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SAI--444-82-143-LJ

DE83 002436

PROGRAM LISTING FOR
HEAT-PUMP SEASONAL-PERFORMANCE MODEL (SPM)

Topical Report Task 3

CONSUMER-PRODUCTS MINIMUM-ENERGY-
EFFICIENCY STANDARDS PROGRAM

30 June 1982

Prepared for

Assistant Secretary for Conservation
and Renewable Energy
U. S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

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PROGRAM CNHSPM

C
C*****

C
C *** S A I COOLING AND HEATING SEASONAL PERFORMANCE MODEL ***

C
C THIS MODEL PREDICTS HEAT PUMP SEASONAL ENERGY CONSUMPTION
C (INCLUDING DEFROST, CYCLIC DEGRADATION, AND SUPPLEMENTARY HEAT)
C USING STEADY STATE RATING POINT PERFORMANCE AND BINNED WEATHER
C DATA.

C
C+++++

C
C REFERENCES:

- C
C 1. "USER'S MANUAL FOR HEAT PUMP SEASONAL PERFORMANCE MODEL
C (SPM) WITH SELECTED PARAMETRIC EXAMPLES", SAI-444-82-141-LJ,
C CONTRACT DE-AC03-79-CS10757 (MOD-1), JUNE 30, 1982.
- C
C 2. "HEAT PUMP SEASONAL PERFORMANCE (HPSPM) MODEL DATA BASES",
C SAI-444-80-473-LJ, CONTRACT DE-AC03-79-CS10757 (MOD-1),
C AUGUST 28, 1980.
- C
C 3. "SEASONAL PERFORMANCE MODELING OF ROOM AND CENTRAL AIR
C CONDITIONERS AND HEAT PUMPS", SAI-444-80-279-LJ, CONTRACT
C DE-AC03-79-CS10757, FEBRUARY 28, 1980.
- C
C 4. "ENERGY EFFICIENCY PROGRAM FOR ROOM AIR CONDITIONERS,
C CENTRAL AIR CONDITIONERS, DEHUMIDIFIERS AND HEAT PUMPS",
C SAI-77-858-LJ, CONTRACT NO. CR-04-60724-00, MARCH 1978.

C
C+++++

C
C THIS IS THE MAIN PROGRAM FOR THE COMBINED COOLING AND HEATING
C SEASONAL PERFORMANCE MODEL (HEAT PUMP).

C
C THIS IS A DRIVER TO RUN SUBROUTINES FROM:

C
C "DFHSPM" (HEATING)

C
C AND "CACSPM" (COOLING)

C
C WHICH ARE MODIFIED VERSIONS OF RJR'S SPM'S (OF SUMMER '80).

C
C [HCB, 3-10-82]

C
C*****

C
C INCLUDE 'CASES.COM'

C
C INCLUDE 'CLWEAT.COM'

C
C INCLUDE 'CPWID.COM'

C
C INCLUDE 'DOE.COM'

C
C INCLUDE 'CSZ.COM'

C

INCLUDE 'HTWEAT.COM'

INCLUDE 'HSZ.COM'

INCLUDE 'MOD.COM'

INCLUDE 'RW.COM'

INCLUDE 'SITE.COM'

INCLUDE 'SUMRY.COM'

C--START EXECUTABLE STMTS.

C--READ THE CASES TO BE ANALYZED.

CALL CASER

C--INITIALIZE.

CALL INIMS

C--PRINTOUT RUN SUMMARY LISTING IF REQUESTED.

IMODEP=3

IF(IPRNTA .EQ. 'Y') CALL PRNTMS(1)

C--ZERO STARTING VARIABLES.

CALL ZEROMS(1)

IPASS=0

START RUN LOOP

10 CONTINUE

IPASS=IPASS+1

TYPE 5500, IPASS

5500 FORMAT(' BEGIN RUN ',I2)

ISBST = IPASS - ISTSZ * ((IPASS - 1) / ISTSZ)

IROW = IPASS

C--ZERO CASE VARIABLES.

CALL ZEROMS(2)

C--INITIALIZE CASE VARIABLES & SUBROUTINES.

ISITE = ISITEM(IPASS)

TODC=STODC(ISITE)

DELTD = TODC - 75.

KENTER=1


```
C
C READ LOW OR SINGLE SPEED HEAT PUMP DATA
C
C CALL HPMOD(KENTER,62.,20.)
C
C IF(KENTER.LT.0)GO TO 10
C
C --FILL THE COMMONS RELATED TO DOE SEER CALCULATIONS AND
C DETERMINE THE SEER FOR THIS CAC.
C
C   IFAN = 1
C   CDC1 = 0.25
C   CALL CACPM5(82., 80., 67.)
C   EERB=HCTOT/HETOT
C   PLF=1.-.5*CDC1
C   SEER=PLF*EERB
C
C   ISHRS = 'N'
C   IDHRS = 'N'
C
C   ICYDEG=0
C   IF(ICYCLE.GT.0.AND.TAUON.GT.-98.)ICYDEG=1
C
C   ASSIGN HEAT PUMP COOLING DESIGN PROPERTIES
C
C   CLCAP=CACLRP
C   IF (ISPEED.EQ.1) CLCAP=CACLRP
C   TAUON=HTAUON
C   TAUOFF=HTAUOF
C   FHCAPH=1.
C   FHCAPL=1.
C   FPWRH=1.
C   FPWRL=1.
C
C   GET WEATHER DATA
C
C   CALL HWREAD
C   CALL CWREAD
C
C   IF(ABS(TODBM(1)-999.).LT.1.)GO TO 10
C   IF(ABS(TODBCM(1)-999.).LT.1.)GO TO 10
C
C   TODC=STODC(ISITE)
C   NRAN=ISRA(ISITE)
C   TODH=STODH(ISITE)
C   DDYSNO = SGGDY(ISITE)
C   EFLHNO = DDYSNO * 24. / (65. - TODH)
C   EFLHSP = EDDYS * 24. / (65. - TODH)
C   DOEHLH = SHLH(ISITE)
C   DOERGN(1) = SRGN(ISITE, 1)
C   DOERGN(2) = SRGN(ISITE, 2)
C
C   DO WEATHER RELATED TOTALS
C
C   CALL ZEROMS(5)
C   CALL TOTMS(4, 99)
```

```
C      CALL AVGMS(4, 99)
C
C      PERFORM HEATPUMP/BUILDING SIZING
C
C      CALL HTSIZE
C
C
C      END GENERAL RUN BY RUN SETUP
C
C ***** START COOLING CALCULATIONS *****
C
C      IF(IMODE.EQ.2) GOTO 20
C      IMODEP=1
C      TIDB=TIDBC
C      ANACH=ANACHC
C
C      SET UP TOTAL BIN HOURS FOR DRY-BULB BIN CALCULATIONS
C      BEFORE COMPRESSING BIN HOURS FOR SPM ANALYSIS.
C
C      CALL DBBMS(1)
C
C      C--COMPRESS BIN HOURS FOR SPM ANALYSIS BY ELIMINATING
C      C-- HOURS FOR TEMP < TMIN & TMIN & SUM THE SOLAR & DARK
C      C-- HOURS LEFT.
C
C      CALL ZEROMS(3)
C
C      C--DETERMINE THE AIR CHANGEOVER RATE FOR EACH BIN.
C
C      CALL QLMS(3, 99, 99., 99., 99.)
C
C      DO SOLAR HOUR ANALYSIS
C
C      IF(SHTOT .GT. 0.01) ISHRS = 'Y'
C
C      IF(ISHRS .EQ. 'N') GO TO 1140
C
C      C--CALCULATE OPERATING POINT RESULTS
C      C-- FOR SOLAR HOURS.
C
C      CALL SPCMS(1, DELTD)
C
C      1140 CONTINUE
C
C      DO DARK HOURS ANALYSIS
C
C      CALL ZEROMS(4)
C      IF(DHTOT .GT. 0.01) IDHRS = 'Y'
C      IF(IDHRS .EQ. 'N') GO TO 1240
C
C      C--CALCULATE OPERATING POINT RESULTS FOR
C      C-- DARK HOURS.
C
C      CALL SPCMS(2, DELTD)
C
C      C--COMBINE THE SOLAR & DARK HOUR RESULTS.
```


CALL SPCMS(3, 99.)

1240 CONTINUE

--DO COLUMN TOTALS.

CALL TOTMS(1, 99)

--DO AVERAGES.

CALL AVGMS(1, 99)

--DETERMINE FAN ENERGY CONSUMPTION DURING OFF PERIODS
-- & ADD TO R*KWH-S.

IF(IAF.EQ. 0)CALL SPCMS(4, 99.)

--CALCULATE EER-S.

CALL SPCMS(5, 99.)

--SAVE TOTALS FOR COMPRESSED SP PRINTOUT.

CALL TOTMS(2, IROW)

--SAVE AVERAGES FOR COMPRESSED SP PRINTOUT.

CALL AVGMS(2, IROW)

IF(INBS.EQ.'N')GO TO 345

DO DRY-BULB (NBS-TYPE) BIN CALCULATIONS. ASSUME PER NBS
THAT QLOAD=0. AT 65 DEG-F AND QLOAD=HCTRP/1.1 AT 95 DEG-F

CALL DBBMS(2)

345 CONTINUE

--DO TOTALS.

CALL TOTMS(3, IROW)

--DO AVERAGES.

CALL AVGMS(3, IROW)

*** END OF COOLING CALCULATIONS ***
***** BEGIN HEATING CALCULATIONS *****

CONTINUE

IF(IMODE.EQ.1) GOTO 30

IMODEP=2

TIDB=TIDBH

```
      ANACH=ANACHH
C
      CALL HPHMDL
C
C ***   END HEATING CALCULATIONS   ***
C      CALL FOR OUTPUTS
C
      30 CONTINUE
C
C      COOLING OUTPUT
C
C--PRINT THE WEATHER STATISTICS IF REQUESTED.
C
      IF(IMODE.EQ.2) GOTO 40
      IMODEP=1
      TIDB=TIDBC
      ANACH=ANACHC
C
      IF(IWEA .EQ. 'N') GO TO 1120
      CALL PRNTMS(13)
      IF(IWEA .EQ. 'WO') GO TO 1800
C
C--PRINT THE PRODUCT DATA IF REQUESTED.
C
      1120 CONTINUE
      IF(IPROD .EQ. 'N') GO TO 1110
      CALL PRNTMS(2)
      IF(IPROD .EQ. 'PO') GO TO 1800
      1110 CONTINUE
C
      IF(IPRNTL .EQ. 'N') GO TO 1150
C
C--PRINT OPERATING POINT RESULTS.
C
      CALL PRNTMS(3)
C
C--PRINTOUT OF LOAD RESULTS FOR SOLAR HOURS.
C
      CALL PRNTMS(4)
C
      1150 CONTINUE
C
      IF(IPRNTM .EQ. 'N') GO TO 1250
C
C--PRINT OPERATING POINT RESULTS FOR DARK HOURS.
C
      CALL PRNTMS(5)
C
C--PRINT LOAD COMPONENT RESULTS FOR DARK HOURS.
C
      CALL PRNTMS(6)
C
      1250 CONTINUE
```

```
C
      IF(ISHRS.EQ.'N' .OR. ISOL.EQ.'N')GO TO 325
C--PRINT SOLAR HOUR SP RESULTS.
C
      CALL PRNTMS(7)
325    CONTINUE
C
      IF(IDHRS.EQ.'N' .OR. IDARK.EQ.'N')GO TO 335
C
C--PRINT DARK HOUR SP RESULTS.
C
      CALL PRNTMS(8)
335    CONTINUE
C
C--PRINT COMBINED SP RESULTS.
C
      CALL PRNTMS(10)
C
C--PRINT THE DRY-BULB-RIN RESULTS.
C
      IF(INBS.EQ.'CO' .OR. INBS.EQ.'N') GO TO 1800
      CALL PRNTMS(11)
C
1800  CONTINUE
C
C
C *** END COOLING BASED OUTPUT ***
C *** CALL FOR HEATING BASED OUTPUT ***
C
40    CONTINUE
      IF(IMODE.EQ.1) GOTO 50
      IMODEP=2
      TIDB=TIDBH
      ANACH=ANACHH
C
      CALL PRNTL
C
C *** END HEATING PRINTOUT ***
C
50    CONTINUE
C
C--CALL FOR ECONOMICS & OUTPUT
C
      IMODEP=3
      IF(IECON.EQ.1) CALL ECONO(1)
      IF(IECON.EQ.1) CALL PRNTMS(18)
C
C      DO NEXT RUN
C
      IF(IPASS.LT.NCASES)GO TO 10
C
C
C      PRINT SUMMARIES
C
      IMODEP=3
```

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WAS INTENTIONALLY
LEFT BLANK

INCLUDE 'TOTS.COM'

C

C--START EXECUTABLE STMTS.

C

GO TO (1100, 1200, 1300, 1400) IWHERE

C

1100 CONTINUE

C

DO 1150 I=1,60

RHO = RHOM(I)

IF(CPHRST(I) .LT. 0.01) GO TO 1110

RHI AVG(I)=(CPHRSS(I)*RHIS(I)+CPHRSD(I)
& *RHID(I))/CPHRST(I)

1110 CONTINUE

IF(TOTH(I) .LT. 0.01) GO TO 1120

FCY AVG(I)=(SOLH(I)*FCYS(I)+
& DKH(I)*FCYD(I))/TOTH(I)FONAAM(I)=(SOLH(I)*FONASM(I)+
& DKH(I)*FONADM(I))/TOTH(I)

1120 CONTINUE

X1=0.

X2=0.

IF(PWSOL(I).GT.0.00001)X1=CPHRSS(I)/PWSOL(I)

IF(PWDRK(I).GT.0.00001)X2=CPHRSD(I)/PWDRK(I)

IF(X1.GT.0.00001.OR.X2.GT.0.00001)PWAVG(I)=CPHRST(I)/(X1+X2)

RHIWAS=CPHRSS(I)*RHIS(I)+RHIWAS

RHIWAD=CPHRSD(I)*RHID(I)+RHIWAD

RHIWAT=CPHRST(I)*RHI AVG(I)+RHIWAT

RHOWAS=CPHRSS(I)* RHO +RHOWAS

RHOWAD=CPHRSD(I)* RHO +RHOWAD

RHOWAT=CPHRST(I)* RHO +RHOWAT

RHIACS = SOLH(I) * RHIS(I) + RHIACS

RHIACD = DKH(I) * RHID(I) + RHIACD

RHIACT = SOLH(I) * RHIS(I) + DKH(I) * RHID(I) + RHIACT

RHOACS = SOLH(I) * RHO + RHOACS

RHOACD = DKH(I) * RHO + RHOACD

RHOACT = SOLH(I) * RHO + DKH(I) * RHO + RHOACT

FCYWAS=SOLH(I)*FCYS(I)+FCYWAS

FCYWAD=DKH(I)*FCYD(I)+FCYWAD

FCYWAT=TOTH(I)*FCY AVG(I)+FCYWAT

FONAAS=SOLH(I)*FONASM(I)+FONAAS

FONAAD=DKH(I)*FONADM(I)+FONAAD

FONAAT=TOTH(I)*FONAAM(I)+FONAAT

IF(PWSOL(I).GT.0.00001)PWWAS=CPHRSS(I)/PWSOL(I)+PWWAS

IF(PWDRK(I).GT.0.00001)PWWAD=CPHRSD(I)/PWDRK(I)+PWWAD

IF(PWAVG(I).GT.0.00001)PWWAT=CPHRST(I)/PWAVG(I)+PWWAT

1150 CONTINUE

C

IF(SHTOT .LE. 0.01)GO TO 311

RHIWAS=RHIWAS/TOT(16)

RHIACS = RHIACS / TOT(13)

RHOWAS=RHOWAS/TOT(16)

RHOACS = RHOACS / TOT(13)

FCYWAS=FCYWAS/TOT(13)

FONAAS = FONAAS / TOT(13)

311 CONTINUE

IF(DHTOT .LE. 0.01) GO TO 312

RHIWAD=RHIWAD/TOT(17)

RHIACD = RHIACD / TOT(14)

RHOWAD=RHOWAD/TOT(17)

RHOACD = RHOACD / TOT(14)

FCYWAD=FCYWAD/TOT(14)

FONAAD = FONAAD / TOT(14)

312 CONTINUE

RHIWAT=RHIWAT/TOT(18)

RHIACT = RHIACT / TOT(15)

RHOWAT=RHOWAT/TOT(18)

RHOACT = RHOACT / TOT(15)

FCYWAT=FCYWAT/TOT(15)

FONAAT = FONAAT / TOT(15)

IF(PWWAS.GT.0.00001)PWWAS=TOT(16)/PWWAS

IF(PWWAD.GT.0.00001)PWWAD=TOT(17)/PWWAD

IF(PWWAT.GT.0.00001)PWWAT=TOT(18)/PWWAT

GO TO 9990

C

1200 CONTINUE

C

AVGPRT(IROW, 1) = RHOWAT

AVGPRT(IROW, 2) = TOT(3) / TOT(12)

AVGPRT(IROW, 3) = TOT(9) / TOT(3) * 100.

AVGPRT(IROW, 4)=RHIWAT

AVGPRT(IROW, 5)=FCYWAT

AVGPRT(IROW, 6)=PWWAT

AVGPRT(IROW, 7) = 100. * FONAAT

AVGPRT(IROW, 8) = RHOACT

AVGPRT(IROW, 9) = EERRP

AVGPRT(IROW, 10) = RHIACT

C

DO 341 I=1, 10

AVGPRT(61,I)=AVGPRT(IROW,I)+AVGPRT(61,I)

341 CONTINUE

C

GO TO 9990

C

1300 CONTINUE

C

ANBAPR(IROW)= TOTDB(3) / TOTDB(4)

ANBAPR(61)=ANBAPR(61)+ANBAPR(IROW)

GO TO 9990

C

1400 CONTINUE

C

C--AVERAGE OUTDOOR RH OVER BIN HOURS.

C

DO 1410 I = 1, 6

RHOAHS = RHOBAS(I) * TOWRHS(I) + RHOAHS

RHOAHD = RHOBAS(I) * TOWRHD(I) + RHOAHD

RHOAHT = RHOBAS(I) * TOWRHT(I) + RHOAHT

1410 CONTINUE

C

DUMA = 0.

DUMB = 0.

DUMC = 0.

DO 1420 I = 1, 6

DUMA = TOWRHS(I) + DUMA

DUMB = TOWRHD(I) + DUMB

DUMC = TOWRHT(I) + DUMC

1420 CONTINUE

C

RHOAHS = RHOAHS / DUMA

RHOAHD = RHOAHD / DUMB

RHOAHT = RHOAHT / DUMC

C

9990 CONTINUE

RETURN

END

SUBROUTINE CACIT(TODB,RHO,TIDB,TIWB,FON,NIT)

C

C*****

C

THIS SUBROUTINE PERFORMS ITERATIONS ON THE FOLLOWING

TWO EQUATION FORMS TO DETERMINE A SELF-CONSISTENT

SET OF WI, HI, AND FON:

AA*WI+FON*HL/1060.=RHS98 (WATER BALANCE)

AA*HI+FON*HCTOT=RHS108 (TOTAL HEAT BALANCE)

THE RHS'S ARE CONSTANTS. HL AND HCTOT DEPEND ON WI AND/
OR HI.

C

C*****

C

VARIABLE

DEFINITION

UNITS

DEFINED IN:

C

AA

AIR CHANGED

(LB/HR)

SPCSC

C

RHS98

LATENT LOAD

(LB-H2O/HR)

"

C

RHS108

TOTAL LOAD

(BTU/HR)

"

C

HL

COOLING CAPACITY, LATENT (BTU/HR)

CACPMS

C

HCTOT

" " , TOTAL (S&L) (BTU/HR)

"

C

W

HUMIDITY RATIO (LB-H2O/LB-AIR)

PSYALL

C

H

ENTHALPY

(BTU/LB)

"

C

FON

FRACTIONAL ON TIME

(HR/HR)

(OUTPUT)

C

C+++++

C

NOTES:

C

1)

THE ITERATION IS MADE BY ASSUMING A VALUE FOR THE
INDOOR WET BULB TEMP. (ACTUALLY FIVE VALUES FOR THE
CONVERGENCE METHOD USED) AND TESTING THE DIFFERENCE IN
FON CALCULATED VIA THE ABOVE EQU'S.

C

C+++++

C

DIMENSION TWE(5),FOA(5),FOB(5),DIF(5),KK(5)

C

COMMON/RIT/RHS98,RHS108,AA,LHS98,LHS108

C

COMMON/RM/KENTER,MODNUM,HCTRP,HERP,EERRP,TAUON,TAUOFF,

C

1 HS,HL,HCTOT

C

COMMON/CP/TD,TW,TDEE,TDEW,RH,W,WS,H

```
C
  INCLUDE 'PSYC.COM'
  INCLUDE 'RIT.COM'
C
  INCLUDE 'MOD.COM'
C
C--START EXECUTABLE STATEMENTS.
C
  TD=TIDB
C
  SET UP FOR CONVERGENCE ITERATIONS
C
  TWE(1)=TIDB-0.001
  TWE(2)=TIDB-7.5
  TWE(3)=TIDB-13.
  TWE(4)=TIDB-21.5
  TWE(5)=TIDB-30.
  CRI=0.00028
C--THIS TOLERANCE IS ABOUT 1 SEC/HR.
  NITMAX=20
  NIT=1
  KEND=0
C
  BEGIN ITERATIONS AT GUESS 1
C
10 CONTINUE
  TW=TWE(1)
  TIWB = TW
C
C--GET PRODUCT AND AIR DATA
C
  CALL CACPMS(TODB, TIDB, TIWB)
  CALL PSYALL
C
  IF(HL.LT. 1.)HL= 1.
C
C--CALC. AND TEST ITERATION 1
C
  FOA(1)=(RHS9B-AA*W)*1060./HL
  FOB(1)=(RHS10B-AA*H)/HCTOT
  DIF(1)=FOB(1)-FOA(1)
  IF(ABS(DIF(1)).LT.CRI)KEND=1
  DO 15 I=1,5
  KK(I)=0
15 CONTINUE
C
  GUESSES 2 THRU 5
C
DO 20 I=2,5
  IF(KEND.GT.0)GO TO 20
  TW=TWE(I)
  TIWB = TW
  CALL CACPMS(TODB, TIDB, TIWB)
  CALL PSYALL
```

```
C      IF(HL.LT.1.)HL=1.
      FOA(I)=(RHS9B-AA*W)*1060./HL
      FOB(I)=(RHS10B-AA*H)/HCTOT
      DIF(I)=FOB(I)-FOA(I)
      IF(ABS(DIF(I)).LT.CRI)KEND=I
      X1=FOA(I)-FOB(I)
      X2=FOB(I-1)-FOA(I-1)
      Y1=-X1
      Y2=-X2
      IF(X1.GT.0..AND.X2.GT.0.)KK(I)=I
      IF(Y1.GT.0..AND.Y2.GT.0.)KK(I)=I
20  CONTINUE

C      TESTS AFTER EACH COMPLETE ITERATION
C
C      KCOUNT=0
      DO 30 I=1,5
      IF(KK(I).GT.0)KCOUNT=KCOUNT+1
      IF(KK(I).GT.0)KKK=I
30  CONTINUE
      IF(KEND.GT.0)GO TO 80
      IF(KCOUNT.GT.1)GO TO 998
      IF(KCOUNT.LT.1)GO TO 998

C      SET UP FOR NEXT ITERATION
C
C      TWE(5)=TWE(KKK)
      TWE(1)=TWE(KKK-1)
      TWE(3)=(TWE(5)+TWE(1))/2.
      TWE(2)=(TWE(1)+TWE(3))/2.
      TWE(4)=(TWE(3)+TWE(5))/2.
      NIT=NIT+1
      IF(NIT.GT.NITMAX)GO TO 999
      GO TO 10

C      ITERATION CONVERGED SUCESSFULLY
C      ASSIGN WET BULB TEMPERATURE AND FON (IDEAL)
C
80  TIWB=TWE(KEND)
      FON=(FOB(KEND)+FOA(KEND))/2.
      IF(FON.LT.0.00001)FON=0.00001
      ALS9B=W*AA+FON*HL/1060.
      ALS10B=H*AA+FON*HCTOT
      RETURN

C      ERROR MESSAGES
C
998 CONTINUE

C      IF KCOUNT .GT. 1 THERE ARE MORE THAN 1 CONVERGENCE
C      TARGET POINTS.  *** BAIL OUT ***.
C
      FON=FLOAT(10*KCOUNT)

C      IF KCOUNT .EQ. 0 THERE IS NO CONVERGENCE TARGET
C      POINT.  *** BAIL OUT ***.
```

```

C
  IF(KCOUNT.EQ.0)FON=-1.
  RETURN
999 CONTINUE
  WRITE(5,5001) NIT, TODB, RHO
  NIT=NIT-1
  FON=999.
C
9990 CONTINUE
  RETURN
5001 FORMAT(/,' NIT=',I3,' .GT. NITMAX IN CACIT CAUSING RETURN',
1      ' TO MAIN WITH FON=999.',/, ' TODB=',F5.1,' RHO=',F4.1)
  END
  SUBROUTINE CACPM5(TODB, TIDB, TIWB)

```

```

C
C*****
C
C  CAC PRODUCT MASTER SUBROUTINE.
C
C  R. J. RETTBERG   20 AUG 1979.
C
C*****

```

```

C
C  NOTES:
C    1. MODEL OF GE BWB936A CONDENSING UNIT W/ BWV936G AIR
C       HANDLER @ 1200 CFM.
C
C    2. PRODUCT DATA IS DEFINED IN THE CODE OF SUBROUTINES:
C       HPMOD
C       SENXXX
C       CPPWR
C       XXXCAP.
C
C    3. OUTPUTS ARE GIVEN IN LAST LINES OF THIS CODE.
C
C    4. THE SCALE FACTORS 'SFCPC' AND 'SFPWC' HAVE BEEN ADDED
C       TO THE OUTPUT CALCULATIONS. [HCB, 4-82].
C
C*****

```

```

C*****
C
C      VARIABLE                DEFINITION                DEFINED IN:
C
C      BHECP                   COMPRESSOR ENERGY                CPPWR
C      BHEFI                   FAN ENERGY, INDOOR              INIMS
C      BHEFO                   " " , OUTDOOR                    "
C      BHCXXX                   COOLING CAPACITY
C      DRY                      , DRY                            DRYCAP
C      TOT                      , TOTAL (S&L)                    "
C      S                        , SENSIBLE                        SENXXX
C      L                        , LATENT                          (HERE)
C
C*****

```

```

C*****
C
C  DIMENSION TEMPLM(4)
C
C  INCLUDE 'BCACOD.COM'

```



```
C
C      INCLUDE 'BCACRD.COM'
C
C      INCLUDE 'CSZ.COM'
C
C      INCLUDE 'MOD.COM'
C
C      DATA TEMPLM/ 65., 85., 95., 115./
C
C--START EXECUTABLE STATEMENTS.
C
C
C      DETERMINE COOLING CAPACITIES
C
C      CALL CPPWR(TODB, TIWB, BHECP)
C      BHETOT = BHECP + BHEFI + BHEFO
C      CALL DRYCAP(TODB, TIDB, BHCDRY)
C      CALL TOTCAP(TODB, TIWB, BHCTOT)
C
C
C      DETERMINE SENSIBLE COOLING CAPACITY
C
C      IF(TODB .LE. 65.)GO TO 1400
C      IF(TODB .GE. 115) GO TO 1450
C
C      INTERPOLATE FOR SENSIBLE COOLING CAPACITY WHEN TODB IS
C      BETWEEN 65 AND 115 F.
C
C      DO 1080 I = 1, 3
C          ISAVE = I
C          IF(TODB .LT. TEMPLM(I+1)) GO TO 1081
C      1080 CONTINUE
C      1081 CONTINUE
C
C      GO TO (1165, 1185, 1195) ISAVE
C
C      1165 CONTINUE
C
C--TODB BETWEEN 65 & 85 DEG-F.
C
C      CALL SEN65(TIDB, TIWB, BHCS)
C      DUMA = BHCS
C      CALL SEN85(TIDB, TIWB, BHCS)
C      DUMB = BHCS
C      DUMC = TODB - 65.
C      DUMD = 85. - 65.
C      BHCS = DUMA + (DUMC / DUMD) * (DUMB - DUMA)
C      GO TO 1480
C
C      1185 CONTINUE
C
C--TODB BETWEEN 85 & 95 DEG-F.
C
C      CALL SEN85(TIDB, TIWB, BHCS)
C      DUMA = BHCS
C      CALL SEN95(TIDB, TIWB, BHCS)
C      DUMB = BHCS
```

DUMC = TODR - 85.

DUMD = 95. - 85.

BHCS = DUMA + (DUMC / DUMD) * (DUMB - DUMA)

GO TO 1480

C

1195 CONTINUE

C

C--TODR BETWEEN 95 & 115 DEG-F.

C

CALL SEN95(TIDR, TIWR, BHCS)

DUMA = BHCS

CALL SEN115(TIDR, TIWR, BHCS)

DUMB = BHCS

DUMC = TODR - 95.

DUMD = 115. - 95.

BHCS = DUMA + (DUMC / DUMD) * (DUMB - DUMA)

GO TO 1480

C

C

1400 CONTINUE

CALL SEN65(TIDR, TIWR, BHCS)

GO TO 1480

1450 CONTINUE

CALL SEN115(TIDR, TIWR, BHCS)

C

1480 CONTINUE

IF(BHCS .LT. BHCTOT) GO TO 1500

BHCS = BHCTOT

C

C--SET BHCL TO SOME NONZERO VALUE DECREASING TO ZERO W/

C-- DECREASING RH SO THAT UNDER VERY LOW RH CONDITIONS

C-- THE ITERATION EQUATIONS DO NOT ASSUME A DEGENERATE

C-- FORM.

C

BHCL = 1. * TIWR / TIDR

BHCTOT = BHCTOT

GO TO 1600

C

C

CALCULATE AND ASSIGN OUTPUTS

C

1500 CONTINUE

BHCL = BHCTOT - BHCS

C

1600 CONTINUE

C

C--SET VALUES IN CM.COM (OUTPUTS)

C

HS = BHCS * SFCPC

HL = BHCL * SFCPC

HCTOT = BHCTOT * SFCPC

HETOT = BHETOT * SFPWC

C

C--DETERMINE ACTUAL & RELATIVE EER-S.

C

BEERAC = HCTOT / HETOT

BEERRE = BEERAC / BRPEER

C

9990 CONTINUE
 RETURN
 END
 SUBROUTINE CASER

C

C*****

C

C CASE READING SUBROUTINE FOR COOLING AND HEATING SPM'S. MODIFIED FROM
 C THOSE OF R. J. RETTBERG (JAN 1980). HCB [2-82]

C

C*****

C

C

C NOTES:

C

C

C

C 1) ECONOMIC PARAMETER INPUTS ADDED [HCB, 4-82].

C

C

C

C 2) THE HEAT PUMP IS NOW DEFINED BY INPUT VALUES GIVEN FOR THREE
 C STATE POINTS (95, 47, 17 DEG-F). [HCB, 4-82]

C

C+++++

C

C INCLUDE 'BCACRD.COM'

C

C INCLUDE 'CASES.COM'

C

C INCLUDE 'ECON.COM'

C

C INCLUDE 'MOD.COM'

C

C INCLUDE 'RW.COM'

C

C INCLUDE 'CPWID.COM'

C

C--START EXECUTABLE STMTS.

C

C OPEN (UNIT=12,DEVICE='DSK',ACCESS='SEQIN',FILE='SPMRUN.DAT')

C

C

C READ ALL RUN DATA EXCEPT MODEL AND SITE IDENTIFICATIONS.

C

C READ(12, *) NCASES, ISTSZ, IMODE

C READ(12, *) IAF, ICYCLE, IECON, ISPEED

C READ(12, *) IWEAT, IRSARE

C READ(12, *) TIDBC, TIDBH, TIDBBN, TMINS, TMIND

C READ(12, *) ANACHC, ANACHH, QIIPSF, RESARI, EOSIZE, SHSF

C READ(12, *) TSNAM, CYCMAX, TAU

C READ(12, *) (RHOBAS(JA), JA = 1, 6)

C READ(12, *) CACLRP, EERLRP

C READ(12, *) CAHLRP, COHLRP

C READ(12, *) CALLRP, COLLRP

C

C

C

C NCASES = # CASES TO BE ANALYZED WHERE EACH
 C PRODUCT MODLE/SITE COMBINATION IS A CASE.

C

C

C ISTSZ = # CASES PER SET. A SUMMARY LISTING IS PROVIDED
 C AFTER EACH "ISTSZ" CASES. IF ISTSZ = 0, OR

C

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IPRNTH = WEATHER DATA STATISTICS PRINTOUT.
NOTE - "WO" = WEATHER P/O ONLY (COOLING).

IPRNTI = TEMPERING HEAT DETAIL PRINTOUT.
NOTE: "TO" = T.H. P/O ONLY (HEATING).

IPRNTJ = "Y" IF YOU ONLY WANT SUMMARIES OF RESULTS (HEATING).

