1,3

320 TZERO(I) = TTBE

C INITIALIZE EPGs SERVO-VALVE POSITIONS

DO 330 I=1,4

330 GMVR(I)=GMVR0(I)=CSP(I)

DO 340 I=1,2

J=4+I

340 GMVT(I)=GMVT0(I)=CSP(J)

DO 350 I=1,4

J=8+I

350 GMVE(I)=GMVE0(I)=CSP(J)

C
C
C

RETURN
END

SUBROUTINE MCSAUX

THIS SUBROUTINE TRANSFORMS MCS DATA INTO ENGINEERING UNITS
AS REQUIRED BY EPGS

EXECUTIVE AND PROGRAM CONTROL DATA

INTEGER ATIMO,ATIDAY
LOGICAL OUTFG,END,DIAG
COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1 DIAG(40)

OUTFG(I,J) OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
END END OF RUN FLAG
ATILCL LOCAL TIME (SECONDS FROM MIDNIGHT)
ATITST TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
ATIMO MONTH
ATIDAY DAY
DIAG DIAGNOSTIC PRINT FLAG ARRAY

MASTER CONTROL SUBSYSTEM DATA

INTEGER CMODE,CNMODE,CNSP,CNMV,CMVRTBL,CMVLA,CMVPA,
1 CMVRC,CNM,CNMVEL,CNNM
COMMON /CDATA/ CMODE,CNMODE,CSPTBL(7,16),CSP(16),CNSP,
1 CMVLTBL(6,4,7),CMVL(6,4),CNMV,CMVRTBL(7,7,4),
2 CMVLA(7),CMVPA(4),CMVRC(4),CNM(4),CNMVEL,CNNM

CMODE CURRENT MODE OF OPERATION
CNMODE NUMBER OF DIFFERENT MODES OF OPERATION
CSPTBL SETPOINT TABLE
CSP SETPOINTS FOR CURRENT MODE OF OPERATION
CNSP NUMBER OF SETPOINTS
CMVLTBL TABLE OF OPERATING LIMITS FOR MONITORED VARIABLES
CMVL OPERATING LIMITS OF MONITORED VARIABLES FOR CURRENT
MODE OF OPERATION
CNMV NUMBER OF MONITORED VARIABLES
CMVRTBL TABLE OF MCS RESPONSES FOR MONITORED VARIABLES
EXCEEDING THEIR LIMITS
CMVLA MONITORED VARIABLE LIMIT ARGUMENT FOR RESPONSE TABLE
CMVPA MONITORED VARIABLE ARGUMENT FOR RESPONSE TABLE
CMVRC RESPONSE CODES FOR MONITORED VARIABLES CROSSING LIMITS
CNM POTENTIAL NEW MODES TO CORRECT MONITORED VARIABLE
LIMIT CROSSINGS
CNMVEL NUMBER OF MONITORED VARIABLES EXCEEDING LIMITS
AT ANY INSTANT OF TIME
CNNM NUMBER OF NEW MODE REQUESTS AT ANY INSTANT OF TIME

STANDARD DEFINITION OF PILOT PLANT OPERATING MODES

1= RECEIVER STEAM TO EPGS
2= RECEIVER STEAM TO EPGS AND THERMAL STORAGE
3= RECEIVER STEAM TO EPGS AND THERMAL STORAGE STEAM TO EPGS
4= RECEIVER STEAM TO THERMAL STORAGE AND THERMAL STORAGE
STEAM TO EPGS
5= RECEIVER STEAM TO THERMAL STORAGE
6= THERMAL STORAGE STEAM TO EPGS

7= OVERNIGHT SHUTDOWN AND HOLD

ARGUMENT DEFINITIONS FOR SETPOINT ARRAY CSP(I)

I=1,4 EPGS VALVE SETPOINTS FOR VALVES R1-R4
I=5,6 EPGS VALVE SETPOINTS FOR VALVES T1,T2
I=7,8 EPGS VALVE SETPOINTS FOR DRAIN VALVES
I=9,12 EPGS VALVE SETPOINTS FOR VALVES E1-E4
I=13 EPGS CONDENSER FAN SETPOINT
I=14 EPGS FEED PUMP PRESSURE SETPOINT
I=15 RECEIVER OUTLET TEMPERATURE SETPOINT
I=16 TSS OUTLET STEAM FLOW RATE SETPOINT

CURRENT LIST OF MONITORED VARIABLES

RECEIVER OUTLET PRESSURE
RECEIVER OUTLET TEMPERATURE
EPGS FEEDWATER PRESSURE
TSS THERMOCLINE LEVEL

EPGS CONSTANTS

COMMON /GCDATA/ GMVR(4),GMVT(2),GMVE(4),VRATE(12),GMVR0(4),
1 GMVT0(2),GMVE0(4),SSP(12),TZERO(3),GPSPT3,GETAT3,GLZT3,
2 GKLC3,GPSPT1,GMCT1,GPSPT2,GETAT2,GLZT2,GKLC2,GRIDC,
3 GRODC,GLDC,UTC,GRISP,GROSP,GLSPTG,NPORTS,IFAN,GPTD(4),
4 GTEFF,GPHRD(3,6),GMHPD(3),GTHRD(6),GENEFF,GKEFF,GKGAIN,
5 GKINERT,GPFSP,GPFPR,GFPR,GWFFR,GFPTR,GVFPR,GRIRC,GRORC,
6 GLRC,GRIDS,GRODS,GLDESP,GFFPSP,GLFWP,GRIFWP,GROFWP,TNOM,
7 VNOM,BPUMP(5),HPUMP(5),H1PARM(3),H2PARM(3),H4PARM(3),
8 H5PARM(3),GMCH3,GMCHW

GMVR(4) SETTING OFR EPGS SERVO-CONTROLLED VALVES R1-R4
RANGE IS 0. TO 1.0
GMVT(2) SETTING FOR EPGS SERVO-CONTROLLED VALVES T1 AND T2
RANGE IS 0. TO 1.0
GMVE(4) SETTING FOR EPGS SERVO-CONTROLLED VALVES E1-E4
RANGE IS 0. TO 1.0
VRATE(10) MAX RATE FOR VALVES TO MOVE FROM OPEN TO CLOSE
POSITONS
GMVR0(4) VALVE SETTING FOR R1-R4 AT TIME TZERO(1)
GMVT0(2) VALVE SETTING FOR T1-T2 AT TIME TZERO(2)
GMVE0(4) VALVE SETTING FOR E1-E4 AT TIME TZERO(3)
TZERO(3) LAST TIME SET POINT WAS CHANGED (SEC)
SSP(11) SAVE SP(11) FROM COMMON BLOCK /CDA/
GPSPT3 PRESSURE (PSIA) SET POINT FOR TANK 3 (RECVR FLASH)
GETAT3 SIZING CONSTANT FOR TANK 3 (MAX LEVEL DIVIDED BY
MAX OUTPUT FLOW RATE)
GLZT3 NOMINAL WATER LEVEL (FT) FOR TANK 3
GKLC3 CONSTANT FOR LEVEL CONTROL IN TANK 3
GPSPT1 PRESSURE (PSIA) SET POINT FOR TANK 1 (TSS DRAIN SYS)
GMCT1 MASS(LBM) OF CONDENSATE IN TANK 1
GPSPT2 PRESSURE (PSIA) SET POINT FOR TANK 2 (TSS DRAIN SYS)
GETAT2 SIZING CONSTANT FOR TANK 2 (MAX LEVEL / MAX FLOW)
GLZT2 NOMINAL WATER LEVEL (FT) IN TANK 2
GKLC2 LEVEL CONTROL GAIN FOR TANK 2
GRISP INSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
GROSP OUTSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
GLSPTG LENGTH (FT) OF STEAM PIPE (TSS TO EPGS)

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C   GRIDC      INSIDE RADIUS (FT) OF DOWNCOMER
C   GRODC      OUTSIDE RADIUS (FT) OF DOWNCOMER
C   GTC        THERMAL CONDUCTIVITY OF DOWNCOMER INSULATION
C              (BTU/HR-FT-DEG R)
C   GLDC       LENGTH OF DOWNCOMER IN FEET
C   NPORTS     NUMBER OF TURBINE EXTRACTION PORTS
C   IFAN       COOLING TOWER FAN CONDITIONS  1  2 FANS FULL SPEED
C              2  1 HALF 1 FULL
C              3  2 FANS HALF SPEED
C   GPTED(4)   EXTRACTION PRESSURE (PSIA) PER UNIT OF APPARENT LP
C              FLOW (LBM/SEC)
C   GTEFF      TURBINE/GENERATOR EFFICIENCY
C   GPHRD(3,6) CONDENSER PRESSURE (PSIA) AT GWHRD(3) AND GTHRD(6)
C   GWHRD(3)   CONDENSER FLOW (LBM/HR) DATA AT 3 DIFFERENT VALUES
C   GTHRD(6)   AMBIENT TEMP. (F) DATA AT 6 DIFFERENT VALUES
C   GMEFF      ELECTRO-MECHANICAL EFFICIENCY OF RECVR FEEDPUMP
C   GKEFF      FEED PUMP EFFICIENCY
C   GKGAIN     FEED PUMP CONTROL GAIN
C   GKINERT    FEED PUMP MOMENT OF INERTIA
C   GPFRRSP    RECVR INLET PRESSURE (PSIA) SET POINT
C   GPFHR      FEED PUMP RATED HEAD (FT)
C   GFPSR      FEED PUMP RATED SPEED (RPM)
C   GNFFR      FEED PUMP RATED FLOW (LBM/SEC)
C   GFPTR      FEED PUMP RATED TORQUE (FT-LBS)
C   GVFPFR     SPECIFIC VOLUME (FT**3/LBM) AT RATED CONDITIONS
C   GRIRC      INSIDE RADIUS (FT) OF RISER
C   GRORC      OUTSIDE RADIUS (FT) OF RISER
C   GLRC       LENGTH (FT) OF RISER
C   GRIDS      INSIDE RADIUS (FT) OF FW PIPE FEED PUMP TO DESUPHRTR
C   GRODS      OUTSIDE RADIUS (FT)   FW PIPE FEED PUMP TO DESUPHRTR
C   GLDESP     LENGTH (FT) OF FW PIPE FEED PUMP TO DESUPERHRTR
C   GPFPS      RECVR INLET PRESSURE (PSIA) SET POINT
C   GLFHP      LENGHT (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
C   GRIFNP     INNER RADIUS (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
C   BPUMP(5)   PARAMETERS FOR BOOST PUMP (SEE ROUTINE PUMPSS)
C   HPUMP(5)   PARAMETERS FOR HOTWELL PUMP (SEE ROUTINE PUMPSS)
C   H1PARM(3)  PARAMETERS FOR HEATER 1 (SEE ROUTINE CFWHTR)
C   H2PARM(3)  PARAMETERS FOR HEATER 2 (SEE ROUTINE CFWHTR)
C   H4PARM(3)  PARAMETERS FOR HEATER 4 (SEE ROUTINE CFWHTR)
C   H5PARM(3)  PARAMETERS FOR HEATER 5 (SEE ROUTINE CFWHTR)
C   GMCH3      MASS OF CONDENSATE (LBM) STORED IN HEATER 3
C   GROFHP     OUTER RADIUS (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
C   GMCHW      MASS OF CONDENSATE (LBM) STORED IN CONDENSER HOTWELL
C   TNOM       NOMINAL TEMP (F) OF AIR SURROUNDING FW SYS COMPONENTS
C   VNOM       NOMINAL AIR VELOCITY (FT/SEC) ABOUT FW SYS COMPONENTS
C              (NORMALLY SET TO ZERO)
C
C   COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
C   INAFO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
C   2,TTCLR,TTFIN,TRIB(25),TTSET
C
C
C              SET EPGS VALVES IN RECEIVER AUXILIARY
C              ROUTINE
C   DO 90 I=1,4
C
C              TEST FOR CHANGE IN SET POINT
C   IF (SSP(I).EQ.CSP(I)) GO TO 90
C
C              CHANGE DETECTED. RESET SSP, TZERO, AND GMVRO.
C   TZERO(1)=TNOW

```

```

      SSP(I)=CSP(I)
      GMVR0(I)=GMVR(I)
C      COMPUTE VALVE SETTING
90  CONTINUE
      DO 100 I=1,4
C      COMPUTE TIME STEP (NEG. SIGN)
      TDEL=TZERO(1)-TNOW
      GMVR(I)=CSP(I)+(GMVR0(I)-CSP(I))*EXP(-(TDEL/VRATE(I))**2)
100  CONTINUE
C      SET EPGS VALVES IN TSS AUXILIARY ROUTINE
C
      DO 190 I=1,2
C      TEST FOR CHANGE IN SET POINT
      J=4+I
      IF (SSP(J).EQ.CSP(J)) GO TO 190
C      CHANGE DETECTED. RESET SSP, TZERO,
C      AND GMVT0.
      TZERO(2)=TNOW
      SSP(J)=CSP(J)
      GMVT0(I)=GMVT(I)
C      COMPUTE VALVE SETTINGS
190  CONTINUE
C
      DO 200 I=1,2
      J=4+I
      TDEL=TZERO(2)-TNOW
      GMVT(I)=CSP(J)+(GMVT0(I)-CSP(J))*EXP(-(TDEL/VRATE(J))**2)
200  CONTINUE
C
C      SET EPGS TURBINE EXTRACTION VALVES
      DO 290 I=1,4
C
C      TEST FOR CHANGE IN SET POINT
      J=8+I
      IF (SSP(J).EQ.CSP(J)) GO TO 290
C      CHANGE DETECTED. RESET SSP, TZERO
C      AND GMVE0.
      TZERO(3)=TNOW
      SSP(J)=CSP(J)
      GMVE0(I)=GMVE(I)
C      SET VALVE SETINGS
290  CONTINUE
C
      DO 300 I=1,4
      J=8+I
      TDEL=TZERO(3)-TNOW
      GMVE(I)=CSP(J)+(GMVE0(I)-CSP(J))*EXP(-(TDEL/VRATE(J))**2)
C
300  CONTINUE
C      SET COOLING TOWER FAN STATE
      IFAN=CSP(13)+.05
C
C      SET RECVR INLET PRESSURE
      GPFPS=CSP(14)
C
      RETURN
      END

```

SUBROUTINE PIPELOS(TAMB,TFLUID,PRAMB,WVEL,DIAMOUT,DIAMIN,RLENGTH,
1 PIPECON,HLOSS)

THIS SUBROUTINE CALCULATES THE HEAT LOSS OF A PIPE

FUNDAMENTAL PHYSICAL CONSTANTS

COMMON /CONSTS/ PI,ZFR,GRAV,GRAVO,SBC,GCAIR

PI PI
ZFR ZERO FAHRENHEIT (DEGREES RANKINE)
GRAV LOCAL ACCELERATION DUE TO GRAVITY (FT/(SEC)**2)
GRAVO GRAVITATIONAL CONSTANT (LBM FT/LBF (SEC)**2)
SBC STEFAN-BOLTZMANN CONSTANT (BTU/SEC-SQ FT (DEG R)**4)
GCAIR GAS CONSTANT FOR AIR (FT LBF/LBM (DEG R))

RADOUT=.5*DIAMOUT
RADIN=.5*DIAMIN

1. FORCE CONVECTION OF FILM COEFF
(GFCFC)
A. FILM TEMPERATURE IN DEG F
(TFF) AND DEG C (TFC)

TFF=.5*(TAMB+TFLUID)
TFC=(5./9.)*(TFF-32.)

B. FILM TEMPERATURE IN DEG R
(TFR)

TFR=TFF+ZFR

C. SPECIFIC VOLUME OF AIR FROM
IDEAL GAS LAW (SVAIR)

SVAIR=(GCAIR*TFR)/(PRAMB*144.)

D. AIR DENSITY (RHO)

RHO=1./SVAIR

E. VOLUMETRIC DIFFUSIVITY (BETA)

BETA=1./TFF

F. AVG WIND VELOCITY (AVGWND)

AVGWND=WVEL *(.05*RLENGTH)**0.15

G. AMBIENT PRESS IN ATOMSPHERES

PAI=PRAMB*6.80046E-02

H. DYNAMIC VISCOSITY OF AIR
(GMUAIR) (LBM/FT-SEC)

GMUAIR=(1813.+(TFC-20.)*4.78+(PAI-1.0)*2.4)/1.488164E+08

I. REYNOLDS NUMBER OR AIR
(GREAIR)

GREAIR=(RHO*AVGWND*DIAMOUT)/GMUAIR

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J. PRANDTL NUMBER (GPRAIR)
K. THERMAL CONDUCTIVITY FOR AIR(CF)

CF=5.2991E-04
GPRAIR=3.5*GCAIR*GMUAIR/CF

IF (GREAIR .GE. 0 .AND. GREAIR .LE. 4) CONST=0.989
IF (GREAIR .GE. 0 .AND. GREAIR .LE. 4) POWER=0.33
IF (GREAIR .GT. 4 .AND. GREAIR .LE. 40) CONST=0.911
IF (GREAIR .GT. 4 .AND. GREAIR .LE. 40) POWER=0.385
IF (GREAIR .GT. 40 .AND. GREAIR .LE. 4000) CONST=0.683
IF (GREAIR .GT. 40 .AND. GREAIR .LE. 4000) POWER=0.466
IF (GREAIR .GT. 4000 .AND. GREAIR .LE. 40000) CONST=0.193
IF (GREAIR .GT. 4000 .AND. GREAIR .LE. 40000) POWER=0.618
IF (GREAIR .GT. 40000 .AND. GREAIR .LE. 400000) CONST=0.0266
IF (GREAIR .GT. 40000 .AND. GREAIR .LE. 400000) POWER=0.805

GFCFC=CONST*(CF/DIAMOUT:*GREAIR**POWER*GPRAIR**0.33333

2. FREE CONVECTION OF FILM COEFF
(GFCFC)
A. GRESHOF NUMBER(GGRN)

GGRN=RHO*RHO*GRAV*BETA*(TFLUID-TAMB)*RLENGTH*RLENGTH*RLENGTH/
1 (GMUAIR*GMUAIR)

PROD=GGRN*GPRAIR
IF (PROD .GT. 0 .AND. PROD .LE. 1.E4) GFCFC=0.
IF (PROD .GT. 1.E4 .AND. PROD .LE. 1.E9)
1 GFCFC=0.044*((TFLUID-TAMB)/RLENGTH)**0.25
IF (PROD .GT. 1.E9)GFCFC=0.041*(TFLUID-TAMB)**0.33333

3. RESULTANT FILM COEFF (GFC)
(BTU/HR-FT**2-DEG R)

GFC=3600.*(GFCFC*GFCFC+6FRCFC*GFCFC)**0.5

5. HEAT LOSS IN DOWNCOMER(HLOSS)

HLOSS=(2*PI*RLENGTH*(TF_UID-TAMB))/((ALOG(RADOUT/RADIN)/PIPECON)+
1 (1./(RADOUT*GFC)))

RETURN
END

```

```

      SUBROUTINE PLT
C
C SUBROUTINE PLT PERFORMS PLOTS
C
C   PLOT DATA IS ON TAPE 8
C
C   LOGICAL END
C
C   COMMON /PLTBLK/ NLAB,VAR(100),RLABEL(100,5),BUF(7),
C                   NCR,VARC,REC(100),
C                   XVAL(1000),YVAL(1000),C(18),D(18),E(41)
C
C   /PLTBLK/ PLOT COMMON BLOCK
C
C   NLAB          NUMBER OF LABELS
C   VAR(I)        I-TH VARIABLE  I=1,2,...,NLAB
C   RLABEL(I,J)   J-TH WORD OF I-TH LABEL
C                   I=1,2,...,NLAB
C                   J=1,2,...,5
C                   NOTE -- I-TH LABEL ONE-FOR-ONE WITH I-TH VARIABLE
C   BUF(I)        I-TH WORD OF INPUT BUFFER
C   NCR           NUMBER OF CARDS OF PLOT REQUEST READ IN
C   VARC          CURRENT VARIABLE
C   REC(I)        I-TH WORD OF INPUT RECORD (FROM TAPE 8)
C   XVAL(I)       I-TH WORD OF X-VALUE ARRAY
C   YVAL(I)       I-TH WORD OF Y-VALUE ARRAY
C   C(I)          I-TH WORD OF C-ARRAY
C   D(I)          I-TH WORD OF D-ARRAY
C   E(I)          I-TH WORD OF E-ARRAY
C
C
C   DATA (D(I),I=1,5)/10HBARSTOW PI,
C           10HLOT POWER ,
C           10HPLANT      ,
C           10H           ,
C           10H           /
C
C INITIALIZE PLOT
C   CALL PLOTS(0,0,0)
C   CALL STPLOT(3H0AS)
C
C READ VARIABLES/LABELS INPUT CARDS
C   CALL READVL
C
C INITIALIZE D ARRAY
C   DO 5 I=1,5
C     5 D(6+I)=RLABEL(1,I)
C     DO 6 I=6,18,6
C       6 D(I)=10H
C
C PRIME INPUT BUFFER FOR PLOT REQUESTS
C   READ(5,1000) (BUF(I),I=1,7)
C   1000 FORMAT(7A10)
C
C READ PLOT REQUEST
C   10 CALL READPL(END)
C   IF (END) RETURN
C
C
C

```

```

      SUBROUTINE PLOT
C
C SUBROUTINE PLOT PERFORMS A PLOT
C
      COMMON /PLTBLK/ NLAB,VAR(100),RLABEL(100,5),BUF(7),
C                    NCR,VARC,REC(100),
C                    XVAL(1000),YVAL(1000),C(18),D(18),E(41)
C
C      XCUR      CURRENT VALUE OF X
C      YCUR      CURRENT VALUE OF Y
C      IND       INDEX FOR BUILDING XVAL AND YVAL ARRAYS
C
C PERFORM INITIALIZATION
      10 IND=1
      REWIND 8
C
C DETERMINE POSITION OF VARIABLE (INDEX) ON TAPE
      DO 20 INDEX=1,100
      IF(VARC.EQ.VAR(INDEX)) GO TO 30
      20 CONTINUE
C
C REQUESTED VARIABLE NOT IN VARIABLE TABLE
      CALL ERR(3)
C
C READ RECORD ON TAPE
      30 READ(8) (REC(I),I=1,NLAB)
      IF(EOF(8)) 40,50
C
C      50 XCUR=REC(1)
C        YCUR=REC(INDEX)
C        XVAL(IND)=XCUR
C        YVAL(IND)=YCUR
C
C      IND=IND+1
C      IF(IND.GT.1000) CALL ERR(4)
C
C      GO TO 30
C
C COMPUTE C ARRAY
      40 C(1)=0.
C      C(2)=IND-1
C      C(3)=0.
C      C(4)=0.
C      C(5)=-1.
C      C(6)=0.
C      C(7)=1.
C      C(8)=0.
C      C(9)=-1.
C      C(10)=0.
C      C(11)=1.
C      C(12)=0.
C      C(13)=0.
C      C(14)=0.
C      C(15)=1.
C      C(16)=1.
C      C(17)=0.
C      C(18)=3H3AS

```

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[illegible]

1) PRESSURE RISE -P- PSIA
2) ENTHALPY RISE -H- BTU/LBM
3) AUXILIARY POWER -AUXP- KW

INPUTS:	W	PUMP FLOW RATE IN LBM/SEC
	PARM(1)	PUMP HEAD AT DESIGN IN FT.
	(3)	PUMP FLOW AT DESIGN IN LBM/SEC
	(3)	PUMP SPEED AT DESIGN IN RPM
	(4)	PUMP TORQUE AT DESIGN IN FT-LBS
	(5)	ELECTRICAL MOTOR EFFICIENCY

DIMENSION PARM(5)

$$V=W/PARM(2)$$

```
HD=PARM(1)*(1.3-0.3*V*V)
TQ=PARM(4)*(0.5+V*(5/9))
```

$$P = HD / 2.327$$

H=HD/778

```
AUXP=2.26061E-05*PARM(3)*TQ/PARM(5)
```

RETURN
END

```

C      FUNCTION QABS(ISP,ICV,RL13,RL15,RKL17)
C      CALCULATE ABSORBED HEAT FLUX IN SPECIFIED CONTROL VOLUME
C      OF SPECIFIED SUPERPANEL
C
C      EXECUTIVE AND PROGRAM CONTROL DATA
C
C      INTEGER ATIMO,ATIDAY
C      LOGICAL OUTFG,END,DIAG
C      COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1      DIAG(40)
C
C      OUTFG(I,J)  OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
C      END        END OF RUN FLAG
C      ATILCL     LOCAL TIME (SECONDS FROM MIDNIGHT)
C      ATITST     TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
C      ATIMO      MONTH
C      ATIDAY     DAY
C      DIAG       DIAGNOSTIC PRINT FLAG ARRAY
C
C      COLLECTOR SUBSYSTEM DATA
C
C      COMMON /HDATA/ HFLRN(20,8),HCEF(121),HREF,HCFL,XTIST,XTIEND,
1      XVAL,XDIR,XDTC
C
C      HFLRN      HELIOSTAT OUTPUT SOLAR ARRAY FLUX AT RECEIVER NODES
C                  (BTU/SEC)
C      HCEF       HELIOSTAT FIELD CELL EFFICIENCIES (ND)
C      HREF       HELIOSTAT REFLECTIVE EFFICIENCY (ND)
C      HCFL       COLLECTOR FIELD SIZE (FEET)
C      XTIST      START TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD FRONT INTERCEPTS CORNER OF CELL ARRAY
C      XTIEND     END TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD REAR INTERCEPTS CORNER OF CELL ARRAY
C      XVAL       CLOUD VELOCITY (MILES/HOUR)
C      XDIR       CLOUD DIRECTION (DEGREES FROM N TO S DIRECTION)
C                  (0 = N TO S, 90 = W TO E, -90 = E TO W, 180 = S TO N)
C      XDTC       CLOUD UPDATE SCHEDULING INTERVAL (SEC)
C
C      DATA NZ /20/
C      NZ         NUMBER OF HEAT FLUX ZONES.  EACH ZONE IS A HORIZONTAL
C                  BAND ACROSS SUPERPANEL.  ALL ZONES ARE OF EQUAL HEIGHT
C
C      ISPS=ISP
C      ISP=ISP-1
C      IF(ISP.LT.1) ISP=8
C
C      CALCULATE BEGINNING AND ENDING ZONE VALUES FOR REQUESTED
C      CONTROL VOLUME
C      DETERMINE REQUESTED CONTROL VOLUME
C      JCV=ICV/2
C      GO TO (140,160,180), JCV
C      CONTROL VOLUME R2
C
C      140 ZLO=0.0
C          ZHI=NZ*RL13/RKL17
C          GO TO 220
C      CONTROL VOLUME R4

```

```

160 ZLO=NZ*RL13/RKL17
    ZHI=NZ*RL15/RKL17
    GO TO 220
C     CONTROL VOLUME R6
180 ZLO=NZ*RL15/RKL17
    ZHI=NZ
    GO TO 220
C     CALCULATE INTEGRAL ZONE INDICES AND LOW AND HIGH FRACTIONAL
C     REMAINDERS
220 IF (ZLO.LT.0.0) ZLO=0.0
    IF (ZHI.GT.NZ) ZHI=NZ
    QABS=0.0
    IF (ZLO.GT.ZHI) GO TO 340
    JLO=1+INT(ZLO+0.99999999)
    JHI=ZHI
    FLO=(JLO-1)-ZLO
    FHI=ZHI-AINT(ZHI)
C     SUM HEAT FLUX CONTRIBUTIONS OVER INTEGRAL ZONES
    SUM=0.0
    IF (JLO.GT.JHI) GO TO 280
    DO 240 J=JLO,JHI
240 SUM=SUM+HFLRN(NZ-J+1,ISP)
    GO TO 300
280 IF (JLO.EQ.JHI+2) SUM=-HFLRN(NZ-JLO+2,ISP)
C     ADD CORRECTION (IF ANY) FOR LOW AND HIGH FRACTIONAL PANELS TO
C     COMPUTE ABSORBED HEAT FLUX
300 CLO=0.0
    IF (JLO.LE.1) GO TO 310
    CLO=FLO*HFLRN(NZ-JLO+2,ISP)
310 CHI=0.0
    IF (JHI.GE.NZ) GO TO 320
    CHI=FHI*HFLRN(NZ-JHI,ISP)
320 QABS=SUM+CLO+CHI
C
340 ISP=ISPS
C     GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
    IF (DIAG(14)) WRITE (6,345)
1   ISP,ICV,NZ,JCV,JLO,JHI,RL13,RL15,RKL17,
2   ZLO,ZHI,FLO,FHI,SUM,CLO,CHI,QABS
345 FORMAT(1H ,3X,13HDIAG14/QABS ,6I3,2X,7G10.4/(1H ,16X,9G10.4))
C
    RETURN
    END

```

```

      SUBROUTINE READPL(END)
C
C SUBROUTINE READPL READS A PLOT SPECIFICATION
C
      LOGICAL END
C
      COMMON /PLTBLK/ NLAB,VAR(100),RLABEL(100,5),BUF(7),
C                   NCR,VARC,REC(100),
C                   XVAL(1000),YVAL(1000),C(18),D(18),E(41)
C
C      VARC          CURRENT VARIABLE
C
C
C TEST FOR END CARD
      END=.FALSE.
      IF(BUF(1).NE.3HEND) GO TO 5
C
C TERMINATE PROGRAM
      CALL ENPLOT(A)
      END=.TRUE.
      RETURN
C
C INITIALIZE NUMBER OF CARDS READ IN
      5 NCR=1
C
C      COMPUTE VARC
      VARC=BUF(1)
C
C TRANSFER CONTENTS OF INPUT BUFFER TO E ARRAY
      10 DO 20 I=1,6
      20 E(6*NCR+I-2)=BUF(I+1)
C
C READ CARD INTO INPUT BUFFER
      READ(5,1000) (BUF(I),I=1,7)
      1000 FORMAT(7A10)
C
C IS CARD EITHER (1) START OF A NEW PLOT REQUEST OR (2) AN END CARD
      IF(BUF(1).NE.10H          ) GO TO 30
C
C INCREMENT NCR
      NCR=NCR+1
C
C ARE THERE TOO MANY PLOT REQUEST CARDS
      IF(NCR.GT.6) CALL ERR(2)
C
      GO TO 10
C
      30 E(6*NCR+5)=0.
      RETURN
      END

```

```

      SUBROUTINE READVL
C
C SUBROUTINE READVL READS THE VARIABLES/LABELS DECK
C
      COMMON /PLTBLK/ NLAB,VAR(100),RLABEL(100,5),BUF(7),
C              .NCR,VARC,REC(100),
C              XVAL(1000),YVAL(1000),C(18),D(18),E(41)
C
C
C INITIALIZE NLAB
      NLAB=0
C
C READ CARD INTO INPUT BUFFER
      10 READ(5,1000) (BUF(I),I=1,6)
      1000 FORMAT(6A10)
C
C WAS END CARD READ
      IF(BUF(1).EQ.3HEND) GO TO 30
C
C INCREMENT NLAB
      NLAB=NLAB+1
C
C ARE THERE TOO MANY VARIABLE/LABEL CARDS
      IF(NLAB.GT.100) CALL ERR(1)
C
C TRANSFER CONTENTS OF INPUT BUFFER TO VAR AND RLABEL ARRAYS
      VAR(NLAB)=BUF(1)
C
      DO 20 I=1,5
      20 RLABEL(NLAB,I)=BUF(I+1)
C
      GO TO 10
C
C TERMINATE SUBROUTINE
      30 RETURN
      END

```


SUBROUTINE RECFEED(GPFP,GTFP,GHFP)

PURPOSE OF THIS SECTION OF CODE - COMPUTE

1. FEEDWATER PRESSURE
2. TEMPERATURE AND
3. ENTHALPY AT
PREHEATER AND DESUPERHEATER INLET
4. AUXILIARY POWER NEEDED BY RECEIVER
PUMPS

INPUT VARIABLES

1. RECEIVER MASS FLOW RATE IN
2. DESUPERHEATER MASS FLOW RATE IN
3. TEMPERATURE, PRESSURE AND ENTHALPY
OUTPUT OF FEEDWATER HEATER NO. 1

ALSO REQUIRED ARE GAIN, EFFICIENCY AND
SPEED OF THE PUMP. PUMP SPEED IS A STATE
VARIABLE.

EXECUTIVE AND PROGRAM CONTROL DATA

INTEGER ATIMO,ATIDAY
LOGICAL OUTFG,END,DIAG
COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1 DIAG(40)

OUTFG(I,J) OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
END END OF RUN FLAG
ATILCL LOCAL TIME (SECONDS FROM MIDNIGHT)
ATITST TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
ATIMO MONTH
ATIDAY DAY
DIAG DIAGNOSTIC PRINT FLAG ARRAY

ENVIRONMENTAL DATA

COMMON /EDATA/ ETEAMB,EPRAMB,EVWAMB,EINDIR,EDWAMB,ETDAMB

ETEAMB AMBIENT TEMPERATURE (DEGREES FAHRENHEIT)
EPRAMB AMBIENT PRESSURE (LB/SQ IN ABS)
EVWAMB AMBIENT WIND VELOCITY (FT/SEC)
EINDIR DIRECT INSOLATION (KILOWATTS/SQ METER)
EDWAMB WIND DIRECTION (DEGREES AZIMUTH)
ETDAMB DEW POINT TEMPERATURE (DEGREES FAHRENHEIT)

RECEIVER SUBSYSTEM DATA

RECVR VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)

INTEGER RCVST,RAFLGC
COMMON /RDATA/ RHISH(6),RWISH(6),RHSR,RPPSH,RTESH,RWOSH,RFMV(6),
1 RLV(6),RHIV,RPRIV,RFRISV,RFROSV,RVIV,RHOV(6),RPROV(6),RWV(6),
2 RWVSUM,RHF1(8),RPRF1(8),RTEF1(8),RUF1(8),RVF1(8),RHCF2(8),

3 RHF2(8),RPRF2(8),RQF2(8),RTEF2(8),RTEFF2(8),RUF2(8),RVF2(8),
 4 RWF2(8),RHCM2(8),RHFCM2(8),RHFRM2(8),RQM2(8),RQAM2(8),RQCM2(8),
 5 RQEM2(8),RPRF3(8),RTEF3(8),RUF3(8),RVF3(8),RHCF4(8),RHN3F4(8),
 6 RHFBF4(8),RHF4(8),RPRF4(8),RQF4(8),RTEF4(8),RTEFF4(8),RUF4(8),
 7 RVF4(8),RWF4(8),RHCM4(8),RHFCM4(8),RHFRM4(8),RQM4(8),RQAM4(8),
 8 RQCM4(8),RQEM4(8),RPRF5(8),RTEF5(8),RUF5(8),RVF5(8),RXF5(8),
 9 RHCF6(8),RHF6(8),RPRF6(8),RQF6(8),RTEF6(8),RTEFF6(8),RUF6(8),
 A RVF6(8),RWF6(8),RHCM6(8),RHFCM6(8),RHFRM6(8),RQM6(8),RQAM6(8),
 B RQCM6(8),RQEM6(8),RHF7(8),RPRF7(8),RTEF7(8),RUF7(8),RVF7(8),
 C RUF8(8),RVFSAT(8),RUVSAT(8),RVVSAT(8),RL35(8),RL57(8),RWSP(8),
 D RCVST(8),RAFLGC(6),RERPTC(6),RLPROC(6),RLSUMC(6),RTSETC

C
 C RHISH(ISP) FLUID ENTHALPY AT STEAM HEADER INLET
 C (BTU/LBM)
 C
 C RWISH(ISP) FLUID MASS FLOW RATE AT STEAM HEADER INLET
 C (LBM/SEC)
 C
 C RSHH FLUID ENTHALPY IN STEAM HEADER
 C (BTU/LBM)
 C
 C RFRSH FLUID PRESSURE IN STEAM HEADER
 C (PSIA)
 C
 C RTESH FLUID TEMPERATURE IN STEAM HEADER
 C (DEGREES F)
 C
 C RWOSH FLUID MASS FLOW RATE AT STEAM HEADER OUTLET
 C (LBM/SEC)
 C
 C RFMV(IV) MODIFIED FRICTION FLOW COEFFICIENT FOR FLOW
 C CONTROL VALVE (PSI,SEC**2/LBM,CU FT)
 C
 C RLV(IV) STEM DISPLACEMENT OF FLOW CONTROL VALVE
 C (PERCENT)
 C
 C RHIV FLUID ENTHALPY AT FLOW CONTROL VALVE INLETS
 C (BTU/LBM)
 C
 C RPRIV FLUID PRESSURE AT FLOW CONTROL VALVE INLETS
 C (PSIA)
 C
 C RPRISV FLUID PRESSURE AT RECEIVER SUBSYSTEM INLET
 C (PSIA)
 C
 C RPROSV FLUID PRESSURE AT RECEIVER SUBSYSTEM OUTLET
 C (PSIA)
 C
 C RVIV FLUID SPECIFIC VOLUME AT FLOW CONTROL VALVE INLETS
 C (CU FT/LBM)
 C
 C RHOV(IV) FLUID ENTHALPY AT FLOW CONTROL VALVE OUTLET
 C (BTU/LBM)
 C
 C RFROV(IV) FLUID PRESSURE AT FLOW CONTROL VALVE OUTLET
 C (PSIA)
 C
 C RWV(IV) FLUID MASS FLOW RATE THROUGH FLOW CONTROL VALVE
 C (LBM/SEC)
 C
 C RWVSUM FLUID MASS FLOW RATE THROUGH ALL FLOW CONTROL VALVES
 C (LBM/SEC)
 C
 C RHF1(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 1
 C (BTU/LBM)
 C
 C RPRF1(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 1
 C (PSIA)
 C
 C RTEF1(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 1
 C (DEGREES F)
 C
 C RUF1(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 1
 C (BTU/LBM)
 C
 C RVF1(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 1
 C (CU FT/LBM)
 C
 C RHCF2(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C
 C RHF2(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 2
 C (BTU/LBM)

C RPRF2(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 2
 C (PSIA)
 C RQF2(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RTEF2(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 C (DEGREES F)
 C RTEFF2(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 C (DEGREES F)
 C RUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
 C (BTU/LBM)
 C RVF2(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 2
 C (CU FT/LBM)
 C RWF2(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 2 (LBM/SEC)
 C RHCM2(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFCM2(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFRM2(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RQM2(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQAM2(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQCM2(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQEM2(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RPRF3(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 3
 C (PSIA)
 C RTEF3(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 3
 C (DEGREES F)
 C RUF3(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RVF3(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 3
 C (CU FT/LBM)
 C RHCF4(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHBNF4(ISP) INTERNAL NUCLEATE BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHBF4(ISP) INTERNAL FILM BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHF4(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RPRF4(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 4
 C (PSIA)
 C RQF4(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RTEF4(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RTEFF4(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RUF4(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RVF4(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 4
 C (CU FT/LBM)
 C RWF4(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 4 (LBM/SEC)
 C RHCM4(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)

C RHFCM4(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFRM4(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RQM4(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQAM4(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQCM4(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQEM4(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RPRF5(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 5
 C (PSIA)
 C RTEF5(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 5
 C (DEGREES F)
 C RUF5(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RVF5(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 5
 C (CU FT/LBM)
 C RXF5(ISP) FLUID QUALITY AT SUPERPANEL NODE NUMBER 5
 C (PERCENT)
 C RHCF6(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHF6(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RPRF6(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 6
 C (PSIA)
 C RQF6(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RTEF6(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RTEFF6(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RUF6(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RVF6(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 6
 C (CU FT/LBM)
 C RWTf6(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 6 (LBM/SEC)
 C RHCM6(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFCM6(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFRM6(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RQM6(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQAM6(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQCM6(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQEM6(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RHF7(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RPRF7(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 7
 C (PSIA)
 C RTEF7(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 7
 C (DEGREES F)

C RUF7(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RVF7(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 7
 C (CU FT/LBM)
 C RUF SAT(ISP) INTERNAL ENERGY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RVF SAT(ISP) SPECIFIC VOLUME OF A SATURATED LIQUID
 C (CU FT/LBM)
 C RUVSAT(ISP) INTERNAL ENERGY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RVVSAT(ISP) SPECIFIC VOLUME OF A SATURATED VAPOR
 C (CU FT/LBM)
 C RL35(ISP) LENGTH OF SUPERPANEL TWO-PHASE MIXTURE SECTION
 C (FEET)
 C RL57(ISP) LENGTH OF SUPERPANEL SUPERHEATED SECTION
 C (FEET)
 C RWSP(ISP) FLUID MASS FLOW RATE THROUGH SUPERPANEL
 C (LBM/SEC)
 C RCVST(ISP) SUPERPANEL FLUID CONTROL VOLUME STATE
 C RCVST = 1 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
 C FLUID STATES ONLY
 C RCVST = 2 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
 C AND SATURATED FLUID STATES
 C RCVST = 3 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED,
 C SATURATED, AND SUPERHEATED FLUID STATES
 C RAFLGC(IC) CONTROLLER ACTIVATION FLAG
 C RAFLGC = 1 SIGNIFIES RTSENC .LT. RKTHSC
 C RAFLGC = 2 SIGNIFIES RTSENC .GT. RKTHSC
 C RERRTC(IC) CONTROLLER TEMPERATURE ERROR SIGNAL
 C (DEGREES F)
 C RLPROC(IC) CCNTROLLER PROPORTIONAL SIGNAL OF VALVE STEM
 C DISPLACEMENT (PERCENT)
 C RLSUMC(IC) CONTROLLER COMMAND SIGNAL OF VALVE STEM DISPLACEMENT
 C (PERCENT)
 C RTSETC CONTROLLER SET POINT FOR RECEIVER SUBSYSTEM OUTLET
 C TEMPERATURE (DEGREES F)
 C
 C
 C THERMAL STORAGE SUBSYSTEM DATA
 C
 C TSS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)
 C
 C COMMON /TDATA/ TP1,TP4,TH1,TH2,TH3,TH4,TH9,TW1,TW1A,TW1M,TW2,TW3,
 1 TW5A,TW7A,TWE,TKDSH,TKTSH,TKSG,TPPC,TPPE,TPPT,TFC,TFE,TK1,TK2,
 2 TK3,TK4,TCONC,TCONE,TLT,TFLAGU,TFLAGL
 C
 C TP1 PRESSURE OF STEAM INTO DESUPERHEATER,
 C AND PRESSURE OF DESUPERHEATED STEAM (PSIA)
 C TP4 PRESSURE OF WATER FROM STORAGE HEATER (PSIA)
 C TH1 ENTHALPY OF STEAM INTO DESUPERHEATER (BTU/LBM)
 C TH2 ENTHALPY OF WATER INTO DESUPERHEATER (BTU/LBM)
 C TH3 ENTHALPY OF STEAM FROM DESUPERHEATER (BTU/LBM)
 C TH4 ENTHALPY OF WATER FROM STORAGE HEATER (BTU/LBM)
 C TH9 ENTHALPY OF WATER INTO STEAM GENERATOR (BTU/LBM)
 C TW1 STEAM FLOW AVAILABLE TO DESUPERHEATER (LBM/SEC)
 C TW1A ACTUAL STEAM FLOW TO DESUPERHEATER (LBM/SEC)
 C TW1M MAXIMUM STEAM FLOW TO DESUPERHEATER (LBM/SEC)
 C TW2 WATER FLOW TO DESUPERHEATER (LBM/SEC)
 C TW3 STEAM FLOW FROM DESUPERHEATER (LBM/SEC)
 C TW5A ACTUAL OIL FLOW INTO STORAGE (LBM/SEC)

C TH7A ACTUAL OIL FLOW FROM STORAGE (LBM/SEC)
 C TWE CONTROLLER SET POINT FOR STEAM GENERATOR STEAM FLOW
 C (LBM/SEC)
 C TKDSH FLOW RATE GAIN FACTOR OF DESUPERHEATER (RECIPROCAL
 C OF SPECIFIC ENTHALPY LOSS FACTOR) (DIMENSIONLESS)
 C TKTSH RATIO OF SPECIFIC ENTHALPY GAIN OF OIL TO SPECIFIC
 C ENTHALPY LOSS OF STEAM IN THERMAL STORAGE HEATER
 C (DIMENSIONLESS)
 C TMSG RATIO OF SPECIFIC ENTHALPY GAIN OF WATER TO
 C SPECIFIC ENTHALPY LOSS OF OIL IN STEAM GENERATOR
 C (DIMENSIONLESS)
 C TPPC CHARGING OIL PUMPING POWER (WATTS)
 C TPPE EXTRACTION OIL PUMPING POWER (WATTS)
 C TPPT THERMAL STORAGE SUBSYSTEM TOTAL PUMPING POWER (WATTS)
 C TFC FRACTION OF MAX. CHARGING OIL FLOW (DIMENSIONLESS)
 C TFE FRACTION OF MAX. EXTRACTION OIL FLOW (DIMENSIONLESS)
 C TK1 Y INTERCEPT OF CHARGING PUMP POWER CURVE (WATTS)
 C TK2 SLOPE OF CHARGING PUMP POWER CURVE (WATTS/LBM/SEC)
 C TK3 Y INTERCEPT OF EXTRACTION PUMP POWER CURVE (WATTS)
 C TK4 SLOPE OF EXTRACTION PUMP POWER CURVE (WATTS/LBM/SEC)
 C TCONC NUMBER OF CHARGING PUMPS OPERATING IN LAST TIME
 C INTERVAL (DIMENSIONLESS)
 C TCONE NUMBER OF EXTRACTION PUMPS OPERATING IN LAST TIME
 C INTERVAL (DIMENSIONLESS)
 C TLT FRACTIONAL POSITION OF THERMOCLINE (DIMENSIONLESS)
 C TFLAGU 2 IS NORMAL, 0 CUTS OFF CHARGING, 1 WARNS OF
 C OVERCHARGING AND PREVENTS START OF CHARGING
 C TFLAGL 2 IS NORMAL, 0 CUTS OFF EXTRACTION, 1 WARNS OF
 C DEPLETION AND PREVENTS START OF EXTRACTION

ELECTRICAL POWER GENERATION SUBSYSTEM DATA

EPGS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)

COMMON /GDATA/ GPT3, GLT3, GWSOT3, GHSOT3, GWSBDC, GPSBDC, GTSBDC,
 1 GHLOSSD, GHSRG, GHSRT, GHSTSG, GPSTSG, GTSTSG, GPT1, GHSTH1, GHSTH1,
 2 GPT2, GHSTH2, GHSTH2, GHCT2, GLT2, GHCTC, GHCTH3, GHCTH5, GHTALP,
 3 GWTEXH, GPTEXH, GHTEXH, GWTEXT(4), GPTEXT(4), GHTEXT(4), GTPower,
 4 GEPOUT, GHLOSSR, GTFPR, GFOUT, GHOUTP, GFPAUX, GWFPT, GFPH, GFPT, GTDSI,
 5 GFCTSG, CTCTSG, GHLOSSD, GHLOTS, GTAUXP, APBP, APHP, GHHTRI, GPHTRI,
 6 GHTRI, GPSH1, GHSH1, GPSH2, GHSH2, GHCH4C, GHCH5C, GHCH23, GHCH12

C GPT3 PRESSURE (PSIA) IN TANK 3 (RECVR FLASH TANK)
 C GLT3 CONDENSATE LEVEL (FT.) IN TANK 3
 C GWSOT3 FLOW (LBM/SEC) OF STEAM OUT OF TANK 3
 C GHSOT3 ENTHALPY (BTU/LBM) OF STEAM OUT OF TANK 3
 C GWSBDC FLOW (LBM/SEC) OF STEAM AT BOTTOM OF DOWNCOMER
 C GPSBDC PRESSURE (PSIA) OF STEAM AT BOTTOM OF DOWNCOMER
 C GTSBDC TEMPERATURE (F) OF STEAM AT BOTTOM OF DOWNCOMER
 C GHLOSSD HEAT LOSS (BTU/HR) FROM DOWNCOMER
 C GHSRG FLOW (LBM/SEC) OF RECVR STEAM TO TURBINE MAIN THROTTLE
 C GHSRT FLOW (LBM/SEC) OF RECVR STEAM TO THERMAL STORAGE
 C GHSTSG STEAM FLOW (LBM/SEC) AT TURBINE ADMISSION PORT
 C GPSTSG PRESSURE (PSIA) STEAM AT TURBINE ADMISSION PORT
 C GTSTSG TEMP (F) STEAM AT TURBINE ADMISSION PORT
 C GPT1 PRESSURE (PSIA) IN TANK 1 (TSS DRAIN SYS)
 C GHSTH1 STEAM FLOW (LBM/SEC) TO F.W. HEATER 1 FROM TSS DRAIN
 C GHSTH1 ENTHALPY (BTU/LBM) TO F.W. HEATER 1 FROM TSS DRAIN
 C GPT2 PRESSURE (PSIA) IN TANK 2 (TSS DRAIN SYS)

C	GWSTH2	STEAM FLOW (LBM/SEC) TO F.W. HEATER 2 FROM TSS DRAIN
C	GHSTH2	ENTHALPY (BTU/LBM) TO F.W. HEATER 2 FROM TSS DRAIN
C	GHCIT2	ENTHALPY (BTU/LBM) CONDENSATE INTO TANK 2
C	GLT2	CONDENSATE LEVEL (FT) IN TANK 2
C	GWCTC	CONDENSATE FLOW (LBM/SEC) TO CONDENSER FROM TSS DRAIN
C	GWCTH3	CONDENSATE FLOW (LBM/SEC) TO F.W. HEATER 3 FROM TSS
C	GWCTH5	CONDENSATE FLOW (LBM/SEC) TO F.W. HEATER 5 FROM TSS
C	GWALP	TURBINE APPARENT LP STEAM FLOW (LBM/SEC)
C	GWTEXH	TURBINE EXHAUST FLOW (LBM/SEC)
C	GPTEXH	TURBINE EXHAUST PRESSURE (PSIA)
C	GHTEXH	TURBINE EXHAUST ENTHALPY (BTU/LBM)
C	GWTEXT(4)	TURBINE EXTRACTION FLOWS (LBM/SEC)
C	GPTEXT(4)	TURBINE EXTRACTION PRESSURES (PSIA)
C	GHTEXT(4)	TURBINE EXTRACTION ENTHALPIES (BTU/LBM)
C	GTPOWER	THERMAL AVAILABILITY (BTU/SEC)
C	GEFOUT	ELECTRICAL POWER (MEGA-WATTS)
C	GHLOSSR	RISER HEAT LOSSES (BTU/HR)
C	GTFFR	RECVR INLET TEMPERATURE (F)
C	GPOUT	RECVR FEED PUMP OUTPUT PRESSURE (PSIA)
C	GHCUTP	RECVR FEED PUMP OUTPUT ENTHALPY (BTU/LBM)
C	GFPAX	RECVR FEED PUMP AUX POWER (KW)
C	GWFT	TOTAL RECVR FEED PUMP FLOW (LBM/SEC)
C	GFPH	RECVR FEED PUMP HEAD (FT)
C	GFPT	RECVR FEED PUMP TORQUE (FT-LBS)
C	GTDSI	F.W. TEMPERATURE (F) AT DESUPERHEATER INLET
C	GPCTSG	PRESSURE (PSIA) AT TSS STEAM GENERATOR INLET
C	GTCTSG	TEMPERATURE (F) AT TSS STEAM GENERATOR INLET
C	GHLOSSS	HEAT LOSS (BTU/HR) IN DESUPERHEATER FW PIPE
C	GHLOTSG	HEAT LOSS (BTU/HR) IN TSS STEAM GENERATOR FW PIPE
C	GTAUXP	TOTAL AUX POWER (KW) REQUIRED BY FEEDWATER PUMPS
C	AFBP	AUX POWER (KW) REQUIRED BY BOOST PUMP
C	APHF	AUX POWER (KW) REQUIRED BY HOTWELL PUMP
C	GHHTR1	ENTHALPY (BTU/LBM) OF WATER IN HEATER 1
C	GFHTR1	PRESSURE (PSIA) OF WATER IN HEATER 1
C	GTHTR1	TEMPERATURE (F) OF WATER IN HEATER 1
C	GPSH1	PRESSURE (PSIA) OF STEAM TO HEATER 1
C	GHS1	ENTHALPY (BTU/LBM) OF STEAM TO HEATER 1
C	GPSH2	PRESSURE (PSIA) OF STEAM TO HEATER 2
C	GHS2	ENTHALPY (BTU/LBM) OF STEAM TO HEATER 2
C	GHCH4C	ENTHALPY (BTU/LBM) OF HEATER 4 CONDENSATE DRAIN
C	GHCH5C	ENTHALPY (BTU/LBM) OF HEATER 5 CONDENSATE DRAIN
C	GHCH23	ENTHALPY (BTU/LBM) OF HEATER 2 CONDENSATE DRAIN
C	GHCH12	ENTHALPY (BTU/LBM) OF HEATER 1 CONDENSATE DRAIN

EPGS CONSTANTS

COMMON /GCDATA/ GMVR(4),GMVT(2),GMVE(4),VRATE(12),GMVR0(4),
 1 GMVT0(2),GMVE0(4),SSP(12),TZERO(3),GPSPT3,GETAT3,GLZT3,
 2 GKLC3,GPSPT1,GMCT1,GPSPT2,GETAT2,GLZT2,GKLC2,GRIDC,
 3 GRODC,GLDC,GTG,GRISP,GROSP,GLSPTG,NFORTS,IFAN,GPTD(4),
 4 GTEFF,GPHRD(3,6),GPHRD(3),GTHRD(6),GEMEFT,GKEFF,GKGAIN,
 5 GKINERT,GPFERSP,GPFHR,GFPSR,GHFFR,GFPTR,GVFFR,GRIRC,GRORC,
 6 GLRC,GRIDS,GRODS,GLDESP,GPFPS,GLFWP,GRIFWP,GROFWP,TNOM,
 7 VNOM,BPUMP(5),HFUMP(5),H1PARM(3),H2PARM(3),H4PARM(3),
 8 H5PARM(3),GMCH3,GMCHW

C		
C	GMVR(4)	SETTING OFR EPGS SERVO-CONTROLLED VALVES R1-R4
C		RANGE IS 0. TO 1.0
C	GMVT(2)	SETTING FOR EPGS SERVO-CONTROLLED VALVES T1 AND T2

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C      RANGE IS 0. TO 1.0
C      GMVE(4)  SETTING FOR EPGS SERVO-CONTROLLED VALVES E1-E4
C      RANGE IS 0. TO 1.0
C      VRATE(10) MAX RATE FOR VALVES TO MOVE FROM OPEN TO CLOSE
C      POSITONS
C      GMVR0(4)  VALVE SETTING FOR R1-R4 AT TIME TZERO(1)
C      GMVT0(2)  VALVE SETTING FOR T1-T2 AT TIME TZERO(2)
C      GMVE0(4)  VALVE SETTING FOR E1-E4 AT TIME TZERO(3)
C      TZERO(3)  LAST TIME SET POINT WAS CHANGED (SEC)
C      SSP(11)   SAVE SP(11) FROM COMMON BLOCK /CDATA/
C      GPSPT3    PRESSURE (PSIA) SET POINT FOR TANK 3 (RECVR FLASH )
C      GETAT3    SIZING CONSTANT FOR TANK 3 (MAX LEVEL DIVIDED BY
C      MAX OUTPUT FLOW RATE)
C      GLZT3     NOMINAL WATER LEVEL (FT) FOR TANK 3
C      GKLC3     CONSTANT FOR LEVEL CONTROL IN TANK 3
C      GPSPT1    PRESSURE (PSIA) SET POINT FOR TANK 1 (TSS DRAIN SYS)
C      GMCT1     MASS(LEM) OF CONDENSATE IN TANK 1
C      GPSPT2    PRESSURE (PSIA) SET POINT FOR TANK 2 (TSS DRAIN SYS)
C      GETAT2    SIZING CONSTANT FOR TANK 2 (MAX LEVEL / MAX FLOW)
C      GLZT2     NOMINAL WATER LEVEL (FT) IN TANK 2
C      GKLC2     LEVEL CONTROL GAIN FOR TANK 2
C      GRISP     INSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
C      GROSP     OUTSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
C      GLSPTG    LENGTH (FT) OF STEAM PIPE (TSS TO EPGS)
C      GRIDC     INSIDE RADIUS (FT) OF DOWNCOMER
C      GRODC     OUTSIDE RADIUS (FT) OF DOWNCOMER
C      GTC       THERMAL CONDUCTIVITY OF DOWNCOMER INSULATION
C      (BTU/HR-FT-DEG R)
C      GLDC      LENGTH OF DOWNCOMER IN FEET
C      NPORTS    NUMBER OF TURBINE EXTRACTION PORTS
C      IFAN      COOLING TOWER FAN CONDITIONS  1  2 FANS FULL SPEED
C      2  1 HALF 1 FULL
C      3  2 FANS HALF SPEED
C      GPTED(4)  EXTRACTION PRESSURE (PSIA) PER UNIT OF APPARENT LP
C      FLOW (LBM/SEC)
C      GTEFF     TURBINE/GENERATOR EFFICIENCY
C      GPHRD(3,6) CONDENSER PRESSURE (PSIA) AT GWHRD(3) AND GTHRD(6)
C      GWHRD(3)  CONDENSER FLOW (LEM/HR) DATA AT 3 DIFFERENT VALUES
C      GTHRD(6)  AMBIENT TEMP. (F) DATA AT 6 DIFFERENT VALUES
C      GEMEFFF   ELECTRO-MECHANICAL EFFICIENCY OF RECVR FEEDPUMP
C      GKEFF     FEED PUMP EFFICIENCY
C      GKGAIN    FEED PUMP CONTROL GAIN
C      GKINERT   FEED PUMP MOMENT OF INERTIA
C      GPFERSP   RECVR INLET PRESSURE (PSIA) SET POINT
C      GFPHR     FEED PUMP RATED HEAD (FT)
C      GFPSR     FEED PUMP RATED SPEED (RPM)
C      GWFPR     FEED PUMP RATED FLOW (LBM/SEC)
C      GFPTR     FEED PUMP RATED TORQUE (FT-LBS)
C      GVFFR     SPECIFIC VOLUME (FT**3/LBM) AT RATED CONDITIONS
C      GRIRC     INSIDE RADIUS (FT) OF RISER
C      GRCRC     OUTSIDE RADIUS (FT) OF RISER
C      GLRC      LENGTH (FT) OF RISER
C      GRIDS     INSIDE RADIUS (FT) OF FW PIPE FEED PUMP TO DESUPHRTTR
C      GRODS     OUTSIDE RADIUS (FT)  FW PIPE FEED PUMP TO DESUPHRTTR
C      GLDESP    LENGTH (FT) OF FW PIPE FEED PUMP TO DESUPERHRTTR
C      GFFPSP    RECVR INLET PRESSURE (PSIA) SET POINT
C      GLFWP     LENGTH (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
C      GRIFWP    INNER RADIUS (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
C      BFUMP(5)  PARAMETERS FOR BOOST PUMP (SEE ROUTINE PUMPSS)
C      HPUMP(5)  PARAMETERS FOR HOTWELL PUMP (SEE ROUTINE PUMPSS)