SWITCH REASSIGNMENTS FOR COOLING MODEL
(THERE ARE NONE FOR THE HEATING MODEL)

ICOMP = IPRNTB
ILOAD = IPRNTC
ISOL = IPRNTD
IDARK = IPRNTE
IPROD = IPRNTF
INBS = IPRNTG
IWEA = IPRNTH
IF(ILOAD .EQ. 'Y' .AND. ISOL .EQ. 'Y') IPRNTL = 'Y'
IF(ILOAD .EQ. 'Y' .AND. IDARK .EQ. 'Y') IPRNTM = 'Y'

INPUTS FOR ECONOMIC CALCULATIONS

READ(12, *) RFI, RDSC, REE, ECKWH
READ(12, *) HPLIFE, WRNTY
READ(12, *) SVGWOD, SVGWD

RFI = INTEREST RATE ON LOAN (%/YEAR)

RDSC = DISCOUNT RATE (%/YEAR)

REE = ELECTRICITY ESCALATION RATE (%/YEAR)

ECKWH = ELECTRICITY COST (\$/KWH)

HPLIFE = HEAT PUMP LIFE (YEARS)

WRNTY = LENGTH OF HP WARRANTY (YEARS)

SVGWOD = SALVAGE VALUE OF SYSTEM W/O DUCTS

SVGWD = SALVAGE VALUE OF SYSTEM INCLUDING DUCTS

DO 1200 I = 1, NCASES

READ(12,*, END = 1201) ISITEM(I), IDEFT(I), IDFMOD(I),
& TDFBAS(I)

1200 CONTINUE

1201 CONTINUE

+++++

ISITEM(I) = SITE NUMBER, REFERING TO WEATHER FILE REFERENCE NUMBERS.
= 1 MINNEAPOLIS

C = 2 CHICAGO
C = 3 BOSTON
C = 4 SEATTLE
C = 5 KANSAS CITY
C = 6 PHILADELPHIA
C = 7 SACRAMENTO
C = 8 LAS VEGAS
C = 9 DALLAS
C =10 LOS ANGELES
C =11 NEW ORLEANS
C =12 MIAMI
C =13 LOUISVILLE
C =14 CINCINNATI

C IDEFT(I) = DEFROST TYPE FOR DEFROST CALCULATION SUBROUTINE

C = 0 DO NOT CALL DEFROST CALCULATION SUBROUTINE
C (HP FILE REMAINS AS READ).
C = 1 PEAK, NO DEFROST CYCLE
C = 2 DEMAND DEFROST CYCLE, PRESSURE DIFFERENTIAL SENSOR
C = 3 DEMAND DEFROST CYCLE, TEMPERATURE SENSORS
C = 4 TIMED DEFROST CYCLE WITH DEACTIVATION BY OUTDOOR
C AIR TEMP.
C = 5 TIMED DEFROST CYCLE WITH DEACTIVATION BY OUTDOOR
C COIL TEMP.
C = 6 OPTIMUM DEFROST CYCLE, MAXIMUM HEAT OUTPUT
C = 7 OPTIMUM DEFROST CYCLE, MAXIMUM COP

C IDFMOD(I) = SELECTOR FOR TYPE OF TIMED DEFROST CONTROL
C (APPLIES TO TIMED CONTROLS ONLY).

C = 1 TIME BETWEEN DEFROSTS = 1HR*BASET
C = 2 GE PROGRAMMED CONTROL
C = 3 HONEYWELL PROGRAMMED CONTROL
C = 4 RANCO PROGRAMMED CONTROL

C TDFBAS(I) = BASE TIME FOR TIMED DEFROST OPTIONS (APPLIES TO TIMED
C CONTROLS ONLY). (MIN)

C ++++++

C 9990 CONTINUE

C CLOSE(UNIT=12)

C RETURN

C END

C SUBROUTINE CLSIZE

C *****

C COOLING SIDE SIZING ROUTINE

C R.J.RETTBERG 19 DEC 1978.

C *****

NOTES:

1. ORIGINALLY DEVELOPED FOR DOE HPSPM 1977/78.
2. THIS VERSION FOR DOE 1979/1980 PROGRAM.
 - A. MODIFICATIONS MAINLY IN RELABELING.
3. THE FRACTIONAL PERCENTAGES USED IN THE "F" ARRAY ARE DESCRIBED IN TABLE B2-4 OF THE ORANGE REPORT OF 3-78. THE GENERAL EQU'S, ETC. ARE ALSO GIVEN IN THAT REPORT.
4. MODIFIED TO INCLUDE SENSITIVITY TO EQUIPMENT OVERSIZE FACTOR "EOSIZE", 2-82. RAY PREVIOUSLY HAD THIS FIXED AT 1.475.
5. THE VOLUME (AND AREA) OF THE BUILDING ARE CALCULATED BY DETERMINING THE AIR FLOW RATE AT THE DESIGN DELTA T REQUIRED TO PROVIDE THE INFILTRATION LOAD PREVIOUSLY CALCULATED ($1.08 = .24 * 60 * .075$ AND THE 2 IS THE DESIGN AIR CHANGE RATE).
6. MODIFIED TO INCLUDE A SCALE FACTOR "SFAREA" WHICH FORCES THE BUILDING AREA TO REMAIN CONSTANT. THE DESIGN LOADS ARE THEREFORE MULTIPLIED BY "SFAREA" TO MAINTAIN THE SAME LOAD/AREA. 2-82

```
INCLUDE 'CSZ.COM'
INCLUDE 'CASES.COM'
```

```
DIMENSION F(7),XF4(3),XF5(3),XFX(3),XFY(3)
```

```
DATA XF4/67.4,71.4,76.4/,XF5/51.,55.,60./,
1    XFX/7.6,3.6,-1.4/,XFY/24.,20.,15./
DATA SFAREA /1.0/
```

```
C--START GENERAL EQS
```

```
EQA(A)=AMAX1((1.+(A-90.)/100.)/1.05,1./1.05)
EQB(A)=(A-79.)/16.
EQC(A)=(A-75.)/20.
EQD(A,B)=(A-B)/23.6
EQE(A,B)=(A-B)/40.
```

```
C--END GENERAL EQS
```

```
C--START EXECUTABLE STATEMENTS.
```

```
XXF4=XF4(NRAN+2)
XXF5=XF5(NRAN+2)
XC=XFX(NRAN+2)
YC=XFY(NRAN+2)
FTSZ=EQA(TODC)
QCSDL=CLCAP/EOSIZE/FTSZ
```

C MAKE TEMPERATURE CORRECTIONS TO LOAD COMPONENTS

C
C
C
F(1)=.275
F(2)=EQB(TODC)*0.078
F(3)=EQC(TODC)*0.121
F(4)=EQD(TODC,XXF4)*0.285
F(5)=EQE(TODC,XXF5)*0.124
F(6)=0.068
F(7)=0.049
FTOT=0.

C
C RECALCULATE FRACTIONAL DISTRIBUTION OF LOAD COMPONENTS

C
C
C
DO 1050 I=1,7
FTOT=FTOT+F(I)
1050 CONTINUE
DO 1060 I=1,7
F(I)=F(I)/FTOT
1060 CONTINUE

C
C COMPUTE "SFAREA" FOR CONSTANT RESARE RUNS

C
C
C
IF(IRSARE.NE.1) GOTO 1070
QCSINF=QCSDL*F(3)
RESARE=QCSINF*2.*60./1.08/(TODC-75.)/8.0
SFAREA=RESARI/RESARE
QCSDL =QCSDL*SFAREA
1070 CONTINUE

C
C CALCULATE ACTUAL DESIGN LOAD COMPONENTS, ETC.

C
C
C
QCTDL(1)=QCSDL*F(1)
QCTDL(2)=QCSDL*F(2)
QCSINF=QCSDL*F(3)
RESVOL=QCSINF*2.*60./1.08/(TODC-75.)
QCTDL(3)=QCSDL*F(4)
QCTDL(4)=QCSDL*F(5)
QIIDES=QCSDL*(F(6)+F(7))
QCII=500.*RESVOL/4000.
AMWIIIC=0.25*RESVOL/4000.
RESARE = RESVOL / 8.

C
C 9990 CONTINUE
C RETURN
C END
C SUBROUTINE CPPWR(TODB, TIWB, HECF)

C
C *****

C
C CAC COMPRESSOR INPUT POWER.

C
C R. J. RETTBERG 16 AUG 1979

C
C *****

C
C INPUTS:

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```

THIGH = TEMPLM(ILOW + 1)
DUMA = F(ILOW, TIWB)
DUMB = F(ILOW + 1, TIWB)
DUMC = DUMB - DUMA
DUMD = TODB - TLOW
DUME = THIGH - TLOW
HECP = DUMA + (DUMD / DUME) * DUMC
GO TO 9990

```

C
C

```

1100 CONTINUE
HECP = F(1, TIWB)
GO TO 9990

```

C

```

1200 CONTINUE
HECP = F(7, TIWB)
9990 CONTINUE
HECP = 1000. * HECP
RETURN
END
SUBROUTINE CWREAD

```

C

C*****

C

C THIS SUBROUTINE READS COOLING WEATHER DATA FOR A
C SPECIFIED SITE AND PUTS THE DATA IN COMMON STORE CLWEAT

C

C*****

C

```

DIMENSION INDX(9), DUMDUM(15)

```

C

```

INCLUDE 'CASES.COM'

```

C

```

INCLUDE 'CLWEAT.COM'

```

C

```

INCLUDE 'DUMX.COM'

```

C

```

INCLUDE 'RW.COM'

```

C

```

DATA INDX/ 0, 1, 0, 2, 0, 3, 4, 5, 6/

```

C

C--START EXECUTABLE STATEMENTS.

C

```

OPEN(UNIT=11,DEVICE='DSK',ACCESS='SEQIN',FILE='CWP.DAT')

```

C

```

10 CONTINUE

```

C

```

READ(11,5000,END=999)N,(DUMDUM(II),II=1,15)

```

C

```

DO 20 I=1,60

```

```

    READ(11,5001,END=999)TODBCM(I),RHOM(I),SOLH(I),DKH(I),
    TOTM(I)

```

1

```

20 CONTINUE

```

```

IF(N.NE.ISITE)GO TO 10

```

C

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```

FCY95(A)=3.-(A-85.4)**2/86.64+MIN0(1,IFIX(A/65.))
1      *MAX0(0,MIN0(1,IFIX(70.-A)))*(1.8033-(A-65.)/
2      (70.-65.))*(1.8033-0.4373))+MIN0(1,IFIX(A/70.))
3      *MAX0(0,MIN0(1,IFIX(74.0-A)))*(0.4373-(A-70.)
4      /(74.0-70.))*0.4373)
FCY85(A)=3.-(A-79.15)**2/38.00+MIN0(1,IFIX(A/65.))
1      *MAX0(0,MIN0(1,IFIX(70.-A)))*(2.2690-(A-65.)/
2      (70.-65.))*(2.2690-0.2332))+MIN0(1,IFIX(A/70.))
3      *MAX0(0,MIN0(1,IFIX(71.6-A)))*(0.2332-(A-70.)
4      /(71.6-70.))*0.2332)
FCY100(A)=3.-(A-87.9)**2/117.
FCY90(A)=3.-(A-82.275)**2/63.
FCY80(A)=3.-(A-75.4)**2/25.
EQA(TPA,TAUON)=TPA+TAUON*AMAX1(0.00000001,EXP(-TPA/TAUON))
EGB(TPA,TAUON,TAUOFF)=TPA+(TAUON-TAUOFF)*
1      AMAX1(0.00000001,EXP(-TPA/TAUON))

```

C

C--END GENERAL EQUATIONS.

C

C

C--START EXECUTABLE STATEMENTS.

C

```

      IF(IENTER.GT.1) GO TO 10
      TODB1=0.
      TOD1=0.
10    TODB2=TODB
      TOD2=TODC
      XA=ABS(TODB2-TODB1)
      XB=ABS(TOD2-TOD1)
      IF(XA.LT.CRI.AND.XB.LT.CRI)GO TO 51
      TODB1=TODB2
      TOD1=TOD2
      IF(ABS(TODC-105.).LT.0.1)FCYTEM=FCY105(TODB)
      IF(ABS(TODC-95.).LT.0.1)FCYTEM=FCY95(TODB)
      IF(ABS(TODC-85.).LT.0.1)FCYTEM=FCY85(TODB)
      IF(ABS(TODC-100.).LT.0.1)GO TO 100
      IF(ABS(TODC-90.).LT.0.1)GO TO 90
      IF(ABS(TODC-80.).LT.0.1)GO TO 80
50    CONTINUE
      IF(TODB.GT.80..AND.FCYTEM.LT.0.)FCYTEM=0.
51    CONTINUE
      FCY=FCYTEM
      IF(FCY.LT.0.00001)GO TO 71
      PWI=FONI/FCY*60.
      IF(ICYDEG.EQ.0)PWACT=PWI
      IF(ICYDEG.EQ.0)RETURN
      IF(PWI/TAUON.GT.10.)GO TO 72
      RHS=PWI+TAUON-TAUOFF
      IF(IAF.EQ.1)RHS=PWI+TAUON
      T(1)=AMAX1(0.01,PWI-TAUOFF)
      T(3)=PWI+3*TAUON
      T(2)=(T(1)+T(3))/2.
      NIT=0
      KK=0
55    CONTINUE
      NIT=NIT+1

```

```

DO 60 I=1,3
ERR(I)=EQA(T(I),TAUON)-RHS
IF(IAF.EQ.0)ERR(I)=EQB(T(I),TAUON,TAUOFF)-RHS
IF(ABS(ERR(I)).LT.CRI)KK=I
60 CONTINUE
IF(KK.GT.0)GO TO 70
IF(NIT.GT.NITMAX)GO TO 75
IF(ERR(2).GT.0.)GO TO 65
T(1)=T(2)
T(2)=T(2)+ABS(ERR(2))/(ABS(ERR(2))+ERR(3))*(T(3)-T(2))
GO TO 55
65 CONTINUE
T(3)=T(2)
T(2)=T(1)+ABS(ERR(1))/(ABS(ERR(1))+ERR(2))*(T(2)-T(1))
GO TO 55
70 CONTINUE
PWACT=T(KK)
RETURN
71 CONTINUE
PWI=60.
PWACT=60.
RETURN
72 CONTINUE
PWACT=PWI+TAUON-TAUOFF
IF(IAF.EQ.1)PWACT=PWI+TAUON
RETURN
75 CONTINUE
PWACT=PWI
WRITE(5,5000)
RETURN
80 CONTINUE
FCYTEM=FCY80(TODB)
IF(ABS(TODB-67.).LT.0.1)FCYTEM=0.6
GO TO 50
90 CONTINUE
FCYTEM=FCY90(TODB)
IF(TODB.LT.72.63)FCYTEM=(FCY95(TODB)+FCY85(TODB))/2.
GO TO 50
100 CONTINUE
FCYTEM=FCY100(TODB)
IF(TODB.LT.74.65)FCYTEM=(FCY105(TODB)+FCY95(TODB))/2.
GO TO 50
5000 FORMAT(/, 'CONVERGENCE WAS NOT ACHIEVED IN CYCDEG. PWACT',
1      ' SET = PWI TO AVOID DESTROYING ALL RESULTS.')
```

C

```

9990 CONTINUE
END
SUBROUTINE DBBMS(IWHERE)
```

C

C*****

C

C DRY-BULB-BIN MASTER SUBROUTINE.

C

R. J. RETTBERG 14 JAN 1980.

C

C*****

C

C--START EXECUTABLE STMTS.

GO TO (1100, 1200) IWHERE

C

1100 CONTINUE

C

C--DO TEMPERATURE & HOURS BINNING.

C

CALL DBBSA

GO TO 9990

C

1200 CONTINUE

C

C--DO SP CALCULATIONS.

C

CALL DBBSB

C

9990 CONTINUE

RETURN

END

SUBROUTINE DBBSA

C

C*****

C

C DRY-BULB-BIN TEMPERATURE & HOURS BINNING SUBROUTINE.

C

C R. J. RETTBERG 14 JAN 1980.

C

C*****

C

INCLUDE 'CLWEAT.COM'

C

INCLUDE 'DBBIN.COM'

C

C--START EXECUTABLE STMTS.

C

DO 400 I=1,10

TODBBN(I)=62.+FLOAT(5*I)

HRSBN(I)=0.

DO 400 J=1,6

KK=6*I-6+J

HRSBN(I)=TOTH(KK)+HRSBN(I)

400 CONTINUE

C

9990 CONTINUE

RETURN

END

SUBROUTINE DBBSB

C

C*****

C

C DRY-BULB-BIN SP CALCULATIONS.

C

C R. J. RETTBERG 14 JAN 1980.

C

C*****
C

NOTES:

1) THIS SUBROUTINE MAY NOT WORK WITH THE SCALE FACTORS FOR
HP SIZING AND BUILDING SIZE.

C+++++

INCLUDE 'BINA.COM'

INCLUDE 'CASES.COM'

INCLUDE 'CLWEAT.COM'

INCLUDE 'CSZ.COM'

INCLUDE 'DBBIN.COM'

INCLUDE 'PSYC.COM'

INCLUDE 'MOD.COM'

C--START EXECUTABLE STMTS.

CALCULATE THE LOAD

QLRP=HCTRP/1.1

DO 410 I=1,10

QLBN(I)=QLRP*(TODBBN(I)-TIDBBN+15.)/(110.-TIDBBN)

410 CONTINUE

C--NOTE: THE ABOVE IS GENERALIZED TO PERMIT A 75 DEG-F
C-- TIDB. HOWEVER, ALL KNOWN BIN ANALYSES SEEM TO ASSUME
C-- 80 DEG-F FOR TIDB, PROBABLY BECAUSE THIS REPRESENTS
C-- THE CONDITION FOR THE CAPACITY RATING

DO 1050 I=1,10

TODB=TODBBN(I)

CALL CACPM5(TODB, 80., 67.)

CPHRST(I)=QLBN(I)/HCTOT*HRSBN(I)

RTBTU(I)=HCTOT*CPHRST(I)/1000.

RTKWH(I)=HETOT*CPHRST(I)/1000.

EERT(I)=HCTOT/HETOT

HCBN(I)=HCTOT

HEBN(I)=HETOT

1050 CONTINUE

9990 CONTINUE

RETURN

END

SUBROUTINE DEFRST(FLAG)

C DEFRST IS A TIME-STEP SIMULATION OF FROST BUILD-UP AND THE
C DEFROST PROCESS

```
C
C
C      INCLUDE 'DEF.COM'
C      IDUM = 1
C
C
C      C BRANCH ON TYPE OF CYCLE REQUIRED
C
C      IF(FLAG .EQ. 'NOICE') GO TO 1000
C      IF(FLAG .EQ. 'DEFST') GO TO 2000
C
C
C      C--NO DEFROST CYCLE:
C
C      QSUM(I)=QPEAK(I)
C      ESUM(I)=EPEAK(I)
C      CSUM(I)=COPEAK(I)
C
C      RETURN
C
C      C--DEFROST CYCLE WITH NO FROST BUILD UP
C
C      C SET INTEGRATED Q AND E TO ZERO
C
C      1000 TOTQ = 0.0
C          TOTE = 0.0
C
C      C CALCULATE TIME BETWEEN DEFROSTS
C
C      TIME = DEFHR(I) - TMIN - 0.085
C      SAVET = DTIME
C      DTIME = TIME
C
C      C SET TEMPERATURE RATIO
C
C      1500 TRATIO = 0.0
C
C      C DO INTEGRATION
C
C      CALL SUM
C
C      C RESTORE DELTA T
C
C      DTIME = SAVET
C
C      C THE ABOVE ASSIGNS THE DEFROST TIME FOR CONTROLS THAT DEFROST WHEN
C      C THERE IS NO FROST.
C
C      RETURN
C
C      C DEFROST CYCLE WITH FROST BUILD-UP
C
C      CALCULATE TRANSITION TIME BETWEEN PRIMARY AND SECONDARY
C      C FROST BUILD-UP
C
```

```
2000 TTIME = 0.82*DSPH**-0.6
C
C CALCULATE SLOPE OF PRIMARY AND SECONDARY FROST CORRELATIONS
C
PSLOPE=0.0852*DSPH**0.12
SSLOPE=4.51*DSPH**0.86
C
C CALCULATE TEMPERATURE DIFFERENCE AT TRANSITION TIME
C
2050 DTTRAN=DTOUT*EXP(PSLOPE*TTIME)
C
C CALCULATE TEMPERATURE DIFFERENCE AT INITIATION OF DEMAND
C DEFROST = PRESSURE ACTIVATED AND TEMPERATURE ACTIVATED
C
DTDEMD = 9.1 + 0.20*DTOUT
IF(IDTYPE .EQ. 3) DTDEMD = SETT
C
C INITIALIZE STEP COUNTER, HEAT, ENERGY, TIME TO ZERO
C
ESUM(I) = 0.0
NSTEP = 0
OLDCOP = 0.0
OLDQ = 0.0
QSUM(I) = 0.0
TIME = 0.0
TOTE = 0.0
TOTQ = 0.0
TCYCD(I) = 0.0
C
C START ITERATION
C
C INCREMENT TIME AND STEP
C
2500 TIME = TIME + DTIME
C
NSTEP = NSTEP+1
C
C TERMINATE LOOP IF MAXIMUM TIME OR STEPS ARE EXCEEDED:
C
IF (TCYCD(I) .GE. TMAX) RETURN
C
IF(NSTEP.GT.1000) RETURN
C
C OUTDOOR AIR-TO-OUTDOOR COIL TEMPERATURE DIFFERENCE
C DURING PRIMARY FROST BUILD-UP:
C
DTCOIL=DTOUT*EXP(PSLOPE*TIME)
C
C DURING SECONDARY FROST BUILDUP:
C
IF(TIME .GE. TTIME) DTCOIL=DTOUT+(DTTRAN-DTOUT)
*EXP(SSLOPE*(TIME-TTIME))
C
C CALCULATE INDOOR AIR TEMP - OUTDOOR COIL TEMP
C
DTIN=TIN+DTCOIL-TOUT
```

```
C
C CALCULATE OUTDOOR COIL TEMPERATURE
C
C      OCT = TOUT - DTcoil
C
C CALCULATE TEMPERATURE RATIO
C
C      TRATIO = (DTcoil - DTOUT)/(DTDEMD - DTOUT)
C
C INSTANTANEOUS HEAT, ELECTRIC POWER, AND COP
C
C      CALL HEAT(DTIN,Q,E,COP)
C
C CUMULATIVE VALUES
C
C      CALL SUM
C
C CHECK CONTROL TO SEE IF TIME TO TERMINATE DEFROST CYCLE
C
C      GOTO (3100,3200,3300,3400,3500,3600,3700) IDTYPE
C
C IDTYPE=1: PEAK PERFORMANCE - NO DEFROST
C
C 3100      RETURN
C
C IDTYPE=2: DEMAND DEFROST - PRESSURE ACTIVATED
C
C 3200      IF( DTcoil .LT. DTDEMD) GO TO 2500
C           RETURN
C
C--IDTYPE=3: DEMAND DEFROST CYCLE TEMPERATURE SENSOR OUTDOORS
C
C 3300      IF( DTcoil .LT. DTDEMD) GO TO 2500
C           RETURN
C
C--IDTYPE=4: TIMED DEFROST CYCLE WITH DEACTIVATION BY
C OUTDOOR AIR TEMPERATURE:
C
C 3400      IF (TCYCD(I) .LT. DEFHR(I)) GO TO 2500
C           RETURN
C
C--IDTYPE=5: TIMED DEFROST CYCLE DEACTIVATION BY
C OUTDOOR COIL TEMPERATURE:
C 3500 CONTINUE
C
C           IF(TCYCD(I) .LT. DEFHR(I)) GO TO 2500
C           RETURN
C
C--IDTYPE=6: OPTIMUM DEFROST CYCLE, MAXIMUM HEAT OUTPUT:
C
C 3600      IF (QSUM(I) .LT. OLDQ) RETURN
C           OLDQ=QSUM(I)
C           GOTO 2500
C
C--IDTYPE=7: OPTIMUM DEFROST CYCLE, MAXIMUM COP:
C
```


3700

IF (CSUM(I) .LT. OLDCOP) RETURN
 OLDCOP=CSUM(I)
 GOTO 2500

C

END

SUBROUTINE DRYCAP(TODB, TIDB, HCDRY)

C

C*****

C

C CAC DRY COIL COOLING.

C

C R. J. RETTBERG 16 AUG 1979

C

C*****

C

C INPUTS:

C

C TIDB - INDOOR THERMOSTAT SETTING IN DEG-F.

C

C TODB - OUTDOOR DRY-BULB TEMP IN DEG-F.

C

C OUTPUTS:

C

C HCDRY - CAC DRY COIL COOLING CAPACITY IN BTU/H.

C

C*****

C

C DIMENSION INDXM(10), TEMPLM(7)

C

C DATA INDXM/ 1, 1, 1, 1, 2, 3, 4, 5, 6, 6/

C DATA TEMPLM/ 65., 85., 90., 95., 100., 105., 115./

C

C--DEFINE SUBROUTINE FUNCTIONS.

C

C-- F65 ETC. ARE DRY-COIL CAPACITIES IN KBTU/H FOR 65 DEG-F

C--

C OUTDOOR DRY-BULB TEMP.

C

F65(TIDB) = 33.6 + (TIDB - 80.) * 0.129

F85(TIDB) = 32.3 + (TIDB - 80.) * 0.254

F90(TIDB) = 31.8 + (TIDB - 80.) * 0.279

F95(TIDB) = 31.1 + (TIDB - 80.) * 0.283

F100(TIDB) = 30.4 + (TIDB - 80.) * 0.317

F105(TIDB) = 29.6 + (TIDB - 80.) * 0.342

F115(TIDB) = 27.6 + (TIDB - 80.) * 0.350

C

C-- FC IS A COEFFICIENT SELECTION FUNCTION. IT SETS ALL

C--

C COEFFICIENTS EXCEPT THE I = IX ONE TO ZERO. THE

C--

C SELECTED COEFFICIENT IS SET = 1.

C

FC(I, IX) = MAX0(0, I - IX + 1) * MAX0(0, IX - I + 1)

C

C-- F SELECTS F65 - F115 BASED IN INDEX I & THE SELECTED

C--

C FUNCTION IS EVALUATED AT TIDB.

C

F(I, TIDB) = FC(I, 1) * F65(TIDB)

& + FC(I, 2) * F85(TIDB)

& + FC(I, 3) * F90(TIDB)

& + FC(I, 4) * F95(TIDB)

& + FC(I, 5) * F100(TIDB)

```

&      + FC(I, 6) * F105(TIDB)
&      + FC(I, 7) * F115(TIDB)

```

C--START EXECUTABLE STATEMENTS.

```

C
  IF(TODB .LE. 65.) GO TO 1100
  IF(TODB .GE. 115.) GO TO 1200
C
  IDUMA = IFIX((TODB - 60.) / 5.)
  ILOW = INDXM(IDUMA)
  TLOW = TEMPLM(ILOW)
  THIGH = TEMPLM(ILOW + 1)
  DUMA = F(ILOW, TIDB)
  DUMB = F(ILOW + 1, TIDB)
  DUMC = DUMB - DUMA
  DUMD = TODB - TLOW
  DUME = THIGH - TLOW
  HCDRY = DUMA + (DUMD / DUME) * DUMC
  GO TO 9990

```

```

C
1100 CONTINUE
  HCDRY = F(1, TIDB)
  GO TO 9990

```

```

C
1200 CONTINUE
  HCDRY = F(7, TIDB)
9990 CONTINUE
  HCDRY = 1000. * HCDRY
  RETURN
  END
  SUBROUTINE ECONO(IWHERE)

```

```

C
C+++++

```

```

C
C      ECONOMICS CALCULATION SUBROUTINE
C
C      [HCB, 4-82]

```

```

C
C+++++

```

```

C
  INCLUDE 'CASES.COM'
C
  INCLUDE 'ECON.COM'
C
  INCLUDE 'MOD.COM'
C
  INCLUDE 'RW.COM'

```

C--CLCM IS A SERIES PRESENT WORTH FUNCTION

```

C
  CLCM(X,Z)=((1+(X)/100)**Z-1)/(((X)/100)*(1+(X)/100)**Z)
C
  GOTO (1100, 1200) IWHERE

```

```

C
1100 CONTINUE
C

```

C--INDIVIDUAL RUN ECONOMIC CALCULATIONS

$$HPSTON(IPASS) = CACLRP / 12000.$$

C

C--CPP***'S ARE HEAT PUMP FIRST COST EQU'S (W/O & W/ DUCTS)

$$CCPWOD = 650. + 600. * HPSTON(IPASS) + 111. * EERLRP - 824.$$
$$CCPWD = 1650. + 600. * HPSTON(IPASS) + 111. * EERLRP - 824.$$

C

C--CMNTN IS THE COST OF A MAINTENANCE CONTRACT PER YEAR

$$CMNTN = 18.5 * HPSTON(IPASS) + 19.5$$

C

C--SET UP FACTORS, ETC.

$$TOTKWH = TOTE C(IPASS) + TOTEHP(IPASS) + TOTETH(IPASS)$$
$$CLCM1 = HPLIFE$$
$$CLCM2 = HPLIFE$$
$$EI1 = RDSC$$
$$EI2 = (RDSC - REE) / (1 + REE / 100)$$
$$IF (ABS(EI1) .GT. 0.001) CLCM1 = CLCM(EI1, HPLIFE)$$
$$IF (ABS(EI2) .GT. 0.001) CLCM2 = CLCM(EI2, HPLIFE)$$

C

C-- DETERMINE PW OF SALVAGE VALUE

$$SLVWOD = SVGWOD * (1 + RDSC / 100) ** (-HPLIFE)$$
$$SLVWD = SVGWD * (1 + RDSC / 100) ** (-HPLIFE)$$

C

C--DETERMINE CAPITAL LCC

$$PMTWOD = CCPWOD * RFI / 100 / (1 - (1 + RFI / 100) ** (-HPLIFE))$$
$$PMTWD = CCPWD * RFI / 100 / (1 - (1 + RFI / 100) ** (-HPLIFE))$$
$$CLCWOD(IPASS) = PMTWOD * CLCM1 - SLVWOD$$
$$CLCWD(IPASS) = PMTWD * CLCM1 - SLVWD$$

C

C--CALC. ENERGY LCC

$$CLE(IPASS) = TOTKWH * ECKWH * CLCM2$$

C

C--CALC. MAINTENANCE LCC

$$CLM(IPASS) = CMNTN * (HPLIFE - WRNTY)$$
$$IF (ABS(EI1) .GT. 0.001) CLM(IPASS) = CMNTN *$$
$$\& (CLCM(EI1, HPLIFE) - CLCM(EI1, WRNTY))$$

C

C--DO TOTALS

$$CLTWOD(IPASS) = CLM(IPASS) + CLCWOD(IPASS) + CLE(IPASS)$$
$$CLTWD(IPASS) = CLM(IPASS) + CLCWD(IPASS) + CLE(IPASS)$$

GOTO 9990

C

1200 CONTINUE

C

C--ECONOMIC SUMMARY CALCS.

C

C--CALC. TOTALS

DO 110 I=1, NCASES

$$TEC = TEC + TOTE C(I)$$
$$TEHP = TEHP + TOTEHP(I)$$
$$TETH = TETH + TOTETH(I)$$
$$THPS = THPS + HPSTON(I)$$
$$TCLWOD = TCLWOD + CLTWOD(I)$$
$$TCLWD = TCLWD + CLTWD(I)$$

110 CONTINUE

C

C--CALC. AVERAGES

CASES=FLOAT(NCASES)

AEC=TEC/CASES

AEHP=TEHP/CASES

AETH=TETH/CASES

AHPS=THPS/CASES

ACLWOD=TCLWOD/CASES

ACLWD=TCLWD/CASES

C

GOTO 9990

C

9990 CONTINUE

RETURN

END

SUBROUTINE HEAT(TIN,QOUT,EOUT,COPOUT)

C

C

C HEAT CALCULATES THE HEAT OUTPUT, ENERGY INPUT, AND COP

C

DIMENSION T(21),Q(21),E(21)

C

DATA T/8.58200, 13.15200, 17.72200, 22.29200,

* 26.86200, 31.43200, 36.00200, 40.57200,

* 45.14200, 49.71200, 54.28200, 58.85200,

* 63.42200, 67.99200, 72.56200, 77.13200,

* 81.70200, 86.27200, 90.84200, 95.41200,

* 99.98200/

DATA Q/161362., 110591., 49500., 47800.,

* 46200., 44500., 42800., 40808.,

* 37130., 34092., 31540., 29362.,

* 27482., 24500., 22000., 20000.,

* 17500., 20931., 19996., 19146.,

* 18369./

DATA E/9002.0, 7457.2, 5000.0, 4950.0,

* 4890.0, 4810.0, 4690.0, 4537.5,

* 4328.9, 4148.7, 3990.9, 3851.1,

* 3726.2, 3670.0, 3630.0, 3610.0,

* 3600.0, 3253.3, 3180.1, 3112.0,

* 3048.5/

C

C DO TABLE LOOK UP

C

CALL FRENCH(T,Q,21,TIN,QOUT)

CALL FRENCH(T,E,21,TIN,EOUT)

C

C CALCULATE COP

C

COPOUT = QOUT/(EOUT*3.413)

C

C THAT'S IT

C

RETURN

END

SUBROUTINE HPDEF(TDUM,RDUM,HHPEAK,HEPEAK,JTYP,II,MODNO,
* HHINT,HETOT,DFH,DFE,DFTDD,DFTOUR,TTIN,BASETM)

C

C

C HPDEF SIMULATES THE CONTROLS OF THE HEAT PUMP, DETERMINING
 C IF A DEFROST WOULD BE ORDERED BY THE CONTROLS. IT ALSO CHECKS
 C WHETHER THERE IS FROST BUILT UP ON THE OUTDOOR COIL OR NOT
 C AND SETS THE DEFROST FLAG ACCORDINGLY.