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C      H1PARM(3)  PARAMETERS FOR HEATER 1 (SEE ROUTINE CFWHTR)
C      H2PARM(3)  PARAMETERS FOR HEATER 2 (SEE ROUTINE CFWHTR)
C      H4PARM(3)  PARAMETERS FOR HEATER 4 (SEE ROUTINE CFWHTR)
C      H5PARM(3)  PARAMETERS FOR HEATER 5 (SEE ROUTINE CFWHTR)
C      GMCH3      MASS OF CONDENSATE (LBM) STORED IN HEATER 3
C      GROFWP     OUTER RADIUS (FT) OF FW PIPE EGGS TO TSS STEAM GEN.
C      GMCHW      MASS OF CONDENSATE (LBM) STORED IN CONDENSER HOTWELL
C      TNOM       NOMINAL TEMP (F) OF AIR SURROUNDING FW SYS COMPONENTS
C      VNOM       NOMINAL AIR VELOCITY (FT/SEC) ABOUT FW SYS COMPONENTS
C                  (NORMALLY SET TO ZERO)
C
C
C
C
C      GASP-IV SIMULATION SYSTEM DATA
C
C      COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
INAFD,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NFRNT,PPARM(50,4),TNOW,TTBEG
2,TTCLR,TTFIN,TTRIB(25),TTSET
C
C      COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
1,NEEQD,NEEQS,NEEQT,SS(600),SSL(600),TTNEX
C
C      DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
1  RLINTC(6),RL15(8),RHFSAT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
2  RDIUF2(8),RDL13(8),RDTEM2(8),RDIHF3(8),RDTEM4(8),RDTEM6(8),
3  RDLINTC(6)
C
C      EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
1  (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
2  (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
3  (TW5,SS(83)),(TW7,SS(84)),(TW3,SS(85)),
4  (THTSU,SS(86)),(GMCT3,SS(87)),(GHDCOT3,SS(88)),
5  (GHDCOT3,SS(89)),(GHSDDC,SS(90)),(GHSTSG,SS(91)),
6  (GHDCOT1,SS(92)),(GHDCOT2,SS(93)),(GHCT2,SS(94)),
7  (GHDCOT2,SS(95)),(GFPS,SS(96)),(GHRCI,SS(97)),
8  (GHDSI,SS(98)),(GHDCCH3,SS(99)),(GHCTSG,SS(100)),
9  (GHCHW,SS(101)),
A  (RL15(1),SS(102)),(RHFSAT(1),SS(110)),(RHF3(1),SS(118)),
B  (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
C  (CPFRSH,SS(151)),(CRTESH,SS(152)),(CGPFFR,SS(153)),
D  (CTLT,SS(154)),
E  (GPFFR,SS(161)),(GPDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
F  (XK3,SS(165))
C
C      EQUIVALENCE (RDIUF2(1),DD(1)),(RDL13(1),DD(9)),(RDTEM2(1),DD(17)),
1  (RDIHF3(1),DD(25)),(RDTEM4(1),DD(33)),(RDTEM6(1),DD(41)),
2  (ROUSH,DD(49)),(ROVSH,DD(50)),(RDLINTC(1),DD(51)),
3  (TDW5,DD(83)),(TDW7,DD(84)),
4  (TDW8,DD(85)),(TDHTSU,DD(86)),(GMDCOT3,DD(87)),
5  (GHDCOT3,DD(88)),(GHDCOT3,DD(89)),(GHSDSDC,DD(90)),
6  (GHSTSG,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),
7  (GHDCOT2,DD(94)),(GHDCOT2,DD(95)),(GDFPS,DD(96)),
8  (GHDCI,DD(97)),(GHDSI,DD(98)),(GHDCCH3,DD(99)),
9  (GHDCOTSG,DD(100)),(GHCHW,DD(101))
C
C
C      INTEGRATED STATE VARIABLES
C
C      RIUF2(ISP)  FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
C                  (BTU/LEM)
C      RL13(ISP)  LENGTH OF SUPERPANEL SUBCOOLED SECTION
C                  (FEET)

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C RTEM2(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 C (DEGREES F)
 C RIHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RTEM4(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RTEM6(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RUSH FLUID INTERNAL ENERGY IN STEAM HEADER
 C (BTU/LBM)
 C RVSH FLUID SPECIFIC VOLUME IN STEAM HEADER
 C (CU FT/LBM)
 C RLINTC(IC) CONTROLLER INTEGRAL SIGNAL OF VALVE STEM DISPLACEMENT
 C (PERCENT)
 C
 C TW5 NOMINAL OIL FLOW INTO STORAGE (LBM/SEC)
 C TW7 NOMINAL OIL FLOW FROM STORAGE (LBM/SEC)
 C TN8 STEAM FLOW FROM STEAM GENERATOR (LBM/SEC)
 C THTSU HEAT STORED IN THERMAL STORAGE UNIT (BTU)
 C
 C GMCT3 CONDENSATE MASS (LBM) IN TANK 3 (RECVR FLASH TANK)
 C GHCOT3 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 3
 C GHCOT3 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 3
 C GHSSDC ENTHALPY (BTU/LBM) OF STEAM AT BOTTOM OF DOWNCOMER
 C GHSTSG ENTHALPY (BTU/LBM) OF ADMISSION STEAM
 C GHCOT1 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 1
 C GHCOT2 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 2
 C GMCT2 MASS (LBM) OF CONDENSATE IN TANK 2
 C GHCOT2 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 2
 C GFPS RECVR FEED PUMP SPEED (RPM)
 C GHRCI F.W. ENTHALPY (BTU/LBM) AT RECVR INLET
 C GHDSI F.W. ENTHALPY (BTU/LBM) AT DESUPERHEATER INLET
 C GHCOH3 F.W. ENTHALPY (BTU/LBM) OUT OF FW HRTR NO. 3
 C GHCTSG ENTHALPY (BTU/LBM) AT TSS STEAM GEN. INLET
 C GHCHW ENTHALPY (BTU/LBM) OF CONDENSATE IN CONDENSER HOTWELL
 C
 C ADDITIONALLY REQUIRED GASP-IV STATE VARIABLES
 C
 C RL15(ISP) COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND
 C TWO-PHASE MIXTURE SECTIONS (FEET)
 C RHFSAT(ISP) ENTHALPY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RHVSAT(ISP) ENTHALPY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RHF5(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RTSENC(IC) CONTROLLER TEMPERATURE SENSOR SIGNAL OF BOILER
 C SUPERPANEL OUTLET TEMPERATURE (DEGREES F)
 C CRFRSH FLUID PRESSURE IN RECEIVER STEAM HEADER
 C (PSIA)
 C CRTESH FLUID TEMPERATURE IN RECEIVER STEAM HEADER
 C (DEGREES F)
 C CGPFPR FLUID PRESSURE AT RECEIVER INLET
 C (PSIA)
 C CTLT POSITION OF TSS THERMOCLINE
 C (PERCENT)
 C GPFPR FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
 C GFDISI FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)

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C      XK1,XK2,XK3 EPGS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND
C      PRESSURE AT RECEIVER INLET
C
C      TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES
C
C      RDIUF2(ISP) TIME DERIVATIVE OF RIUF2(ISP)
C      RDL13(ISP) TIME DERIVATIVE OF RL13(ISP)
C      RDTM2(ISP) TIME DERIVATIVE OF RTEM2(ISP)
C      RDIHF3(ISP) TIME DERIVATIVE OF RIHF3(ISP)
C      RDTM4(ISP) TIME DERIVATIVE OF RTEM4(ISP)
C      RDTM6(ISP) TIME DERIVATIVE OF RTEM6(ISP)
C      RDUSH      TIME DERIVATIVE OF RUSH
C      RDVSH      TIME DERIVATIVE OF RVSH
C      RDLINTC(IC) TIME DERIVATIVE OF RLINTC(IC)
C
C      TDW5      TIME DERIVATIVE OF TW5
C      TDW7      TIME DERIVATIVE OF TW7
C      TDW8      TIME DERIVATIVE OF TW8
C      TDHTSU    TIME DERIVATIVE OF THTSU
C
C      GMCDT3    TIME DERIVATIVE OF GMCT3
C      GHDCOT3    TIME DERIVATIVE OF GHCOT3
C      GWDCOT3    TIME DERIVATIVE OF GWCOT3
C      GHSDBDC    TIME DERIVATIVE OF GHSBDC
C      GHSTSG     TIME DERIVATIVE OF GHSTSG
C      GHDCOT1    TIME DERIVATIVE OF GHCOT1
C      GHDCOT2    TIME DERIVATIVE OF GHCOT2
C      GMDCT2     TIME DERIVATIVE OF GMCT2
C      GHDCOT2    TIME DERIVATIVE OF GHCOT2
C      GDFPS      TIME DERIVATIVE OF GFPS
C      GHDRCI     TIME DERIVATIVE OF GHRCI
C      GHDDSI     TIME DERIVATIVE OF GHDSI
C      GHDCOH3    TIME DERIVATIVE OF GHCOH3
C      GHDCTSG    TIME DERIVATIVE OF GHCTSG
C      GHDCWH     TIME DERIVATIVE OF GHCHW
C
C      FUNDAMENTAL PHYSICAL CONSTANTS
C
C      COMMON /CONSTS/ PI,ZFR,GRAV,GRAV0,SBC,GCAIR
C
C      PI          PI
C      ZFR         ZERO FAHRENHEIT (DEGREES RANKINE)
C      GRAV        LOCAL ACCELERATION DUE TO GRAVITY (FT/(SEC)**2)
C      GRAV0       GRAVITATIONAL CONSTANT (LBM FT/LBF (SEC)**2)
C      SSC         STEFAN-BOLTZMANN CONSTANT (BTU/SEC-SQ FT (DEG R)**4)
C      GCAIR       GAS CONSTANT FOR AIR (FT LBF/LBM (DEG R))
C
C      COMPRESSED WATER/SUPERHEATED STEAM TABLE DATA
C
C      LOGICAL NO COMP,SATURD
C      REAL HE,PE,SE,TE,VE,XE
C      COMMON /USECOM/ HE,PE,SE,TE,VE,XE,NO COMP,SATURD
C
C      GDORC=2.*GRORC
C      GDODS=2.*GRDDS
C      GDIDS=2.*GRIDS
C      GDIRC=2.*GRIRC

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C          1.CALCULATE TOTAL FLOW THROUGH FEEDWATER
C          PUMPS (GWFT) = SUM OF FLOWS TO RECEIVER
C          AND DESUPERHEATER
C          INTERFACE FROM TSS TO EPGS - FLOW REQUESTED BY TSS (TW2)
C          TWFP=TW2
100 GWFT=RWVSUM+TWFP
C
C          2.COMPUTE SPECIFIC VOLUME OF FEEDWATER USING
C          ENTHALPY AND PRESSURE (GVFP)
200 CALL USE HP(GHFP,GPFP)
    GVFP=VE
C
C          3.CALCULATE THE HEAD ACROSS THE PUMP (GFPH)
C          USING PUMP SPEED AND FLOW (RATED AND
C          ACTUAL)
300 RATIO=GFPS/GFPSR
    GFPH=GFPHR*(1.3*RATIO*RATIO - .3*GWFT*GWFT/GWFR/GWFR)
C          4.CALCULATE LOAD TORQUE (GFPT) USING VOLUMES
C          FLOWS AND SPEEDS (RATED AND ACTUAL) AS
C          WELL AS FRICTIONAL TORQUE (GFPTFR)
400 GFPTFR=.2*GFPTR
C
C          GFPT=(GFPTR*GVFPR/GVFP)*RATIO*(.5*RATIO + (.5/.9)*GWFT/GWFR)
1          +GFPTFR*RATIO*RATIO
C
C          CALCULATE AUXILIARY POWER (GPAUX)
C          GPAUX=2.26061E-05*GFPS*GFPT/GKEFF
C          GTAUXP=GTAUXP+GPAUX
C
C          5.CALCULATE PRESSURE AT RECEIVER INLET
C          (GPFPR) USING THE INLET PRESSURE,HEAD
C          PIPE LENGTH, VOLUME AND FRICTION LOSSES
C          (GPDELR)
C          FIRST REQUIREMENT IS A REYNOLDS NUMBER AND
C          VISCOSITY FOR THE FLUID (GRESR,GMUSR)
500 GRESR=AIREWA(GTFP,GPFP,GFPT,GDIRC)
C
C          DYNAMIC VISCOSITY
C          GMUSR= AIVISC(GTFP,GPFP)
C          CALL FRLOSS(GDIRC ,GRESR ,GMUSR ,GLRC ,GVFP ,GPDELR)
C
C          COMPUTE PRESSURE AT INLET (GPFPR)
C          GPOUT=GPFP+GFPH/144./GVFP
C          GPFPR=GPOUT-GLRC/144./GVFP-GPDELR
C
C          CALCULATE EPGS/RECVR INTERFACE VARIABLES
C          FOR THE SOLUTION OF RECEIVER FLOW RATE
C          AND INLET PRESSURE
C
SATURD=.FALSE.
IF (GPTEXT(3).LE.1.) GPTEXT(3)=1.
CALL USE TSAT(GPTEXT(3),DUM)
GVCH3=VE
GAMMA=H1PARM(2)*H2PARM(2)

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C                                     VISCOSITY (GMUSDS) AND FRICTION LOSS
C                                     (GPDELS)
1000 CALL USE HP(GHOUTP,GPOUT)
    GRESDS=AIREWA(TE,GPOUT,TWFP,GDIDS)
C
    GMUSDS=AIVISC(TE,GPOUT)
C
    CALL FRLOSS(GDIDS ,GRESDS,GMUSDS,GLDESP ,GVFP,GPDELS)
C
    GPDSI=GPOUT-GPDELS
C
C                                     COMPUTE TEMPERATURE AT DESUPERHEATER
C
    CALL USE HP(GHDSI,GPDSI)
    GTDSI=TE
C
C                                     COMPUTE AVERAGE TEMPERATURE OF CONDENSATE
C                                     IN DESUPERHEATER FEEDWATER PIPE (GTCIDS)
C
    GTCIDS=(GTFP+GTDSI)/2.0
C
C                                     COMPUTE HEAT LOSSES IN DESUPERHEATER PIPE
C
    CALL PIPELOS(TNOM,GTCIDS,EPRAMB,VNOM,GDOOS,GDIDS,GLDESP,GTC,
1      GHLOSDS)
C
C                                     COMPUTE ENTHALPY TRANSPORT DELAY TO
C                                     THE DESUPERHEATER
C
    GMDS=GLDESP*PI*GRIDS*GRIDS/GVFP
    GHDDSI=(TWFP*(GHOUTP-GHDSI)-(GHLOSDS/3600.))*(2.0/GMDS)
C
C                                     DIAGNOSTIC PRINT IF DESIRED
C
    IF (DIAG(25)) WRITE (6,909) GWFP,GVFP,
1      GFPH,GFPTFR,GFPT,GFPAUX,
2      GRESR,GMUSR,GPFP,GPDEL,
3      GCPEFP,GCTFP,GFPS,GDFPS,
4      GHOUTP,GPOUT,GHLOSSR,GMRC,
5      GHRCI,GHRCI,GTFFR,GTCIR
909  FORMAT(1H ,36HDIAG25/EPGS-RECVR FEEDPUMP AND RISER,/,
1      19X,9H  GWFP=,G10.4,9H  GVFP=,G10.4,/,
2      19X,9H  GFPH=,G10.4,9H  GFPTFR=,G10.4,9H  GFPT=,G10.4,
3      9H  GFPAUX=,G10.4,/,
4      19X,9H  GRESR =,G10.4,9H  GMUSR =,G10.4,9H  GPFP =,G10.4,
5      9H  GPDEL=,G10.4,/,
6      19X,9H  GCPEFP=,G10.4,9H  GCTFP =,G10.4,9H  GFPS =,G10.4,
7      9H  GDFPS=,G10.4,/,
8      19X,9H  GHOUTP=,G10.4,9H  GPOUT =,G10.4,9H  GHLOSSR=,G10.4,
9      9H  GMRC=,G10.4,/,
10     19X,9H  GHRCI=,G10.4,9H  GHRCI=,G10.4,9H  GTFFR=,G10.4,
11     9H  GTCIR=,G10.4)
C
C                                     DIAGNOSTIC PRINT IF DESIRED
C
    IF (DIAG(25)) WRITE (6,1009) GRESDS,GMUSDS,
1      GPDSI,GPDELS,GMDS,
2      GHDSI,GHDDSI,GTDSI,GHLOSDS
1009 FORMAT(1H ,36HDIAG25/EPGS- DESUPERHEATER FEEDWATER,/,

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1      19X,9H  GRESDS=,G10.4,9H  GMUSDS=,G10.4,/,
2      19X,9H  GPDSI =,G10.4,9H  GPDELOS=,G10.4,9H  GMDS=,G10.4,/
3      19X,9H  GHDSI =,G10.4,9H  GHDDSI =,G10.4,9H  GTDSI =,G10.4,
3      9H  GHLOSDS=,G10.4)
      RETURN
      END
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C      SUBROUTINE RECVR
C      CALCULATE STATE VARIABLE EQUATIONS FOR RECEIVER SUBSYSTEM
C
C      MODELING AND CODING BY K. L. ZONDERVAN, X86317,
C      BLDG A3, RM 2923, AEROSPACE CORPORATION
C
C      EXECUTIVE AND PROGRAM CONTROL DATA
C
C      INTEGER ATIMO,ATIDAY
C      LOGICAL OUTFG,END,DIAG
C      COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1  DIAG(40)
C
C      OUTFG(I,J)  OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
C      END          END OF RUN FLAG
C      ATILCL       LOCAL TIME (SECONDS FROM MIDNIGHT)
C      ATITST       TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
C      ATIMO        MONTH
C      ATIDAY       DAY
C      DIAG         DIAGNOSTIC PRINT FLAG ARRAY
C
C      ENVIRONMENTAL DATA
C
C      COMMON /EDATA/ ETEAMB,EPRAMB,EVWAMB,EINDIR,EDWAMB,ETDAMB
C
C      ETEAMB       AMBIENT TEMPERATURE (DEGREES FAHRENHEIT)
C      EPRAMB       AMBIENT PRESSURE (LB/SQ IN ABS)
C      EVWAMB       AMBIENT WIND VELOCITY (FT/SEC)
C      EINDIR       DIRECT INSOLATION (KILOWATTS/SQ METER)
C      EDWAMB       WIND DIRECTION (DEGREES AZIMUTH)
C      ETDAMB       DEW POINT TEMPERATURE (DEGREES FAHRENHEIT)
C
C      MASTER CONTROL SUBSYSTEM DATA
C
C      INTEGER CMODE,CNMODE,CNSP,CNMV,CMVRTBL,CMVLA,CMVPA,
1  CMVRC,CNM,CNMVEL,CNMH
C      COMMON /CDATA/ CMODE,CNMODE,CSPTBL(7,16),CSP(16),CNSP,
1  CMVLTBL(6,4,7),CMVL(6,4),CNMV,CMVRTBL(7,7,4),
2  CMVLA(7),CMVPA(4),CMVRC(4),CNM(4),CNMVEL,CNMH
C
C      CMODE        CURRENT MODE OF OPERATION
C      CNMODE       NUMBER OF DIFFERENT MODES OF OPERATION
C      CSPTBL       SETPOINT TABLE
C      CSP          SETPOINTS FOR CURRENT MODE OF OPERATION
C      CNSP         NUMBER OF SETPOINTS
C      CMVLTBL      TABLE OF OPERATING LIMITS FOR MONITORED VARIABLES
C      CMVL         OPERATING LIMITS OF MONITORED VARIABLES FOR CURRENT
C                   MODE OF OPERATION
C      CNMV         NUMBER OF MONITORED VARIABLES
C      CMVRTBL      TABLE OF MCS RESPONSES FOR MONITORED VARIABLES
C                   EXCEEDING THEIR LIMITS
C      CMVLA        MONITORED VARIABLE LIMIT ARGUMENT FOR RESPONSE TABLE
C      CMVPA        MONITORED VARIABLE ARGUMENT FOR RESPONSE TABLE
C      CMVRC        RESPONSE CODES FOR MONITORED VARIABLES CROSSING LIMITS
C      CNM          POTENTIAL NEW MODES TO CORRECT MONITORED VARIABLE
C                   LIMIT CROSSINGS

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C CNMVEL NUMBER OF MONITORED VARIABLES EXCEEDING LIMITS
 C AT ANY INSTANT OF TIME
 C CNNM NUMBER OF NEW MODE REQUESTS AT ANY INSTANT OF TIME
 C
 C STANDARD DEFINITION OF PILOT PLANT OPERATING MODES
 C
 C 1= RECEIVER STEAM TO EPGS
 C 2= RECEIVER STEAM TO EPGS AND THERMAL STORAGE
 C 3= RECEIVER STEAM TO EPGS AND THERMAL STORAGE STEAM TO EPGS
 C 4= RECEIVER STEAM TO THERMAL STORAGE AND THERMAL STORAGE
 C STEAM TO EPGS
 C 5= RECEIVER STEAM TO THERMAL STORAGE
 C 6= THERMAL STORAGE STEAM TO EPGS
 C 7= OVERNIGHT SHUTDOWN AND HOLD
 C
 C ARGUMENT DEFINITIONS FOR SETPOINT ARRAY CSP(I)
 C
 C I=1,4 EPGS VALVE SETPOINTS FOR VALVES R1-R4
 C I=5,6 EPGS VALVE SETPOINTS FOR VALVES T1,T2
 C I=7,8 EPGS VALVE SETPOINTS FOR DRAIN VALVES
 C I=9,12 EPGS VALVE SETPOINTS FOR VALVES E1-E4
 C I=13 EPGS CONDENSER FAN SETPOINT
 C I=14 EPGS FEED PUMP PRESSURE SETPOINT
 C I=15 RECEIVER OUTLET TEMPERATURE SETPOINT
 C I=16 TSS OUTLET STEAM FLOW RATE SETPOINT
 C
 C CURRENT LIST OF MONITORED VARIABLES
 C
 C RECEIVER OUTLET PRESSURE
 C RECEIVER OUTLET TEMPERATURE
 C EPGS FEEDWATER PRESSURE
 C TSS THERMOCLINE LEVEL
 C
 C RECEIVER SUBSYSTEM DATA
 C
 C RECVR VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)
 C
 C INTEGER RCVST,RAFLGC
 C COMMON /RDATA/ RHISH(6),RWISH(6),RHSH,RPRSH,RTESH,RWOSH,RFMV(6),
 C 1 RLV(6),RHIV,RPRIV,RFRISV,RFROSV,RVIV,RHOV(6),RFROV(6),RHV(6),
 C 2 RWVSUM,RHF1(8),RPRF1(8),RTEF1(8),RUF1(8),RVF1(8),RHCF2(8),
 C 3 RHF2(8),RPRF2(8),RQF2(8),RTEF2(8),RTEFF2(8),RUF2(8),RVF2(8),
 C 4 RWF2(8),RHCM2(8),RHFCM2(8),RHFRM2(8),RQM2(8),RQAM2(8),RQCM2(8),
 C 5 RQEM2(8),RPRF3(8),RTEF3(8),RUF3(8),RVF3(8),RHCF4(8),RHNSF4(8),
 C 6 RHFSF4(8),RHF4(8),RPRF4(8),RQF4(8),RTEF4(8),RTEFF4(8),RUF4(8),
 C 7 RVF4(8),RHTF4(8),RHCM4(8),RHFCM4(8),RHFRM4(8),RQM4(8),RQAM4(8),
 C 8 RQCM4(8),RQEM4(8),RPRF5(8),RTEF5(8),RUF5(8),RVF5(8),RXF5(8),
 C 9 RHCF6(8),RHF6(8),RPRF6(8),RQF6(8),RTEF6(8),RTEFF6(8),RUF6(8),
 C A RVF6(8),RWF6(8),RHCM6(8),RHFCM6(8),RHFRM6(8),RQM6(8),RQAM6(8),
 C B RQCM6(8),RQEM6(8),RHF7(8),RPRF7(8),RTEF7(8),RUF7(8),RVF7(8),
 C C RUF8(8),RVFSAT(8),RUVSAT(8),RVVSAT(8),RL35(8),RL57(8),RWSP(8),
 C D RCVST(8),RAFLGC(6),RERRTC(6),RLPROC(6),RLSUMC(6),RTSETC
 C
 C RHISH(ISP) FLUID ENTHALPY AT STEAM HEADER INLET
 C (BTU/LBM)
 C RWISH(ISP) FLUID MASS FLOW RATE AT STEAM HEADER INLET
 C (LBM/SEC)
 C RHSH FLUID ENTHALPY IN STEAM HEADER
 C (BTU/LBM)

C	RPRSH	FLUID PRESSURE IN STEAM HEADER
C		(PSIA)
C	RTESH	FLUID TEMPERATURE IN STEAM HEADER
C		(DEGREES F)
C	RWOSH	FLUID MASS FLOW RATE AT STEAM HEADER OUTLET
C		(LBM/SEC)
C	RFMV(IV)	MODIFIED FRICTION FLOW COEFFICIENT FOR FLOW
C		CONTROL VALVE (PSI,SEC**2/LBM,CU FT)
C	RLV(IV)	STEM DISPLACEMENT OF FLOW CONTROL VALVE
C		(PERCENT)
C	RHIV	FLUID ENTHALPY AT FLOW CONTROL VALVE INLETS
C		(BTU/LBM)
C	RPRIV	FLUID PRESSURE AT FLOW CONTROL VALVE INLETS
C		(PSIA)
C	RPRISV	FLUID PRESSURE AT RECEIVER SUBSYSTEM INLET
C		(PSIA)
C	RPROSV	FLUID PRESSURE AT RECEIVER SUBSYSTEM OUTLET
C		(PSIA)
C	RVIV	FLUID SPECIFIC VOLUME AT FLOW CONTROL VALVE INLETS
C		(CU FT/LBM)
C	RHOV(IV)	FLUID ENTHALPY AT FLOW CONTROL VALVE OUTLET
C		(BTU/LBM)
C	RPROV(IV)	FLUID PRESSURE AT FLOW CONTROL VALVE OUTLET
C		(PSIA)
C	RWV(IV)	FLUID MASS FLOW RATE THROUGH FLOW CONTROL VALVE
C		(LBM/SEC)
C	RWVSUM	FLUID MASS FLOW RATE THROUGH ALL FLOW CONTROL VALVES
C		(LBM/SEC)
C	RHF1(ISP)	FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 1
C		(BTU/LBM)
C	RPRF1(ISP)	FLUID PRESSURE AT SUPERPANEL NODE NUMBER 1
C		(PSIA)
C	RTEF1(ISP)	FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 1
C		(DEGREES F)
C	RUF1(ISP)	FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 1
C		(BTU/LBM)
C	RVF1(ISP)	FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 1
C		(CU FT/LBM)
C	RHCF2(ISP)	INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C		SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
C	RHF2(ISP)	FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 2
C		(BTU/LBM)
C	RPRF2(ISP)	FLUID PRESSURE AT SUPERPANEL NODE NUMBER 2
C		(PSIA)
C	RQF2(ISP)	HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
C		SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
C	RTEF2(ISP)	FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C		(DEGREES F)
C	RTEFF2(ISP)	FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C		(DEGREES F)
C	RUF2(ISP)	FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
C		(BTU/LBM)
C	RVF2(ISP)	FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 2
C		(CU FT/LBM)
C	RWTF2(ISP)	FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
C		NUMBER 2 (LBM/SEC)
C	RHCM2(ISP)	EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C		SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
C	RHFCM2(ISP)	EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
C		AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)

C RHFRM2(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RQM2(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQAM2(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQCM2(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQEM2(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RPRF3(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 3
 C (PSIA)
 C RTEF3(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 3
 C (DEGREES F)
 C RUF3(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RVF3(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 3
 C (CU FT/LBM)
 C RHCF4(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHNBF4(ISP) INTERNAL NUCLEATE BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFBF4(ISP) INTERNAL FILM BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHF4(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RPRF4(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 4
 C (PSIA)
 C RQF4(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RTEF4(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RTEFF4(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RUF4(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RVF4(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 4
 C (CU FT/LBM)
 C RWTF4(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 4 (LBM/SEC)
 C RHCM4(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFCM4(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFRM4(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RQM4(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQAM4(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQCM4(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQEM4(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RPRF5(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 5
 C (PSIA)
 C RTEF5(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 5
 C (DEGREES F)
 C RUF5(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)

C RVF5(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 5
 C (CU FT/LBM)
 C RXF5(ISP) FLUID QUALITY AT SUPERPANEL NODE NUMBER 5
 C (PERCENT)
 C RHCF6(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHF6(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RPRF6(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 6
 C (PSIA)
 C RQF6(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RTEF6(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RTEFF6(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RUF6(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RVF6(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 6
 C (CU FT/LBM)
 C RWF6(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 6 (LBM/SEC)
 C RHCM6(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFCM6(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFRM6(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RQM6(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQAM6(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQCM6(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQEM6(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RHF7(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RPRF7(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 7
 C (PSIA)
 C RTEF7(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 7
 C (DEGREES F)
 C RUF7(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RVF7(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 7
 C (CU FT/LBM)
 C RUFSAT(ISP) INTERNAL ENERGY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RVFSAT(ISP) SPECIFIC VOLUME OF A SATURATED LIQUID
 C (CU FT/LBM)
 C RUVSAT(ISP) INTERNAL ENERGY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RVVSAT(ISP) SPECIFIC VOLUME OF A SATURATED VAPOR
 C (CU FT/LBM)
 C RL35(ISP) LENGTH OF SUPERPANEL TWO-PHASE MIXTURE SECTION
 C (FEET)
 C RL57(ISP) LENGTH OF SUPERPANEL SUPERHEATED SECTION
 C (FEET)
 C RWSP(ISP) FLUID MASS FLOW RATE THROUGH SUPERPANEL
 C (LBM/SEC)

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C   RCVST(ISP) SUPERPANEL FLUID CONTROL VOLUME STATE
C   RCVST = 1 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
C   FLUID STATES ONLY
C   RCVST = 2 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
C   AND SATURATED FLUID STATES
C   RCVST = 3 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED,
C   SATURATED, AND SUPERHEATED FLUID STATES
C   RAFLGC(IC) CONTROLLER ACTIVATION FLAG
C   RAFLGC = 1 SIGNIFIES RTSENC .LT. RKTHSC
C   RAFLGC = 2 SIGNIFIES RTSENC .GT. RKTHSC
C   RERRTC(IC) CONTROLLER TEMPERATURE ERROR SIGNAL
C   (DEGREES F)
C   RLPROC(IC) CONTROLLER PROPORTIONAL SIGNAL OF VALVE STEM
C   DISPLACEMENT (PERCENT)
C   RLSUMC(IC) CONTROLLER COMMAND SIGNAL OF VALVE STEM DISPLACEMENT
C   (PERCENT)
C   RTSETC CONTROLLER SET POINT FOR RECEIVER SUBSYSTEM OUTLET
C   TEMPERATURE (DEGREES F)
C
C   RECVR CONSTANTS
C
C   INTEGER RKNTB,RKNPSP,RKNBSP
C   COMMON /RCDATA/ RKCM,RKDNM,RKCSP,RKEESP,RKHFC,RKHFR,RKIDTB,
1  RKODTB,RKWSP,RKL17,RKASP,RKSSP,RKNTB,RKNPSP,RKNBSP,RKFF2,
2  RKFF4,RKFF6,RKFV(6),RKAHV(6),RKVSH,RKINTC(6),RKPROC(6),RKTHSC
C
C   RKCM HEAT CAPACITY OF SUPERPANEL TUBE METAL
C   (BTU/LBM,F)
C   RKDNM DENSITY OF SUPERPANEL TUBE METAL
C   (LBM/CU FT)
C   RKCSP HEAT CAPACITY OF A SUPERPANEL PER UNIT LENGTH
C   (BTU/FT,F)
C   RKEESP EMISSIVITY OF EXTERNAL SUPERPANEL COATING
C   (ND)
C   RKHFC EXTERNAL FORCED CONVECTION HEAT TRANSFER CONSTANT
C   ( )
C   RKHFR EXTERNAL FREE CONVECTION HEAT TRANSFER CONSTANT
C   ( )
C   RKIDTB INSIDE DIAMETER OF A SUPERPANEL TUBE
C   (FEET)
C   RKODTB OUTSIDE DIAMETER OF A SUPERPANEL TUBE
C   (FEET)
C   RKWSP WIDTH OF A SUPERPANEL
C   (FEET)
C   RKL17 INSULATION EXPOSED LENGTH OF A SUPERPANEL
C   (FEET)
C   RKASP FLOW CROSS SECTIONAL AREA OF A SUPERPANEL
C   (SQ FT)
C   RKSSP INSIDE SURFACE AREA PER UNIT LENGTH OF A SUPERPANEL
C   (FEET)
C   RKNTB NUMBER OF TUBES COMPOSING A SUPERPANEL
C   (ND)
C   RKNPSP NUMBER OF PREHEATER SUPERPANELS
C   (ND)
C   RKNBSP NUMBER OF BOILER SUPERPANELS
C   (ND)
C   RKFF2 FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 2
C   (PSI,SEC**2/LBM,CU FT)
C   RKFF4 FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 4

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C (PSI,SEC**2/LBM,CU FT)
 C RKFF6 FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 6
 C (PSI,SEC**2/LBM,CU FT)
 C RKFFV(IV) FLUID FLOW COEFFICIENT OF FLOW CONTROL VALVE
 C (PSI,SEC**2/LBM,CU FT)
 C RKAIV(IV) PERCENT SUBSYSTEM PRESSURE DROP ACROSS
 C FLOW CONTROL VALVE (PERCENT)
 C RKVSH VOLUME OF STEAM HEADER
 C (CU FT)
 C RKINTC(IC) CONTROLLER INTEGRAL GAIN CONSTANT
 C (PERCENT,SEC/F)
 C RKPROC(IC) CONTROLLER PROPORTIONAL GAIN CONSTANT
 C (PERCENT/F)
 C RKTHSC CONTROLLER ACTIVATION TEMPERATURE THRESHOLD
 C (DEGREES F)

ELECTRICAL POWER GENERATION SUBSYSTEM DATA

EPGS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)

COMMON /GDATA/ GPT3,GLT3,GWSOT3,GHSOT3,GWSBDC,GPSBDC,GTSBDC,
 1 GHLOSSD,GWSPG,GWSRT,GWSTSG,GPSTSG,GTSTSG,GPT1,GWSTH1,GHSTH1,
 2 GPT2,GWSTH2,GHSTH2,GHCIT2,GLT2,GWCTC,GWCTH3,GWCTH5,GWTALP,
 3 GWTEXH,GPTEXH,GHTEXH,GWTEXT(4),GPTEXT(4),GHTEXT(4),GTPower,
 4 GEPOUT,GHLOSSR,GTFFR,GPOUT,GHOUTP,GFPAX,GWFT,GFPH,GFFT,GTDISI,
 5 GPCTSG,CTCTSG,GHLOSSS,GHLOTSG,GTAXP,APBP,APHP,GHHTRI,GPHTRI,
 6 GHTRI1,GPSH1,GHSH1,GPSH2,GHSH2,GHCH4C,GHCH5C,GHCH23,GHCH12

C GPT3 PRESSURE (PSIA) IN TANK 3 (RECVR FLASH TANK)
 C GLT3 CONDENSATE LEVEL (FT.) IN TANK 3
 C GWSOT3 FLOW (LBM/SEC) OF STEAM OUT OF TANK 3
 C GHSOT3 ENTHALPY (BTU/LBM) OF STEAM OUT OF TANK 3
 C GWSBDC FLOW (LBM/SEC) OF STEAM AT BOTTOM OF DOWNCOMER
 C GPSBDC PRESSURE (PSIA) OF STEAM AT BOTTOM OF DOWNCOMER
 C GTSBDC TEMPERATURE (F) OF STEAM AT BOTTOM OF DOWNCOMER
 C GHLOSSD HEAT LOSS (BTU/HR) FROM DOWNCOMER
 C GWSRG FLOW (LBM/SEC) OF RECVR STEAM TO TURBINE MAIN THROTTLE
 C GWSRT FLOW (LBM/SEC) OF RECVR STEAM TO THERMAL STORAGE
 C GWSTSG STEAM FLOW (LBM/SEC) AT TURBINE ADMISSION PORT
 C GPSTSG PRESSURE (PSIA) STEAM AT TURBINE ADMISSION PORT
 C GTSTSG TEMP (F) STEAM AT TURBINE ADMISSION PORT
 C GPT1 PRESSURE (PSIA) IN TANK 1 (TSS DRAIN SYS)
 C GWSTH1 STEAM FLOW (LBM/SEC) TO F.W. HEATER 1 FROM TSS DRAIN
 C GHSTH1 ENTHALPY (BTU/LBM) TO F.W. HEATER 1 FROM TSS DRAIN
 C GPT2 PRESSURE (PSIA) IN TANK 2 (TSS DRAIN SYS)
 C GWSTH2 STEAM FLOW (LBM/SEC) TO F.W. HEATER 2 FROM TSS DRAIN
 C GHSTH2 ENTHALPY (BTU/LBM) TO F.W. HEATER 2 FROM TSS DRAIN
 C GHCIT2 ENTHALPY (BTU/LBM) CONDENSATE INTO TANK 2
 C GLT2 CONDENSATE LEVEL (FT) IN TANK 2
 C GWCTC CONDENSATE FLOW (LBM/SEC) TO CONDENSER FROM TSS DRAIN
 C GWCTH3 CONDENSATE FLOW (LBM/SEC) TO F.W. HEATER 3 FROM TSS
 C GWCTH5 CONDENSATE FLOW (LBM/SEC) TO F.W. HEATER 5 FROM TSS
 C GWTALP TURBINE APPARENT LP STEAM FLOW (LBM/SEC)
 C GWTEXH TURBINE EXHAUST FLOW (LBM/SEC)
 C GPTEXH TURBINE EXHAUST PRESSURE (PSIA)
 C GHTEXH TURBINE EXHAUST ENTHALPY (BTU/LBM)
 C GWTEXT(4) TURBINE EXTRACTION FLOWS (LBM/SEC)
 C GPTEXT(4) TURBINE EXTRACTION PRESSURES (PSIA)
 C GHTEXT(4) TURBINE EXTRACTION ENTHALPIES (BTU/LBM)

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C      GTPOWER      THERMAL AVAILABILITY (BTU/SEC)
C      GEPOUT       ELECTRICAL POWER (MEGA-WATTS)
C      GHLOSSR      RISER HEAT LOSSES (BTU/HR)
C      GTFPR        RECVR INLET TEMPERATURE (F)
C      GPOUT        RECVR FEED PUMP OUTPUT PRESSURE (PSIA)
C      GHOUTP       RECVR FEED PUMP OUTPUT ENTHALPY (BTU/LBM)
C      GFPAUX       RECVR FEED PUMP AUX POWER (KW)
C      GWFPT        TOTAL RECVR FEED PUMP FLOW (LBM/SEC)
C      GFPH         RECVR FEED PUMP HEAD (FT)
C      GFPT         RECVR FEED PUMP TORQUE (FT-LBS)
C      GTDSI        F.W. TEMPERATURE (F) AT DESUPERHEATER INLET
C      GPCTSG       PRESSURE (PSIA) AT TSS STEAM GENERATOR INLET
C      GTCTSG       TEMPERATURE (F) AT TSS STEAM GENERATOR INLET
C      GHLOSDDS     HEAT LOSS (BTU/HR) IN DESUPERHEATER FW PIPE
C      GHLOTSG      HEAT LOSS (BTU/HR) IN TSS STEAM GENERATOR FW PIPE
C      GTAUXP       TOTAL AUX POWER (KW) REQUIRED BY FEEDWATER PUMPS
C      APBP         AUX POWER (KW) REQUIRED BY BOOST PUMP
C      APHP         AUX POWER (KW) REQUIRED BY HOTWELL PUMP
C      GHNTR1       ENTHALPY (BTU/LBM) OF WATER IN HEATER 1
C      GPHTR1       PRESSURE (PSIA) OF WATER IN HEATER 1
C      GTHTR1       TEMPERATURE (F) OF WATER IN HEATER 1
C      GPSH1        PRESSURE (PSIA) OF STEAM TO HEATER 1
C      GSH1         ENTHALPY (BTU/LBM) OF STEAM TO HEATER 1
C      GPSH2        PRESSURE (PSIA) OF STEAM TO HEATER 2
C      GSH2         ENTHALPY (BTU/LBM) OF STEAM TO HEATER 2
C      GHCH4C       ENTHALPY (BTU/LBM) OF HEATER 4 CONDENSATE DRAIN
C      GHCH5C       ENTHALPY (BTU/LBM) OF HEATER 5 CONDENSATE DRAIN
C      GHCH23       ENTHALPY (BTU/LBM) OF HEATER 2 CONDENSATE DRAIN
C      GHCH12       ENTHALPY (BTU/LBM) OF HEATER 1 CONDENSATE DRAIN

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GASP-IV SIMULATION SYSTEM DATA

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COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
1NAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
2,TTCLR,TTFIN,ATTRIB(25),TTSET

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COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
1,NNEQD,NNEQS,NNEQT,SS(600),SSL(600),TTNEX

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DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
1 RLINTC(6),RL15(8),RHFSAT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
2 RDIUF2(8),RDL13(8),RDTEM2(8),RDIHF3(8),RDTEM4(8),RDTEM6(8),
3 RDLINTC(6)

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EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
1 (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
2 (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
3 (TWS,SS(83)),(TW7,SS(84)),(TWS,SS(85)),
4 (THTSU,SS(86)),(GMCT3,SS(87)),(GHCOT3,SS(88)),
5 (GWCOT3,SS(89)),(GHSBDC,SS(90)),(GHSTSG,SS(91)),
6 (GHCOT1,SS(92)),(GHCOT2,SS(93)),(GMCT2,SS(94)),
7 (GWCOT2,SS(95)),(GFPS,SS(96)),(GHRCI,SS(97)),
8 (GHDSI,SS(98)),(GHCOH3,SS(99)),(GHCTSG,SS(100)),
9 (GHCHW,SS(101)),
A (RL15(1),SS(102)),(RHFSAT(1),SS(110)),(RHF3(1),SS(118)),
B (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
C (CRFRSH,SS(151)),(CRTESH,SS(152)),(CGPFPR,SS(153)),
D (CTLT,SS(154)),
E (GPFPFR,SS(161)),(GPDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
F

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G (XK3,SS(165))

C
C EQUIVALENCE (RDIUF2(1),DC(1)),(RDL13(1),DD(9)),(RDTM2(1),DD(17)),
1 (RDIHF3(1),DD(25)),(RDTM4(1),DD(33)),(RDTM6(1),DD(41)),
2 (RDUSH,DD(49)),(RDVSH,DD(50)),(RDLINTC(1),DD(51)),
3 (TDW5,DD(83)),(TDW7,DD(84)),
5 (TDW8,DD(85)),(TDHTSU,DD(86)),(GMCOT3,DD(87)),
6 (GHDCOT3,DD(88)),(GWDCOT3,DD(89)),(GHSBDC,DD(90)),
7 (GHSTSG,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),
8 (GHDCOT2,DD(94)),(GHDCOT2,DD(95)),(GDFPS,DD(96)),
9 (GHRCI,DD(97)),(GHDSI,DD(98)),(GHDCOH3,DD(99)),
A (GHCTSG,DD(100)),(GHCHW,DD(101))

C
C INTEGRATED STATE VARIABLES

C
C RIUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
C (BTU/LBM)
C RL13(ISP) LENGTH OF SUPERPANEL SUBCOOLED SECTION
C (FEET)
C RTEM2(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C (DEGREES F)
C RIHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
C (BTU/LBM)
C RTEM4(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 4
C (DEGREES F)
C RTEM6(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 6
C (DEGREES F)
C RUSH FLUID INTERNAL ENERGY IN STEAM HEADER
C (BTU/LBM)
C RVSH FLUID SPECIFIC VOLUME IN STEAM HEADER
C (CU FT/LBM)
C RLINTC(IC) CONTROLLER INTEGRAL SIGNAL OF VALVE STEM DISPLACEMENT
C (PERCENT)
C
C TW5 NOMINAL OIL FLOW INTO STORAGE (LBM/SEC)
C TW7 NOMINAL OIL FLOW FROM STORAGE (LBM/SEC)
C TW8 STEAM FLOW FROM STEAM GENERATOR (LBM/SEC)
C THTSU HEAT STORED IN THERMAL STORAGE UNIT (BTU)
C
C GMCT3 CONDENSATE MASS (LBM) IN TANK 3 (RECVR FLASH TANK)
C GHCT3 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 3
C GWCOT3 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 3
C GHSBDC ENTHALPY (BTU/LBM) OF STEAM AT BOTTOM OF DOWNCOMER
C GHSTSG ENTHALPY (BTU/LBM) OF ADMISSION STEAM
C GHCT1 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 1
C GHCT2 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 2
C GMCT2 MASS (LBM) OF CONDENSATE IN TANK 2
C GWCOT2 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 2
C GDFPS RECVR FEED PUMP SPEED (RPM)
C GHRCI F.W. ENTHALPY (BTU/LBM) AT RECVR INLET
C GHDSI F.W. ENTHALPY (BTU/LBM) AT DESUPERHEATER INLET
C GHCOH3 F.W. ENTHALPY (BTU/LBM) OUT OF FW HRTR NO. 3
C GHCTSG ENTHALPY (BTU/LBM) AT TSS STEAM GEN. INLET
C GHCHW ENTHALPY (BTU/LBM) OF CONDENSATE IN CONDENSER HOTWELL

C
C ADDITIONALLY REQUIRED GASP-IV STATE VARIABLES

C
C RL15(ISP) COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND
C TWO-PHASE MIXTURE SECTIONS (FEET)
C RHFSAT(ISP) ENTHALPY OF A SATURATED LIQUID


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C      (BTU/LBM)
C      RHF3(ISP)  FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
C      (BTU/LBM)
C      RHVSAT(ISP) ENTHALPY OF A SATURATED VAPOR
C      (BTU/LBM)
C      RHF5(ISP)  FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5
C      (BTU/LBM)
C      RTSENC(IC) CONTROLLER TEMPERATURE SENSOR SIGNAL OF BOILER
C      SUPERPANEL OUTLET TEMPERATURE (DEGREES F)
C      CRPRSH     FLUID PRESSURE IN RECEIVER STEAM HEADER
C      (PSIA)
C      CRTESH     FLUID TEMPERATURE IN RECEIVER STEAM HEADER
C      (DEGREES F)
C      CGPFPR     FLUID PRESSURE AT RECEIVER INLET
C      (PSIA)
C      CTLT       POSITION OF TSS THERMOCLINE
C      (PERCENT)
C      GPFPR      FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
C      GFDSI      FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)
C      XK1,XK2,XK3 EPGS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND
C      PRESSURE AT RECEIVER INLET
C
C      TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES
C
C      RDIUF2(ISP) TIME DERIVATIVE OF RIUF2(ISP)
C      RDL13(ISP)  TIME DERIVATIVE OF RL13(ISP)
C      RDTM2(ISP)  TIME DERIVATIVE OF RTM2(ISP)
C      RDIHF3(ISP) TIME DERIVATIVE OF RIHF3(ISP)
C      RDTM4(ISP)  TIME DERIVATIVE OF RTM4(ISP)
C      RDTM6(ISP)  TIME DERIVATIVE OF RTM6(ISP)
C      RDUSH       TIME DERIVATIVE OF RUSH
C      RDVSH       TIME DERIVATIVE OF RVSH
C      RDLINTC(IC) TIME DERIVATIVE OF RLINTC(IC)
C
C      TDW5        TIME DERIVATIVE OF TW5
C      TDW7        TIME DERIVATIVE OF TW7
C      TDW8        TIME DERIVATIVE OF TW8
C      TDHTSU      TIME DERIVATIVE OF THTSU
C
C      GMCDT3      TIME DERIVATIVE OF GMCT3
C      GHDCOT3     TIME DERIVATIVE OF GHCOT3
C      GWDCT3      TIME DERIVATIVE OF GWCOT3
C      GHSDBOC     TIME DERIVATIVE OF GHSEOC
C      GHDSTSG     TIME DERIVATIVE OF GHSTSG
C      GHDCOT1     TIME DERIVATIVE OF GHCOT1
C      GHDCOT2     TIME DERIVATIVE OF GHCOT2
C      GMDCT2      TIME DERIVATIVE OF GMCT2
C      GWDCT2      TIME DERIVATIVE OF GWCOT2
C      GDFPS       TIME DERIVATIVE OF GFPS
C      GHDRCI      TIME DERIVATIVE OF GHRCI
C      GHDDSI      TIME DERIVATIVE OF GHDSI
C      GHDCOH3     TIME DERIVATIVE OF GHCOH3
C      GHDCTSG     TIME DERIVATIVE OF GHCTSG
C      GHCHW       TIME DERIVATIVE OF GHCHW
C
C      FUNDAMENTAL PHYSICAL CONSTANTS
C
C      COMMON /CONSTS/ PI,ZFR,GRAV,GRAVO,SBC,GCAIR
C

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C      PI          PI
C      ZFR          ZERO FAHRENHEIT (DEGREES RANKINE)
C      GRAV          LOCAL ACCELERATION DUE TO GRAVITY (FT/(SEC)**2)
C      GRAVO          GRAVITATIONAL CONSTANT (LBM FT/LBF (SEC)**2)
C      SBC          STEFAN-BOLTZMANN CONSTANT (BTU/SEC-SQ FT (DEG R)**4)
C      GCAIR          GAS CONSTANT FOR AIR (FT LBF/LBM (DEG R))
C
C
C***** BEGIN COMPUTATIONS *****
C
C----- STEAM HEADER MODEL -----
C
C      STEAM HEADER MODEL INPUTS ARE PROVIDED PRIOR TO THE CALCULATION
C      OF THE MODELS DERIVATIVE CALCULATIONS
C
C      ALGEBRAIC EQUATIONS - STEAM HEADER MODEL
C
C          CALCULATE FLUID PRESSURE, TEMPERATURE, AND ENTHALPY IN
C          STEAM HEADER
C          CALL STEAM(22,RUSH,RVSH,RPRSH,RPRSH,RHSH,RTESH)
C
C
C----- FLOW CONTROL VALVE MODEL -----
C
C      DEFINE FLOW CONTROL VALVE MODEL INPUTS:
C
C          1. RECEIVER SUBSYSTEM OUTLET PRESSURE
C          RPROSV = RPRSH
C
C          3. INLET ENTHALPY
C          RHIV = RHVF7(RKNPSP) = RIHF3(RKNPSP)
C
C          3. INLET PRESSURE
C          NOT YET AVAILABLE
C
C          4. VALVE STEM DISPLACEMENT
C          DEFINED BELOW
C
C      ALGEBRAIC EQUATIONS - FLOW CONTROL VALVE MODEL
C
C          CALCULATE FLUID SPECIFIC VOLUME AT FLOW CONTROL VALVE INLETS
C          CALL ALINTS(3,5,RHIV,RVIV)
C
C          CALCULATE TOTAL GRAVITY HEAD IN PREHEATER SUPERPANELS
C          T19=0.0
C          DO 110 I=1,RKNPSP
C          CALL ALINTS(2,5,RIUF2(I),RVF2(I))
C          SGN=2*MOD(I,2)-1
C          T19=T19+SGN*RL13(I)/(144.0*RVF2(I))
C 110 CONTINUE
C
C          CALCULATE TOTAL GRAVITY HEAD IN BOILER SUPERPANELS
C          T20=0.0
C          DO 120 I=1,RKNBSP
C          J=I+RKNPSP
C          T20=T20+RL13(J)/(144.0*RVIV)
C 120 CONTINUE
C

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C      CALCULATE TOTAL GRAVITY HEAD IN RECEIVER SUBSYSTEM
T20=T19+T20/RKNBSP
C
C      CALCULATE RECEIVER SUBSYSTEM FLUID FLOW COEFFICIENT
T11=0.0
DO 130 IV=1,RKNBSP
  RLV(IV)=RLINTC(IV)
  T10=(RLV(IV))**4
  RFMV(IV)=RKFEV(IV)*(RKAIV(IV)+(1.0-RKAIV(IV))*T10)/
1  (T10*RKAIV(IV))
  T11=T11+1/SQRT(RFMV(IV))
130 CONTINUE
T12=RKFF2*(RVF2(1)+RVF2(2))+RVIV/(T11*T11)
C
C      CALCULATE RECEIVER SUBSYSTEM FLOW RATE AND INLET PRESSURE
C1=RFRSH+T20
C2=T12
C3=(XK2/(C2+XK3))**2 + 4.0*(XK1-C1)/(C2+XK3)
IF (C3.LT.0.0036) C3=0.0036
RWVSUM=0.5*(SQRT(C3) - XK2/(C2+XK3))
IF (RWVSUM.LT.0.06) RWVSUM=0.06
RPRISV=XK1-XK2*RWVSUM-XK3*RWVSUM**2
IF (RPRISV.LT.RFRSH) RPRISV=RFRSH
C
C
C
DO 200 ISP=1,RKNPSP
C----- PREHEATER SUPERPANEL MODEL -----
C
C      DEFINE PREHEATER SUPERPANEL MODEL INPUTS:
C
C      1. INLET ENTHALPY
RHF1(1) = GHRCI
IF (ISP.GT.1) RHF1(ISP) = RHF7(ISP-1)
C
C      2. INLET PRESSURE
RPRF1(1) = RPRISV
IF (ISP.GT.1) RPRF1(ISP) = RPRF7(ISP-1)
C
C      3. FLOW RATE
RWSP(ISP) = RWVSUM
C
C      4. HEAT FLUX AND ENVIRONMENTAL PARAMETERS ARE DEFINED
C      WHERE THEY ARE USED
C
C      ALGEBRAIC AND DIFFERENTIAL EQUATIONS - PREHEATER SUPERPANEL MODEL
CALL RSP(ISP)
C
200 CONTINUE
C
C
SUM1SH=SUM2SH=0.0
DO 300 I=1,RKNBSP
  IV = I
  IC = I
  ISP = I+RKNPSP
C
C----- FLOW CONTROL VALVE MODEL -----
C

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C   DEFINE FLOW CONTROL VALVE MODEL INPUTS:
C
C   1. RECEIVER SUBSYSTEM OUTLET PRESSURE
C   PREVIOUSLY DEFINED
C
C   2. INLET ENTHALPY
C   RHIV = RHF7(RKNPSP)
C
C   3. INLET PRESSURE
C   RPRIV = RPRF7(RKNPSP)
C
C   4. VALVE STEM DISPLACEMENT
C   PREVIOUSLY DEFINED
C
C   ALGEBRAIC EQUATIONS - FLOW CONTROL VALVE MODEL
C
C   CALCULATE FLOW RATE THROUGH FLOW CONTROL VALVE
C   T10=(RPRIV-RFRSH-RL13(ISP)/(144.0*RVIV))/
C   1 (RFMV(IV)*RVIV)
C   IF (T10.LT.0.0001) T10=0.0001
C   RWV(IV)=SQRT(T10)
C
C   CALCULATE PRESSURE AT FLOW CONTROL VALVE OUTLET
C   RPROV(IV)=RPRIV-(RKfV(IV)*RVIV*RWV(IV)**2)/RLV(IV)**4
C
C   CALCULATE ENTHALPY AT FLOW CONTROL VALVE OUTLET
C   RHOV(IV)=RHIV
C
C   GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
C   IF (DIAG(5)) PRINT *,#DIAG(5)/RECVR VALVE #,IV,#: #,
C   1 # RPRISV = #,RPRISV,# RPROSV = #,RPROSV,# RHIV = #,RHIV,
C   2 # RFRIV = #,RFRIV,# RLW = #,RLV(IV),# RVIV = #,RVIV,
C   3 # RFMV = #,RFMV(IV),# RWV = #,RWV(IV),# RWVSUM = #,RWVSUM,
C   4 # RPROV = #,RPROV(IV),# RHOV = #,RHOV(IV)
C
C----- BOILER SUPERPANEL MODEL -----
C
C   DEFINE BOILER SUPERPANEL MODEL INPUTS:
C
C   1. INLET ENTHALPY
C   RHF1(ISP) = RHOV(IV)
C
C   2. INLET PRESSURE
C   RPRF1(ISP) = RPROV(IV)
C
C   3. FLOW RATE
C   RWSP(ISP) = RWV(IV)
C
C   4. HEAT FLUX AND ENVIRONMENTAL PARAMETERS ARE DEFINED
C   WHERE THEY ARE USED
C
C   ALGEBRAIC AND DIFFERENTIAL EQUATIONS - BOILER SUPERPANEL MODEL
C   CALL RSP(ISP)
C
C----- CONTROLLER MODEL -----
C
C   DEFINE CONTROLLER MODEL INPUTS:
C

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C      1. TEMPERATURE SENSOR SIGNAL
RTSENC(IC) = RTEF7(ISP)
C
C      2. TEMPERATURE SET POINT
RTSETC = CSP(15)
C
C      ALGEBRAIC EQUATIONS - CONTROLLER MODEL
C
C      CALCULATE CONTROLLER TEMPERATURE ERROR SIGNAL
RERRTC(IC)=RTSENC(IC)-RTSETC
IF(RAFLGC(IC).EQ.1) RERRTC(IC)=0.0
C
C      CALCULATE CONTROLLER PROPORTIONAL SIGNAL
RLPROC(IC)=RKPROC(IC)*RERRTC(IC)
C
C      CALCULATE CONTROLLER COMMAND SIGNAL
IF(RAFLGC(IC).EQ.1) RLINTC(IC)=1.0
RLSUMC(IC)=RLPROC(IC)+RLINTC(IC)
IF(RLSUMC(IC).LT.0.05) RLSUMC(IC)=0.05
IF(RLSUMC(IC).GT.1.0) RLSUMC(IC)=1.0
C
C      DIFFERENTIAL EQUATION - CONTROLLER MODEL
C
C      CALCULATE DERIVATIVE OF CONTROLLER INTEGRAL SIGNAL
RDLINTC(IC)=RKINTC(IC)*RERRTC(IC)
C
C      GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
IF (DIAG(7)) PRINT *,*DIAG(7)/RECVR CONTROLLER *,IC,*,*,
1 * RTSETC = *,RTSETC,* RTSENC = *,RTSENC(IC),
2 * RERRTC = *,RERRTC(IC),* RLPROC = *,RLPROC(IC),
3 * RLINTC = *,RLINTC(IC),* RDLINTC = *,RDLINTC(IC),
4 * RLSUMC = *,RLSUMC(IC)
C
C----- STEAM HEADER MODEL -----
C
C      DEFINE STEAM HEADER MODEL INPUTS:
C
C      1. INLET ENTHALPY
RHISH(I) = RH7(ISP)
C
C      2. INLET FLOW RATE
RWISH(I) = RWSP(ISP)
C
C      3. OUTLET FLOW RATE
TW=(RFRSH-1465.)/(0.119*RVSH)
RWOSH=SQRT(AMAX1(0.0001,TW))
C
C      DIFFERENTIAL EQUATIONS - STEAM HEADER MODEL
C
C      CALCULATE DERIVATIVE OF FLUID SPECIFIC VOLUME IN
STEAM HEADER
SUM1SH=SUM1SH+RWISH(I)
RDVSH=RVSH*RVSH*(RWOSH-SUM1SH)/RKVSH
C
C      CALCULATE DERIVATIVE OF FLUID INTERNAL ENERGY IN
STEAM HEADER
SUM2SH=SUM2SH+RWISH(I)*RHISH(I)
RDUSH=RVSH*((SUM2SH-SUM1SH*RUSH)-RWOSH*(RHSH-RUSH))/RKVSH
C