C

C

C IDTYPE:

C

C 1=PEAK,NO DEFROST CYCLE

C 2=DEMAND DEFROST CYCLE, PRESSURE DIFFERENTIAL SENSOR

C 3=DEMAND DEFROST CYCLE, TEMPERATURE SENSORS

C 4=TIMED DEFROST CYCLE WITH DEACTIVATION BY OUTDOOR AIR TEMP

C 5=TIMED DEFROST CYCLE WITH DEACTIVATION BY OUTDOOR COIL TEMP

C 6=OPTIMUM DEFROST CYCLE, MAXIMUM HEAT OUTPUT

C 7=OPTIMUM DEFROST CYCLE, MAXIMUM COP

C

C

C INCLUDE 'DEF.COM'

C

C START EXECUTABLE STATEMENTS

C

C TIN=TTIN

C EIN = HEPEAK

C I = II

C IDTYPE = JTYP

C IF(JTYP.NE.3 .AND. JTYP.NE.4) MODNUM=0

C IF(MODNO .NE. 0) MODNUM = MODNO

C QIN = HHPEAK

C RH = RDUM

C TOUT = TDUM

C BASET=BASETM/60.

C

C INITIALIZE INPUT DATA (FORMERLY PERFORMED BY 'GETIT')

C

C DTIME=0.015

C SETT=16.

C TDEACT=45.

C TMIN=0.025

C TMAX=12.

C

C VARIABLE DESCRIPTION

C

C DTIME TIME STEP FOR INTEGRATIONS (HRS)

C SETT MINIMUM TEMP. FOR DEFROST

C TDEACT MAXIMUM TEMP. FOR DEFROST

C TMIN MINIMUM LENGTH OF A DEFROST CYCLE (HRS)

C TMAX MAXIMUM LENGTH OF A DEFROST CYCLE (HRS)

C

C SET BASE TIME BETWEEN DEFROSTS

C

```
      BASET2 = BASET  
      IF(MODNUM .NE. 1)      BASET2 = 1.
```

```
C INITIALIZE THE ARRAYS
```

```
C
```

```
      CFAC(I)   = -1.0  
      COPEAK(I) = -1.0  
      DEFT(I)   = -1.0  
      EFAC(I)   = -1.0  
      EPEAK(I)  = -1.0  
      ESUM(I)   = -1.0  
      QFAC(I)   = -1.0  
      QPEAK(I)  = -1.0  
      QSUM(I)   = -1.0  
      TCYCD(I)  = 12000.
```

```
C
```

```
C FILL TIME COONSTANTS
```

```
C
```

```
      IDUM = I  
      CALL TIMED(IDUM,MODNUM,BASET2,DEFHR(I))
```

```
C
```

```
C CALCULATE OUTDOOR AIR-OUTDOOR COIL TEMPERATURE DIFFERENCE  
C (FROM CORRELATION)
```

```
C
```

```
      DTOUT = 10.41 - 0.086 *(TIN - TOUT)
```

```
C
```

```
C CALCULTATE OUTDOOR COIL TEMPERATURE
```

```
C
```

```
      TCOIL = TOUT - DTOUT
```

```
C
```

```
C CALCULATE INDOOR AIR- OUTDOOR COIL TEMPERATURE DIFFERENCE
```

```
C
```

```
      DTIN = TIN - TCOIL
```

```
C
```

```
C GET HEAT PUMP Q,E,AND COP
```

```
C
```

```
      CALL HEAT(DTIN,Q,E,COP)
```

```
C
```

```
C SAVE PEAK Q,E,AND COP
```

```
C
```

```
      QPEAK(I) = Q  
      EPEAK(I) = E  
      COPEAK(I) = COP
```

```
C
```

```
C CHECK FOR MINIMUM CUTOUT TEMPERATURE
```

```
C
```

```
      IF(TOUT .GT. 15.)      GO TO 25  
      FLAG = 'NODEF'  
      GO TO 2000
```

```
C
```

```
C FOR TIMED DEFROST(IDTYPE=4 OR 5) SKIP CHECK OF COIL TEMP.
```

```
C
```

```
25  IF( IDTYPE .EQ. 4 .OR. IDTYPE .EQ. 5)  GO TO 50
```

```
C CHECK TO SEE IF OUTDOOR COIL IS BELOW FREEZING
```

```
C
```

```
      IF( TCOIL .LE. 32.) GO TO 50
C
C IF COIL IS ABOVE FREEZING THEN SKIP DEFROST
C
      FLAG = 'NODEF'
      GO TO 2000
C
C BRANCH TO DETERMINE IF A DEFROST CYCLE CAN BE SKIPPED -
C FOR THOSE SYSTEMS WHICH CANNOT PREDICT IF A DEFROST CYCLE CAN
C BE SKIPPED, GO TO LINE 1000.
C
      50 FLAG = 'DEFST'
C
      GO TO (100,1000,1000,400,500,1000,1000) IDTYPE
C
C NO DEFROST FOR PEAK PERFORMANCE
C
      100 CONTINUE
C
      FLAG = 'NODEF'
C
      GO TO 1000
C
C TIMED DEFROST WITH DEACTIVATION BY OUTDOOR AIR TEMP
C
      400 CONTINUE
C
      IF (TOUT .GT. TDEACT) FLAG = 'NODEF'
C
      GO TO 1000
C
C TIMED DEFROST CYCLE WITH DEACTIVATION BY OUTDOOR COIL TEMP
C
      500 CONTINUE
C
      IF(TCOIL .GT. 32.0) FLAG = 'NODEF'
C
      GO TO 1000
C
C PERFORM HUMIDITY CLACULATIONS TO SEE IF IT IS A NO FROST OR
C FROST BUILD-UP
C
      1000 IF(FLAG .EQ. 'NODEF') GO TO 2000
C
      CALL HUMID(TOUT,RH,'WATER',SPH)
C
C GET SPECIFIC HUMIDITY AT COIL TEMP
C
      CALL HUMID(TCOIL,RH,'ONICE',SPCOIL)
C
C CALCULATE SPECIFIC HUMIDITY DIFFERENCE
C
      DSPH = (SPH - SPCOIL)*1000.
C
C CHECK TO SEE IF COIL HAS NO FROST BUILD-UP
```

```
C
1050 IF (DSPH .GT. 0.0) GO TO 2000
1100 FLAG = 'NOICE'
1150 GO TO (1500,1500,1500,2000,2000,1500,1500) IDTYPE
1500 FLAG = 'NODEF'

C
C CALL DEFROST ROUTINE
C
2000 CALL DEFRST(FLAG)
C
C CALCULATE PERFORMANCE FACTORS
C
      QFAC(I) = QSUM(I) / QPEAK(I)
      EFAC(I) = ESUM(I) / EPEAK(I)
      CFAC(I) = CSUM(I) / COPEAK(I)

C
C CONVERT DEFROST TIMES FROM HOURS TO MINUTES
C
      DEFT(I)=DEFT(I)*60.
      IF(DEFT(I).LT.0) DEFT(I)=0.0
      TCYCD(I)=TCYCD(I)*60.

C
C SET DUMMY VARIABLES EQUAL TO CORRESPONDING VARIABLES
C
      HHINT = QSUM(I)/QPEAK(I)*QIN
      HETOT = ESUM(I)/EPEAK(I)*EIN
      DFH = QFAC(I)
      DFE = EFAC(I)
      DFTDD = TCYCD(I)
      DFTDUR = DEFT(I)

C
C THAT'S IT
C
9990 CONTINUE
      RETURN
      END
      SUBROUTINE HPHMDL

C
C+++++
C
      THIS SUBROUTINE IS BASED ON THE PORTIONS OF THE 'HPSPM' MAIN
      PROGRAM OF 2-82 THAT PERFORM THE HEATING RELATED CALCULATIONS.
C
      [HCB,3-16-82].
C
C+++++
C
      INCLUDE 'BALPT.COM'
C
      INCLUDE 'BIN.COM'
C
      INCLUDE 'CASES.COM'
C
      INCLUDE 'CPWID.COM'
C
      INCLUDE 'CSZ.COM'
```



```
C      INCLUDE 'DOE.COM'
C      INCLUDE 'DUMX.COM'
C      INCLUDE 'ECON.COM'
C      INCLUDE 'MOD.COM'
C      INCLUDE 'HSZ.COM'
C      INCLUDE 'HTOUT.COM'
C      INCLUDE 'HTWEAT.COM'
C      INCLUDE 'PROD.COM'
C      INCLUDE 'PROG.COM'
C      INCLUDE 'QL.COM'
C      INCLUDE 'RW.COM'
C      INCLUDE 'SHSIZ.COM'
C      INCLUDE 'SITE.COM'
C      INCLUDE 'SUMRY.COM'
C      INCLUDE 'TOTS.COM'
C      INCLUDE 'TSTAT.COM'
C--START GEN EQS
C      FAVG(A, B) = 0.5 * (A + B)
C--END GEN EQS
C
C      BEGIN HEATING MODEL
C      CALL HPMOD(2, 47., 60.)
C
C      DESIGN LOAD CALCULATIONS
C      DOEL14(1) = 0.77 * HHINT * (65. - TODH) / 60.
C      DOEL14(2) = 2. * DOEL14(1)
C      DOEL14(3) = FAVG(DOEL14(1), DOEL14(2))
C      DOEL5(1) = 0.77 * HHINT
C      DOEL5(2) = 2.2 * DOEL5(1)
C      DOEL5(3) = FAVG(DOEL5(1), DOEL5(2))
C      DUMA = 24. * EQDDYS / (65. - TODH) * 0.001
C      DOE014(1) = DUMA * DOEL14(1)
C      DOE014(2) = DUMA * DOEL14(2)
```



```
C
C-- CALCULATE APPROXIMATE ZERO LOAD TEMPERATURE.
C
  DUMA = QHLM(ISTRT - 1)
  DUMB = QHLM(ISTRT)
  DUMC = (DUMB - DUMA) * 0.20
  DUMD = DUMA / DUMC
  ZLTEMP = TODBM(ISTRT - 1) + DUMD
C
C--CALCULATE NOMINAL BALANCE POINT TEMPERATURE.
C
  KBPNOM = 0
C
  DO 1040 I = 47, ISTRT, -1
    IF(KBPNOM .GT. 0) GO TO 1041
    IF(HCAPM(I).GT.QHLM(I)) KBPNOM = I
  1040 CONTINUE
  1041 CONTINUE
C
  TBPNOB = TODBM(KBPNOM) - 2.
C
C    DUAL SPEED CALCULATION --- REASSIGN DATA (TO HIGH SPEED) FOR
C    ALL BINS BELOW LOW SPEED BP.
C
  IF(ISPEED.EQ.1) GO TO 11
C
  CALL HPMOD(3,62.,20.)
C
  DO 1031 I=KBPNOM+1,47
    TODB=TODBM(I)
    RH=RHM(I)
    CALL HPMOD(2,TODB,RH)
    HCAPM(I)=HHINT
    HPWRM(I)=HEHTOT
    HCOPM(I) = HCAPM(I) / HPWRM(I) / 3.413
    DFCAPM(I) = DFH
    DFPWRM(I) = DFE
    DFCOPM(I) = DFH / DFE
    TIMDDM(I) = DFTDD
    TIMDUM(I) = DFTDUR
  1031 CONTINUE
C
  11 CONTINUE
C
C--CALCULATE AN ACCURATE BALANCE POINT TEMP.
C
  DO 1070 I = ISTRT, 6
    DDUMA(I) = HCAPM(I)
    DDUMB(I) = TODBM(I)
    DDUMC(I) = QHLM(I)
  1070 CONTINUE
C
  DO 1075 I = 43, 47
    K = I - 30
    DDUMA(K) = HCAPM(I)
    DDUMB(K) = TODBM(I)
```

```
      DDUMC(K) = QHLM(I)
1075 CONTINUE
C
      DO 1080 I = 8, 38, 6
        K = (I - 2) / 6 + 6
        DDUMA(K) = HCAPH(I)
        DDUMB(K) = TODBM(I)
        DDUMC(K) = QHLM(I)
1080 CONTINUE
C
      KBPACC = 0
C
      DO 1085 I = ISTRT, 17
        IF(DDUMA(I) .LT. DDUMC(I)) KBPACC = I
        IF(KBPACC .LT. 1) GO TO 1085
      GO TO 1086
1085 CONTINUE
1086 CONTINUE
C
      IDUMA = KBPACC - 1
      IDUMB = KBPACC
      DUMA = DDUMA(IDUMA) - DDUMC(IDUMA)
      DUMA = 5. * DUMA
      DUMB = DDUMC(IDUMB) - DDUMC(IDUMA) + DDUMA(IDUMA) - DDUMA(IDUMB)
      DUMC = DUMA / DUMB
      TBPACC = DDUMB(IDUMA) - DUMC
C
      SELECT THERMOSTAT
C
      IF(TSNAM .EQ. 'NEW') GO TO 1100
      IF(TSNAM .EQ. 'ITT') GOTO 1150
C
C--THE TODB THERMOSTAT HAS BEEN REQUESTED ('OLD').
C
      IESTAT=1
      CALL TSMS(3)
      IESTAT=2
C
      DO 1090 I = ISTRT, 47
        TODB = TODBM(I)
        CALL TSMS(3)
        FCYM(I) = FCY
1090 CONTINUE
C
      GO TO 1155
C
      1100 IF(TSNAM.NE.'NEW') GOTO 1155
C
C--THE "NEW" PERCENT ON-TIME THERMOSTAT HAS BEEN SELECTED.
C
C
C-- FOR THE "NEW" TSTAT, FONI IS REQUIRED TO DETERMINE FCY.
C-- USE AN ARTIFICIAL FONI = LOAD / (PEAK CAPACITY) SO THAT
C-- PRODUCTS W/ THE SAME PEAK CAPACITY PRODUCE THE SAME
C-- FCY. OTHERWISE CHANGES IN DEFROST CONTROL STRATEGIES
C-- AFFECT THE CYCLE RATE WHICH AFFECTS THE CYCLIC DEGRADATION
```

C-- CALCULATIONS & CONFUSION RESULTS.

C

```
DO 1150 I = ISTRT, 47
  FONIM(I)=QHLM(I)/HCAPM(I)
  IF(FONIM(I) .GE. 1.0) GO TO 1148
  FONI = FONIM(I)
  CALL TSMS(1)
  FONI = FONI + TAUON * FCY / 60.
  IF(FONI .GE. 1.0) GO TO 1148
  CALL TSMS(1)
  FCYM(I)=FCY
  GO TO 1150
```

1148 CONTINUE

FCYM(I) = 1.E-6

1150 CONTINUE

C

IF(TSNAM.NE.'ITT') GOTO 1155

C

C

C

ITTEATION THERMOSTAT

C

DO 1190 I=ISTRT, 47

IBIN=I

FONIM(I)=QHLM(I)/HCAPM(I)

FONI=FONIM(I)

CALL TSMS(2)

FCYM(I)=FCY

ANCPCM(I)=FCYM(I)*HRSM(I)

FONIM(I)=FONI

FONAM(I)=FONA

PWIM(I)=PWI

PWAM(I)=PWACT

CPHRSM(I)=FONAM(I)*HRSM(I)

ENERTM(I)=CPHRSM(I)*HPWRM(I)/1000.

HPBTU(I)=AMIN1(1.,FONIM(I))*HCAPM(I)*HRSM(I)

SUPHM(I)=AMAX1(0.,QHLM(I)-HCAPM(I))

IF(SUPHM(I) .GT. 0.1) SHBTU(I)=(QHLM(I)*HRSM(I))-

& HPBTU(I)

1190 CONTINUE

IF (TSNAM.EQ.'ITT') GOTO 1160

C

1155 CONTINUE

C

IPW = 1

C

C--THE FOLLOWING CALCULATIONS OF PULSE WIDTH MUST USE

C-- THE CORRECT FONI.

C

DO 1160 I = ISTRT, 47

FONI=FONIM(I)

FCY=FCYM(I)

ANCPCM(I) = FCY * HRSM(I)

CALL PWIDTH

FONAM(I)=FONA

PWIM(I)=PWI

```
PWAM(I)=PWACT
CPHRSM(I)=FONAM(I)*HRSM(I)
ENERTM(I)=CPHRSM(I)*HPWRM(I)/1000.
HPBTU(I)=AMIN1(1.,FONIM(I))*HCAPM(I)*HRSM(I)
SUPHM(I)=AMAX1(0.,QHLM(I)-HCAPM(I))
IF(SUPHM(I).GT.0.1)SHBTU(I)=(QHLM(I)*HRSM(I))-HPBTU(I)
```

1160 CONTINUE

C

C--ADD TEMPERING HEAT REQUIREMENTS.

C

C-- DETERMINE THE SIZE OF THE TEMPERING HEAT STRIP HEATER.

C

CALL SHSIZE

C

```
DO 1165 I = 7, KBPNOM
  IF (PWAM(I).GE.600) GOTO 1165
  IF (SHBTU(I).GT.0.01) GO TO 1165
  IF (HRSM(I).LT.0.01) GO TO 1165
  IF (TIMDUM(I) / TIMDDM(I).LT.1.E-6) GO TO 1165
  DUMA = CPHRSM(I) * 60. / TIMDDM(I)
  IF (DUMA.LT.0.01) DUMA = 0.0
  ANDEFM(I) = DUMA
  IF (DUMA.LT.0.01) GO TO 1165
  TIMTHM(I) = ANDEFM(I) * TIMDUM(I) / 60.
  SUPHM(I) = S1BTUH
  SHBTU(I) = S1BTUH * TIMTHM(I)
  TEMHOM(I) = SHBTU(I)
  TEMHIM(I) = TEMHOM(I) / 3413.
  HPBTU(I) = HPBTU(I) - SHBTU(I)
  DUMA = CPHRSM(I)
  CPHRSM(I) = CPHRSM(I) - SHBTU(I) / HCAPM(I)
  ENERTM(I) = CPHRSM(I) * HPWRM(I) * 1.E-3
  DCPHM(I) = DUMA - CPHRSM(I)
  DUMC = (DCPHM(I) / ANCPM(I)) * 60.
  TIMPSM(I) = DUMC
  PWIM(I) = PWIM(I) - DUMC
  PWAM(I) = PWAM(I) - DUMC
  FONIM(I) = FCYM(I) * PWIM(I) / 60.
  FONAM(I) = FCYM(I) * PWAM(I) / 60.
```

1165 CONTINUE

C

```
DO 1168 I = KBPNOM + 1, 47
  DUMA = CPHRSM(I) * 60. / TIMDDM(I)
  IF (DUMA.LT.0.01) DUMA = 0.0
  ANDEFM(I) = DUMA
```

1168 CONTINUE

C

C

DO TOTALS AND AVERAGES

C

```
DO 1170 I=1,30
  TOTHM(I)=0.
```

1170 CONTINUE

C

```
DO 1180 I = ISTRT, 47
  TOTHM(1)=CPHRSM(I)*TODBM(I)+TOTHM(1)
  TOTHM(2)=CPHRSM(I)+TOTHM(2)
```

```

TOTHM(3)=CPHRSM(I)*DFCAPM(I)+TOTHM(3)
TOTHM(4)=CPHRSM(I)*HCAPM(I)+TOTHM(4)
TOTHM(5)=ENERTM(I)+TOTHM(5)
TOTHM(6)=QHLM(I)*HRSM(I)+TOTHM(6)
TOTHM(7)=HRSM(I)+TOTHM(7)
TOTHM(8)=SUPHM(I)+TOTHM(8)
TOTHM(9)=HPBTU(I)+TOTHM(9)
TOTHM(10)=SHBTU(I)+TOTHM(10)
TOTHM(11)=(1.-DFCAPM(I))*HPBTU(I)/DFCAPM(I)+TOTHM(11)
TOTHM(12)=CPHRSM(I)*DFPWRM(I)+TOTHM(12)
TOTHM(13)=CPHRSM(I)*DFCOPM(I)+TOTHM(13)
TOTHM(14) = ANCPM(I) + TOTHM(14)
TOTHM(15) = TOTHM(15) + TEMHOM(I)
TOTHM(16) = TOTHM(16) + TEMHIM(I)
TOTHM(17) = TOTHM(17) + ANDEFM(I)
IF(TIMTHM(I).GT. 0.01) TOTHM(18) = TOTHM(18) + ANDEFM(I)
COPIM(I)=0.
IF(ENERTM(I).GT.0.01)COPIM(I)=HPBTU(I)/ENERTM(I)/3.413/1000.

```

1180 CONTINUE

C

```

WATEMP=TOTHM(1)/TOTHM(2)
WADFCA = TOTHM(3) / TOTHM(2)
WADFPW = TOTHM(12) / TOTHM(2)
WADFCO = TOTHM(13) / TOTHM(2)
WACAP=TOTHM(4)/TOTHM(2)
WAPWR=TOTHM(5)/TOTHM(2)*1000.
ABTUH=TOTHM(6)/TOTHM(7)
SCOP=TOTHM(9)/TOTHM(5)/3.413/1000.
WAFCY = TOTHM(14) / TOTHM(7)
APCTON = TOTHM(2) / TOTHM(7) * 100.
WAPW = 60. * APCTON * 1.E-2 / WAFCY
NCPCYC = IFIX(TOTHM(14))
NDFCYC = IFIX(TOTHM(17))
TKBTUO = (TOTHM(9) + TOTHM(10)) * 1.E-3
TKWHI = TOTHM(5) + TOTHM(10) / 3413.

```

C

```

TOTEHP(IPASS)=TOTHM(5)
TOTETH(IPASS)=TOTHM(10)/3413.

```

C

C--FILL THE SUMMARY PRINTOUT VECTORS.

C

```

IF(ISTSZ .EQ. 999) GO TO 1250

```

C

```

ICASEA(ISBST) = IPASS
ATOUT(ISBST) = TKBTUO
AHOUT(ISBST) = TOTHM(9) * 0.001
ATIN(ISBST) = TKWHI
AHIN(ISBST) = TOTHM(5)
ASYCOP(ISBST) = TKBTUO / TKWHI / 3.413
ACPC(ISBST) = TOTHM(14)
ADCY(ISBST) = TOTHM(17)
ABPN(ISBST) = TBPNO
ABPDR(ISBST) = TBPACC
ABPDE(ISBST) = TBPDES
A1KW(ISBST) = S1KW
AZLT(ISBST) = ZLTEMP

```

ACPH(ISBST) = TOTHM(2)

250 CONTINUE

BTOUT(IPASS) = TKBTUO
 BHOUT(IPASS) = TOTHM(9) * 0.001
 BTIN(IPASS) = TKWHI
 BHIN(IPASS) = TOTHM(5)
 BSYCOP(IPASS) = TKBTUO / TKWHI / 3.413
 BCPC(IPASS) = TOTHM(14)
 BDCY(IPASS) = TOTHM(17)
 BBPN(IPASS) = TBPNO
 BBPDR(IPASS) = TBPACC
 BBPDE(IPASS) = TBPDES
 B1KW(IPASS) = S1KW
 BZLT(IPASS) = ZLTEMP
 BCPH(IPASS) = TOTHM(2)

***** END HEATING CALCULATIONS FOR THIS PASS *****

9990 CONTINUE

RETURN

END

SUBROUTINE HPMOD(KENTER, TODB, RHO)

C--DETERMINATION OF HP MODEL PERFORMANCE CHARACTERISTICS.

C--R. J. RETTBERG 1978.

BEWARE -- THE DATA ARE COMPLETE ONLY BETWEEN 62 AND -8 DEG-F.

+++++

---- NOTES: ----

1) THE INPUT FLAG "KENTER" MAKES THE FOLLOWING SELECTIONS:

KENTER = 1, USE LOW OR SINGLE SPEED HPMOD FILE.
 2, CALL HEAT PUMP DATA UP FROM PREVIOUSLY
 ESTABLISHED ARRAYS.
 3, USE HIGH SPEED FILE ("HPMODH.DAT").

4) THE VARIABLES AVAILABLE AS OUTPUT FROM THIS SUBROUTINE ARE:

VARIABLE	DEFINITION
HHINT	H. P. OUTPUT, ACTUAL (BTU/HR)
HEHTOT	H. P. ENERGY, " (KWH/HR)
DFH	DEFROST DEGRADATION FACTOR, OUTPUT
DPE	" " " " ENERGY
DFTDD	TIME, DEFROST TO DEFROST (MIN)
DFTDUR	TIME, DEFROST DURATION (MIN)

-- PEAK VALUES ARE NOT DIRECTLY AVAILABLE --

C 5) AN OPTIONAL DEFROST CALCULATION SUBROUTINE HAS BEEN
C ADDED [3-1-82].
C

C 6) HEATING CAPACITY AND ENERGY ARE NOW CALCULATED LINEARLY
C FROM INPUT DATA AT 17 AND 47 DEG-F ONLY. [HCB, 4-82]
C

C 7) THIS ROUTINE IS SETUP FOR SINGLE SPEED HP ONLY.
C

C+++++

C
C DIMENSION HETOTM(21),
C 1 HHVEC(21),
C & HHIM(6,6), HEIM(6,6), DFHM(21), DFEM(21),
C & DFHMM(6,6), DFEMM(6,6),
C & DFTDDV(21), DFTDUV(21), DFTDDM(6, 6), DFTDUM(6, 6),
C & RHXX(6)

C
C INCLUDE 'BCACRD.COM'

C
C INCLUDE 'CASES.COM'

C
C INCLUDE 'CSZ.COM'

C
C INCLUDE 'DUMX.COM'

C
C INCLUDE 'MOD.COM'

C
C INCLUDE 'RW.COM'

C
C DATA RHXX/20., 40., 60., 75., 85., 95./

C
C--START EXECUTABLE STMTS.
C

C
C 1 CONTINUE
C IF(KENTER.EQ.1) ISTART=1
C IF(KENTER.EQ.1) JSTART=1
C IF(KENTER.EQ.2)GO TO 500
C GOTO 600

C
C IF THE HP MODEL IS THE SAME BUT A DIFFERENT DEFROST CONTROL IS
C REQUESTED JUST RECALCULATE THE DEFROST DATA; OTHERWISE CONTINUE.
C

C
C IF(KENTER.EQ.3) GOTO 600
C NLRUN=IPASS-1
C IF(IDEFT(IPASS) .NE. IDEFT(NLRUN) .OR.
C & IDFMOD(IPASS).NE.IDFMOD(NLRUN)) GOTO 700
C GOTO 500
C 600 CONTINUE

C
C INITIALIZE DESIGN DATA
C

C-- 95

C POCLRP=CACLRP/EERLRP/1000.
C CALCULATE COOLING SCALE FACTORS
C SFCPC = CACLRP / 34000.
C SFPWC = POCLRP / 4.85

C-- 47

$$POHLRP = CAHLRP / COHLRP / 3.413$$

C-- 17

POLLRP=CALLRP/COLLRP/3.413

C-- MISC.

BHEFI = 1000.*POCLRP*0.10

BHEFO = 1000, *POCLRP*0.08

TAUON 3 TAU

TAUOFF= TAU

HEFAN = BHEFI + BHEFO

BRPHCT=CACLRP

$$BRPHEC = POCLRP \times 1000, -HEFAN$$

HEHFAN=BHEFI

$$HEIFAN = BHEFI / (BHEFI + BHEFO)$$
$$\text{BRPHET} = \text{POCLRP} \times 1000.$$
$$BRPEER = BRPHCT / BRPHET$$

EERRP=BRPEER

CTAUON=TAUON

CTAUOF=TAUOFF

HTAUON=TAUON

HTAUOF=TAUOFF

HCTRP = CACLRP

HERP =BRPHET

CALCULATE HEATING PERFORMANCE SLOPES (LINEAR)

SLPXXX ARE THE SLOPES, 6 IS THE TEMP DELTA IN BINS BETWEEN
47 AND 17

$$SLPHCP = (CAHHRP - CALHRP) / 6.0$$
$$SLPHPW = (POHHRP - POLHRP) / 6.0$$
$$SLPCAP = (CAHLRP - CALLRP) / 6.0$$
$$SLPPOW = (POHLRP - POLLRP) / 6.0$$

```
IF(KENTER.EQ.3) GO TO 11
```

DO 2.0 I=1,6

DO 20 J=1,6

$$HHIM(I, J) = 0.$$
$$\text{HEIM}(I, J) = 0.$$
$$DFHMM(I, J) = 0.$$

```
DFEMM(I, J) = 0.
```

20 CONTINUE

00 30 I=1,21

$$DFHM(I) = 0.$$
$$DFEM(T) = 0.$$
$$HHVEC(I)=0.$$

NETOTM(I)=0.

30 CONTINUE

FOR HIGH SPEED OF DUAL SPEED HP, SKIP BINS ABOVE LOW SPEED BP
THEN REASSIGN HP DATA (BELOW LOW SPEED BP).

```
11 IF(KENTER,NE.3) GO TO 12
```

```
KP=KBPNO-6
KPP=(KP/6)
ISTART=KPP+7
JSTART=KP-6*KPP+1
```

```
C
C      ASSIGN LOW OR HIGH SPEED DATA
C
```

```
12 CONTINUE
SLPC=SLPCAP
SLPP=SLPPW
IF(KENTER.EQ.3) SLPC=SLPHCP
IF(KENTER.EQ.3) SLPP=SLPHPW
```

```
C
C      DO 1200 I = ISTART, 21
```

```
C
C--OUT OF DEFROST REGION
```

```
C
      IF(I.GT.6 .AND. I.LT.13) GOTO 1180
      HHVEC(I) = (SLPCAP*(6.0-FLOAT(I))+CAHLRP)
      HETOTM(I) = (SLPPW*(6.0-FLOAT(I))+POHLRP)
      DFHM(I) = 1.0
      DFEM(I) = 1.0
      DFTDDV(I)=1.0E+6
      DFTDUV(I)=1.0E-9
      GO TO 1200
```

```
C
1180 CONTINUE
```

```
C
C--IN DEFROST REGION
```

```
C
      HHPEAK = (SLPCAP*(6.0-FLOAT(I))+CAHLRP)
      HEPEAK = (SLPPW*(6.0-FLOAT(I))+POHLRP)
      IF(I.GT.ISTART) JSTART=1
      DO 1190 J = JSTART, 6
        K = I - 6
        IIBIN=(I-6)*6+J
        TO=72.0-FLOAT(I-1)*5.0
```

```
C
      IF(IDEFT(IPASS).NE.8) CALL HPDEF(TO,RHXX(J),HHPEAK,HEPEAK,
&      IDEFT(IPASS),IIBIN,IDFMD(IPASS),HHIM(K,J),HEIM(K,J),
&      DFHMM(K,J),DFEMM(K,J),DFTDDM(K,J),DFTDUM(K,J),
&      TIDBH,TOFBAS(IPASS))
```

```
C
      IF(IDEFT(IPASS).NE.8) GOTO 1190
```

```
C
      DFHMM(K, J) = 1.0
      DFEMM(K, J) = 1.0
      HHIM(K, J) = HHPEAK
      HEIM(K, J) = HEPEAK
      DFTDDM(K,J)=1.0E6
      DFTDUM(K,J)=1.0E-9
```

```
1190 CONTINUE
```

```
C
1200 CONTINUE
```

```
C
      GOTO 500
```

```
C
C      RECALCULATE DEFROST DATA ONLY (SAME HP)
C
700  CONTINUE
      DO 1250 I=7, 12
      K=I-6
      DO 1260 J=1, 6
      HHPEAK=HHIM(K,J)/DFHMM(K,J)
      HEPEAK=HEIM(K,J)/DFEMM(K,J)
      IF(IDEFT(IPASS).NE.8) GOTO 710
C
C      REMOVE DEFROST (IDEFT=8 MEANS IDEAL)
C
      HHIM(K,J)=HHPEAK
      HEIM(K,J)=HEPEAK
      DFHMM(K,J)=1.0
      DFEMM(K,J)=1.0
      DFTDDM(K,J)=1.0E6
      DFTDUM(K,J)=1.0E-9
      GOTO 1260
710  CONTINUE
      TO=72.0-FLOAT(I-1)*5.0
      IIBIN=(I-6)*6+J
C
      IF(IDEFT(IPASS).NE.8) CALL HPDEF(TO,RHXX(J),HHPEAK,HEPEAK,
&      IDEFT(IPASS),IIBIN,IDFMOD(IPASS),HHIM(K,J),HEIM(K,J),
&      DFHMM(K,J),DFEMM(K,J),DFTDDM(K,J),DFTDUM(K,J),
&      TIDBH,TDFBAS(IPASS))
C
1260  CONTINUE
1250  CONTINUE
      GOTO 500
C
C--CALLING UP DATA.
C
500  CONTINUE
      N=IFIX(72.001-TODB)/5+1
      IF(N.LT.7.OR.N.GT.12)GO TO 510
      I=N-6
      IF(ABS(RHO-20.).LT.0.00001)J=1
      IF(ABS(RHO-40.).LT.0.00001)J=2
      IF(ABS(RHO-60.).LT.0.00001)J=3
      IF(ABS(RHO-75.).LT.0.00001)J=4
      IF(ABS(RHO-85.).LT.0.00001)J=5
      IF(ABS(RHO-95.).LT.0.00001)J=6
      DFH = DFHMM(I, J)
      DFE = DFEMM(I, J)
      HHINT=HHIM(I,J)
      HEHTOT=HEIM(I, J)
      DFTDD = DFTDDM(I, J)
      DFTDUR = DFTDUM(I, J)
      GO TO 9990
C
510  CONTINUE
      HHINT=HHVEC(N)
      HEHTOT=HETOTM(N)
```

```
DFH = DFHM(N)
DFE = DFEM(N)
DFTDD = DFTDDV(N)
DFTDUR = DFTDUV(N)
GO TO 9990
```

```
C
9990 CONTINUE
RETURN
END
SUBROUTINE HTSIZE
```

```
C
C*****
```

```
C
C--HP HEATING SIDE SIZING ROUTINE
```

```
C
C--R. J. RETTBERG 1978.
```

```
C
C*****
```

```
C
C--NOTES:
```

```
C
C    1. FACTOR FOR 95/75/M IS 11.90082645 BTU/H/FT**2,
C       WHICH IS (QCSOL / FLOOR AREA).
```

```
C
C*****
```

```
C
C    INCLUDE 'CSZ.COM'
```

```
C
C    INCLUDE 'HSZ.COM'
```

```
C
C--START EXECUTABLE STMTS.
```

```
C
CALL CLSIZE
QC95 = RESVOL / 8.0 * 11.90082645
QH9560 = 2.0 * QC95
QHDL = QH9560 * (70. - TODH) / 60.
```

```
C
9990 CONTINUE
RETURN
END
SUBROUTINE HUMID(TIN,RHIN,FLAG,SPHUM)
```

```
C*****
```

```
C
C SUBROUTINE FOR CALCULATING SPECIFIC HUMIDITY FROM TEMPERATURE
C AND RELATIVE HUMIDITY
```

```
C
C SEE ASHRAE FUNDAMENTALS 1981 - CHAPTER 5
C EQUATION NUMBERS IN COMMENTS MATCH ASHRAE EQN NUMBERS
```

```
C
C*****
C    DIMENSION C1(2),C2(2),C3(2),C4(2),C5(2),C6(2),C7(2)
```

```
C
C    : THESE ARE CONSTANTS FOR USE IN THE EQUATIONS
```

```
C
C    DATA C1/-5.67453590E+03,-5.80022060E+03/,
```

```
* C2/ 6.39252470E+00, 1.39149930E+00/,
* C3/-0.96778430E-02,-0.04860239E+00/,
* C4/ 0.62215701E-06, 0.41764768E-04/,
* C5/ 0.20747825E-08,-0.14452093E-07/,
* C6/-0.94840240E-12, 0.00000000E+00/,
* C7/ 4.16350190E+00, 6.54596730E+00/,
* P/101325.0/
```

```
C
C SET SPECIFIC HUMIDITY TO ZERO
C
  SPHUM = 0.0
  RH = RHIN
C
C IF RELATIVE HUMIDITY IS ZERO, SO IS SPECIFIC HUMIDITY
C
  IF (RH .GE. 0.1) GO TO 100
  IF (FLAG .EQ. 'ONICE') GO TO 100
  RETURN
C
C CONVERT INPUT TEMPERATURE TO DEGREES KELVIN
C
100 T = (TIN - 32.0)/1.8 + 273.15
C
C SET FLAG TO 2 (OVER LIQUID)
C
  J = 2
C
C CHECK TO SEE IF TEMPERATURE IS BELOW FREEZING, OR IF
C SPECIFIC HUMIDITY IS FOR OVER ICE AND IF TRUE SET J
C
  IF(TIN .LE. 32.0) J = 1
  IF(FLAG .EQ. 'ONICE') J = 1
  IF(FLAG .EQ. 'ONICE') RH = 100.
C
C CALCULATE THE SATURATION PRESSURE (EQN 3 OR 4)
C
  PWS = (C1(J)/T) + C2(J) + (C3(J)*T) + (C4(J)*(T**2)) +
  * (C5(J)*(T**3)) + (C6(J)*(T**4)) + (C7(J)*ALOG(T))
  PWS = EXP(PWS)
C
C CALCULATE THE PARTIAL PRESSURE OF WATER (EQN 22)
C
  PW = PWS*RH/100.
C
C CALCULATE THE HUMIDITY RATIO (EQN 20)
C
  W = 0.62198 * PW/(P - PW)
C
C CALCULATE THE HUMIDITY RATIO AN SATURATION (EQN 21)
C
  IF (J .EQ. 2) W = PWS * .62198/(P - PWS) * RH/100.
C
C CALCULATE THE SPECIFIC HUMIDITY (EQN 8)
C
  SPHUM = W/(W + 1.)
C
```

C THAT'S IT FOLKS!

C

RETURN

END

SUBROUTINE HWREAD

C

C*****

C

THIS SUBROUTINE READS HEATING WEATHER DATA
FOR A SPECIFIED SITE AND PUTS THE DATA IN
A COMMON STORE HTWEAT.

C

C*****

C

INCLUDE 'DUMX.COM'

C

INCLUDE 'HTWEAT.COM'

C

INCLUDE 'RW.COM'

C

DATA ISTSAV/ 0/
DATA DOBASE/ 65./

C

C--START EXECUTABLE STMTS.

C

C--IF THE LAST CALL WAS FOR THE SAME SITE THE DATA ARE ALREADY
C-- IN /HTWEAT/. THEREFORE SKIP OUT.

C

IF(ISITE.EQ. ISTSAV) GO TO 9990

C

OPEN(UNIT=11,DEVICE='DSK',ACCESS='SEQIN',FILE=WEAFIL)

10 CONTINUE

READ(11,5000,END=999)N,(WSTTL(II),II=1,15)

5000 FORMAT(I5,15A5)

C

DO 20 I=1,6

READ(11,5001,END=999)TODBM(I),HRSM(I)

5001 FORMAT(F10,1,60X,F10,1)

RHM(I)=' ALL'

TODBTM(I)=TODBM(I)

HRSTM(I)=HRSM(I)

20 CONTINUE

DO 40 I=1,6

K=6*I-6+7

KK=I+6

READ(11,5002,END=999)TODBTM(KK),(HRSM(II),II=K,K+5),

1 HRSTM(KK)

5002 FORMAT(8F10,1)

C

DO 30 J=K,K+5

TODBM(J)=TODBTM(KK)

IF(J.LT. K + 3) RHM(J) = FLOAT(20 * ((J - K) + 1))

IF(J.GE. K + 3) RHM(J) = 65. + FLOAT(10 * (J - K - 2))

30 CONTINUE

C

40 CONTINUE

C

```

DO 50 I=43,51
  KK=I-30
  READ(11,5001,END=999)TODBM(I),HRSM(I)
  RHM(I)=' ALL'
  TODBTM(KK)=TODBM(I)
  HRSTM(KK)=HRSM(I)
50 CONTINUE
  IF(N.NE.ISITE)GO TO 10
  CLOSE(UNIT=11)

```

C--CALCULATE THE "EQUIVALENT" DEGREE DAYS FOR THIS SITE.

C

```

EQDDYS = 0.

```

C

```

DO 1200 I = 1, 21
  DUMA = DDBASE - TODBTM(I)
  IF(DUMA .GT. 0.) EQDDYS = EQDDYS + DUMA * HRSTM(I)
1200 CONTINUE

```

C

```

EQDDYS = EQDDYS / 24.
GO TO 9990

```

C

```

999 CONTINUE

```

C

```

WRITE(5,6000)
6000 FORMAT(/, ' THERE WAS A PROBLEM READING THE HEATING',
1         ' WEATHER DATA CAUSING',/, ' A BAILOUT FROM HWREAD.',
2         ' TODBM(1) SET = 999. ')
TODBM(1)=999.
CLOSE(UNIT=11)

```

C

```

9990 CONTINUE
  ISTSAV = ISITE
  RETURN
  END
  SUBROUTINE INIMS

```

C

C*****

C

C INITIALIZATION MASTER SUBROUTINE FOR HEAT PUMP SPM-S.

C

C R. J. RETTBERG JAN 1980.

C

C*****

C

C ADAPTED FOR COMBINED COOLING AND HEATING MODEL [HCB, 3-11-82].

C

C+++++

C

```

INCLUDE 'CASES.COM'

```

C

```

INCLUDE 'DOE.COM'

```

C

```

INCLUDE 'DUMX.COM'

```

C

INCLUDE 'HTWEAT.COM'

INCLUDE 'MOD.COM'

INCLUDE 'PROD.COM'

INCLUDE 'PROG.COM'

INCLUDE 'PSYC.COM'

INCLUDE 'RW.COM'

INCLUDE 'SITE.COM'

INCLUDE 'SUMRY.COM'

DATA PT/29.921/

THE SOURCES FOR THE FOLLOWING WEATHER DESIGN DATA ARE:

STODC, STODH, ISRA

MANUAL 'J'. (ISRA IS A RANGE SWITCH, -1=LOW, 0=MED, 1=HIGH).

SRGN, SHLH

DOE TEST PROCEDURES. ESTIMATES MADE FROM THE HEATING LOAD HOUR MAP.

SDGDY

NOAA LOCAL CLIMATOLOGICAL DATA, ANNUAL SUMMARIES FOR 1975 (NORMAL DEGREE DAYS).

```

DATA STODC/90.,90.,90.,80.,95.,90.,95.,105.,100.,85.,90.,
1 90.,95.,90./
DATA IPRNTL, IPRNTM/'N', 'N'/
DATA ISRA/0,0,0,0,0,0,1,1,0,0,0,0,0,0/
DATA STODH/-10.,0.,10.,10.,5.,15.,30.,25.,20.,40.,35.,40.,10.,10./
DATA ((SRGN(JA, JB), JB = 1, 2), JA = 1, 14)/
&      'V'      'I'      'I'      'IV/V'      'I'      'I'
&      'IV'      'I'      'I'      'IV/V'      'I'      'I'
&      'III/I'      'V'      'I'      'IV'      'I'      'I'
&      'III/I'      'V'      'I'      'III'      'I'      'I'
&      'II'      'I'      'I'      'III/I'      'V'      'I'
&      'II'      'I'      'I'      '< I'      'I'      'I'
&      'IV'      'I'      'I'      'IV'      'I'      'I'
DATA SHLH/ 2750., 2500., 2400., 2500., 2000.,
&          2250., 2000., 1750., 1375., 2000.,
&          1100., 99., 2100., 2200./
DATA SDGDY/ 8159., 6497., 5621., 5185., 5161.,
&          4865., 2843., 2601., 2382., 1819.,
&          1465., 206., 4645., 4844./

DATA VTTL/ 'C&HSP', 'M82-1'/

DATA ((MODEP(JJ,J),J=1, 2),JJ=1, 3)/
&      'CO', 'OLING',
&      'HE', 'ATING',

```

& 'GE','NERAL'/

C
C--START EXECUTABLE STMTS.
C
C--SET ISTSZ FLAG TO 999 IF ISTSZ .GE. NCASES OR ISTSZ = 0.
C

IF(ISTSZ .EQ. 0) ISTSZ = 999
IF(ISTSZ .GE. NCASES) ISTSZ = 999
AISTSZ = FLOAT(ISTSZ)
BCASES = FLOAT(NCASES)

C
C--SET WEATHER FILE NAME IN /HTWEAT/.
C

IF(IWEAT .EQ. 'ANN') WFAFIL = 'HWPALL.DAT'
IF(IWEAT .EQ. 'SIX') WFAFIL = 'HWP6M.DAT'
IF(IWEAT .EQ. 'EST') WFAFIL = 'HWPEST.DAT'

C
C--READ ABBREVIATED SITE TITLES.
C

OPEN (UNIT = 13, DEVICE = 'DSK', ACCESS = 'SEQIN',
& FILE = 'STTLAB.DAT')

C
DO 1050 I = 1, 14
READ(13, 5050, END = 1051) (STTLAB(I, JA), JA = 1, 2)
5050 FORMAT(2A5)
1050 CONTINUE
1051 CONTINUE

C
CLOSE(UNIT = 13)

C
C--READ DEFROST LABELS.
C

OPEN (UNIT = 19, DEVICE = 'DSK', ACCESS = 'SEQIN',
& FILE = 'DFTLAB.DAT')

C
DO 2000 I=1, 8
READ (19, 5090) (DFTLAB(I, J), J=1,7)
2000 CONTINUE
5090 FORMAT(7A5)
CLOSE(UNIT=19)

C
C
OPEN (UNIT = 21, DEVICE = 'DSK', ACCESS = 'SEQIN',
& FILE = 'DFMLAB.DAT')

C
DO 2010 I=1, 5
READ (21, 5090) (DFMLAB(I, J), J=1,5)
2010 CONTINUE
CLOSE(UNIT=21)

C
DO 2020 I=1, NCASES
IF(IDEFT(I).NE.4 .AND. IDEFT(I).NE.5) IDFMOD(I)=5
IF(IDEFT(I).EQ.0) IDEFT(I)=8
2020 CONTINUE

C
9990 CONTINUE

RETURN

END

SUBROUTINE PRNTMS(IWHERE)

```
C
C*****
C
C  PRINTOUT MASTER SUBROUTINE.
C
C  R. J. RETTBERG  14 JAN 1980.
C
C*****
C
C    MODIFIED FOR COOLING AND HEATING (HCB, 5-82).
C
C+++++
C
C--START EXECUTABLE STMTS.
C
C      GO TO (1100, 1200, 1300, 1400, 1500,
C      &      1600, 1700, 1800, 1900, 2000,
C      &      2100, 2200, 2300, 2400, 2500,
C      &      2600, 2700, 2800, 2900) IWHERE
C
C  1100 CONTINUE
C
C--RUN DESCRIPTION SHEETS.
C
C      CALL PRNTH
C      GO TO 9990
C
C  1200 CONTINUE
C
C--PRODUCT DATA.
C
C      CALL PRNTA(8, 99)
C      CALL PRNTJ(1)
C      CALL PRNTJ(5)
C      GO TO 9990
C
C  1300 CONTINUE
C
C--SOLAR HOUR OPERATING POINT DATA.
C
C      CALL PRNTA(1, 1)
C      CALL PRNTD(1)
C      GO TO 9990
C
C  1400 CONTINUE
C
C--SOLAR HOUR: LOAD COMPONENT DATA.
C
C      CALL PRNTA(1, 2)
C      CALL PRNTE(2)
C      CALL PRNTJ(4)
C      GO TO 9990
C
```

1500 CONTINUE

C

C--DARK HOUR OPERATING POINT DATA.

C

CALL PRNTA(2, 1)

CALL PRNTD(2)

GO TO 9990

C

1600 CONTINUE

C

C--DARK HOUR LOAD COMPONENT DATA.

C

CALL PRNTA(2, 2)

CALL PRNTE(3)

GO TO 9990

C

1700 CONTINUE

C

C--SOLAR HOUR SP RESULTS.

C

CALL PRNTA(3, 3)

CALL PRNTF(1)

CALL PRNTJ(5)

GO TO 9990

C

1800 CONTINUE

C

C--DARK HOUR SP RESULTS.

C

CALL PRNTA(4, 3)

CALL PRNTF(2)

CALL PRNTJ(5)

GO TO 9990

C

1900 CONTINUE

C

C--COMPRESSED (SUMMARY) PRINTOUT FOR SP RESULTS.

C

CALL PRNTA(5, 4)

CALL PRNTC(1)

CALL PRNTJ(5)

GO TO 9990

C

2000 CONTINUE

C

C--COMBINED SOLAR & DARK HOUR SP RESULTS.

C

CALL PRNTA(5, 3)

CALL PRNTF(3)

CALL PRNTJ(5)

GO TO 9990

C

2100 CONTINUE

C

C--DRY-BULB BIN RESULTS.

C

CALL PRNTA(6, 5)
CALL PRNTG
CALL PRNTJ(5)
GO TO 9990

C

2200 CONTINUE

C

C--COMPRESSED (SUMMARY) PRINTOUT FOR DRY-BULB-BIN RESULTS.

C

CALL PRNTA(6, 6)
CALL PRNTC(2)
CALL PRNTJ(5)
GO TO 9990

C

2300 CONTINUE

C

C--PRINT WEATHER STATISTICS.

C

CALL PRNTI

C

GOTO 9990

C

2400 CONTINUE

C

C--LOAD COMPONENT DATA (HEATING).

C

CALL PRNTA(0, 0)
CALL PRNTE(1)
CALL PRNTA(0, 0)
CALL PRNTJ(4)
GOTO 9990

C

2500 CONTINUE

C

C--SUBSET SUMMARY PRINTOUT.

C

CALL PRNTA(0, 0)
CALL PRNTK(1)
GO TO 9990

C

2600 CONTINUE

C

C--SUMMARY PRINTOUT FOR ALL THE CASES.

C

CALL PRNTA(0, 0)
CALL PRNTK(2)
GO TO 9990

C

2700 CONTINUE

C

C--TEMPERING HEAT DETAILS.

C

CALL PRNTA(0, 0)
CALL PRNTB
GO TO 9990

2800 CONTINUE

C
C--INDIVIDUAL RUN ECONOMICS

C
CALL PRNTM(1)
GOTO 9990
2900 CONTINUE

C
C--ECONOMICS SUMMARY

C
CALL PRNTM(2)
GOTO 9990
C
9990 CONTINUE
RETURN
END
SUBROUTINE PRNTA(IPHL, ITHL)

C
C*****

C
C HEADING PRINTOUT.

C
C R. J. RETTBERG 14 JAN 1980.

C
C*****

C
C NOTES:
C 1) PAGE NO'S ADDED [2-82].

C
C 2) COMBINED FOR COOLING AND HEATING. FOR HEATING PAGE NO.,
C HP HEADING (WITH DEFROST) OR SITE HEADING IPHL=0 AND:

C
C ITHL = 0 PAGE NO. ONLY
C = 1 HEAT PUMP LABEL ONLY.
C = 2 SITE ONLY.
C = 3 HEAT PUMP AND SITE ONLY.

C
C OTHERWISE THIS 'PRNTA' IS THE SAME AS THAT IN THE 'CACSPM'
C [HCB, 3-82].

C
C*****

C
C INCLUDE 'CASES.COM'
C
C INCLUDE 'CLWEAT.COM'
C
C INCLUDE 'HTWEAT.COM'
C
C INCLUDE 'MOD.COM'
C
C INCLUDE 'PROD.COM'
C
C INCLUDE 'PROG.COM'
C
C INCLUDE 'RW.COM'
C
C INCLUDE 'SITE.COM'

```
C
C--START EXECUTABLE STMTS.
C
      IF(IPHL.EQ.0 .AND. ITHL.NE.0) GOTO 1000
C
C--CODE VERSION LABEL IN UPPER RIGHT HAND CORNER.
C
      IF (IPASS.EQ.ITEST) IPAGE=IPAGE+1
      IF (IPASS.NE.ITEST) IPAGE=1
      IF (IPASS.NE.ITEST) ITEST=IPASS
      IF (IPASS.LE.1) ITEST=1
      IF(ITEST.GT.NCASES) WRITE(IWRITE,6002) (VTTL(JA),JA=1, 2),
&      (MODEP(IMODEP,JA),JA=1, 2), IPAGE
      IF(ITEST.GT.NCASES) GOTO 1000
      WRITE(IWRITE, 6001) (VTTL(JA), JA = 1, 2),
&      (MODEP(IMODEP,JA),JA=1, 2), ITEST, IPAGE
6001      FORMAT('1', 90X, 2A5,' ', ' ', 2A5,' RUN ',I2,',', PAGE ',I2)
6002      FORMAT('1', 105X, 2A5,' ', ' ',2A5,' SUMMARY',',', PAGE ',I2)
C
1000 CONTINUE
C
C ----- HEATING PRODUCT AND SITE HEADINGS -----
C
      IF(IPHL.NE.0) GOTO 2000
      IF(ITHL.EQ.0) GOTO 9990
C
C      HP MODEL HEADING
C
      IF(ITHL.NE.1 .AND. ITHL.NE.3) GOTO 1500
C
      IF(IDEFT(IPASS).NE.4 .AND. IDEFT(IPASS).NE.5) GOTO 1210
      IF(IDFMOD(IPASS).NE.1) GOTO 1210
C--TIMED DEFROST, FIXED INTERVAL
      WRITE(IWRITE,6004) (DFTLAB(IDEFT(IPASS),II),II=1, 7),
&      (DFMLAB(IDFMOD(IPASS),II),II=1, 5), TDFBAS(IPASS)
6004      FORMAT(/13X, 'DEFROST DESCRIPTION:', 5X, '--- ', 7A5, 5X, 5A5,
&      1X, F4.0, ' MIN')
C
      GOTO 1500
C
1210 CONTINUE
C--ALL OTHERS
      WRITE(IWRITE,6003) (DFTLAB(IDEFT(IPASS),II),II=1, 7),
&      (DFMLAB(IDFMOD(IPASS),II),II=1, 5)
6003      FORMAT(/13X, 'DEFROST DESCRIPTION:', 5X, '--- ', 7A5, 5X, 5A5)
C
1500 CONTINUE
C
C      SITE HEADING
C
      IF(ITHL.NE.2 .AND. ITHL.NE.3) GOTO 1510
C
      WRITE(IWRITE,6005)ISITE,(WSTTL(II),II=1,15)
6005      FORMAT(28X, 'SITE:', I4, 15A5)
C
1510 CONTINUE
```

GOTO 9990

C
C
C
END OF CHANGES TO CACSPM 'PRNTA'

2000 CONTINUE

C
IF(IPHL .EQ. 1) WRITE(IWRITE,5001)
IF(IPHL .EQ. 2) WRITE(IWRITE,5004)
IF(IPHL .EQ. 3) WRITE(IWRITE,5005)
IF(IPHL .EQ. 4) WRITE(IWRITE,5010)
IF(IPHL .EQ. 5) WRITE(IWRITE, 5011)
IF(IPHL .EQ. 5 .AND. ITHL .EQ. 4) GO TO 1100
IF(IPHL .EQ. 6) WRITE(IWRITE, 5017)
IF(IPHL .EQ. 6 .AND. ITHL .EQ. 6) GO TO 1100
IF(IPHL .EQ. 8) WRITE(IWRITE, 6000)
IF(IPHL .EQ. 9) GOTO 9990
WRITE(IWRITE,5000)ISITE,(WSTTL(II),
1 II=1,15)

5000 FORMAT(/20X,I5,15A5)

C
IF(IPHL .EQ. 8) GO TO 9990
IF(IPHL .EQ. 6) GO TO 1200

C
1100 CONTINUE

C
IF(TSNAM .EQ. 'RAC')WRITE(IWRITE,5023)IAF,ICYCLE,ANACH,TSNAM,
8 DELTSW,TIDB,TMINS,TMIND
5023 FORMAT(/,5X,'IAF=',I3,2X,'ICYCLE=',I3,2X,'NACH=',F5.2,2X,
1 'T-STAT=',A5,2X,'DEL-TDB=',F5.1,
2 2X,'TIDB=',F5.0,2X,'TEMP-MIN-S=',F5.0,
3 2X,'TEMP-MIN-D=',F5.0)
IF(TSNAM .NE. 'RAC')WRITE(IWRITE,5024)IAF,ICYCLE,ANACH,TSNAM,
8 TIDB,TMINS,TMIND
5024 FORMAT(/,10X,'IAF=',I3,2X,'ICYCLE=',I3,2X,'NACH=',F5.2,2X,
1 'T-STAT=',A5,
2 2X,'TIDB=',F5.0,2X,'TEMP-MIN-S=',F5.0,
3 2X,'TEMP-MIN-D=',F5.0)

C
1200 CONTINUE

IF(ITHL .EQ. 1) WRITE(IWRITE,5002)
IF(ITHL .EQ. 2) WRITE(IWRITE,5012)
IF(ITHL .EQ. 3) WRITE(IWRITE,5006)
IF(ITHL .EQ. 4) WRITE(IWRITE, 5027)
IF(ITHL .EQ. 5) WRITE(IWRITE, 5018)
IF(ITHL .EQ. 6) WRITE(IWRITE, 5034)

C
6000 FORMAT(40X,'***** PRODUCT AND SITE ',
1 'DATA *****')
5001 FORMAT(40X,'***** SOLAR HOUR PER HOUR ',
1 'ANALYSIS RESULTS *****')

5002 FORMAT(/T3,'-- EQUIPMENT DATA --',//
8 T3,'I',T7,'TODB',T15,'RHO',T21,'TIDB',T28,
1 'TIWB',T36,'RHI',T40,'--CAPACITY (BTU/H)--',
2 T62,'SENS.',T69,'HETOT',T76,'FREQ.',T83,'ON-TIME/CYC.',
3 T97,'PCT.-ON-TIME',T110,'COOLING',
4 T119,'COMP', 2X, 'BNACH',


```
      8      /,T40,'LATENT',2X,'SENS',3X,'TOTAL',T62,'RATIO',T68,'(WATTS)',
      5      T75,'(CYC/H)',T83,'IDEAL',T92,'ACT',T97,'IDEAL',T106,'ACT',
      6      T112,'HRS',T120,'HRS',1X,'(ACH/H)')
5004  FORMAT(40X,'***** DARK HOUR PER HOUR ',
      1      'ANALYSIS RESULTS *****')
5012  FORMAT(/,T5,'--- LOAD DATA ---',//
      8      ,T3,'I',T9,'TODB',T19,'RHO',T27,'QSUN',T33,
      1      'QCOND NET',T45,'SENS TOT',T56,'----- INTERNAL -----',
      2      T85,'SENS TOT',T97,
      3      'Q INFILTRATION',T118,'QTOT',T124,'SENSIBLE',/T50,
      4      T56,'SENSIBLE',T66,'LATENT',T77,'TOTAL',
      5      T86,'+INTERNAL',T97,'LATENT',3X,'TOTAL',T126,'RATIO')
5005  FORMAT(40X,'***** SOLAR HOUR AGGREGATED RESULTS ',
      1      '*****')
5006  FORMAT(/,T5,'I',T12,'TODB',T24,'RH',T32,'CHRS',T37,'KBTU-COOL',
      1      T49,'KWH-TOT',T63,'EER',T68,'SENS-RAT',T83,'RHI',
      2      T87,'HR(RH>65)',T101,'CPHRS',T113,'FCY',
      3      T124,'PW',T128,'DF(X)')
5010  FORMAT(40X,'***** DARK HOUR AGGREGATED ',
      1      'RESULTS *****')
5011  FORMAT(40X,'***** TOTAL COOLING HOUR AGGREGATED ',
      1      'RESULTS *****')
5017  FORMAT(40X,'***** DRY BULB BIN',
      1      'CALCULATION RESULTS *****')
5018  FORMAT(/,T10,'I',T17,'TODB',T27,'TIDB',T38,'HRS',
      1      T42,'COOL-LOAD',T53,'COOL-CAP',T66,'HETOT',
      2      T76,'CPHRS',T82,'KBTU-COOL',T94,'KWH-TOT',
      3      T108,'EER')
5027  FORMAT(/,3X,'SITE',T23,'RHO',
      8      T32,'CHRS',T37,'KBTU-COOL',
      8      T49,'KWH-TOT',T63,'EER',T68,'SENS-RAT',T83,'RHI',
      2      T87,'HR(RH>65)',T101,'CPHRS',T113,'FCY',
      3      T124,'PW',T128,'DF(X)')
5034  FORMAT(/,3X,'SITE',T27,'TIDB',T38,'HRS',
      1      T42,'COOL-LOAD',T53,'COOL-CAP',T66,'HETOT',
      2      T76,'CPHRS',T82,'KBTU-COOL',T94,'KWH-TOT',
      3      T108,'EER',/)
```

C

```
9990  CONTINUE
      RETURN
      END
      SUBROUTINE PRNTB
```

C

C*****

C

C PRINTOUT OF TEMPERING HEAT DETAILS.

C

C R. J. RETTBERG 2 MAY 1980.

C

C*****

C

C INCLUDE 'BALPT.COM'

C

C INCLUDE 'BIN.COM'

C

C INCLUDE 'CASES.COM'

```
C      INCLUDE 'DUMX.COM'
C      INCLUDE 'MOD.COM'
C      INCLUDE 'HSZ.COM'
C      INCLUDE 'HTWEAT.COM'
C      INCLUDE 'RW.COM'
C      INCLUDE 'SHSIZ.COM'
C      INCLUDE 'TOTS.COM'
C
C--START EXECUTABLE STMTS.
      WRITE(IWRITE, 6000)
6000    FORMAT(/T40, '***** TEMPERING HEAT DETAILS *****')
      CALL PRNTA(0,3)
      WRITE(IWRITE, 6030)
6030    FORMAT( //T10, 'I', T17, 'TODB', T28, 'RHO',
&          T36, 'CPHRS', T43, 'TIM(D-D)', T56, '# DEF',
&          T63, 'TIM(DUR)', T76, 'TH-ON',
&          T85, 'TH-CAP', T95, 'TH-OUT',
&          T106, 'TH-IN', T115, 'DELTIM',
&          /T76, '(HRS)', T84, '(BTU/H)',
&          T95, '(KBTU)', T106, '(KWH)', T112, '(MIN/CYC)', /)
C
      IDUMA = 1
C
      DO 1050 I = 7, KBPNOM
          DUMA = TEMHOM(I) * 1.E-3
          IF(I .GT. 42) IDUMA = 2
          GO TO (1045, 1047) IDUMA
C
1045    CONTINUE
          IF(TIMDDM(I) .GT. 1.E4 .AND. TIMDUM(I) .LT. 1.E-4)
&              GO TO 1046
          WRITE(IWRITE, 6050) I, TODBM(I), RHM(I), CPHRSM(I),
&              TIMDDM(I), ANDEFM(I), TIMDUM(I),
&              TIMTHM(I), SUPHM(I), DUMA,
&              TEMHIM(I), TIMPSM(I)
6050    FORMAT(I10, 2F10.1, F10.2, 4F10.2, 3F10.0, F10.3)
          GO TO 1050
C
1046 CONTINUE
          WRITE(IWRITE, 6080) I, TODBM(I), RHM(I), CPHRSM(I),
&              TIMDDM(I), ANDEFM(I), TIMDUM(I),
&              TIMTHM(I), SUPHM(I), DUMA,
&              TEMHIM(I), TIMPSM(I)
6080    FORMAT(I10, 2F10.1, F10.2, 1PE10.0, 0P3F10.2, 3F10.0, F10.3)
          GO TO 1050
C
1047 CONTINUE
          WRITE(IWRITE, 6060)
6060    FORMAT(/T5, '***** TBP BELOW 17 DEG-F. P/O ROUTINE',
```

& ' NOT PROGRAMMED TO HANDLE SUCH A CASE. *****', /)