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C      GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
      IF (DIAG(8)) PRINT *,*DIAG(8)/RECVR STEAM HEADER (INLET #,I,#): #,
1      # RHISH = #,RHISH(I),# PWISH = #,RWISH(I),# RWOSH = #,RWOSH,
2      # RVSH = #,RVSH,# RDVSH = #,RDVSH,# RUSH = #,RUSH,
3      # RDUSH = #,RDUSH,# RPRSH = #,RPRSH,# RHSH = #,RHSH,
4      # RTESH = #,RTESH
C
300  CONTINUE
C
C      SET MCS MONITORED VARIABLES TO THEIR EQUIVALENCED
C      GASP-IV STATE VARIABLES
C
      CRPRSH = RPRSH
      CRTESH = RTESH
C
C      ALL OTHER RECEIVER SUBSYSTEM OUTPUT VARIABLES TO OTHER
C      SUBSYSTEMS (E.G., RHSH, RPRSH, RWVSUM) ARE OBTAINED THROUGH
C      COMMON BLOCK RDATA. ANY MODIFICATIONS TO THESE VARIABLES
C      (E.G., EPGS MIGHT REQUIRE THE FIRST LETTER TO BE CHANGED
C      FROM AN R TO A G FOR NOMENCLATURE CONSISTENCY) MUST
C      BE DONE BY THE SUBSYSTEM USING THE VARIABLE.
C
C
      RETURN
      END

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SUBROUTINE RIAUXC

THE PURPOSE OF THIS ROUTINE IS TO CALCULATE

- 1) STEAM FLOW TO THE DESUPERHEATER
- 2) STEAM FLOW TO THE TURBINE MAIN THROTTLE
- 3) STEAM FLOW FROM RECEIVER FLASH TANK TO HEATER NO. 1 AND CONDENSER
- 4) CONDENSATE FROM RECEIVER FLASH TANK TO HEATER NO. 3 AND CONDENSER

RECEIVER FLASH TANK IS HERE AFTER DENOTED AS TANK NO. 3

THE STEAM CONDITIONS AT THE RECEIVER EVAPORATOR HEADER WHICH ARE KNOWN ARE

- 1) MASS FLOW RATE (LBM/HR) -RWOSH
- 2) TEMPERATURE (F) -RTESH
- 3) PRESSURE (PSIA) -RPRSH
- 4) ENTHALPY (BTU/LBM) -RHSH

THE ABOVE FOUR VALUES ARE PASSED TO THE ROUTINE VIA COMMON BLOCK /RDATA/

EXECUTIVE AND PROGRAM CONTROL DATA

INTEGER ATIMO,ATIDAY

LOGICAL CUTFG,END,DIAG

COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,

1 DIAG(40)

OUTFG(I,J) OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)

END END OF RUN FLAG

ATILCL LOCAL TIME (SECONDS FROM MIDNIGHT)

ATITST TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)

ATIMO MONTH

ATIDAY DAY

DIAG DIAGNOSTIC PRINT FLAG ARRAY

ENVIRONMENTAL DATA

COMMON /EDATA/ ETEAMB,EPRAMB,EVWAMB,EINDIR,EDWAMB,ETDAMB

ETEAMB AMBIENT TEMPERATURE (DEGREES FAHRENHEIT)

EPRAMB AMBIENT PRESSURE (LB/SQ IN ABS)

EVWAMB AMBIENT WIND VELOCITY (FT/SEC)

EINDIR DIRECT INSOLATION (KILOWATTS/SQ METER)

EDWAMB WIND DIRECTION (DEGREES AZIMUTH)

ETDAMB DEW POINT TEMPERATURE (DEGREES FAHRENHEIT)

RECEIVER SUBSYSTEM DATA

RECVR VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)

INTEGER RCVST,RAFLGC

COMMON /RDATA/ RHSH(6),RWISH(6),RHSH,RPRSH,RTESH,RWOSH,RFMV(6),

1 RLV(6),RHIV,RPRIV,RPRISV,RPROSV,RVIV,RHOV(6),RPROV(6),RWV(6),

2 RWVSUM,RHF1(8),RPRF1(8),RTEF1(8),RUF1(8),RVF1(8),RHCF2(8),

3 RHF2(8),RPRF2(8),RQF2(8),RTEF2(8),RTEFF2(8),RUF2(8),RVF2(8),

4 RWF2(8),RHCM2(8),RHFCM2(8),RHFRM2(8),RQM2(8),RQAM2(8),RQCM2(8),
5 RQEM2(8),RPRF3(8),RTEF3(8),RUF3(8),RVF3(8),RHCF4(8),RHHSF4(8),
6 RHFBF4(8),RHF4(8),RPRF4(8),RQF4(8),RTEF4(8),RTEFF4(8),RUF4(8),
7 RVF4(8),RWF4(8),RHCM4(8),RHFCM4(8),RHFRM4(8),RQM4(8),RQAM4(8),
8 RQCM4(8),RQEM4(8),RPRF5(8),RTEF5(8),RUF5(8),RVF5(8),RXF5(8),
9 RHCF6(8),RHF6(8),RPRF6(8),RQF6(8),RTEF6(8),RTEFF6(8),RUF6(8),
A RVF6(8),RWF6(8),RHCM6(8),RHFCM6(8),RHFRM6(8),RQM6(8),RQAM6(8),
B RQCM6(8),RQEM6(8),RHF7(8),RPRF7(8),RTEF7(8),RUF7(8),RVF7(8),
C RUF8(8),RVFSAT(8),RLVSAT(8),RVVSAT(8),RL35(8),RL57(8),RWSP(8),
D RCVST(8),RAFLGC(6),RERRTC(6),RLPROC(6),RLSUMC(6),RTSETC

C
C RHISH(ISP) FLUID ENTHALPY AT STEAM HEADER INLET
C (BTU/LBM)
C
C RWISH(ISP) FLUID MASS FLOW RATE AT STEAM HEADER INLET
C (LBM/SEC)
C
C RSHS FLUID ENTHALPY IN STEAM HEADER
C (BTU/LBM)
C
C RPRSH FLUID PRESSURE IN STEAM HEADER
C (PSIA)
C
C RTESH FLUID TEMPERATURE IN STEAM HEADER
C (DEGREES F)
C
C RWOSH FLUID MASS FLOW RATE AT STEAM HEADER OUTLET
C (LBM/SEC)
C
C REMV(IV) MODIFIED FRICTION FLOW COEFFICIENT FOR FLOW
C CONTROL VALVE (PSI,SEC**2/LBM,CU FT)
C
C RLV(IV) STEM DISPLACEMENT OF FLOW CONTROL VALVE
C (PERCENT)
C
C RHIV FLUID ENTHALPY AT FLOW CONTROL VALVE INLETS
C (BTU/LBM)
C
C RPRIV FLUID PRESSURE AT FLOW CONTROL VALVE INLETS
C (PSIA)
C
C RPRISV FLUID PRESSURE AT RECEIVER SUBSYSTEM INLET
C (PSIA)
C
C RFROSV FLUID PRESSURE AT RECEIVER SUBSYSTEM OUTLET
C (PSIA)
C
C RVIV FLUID SPECIFIC VOLUME AT FLOW CONTROL VALVE INLETS
C (CU FT/LBM)
C
C RHOV(IV) FLUID ENTHALPY AT FLOW CONTROL VALVE OUTLET
C (BTU/LBM)
C
C RFROV(IV) FLUID PRESSURE AT FLOW CONTROL VALVE OUTLET
C (PSIA)
C
C RWV(IV) FLUID MASS FLOW RATE THROUGH FLOW CONTROL VALVE
C (LBM/SEC)
C
C RWVSUM FLUID MASS FLOW RATE THROUGH ALL FLOW CONTROL VALVES
C (LBM/SEC)
C
C RHF1(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 1
C (BTU/LBM)
C
C RPRF1(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 1
C (PSIA)
C
C RTEF1(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 1
C (DEGREES F)
C
C RUF1(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 1
C (BTU/LBM)
C
C RVF1(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 1
C (CU FT/LBM)
C
C RHCF2(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
C
C RHF2(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 2
C (BTU/LBM)
C
C RPRF2(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 2

C (PSIA)
 C RQF2(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RTEF2(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 C (DEGREES F)
 C RTEFF2(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 C (DEGREES F)
 C RUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
 C (BTU/LBM)
 C RVF2(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 2
 C (CU FT/LBM)
 C RUTF2(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 2 (LBM/SEC)
 C RHCM2(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFCM2(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFRM2(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RQM2(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQAM2(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQCM2(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQEM2(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RPRF3(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 3
 C (PSIA)
 C RTEF3(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 3
 C (DEGREES F)
 C RUF3(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RVF3(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 3
 C (CU FT/LBM)
 C RHCF4(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHNSF4(ISP) INTERNAL NUCLEATE BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFBF4(ISP) INTERNAL FILM BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHF4(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RPRF4(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 4
 C (PSIA)
 C RQF4(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RTEF4(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RTEFF4(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RUF4(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RVF4(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 4
 C (CU FT/LBM)
 C RUTF4(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 4 (LBM/SEC)
 C RHCM4(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFCM4(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT

C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFRM4(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RQM4(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQAM4(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQCM4(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQEM4(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RPRF5(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 5
 C (PSIA)
 C RTEF5(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 5
 C (DEGREES F)
 C RUF5(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RVF5(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 5
 C (CU FT/LBM)
 C RXF5(ISP) FLUID QUALITY AT SUPERPANEL NODE NUMBER 5
 C (PERCENT)
 C RHCF6(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHF6(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RPRF6(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 6
 C (PSIA)
 C RQF6(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RTEF6(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RTEFF6(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RUF6(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RVF6(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 6
 C (CU FT/LBM)
 C RWF6(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 6 (LBM/SEC)
 C RHCM6(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFCM6(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFRM6(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RQM6(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQAM6(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQCM6(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQEM6(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RHF7(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RPRF7(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 7
 C (PSIA)
 C RTEF7(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 7
 C (DEGREES F)
 C RUF7(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 7

C (BTU/LBM)
 C RVF7(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 7
 C (CU FT/LBM)
 C RUF SAT(ISP) INTERNAL ENERGY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RVFSAT(ISP) SPECIFIC VOLUME OF A SATURATED LIQUID
 C (CU FT/LBM)
 C RUVSAT(ISP) INTERNAL ENERGY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RVVSAT(ISP) SPECIFIC VOLUME OF A SATURATED VAPOR
 C (CU FT/LBM)
 C RL35(ISP) LENGTH OF SUPERPANEL TWO-PHASE MIXTURE SECTION
 C (FEET)
 C RL57(ISP) LENGTH OF SUPERPANEL SUPERHEATED SECTION
 C (FEET)
 C RWSP(ISP) FLUID MASS FLOW RATE THROUGH SUPERPANEL
 C (LBM/SEC)
 C RCVST(ISP) SUPERPANEL FLUID CONTROL VOLUME STATE
 C RCVST = 1 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
 C FLUID STATES ONLY
 C RCVST = 2 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
 C AND SATURATED FLUID STATES
 C RCVST = 3 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED,
 C SATURATED, AND SUPERHEATED FLUID STATES
 C RAFLGC(IC) CONTROLLER ACTIVATION FLAG
 C RAFLGC = 1 SIGNIFIES RTSENC .LT. RKTHSC
 C RAFLGC = 2 SIGNIFIES RTSENC .GT. RKTHSC
 C RERRTC(IC) CONTROLLER TEMPERATURE ERROR SIGNAL
 C (DEGREES F)
 C RLPROC(IC) CONTROLLER PROPORTIONAL SIGNAL OF VALVE STEM
 C DISPLACEMENT (PERCENT)
 C RLSUMC(IC) CONTROLLER COMMAND SIGNAL OF VALVE STEM DISPLACEMENT
 C (PERCENT)
 C RTSETC CONTROLLER SET POINT FOR RECEIVER SUBSYSTEM OUTLET
 C TEMPERATURE (DEGREES F)

ELECTRICAL POWER GENERATION SUBSYSTEM DATA

EPGS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)

C COMMON /GDATA/ GPT3, GLT3, GWSOT3, GHSOT3, GWSBDC, GPSBDC, GTSBDC,
 1 GHLOSSD, GWSRG, GWSRT, GHSTSG, GPSTSG, GTSTSG, GPT1, GHSTH1, GHSTH1,
 2 GPT2, GHSTH2, GHSTH2, GHCT2, GLT2, GHCTC, GHCTH3, GHCTH5, GHATLP,
 3 GHTEXH, GPTEXH, GHTEXH, GHTEXT(4), GPTEXT(4), GHTEXT(4), GTPower,
 4 GEPOUT, GHLOSSR, GTFPR, GPOUT, GHCTP, GFPAUX, GWFPT, GFPH, GFPT, GTDSI,
 5 GFCTSG, CTCTSG, GHLOSSD, GHLOTSG, GTAXP, APBP, APHP, CHHTR1, GPHTR1,
 6 GTHTR1, GPSH1, GHSH1, GPSH2, GHSH2, GHCH4C, GHCH5C, GHCH23, GHCH12
 C
 C GPT3 PRESSURE (PSIA) IN TANK 3 (RECVR FLASH TANK)
 C GLT3 CCNDENSATE LEVEL (FT.) IN TANK 3
 C GHSOT3 FLOW (LBM/SEC) OF STEAM OUT OF TANK 3
 C GHSOT3 ENTHALPY (BTU/LBM) OF STEAM OUT OF TANK 3
 C GWSBDC FLOW (LBM/SEC) OF STEAM AT BOTTOM OF DOWNCOMER
 C GPSBDC PRESSURE (PSIA) OF STEAM AT BOTTOM OF DOWNCOMER
 C GTSBDC TEMPERATURE (F) OF STEAM AT BOTTOM OF DOWNCOMER
 C GHLOSSD HEAT LOSS (BTU/HR) FROM DOWNCOMER
 C GWSRG FLOW (LBM/SEC) OF RECVR STEAM TO TURBINE MAIN THROTTLE
 C GWSRT FLOW (LBM/SEC) OF RECVR STEAM TO THERMAL STORAGE
 C GHSTSG STEAM FLOW (LBM/SEC) AT TURBINE ADMISSION PORT

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COMMON /GCDATA/ GMVR(4),GMVT(2),GMVE(4),VRATE(12),GMVRO(4),
1  GKLT0(2),GMVE0(4),SSPI(12),TZERO(3),GPSPT3,GETAT3,GLTZ3,
2  GKLT3,GPSPT1,GMCT1,GPSPT2,GETAT2,GLTZ2,GKLT2,GRIDC,
3  GRODC,GLDC,GTG,GRISP,GROSP,GLSPGT,NPORTS,IFAN,GPTD(4),
4  GTEFF,GPHRDI(3,6),GWHRD(3),GTHRD(6),GMEFF,GKEFF,GKSGAIN,
5  GKINERT,GPFSPR,GFFHR,GFSPR,GFFPR,GFPTR,GVFPR,GRIEC,GRORC,
6  GLRC,GRIDS,GRODS,GLDSP,GFFSP,GLFWP,GRIFWP,GROFWP,INOM,
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7 VNOM,BPUMP(5),HPUMP(5),H1PARM(3),H2PARM(3),H4PARM(3),
8 H5PARM(3),GMCH3,GMCHW

C
C GMVR(4) SETTING OFR EPGS SERVO-CONTROLLED VALVES R1-R4
C RANGE IS 0. TO 1.0
C GHVT(2) SETTING FOR EPGS SERVO-CONTROLLED VALVES T1 AND T2
C RANGE IS 0. TO 1.0
C GMVE(4) SETTING FOR EPGS SERVO-CONTROLLED VALVES E1-E4
C RANGE IS 0. TO 1.0
C VRATE(10) MAX RATE FOR VALVES TO MOVE FROM OPEN TO CLOSE
C POSITONS
C GMVR0(4) VALVE SETTING FOR R1-R4 AT TIME TZERO(1)
C GHVT0(2) VALVE SETTING FOR T1-T2 AT TIME TZERO(2)
C GMVE0(4) VALVE SETTING FOR E1-E4 AT TIME TZERO(3)
C TZERO(3) LAST TIME SET POINT WAS CHANGED (SEC)
C SSP(11) SAVE SP(11) FROM COMMON BLOCK /C/DATA/
C GPSPT3 PRESSURE (PSIA) SET POINT FOR TANK 3 (RECVR FLASH)
C GETAT3 SIZING CONSTANT FOR TANK 3 (MAX LEVEL DIVIDED BY
C MAX OUTPUT FLOW RATE)
C GLZT3 NOMINAL WATER LEVEL (FT) FOR TANK 3
C GKLC3 CONSTANT FOR LEVEL CONTROL IN TANK 3
C GPSPT1 PRESSURE (PSIA) SET POINT FOR TANK 1 (TSS DRAIN SYS)
C GMCT1 MASS(LBM) OF CONDENSATE IN TANK 1
C GPSPT2 PRESSURE (PSIA) SET POINT FOR TANK 2 (TSS DRAIN SYS)
C GETAT2 SIZING CONSTANT FOR TANK 2 (MAX LEVEL / MAX FLOW)
C GLZT2 NOMINAL WATER LEVEL (FT) IN TANK 2
C GKLC2 LEVEL CONTROL GAIN FOR TANK 2
C GRISP INSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
C GROSP OUTSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
C GLSPTG LENGTH (FT) OF STEAM PIPE (TSS TO EPGS)
C GRIDC INSIDE RADIUS (FT) OF DOWNCOMER
C GRCDC OUTSIDE RADIUS (FT) OF DOWNCOMER
C GTC THERMAL CONDUCTIVITY OF DOWNCOMER INSULATION
C (BTU/HR-FT-DEG R)
C GLDC LENGTH OF DOWNCOMER IN FEET
C NPORTS NUMBER OF TURBINE EXTRACTION PORTS
C IFAN COOLING TOWER FAN CONDITIONS 1 2 FANS FULL SPEED
C 2 1 HALF 1 FULL
C 3 2 FANS HALF SPEED
C GPTED(4) EXTRACTION PRESSURE (PSIA) PER UNIT OF APPARENT LP
C FLOW (LBM/SEC)
C GTEFF TURBINE/GENERATOR EFFICIENCY
C GPHRD(3,6) CONDENSER PRESSURE (PSIA) AT GPHRD(3) AND GTHRD(6)
C GPHRD(3) CONDENSER FLOW (LBM/HR) DATA AT 3 DIFFERENT VALUES
C GTHRD(6) AMBIENT TEMP. (F) DATA AT 6 DIFFERENT VALUES
C GEMEFF ELECTRO-MECHANICAL EFFICIENCY OF RECVR FEEDPUMP
C CKEFF FEED PUMP EFFICIENCY
C KGAIN FEED PUMP CONTROL GAIN
C KINERT FEED PUMP MOMENT OF INERTIA
C GPFRRP RECVR INLET PRESSURE (PSIA) SET POINT
C GPFHR FEED PUMP RATED HEAD (FT)
C GPFSPR FEED PUMP RATED SPEED (RPM)
C GPFPR FEED PUMP RATED FLOW (LBM/SEC)
C GPFTR FEED PUMP RATED TORQUE (FT-LBS)
C GVFPF SPECIFIC VOLUME (FT**3/LBM) AT RATED CONDITIONS
C GRIRC INSIDE RADIUS (FT) OF RISER
C GRORC OUTSIDE RADIUS (FT) OF RISER
C GLRC LENGTH (FT) OF RISER
C GRIDS INSIDE RADIUS (FT) OF FW PIPE FEED PUMP TO DESUPHRT
C GRCDS OUTSIDE RADIUS (FT) FW PIPE FEED PUMP TO DESUPHRT

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C      GLDESP      LENGTH (FT) OF FW PIPE FEED PUMP TO DESUPERHRTR
C      GFFPSP      RECVR INLET PRESSURE (PSIA) SET POINT
C      GLFWP       LENGHT (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
C      GRIFWP      INNER RADIUS (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
C      BFUMP(5)    PARAMETERS FOR BOOST PUMP (SEE ROUTINE PUMPSS)
C      HFUMP(5)    PARAMETERS FOR HOTWELL PUMP (SEE ROUTINE PUMPSS)
C      H1PARM(3)   PARAMETERS FOR HEATER 1 (SEE ROUTINE CFH1HTR)
C      H2PARM(3)   PARAMETERS FOR HEATER 2 (SEE ROUTINE CFH2HTR)
C      H4PARM(3)   PARAMETERS FOR HEATER 4 (SEE ROUTINE CFH4HTR)
C      H5PARM(3)   PARAMETERS FOR HEATER 5 (SEE ROUTINE CFH5HTR)
C      GMCH3       MASS OF CONDENSATE (LBM) STORED IN HEATER 3
C      GROFWP      OUTER RADIUS (FT) OF FW PIPE EPGS TO TSS STEAM GEN.
C      GMCHW       MASS OF CONDENSATE (LBM) STORED IN CONDENSER HOTWELL
C      TNOM        NOMINAL TEMP (F) OF AIR SURROUNDING FW SYS COMPONENTS
C      VNOM        NOMINAL AIR VELOCITY (FT/SEC) ABOUT FW SYS COMPONENTS
C                  (NORMALLY SET TO ZERO)
C
C
C
C      GASP-IV SIMULATION SYSTEM DATA
C
C      COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
1NAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
2,TTCLR,TTFIN,TTTRIB(25),TTSET
C
C      COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
1,NNEQD,NNEQS,NNEQT,SS(600),SSL(600),TTNEX
C
C      DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
1  RLINTC(6),RL15(8),RHFSAT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
2  RDIUF2(8),RDL13(8),RDEM2(8),RDIHF3(8),RDEM4(8),RDEM6(8),
3  RDLINTC(6)
C
C      EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
1  (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
2  (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
4  (TDH5,SS(83)),(TDH7,SS(84)),(TDH8,SS(85)),
5  (TDH9,SS(86)),(GDCOT3,SS(87)),(GHDCOT3,SS(88)),
6  (GHDCOT3,SS(89)),(GHSDDC,SS(90)),(GHSTSG,SS(91)),
7  (GHDCOT1,SS(92)),(GHDCOT2,SS(93)),(GHDCOT2,SS(94)),
8  (GHDCOT2,SS(95)),(GFPS,SS(96)),(GHPCI,SS(97)),
9  (GHDSI,SS(98)),(GHCOH3,SS(99)),(GHCTSG,SS(100)),
A  (GHCHW,SS(101)),
B  (RL15(1),SS(102)),(RHFSAT(1),SS(110)),(RHF3(1),SS(118)),
C  (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
D  (CRPRSH,SS(151)),(CRTESH,SS(152)),(CGPFPR,SS(153)),
E  (CTLT,SS(154)),
F  (GPFP,SS(161)),(GPDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
G  (XK3,SS(165))
C
C      EQUIVALENCE (RDIUF2(1),DD(1)),(RDL13(1),DD(9)),(RDEM2(1),DD(17)),
1  (RDIHF3(1),DD(25)),(RDEM4(1),DD(33)),(RDEM6(1),DD(41)),
2  (RDUSH,DD(49)),(RDVSH,DD(50)),(RDLINTC(1),DD(51)),
3  (TDH5,DD(83)),(TDH7,DD(84)),
5  (TDH8,DD(85)),(TDH9,DD(86)),(GHDCOT3,DD(87)),
6  (GHDCOT3,DD(88)),(GHDCOT3,DD(89)),(GHSDDC,DD(90)),
7  (GHSTSG,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),
8  (GHDCOT2,DD(94)),(GHDCOT2,DD(95)),(GFPS,DD(96)),
9  (GHDCI,DD(97)),(GHDSI,DD(98)),(GHCOH3,DD(99)),
A  (GHDCOT3,DD(100)),(GHCHW,DD(101))
C

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C      INTEGRATED STATE VARIABLES
C
C      RIUF2(ISP)  FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
C                  (BTU/LBM)
C      RL13(ISP)  LENGTH OF SUPERPANEL SUBCOOLED SECTION
C                  (FEET)
C      RTEM2(ISP)  METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C                  (DEGREES F)
C      RIHF3(ISP)  FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
C                  (BTU/LBM)
C      RTEM4(ISP)  METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 4
C                  (DEGREES F)
C      RTEM6(ISP)  METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 6
C                  (DEGREES F)
C      RUSH       FLUID INTERNAL ENERGY IN STEAM HEADER
C                  (BTU/LBM)
C      RVSH       FLUID SPECIFIC VOLUME IN STEAM HEADER
C                  (CU FT/LBM)
C      RLINTC(IC)  CONTROLLER INTEGRAL SIGNAL OF VALVE STEM DISPLACEMENT
C                  (PERCENT)
C
C      TW5        NOMINAL OIL FLOW INTO STORAGE (LBM/SEC)
C      TW7        NOMINAL OIL FLOW FROM STORAGE (LBM/SEC)
C      TW8        STEAM FLOW FROM STEAM GENERATOR (LBM/SEC)
C      THTSU      HEAT STORED IN THERMAL STORAGE UNIT (BTU)
C
C      GMCT3      CONDENSATE MASS (LBM) IN TANK 3 (RECVR FLASH TANK)
C      GHCOT3     ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 3
C      GHCOT3     FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 3
C      GHSSDC     ENTHALPY (BTU/LBM) OF STEAM AT BOTTOM OF DOWNCOMER
C      GHSTSG     ENTHALPY (BTU/LBM) OF ADMISSION STEAM
C      GHCOT1     ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 1
C      GHCOT2     ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 2
C      GMCT2      MASS (LBM) OF CONDENSATE IN TANK 2
C      GHCOT2     FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 2
C      GFPS      RECVR FEED PUMP SPEED (RPM)
C      GHRCI      F.W. ENTHALPY (BTU/LBM) AT RECVR INLET
C      GHDSI      F.W. ENTHALPY (BTU/LBM) AT DESUPERHEATER INLET
C      GHCOH3     F.W. ENTHALPY (BTU/LBM) OUT OF FW HRTR NO. 3
C      GHCTSG     ENTHALPY (BTU/LBM) AT TSS STEAM GEN. INLET
C      GHCHW      ENTHALPY (BTU/LBM) OF CONDENSATE IN CONDENSER HOTWELL
C
C      ADDITIONALLY REQUIRED GASP-IV STATE VARIABLES
C
C      RL15(ISP)  COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND
C                  TWO-PHASE MIXTURE SECTIONS (FEET)
C      RHFSAT(ISP) ENTHALPY OF A SATURATED LIQUID
C                  (BTU/LBM)
C      RHF3(ISP)  FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
C                  (BTU/LBM)
C      RHVSAT(ISP) ENTHALPY OF A SATURATED VAPOR
C                  (BTU/LBM)
C      RHF5(ISP)  FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5
C                  (BTU/LBM)
C      RTSENC(IC) CONTROLLER TEMPERATURE SENSOR SIGNAL OF BOILER
C                  SUPERPANEL OUTLET TEMPERATURE (DEGREES F)
C      CRPRSH     FLUID PRESSURE IN RECEIVER STEAM HEADER
C                  (PSIA)
C      CRTESH     FLUID TEMPERATURE IN RECEIVER STEAM HEADER
C                  (DEGREES F)

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C CGPFPR FLUID PRESSURE AT RECEIVER INLET
C (PSIA)
C CTLT POSITION OF TSS THERMOCLINE
C (PERCENT)
C GPFPR FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
C GPDSI FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)
C XK1,XK2,XK3 EFGS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND
C PRESSURE AT RECEIVER INLET
C
C TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES
C
C RDIUF2(ISP) TIME DERIVATIVE OF RIUF2(ISP)
C RDL13(ISP) TIME DERIVATIVE OF RL13(ISP)
C RDTEN2(ISP) TIME DERIVATIVE OF RTEM2(ISP)
C RDIHF3(ISP) TIME DERIVATIVE OF RIHF3(ISP)
C RDTEN4(ISP) TIME DERIVATIVE OF RTEM4(ISP)
C RDTEN6(ISP) TIME DERIVATIVE OF RTEM6(ISP)
C RDUSH TIME DERIVATIVE OF RUSH
C RDVSH TIME DERIVATIVE OF RVSH
C RDLINTC(IC) TIME DERIVATIVE OF RLINTC(IC)
C
C TDW5 TIME DERIVATIVE OF TW5
C TDW7 TIME DERIVATIVE OF TW7
C TDW8 TIME DERIVATIVE OF TW8
C TDHTSU TIME DERIVATIVE OF THTSU
C
C GMCDT3 TIME DERIVATIVE OF GMCT3
C GHDCOT3 TIME DERIVATIVE OF GHCOT3
C GHDCOT3 TIME DERIVATIVE OF GHCOT3
C GHS9SDC TIME DERIVATIVE OF GHS9DC
C GHSTSG TIME DERIVATIVE OF GHSTSG
C GHDCOT1 TIME DERIVATIVE OF GHCOT1
C GHDCOT2 TIME DERIVATIVE OF GHCOT2
C GMDCT2 TIME DERIVATIVE OF GMCT2
C GHDCOT2 TIME DERIVATIVE OF GXCOT2
C GDFFS TIME DERIVATIVE OF GFFS
C GHRCI TIME DERIVATIVE OF GHRCI
C GHDDSI TIME DERIVATIVE OF GHDSI
C GHDCOH3 TIME DERIVATIVE OF GHCOH3
C GHCTSG TIME DERIVATIVE OF GHCTSG
C GHCHW TIME DERIVATIVE OF GHCHW
C
C
C COMPRESSED WATER/SUPERHEATED STEAM TABLE DATA
C
C LOGICAL NO COMP,SATURD
C REAL HE,PE,SE,TE,VE,XE
C COMMON /USECCM/ HE,PE,SE,TE,VE,XE,NO COMP,SATURD
C
C
C FUNDAMENTAL PHYSICAL CONSTANTS
C
C COMMON /CONSTS/ PI,ZFE,GRAV,GRAV0,SBC,GCAIR
C
C PI PI
C ZFR ZERO FAHRENHEIT (DEGREES RANKINE)
C GRAV LOCAL ACCELERATION DUE TO GRAVITY (FT/(SEC)**2)
C GRAV0 GRAVITATIONAL CONSTANT (LBM FT/LBF (SEC)**2)
C SBC STEFAN-BOLTZMANN CONSTANT (BTU/SEC-SQ FT (DEG R)**4)
C GCAIR GAS CONSTANT FOR AIR (FT LBF/LBM (DEG R))

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ITK3 AND IDC ARE FLAGS TO INDICATE WHETHER OR NOT ANY FLOW TO FLASH TANK NO. 3 AND THE DOWNCOMER, RESPECTIVELY. ZERO VALUE MEANS NO FLOW.

IF SUM IS LE 0, THAT IMPLIES NO STEAM FLOW TO FLASH TANK NO. 3 OR TO THE DOWN-COMER. THEREFORE, SKIP ALL CALCULATIONS FOR TANK NO. 3 AND THE DOWNCOMER.

```
GWSIT3=0
GWSIDC=0
GO TO 1000
```

END OF SECTION 1.

IF ITK3 =0 (NO FLOW TO FLASH TANK),
SKIP ALL CALCULATION FOR TANK NO. 3

ENTHALPY OF CONDENSATE INTO TANK NO. 3
(GHCIT3)
FLOW OF CONDENSATE INTO TANK NO. 3
(GHCIT3)

END OF SECTION 2.

SECTION 3 (STATEMENT LABELS 300 TO 400)
CALCULATES THE MASS COLLECTION IN TANK
NO. 3, THE STATE OF CUTPUT CONDENSATE FROM
FROM TANK NO. 3, AND THE LEVEL CONTROL

```

C                                     OF TANK NO. 3.
C
C                                     1) CALCULATE TIME DERIVATIVE OF
C                                     CONDENSATE OUTPUT (GWDCOT3)
C      GWDCOT3=(GWCIT3-GWCOT3)/GKLCT3
C
C                                     2) CALCULATE TIME DERIVATIVE OF
C                                     MASS (GMCOT3)
C      GMCOT3=GWCIT3-GWCOT3
C
C                                     3) CALCULATE TIME DERIVATIVE OF
C                                     EXIT ENTHALPY (GHDCOT3)
C                                     A) SPECIFIC VOLUME OF WATER AT STATED
C                                     PRESSURE AND ENTHALPY (GVCT3)
C
C      CALL USE HP(GHCOT3,GPT3)
C      GVCT3=VE
C
C      GHDCOT3=(GWCIT3*(GHCIT3-GHCOT3)+GPT3*GVCT3*(GWCIT3-GWCOT3))/
1      GMCT3
C
C                                     4) CALCULATE TANK NO. 3 LEVEL (GLT3)
C
C      GLT3=GLZT3+GETAT3*GWCOT3
400 CONTINUE
C
C                                     END OF SECTION 3.
C                                     ENDED CALCULATIONS FOR TANK NO. 3.
C
500 CONTINUE
C      DIAGNOSTIC PRINT IF DESIRED
C      IF (DIAG(21)) WRITE (6,509) GWSIT3,GPT3,GVCT3,GWCIT3,GWCOT3,
1      GMCT3,GHCIT3,GHCOT3,GLT3,GWSOT3,
2      GHSOT3
509 FORMAT(1H ,28HDIAG21/EPGS-RECVR FLASH TANK,/
1      19X,8H GWSIT3=,G10.4,8H GPT3=,G10.4,8H GVCT3=,
2      G10.4,8H GWCIT3=,G10.4,8H GWCOT3=,G10.4,/,19X,8H GMCT3=,
3      G10.4,8H GHCIT3=,G10.4,8H GHCOT3=,G10.4,8H GLT3=,G10.4,
4      8H GWSOT3=,G10.4,8H GHSOT3=,G10.4)
C      SECTION 4 DOES THE CALCULATIONS FOR THE
C      DOWNCOMER.
C
C      IF IDC EQ 0 (NO FLOW TO DOWNCOMER), SKIP
C      ALL CALCULATIONS FOR DOWNCOMER.
C
C      INITIAL FLOW IN BOTTOM OF THE
C      DOWNCOMER IS ZERO.
C
C      GWSBDC=0.
C      IF (IDC .EQ. 0) GO TO 1000
C
C      1) CALCULATE DOWNCOMER LOSSES
C      INSIDE DIAMETER OF DOWNCOMER (GDIDC)
C      GDIDC=2.*GRIDC
C      OUTSIDE DIAMETER OF DOWNCOMER (GDODC)
C      GDODC=2.*GRODC
C
C      A) CALCULATE REYNOLDS NUMBER FOR STEAM

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C          AT DOWNCOMER (GRESDC)
GRESDC=ALREWA(RTESH,RPRSH,GWSIDC,GDIDC)

C          B) CALCULATE FRICTION FACTOR (GFRCTD)
C
C
C          C) CALCULATE CHANGE IN PRESSURE
C          (GPDELD)
C          SPECIFIC VOLUME OF STEAM IN
C          DOWNCOMER (GVSDC)
C
C          CALL USE HP(RHSH,RPRSH)
GVSDC=VE
C          DYNAMIC VISCOSITY OF STEAM IN
C          DOWNCOMER (GMUSDC)
C
C          GMUSDC=A1VISC(RTESH,RPRSH)
C          CALL FRLOSS(GDIDC,GRESDC,GMUSDC,GLDC,GVSDC,GPDELD)
C
C          D) CALCULATE HEAT LOSSES FOR DOWNCOMER
C
C          CALL PIPELOS(ETEAMB,RTESH,EPRAMB,EVWAMB,GDODC,GDIDC,GLDC,GTC,
1          GHLOSSD)
C
C          2) CALCULATE FLUID STATE AT THE BOTTOM OF
C          DOWNCOMER
C          FLOW AT BOTTOM OF DOWNCOMER
C          GWSBDC=GWSIDC
C          A) PRESSUR-GPBD C
GPDELD=0.119*RVSH*RWOSH**2
GPSBDC=RPRSH-GPDELD
GPSBDC=1465.0
C          B) ENTHALPY TRANSPORT DELAY
C          CALCULATE TOTAL MASS IN
C          DOWNCOMER (GMDC)
GMDC=GLDC*PI*GRIDC*GRIDC/GVSDC
C          CALCULATE DERIVATIVE OF
C          ENTHALPY AT BOTTOM OF
C          DOWNCOMER (GHSBDC)
GHSBDC=(2./GMDC)*(GWSIDC*(RHSH-GHSBDC)
1          -(GHLOSSD/3600.)+(GWSIDC*GLDC/778.))
C          C) TEMPERATURE -GTSBDC
CALL USE HP(GHSBDC,GPSBDC)
GTSBDC=TE
C          END OF SECTION 4
C          END OF CALCULATIONS FOR DOWNCOMER
C          1000 CONTINUE
C          SECTION 5 (STATEMENT LABELS 1000 TO 1100)
C          CALCULATES THE FLOWS TO R3, R4.
C

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C      SUBROUTINE RSP(ISP)
C      CALCULATE STATE VARIABLE EQUATIONS FOR A SUPERPANEL
C
C      MODELING AND CODING BY K. L. ZONDERVAN, X86317,
C      BLDG A3, RM 2923, AEROSPACE CORPORATION
C
C      EXECUTIVE AND PROGRAM CONTROL DATA
C
C      INTEGER ATIMO,ATIDAY
C      LOGICAL OUTFG,END,DIAG
C      COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1      DIAG(40)
C
C      OUTFG(I,J) OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
C      END      END OF RUN FLAG
C      ATILCL   LOCAL TIME (SECONDS FROM MIDNIGHT)
C      ATITST   TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
C      ATIMO    MONTH
C      ATIDAY   DAY
C      DIAG     DIAGNOSTIC PRINT FLAG ARRAY
C
C      ENVIRONMENTAL DATA
C
C      COMMON /EDATA/ ETEAMB,EPRAMB,EVWAMB,EINDIR,EDWAMB,ETDAMB
C
C      ETEAMB   AMBIENT TEMPERATURE (DEGREES FAHRENHEIT)
C      EPRAMB   AMBIENT PRESSURE (LB/SQ IN ABS)
C      EVWAMB   AMBIENT WIND VELOCITY (FT/SEC)
C      EINDIR   DIRECT INSOLATION (KILOWATTS/SQ METER)
C      EDWAMB   WIND DIRECTION (DEGREES AZIMUTH)
C      ETDAMB   DEW POINT TEMPERATURE (DEGREES FAHRENHEIT)
C
C      RECEIVER SUBSYSTEM DATA
C
C      RECVR VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)
C
C      INTEGER RCVST,RAFLGC
C      COMMON /RDATA/ RHISH(6),RWISH(6),RHSH,RPRSH,RTESH,RWOSH,RFMV(6),
1      RLV(6),RHIV,RPRIV,RFRISV,RPROSV,RVIV,RHGV(6),RPROV(6),RWV(6),
2      RWVSUM,RHF1(8),RPRF1(8),RTEF1(8),RUF1(8),RVF1(8),RHCF2(8),
3      RHF2(8),RPRF2(8),RQF2(8),RTEF2(8),RTEFF2(8),RUF2(8),RVF2(8),
4      RWTF2(8),RHCM2(8),RHFCM2(8),RHFRM2(8),RQM2(8),RQAM2(8),RQCM2(8),
5      RQEM2(8),RPRF3(8),RTEF3(8),RUF3(8),RVF3(8),RHCF4(8),RHNSF4(8),
6      RHFBF4(8),RHF4(8),RPRF4(8),RQF4(8),RTEF4(8),RTEFF4(8),RUF4(8),
7      RVF4(8),RWTF4(8),RHCM4(8),RHFCM4(8),RHFRM4(8),RQM4(8),RQAM4(8),
8      RQCM4(8),RQEM4(8),RPRF5(8),RTEF5(8),RUF5(8),RVF5(8),RXF5(8),
9      RHCF6(8),RHF6(8),RPRF6(8),RQF6(8),RTEF6(8),RTEFF6(8),RUF6(8),
A      RVF6(8),RWTF6(8),RHCM6(8),RHFCM6(8),RHFRM6(8),RQM6(8),RQAM6(8),
B      RQCM6(8),RQEM6(8),RHF7(8),RPRF7(8),RTEF7(8),RUF7(8),RVF7(8),
C      RUF8(8),RVFSAT(8),RUVSAT(8),RVVSAT(8),RL35(8),RL57(8),RHSP(8),
D      RCVST(8),RAFLGC(6),RERRTC(6),RLPROC(6),RLSUNC(6),RTSETC
C
C      RHISH(ISP) FLUID ENTHALPY AT STEAM HEADER INLET
C      (BTU/LBM)
C      RWISH(ISP) FLUID MASS FLOW RATE AT STEAM HEADER INLET
C      (LBM/SEC)

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C	RHSH	FLUID ENTHALPY IN STEAM HEADER
C		(BTU/LBM)
C	RPRSH	FLUID PRESSURE IN STEAM HEADER
C		(PSIA)
C	RTESH	FLUID TEMPERATURE IN STEAM HEADER
C		(DEGREES F)
C	RWOSH	FLUID MASS FLOW RATE AT STEAM HEADER OUTLET
C		(LBM/SEC)
C	RFMV(IV)	MODIFIED FRICTION FLOW COEFFICIENT FOR FLOW
C		CONTROL VALVE (PSI,SEC**2/LBM,CU FT)
C	RLV(IV)	STEM DISPLACEMENT OF FLOW CONTROL VALVE
C		(PERCENT)
C	RHIV	FLUID ENTHALPY AT FLOW CONTROL VALVE INLETS
C		(BTU/LBM)
C	RFRIV	FLUID PRESSURE AT FLOW CONTROL VALVE INLETS
C		(PSIA)
C	RPRISV	FLUID PRESSURE AT RECEIVER SUBSYSTEM INLET
C		(PSIA)
C	RPROSV	FLUID PRESSURE AT RECEIVER SUBSYSTEM OUTLET
C		(PSIA)
C	RVIV	FLUID SPECIFIC VOLUME AT FLOW CONTROL VALVE INLETS
C		(CU FT/LBM)
C	RHOV(IV)	FLUID ENTHALPY AT FLOW CONTROL VALVE OUTLET
C		(BTU/LBM)
C	RPROV(IV)	FLUID PRESSURE AT FLOW CONTROL VALVE OUTLET
C		(PSIA)
C	RWV(IV)	FLUID MASS FLOW RATE THROUGH FLOW CONTROL VALVE
C		(LBM/SEC)
C	RWVSUM	FLUID MASS FLOW RATE THROUGH ALL FLOW CONTROL VALVES
C		(LBM/SEC)
C	RHF1(ISP)	FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 1
C		(BTU/LBM)
C	RPRF1(ISP)	FLUID PRESSURE AT SUPERPANEL NODE NUMBER 1
C		(PSIA)
C	RTEF1(ISP)	FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 1
C		(DEGREES F)
C	RUF1(ISP)	FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 1
C		(BTU/LBM)
C	RVF1(ISP)	FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 1
C		(CU FT/LBM)
C	RHCF2(ISP)	INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C		SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
C	RHF2(ISP)	FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 2
C		(BTU/LBM)
C	RPRF2(ISP)	FLUID PRESSURE AT SUPERPANEL NODE NUMBER 2
C		(PSIA)
C	RQF2(ISP)	HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
C		SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
C	RTEF2(ISP)	FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C		(DEGREES F)
C	RTEFF2(ISP)	FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C		(DEGREES F)
C	RUF2(ISP)	FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
C		(BTU/LBM)
C	RVF2(ISP)	FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 2
C		(CU FT/LBM)
C	RWTF2(ISP)	FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
C		NUMBER 2 (LBM/SEC)
C	RHCM2(ISP)	EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C		SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)

C RHFCM2(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFRM2(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RQM2(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQAM2(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQCM2(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQEM2(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RPRF3(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 3
 C (PSIA)
 C RTEF3(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 3
 C (DEGREES F)
 C RUF3(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RVF3(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 3
 C (CU FT/LBM)
 C RHCF4(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHNBF4(ISP) INTERNAL NUCLEATE BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFBF4(ISP) INTERNAL FILM BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHF4(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RPRF4(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 4
 C (PSIA)
 C RQF4(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RTEF4(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RTEFF4(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RUF4(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RVF4(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 4
 C (CU FT/LBM)
 C RWF4(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 4 (LBM/SEC)
 C RHCM4(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFCM4(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFRM4(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RQM4(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQAM4(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQCM4(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQEM4(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RPRF5(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 5
 C (PSIA)
 C RTEF5(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 5
 C (DEGREES F)

C RUF5(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RVF5(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 5
 C (CU FT/LBM)
 C RXF5(ISP) FLUID QUALITY AT SUPERPANEL NODE NUMBER 5
 C (PERCENT)
 C RHCF6(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHF6(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RPRF6(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 6
 C (PSIA)
 C RQF6(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RTEF6(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RTEFF6(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RUF6(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RVF6(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 6
 C (CU FT/LBM)
 C RWF6(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 6 (LBM/SEC)
 C RHCM6(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFCM6(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFRM6(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RQM6(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQAM6(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQCM6(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQEM6(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RHF7(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RPRF7(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 7
 C (PSIA)
 C RTEF7(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 7
 C (DEGREES F)
 C RUF7(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RVF7(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 7
 C (CU FT/LBM)
 C RUF5AT(ISP) INTERNAL ENERGY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RVFSAT(ISP) SPECIFIC VOLUME OF A SATURATED LIQUID
 C (CU FT/LBM)
 C RUVSAT(ISP) INTERNAL ENERGY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RVVSAT(ISP) SPECIFIC VOLUME OF A SATURATED VAPOR
 C (CU FT/LBM)
 C RL35(ISP) LENGTH OF SUPERPANEL TWO-PHASE MIXTURE SECTION
 C (FEET)
 C RL57(ISP) LENGTH OF SUPERPANEL SUPERHEATED SECTION
 C (FEET)

C RWSP(ISP) FLUID MASS FLOW RATE THROUGH SUPERPANEL
 C (LBM/SEC)
 C RCVST(ISP) SUPERPANEL FLUID CONTROL VOLUME STATE
 C RCVST = 1 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
 C FLUID STATES ONLY
 C RCVST = 2 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
 C AND SATURATED FLUID STATES
 C RCVST = 3 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED,
 C SATURATED, AND SUPERHEATED FLUID STATES
 C RAFLGC(IC) CONTROLLER ACTIVATION FLAG
 C RAFLGC = 1 SIGNIFIES RTSENC .LT. RKTHSC
 C RAFLGC = 2 SIGNIFIES RTSENC .GT. RKTHSC
 C RERRTC(IC) CONTROLLER TEMPERATURE ERROR SIGNAL
 C (DEGREES F)
 C RLPROC(IC) CONTROLLER PROPORTIONAL SIGNAL OF VALVE STEM
 C DISPLACEMENT (PERCENT)
 C RLSUMC(IC) CONTROLLER COMMAND SIGNAL OF VALVE STEM DISPLACEMENT
 C (PERCENT)
 C RTSETC CONTROLLER SET POINT FOR RECEIVER SUBSYSTEM OUTLET
 C TEMPERATURE (DEGREES F)

RECVR CONSTANTS

C INTEGER RKNTB,RKNPSP,RKNBSP
 C COMMON /RCDATA/ RKCM,RKDNM,RKCSP,RKEESP,RKHFC,RKHFR,RKIDTB,
 C 1 RKODTB,RKWSP,RKL17,RKASP,RKSSP,RKNTB,RKNPSP,RKNBSP,RKFF2,
 C 2 RKFF4,RKFF6,RKFV(6),RKAHV(6),RKVSH,RKINTC(6),RKPROC(6),RKTHSC

C RKCM HEAT CAPACITY OF SUPERPANEL TUBE METAL
 C (BTU/LBM,F)
 C RKDNM DENSITY OF SUPERPANEL TUBE METAL
 C (LBM/CU FT)
 C RKCSP HEAT CAPACITY OF A SUPERPANEL PER UNIT LENGTH
 C (BTU/FT,F)
 C RKEESP EMISSIVITY OF EXTERNAL SUPERPANEL COATING
 C (ND)
 C RKHFC EXTERNAL FORCED CONVECTION HEAT TRANSFER CONSTANT
 C ()
 C RKHFR EXTERNAL FREE CONVECTION HEAT TRANSFER CONSTANT
 C ()
 C RKIDTB INSIDE DIAMETER OF A SUPERPANEL TUBE
 C (FEET)
 C RKODTB OUTSIDE DIAMETER OF A SUPERPANEL TUBE
 C (FEET)
 C RKWSP WIDTH OF A SUPERPANEL
 C (FEET)
 C RKL17 INSULATION EXPOSED LENGTH OF A SUPERPANEL
 C (FEET)
 C RKASP FLOW CROSS SECTIONAL AREA OF A SUPERPANEL
 C (SQ FT)
 C RKSSP INSIDE SURFACE AREA PER UNIT LENGTH OF A SUPERPANEL
 C (FEET)
 C RKNTB NUMBER OF TUBES COMPOSING A SUPERPANEL
 C (ND)
 C RKNPSP NUMBER OF PREHEATER SUPERPANELS
 C (ND)
 C RKNBSP NUMBER OF BOILER SUPERPANELS
 C (ND)
 C RKFF2 FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 2

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C      (PSI,SEC**2/LBM,CU FT)
C      RKFF4      FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 4
C      (PSI,SEC**2/LBM,CU FT)
C      RKFF6      FLUID FLOW COEFFICIENT AT SUPERPANEL NODE NUMBER 6
C      (PSI,SEC**2/LBM,CU FT)
C      RKFV(IV)    FLUID FLOW COEFFICIENT OF FLOW CONTROL VALVE
C      (PSI,SEC**2/LBM,CU FT)
C      RKAIV(IV)   PERCENT SUSSYSTEM PRESSURE DROP ACROSS
C      FLOW CONTROL VALVE (PERCENT)
C      RKVSH       VOLUME OF STEAM HEADER
C      (CU FT)
C      RKINTC(IC)  CONTROLLER INTEGRAL GAIN CONSTANT
C      (PERCENT,SEC/F)
C      RKPROC(IC)  CONTROLLER PROPORTIONAL GAIN CONSTANT
C      (PERCENT/F)
C      RKTWSC      CONTROLLER ACTIVATION TEMPERATURE THRESHOLD
C      (DEGREES F)
C
C      GASP-IV SIMULATION SYSTEM DATA
C
C      COMMON /GCOM1/, ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
1NAFO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
2,TTCLR,TTFIN,TTTRIB(25),TTSET
C
C      COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
1,NNEQD,NNEQS,NNEQT,SS(600),SSL(600),TTNEX
C
C      DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
1  RLINTC(6),RL15(8),RHFSAT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
2  RDIUF2(8),RDL13(8),RDEM2(8),RDIHF3(8),RDEM4(8),RDEM6(8),
3  RDLINTC(6)
C
C      EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
1  (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
2  (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
3  (TW5,SS(83)),(TW7,SS(84)),(TW8,SS(85)),
4  (THTSU,SS(86)),(GHCT3,SS(87)),(GHCT3,SS(88)),
5  (GHCT3,SS(89)),(GHSDDC,SS(90)),(GHSTSG,SS(91)),
6  (GHCT1,SS(92)),(GHCT2,SS(93)),(GHCT2,SS(94)),
7  (GHCT2,SS(95)),(GFPS,SS(96)),(GHRCI,SS(97)),
8  (GHDSI,SS(98)),(GHCOH3,SS(99)),(GHCTSG,SS(100)),
9  (GHCHW,SS(101)),
A  (RL15(1),SS(102)),(RHFSAT(1),SS(110)),(RHF3(1),SS(118)),
B  (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
C  (CRFRSH,SS(151)),(CRTESH,SS(152)),(CGFFPR,SS(153)),
D  (CTLT,SS(154)),
E  (GFFPR,SS(161)),(GPDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
F  (XK3,SS(165))
C
C      EQUIVALENCE (RDIUF2(1),DD(1)),(RDL13(1),DD(9)),(RDEM2(1),DD(17)),
1  (RDIHF3(1),DD(25)),(RDEM4(1),DD(33)),(RDEM6(1),DD(41)),
2  (RDUSH,DD(49)),(RDVSH,DD(50)),(RDLINTC(1),DD(51)),
3  (TDW5,DD(83)),(TDW7,DD(84)),
4  (TDW8,DD(85)),(TDHTSU,DD(86)),(GHCT3,DD(87)),
5  (GHCT3,DD(88)),(GHCT3,DD(89)),(GHSDDC,DD(90)),
6  (GHCTSG,DD(91)),(GHCT1,DD(92)),(GHCT2,DD(93)),
7  (GHCT2,DD(94)),(GHCT2,DD(95)),(GFPS,DD(96)),
8  (GHRCI,DD(97)),(GHDSI,DD(98)),(GHCOH3,DD(99)),
9  (GHCTSG,DD(100)),(GHCHW,DD(101))

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C      (DEGREES F)
C      CGPFPR      FLUID PRESSURE AT RECEIVER INLET
C                  (PSIA)
C      CTLT        POSITION OF TSS THERMOCLINE
C                  (PERCENT)
C      GPFPR        FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
C      GPDSI        FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)
C      XK1,XK2,XK3  EFGS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND
C                  PRESSURE AT RECEIVER INLET
C
C      TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES
C
C      RDIUF2(ISP)  TIME DERIVATIVE OF RIUF2(ISP)
C      RDL13(ISP)   TIME DERIVATIVE OF RL13(ISP)
C      RDTM2(ISP)   TIME DERIVATIVE OF RTM2(ISP)
C      RDIHF3(ISP)  TIME DERIVATIVE OF RIHF3(ISP)
C      RDTM4(ISP)   TIME DERIVATIVE OF RTM4(ISP)
C      RDTM6(ISP)   TIME DERIVATIVE OF RTM6(ISP)
C      RDUSH        TIME DERIVATIVE OF RUSH
C      RDVSH        TIME DERIVATIVE OF RVSH
C      RDLINTC(IC)  TIME DERIVATIVE OF RLINTC(IC)
C
C      TDW5         TIME DERIVATIVE OF TW5
C      TDW7         TIME DERIVATIVE OF TW7
C      TDW8         TIME DERIVATIVE OF TW8
C      TDHTSU       TIME DERIVATIVE OF THTSU
C
C      GHCDT3       TIME DERIVATIVE OF GHCT3
C      GHDCOT3      TIME DERIVATIVE OF GHCT3
C      GHDCOT3      TIME DERIVATIVE OF GHCT3
C      GHSOSDC      TIME DERIVATIVE OF GHSBDC
C      GHDSISG      TIME DERIVATIVE OF GHSTSG
C      GHDCOT1      TIME DERIVATIVE OF GHCT1
C      GHDCOT2      TIME DERIVATIVE OF GHCT2
C      GHDCOT2      TIME DERIVATIVE OF GHCT2
C      GHDCOT2      TIME DERIVATIVE OF GHCT2
C      GDFFS        TIME DERIVATIVE OF GFPS
C      GHDRCI       TIME DERIVATIVE OF GHRCI
C      GHDDSI       TIME DERIVATIVE OF GHDSI
C      GHDCOH3      TIME DERIVATIVE OF GHCOH3
C      GHDCISG      TIME DERIVATIVE OF GHCTSG
C      GHDCWH       TIME DERIVATIVE OF GHCHW
C
C      FUNDAMENTAL PHYSICAL CONSTANTS
C
C      COMMON /CONSTS/ PI,ZFR,GRAV,GRAV0,SBC,GCAIR
C
C      PI           PI
C      ZFR          ZERO FAHRENHEIT (DEGREES RANKINE)
C      GRAV         LOCAL ACCELERATION DUE TO GRAVITY (FT/(SEC)**2)
C      GRAV0        GRAVITATIONAL CONSTANT (LBM FT/LBF (SEC)**2)
C      SEC          STEFAN-BOLTZMANN CONSTANT (BTU/SEC-SQ FT (DEG R)**4)
C      GCAIR        GAS CONSTANT FOR AIR (FT LBF/LBM (DEG R))
C
C      ***** BEGIN COMPUTATIONS *****
C
C      ***** ALGEBRAIC EQUATIONS - FLUID CONTROL VOLUME OF SUPERPANEL

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C      SUBCOOLED SECTION
C
C
C      IF (RL13(ISP).LT.0.0) RL13(ISP)=0.0
C      CALCULATE FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 1
C      CALL ALINTS(3,11,RHF1(ISP),RTEF1(ISP))
C
C      CALCULATE FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 1
C      CALL ALINTS(3,2,RHF1(ISP),RUF1(ISP))
C
C      CALCULATE FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 1
C      CALL ALINTS(3,5,RHF1(ISP),RVF1(ISP))
C
C      IF (RCVST(ISP).EQ.1) RUF2(ISP)=RIUF2(ISP)
C
C      BEGIN ITERATIVE CALCULATIONS FOR FLUID INTERNAL ENERGY AT
C      SUPERPANEL NODE NUMBER 2 FOR RCVST .EQ. 2 OR RCVST .EQ. 3
C      ITER=0
C
C      CALCULATE FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 2
100 CALL ALINTS(2,5,RUF2(ISP),RVF2(ISP))
C
C      CALCULATE FLUID PRESSURE AT SUPERPANEL NODE NUMBER 3
C      SGN=1.0
C      IF (ISP.LE.RKNPSP) SGN=(2*MOD(ISP,2)-1)
C      RPRF3(ISP)=RPRF1(ISP)-(RL13(ISP)/RKLL17)*RKFF2*RVF2(ISP)*RWSP(ISP)
1  *RWSP(ISP)-SGN*(RL13(ISP)*GRAV)/(144.0*GRAV0*RVF2(ISP))
C
C      CALCULATE INTERNAL ENERGY OF A SATURATED LIQUID FOR PRESSURE
C      AT SUPERPANEL NODE NUMBER 3
C      CALL ALINTS(10,2,RPRF3(ISP),RUFSAT(ISP))
C
C      IF (RCVST(ISP).EQ.1) GO TO 200
C
C      CALCULATE FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
C      FOR RCVST .EQ. 2 OR RCVST .EQ. 3
C      RNUF2=0.5*(RUF1(ISP)+RUFSAT(ISP))
C
C      CHECK CONVERGENCE OF ITERATIVE CALCULATIONS FOR FLUID
C      INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2 FOR RCVST
C      .EQ. 2 OR RCVST .EQ. 3
C      ERR=(RNUF2-RUF2(ISP))/RUF2(ISP)
C      RUF2(ISP)=RNUF2
C      ITER=ITER+1
C      IF (ABS(ERR).GT.0.001.AND.ITER.LT.25) GO TO 100
C      IF (ITER.EQ.25) PRINT *,#      ITERATIVE LOOP IN FLUID CONTROL #,
1  *VOLUME CALCULATIONS FOR THE SUBCOOLED SECTION OF RECEIVER #,
2  *SUPERPANEL #,ISP,# HAS FAILED TO CONVERGE#
C
C      CALCULATE FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 2
200 CALL ALINTS(2,3,RUF2(ISP),RHF2(ISP))
C
C      CALCULATE FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C      CALL ALINTS(2,11,RUF2(ISP),RTEF2(ISP))
C
C      CALCULATE ENTHALPY OF A SATURATED LIQUID FOR PRESSURE AT
C      SUPERPANEL NODE NUMBER 3
C      CALL ALINTS(10,3,RPRF3(ISP),RHFSAT(ISP))
C
C      CALCULATE SPECIFIC VOLUME OF A SATURATE LIQUID FOR PRESSURE AT

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C      SUPERPANEL NODE NUMER 3
C      CALL A1INTS(10,5,RPRF3(ISP),RVFSAT(ISP))
C
C      IF (RCVST(ISP).EQ.1) GO TO 300
C
C      CALCULATE FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
C      FOR RCVST .EQ. 2 OR RCVST .EQ. 3
C
C      RHF3(ISP)=RHFSAT(ISP)
C
C      CALCULATE FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 3
C      FOR RCVST .EQ. 2 OR RCVST .EQ. 3
C      RUF3(ISP)=RUF3SAT(ISP)
C
C      CALCULATE FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 3
C      FOR RCVST .EQ. 2 OR RCVST .EQ. 3
C      RVF3(ISP)=RVFSAT(ISP)
C
C      GO TO 400
C
C 300 RHF3(ISP)=RIHF3(ISP)
C
C      CALCULATE FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 3
C      FOR RCVST .EQ. 1
C      CALL A1INTS(3,2,RHF3(ISP),RUF3(ISP))
C
C      CALCULATE FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 3
C      FOR RCVST .EQ. 1
C      CALL A1INTS(3,5,RHF3(ISP),RVF3(ISP))
C
C      CALCULATE FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 3
C 400 CALL A1INTS(3,11,RHF3(ISP),RTEF3(ISP))
C
C      CALCULATE FLUID PRESSURE AT SUPERPANEL NODE NUMBER 2
C      RPRF2(ISP)=0.5*(RPRF1(ISP)+RPRF3(ISP))
C
C      CALCULATE FLUID FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C      RTEFF2(ISP)=0.5*(RTEF2(ISP)+RTEM2(ISP))
C
C      CALCULATE FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
C      NUMBER 2
C      RWTF2(ISP)=RWSP(ISP)/RKNTB
C
C      CALCULATE INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C      SUPERPANEL NODE NUMBER 2
C      RHCF2(ISP)=A1HTAR(RTEFF2(ISP),RPRF2(ISP),RWTF2(ISP),RKIDTB)
C 1  *(((RTEF2(ISP)+ZFR)/(RTEFF2(ISP)+ZFR))*0.8)
C
C      CALCULATE HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
C      SUPERPANEL SUBCOOLED SECTION
C      RQF2(ISP)=RHCF2(ISP)*RKSSP*RL13(ISP)*(RTEM2(ISP)-RTEF2(ISP))
C
C      IF (RCVST(ISP).EQ.2 .OR. RCVST(ISP).EQ.3) GO TO 500
C
C      DEFINE SUPERPANEL OUTLET CONDITIONS FOR RCVST .EQ. 1
C      RPRF7(ISP)=RPRF3(ISP)
C      RHF7(ISP)=RHF3(ISP)
C      RTEF7(ISP)=RTEF3(ISP)
C      RUF7(ISP)=RUF3(ISP)
C      RVF7(ISP)=RVF3(ISP)

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C      GO TO 1000.
C
C      500  CONTINUE
C
C      ***** ALGEBRAIC EQUATIONS - FLUID CONTROL VOLUME OF SUPERPANEL
C              TWO-PHASE MIXTURE SECTION
C
C      CALCULATE ENTHALPY OF A SATURATED VAPOR FOR PRESSURE AT
C      SUPERPANEL NODE NUMBER 3
C      CALL A1INTS(10,7,RPRF3(ISP),RHVSAT(ISP))
C
C      CALCULATE INTERNAL ENERGY OF A SATURATED VAPOR FOR PRESSURE AT
C      SUPERPANEL NODE NUMBER 3
C      CALL A1INTS(10,6,RPRF3(ISP),RUVSAT(ISP))
C
C      CALCULATE SPECIFIC VOLUME OF A SATURATED VAPOR FOR PRESSURE AT
C      SUPERPANEL NODE NUMBER 3
C      CALL A1INTS(10,9,RPRF3(ISP),RVVSAT(ISP))
C
C      CALCULATE INTERNAL NUCLEATE BOILING HEAT TRANSFER COEFFICIENT
C      AT SUPERPANEL NODE NUMBER 4
C      RHNSF4(ISP)=0.000536*(EXP(AMAX1(15.0,RPRF3(ISP))/630.0))
C      1 *(ABS(RTEM4(ISP)-RTEF3(ISP)))
C
C      CALCULATE FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 4
C      RTEF4(ISP)=RTEF3(ISP)
C
C      CALCULATE FLUID FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 4
C      RTEFF4(ISP)=0.5*(RTEM4(ISP)+RTEF4(ISP))
C
C      CALCULATE FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
C      NUMBER 4
C      RWF4(ISP)=RWSP(ISP)/RKNTB
C
C      CALCULATE INTERNAL FILM BOILING HEAT TRANSFER COEFFICIENT AT
C      SUPERPANEL NODE NUMBER 4
C      RHFBF4(ISP)=A1HTAR(RTEFF4(ISP),RPRF3(ISP),RWF4(ISP),RKIDTB)
C
C      CALCULATE INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C      SUPERPANEL NODE NUMBER 4
C      RHCF4(ISP)=0.76*RHNSF4(ISP)+0.24*RHFBF4(ISP)
C
C      IF (RCVST(ISP).EQ.3) GO TO 600
C
C      CALCULATE LENGTH OF SUPERPANEL TWO-PHASE MIXTURE SECTION
C      FOR RCVST .EQ. 2
C      RL35(ISP)=RKL17-RL13(ISP)
C
C      CALCULATE HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
C      SUPERPANEL TWO-PHASE MIXTURE SECTION FOR RCVST .EQ. 2
C      RQF4(ISP)=RHCF4(ISP)*RKSSP*RL35(ISP)*((RTEM4(ISP)-RTEF4(ISP))
C
C      CALCULATE FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5
C      FOR RCVST .EQ. 2
C      RHF5(ISP)=RHF3(ISP)+RQF4(ISP)/RWSP(ISP)
C
C      600  IF (RCVST(ISP).EQ.2) GO TO 700

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C
C      CALCULATE FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5
C      FOR RCVST .EQ. 3
C      RHF5(ISP)=RHVSAT(ISP)

C
C      CALCULATE HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
C      SUPERPANEL TWO-PHASE MIXTURE SECTION FOR RCVST .EQ. 3
C      RQF4(ISP)=RWSP(ISP)*(RHF5(ISP)-RHF3(ISP))

C
C      CALCULATE LENGTH OF SUPERPANEL TWO-PHASE MIXTURE SECTION
C      FOR RCVST .EQ. 3
C      T10=RHCF4(ISP)*RKSSP*(RTEM4(ISP)-RTEF4(ISP))
C      RL35(ISP)=RQF4(ISP)/T10
C      IF (RL35(ISP).LT.0.0) RL35(ISP)=0.0
C      IF (RL35(ISP).GT.(RKL17-RL13(ISP))) RL35(ISP)=RKL17-RL13(ISP)

C
C      CALCULATE COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND
C      TWO-PHASE MIXTURE SECTIONS
C      700 RL15(ISP)=RL13(ISP)+RL35(ISP)

C
C      CALCULATE FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 5
C      RTEF5(ISP)=RTEF4(ISP)

C
C      CALCULATE STEAM QUALITY AT SUPERPANEL NODE NUMBER 5
C      RXF5(ISP)=(RHF5(ISP)-RHF3(ISP))/(RHVSAT(ISP)-RHF3(ISP))
C      IF (RXF5(ISP).LT.0.0) RXF5(ISP)=0.0
C      IF (RXF5(ISP).GT.1.0) RXF5(ISP)=1.0

C
C      CALCULATE FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 5
C      RUF5(ISP)=RUF3(ISP)+RXF5(ISP)*(RUVSAT(ISP)-RUF3(ISP))

C
C      CALCULATE FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 5
C      RVF5(ISP)=RVF3(ISP)+RXF5(ISP)*(RVVSAT(ISP)-RVF3(ISP))

C
C      CALCULATE FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 4
C      RHF4(ISP)=0.5*(RHF3(ISP)+RHF5(ISP))

C
C      CALCULATE FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 4
C      RUF4(ISP)=0.5*(RUF3(ISP)+RUF5(ISP))

C
C      CALCULATE FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 4
C      RVF4(ISP)=0.5*(RVF3(ISP)+RVF5(ISP))

C
C      CALCULATE FLUID PRESSURE AT SUPERPANEL NODE NUMBER 5
C      RPRF5(ISP)=RPRF3(ISP)-(RL35(ISP)/RKL17)*RKFF4*RVF4(ISP)*RWSP(ISP)
C      1 *RWSP(ISP)-SGN*(RL35(ISP)*GRAV)/(144.0*GRAV0*RVF4(ISP))

C
C      CALCULATE FLUID PRESSURE AT SUPERPANEL NODE NUMBER 4
C      RPRF4(ISP)=0.5*(RPRF3(ISP)+RPRF5(ISP))

C
C      IF (RCVST(ISP).EQ.3) GO TO 800

C
C      DEFINE SUPERPANEL OUTLET CONDITIONS FOR RCVST .EQ. 2
C      RPRF7(ISP)=RPRF5(ISP)
C      RHF7(ISP)=RHF5(ISP)
C      RTEF7(ISP)=RTEF5(ISP)
C      RUF7(ISP)=RUF5(ISP)
C      RVF7(ISP)=RVF5(ISP)

C
C      GO TO 1000

```



```

C
C 800 CONTINUE
C
C ***** ALGEBRAIC EQUATIONS - FLUID CONTROL VOLUME OF SUPERPANEL
C SUPERHEATED SECTION
C
C CALCULATE LENGTH OF SUPERPANEL SUPERHEATED SECTION
C RL57(ISP)=RKL17-RL15(ISP)
C
C CALCULATE FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
C NUMBER 6
C RWF6(ISP)=RWSP(ISP)/RKNTB
C
C BEGIN ITERATIVE CALCULATIONS FOR FLUID PROPERTIES AT
C SUPERPANEL NODE NUMBER 7
C ITER=0
C PRNTEF7=RTEF7(ISP)
C PRTEF7=RTEF7(ISP)-1.0
C
C CALCULATE FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 6
C 900 RTEF6(ISP)=0.5*(RTEF5(ISP)+RTEF7(ISP))
C
C CALCULATE FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 6
C RVF6(ISP)=RVF5(ISP)
C
C CALCULATE FLUID PRESSURE AT SUPERPANEL NODE NUMBER 7
C RPRF7(ISP)=RPRF5(ISP)-(RL57(ISP)/RKL17)*RKFF6*RVF6(ISP)*RWSP(ISP)
C 1 *RWSP(ISP)-SGN*(RL57(ISP)*GRAV)/(144.0*GRAV0*RVF6(ISP))
C
C CALCULATE FLUID PRESSURE AT SUPERPANEL NODE NUMBER 6
C RPRF6(ISP)=0.5*(RPRF5(ISP)+RPRF7(ISP))
C
C CALCULATE FLUID FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 6
C RTEFF6(ISP)=0.5*(RTEF6(ISP)+RTEM6(ISP))
C
C CALCULATE INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C SUPERPANEL NODE NUMBER 6
C RHCF6(ISP)=A1HTAR(RTEFF6(ISP),RPRF6(ISP),RWF6(ISP),RKIDTB)
C 1 *(((RTEF6(ISP)+ZFR)/(RTEFF6(ISP)+ZFR))*0.8)
C
C CALCULATE HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
C SUPERPANEL SUPERHEATED SECTION
C RQF6(ISP)=RHCF6(ISP)*RKSSP*RL57(ISP)*(RTEM6(ISP)-RTEF6(ISP))
C
C CALCULATE FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 7
C RHF7(ISP)=RHF5(ISP)+RQF6(ISP)/RWSP(ISP)
C
C CALCULATE FLUID SPECIFIC VOLUME, INTERNAL ENERGY, AND
C TEMPERATURE AT SUPERPANEL NODE NUMBER 7
C CALL STEAM(11,RHF7(ISP),RVF6(ISP),RPRF7(ISP),RVF7(ISP),RUF7(ISP),
C 1 RTEF7)
C
C CHECK CONVERGENCE OF ITERATIVE CALCULATIONS
C
C ERR=(RNTEF7-RTEF7(ISP))/RTEF7(ISP)
C SLOPE1=-0.5*RL57(ISP)/(RWSP(ISP)+1.0)**0.8
C SLOPE2=(RNTEF7-PRNTEF7)/(RTEF7(ISP)-PRTEF7)
C IF (ITER.EQ.0 .OR. ABS(ERR).GT.0.2) SLOPE2=SLOPE1

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PRNTEF7=RNTEF7 $ PRTEF7=RTEF7(,ISP)
GAIN=1.0/(1.0-SLOPE2)
RTEF7(,ISP)=RTEF7(,ISP)+GAIN*(RNTEF7-RTEF7(,ISP))
ITER=ITER+1
IF (ABS(ERR).GT.0.001.AND.ITER.LT.25) GO TO 900
IF (ITER.EQ.25) PRINT *,# ITERATIVE LOOP IN FLUID CONTROL #,
1 #VOLUME CALCULATIONS FOR THE SUPERHEATED SECTION OF RECEIVER #,
2 #SUPERPANEL #,ISP,# HAS FAILED TO CONVERGE#

C
C CALCULATE FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 6
RHF6(,ISP)=0.5*(RHF5(,ISP)+RHF7(,ISP))

C
C CALCULATE FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 6
RUF6(,ISP)=0.5*(RUF5(,ISP)+RUF7(,ISP))

C
1000 CONTINUE

C
C ***** ALGEBRAIC EQUATIONS - METAL CONTROL VOLUME OF SUPERPANEL
C SUBCOOLED SECTION
C
C CALCULATE HEAT ABSORBED BY METAL CONTROL VOLUME OF SUPERPANEL
C SUBCOOLED SECTION
RQAM2(,ISP)=QABS(,ISP,2,RL13(,ISP),RL15(,ISP),RKL17)

C
C CALCULATE HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME OF
C SUPERPANEL SUBCOOLED SECTION
RQEM2(,ISP)=SBC*RKEESP*RWSP*RL13(,ISP)*((RTEM2(,ISP)+ZFR)**4
1 -(ETEAMB+ZFR)**4)

C
C CALCULATE EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
C AT SUPERPANEL NODE NUMBER 2
T10=RTEM2(,ISP)-ETEAMB
IF (T10.LT.0.0) T10=0.0
RHFRM2(,ISP)=RKHFR*((T10)**0.33333333)

C
C CALCULATE EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
C AT SUPERPANEL NODE NUMBER 2
RHFCM2(,ISP)=RKHFC*((IEVWAMB)**0.8)

C
C CALCULATE EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C SUPERPANEL NODE NUMBER 2
RHCM2(,ISP)=SQRT(RHFRM2(,ISP)*RHFRM2(,ISP)+RHFCM2(,ISP)*RHFCM2(,ISP))

C
C CALCULATE HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME OF
C SUPERPANEL SUBCOOLED SECTION
RQCM2(,ISP)=RHCM2(,ISP)*RWSP*RL13(,ISP)*(RTEM2(,ISP)-ETEAMB)

C
C CALCULATE HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
C SUPERPANEL SUBCOOLED SECTION
RQM2(,ISP)=RQAM2(,ISP)-RQEM2(,ISP)-RQCM2(,ISP)

C
IF (RCVST(,ISP).EQ.1) GO TO 1100

C
C ***** ALGEBRAIC EQUATIONS - METAL CONTROL VOLUME OF SUPERPANEL
C TWO-PHASE MIXTURE SECTION
C
C

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C      CALCULATE HEAT ABSORBED BY METAL CONTROL VOLUME OF SUPERPANEL
C      TWO-PHASE MIXTURE SECTION
C      RQAM4(ISP)=QABS(ISP,4,RL13(ISP),RL15(ISP),RKL17)

C      CALCULATE HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME OF
C      SUPERPANEL TWO-PHASE MIXTURE SECTION
C      RQEM4(ISP)=SBC*RKEESP*RKWSP*RL35(ISP)*((RTEM4(ISP)+ZFR)**4
1  -(ETEAMB+ZFR)**4)

C      CALCULATE EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
C      AT SUPERPANEL NODE NUMBER 4
C      T10=RTEM4(ISP)-ETEAMB
C      IF (T10.LT.0.0) T10=0.0
C      RHFRM4(ISP)=RKHFR*((T10)**0.33333333)

C      CALCULATE EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
C      AT SUPERPANEL NODE NUMBER 4
C      RHFCM4(ISP)=RKHFC*((EVWAMB)**0.8)

C      CALCULATE EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C      SUPERPANEL NODE NUMBER 4
C      RHCM4(ISP)=SQRT(RHFRM4(ISP)*RHFRM4(ISP)+RHFCM4(ISP)*RHFCM4(ISP))

C      CALCULATE HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME OF
C      SUPERPANEL TWO-PHASE MIXTURE SECTION
C      RQCM4(ISP)=RHCM4(ISP)*RKWSP*RL35(ISP)*(RTEM4(ISP)-ETEAMB)

C      CALCULATE HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
C      SUPERPANEL TWO-PHASE MIXTURE SECTION
C      RQM4(ISP)=RQAM4(ISP)-RQEM4(ISP)-RQCM4(ISP)

C      IF (RCVST(ISP).EQ.2) GO TO 1100

C      ***** ALGEBRAIC EQUATIONS - METAL CONTROL VOLUME OF SUPERPANEL
C      SUPERHEATED SECTION

C      CALCULATE HEAT ABSORBED BY METAL CONTROL VOLUME OF SUPERPANEL
C      SUPERHEATED SECTION
C      RQAM6(ISP)=QABS(ISP,6,RL13(ISP),RL15(ISP),RKL17)

C      CALCULATE HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME OF
C      SUPERPANEL SUPERHEATED SECTION
C      RQEM6(ISP)=SBC*RKEESP*RKWSP*RL57(ISP)*((RTEM6(ISP)+ZFR)**4
1  -(ETEAMB+ZFR)**4)

C      CALCULATE EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
C      AT SUPERPANEL NODE NUMBER 6
C      T10=RTEM6(ISP)-ETEAMB
C      IF (T10.LT.0.0) T10=0.0
C      RHFRM6(ISP)=RKHFR*((T10)**0.33333333)

C      CALCULATE EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
C      AT SUPERPANEL NODE NUMBER 6
C      RHFCM6(ISP)=RKHFC*((EVWAMB)**0.8)

C      CALCULATE EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C      SUPERPANEL NODE NUMBER 6
C      RHCM6(ISP)=SQRT(RHFRM6(ISP)*RHFRM6(ISP)+RHFCM6(ISP)*RHFCM6(ISP))

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C
C      CALCULATE HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME OF
C      SUPERPANEL SUPERHEATED SECTION
C      RQCM6(ISP)=RHCM6(ISP)*RKWSP*RL57(ISP)*(RTEM6(ISP)-ETEAMB)
C
C      CALCULATE HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
C      SUPERPANEL SUPERHEATED SECTION
C      RQM6(ISP)=RQAM6(ISP)-RQEM6(ISP)-RQCM6(ISP)
C
C 1100 CONTINUE
C
C
C ***** DIFFERENTIAL EQUATIONS - ALL CONTROL VOLUMES
C
C      INITIALIZE DERIVATIVES TO ZERO
C
C      RDIUF2(ISP)=0.0
C      RDIHF3(ISP)=0.0
C      RDL13(ISP)=0.0
C      RDEM2(ISP)=0.0
C      RDEM4(ISP)=0.0
C      RDEM6(ISP)=0.0
C
C      IF (RCVST(ISP).EQ.2 .OR. RCVST(ISP).EQ.3) GO TO 1200
C
C      CALCULATE DERIVATIVE OF FLUID INTERNAL ENERGY AT SUPERPANEL
C      NODE NUMBER 2 FOR RCVST .EQ. 1
C      RDIUF2(ISP)=RVF2(ISP)*(RWSP(ISP)*(RHF1(ISP)-RHF3(ISP))
C 1 +RQF2(ISP))/(RKASP*RL13(ISP))
C
C      CALCULATE DERIVATIVE OF FLUID ENTHALPY AT SUPERPANEL NODE
C      NUMBER 3 FOR RCVST .EQ. 1
C      RDIHF3(ISP)=RVF2(ISP)*(2.0*RWSP(ISP)*(RHF2(ISP)-RHF3(ISP))
C 1 +RQF2(ISP))/(RKASP*RL13(ISP))
C
C      CALCULATE DERIVATIVE OF METAL TEMPERATURE AT SUPERPANEL NODE
C      NUMBER 2 FOR RCVST .EQ. 1
C      RDEM2(ISP)=(RQM2(ISP)-RQF2(ISP))/(RKASP*RL13(ISP))
C
C      GO TO 1300
C
C 1200 CONTINUE
C
C      CALCULATE DERIVATIVE OF LENGTH OF SUPERPANEL SUBCOOLED SECTION
C      FOR RCVST .EQ. 2 OR RCVST .EQ. 3
C      RDL13(ISP)=-RVF3(ISP)*(RWSP(ISP)*(RHF1(ISP)-RHF3(ISP))+RQF2(ISP))
C 1 /(RKASP*(RHF3(ISP)-RUF2(ISP)))
C
C      CALCULATE DERIVATIVE OF METAL TEMPERATURE AT SUPERPANEL NODE
C      NUMBER 2 FOR RCVST .EQ. 2 OR RCVST .EQ. 3
C      RDEM2(ISP)=(RQM2(ISP)-RQF2(ISP))/(RKASP*AMAX1(1.0,RL13(ISP)))
C 1 +RDL13(ISP)*(RTEM4(ISP)-RTEM2(ISP))/AMAX1(1.0,RL15(ISP))
C
C      CALCULATE DERIVATIVE OF METAL TEMPERATURE AT SUPERPANEL NODE
C      NUMBER 4 FOR RCVST .EQ. 2 OR RCVST .EQ. 3
C      RDEM4(ISP)=(RQM4(ISP)-RQF4(ISP))/(RKASP*AMAX1(1.0,RL35(ISP)))
C 1 +RDL13(ISP)*(RTEM4(ISP)-RTEM2(ISP))/AMAX1(1.0,RL15(ISP))
C
C      IF (RCVST(ISP).NE.3) GO TO 1300

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C
C      CALCULATE DERIVATIVE OF METAL TEMPERATURE AT SUPERPANEL NODE
C      NUMBER 6 FOR RCVST .EQ. 3
C      RDTEM6(ISP)=(RQM6(ISP)-RQF6(ISP))/(RKCS*AMAX1(1.0,RL57(ISP)))
C
C      1300 CONTINUE
C
C
C***** END COMPUTATIONS *****
C
C
C      GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
C      I=ISP
C      IF (.NOT.DIAG(6)) RETURN
C      PRINT *,*
C      PRINT *,*
C      PRINT *,DIAG(6)/RCVR SUPERPANEL *,I,*,*
C      PRINT *,TNOW = *,TNOW,*, DTNOW = *,DTNOW
C      PRINT *,
1  * RHF1 = *,RHF1(I),* RPRF1 = *,RPRF1(I),* RTEF1 = *,RTEF1(I),
2  * RUF1 = *,RUF1(I),* RVF1 = *,RVF1(I),* RHCF2 = *,RHCF2(I),
3  * RHF2 = *,RHF2(I),* RPRF2 = *,RPRF2(I),* RQF2 = *,RQF2(I),
4  * RTEF2 = *,RTEF2(I),* RTEFF2 = *,RTEFF2(I),* RUF2 = *,RUF2(I),
5  * RIUF2 = *,RIUF2(I),* RVF2 = *,RVF2(I),* RUTF2 = *,RUTF2(I),
6  * RHC2 = *,RHC2(I),* RHFC2 = *,RHFC2(I),
7  * RHFRM2 = *,RHFRM2(I),* RTE2 = *,RTE2(I),
8  * RQM2 = *,RQM2(I),* RQAM2 = *,RQAM2(I),* RQCM2 = *,RQCM2(I),
9  * RQEM2 = *,RQEM2(I),* RHF3 = *,RHF3(I),* RIHF3 = *,RIHF3(I),
A  * RHFSAT = *,RHFSAT(I),* RPRF3 = *,RPRF3(I),
B  * RTEF3 = *,RTEF3(I),* RUF3 = *,RUF3(I),* RUFSAT = *,RUFSAT(I),
C  * RVF3 = *,RVF3(I),* RVFSAT = *,RVFSAT(I),
D  * RHCF4 = *,RHCF4(I),* RHNSF4 = *,RHNSF4(I),
E  * RHBF4 = *,RHBF4(I),* RHF4 = *,RHF4(I),* RPRF4 = *,RPRF4(I),
F  * RQF4 = *,RQF4(I),* RTEF4 = *,RTEF4(I),* RTEFF4 = *,RTEFF4(I),
G  * RUF4 = *,RUF4(I),* RVF4 = *,RVF4(I),* RUTF4 = *,RUTF4(I),
H  * RHC4 = *,RHC4(I),* RHFC4 = *,RHFC4(I),
I  * RHFRM4 = *,RHFRM4(I),* RTE4 = *,RTE4(I),
J  * RQM4 = *,RQM4(I),* RQAM4 = *,RQAM4(I),* RQCM4 = *,RQCM4(I),
PRINT *,*, RQEM4 = *,RQEM4(I),* RHF5 = *,RHF5(I),
1  * RHVSAT = *,RHVSAT(I),* RPRF5 = *,RPRF5(I),* RTEF5 = *,RTEF5(I),
2  * RUF5 = *,RUF5(I),* RUVSAT = *,RUVSAT(I),* RVF5 = *,RVF5(I),
3  * RVVSAT = *,RVVSAT(I),* RXF5 = *,RXF5(I),* RHCF6 = *,RHCF6(I),
4  * RHF6 = *,RHF6(I),* RPRF6 = *,RPRF6(I),* RQF6 = *,RQF6(I),
5  * RTEF6 = *,RTEF6(I),* RTEFF6 = *,RTEFF6(I),* RUF6 = *,RUF6(I),
6  * RVF6 = *,RVF6(I),* RUTF6 = *,RUTF6(I),* RHC6 = *,RHC6(I),
7  * RHFC6 = *,RHFC6(I),* RHFRM6 = *,RHFRM6(I),
8  * RTE6 = *,RTE6(I),* RQM6 = *,RQM6(I),* RQAM6 = *,RQAM6(I),
9  * RQCM6 = *,RQCM6(I),* RQEM6 = *,RQEM6(I),* RHF7 = *,RHF7(I),
A  * RPRF7 = *,RPRF7(I),* RTEF7 = *,RTEF7(I),* RUF7 = *,RUF7(I),
B  * RVF7 = *,RVF7(I),* RL13 = *,RL13(I),* RL35 = *,RL35(I),
C  * RL15 = *,RL15(I),* RL57 = *,RL57(I)
PRINT *,*, RDIUF2 = *,RDIUF2(I),
1  * RDIHF3 = *,RDIHF3(I),* RDL13 = *,RDL13(I),
2  * RDTEM2 = *,RDTEM2(I),* RDTEM4 = *,RDTEM4(I),
3  * RDTEM6 = *,RDTEM6(I)
C
C
C      RETURN
C      END

```

SUBROUTINE SCOND
EVALUATE STATE EVENT CONDITIONS

EXECUTIVE AND PROGRAM CONTROL DATA

INTEGER ATIMO,ATIDAY
LOGICAL OUTFG,END,DIAG
COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1 DIAG(40)

OUTFG(I,J) OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
END END OF RUN FLAG
ATILCL LOCAL TIME (SECONDS FROM MIDNIGHT)
ATITST TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
ATIMO MONTH
ATIDAY DAY
DIAG DIAGNOSTIC PRINT FLAG ARRAY

MASTER CONTROL SUBSYSTEM DATA

INTEGER CMODE,CNMODE,CNSP,CNMV,CMVRTBL,CMVLA,CMVPA,
1 CMVRC,CNM,CNMVEL,CNNM
COMMON /CDATA/ CMODE,CNMODE,CSPTBL(7,16),CSP(16),CNSP,
1 CMVLTBL(6,4,7),CMVL(6,4),CNMV,CMVRTBL(7,7,4),
2 CMVLA(7),CMVPA(4),CMVRC(4),CNM(4),CNMVEL,CNNM

CMODE CURRENT MODE OF OPERATION
CNMODE NUMBER OF DIFFERENT MODES OF OPERATION
CSPTBL SETPOINT TABLE
CSP SETPOINTS FOR CURRENT MODE OF OPERATION
CNSP NUMBER OF SETPOINTS
CMVLTBL TABLE OF OPERATING LIMITS FOR MONITORED VARIABLES
CMVL OPERATING LIMITS OF MONITORED VARIABLES FOR CURRENT
MODE OF OPERATION
CNMV NUMBER OF MONITORED VARIABLES
CMVRTBL TABLE OF MCS RESPONSES FOR MONITORED VARIABLES
EXCEEDING THEIR LIMITS
CMVLA MONITORED VARIABLE LIMIT ARGUMENT FOR RESPONSE TABLE
CMVPA MONITORED VARIABLE ARGUMENT FOR RESPONSE TABLE
CMVRC RESPONSE CODES FOR MONITORED VARIABLES CROSSING LIMITS
CNM POTENTIAL NEW MODES TO CORRECT MONITORED VARIABLE
LIMIT CROSSINGS
CNMVEL NUMBER OF MONITORED VARIABLES EXCEEDING LIMITS
AT ANY INSTANT OF TIME
CNNM NUMBER OF NEW MODE REQUESTS AT ANY INSTANT OF TIME

STANDARD DEFINITION OF PILOT PLANT OPERATING MODES

1= RECEIVER STEAM TO EPGS
2= RECEIVER STEAM TO EPGS AND THERMAL STORAGE
3= RECEIVER STEAM TO EPGS AND THERMAL STORAGE STEAM TO EPGS
4= RECEIVER STEAM TO THERMAL STORAGE AND THERMAL STORAGE
STEAM TO EPGS
5= RECEIVER STEAM TO THERMAL STORAGE
6= THERMAL STORAGE STEAM TO EPGS
7= OVERNIGHT SHUTDOWN AND HOLD

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C      ARGUMENT DEFINITIONS FOR SETPOINT ARRAY CSP(I)
C
C      I=1,4  EPGS VALVE SETPOINTS FOR VALVES R1-R4
C      I=5,6  EPGS VALVE SETPOINTS FOR VALVES T1,T2
C      I=7,8  EPGS VALVE SETPOINTS FOR DRAIN VALVES
C      I=9,12 EPGS VALVE SETPOINTS FOR VALVES E1-E4
C      I=13   EPGS CONDENSER FAN SETPOINT
C      I=14   EPGS FEED PUMP PRESSURE SETPOINT
C      I=15   RECEIVER OUTLET TEMPERATURE SETPOINT
C      I=16   TSS OUTLET STEAM FLOW RATE SETPOINT
C
C      CURRENT LIST OF MONITORED VARIABLES
C
C      RECEIVER OUTLET PRESSURE
C      RECEIVER OUTLET TEMPERATURE
C      EPGS FEEDWATER PRESSURE
C      TSS THERMOCLINE LEVEL
C
C      COLLECTOR SUBSYSTEM DATA
C
C      COMMON /HDATA/ HFLRN(20,8),HCEF(121),HREF,HCFL,XTIST,XTIEND,
1  XVAL,XDIR,XDTCS
C
C      HFLRN      HELIOSTAT OUTPUT SOLAR ARRAY FLUX AT RECEIVER NODES
C                  (BTU/SEC)
C      HCEF      HELIOSTAT FIELD CELL EFFICIENCIES (ND)
C      HREF      HELIOSTAT REFLECTIVE EFFICIENCY (ND)
C      HCFL      COLLECTOR FIELD SIZE (FEET)
C      XTIST      START TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD FRONT INTERCEPTS CORNER OF CELL ARRAY
C      XTIEND      END TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD REAR INTERCEPTS CORNER OF CELL ARRAY
C      XVAL      CLOUD VELOCITY (MILES/HOUR)
C      XDIR      CLOUD DIRECTION (DEGREES FROM N TO S DIRECTION)
C                  (0 = N TO S, 90 = W TO E, -90 = E TO W, 180 = S TO N)
C      XDTCS      CLOUD UPDATE SCHEDULING INTERVAL (SEC)
C
C      RECEIVER SUBSYSTEM DATA
C
C      RECVR VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)
C
C      INTEGER RCVST,RAFLGC
C      COMMON /RDATA/ RHISH(6),RWISH(6),RHSB,RPRSH,RTESH,RWOSH,RFMV(6),
1  RLV(6),RHIV,RFRIV,RPRISV,RFRQSV,RVIV,RHGV(6),RPROV(6),RWV(6),
2  RWVSUM,RHF1(8),RPRF1(8),RTEF1(8),RUF1(8),RVF1(8),RHCF2(8),
3  RHF2(8),RPRF2(8),RQF2(8),RTEF2(8),RTEFF2(8),RUF2(8),RVF2(8),
4  RHTF2(8),RHCM2(8),RHFCM2(8),RHFRM2(8),RQM2(8),RQAM2(8),RQCM2(8),
5  RQEM2(8),RPRF3(8),RTEF3(8),RUF3(8),RVF3(8),RHCF4(8),RHNBF4(8),
6  RHFBF4(8),RHF4(8),RPRF4(8),RQF4(8),RTEF4(8),RTEFF4(8),RUF4(8),
7  RVF4(8),RHTF4(8),RHCM4(8),RHFCM4(8),RHFRM4(8),RQM4(8),RQAM4(8),
8  RQCM4(8),RQEM4(8),RPRF5(8),RTEF5(8),RUF5(8),RVF5(8),RXF5(8),
9  RHCF6(8),RHF6(8),RPRF6(8),RQF6(8),RTEF6(8),RTEFF6(8),RUF6(8),
A  RVF6(8),RHTF6(8),RHCM6(8),RHFCM6(8),RHFRM6(8),RQM6(8),RQAM6(8),
B  RQCM6(8),RQEM6(8),RHF7(8),RPRF7(8),RTEF7(8),RUF7(8),RVF7(8),
C  RUF8(8),RVFSAT(8),RUVSAT(8),RVVSAT(8),RL35(8),RL57(8),RWSP(8),
D  RCVST(8),RAFLGC(6),RERRTC(6),RLPROC(6),RLSUMC(6),RTSETC
C
C      RHISH(ISP) FLUID ENTHALPY AT STEAM HEADER INLET

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C		(BTU/LBM)
C	RWISH(ISP)	FLUID MASS FLOW RATE AT STEAM HEADER INLET
C		(LBM/SEC)
C	RHSH	FLUID ENTHALPY IN STEAM HEADER
C		(BTU/LBM)
C	RPRSH	FLUID PRESSURE IN STEAM HEADER
C		(PSIA)
C	RTESH	FLUID TEMPERATURE IN STEAM HEADER
C		(DEGREES F)
C	RWOSH	FLUID MASS FLOW RATE AT STEAM HEADER OUTLET
C		(LBM/SEC)
C	RFMV(IV)	MODIFIED FRICTION FLOW COEFFICIENT FOR FLOW
C		CONTROL VALVE (PSI, SEC**2/LBM, CU FT)
C	RLV(IV)	STEM DISPLACEMENT OF FLOW CONTROL VALVE
C		(PERCENT)
C	RHIV	FLUID ENTHALPY AT FLOW CONTROL VALVE INLETS
C		(BTU/LBM)
C	RPRIV	FLUID PRESSURE AT FLOW CONTROL VALVE INLETS
C		(PSIA)
C	RPRISV	FLUID PRESSURE AT RECEIVER SUBSYSTEM INLET
C		(PSIA)
C	RPROSV	FLUID PRESSURE AT RECEIVER SUBSYSTEM OUTLET
C		(PSIA)
C	RVIV	FLUID SPECIFIC VOLUME AT FLOW CONTROL VALVE INLETS
C		(CU FT/LBM)
C	RHOV(IV)	FLUID ENTHALPY AT FLOW CONTROL VALVE OUTLET
C		(BTU/LBM)
C	RPROV(IV)	FLUID PRESSURE AT FLOW CONTROL VALVE OUTLET
C		(PSIA)
C	RWV(IV)	FLUID MASS FLOW RATE THROUGH FLOW CONTROL VALVE
C		(LBM/SEC)
C	RWVSUM	FLUID MASS FLOW RATE THROUGH ALL FLOW CONTROL VALVES
C		(LBM/SEC)
C	RHF1(ISP)	FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 1
C		(BTU/LBM)
C	RPRF1(ISP)	FLUID PRESSURE AT SUPERPANEL NODE NUMBER 1
C		(PSIA)
C	RTEF1(ISP)	FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 1
C		(DEGREES F)
C	RUF1(ISP)	FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 1
C		(BTU/LBM)
C	RVF1(ISP)	FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 1
C		(CU FT/LBM)
C	RHCF2(ISP)	INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
C		SUPERPANEL NODE NUMBER 2 (BTU/SEC, SQ FT, F)
C	RHF2(ISP)	FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 2
C		(BTU/LBM)
C	RPRF2(ISP)	FLUID PRESSURE AT SUPERPANEL NODE NUMBER 2
C		(PSIA)
C	RQF2(ISP)	HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
C		SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
C	RTEF2(ISP)	FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C		(DEGREES F)
C	RTEFF2(ISP)	FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 2
C		(DEGREES F)
C	RUF2(ISP)	FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
C		(BTU/LBM)
C	RVF2(ISP)	FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 2
C		(CU FT/LBM)
C	RWTF2(ISP)	FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE

C NUMBER 2 (LBM/SEC)
 C RHCM2(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFCM2(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFRM2(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RQM2(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQAM2(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQCM2(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQEM2(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RPRF3(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 3
 C (PSIA)
 C RTEF3(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 3
 C (DEGREES F)
 C RUF3(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RVF3(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 3
 C (CU FT/LBM)
 C RHCF4(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHNB4(ISP) INTERNAL NUCLEATE BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFB4(ISP) INTERNAL FILM BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHF4(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RPRF4(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 4
 C (PSIA)
 C RQF4(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RTEF4(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RTEFF4(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RUF4(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RVF4(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 4
 C (CU FT/LBM)
 C RWTF4(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 4 (LBM/SEC)
 C RHCM4(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFCM4(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFRM4(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RQM4(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQAM4(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQCM4(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQEM4(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RPRF5(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 5

C (PSIA)
 C RTEF5(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 5
 C (DEGREES F)
 C RUF5(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RVF5(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 5
 C (CU FT/LBM)
 C RXF5(ISP) FLUID QUALITY AT SUPERPANEL NODE NUMBER 5
 C (PERCENT)
 C RHCF6(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHF6(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RPRF6(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 6
 C (PSIA)
 C RQF6(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RTEF6(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RTEFF6(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RUF6(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RVF6(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 6
 C (CU FT/LBM)
 C RUTF6(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 6 (LBM/SEC)
 C RHCM6(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFCM6(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFRM6(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RQM6(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQAM6(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQCM6(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQEM6(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RHF7(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RPRF7(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 7
 C (PSIA)
 C RTEF7(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 7
 C (DEGREES F)
 C RUF7(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RVF7(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 7
 C (CU FT/LBM)
 C RUF6SAT(ISP) INTERNAL ENERGY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RVF6SAT(ISP) SPECIFIC VOLUME OF A SATURATED LIQUID
 C (CU FT/LBM)
 C RUV6SAT(ISP) INTERNAL ENERGY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RVV6SAT(ISP) SPECIFIC VOLUME OF A SATURATED VAPOR
 C (CU FT/LBM)
 C RL35(ISP) LENGTH OF SUPERPANEL TWO-PHASE MIXTURE SECTION


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C   RKNBSP      NUMBER OF BOILER SUPERPANELS
C               (ND)
C   RKFF2       FLUID FLCW COEFFICIENT AT SUPERPANEL NODE NUMBER 2
C               (PSI,SEC**2/LBM,CU FT)
C   RKFF4       FLUID FLCW COEFFICIENT AT SUPERPANEL NODE NUMBER 4
C               (PSI,SEC**2/LBM,CU FT)
C   RKFF6       FLUID FLCW COEFFICIENT AT SUPERPANEL NODE NUMBER 6
C               (PSI,SEC**2/LBM,CU FT)
C   RKFV(IV)    FLUID FLCW COEFFICIENT OF FLOW CONTROL VALVE
C               (PSI,SEC**2/LBM,CU FT)
C   RKAIV(IV)   PERCENT SUBSYSTEM PRESSURE DROP ACROSS
C               FLOW CONTROL VALVE (PERCENT)
C   RKVSH       VOLUME OF STEAM HEADER
C               (CU FT)
C   RKINTC(IC)  CONTROLLER INTEGRAL GAIN CONSTANT
C               (PERCENT,SEC/F)
C   RKPROC(IC)  CONTROLLER PROPORTIONAL GAIN CONSTANT
C               (PERCENT/F)
C   RKTHSC      CONTROLLER ACTIVATION TEMPERATURE THRESHOLD
C               (DEGREES F)
C
C   GASP-IV SIMULATION SYSTEM DATA
C
C   COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
1NAFO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARI(50,4),TNOW,TTBEG
2,TTCLR,TTFIN,TRIB(25),TTSET
C
C   COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
1,NNEQD,NNEQS,NNEQT,SS(600),SSL(600),TTNEX
C
C   DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
1  RLINTC(6),RL15(8),RHFSAT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
2  RDIUF2(8),RDL13(8),RDTEM2(8),RDIHF3(8),RDTEM4(8),RDTEM6(8),
3  RDLINTC(6)
C
C   EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
1  (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
2  (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
4  (TH5,SS(83)),(TW7,SS(84)),(TW9,SS(85)),
5  (THTSU,SS(86)),(GMCT3,SS(87)),(GHCO3,SS(88)),
6  (GHCO3,SS(89)),(GHSD3C,SS(90)),(GHSTSG,SS(91)),
7  (GHCO1,SS(92)),(GHCO2,SS(93)),(GMCT2,SS(94)),
8  (GHCO2,SS(95)),(GFPS,SS(96)),(GHRCI,SS(97)),
9  (GHDSI,SS(98)),(GHCOH3,SS(99)),(GHCTSG,SS(100)),
A  (GHCHW,SS(101)),
B  (RL15(1),SS(102)),(RHFSAT(1),SS(110)),(RHF3(1),SS(118)),
C  (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
D  (CRPRSH,SS(151)),(CRTESH,SS(152)),(CGPFPR,SS(153)),
E  (CTLT,SS(154)),
F  (GPFPR,SS(161)),(GPDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
G  (XK3,SS(165))
C
C   EQUIVALENCE (RDIUF2(1),DD(1)),(RDL13(1),DD(9)),(RDTEM2(1),DD(17)),
1  (RDIHF3(1),DD(25)),(RDTEM4(1),DD(33)),(RDTEM6(1),DD(41)),
2  (RDUSH,DD(49)),(RDVSH,DD(50)),(RDLINTC(1),DD(51)),
3  (TDH5,DD(83)),(TDH7,DD(84)),
5  (TDH8,DD(85)),(TDHTSU,DD(86)),(GMCDT3,DD(87)),
6  (GHDCOT3,DD(88)),(GHDCOT3,DD(89)),(GHSD3C,DD(90)),
7  (GHSTSG,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),

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8 (GMDCT2,DD(94)),(GWDCOT2,DD(95)),(GDFPS,DD(96)),
 9 (GHDRCI,DD(97)),(GHDDSI,DD(98)),(GHDCOH3,DD(99)),
 A (GHDCOTSG,DD(100)),(GHDCWH,DD(101))

INTEGRATED STATE VARIABLES

RIUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
 (BTU/LBM)
 RL13(ISP) LENGTH OF SUPERPANEL SUBCOOLED SECTION
 (FEET)
 RTEM2(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 (DEGREES F)
 RIHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 (BTU/LBM)
 RTEM4(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 (DEGREES F)
 RTEM6(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 (DEGREES F)
 RUSH FLUID INTERNAL ENERGY IN STEAM HEADER
 (BTU/LBM)
 RVSH FLUID SPECIFIC VOLUME IN STEAM HEADER
 (CU FT/LBM)
 RLINTC(IC) CONTROLLER INTEGRAL SIGNAL OF VALVE STEM DISPLACEMENT
 (PERCENT)
 TW5 NOMINAL OIL FLOW INTO STORAGE (LBM/SEC)
 TW7 NOMINAL OIL FLOW FROM STORAGE (LBM/SEC)
 TMS STEAM FLOW FROM STEAM GENERATOR (LBM/SEC)
 THTSU HEAT STORED IN THERMAL STORAGE UNIT (BTU)
 GMCT3 CONDENSATE MASS (LBM) IN TANK 3 (RECVR FLASH TANK)
 GHCOT3 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 3
 GHCOT3 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 3
 GHSSDC ENTHALPY (BTU/LBM) OF STEAM AT BOTTOM OF DOWNCOMER
 GHSTSG ENTHALPY (BTU/LBM) OF ADMISSION STEAM
 GHCOT1 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 1
 GHCOT2 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 2
 GHCT2 MASS (LBM) OF CONDENSATE IN TANK 2
 GHCOT2 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 2
 GFPS RECVR FEED PUMP SPEED (RPM)
 GHRCI F.W. ENTHALPY (BTU/LBM) AT RECVR INLET
 GHDSI F.W. ENTHALPY (BTU/LBM) AT DESUPERHEATER INLET
 GHCOH3 F.W. ENTHALPY (BTU/LBM) OUT OF FW HRTR NO. 3
 GHCTSG ENTHALPY (BTU/LBM) AT TSS STEAM GEN. INLET
 GHCHN ENTHALPY (BTU/LBM) OF CONDENSATE IN CONDENSER HOTWELL

ADDITIONALLY REQUIRED GASP-IV STATE VARIABLES

RL15(ISP) COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND
 TWO-PHASE MIXTURE SECTIONS (FEET)
 RHFSAT(ISP) ENTHALPY OF A SATURATED LIQUID
 (BTU/LBM)
 RHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 (BTU/LBM)
 RHVSAT(ISP) ENTHALPY OF A SATURATED VAPOR
 (BTU/LBM)
 RHF5(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5
 (BTU/LBM)
 RTSENC(IC) CONTROLLER TEMPERATURE SENSOR SIGNAL OF BOILER
 SUPERPANEL OUTLET TEMPERATURE (DEGREES F)

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C   CRPRSH      FLUID PRESSURE IN RECEIVER STEAM HEADER
C               (PSIA)
C   CRTESH      FLUID TEMPERATURE IN RECEIVER STEAM HEADER
C               (DEGREES F)
C   CGPFPR      FLUID PRESSURE AT RECEIVER INLET
C               (PSIA)
C   CTLT        POSITION OF TSS THERMOCLINE
C               (PERCENT)
C   GPFPR       FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
C   GPDSI       FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)
C   XK1,XK2,XK3 EPGS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND
C               PRESSURE AT RECEIVER INLET
C
C   TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES
C
C   RDIUF2(ISP) TIME DERIVATIVE OF RIUF2(ISP)
C   RDL13(ISP)  TIME DERIVATIVE OF RL13(ISP)
C   RDTM2(ISP)  TIME DERIVATIVE OF RTM2(ISP)
C   RDIHF3(ISP) TIME DERIVATIVE OF RIHF3(ISP)
C   RDTM4(ISP)  TIME DERIVATIVE OF RTM4(ISP)
C   RDTM6(ISP)  TIME DERIVATIVE OF RTM6(ISP)
C   RDUSH       TIME DERIVATIVE OF RUSH
C   RCVSH       TIME DERIVATIVE OF RVSH
C   RDLINTC(IC) TIME DERIVATIVE OF RLINTC(IC)
C
C   TDW5        TIME DERIVATIVE OF TW5
C   TDW7        TIME DERIVATIVE OF TW7
C   TDW8        TIME DERIVATIVE OF TW8
C   TDHTSU      TIME DERIVATIVE OF THTSU
C
C   GHCDT3      TIME DERIVATIVE OF GHCT3
C   GHDCOT3     TIME DERIVATIVE OF GHCT3
C   GHDCOT3     TIME DERIVATIVE OF GHCT3
C   GHSDSDC     TIME DERIVATIVE OF GHSDC
C   GHSTSG      TIME DERIVATIVE OF GHSTG
C   GHDCOT1     TIME DERIVATIVE OF GHCT1
C   GHDCOT2     TIME DERIVATIVE OF GHCT2
C   GHDCOT2     TIME DERIVATIVE OF GHCT2
C   GHDCOT2     TIME DERIVATIVE OF GHCT2
C   GDFFS       TIME DERIVATIVE OF GFPS
C   GHRDCI      TIME DERIVATIVE OF GHRCI
C   GHDDSI      TIME DERIVATIVE OF GHDSI
C   GHDCOH3     TIME DERIVATIVE OF GHCOH3
C   GHDCOTSG    TIME DERIVATIVE OF GHCTSG
C   GHDCWH      TIME DERIVATIVE OF GHCHW
C
C   REAL LNTOL
C   DATA LNTOL,HTOL,TETOL /0.2,10.0,5.0/
C   LNTOL       LENGTH TOLERANCE
C
C   HTOL        ENTHALPY TOLERANCE
C   TETOL       TEMPERATURE TOLERANCE
C
C *****RECEIVER SUBSYSTEM STATE CONDITION TESTS*****
C
C   PERFORM THE FOLLOWING TESTS FOR EACH SUPERPANEL
C   NSP=RKNPSP+RKN3SP

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DO 500 ISP=1,NSP
  LFLAG(ISP)=0
C    CALCULATE SS INDICES OF RL13 AND RL15
  J1=ISP+NSP
  J2=ISP+21+10*NSP
C    TEST LENGTH OF SUBCOOLED SECTION FOR POSITIVE OR NEGATIVE
C    CROSSING OF 0.0
  J3=KROSS(J1,0,0.0,0.0,0,LNTOL)
  IF (J3.EQ.-1) LFLAG(ISP)=LFLAG(ISP)+2
  IF (J3.EQ.+1) LFLAG(ISP)=LFLAG(ISP)+1
C    TEST LENGTH OF SUBCOOLED AND TWO-PHASE MIXTURE SECTIONS FOR
C    POSITIVE OR NEGATIVE CROSSING OF SUPERPANEL LENGTH MINUS
C    AN OFFSET
  J4=KROSS(J2,0,0.0,RKL17-0.1*LNTOL,0,LNTOL)
  IF (J4.EQ.-1) LFLAG(ISP)=LFLAG(ISP)+16
  IF (J4.EQ.+1) LFLAG(ISP)=LFLAG(ISP)+8
C    TEST LENGTH OF SUBCOOLED SECTION FOR POSITIVE OR NEGATIVE
C    CROSSING OF SUPERPANEL LENGTH MINUS AN OFFSET
  J5=KROSS(J1,0,0.0,RKL17-0.1*LNTOL,0,LNTOL)
  IF (J5.EQ.-1) LFLAG(ISP)=LFLAG(ISP)+128
  IF (J5.EQ.+1) LFLAG(ISP)=LFLAG(ISP)+64
C
C    CALCULATE SS INDICES OF RHFSAT,RHF3,RHVSAT,AND RHF5
  J6=ISP+21+11*NSP
  J7=ISP+21+12*NSP
  J8=ISP+21+13*NSP
  J9=ISP+21+14*NSP
C    TEST FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3 FOR POSITIVE
C    OR NEGATIVE CROSSING OF SATURATED FLUID ENTHALPY MINUS AN
C    OFFSET
  J10=KROSS(J7,J6,1.0,-0.1*HTOL,0,HTOL)
  IF (J10.EQ.-1) LFLAG(ISP)=LFLAG(ISP)+1024
  IF (J10.EQ.+1) LFLAG(ISP)=LFLAG(ISP)+512
C    TEST FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5 FOR POSITIVE
C    OR NEGATIVE CROSSING OF SATURATED VAPOR ENTHALPY MINUS AN
C    OFFSET
  J11=KROSS(J9,J8,1.0,-0.1*HTOL,0,HTOL)
  IF (J11.EQ.-1) LFLAG(ISP)=LFLAG(ISP)+8192
  IF (J11.EQ.+1) LFLAG(ISP)=LFLAG(ISP)+4096
500 CONTINUE
C
C    PERFORM THE FOLLOWING TEST FOR EACH TEMPERATURE CONTROLLER
DO 600 IC=1,RKNBSP
  ISP=IC+RKNPSP
C    CALCULATE SS INDEX OF RTSENC
  J12=IC+21+15*NSP
C    TEST FLUID TEMPERATURE AT SUPERPANEL OUTLET FOR POSITIVE
C    OR NEGATIVE CROSSING OF FLOW CONTROLLER TEMPERATURE THRESHOLD
  J13=KROSS(J12,0,0.0,RKTHSC,0,TETOL)
  IF (J13.EQ.-1) LFLAG(ISP)=LFLAG(ISP)+65536
  IF (J13.EQ.+1) LFLAG(ISP)=LFLAG(ISP)+32768
C    MAINTAIN LIMITS ON INTEGRAL VALVE POSITION
  IF (RLINTC(IC).LT.0.05) RLINTC(IC)=0.05
  IF (RLINTC(IC).GT.1.0) RLINTC(IC)=1.0
600 CONTINUE
C
C    GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
  IF (DIAG(9).AND.LFLAG(ISP).NE.0) WRITE (6,410) TNOW,
1  ISP,LFLAG(ISP),J1,J2,J3,J4,J5,J6,J7,J8,J9,J10,J11,J12,J13,
2  SS(J1),SS(J2),RKL17,LNTOL,SS(J7),SS(J6),SS(J9),

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3  SS(J8),HTOL,SS(J12),RKTHSC,I1,IOL
410 FORMAT(1H ,3X,13HDIAG9/SECOND ,E17.10,I4,I16,13I4/
1  (1H ,16X,9S10.4))
C
C
C
C*****MASTER CONTROL SUBSYSTEM STATE CONDITION TESTS*****
C
C
C      PERFORM MASTER CONTROL MONITORING FUNCTION
C
C      TEST FOR THE MONITORED VARIABLES CROSSING THEIR LOW LIMITS
C
C      DO 120 I=1,CNMV
C      DO 110 J=1,3
C
C      IFLGMV=8+I
C      ISSMV=150+I
C
C      LCROSS=KROSS(ISSMV,0.0,0.0,CMVL(J,I),-1,.01*CMVL(J,I))
C      IF (IABS(LCROSS).GT.1) LCROSS=0
C      LFLAG(IFLGMV)=LFLAG(IFLGMV)+(4-J)*LCROSS
C
C      IF (DIAG(27).AND.LFLAG(IFLGMV).NE.0) PRINT *,*DIAG(27) *,
1  *SS(*,ISSMV,*) = *,SS(ISSMV),* CMVL(*,J,*,*,I,*) = *,CMVL(J,I),
2  * LCROSS = *,LCROSS,* LFLAG(*,IFLGMV,*) = *,LFLAG(IFLGMV)
C
C      IF (LCROSS.NE.0) PRINT *,*MONITORED VARIABLE *,I,
1  * HAS CROSSED THE *,CMVL(J,I),* LIMIT AFTER *,TNOW,
2  * SECONDS OF SIMULATION TIME*
C
C      110 CONTINUE
C      120 CONTINUE
C
C      TEST FOR THE MONITORED VARIABLES CROSSING THEIR HIGH LIMITS
C
C      DO 140 I=1,CNMV
C      DO 130 J=4,6
C
C      IFLGMV=8+I
C      ISSMV=150+I
C
C      LCROSS=KROSS(ISSMV,0.0,0.0,CMVL(J,I),+1,.01*CMVL(J,I))
C      IF (IABS(LCROSS).GT.1) LCROSS=0
C      LFLAG(IFLGMV)=LFLAG(IFLGMV)+(J-3)*LCROSS
C
C      IF (DIAG(27).AND.LFLAG(IFLGMV).NE.0) PRINT *,*DIAG(27) *,
1  *SS(*,ISSMV,*) = *,SS(ISSMV),* CMVL(*,J,*,*,I,*) = *,CMVL(J,I),
2  * LCROSS = *,LCROSS,* LFLAG(*,IFLGMV,*) = *,LFLAG(IFLGMV)
C
C      IF (LCROSS.NE.0) PRINT *,*MONITORED VARIABLE *,I,
1  * HAS CROSSED THE *,CMVL(J,I),* LIMIT AFTER *,TNOW,
2  * SECONDS OF SIMULATION TIME*
C
C      130 CONTINUE
C      140 CONTINUE
C
C      END OF MASTER CONTROL MONITORING FUNCTION
C
C
C

```



```

      IF (ISEES.GE.0) RETURN
C
C      UPON PASSING A STATE EVENT OUT OF TOLERANCE, RESET NON-
C      DERIVATIVE STATE VARIABLES TO THEIR LAST VALUES.
C      SOME OF THESE STATE VARIABLES BELONG TO STABLE,
C      SELF-BALANCING, IMPLICIT EQUATION SETS WHICH DO NOT
C      REQUIRE ITERATIVE SOLUTION TECHNIQUES.
C
      NND=NNEQD+1
      DO 300 I=NND,NNEQT
300  SS(I)=SSL(I)
C
C      RETURN
      END

```

SUBROUTINE SETH(KS,IK,IS,FS)

USED ONLY FOR ID .GT. 4

THIS ROUTINE SETS HCEF TO A VALUE FS FOR ALL CELLS
INTERCEPTED

FOR IS=0 SET ALL CELLS FULLY INTERCEPTED

IS=1 SET ALL CELLS PARTIALLY INTERCEPTED

IK DEFINES THE DIRECTION OF THE FRONT (REAR)

IK=1 SOUTH (0.0)

IK=2 WEST (-90.0)

IK=3 NORTH (180.0)

IK=4 EAST (90.0)

COLLECTOR SUBSYSTEM DATA

COMMON /HDATA/ HFLRN(20,8),HCEF(121),HREF,HCFL,XTIST,XTIEND,
1 XVAL,XDIR,XDTCS

HFLRN HELIOSTAT OUTPUT SOLAR ARRAY FLUX AT RECEIVER NODES
(BTU/SEC)

HCEF HELIOSTAT FIELD CELL EFFICIENCIES (ND)

HREF HELIOSTAT REFLECTIVE EFFICIENCY (ND)

HCFL COLLECTOR FIELD SIZE (FEET)

XTIST START TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)

TIME CLOUD FRONT INTERCEPTS CORNER OF CELL ARRAY

XTIEND END TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)

TIME CLOUD REAR INTERCEPTS CORNER OF CELL ARRAY

XVAL CLOUD VELOCITY (MILES/HOUR)

XDIR CLOUD DIRECTION (DEGREES FROM N TO S DIRECTION)

(0 = N TO S, 90 = W TO E, -90 = E TO W, 180 = S TO N)

XDTCS CLOUD UPDATE SCHEDULING INTERVAL (SEC)

IF (IS .EQ. 1) GO TO 10

WHOLE CELLS ONLY

IF (KS .EQ. 1) RETURN

K1 = 1

K2 = KS - 1

GO TO 20

SET PARTIALS

10 K1 = KS

K2 = KS

SET THE CELLS

20 DO 25 K=K1,K2

DO 25 N=1,11

LOOP ON CELLS PARALLEL TO FRONT (REAR) - N

LOOP ON CELLS PERPENDICULAR TO FRONT - K

GO TO (1,2,3,4) IK

1 I = K

J = N

GO TO 5

2 J = 12 - K

I = N

GO TO 5

3 I = 12 - K