1050 CONTINUE

```

C
  DUMA = TOTHM(15) * 1.E-3
  WRITE(IWRITE, 6070) TOTHM(18), DUMA, TOTHM(16)
6070   FORMAT(/T15, 'TOTALS:', T51, F10.2, T91, 2F10.0)
  WRITE(IWRITE, 6010) TBPNO
6010   FORMAT(/T15, 'TEMPERING HEAT CALCULATIONS ARE MADE',
&       ' ONLY FOR TODH > ', F4.1, ' , BECAUSE BELOW',
&       ' THIS TEMPERATURE THE HP IS ALWAYS ON.')
```

```

  WRITE(IWRITE, 6020) S1KW, S1BTUH
6020   FORMAT(/T15, 'THE TEMPERING HEAT STRIP HEATER CAPACITY IS:',
&       F8.4, ' KW, OR', F7.0, ' BTU/H.')
```

```

  WRITE(IWRITE, 6200)
6200   FORMAT(/T20, 'THE TEMPERING HEAT CAPACITY IS BASED ON',
&       ' THE FOLLOWING RESULTS:')
  DUMA = 3413. * SHTOT
  WRITE(IWRITE, 6210) TODH, QHDL, TODH, HHDES,
&       SHSF, DUMA, SHTOT, TBPDES,
&       S1PCT, S1PCT, S1BTUH, S1KW
6210   FORMAT(/T25, 'DESIGN LOAD * TODH =', F6.1, ' DEG-F IS:',
&       T80, F10.0,
&       /T25, 'HP CAPACITY * TODH =', F6.1, ' DEG-F IS:',
&       T80, F10.0, /T80, '-----',
&       //T25, 'WHICH, FOR A SH SCALE FACTOR = ', F4.2,
&       ' , RESULTS IN',
&       /T25, 'A TOTAL SUPPLEMENTARY HEATER CAPACITY OF:',
&       T80, F10.0, ' BTU/H, OR', T100, F10.4, ' KW.',
&       //T25, 'THE TEMPERING HEATER (I.E. 1ST STAGE)',
&       ' PERCENT OF TOTAL',
&       /T25, 'FOR THE CALCULATED DESIGN BALANCE POINT',
&       /T25, 'TEMPERATURE OF ', F5.2, ' DEG-F IS:',
&       T80, F10.0, ' X', T100, F10.4, ' X',
&       /T80, '-----', T100, '-----',
&       //T25, 'WHICH RESULTS IN THE FOLLOWING HEATER CAPACITY:',
&       T80, F10.0, ' BTU/H, OR', T100, F10.4, ' KW.',
&       /T80, '-----', T100, '-----')
```

```

C
9990 CONTINUE
  RETURN
  END
  SUBROUTINE PRNTC(IWHERE)
```

```

C
C*****
```

```

C
C PRINTOUT OF COMPRESSED SP & DBB RESULTS.
```

```

C
C R. J. RETTBERG 14 JAN 1980.
```

```

C
C*****
```

```

C
C INCLUDE 'AVGS.COM'
```

```

C
C INCLUDE 'BIN.COM'
```

```

C
C INCLUDE 'CASES.COM'
```

```
C      INCLUDE 'RW.COM'
C      INCLUDE 'SITE.COM'
C      INCLUDE 'TOTS.COM'
C
C--START EXECUTABLE STMTS.
C
C      GO TO (1100, 1200) IWHERE
C
C 1100 CONTINUE
C
C      *** SUMMARY OF SP RESULTS (COOLING) ***
C
C      WRITE(IWRITE,5028)
C      PCALL=1.0
C
C      DO 436 I=1,NCASES
C
C-- (THIS IS A PAGE TURNER)
C      5 SUMMARIES/FULL PAGE
C      4 WITH AVERAGES
C
C      IF(NCASES.LE.4) GOTO 450
C      PTST=(FLOAT(I)-1.0)/(5.0*PCALL)
C      IF(PTST.EQ.1.0) CALL PRNTA(5,4)
C      IF(NCASES.EQ.5 .AND. I.EQ.5) CALL PRNTA(5,4)
C      IF(PTST.EQ.1.0) PCALL=PCALL+1
C      IF(PTST.EQ.1.0) WRITE(IWRITE,5028)
C      IF(NCASES.EQ.5 .AND. I.EQ.5) WRITE(IWRITE,5028)
C
C-- (END PAGE TURNER)
C
C 450 CONTINUE
C      K=ISITEM(I)
C      WRITE(IWRITE,5029)K,(STTLAB(K,J),J=1,2)
C      WRITE(IWRITE,5008) (TOTPRT(I,K),K=1,4), TOTPRT(I, 6)
C      WRITE(IWRITE,5009)(AVGPRT(I,K),K=1,8), AVGPRT(I,10)
C      DMSEER = TOTPRT(I,2)/TOTPRT(I,3)
C      WRITE(IWRITE,5010) TOTPRT(I, 7), DMSEER
C      WRITE(IWRITE,5028)
C 436 CONTINUE
C      XA=1./FLOAT(NCASES)
C      DO 437 I=1, 6
C      TOTPRT(61,I)=TOTPRT(61,I)*XA
C      AVGPRT(61,I)=AVGPRT(61,I)*XA
C 437 CONTINUE
C
C      DO 1150 I = 7, 10
C      AVGPRT(61, I) = AVGPRT(61, I) * XA
C 1150 CONTINUE
C
C      WRITE(IWRITE,5028)
C      WRITE(IWRITE,5033)NCASES
C      WRITE(IWRITE,5031) (TOTPRT(61,I),I=1,4), TOTPRT(61, 6)
```

```
WRITE(IWRITE,5032)(AVGPRT(61,I),I=1,8), AVGPRT(61,10)
WRITE(IWRITE,5028)
WRITE(IWRITE,5028)
GO TO 9990
```

```
C
1200 CONTINUE
```

```
C
C--SUMMARY OF DBB RESULTS.
```

```
C
XA = 1. / FLOAT(NCASES)
```

```
C
DO 438 I=1,4
ANBTPR(61,I)=ANBTPR(61,I)*XA
438 CONTINUE
```

```
C
ANBAPR(61)=ANBAPR(61)*XA
WRITE(IWRITE,5028)
PCALL=1
```

```
C
DO 439 I=1,NCASES
```

```
C
C-- (THIS IS A PAGE TURNER)
C
7 SUMMARIES/FULL PAGE
C
6 WITH AVERAGES
C
```

```
IF(NCASES.LE.6) GOTO 460
PTST=(FLOAT(I)-1.0)/(7.0*PCALL)
IF(PTST.EQ.1.0) CALL PRNTA(6,6)
IF(NCASES.EQ.7 .AND. I.EQ.7) CALL PRNTA(6,6)
IF(PTST.EQ.1.0) PCALL=PCALL+1
IF(PTST.EQ.1.0) WRITE(IWRITE,5028)
IF(NCASES.EQ.7 .AND. I.EQ.7) WRITE(IWRITE,5028)
```

```
C
C-- (END PAGE TURNER)
```

```
C
460 CONTINUE
K=ISITEM(I)
WRITE(IWRITE,5035)K,(STTLAB(K,J),J=1,2),TID8BN
WRITE(IWRITE,5020)(ANBTPR(I,K),K=1,4)
WRITE(IWRITE,5021)ANBAPR(I)
WRITE(IWRITE,5028)
```

```
439 CONTINUE
WRITE(IWRITE,5028)
WRITE(IWRITE,5033)NCASES
WRITE(IWRITE,5036)(ANBTPR(61,K),K=1,4)
WRITE(IWRITE,5037)ANBAPR(61)
WRITE(IWRITE,5028)
WRITE(IWRITE,5028)
```

```
C
5008 FORMAT(/10X,'TOTALS',9X,F10.2,2F10.0,30X,2F10.2)
5009 FORMAT(/10X,'AVERAGES', F7.1, 30X, F10.2, 2F10.1,
& 20X, 2F10.2, F7.1,
& /20X, '(', F4.1, ')', 33X, 7X,
& 14X, '(', F4.1, ')')
5010 FORMAT(/10X,'NUMBER OF COMPRESSOR CYCLES = ',F6.0, :,
& T70, 'ACTUAL SEER = ', F8.3, /)
```

```

5020 FORMAT(/10X,'TOTALS',14X,F10.2,30X,F10.2,2F10.0)
5021 FORMAT(/10X,'AVERAGES',82X,F10.2)
5028 FORMAT(1X,131('*'))
5029 FORMAT(6X,I4,2X,2A5)
5031 FORMAT(/7X,'AVG OF TOTALS',5X,F10.2,2F10.0,30X,2F10.2)
5032 FORMAT(/7X,'AVG OF AVGS',F7.1,30X,F10.2,2F10.1,
&      20X,2F10.2,F7.1,
&      /20X,'(',F4.1,')',33X,7X,
&      14X,'(',F4.1,')',
&      /20X,'(RH AVERAGES WITH BRACKETS ARE LOAD HOUR WEIGHTED',
&      ', THOSE WITHOUT ARE COMPRESSOR HOUR WEIGHTED.)')
5033 FORMAT(/5X,'NCASES = ',I2)
5035 FORMAT(6X,I4,2X,2A5,F8.0)
5036 FORMAT(/10X,'AVG OF TOTALS',7X,F10.2,30X,F10.2,2F10.0)
5037 FORMAT(/10X,'AVG OF AVGS',79X,F10.2)
C
9990 CONTINUE
      RETURN
      END
      SUBROUTINE PRNTD(IWHERE)

```

```

C
C*****
C
C  PRINTOUT OF LINES OF OPERATING POINT RESULTS.
C
C  R. J. RETTBERG  14 JAN 1980.
C
C*****
C
C      INCLUDE 'BINA.COM'
C
C      INCLUDE 'CASES.COM'
C
C      INCLUDE 'CLWEAT.COM'
C
C      INCLUDE 'QLC.COM'
C
C      INCLUDE 'RW.COM'
C
C--START EXECUTABLE STMTS.
C
C      GO TO (1100, 1200) IWHERE
C
C 1100 CONTINUE
C
C      DO 1150 I = 1, 60
C          IF(SOLH(I) .LT. 0.01) GO TO 1150
C          XA=100.*FONISM(I)
C          XB=100.*FONASM(I)
C          WRITE(IWRITE,5003)I,TODBCM(I),RHOM(I),TIDB,
&      TIWBSM(I),RHIS(I),HCLSM(I),HCSSM(I),
&      HCTSM(I),SRATS(I),HETSM(I),FCYS(I),
&      PWISM(I),PWSOL(I),XA,XB,
&      SOLH(I),CPHRSS(I),BNASM(I)
5003 FORMAT(I3,3F7.0,2F7.1,3F7.0,F7.1,F7.0,F7.3,2F7.2,
1      2F7.1,2F7.2,F7.3)

```

1150 CONTINUE

C

GO TO 9990

C

1200 CONTINUE

C

DO 1250 I = 1, 60

IF(DKH(I) .LT. 0.01) GO TO 1250

XA=100.*FONIDM(I)

XB=100.*FONADM(I)

WRITE(IWRITE,5003)I,TOORCM(I),RHOM(I),TIDB,

& TIWBDM(I),RHID(I), HCLDM(I), HCSDM(I),

& HCTDM(I), SRATD(I), HETDM(I), FCYD(I),

& PWIDM(I), PWDRK(I), XA, XB,

& DKH(I), CPHRSD(I), BNADM(I)

1250 CONTINUE

C

9990 CONTINUE

RETURN

END

SUBROUTINE PRNTE(IWHERE)

C

C*****

C

C PRINTOUT OF HEATING LOAD COMPONENT DATA

C

C R. J. RETTBERG 2 MAR 1980.

C

C*****

C

C THIS IS A MODIFIED VERSION OF THE HPSPM FORM OF 'PRNTE' FOR
C FOR THE COMBINED COOLING AND HEATING SPM [HCB, 3-82].

C

C NOTES:

C

C 1) IWHERE = 1

C HEATING LOAD DATA PRINTOUT

C

C = 2 OR 3

C COOLING " " "

C

C (FORMERLY 1 OR 2)

C

C+++++

C

C INCLUDE 'BIN.COM'

C

C INCLUDE 'BINA.COM'

C

C INCLUDE 'CASES.COM'

C

C INCLUDE 'CLWEAT.COM'

C

C INCLUDE 'CSZ.COM'

C

C INCLUDE 'DUMX.COM'

C

C INCLUDE 'MOD.COM'

C

```
      INCLUDE 'HTWEAT.COM'
C
      INCLUDE 'QL.COM'
C
      INCLUDE 'QLC.COM'
C
      INCLUDE 'RW.COM'
C
      INCLUDE 'TOTS.COM'
C
C--START EXECUTABLE STMTS.
C
      GO TO (1100, 1200, 1300, 9990) IWHERE
C
      HEATING LOAD OUTPUT
C
1100 CONTINUE
C
      WRITE(IWRITE,5000)
5000   FORMAT(28X,'***** HEAT PUMP LOAD DATA',
1       ' AS MODELED *****',/)
      CALL PRNTA(0,2)
      WRITE(IWRITE,5001)
5001   FORMAT(/, T15, 'I', T22, 'TODB', T33, 'RHO',
&       T44, 'HEATING-HRS', T62, 'NACH', T72, 'QINF',
&       T81, 'QTRAN', T93, 'QII', T99, 'QTOTAL',
&       T108, 'TOTAL/BIN',
&       /, T43, 'BIN', T53, 'AGG',
&       T72, '----- (BTU/HOUR) -----', T110, '(KBTU)',/)
C
      IDUMB = 0
      DUMB = 0.
C
      DO 1510 I=3,47
          IDUMA = 2
          IF(I .LT. 7 .OR. I .GT. 42) IDUMA = 1
          DUMA = (HPBTU(I) + SHBTU(I)) * 1.E-3
          GO TO (1505, 1506) IDUMA
1505   CONTINUE
          WRITE(IWRITE,5002)I,TODBM(I),RHM(I),
&       HRSM(I), HRSM(I), BNACHM(I), QINFM(I),
&       QTRANM(I), QIIM(I), QHLM(I),
&       DUMA
5002   FORMAT(10X, I5, F10.1, 5X, A5,
&       2F10.0, F10.3, 5F10.0)
          GO TO 1510
C
1506   CONTINUE
          IDUMB = IDUMB + 1
          DUMB = DUMB + HRSM(I)
          WRITE(IWRITE,5003)I,TODBM(I),RHM(I),
&       HRSM(I), BNACHM(I), QINFM(I),
&       QTRANM(I), QIIM(I), QHLM(I),
&       DUMA
5003   FORMAT(10X, I5, F10.1, F10.1,
&       F10.0, 10X, F10.3, 5F10.0)
```



```

      IF(IDUMB .NE. 6) GO TO 1510
      WRITE(IWRITE, 6004) DUMB
6004   FORMAT( T46, F10.0)
      IDUMB = 0
      DUMB = 0.
1510 CONTINUE
C
C--WRITE TOTALS.
C
      DUMA = (TOTHM(9) + TOTHM(10)) * 1.E-3
      WRITE(IWRITE, 6005) TOTHM(7), TOTHM(7), DUMA
6005   FORMAT(/18X, 'TOTALS:',
&      T36, 2F10.0, T106, F10.0)
C
      WRITE(IWRITE, 6010) QIIPSF, ZLTEMP
6010   FORMAT(/T56, 'QIIPSF:', F6.2, T76, 'ZLTEMP:', F6.2)
C
      GOTO 9990
C
C      COOLING LOAD DATA
C
1200 CONTINUE
C--SOLAR HOURS
      DO 120 I=1,60
      IF(SOLH(I).LT.0.01)GO TO 120
      HRS=SOLH(I)
      HHRS=0.
      IF(QILATS(I).GT.0.00001)HHRS=HRS
      QX=(QCII+QILATS(I))*HHRS/HRS
      QY=(QX+QTOIS(I))*HHRS/HRS
      QA=QCII*HHRS/HRS
      QB=QTOIS(I)*HHRS/HRS
      QC=100.-QMOIRS(I)
      WRITE(IWRITE,5013)I,TODBCM(I),RHOM(I),QSUNSM(I),QCONNS(I),QB,QA,
1      QILATS(I),QX,QY,QINFLS(I),QINFIS(I),QTOTS(I),QC
5013  FORMAT(I3,2F9.1,10F10.0,F9.1)
120 CONTINUE
C
      GO TO 9990
C
1300 CONTINUE
C
      DO 220 I=1,60
      IF(DKH(I).LT.0.01)GO TO 220
      HRS=DKH(I)
      HHRS=0.
      IF(QILATD(I).GT.0.00001)HHRS=HRS
      QX=(QCII+QILATD(I))*HHRS/HRS
      QY=(QX+QTODID(I))*HHRS/HRS
      QA=QCII*HHRS/HRS
      QB=QTODID(I)*HHRS/HRS
      QC=100.-QMOIRD(I)
      WRITE(IWRITE,5013)I,TODBCM(I),RHOM(I),QSUNDM(I),QCONND(I),QB,QA,
1      QILATD(I),QX,QY,QINFLD(I),QINFID(I),QTOTD(I),QC
220 CONTINUE
C

```

9990 CONTINUE

RETURN

END

SUBROUTINE PRNTF(IWHERE)

C

C*****

C

C PRINTOUT OF SEASONAL PERFORMANCE RESULTS.

C

C R. J. RETTBERG 14 JAN 1980.

C

C*****

C

C INCLUDE 'AVGS.COM'

C

C INCLUDE 'BINA.COM'

C

C INCLUDE 'CLWEAT.COM'

C

C INCLUDE 'DUMX.COM'

C

C INCLUDE 'MOD.COM'

C

C INCLUDE 'RW.COM'

C

C INCLUDE 'TOTS.COM'

C

C--START EXECUTABLE STMTS.

C

C GO TO (1100, 1200, 1300) IWHERE

C

C 1100 CONTINUE

C

C

C

C SOLAR HOUR AGGREGATED RESULTS

C

C RHIMX=0.0

C CYCNS=0.0

C DO 320 I=1,60

C IF(SOLH(I).LT.0.01)GO TO 320

C CYCNS=CYCNS+CPHRSS(I)*FCYS(I)

C IF(RHIS(I).GT.RHIMX) IRHMX=I

C RHIMX=AMAX1(RHIMX, RHIS(I))

C DUMA = 100. * FONASM(I)

C WRITE(IWRITE,5007)I,TOD8CH(I),RHOM(I),SOLH(I),RSBTU(I),RSKWH(I),

1 EERS(I),SRATS(I),RHIS(I),HRH6SS(I),CPHRSS(I),

2 FCYS(I),PWSOL(I), DUMA

C 320 CONTINUE

C EERX=TOT(1)/TOT(10)

C SRX=TOT(7)/TOT(1)*100.

C DUMA = 100. * FONAAS

C WRITE(IWRITE,5008)TOT(13),TOT(1),TOT(10),TOT(19),TOT(16)

C WRITE(IWRITE,5009) RHOWAS, EERX, SRX, RHIWAS, FCYWAS,

8 PWWAS, DUMA, RHOACS, RHIACS

C WRITE(IWRITE,5010) CYCNS, RHIMX, IRHMX

C GO TO 9990

C

1200 CONTINUE

C
C
C

DARK HOUR AGG. RESULTS

RHIMX=0.0

CYCND=0.0

DO 330 I=1,60

IF(DKH(I).LT.0.01)GO TO 330

CYCND=CYCND+CPHRSD(I)*FCYD(I)

IF(RHID(I).GT.RHIMX) IRHMX=I

RHIMX=AMAX1(RHIMX, RHID(I))

DUMA = 100. * FONADM(I)

WRITE(IWRITE,5007)I,TODBCM(I),RHOM(I),DKH(I),ROBTU(I),RDKWH(I),

1 EERD(I),SRATD(I),RHID(I),HRH65D(I),CPHRSD(I),

2 FCYD(I),PWDRK(I), DUMA

330 CONTINUE

EERX=TOT(2)/TOT(11)

SRX=TOT(8)/TOT(2)*100.

DUMA = 100. * FONAAD

WRITE(IWRITE,5008)TOT(14),TOT(2),TOT(11),TOT(20),TOT(17)

WRITE(IWRITE,5009) RHOWAD, EERX, SRX, RHIWAD, FCYWAD,

8 PWWAD, DUMA, RHOACD, RHIACD

WRITE(IWRITE,5010) CYCND, RHIMX, IRHMX

GO TO 9990

C

1300 CONTINUE

C

C

C

TOTAL HOUR AGG. RESULTS

RHIMX=0.0

DO 340 I=1,60

IF(TOTH(I).LT.0.01)GO TO 340

IF(RHIAVG(I).GT.RHIMX) IRHMX=I

RHIMX=AMAX1(RHIMX, RHIAVG(I))

DUMA = 100. * FONAAM(I)

WRITE(IWRITE,5007)I,TODBCM(I),RHOM(I),TOTH(I),RTBTU(I),RTKWH(I),

1 EERT(I),SRATT(I),RHIAVG(I),HRH65T(I),CPHRST(I),

2 FCYAVG(I),PWAVG(I), DUMA

340 CONTINUE

TOTPRT(IROW, 7)=CYCNS+CYCND

EERX=TOT(3)/TOT(12)

SRX=TOT(9)/TOT(3)*100.

DUMA = 100. * FONAAT

WRITE(IWRITE,5008)TOT(15),TOT(3),TOT(12),TOT(21),

1 TOT(18)

WRITE(IWRITE,5009) RHOWAT, EERX, SRX, RHIWAT, FCYWAT,

8 PWWAT, DUMA, RHOACT, RHIACT

DMSEER = TOT(3) / TOT(12)

WRITE(IWRITE,5010) TOTPRT(IROW,7), RHIMX, IRHMX, DMSEER

5007 FORMAT(15,2F10.1,F10.2,2F10.0,F10.2,2F10.1,3F10.2,

1 F10.2,F7.1)

5008 FORMAT(/10X,'TOTALS',9X,F10.2,2F10.0,30X,2F10.2)

5009 FORMAT(/10X,'AVERAGES', F7.1, 30X, F10.2, 2F10.1,

8 20X, 2F10.2, F7.1,

8 /20X, '(', F4.1, ')', 33X, 7X,

8 14X, '(', F4.1, ')',

```
&      /,20X,'(RH AVERAGES WITH BRACKETS ARE LOAD HOUR WEIGHTED',
&      ', THOSE WITHOUT ARE COMPRESSOR HOUR WEIGHTED.)')
5010 FORMAT(/10X,'NUMBER OF COMPRESSOR CYCLES = ',F6.0,
&      T52,' MAXIMUM INDOOR RH IS ',F5.1,' %, AND OCCURS IN BIN ',
&      I2,'.',', ',T107,' ACTUAL SEER = ',F8.3)
C
9990 CONTINUE
      RETURN
      END
      SUBROUTINE PRNTG
C
C*****
C
C PRINTOUT OF DRY-BULB-BIN RESULTS.
C
C R. J. RETTBERG 14 JAN 1980.
C
C*****
C
      INCLUDE 'BINA.COM'
C
      INCLUDE 'CASES.COM'
C
      INCLUDE 'DBBIN.COM'
C
      INCLUDE 'RW.COM'
C
      INCLUDE 'TOTS.COM'
C
C--START EXECUTABLE STMTS.
      DO 430 I = 1, 10
        WRITE(IWRITE,5019)I,TOTDBN(I),TIDBBN,HRSBN(I),QLBN(I),
1      HCBN(I),HEBN(I),CPHRST(I),RTBTU(I),RTKWH(I),EERT(I)
430 CONTINUE
C
      EERX=TOTDB(3)/TOTDB(4)
      WRITE(IWRITE,5020)TOTDB(1),TOTDB(2),TOTDB(3),TOTDB(4)
      WRITE(IWRITE,5021)EERX
C
5019 FORMAT(I10,2F10.0,F10.2,3F10.0,F10.2,2F10.0,F10.2)
5020 FORMAT(/10X,'TOTALS',14X,F10.2,30X,F10.2,2F10.0)
5021 FORMAT(/10X,'AVERAGES',82X,F10.2)
C
9990 CONTINUE
      RETURN
      END
      SUBROUTINE PRNTH
C
C*****
C
C PRINTOUT OF RUN DESCRIPTION.
C
C R. J. RETTBERG 14 JAN 1980.
C
C*****
C
```

C COMBINED COOLING AND HEATING SUBROUTINE BASED ON THE HPSPM
 C VERSION OF 3-82. [HCB, 3-82].
 C

C+++++

C
 C INCLUDE 'CASES.COM'

C
 C INCLUDE 'CPWID.COM'

C
 C INCLUDE 'DUMX.COM'

C
 C INCLUDE 'MOD.COM'

C
 C INCLUDE 'PROD.COM'

C
 C INCLUDE 'RW.COM'

C
 C INCLUDE 'SITE.COM'

C
 C
 C DIMENSION DMODE(4), TSNAMM(3,6)
 C DATA DMODE/ 'COOLI', 'NG & ', 'HEATI', 'NG ' /
 C DATA (TSNAMM(1,J),J=1,6)/ '50 PE', 'RCENT', ' DUTY', ' CYCL',
 C & 'E PAR', 'ABOLA' /
 C DATA (TSNAMM(2,J),J=1,6)/ 'ITERA', 'TIVE ', 'PARAB', ' W/ D',
 C & 'EGRAD', 'ATION' /
 C DATA (TSNAMM(3,J),J=1,6)/ 'BASED', ' ON T', 'ODB A', 'ND BA',
 C & 'LPT T', 'EMP. ' /

C
 C--START EXECUTABLE STMTS.

C
 C
 C DO 1010 I = 1, 20
 C DDUMA(I) = 0.
 C DDUMB(I) = 0.
 C DDUMC(I) = 0.

C 1010 CONTINUE

C
 C
 C WRITE(ITTY,5000)
 C 5000 FORMAT(/, ' INPUT THE TITLE FOR THE SET OF RUNS. (12A5):')
 C READ(ITTY, 5010)(DDUMA(JA),JA=1,12)
 C 5010 FORMAT(12A5)
 C CALL DATE(DDUMB)
 C CALL TIME(DDUMC(1),DDUMC(2))
 C IF(IMODE.EQ.3) GOTO 1050
 C IF(IMODE.NE.1) GOTO 100
 C DMODE(1)='COOLI'
 C DMODE(2)='NG ON'
 C DMODE(3)='LY '
 C DMODE(4)=' '
 C 100 CONTINUE
 C IF(IMODE.NE.2) GOTO 1050
 C DMODE(1)='HEATI'
 C DMODE(2)='NG ON'

```

DMODE(3)='LY  '
DMODE(4)='      '

```

```

C
1050 CONTINUE
C
C --- PRINTOUT THE HEADING.
C
      IF(IWHERE.GT.1)GO TO 1081
      IDUMB=0
      DO 1060 I=1,12
        IF(DDUMA(I).NE.' ')IDUMB=I
        IF(IDUMB.LT.I)GO TO 1061
1060 CONTINUE
1061 CONTINUE
C
      IDUMD=(12-IDUMB)/2
      IF(IDUMD.LT.1)GO TO 1081
C
      DO 1080 I = IDUMB + IDUMD, 1, -1
        IDUMC=I-IDUMD
        IF(IDUMC .LE. 0) GO TO 1078
        DDUMA(I)=DDUMA(IDUMC)
        GO TO 1080
1078 CONTINUE
        DDUMA(I)= ' '
1080 CONTINUE
1081 CONTINUE
C
      WRITE(IWRITE, 6000) (DDUMA(JA),JA=1,12), (DMODE(JA),JA=1,4)
6000 FORMAT( /, 20X, '***** ', 12A5, ' ***** ', 4A5)
      WRITE(IWRITE,6010) (DDUMB(JA),JA=1,2), (DDUMC(JA),JA=1,2)
6010 FORMAT( /70X, 'DATE ', 2A5, 'AT ', A5, ':', A5)
C
      WRITE(IWRITE, 6020) NCASES
6020 FORMAT( //T5, 'THE NUMBER OF RUNS IN THE SET IS:',
1 T80, I3)
      WRITE(IWRITE, 6030)
6030 FORMAT(//, T5, 'DATA THAT ARE CONSTANT FOR THE SET OF RUNS:')
      WRITE(IWRITE, 6050) CACLRP, EERLRP
6050 FORMAT(/T10, 'THE HEAT PUMP 95 DEG-F RATING POINT, CAPACITY IS:',
& T78, F8.0, ' BTU/HOUR',
& /T10, ' ', EER IS:',
& T80, F6.2)
      WRITE(IWRITE, 6060)TIDRC, TIDBH
6060 FORMAT( /T10, 'THE INDOOR TEMPERATURE SETTING IS (DEG-F):',
1 T70,'COOLING,',T80,F6.2,/,T70,'HEATING,',T80,F6.2)
      WRITE(IWRITE, 6068)TMINS, TMIND
6068 FORMAT( /T10, 'THE MINIMUM TEMPERATURES (DEG-F) ALLOWED FOR ',
& 'COOLING OPERATION ARE:',
& /T70, 'DAYTIME,', T80, F6.2,
& /T70, 'NIGHTTIME,', T80, F6.2)
      WRITE(IWRITE, 6067) (RHOBAS(JA), JA = 1, 6)
6067 FORMAT( /T10, 'THE COOLING OUTDOOR RELATIVE HUMIDITY ',
1 'BASES ARE (X):', T80, 5(F6.2, 3X), F6.2)
      WRITE(IWRITE, 6062)ANACHC, ANACHH
6062 FORMAT( /T10, 'THE DESIGN LOAD AIR CHANGEOVER RATES (ACH/H) ARE:',

```

```

1  T70, 'COOLING,', F6.2, /,
2  T70, 'HEATING,', F6.2)
  WRITE(IWRITE, 6063) QIIPSF, EOSIZE
6063  FORMAT(/T10, 'THE INTERNAL HEAT GAIN IS (BTU/H/FT**2):',
&      T80, F6.2, //, T10 'THE EQUIPMENT OVERSIZE FACTOR IS:'
&      T80, F6.2)
  IF(TSNAM.EQ.'NEW') ITS=1
  IF(TSNAM.EQ.'ITT') ITS=2
  IF(TSNAM.EQ.'OLD') ITS=3
  WRITE(IWRITE, 6064) TSNAM, (TSNAMM(ITS,J),J=1,6)
6064  FORMAT( /T10, 'THE TYPE OF THERMOSTAT IS:',
1      T80, A5, ', (', 6A5, ')')
  IF(TSNAM.EQ.'NEW'.OR.TSNAM.EQ.'ITT') WRITE (IWRITE,6065) CYCMAX
6065  FORMAT(T80,'PEAK CYCLE RATE IS ',F4.2)
  WRITE(IWRITE, 6066) SHSF
6066  FORMAT(/T10, 'THE SUPPLEMENTARY HEATER CAPACITY SCALE',
&      ' FACTOR IS:', T80, F6.2, ' (0 = NO TEMPERING HEAT)')
  IF(IWEAT.EQ.'ANN') WRITE(IWRITE, 6400)
6400  FORMAT(/T10, 'THE HEATING SEASON IS:',
&      T80, 'ANNUAL (I.E. 12-MONTHS).')
  IF(IWEAT.EQ.'SIX') WRITE(IWRITE, 6420)
6420  FORMAT(/T10, 'THE HEATING SEASON IS:',
&      T80, 'SIX MONTHS (NOV-APRIL).')
  IF(IWEAT.EQ.'EST') WRITE(IWRITE, 6440)
6440  FORMAT(/T10, 'THE HEATING SEASON IS:',
&      T80, 'SAI-S ESTIMATE (6-11 MONTHS DEPENDING ON SITE).')
  WRITE(IWRITE, 6070)
6070  FORMAT( /T10, 'THE OPTIONS SELECTED FOR THIS SET OF RUNS ARE:')
  IF(IAF.LT.1)WRITE(IWRITE, 6080)
6080  FORMAT( T80, 'CONTINUOUS FAN OPERATION.')
  IF(IAF.GT.0) WRITE(IWRITE, 6090)
6090  FORMAT( T80, '"AUTOFAN" OPERATION.')
  IF(ICYCLE.LT.1)WRITE(IWRITE, 6100)
6100  FORMAT( T80, 'IDEAL PULSE OPERATION (I. E. NO CYCLIC LOSSES).')
  IF(ICYCLE.GT.0)WRITE(IWRITE, 6110)
6110  FORMAT( T80, 'CYCLIC DEGRADATION INCLUDED IN CALCULATIONS.')
  IF(IRSARE.EQ.0) WRITE(IWRITE,6112)
6112  FORMAT(T80, 'BUILDING SIZED TO HEAT PUMP CAPACITY.')
  IF(IRSARE.EQ.1) WRITE(IWRITE,6114) RESARI
6114  FORMAT(T80, 'THE FLOOR AREA IS FIXED AT ',F8.1
&      ', ' SQUARE FEET.')
  IF(IECON.EQ.1) WRITE(IWRITE, 6119)
6119  FORMAT(T80, 'LIFE CYCLE COSTS ARE CALCULATED.')
  WRITE(IWRITE,6120)
6120  FORMAT(/T10,'THE COMPRESSOR TYPE IS:')
  IF(ISPEED.EQ.1) WRITE(IWRITE,6130)
6130  FORMAT(T80,'SINGLE SPEED.')
  IF(ISPEED.EQ.2) WRITE(IWRITE,6140)
6140  FORMAT(T80,'DUAL SPEED.')
C
C --- PRINTOUT THE RUN BY RUN DATA.
C
  IDUMA = 1
  IDUMB = MIN0(25, NCASES)
C
1120 CONTINUE

```

```

      IF(IDUMA .GT. 1) CALL PRNTA(0,0)
      WRITE(IWRITE, 6200)
6200  FORMAT( //, T5, 'THE SET OF RUN INPUTS IS AS FOLLOWS:')
      WRITE(IWRITE, 6210)
6210  FORMAT( /, T10, 'RUN #   SITE #',
&          T30, 'SITE NAME',
&          T45, 'DEFROST CONTROL DESCRIPTION (MODEL, TIMER)',
&          /, T10, '-----',
&          T30, '-----',
&          T45, '-----', /)
C
      DO 1150 I=IDUMA, IDUMB
      K = ISITEM(I)
      KD=IDEFT(I)
      IF(KD.EQ.8) KD=0
      KDM=IDFMOD(I)
      KDM=KDM
      IF(IDEFT(I).NE.4 .AND. IDEFT(I).NE.5) KDM=0
      IF(IDEFT(I).NE.4 .AND. IDEFT(I).NE.5) KDM=5
C
      WRITE(IWRITE, 6250) I,K, (STTLAB(K, JA), JA = 1, 2), KD,
&          (DFTLAB(IDEFT(I), JA), JA = 1, 7), KDM,
&          (DFMLAB(KDM, JA), JA = 1, 5)
6250  FORMAT(10X,I2,6X, I2, T30, 2A5, T45,
&          '(,I1,)' ', 7A5, ', (,I1,)' ', 5A5)
1150  CONTINUE
C
      IF(IDUMA .GT.1) CALL PRNTA(0,0)
      IDUMA = IDUMB
      IDUMB = NCASES
      IF(IDUMA .NE. IDUMB) GO TO 1120
C
9990  CONTINUE
      RETURN
      END
      SUBROUTINE PRNTI
C
C*****
C
C  PRINTOUT OF WEATHER STATISTICS.
C
C  R. J. RETTBERG  14 JAN 1980.
C
C*****
C
      INCLUDE 'AVGS.COM'
C
      INCLUDE 'CASES.COM'
C
      INCLUDE 'CLWEAT.COM'
C
      INCLUDE 'DUMX.COM'
C
      INCLUDE 'HTWEAT.COM'
C
      INCLUDE 'PROG.COM'