```
J = N  
GO TO 5  
4 J = K  
I = N  
5 L = 11*(I-1) + J  
25 HCEF(L) = FS  
RETURN  
END
```

```

C      SUBROUTINE SSAVE
C      RECORD STATUS
C
C
C      EXECUTIVE AND PROGRAM CONTROL DATA
C
C      INTEGER ATIMO,ATIDAY
C      LOGICAL OUTFG,END,DIAG
C      COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1  DIAG(40)
C
C      OUTFG(I,J)  OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
C      END        END OF RUN FLAG
C      ATILCL     LOCAL TIME (SECONDS FROM MIDNIGHT)
C      ATITST     TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
C      ATIMO      MONTH
C      ATIDAY     DAY
C      DIAG       DIAGNOSTIC PRINT FLAG ARRAY
C
C
C      COLLECTOR SUBSYSTEM DATA
C
C      COMMON /HDATA/ HFLRN(20,8),HCEF(121),HREF,HCFL,XTIST,XTIEND,
1  XVAL,XDIR,XDTC
C
C      HFLRN      HELIOSTAT OUTPUT SOLAR ARRAY FLUX AT RECEIVER NODES
C                  (BTU/SEC)
C      HCEF       HELIOSTAT FIELD CELL EFFICIENCIES (ND)
C      HREF       HELIOSTAT REFLECTIVE EFFICIENCY (ND)
C      HCFL       COLLECTOR FIELD SIZE (FEET)
C      XTIST      START TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD FRONT INTERCEPTS CORNER OF CELL ARRAY
C      XTIEND     END TIME - LOCAL TIME (SECONDS FROM MIDNIGHT)
C                  TIME CLOUD REAR INTERCEPTS CORNER OF CELL ARRAY
C      XVAL       CLOUD VELOCITY (MILES/HOUR)
C      XDIR       CLOUD DIRECTION (DEGREES FROM N TO S DIRECTION)
C                  (0 = N TO S, 90 = W TO E, -90 = E TO W, 180 = S TO N)
C      XDTC      CLOUD UPDATE SCHEDULING INTERVAL (SEC)
C
C
C      RECEIVER SUBSYSTEM DATA
C
C      RECVR VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)
C
C      INTEGER RCVST,RAFLGC
C      COMMON /RDATA/ RHISH(6),RWISH(6),RHSH,RPRSH,RTESH,RWOSH,RFMV(6),
1  RLV(6),RHIV,RFRIV,RPRISV,RFROSV,RVIV,RHOV(6),RFROV(6),RWV(6),
2  RWVSUM,RHF1(8),RPRF1(8),RTEF1(8),RUF1(8),RVF1(8),RHCF2(8),
3  RHF2(8),RPRF2(8),RQF2(8),RTEF2(8),RTEFF2(8),RUF2(8),RVF2(8),
4  RHTF2(8),RHCM2(8),RHFCM2(8),RHFRM2(8),RQM2(8),RQAM2(8),RQCM2(8),
5  RQEM2(8),RPRF3(8),RTEF3(8),RUF3(8),RVF3(8),RHCF4(8),RHNEF4(8),
6  RHBF4(8),RHF4(8),RPRF4(8),RQF4(8),RTEF4(8),RTEFF4(8),RUF4(8),
7  RVF4(8),RHTF4(8),RHCM4(8),RHFCM4(8),RHFRM4(8),RQM4(8),RQAM4(8),
8  RQCM4(8),RQEM4(8),RPRF5(8),RTEF5(8),RUF5(8),RVF5(8),RXF5(8),
9  RHCF6(8),RHF6(8),RPRF6(8),RQF6(8),RTEF6(8),RTEFF6(8),RUF6(8),
A  RVF6(8),RHTF6(8),RHCM6(8),RHFCM6(8),RHFRM6(8),RQM6(8),RQAM6(8),
B  RQCM6(8),RQEM6(8),RHF7(8),RPRF7(8),RTEF7(8),RUF7(8),RVF7(8),
C  RUF8(8),RVFSAT(8),RUVSAT(8),RVVSAT(8),RL35(8),RL57(8),RWSP(8),
D  RCVST(8),RAFLGC(6),RERRTC(6),RLPROC(6),RLSUNIC(6),RTSETC

```

C
 C RHISH(ISP) FLUID ENTHALPY AT STEAM HEADER INLET
 C (BTU/LBM)
 C
 C RWISH(ISP) FLUID MASS FLOW RATE AT STEAM HEADER INLET
 C (LBM/SEC)
 C
 C RSHH FLUID ENTHALPY IN STEAM HEADER
 C (BTU/LBM)
 C
 C RPRSH FLUID PRESSURE IN STEAM HEADER
 C (PSIA)
 C
 C RTESH FLUID TEMPERATURE IN STEAM HEADER
 C (DEGREES F)
 C
 C RWOSH FLUID MASS FLOW RATE AT STEAM HEADER OUTLET
 C (LBM/SEC)
 C
 C RFMV(IV) MODIFIED FRICTION FLOW COEFFICIENT FOR FLOW
 C CONTROL VALVE (PSI,SEC**2/LBM,CU FT)
 C
 C RLV(IV) STEM DISPLACEMENT OF FLOW CONTROL VALVE
 C (PERCENT)
 C
 C RHIV FLUID ENTHALPY AT FLOW CONTROL VALVE INLETS
 C (BTU/LBM)
 C
 C RPRIV FLUID PRESSURE AT FLOW CONTROL VALVE INLETS
 C (PSIA)
 C
 C RPRISV FLUID PRESSURE AT RECEIVER SUBSYSTEM INLET
 C (PSIA)
 C
 C RFROSV FLUID PRESSURE AT RECEIVER SUBSYSTEM OUTLET
 C (PSIA)
 C
 C RVIV FLUID SPECIFIC VOLUME AT FLOW CONTROL VALVE INLETS
 C (CU FT/LBM)
 C
 C RHOV(IV) FLUID ENTHALPY AT FLOW CONTROL VALVE OUTLET
 C (BTU/LBM)
 C
 C RPROV(IV) FLUID PRESSURE AT FLOW CONTROL VALVE OUTLET
 C (PSIA)
 C
 C RWV(IV) FLUID MASS FLOW RATE THROUGH FLOW CONTROL VALVE
 C (LBM/SEC)
 C
 C RWVSUM FLUID MASS FLOW RATE THROUGH ALL FLOW CONTROL VALVES
 C (LBM/SEC)
 C
 C RHF1(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 1
 C (BTU/LBM)
 C
 C RPRF1(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 1
 C (PSIA)
 C
 C RTEF1(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 1
 C (DEGREES F)
 C
 C RUF1(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 1
 C (BTU/LBM)
 C
 C RVF1(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 1
 C (CU FT/LBM)
 C
 C RHCF2(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C
 C RHF2(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 2
 C (BTU/LBM)
 C
 C RPRF2(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 2
 C (PSIA)
 C
 C RQF2(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C
 C RTEF2(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 C (DEGREES F)
 C
 C RTEFF2(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 C (DEGREES F)
 C
 C RUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
 C (BTU/LBM)
 C
 C RVF2(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 2

C (CU FT/LBM)
 C RWTf2(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 2 (LBM/SEC)
 C RHCM2(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFCM2(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RHFRM2(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 2 (BTU/SEC,SQ FT,F)
 C RQM2(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQAM2(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQCM2(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RQEM2(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUBCOOLED SECTION (BTU/SEC)
 C RPRF3(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 3
 C (PSIA)
 C RTEF3(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 3
 C (DEGREES F)
 C RUF3(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RVF3(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 3
 C (CU FT/LBM)
 C RHCF4(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHNBF4(ISP) INTERNAL NUCLEATE BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHBF4(ISP) INTERNAL FILM BOILING HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHF4(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RPRF4(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 4
 C (PSIA)
 C RQF4(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RTEF4(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RTEFF4(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 C (DEGREES F)
 C RUF4(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 4
 C (BTU/LBM)
 C RVF4(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 4
 C (CU FT/LBM)
 C RWTf4(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 4 (LBM/SEC)
 C RHCM4(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFCM4(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RHFRM4(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 4 (BTU/SEC,SQ FT,F)
 C RQM4(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQAM4(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQCM4(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RQEM4(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME

C OF SUPERPANEL TWO-PHASE MIXTURE SECTION (BTU/SEC)
 C RPRF5(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 5
 C (PSIA)
 C RTEF5(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 5
 C (DEGREES F)
 C RUF5(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RVF5(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 5
 C (CU FT/LBM)
 C RXF5(ISP) FLUID QUALITY AT SUPERPANEL NODE NUMBER 5
 C (PERCENT)
 C RHCF6(ISP) INTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHF6(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RPRF6(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 6
 C (PSIA)
 C RQF6(ISP) HEAT TRANSFERRED TO FLUID CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RTEF6(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RTEFF6(ISP) FILM TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 C (DEGREES F)
 C RUF6(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 6
 C (BTU/LBM)
 C RVF6(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 6
 C (CU FT/LBM)
 C RWF6(ISP) FLUID MASS FLOW RATE PER TUBE AT SUPERPANEL NODE
 C NUMBER 6 (LBM/SEC)
 C RHCM6(ISP) EXTERNAL CONVECTIVE HEAT TRANSFER COEFFICIENT AT
 C SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFCM6(ISP) EXTERNAL FORCED CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RHFRM6(ISP) EXTERNAL FREE CONVECTION HEAT TRANSFER COEFFICIENT
 C AT SUPERPANEL NODE NUMBER 6 (BTU/SEC,SQ FT,F)
 C RQM6(ISP) HEAT TRANSFERRED TO METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQAM6(ISP) HEAT ABSORBED BY METAL CONTROL VOLUME OF
 C SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQCM6(ISP) HEAT LOSS BY CONVECTION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RQEM6(ISP) HEAT LOSS BY EMISSION FROM METAL CONTROL VOLUME
 C OF SUPERPANEL SUPERHEATED SECTION (BTU/SEC)
 C RHF7(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RPRF7(ISP) FLUID PRESSURE AT SUPERPANEL NODE NUMBER 7
 C (PSIA)
 C RTEF7(ISP) FLUID TEMPERATURE AT SUPERPANEL NODE NUMBER 7
 C (DEGREES F)
 C RUF7(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 7
 C (BTU/LBM)
 C RVF7(ISP) FLUID SPECIFIC VOLUME AT SUPERPANEL NODE NUMBER 7
 C (CU FT/LBM)
 C RUFSAT(ISP) INTERNAL ENERGY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RVFSAT(ISP) SPECIFIC VOLUME OF A SATURATED LIQUID
 C (CU FT/LBM)
 C RUVSAT(ISP) INTERNAL ENERGY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RVVSAT(ISP) SPECIFIC VOLUME OF A SATURATED VAPOR

C (CU FT/LBM)
 C RL35(ISP) LENGTH OF SUPERPANEL TWO-PHASE MIXTURE SECTION
 C (FEET)
 C RL57(ISP) LENGTH OF SUPERPANEL SUPERHEATED SECTION
 C (FEET)
 C RWSP(ISP) FLUID MASS FLOW RATE THROUGH SUPERPANEL
 C (LBM/SEC)
 C RCVST(ISP) SUPERPANEL FLUID CONTROL VOLUME STATE
 C RCVST = 1 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
 C FLUID STATES ONLY
 C RCVST = 2 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED
 C AND SATURATED FLUID STATES
 C RCVST = 3 SIGNIFIES SUPERPANEL CONTAINS SUBCOOLED,
 C SATURATED, AND SUPERHEATED FLUID STATES
 C RAFLGC(IC) CONTROLLER ACTIVATION FLAG
 C RAFLGC = 1 SIGNIFIES RTSENC .LT. RKTHSC
 C RAFLGC = 2 SIGNIFIES RTSENC .GT. RKTHSC
 C RERRTC(IC) CONTROLLER TEMPERATURE ERROR SIGNAL
 C (DEGREES F)
 C RLPROC(IC) CONTROLLER PROPORTIONAL SIGNAL OF VALVE STEM
 C DISPLACEMENT (PERCENT)
 C RLSUMC(IC) CONTROLLER COMMAND SIGNAL OF VALVE STEM DISPLACEMENT
 C (PERCENT)
 C RTSETC CONTROLLER SET POINT FOR RECEIVER SUBSYSTEM OUTLET
 C TEMPERATURE (DEGREES F)

THERMAL STORAGE SUBSYSTEM DATA

TSS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)

COMMON /TDATA/ TP1,TP4,TH1,TH2,TH3,TH4,TH9,TW1,TW1A,TW1M,TW2,TW3,
 1 TW5A,TW7A,TWE,TKDSH,TKTSH,TKSG,TPPC,TPPE,TPPT,TFC,TFE,TK1,TK2,
 2 TK3,TK4,TCONC,TCONC,TLT,TFLAGU,TFLAGL

C TP1 PRESSURE OF STEAM INTO DESUPERHEATER,
 C AND PRESSURE OF DESUPERHEATED STEAM (PSIA)
 C TP4 PRESSURE OF WATER FROM STORAGE HEATER (PSIA)
 C TH1 ENTHALPY OF STEAM INTO DESUPERHEATER (BTU/LBM)
 C TH2 ENTHALPY OF WATER INTO DESUPERHEATER (BTU/LBM)
 C TH3 ENTHALPY OF STEAM FROM DESUPERHEATER (BTU/LBM)
 C TH4 ENTHALPY OF WATER FROM STORAGE HEATER (BTU/LBM)
 C TH9 ENTHALPY OF WATER INTO STEAM GENERATOR (BTU/LBM)
 C TW1 STEAM FLOW AVAILABLE TO DESUPERHEATER (LBM/SEC)
 C TW1A ACTUAL STEAM FLOW TO DESUPERHEATER (LBM/SEC)
 C TW1M MAXIMUM STEAM FLOW TO DESUPERHEATER (LBM/SEC)
 C TW2 WATER FLOW TO DESUPERHEATER (LBM/SEC)
 C TW3 STEAM FLOW FROM DESUPERHEATER (LBM/SEC)
 C TW5A ACTUAL OIL FLOW INTO STORAGE (LBM/SEC)
 C TW7A ACTUAL OIL FLOW FROM STORAGE (LBM/SEC)
 C TWE CONTROLLER SET POINT FOR STEAM GENERATOR STEAM FLOW
 C (LBM/SEC)
 C TKDSH FLOW RATE GAIN FACTOR OF DESUPERHEATER (RECIPROCAL
 C OF SPECIFIC ENTHALPY LOSS FACTOR) (DIMENSIONLESS)
 C TKTSH RATIO OF SPECIFIC ENTHALPY GAIN OF OIL TO SPECIFIC
 C ENTHALPY LOSS OF STEAM IN THERMAL STORAGE HEATER
 C (DIMENSIONLESS)
 C TKSG RATIO OF SPECIFIC ENTHALPY GAIN OF WATER TO
 C SPECIFIC ENTHALPY LOSS OF OIL IN STEAM GENERATOR
 C (DIMENSIONLESS)


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C  GWTEXT(4)  TURBINE EXTRACTION FLOWS (LBM/SEC)
C  GPTEXT(4)  TURBINE EXTRACTION PRESSURES (PSIA)
C  GHTEXT(4)  TURBINE EXTRACTION ENTHALPIES (BTU/LBM)
C  GTPOWER    THERMAL AVAILABILITY (BTU/SEC)
C  GEPOUT     ELECTRICAL POWER (MEGA-WATTS)
C  GHLOSSR    RISER HEAT LOSSES (BTU/HR)
C  GTFPR      RECVR INLET TEMPERATURE (F)
C  GFOUT      RECVR FEED PUMP OUTPUT PRESSURE (PSIA)
C  GHOUTP     RECVR FEED PUMP OUTPUT ENTHALPY (BTU/LBM)
C  GFPAUX     RECVR FEED PUMP AUX POWER (KW)
C  GNFPT      TOTAL RECVR FEED PUMP FLOW (LBM/SEC)
C  GFFH       RECVR FEED PUMP HEAD (FT)
C  GFPT       RECVR FEED PUMP TORQUE (FT-LBS)
C  GTDSI      F.W. TEMPERATURE (F) AT DESUPERHRTR INLET
C  GFCTSG     PRESSURE (PSIA) AT TSS STEAM GENERATOR INLET
C  GTCTSG     TEMPERATURE (F) AT TSS STEAM GENERATOR INLET
C  GHLOSSDS   HEAT LOSS (BTU/HR) IN DESUPERHEATER FW PIPE
C  GHLOTSG    HEAT LOSS (BTU/HR) IN TSS STEAM GENERATOR FW PIPE
C  GTAUXP     TOTAL AUX POWER (KW) REQUIRED BY FEEDWATER PUMPS
C  AFBP       AUX POWER (KW) REQUIRED BY BOOST PUMP
C  AFHP       AUX POWER (KW) REQUIRED BY HOTWELL PUMP
C  GHNTR1     ENTHALPY (BTU/LBM) OF WATER IN HEATER 1
C  GFHTR1     PRESSURE (PSIA) OF WATER IN HEATER 1
C  GTHTR1     TEMPERATURE (F) OF WATER IN HEATER 1
C  GPSH1      PRESSURE (PSIA) OF STEAM TO HEATER 1
C  GNSH1      ENTHALPY (BTU/LBM) OF STEAM TO HEATER 1
C  GPSH2      PRESSURE (PSIA) OF STEAM TO HEATER 2
C  GNSH2      ENTHALPY (BTU/LBM) OF STEAM TO HEATER 2
C  GHCH4C     ENTHALPY (BTU/LBM) OF HEATER 4 CONDENSATE DRAIN
C  GHCH5C     ENTHALPY (BTU/LBM) OF HEATER 5 CONDENSATE DRAIN
C  GHCH23     ENTHALPY (BTU/LBM) OF HEATER 2 CONDENSATE DRAIN
C  GHCH12     ENTHALPY (BTU/LBM) OF HEATER 1 CONDENSATE DRAIN
C
C
C  GASP-IV SIMULATION SYSTEM DATA
C
C  COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
1  INAPO,NNAPT,NHATR,NKFI,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
2  ,TTCLR,TTFIN,TRIB(25),TTSET
C
C  COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTHOW,ISEES,LFLAG(200),KFLAG
1  ,NNEQD,NNEQS,NNEQT,SS(600),SSL(600),TTNEX
C
C  DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
1  RLINTC(6),RL15(8),RHFSAT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
2  RDIUF2(8),RDL13(8),RDEM2(8),RDIHF3(8),RDEM4(8),RDEM6(8),
3  RDLINTC(6)
C
C  EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
1  (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
2  (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
3  (TW5,SS(83)),(TW7,SS(84)),(TW8,SS(85)),
4  (THTSU,SS(86)),(GHCT3,SS(87)),(GHCT3,SS(88)),
5  (GHCT3,SS(89)),(GHSDC,SS(90)),(GHSTSG,SS(91)),
6  (GHCT1,SS(92)),(GHCT2,SS(93)),(GHCT2,SS(94)),
7  (GHCT2,SS(95)),(GFPS,SS(96)),(GHRCI,SS(97)),
8  (GHDSI,SS(98)),(GHCON3,SS(99)),(GHCTSG,SS(100)),
9  (GHCHN,SS(101)),
A  (RL15(1),SS(102)),(RHFSAT(1),SS(110)),(RHF3(1),SS(118)),
B  (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
C

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D (CRPRSH,SS(151)),(CRTESH,SS(152)),(CGPFPR,SS(153)),
 E (CTLT,SS(154)),
 F (GPFP,SS(161)),(GPDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
 G (XK3,SS(165)).

C.

EQUIVALENCE (RDIUF2(1),DD(1)),(RDL13(1),DD(9)),(RDEM2(1),DD(17)),
 1 (RDIHF3(1),DD(25)),(RDEM4(1),DD(33)),(RDEM6(1),DD(41)),
 2 (RDUSH,DD(49)),(RDVSH,DD(50)),(RLINTC(1),DD(51)),
 3 (TDW5,DD(83)),(TDW7,DD(84)),
 5 (TDW8,DD(85)),(TDHTSU,DD(86)),(GMCOT3,DD(87)),
 6 (GHDCOT3,DD(88)),(GHDCOT3,DD(89)),(GHSDBC,DD(90)),
 7 (GHSTSG,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),
 8 (GHDCOT2,DD(94)),(GHDCOT2,DD(95)),(GDFPS,DD(96)),
 9 (GHRCI,DD(97)),(GHDSI,DD(98)),(GHDCCH3,DD(99)),
 A (GHCTSG,DD(100)),(GHCHW,DD(101))

C

C

INTEGRATED STATE VARIABLES

C

C

RIUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
 (BTU/LBM)

C

RL13(ISP) LENGTH OF SUPERPANEL SUBCOOLED SECTION
 (FEET)

C

RTEM2(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 (DEGREES F)

C

RIHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 (BTU/LBM)

C

RTEM4(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 (DEGREES F)

C

RTEM6(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 (DEGREES F)

C

RUSH FLUID INTERNAL ENERGY IN STEAM HEADER
 (BTU/LBM)

C

RVSH FLUID SPECIFIC VOLUME IN STEAM HEADER
 (CU FT/LBM)

C

RLINTC(IC) CONTROLLER INTEGRAL SIGNAL OF VALVE STEM DISPLACEMENT
 (PERCENT)

C

C

TW5 NOMINAL OIL FLOW INTO STORAGE (LBM/SEC)

C

TW7 NOMINAL OIL FLOW FROM STORAGE (LBM/SEC)

C

THS STEAM FLOW FROM STEAM GENERATOR (LBM/SEC)

C

THTSU HEAT STORED IN THERMAL STORAGE UNIT (BTU)

C

GMCOT3 CONDENSATE MASS (LBM) IN TANK 3 (RECVR FLASH TANK)

C

GHDCOT3 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 3

C

GHDCOT3 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 3

C

GHSDBC ENTHALPY (BTU/LBM) OF STEAM AT BOTTOM OF DOWNCOMER

C

GHSTSG ENTHALPY (BTU/LBM) OF ADMISSION STEAM

C

GHDCOT1 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 1

C

GHDCOT2 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 2

C

GMCOT2 MASS (LBM) OF CONDENSATE IN TANK 2

C

GHDCOT2 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 2

C

GDFPS RECVR FEED PUMP SPEED (RPM)

C

GHRCI F.W. ENTHALPY (BTU/LBM) AT RECVR INLET

C

GHDSI F.W. ENTHALPY (BTU/LBM) AT DESUPERHEATER INLET

C

GHCOH3 F.W. ENTHALPY (BTU/LBM) OUT OF FW HRTR NO. 3

C

GHCTSG ENTHALPY (BTU/LBM) AT TSS STEAM GEN. INLET

C

GHCHW ENTHALPY (BTU/LBM) OF CONDENSATE IN CONDENSER HOTWELL

C

C

ADDITIONALLY REQUIRED GASP-IV STATE VARIABLES

C

C RL15(ISP) COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND
 C TWO-PHASE MIXTURE SECTIONS (FEET)
 C RHFSAT(ISP) ENTHALPY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RHVSAT(ISP) ENTHALPY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RHF5(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RTSENC(IC) CONTROLLER TEMPERATURE SENSOR SIGNAL OF BOILER
 C SUPERPANEL OUTLET TEMPERATURE (DEGREES F)
 C CRPRSH FLUID PRESSURE IN RECEIVER STEAM HEADER
 C (PSIA)
 C CRTESH FLUID TEMPERATURE IN RECEIVER STEAM HEADER
 C (DEGREES F)
 C CGPFPR FLUID PRESSURE AT RECEIVER INLET
 C (PSIA)
 C CTLT POSITION OF TSS THERMOCLINE
 C (PERCENT)
 C GPFPR FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
 C GFDSI FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)
 C XK1,XK2,XK3 EPGS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND
 C PRESSURE AT RECEIVER INLET
 C
 C TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES
 C
 C RDIUF2(ISP) TIME DERIVATIVE OF RIUF2(ISP)
 C RDL13(ISP) TIME DERIVATIVE OF RL13(ISP)
 C RDEM2(ISP) TIME DERIVATIVE OF RTEM2(ISP)
 C RDIHF3(ISP) TIME DERIVATIVE OF RIHF3(ISP)
 C RDEM4(ISP) TIME DERIVATIVE OF RTEM4(ISP)
 C RDEM6(ISP) TIME DERIVATIVE OF RTEM6(ISP)
 C RDOUSH TIME DERIVATIVE OF RUSH
 C RDVSH TIME DERIVATIVE OF RVSH
 C RDLINTC(IC) TIME DERIVATIVE OF RLINTC(IC)
 C
 C TDW5 TIME DERIVATIVE OF TW5
 C TDW7 TIME DERIVATIVE OF TW7
 C TDW8 TIME DERIVATIVE OF TW8
 C TDHTSU TIME DERIVATIVE OF THTSU
 C
 C GHCDT3 TIME DERIVATIVE OF GHCT3
 C GHDCOT3 TIME DERIVATIVE OF GHCT3
 C GHDCOT3 TIME DERIVATIVE OF GHCT3
 C GHSDSDC TIME DERIVATIVE OF GHSDC
 C GHSTSG TIME DERIVATIVE OF GHSTSG
 C GHDCOT1 TIME DERIVATIVE OF GHCT1
 C GHDCOT2 TIME DERIVATIVE OF GHCT2
 C GHDCOT2 TIME DERIVATIVE OF GHCT2
 C GHDCOT2 TIME DERIVATIVE OF GHCT2
 C GHDCOT2 TIME DERIVATIVE OF GHCT2
 C GDFPS TIME DERIVATIVE OF GFPS
 C GHDRCI TIME DERIVATIVE OF GHRCI
 C GHDSI TIME DERIVATIVE OF GHDSI
 C GHDCOH3 TIME DERIVATIVE OF GHCOH3
 C GHDCOTSG TIME DERIVATIVE OF GHCTSG
 C GHDCWH TIME DERIVATIVE OF GHCHW

DIMENSION RDATA(693)

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      EQUIVALENCE (RHISH(1),RDATA(1))
C
C
C      CALCULATE TOTAL SOLAR FLUX ON RECEIVER
      HSUM=0.0
      DO 160 I1=1,20
      DO 160 I2=1,8
160   HSUM=HSUM+HFLRN(I1,I2)
      HSUM=0.001055*HSUM
C
C      WRITE PLOT DATA TAPE RECORD
      WRITE (8)
C  VARIABLES OF RECVR SUPERPANELS
      1  TNOW,HSUM,(RWSP(I),RHF7(I),I=1,2),RPRIV,(RPROV(I),I=1,6),
      2  (RWSP(I),RL13(I),RL35(I),RL57(I),RTEF7(I),I=3,8),
C  PROPERTIES OF STEAM IN RECVR STEAM HEADER
      3  RWVSUM,RHSH,RPRSH,RTESH,RWOSH,
C  PROPERTIES OF STEAM AT BOTTOM OF TOWER DOWNCOMER
      4  GWSBDC,GHSBDC,GPSBDC,GTBDC,
C  PROPERTIES OF STEAM AT TURBINE MAIN THROTTLE VALVE
      5  GWSRG,
C  PROPERTIES OF STEAM AT TURBINE ADMISSION THROTTLE VALVE
      6  GWSTSG,GHSTSG,GPSTSG,GTSTSG,
C  TURBINE EXTRACTION PROPERTIES AND GENERATOR POWER
      7  GEFOUT,(GWTEXT(I),I=1,4),GWTEXH,(GPTEXT(I),I=1,4),GPTEXH,
      8  (GHTEXT(I),I=1,4),GHTEXH,
C  PROPERTIES OF WATER IN HEATER/DEAERATOR
      9  GHCOH3,
C  PROPERTIES OF WATER IN LAST (NO. 1) FEEDWATER HEATER
      A  GWFPT,GHHTR1,GPHTR1,GTHTR1,
C  PROPERTIES OF WATER AT FEED PUMP OUTLET
      B  GWFPT,GHOUTP,GPOUT,
C  PROPERTIES OF WATER AT RECVR INLET
      C  GHRCI,GPFPF,GTFPF,
C  PROPERTIES OF WATER AT TSS DESUPERHEATER INLET
      D  TW2,TH2,GHDSI,GFDSI,
C  PROPERTIES OF STEAM AT TSS DESUPERHEATER INLET
      E  GWSRT,TW1A,TH1,TP1,
C  PROPERTIES OF STEAM/WATER AT TSS STORAGE HEATER OUTLET
      F  TW3,TW5A,TW7A,TLT,TW8,TH9
C
C      GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
      IF (DIAG(3)) WRITE (6,225)
      1  TNOW,HSUM,(RWSP(I),RHF1(I),I=1,2),RPRIV,(RPROV(I),I=1,6),
      2  (RWSP(I),RL13(I),RL35(I),RL57(I),RTEF7(I),I=3,8),
      3  RWVSUM,RHSH,RPRSH,RTESH,RWOSH,
      4  GWSBDC,GHSBDC,GPSBDC,GTBDC,
      5  GWSRG,
      6  GWSTSG,GHSTSG,GPSTSG,GTSTSG,
      7  GEFOUT,(GWTEXT(I),I=1,4),GWTEXH,(GPTEXT(I),I=1,4),GPTEXH,
      8  (GHTEXT(I),I=1,4),GHTEXH,
      9  GHCOH3,
      A  GWFPT,GHHTR1,GPHTR1,GTHTR1,
      B  GWFPT,GHOUTP,GPOUT,
      C  GHRCI,GPFPF,GTFPF,
      D  TW2,TH2,GHDSI,GFDSI,
      E  GWSRT,TW1A,TH1,TP1,
      F  TW3,TW5A,TW7A,TLT,TW8,TH9
225  FORMAT(1H ,2X,39HDIAG3/SSAVE PLOT DATA FILE VARIABLES =,
      1  6X,6G10.4/(1H ,7X,10G10.4))

```

```

C
C      PRINT CURRENT SIMULATION TIME AND CENTRAL PROCESSOR TIME FROM
C      START OF RUN (IF REQUESTED)
C      IF (.NOT.(DIAG(11).OR.DIAG(12))) GO TO 810
C      CALL SECOND(CPT)
C      WRITE (6,805) TNOW,CPT
805  FORMAT(1H ,3X,25HCURRENT SIMULATION TIME =,F10.3,
1  46H  CENTRAL PROCESSOR TIME FROM START OF RUN =,F10.3)
810  CONTINUE
C
C      PRINT STATE VARIABLE ARRAY (IF REQUESTED)
C      IF (DIAG(11)) WRITE (6,815) TNOW,(SS(I1),I1=1,NNEQT)
815  FORMAT(1H ,2X,19HDIAG11/SSAVE  TNOW=,G10.4,5H  SS=,7G10.4/
1  (1H ,16X,9G10.4))
C
C      PRINT STATE VARIABLE DERIVATIVE ARRAY (IF REQUESTED)
C      IF (DIAG(12)) WRITE (6,825) TNOW,(DD(I1),I1=1,NNEGD)
825  FORMAT(1H ,2X,19HDIAG12/SSAVE  TNOW=,G10.4,5H  DD=,7G10.4/
1  (1H ,16X,9G10.4))
C
C      PRINT ALGEBRAIC VARIABLE ARRAY (IF REQUESTED)
C      IF (DIAG(13)) WRITE(6,835) TNOW,RDATA
835  FORMAT(1H ,2X,19HDIAG13/SSAVE  TNOW=,G10.4,8X,6HRDATA=,6G10.4/
1  (1H ,16X,9G10.4))
C
C
C
C      RETURN
C      END

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SUBROUTINE STATE
UPDATE STATE VARIABLES

EXECUTIVE AND PROGRAM CONTROL DATA

INTEGER ATIMO,ATIDAY
LOGICAL OUTFG,END,DIAG
COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1 DIAG(40)

OUTFG(I,J) OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
END END OF RUN FLAG
ATILCL LOCAL TIME (SECONDS FROM MIDNIGHT)
ATITST TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
ATIMO MONTH
ATIDAY DAY
DIAG DIAGNOSTIC PRINT FLAG ARRAY

GASP-IV SIMULATION SYSTEM DATA

COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
1NAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
2,TTCLR,TTFIN,TTRIB(25),TTSET

COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
1,NNEQD,NNEQS,NNEQT,SS(600),SSL(600),TTNEX

DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
1 RLINTC(6),RL15(8),RHF5AT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
2 RDIUF2(8),RDL13(8),RDTEM2(8),RDIHF3(8),RDTEM4(8),RDTEM6(8),
3 RDLINTC(6)

EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
1 (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
2 (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
4 (TWS,SS(83)),(TW7,SS(84)),(TWS,SS(85)),
5 (THTSU,SS(86)),(GHCT3,SS(87)),(GHCT3,SS(88)),
6 (GHCT3,SS(89)),(GHSDC,SS(90)),(GHSTSG,SS(91)),
7 (GHCT1,SS(92)),(GHCT2,SS(93)),(GHCT2,SS(94)),
8 (GHCT2,SS(95)),(GFPS,SS(96)),(GHCI,SS(97)),
9 (GHDSI,SS(98)),(GHCH3,SS(99)),(GHCTSG,SS(100)),
A (GHCHW,SS(101)),
B (RL15(1),SS(102)),(RHF5AT(1),SS(110)),(RHF3(1),SS(118)),
C (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
D (CRFRSH,SS(151)),(CRTESH,SS(152)),(CGFFFR,SS(153)),
E (CTLT,SS(154)),
F (GPFFR,SS(161)),(GPDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
G (XK3,SS(165))

EQUIVALENCE (RDIUF2(1),DD(1)),(RDL13(1),DD(9)),(RDTEM2(1),DD(17)),
1 (RDIHF3(1),DD(25)),(RDTEM4(1),DD(33)),(RDTEM6(1),DD(41)),
2 (RDUSH,DD(49)),(RDVSH,DD(50)),(RDLINTC(1),DD(51)),
3 (TDWS,DD(83)),(TDW7,DD(84)),
5 (TDWS,DD(85)),(TDHTSU,DD(86)),(GHCDT3,DD(87)),
6 (GHDCOT3,DD(88)),(GHDCOT3,DD(89)),(GHSDC,DD(90)),
7 (GHSTSG,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),
8 (GHDCOT2,DD(94)),(GHDCOT2,DD(95)),(GDFPS,DD(96)),

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9 (GHORCI,DD(97)),(GHDDSI,DD(98)),(GHDCOH3,DD(99)),
 A (GHDC TSG,DD(100)),(GHDC HW,DD(101))

INTEGRATED STATE VARIABLES

RIUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
 (BTU/LBM)
 RL13(ISP) LENGTH OF SUPERPANEL SUBCOOLED SECTION
 (FEET)
 RTE M2(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 (DEGREES F)
 RIHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 (BTU/LBM)
 RTE M4(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 (DEGREES F)
 RTE M6(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 (DEGREES F)
 RUSH FLUID INTERNAL ENERGY IN STEAM HEADER
 (BTU/LBM)
 RVSH FLUID SPECIFIC VOLUME IN STEAM HEADER
 (CU FT/LBM)
 RLINTC(IC) CONTROLLER INTEGRAL SIGNAL OF VALVE STEM DISPLACEMENT
 (PERCENT)
 TW5 NOMINAL OIL FLOW INTO STORAGE (LBM/SEC)
 TW7 NOMINAL OIL FLOW FROM STORAGE (LBM/SEC)
 TW8 STEAM FLOW FROM STEAM GENERATOR (LBM/SEC)
 THTSU HEAT STORED IN THERMAL STORAGE UNIT (BTU)
 GMCT3 CONDENSATE MASS (LBM) IN TANK 3 (RECVR FLASH TANK)
 GHCOT3 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 3
 GHCOT3 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 3
 GHSDC ENTHALPY (BTU/LBM) OF STEAM AT BOTTOM OF DOWNCOMER
 GHSTSG ENTHALPY (BTU/LBM) OF ADMISSION STEAM
 GHCOT1 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 1
 GHCOT2 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 2
 GMCT2 MASS (LBM) OF CONDENSATE IN TANK 2
 GHCOT2 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 2
 GFPS RECVR FEED PUMP SPEED (RPM)
 GHRCI F.W. ENTHALPY (BTU/LBM) AT RECVR INLET
 GHDSI F.W. ENTHALPY (BTU/LBM) AT DESUPERHEATER INLET
 GHCOH3 F.W. ENTHALPY (BTU/LBM) OUT OF FW HRTR NO. 3
 GHCTSG ENTHALPY (BTU/LBM) AT TSS STEAM GEN. INLET
 GHCHW ENTHALPY (BTU/LBM) OF CONDENSATE IN CONDENSER HOTWELL

ADDITIONALLY REQUIRED GASP-IV STATE VARIABLES

RL15(ISP) COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND
 TWO-PHASE MIXTURE SECTIONS (FEET)
 RHFSAT(ISP) ENTHALPY OF A SATURATED LIQUID
 (BTU/LBM)
 RHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 (BTU/LBM)
 RHVSAT(ISP) ENTHALPY OF A SATURATED VAPOR
 (BTU/LBM)
 RHF5(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5
 (BTU/LBM)
 RTSENC(IC) CONTROLLER TEMPERATURE SENSOR SIGNAL OF BOILER
 SUPERPANEL OUTLET TEMPERATURE (DEGREES F)
 CRPRSH FLUID PRESSURE IN RECEIVER STEAM HEADER


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C      (PSIA)
C      CRTESH      FLUID TEMPERATURE IN RECEIVER STEAM HEADER
C                  (DEGREES F)
C      CGPFPR      FLUID PRESSURE AT RECEIVER INLET
C                  (PSIA)
C      CTLT        POSITION OF TSS THERMOCLINE
C                  (PERCENT)
C      GPFPR       FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
C      GFDISI      FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)
C      XK1,XK2,XK3 EPGS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND
C                  PRESSURE AT RECEIVER INLET
C
C      TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES
C
C      RDIUF2(ISP) TIME DERIVATIVE OF RIUF2(ISP)
C      RDL13(ISP)  TIME DERIVATIVE OF RL13(ISP)
C      RDTM2(ISP)  TIME DERIVATIVE OF RTM2(ISP)
C      RDIHF3(ISP) TIME DERIVATIVE OF RIHF3(ISP)
C      RDTM4(ISP)  TIME DERIVATIVE OF RTM4(ISP)
C      RDTM6(ISP)  TIME DERIVATIVE OF RTM6(ISP)
C      ROUSH       TIME DERIVATIVE OF RUSH
C      RDVSH       TIME DERIVATIVE OF RVSH
C      RDLINTC(IC) TIME DERIVATIVE OF RLINTC(IC)
C
C      TDW5        TIME DERIVATIVE OF TW5
C      TDW7        TIME DERIVATIVE OF TW7
C      TDW8        TIME DERIVATIVE OF TW8
C      TDHTSU      TIME DERIVATIVE OF THTSU
C
C      GMCDT3      TIME DERIVATIVE OF GMCT3
C      GHDCOT3     TIME DERIVATIVE OF GHCOT3
C      GWCOT3      TIME DERIVATIVE OF GWCOT3
C      GHSDDC      TIME DERIVATIVE OF GHSDDC
C      GHSTSG      TIME DERIVATIVE OF GHSTSG
C      GHDCOT1     TIME DERIVATIVE OF GHCOT1
C      GHDCOT2     TIME DERIVATIVE OF GHCOT2
C      GMCT2       TIME DERIVATIVE OF GMCT2
C      GWCOT2      TIME DERIVATIVE OF GWCOT2
C      GDFPS       TIME DERIVATIVE OF GFPS
C      GHORCI      TIME DERIVATIVE OF GHRCI
C      GHDDSI      TIME DERIVATIVE OF GHDSI
C      GHDCOH3     TIME DERIVATIVE OF GHCOH3
C      GHDCSTG     TIME DERIVATIVE OF GHCTSG
C      GHCHW       TIME DERIVATIVE OF GHCHW
C
C      CALCULATE CURRENT LOCAL TIME
C      ATILCL=TNOW
C      CALCULATE RECEIVER SUBSYSTEM STATE EQUATIONS
C      CALL RECVR
C      CALCULATE ELECTRICAL POWER GENERATION SUBSYSTEM
C      STATE EQUATIONS
C      CALL EPGS
C      CALCULATE THERMAL STORAGE SUBSYSTEM STATE EQUATIONS
C      CALL TSS
C
C      RETURN
C      END

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SUBROUTINE TSS
C   CALCULATE STATE VARIABLE EQUATIONS FOR THERMAL STORAGE SYBSYSTEM
C
C   THIS SUBROUTINE COMPUTES OUTPUT STEAM FLOW (TW8), THERMOCLINE
C   LEVEL (TLT), FEED WATER FLCW (TW2), AND TOTAL PUMPING POWER
C   (TPPT) AS FUNCTIONS OF TIME. IT IS CALLED BY SUBROUTINE STATE
C
C   EXECUTIVE AND PROGRAM CONTROL DATA
C
C   INTEGER ATIMO,ATIDAY
C   LOGICAL OUTFG,END,DIAG
C   COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1  DIAG(40)
C
C   OUTFG(I,J)  OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
C   END         END OF RUN FLAG
C   ATILCL      LOCAL TIME (SECONDS FROM MIDNIGHT)
C   ATITST      TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
C   ATIMO       MONTH
C   ATIDAY      DAY
C   DIAG        DIAGNOSTIC PRINT FLAG ARRAY
C
C   MASTER CONTROL SUBSYSTEM DATA
C
C   INTEGER CMODE,CNMODE,CNSP,CNMV,CMVRTBL,CMVLA,CMVPA,
1  CMVRC,CNM,CNMVEL,CNNM
C   COMMON /CDATA/ CMODE,CNMODE,CSPTBL(7,16),CSP(16),CNSP,
1  CMVLTBL(6,4,7),CMVL(6,4),CMNV,CMVRTBL(7,7,4),
2  CMVLA(7),CMVPA(4),CMVRC(4),CNM(4),CNMVEL,CNNM
C
C   CMODE       CURRENT MODE OF OPERATION
C   CNMODE      NUMBER OF DIFFERENT MODES OF OPERATION
C   CSPTBL      SETPOINT TABLE
C   CSP         SETPOINTS FOR CURRENT MODE OF OPERATION
C   CNSP        NUMBER OF SETPOINTS
C   CMVLTBL     TABLE OF OPERATING LIMITS FOR MONITORED VARIABLES
C   CMVL        OPERATING LIMITS OF MONITORED VARIABLES FOR CURRENT
C               MODE OF OPERATION
C   CNMV        NUMBER OF MONITORED VARIABLES
C   CMVRTBL     TABLE OF MCS RESPONSES FOR MONITORED VARIABLES
C               EXCEEDING THEIR LIMITS
C   CMVLA       MONITORED VARIABLE LIMIT ARGUMENT FOR RESPONSE TABLE
C   CMVPA       MONITORED VARIABLE ARGUMENT FOR RESPONSE TABLE
C   CMVRC       RESPONSE CODES FOR MONITORED VARIABLES CROSSING LIMITS
C   CNM         POTENTIAL NEW MODES TO CORRECT MONITORED VARIABLE
C               LIMIT CROSSINGS
C   CNMVEL      NUMBER OF MONITORED VARIABLES EXCEEDING LIMITS
C               AT ANY INSTANT OF TIME
C   CNNM        NUMBER OF NEW MODE REQUESTS AT ANY INSTANT OF TIME
C
C   STANDARD DEFINITION OF PILOT PLANT OPERATING MODES
C
C   1= RECEIVER STEAM TO EPGS
C   2= RECEIVER STEAM TO EPGS AND THERMAL STORAGE
C   3= RECEIVER STEAM TO EPGS AND THERMAL STORAGE STEAM TO EPGS
C   4= RECEIVER STEAM TO THERMAL STORAGE AND THERMAL STORAGE
C       STEAM TO EPGS

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C 5= RECEIVER STEAM TO THERMAL STORAGE
 C 6= THERMAL STORAGE STEAM TO EPGs
 C 7= OVERNIGHT SHUTDOWN AND HOLD
 C
 C ARGUMENT DEFINITIONS FOR SETPOINT ARRAY CSP(I)
 C
 C I=1,4 EPGs VALVE SETPOINTS FOR VALVES R1-R4
 C I=5,6 EPGs VALVE SETPOINTS FOR VALVES T1,T2
 C I=7,8 EPGs VALVE SETPOINTS FOR DRAIN VALVES
 C I=9,12 EPGs VALVE SETPOINTS FOR VALVES E1-E4
 C I=13 EPGs CONDENSER FAN SETPOINT
 C I=14 EPGs FEED PUMP PRESSURE SETPOINT
 C I=15 RECEIVER OUTLET TEMPERATURE SETPOINT
 C I=16 TSS OUTLET STEAM FLOW RATE SETPOINT
 C
 C CURRENT LIST OF MONITORED VARIABLES
 C
 C RECEIVER OUTLET PRESSURE
 C RECEIVER OUTLET TEMPERATURE
 C EPGs FEEDWATER PRESSURE
 C TSS THERMOCLINE LEVEL
 C
 C THERMAL STORAGE SUBSYSTEM DATA
 C
 C TSS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)
 C
 C COMMON /TDATA/ TP1,TP4,TH1,TH2,TH3,TH4,TH9,TW1,TW1A,TW1M,TW2,TW3,
 1 TW5A,TW7A,TWE,TKDSH,TKTSH,TKSG,TPPC,TPPE,TPPT,TFC,TFE,TK1,TK2,
 2 TK3,TK4,TCONC,TCONE,TLT,TFLAGU,TFLAGL
 C
 C TP1 PRESSURE OF STEAM INTO DESUPERHEATER,
 C AND PRESSURE OF DESUPERHEATED STEAM (PSIA)
 C TP4 PRESSURE OF WATER FROM STORAGE HEATER (PSIA)
 C TH1 ENTHALPY OF STEAM INTO DESUPERHEATER (BTU/LBM)
 C TH2 ENTHALPY OF WATER INTO DESUPERHEATER (BTU/LBM)
 C TH3 ENTHALPY OF STEAM FROM DESUPERHEATER (BTU/LBM)
 C TH4 ENTHALPY OF WATER FROM STORAGE HEATER (BTU/LBM)
 C TH9 ENTHALPY OF WATER INTO STEAM GENERATOR (BTU/LBM)
 C TW1 STEAM FLOW AVAILABLE TO DESUPERHEATER (LBM/SEC)
 C TW1A ACTUAL STEAM FLOW TO DESUPERHEATER (LBM/SEC)
 C TW1M MAXIMUM STEAM FLOW TO DESUPERHEATER (LBM/SEC)
 C TW2 WATER FLOW TO DESUPERHEATER (LBM/SEC)
 C TW3 STEAM FLOW FROM DESUPERHEATER (LBM/SEC)
 C TW5A ACTUAL OIL FLOW INTO STORAGE (LBM/SEC)
 C TW7A ACTUAL OIL FLOW FROM STORAGE (LBM/SEC)
 C TWE CONTROLLER SET POINT FOR STEAM GENERATOR STEAM FLOW
 C (LBM/SEC)
 C TKDSH FLOW RATE GAIN FACTOR OF DESUPERHEATER (RECIPROCAL
 C OF SPECIFIC ENTHALPY LOSS FACTOR) (DIMENSIONLESS)
 C TKTSH RATIO OF SPECIFIC ENTHALPY GAIN OF OIL TO SPECIFIC
 C ENTHALPY LOSS OF STEAM IN THERMAL STORAGE HEATER
 C (DIMENSIONLESS)
 C TKSG RATIO OF SPECIFIC ENTHALPY GAIN OF WATER TO
 C SPECIFIC ENTHALPY LOSS OF OIL IN STEAM GENERATOR
 C (DIMENSIONLESS)
 C TPPC CHARGING OIL PUMPING POWER (WATTS)
 C TPPE EXTRACTION OIL PUMPING POWER (WATTS)
 C TPPT THERMAL STORAGE SUBSYSTEM TOTAL PUMPING POWER (WATTS)
 C TFC FRACTION OF MAX. CHARGING OIL FLOW (DIMENSIONLESS)

C	TFE	FRACTION OF MAX. EXTRACTION OIL FLOW (DIMENSIONLESS)
C	TK1	Y INTERCEPT OF CHARGING PUMP POWER CURVE (WATTS)
C	TK2	SLOPE OF CHARGING PUMP POWER CURVE (WATTS/LBM/SEC)
C	TK3	Y INTERCEPT OF EXTRACTION PUMP POWER CURVE (WATTS)
C	TK4	SLOPE OF EXTRACTION PUMP POWER CURVE (WATTS/LBM/SEC)
C	TCONC	NUMBER OF CHARGING PUMPS OPERATING IN LAST TIME
C		INTERVAL (DIMENSIONLESS)
C	TCONE	NUMBER OF EXTRACTION PUMPS OPERATING IN LAST TIME
C		INTERVAL (DIMENSIONLESS)
C	TLT	FRACTIONAL POSITION OF THERMOCLINE (DIMENSIONLESS)
C	TFLAGU	2 IS NORMAL, 0 CUTS OFF CHARGING, 1 WARNS OF
C		OVERCHARGING AND PREVENTS START OF CHARGING
C	TFLAGL	2 IS NORMAL, 0 CUTS OFF EXTRACTION, 1 WARNS OF
C		DEPLETION AND PREVENTS START OF EXTRACTION

TSS CONSTANTS

COMMON /TCDATA/ TT3,TT4,TT5,TT6,TT8,TP8,TH8,TPDTSH,TC5,TC6,TW5M,
 1 TW5MF,TW7M,TW7MF,TKHC,TKTMTSH,TKTMSG,TKTMECS,TKG,TPPA,TPPCM,
 2 TPPEM,TPL1,TPL2,TPL3,TAK1,TBK1,TCK1,TOK1,TAK2,TBK2,TCK2,TOK2,
 3 TAK3,TBK3,TAK4,TBK4,TK5,TK6,THTSUM,TLTU1,TLTU2,TLTL1,TLTL2,
 4 TTSC,TTSE

C	TT3	TEMPERATURE OF DESUPERHEATED STEAM (DEG. F)
C	TT4	TEMPERATURE OF WATER FROM STORAGE HEATER (DEG. F)
C	TT5	TEMPERATURE OF OIL FROM STORAGE HEATER (DEG. F)
C	TT6	TEMPERATURE OF OIL INTO STORAGE HEATER (DEG. F)
C	TT8	TEMPERATURE OF STEAM FROM STEAM GENERATOR (DEG. F)
C	TP8	PRESSURE OF STEAM FROM STEAM GENERATOR (PSIA)
C	TH8	ENTHALPY OF STEAM FROM STEAM GENERATOR (BTU/LBM)
C	TPDTSH	PRESSURE DROP THROUGH THERMAL STORAGE HEATER (PSIA)
C	TC5	HEAT CAPACITY OF OIL INTO STORAGE (BTU/LBM DEG. F)
C	TC6	HEAT CAPACITY OF OIL FROM STORAGE (BTU/LBM DEG. F)
C	TW5M	MAXIMUM OIL FLOW INTO STORAGE (LBM/SEC)
C	TW5MF	MINIMUM NON-ZERO OIL FLOW INTO STORAGE (LBM/SEC)
C	TW7M	MAXIMUM OIL FLOW FROM STORAGE (LBM/SEC)
C	TW7MF	MINIMUM NON-ZERO OIL FLOW FROM STORAGE (LBM/SEC)
C	TKHC	SPECIFIC ENTHALPY GAIN OF OIL IN THERMAL STORAGE
C		HEATER OR LOSS IN STEAM GENERATOR (BTU/LBM)
C	TKTMTSH	TIME CONSTANT OF THERMAL STORAGE HEATER (SEC)
C	TKTMSG	TIME CONSTANT OF STEAM GENERATOR (SEC)
C	TKTMECS	TIME CONSTANT OF EXTRACTION CONTROL SYSTEM (SEC)
C		(RESPONSE OF OIL FLOW TO ERROR IN OUTPUT STEAM FLOW)
C	TKG	GAIN OF EXTRACTION CONTROL SYSTEM (DIMENSIONLESS)
C		(REQUESTED OIL FLOW/ERROR IN OUTPUT STEAM FLOW)
C	TPPA	AUXILIARY PUMPING POWER (WATTS)
C	TPPCM	MAXIMUM CHARGING OIL PUMPING POWER (WATTS)
C	TPPEM	MAXIMUM EXTRACTION OIL PUMPING POWER (WATTS)
C	TPL1	UPPER LIMIT OF TFC FOR ONE PUMP, LOW SPEED
C		(DIMENSIONLESS)
C	TPL2	LOWER LIMIT OF TFC FOR TWO PUMPS, HIGH SPEED
C		(DIMENSIONLESS)
C	TPL3	LOWER LIMIT OF TFE FOR TWO PUMPS (DIMENSIONLESS)
C	TAK1	TK1 FOR ONE PUMP AT LOW SPEED (WATTS)
C	TBK1	TK1 FOR TWO PUMPS AT LOW SPEED (WATTS)
C	TCK1	TK1 FOR ONE PUMP AT HIGH SPEED (WATTS)
C	TOK1	TK1 FOR TWO PUMPS AT HIGH SPEED (WATTS)
C	TAK2	TK2 FOR ONE PUMP AT LOW SPEED (WATTS/LBM/SEC)
C	TBK2	TK2 FOR TWO PUMPS AT LOW SPEED (WATTS/LBM/SEC)

C TK2 TK2 FOR ONE PUMP AT HIGH SPEED (WATTS/LBM/SEC)
 C TK2 TK2 FOR TWO PUMPS AT HIGH SPEED (WATTS/LBM/SEC)
 C TAK3 TK3 FOR ONE PUMP (WATTS)
 C TBK3 TK3 FOR TWO PUMPS (WATTS)
 C TAK4 TK4 FOR ONE PUMP (WATTS/LBM/SEC)
 C TBK4 TK4 FOR TWO PUMPS (WATTS/LBM/SEC)
 C TK5 HEAT LOSS FROM STORAGE UNIT WITH THERMOCLINE AT
 C TOP (BTU/SEC)
 C TK6 ADDITIONAL HEAT LOSS FROM STORAGE UNIT WITH
 C THERMOCLINE AT BOTTOM (BTU/SEC)
 C THTSUM CAPACITY OF THERMAL STORAGE UNIT (BTU)
 C TLTU1 TFLAGU=0 WHEN TLT.GT.TLTU1, 1 OR 2 WHEN TLT.LE.TLTU1
 C TLTU2 TFLAGU=2 WHEN TLT.LT.TLTU2, 1 OR 0 WHEN TLT.GE.TLTU2
 C TLT1 TFLAGL=0 WHEN TLT.LT.TLT1, 1 OR 2 WHEN TLT.GE.TLT1
 C TLT2 TFLAGL=2 WHEN TLT.GT.TLT2, 1 OR 0 WHEN TLT.LE.TLT2
 C TTSC 0 FOR HOT START CHARGE, 1 FOR STEADY STATE
 C TTSE 0 FOR HOT START EXTRACTION, 1 FOR STEADY STATE

ELECTRICAL POWER GENERATION SUBSYSTEM DATA

EPGS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)

COMMON /GDATA/ GPT3, GLT3, GWSOT3, GHSOT3, GWSBDC, GPSBDC, GTSBDC,
 1 GHLOSSD, GWSRG, GWSRT, GWSTSG, GPSTSG, GTSTSG, GPT1, GASTH1, GHSTH1,
 2 GPT2, GHSTH2, GHSTH2, GHCIT2, GLT2, GWCTC, GWCTH3, GWCTH5, GWALP,
 3 GWTEXH, GPTEXH, GWTEXH, GWTEXT(4), GPTEXT(4), GWTEXT(4), GTPower,
 4 GEPOUT, GHLOSSR, GTFPR, GPOUT, GHCUTP, GFPAUX, GWFPT, GFPH, GFPT, GDSI,
 5 GPCTSG, CTCTSG, GHLOSS, GHLOTSG, GTAXP, APBP, APHP, GHHTRI, GPHTRI,
 6 GHTRI, GPSH1, GSH1, GSH2, GSH2, GHCH4C, GHCH5C, GHCH23, GHCH12

C GPT3 PRESSURE (PSIA) IN TANK 3 (RECVR FLASH TANK)
 C GLT3 CONDENSATE LEVEL (FT.) IN TANK 3
 C GWSOT3 FLOW (LBM/SEC) OF STEAM OUT OF TANK 3
 C GHSOT3 ENTHALPY (BTU/LBM) OF STEAM OUT OF TANK 3
 C GWSBDC FLOW (LBM/SEC) OF STEAM AT BOTTOM OF DOWNCOMER
 C GPSBDC PRESSURE (PSIA) OF STEAM AT BOTTOM OF DOWNCOMER
 C GTSBDC TEMPERATURE (F) OF STEAM AT BOTTOM OF DOWNCOMER
 C GHLOSSD HEAT LOSS (BTU/HR) FROM DOWNCOMER
 C GWSRG FLOW (LBM/SEC) OF RECVR STEAM TO TURBINE MAIN THROTTLE
 C GWSRT FLOW (LBM/SEC) OF RECVR STEAM TO THERMAL STORAGE
 C GWSTSG STEAM FLOW (LBM/SEC) AT TURBINE ADMISSION PORT
 C GPSTSG PRESSURE (PSIA) STEAM AT TURBINE ADMISSION PORT
 C GTSTSG TEMP (F) STEAM AT TURBINE ADMISSION PORT
 C GPT1 PRESSURE (PSIA) IN TANK 1 (TSS DRAIN SYS)
 C GASTH1 STEAM FLOW (LBM/SEC) TO F.W. HEATER 1 FROM TSS DRAIN
 C GHSTH1 ENTHALPY (BTU/LBM) TO F.W. HEATER 1 FROM TSS DRAIN
 C GPT2 PRESSURE (PSIA) IN TANK 2 (TSS DRAIN SYS)
 C GHSTH2 STEAM FLOW (LBM/SEC) TO F.W. HEATER 2 FROM TSS DRAIN
 C GHSTH2 ENTHALPY (BTU/LBM) TO F.W. HEATER 2 FROM TSS DRAIN
 C GHCIT2 ENTHALPY (BTU/LBM) CONDENSATE INTO TANK 2
 C GLT2 CONDENSATE LEVEL (FT) IN TANK 2
 C GWCTC CONDENSATE FLOW (LBM/SEC) TO CONDENSER FROM TSS DRAIN
 C GWCTH3 CONDENSATE FLOW (LBM/SEC) TO F.W. HEATER 3 FROM TSS
 C GWCTH5 CONDENSATE FLOW (LBM/SEC) TO F.W. HEATER 5 FROM TSS
 C GWALP TURBINE APPARENT LP STEAM FLOW (LBM/SEC)
 C GWTEXH TURBINE EXHAUST FLOW (LBM/SEC)
 C GPTEXH TURBINE EXHAUST PRESSURE (PSIA)
 C GWTEXH TURBINE EXHAUST ENTHALPY (BTU/LBM)
 C GWTEXT(4) TURBINE EXTRACTION FLOWS (LBM/SEC)

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C  GPTEXT(4)  TURBINE EXTRACTION PRESSURES (PSIA)
C  GHTEXT(4)  TURBINE EXTRACTION ENTHALPIES (BTU/LBM)
C  GTPower    THERMAL AVAILABILITY (BTU/SEC)
C  GEFOUT     ELECTRICAL POWER (MEGA-WATTS)
C  GHLOSSR    RISER HEAT LOSSES (BTU/HR)
C  GTFPR      RECVR INLET TEMPERATURE (F)
C  GPOUT      RECVR FEED PUMP OUTPUT PRESSURE (PSIA)
C  GHOUTP     RECVR FEED PUMP OUTPUT ENTHALPY (BTU/LBM)
C  GFFAUX     RECVR FEED PUMP AUX POWER (KW)
C  GWFPT      TOTAL RECVR FEED PUMP FLOW (LBM/SEC)
C  GFPH       RECVR FEED PUMP HEAD (FT)
C  GFPT       RECVR FEED PUMP TORQUE (FT-LBS)
C  GTDSI      F.W. TEMPERATURE (F) AT DESUPERHRTR INLET
C  GPCTSG     PRESSURE (PSIA) AT TSS STEAM GENERATOR INLET
C  GTCTSG     TEMPERATURE (F) AT TSS STEAM GENERATOR INLET
C  GHLOSDS    HEAT LOSS (BTU/HR) IN DESUPERHEATER FW PIPE
C  GHLOTSG    HEAT LOSS (BTU/HR) IN TSS STEAM GENERATOR FW PIPE
C  GTAUXP     TOTAL AUX POWER (KW) REQUIRED BY FEEDWATER PUMPS
C  AFBP       AUX POWER (KW) REQUIRED BY BOOST PUMP
C  APHP       AUX POWER (KW) REQUIRED BY HOTWELL PUMP
C  GHNTR1     ENTHALPY (BTU/LBM) OF WATER IN HEATER 1
C  GPHTR1     PRESSURE (PSIA) OF WATER IN HEATER 1
C  GTHTR1     TEMPERATURE (F) OF WATER IN HEATER 1
C  GPSH1      PRESSURE (PSIA) OF STEAM TO HEATER 1
C  GSH1       ENTHALPY (BTU/LBM) OF STEAM TO HEATER 1
C  GPSH2      PRESSURE (PSIA) OF STEAM TO HEATER 2
C  GSH2       ENTHALPY (BTU/LBM) OF STEAM TO HEATER 2
C  GHCH4C     ENTHALPY (BTU/LBM) OF HEATER 4 CONDENSATE DRAIN
C  GHCH5C     ENTHALPY (BTU/LBM) OF HEATER 5 CONDENSATE DRAIN
C  GHCH23     ENTHALPY (BTU/LBM) OF HEATER 2 CONDENSATE DRAIN
C  GHCH12     ENTHALPY (BTU/LBM) OF HEATER 1 CONDENSATE DRAIN
C
C  GASP-IV SIMULATION SYSTEM DATA
C
C  COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
INAP0,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
2,TTCLR,TTFIN,TRIB(25),TTSET
C
C  COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
1,NNEQ0,NNEQS,NNEQT,SS(600),SSL(600),TTNEX
C
C  DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
1  RLINTC(6),RL15(8),RHFSAT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
2  RDIUF2(8),RDL13(8),RDEM2(8),RDIHF3(8),RDEM4(8),RDEM6(8),
3  RDLINTC(6)
C
C  EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
1  (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
2  (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
4  (TWS,SS(83)),(TW7,SS(84)),(TWS,SS(85)),
5  (THTSU,SS(86)),(GHCT3,SS(87)),(GHOT3,SS(88)),
6  (GHCOT3,SS(89)),(GHSBDC,SS(90)),(GHSTSG,SS(91)),
7  (GHCOT1,SS(92)),(GHCOT2,SS(93)),(GHCT2,SS(94)),
8  (GHCOT2,SS(95)),(GFFS,SS(96)),(GHRCI,SS(97)),
9  (GHDSI,SS(98)),(GHCOH3,SS(99)),(GHCTSG,SS(100)),
A  (GHCHW,SS(101)),
B  (RL15(1),SS(102)),(RHFSAT(1),SS(110)),(RHF3(1),SS(118)),
C  (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
D  (CRPRSH,SS(151)),(CRTESH,SS(152)),(CGPFPR,SS(153)),

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E (CTLT,SS(154)),
 F (GPFPR,SS(161)),(GPDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
 G (XK3,SS(165))

C

EQUIVALENCE (RDIUF2(1),DD(1)),(RDL13(1),DD(9)),(RDTM2(1),DD(17)),
 1 (RDIHF3(1),DD(25)),(RDTM4(1),DD(33)),(RDTM6(1),DD(41)),
 2 (RDUSH,DD(49)),(RDVSH,DD(50)),(RDLINTC(1),DD(51)),
 3 (TDW5,DD(83)),(TDW7,DD(84)),
 5 (TDW8,DD(85)),(TDHTSU,DD(86)),(GHCDT3,DD(87)),
 6 (GHDCOT3,DD(88)),(GHDCOT3,DD(89)),(GHSDBC,DD(90)),
 7 (GHSTSS,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),
 8 (GHDCOT2,DD(94)),(GHDCOT2,DD(95)),(GDFPS,DD(96)),
 9 (GHORCI,DD(97)),(GHODSI,DD(98)),(GHDCOH3,DD(99)),
 A (GHCTSG,DD(100)),(GHCHW,DD(101))

C

INTEGRATED STATE VARIABLES

C

RIUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
 (BTU/LBM)

C

RL13(ISP) LENGTH OF SUPERPANEL SUBCOOLED SECTION
 (FEET)

C

RTEM2(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 (DEGREES F)

C

RIHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 (BTU/LBM)

C

RTEM4(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 (DEGREES F)

C

RTEM6(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 (DEGREES F)

C

RUSH FLUID INTERNAL ENERGY IN STEAM HEADER
 (BTU/LBM)

C

RVSH FLUID SPECIFIC VOLUME IN STEAM HEADER
 (CU FT/LBM)

C

RLINTC(IC) CONTROLLER INTEGRAL SIGNAL OF VALVE STEM DISPLACEMENT
 (PERCENT)

C

TW5 NOMINAL OIL FLOW INTO STORAGE (LBM/SEC)

C

TW7 NOMINAL OIL FLOW FROM STORAGE (LBM/SEC)

C

TW8 STEAM FLOW FROM STEAM GENERATOR (LBM/SEC)

C

THTSU HEAT STORED IN THERMAL STORAGE UNIT (BTU)

C

GHCT3 CONDENSATE MASS (LBM) IN TANK 3 (RECVR FLASH TANK)

C

GHCT3 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 3

C

GHCT3 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 3

C

GHSDC ENTHALPY (BTU/LBM) OF STEAM AT BOTTOM OF DOWNCOMER

C

GHSTSS ENTHALPY (BTU/LBM) OF ADMISSION STEAM

C

GHCT1 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 1

C

GHCT2 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 2

C

GHCT2 MASS (LBM) OF CONDENSATE IN TANK 2

C

GHCT2 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 2

C

GFPF RECVR FEED PUMP SPEED (RPM)

C

GHORCI F.W. ENTHALPY (BTU/LBM) AT RECVR INLET

C

GHODSI F.W. ENTHALPY (BTU/LBM) AT DESUPERHEATER INLET

C

GHCHW F.W. ENTHALPY (BTU/LBM) OUT OF FW HRTR NO. 3

C

GHCTSG ENTHALPY (BTU/LBM) AT TSS STEAM GEN. INLET

C

GHCHW ENTHALPY (BTU/LBM) OF CONDENSATE IN CONDENSER HOTWELL

C

ADDITIONALLY REQUIRED GASP-IV STATE VARIABLES

C

RL15(ISP) COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND

C

C TWO-PHASE MIXTURE SECTIONS (FEET)
 C RHFSAT(ISP) ENTHALPY OF A SATURATED LIQUID
 C (BTU/LBM)
 C RHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 C (BTU/LBM)
 C RHVSAT(ISP) ENTHALPY OF A SATURATED VAPOR
 C (BTU/LBM)
 C RHF5(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RTSENC(IC) CONTROLLER TEMPERATURE SENSOR SIGNAL OF BOILER
 C SUPERPANEL OUTLET TEMPERATURE (DEGREES F)
 C CRPRSH FLUID PRESSURE IN RECEIVER STEAM HEADER
 C (PSIA)
 C CRTESH FLUID TEMPERATURE IN RECEIVER STEAM HEADER
 C (DEGREES F)
 C CGPFPR FLUID PRESSURE AT RECEIVER INLET
 C (PSIA)
 C CTLT POSITION OF TSS THERMOCLINE
 C (PERCENT)
 C GPFPR FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
 C GFDISI FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)
 C XK1,XK2,XK3 EPGS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND
 C PRESSURE AT RECEIVER INLET

TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES

C RDIUF2(ISP) TIME DERIVATIVE OF RIUF2(ISP)
 C RDL13(ISP) TIME DERIVATIVE OF RL13(ISP)
 C RDEM2(ISP) TIME DERIVATIVE OF RTEM2(ISP)
 C RDIHF3(ISP) TIME DERIVATIVE OF RIHF3(ISP)
 C RDEM4(ISP) TIME DERIVATIVE OF RTEM4(ISP)
 C RDEM6(ISP) TIME DERIVATIVE OF RTEM6(ISP)
 C RDUSH TIME DERIVATIVE OF RUSH
 C RDVSH TIME DERIVATIVE OF RVSH
 C RDLINTC(IC) TIME DERIVATIVE OF RLINTC(IC)

C TDW5 TIME DERIVATIVE OF TW5
 C TDW7 TIME DERIVATIVE OF TW7
 C TDWS TIME DERIVATIVE OF TWS
 C TDHTSU TIME DERIVATIVE OF THTSU

C GHCDT3 TIME DERIVATIVE OF GMCT3
 C GHDCOT3 TIME DERIVATIVE OF GHCOT3
 C GHDCOT3 TIME DERIVATIVE OF GWCOT3
 C GHSDSDC TIME DERIVATIVE OF GHSDDC
 C GHSTSG TIME DERIVATIVE OF GHSTSG
 C GHDCOT1 TIME DERIVATIVE OF GHCOT1
 C GHDCOT2 TIME DERIVATIVE OF GHCOT2
 C GHDCOT2 TIME DERIVATIVE OF GMCT2
 C GHDCOT2 TIME DERIVATIVE OF GWCOT2
 C GDFFS TIME DERIVATIVE OF GFPS
 C GHORCI TIME DERIVATIVE OF GHRCI
 C GHODSI TIME DERIVATIVE OF GHDSI
 C GHDCOH3 TIME DERIVATIVE OF GHCOH3
 C GHDCOTSG TIME DERIVATIVE OF GHCTSG
 C GHDCOH TIME DERIVATIVE OF GHCHW

COMPRESSED WATER/SUPERHEATED STEAM TABLE DATA