```



```
C
      INCLUDE 'RW.COM'
C
      INCLUDE 'SITE.COM'
C
      INCLUDE 'TOTS.COM'
C
C--START EXECUTABLE STMTS.
C
      CALL PRNTA(9,0)
C
      WRITE(IWRITE, 6000)
6000      FORMAT(40X, '***** COOLING WEATHER DATA/STATISTICS',
&          ' *****')
      WRITE(IWRITE, 6010) ISITE, (WSTTL(JA), JA = 1, 15)
6010      FORMAT(/, 34X, I5, 15A5)
C
      DO 1030 I = 1, 6
          IIDUMA(I) = IFIX(RHOBAS(I))
1030      CONTINUE
C
      WRITE(IWRITE, 6020) (IIDUMA(JA), JA = 1, 6)
6020      FORMAT(/, T27, 'TODB', T36, '*****',
&          '      TOTAL HOURS FOR SPECIFIED RH      ',
&          '*****',
&          T95, 'TOTALS',
&          /, T31, 6(7X, I2, 'X'),
&          /)
C
      SUMSUM = 0.
C
      DO 1050 I = 1, 10
          J = 6 * I - 6 + 1
          TODB = TODBCM(J)
          SUM = TOWDBT(I)
          WRITE(IWRITE, 6040) TODB, (TOTH(JA), JA = J, J + 5),
&              SUM
6040      FORMAT(20X, 8F10.1)
          SUMSUM = SUMSUM + SUM
1050      CONTINUE
C
      WRITE(IWRITE, 6060) (TOWRHT(JA), JA = 1, 6), SUMSUM, RHOAHT
6060      FORMAT(/, 22X, 'TOTALS:', T31, 7F10.1,
&          /, 22X, 'AVERAGE RH:', T91, F10.1)
C
      WRITE(IWRITE, 6120) (IIDUMA(JA), JA = 1, 6)
6120      FORMAT(/, T27, 'TODB', T36, '*****',
&          '      SOLAR HOURS FOR SPECIFIED RH      ',
&          '*****',
&          T95, 'TOTALS',
&          /, T31, 6(7X, I2, 'X'),
&          /)
C
      SUMSUM = 0.
C
      DO 1150 I = 1, 10
```

```

      J = 6 * I - 6 + 1
      TODB = TODBCM(J)
      SUM = TOWDBS(I)
      WRITE(IWRITE, 6040) TODB, (SOLH(JA), JA = J, J + 5),
&                                SUM
      SUMSUM = SUMSUM + SUM
1150 CONTINUE
C
      WRITE(IWRITE, 6060) (TOWRHS(JA), JA = 1, 6), SUMSUM, RHOAHS
C
      WRITE(IWRITE, 6220) (IIDUMA(JA), JA = 1, 6)
6220  FORMAT(/, T27, 'TODB', T36, '*****',
&          '      DARK HOURS FOR SPECIFIED RH      ',
&          '*****',
&          T95, 'TOTALS',
&          /, T31, 6(7X, I2, 'X'),
&          /)
C
      SUMSUM = 0.
C
      DO 1250 I = 1, 10
      J = 6 * I - 6 + 1
      TODB = TODBCM(J)
      SUM = TOWDBD(I)
      WRITE(IWRITE, 6040) TODB, (DKH(JA), JA = J, J + 5),
&                                SUM
      SUMSUM = SUMSUM + SUM
1250 CONTINUE
C
      WRITE(IWRITE, 6060) (TOWRHD(JA), JA = 1, 6), SUMSUM, RHOAHD
C
9990 CONTINUE
      RETURN
      END
      SUBROUTINE PRNTJ(IWHERE)
C
C+++++
C
      THIS SUBROUTINE IS A COMBINATION OF 'PRNT?' ROUTINES FROM THE
      HEATING AND COOLING SPM'S OF EARLY '82. THE CALL SWITCH 'IWHERE'
      AND THE FORMER PROGRAM, SUBROUTINE AND SWITCH VALUE ARE AS
      FOLLOWS:
C
      IWHERE  PROG/SUB./SWITCH          DESCRIPTION
C
      1       H/PRNTC/1                 SITE DESIGN DATA
      1       C/PRNTB/-                 RUN LOAD AND PRODUCT DATA
      2       H/PRNTC/2                 HP DESIGN DATA, DUAL SPEED
      3       H/PRNTC/3                 " " " " , SINGLE SPEED
      4       C-H/PRNTJ/1               DESIGN LOAD COMPONENTS (FT-NTS)
      5       C-H/PRNTJ/2               DOE SEER RESULTS
C
C+++++
C
      INCLUDE 'CASES.COM'
C

```

```
      INCLUDE 'CPWID.COM'
C
      INCLUDE 'CSZ.COM'
C
      INCLUDE 'DOE.COM'
C
      INCLUDE 'DUMX.COM'
C
      INCLUDE 'HSZ.COM'
C
      INCLUDE 'MOD.COM'
C
      INCLUDE 'RW.COM'
C
C--START EXECUTABLE STMTS.
C
      RESARE = RESVOL / 8.
      GO TO (1100, 1200, 1100, 1400, 1500) IWHERE
C
1100 CONTINUE
C
      IF(NRAN .EQ. 0) DUMA = 'MED'
      IF(NRAN .EQ. -1) DUMA = 'LOW'
      IF(NRAN .EQ. 1) DUMA = 'HIGH'
      WRITE(IWRITE, 6550) TODH, TODC, DUMA
6550   FORMAT(///T15, 'FOR THIS SITE:', T55, 'TODH:',
&          T70, F8.1, ' DEG-F:', T100, 'TODC:',
&          T115, F8.1, ' DEG-F.',
&          /T100, 'RANGE:', T115, 4X, A4)
C
1200 CONTINUE
      IF(ISPEED.EQ.1) GO TO 11
      WRITE(IWRITE, 6560) CAHHRP, CACHRP, CALHRP
6560   FORMAT(/T15, 'FOR THIS HEAT PUMP:',
&          //T20, 'RATED CAPACITIES AT HIGH SPEED:',
&          T55, ' 47 DEG-F:', T70, F8.1, ' BTU/H:',
&          T100, ' 95 DEG-F:', T115, F8.1, ' BTU/H.',
&          /T55, ' 17 DEG-F:', T70, F8.1, ' BTU/H.')
```

```
      WRITE(IWRITE, 6561) CAHLRP, CACLRP, CALLRP
6561   FORMAT( //T20, 'RATED CAPACITIES AT LOW SPEED:',
&          T55, ' 47 DEG-F:', T70, F8.1, ' BTU/H:',
&          T100, ' 95 DEG-F:', T115, F8.1, ' BTU/H.',
&          /T55, ' 17 DEG-F:', T70, F8.1, ' BTU/H.')
```

```
C
      IF(IWHERE .EQ. 3) GO TO 1250
C
      POCDUM=POCHRP*1000.
      WRITE(IWRITE, 6570) POHHRP, POCDUM, POLHRP
6570   FORMAT(/T20,
&          'RATED POWERS FOR HIGH SPEED:',
&          T55, ' 47 DEG-F:', T70, F8.1, ' WATTS:',
&          T100, ' 95 DEG-F:', T115, F8.1, ' WATTS.',
&          /T55, ' 17 DEG-F:', T70, F8.1, ' WATTS.')
```

```
      WRITE(IWRITE, 6571) POHLRP, POCLRP, POLLRP
6571   FORMAT(/T20,
&          'RATED POWERS FOR LOW SPEED:',
```

```

&      T55, '0 47 DEG-F:', T70, F8.1, ' WATTS:',
&      T100, '0 95 DEG-F:', T115, F8.1, ' WATTS.',
&      /T55, '0 17 DEG-F:', T70, F8.1, ' WATTS.')
```

WRITE(IWRITE, 6580) COHHRP,EERHRP,COLHRP

```

6580  FORMAT(/T20,
&      'RATED EFFICIENCIES FOR HIGH SPEED:',
&      T55, '0 47 DEG-F:', T70, F8.2, ' (COP):',
&      T100, '0 95 DEG-F:', T115, F8.2, ' BTU/WH.',
&      /T55, '0 17 DEG-F:', T70, F8.2, ' (COP).')
```

WRITE(IWRITE, 6581) COHLRP,EERLRP,COLLRP

```

6581  FORMAT(/T20,
&      'RATED EFFICIENCIES FOR LOW SPEED:',
&      T55, '0 47 DEG-F:', T70, F8.2, ' (COP):',
&      T100, '0 95 DEG-F:', T115, F8.2, ' BTU/WH.',
&      /T55, '0 17 DEG-F:', T70, F8.2, ' (COP).')
```

C

11 IF(ISPEED.EQ.2) GO TO 12

WRITE(IWRITE, 6562) CAHLRP,CACLRP,CALLRP

```

6562  FORMAT( //T20, 'RATED CAPACITIES:',
&      T55, '0 47 DEG-F:', T70, F8.1, ' BTU/H:',
&      T100, '0 95 DEG-F:', T115, F8.1, ' BTU/H.',
&      /T55, '0 17 DEG-F:', T70, F8.1, ' BTU/H.')
```

C

IF(IWHERE .EQ. 3) GO TO 1250

POCDUM=POCLRP*1000.

WRITE(IWRITE, 6572) POHLRP,POCDUM,POLLRP

```

6572  FORMAT(/T20,
&      'RATED POWERS FOR:',
&      T55, '0 47 DEG-F:', T70, F8.1, ' WATTS:',
&      T100, '0 95 DEG-F:', T115, F8.1, ' WATTS.',
&      /T55, '0 17 DEG-F:', T70, F8.1, ' WATTS.')
```

C

CALL CACPM(95., 80., 67.)

SRATRP = HS / HCTOT * 100.

C

C--CORRECT FOR RP SCFM VS. OPERATING CFM.

C

HSADJ = 1.025 * HS

HCTADJ = 1.0125 * HCTOT

SRATRP = HSADJ / HCTADJ * 100.

C

WRITE(IWRITE, 6582) COHLRP,EERLRP,COLLRP,SRATRP

```

6582  FORMAT(/T20,
&      'RATED EFFICIENCIES:',
&      T55, '0 47 DEG-F:', T70, F8.2, ' (COP):',
&      T100, '0 95 DEG-F:', T115, F8.2, ' BTU/WH.',
&      /T55, '0 17 DEG-F:', T70, F8.2, ' (COP).',
&      /T100, 'SENS COOLING RATIO ', F4.1, ' %')
```

12 CONTINUE

HOFAN=HEFAN-HEHFAN

WRITE(IWRITE, 6590) HTAUON,HEHFAN,HOFAN,SFCPC,SFPWC

```

6590  FORMAT(/T20,
&      'MISC. EQUIPMENT DATA:',
&      T55, 'TIME CONST. (TAU)', T72, F6.2, ' MINUTES.',
&      /T55, 'INDOOR FAN PWR:', T70, F8.1, ' WATTS.',
```

```

&      T100, 'OUTDOOR FAN PWR:', T116, F7.1, ' WATTS.',
&      /T20, 'SCALE FACTORS:',
&      /T55, 'COOLING CAPACITY', T71, F7.4,
&      /T55, 'COOLING POWER', T70, F8.4)

```

C

```
IF(IWHERE .EQ. 2) GO TO 9990
```

C

```
1250 CONTINUE
```

C

```

WRITE(IWRITE, 6600) QH9560, QHDL, QCSDL, RESVOL, RESARE
6600  FORMAT(/T15,
&      'DESIGN LOAD RESULTS:',
&      T55, 'QH9560:', T70, F8.1, ' BTU/H.', /
&      T55, 'QHDL:', T70, F8.1, ' BTU/H.',
&      T100, 'QCSDL:', T115, F8.1, ' BTU/H.',
&      //T55, 'BUILDING VOLUME:', T71, F7.0, ' CUBIC FEET',
&      /T55, 'FLOOR AREA:', T70, F8.0, ' SQUARE FEET')
WRITE(IWRITE, 6610) DOE14(3), DOE5(3)
6610  FORMAT(/T15,
&      'DOE AVERAGE HEATING LOADS * TODH:',
&      T55, 'I-IV & VI:', T70, F8.1, ' BTU/H.',
&      /T55, 'V:', T70, F8.1, ' BTU/H.')
WRITE(IWRITE, 6620) DOE14(3), DOE5(3)
6620  FORMAT(/T15,
&      'DOE AVG HEATING OUTPUT:',
&      T55, 'I-IV & VI:', T70, F8.1, ' KBTU/Y.',
&      /T55, 'V:', T70, F8.1, ' KBTU/Y.')

```

C

```
GOTO 9990
```

C

```
C--DESIGN LOADS PER SIZING ROUTINES.
```

C

```
1400 CONTINUE
```

C

```

WRITE(IWRITE, 6100) (QCTDL(JA), JA = 1, 4), QCSINF, QCSDL
6100  FORMAT(/, 15X, 'COOLING DESIGN LOAD COMPONENTS:',
&      //25X, 'SUN:', F7.0, 3X, 'WINDOW CONDUCTION:',
&      F7.0, 3X, 'WALL CONDUCTION:', F7.0,
&      3X, 'CEILING CONDUCTION:', F7.0,
&      //25X, 'SENSIBLE INFILTRATION:', F7.0,
&      3X, 'TOTAL SENSIBLE:', F10.0)

```

C

```
IF(IMODEP.EQ.1) GOTO 9990
```

C

```

WRITE(IWRITE, 6110) QC95, QH9560, QHDL
6110  FORMAT(/, 15X, 'HEATING DESIGN LOAD COMPONENTS:',
&      //25X, 'COOLING REFERENCE FOR 95 DEG-F ',
&      'COOLING DESIGN TEMP:', T85, F7.0,
&      /25X, 'HEATING REFERENCE FOR 95 DEG-F ',
&      'COOLING DESIGN TEMP',
&      /45X, ' & 60 DEG-F',
&      'HEATING DESIGN DELTA TEMP:', T85, F7.0,
&      //25X, 'HEATING TOTAL FOR ACTUAL CONDITIONS:',
&      T95, F7.0)
GO TO 9990

```

C

```
1500 CONTINUE
C
C--PRINT DOE SEER RESULTS.
C
      WRITE(IWRITE, 6200) EERB, SEER
6200      FORMAT(/40X, 'EER # 82 DEG-F (EERB) =', F6.2, 5X, 'SEER =', F6.2)
C
      GOTO 9990
C
9990 CONTINUE
      RETURN
      END
      SUBROUTINE PRNTK(IWHERE)
C
C*****
C
C--SUMMARY OF RESULTS PRINTOUTS.
C
C--R. J. RETTBERG  16 JUL 1980.
C
C*****
C
      INCLUDE 'CASES.COM'
C
      INCLUDE 'DUMX.COM'
C
      INCLUDE 'RW.COM'
C
      INCLUDE 'SUMRY.COM'
C
C--START EXECUTABLE STMTS.
C
      DO 1010 I = 1, 13
          DDUMA(I) = 0.
1010 CONTINUE
C
      GO TO (1100, 1200) IWHERE
C
1100 CONTINUE
C
      ISTRT = 1
      IEND = ISTSZ
C
      DO 1120 I = ISTRT, IEND
          DDUMA(1) = DDUMA(1) + ATOUT(I)
          DDUMA(2) = DDUMA(2) + AHOUT(I)
          DDUMA(3) = DDUMA(3) + ATIN(I)
          DDUMA(4) = DDUMA(4) + AHIN(I)
          DDUMA(5) = DDUMA(5) + ASYCOPI(I)
          DDUMA(6) = DDUMA(6) + ACPC(I)
          DDUMA(7) = DDUMA(7) + ADCY(I)
          DDUMA(8) = DDUMA(8) + ABPN(I)
          DDUMA(9) = DDUMA(9) + ABPDR(I)
          DDUMA(10) = DDUMA(10) + ABPDE(I)
          DDUMA(11) = DDUMA(11) + A1KW(I)
          DDUMA(12) = DDUMA(12) + AZLT(I)
```

```
DDUMA(13) = DDUMA(13) + ACPH(I)
1120 CONTINUE
C
DUMA = 1. / AIST9Z
C
DO 1130 I = 1, 13
DDUMA(I) = DDUMA(I) * DUMA
1130 CONTINUE
C
WRITE(IWRITE,6100)
6100 FORMAT(30X,'***** SUBSET SEASONAL PERFORMANCE DATA ',
1 'SUMMARY, HEATING *****',/)
WRITE(IWRITE, 6210) ICYCLE, IAF, TIDB, ANACH,
& QIIPSF, TSNAM, SHSF, ISPEED
WRITE(IWRITE, 6220)
WRITE (IWRITE, 5028)
C
DO 1140 I = ISTRT, IEND
IDUMC = ICASEA(I)
IDUMA = ISITEM(IDUMC)
WRITE(IWRITE, 6230) IDUMA, ATOUT(I),
& ATIN(I), AHIN(I), ASYCOPI(I),
& ACPC(I), ADCY(I),
& ABPN(I), ABPDR(I), ABPDE(I),
& A1KW(I), AZLT(I), ACPH(I)
1140 CONTINUE
C
WRITE(IWRITE, 6240) DDUMA(1), (DDUMA(JA), JA = 3, 13)
WRITE(IWRITE, 5028)
GO TO 9990
C
1200 CONTINUE
C
ISTRT = 1
IEND = NCASES
C
DO 1220 I = ISTRT, IEND
DDUMA(1) = DDUMA(1) + BTOUT(I)
DDUMA(2) = DDUMA(2) + BHOUT(I)
DDUMA(3) = DDUMA(3) + BTIN(I)
DDUMA(4) = DDUMA(4) + BHIN(I)
DDUMA(5) = DDUMA(5) + BSYCOP(I)
DDUMA(6) = DDUMA(6) + BCPC(I)
DDUMA(7) = DDUMA(7) + BDCY(I)
DDUMA(8) = DDUMA(8) + BBPN(I)
DDUMA(9) = DDUMA(9) + BBPDR(I)
DDUMA(10) = DDUMA(10) + BBPDE(I)
DDUMA(11) = DDUMA(11) + B1KW(I)
DDUMA(12) = DDUMA(12) + BZLT(I)
DDUMA(13) = DDUMA(13) + BCPH(I)
1220 CONTINUE
C
DUMA = 1. / BCASES
C
DO 1230 I = 1, 13
DDUMA(I) = DDUMA(I) * DUMA
```

1230 CONTINUE

```
C
WRITE(IWRITE,6200)
6200  FORMAT(35X,'***** SEASONAL PERFORMANCE DATA ',
1      'SUMMARY, HEATING *****',/)
WRITE(IWRITE, 6210) ICYCLE, IAF, TIDB, ANACH,
&      QIIPSF, TSNAM, SHSF, ISPEED
6210  FORMAT(/T15, 'ICYCLE =', I3, T29, 'IAF =', I3,
&      T41, 'TIDB =', F5.1, T55, 'NACH (DESIGN) =', F5.2,
&      T77, 'QIIPSF =', F5.2,
&      T92, 'TSTAT:', I1, A5, T105, 'SHSF =', F5.2,
&      T120, 'ISPEED =', I1)
WRITE(IWRITE, 6220)
6220  FORMAT(/, T4, 'SITE #',
&      T15, 'TOTOUT', T26, 'TOTIN', T37, 'HPIN',
&      T45, 'SYSCOP', T55, '#CPCYC', T64, '#DEFCYC',
&      T75, 'TBPNOI', T85, 'TBPDRY', T95, 'TBPDES',
&      T107, 'S1KW', T115, 'ZLTEMP',
&      T126, 'CPHRS')
```

```
C
WRITE(IWRITE, 5028)
5028  FORMAT(/, '*****',
1      '*****',
2      '*****')
DO 1240 I = ISTRT, IEND
IDUMA = ISITEM(I)
WRITE(IWRITE, 6230) IDUMA, BTOUT(I),
&      BTIN(I), BHIN(I), BSYCOP(I),
&      BCPC(I), BDCY(I),
&      BBPN(I), BBPDR(I), BBPDE(I),
&      B1KW(I), BZLT(I), BCPH(I)
6230  FORMAT(4X, I3, T11, 3F10.0, 1F10.2, 2F10.0,
&      3F10.2, 1F10.4, 1F10.2, F10.0)
```

1240 CONTINUE

```
C
WRITE(IWRITE, 5028)
WRITE(IWRITE, 6240) DDUMA(1), (DDUMA(JA), JA = 3, 13)
6240  FORMAT(/T3, 'AVGS:', T11, 3F10.0, 1F10.2, 2F10.0,
&      3F10.2, 1F10.4, 1F10.2, F10.0)
WRITE(IWRITE, 5028)
GO TO 9990
```

```
C
9990 CONTINUE
RETURN
END
SUBROUTINE PRNTL
```

```
C
C+++++
C
C      THIS IS A HEATING SPM OUTPUT ROUTINE BASED ON THE OUTPUT
C      PORTION OF 'HPSPM' (2-82).
C
C      [HCB, 3-16-82]
C+++++
C
```



```
      INCLUDE 'BALPT.COM'
C
      INCLUDE 'BIN.COM'
C
      INCLUDE 'CASES.COM'
C
      INCLUDE 'CPWID.COM'
C
      INCLUDE 'CSZ.COM'
C
      INCLUDE 'DOE.COM'
C
      INCLUDE 'DUMX.COM'
C
      INCLUDE 'MOD.COM'
C
      INCLUDE 'HSZ.COM'
C
      INCLUDE 'HTOUT.COM'
C
      INCLUDE 'HTWEAT.COM'
C
      INCLUDE 'PROD.COM'
C
      INCLUDE 'PROG.COM'
C
      INCLUDE 'QL.COM'
C
      INCLUDE 'RW.COM'
C
      INCLUDE 'SHSIZ.COM'
C
      INCLUDE 'SITE.COM'
C
      INCLUDE 'SUMRY.COM'
C
      INCLUDE 'TOTS.COM'
C
      INCLUDE 'TSTAT.COM'
C
      BEGIN HEATING OUTPUT
C
C
C
C--IF ONLY A SUMMARY OF RESULTS OUTPUT IS DESIRED, SKIP THE
C-- DETAILED PRINTOUT CODING.
C
      IF(IPRNTJ .EQ. 'Y') GO TO 1800
C
C--PRINT PRODUCT DATA
C
      IF(IPRNTF .EQ. 'N')GO TO 1530
      CALL PRNTA(0, 0)
      WRITE(IWRITE,5000)
5000   FORMAT(35X,'***** HEAT PUMP PERFORMANCE DATA',
1       ' AS MODELED *****', /)
      CALL PRNTA(0, 1)
```

```

WRITE(IWRITE,5001)
5001 FORMAT(/,T3,'I',T10,'TODB',T21,'RHO',
&      T25,'*',T34,'INTEGRATED VALUES',
&      T55,'*',T57,'DEFROST PERFORMANCE FACTORS',
&      T85,'*',T96,'PEAK VALUES',
&      T115,'*',T120,'DEFROST TIMES',
&      /,T123,'(MINUTES)',
&      /T28,'TOTCAP',T38,'TOTPWR',T51,'COP',
&      T61,'CAP',T69,'POWER',T81,'COP',
&      T88,'TOTCAP',T98,'TOTPWR',T111,'COP',
&      T121,'D-O',T131,'DUR',/)

C
DUMD = ' - '

C
DO 1510 I = ISTRT, 47
  IDUMA = 2
  IF(I .LT. 7) IDUMA = 1
  IF(I .GT. 42) IDUMA = 3
  DUMA = HCAPM(I) / DFCAPM(I)
  DUMB = HPWRM(I) / DFPWRM(I)
  DUMC = HCOPM(I) / DFCOPM(I)
  GO TO (1505, 1506, 1508) IDUMA
1505 CONTINUE
  WRITE(IWRITE,5002)I,TODBM(I),RHM(I),
&      HCAPM(I), HPWRM(I), HCOPM(I),
&      DFCAPM(I), DFPWRM(I), DFCOPM(I),
&      DUMA, DUMB, DUMC, DUMD, DUMD
5002 FORMAT(I3, F10.1, 5X, A5, 2F10.0,
&      F10.2, 3F10.3, 2F10.0, F10.2, 2(5X, A5))
  GO TO 1510

C
1506 CONTINUE
  IF(TIMDDM(I) .GT. 1.E4 .AND. TIMDUM(I) .LT. 1.E-4) GO TO 1507
  WRITE(IWRITE,5003)I,TODBM(I),RHM(I),
&      HCAPM(I), HPWRM(I), HCOPM(I),
&      DFCAPM(I), DFPWRM(I), DFCOPM(I),
&      DUMA, DUMB, DUMC, TIMDDM(I), TIMDUM(I)
5003 FORMAT(I3, F10.1, F10.1, 2F10.0,
&      F10.2, 3F10.3, 2F10.0, 3F10.2)
  GO TO 1510

C
1507 CONTINUE
  WRITE(IWRITE,6203)I,TODBM(I),RHM(I),
&      HCAPM(I), HPWRM(I), HCOPM(I),
&      DFCAPM(I), DFPWRM(I), DFCOPM(I),
&      DUMA, DUMB, DUMC, DUMD, DUMD
6203 FORMAT(I3, F10.1, F10.1, 2F10.0,
&      F10.2, 3F10.3, 2F10.0, F10.2, 2(5X, A5))
  GO TO 1510

C
1508 CONTINUE
  IF(TIMDDM(I) .GT. 1.E4 .AND. TIMDUM(I) .LT. 1.E-4) GO TO 1509
  WRITE(IWRITE,5005)I,TODBM(I),RHM(I),
&      HCAPM(I), HPWRM(I), HCOPM(I),
&      DFCAPM(I), DFPWRM(I), DFCOPM(I),
&      DUMA, DUMB, DUMC, TIMDDM(I), TIMDUM(I)

```

```
5005      FORMAT(I3, F10.1, 5X, A5, 2F10.0,
&          F10.2, 3F10.3, 2F10.0, 3F10.2)
      GO TO 1510
C
1509      CONTINUE
      WRITE(IWRITE,6205)I,TODBM(I),RHM(I),
&          HCAPM(I), HPWRM(I), HCOPM(I),
&          DFCAPM(I), DFPWRM(I), DFCOPM(I),
&          DUMA, DUMB, DUMC, DUMD, DUMD
6205      FORMAT(I3, F10.1, 5X, A5, 2F10.0,
&          F10.2, 3F10.3, 2F10.0, F10.2, 2(5X, A5))
1510      CONTINUE
C
C      CALCULATE DEGRADATION COEFFICIENT (CD) AT 47F
C
      IF(FONIM(6).GE.1) CD=0.0
      IF(FONIM(6).GE.1) GOTO 1540
      IF(FONIM(6).LT.1) CD=(1-COPIM(6)/HCOPM(6))/(1-FONIM(6))
1540      CONTINUE
C
      WRITE(IWRITE,5006) (STTLAB(ISITE, JA), JA = 1, 2),
&          WADFC A, WADFPW, WADFCO, CD, TIDBH
5006      FORMAT(/13X, 2A5, 'CPHRS WEIGHTED AVERAGE VALUES:',
&          3F10.3,T88,'DOE DEGRADATION COEFFICIENT (CD) AT 47F=',F5.3,
&          //44X, 'ALL DATA ARE FOR TIDB = ',F5.1,' DEG-F.')
```

```
C
      CALL PRNTA(0, 0)
      CALL PRNTJ(2)
C
      IF(IPRNTF .EQ. 'PO') GO TO 1800
C
1530      CONTINUE
C
C--PRINT LOAD DATA IF REQUESTED.
C
      IF(IPRNTC .EQ. 'N') GO TO 1700
      CALL PRNTMS(14)
      IF(IPRNTC .EQ. 'LO') GO TO 1800
C
1700      CONTINUE
C
      IF(IPRNTI .EQ. 'TO') GO TO 1780
C
C--PRINT SEASONAL PERFORMANCE DATA
C
      CALL PRNTA(0, 0)
      WRITE(IWRITE,6000)
6000      FORMAT(40X,'***** SEASONAL PERFORMANCE DATA ',
1          '*****',/)
      CALL PRNTA(0, 3)
      WRITE(IWRITE,6003)
6003      FORMAT(/T4,'I',T9,'TODB',T18,'RHO',T26,'HRS',T32,'CPHRS',
1          T38,'HT-LOAD',T47,'HP-CAP',T54,'SH-CAP',T61,'HP-KBTU',
2          T69,'SH-KBTU',T77,'HP-KWH',T84,'TOT-KWH',T92,'COP',
3          T97,'IPCT-ON',T105,'APCT-ON',T113,'FCY',T120,'PW-I',
4          T127,'PW-ACT',/)
```

C

```

DO 1720 I = ISTRT, 6
  IF(HRSM(I) .LT. 0.01) GO TO 1720
  XA=100.*FONIM(I)
  XB=100.*FONAM(I)
  XC=HPBTU(I)/1000.
  XD=SHBTU(I)/1000.
  XE=XD/3.413
  ENERTT=XE+ENERTM(I)
  WRITE(IWRITE,6004)I,TODBM(I),RHM(I),HRSM(I),CPHRSM(I),QHLM(I),
1    HCAPM(I),SUPHM(I),XC,XD,ENERTM(I),ENERTT,COPIM(I),XA,XB,
2    FCYM(I),PWIM(I),PWAM(I)
6004  FORMAT(I4,F8.1,3X,A5,2F8.1,2F8.0,5F7.0,F8.2,2F7.1,F8.3,2F7.2)
1720 CONTINUE

```

C

```

IDUM=0.
DUB=0.
DO 1740 I=7,42
  IDUM=IDUM+1
  IF(HRSM(I) .LT. 0.01) GO TO 1740
  XA=100.*FONIM(I)
  XB=100.*FONAM(I)
  XC=HPBTU(I)/1000.
  XD=SHBTU(I)/1000.
  XE=XD/3.413
  ENERTT=XE+ENERTM(I)
  DUB=DUB+ENERTT
  WRITE(IWRITE,6005)I,TODBM(I),RHM(I),HRSM(I),CPHRSM(I),QHLM(I),
1    HCAPM(I),SUPHM(I),XC,XD,ENERTM(I),ENERTT,COPIM(I),XA,XB,
2    FCYM(I),PWIM(I),PWAM(I)
6005  FORMAT(I4,4F8.1,2F8.0,5F7.0,F8.2,2F7.1,F8.3,2F7.2)
  IF(IDUM.NE.6) GO TO 1740
  WRITE (IWRITE,4000) DUB
4000  FORMAT(T80,F10.0)
  IDUM=0.
  DUB=0.
1740 CONTINUE

```

C

```

DO 1760 I=43,47
  IF(HRSM(I) .LT. 0.01) GO TO 1760
  XA=100.*FONIM(I)
  XB=100.*FONAM(I)
  XC=HPBTU(I)/1000.
  XD=SHBTU(I)/1000.
  XE=XD/3.413
  ENERTT=XE+ENERTM(I)
  WRITE(IWRITE,6004)I,TODBM(I),RHM(I),HRSM(I),CPHRSM(I),QHLM(I),
1    HCAPM(I),SUPHM(I),XC,XD,ENERTM(I),ENERTT,COPIM(I),XA,XB,
2    FCYM(I),PWIM(I),PWAM(I)
1760 CONTINUE

```

C

```

TOTHM(9)=TOTHM(9)/1000.
TOTHM(10)=TOTHM(10)/1000.
WRITE(IWRITE,6008)TOTHM(7),TOTHM(2),TOTHM(9),TOTHM(10),TOTHM(5)
6008  FORMAT(/,1X,'TOTALS',13X,2F8.1,23X,3F8.0)
WRITE(IWRITE,6009)ABTUH,WACAP,SCOP,APCTON,WAFCY,WAPW

```

```
6009 FORMAT(1X,'AVERAGES',27X,2F8.0,35X,F8.2,6X,F8.1,
1      F8.3,6X,F8.2)
```

C

```
      CALL PRNTA(0, 0)
      WRITE(IWRITE,6500)
      CALL PRNTA(0, 3)
      WRITE(IWRITE, 6002) ICYCLE, IAF, TIOB, ANACH,
&      QIIPSF, TSNAM, SHSF, ISPEED
6002  FORMAT(/T15, 'ICYCLE =', I3, T29, 'IAF =', I3,
&      T41, 'TIOB =', F5.1, T55, 'NACH (DESIGN) =', F5.2,
&      T77, 'QIIPSF =', F5.2,
&      T92, 'TSTAT:', 1X, A5, T105, 'SHSF =', F5.2,
&      T120, 'ISPEED =', I1)
      XA = TKBTUO / TKWHI / 3.413
      WRITE(IWRITE, 6100) TKBTUO, TKWHI, XA, NCPCYC
6100  FORMAT(/T15, 'TOT OUT (KBTU):', F8.0,
&      T40, 'TOT IN (KWH):', F7.0,
&      T65, 'SYSTEM COP:', F5.2,
&      T90, '# COMP CYCLES:', I5)
      IDUMD = IFIX(TOTHM(18))
      DUME = TKBTUO / TKWHI
      WRITE(IWRITE, 6110) TBPNO, TBPACC, TBPDES,
&      NDFCYC, IDUMD, S1KW, EQDDYS,
&      EFLHSP, (DOERGN(JA), JA = 1, 2),
&      ZLTEMP, DDYSNO, EFLHNO, DOEHLH, DUME
6110  FORMAT(/T15, 'TBPNO =', F6.2,
&      T40, 'TBPDRY =', F6.2,
&      T65, 'TBPDES =', F6.2,
&      T90, '# DEFROST CYCLES:', I5, '(', I4, ')',
&      //T15, 'S1KW =', F8.4, T40, 'DEGDYS(ABOVE):', F6.0,
&      T65, 'EQFLH(ABOVE):', F6.0, T90, 'DOERGN:', 4X, 2A5,
&      //T15, 'ZLTEMP:', F6.2, T40, 'DEGDYS(NOAA):', F7.0,
&      T65, 'EQFLH(NOAA):',
&      F7.0, T90, 'DOEHLH:', F6.0,
&      //, T15, 'SEASONAL PERFORMANCE FACTOR =', T52, F8.3)
```

C

C--PAGE OF FOOTNOTES FOLLOWING SP OUTPUT.