```
LOGICAL NO COMP,SATURD :  
REAL HE,PE,SE,TE,VE,XE :  
COMMON /USECOM/ HE,PE,SE,TE,VE,XE,NO COMP,SATURD
```

C

C

C INTERFACE EQUALITIES FROM EPGS TO TSS

C

TH2=GHDSI
TP1=GPSBDC
TH1=GHSBDC
TW1=GWSRT
TH9=GHCTSG

C

C. CHARGING

C

C UPDATE GAIN/LOSS FACTORS

C

CALL USE PT(TP1,TT3)
TH3=HE
TP4=TP1-TPDTSH
CALL USE PT(TP4,TT4)
TH4=HE
TKDSH=(TH1-TH2)/(TH3-TH2)
TKTSH=(TH3-TH4)/TKHC

C

C COMPUTE MAXIMUM ALLOWABLE INPUT STEAM FLOW, AND LIMIT ACTUAL FLOW

C

```

TW1M=TW5M/(TKDSH*TKTSH)
TW1A=AMIN1(TW1,TW1M)

```

C

C IS THERMOCLINE TOO HIGH TO PERMIT CHARGING

C

```
IF(TLT.GT.TLTU1) TFLAGU=0.  
IF(TLT.GT.TLTU1) GO TO 10
```

C

C IF NOT, IS IT LOW ENOUGH TO START OR RESUME CHARGING

C

```
IF(TLT.LT.TLTU2) TFLAGU=2.  
IF(TLT.LT.TLTU2) GO TO 30
```

C

C IF BETWEEN TLTU1 AND TLTU2, HAS SYSTEM BEEN CHARGING

C IF SO, PERMIT CHARGING WITH WARNING

C

```
IF(TFLAGU.GT.0.) TFLAGU=1.  
IF(TFLAGU.GT.0.) GO TO 30
```

C

C IF CHARGING IS NOT PERMITTED, FORCE INPUT FLOW TO ZERO

C

10 TH1A=0.

C

C IF CHARGING IS PERMITTED, LEAVE INPUT FLOW UNCHANGED

C

```

C COMPUTE STEAM FLOW TO STORAGE HEATER (TW3), WATER FLOW TO

```

C DESUPERHEATER (TW2), AND DERIVATIVE OF NOMINAL CHARGING

C OIL FLOW (TMS)

C

```
30 TW3=TKDSH*TW1A
   TW2=TW3-TW1A
   TDW5=(TKTSH*TW3-TW5)/TKTMTSH
```

C

```

C DOES NOMINAL OIL FLOW EXCEED PUMPING THRESHOLD (TW5MF)
C
C   IF(TW5.GE.TW5MF) GO TO 60
C
C IF NOT, SET ACTUAL FLOW (TW5A), FRACTION (TFC) OF MAXIMUM FLOW,
C AND PUMPING POWER (TPPC) TO ZERO
C
C   TW5A=0.
C   TFC=0.
C   TPPC=0.
C   GO TO 250
C
C IF SO, SET ACTUAL OIL FLOW EQUAL TO NOMINAL AND COMPUTE
C FRACTION OF MAXIMUM OIL FLOW
C
C   60 TW5A=TW5
C   TFC=TW5A/TW5M
C
C TEST TO CHOOSE NUMBER (1 OR 2) AND SPEED (HIGH OR LOW) OF
C CHARGING OIL PUMPS AND SET POWER CONSTANTS ACCORDINGLY
C (TCONC INDICATES NO. OF PUMPS OPERATING IN LAST TIME INTERVAL)
C
C   IF(TFC.LE.TPL1) GO TO 110
C   IF(TFC.GT..66) GO TO 140
C   IF(TFC.LE..5 .A. TCONC.EQ.1.) GO TO 130
C
C TWO PUMPS, LOW SPEED
C
C   TK1=TBK1
C   TK2=TEK2
C   GO TO 200
C
C ONE PUMP, LOW SPEED
C
C   110 TK1=TAK1
C   TK2=TAK2
C   GO TO 200
C
C ONE PUMP, HIGH SPEED
C
C   130 TK1=TCK1
C   TK2=TCK2
C   GO TO 200
C
C TWO PUMPS, HIGH SPEED
C
C   140 TK1=TDK1
C   TK2=TDK2
C
C COMPUTE CHARGING OIL PUMPING POWER
C
C   200 TPPC=TPPCH*(TK1+TK2*TFC)
C
C EXTRACTING
C
C IS THERMOCLINE TOO LOW TO PERMIT EXTRACTION
C
C   250 IF(TLT.LT.TLTLL) TFLAGL=0.
C   IF(TLT.LT.TLTLL) GO TO 300
C

```

```

C IF NOT, IS IT HIGH ENOUGH TO START OR RESUME EXTRACTION
C
  IF(TLT.GT.TLTL2) TFLAGL=2.
  IF(TLT.GT.TLTL2) GO TO 303
C
C IF BETWEEN TLTL1 AND TLTL2, HAS SYSTEM BEEN EXTRACTING
C IF SO, PERMIT EXTRACTION WITH WARNING
C
  IF(TFLAGL.GT.0.) TFLAGL=1.
  IF(TFLAGL.GT.0.) GO TO 303
C
C IF EXTRACTION IS NOT PERMITTED, FORCE REQUESTED FLOW TO ZERO
C
  300 TWEA=0.
  GO TO 305
C
C IF EXTRACTION IS PERMITTED, USE INPUT VALUE OF REQUESTED FLOW
C
  303 TWE=CSP(16)
  TWEA=TWE
C
C COMPUTE DERIVATIVE OF NOMINAL EXTRACTION OIL FLOW (TW7), AND
C LIMIT ACTUAL FLOW (TW7A)
C
  305 TKSG=TKHC/(TH8-TH9)
  TDW7=(TW8/TKSG+TKG*(TWEA-TW8)-TW7)/TKTHECS
  TW7A=AMIN1(TW7,TW7M)
C
C DOES OIL FLOW EXCEED PUMPING THRESHOLD (TW7MF)
C
  IF(TW7A.GE.TW7MF) GO TO 307
C
C IF NOT, SET ACTUAL FLOW (TW7A), FRACTION (TFE) OF MAXIMUM FLOW,
C AND PUMPING POKER (TPPE) TO ZERO
C
  TW7A=0.
  TFE=0.
  TPPE=0.
C
C COMPUTE DERIVATIVE OF OUTPUT STEAM FLOW (TW8)
C
  307 TDW8=(TKSG*TW7A-TW8)/TKTMSG
C
C DOES OIL FLOW EXCEED PUMPING THRESHOLD
C
  IF(TW7A.LT.TW7MF) GO TO 500
C
C IF SO, COMPUTE FRACTION OF MAXIMUM OIL FLOW
C
  TFE=TW7A/TW7M
C
C TEST TO CHOOSE 1 OR 2 EXTRACTION OIL PUMPS AND SET POWER
C CONSTANTS ACCORDINGLY (TCONE INDICATES NO. OF PUMPS OPERATING
C IN LAST TIME INTERVAL)
C
  IF(TFE.LE.TPL3) GO TO 310
  IF(TFE.GT..5) GO TO 320
  IF(TCONE.EQ.2.) GO TO 320
C
C ONE PUMP

```

```

C
  310 TK3=TAK3
      TK4=TAK4
      GO TO 400
C
C TWO PUMPS
C
  320 TK3=TBK3
      TK4=TBK4
C
C COMPUTE EXTRACTION OIL PUMPING POWER
C
  400 TPPE=TPPEM*(TK3+TK4*TFE)
C
C COMPUTE TOTAL PUMPING POWER
C
  500 TPPT=TPPA+TPPC+TPPE
C
C STORAGE
C
C COMPUTE DERIVATIVE OF HEAT CONTENT (THTSU) OF THERMAL STORAGE UNIT
C
      TDHTSU= TKHC*(TW5A-TW7A)-TK5-TK6*TLT
C
C COMPUTE FRACTIONAL LEVEL OF THERMOCLINE (TLT)
C
      TLT=THTSU/THTSUM
C
C SET MCS MONITORED VARIABLE TO ITS EQUIVALENCED GASP IV STATE VARIABLE
C
      CTLT=TLT
C
C ARE FRACTIONAL PUMPING RATES OUTSIDE HYSTERESIS REGION
C IF SO, SET NUMBER OF PUMPS FOR NEXT TIME INTERVAL
C
      IF(TFC.LE.TPL1) TCONC=1.
      IF(TFC.GT..5) TCONC=2.
      IF(TFE.LE.TPL3) TCONE=1.
      IF(TFE.GT..5) TCONE=2.
C
C IF NOT, LEAVE NUMBER UNCHANGED
C
C
C      GENERATE DIAGNOSTIC PRINT (IF REQUESTED)
      IF (DIAG(26)) WRITE (6,705)
1   TT3,TT4,TT5,TT6,TT8,TP1,TP4,TP8,TPDTSH,
2   TH1,TH2,TH3,TH4,TH8,TH9,TPPC,TPPE,TPPT,
3   TCS,TC6,TKHC,TKTMTSH,TKTMSG,TKTHECS,TKG,TKDSH,TKTSH,TKSG,
4   TW1,TW1A,TW1M,TW2,TK3,TK5A,TW5M,TW5MF,TW7A,TW7M,TW7MF,TWE,
5   TPFCM,TPPEM,TPPA,TFC,TFE,TK1,TK2,TK3,TK4,TK5,TK6,
6   TAK1,TAK2,TBK1,TBK2,TCK1,TCK2,TOK1,TOK2,TAK3,TAK4,TBK3,TBK4,
7   TPL1,TPL2,TPL3,TCONC,TCONE,TTSC,TTSE,
8   THTSUM,TLT,TLTU1,TLTU2,TLTL1,TLTL2,TFLAGU,TFLAGL
705 FORMAT(1H ,2X,12HDIAG26/TSS ,9G10.4/(1H ,4X,10G10.4))
C
      RETURN
      END

```

SUBROUTINE TSSIAUX

THE PURPOSE OF THIS SUBROUTINE IS TO
CALCULATE:

- 1) ADMISSION STEAM FLOW TO THE TURBINE
(GWSTSG) IN LBM/SEC.
- 2) STEAM FLOW IN LBM/SEC TO HEATERS 1
(GWSTH1) AND 2 (GWSTH2)
- 3) CONDENSATE FLOW TO HEATER 5 (GWCTH5),
THE CONDENSOR (GWCTC),
AND THE DEAERATOR (GWCTH3)

INPUTS FROM TSS ARE:

- 1) CONDENSATE FLOW TO DRAIN TANK
(LBM/HR)-TWCH
- 2) CONDENSATE TEMPERATURE (F)-TTECH
- 3) CONDENSATE PRESSURE (PSIA)-TPRCH
- 4) STEAM FLOW TO TURBINE (LBM/HR)-TWSG
- 5) STEAM TEMPERATURE (F)-TTESG
- 6) STEAM PRESSURE (PSIA)-TPRSG
- 7) STEAM ENTHALPY (BTU/LBM)-THSG

THE INPUTS ARE PASSED VIA COMMON BLOCK
/TDATA/

EXECUTIVE AND PROGRAM CONTROL DATA

INTEGER ATIMO,ATIDAY
LOGICAL OUTFG,END,DIAG
COMMON /ADATA/ OUTFG(2,10),END,ATILCL,ATITST,ATIMO,ATIDAY,
1 DIAG(40)

OUTFG(I,J) OUTPUT FLAG ARRAY (I=1 PRINT OUTPUT, I=2 PLOT OUTPUT)
END END OF RUN FLAG
ATILCL LOCAL TIME (SECONDS FROM MIDNIGHT)
ATITST TRUE SOLAR TIME (SECONDS FROM MIDNIGHT)
ATIMO MONTH
ATIDAY DAY
DIAG DIAGNOSTIC PRINT FLAG ARRAY

ENVIRONMENTAL DATA

COMMON /EDATA/ ETEAMB,EPRAMB,EVWAMB,EINDIR,EDWAMB,ETDAMB
ETEAMB AMBIENT TEMPERATURE (DEGREES FAHRENHEIT)
EPRAMB AMBIENT PRESSURE (LB/SQ IN ABS)
EVWAMB AMBIENT WIND VELOCITY (FT/SEC)
EINDIR DIRECT INSOLATION (KILOWATTS/SQ METER)
EDWAMB WIND DIRECTION (DEGREES AZIMUTH)
ETDAMB DEW POINT TEMPERATURE (DEGREES FAHRENHEIT)

MASTER CONTROL SUBSYSTEM DATA

INTEGER CMODE,CNMODE,CNSP,CNMV,CMVRTBL,CMVLA,CMVPA,
1 CMVRC,CNM,CNMVEL,CNMH
COMMON /CDATA/ CMODE,CNMODE,CSPTBL(7,16),CSP(16),CNSP,
1 CMVLTBL(6,4,7),CMVL(6,4),CNMV,CMVRTBL(7,7,4),
2 CMVLA(7),CMVPA(4),CMVRC(4),CNM(4),CMVEL,CNMH

```

C CMODE      CURRENT MODE OF OPERATION
C CNMODE     NUMBER OF DIFFERENT MODES OF OPERATION
C CSPTBL     SETPOINT TABLE
C CSP        SETPOINTS FOR CURRENT MODE OF OPERATION
C CNSP       NUMBER OF SETPOINTS
C CMVLTBL    TABLE OF OPERATING LIMITS FOR MONITORED VARIABLES
C CMVL       OPERATING LIMITS OF MONITORED VARIABLES FOR CURRENT
C            MODE OF OPERATION
C CNMV       NUMBER OF MONITORED VARIABLES
C CMVRTBL    TABLE OF MCS RESPONSES FOR MONITORED VARIABLES
C            EXCEEDING THEIR LIMITS
C CMVLA      MONITORED VARIABLE LIMIT ARGUMENT FOR RESPONSE TABLE
C CMVPA      MONITORED VARIABLE ARGUMENT FOR RESPONSE TABLE
C CMVRC      RESPONSE CODES FOR MONITORED VARIABLES CROSSING LIMITS
C CNM        POTENTIAL NEW MODES TO CORRECT MONITORED VARIABLE
C            LIMIT CROSSINGS
C CNMVEL     NUMBER OF MONITORED VARIABLES EXCEEDING LIMITS
C            AT ANY INSTANT OF TIME
C CNNM       NUMBER OF NEW MODE REQUESTS AT ANY INSTANT OF TIME
C
C STANDARD DEFINITION OF PILOT PLANT OPERATING MODES
C
C 1= RECEIVER STEAM TO EPGS
C 2= RECEIVER STEAM TO EPGS AND THERMAL STORAGE
C 3= RECEIVER STEAM TO EPGS AND THERMAL STORAGE STEAM TO EPGS
C 4= RECEIVER STEAM TO THERMAL STORAGE AND THERMAL STORAGE
C    STEAM TO EPGS
C 5= RECEIVER STEAM TO THERMAL STORAGE
C 6= THERMAL STORAGE STEAM TO EPGS
C 7= OVERNIGHT SHUTDOWN AND HOLD
C
C ARGUMENT DEFINITIONS FOR SETPOINT ARRAY CSP(I)
C
C I=1,4      EPGS VALVE SETPOINTS FOR VALVES R1-R4
C I=5,6      EPGS VALVE SETPOINTS FOR VALVES T1,T2
C I=7,8      EPGS VALVE SETPOINTS FOR DRAIN VALVES
C I=9,12     EPGS VALVE SETPOINTS FOR VALVES E1-E4
C I=13       EPGS CONDENSER FAN SETPOINT
C I=14       EPGS FEED PUMP PRESSURE SETPOINT
C I=15       RECEIVER OUTLET TEMPERATURE SETPOINT
C I=16       TSS OUTLET STEAM FLOW RATE SETPOINT
C
C CURRENT LIST OF MONITORED VARIABLES
C
C RECEIVER OUTLET PRESSURE
C RECEIVER OUTLET TEMPERATURE
C EPGS FEEDWATER PRESSURE
C TSS THERMOCLINE LEVEL
C
C THERMAL STORAGE SUBSYSTEM DATA
C
C TSS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)
C
C COMMON /TDATA/ TP1,TP4,TH1,TH2,TH3,TH4,TH9,TW1,TW1A,TW1M,TW2,TW3,
1 TW5A,TW7A,TWE,TKDSH,TKTSH,TKSG,TPFC,TPPE,TPPT,TFC,TFE,TK1,TK2,
2 TK3,TK4,TCONC,TCONE,TLT,TFLAGU,TFLAGL
C
C TP1        PRESSURE OF STEAM INTO DESUPERHEATER,
C            AND PRESSURE OF DESUPERHEATED STEAM (PSIA)

```

C	TP4	PRESSURE OF WATER FROM STORAGE HEATER (PSIA)
C	TH1	ENTHALPY OF STEAM INTO DESUPERHEATER (BTU/LBM)
C	TH2	ENTHALPY OF WATER INTO DESUPERHEATER (BTU/LBM)
C	TH3	ENTHALPY OF STEAM FROM DESUPERHEATER (BTU/LBM)
C	TH4	ENTHALPY OF WATER FROM STORAGE HEATER (BTU/LBM)
C	TH9	ENTHALPY OF WATER INTO STEAM GENERATOR (BTU/LBM)
C	TH1	STEAM FLOW AVAILABLE TO DESUPERHEATER (LBM/SEC)
C	TH1A	ACTUAL STEAM FLOW TO DESUPERHEATER (LBM/SEC)
C	TH1M	MAXIMUM STEAM FLOW TO DESUPERHEATER (LBM/SEC)
C	TW2	WATER FLOW TO DESUPERHEATER (LBM/SEC)
C	TW3	STEAM FLOW FROM DESUPERHEATER (LBM/SEC)
C	TW5A	ACTUAL OIL FLOW INTO STORAGE (LBM/SEC)
C	TW7A	ACTUAL OIL FLOW FROM STORAGE (LBM/SEC)
C	TWE	CONTROLLER SET POINT FOR STEAM GENERATOR STEAM FLOW (LBM/SEC)
C	TKOSH	FLOW RATE GAIN FACTOR OF DESUPERHEATER (RECIPROCAL OF SPECIFIC ENTHALPY LOSS FACTOR) (DIMENSIONLESS)
C	TKTSH	RATIO OF SPECIFIC ENTHALPY GAIN OF OIL TO SPECIFIC ENTHALPY LOSS OF STEAM IN THERMAL STORAGE HEATER (DIMENSIONLESS)
C	TKSG	RATIO OF SPECIFIC ENTHALPY GAIN OF WATER TO SPECIFIC ENTHALPY LOSS OF OIL IN STEAM GENERATOR (DIMENSIONLESS)
C	TPPC	CHARGING OIL PUMPING POWER (WATTS)
C	TPPE	EXTRACTION OIL PUMPING POWER (WATTS)
C	TPPT	THERMAL STORAGE SUBSYSTEM TOTAL PUMPING POWER (WATTS)
C	TFC	FRACTION OF MAX. CHARGING OIL FLOW (DIMENSIONLESS)
C	TFE	FRACTION OF MAX. EXTRACTION OIL FLOW (DIMENSIONLESS)
C	TK1	Y INTERCEPT OF CHARGING PUMP POWER CURVE (WATTS)
C	TK2	SLOPE OF CHARGING PUMP POWER CURVE (WATTS/LBM/SEC)
C	TK3	Y INTERCEPT OF EXTRACTION PUMP POWER CURVE (WATTS)
C	TK4	SLOPE OF EXTRACTION PUMP POWER CURVE (WATTS/LBM/SEC)
C	TCONC	NUMBER OF CHARGING PUMPS OPERATING IN LAST TIME INTERVAL (DIMENSIONLESS)
C	TCONE	NUMBER OF EXTRACTION PUMPS OPERATING IN LAST TIME INTERVAL (DIMENSIONLESS)
C	TLT	FRACTIONAL POSITION OF THERMOCLINE (DIMENSIONLESS)
C	TFLAGU	2 IS NORMAL, 0 CUTS OFF CHARGING, 1 WARNS OF OVERCHARGING AND PREVENTS START OF CHARGING
C	TFLAGL	2 IS NORMAL, 0 CUTS OFF EXTRACTION, 1 WARNS OF DEPLETION AND PREVENTS START OF EXTRACTION

TSS CONSTANTS

COMMON /TCDATA/ TT3,TT4,TT5,TT6,TT8,TP8,TH8,TPDTSH,TC5,TC6,TH5M,
 1 TH5MF,TW7M,TW7MF,TKHC,TKTMTSH,TKTMSG,TKTHECS,TKG,TPPA,TPPCM,
 2 TPPEM,TPL1,TPL2,TPL3,TAK1,TBK1,TCK1,TDK1,TAK2,TBK2,TCK2,TDK2,
 3 TAK3,TBK3,TAK4,TEK4,TK5,TK6,THTSUM,TLTU1,TLTU2,TLTL1,TLTL2,
 4 TTSC,TTSE

C	TT3	TEMPERATURE OF DESUPERHEATED STEAM (DEG. F)
C	TT4	TEMPERATURE OF WATER FROM STORAGE HEATER (DEG. F)
C	TT5	TEMPERATURE OF OIL FROM STORAGE HEATER (DEG. F)
C	TT6	TEMPERATURE OF OIL INTO STORAGE HEATER (DEG. F)
C	TT8	TEMPERATURE OF STEAM FROM STEAM GENERATOR (DEG. F)
C	TP8	PRESSURE OF STEAM FROM STEAM GENERATOR (PSIA)
C	TH8	ENTHALPY OF STEAM FROM STEAM GENERATOR (BTU/LBM)
C	TFDTSH	PRESSURE DROP THROUGH THERMAL STORAGE HEATER (PSIA)
C	TC5	HEAT CAPACITY OF OIL INTO STORAGE (BTU/LBM DEG. F)

C TC6 HEAT CAPACITY OF OIL FROM STORAGE (BTU/LBM DEG. F)
 C TW5M MAXIMUM OIL FLOW INTO STORAGE (LBM/SEC)
 C TW5MF MINIMUM NON-ZERO OIL FLOW INTO STORAGE (LBM/SEC)
 C TW7M MAXIMUM OIL FLOW FROM STORAGE (LBM/SEC)
 C TW7MF MINIMUM NON-ZERO OIL FLOW FROM STORAGE (LBM/SEC)
 C TKHC SPECIFIC ENTHALPY GAIN OF OIL IN THERMAL STORAGE
 C HEATER OR LOSS IN STEAM GENERATOR (BTU/LBM)
 C TKTMTSH TIME CONSTANT OF THERMAL STORAGE HEATER (SEC)
 C TKTMSG TIME CONSTANT OF STEAM GENERATOR (SEC)
 C TKTMECS TIME CONSTANT OF EXTRACTION CONTROL SYSTEM (SEC)
 C (RESPONSE OF OIL FLOW TO ERROR IN OUTPUT STEAM FLOW)
 C TK6 GAIN OF EXTRACTION CONTROL SYSTEM (DIMENSIONLESS)
 C (REQUESTED OIL FLOW/ERROR IN OUTPUT STEAM FLOW)
 C TPPA AUXILIARY PUMPING POWER (WATTS)
 C TPFCM MAXIMUM CHARGING OIL PUMPING POWER (WATTS)
 C TPPEM MAXIMUM EXTRACTION OIL PUMPING POWER (WATTS)
 C TPL1 UPPER LIMIT OF TFC FOR ONE PUMP, LOW SPEED
 C (DIMENSIONLESS)
 C TPL2 LOWER LIMIT OF TFC FOR TWO PUMPS, HIGH SPEED
 C (DIMENSIONLESS)
 C TPL3 LOWER LIMIT OF TFE FOR TWO PUMPS (DIMENSIONLESS)
 C TAK1 TK1 FOR ONE PUMP AT LOW SPEED (WATTS)
 C TBK1 TK1 FOR TWO PUMPS AT LOW SPEED (WATTS)
 C TCK1 TK1 FOR ONE PUMP AT HIGH SPEED (WATTS)
 C TDK1 TK1 FOR TWO PUMPS AT HIGH SPEED (WATTS)
 C TAK2 TK2 FOR ONE PUMP AT LOW SPEED (WATTS/LBM/SEC)
 C TBK2 TK2 FOR TWO PUMPS AT LOW SPEED (WATTS/LBM/SEC)
 C TCK2 TK2 FOR ONE PUMP AT HIGH SPEED (WATTS/LBM/SEC)
 C TDK2 TK2 FOR TWO PUMPS AT HIGH SPEED (WATTS/LBM/SEC)
 C TAK3 TK3 FOR ONE PUMP (WATTS)
 C TEK3 TK3 FOR TWO PUMPS (WATTS)
 C TAK4 TK4 FOR ONE PUMP (WATTS/LBM/SEC)
 C TBK4 TK4 FOR TWO PUMPS (WATTS/LBM/SEC)
 C TK5 HEAT LOSS FROM STORAGE UNIT WITH THERMOCLINE AT
 C TOP (BTU/SEC)
 C TK6 ADDITIONAL HEAT LOSS FROM STORAGE UNIT WITH
 C THERMOCLINE AT BOTTOM (BTU/SEC)
 C THTSUM CAPACITY OF THERMAL STORAGE UNIT (BTU)
 C TLTU1 TFLAGU=0 WHEN TLT.GT.TLTU1, 1 OR 2 WHEN TLT.LE.TLTU1
 C TLTU2 TFLAGU=2 WHEN TLT.LT.TLTU2, 1 OR 0 WHEN TLT.GE.TLTU2
 C TLTL1 TFLAGL=0 WHEN TLT.LT.TLTL1, 1 OR 2 WHEN TLT.GE.TLTL1
 C TLTL2 TFLAGL=2 WHEN TLT.GT.TLTL2, 1 OR 0 WHEN TLT.LE.TLTL2
 C TTSC 0 FOR HOT START CHARGE, 1 FOR STEADY STATE
 C TTSE 0 FOR HOT START EXTRACTION, 1 FOR STEADY STATE

ELECTRICAL POWER GENERATION SUBSYSTEM DATA

EPGS VARIABLES (GASP-IV STATE VARIABLES EXCLUDED)

COMMON /GDATA/ GPT3, GLT3, GWSOT3, GHSOT3, GWSBDC, GPSSDC, GTSBDC,
 1 GHLOSSD, GWSRG, GWSRT, GHSTSG, GPSTSG, GTSTSG, GPT1, GWSH1, GHSTH1,
 2 EPT2, GHSTH2, GHSTH2, GHCT2, GLT2, GHCTC, GHCTH3, GHCTH5, GHCTALP,
 3 GHTEXH, GPTEXH, GHTEXH, GHTEXT(4), GPTEXT(4), GHTEXT(4), GTPWER,
 4 GEPCUT, GHLOSSR, GTFPR, GPOUT, GHOUTP, GFPAUX, GNFPT, GFPH, GFPT, GTDSI,
 5 GPCTSG, CTCTSG, GHLOSSS, GHLOTSG, GTAUXP, AFBP, APHP, GHHTR1, GFHTR1,
 6 GHHTR1, GPSH1, GHSH1, GPSH2, GHSH2, GHCH4C, GHCH5C, GHCH23, GHCH12

C GPT3 PRESSURE (PSIA) IN TANK 3 (RECVR FLASH TANK)
 C GLT3 CONDENSATE LEVEL (FT.) IN TANK 3

C	GNSOT3	FLOW (LBM/SEC) OF STEAM OUT OF TANK 3
C	GHOT3	ENTHALPY (BTU/LBM) OF STEAM OUT OF TANK 3
C	GHSDDC	FLOW (LBM/SEC) OF STEAM AT BOTTOM OF DOWNCOMER
C	GPSSDC	PRESSURE (PSIA) OF STEAM AT BOTTOM OF DOWNCOMER
C	GTSSDC	TEMPERATURE (F) OF STEAM AT BOTTOM OF DOWNCOMER
C	GHLOSSD	HEAT LOSS (BTU/HR) FROM DOWNCOMER
C	GNSRG	FLOW (LBM/SEC) OF RECVR STEAM TO TURBINE MAIN THROTTLE
C	GNSRT	FLOW (LBM/SEC) OF RECVR STEAM TO THERMAL STORAGE
C	GNSTSG	STEAM FLOW (LBM/SEC) AT TURBINE ADMISSION PORT
C	GPSTSG	PRESSURE (PSIA) STEAM AT TURBINE ADMISSION PORT
C	GTSTSG	TEMP (F) STEAM AT TURBINE ADMISSION PORT
C	GPT1	PRESSURE (PSIA) IN TANK 1 (TSS DRAIN SYS)
C	GNSTH1	STEAM FLOW (LBM/SEC) TO F.W. HEATER 1 FROM TSS DRAIN
C	GHSTH1	ENTHALPY (BTU/LBM) TO F.W. HEATER 1 FROM TSS DRAIN
C	GPT2	PRESSURE (PSIA) IN TANK 2 (TSS DRAIN SYS)
C	GNSTH2	STEAM FLOW (LBM/SEC) TO F.W. HEATER 2 FROM TSS DRAIN
C	GHSTH2	ENTHALPY (BTU/LBM) TO F.W. HEATER 2 FROM TSS DRAIN
C	GHCT2	ENTHALPY (BTU/LBM) CONDENSATE INTO TANK 2
C	GLT2	CONDENSATE LEVEL (FT) IN TANK 2
C	GHCTC	CONDENSATE FLOW (LBM/SEC) TO CONDENSER FROM TSS DRAIN
C	GHCTH3	CONDENSATE FLOW (LBM/SEC) TO F.W. HEATER 3 FROM TSS
C	GHCTH5	CONDENSATE FLOW (LBM/SEC) TO F.W. HEATER 5 FROM TSS
C	GHTALP	TURBINE APPARENT LP STEAM FLOW (LBM/SEC)
C	GHTEXH	TURBINE EXHAUST FLOW (LBM/SEC)
C	GPTEXH	TURBINE EXHAUST PRESSURE (PSIA)
C	GHTEXH	TURBINE EXHAUST ENTHALPY (BTU/LBM)
C	GHTEXT(4)	TURBINE EXTRACTION FLOWS (LBM/SEC)
C	GPTEXT(4)	TURBINE EXTRACTION PRESSURES (PSIA)
C	GHTEXT(4)	TURBINE EXTRACTION ENTHALPIES (BTU/LBM)
C	GTFOWER	THERMAL AVAILABILITY (BTU/SEC)
C	GEFOUT	ELECTRICAL POWER (MEGA-WATTS)
C	GHLOSSR	RISER HEAT LOSSES (BTU/HR)
C	GTFFR	RECVR INLET TEMPERATURE (F)
C	GPOUT	RECVR FEED PUMP OUTPUT PRESSURE (PSIA)
C	GHOUTP	RECVR FEED PUMP OUTPUT ENTHALPY (BTU/LBM)
C	GFFAUX	RECVR FEED PUMP AUX POWER (KW)
C	GNFPT	TOTAL RECVR FEED PUMP FLOW (LBM/SEC)
C	GFFH	RECVR FEED PUMP HEAD (FT)
C	GFPT	RECVR FEED PUMP TORQUE (FT-LBS)
C	GTDSI	F.W. TEMPERATURE (F) AT DESUPERHEATER INLET
C	GFCTSG	PRESSURE (PSIA) AT TSS STEAM GENERATOR INLET
C	GTCTSG	TEMPERATURE (F) AT TSS STEAM GENERATOR INLET
C	GHLOSSDS	HEAT LOSS (BTU/HR) IN DESUPERHEATER FW PIPE
C	GHLOTSG	HEAT LOSS (BTU/HR) IN TSS STEAM GENERATOR FW PIPE
C	GTAUXP	TOTAL AUX POWER (KW) REQUIRED BY FEEDWATER PUMPS
C	AFSP	AUX POWER (KW) REQUIRED BY BOOST PUMP
C	ARHP	AUX POWER (KW) REQUIRED BY HOTWELL PUMP
C	GHHTR1	ENTHALPY (BTU/LBM) OF WATER IN HEATER 1
C	GFHTR1	PRESSURE (PSIA) OF WATER IN HEATER 1
C	GTHTR1	TEMPERATURE (F) OF WATER IN HEATER 1
C	GPSH1	PRESSURE (PSIA) OF STEAM TO HEATER 1
C	GHSH1	ENTHALPY (BTU/LBM) OF STEAM TO HEATER 1
C	GPSH2	PRESSURE (PSIA) OF STEAM TO HEATER 2
C	GHSH2	ENTHALPY (BTU/LBM) OF STEAM TO HEATER 2
C	GHCH4C	ENTHALPY (BTU/LBM) OF HEATER 4 CONDENSATE DRAIN
C	GHCH5C	ENTHALPY (BTU/LBM) OF HEATER 5 CONDENSATE DRAIN
C	GHCH23	ENTHALPY (BTU/LBM) OF HEATER 2 CONDENSATE DRAIN
C	GHCH12	ENTHALPY (BTU/LBM) OF HEATER 1 CONDENSATE DRAIN
C		
C		

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C      EPGS CONSTANTS
C
C      COMMON /GCDATA/ GMVR(4),GMVT(2),GMVE(4),VRATE(12),GMVR0(4),
1  GMVT0(2),GMVE0(4),SSP(12),TZERO(3),GPSPT3,GETAT3,GLZT3,
2  GKLCT3,GPSPT1,GMCT1,GPSPT2,GETAT2,GLZT2,GKLCT2,GRIDC,
3  GRODC,GLDC,GTG,GRISP,GROSP,GLSPTG,NPORTS,IFAN,GPTED(4),
4  GTEFF,GPHRD(3,6),GWHRD(3),GTHRD(6),GMEFF,GKEFF,GKGAIN,
5  GKINERT,GFFRSP,GFFHR,GFFSR,GWFFR,GFPTR,GVFFR,GRIRC,GRORC,
6  GLRC,GRIDS,GRODS,GLDESP,GFFPSP,GLFHP,GRIFHP,GROFHP,TNOM,
7  VNOM,BPUMP(5),HPUMP(5),H1PARM(3),H2PARM(3),H4PARM(3),
8  H5PARM(3),GMCH3,GMCHW
C
C      GMVR(4)      SETTING OFR EPGS SERVO-CONTROLLED VALVES R1-R4
C                   RANGE IS 0. TO 1.0
C      GMVT(2)      SETTING FOR EPGS SERVO-CONTROLLED VALVES T1 AND T2
C                   RANGE IS 0. TO 1.0
C      GMVE(4)      SETTING FOR EPGS SERVO-CONTROLLED VALVES E1-E4
C                   RANGE IS 0. TO 1.0
C      VRATE(10)    MAX RATE FOR VALVES TO MOVE FROM OPEN TO CLOSE
C                   POSITONS
C      GMVR0(4)     VALVE SETTING FOR R1-R4 AT TIME TZERO(1)
C      GMVT0(2)     VALVE SETTING FOR T1-T2 AT TIME TZERO(2)
C      GMVE0(4)     VALVE SETTING FOR E1-E4 AT TIME TZERO(3)
C      TZERO(3)     LAST TIME SET POINT WAS CHANGED (SEC)
C      SSP(11)      SAVE SP(11) FROM COMMON BLOCK /GCDATA/
C      GPSPT3       PRESSURE (PSIA) SET POINT FOR TANK 3 (RECVR FLASH )
C      GETAT3       SIZING CONSTANT FOR TANK 3 (MAX LEVEL DIVIDED BY
C                   MAX OUTPUT FLOW RATE)
C      GLZT3        NOMINAL WATER LEVEL (FT) FOR TANK 3
C      GKLCT3       CONSTANT FOR LEVEL CONTROL IN TANK 3
C      GPSPT1       PRESSURE (PSIA) SET POINT FOR TANK 1 (TSS DRAIN SYS)
C      GMCT1        MASS(LBM) OF CONDENSATE IN TANK 1
C      GFSPT2       PRESSURE (PSIA) SET POINT FOR TANK 2 (TSS DRAIN SYS)
C      GETAT2       SIZING CONSTANT FOR TANK 2 (MAX LEVEL / MAX FLOW)
C      GLZT2        NOMINAL WATER LEVEL (FT) IN TANK 2
C      GKLCT2       LEVEL CONTRL GAIN FOR TANK 2
C      GRISP        INSIDE RADIJS (FT) OF STEAM PIPE (TSS TO EPGS)
C      GROSP        OUTSIDE RADIUS (FT) OF STEAM PIPE (TSS TO EPGS)
C      GLSPTG       LENGTH (FT) OF STEAM PIPE (TSS TO EPGS)
C      GRIDC        INSIDE RADIJS (FT) OF DOWNCOMER
C      GRODC        OUTSIDE RADIUS (FT) OF DOWNCOMER
C      GTG          THERMAL CONDUCTIVITY OF DOWNCOMER INSULATION
C                   (BTU/HR-FT-DEG R)
C      GLDC         LENGTH OF DOWNCOMER IN FEET
C      NPORTS       NUMBER OF TURBINE EXTRACTION PORTS
C      IFAN         COOLING TOWER FAN CONDITIONS  1   2 FANS FULL SPEED
C                                           2   1 HALF 1 FULL
C                                           3   2 FANS HALF SPEED
C      GPTED(4)     EXTRACTION PRESSURE (PSIA) PER UNIT OF APPARENT LP
C                   FLOW (LSM/SEC)
C      GTEFF        TURBINE/GENERATOR EFFICIENCY
C      GPHRD(3,6)   CONDENSER PRESSURE (PSIA) AT GWHRD(3) AND GTHRD(6)
C      GWHRD(3)     CONDENSER FLOW (LSM/HR) DATA AT 3 DIFFERENT VALUES
C      GTHRD(6)     AMBIENT TEMP. (F) DATA AT 6 DIFFERENT VALUES
C      GMEFF        ELECTRO-MECHANICAL EFFICIENCY OF RECVR FEEDPUMP
C      GKEFF        FEED PUMP EFFICIENCY
C      GKGAIN       FEED PUMP CONTROL GAIN
C      GKINERT      FEED PUMP MOMENT OF INERTIA
C      GFFRSP       RECVR INLET PRESSURE (PSIA) SET POINT
C      GFFHR        FEED PUMP PATED HEAD (FT)

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C GFPSR FEED PUMP RATED SPEED (RPM)
 C GWFFR FEED PUMP RATED FLOW (LBM/SEC)
 C GFPTR FEED PUMP RATED TORQUE (FT-LBS)
 C GVFFR SPECIFIC VOLUME (FT**3/LBM) AT RATED CONDITIONS
 C GRIRC INSIDE RADIUS (FT) OF RISER
 C GOROC OUTSIDE RADIUS (FT) OF RISER
 C GLRC LENGTH (FT) OF RISER
 C GRIDS INSIDE RADIUS (FT) OF FW PIPE FEED PUMP TO DESUPHRTR
 C GROSS OUTSIDE RADIUS (FT) FW PIPE FEED PUMP TO DESUPHRTR
 C GLDESP LENGTH (FT) OF FW PIPE FEED PUMP TO DESUPERHRTR
 C GPFPS RECVR INLET PRESSURE (PSIA) SET POINT
 C GLFWP LENGHT (FT) OF FW PIPE EPSS TO TSS STEAM GEN.
 C GRIFWP INNER RADIUS (FT) OF FW PIPE EPSS TO TSS STEAM GEN.
 C BPUMP(5) PARAMETERS FOR BOOST PUMP (SEE ROUTINE PUMPSS)
 C HPUMP(5) PARAMETERS FOR HOTWELL PUMP (SEE ROUTINE PUMPSS)
 C H1PARN(3) PARAMETERS FOR HEATER 1 (SEE ROUTINE CFWHTR)
 C H2PARN(3) PARAMETERS FOR HEATER 2 (SEE ROUTINE CFWHTR)
 C H4PARN(3) PARAMETERS FOR HEATER 4 (SEE ROUTINE CFWHTR)
 C H5PARN(3) PARAMETERS FOR HEATER 5 (SEE ROUTINE CFWHTR)
 C GMCH3 MASS OF CONDENSATE (LBM) STORED IN HEATER 3
 C GROFWP OUTER RADIUS (FT) OF FW PIPE EPSS TO TSS STEAM GEN.
 C GMCHW MASS OF CONDENSATE (LBM) STORED IN CONDENSER HOTWELL
 C TNOM NOMINAL TEMP (F) OF AIR SURROUNDING FW SYS COMPONENTS
 C VNOM NOMINAL AIR VELOCITY (FT/SEC) ABOUT FW SYS COMPONENTS
 C (NORMALLY SET TO ZERO)

GASP-IV SIMULATION SYSTEM DATA

COMMON /GCOM1/ ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,NCRDR,N
 1NAPD,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),TNOW,TTBEG
 2,TTCLR,TTFIN,TRIB(25),TTSET

COMMON /GCOM2/ DD(600),DDL(600),DTFUL,DTNOW,ISEES,LFLAG(200),NFLAG
 1,NNEQD,NNEQS,NNEQT,SS(600),SSL(600),TTTEX

DIMENSION RIUF2(8),RL13(8),RTEM2(8),RIHF3(8),RTEM4(8),RTEM6(8),
 1 RLINTC(6),RL15(8),RHFSAT(8),RHF3(8),RHVSAT(8),RHF5(8),RTSENC(6),
 2 RDIUF2(8),RDL13(8),RDEM2(8),RDIHF3(8),RDEM4(8),RDEM6(8),
 3 ROLINTC(6)

EQUIVALENCE (RIUF2(1),SS(1)),(RL13(1),SS(9)),(RTEM2(1),SS(17)),
 1 (RIHF3(1),SS(25)),(RTEM4(1),SS(33)),(RTEM6(1),SS(41)),
 2 (RUSH,SS(49)),(RVSH,SS(50)),(RLINTC(1),SS(51)),
 4 (TW5,SS(83)),(TW7,SS(84)),(TW8,SS(85)),
 5 (THTSU,SS(86)),(GHCT3,SS(87)),(GHCT3,SS(88)),
 6 (GHCT3,SS(89)),(GHSDDC,SS(90)),(GHSTSG,SS(91)),
 7 (GHCT1,SS(92)),(GHCT2,SS(93)),(GHCT2,SS(94)),
 8 (GHCT2,SS(95)),(GFPS,SS(96)),(GHRCI,SS(97)),
 9 (GHDSI,SS(98)),(GHCOH3,SS(99)),(GHCTSG,SS(100)),
 A (GHCHW,SS(101)),
 B (RL15(1),SS(102)),(RHFSAT(1),SS(110)),(RHF3(1),SS(118)),
 C (RHVSAT(1),SS(126)),(RHF5(1),SS(134)),(RTSENC(1),SS(142)),
 D (CRFRSH,SS(151)),(CRTESH,SS(152)),(CGPFFR,SS(153)),
 E (CTLT,SS(154)),
 F (GPFFR,SS(161)),(GFDSI,SS(162)),(XK1,SS(163)),(XK2,SS(164)),
 G (XK3,SS(165))

EQUIVALENCE (RDIUF2(1),DD(1)),(RDL13(1),DD(9)),(RDEM2(1),DD(17)),
 1 (RDIHF3(1),DD(25)),(RDEM4(1),DD(33)),(RDEM6(1),DD(41)),

2 (RDUSH,DD(49)),(RDVSH,DD(50)),(RDLINTC(1),DD(51)),
 3 (TDW5,DD(83)),(TDW7,DD(84)),
 5 (TDW8,DD(85)),(TDHTSU,DD(86)),(GMCDT3,DD(87)),
 6 (GHDCOT3,DD(88)),(GHDCOT3,DD(89)),(GHSOEDC,DD(90)),
 7 (GHSTSG,DD(91)),(GHDCOT1,DD(92)),(GHDCOT2,DD(93)),
 8 (GHDCOT2,DD(94)),(GHDCOT2,DD(95)),(GDFPS,DD(96)),
 9 (GHDCI,DD(97)),(GHDSI,DD(98)),(GHDCOH3,DD(99)),
 A (GHCTSG,DD(100)),(GHCHW,DD(101))

INTEGRATED STATE VARIABLES

RIUF2(ISP) FLUID INTERNAL ENERGY AT SUPERPANEL NODE NUMBER 2
 (BTU/LBM)
 RL13(ISP) LENGTH OF SUPERPANEL SUBCOOLED SECTION
 (FEET)
 RTEM2(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 2
 (DEGREES F)
 RIHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 (BTU/LBM)
 RTEM4(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 4
 (DEGREES F)
 RTEM6(ISP) METAL TEMPERATURE AT SUPERPANEL NODE NUMBER 6
 (DEGREES F)
 RUSH FLUID INTERNAL ENERGY IN STEAM HEADER
 (BTU/LBM)
 RVSH FLUID SPECIFIC VOLUME IN STEAM HEADER
 (CU FT/LBM)
 RLINTC(IC) CONTROLLER INTEGRAL SIGNAL OF VALVE STEM DISPLACEMENT
 (PERCENT)
 TW5 NOMINAL OIL FLOW INTO STORAGE (LBM/SEC)
 TW7 NOMINAL OIL FLOW FROM STORAGE (LBM/SEC)
 TW8 STEAM FLOW FROM STEAM GENERATOR (LBM/SEC)
 THTSU HEAT STORED IN THERMAL STORAGE UNIT (BTU)
 GMCT3 CONDENSATE MASS (LBM) IN TANK 3 (RECVR FLASH TANK)
 GHCT3 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 3
 GHCT3 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 3
 GHSOEC ENTHALPY (BTU/LBM) OF STEAM AT BOTTOM OF DOWNCOMER
 GHSTSG ENTHALPY (BTU/LBM) OF ADMISSION STEAM
 GHCT1 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 1
 GHCT2 ENTHALPY (BTU/LBM) OF CONDENSATE OUT OF TANK 2
 GMCT2 MASS (LBM) OF CONDENSATE IN TANK 2
 GHCT2 FLOW (LBM/SEC) OF CONDENSATE OUT OF TANK 2
 GFPS RECVR FEED PUMP SPEED (RPM)
 GHRCI F.W. ENTHALPY (BTU/LBM) AT RECVR INLET
 GHDSI F.W. ENTHALPY (BTU/LBM) AT DESUPERHEATER INLET
 GHCOH3 F.W. ENTHALPY (BTU/LBM) OUT OF FW HRTR NO. 3
 GHCTSG ENTHALPY (BTU/LBM) AT TSS STEAM GEN. INLET
 GHCHW ENTHALPY (BTU/LBM) OF CONDENSATE IN CONDENSER HOTWELL

ADDITIONALLY REQUIRED GASP-IV STATE VARIABLES

RL15(ISP) COMBINED LENGTH OF SUPERPANEL SUBCOOLED AND
 TWO-PHASE MIXTURE SECTIONS (FEET)
 RHFSAT(ISP) ENTHALPY OF A SATURATED LIQUID
 (BTU/LBM)
 RHF3(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 3
 (BTU/LBM)
 RHVSAT(ISP) ENTHALPY OF A SATURATED VAPOR

C (BTU/LBM)
 C RHF5(ISP) FLUID ENTHALPY AT SUPERPANEL NODE NUMBER 5
 C (BTU/LBM)
 C RTSENC(IC) CONTROLLER TEMPERATURE SENSOR SIGNAL OF BOILER
 C SUPERPANEL OUTLET TEMPERATURE (DEGREES F)
 C CRPRSH FLUID PRESSURE IN RECEIVER STEAM HEADER
 C (PSIA)
 C CRTESH FLUID TEMPERATURE IN RECEIVER STEAM HEADER
 C (DEGREES F)
 C CGPFPR FLUID PRESSURE AT RECEIVER INLET
 C (PSIA)
 C CTLT POSITION OF TSS THERMOCLINE
 C (PERCENT)
 C GPFPR FEEDWATER PRESSURE AT RECEIVER INLET (PSIA)
 C GFDSI FEEDWATER PRESSURE AT TSS DESUPERHEATER INLET (PSIA)
 C XK1,XK2,XK3 EFSS/RECVR INTERFACE VARIABLES FOR FLOW RATE AND
 C PRESSURE AT RECEIVER INLET

TIME DERIVATIVE VARIABLES CORRESPONDING TO INTEGRATED VARIABLES

C RDIUF2(ISP) TIME DERIVATIVE OF RIUF2(ISP)
 C RDL13(ISP) TIME DERIVATIVE OF RL13(ISP)
 C RSTEM2(ISP) TIME DERIVATIVE OF RTEM2(ISP)
 C RDIHF3(ISP) TIME DERIVATIVE OF RIHF3(ISP)
 C RSTEM4(ISP) TIME DERIVATIVE OF RTEM4(ISP)
 C RSTEM5(ISP) TIME DERIVATIVE OF RTEM5(ISP)
 C RDUSH TIME DERIVATIVE OF RUSH
 C RDVSH TIME DERIVATIVE OF RVSH
 C RDLINTC(IC) TIME DERIVATIVE OF RLINTC(IC)

C TDW5 TIME DERIVATIVE OF TW5
 C TDW7 TIME DERIVATIVE OF TW7
 C TDW8 TIME DERIVATIVE OF TW8
 C TDHTSU TIME DERIVATIVE OF THTSU

C GMCOT3 TIME DERIVATIVE OF GMCT3
 C GHDCOT3 TIME DERIVATIVE OF GHCOT3
 C GWDCOT3 TIME DERIVATIVE OF GWCOT3
 C GHSDEDC TIME DERIVATIVE OF GHS9DC
 C GHSTSG TIME DERIVATIVE OF GHSTSG
 C GHDCOT1 TIME DERIVATIVE OF GHCOT1
 C GHDCOT2 TIME DERIVATIVE OF GHCOT2
 C GMDCT2 TIME DERIVATIVE OF GMCT2
 C GHDCOT2 TIME DERIVATIVE OF GWCOT2
 C GFPS TIME DERIVATIVE OF GFPS
 C GHDRCI TIME DERIVATIVE OF GHRCI
 C GHDSI TIME DERIVATIVE OF GHDSI
 C GHDCOH3 TIME DERIVATIVE OF GHCCH3
 C GHDCCTSG TIME DERIVATIVE OF GHCTSG
 C GHDCWH TIME DERIVATIVE OF GHCHW

FUNDAMENTAL PHYSICAL CONSTANTS

COMMON /CONSTS/ PI,ZFR,GRAV,GRAV0,SBC,GCAIR

C PI PI
 C ZFR ZERO FAHRENHEIT (DEGREES RANKINE)
 C GRAV LOCAL ACCELERATION DUE TO GRAVITY (FT/(SEC)**2)
 C GRAV0 GRAVITATIONAL CONSTANT (LBM FT/LBF (SEC)**2)

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C   SBC           STEFAN-BOLTZMANN CONSTANT (BTU/SEC-SQ FT (DEG R)**4)
C   GCAIR         GAS CONSTANT FOR AIR (FT LBF/LBM (DEG R))
C
C
C   COMPRESSED WATER/SUPERHEATED STEAM TABLE DATA
C
C   LOGICAL NO COMP,SATURD
C   REAL HE,PE,SE,TE,VE,XE
C   COMMON /USECOM/ HE,PE,SE,TE,VE,XE,NO COMP,SATURD
C
C
C   INTERFACE EQUALITIES FROM TSS TO EPGS
C
C   TWSG=TW8
C   TWCH=TW3
C   TTECH=TT4
C   TPRCH=TF4
C   TTESG=TT8
C   TPRSG=TP8
C   THSG=TH8
C
C   SECTION 1 (STATEMENT LABELS 100 TO 199)
C   CALCULATES THE STEAM CONDITIONS AT THE
C   TURBINE ADMISSION PORT. CALCULATES
C   FLOW TO TURBINE AND FLOW TO NO. 2 FLASH
C   TANK.
C
C   100 CONTINUE
C
C   1) FLOW TO TURBINE (GWSTSG) AND FLASH
C   TANK NO. 2 (GWSIT2)
C
C   SUM=GMVT(1)+GMVT(2)
C   IF (SUM.GT.0.0) GO TO 110
C
C   IF SUM IS.LT. ZERO NO STEAM FLOW
C   GO TO DIAGNOSTIC PRINT AND SECTION 2.
C
C   GWSTSG=0.0
C   GWSIT2=0.0
C   GO TO 190
C
C   110 CONTINUE
C   GWSTSG=(GMVT(1)/SUM)*TWSG
C   GWSIT2=TWSG-GWSTSG
C
C   190 CONTINUE
C
C   2) CALCULATE PIPING LOSSES FROM TSS
C   STEAM GENERATOR TO TURBINE
C   INSIDE DIAMETER OF STEAM PIPE (GDISP)
C
C   GDISP=2.*GRISP
C
C   OUTSIDE DIAMETER OF STEAM PIPE (GDOSP)
C
C   GDOSP=2.*GROSP
C
C   CALCULATE REYNOLDS NUMBER FOR STEAM
C   IN THE PIPE (GRES)
C
C   GRESP=AIRENA(TTESG,TPRSG,TWSG,GDISP)
C
C   SPECIFIC VOLUME OF STEAM (GVSP)
C
C   CALL USE HP(THSG,TPRSG)
C   GVSP=VE
C
C   DYNAMIC VISCOSITY OF STEAM (GMUSP)
C
C   GMUSP=AIVISC(TTESG,TPRSG)
C
C   CALCULATE PRESSURE DROP DUE TO
C   FRICTIONAL LOSSES (GPDEL)
C
C   CALL FRLOSS(GDISP,GRESP,GMUSP,GLSPTG,GVSP,GPDEL)
C
C   CALCULATE HEAT LOSSES FOR STEAM
C   PIPE (VNOH=0. INDICATES NO WIND)
C   (THOM=75.INDICATES ROOM TEMP)

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      CALL PIPELOS(TNOM,TTESG,EPRMB,VNOM,GDOSP,GDISP,GLSPTG,GTC,
1      GHLOSS)
C
C      3) CALCULATE FLUID STATE AT TURBINE
C      PRESSURE (GPSSAP)
C
C      GPSTSG=TPRSG-GPDEL
C      ENTHALPY TRANSPORT DELAY EQUATIONS
C      TOTAL MASS IN PIPE (GMSP)
C      GMSP=GLSPTG*PI*GRISP*GRISP/GVSP
C      DERIVATIVE OF ENTHALPY AT TURBINE INPT
C      GHSTSG=(2./GMSP)*(TWSG*(THSG-GHSTSG)-(GHLOSS/3600.))
C
C      TEMPERATURE OF STEAM AT TURBINE
C      CALL USE HP(GHSTSG,GPSTSG)
C      GTSTSG=TE
C
C      DIAGNOSTIC PRINT IF DESIRED - STEAM INPUT
C
C      IF (DIAG(23)) WRITE (6,199) TWSG,TTESG,TPRSG,THSG,GHSTSG,GHSIT2,
1      GRESP,GVSP,GMUSP,GPDEL,GHLOSS,GPSTSG,
2      GMSP,GHSTSG,GHSTSG,GTSTSG
199 FORMAT(1H ,27HDIAG23/EPGS-TSS STEAM INPUT,/,
1      19X,8H TWSG=,G10.4,8H TTESG=,G10.4,8H TPRSG=,G10.4,
1      8H THSG=,G10.4,/,
2      19X,8H GHSTSG=,G10.4,8H GHSIT2=,G10.4,8H GRESP=,G10.4,
2      8H GVSP=,G10.4,/,
3      19X,8H GMUSP=,G10.4,8H GPDEL=,G10.4,8H GHLOSS=,G10.4,
3      8H GPSTSG=,G10.4,/,
4      19X,8H GMSP=,G10.4,8H GHSTSG=,G10.4,8H GHSTSG=,G10.4,
4      8H GTSTSG=,G10.4)
C
200 CONTINUE
C
C      SECTION 2 (STATEMENT LABELS 200 TO 299)
C      CALCULATIONS FOR FLASH TANK NO. 1
C
C      1) CALCULATE ENTHALPY OF CONDENSATE INPUT
C      TO TANK NO. 1 FROM TSS (GHGIN)
C
C      CALL USE PT(TPRCH,TTECH)
C      GHGIN=HE
C
C      2) CALCULATE STATE OF FLASH STEAM AND
C      DRAIN CONDENSATE FOR TANK NO. 1
C      ENTHALPY OF CONDENSATE INTO TANK-GHCIT1
C      FLOW OF CONDENSATE INTO TANK- GWCIT1
C      ENTHALPY OF STEAM OUT OF TANK- GHSTH1
C      FLOW OF STEAM OUT OF TANK- GWSTH1
C      PRESSURE OF OUTPUT STREAMS- GPT1
C
C      CALL FTANK(TPRCH,GPSPT1,TWCH,GHCIN,GHCIT1,GHCIT1,GHSTH1,GWSTH1,
1      GPT1)
C
C      3) CONDENSATE OUTPUT FLOW RATE- GWCOT1
C      (NO CONTROL)
C
C      GWCOT1=GWCIT1
C
C      4) DERIVATIVE OF OUTPUT CONDENSATE
C      ENTHALPY
C      GHDCOT1=(GHCIT1-GWCOT1)*GWCOT1/GHCT1
C
300 CONTINUE
C
C      SECTION 3 (STATEMENT LABELS 300 TO 399)
C      CALCULATIONS FOR FLASH TANK NO. 2
C
C      1) CALCULATE OPERATING PRESSURE OF TANK 2
C      GPOPT2=AMIN1(GPSTSG,GPSPT2,GPT1)

```

```

C      IF (GWSIT2.LT.1.0E-04) GFOPT2=GFSPT2
C      2) CALCULATE STATE OF OUTPUT STEAM AND
C          DRAIN CONDENSATE DUE TSS STEAM
C          CONDENSATE ENTHALPY      GHCIT2A
C          CONDENSATE FLOW          GWCIT2A
C          STEAM ENTHALPY          GHSOT2A
C          STEAM FLOW              GWSOT2A
C      CALL FTANK(GPSTSG,GFOPT2,GWSIT2,GHSTSG,GHCIT2A,GWCIT2A,
1          GHSOT2A,GWSOT2A,GPT2)
C      3) CALCULATE STATE OF OUTPUT STEAM AND
C          DRAIN CONDENSATE DUE TO TANK1 DRAIN
C          CONDENSATE ENTHALPY      GHCIT2B
C          CONDENSATE FLOW          GWCIT2B
C          STEAM ENTHALPY          GHSOT2B
C          STEAM FLOW              GWSOT2B
C      CALL FTANK(GPT1,GFOPT2,GWCOT1,GHCOT1,GHCIT2B,GWCIT2B,
1          GHSOT2B,GWSOT2B,GPT2)
C      4) CALCULATE OUTPUT STEAM CONDITIONS TO
C          HEATER NO. 2      FLOW      GWSTH2
C                               ENTHALPY  GHSTH1
C      GWSTH2=GWSOT2A+GWSOT2B
C      IF (GWSTH2.GT.0.0) GHSTH2=(GWSOT2A*GHSOT2A+GWSOT2B*GHSOT2B)/GWSTH2
C      5) CALCULATE CONDENSATE DRAIN CONDITIONS
C          TO TANK NO. 2      FLOW      GWCIT2
C                               ENTHALPY  GHCIT2
C      GWCIT2=GWCIT2A+GWCIT2B
C      IF (GWCIT2.GT.0.0) GHCIT2=(GWCIT2A*GHCIT2A+GWCIT2B*GHCIT2B)/GWCIT2
C      6) DERIVATIVE OF OUTPUT CONDENSATE FLOW
C          PROPORTIONAL CONTROL      (GWCOT2)
C      GWCOT2=(GWCIT2-GWCOT1)/SKLCT2
C      7) DERIVATIVE OF MASS IN TANK NO. 2
C                               (GMCT2)
C      GMCT2=GWCIT2-GWCOT2
C      8) SPECIFIC VOLUME OF CONDENSATE - GVCT2
C      CALL USE HP(GHCOT2,GPT2)
C      GVCT2=VE
C      9) DERIVATIVE OF OUTPUT CONDENSATE
C          ENTHALPY      GHCOT2
C      GHDCOT2=(GWCIT2*(GHCIT2-GHCOT2)+GPT2*GVCT2*(GHCIT2-GWCOT2))/GMCT2
C      10) WATER LEVEL IN TANK NO. 2 (GLT2)
C      GLT2=GLZT2+GETAT2*GWCOT2
C      DIAGNOSTIC PRINT IF DESIRED - DRAIN SYSTEM
C      IF (DIAG(24)) GO TO 350
C      GO TO 400
350  CONTINUE
C      FLASH TANK NO. 1
C      WRITE(6,389) TWCH,TTECH,TPRCH,GHCIN,GWSTH1,GHSTH1,GPT1,
1          GWCIT1,GHCIT1,GHCOT1,GHDCOT1
389  FORMAT(1H,41HDIAG24/EFGS - TSS DRAIN SYSTEM/TANK NO. 1,/,
1      19X,8H TWCH=,G10.4,8H TTECH=,G10.4,8H TPRCH=,G10.4,
1      8H GHCIN=,G10.4,/,
2      19X,8H GWSTH1=,G10.4,8H GHSTH1=,G10.4,8H GPT1=,G10.4,/,
3      19X,8H GWCIT1=,G10.4,8H GHCIT1=,G10.4,8H GHCOT1=,G10.4,

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      3      8HGHDCOT1=,G10.4)
C
C      FLASH TANK NO. 2
C
      WRITE(6,399) GPOPT2,GPT2,GLT2,GVCT2,
1      GWCIT2A,GHCIT2A,GWSOT2A,GHSOT2A,
2      GWCIT2B,GHCIT2B,GWSOT2B,GHSOT2B,
3      GWCIT2,GHCIT2,GWSTH2,GHSTH2,
4      GWCOT2,GWDCOT2,GHCOT2,GHDCOT2,GMCT2,GMDCT2
399 FORMAT(1H ,41HDIAG24/EPGS - TSS DRAIN SYSTEM/TANK NO. 2,/,
1      19X,9H GPOPT2=,G10.4,9H GPT2=,G10.4,9H GLT2=,G10.4,
1      9H GVCT2=,G10.4,/,
2      19X,9H GWCIT2A=,G10.4,9H GHCIT2A=,G10.4,9H GWSOT2A=,G10.4,
2      9H GHSOT2A=,G10.4,/,
3      19X,9H GWCIT2B=,G10.4,9H GHCIT2B=,G10.4,9H GWSOT2B=,G10.4,
3      9H GHSOT2B=,G10.4,/,
4      19X,9H GWCIT2=,G10.4,9H GHCIT2=,G10.4,9H GWSTH2=,G10.4,
4      9H GHSTH2=,G10.4,/,
5      19X,9H GWCOT2=,G10.4,9H GWDCOT2=,G10.4,9H GHCOT2=,G10.4,
5      9H GHDCOT2=,G10.4,/,
6      19X,9H GMCT2=,G10.4,9H GMDCT2=,G10.4)
C
C      400 CONTINUE
C
C      SECTION 4
C      CALCULATES CONDENSATE FLOW RATES TO
C      CONDENSOR, HEATER NO. 5, AND HEATER NO. 3
C      (DEAERATOR)
C
      GWCTH3=CSP(7)*GWCOT2
      GWCTH5=CSP(8)*GWCOT2
      GWCTC=GWCOT2-GWCTH3-GWCTH5
      GWCTC=AMAX1(0.0,GWCTC)
C
C
      RETURN
      END

```

SUBROUTINE ALINIT
LIST,NONE

SUBROUTINE TO INITIALIZE THE SATURATED WATER AND STEAM
ARRAY, XZMTAB(30,11)

JANUARY 1978

THE COLUMNS OF THE ARRAY CONTAIN THE FOLLOWING
THERMODYNAMIC PROPERTIES IN ENGLISH UNITS:

COLUMN	THERMODYNAMIC PROPERTY
*****	*****
1	SEARCH PARAMETER, $M = (UG - UF)/(VG - VF)$
2	SAT. LIQ. SPECIFIC INTERNAL ENERGY (UF)
3	SATURATED LIQUID SPECIFIC ENTHALPY (HF)
4	SATURATED LIQUID SPECIFIC ENTROPY (SF)
5	SATURATED LIQUID SPECIFIC VOLUME (VF)
6	SAT. VAP. SPECIFIC INTERNAL ENERGY (UG)
7	SATURATED VAPOR SPECIFIC ENTHALPY (HG)
8	SATURATED VAPOR SPECIFIC ENTROPY (SG)
9	SATURATED VAPOR SPECIFIC VOLUME (VG)
10	SATURATED SYSTEM PRESSURE (P)
11	SATURATED SYSTEM TEMPERATURE (T)

COMMON /XZMCOM/ XZMTAB(30,11)
DIMENSION XZ(30,11)

DATA ((XZ(I,J),I=1,30),J=1,4)/1.109, 10.36, 23.72, 44.13, 81.69,
M1 116.82, 150.40, 182.86, 260.46, 334.48, 405.86, 475.31,
M2 543.09, 609.67, 739.20, 865.37, 988.88, 1229.57, 1288.61,
M3 1347.41, 1579.98, 1695.20, 1809.05, 1922.91, 2037.31,
M4 2265.20, 2496.00, 2612.52, 2847.01, 2964.74,

UF1 36.991, 120.90, 161.23, 196.21, 236.0,
UF2 262.0, 281.9, 298.2, 330.1, 354.8, 375.3, 392.9, 408.6,
UF3 422.7, 447.7, 469.5, 488.9, 523.2, 531.0, 538.6, 556.9,
UF4 580.1, 592.9, 605.2, 617.1, 640.3, 662.6, 673.6, 695.6,
UF5 706.6,

HF1 36.992, 120.92, 161.26, 196.27, 236.1,
HF2 262.2, 282.1, 298.5, 330.6, 355.5, 376.1, 394.0, 409.8,
HF3 424.2, 449.5, 471.7, 491.6, 526.7, 534.7, 542.6, 571.9,
HF4 585.6, 598.8, 611.7, 624.2, 648.5, 672.1, 683.8, 707.2,
HF5 719.0,

SF1 .0725, .2199, .2836, .3358, .3921,
SF2 .4273, .4534, .4743, .5141, .5438, .5679, .5892, .6059,
SF3 .6217, .6490, .6723, .6928, .7279, .7358, .7434, .7714,
SF4 .7843, .7966, .8085, .8199, .8417, .8625, .8727, .8929,
SF5 .9031/

DATA ((XZ(I,J),I=1,30),J=5,8)/.016048, .016358, .016592, .016834,
VF1 .017151, .017383, .017573, .017740, .01809, .01839, .01865,
VF2 .01889, .01912, .01934, .01975, .02013, .0205, .02123,

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VF3      .02141, .02159, .02232, .02269, .02307, .02346, .02387,
VF4      .02472, .02565, .02615, .02727, .02790,
C
UG1      1033.4, 1060.2, 1072.3, 1082.0, 1092.1,
UG2      1098.0, 1102.1, 1105.2, 1110.4, 1113.7, 1115.8, 1117.2,
UG3      1118.1, 1118.7, 1118.8, 1118.2, 1116.9, 1113.0, 1111.7,
UG4      1110.4, 1104.3, 1100.9, 1097.1, 1093.1, 1088.9, 1079.5,
UG5      1068.6, 1062.5, 1048.8, 1041.2,
C
HG1      1091.6, 1127.3, 1143.3, 1156.3, 1169.8,
HG2      1177.6, 1183.1, 1187.2, 1194.1, 1198.3, 1201.1, 1202.9,
HG3      1204.0, 1204.6, 1204.7, 1203.7, 1201.8, 1196.4, 1194.7,
HG4      1192.9, 1184.8, 1180.2, 1175.3, 1170.1, 1164.5, 1152.3,
HG5      1138.3, 1130.5, 1113.2, 1103.7,
C
SG1      2.0676, 1.8626, 1.7879, 1.7320, 1.6765,
SG2      1.6440, 1.6208, 1.6027, 1.5695, 1.5454, 1.5264, 1.5105,
SG3      1.4968, 1.4847, 1.4639, 1.4461, 1.4304, 1.4032, 1.3970,
SG4      1.3910, 1.3683, 1.3577, 1.3474, 1.3373, 1.3274, 1.3079,
SG5      1.2881, 1.2780, 1.2569, 1.2460/
C
DATA ((XZ(I,J),I=1,30),J=9,11)/ 898.6, 90.64, 38.42, 20.087,
VG1      10.4965, 7.1736, 5.4711, 4.431, 3.0139, 2.28728, 1.84317,
VG2      1.54274, 1.32554, 1.16095, .92762, .76975, .65556,
VG3      .50091, .47205, .44596, .36245, .32991, .30178, .27719,
VG4      .25545, .21861, .18831, .17501, .15133, .14076,
C
P1      0.35, 4.0, 10.0, 20.0, 40.0, 60.0,
P2      80.0, 100.0, 150.0, 200.0, 250.0, 300.0, 350.0, 400.0,
P3      500.0, 600.0, 700.0, 900.0, 950.0, 1000.0, 1200.0,
P4      1300.0, 1400.0, 1500.0, 1600.0, 1800.0, 2000.0, 2100.0,
P5      2300.0, 2400.0,
C
T1      68.939, 152.96, 193.21, 227.96, 267.25,
T2      292.71, 312.04, 327.82, 358.43, 381.8, 400.97, 417.35,
T3      431.73, 444.6, 467.01, 486.2, 503.08, 531.95, 538.39,
T4      544.58, 567.19, 577.42, 587.07, 596.2, 604.87, 621.02,
T5      635.8, 642.76, 655.89, 662.11/
C
C
DO 100 I=1,30
DO 200 J=1,11
XZMTAB(I,J)=XZ(I,J)
200 CONTINUE
100 CONTINUE
C
RETURN
END

```

```

C/      SUBROUTINE A2SATB(XM,U,V,UF,HF,SF,VF,UG,HG,SG,VG,P,T,YM)
C      LIST,NONE
C
C      SUBROUTINE TO SEARCH FOR AND CONVERGE TO THE BEST VALUE
C      OF M FOR GIVEN VALUES OF U AND V
C
C      JANUARY 1978
C
C      THE SUBROUTINE EMPLOYS THE NEWTON-RAPHSON METHOD TO
C      LOCATE M.  THE ALGORITHM IS LIMITED TO 50 ITERATIONS.
C
C      WHEN M IS FOUND ALL THE SATURATED THERMODYNAMIC
C      PROPERTIES DEFINED BY U AND V ARE ALSO LOCATED
C      AND MADE AVAILABLE TO THE CALLING PROGRAM.
C
C      *** INPUT ***
C      XM:  INITIAL GUESS OF M
C      U:   SAT. SYSTEM INTERNAL ENERGY, BTU/LBM
C      V:   SATURATED SYSTEM VOLUME, FT**3/LBM
C
C      *** OUTPUT ***
C      UF:  SAT. LIQ. INTERNAL ENERGY, BTU/LBM
C      HF:  SATURATED LIQ. ENTHALPY, BTU/LBM
C      SF:  SATURATED LIQ. ENTROPY, BTU/LBM,R
C      VF:  SATURATED LIQ. VOLUME, FT**3/LBM
C      UG:  SAT. VAP. INTERNAL ENERGY, BTU/LBM
C      HG:  SATURATED VAPOR ENTHALPY, BTU/LBM
C      SG:  SATURATED VAPOR ENTROPY, BTU/LBM,R
C      VG:  SATURATED VAPOR VOLUME, FT**3/LBM
C      P:   SATURATED SYSTEM PRESSURE, PSIA
C      T:   SATURATED SYSTEM TEMPERATURE, F
C      YM:  FITTED M VALUE
C
C      COMMON /XZMCOM/ XZMTAB(20,11)
C      EXTERNAL A1INTM
C
C      BEGIN COMPUTATIONS
C
C      YM=XM
C
C      LIMIT THE NUMBER OF SEARCHES TO 50
C      DO 40 N=1,50
C
C      CALL A1INTM FOR THE THERMODYNAMIC PROPERTIES
C      CALL A1INTM(YM,UF,HF,SF,VF,UG,HG,SG,VG,P,T)
C
C      DO 10 I=1,30
C      IF (YM .LT. XZMTAB(I,1)) GO TO 20
C      10 CONTINUE
C
C      20 NROW=I-1
C      IF (NROW .EQ. 0) NROW=1
C      XXX=YM-XZMTAB(NROW,1)
C      IF(XXX .EQ. 0.0) XXX=1.0E-10
C      VFD=(V -XZMTAB(NROW,5))/XXX
C      UFD=(U -XZMTAB(NROW,2))/XXX

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```

X1=V-VF
X1L=(1.0E-6)*(VG-VF)
IF(ABS(X1) .LT. X1L) X1=X1L
X2=U-UF
X2L=(1.0E-6)*(UG-UF)
IF(ABS(X2) .LT. X2L) X2=X2L
FM=YM-X2/X1
FMP=1.+UFD/X1-X2*VFD/(X1*X1)
YM=YM-FM/FMP
IF(YM .LT. 1.109) YM = 1.109
IF(YM .GT. 2964.47) YM = 2964.47
YY=FM/(FMP*YM)

```

```

C
C IF M DEVIATION IS WITHIN .1 PERCENT, TERMINATE SEARCH
C
  IF (YM .GT. 150.) GO TO 30
  IF (ABS(YY) .LT. 0.05) GO TO 50
  GO TO 40
30 IF (YY .LT. 0.0003) GO TO 50
C
40 CONTINUE
C
50 RETURN
  END

```

```

C/  SUBROUTINE A1INTM(RM,UF,HF,SF,VF,UG,HG,SG,VG,P,T)
C    LIST,NONE
C
C    SUBROUTINE TO DETERMINE THE THERMODYNAMIC PROPERTIES OF
C    SATURATED WATER AND STEAM CORRESPONDING TO A VALUE OF
C    M, THE SEARCH PARAMETER
C
C    JANUARY 1978
C
C    *** INPUT ***
C      RM:  VALUE OF M
C
C    *** OUTPUT ***
C      UF:  SAT. LIQ. INTERNAL ENERGY, BTU/LBM
C      HF:  SATURATED LIQ. ENTHALPY, BTU/LBM
C      SF:  SATURATED LIQ. ENTROPY, BTU/LBM,R
C      VF:  SATURATED LIQ. VOLUME, FT**3/LBM
C      UG:  SAT. VAP. INTERNAL ENERGY, BTU/LBM
C      HG:  SATURATED VAP. ENTHALPY, BTU/LBM
C      SG:  SATURATED VAP. ENTROPY, BTU/LBM,R
C      VG:  SATURATED VAP. VOLUME, FT**3/LBM
C      P:   SATURATED SYSTEM PRESSURE, PSIA
C      T:   SATURATED SYSTEM TEMPERATURE, F
C
C    THIS SUBROUTINE REQUIRES THE SATURATED THERMODYNAMIC DATA
C    CONTAINED IN ARRAY XZMTAB(30,11)
C
C    COMMON /XZMCOM/ XZMTAB(30,11)
C    DIMENSION V(11)
C
C    CALL TABLE LOOK-UP SUBROUTINE TO GET INDEX USED FOR INTERPOLAT.
C
C    CALL A1TBLK(1,RM,INDEX)
C
C    SLOPE=(RM-XZMTAB(INDEX-1,1))/(XZMTAB(INDEX,1)-XZMTAB(INDEX-1,1))
C
C    INTERPOLATE ALL OTHER PROPERTIES
C
C    DO 100 J=2,11
C      V(J)=XZMTAB(INDEX-1,J)+SLOPE*(XZMTAB(INDEX,J)-XZMTAB(INDEX-1,J))
C 100 CONTINUE
C
C    UF = V(2)
C    HF = V(3)
C    SF = V(4)
C    VF = V(5)
C    UG = V(6)
C    HG = V(7)
C    SG = V(8)
C    VG = V(9)
C    P  = V(10)
C    T  = V(11)
C
C    RETURN
C    END

```

```

C/  SUBROUTINE ALINTS(J,L,VALIN,VALOUT)
C    LIST,NONE
C
C    SUBROUTINE TO DETERMINE A THERMODYNAMIC PROPERTY OF SATURATED
C    WATER AND STEAM CORRESPONDING TO AN INPUT PROPERTY
C
C    *** INPUT ***
C      J: INPUT FLAG (TYPE OF VALIN)
C        WHERE: J = 1 DENOTES H
C                  2 DENOTES UF
C                  3 DENOTES HF
C                  4 DENOTES SF
C                  5 DENOTES VF
C                  6 DENOTES UG
C                  7 DENOTES HG
C                  8 DENOTES SG
C                  9 DENOTES VG
C                 10 DENOTES P
C                 11 DENOTES T
C
C      VALIN: VALUE OF PROPERTY (TYPE IS SPECIFIED BY J)
C
C      L: OUTPUT FLAG (TYPE OF VALOUT)
C        WHERE: L = 1 TO 11 AND DENOTES THE SAME
C               PROPERTIES AS J ABOVE
C
C    *** OUTPUT ***
C      VALOUT: VALUE OF PROPERTY (TYPE IS SPECIFIED BY L)
C
C    THIS SUBROUTINE REQUIRES THE SATURATED THERMODYNAMIC DATA
C    CONTAINED IN ARRAY XZMTAB(30,11)
C
C    COMMON /XZMCOM/ XZMTAB(30,11)
C
C    CALL TABLE LOOK-UP SUBROUTINE TO GET INDEX USED FOR INTERPOLATION
C
C    CALL AITBLK(J,VALIN,INDEX)
C
C    SLOPE=(VALIN-XZMTAB(INDEX-1,J))/
C    *      (XZMTAB(INDEX,J)-XZMTAB(INDEX-1,J))
C
C    VALOUT=XZMTAB(INDEX-1,L)+SLOPE*(XZMTAB(INDEX,L)-XZMTAB(INDEX-1,L))
C
C    RETURN
C    END

```

```

C/  SUBROUTINE ALTBLK(J,VALUE,INDEX)
C    LIST,NONE
C
C    SUBROUTINE TO DETERMINE WHICH OF THE 11 COLUMNS OF THE
C    SATURATED TABLE ARRAY, XZMTAB(30,11), CONTAINS THE
C    NEAREST EQUIVALENT VALUE OF AN INPUT PROPERTY
C
C    JANUARY 1978
C
C    *** INPUT ***
C      J: INPUT FLAG (TYPE OF VALUE)
C        WHERE: J = 1 DENOTES M
C                  2 DENOTES UF
C                  3 DENOTES HF
C                  4 DENOTES SF
C                  5 DENOTES VF
C                  6 DENOTES UG
C                  7 DENOTES HG
C                  8 DENOTES SG
C                  9 DENOTES VG
C                 10 DENOTES P
C                 11 DENOTES T
C
C      VALUE: VALUE OF PROPERTY (TYPE IS SPECIFIED BY J)
C
C    *** OUTPUT ***
C      INDEX: A COLUMN OF THE SATURATED TABLE ARRAY
C             THIS INTEGER IS USED IN INTERPOLATION ALGORITHMS
C
C      THIS SUBROUTINE REQUIRES THE SATURATED THERMODYNAMIC DATA
C      CONTAINED IN ARRAY XZMTAB(30,11)
C
C      COMMON /XZMCOM/ XZMTAB(30,11)
C
C      IF(J.EQ.8 .OR. J.EQ.9) GO TO 10
C
C      DO 100 I=1,30
C        IF(VALUE .LT. XZMTAB(I,J)) GO TO 30
C100  CONTINUE
C      GO TO 20
C
C      10 DO 200 I=1,30
C        IF(1./VALUE .LT. 1./XZMTAB(I,J)) GO TO 30
C200  CONTINUE
C
C      20 I=31
C        IF(VALUE .EQ. XZMTAB(30,J)) I=30
C      30 IF(I.LT.2 .OR. I.GT.30) GO TO 40
C        INDEX=I
C        RETURN
C
C      40 PRINT *,# #
C        PRINT *,***** ATTENTION ***** ATTENTION ***** ATTENTION *****
C        PRINT *,#      THE INPUT PROPERTY TO THE SATURATED WATER TABLE#,
C      1 # DOES NOT EXIST IN THE SATURATED STATE FOR THE PRESSURE#,
C      2 # RANGE OF THE TABLE#
C        PRINT *,#      THE INPUT PROPERTY CORRESPONDS TO A SATURATED#,
C      1 # TABLE INPUT FLAG OF #,J,# AND HAS A VALUE OF #,VALUE

```


C

```
IF(I.EQ.1) INDEX=2
IF(I.EQ.31) INDEX=I=30
VALUE=XZMTAB(I,J)
PRINT *,*      THE INPUT PROPERTY VALUE HAS BEEN RESET TO *,VALUE
RETURN
END
```

```

C/  FUNCTION AISPHE(T,P)
C    LIST,NONE
C
C    FUNCTION SUBPROGRAM TO OBTAIN SPECIFIC HEAT OF WATER/STEAM
C      JAN 1977
C
C    INPUT   T: TEMPERATURE(F)
C            P: PRESSURE(Psia)
C
C    OUTPUT  AISPHE(T,P): SPECIFIC HEAT(BTU/LBM/F)
C    THIS FUNCTION CALLS AINTP
C            REQUIRES XZSPHE(26,8)(SPECIFIC HEAT)
C    FIRST ELEMENT(26) CORRESPONDS TO XZTELI(26)
C    SECOND ELEMENT(8) CORRESPONDS TO XZFRLI(8)
C
C    DIMENSION XZSPHE(26,8)
C
C    DATA ((XZSPHE(I,J),I=1,25),J=1,4)/
C      *      0.542, 0.538, 0.533, 0.529, 0.524, 0.520, 0.515,
C      *      0.511, 0.506, 0.502, 0.497, 0.493, 0.489, 0.485,
C      *      0.481, 0.477, 0.475, 0.471, 0.470, 0.469, 0.469,
C      *      0.471, 0.475, 1.0, 0.998, 1.002,
C      *      0.543, 0.538, 0.534, 0.529, 0.525, 0.520, 0.516,
C      *      0.511, 0.507, 0.502, 0.498, 0.494, 0.49, 0.487,
C      *      0.483, 0.480, 0.478, 0.476, 0.476, 0.476, 0.482,
C      *      0.489, 1.005, 1.0, 0.998, 1.002,
C      *      0.543, 0.539, 0.534, 0.530, 0.526, 0.521, 0.517,
C      *      0.512, 0.508, 0.504, 0.5, 0.497, 0.493, 0.490,
C      *      0.489, 0.486, 0.488, 0.492, 0.497, 0.508, 0.574,
C      *      1.014, 1.005, 1.0, 0.998, 1.002,
C      *      0.545, 0.540, 0.536, 0.532, 0.528, 0.523, 0.519,
C      *      0.515, 0.512, 0.508, 0.505, 0.501, 0.5, 0.499,
C      *      0.499, 0.502, 0.508, 0.519, 0.536, 0.565, 1.029,
C      *      1.014, 1.005, 1.0, 0.998, 1.001/
C    DATA ((XZSPHE(I,J),I=1,26),J=5,8)/
C      *      0.548, 0.543, 0.54, 0.535, 0.532, 0.528, 0.524,
C      *      0.520, 0.516, 0.514, 0.513, 0.512, 0.513, 0.516,
C      *      0.522, 0.534, 0.554, 0.586, 0.636, 1.049, 1.028,
C      *      1.013, 1.004, 1.00, 0.997, 1.001,
C      *      0.556, 0.553, 0.549, 0.546, 0.544, 0.541, 0.539,
C      *      0.537, 0.537, 0.537, 0.542, 0.55, 0.563, 0.585, 0.621,
C      *      0.679, 0.773, 1.122, 1.077, 1.048, 1.027, 1.013,
C      *      1.004, 0.998, 0.996, 0.999,
C      *      0.57, 0.568, 0.567, 0.565, 0.564, 0.565, 0.566,
C      *      0.569, 0.576, 0.587, 0.605, 0.635, 0.681, 0.758,
C      *      0.868, 1.134, 1.181, 1.114, 1.072, 1.044, 1.024,
C      *      1.012, 1.002, 0.996, 0.994, 0.995,
C      *      0.6, 0.601, 0.603, 0.607, 0.612, 0.620, 0.633,
C      *      0.653, 0.683, 0.729, 0.8, 0.926, 1.181, 1.929,
C      *      1.453, 1.255, 1.157, 1.101, 1.063, 1.038, 1.019,
C      *      1.006, 0.998, 0.993, 0.99, 0.989/
C
C    CALL AINTP(T,P,XZSPHE,CP)
C
C    AISPHE=CP
C
C    RETURN
C    END

```

```

C/
C
C      FUNCTION ALTHEM(T,P)
C      LIST,NONE
C
C      FUNCTION SUSPROGRAM TO OBTAIN THERMAL CONDUCTIVITY OF
C      WATER AND STEAM
C      JAN 1977
C
C      INPUT  T: TEMPERATURE(F)
C      P: PRESSURE(PSIA)
C
C      OUTPUT ALTHEM(T,P): THERMAL CONDUCTIVITY(BTU/SEC/FT/F)
C
C      THIS FUNCTION CALLS ALINTP
C      REQUIRES XZTHEM(26,8) (THERM. COND.)
C      FIRST ELEMENT(26) CORRESPONDS TO XZTELI(26)
C      SECOND ELEMENT(8) CORRESPONDS TO XZPRLI(8)
C
C      *** NOTE *** DATA IN XZTHEM ARE IN(BTU/HR/FT/F)E-3
C      NEED TO CONVERT IT TO BTU/SEC/FT/F
C
C      DIMENSION XZTHEM(26,8)
C
C      DATA ((XZTHEM(I,J),I=1,26),J=1,4)/
C      *      54.8, 52.6, 50.4, 48.2, 46.0, 43.9, 41.8, 39.7,
C      *      37.6, 35.6, 33.6, 31.6, 29.7, 27.9, 26.1, 24.3,
C      *      22.6, 21.0, 19.4, 17.9, 16.5, 15.2, 14.0, 380.5,
C      *      363.3, 339.1,
C      *      54.8, 52.6, 50.4, 48.2, 46.1, 43.9, 41.8, 39.7,
C      *      37.6, 35.6, 33.6, 31.7, 29.8, 27.9, 26.1, 24.4,
C      *      22.7, 21.0, 19.5, 18.0, 16.6, 15.3, 391.6, 380.6,
C      *      363.3, 339.2,
C      *      54.9, 52.7, 50.5, 48.3, 46.2, 44.0, 41.9, 39.8,
C      *      37.7, 35.7, 33.7, 31.8, 29.9, 28.0, 26.2, 24.5,
C      *      22.8, 21.2, 19.6, 18.2, 16.9, 396.9, 391.6, 380.7,
C      *      363.4, 339.3,
C      *      55.1, 52.9, 50.7, 48.5, 46.3, 44.2, 42.1, 40.0,
C      *      37.9, 35.9, 33.9, 32.0, 30.1, 28.2, 26.4, 24.7,
C      *      23.0, 21.4, 20.0, 18.8, 396.9, 397.0, 391.8, 380.8,
C      *      363.6, 339.4/
C      DATA ((XZTHEM(I,J),I=1,26),J=5,8)/
C      *      55.5, 53.2, 51.0, 48.9, 46.7, 44.6, 42.4, 40.3,
C      *      38.3, 36.3, 34.3, 32.3, 30.4, 28.6, 26.9, 25.2,
C      *      23.6, 22.3, 21.3, 392.0, 397.2, 397.3, 392.1, 381.1,
C      *      363.9, 339.8,
C      *      56.5, 54.3, 52.1, 49.9, 47.8, 45.6, 43.5, 41.4,
C      *      39.4, 37.4, 35.5, 33.6, 31.8, 30.1, 28.7, 27.5,
C      *      26.9, 368.1, 383.0, 392.9, 398.0, 398.1, 393.0, 382.1,
C      *      365.0, 340.8,
C      *      58.3, 56.1, 53.9, 51.8, 49.6, 47.5, 45.5, 43.5,
C      *      41.5, 39.7, 37.9, 36.3, 35.0, 34.1, 34.1, 36.1,
C      *      350.8, 370.6, 384.9, 394.4, 399.3, 399.4, 394.4,
C      *      383.7, 366.6, 342.5,
C      *      62.0, 59.9, 57.8, 55.7, 53.7, 51.8, 50.0, 48.3,
C      *      46.8, 45.6, 44.9, 45.2, 47.5, 55.7, 301.9, 333.7,
C      *      357.4, 375.3, 388.5, 397.4, 402.0, 402.1, 397.2,
C      *      386.7, 369.8, 345.71/
C
C      CALL ALINTP(T,P,XZTHEM,THEM)
C
C      ALTHEM=THEM*2.7777E-7
C
C      RETURN
C      END

```

```

C/  FUNCTION A1VISC(T,P)
C    LIST,NONE
C
C      FUNCTION SUBPROGRAM TO ESTIMATE VISCOSITY OF WATER OR STEAM
C      JAN 1977
C
C      INPUT: T: TEMPERATURE(F)
C             P: PRESSURE(Psia)
C
C      OUTPUT: A1VISC(LBM/FT/SEC)
C
C      THIS PROGRAM CALLS SUBROUTINE A1INTP
C              REQUIRES VISCOSITY DATA IN XZVISC(26,8)
C              FIRST ELEMENT(26) CORRESPONDS TO XZTELI(26) IN
C              A1INTP.
C              SECOND ELEMENT(8) CORRESPONDS TO XZPRLI(8) IN
C              A1INTP
C
C      ***NOTE: DATA USED HERE ARE IN(LBF SEC/FT**2)E7
C              THIS PROGRAM CONVERTED TO LBM/FT/SEC
C
C      DIMENSION XZVISC(26,8)
C
C      DATA ((XZVISC(I,J),I=1,26),J=1,4)/
C      *      7.7, 7.4, 7.2, 7.0, 6.7, 6.5, 6.3, 6.0, 5.8,
C      *      5.5, 5.3, 5.1, 4.8, 4.6, 4.4, 4.1, 3.9, 3.7,
C      *      3.4, 3.2, 2.9, 2.7, 2.5, 89.1, 142.0, 271.4,
C      *      7.7, 7.4, 7.2, 7.0, 6.7, 6.5, 6.3, 6.0, 5.8,
C      *      5.5, 5.3, 5.1, 4.8, 4.6, 4.4, 4.1, 3.9, 3.6,
C      *      3.4, 3.2, 2.9, 2.7, 62.6, 89.1, 142.0, 271.4,
C      *      7.7, 7.4, 7.2, 7.0, 6.7, 6.5, 6.3, 6.0, 5.8,
C      *      5.5, 5.3, 5.1, 4.8, 4.6, 4.4, 4.1, 3.9, 3.6,
C      *      3.4, 3.2, 2.9, 47.6, 62.6, 89.1, 142.0, 271.4,
C      *      7.7, 7.4, 7.2, 7.0, 6.7, 6.5, 6.3, 6.0, 5.8,
C      *      5.6, 5.3, 5.1, 4.9, 4.6, 4.4, 4.1, 3.9, 3.6,
C      *      3.4, 3.1, 38.1, 47.6, 62.6, 69.1, 142.0, 271.4/
C      DATA ((XZVISC(I,J),I=1,26),J=5,8)/
C      *      7.7, 7.5, 7.2, 7.0, 6.7, 6.5, 6.3, 6.0, 5.8,
C      *      5.6, 5.3, 5.1, 4.9, 4.6, 4.4, 4.1, 3.8, 3.6,
C      *      3.3, 31.8, 38.2, 47.6, 62.7, 89.1, 142.0, 271.3,
C      *      7.7, 7.5, 7.3, 7.0, 6.8, 6.6, 6.3, 6.1, 5.9,
C      *      5.6, 5.4, 5.2, 4.9, 4.7, 4.4, 4.1, 3.8, 24.1,
C      *      27.4, 31.9, 38.3, 47.7, 62.8, 89.2, 142.0, 271.2,
C      *      7.8, 7.6, 7.3, 7.1, 6.9, 6.6, 6.4, 6.2, 5.9,
C      *      5.7, 5.5, 5.3, 5.0, 4.7, 4.4, 4.0, 21.6, 24.2,
C      *      27.6, 32.1, 38.4, 47.8, 62.9, 89.3, 142.1, 271.0,
C      *      7.9, 7.7, 7.5, 7.2, 7.0, 6.8, 6.6, 6.4, 6.1, 5.9,
C      *      5.7, 5.5, 5.4, 4.9, 18.1, 19.9, 22.0, 24.6, 27.9,
C      *      32.4, 38.7, 48.2, 63.2, 89.5, 142.1, 270.6/
C
C      CALL SUBR. A1INTP TO GET VISCOSITY AT T AND P
C      CALL A1INTP(T,P,XZVISC,V)
C
C      V=VISCOSITY IN (LBF SEC/FT**2)ET
C      CONVERT TO LBM/FT/SEC
C
C      A1VISC=V*3.2175E-6
C
C
C      RETURN
C      END

```

SUBROUTINE AINTP(T,P,VARIA,OUT)
LIST,NONE

GENERAL SUBROUTINE TO INTERPOLATE OR EXTRAPOLATE WATER
PROPERTIES BY LINEAR INTERPOLATION OF PRESSURE AND TEMP.

JAN 1977

CALLED ONLY BY AIVISC FOR VISCOSITY
ALTEM FOR THERMAL CONDUCTIVITY
ALSPHE FOR SPECIFIC HEAT

INPUT: T: TEMPERATURE(F)
P: PRESSURE(Psia)
VARIA(26,8): ARRAY OF PROPERTIES(VISCOSITY,
SPECIFIC HEAT OR THERMAL CONDUCT.)
FIRST ELEMENT=TEMPERATURE
SECOND ELEMENT=PRESSURE

OUTPUT: OUT: INTERPOLATED VALUE(VISCOSITY, SPECIFIC HEAT
OR THERMAL CONDUCTIVITY)

*****NOTE *** TEMPERATURE AND PRESSURE USED FOR INTERPOLATION
ARE FIXED AS SPECIFIED BY XZTELI(26) AND
XZPRLI(8)

XZSTLI(8): SATURATION TEMP CORRESP. TO XZPRLI(8)

DIMENSION XVARIA(2)
DIMENSION VARIA(26,8)
DIMENSION XZTELI(26),XZPRLI(8),XZSTLI(8)

TEMPERATURES USED FOR INTERPOLATION

DATA XZTELI/1300., 1250., 1200., 1150., 1100., 1050., 1000.,
* 950., 900., 850., 800., 750., 700., 650., 600.,
* 550., 500., 450., 400., 350., 300., 250.,
* 200., 150., 100., 50./

PRESSURES USED FOR INTERPOLATION

DATA XZPRLI/10., 20., 50., 100., 200., 500., 1000., 2000./

SATURATION TEMPERATURE CORRESPONDING TO XZPRLI

DATA XZSTLI/193.2, 227.9, 281.0, 327.8, 381.8, 467., 544.6, 635.8/

IF(T.LT.32.0 .OR. T.GT.1500.0) GO TO 10
IF(P.GE.0.001 .AND. P.LE.3000.0) GO TO 20

10 PRINT *,* *

PRINT *,***** ATTENTION ***** ATTENTION ***** ATTENTION *****
PRINT *,* AN INPUT PROPERTY TO SUBROUTINE AINTP IS OUT OF*,

1 * RANGE*

PRINT *,* THE INPUT PROPERTY VALUES ARE: T = *,T,

1 * P = *,P

IF(T.LT. 32.0) T=32.0

IF(T.GT.1500.0) T=1500.0

```

      IF(P.LT. 0.001) P=0.001
      IF(P.GT.3000.0) P=3000.0
      PRINT *,* THE INPUT PROPERTY VALUES HAVE BEEN RESET TO:*,
      1 * T = *,T,* P = *,P

```

```

C
C      FIND PRESSURE RANGE      IP=PRESSURE POINT INDEX
C
      20 DO 100 K=2,8
      I=K
      IF(P .LE. XZPRLI(I)) GO TO 200
      100 CONTINUE
C
      200 IP=I
C
C      FIND WHETHER SUPERHEATED OR SUBCOOLED
C      ISAT=0 SUBCOOLED
C      ISAT=1 SUPERHEATED
C      TSAT: SATURATION TEMP. AT P BY LINEAR INTP.
C
      ISAT=0
C      SLOPE
      SLOPE=(P-XZFRLI(IP-1))/(XZPRLI(IP)-XZPRLI(IP-1))
      TSAT=XZSTLI(IP-1)+SLOPE*(XZSTLI(IP)-XZSTLI(IP-1))
      IF(T .GE. TSAT) ISAT=1
C
C      FIND TEMPERATURE RANGE      IT=TEMPERATURE POINT INDEX
C      ITINDX=SAME AS ABOVE
C
      DO 250 K=2,26
      I=K
      IF(T .GE. XZTELI(I)) GO TO 300
      250 CONTINUE
C
      300 IT=I
C
C      INTERPOLATE OR EXTRAPOLATE PROPERTIES AT 2 PRESSURE POINTS
C
      DO 500 J=1,2
      SATURATION CHECK
      IF(ISAT .EQ. 0) GO TO 510
C
C      SUPERHEATED      ADJUST INDEX IT TO ENSURE SUPERHEATED VALUES
C
      K=IT+1
      520 K=K-1
      IF(XZTELI(K) .LT. XZSTLI(IP-2+J)) GO TO 520
      ITINDX=K
      GO TO 400
C
C      SUBCOOLED      ADJUST INDEX IT TO ENSURE SUBCOOLED VALUES
C
      510 K=IT-1
      530 K=K+1
      IF(XZTELI(K) .GT. XZSTLI(IP-2+J)) GO TO 530
      IF(XZTELI(K-1) .GT. XZSTLI(IP-2+J)) GO TO 530
      ITINDX=K
C
C      LINEAR INTERPOLATION BY TEMPERATURE AT (IP-2+J)-TH POINT
C
      400 DELT=(VARIA(ITINDX,IP-2+J)-VARIA(ITINDX-1,IP-2+J))/(XZTELI(ITINDX)

```

```

      *      -XZTELI(ITINDX-1))
      XVARIA(J)=VARIA(ITINDX-1,IP-2+J)+DELT*(T-XZTELI(ITINDX-1))
500 CONTINUE
C
C      LINEAR INTERPOLATION BY PRESSURE
C
C      DELT=(XVARIA(2)-XVARIA(1))/(XZPRLI(IP)-XZPRLI(IP-1))
C
C      OUT=XVARIA(1)+DELT*(P-XZPRLI(IP-1))
C
C      RETURN
      END

FUNCTION AIPRWA(T,P)
LIST,NONE
C/
C
C      FUNCTION SUBPROGRAM TO COMPUTE PRANDTL NUMBER OF WATER
C      OR STEAM FLOW
C
C      JAN 1977
C
C      INPUT   T: TEMPERATURE(F)
C              P: PRESSURE(Psia)
C
C      OUTPUT  AIPRWA(T,P): PRANDTL NUMBER
C
C      THIS FUNCTION CALLS AIVISC(T,P), ALTHEM(T,P) AND AISPHE(T,P)
C
C
C      VIS=AIVISC(T,P)
C      CP=AISPHE(T,P)
C      THER=ALTHEM(T,P)
C
C      AIPRWA=CP*VIS/THER
      RETURN
      END

```


SUBROUTINE STEAM(J,HORU,V,P,VORP,UORH,T)

LIST,NONE

SUBROUTINE TO ITERATIVELY DETERMINE 3 THERMODYNAMIC PROPERTIES
OF SUPERHEATED STEAM CORRESPONDING TO 2 INPUT PROPERTIES.

THE SUBROUTINE REQUIRES 4 INPUT PARAMETERS: AN OPTION FLAG
DENOTING THE INPUT-OUTPUT SELECTION, TWO THERMODYNAMIC PROPERTY
VALUES WHICH DEFINE THE STATE OF THE SUPERHEATED STEAM, AND
AN INITIAL GUESS OF ONE OF THE DESIRED OUTPUT PROPERTIES.

THE ITERATION ALGORITHM IS LIMITED TO 20 ITERATIONS.

APRIL 1978

*** INPUTS ***

J: OPTION FLAG DENOTING INPUT-OUTPUT SELECTION

WHERE: J = 11 DENOTES INPUTS OF H, V, AND P
AND OUTPUTS OF V, U, AND T.
H AND P DEFINE THE THERMODYNAMIC
STATE OF THE SUPERHEATED STEAM.

= 12 DENOTES INPUTS OF H, V, AND P
AND OUTPUTS OF P, U, AND T.
H AND V DEFINE THE THERMODYNAMIC
STATE OF THE SUPERHEATED STEAM.

= 21 DENOTES INPUTS OF U, V, AND P
AND OUTPUTS OF V, H, AND T.
U AND P DEFINE THE THERMODYNAMIC
STATE OF THE SUPERHEATED STEAM.

= 22 DENOTES INPUTS OF U, V, AND P
AND OUTPUTS OF P, H, AND T.
U AND V DEFINE THE THERMODYNAMIC
STATE OF THE SUPERHEATED STEAM.

HORU: VALUE OF ENTHALPY, H, OR INTERNAL ENERGY, U,
DEFINING THE STATE OF THE SUPERHEATED STEAM.

V: VALUE OF SPECIFIC VOLUME. THIS PROPERTY MAY
BE A KNOWN INPUT OR ONE OF THE DESIRED OUTPUTS
WHICH MUST BE INITIALLY GUESSED.

P: VALUE OF PRESSURE. THIS PROPERTY MAY BE A
KNOWN INPUT OR ONE OF THE DESIRED OUTPUTS
WHICH MUST BE INITIALLY GUESSED.

*** OUTPUTS ***

VORP: VALUE OF SPECIFIC VOLUME, V, OR PRESSURE, P,
DEPENDING ON WHETHER THE OPTION FLAGS SECOND
PARAMETER IS 1 OR 2.

UORH: VALUE OF INTERNAL ENERGY, U, OR ENTHALPY, H,
DEPENDING ON WHETHER THE OPTION FLAGS FIRST
PARAMETER IS 1 OR 2.

```

C
C      T:  VALUE OF TEMPERATURE.
C
C
C      COMPRESSED WATER/SUPERHEATED STEAM TABLE DATA
C
C      LOGICAL NO COMP,SATURD
C      REAL HE,PE,SE,TE,VE,XE
C      COMMON /USECOM/ HE,PE,SE,TE,VE,XE,NO COMP,SATURD
C
C
C      I = J - (J/10)*(11 - (J/10))
C      GO TO (11,12,21,22) I
C
C      11 H = HORU
C      VG = V
C      CALL USE HP(AMAX1(1079.0,H),P)
C      T = TE
C      VORP = VE
C      UORH = H - 144./778.*P*VORP
C      RETURN
C
C      12 K = 0
C      H = HORU
C      PG = P
C      100 K = K + 1
C      IF (K .GT. 20) RETURN
C      CALL USE HP(AMAX1(1079.0,H),PG)
C      VG = VE
C      P = PG*VG/V
C      PG = PG + .9*(P - PG)
C      ERR = (P - PG)/P
C      IF (ABS(ERR) .GT. .0001) GO TO 100
C      VORP = P
C      UORH = H - 144./778.*VORP*V
C      CALL USE HP(H,VORP)
C      T = TE
C      RETURN
C
C      21 K = 0
C      U = HORU
C      VG = V
C      200 K = K + 1
C      IF (K .GT. 20) RETURN
C      HG = U + 144./778.*P*VG
C      CALL USE HP(AMAX1(1079.0,HG),P)
C      V = VE
C      VG = VG + .9*(V - VG)
C      ERR = (V - VG)/V
C      IF (ABS(ERR) .GT. .0001) GO TO 200
C      VORP = V
C      UORH = U + 144./778.*P*VORP
C      CALL USE HP(UORH,P)
C      T = TE
C      RETURN
C
C      22 K = 0
C      U = HORU
C      PG = P
C      300 K = K + 1

```

```

IF (K .GT. 20) RETURN
HG = U + 144./778.*PG*V
CALL USE HP(AMAX1(1079.0,HG),PG)
VG = VE
P = PG*VG/V
PG = PG + .9*(P - PG)
ERR = (P - PG)/P
IF (ABS(ERR) .GT. .0001) GO TO 300
VORP = P
UORH = U + 144./778.*VORP*V
CALL USE HP(UORH,VORP)
T = TE
RETURN

```

C

END

```

SUBROUTINE USEVAL(ARG1,ARG2)
C/  LIST,NONE
REAL  ARG1      ,ARG2
COMMON/USECOM/  HE      ,PE      ,SE      ,TE
*      ,VE      ,XE
*      ,NO COMP  ,VAPOR
REAL  HE      ,PE      ,SE      ,TE
*      ,VE      ,XE
LOGICAL NO COMP  ,VAPOR
COMMON/USEICOM/
*      HI      ,PI      ,SI      ,TI
*      ,VI      ,XI
*      ,NO NTRP
REAL
*      HI      ,PI      ,SI      ,TI
*      ,VI      ,XI
LOGICAL
*      NO NTRP
REAL
*      TOL
*      ,W      ,WL      ,WR
*      ,Z      ,ZL      ,ZR
*      ,Z SAVE
INTEGER
*      ITER      ,ITMAX
LOGICAL
*      HALVE      ,H SERCH  ,P ASGND  ,S SERCH
*      ,T ASGND  ,V SERCH
*      ,LF DFND  ,RT DFND
DATA  ITMAX/50/ ,TOL/.001/
1 CONTINUE
ENTRY  USE HP
100 CONTINUE
P ASGND = .TRUE.
T ASGND = .FALSE.
H SERCH = .TRUE.
S SERCH = .FALSE.
V SERCH = .FALSE.
HE = ARG1
PE = ARG2
GO TO 1000
ENTRY  USE HT
200 CONTINUE
P ASGND = .FALSE.
T ASGND = .TRUE.
H SERCH = .TRUE.
S SERCH = .FALSE.
V SERCH = .FALSE.
HE = ARG1
TE = ARG2
GO TO 1000
ENTRY  USE PS
300 CONTINUE
P ASGND = .TRUE.
T ASGND = .FALSE.
H SERCH = .FALSE.
S SERCH = .TRUE.
V SERCH = .FALSE.
PE = ARG1

```

```

SE = ARG2
GO TO 1000
ENTRY USE PT
400 CONTINUE
P ASGND = .TRUE.
T ASGND = .TRUE.
H SERCH = .FALSE.
S SERCH = .FALSE.
V SERCH = .FALSE.
PE = ARG1
TE = ARG2
GO TO 6000
ENTRY USE PV
500 CONTINUE
P ASGND = .TRUE.
T ASGND = .FALSE.
H SERCH = .FALSE.
S SERCH = .FALSE.
V SERCH = .TRUE.
PE = ARG1
VE = ARG2
GO TO 1000
ENTRY USE TSAT
PE = ARG1
XE = 0.
IF(VAPOR) XE = 1.
GO TO 610
ENTRY USE PX
600 CONTINUE
PE = ARG1
XE = ARG2
610 CONTINUE
CALL USE NPX(PE,XE)
IF(NO NTRP) GO TO 9000
HE = HI
SE = SI
TE = TI
VE = VI
NO COMP = .FALSE.
VAPOR = XE.EQ.1.
GO TO 9999
ENTRY USE ST
700 CONTINUE
P ASGND = .FALSE.
T ASGND = .TRUE.
H SERCH = .FALSE.
S SERCH = .TRUE.
V SERCH = .FALSE.
SE = ARG1
TE = ARG2
GO TO 1000
ENTRY USE TV
800 CONTINUE
P ASGND = .FALSE.
T ASGND = .TRUE.
H SERCH = .FALSE.
S SERCH = .FALSE.
V SERCH = .TRUE.
TE = ARG1
VE = ARG2

```

```

GO TO 1000
ENTRY USE PSAT
TE = ARG1
XE = 0.
IF(VAPOR) XE = 1.
GO TO 910
ENTRY USE TX
900 CONTINUE
TE = ARG1
XE = ARG2
910 CONTINUE
CALL USE NTX(TE,XE)
IF(NO NTRP) GO TO 9000
HE = HI
PE = PI
SE = SI
VE = VI
NO COMP = .FALSE.
VAPOR = XE.EQ.1.
GO TO 9999
1000 CONTINUE
IF(H SERCH) W = HE
IF(S SERCH) W = SE
IF(V SERCH) W = VE
IF(P ASGND) CALL USE NPX(PE,0.)
IF(T ASGND) CALL USE NTX(TE,0.)
IF(NO NTRP) GO TO 5000
IF(H SERCH) WL = HI
IF(S SERCH) WL = SI
IF(V SERCH) WL = VI
IF(W.LT.WL) GO TO 5100
IF(T ASGND.AND.H SERCH .AND. TI.LT.475. .AND. W.LT.450.)GO TO 5100
IF(P ASGND) CALL USE NPX(PE,1.)
IF(T ASGND) CALL USE NTX(TE,1.)
IF(H SERCH) WR = HI
IF(S SERCH) WR = SI
IF(V SERCH) WR = VI
IF(WR.LT.W) GO TO 5200
XE = (W - WL)/(WR - WL)
IF(P ASGND) CALL USE NPX(PE,XE)
IF(T ASGND) CALL USE NTX(TE,XE)
IF(.NOT. H SERCH) HE = HI
IF(.NOT. P ASGND) PE = PI
IF(.NOT. T ASGND) TE = TI
IF(.NOT. S SERCH) SE = SI
IF(.NOT. V SERCH) VE = VI
VAPOR = XE.EQ.1.
GO TO 9999
5000 CONTINUE
LF DFND = .FALSE.
RT DFND = .FALSE.
GO TO 5300
5100 CONTINUE
IF(.NOT. T ASGND) GO TO 5120
5110 CONTINUE
IF(H SERCH .AND. TE.LT.525. .AND. HE.LT.HI) GO TO 9000
ZL = PI
LF DFND = .TRUE.
RT DFND = .FALSE.
GO TO 5340

```

```

5120 CONTINUE
      ZR = TI
      IF(H SERCH) WR = HE - HI
      IF(V SERCH) WR = VE - VI
      LF DFND = .FALSE.
      RT DFND = .TRUE.
      GO TO 5300
5200 CONTINUE
      IF(.NOT. T ASGND) GO TO 5220
5210 CONTINUE
      ZR = PI
      IF(H SERCH) WR = HE - HI
      IF(S SERCH) WR = SE - SI
      IF(V SERCH) WR = VE - VI
      LF DFND = .FALSE.
      RT DFND = .TRUE.
      GO TO 5300
5220 CONTINUE
      ZL = TI
      LF DFND = .TRUE.
      RT DFND = .FALSE.
      GO TO 5340
5300 CONTINUE
      IF(LF DFND) GO TO 5350
      IF(.NOT. T ASGND) GO TO 5320
5310 CONTINUE
      PE = 1.
      ZL = 1.
      GO TO 5330
5320 CONTINUE
      TE = 100.
      ZL = 100.
5330 CONTINUE
      CALL USE NTRP(PE,TE)
      IF(NO NTRP) GO TO 9000
5340 CONTINUE
      IF(H SERCH) WL = HE - HI
      IF(S SERCH) WL = SE - SI
      IF(V SERCH) WL = VE - VI
      IF(RT DFND) GO TO 5400
5350 CONTINUE
      IF(.NOT. T ASGND) GO TO 5370
5360 CONTINUE
      PE = 7000.
      ZR = 7000.
      GO TO 5380
5370 CONTINUE
      TE = 1500.
      ZR = 1500.
5380 CONTINUE
      CALL USE NTRP(PE,TE)
      IF(H SERCH) WR = HE - HI
      IF(S SERCH) WR = SE - SI
      IF(V SERCH) WR = VE - VI
5400 CONTINUE
      IF(SIGN(1.,WL) .NE. SIGN(1.,WR)) GO TO 5500
      Z = ZL
      IF(ABS(WL) .GT. ABS(WR)) Z = ZR
      IF(.NOT. P ASGND) PE = Z
      IF(.NOT. T ASGND) TE = Z

```