C

```
      CALL PRNTA(0, 0)
      WRITE(IWRITE,6500)
6500  FORMAT(40X,'***** SEASONAL PERFORMANCE DATA (CONT.) ',
1      '*****',/)
      CALL PRNTA(0, 3)
      DUMA = 100. * (WADFCA - 1.)
      DUMB = 100. * (WADFPW - 1.)
      DUMC = 100. * (WADFCO - 1.)
      WRITE(IWRITE, 6007) WADFCA, DUMA, WADFPW, DUMB, WADFCO, DUMC
6007  FORMAT(///T15, 'THE DEFROST PERFORMANCE FACTORS (COMPRESSOR',
&      ' HOUR WEIGHTED) ARE:',
&      //T20, 'CAPACITY:', T80, F11.3, 3X, '(', F5.1, ' x)',
&      //T20, 'AVERAGE POWER:', T80, F11.3, 3X, '(', F5.1, ' x)',
&      //T20, 'COP:', T80, F11.3, 3X, '(', F5.1, ' x)')
      TOTHM(11)=TOTHM(11)/1000.
      DUMA = TOTHM(11) / TOTHM(9) * 100.
      DUMB = TOTHM(11) / TKBTUO * 100.
      WRITE(IWRITE,6010) TOTHM(11)
```

```
6010  FORMAT( //T15, 'THE HP HEAT OUTPUT LOST TO THE',
&      ' DEFROST CYCLES IS:', T80, F8.0, ' KBTU.')
```

```
6020  FORMAT(/T20, 'THE LOST OUTPUT CORRESPONDS TO THE FOLLOWING',
&      ' PERCENTAGES:',
&      /T80, F10.2, ' % OF TOTAL ACTUAL HP OUTPUT;',
&      /T80, F10.2, ' % OF TOTAL ACTUAL SYSTEM OUTPUT.')
```

C

```
      CALL PRNTJ(1)
```

C

```
C--PRINTOUT TEMPERING HEAT DETAILS IF REQUESTED.
```

C

```
1780  CONTINUE
```

C

```
      IF(IPRNTI .EQ. 'N') GO TO 1800
      CALL PRNTMS(17)
```

C

```
1800  CONTINUE
```

C

```
C--SUBSET SUMMARY PRINTOUT
      IF(ISTSZ.GE.NCASES) GOTO 9990
      IF(ISTSZ .NE. 999 .AND. ISTSZ .EQ. ISBST) CALL PRNTMS(15)
```

C

```
9990  CONTINUE
      RETURN
      END
      SUBROUTINE PRNTM(IWHERE)
```

C

```
C+++++
```

C

```
      ECONOMICS P/O SUBROUTINE
```

C

```
      [HCB, 4-82]
```

C

```
C+++++
```

C

```
      INCLUDE 'CASES.COM'
      INCLUDE 'ECON.COM'
      INCLUDE 'RW.COM'
      GOTO (1100, 1200) IWHERE
```

C

```
1100  CONTINUE
```

C

```
C--INDIVIDUAL RUN ECONOMICS OUTPUT
```

C

```
      CALL PRNTA(0, 0)
      WRITE(IWRITE, 5000)
5000  FORMAT(T40, 10(' '), ' LIFE CYCLE COSTS ', 10(' '))
      CALL PRNTA(0, 3)
      I=IPASS
      TOTE=TOTEC(I)+TOTEHP(I)+TOTETH(I)
      PCTEC=TOTEC(I)/TOTE*100.
      PCTEHP=TOTEHP(I)/TOTE*100.
```

```

PCTETH=TOTETH(I)/TOTE*100.
WRITE(IWRITE, 5010) TOTEC(I), PCTEC, TOTHP(I), PCTHP,
& TOTETH(I), PCTETH, TOTE
5010 FORMAT(///,T30,'ANNUAL ENERGY USAGE (KWH)',5X,
& 'PERCENT OF TOTAL',//,
& T10, 'COOLING', T40, F10.1, T60, F10.2,/
& T10, 'HEATING (HEAT PUMP)', T40, F10.1, T60, F10.2,/
& T10, 'RESISTANCE HEAT', T40, F10.1, T60, F10.2,//
& T10, 'TOTAL', T40, F10.1, T60, 4X, 6(' '),//)

C
WRITE(IWRITE,5020) RFI, ECKWH, RDSC, WRNTY, REE, HPLIFE,
& SVGWOD, SVGWD
5020 FORMAT(/,T10, 'INTEREST RATE (LOAN)', T40, F10.2, ' X',
& T70, 'ELECTRIC RATE',T100, F10.3, ' $/KWH',/
& T10, 'DISCOUNT RATE', T40, F10.2, ' X',
& T70, 'WARRANTY DURATION', T100, F10.2, ' YEARS',/
& T10, 'ELECTRICITY ESCALATION RATE', T40, F10.2, ' X',
& T70, 'EQUIPMENT LIFE', T100, F10.2, ' YEARS',/
& T70, 'SALVAGE VALUE W/O DUCTS', T100, F10.2, ' $',/
& T70, 'SALVAGE VALUE W/ DUCTS', T100, F10.2, ' $')

C
WRITE(IWRITE,5025) CCPWOD, CCPWD, CMNTN
5025 FORMAT(///,T10,'SYSTEM COST, W/O DUCTS', T40, F10.2, ' $',/,
& T10, ' ', ' W/ DUCTS', T40, F10.2, ' $',/,
& T10, 'MAINTENANCE COST', T40, F10.2, ' $/YEAR')

C
PWODC=CLCWOD(I)*100./CLTWOD(I)
PWODM=CLM(I)*100./CLTWOD(I)
PWODE=CLE(I)*100./CLTWOD(I)

C
PWDC=CLCWD(I)*100./CLTWD(I)
PWDM=CLM(I)*100./CLTWD(I)
PWDE=CLE(I)*100./CLTWD(I)

C
WRITE(IWRITE, 5030) CLCWOD(I), PWODC, CLCWD(I), PWDC, CLM(I),
& PWODM, PWDM, CLE(I), PWODE, PWDE, CLTWOD(I), CLTWD(I)
5030 FORMAT(///,T37, 'LIFE CYCLE COST', T63, '----- PERCENT OF TOTAL',
& ' -----',/,T37, '-----',T63, 'W/O DUCTS',
& T84, 'W/ DUCTS', //,
& T10, 'CAPITAL (INC SLVG), W/O DUCTS', T40, F10.2,T60,F10.2,
& T84, 6(' '), /,
& T10, ' ', ' W/ DUCTS', T40, F10.2, T64,6(' '),
& T80, F10.2, /,
& T10, 'MAINTENANCE', T40, F10.2, T60, F10.2, T80, F10.2,/,
& T10, 'ELECTRICITY', T40, F10.2, T60, F10.2, T80, F10.2,/,
& T10, 'TOTAL, W/O DUCTS', T40, F10.2,/,
& T10, ' ', ' W/ DUCTS', T40, F10.2)
GOTO 9990

C
1200 CONTINUE
C
C--ECONOMICS SUMMARY OUTPUT
C
CALL PRNTA(0, 0)
WRITE(IWRITE, 6000)
6000 FORMAT(T35, 10(' '), ' LIFE CYCLE COST SUMMARY ', 10(' '), /)

```

```

      WRITE(IWRITE, 6040)
      WRITE(IWRITE, 5020) RFI, ECKWH, RDSC, WRNTY, REE, HPLIFE,
&   SVGWOD, SVGWD
      WRITE(IWRITE, 6040)
      WRITE(IWRITE, 6010)
6010  FORMAT(/, T10, 'RUN #', T18, 'SITE #', T34,
&   16(' '), ' KWH ', 16(' '), 4X, 'HP SIZE', 5X,
&   ' - LIFE CYCLE COST -', /,
&   T34, 'COOLING', T44, 'HEATING', T54, 'STRIP HEAT TOTAL',
&   T76, '(TONS)', 5X, 'W/O DUCTS  W/ DUCTS')
      WRITE(IWRITE, 6050)
6040  FORMAT(/, 1X, 131('*'), /)
6050  FORMAT(/, 1X, 131(' '), /)
C
      DO 100 I=1, NCASES
      TOT1=TOTEC(I)+TOTHP(I)+TOTETH(I)
      WRITE(IWRITE, 6020) I, ISITEM(I), TOTEC(I), TOTHP(I),
&   TOTETH(I), TOT1, HPSTON(I), CLTWOD(I), CLTWD(I)
6020  FORMAT(10X, 2(I2, 8X), 4(F10.0), F10.2, 5X, 2(F10.2))
      100 CONTINUE
C
      WRITE(IWRITE, 6050)
      TOT2=AEC+AEHP+AETH
      WRITE(IWRITE, 6030) AEC, AEHP, AETH, TOT2, AHPS, ACLWOD, ACLWD
6030  FORMAT(T10, 'AVERAGES:', T31, 4(F10.0), F10.2, 5X, 2(F10.2))
C
      WRITE(IWRITE, 6040)
      GOTO 9990
C
9990  CONTINUE
      RETURN
      END
      SUBROUTINE PSYALL
C
C *****
C
C   THIS SUBROUTINE CALCULATES ALL PSYCHROMETRIC PARAMETERS OF INTEREST
C   FROM DRY BULB TEMP(TD), AND WET BULB (TW) TEMP (DEG-F), AND
C   TOTAL PRESSURE (IN-HG)
C *****
C
C   NOMENCLATURE:
C
C   H           = ENTHALPY OF MOIST AIR IN BTU / (LBM OF DRY AIR).
C
C   HF          = ENTHALPY OF LIQUID WATER.
C
C   HG          = ENTHALPY OF SATURATED WATER VAPOR.
C
C   HFG         = HF + HG.
C
C   PT          = TOTAL PRESSURE IN INCHES OF MERCURY.
C
C   PWS         = PRESSURE OF SATURATED WATER VAPOR.
C

```


C TD = DRY-BULB TEMPERATURE IN DEG-F.
 C
 C TW = WET-BULB TEMPERATURE IN DEG-F.
 C
 C W = HUMIDITY RATIO IN LB-WATER / LB-DRY-AIR.
 C
 C WS = SPECIFIC HUMIDITY AT SATURATION.
 C

C*****

C SOURCE:

C LT. COL. PETER HUANG-S MASTERS THESIS @ VANDERBILT UNIVERSITY
 C UNDER JOHN W. WILLIAMSON, PROFESSOR : MECHANICAL
 C ENGINEERING. (615)322-7311. REC-D JUN 30, 1977.
 C

C*****

C ROUTINE APPEARS ACCURATE TO 1-PERCENT OR BETTER IN THE
 C RANGE OF TDB = 10,110 DEG-F
 C

C*****

C COMMON/CP/TD,TW,TDE,TDEW,RH,W,WS,H,HF,HG,HFG,PWSD,PW,PT,
 C 1 GNU,RHO
 C

C INCLUDE 'PSYC.COM'

C--START GENERAL EQUATIONS.

C
 C CPWS(A)=0.0247376-3.05625E-04*A+1.11272E-04*A**2
 C 1 -2.18039E-06*A**3+3.48030E-08*A**4
 C 2 -2.02293E-10*A**5+5.65645E-13*A**6
 C CPW(A,B)=(A*B)/(0.62198+B)
 C CW(A,B)=0.62198*(A/(B-A))
 C CTDWA(A)=79.047+30.5790*A+1.8893*A**2
 C CTDWB(A)=71.98+24.873*A+0.8927*A**2
 C

C--END GENERAL EQS.

C--START EXECUTABLE STATEMENTS.

C
 C PWSD=CPWS(TD)*29.921/14.6960
 C PWSW=CPWS(TW)*29.921/14.6960
 C IF(TW-32.)15,15,20
 C 15 HFG=1220.29-5.26779E-02*TW
 C HF=-159.179+0.491976*TW
 C GO TO 40
 C 20 HFG=1093.27-0.565495*TW
 C IF(TW-42.)25,25,30
 C 25 HF=-32.1518+1.0048*TW
 C GO TO 40
 C 30 HF=-31.9412+1.00027*TW
 C 40 HG=1061.27+0.435566*TD
 C WS=CW(PWSW,PT)

```

W=AMAX1(1.E-08,((WS*HFG)-0.24*(TD-TW))/(HG-HF))
PW=CPW(PT,W)
RH=PW/PWSD*100.
XPW=ALOG(PW)
IF(TD.LT.32.)TDEW=CTDWB(XPW)
IF(TD.GE.32.)TDEW=CTDWA(XPW)
TDEP=TD-TW
GNU=53.352*(TD+459.67)*(1+1.6078*W)/PT/70.7262
RHO=1./GNU
H=0.24*TD+W*HG

```

```

C
C 9990 CONTINUE
C
C--CONVERT TERMINOLOGY TO CORRESPOND W/ COMMON STORE.
C

```

```

TDE = TDEP
DEN = RHO
PWS = PWSD

```

```

C
C RETURN
C END
C SUBROUTINE PSYTW(NIT)

```

```

C
C *****
C

```

```

C THIS SUBROUTINE CALCULATES THE WET BULB TEMP FOR A GIVEN DRY BULB
C TEMP, RH, AND TOTAL PRESSURE(IN=HG)
C

```

```

C *****
C

```

```

C DIMENSION ATW(3),WTEST(3),ERR(3)
C COMMON/CP/TD,TW,TDE,TDEW,RH,W,WS,H,HF,HG,HFG,PWS,PW,PT
C

```

```

C INCLUDE 'PSYC.COM'
C

```

```

C--START GENERAL EQUATIONS.
C

```

```

CPWS(A)=0.0247376-3.05625E-04*A+1.11272E-04*A**2
1 -2.18039E-06*A**3+3.48030E-08*A**4
2 -2.02293E-10*A**5+5.65645E-13*A**6
WCAL(A,B)=0.62198*(A/(B-A))
WIT(A,B,C)=(((1093.-0.556*A)*B)-0.240*(C-A))/(1093.+0.444*C-A)

```

```

C--END GENERAL EQUATIONS.
C

```

```

C--START EXECUTABLE STATEMENTS.
C

```

```

PWSD=CPWS(TD)*29.921/14.6960
PWD=PWSD*RH/100.
WACT=WCAL(PWD,PT)
NIT=0
K=0
IF(TD.LT.50)CRI=1.E-07
IF(TD.GE.50)CRI=1.E-06

```

```

      ATW(1)=TD-0.2
      ATW(2)=TD-10.
      ATW(3)=TD-30.
      IF(TD.GT.80)ATW(2)=ATW(2)-20
      IF(TD.GT.80)ATW(3)=ATW(3)-20.
      IF(TD.LT.10)ATW(2)=ATW(2)+7.5
      IF(TD.LT.10)ATW(3)=ATW(3)+25.
1    NIT=NIT+1
      IF(NIT.GT.15)GO TO 35
      DO 5 I=1,3
      TW=AMIN1((TD-.0001),ATW(I))
      CALL PSYALL
      WTEST(I)=W
      ERR(I)=WACT-W
5    IF(ABS(ERR(I)).LT.CRI)K=I
      IF(K.GT.0)GO TO 30
      IF(ERR(2))20,20,25
25   ATW(3)=ATW(2)
      ATW(2)=ATW(1)+ABS(ERR(1))/(ABS(ERR(2))+ABS(ERR(1)))
1     *(ATW(3)-ATW(1))
      GO TO 1
20   ATW(1)=ATW(2)
      ATW(2)=ATW(1)+ABS(ERR(2))/(ABS(ERR(2))+ABS(ERR(3)))
1     *(ATW(3)-ATW(1))
      GO TO 1
30   TW=ATW(K)
      GO TO 9990
35   TW=99.99
      NIT=NIT-1
C
9990 CONTINUE
      RETURN
      END
      SUBROUTINE PWIDTH

```

```

C
C*****
C
C   THIS SUBROUTINE CALCULATES AN ACTUAL PULSE ON TIME
C   AND PERCENT ON-TIME FROM AN IDEAL ON-TIME AND
C   LEADING AND TRAILING EDGE TIME CONSTANTS.
C
C*****

```

NOTES:

```

C   IPW=0  ONLY PWI IS CALCULATED; PWACT SET = PWI
C          FONA SET = FONI UNLESS FONI> 1 IN WHICH CASE
C          FONA SET = 1.
C          1  WILL CALCULATE PWACT AND FONA BASED ON TAUON
C             AND TAUOFF IF ICYDEG=1. OTHERWISE PRODUCES SAME
C             RESULTS AS IPW=0.

```

```

C   THIS VERSION IS FOR THE COOLING AND HEATING MODEL AND IS BASED
C   ON THE HEATING 'DFHSPM' VERSION (HCB, 3-15-82).
C
C*****

```

```
C      DIMENSION T(3),ERR(3)
C
C      INCLUDE 'CPWID.COM'
C
C      INCLUDE 'CASES.COM'
C
C      DATA CRI,NITMAX/0.001,20/
C
C--START GENERAL EQUATIONS.
C
C      EQA(TPA,TAUON)=TPA+TAUON*EXP(-TPA/TAUON)
C      EQB(TPA,TAUON,TAUOFF)=TPA+(TAUON-TAUOFF)*EXP(-TPA/TAUON)
C
C--END GENERAL EQUATIONS.
C
C--START EXECUTABLE STMTS.
C
C      ICYDEG = ICYCLE
C      PWI= 600.
C      IF(FCY.GT.1.E-6)PWI=FONI/FCY*60.
C      PWACT=PWI
C      FONA=FONI
C      IF(FONI .GT. 1.) GO TO 40
C      IF(IPW*ICYDEG.EQ.0)GO TO 80
C      IF(FCY.LE.1.E-6)GO TO 40
C      IF(PWI/TAUON.GT.10.)GO TO 50
C      IF(PWI.LT.0.00001)GO TO 80
C      RHS=PWI+TAUON-TAUOFF
C      IF(IAF.EQ.1)RHS=PWI+TAUON
C      T(1)=AMAX1(0.01,PWI-TAUOFF)
C      T(3)=PWI+3*TAUON
C      T(2)=(T(1)+T(3))/2.
C      NIT=0
C      KK=0
55  CONTINUE
C      NIT=NIT+1
C      DO 60 I=1,3
C      ERR(I)=EQA(T(I),TAUON)-RHS
C      IF(IAF.EQ.0)ERR(I)=EQB(T(I),TAUON,TAUOFF)-RHS
C      IF(ABS(ERR(I)).LT.CRI)KK=I
60  CONTINUE
C      IF(KK.GT.0)GO TO 70
C      IF(NIT.GT.NITMAX)GO TO 75
C      IF(ERR(2).GT.0.)GO TO 65
C      T(1)=T(2)
C      T(2)=T(2)+ABS(ERR(2))/(ABS(ERR(2))+ERR(3))*(T(3)-T(2))
C      GO TO 55
65  CONTINUE
C      T(3)=T(2)
C      T(2)=T(1)+ABS(ERR(1))/(ABS(ERR(1))+ERR(2))*(T(2)-T(1))
C      GO TO 55
70  CONTINUE
C      PWACT=T(KK)
C      FONA=PWACT*FONI/PWI
C      RETURN
```

```

75 CONTINUE
  PWACT=PWI
  FONA=FONI
  WRITE(5,5000)
  RETURN
50 CONTINUE
  PWACT=PWI+TAUON-TAUOFF
  IF(IAF.EQ.1)PWACT=PWI+TAUON
  FONA=PWACT*FONI/PWI
  PWACT=AMIN1(600.,PWACT)
  PWI = AMIN1(600., PWI)
  IF(FONA.GT.1.)FONA=1.
  RETURN
40 CONTINUE
  FONA=1.
  PWI=600.
  PWACT=600.
  RETURN
80 CONTINUE
  FONA=FONI
  PWI=AMIN1(600.,PWI)
  PWACT=PWI
  IF(FONA .GT. 1.) FONA = 1.
  RETURN
5000 FORMAT('/', 'CONVERGENCE WAS NOT ACHIEVED IN PWIDTH.  PWACT',
1      ' SET = PWI TO AVOID DESTROYING ALL RESULTS. ')
END
SUBROUTINE GLMS(IWHERE, IROW, DELTD, TODB, RHO)

```

C
C *****

C
C LOAD CALCULATION MASTER SUBROUTINE FOR COOLING SP CALCULATIONS.

C
C R. J. RETTBERG 14 JAN 1980.

C
C *****

C
C NOTES:

C
C 1. SOLAR ALGORITHMS ARE PER SPMLD ANALYSES OF FEB/1980 W/
C FOLLOWING MODIFICATION:

C
C A. SPMLD ASSUMED ZERO SHADOW FACTOR FOR WINDOWS.
C THE FOLLOWING TABLE INDICATES THE EFFECT ON SOLAR
C GAIN FOR VARIOUS ASSUMPTIONS RE DIRECT/INDIRECT
C RADIATION LEVELS & ASSUMED SHADOW FACTORS.

C
C

	D = I	D = 0.5 * I
--	-------	-------------

C
C

SF = 0.25	0.875	0.916
-----------	-------	-------

C
C

SF = 0.50	0.750	0.833
-----------	-------	-------

C
C

AVERAGE VALUE = 0.845 OR APPROX. 0.85

C
C B. THEREFORE THE ALGORITHM RESULTS ARE MULTIPLIED BY 0.85

```
C
C*****
C
C      INCLUDE 'CASES.COM'
C
C      INCLUDE 'CSZ.COM'
C
C      INCLUDE 'QLC.COM'
C
C--START GENERAL EQS.
C
C      EQA(A,B,C)=(A+C)/(B+C)
C      EQB(A,B,C)=A/(B+C)
C
C--END GENERAL EQS.
C
C--START EXECUTABLE STMTS.
C
C      DELTA = TODB - TIDB
C
C      GO TO (1100, 1200, 1300) IWHERE
C
C      1100 CONTINUE
C
C--SOLAR HOUR LOAD CALCULATIONS.
C
C      QSUNSM(IROW) = QCTDL(1)
C      & * (1.6 - 0.01 * RHO - 0.005 * (95. - TODB))
C      QSUNSM(IROW) = AMAX1(0.85 * QSUNSM(IROW), 0.)
C      QWICSM(IROW) = EQA(DELTA, DELTD, -4.) * QCTDL(2)
C      QWACSM(IROW) = EQA(DELTA, DELTD, XC) * QCTDL(3)
C      QCCSM(IROW) = EQA(DELTA, DELTD, YC) * QCTDL(4)
C      GO TO 9990
C
C      1200 CONTINUE
C
C--DARK HOUR LOAD CALCULATIONS.
C
C      QSUNDM(IROW) = QCTDL(1)
C      & * (0.36 - 0.006 * (RHO - 60.)
C      & - 0.005 * (95. - TODB))
C      QSUNDM(IROW) = AMAX1(0.85 * QSUNDM(IROW), 0.)
C      QWICDM(IROW) = EQB(DELTA, DELTD, -4.) * QCTDL(2)
C      QWACDM(IROW) = EQB(DELTA, DELTD, XC) * QCTDL(3)
C      QCCDM(IROW) = EQB(DELTA, DELTD, YC) * QCTDL(4)
C      GO TO 9990
C
C      1300 CONTINUE
C
C--DETERMINE THE AIR CHANGEOVER RATE FOR EACH BIN.
C
C      CALL QLSA
C
C      9990 CONTINUE
C      RETURN
```

END

SUBROUTINE QLSA

```
C
C*****
C
C  CALCULATION OF AIR CHANGEOVER RATE BASED ON ALGORITHM OF
C  NOTE 1.
C
C  R. J. RETTBERG  20 FEB 1980.
C
C*****
C  NOTES:
C
C    1. ACTUAL NACH = DESIGN NACH * (0.68 + 0.016 * ABS(TODB - TIDB))
C
C    2. THE DESIGN NACH IS THAT AT 95 DEG-F FOR AN INDOOR TEMP OF
C       75 DEG-F.
C
C*****
C
C    INCLUDE 'CASES.COM'
C
C    INCLUDE 'CLWEAT.COM'
C
C    INCLUDE 'DUMX.COM'
C
C    INCLUDE 'QLC.COM'
C
C--START EXECUTABLE STMTS.
C
C    DO 1050 I = 1, 60
C      TODB = TODBCM(I)
C      DUMA = ABS(TODB - TIDB)
C      BNACH = ANACH * ( 0.68 + 0.016 * DUMA)
C      IF(SOLH(I) .GT. 0.01) BNASH(I) = BNACH
C      IF(DKH(I) .GT. 0.01) BNADM(I) = BNACH
C1050 CONTINUE
C
C9990 CONTINUE
C      RETURN
C      END
C      SUBROUTINE SEN65(TIDB, TIWB, HCS)
C
C*****
C
C  CAC SENSIBLE COOLING FOR 65 DEG-F TODB.
C
C  R. J. RETTBERG  16 AUG 1979
C
C*****
C
C  INPUTS:
C    TIDB      - INDOOR THERMOSTAT SETTING IN DEG-F.
C    TIWB      - INDOOR WET-BULB TEMP IN DEG-F.
```

C OUTPUTS:

C HCS - CAC SENSIBLE COOLING CAPACITY IN BTU/H.

C

C*****

C

C--DEFINE SUBROUTINE FUNCTIONS.

C

C-- F55 ETC. ARE SENSIBLE CAPACITY IN KBTU/H FOR 55 DEG-F WET-BULB TEMP.

C

F55(TIDB) = 32.7 + (TIDB - 72.) * 2.0 / 2.

F59(TIDB) = 27.4 + (TIDB - 72.) * 1.9 / 2.

F63(TIDB) = 22.4 + (TIDB - 72.) * 1.8 / 2.

F67(TIDB) = 17.7 + (TIDB - 72.) * 1.7 / 2.

F71(TIDB) = 13.5 + (TIDB - 72.) * 1.6 / 2.

C

C-- FC IS A COEFFICIENT SELECTION FUNCTION. IT SETS ALL

C-- COEFFICIENTS, EXCEPT WHEN I = IX, EQUAL TO ZERO. THE

C-- SELECTED COEFFICIENT (WHEN I = IX) IS SET = 1.

C

FC(I, IX) = MAX0(0, I - IX + 1) * MAX0(0, IX - I + 1)

C

C-- F SELECTS F55 - F71 BASED IN INDEX I & THE SELECTED

C-- FUNCTION IS EVALUATED AT TIDB.

C

F(I, TIDB) = FC(I, 1) * F55(TIDB)

& + FC(I, 2) * F59(TIDB)

& + FC(I, 3) * F63(TIDB)

& + FC(I, 4) * F67(TIDB)

& + FC(I, 5) * F71(TIDB)

C

C--START EXECUTABLE STATEMENTS.

C

IF(TIWB .LE. 55.) GO TO 1100

IF(TIWB .GE. 71.) GO TO 1200

C

ILOW = IFIX((TIWB - 51.) / 4.)

DUMA = F(ILOW, TIDB)

DUMB = F(ILOW + 1, TIDB)

DUMC = DUMB - DUMA

DELX = TIWB - (51. + 4. * ILOW)

HCS = DUMA + (DELX / 4.) * DUMC

GO TO 9990

C

1100 CONTINUE

HCS = F(1, TIDB)

GO TO 9990

C

1200 CONTINUE

HCS = F(5, TIDB)

9990 CONTINUE

HCS = 1000. * HCS

RETURN

END

SUBROUTINE SEN85(TIDB, TIWB, HCS)

C

C*****


```

C
C CAC SENSIBLE COOLING FOR 85 DEG-F TODB.
C
C R. J. RETTBERG 16 AUG 1979
C
C*****
C
C INPUTS:
C TIDB - INDOOR THERMOSTAT SETTING IN DEG-F.
C TIWB - INDOOR WET-BULB TEMP IN DEG-F.
C
C OUTPUTS:
C HCS - CAC SENSIBLE COOLING CAPACITY IN BTU/H.
C
C*****
C
C--DEFINE SUBROUTINE FUNCTIONS.
C
C-- F55 ETC. ARE SENSIBLE CAPACITY IN KBTU/H FOR 55 DEG-F WET-BULB TEMP.
C
F55(TIDB) = 31.9 + (TIDB - 72.) * 2.2 / 2.
F59(TIDB) = 26.6 + (TIDB - 72.) * 2.1 / 2.
F63(TIDB) = 21.6 + (TIDB - 72.) * 2.0 / 2.
F67(TIDB) = 16.9 + (TIDB - 72.) * 1.9 / 2.
F71(TIDB) = 12.7 + (TIDB - 72.) * 1.8 / 2.
C
C-- FC IS A COEFFICIENT SELECTION FUNCTION. IT SETS ALL
C-- COEFFICIENTS, EXCEPT WHEN I = IX, EQUAL TO ZERO. THE
C-- SELECTED COEFFICIENT (WHEN I = IX) IS SET = 1.
C
FC(I, IX) = MAX0(0, I - IX + 1) * MAX0(0, IX - I + 1)
C
C-- F SELECTS F55 - F71 BASED IN INDEX I & THE SELECTED
C-- FUNCTION IS EVALUATED AT TIDB.
C
F(I, TIDB) = FC(I, 1) * F55(TIDB)
& + FC(I, 2) * F59(TIDB)
& + FC(I, 3) * F63(TIDB)
& + FC(I, 4) * F67(TIDB)
& + FC(I, 5) * F71(TIDB)
C
C--START EXECUTABLE STATEMENTS.
C
IF(TIWB .LE. 55.) GO TO 1100
IF(TIWB .GE. 71.) GO TO 1200
C
ILOW = IFIX((TIWB - 51.) / 4.)
DUMA = F(ILOW, TIDB)
DUMB = F(ILOW + 1, TIDB)
DUMC = DUMB - DUMA
DELX = TIWB - (51. + 4. * ILOW)
HCS = DUMA + (DELX / 4.) * DUMC
GO TO 9990
C
1100 CONTINUE
HCS = F(1, TIDB)

```

GO TO 9990

C

1200 CONTINUE

HCS = F(5, TIDB)

9990 CONTINUE

HCS = 1000. * HCS

RETURN

END

SUBROUTINE SEN95(TIDB, TIWB, HCS)

C

C*****

C

C CAC SENSIBLE COOLING FOR 95 DEG-F TODB.

C

C R. J. RETTBERG 16 AUG 1979

C

C*****

C

C INPUTS:

C TIDB - INDOOR THERMOSTAT SETTING IN DEG-F.

C TIWB - INDOOR WET-BULB TEMP IN DEG-F.

C

C OUTPUTS:

C HCS - CAC SENSIBLE COOLING CAPACITY IN BTU/H.

C

C*****

C

C--DEFINE SUBROUTINE FUNCTIONS.

C

C-- F55 ETC. ARE SENSIBLE CAPACITY IN KBTU/H FOR 55 DEG-F WET-BULB TEMP.

C

F55(TIDB) = 27.5 + (TIDB - 72.) * 2.3 / 2.

F59(TIDB) = 26.2 + (TIDB - 72.) * 2.2 / 2.

F63(TIDB) = 21.2 + (TIDB - 72.) * 2.1 / 2.

F67(TIDB) = 16.5 + (TIDB - 72.) * 2.0 / 2.

F71(TIDB) = 12.3 + (TIDB - 72.) * 1.9 / 2.

C

C-- FC IS A COEFFICIENT SELECTION FUNCTION. IT SETS ALL

C-- COEFFICIENTS, EXCEPT WHEN I = IX, EQUAL TO ZERO. THE

C-- SELECTED COEFFICIENT (WHEN I = IX) IS SET = 1.

C

FC(I, IX) = MAX0(0, I - IX + 1) * MAX0(0, IX - I + 1)

C

C-- F SELECTS F55 - F71 BASED IN INDEX I & THE SELECTED

C-- FUNCTION IS EVALUATED AT TIDB.

C

F(I, TIDB) = FC(I, 1) * F55(TIDB)

& + FC(I, 2) * F59(TIDB)

& + FC(I, 3) * F63(TIDB)

& + FC(I, 4) * F67(TIDB)

& + FC(I, 5) * F71(TIDB)

C

C--START EXECUTABLE STATEMENTS.

C

IF(TIWB .LE. 55.) GO TO 1100

IF(TIWB .GE. 71.) GO TO 1200

```

C
  ILOW = IFIX((TIWB - 51.) / 4.)
  DUMA = F(ILOW, TIDB)
  DUMB = F(ILOW + 1, TIDB)
  DUMC = DUMB - DUMA
  DELX = TIWB - (51. + 4. * ILOW)
  HCS = DUMA + (DELX / 4.) * DUMC
  GO TO 9990

C
1100 CONTINUE
  HCS = F(1, TIDB)
  GO TO 9990

C
1200 CONTINUE
  HCS = F(5, TIDB)
9990 CONTINUE
  HCS = 1000. * HCS
  RETURN
  END
  SUBROUTINE SEN115(TIDB, TIWB, HCS)

C
C*****
C
C  CAC SENSIBLE COOLING FOR 115 DEG-F TIDB.
C
C  R. J. RETTBERG   16 AUG 1979
C
C*****
C
C  INPUTS:
C    TIDB          - INDOOR THERMOSTAT SETTING IN DEG-F.
C    TIWB          - INDOOR WET-BULB TEMP IN DEG-F.
C
C  OUTPUTS:
C    HCS           - CAC SENSIBLE COOLING CAPACITY IN BTU/H.
C
C*****
C
C--DEFINE SUBROUTINE FUNCTIONS.
C
C--  F55 ETC. ARE SENSIBLE CAPACITY IN KBTU/H FOR 55 DEG-F WET-BULB TEMP.
C
  F55(TIDB) = 29.0 + (TIDB - 72.) * 2.4 / 2.
  F59(TIDB) = 24.3 + (TIDB - 72.) * 2.3 / 2.
  F63(TIDB) = 19.7 + (TIDB - 72.) * 2.2 / 2.
  F67(TIDB) = 15.2 + (TIDB - 72.) * 2.1 / 2.
  F71(TIDB) = 10.9 + (TIDB - 72.) * 2.0 / 2.

C
C--  FC IS A COEFFICIENT SELECTION FUNCTION. IT SETS ALL
C--  COEFFICIENTS, EXCEPT WHEN I = IX, EQUAL TO ZERO. THE
C--  SELECTED COEFFICIENT (WHEN I = IX) IS SET = 1.
C
  FC(I, IX) = MAX0(0, I - IX + 1) * MAX0(0, IX - I + 1)

C
C--  F SELECTS F55 - F71 BASED IN INDEX I & THE SELECTED
C--  FUNCTION IS EVALUATED AT TIDB.