```

      GO TO 6000
5500 CONTINUE
      Z SAVE = ZL
      DO 5900 ITER = 1,ITMAX
      HALVE = 2*(ITER/2).EQ.ITER .OR. WL.EQ.WR
      IF(HALVE) Z = (ZL + ZR)/2.
      IF(.NOT.HALVE) Z = AMAX1(ZL,AMIN1((WR*ZL-WL*ZR)/(WR-WL),ZR))
      IF(.NOT.P ASSND) PE = Z
      IF(.NOT.T ASSND) TE = Z
      IF(ITER.NE.1.AND.ABS(Z - Z SAVE) .LE. TOL) GO TO 6000
      CALL USE NTRP(PE,TE)
      IF(NO NTRP) GO TO 9000
      IF(H SERCH) W = HE - HI
      IF(S SERCH) W = SE - SI
      IF(V SERCH) W = VE - VI
5600 CONTINUE
      IF(SIGN(1.,W).NE.SIGN(1.,WL)) GO TO 5700
      WL = W
      ZL = Z
      GO TO 5800
5700 CONTINUE
      WR = W
      ZR = Z
5800 CONTINUE
      Z SAVE = Z
5900 CONTINUE
      NO COMP = .TRUE.
      GO TO 6010
6000 CONTINUE
      NO COMP = .FALSE.
6010 CONTINUE
      CALL USE NTRP(PE,TE)
      IF(NO NTRP) GO TO 9000
      IF(.NOT. H SERCH) HE = HI
      IF(.NOT. S SERCH) SE = SI
      IF(.NOT. V SERCH) VE = VI
      XE = XI
      VAPOR = XE.EQ.1.
      GO TO 9999
9000 CONTINUE
      HE = -1.
      PE = -1.
      SE = -1.
      TE = -1.
      VE = -1.
      XE = -1.
      NO COMP = .TRUE.
      VAPOR = .FALSE.
9999 CONTINUE
      RETURN
      END

```



```

SUBROUTINE USE NTRP(ARG1,ARG2)
C/ LIST,NONE
REAL
* ARG1 ,ARG2
COMMON/USEICOM/
* HI ,PI ,SI ,TI
* ,VI ,XI
* ,NO NTRP
REAL
* HI ,PI ,SI ,TI
* ,VI ,XI
LOGICAL
* NO NTRP
REAL
* A ,B
* ,F(5,5)
* ,H(38,15)
* ,H1 ,H2 ,H3 ,H4
* ,HL(33) ,HV(33)
* ,P ,PARG(38) ,PCS(33) ,PP(5)
* ,P1 ,P2 ,P3 ,P4
* ,S(38,15)
* ,S1 ,S2 ,S3 ,S4
* ,SL(33) ,SV(33)
* ,T ,TARG(15) ,TCS(33) ,TT(5)
* ,T1 ,T2 ,T3 ,T4
* ,V(38,15)
* ,VL(33) ,VV(33)
* ,X
* ,XX(5) ,YY(5)
INTEGER
* II ,IP ,IX(8)
* ,I1 ,I2 ,I3 ,I4
* ,JCSL(33) ,JCSV(33)
* ,JT
* ,J1 ,J2 ,J3 ,J4
LOGICAL
* ,DISCONT ,LIQUID ,P ASGND ,T ASGND
DATA
* (H(I, 1),I=1,38)
* / 68.00000, 68.00999, 68.01999, 68.03999
* , 68.04999, 68.09999, 68.14999, 68.20999
* , 68.25999, 68.31000, 68.37000, 68.42000
* , 68.46999, 68.51999, 68.65999, 68.78999
* , 68.92000, 69.04999, 69.31999, 69.57999
* , 69.84000, 70.10999, 70.37000, 70.62999
* , 70.89999, 71.15999, 71.67999, 72.20999
* , 72.73000, 73.25999, 74.56999, 75.87999
* , 76.39999, 77.20000, 78.50000, 81.09999
* , 83.70000, 86.20000 /
DATA
* (H(I, 2),I=1,38)
* / 1150.19995, 1148.59985, 1146.59985, 168.09000
* , 168.10999, 168.14999, 168.20000, 168.23999
* , 168.28999, 168.32999, 168.37999, 168.42000
* , 168.46999, 168.50999, 168.62999, 168.73999
* , 168.84999, 168.96999, 169.18999, 169.42000
* , 169.64999, 169.87999, 170.09999, 170.32999
* , 170.56000, 170.78000, 171.23999, 171.68999

```

```

*      , 172.14999, 172.59999, 173.73999, 174.87999
*      , 175.29999, 176.00000, 177.20000, 179.50000
*      , 181.70000, 184.39999

```

DATA

```

*      (H(I, 3),I=1,38)
*      / 1195.69995, 1194.79980, 1193.69995, 1192.50000
*      , 1191.39990, 1186.59985, 1181.59985, 269.73999
*      , 269.76978, 269.80981, 269.84985, 269.88989
*      , 269.91992, 269.95996, 270.04980, 270.13989
*      , 270.23999, 270.32983, 270.50977, 270.69995
*      , 270.88989, 271.06982, 271.25977, 271.43994
*      , 271.62988, 271.81982, 272.18994, 272.56982
*      , 272.94995, 273.31982, 274.26978, 275.21997
*      , 275.59985, 276.19995, 277.09985, 279.09985
*      , 281.00000, 283.00000

```

DATA

```

*      (H(I, 4),I=1,38)
*      / 1241.79980, 1241.29980, 1240.59985, 1239.89990
*      , 1239.19995, 1236.39990, 1233.50000, 1230.50000
*      , 1227.39990, 1224.09985, 1220.79980, 1217.39990
*      , 1213.79980, 1210.09985, 375.09985, 375.14990
*      , 375.20996, 375.26978, 375.37988, 375.48999
*      , 375.60986, 375.72998, 375.83984, 375.95996
*      , 376.07983, 376.19995, 376.43994, 376.68994
*      , 376.92993, 377.18994, 377.81982, 378.46997
*      , 378.59995, 379.09985, 379.79980, 381.19995
*      , 382.59995, 384.19995

```

DATA

```

*      (H(I, 5),I=1,38)
*      / 1288.59985, 1288.19995, 1287.79980, 1287.29980
*      , 1286.89990, 1285.00000, 1283.19995, 1281.29980
*      , 1279.29990, 1277.39990, 1275.29980, 1273.29990
*      , 1271.19995, 1269.00000, 1263.50000, 1257.69995
*      , 1251.50000, 1245.09985, 1231.19995, 1215.89990
*      , 487.92993, 487.87988, 487.82983, 487.78979
*      , 487.75000, 487.71997, 487.64990, 487.59995
*      , 487.55981, 487.52979, 487.50000, 487.51978
*      , 487.50000, 487.59985, 487.69995, 488.09985
*      , 488.59985, 489.29980

```

DATA

```

*      (H(I, 6),I=1,38)
*      / 1336.09985, 1335.89990, 1335.50000, 1335.19995
*      , 1334.89990, 1333.59985, 1332.29980, 1330.89990
*      , 1329.59985, 1328.09985, 1326.79980, 1325.39990
*      , 1324.00000, 1322.59985, 1319.00000, 1315.19995
*      , 1311.39990, 1307.39990, 1299.09985, 1290.29980
*      , 1281.00000, 1271.09985, 1260.59985, 1249.29980
*      , 1237.29980, 1224.19995, 1194.09985, 616.76978
*      , 615.57983, 614.47988, 612.07983, 610.07983
*      , 609.39990, 608.39990, 606.89990, 604.59985
*      , 602.89990, 601.69995

```

DATA

```

*      (H(I, 7),I=1,38)
*      / 1384.50000, 1384.29980, 1384.00000, 1383.79980
*      , 1383.50000, 1382.50000, 1381.50000, 1380.50000
*      , 1379.50000, 1378.39990, 1377.39990, 1376.39990
*      , 1375.29980, 1374.29980, 1371.59985, 1368.89990
*      , 1366.19995, 1363.39990, 1357.69995, 1351.79980
*      , 1345.59985, 1339.19995, 1332.69995, 1325.89990
*      , 1318.79980, 1311.50000, 1296.09985, 1279.39990

```

```

*      , 1261.09985, 1240.89990, 1176.69995, 1060.50000
*      , 800.79980, 779.39990, 763.00000, 746.00000
*      , 736.09985, 729.29980
DATA
*      (H(I, 8), I=1, 38)
*      / 1433.69995, 1433.59985, 1433.39990, 1433.19995
*      , 1432.89990, 1432.09985, 1431.29980, 1430.50000
*      , 1429.69995, 1423.79980, 1428.00000, 1427.19995
*      , 1426.29980, 1425.50000, 1423.39990, 1421.29980
*      , 1419.19995, 1417.00000, 1412.69995, 1408.29980
*      , 1403.69995, 1399.09985, 1394.39990, 1389.59985
*      , 1384.69995, 1379.69995, 1369.29980, 1358.50000
*      , 1347.19995, 1333.39990, 1303.39990, 1267.00000
*      , 1250.89990, 1224.59985, 1174.29980, 1042.89990
*      , 945.09985, 901.79980
DATA
*      (H(I, 9), I=1, 38)
*      / 1483.79980, 1483.69995, 1483.50000, 1483.39990
*      , 1483.19995, 1482.50000, 1481.79980, 1481.09985
*      , 1480.39990, 1479.79980, 1479.09985, 1478.39990
*      , 1477.69995, 1477.00000, 1475.29980, 1473.59985
*      , 1471.79980, 1470.09985, 1466.59985, 1463.00000
*      , 1459.39990, 1455.79980, 1452.19995, 1448.50000
*      , 1444.69995, 1440.89990, 1433.19995, 1425.19995
*      , 1417.09985, 1408.69995, 1386.69995, 1363.19995
*      , 1353.39990, 1338.19995, 1311.59985, 1252.89990
*      , 1183.79980, 1124.89990
DATA
*      (H(I, 10), I=1, 38)
*      / 1534.79980, 1534.69995, 1534.59985, 1534.50000
*      , 1534.29980, 1533.69995, 1533.19995, 1532.59985
*      , 1532.00000, 1531.39990, 1530.79980, 1530.29980
*      , 1529.69995, 1529.09985, 1527.59985, 1526.19995
*      , 1524.69995, 1523.29980, 1520.29980, 1517.39990
*      , 1514.39990, 1511.39990, 1503.50000, 1504.39990
*      , 1502.39990, 1499.39990, 1493.19995, 1486.89990
*      , 1480.59985, 1474.09985, 1457.50000, 1440.19995
*      , 1433.09985, 1422.19995, 1403.59985, 1364.59985
*      , 1323.59985, 1281.69995
DATA
*      (H(I, 11), I=1, 38)
*      / 1586.79980, 1586.69995, 1586.59985, 1586.50000
*      , 1586.29980, 1585.79980, 1585.29980, 1584.89990
*      , 1584.39990, 1583.89990, 1583.39990, 1582.89990
*      , 1582.39990, 1581.89990, 1580.59985, 1579.39990
*      , 1578.19995, 1576.89990, 1574.39990, 1571.89990
*      , 1569.39990, 1566.89990, 1564.39990, 1561.89990
*      , 1559.39990, 1556.89990, 1551.79980, 1546.59985
*      , 1541.09985, 1536.19995, 1522.89990, 1509.39990
*      , 1503.79980, 1495.50000, 1481.29980, 1452.09985
*      , 1422.29980, 1392.19995
DATA
*      (H(I, 12), I=1, 38)
*      / 1639.59985, 1639.59985, 1639.50000, 1639.39990
*      , 1639.29980, 1638.79980, 1638.39990, 1638.00000
*      , 1637.59985, 1637.09985, 1636.69995, 1636.29980
*      , 1635.89990, 1635.39990, 1634.39990, 1633.29980
*      , 1632.29980, 1631.19995, 1629.09985, 1627.00000
*      , 1624.79980, 1622.69995, 1620.59985, 1618.39990
*      , 1616.29980, 1614.19995, 1609.89990, 1605.59985

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*      , 1601.19995, 1596.89990, 1585.89990, 1574.79980
*      , 1570.29980, 1563.29980, 1552.19995, 1529.09985
*      , 1505.89990, 1482.59985
DATA
*      (H(I,13),I=1,38)
*      / 1693.39990, 1693.29980, 1693.29980, 1693.19995
*      , 1693.09985, 1992.69995, 1692.39990, 1692.00000
*      , 1691.59985, 1691.29980, 1690.89990, 1690.50000
*      , 1690.19995, 1689.79980, 1688.89990, 1688.00000
*      , 1687.09985, 1686.19995, 1684.39990, 1682.59985
*      , 1680.69995, 1678.89990, 1677.09985, 1675.29980
*      , 1673.50000, 1671.59985, 1668.00000, 1664.29980
*      , 1660.69995, 1657.00000, 1647.79980, 1638.50000
*      , 1634.79980, 1629.19995, 1619.79980, 1600.89990
*      , 1582.00000, 1563.09985
DATA
*      (H(I,14),I=1,38)
*      / 1748.09985, 1748.00000, 1747.89990, 1747.79980
*      , 1747.79980, 1747.50000, 1747.09985, 1746.79980
*      , 1746.50000, 1746.19995, 1745.89990, 1745.59985
*      , 1745.29980, 1745.00000, 1744.19995, 1743.39990
*      , 1742.59985, 1741.89990, 1740.29980, 1738.79980
*      , 1737.19995, 1735.00000, 1734.09985, 1732.50000
*      , 1731.00000, 1729.39990, 1726.29980, 1723.19995
*      , 1720.09985, 1717.00000, 1709.19995, 1701.39990
*      , 1698.29980, 1693.59985, 1685.69995, 1670.00000
*      , 1654.19995, 1638.59985
DATA
*      (H(I,15),I=1,38)
*      / 1803.79980, 1803.50000, 1803.39990, 1803.39990
*      , 1803.29980, 1803.00000, 1802.79980, 1802.50000
*      , 1802.19995, 1802.00000, 1801.69995, 1801.39990
*      , 1801.19995, 1800.89990, 1800.19995, 1799.59985
*      , 1798.89990, 1798.19995, 1796.89990, 1795.59985
*      , 1794.29980, 1792.89990, 1791.59985, 1790.29980
*      , 1789.00000, 1787.59985, 1785.00000, 1782.29980
*      , 1779.69995, 1777.09985, 1770.39990, 1761.79980
*      , 1761.19995, 1757.19995, 1750.59985, 1737.39990
*      , 1724.19995, 1711.09985
DATA
*      HL
*      / 69.73000, 130.20000, 161.25999, 181.20999
*      , 196.26999, 236.09999, 262.19995, 282.09985
*      , 298.50000, 312.59985, 325.00000, 336.09985
*      , 346.19995, 355.50000, 376.09985, 394.00000
*      , 409.79980, 424.19995, 449.50000, 471.69995
*      , 491.59985, 509.79980, 526.69995, 542.59985
*      , 557.50000, 571.89990, 598.29980, 624.00000
*      , 648.29980, 672.09985, 731.69995, 801.79980
*      , 890.59985
DATA
*      HV
*      / 1105.79980, 1131.09985, 1143.29980, 1150.89990
*      , 1156.29980, 1169.79980, 1177.59985, 1183.09985
*      , 1187.19995, 1190.39990, 1193.00000, 1195.09985
*      , 1196.89990, 1198.29980, 1201.09985, 1202.89990
*      , 1204.00000, 1204.59985, 1204.69995, 1205.69995
*      , 1201.79980, 1199.39990, 1196.39990, 1192.89990
*      , 1189.09985, 1184.79980, 1175.29980, 1162.89990
*      , 1150.39990, 1138.29980, 1093.29980, 1020.29980

```

```

*          919.59985
* DATA
*          PARG
*          /      1.,      5.,      10.,      15.
*          ,      20.,      40.,      60.,      80.
*          ,      100.,     120.,     140.,     160.
*          ,      180.,     200.,     250.,     300.
*          ,      350.,     400.,     500.,     600.
*          ,      700.,     800.,     900.,    1000.
*          ,     1100.,    1200.,    1400.,    1600.
*          ,     1800.,    2000.,    2500.,    3000.
*          ,     3200.,    3500.,    4000.,    5000.
*          ,     6000.,    7000.
* DATA
*          PCS
*          /      1.,      5.,      10.,      15.
*          ,      20.,      40.,      60.,      80.
*          ,      100.,     120.,     140.,     160.
*          ,      180.,     200.,     250.,     300.
*          ,      350.,     400.,     500.,     600.
*          ,      700.,     800.,     900.,    1000.
*          ,     1100.,    1200.,    1400.,    1600.
*          ,     1800.,    2000.,    2500.,    3000.
*          ,     3200.
* DATA
*          (S(I, 1), I=1, 38)
*          /      0.12950,    0.12950,    0.12950,    0.12950
*          ,      0.12950,    0.12950,    0.12950,    0.12950
*          ,      0.12950,    0.12950,    0.12950,    0.12940
*          ,      0.12940,    0.12940,    0.12940,    0.12940
*          ,      0.12930,    0.12930,    0.12920,    0.12920
*          ,      0.12910,    0.12900,    0.12900,    0.12890
*          ,      0.12890,    0.12880,    0.12870,    0.12860
*          ,      0.12840,    0.12830,    0.12800,    0.12770
*          ,      0.12760,    0.12740,    0.12710,    0.12650
*          ,      0.12530,    0.12520
* DATA
*          (S(I, 2), I=1, 38)
*          /      2.05090,    1.87160,    1.79280,    0.29400
*          ,      0.29400,    0.29400,    0.29390,    0.29390
*          ,      0.29390,    0.29390,    0.29390,    0.29330
*          ,      0.29380,    0.29380,    0.29370,    0.29370
*          ,      0.29360,    0.29350,    0.29340,    0.29330
*          ,      0.29320,    0.29300,    0.29290,    0.29280
*          ,      0.29270,    0.29260,    0.29230,    0.29210
*          ,      0.29180,    0.29160,    0.29100,    0.29040
*          ,      0.29020,    0.28990,    0.28930,    0.28810
*          ,      0.28700,    0.28590
* DATA
*          (S(I, 3), I=1, 38)
*          /      2.11520,    1.93690,    1.85930,    1.81340
*          ,      1.78050,    1.69920,    1.64920,    0.43710
*          ,      0.43710,    0.43710,    0.43700,    0.43700
*          ,      0.43700,    0.43690,    0.43680,    0.43070
*          ,      0.43670,    0.43660,    0.43640,    0.43620
*          ,      0.43630,    0.43580,    0.43570,    0.43550
*          ,      0.43530,    0.43510,    0.43480,    0.43440
*          ,      0.43410,    0.43370,    0.43290,    0.43200
*          ,      0.43170,    0.43120,    0.43040,    0.42870
*          ,      0.42710,    0.42560

```

DATA

```

*      (S(I, 4),I=1,38)
*      /      2.17220,      1.99430,      1.91730,      1.87200
*      ,      1.83970,      1.76080,      1.71340,      1.67900
*      ,      1.65160,      1.62860,      1.60850,      1.59060
*      ,      1.57430,      1.55930,      0.56670,      0.56650
*      ,      0.56640,      0.56630,      0.56600,      0.56570
*      ,      0.56550,      0.56520,      0.56490,      0.56470
*      ,      0.56440,      0.56420,      0.56360,      0.56310
*      ,      0.56260,      0.56210,      0.56090,      0.55970
*      ,      0.55920,      0.55850,      0.55730,      0.55500
*      ,      0.55280,      0.55070

```

DATA

```

*      (S(I, 5),I=1,38)
*      /      2.22370,      2.04600,      1.96920,      1.92420
*      ,      1.89210,      1.81430,      1.76810,      1.73490
*      ,      1.70880,      1.63720,      1.66260,      1.65220
*      ,      1.63760,      1.62420,      1.59510,      1.57030
*      ,      1.54830,      1.52820,      1.49210,      1.45900
*      ,      0.68890,      0.68850,      0.68810,      0.68760
*      ,      0.68720,      0.68680,      0.68590,      0.68510
*      ,      0.68430,      0.68340,      0.68150,      0.67960
*      ,      0.67880,      0.67770,      0.67600,      0.67260
*      ,      0.66930,      0.66630

```

DATA

```

*      (S(I, 6),I=1,38)
*      /      2.27080,      2.09320,      2.01660,      1.97170
*      ,      1.93970,      1.86240,      1.81680,      1.78420
*      ,      1.75850,      1.73760,      1.71960,      1.70390
*      ,      1.69000,      1.67760,      1.65920,      1.62740
*      ,      1.60770,      1.59010,      1.55950,      1.53290
*      ,      1.50900,      1.48690,      1.45590,      1.44570
*      ,      1.42590,      1.40610,      1.36520,      0.81290
*      ,      0.81090,      0.80910,      0.80480,      0.80090
*      ,      0.79940,      0.79730,      0.79400,      0.78800
*      ,      0.78260,      0.77770

```

DATA

```

*      (S(I, 7),I=1,38)
*      /      2.31440,      2.13690,      2.06030,      2.01550
*      ,      1.98360,      1.90650,      1.86120,      1.82890
*      ,      1.80360,      1.78290,      1.76520,      1.74990
*      ,      1.73620,      1.72390,      1.69760,      1.67560
*      ,      1.65710,      1.64060,      1.61230,      1.58440
*      ,      1.56730,      1.54840,      1.53110,      1.51490
*      ,      1.49960,      1.48510,      1.45750,      1.43120
*      ,      1.40540,      1.37940,      1.30760,      1.19650
*      ,      0.97080,      0.95080,      0.93430,      0.91530
*      ,      0.90260,      0.89260

```

DATA

```

*      (S(I, 8),I=1,38)
*      /      2.35500,      2.17760,      2.10110,      2.05630
*      ,      2.02440,      1.94760,      1.90240,      1.87020
*      ,      1.84510,      1.82460,      1.80710,      1.79190
*      ,      1.77840,      1.76630,      1.74050,      1.71920
*      ,      1.70090,      1.68500,      1.65780,      1.63510
*      ,      1.61540,      1.59200,      1.58220,      1.56770
*      ,      1.55420,      1.54150,      1.51820,      1.49680
*      ,      1.47680,      1.45780,      1.41290,      1.36920
*      ,      1.35150,      1.32420,      1.27540,      1.15930
*      ,      1.01760,      1.03500

```

```

DATA
*      (S(I, 9),I=1,38)
*      / 2.39320, 2.21590, 2.13940, 2.09460
*      , 2.06280, 1.98600, 1.94100, 1.90890
*      , 1.88390, 1.86350, 1.84610, 1.83100
*      , 1.81760, 1.80570, 1.78010, 1.75910
*      , 1.74110, 1.72550, 1.69900, 1.67690
*      , 1.65800, 1.64130, 1.62630, 1.61260
*      , 1.60000, 1.58830, 1.56700, 1.54780
*      , 1.53020, 1.51380, 1.47660, 1.44290
*      , 1.43000, 1.41120, 1.38070, 1.32070
*      , 1.26150, 1.20550
DATA
*      (S(I,10),I=1,38)
*      / 2.42940, 2.25210, 2.17570, 2.13090
*      , 2.09910, 2.02240, 1.97740, 1.94540
*      , 1.92050, 1.90010, 1.88280, 1.86780
*      , 1.85450, 1.84260, 1.81730, 1.79640
*      , 1.77870, 1.76320, 1.73710, 1.71550
*      , 1.69700, 1.68070, 1.66620, 1.65300
*      , 1.64100, 1.62980, 1.60960, 1.59160
*      , 1.57530, 1.56030, 1.52690, 1.49760
*      , 1.48660, 1.47090, 1.44610, 1.40010
*      , 1.35740, 1.31710
DATA
*      (S(I,11),I=1,38)
*      / 2.46380, 2.28660, 2.21010, 2.16530
*      , 2.13360, 2.05690, 2.01200, 1.98000
*      , 1.95520, 1.93490, 1.91760, 1.90270
*      , 1.88940, 1.87760, 1.85240, 1.83170
*      , 1.81410, 1.79880, 1.77300, 1.75170
*      , 1.73350, 1.71750, 1.70330, 1.69050
*      , 1.67870, 1.66790, 1.64840, 1.63120
*      , 1.61560, 1.60140, 1.57030, 1.54340
*      , 1.53350, 1.51940, 1.49760, 1.45820
*      , 1.42290, 1.39040
DATA
*      (S(I,12),I=1,38)
*      / 2.49670, 2.31940, 2.24300, 2.19820
*      , 2.16650, 2.08990, 2.04500, 2.01310
*      , 1.98830, 1.96800, 1.95080, 1.93590
*      , 1.92270, 1.91090, 1.88530, 1.86520
*      , 1.84770, 1.83250, 1.80690, 1.78590
*      , 1.76790, 1.75220, 1.73820, 1.72560
*      , 1.71410, 1.70350, 1.68450, 1.66780
*      , 1.65280, 1.63910, 1.60940, 1.58410
*      , 1.57490, 1.56180, 1.54170, 1.50610
*      , 1.47480, 1.44660
DATA
*      (S(I,13),I=1,38)
*      / 2.52820, 2.35090, 2.27440, 2.22970
*      , 2.19790, 2.12240, 2.07650, 2.04460
*      , 2.01990, 1.99960, 1.98250, 1.96760
*      , 1.95450, 1.94270, 1.91770, 1.89720
*      , 1.87980, 1.86470, 1.83930, 1.81840
*      , 1.80060, 1.78510, 1.77130, 1.75890
*      , 1.74750, 1.73710, 1.71850, 1.70220
*      , 1.68760, 1.67430, 1.64560, 1.62140
*      , 1.61260, 1.60020, 1.58120, 1.54810
*      , 1.51940, 1.49380

```

DATA

```

*      (S(I,14),I=1,38)
*      /      2.55840,      2.38110,      2.30460,      2.25990
*      ,      2.22820,      2.15160,      2.10680,      2.07500
*      ,      2.05020,      2.03000,      2.01290,      1.99800
*      ,      1.98490,      1.97320,      1.94820,      1.92780
*      ,      1.91050,      1.89550,      1.87020,      1.84940
*      ,      1.83180,      1.81640,      1.80280,      1.79050
*      ,      1.77930,      1.76910,      1.75080,      1.73440
*      ,      1.72040,      1.70750,      1.67960,      1.65610
*      ,      1.64770,      1.63580,      1.61770,      1.58630
*      ,      1.55930,      1.53550

```

DATA

```

*      (S(I,15),I=1,38)
*      /      2.58750,      2.41010,      2.33370,      2.28900
*      ,      2.25720,      2.18070,      2.13590,      2.10410
*      ,      2.07940,      2.05920,      2.04210,      2.02730
*      ,      2.01420,      2.00250,      1.97760,      1.95720
*      ,      1.94000,      1.92500,      1.89980,      1.87920
*      ,      1.86170,      1.84640,      1.83290,      1.82070
*      ,      1.80970,      1.79960,      1.78150,      1.76570
*      ,      1.75160,      1.73890,      1.71160,      1.68880
*      ,      1.68060,      1.66910,      1.65160,      1.62160
*      ,      1.59620,      1.57350

```

DATA

```

*      SL
*      /      0.13260,      0.23490,      0.28360,      0.31370
*      ,      0.33580,      0.39210,      0.42730,      0.45340
*      ,      0.47430,      0.49190,      0.50710,      0.52060
*      ,      0.53280,      0.54380,      0.56790,      0.58820
*      ,      0.60590,      0.62170,      0.64900,      0.67230
*      ,      0.69280,      0.71110,      0.72790,      0.74340
*      ,      0.75780,      0.77140,      0.79660,      0.81960
*      ,      0.84140,      0.86250,      0.91390,      0.97280
*      ,      1.04780

```

DATA

```

*      SV
*      /      1.97810,      1.84430,      1.78790,      1.75520
*      ,      1.73200,      1.67650,      1.64400,      1.62080
*      ,      1.60270,      1.58790,      1.57520,      1.56410
*      ,      1.55430,      1.54540,      1.52640,      1.51050
*      ,      1.49680,      1.48470,      1.46390,      1.44610
*      ,      1.43040,      1.41630,      1.40320,      1.39100
*      ,      1.37940,      1.36830,      1.34740,      1.32580
*      ,      1.30600,      1.28810,      1.23450,      1.16190
*      ,      1.07300

```

DATA

```

*      TARG
*      /      100.,      200.,      300.,      400.
*      ,      500.,      600.,      700.,      800.
*      ,      900.,      1000.,      1100.,      1200.
*      ,      1300.,      1400.,      1500.

```

DATA

```

*      TCS
*      /      101.74,      162.24,      193.21,      213.03
*      ,      227.96,      267.25,      292.71,      312.04
*      ,      327.82,      341.27,      353.04,      363.55
*      ,      373.08,      381.80,      400.97,      417.35
*      ,      431.73,      444.60,      467.01,      486.20
*      ,      503.08,      518.21,      531.95,      544.58

```



```

*      ,      556.28,      567.19,      587.07,      604.87
*      ,      621.02,      635.80,      668.11,      695.33
*      ,      705.08
DATA
*      (V(I, 1),I=1,38)
*      /      0.01610,      0.01610,      0.01610,      0.01610
*      ,      0.01610,      0.01610,      0.01610,      0.01610
*      ,      0.01610,      0.01610,      0.01610,      0.01610
*      ,      0.01610,      0.01610,      0.01610,      0.01610
*      ,      0.01610,      0.01610,      0.01610,      0.01610
*      ,      0.01610,      0.01610,      0.01610,      0.01610
*      ,      0.01610,      0.01610,      0.01610,      0.01610
*      ,      0.01600,      0.01600,      0.01600,      0.01600
*      ,      0.01600,      0.01600,      0.01590,      0.01590
*      ,      0.01590,      0.01580
DATA
*      (V(I, 2),I=1,38)
*      /      392.50000,      78.14000,      38.84000,      0.01660
*      ,      0.01660,      0.01660,      0.01660,      0.01660
*      ,      0.01660,      0.01660,      0.01660,      0.01660
*      ,      0.01660,      0.01660,      0.01660,      0.01660
*      ,      0.01660,      0.01660,      0.01660,      0.01660
*      ,      0.01660,      0.01660,      0.01660,      0.01660
*      ,      0.01650,      0.01650,      0.01650,      0.01650
*      ,      0.01650,      0.01640,      0.01640,      0.01640
*      ,      0.01630,      0.01630
DATA
*      (V(I, 3),I=1,38)
*      /      452.29980,      90.23999,      44.98000,      29.89899
*      ,      22.35599,      11.03600,      7.25700,      0.01750
*      ,      0.01750,      0.01750,      0.01750,      0.01750
*      ,      0.01740,      0.01740,      0.01740,      0.01740
*      ,      0.01740,      0.01740,      0.01740,      0.01740
*      ,      0.01740,      0.01740,      0.01740,      0.01740
*      ,      0.01740,      0.01740,      0.01740,      0.01730
*      ,      0.01730,      0.01730,      0.01730,      0.01720
*      ,      0.01720,      0.01720,      0.01720,      0.01710
*      ,      0.01700,      0.01700
DATA
*      (V(I, 4),I=1,38)
*      /      511.89990,      102.23999,      51.03000,      33.96300
*      ,      25.42799,      12.62400,      8.35400,      6.21800
*      ,      4.93500,      4.07860,      3.46610,      3.00600
*      ,      2.64740,      2.35980,      0.01860,      0.01860
*      ,      0.01860,      0.01860,      0.01860,      0.01860
*      ,      0.01860,      0.01860,      0.01860,      0.01860
*      ,      0.01850,      0.01850,      0.01850,      0.01850
*      ,      0.01850,      0.01840,      0.01840,      0.01830
*      ,      0.01830,      0.01830,      0.01820,      0.01810
*      ,      0.01800,      0.01800
DATA
*      (V(I, 5),I=1,38)
*      /      571.50000,      114.20999,      57.03999,      37.98499
*      ,      28.45699,      14.16500,      9.40000,      7.01800
*      ,      5.58800,      4.63410,      3.95260,      3.44130
*      ,      3.04330,      2.72470,      2.15040,      1.76650
*      ,      1.49130,      1.28410,      0.99190,      0.79440
*      ,      0.02040,      0.02040,      0.02040,      0.02040
*      ,      0.02030,      0.02030,      0.02030,      0.02020

```

```

*      , 0.02020, 0.02010, 0.02000, 0.02000
*      , 0.01990, 0.01990, 0.01980, 0.01960
*      , 0.01950, 0.01930
DATA
*      (V(I, 6),I=1,38)
*      / 631.09985, 126.14999, 63.03000, 41.98599
*      , 31.46599, 15.68500, 10.42500, 7.79400
*      , 6.21600, 5.16370, 4.41190, 3.84800
*      , 3.40930, 3.05830, 2.46620, 2.00440
*      , 1.70280, 1.47630, 1.15840, 0.94560
*      , 0.79280, 0.67740, 0.58690, 0.51370
*      , 0.45310, 0.40160, 0.31760, 0.02360
*      , 0.02350, 0.02330, 0.02300, 0.02280
*      , 0.02270, 0.02250, 0.02230, 0.02190
*      , 0.02160, 0.02130
DATA
*      (V(I, 7),I=1,38)
*      / 690.69995, 138.07999, 69.00000, 45.97800
*      , 34.46500, 17.19499, 11.43800, 8.56000
*      , 6.83300, 5.68310, 4.85850, 4.24200
*      , 3.76210, 3.37830, 2.68720, 2.22630
*      , 1.89700, 1.64990, 1.30370, 1.07260
*      , 0.90720, 0.78280, 0.68580, 0.60800
*      , 0.54400, 0.49050, 0.40590, 0.34150
*      , 0.29060, 0.24880, 0.16810, 0.09320
*      , 0.03350, 0.03070, 0.02870, 0.02680
*      , 0.02560, 0.02480
DATA
*      (V(I, 8),I=1,38)
*      / 750.29980, 150.00999, 74.98000, 49.96399
*      , 37.45799, 18.69899, 12.44600, 9.31900
*      , 7.44300, 6.19280, 5.29950, 4.62950
*      , 4.10840, 3.69150, 2.94100, 2.44070
*      , 2.08320, 1.81510, 1.43970, 1.18920
*      , 1.01020, 0.87590, 0.77130, 0.68750
*      , 0.61880, 0.56150, 0.47120, 0.40320
*      , 0.35080, 0.30720, 0.22930, 0.17590
*      , 0.15860, 0.13640, 0.10520, 0.05910
*      , 0.03970, 0.03340
DATA
*      (V(I, 9),I=1,38)
*      / 809.89990, 161.93999, 80.93999, 53.94600
*      , 40.44699, 20.19399, 13.45000, 10.07500
*      , 8.05000, 6.70060, 5.73640, 5.01320
*      , 4.45050, 4.00080, 3.19090, 2.65090
*      , 2.26520, 1.97590, 1.57080, 1.30080
*      , 1.10780, 0.95310, 0.85040, 0.76030
*      , 0.68650, 0.62500, 0.52820, 0.45550
*      , 0.39280, 0.35340, 0.27120, 0.21610
*      , 0.19870, 0.17640, 0.14630, 0.10380
*      , 0.07570, 0.05730
DATA
*      (V(I, 10),I=1,38)
*      / 869.50000, 173.85999, 86.90999, 57.92599
*      , 43.43500, 21.69699, 14.45200, 10.82900
*      , 8.65500, 7.20600, 6.17090, 5.39450
*      , 4.79070, 4.30770, 3.43820, 2.85850
*      , 2.44450, 2.13390, 1.69920, 1.40930
*      , 1.20230, 1.04700, 0.92620, 0.82950
*      , 0.75050, 0.68450, 0.58090, 0.50310

```

*	0.44260,	0.39420,	0.30680,	0.24840
*	0.23010,	0.20660,	0.17520,	0.13120
*	0.10200,	0.08160		

C

DATA

*	(V(I,11),I=1,38)			
*	/ 929.00000,	185.78000,	92.87000,	61.90500
*	, 46.42000,	23.19398,	15.45200,	11.58100
*	, 9.25800,	7.70960,	6.60360,	5.77410
*	, 5.12890,	4.61280,	3.68370,	3.06430
*	, 2.62190,	2.29010,	1.82560,	1.51600
*	, 1.29480,	1.12690,	0.99980,	0.89660
*	, 0.81210,	0.74180,	0.63110,	0.54820
*	, 0.48360,	0.43200,	0.33900,	0.27700
*	, 0.25760,	0.23260,	0.19940,	0.15290
*	, 0.12210,	0.10040		

DATA

*	(V(I,12),I=1,38)			
*	/ 988.59985,	197.70000,	98.84000,	65.89199
*	, 49.40500,	24.68900,	16.45000,	12.33100
*	, 9.86000,	8.21190,	7.03490,	6.15220
*	, 5.46570,	4.91650,	3.92780,	3.26830
*	, 2.79800,	2.44500,	1.95070,	1.62110
*	, 1.38590,	1.20930,	1.07200,	0.96220
*	, 0.87230,	0.79740,	0.67980,	0.59150
*	, 0.52290,	0.46800,	0.36920,	0.30330
*	, 0.28270,	0.25630,	0.22100,	0.17180
*	, 0.13910,	0.11600		

DATA

*	(V(I,13),I=1,38)			
*	/ 1048.19995,	209.62000,	104.79999,	69.85799
*	, 52.38799,	26.18300,	17.44800,	13.08100
*	, 10.46000,	8.71300,	7.46520,	6.52930
*	, 5.80140,	5.21910,	4.17090,	3.47210
*	, 2.97300,	2.59370,	2.07460,	1.72520
*	, 1.47570,	1.28850,	1.14300,	1.02660
*	, 0.93130,	0.85190,	0.72720,	0.63360
*	, 0.56090,	0.50270,	0.39800,	0.32820
*	, 0.30650,	0.27840,	0.24110,	0.18900
*	, 0.15440,	0.12980		

DATA

*	(V(I,14),I=1,38)			
*	/ 1107.69995,	221.53000,	110.75999,	73.83299
*	, 55.37000,	27.67599,	18.44499,	13.82900
*	, 11.06000,	9.21340,	7.89460,	6.90550
*	, 6.13630,	5.52090,	4.41310,	3.67460
*	, 3.14710,	2.75130,	2.19770,	1.82840
*	, 1.56470,	1.36690,	1.21310,	1.09010
*	, 0.98340,	0.90550,	0.77370,	0.67490
*	, 0.59800,	0.53650,	0.42590,	0.35220
*	, 0.32910,	0.29950,	0.26010,	0.20500
*	, 0.16340,	0.14240		

DATA

*	(V(I,15),I=1,38)			
*	/ 1167.29980,	233.45000,	116.71999,	77.80699
*	, 58.35199,	29.16800,	19.44099,	14.57700
*	, 11.65900,	9.71300,	8.32330,	7.28110
*	, 6.47040,	5.82190,	4.65460,	3.87640
*	, 3.32050,	2.90370,	2.32000,	1.93090
*	, 1.65300,	1.44460,	1.28250,	1.15290

```

*           , 1.04680, 0.95840, 0.81950, 0.71530
*           , 0.63430, 0.56950, 0.45290, 0.37530
*           , 0.35100, 0.31980, 0.27830, 0.22030
*           , 0.16170, 0.15420

```

DATA

```

*           VL
*           / 0.01614, 0.01641, 0.01659, 0.01673
*           , 0.01683, 0.01715, 0.01738, 0.01757
*           , 0.01774, 0.01789, 0.01803, 0.01815
*           , 0.01827, 0.01839, 0.01855, 0.01889
*           , 0.01913, 0.01930, 0.01980, 0.02010
*           , 0.02050, 0.02090, 0.02120, 0.02160
*           , 0.02200, 0.02230, 0.02310, 0.02396
*           , 0.02472, 0.02570, 0.02860, 0.03430
*           , 0.04805

```

DATA

```

*           VV
*           / 333.59985, 73.53000, 38.42000, 26.28999
*           , 20.08699, 10.49700, 7.17400, 5.47100
*           , 4.43100, 3.72800, 3.21900, 2.83400
*           , 2.53100, 2.28700, 1.84320, 1.54270
*           , 1.32550, 1.16100, 0.92760, 0.76980
*           , 0.65560, 0.56900, 0.50090, 0.44600
*           , 0.40060, 0.36250, 0.30180, 0.25520
*           , 0.21830, 0.18830, 0.13070, 0.08500
*           , 0.05444

```

DATA

```

*           IX
*           / 1, 3, 7, 14
*           , 20, 27, 32, 32/

```

DATA

```

*           JCSL
*           / 1, 1, 1, 2
*           , 2, 2, 2, 3
*           , 3, 3, 3, 3
*           , 3, 3, 4, 4
*           , 4, 4, 4, 4
*           , 5, 5, 5, 5
*           , 5, 5, 5, 6
*           , 6, 6, 6, 6
*           , 7

```

DATA

```

*           JCSV
*           / 2, 2, 3, 3
*           , 3, 3, 4, 4
*           , 4, 4, 4, 4
*           , 4, 5, 5, 5
*           , 5, 5, 5, 6
*           , 6, 6, 6, 6
*           , 6, 6, 7, 7
*           , 7, 7, 7, 8
*           , 8

```

1. CONTINUE

NO NTRP = .FALSE.

P = ARG1

T = ARG2

IF(P .LT. PARG(1) .OR. PARG(38) .LT. P) GO TO 9000

IF(T .LT. TARG(1) .OR. TARG(15) .LT. T) GO TO 9000

DO 10 I = 2,38

```

      IP = I - 1
      IF(PARG(I) .GT. P) GO TO 20
10  CONTINUE
20  CONTINUE
      DO 30 J = 2,15
      JT = J - 1
      IF(TARG(J) .GT. T) GO TO 40
30  CONTINUE
40  CONTINUE
      I1 = IP
      J1 = JT
      I2 = IP + 1
      J2 = JT
      I3 = IP + 1
      J3 = JT + 1
      I4 = IP
      J4 = JT + 1
50  CONTINUE
      P1 = PARG(I1)
      T1 = TARG(J1)
      H1 = H(I1,J1)
      S1 = S(I1,J1)
      V1 = V(I1,J1)
      P2 = PARG(I2)
      T2 = TARG(J2)
      H2 = H(I2,J2)
      S2 = S(I2,J2)
      V2 = V(I2,J2)
      P3 = PARG(I3)
      T3 = TARG(J3)
      H3 = H(I3,J3)
      S3 = S(I3,J3)
      V3 = V(I3,J3)
      P4 = PARG(I4)
      T4 = TARG(J4)
      H4 = H(I4,J4)
      S4 = S(I4,J4)
      V4 = V(I4,J4)
      LIQUID = T.LT.705.08 .AND. P.GE.3200.
      IF(P1.GE.3200. .OR. T1.GE.600.) GO TO 100
      LIQUID = T.LT. ((P-P1)*TCS(I2) - (P-P2)*TCS(I1))/(P2-P1)
      DISCONT = IX(J1).LE.I1 .AND. I1.LE.IX(J1+1)
      IF(.NOT. DISCONT) GO TO 100
      IF(LIQUID) GO TO 60
      J3 = JCSV(I1)
      J4 = J3
      T1 = TCS(I1)
      H1 = HV(I1)
      S1 = SV(I1)
      V1 = VV(I1)
      T2 = TCS(I2)
      H2 = HV(I2)
      S2 = SV(I2)
      V2 = VV(I2)
      T3 = TARG(J3)
      H3 = H(I3,J3)
      S3 = S(I3,J3)
      V3 = V(I3,J3)
      T4 = TARG(J4)
      H4 = H(I4,J4)

```

```

      S4 = S(I4,J4)
      V4 = V(I4,J4)
      GO TO 100
60 CONTINUE
      J1 = JCST(I1)
      J2 = J1
      T1 = TARG(J1)
      H1 = H(I1,J1)
      S1 = S(I1,J1)
      V1 = V(I1,J1)
      T2 = TARG(J2)
      H2 = H(I2,J2)
      S2 = S(I2,J2)
      V2 = V(I2,J2)
      T3 = TCS(I3)
      H3 = HL(I3)
      S3 = SL(I3)
      V3 = VL(I3)
      T4 = TCS(I4)
      H4 = HL(I4)
      S4 = SL(I4)
      V4 = VL(I4)
100 CONTINUE
      EP(1) = P
      PP(2) = P1
      PP(3) = P2
      PP(4) = P3
      PP(5) = P4
      TT(1) = T
      TT(2) = T1
      TT(3) = T2
      TT(4) = T3
      TT(5) = T4
      F(2,1) = H1
      F(3,1) = H2
      F(4,1) = H3
      F(5,1) = H4
      F(2,2) = S1
      F(3,2) = S2
      F(4,2) = S3
      F(5,2) = S4
      F(2,3) = V1
      F(3,3) = V2
      F(4,3) = V3
      F(5,3) = V4
      CALL BLINT2D(PP,TT,3,F,A,B,NO NTRP)
      IF(NO NTRP) GO TO 900C
      HI = F(1,1)
      PI = P
      F(2,1) = HL(I1)
      SI = F(1,2)
      TI = T
      VI = F(1,3)
      XI = 1.
      IF(LIQUID) XI = 0.
      GO TO 9999
1000 CONTINUE
      ENTRY USE NPX
1100 CONTINUE
      P = ARG1

```

```

X = ARG2
P ASGND = .TRUE.
T ASGND = .FALSE.
IF(P.LT.1. .OR. 3200.LT.P) GO TO 9000
IF(X.LT.0. .OR. 1.LT.X) GO TO 9000
DO 1110 I = 2,33
II = I - 1
IF(PCS(I).GT.P) GO TO 1120
1110 CONTINUE
1120 CONTINUE
XX(1) = P
XX(2) = PCS(II)
XX(3) = PCS(II+1)
XX(4) = PCS(II+1)
XX(5) = PCS(II)
GO TO 1300
ENTRY USE NTX
1200 CONTINUE
T = ARG1
X = ARG2
P ASGND = .FALSE.
T ASGND = .TRUE.
IF(T.LT.101.74 .OR. 705.08.LT.T) GO TO 9000
IF(X.LT.0. .OR. 1.LT.X) GO TO 9000
DO 1210 I = 2,33
II = I - 1
IF(TCS(I).GT.T) GO TO 1220
1210 CONTINUE
1220 CONTINUE
XX(1) = T
XX(2) = TCS(II)
XX(3) = TCS(II+1)
XX(4) = TCS(II+1)
XX(5) = TCS(II)
GO TO 1300
1300 CONTINUE
YY(1) = X
YY(2) = 0.
YY(3) = 0.
YY(4) = 1.
YY(5) = 1.
F(2,1) = HL(II)
F(3,1) = HL(II+1)
F(4,1) = HV(II+1)
F(5,1) = HV(II)
F(2,2) = PCS(II)
F(3,2) = PCS(II+1)
F(4,2) = PCS(II+1)
F(5,2) = PCS(II)
F(2,3) = SL(II)
F(3,3) = SL(II+1)
F(4,3) = SV(II+1)
F(5,3) = SV(II)
F(2,4) = TCS(II)
F(3,4) = TCS(II+1)
F(4,4) = TCS(II+1)
F(5,4) = TCS(II)
F(2,5) = VL(II)
F(3,5) = VL(II+1)
F(4,5) = VV(II+1)

```

```

      F(5,5) = VV(II)
      CALL BLINT2D(XX,YY,5,F,A,B,NO NTRP)
      IF(NO NTRP) GO TO 9000
      HI = F(1,1)
      PI = F(1,2)
      IF(P ASGND) PI = P
      SI = F(1,3)
      TI = F(1,4)
      IF(T ASGND) TI = T
      VI = F(1,5)
      XI = X
      GO TO 9999
9000 CONTINUE
      HI = -1.
      PI = -1.
      SI = -1.
      TI = -1.
      VI = -1.
      XI = -1.
      NO NTRP = .TRUE.
      GO TO 9999
9999 CONTINUE
      RETURN
      END

```



```

SUBROUTINE BLINT2D(X,Y,N,F,FA,FB,NO NTRP)
C/ LIST,NONE
C
C *****
C
C THIS SUBROUTINE PERFORMS 2-DIMENSIONAL BILINEAR INTERPOLATION.
C
C LET THE POINT (X(1),Y(1)) LIE WITHIN THE CONVEX REGION DETERMINED
C BY THE COUNTER CLOCKWISE SEQUENCE OF VERTICES (X(I),Y(I)),
C I=2,3,4,5. LET AN N-DIMENSIONAL VALUED FUNCTION BE DEFINED OVER
C THE 2-DIMENSIONAL (X,Y) SPACE. LET F(I,J),I=2,3,4,5 BE THE
C SEQUENCE OF VALUES OF THE J-TH COMPONENT FUNCTION AT THE POINTS
C (X(I),Y(I)),I=2,3,4,5, RESPECTIVELY, WHERE J = 1,...,N. THIS
C ROUTINE RETURNS THE VALUES F(1,J),J=1,...,N OBTAINED BY BILINEAR
C INTERPOLATION FOR EACH OF THE COMPONENT VALUES.
C
C THE VALUES RETURNED ARE COMPUTED FROM A FORMULA OF THE FORM
C
C      F(1,J) = (1 - FA)*(1 - FB)*F(2,J)
C              + FA *(1 - FB)*F(3,J)
C              + FA * FB *F(4,J)
C              +(1 - FA)* FB *F(5,J)
C
C FOR J = 1,...,N. IN THIS FORMULA FA AND FB ARE INTERPOLATION
C PARAMETERS WHOSE VALUES LIE BETWEEN 0. AND 1. FA IS DEFINED
C GEOMETRICALLY IN THE FOLLOWING WAY. LET A LINE THROUGH P1
C INTERSECT THE LINE SEGMENTS P2 TO P3 AND P5 TO P4 IN POINTS Q1 AND
C Q2, RESPECTIVELY. SELECT THE LINE SO THAT THE LINE SEGMENT P2 TO
C Q1 HAS THE SAME RATIO TO THE LINE SEGMENT P2 TO P3 AS THE LINE
C SEGMENT P5 TO Q2 HAS TO THE LINE SEGMENT P5 TO P4. FA IS THE
C COMMON RATIO. FB IS DEFINED SIMILARLY. THE VALUES OF THE
C INTERPOLATION PARAMETERS ARE ALSO RETURNED.
C
C IF THE INTERPOLATION PROBLEM IS WELL FORMULATED GEOMETRICALLY, THE
C INTERPOLATION PARAMETERS ARE UNIQUELY DEFINED. THE LOGICAL
C VARIABLE NO NTRP IS SET TRUE IFF THE PROBLEM FORMULATION DOES NOT
C ADMIT OF A FEASIBLE SOLUTION FOR FA AND FB, I.E. SUCH THAT BOTH
C ARE IN THE RANGE (0,1).
C
C      15 MAY, 1978
C      HARRY E. PICKETT
C      THE AEROSPACE CORPORATION
C      EL SEGUNDO, CALIFORNIA
C
C *****
C
C      EXTERNAL VARIABLES
C
C      PROGRAM ARGUMENTS
C
C      REAL
C      *      F(5,N)      ,FA      ,FB
C      *      ,X(5)      ,Y(5)
C
C      INTEGER

```

```

C      *      N
C      LOGICAL
C      *      NO NTRP
C      C
C      C      INTERNAL VARIABLES
C      C
C      REAL
C      *      A      ,B
C      *      ,C      ,CA      ,CAA
C      *      ,D
C      *      ,DAX      ,DABX      ,DBX      ,DCX
C      *      ,DX
C      *      ,DAY      ,DABY      ,DBY      ,DCY
C      *      ,DY
C      *      ,EPS
C      *      ,PSQ
C      *      ,PX      ,PY
C      *      ,QX      ,QY
C      *      ,RCOT
C      C
C      INTEGER
C      *      I
C      C
C      LOGICAL
C      *      A IN RNG      ,B IN RNG
C      C
C      DATA
C      *      EPS/1.E-5/
C      C
C      C      *****
C      C      THIS ROUTINE IS INVOKED BY THE STATEMENT
C      C
C      C      CALL BLINT2D(X,Y,N,F,FA,FB)
C      C
C      C      WHERE
C      C
C      C      X      = SEQUENCE OF 5 X-COORDINATES OF POINTS P1, P2, P3, P4,
C      C      AND P5, RESPECTIVELY, WHERE POINT P1 LIES IN THE
C      C      CONVEX REGION WHOSE VERTICES, IN COUNTER CLOCKWISE
C      C      ORDER ABOUT P1, ARE P2, P3, P4, AND P5, RESPECTIVELY.
C      C      THE POINTS ARE ALL ASSUMED TO LIE IN A PLANE. P1 IS
C      C      THE POINT AT WHICH INTERPOLATED FUNCTION VALUES ARE
C      C      REQUIRED. P2, P3, P4, AND P5 ARE POINTS AT WHICH
C      C      FUNCTION VALUES ARE KNOWN.
C      C
C      C      Y      = SEQUENCE OF 5 Y-COORDINATES OF THE POINTS P1, P2, P3,
C      C      P4, AND P5, RESPECTIVELY.
C      C
C      C      N      = NUMBER OF COMPONENTS OF THE FUNCTION VALUE. IF N IS
C      C      SPECIFIED TO BE LESS THAN OR EQUAL TO ZERO UPON ACCESS,
C      C      THE PARAMETERS FA AND FB ARE COMPUTED, BUT NO FUNCTION
C      C      VALUES ARE INTERPOLATED.
C      C
C      C      F      = 5 BY N ARRAY OF VALUES OF THE N COMPONENT FUNCTIONS
C      C      AT THE POINTS P1, P2, P3, P4, AND P5, RESPECTIVELY.
C      C      F(2,J), F(3,J), F(4,J), AND F(5,J) ARE THE GIVEN VALUES

```

C OF THE J-TH COMPONENT FUNCTION AT THE POINTS P2, P3,
 C P4, AND P5, RESPECTIVELY. F(1,J) IS THE RETURNED
 C INTERPOLATED VALUE OF THE J-TH COMPONENT FUNCTION.
 C
 C FA = RETURNED VALUE OF THE INTERPOLATION PARAMETER A.
 C
 C FB = RETURNED VALUE OF THE INTERPOLATION PARAMETER B.
 C
 C NO NTRP = LOGICAL VARIABLE SET TRUE IFF A FORMULATION ERROR IS
 C DETECTED.

C THE VECTOR P1 SATISFIES

$$P1 = (1-A)(1-B)P2 + A(1-B)P3 + ABP4 + (1-A)BP5,$$

C WHERE A AND B ARE THE INTERPOLATION PARAMETERS. DEFINE
 C (2-DIMENSIONAL) VECTORS D=P1-P2, DA=P3-P2, DB=P5-P2, DC=P4-P2,
 C AND DAB=DA+DB-DC. THE ABOVE EQUATION CAN BE WRITTEN IN THE FORM

$$(DAB \cdot A - DB) \cdot B = (DA \cdot A - D).$$

C IF BOTH SIDES OF THIS LATTER EQUATION ARE CROSSED WITH THE VECTOR
 C (CONSIDERED NOW AS 3-DIMENSIONAL) $(DAB \cdot A - DB)$, THE FOLLOWING
 C EQUATION RESULTS, IN WHICH THE PARAMETER A APPEARS ALONE.

$$(DAB \cdot A - DB) \times (DA \cdot A - D) = 0.$$

C THE PARAMETER A IS SOLVED FROM THE QUADRATIC EQUATION OBTAINED BY
 C SETTING THE 3-RD COMPONENT ZERO. (THE OTHER TWO ARE ALREADY
 C ZERO.) ONCE A HAS BEEN OBTAINED, THE PARAMETER B IS OBTAINED BY
 C FORMING THE DOT PRODUCT OF BOTH SIDES OF THE ABOVE EQUATION,
 C INSTEAD OF THE CROSS PRODUCT.

C *****

C BEGIN THE ROUTINE

C *****

C 1 CONTINUE

C NO NTRP = .FALSE.

C FORM THE VECTORS D, DA, DB, DC, AND DAB.

C DX = X(1) - X(2)
 C DY = Y(1) - Y(2)

C DAX = X(3) - X(2)
 C DAY = Y(3) - Y(2)

C DBX = X(5) - X(2)
 C DBY = Y(5) - Y(2)

C DCX = X(4) - X(2)
 C DCY = Y(4) - Y(2)


```

C      TWO REAL SOLUTIONS ARE POSSIBLE.  THEY MUST BE CHECKED FOR
C      FEASIBILITY (I.E., 0.LE.A.LE.1).  THE FIRST FEASIBLE SOLUTION IS
C      ACCEPTED.  IF NEITHER SOLUTION IS FEASIBLE, A FORMULATION ERROR
C      EXISTS.
C
C      A = (-CA-ROOT)/(2.*CAA)
C
C      A IN RNG = -EPS.LE.A .AND. A.LE.1.+EPS
C
C      IF(A IN RNG) GO TO 200
C
C      A = (-CA + ROOT)/(2.*CAA)
C
C      A IN RNG = -EPS.LE.A .AND. A.LE.1.+EPS
C
C      IF(.NOT. A IN RNG) GO TO 9000
C
200 CONTINUE
C
C      A FEASIBLE SOLUTION HAS BEEN OBTAINED FOR A.
C
C
C      COMPUTE THE INTERPOLATION PARAMETER B FROM THE EQUATION
C
C      (DAB*A - DB).(DAB*A - DB)*B
C      = (DAB*A - DB).(DA*A - D).
C
C
C      PX = DABX*A - DBX
C      PY = DABY*A - DBY
C
C      QX = DAX*A - DX
C      QY = DAY*A - DY
C
C      PSQ = PX**2 + PY**2
C
C      IF(PSQ.LT.EPS**2) GO TO 9000
C
C      B = (PX*QX + PY*QY)/PSQ
C
C      CHECK IF B IS FEASIBLE.
C
C      B IN RNG = -EPS.LE.B .AND. B.LE.1.+EPS
C
C      IF(.NOT. B IN RNG) GO TO 9000
C
300 CONTINUE
C
C      FEASIBLE VALUES HAVE BEEN OBTAINED FOR THE INTERPOLATION
C      PARAMETERS.  RETURN THE VALUES IN FA AND FB AND INTERPOLATE THE
C      VECTOR FUNCTION.
C
C      FA = A
C      FB = B
C
C      IF(N.LE.0) GO TO 9999
C

```

```

      DO 310 I = 1,N
C
      F(1,I)=      (1. - A)*(1. - B)*F(2,I)
      *            +      A      *(1. - B)*F(3,I)
      *            +      A      *      B      *F(4,I)
      *            + (1. - A)*      B      *F(5,I)
C
310  CONTINUE
C
C
      GO TO 9999
C
C
C *****ERROR RETURNS*****
C
9000  CONTINUE
C
C *****
C
C
      NO NTRP = .TRUE.
C
      GO TO 9999
C
C
C *****
C
C
      RETURN TO THE CALLING PROGRAM
9999  CONTINUE
C *****
C
      RETURN
C
      END

```