```

C

```
F(I, TIDB) = FC(I, 1) * F55(TIDB)
&          + FC(I, 2) * F59(TIDB)
&          + FC(I, 3) * F63(TIDB)
&          + FC(I, 4) * F67(TIDB)
&          + FC(I, 5) * F71(TIDB)
```

C

C--START EXECUTABLE STATEMENTS.

C

```
IF(TIWB .LE. 55.) GO TO 1100
IF(TIWB .GE. 71.) GO TO 1200
```

C

```
ILOW = IFIX((TIWB - 51.) / 4.)
DUMA = F(ILOW, TIDB)
DUMB = F(ILOW + 1, TIDB)
DUMC = DUMB - DUMA
DELX = TIWB - (51. + 4. * ILOW)
HCS = DUMA + (DELX / 4.) * DUMC
GO TO 9990
```

C

```
1100 CONTINUE
HCS = F(1, TIDB)
GO TO 9990
```

C

```
1200 CONTINUE
HCS = F(5, TIDB)
9990 CONTINUE
HCS = 1000. * HCS
RETURN
END
SUBROUTINE SHSIZE
```

C

C*****

C

C--SIZING OF SUPPLEMENTARY HEATERS FOR TEMPERING HEAT CALCULATIONS.

C

C--R. J. RETTBERG 14 JUN 1980.

C

C*****

C

INCLUDE 'BALPT.COM'

C

INCLUDE 'BIN.COM'

C

INCLUDE 'CASES.COM'

C

INCLUDE 'DUMX.COM'

C

INCLUDE 'HSZ.COM'

C

INCLUDE 'HTWEAT.COM'

C

INCLUDE 'SHSIZ.COM'

C

INCLUDE 'SITE.COM'

C

C--DEFINE INTERNAL FUNCTIONS.

```

C
      FS1PCT(TODH, TBPDES) = 10. ** (1.464886798 + 1.02543617E-02
&                                * (60. - (TBPDES - TODH)))

```

C--START EXECUTABLE STMTS.

C--CALCULATE AN ACCURATE BALANCE POINT TEMP.

```

C--  **** USE 90 % OF INSTANTANEOUS CAPACITY • 75 % RH FOR THE
C--  INSTALLER-S VALUE OF INTEGRATED CAPACITY • TEMPERATURES BELOW
C--  47 DEG-F SO THAT PRODUCTS W/ THE SAME PEAK CAPACITIES
C--  PRODUCE THE SAME VALUES OF TEMPERING HEAT. THE 90 % IS
C--  BASED ON TYPICAL RESULTS & ASSUMES THAT PUBLISHED DATA
C--  WILL BE INTEGRATED VALUES BASED ON APPROXIMATELY 75 % RH
C--  IN THE DEFROST REGIME WHERE THE BALANCE POINT WILL BE,
C--  I.E. 25 - 40 DEG-F. *****

```

```

C--  **** ASSUME ALSO THAT THE HVAC CONTRACTOR USES A 70 DEG-F
C--  ZERO LOAD INTERCEPT POINT FOR CALCULATING THE BALANCE
C--  POINT & THE APPROPRIATE SIZE FOR THE SUPPLEMENTARY
C--  HEATERS. *****

```

```

      DUMA = QHDL / (70. - TODH)

```

```

      DO 1070 I = ISTRT, 6
        DDUMA(I) = HCAPM(I)
        DDUMB(I) = TODBM(I)
        DDUMC(I) = DUMA * (70. - TODBM(I))

```

1070 CONTINUE

```

      DO 1075 I = 43, 47
        K = I - 30
        DDUMA(K) = HCAPM(I) / DFCAPM(I) * 0.90
        DDUMB(K) = TODBM(I)
        DDUMC(K) = DUMA * (70. - TODBM(I))

```

1075 CONTINUE

```

      DO 1080 I = 10, 40, 6
        K = (I - 4) / 6 + 6
        DDUMA(K) = HCAPM(I) / DFCAPM(I) * 0.90
        DDUMB(K) = TODBM(I)
        DDUMC(K) = DUMA * (70. - TODBM(I))

```

1080 CONTINUE

```

      KBPDES = 0

```

```

      DO 1085 I = ISTRT, 17
        IF(DDUMA(I) .LT. DDUMC(I)) KBPDES = I
        IF(KBPDES .LT. 1) GO TO 1085
        GO TO 1086

```

1085 CONTINUE

1086 CONTINUE

```

      IDUMA = KBPDES - 1
      IDUMB = KBPDES

```

```

DUMA = DDUMA(IDUMA) - DDUMC(IDUMA)
DUMA = 5. * DUMA
DUMB = DDUMC(IDUMB) - DDUMC(IDUMA) + DDUMA(IDUMA) - DDUMA(IDUMB)
DUMC = DUMA / DUMB
TBPDES = DDUMB(IDUMA) - DUMC

```

```

C
C--DETERMINE THE HEAT PUMP CAPACITY • THE DESIGN TEMPERATURE.
C

```

```

IDUMB = 0

```

```

C
DO 1100 I = ISTRT, 17
  IF(DDUMB(I) .LT. TODH) IDUMB = I
  IF(IDUMB .GT. 0) GO TO 1101

```

```

1100 CONTINUE

```

```

1101 CONTINUE

```

```

C
IF(IDUMB .EQ. 0) GO TO 1160
IDUMA = IDUMB - 1
DUMA = TODH - DDUMB(IDUMB)
DUMB = DDUMA(IDUMA) - DDUMA(IDUMB)
HHDES = DDUMA(IDUMB) + (DUMA / 5.) * DUMB
GO TO 1180

```

```

C
1160 CONTINUE

```

```

C
C-- THE HEATING DESIGN TEMPERATURE IS BELOW -8. DEG-F WHEREAS THE
C-- HP MODELS ARE GOOD ONLY TO -8. DEG-F. ASSUME THE CAPACITY
C-- • TODH IS THAT • -8. DEG-F FOR PURPOSES OF SIZING THE
C-- SUPPLEMENTARY HEATERS.
C

```

```

HHDES = DDUMA(17)

```

```

C
1180 CONTINUE

```

```

C
SHTOT = SHSF * ((QHDL - HHDES) / 3413.)
SHTOT = AMAX1(0.0, SHTOT)
S1PCT = AMIN1(100., FS1PCT(TODH, TBPDES))
S1KW = 0.01 * S1PCT * SHTOT
S1KW = AMAX1(SHSF * 2.5, S1KW)
S1BTUH = S1KW * 3413.

```

```

C
9990 CONTINUE
RETURN
END
SUBROUTINE SPCMS(IWHERE, DELTD)

```

```

C
C*****

```

```

C
C SEASONAL PERFORMANCE CALCULATIONS MASTER SUBROUTINE.

```

```

C
C R. J. RETTBERG 14 JAN 1980.

```

```

C
C*****

```

```

C
INCLUDE 'BINA.COM'

```

```

C

```

C--START EXECUTABLE STMTS.

C
C GO TO (1100, 1200, 1300, 1400, 1500) IWHERE

C
C 1100 CONTINUE

C
C--SOLAR HOURS CALCULATIONS.

C
C CALL SPCSA(DELTD)
C GO TO 9990

C
C 1200 CONTINUE

C
C--DARK HOURS CALCULATIONS.

C
C CALL SPCSB(DELTD)
C GO TO 9990

C
C 1300 CONTINUE

C
C DO 1310 I = 1, 60
C CPHRST(I)=CPHRSS(I)+CPHRSD(I)
C RTKWH(I)=RSKWH(I)+RDKWH(I)
C RTBTU(I)=RSBTU(I)+RDBTU(I)
C ALBTU(I)=ALSBTU(I)+ALDBTU(I)
C STBTU(I)=SSBTU(I)+SDBTU(I)
C HRH65T(I)=HRH65S(I)+HRH65D(I)
C HRH20T(I)=HRH20S(I)+HRH20D(I)
C IF(RTBTU(I).GT.0.1)SRATT(I)=STBTU(I)/RTBTU(I)*100.
C 1310 CONTINUE

C
C GO TO 9990

C
C 1400 CONTINUE

C
C CALL SPCSD
C GO TO 9990

C
C 1500 CONTINUE

C
C--EER-S CALCULATED LAST BECAUSE FAN ENERGY ADDED TO THE
C-- --KWH(I) NEAR THE END OF THE CALCULATIONS.

C
C DO 1510 I=1,60
C IF(RSKWH(I).GT.0.1)EERS(I)=RSBTU(I)/RSKWH(I)
C IF(RDKWH(I).GT.0.1)EERD(I)=RDBTU(I)/RDKWH(I)
C IF(RTKWH(I).GT.0.1)EERT(I)=RTBTU(I)/RTKWH(I)

C 1510 CONTINUE

C
C 9990 CONTINUE
C RETURN
C END

C SUBROUTINE SPCSA(DELTD)

C
C *****
C

C SEASONAL PERFORMANCE CALCULATIONS FOR SOLAR HOURS.

C
C R. J. RETTBERG 14 JAN 1980.

C
C *****

C
C NOTES:

C
C 1) MODIFIED FOR COOLING AND HEATING SPM [HCB, 3-82].

C
C 2) THE COMMON 'QLC' HAS BEEN MODIFIED TO AVIOD REASSIGNMENT
C OF THE SAME VARIABLES FOR SOLAR AND DARK HOUR CALCULATIONS.

C
C ++++++

C
C INCLUDE 'BINA.COM'

C
C INCLUDE 'CASES.COM'

C
C INCLUDE 'CLWEAT.COM'

C
C INCLUDE 'CPWID.COM'

C
C INCLUDE 'CSZ.COM'

C
C INCLUDE 'QLC.COM'

C
C INCLUDE 'MOD.COM'

C
C --START EXECUTABLE STMTS.

C
C DO 1150 I = 1, 60
C IROW = I
C IF(SOLH(I) .LT. 0.01) GO TO 1150
C TODB=TODBCM(I)
C RHO=RHOM(I)
C HRS=SOLH(I)
C HHRS=HRS
C CALL GLMS(I, IROW, DELTD, TODB, RHO)
C QSUN = QSUNSM(I)
C QZ = QSUN + QWICSM(I) + QWACSM(I) + QCCSM(I)
C BNACH = BNASM(I)

C
C CALL SPCSC(IROW, TODB, RHO, HRS, QZ, QSUN, BNACH,
C & TIWB, RHI, HHRS)

C
C IF(HHRS.LT.HRS)SOLH(I)=HHRS
C IF(HHRS.LT.HRS)TOTH(I)=SOLH(I)+DKH(I)
C QCONNS(I)=QCONN
C QILATS(I)=QILAT
C QINFS(I)=QINF
C QINFLS(I)=QINFL
C QTOTS(I)=QTOT
C QMOIRS(I)=QMOIR
C QTOIS(I)=QZ
C FONISM(I) = FONI


```

FONASM(I) = FONA
FCYS(I)=FCY
PWISM(I) = PWI
PWSOL(I)=PWACT
TIWBSM(I) = TIWB
RHIS(I) = RHI
CPHRSS(I)=FONI*HHR5
IF(FONA.GT.0.)CPHRSS(I)=FONA*HHR5
RSKWH(I)=CPHRSS(I)*HETOT/1000.
RSBTU(I)=FONI*HHR5*HCTOT/1000.
ALSBTU(I)=FONI*HHR5*HL/1000.
SSBTU(I)=FONI*HHR5*HS/1000.
IF(RSBTU(I) .GT. 0.1) SRATS(I) =
      SSBTU(I) / RSBTU(I) * 100.
IF(RHI.GT.65.)HRH65S(I)=SOLH(I)
IF(RHI.LT.20..AND.RHI.GT.1.)HRH20S(I)=SOLH(I)
HCSSM(I) = HS
HCLSM(I) = HL
HCTSM(I) = HCTOT
HETSM(I) = HETOT

```

```

1150 CONTINUE

```

```

C
9990 CONTINUE
RETURN
END
SUBROUTINE SPCS8(DELT8)

```

```

C
C*****
C
C SEASONAL PERFORMANCE CALCULATIONS FOR DARK HOURS.
C
C R. J. RETTBERG 14 JAN 1980.
C

```

```

C*****
C
C NOTES:
C
C 1) SEE NOTES FOR 'SPCSA.CNH' [HCB, 3-82].
C

```

```

C+++++
C
C INCLUDE 'BINA.COM'
C
C INCLUDE 'CASES.COM'
C
C INCLUDE 'CLWEAT.COM'
C
C INCLUDE 'CPWID.COM'
C
C INCLUDE 'CSZ.COM'
C
C INCLUDE 'GLC.COM'
C
C INCLUDE 'MOD.COM'
C
C--START EXECUTABLE STMTS.

```

C

```

DO 1150 I = 1, 60
  IROW = I
  IF(DKH(I) .LT. 0.01) GO TO 1150
  TODB=TODBCM(I)
  RHO=RHOM(I)
  HRS=DKH(I)
  HHR=HRS
  CALL QLM5(2, IROW, DELTD, TODB, RHO)
  QSUN = QSUNDM(I)
  QZ = QSUN + QWICDM(I) + QWACDM(I) + QCCDM(I)
  BNACH = BNADM(I)

```

C

```

CALL SPCSC(IROW, TODB, RHO, HRS, QZ, QSUN, BNACH,
&          TIWB, RHI, HHR)

```

C

```

IF(HHR.LT.HRS)DKH(I)=HHR
IF(HHR.LT.HRS)TOT(I)=SOLH(I)+DKH(I)
QCONND(I)=QCONN
QILATD(I)=QILAT
QINF(I)=QINF
QINF(I)=QINF
QINF(I)=QINF
QTOTD(I)=QTOT
QMOIRD(I)=QMOIR
QTOTD(I)=QZ
FONIDM(I) = FONI
FONADM(I) = FONA
FCYD(I)=FCY
PWIDM(I) = PWI
PWRK(I)=PWACT
TIWBDM(I) = TIWB
RHID(I) = RHI
CPHRSD(I)=FONI*HHR
IF(FONA.GT.0.)CPHRSD(I)=FONA*HHR
RDKWH(I)=CPHRSD(I)*HETOT/1000.
RDBTU(I)=FONI*HHR*HCTOT/1000.
ALDBTU(I)=FONI*HHR*HL/1000.
SDBTU(I)=FONI*HHR*HS/1000.
IF(RDBTU(I) .GT. 0.1) SRATD(I) =
&          SDBTU(I) / RDBTU(I) * 100.
IF(RHI.GT.65.)HRH65D(I)=DKH(I)
IF(RHI.LT.20..AND.RHI.GT.1.)HRH20D(I)=DKH(I)
HCSDM(I) = HS
HCLDM(I) = HL
HCTDM(I) = HCTOT
HETDM(I) = HETOT

```

1150 CONTINUE

C

9990 CONTINUE

RETURN=

END

```

SUBROUTINE SPCSC(IROW, TODB, RHO, HRS, QZ, QSUN, BNACH,
&          TIWB, RHI, HHR)

```

C

C*****

C

C ???? SUBROUTINE FOR SEASONAL PERFORMANCE CALCULATIONS.

C
C R. J. RETTBERG 14 JAN 1980.

C
C *****

C NOTES:

C 1) THIS SUBROUTINE CALLS "CACIT" WHICH IS THE HEART OF THE
C EQUIPMENT/LOAD BALANCE CALCULATIONS. THE OUTPUT OF THE
C ITERATIVE CALCULATIONS IN "CACIT" ARE FON (IDEAL) AND
C THE INDOOR WET BULB TEMP. THIS INFORMATION IS THEN
C USED HERE TO INCLUDE CYCLIC DEGRADATION (THE T-STATS)
C AND CALCULATE THE LOAD COMPONENTS. (HCB, 2-23-82).

C 2) SEE NOTES IN 'SPCSA.CNH' FOR GENERAL MODIFICATIONS.

C ++++++

C INCLUDE 'BINA.COM'

C INCLUDE 'CASES.COM'

C INCLUDE 'CPWID.COM'

C INCLUDE 'CSZ.COM'

C INCLUDE 'PSYC.COM'

C INCLUDE 'QLC.COM'

C INCLUDE 'RIT.COM'

C INCLUDE 'MOD.COM'

C --START EXECUTABLE STMTS.

C START COMMON SUBPROGRAM FOR SOLH AND DKH CALCULATIONS

C 150 CONTINUE

C 250 CONTINUE

C SET UP CONSTANTS AND INITIALIZERS FOR CACIT.

C TD=TODB

C RH=RHO

C CALL PSYTW(NIT)

C CALL PSYALL

C W0=W

C H0=H

C RHS98=W0*BNACH*RESVOL*0.075+AMWIIC

C RHS108=H0*BNACH*RESVOL*0.075+1060.*AMWIIC+QZ+QCII

C AA=BNACH*RESVOL*0.075

C CALL CACIT(TODB,RHO,TIDB,TIWB,FONI,NIT)

```
C
IF(FONI.GT.10..OR.FONI.LT.0.0001)HHR=0.
IF(FONI.GT.10..OR.FONI.LT.0.0001)GO TO 160

C
C   CALCULATE ACTUAL EQUIPMENT AND AIR DATA
C
CALL CACPMS(TODB, TIDB, TIWB)
TW=TIWB
TD=TIDB
CALL PSYALL
WI=W
HI=H
IPW=1

C
C   SELECT THERMOSTAT
C
IF(TSNAM .EQ. 'RAC') GO TO 151
IF(TSNAM .EQ. 'OLD') GO TO 1300
IF(TSNAM .EQ. 'NEW') CALL TSMS(1)
IF(TSNAM .EQ. 'NEW') CALL PWIDTH
IF(TSNAM .EQ. 'ITT') CALL TSMS(2)
GO TO 1350

C
C   "OLD" THERMOSTAT
C
1300 CONTINUE
IENTER = IROW
CALL CYCDEG(IENTER, TODB)

C
1350 CONTINUE

C
C   CORRECT FOR INDOOR FAN HEAT IF IAF = 0
C   OTHER THAN RAC
C
IF(IAF.EQ.1)GO TO 152
IF(PWACT .GT. 59.9) GO TO 152
IF(FCY .LT. 1.E-5)GO TO 152
  XTOT=60./FCY
  XOFF=XTOT-PWACT
  XDEL=(XOFF*HEIFAN*HEFAN*3.413)/HCTOT
  PWACT=AMIN1(60.,PWACT+XDEL)
  XOFF=XTOT-PWI
  XDEL=(XOFF*HEIFAN*HEFAN*3.413)/HCTOT
  PWI=AMIN1(60.,PWI+XDEL)
  FONI=PWI/XTOT
152 CONTINUE
IF(PWI.GT.0.00001.AND.TSNAM.NE.'ITT')FONA=FONI*PWACT/PWI
IF(FONA.GT.1.0) FONA=1.0
GO TO 160

C
C   RAC THERMOSTAT
C
151 CONTINUE
XAA=0.24+0.45*WO
QSENSG=QZ+QCII+AA*XAA*(TODB-TIDB)
XAA=0.24+0.45*WI
```

```

XA=DELTSW*XAA*(AA/BNACH)
XOFF=XA/QSENSG*60.
XON=0.
IF(FONI.LT.0.9999)XON=XOFF*FONI/(1.-FONI)
FCY=60./(XON+XOFF)
IF(FONI.GT.0.9998)FCY=0.
CALL PWIDTH
IF(PWI.GT.0.00001)FONA=FONI*PWACT/PWI

```

```

      AFTER CALL TO CACIT, HHR=0 IF FONI.GT.10 OR FONI.LT.0.0001
      OTHERWISE HHR=HRS=SOL OR DARK HRS

```

```

160 CONTINUE

```

```

TIWB=TIWB*HHR/HRS
RHI=RH*HHR/HRS
QINF=AA*(HO-HI)*HHR/HRS
QINFL=AA*(WO-WI)*1060.*HHR/HRS
GSTOT=(QZ+QCII)*HHR/HRS
QCONN=(GSTOT-QSUN-QCII)*HHR/HRS
QILAT=1060.*AMWIIC*HHR/HRS
QTOT=QINF+QILAT+GSTOT
QMRTOT=(AA*(WO-WI)+AMWIIC)*1060.*HHR/HRS
QMOIR=0.
IF(QTOT.GT.1.)QMOIR=QMRTOT/QTOT*100.
QINFR=0.
IF(QTOT.GT.1.)QINFR=QINF/QTOT*100.
HCTOT=HCTOT*HHR/HRS
HL=HL*HHR/HRS
HS=HS*HHR/HRS
HETOT=HETOT*HHR/HRS

```

```

      END COMMON SUBPROGRAM FOR SOLH AND DKH CALCULATIONS

```

```

9990 CONTINUE

```

```

      RETURN

```

```

      END

```

```

      SUBROUTINE SPCSD

```

```

      FAN ENERGY CALCULATIONS.

```

```

      R. J. RETTBERG 14 JAN 1980.

```

```

      INCLUDE 'BINA.COM'

```

```

      INCLUDE 'CLWEAT.COM'

```

```

      INCLUDE 'MOD.COM'

```

```

      INCLUDE 'TOTS.COM'

```

```

      --START EXECUTABLE STMTS.

```

C
C
C
C
C

START CALCULATIONS TO ADD FAN ENERGY FOR CONTINUOUS
FAN OPERATION.

```
350 CONTINUE
DO 380 J=1,10
  XTOT=0.
  DO 371 JJ=1,6
    K=6*J-6+JJ
    XTOT=CPHRSS(K)+XTOT
371 CONTINUE
  IF(XTOT.LT.0.1)GO TO 380
  DO 372 JJ=1,6
    K=6*J-6+JJ
    BBB=(SOLH(K)-CPHRSS(K))*HEFAN/1000.
    RSKWH(K)=RSKWH(K)+BBB
    RTKWH(K)=RTKWH(K)+BBB
    TOT(10)=BBB+TOT(10)
    TOT(12)=BBB+TOT(12)
372 CONTINUE
380 CONTINUE
DO 390 J=1,10
  XTOT=0.
  DO 381 JJ=1,6
    K=6*J-6+JJ
    XTOT=CPHRSD(K)+XTOT
381 CONTINUE
  IF(XTOT.LT.0.01)GO TO 390
  DO 382 JJ=1,6
    K=6*J-6+JJ
    BBB=(DKH(K)-CPHRSD(K))*HEFAN/1000.
    RDKWH(K)=RDKWH(K)+BBB
    RTKWH(K)=RTKWH(K)+BBB
    TOT(11)=BBB+TOT(11)
    TOT(12)=BBB+TOT(12)
382 CONTINUE
390 CONTINUE
```

C
C
C
C
C

END OF CALCULATIONS TO ADD FAN ENERGY

```
9990 CONTINUE
RETURN
END
SUBROUTINE SUM
```

C
C
C
C
C
C
C
C
C

```
INCLUDE 'DEF.COM'
IDUM = 1
```

C

C--CORRECTION FACTORS TO CORRELATION:

C

$$Q=Q/1.03$$

$$E=E/1.01$$

C

C SUM HEAT OUTPUT AND ENERGY CONSUMPTION INTO TOTALS

C

$$TOTQ=TOTQ+Q*DTIME$$

$$TOTE=TOTE+E*DTIME$$

C

C--DEFROST TIME AND ENERGIES:

C

$$DEFT(I)=TMIN+.052*TRATIO$$

$$DEFQ=-4862*TMIN-553*TRATIO$$

$$DEFE=2800*DEFT(I)$$

C

C--INTEGRATED HEAT OUTPUT AND ELECTRIC INPUT:

C

$$TCYCD(I)=DEFT(I)+.085*TIME$$

$$QSUM(I)=(DEFQ+.055*QPEAK(I)+TOTQ)/TCYCD(I)$$

$$ESUM(I)=(DEFE+.088*EPEAK(I)+TOTE)/TCYCD(I)$$

$$CSUM(I)=QSUM(I)/(ESUM(I)*3.413)$$

C

C--RESTORE UNCORRECTED Q AND E:

C

$$Q=Q*1.03$$

$$E=E*1.01$$

C

RETURN

END

SUBROUTINE TIMED(I,MODNUM,BASET,DEFOUT)

C

C*****

C

C TIMED SETS TIME BETWEEN DEFROSTS FOR TIMED DEFROST CONTROLS

C

C*****

C

DIMENSION BB(10, 4), BI(10, 6), BE(10, 5)

C

C MODNUM=1: TIME BETWEEN DEFROSTS = 1HR*FACTOR

C

DATA (BB(1,JA), JA=1,4)/1., 1., 1., 1./

DATA (BI(1,JA), JA=1,6)/1., 1., 1., 1., 1., 1./

DATA (BE(1,JA), JA=1,5)/1., 1., 1., 1., 1./

C

C MODNUM=2: GE PROGRAMMED CONTROL

C

DATA (BB(2, JA), JA = 1, 4)/ 1., 1., 1., 1./

DATA (BI(2, JA), JA = 1, 6)/ 1., 1., 1., 1., 1., 1.555/

DATA (BE(2, JA), JA = 1, 5)/ 2.111, 2.667, 3.333, 3.333, 3.333/

C

C MODNUM=3: HONEYWELL PROGRAMMED CONTROL

C

DATA (BB(3, JA), JA = 1, 4)/ 1., 1., 1., 1./

DATA (BI(3, JA), JA = 1, 6)/ 1., 1.08, 1., 1.16, 1.4, 1.74/

DATA (BE(3, JA), JA = 1, 5)/ 2.3, 3.4, 6.65, 6.667, 6.667/

C
C MODNUM=4; RANCO PROGRAMMED CONTROL
C

DATA (BB(4, JA), JA = 1, 4)/ 1., 1., 1., 1./
DATA (BI(4, JA), JA = 1, 6)/ 1., 1., 1., 1., 1., 2./
DATA (BE(4, JA), JA = 1, 5)/ 2., 2., 2., 4., 4./

C
C*****
C--START EXECUTABLE STMTS.

C
C SET UP MULTIPLYING FACTOR
C

FACTOR = BASET
IF(MODNUM .NE. 1) FACTOR = 1.

C
C DO TEMPERATURES BETWEEN 62 AND 47F
C

IF(I .GT. 6) GO TO 100
K = I - 2
DEFOUT = BB(MODNUM,K)*FACTOR
RETURN

C
C FOR TEMPERATURES BETWEEN 42 AND 17F
C

100 IF(I .GT. 42) GO TO 200
K = IFIX((I-7)/6.) + 1
DEFOUT = BI(MODNUM,K)*FACTOR
RETURN

C
C FOR TEMPERATURES BELOW 12F
C

200 K = I - 42
DEFOUT = BE(MODNUM,K)*FACTOR

C
C THAT'S IT
C

RETURN
END
SUBROUTINE TOTCAP(TODB, TIWB, HCTOT)

C
C*****

C
C CAC TOTAL COOLING CAPACITY.

C
C R. J. RETTBERG 16 AUG 1979
C

C
C*****

C
C INPUTS:
C TODB - OUTDOOR DRY-BULB TEMPERATURE IN DEG-F.
C TIWB - INDOOR WET-BULB TEMP IN DEG-F.
C

C
C OUTPUTS:
C HCTOT - CAC TOTAL COOLING CAPACITY IN BTU/H.
C

C*****

C

DIMENSION INDXM(10), TEMPLM(7)

C

DATA INDXM/ 1, 1, 1, 1, 2, 3, 4, 5, 6, 6/

DATA TEMPLM/ 65., 85., 90., 95., 100., 105., 115./

C

C--DEFINE SUBROUTINE FUNCTIONS.

C

C-- F65 ETC. ARE TOTAL CAPACITIES IN KBTU/H FOR 65 DEG-F

C-- OUTDOOR DRY-BULB TEMP.

C

F65(TIWB) = 32.4 + (TIWB - 59.) * 1.5 / 4.

F85(TIWB) = 31.4 + (TIWB - 59.) * 1.7 / 4.

F90(TIWB) = 30.7 + (TIWB - 59.) * 1.8 / 4.

F95(TIWB) = 29.8 + (TIWB - 59.) * 1.9 / 4.

F100(TIWB) = 28.8 + (TIWB - 59.) * 1.96666 / 4.

F105(TIWB) = 27.6 + (TIWB - 59.) * 2.1 / 4.

F115(TIWB) = 25.0 + (TIWB - 59.) * 2.23333 / 4.

C

C-- FC IS A COEFFICIENT SELECTION FUNCTION. IT SETS ALL

C-- COEFFICIENTS, EXCEPT WHEN I = IX, EQUAL TO ZERO. THE

C-- SELECTED COEFFICIENT (WHEN I = IX) IS SET = 1.

C

FC(I, IX) = MAX0(0, I - IX + 1) * MAX0(0, IX - I + 1)

C

C-- F SELECTS F65 - F115 BASED ON THE INDEX I. THE SELECTED

C-- FUNCTION IS EVALUATED AT TIWB.

C

F(I, TIWB) = FC(I, 1) * F65(TIWB)

& + FC(I, 2) * F85(TIWB)

& + FC(I, 3) * F90(TIWB)

& + FC(I, 4) * F95(TIWB)

& + FC(I, 5) * F100(TIWB)

& + FC(I, 6) * F105(TIWB)

& + FC(I, 7) * F115(TIWB)

C

C--START EXECUTABLE STATEMENTS.

C

IF(TO08 .LE. 65.) GO TO 1100

IF(TO08 .GE. 115.) GO TO 1200

C

IDUMA = IFIX((TO08 - 60.) / 5.)

ILOW = INDXM(IDUMA)

TLOW = TEMPLM(ILOW)

THIGH = TEMPLM(ILOW + 1)

DUMA = F(ILOW, TIWB)

DUMB = F(ILOW + 1, TIWB)

DUMC = DUMB - DUMA

DUMD = TO08 - TLOW

DUME = THIGH - TLOW

HCTOT = DUMA + (DUMD / DUME) * DUMC

GO TO 9990

C

C

1100 CONTINUE

HCTOT = F(1, TIWB)
GO TO 9990

C

1200 CONTINUE

HCTOT = F(7, TIWB)

9990 CONTINUE

HCTOT = 1000. * HCTOT

RETURN

END

SUBROUTINE TOTMS(IWHERE, IROW)

C

C*****

C

C TOTALING SUBROUTINE FOR COOLING SPM-S.

C

C R. J. RETTBERG 15 JAN 1980.

C

C*****

C

INCLUDE 'BINA.COM'

C

INCLUDE 'CLWEAT.COM'

C

INCLUDE 'DBBIN.COM'

C

INCLUDE 'ECON.COM'

C

INCLUDE 'TOTS.COM'

C

C--START EXECUTABLE STMTS.

C

GO TO (1100, 1200, 1300, 1400) IWHERE

C

1100 CONTINUE

C

DO 1110 I = 1, 60

TOT(1)=RSBTU(I)+TOT(1)

TOT(2)=RDBTU(I)+TOT(2)

TOT(3)=RTBTU(I)+TOT(3)

TOT(4)=ALSBTU(I)+TOT(4)

TOT(5)=ALDBTU(I)+TOT(5)

TOT(6)=ALBTU(I)+TOT(6)

TOT(7)=SSBTU(I)+TOT(7)

TOT(8)=SDBTU(I)+TOT(8)

TOT(9)=STBTU(I)+TOT(9)

TOT(10)=RSKWH(I)+TOT(10)

TOT(11)=RDKWH(I)+TOT(11)

TOT(12)=RTKWH(I)+TOT(12)

TOT(13)=SOLH(I)+TOT(13)

TOT(14)=DKH(I)+TOT(14)

TOT(15)=TOTH(I)+TOT(15)

TOT(16)=CPHRSS(I)+TOT(16)

TOT(17)=CPHRSD(I)+TOT(17)

TOT(18)=CPHRST(I)+TOT(18)

TOT(19)=HRH65S(I)+TOT(19)

TOT(20)=HRH65D(I)+TOT(20)

```
TOT(21)=HRH65T(I)+TOT(21)
TOT(22)=HRH20S(I)+TOT(22)
TOT(23)=HRH20D(I)+TOT(23)
TOT(24)=HRH20T(I)+TOT(24)
```

1110 CONTINUE

C

GO TO 9990

C

1200 CONTINUE

C

```
TOTPR(IROW,1)=TOT(15)
TOTPR(IROW,2)=TOT(3)
TOTPR(IROW,3)=TOT(12)
TOTPR(IROW,4)=TOT(21)
TOTPR(IROW,5)=TOT(24)
TOTPR(IROW,6)=TOT(18)
```

C

TOTEC(IROW)=TOT(12)

C

DO 341 I=1,5

TOTPR(61,I)=TOTPR(IROW,I)+TOTPR(61,I)

341 CONTINUE

C

TOTPR(61,6)=TOTPR(IROW,6)+TOTPR(61,6)

GO TO 9990

C

1300 CONTINUE

C

C

DRY BULB CALC. TOTALS

C

DO 430 I=1,10

TOTDB(1)=HRSBN(I)+TOTDB(1)

TOTDB(2)=CPHRST(I)+TOTDB(2)

TOTDB(3)=RTBTU(I)+TOTDB(3)

TOTDB(4)=RTKWH(I)+TOTDB(4)

430 CONTINUE

DO 431 I=1,4

ANBTPR(IROW,I)=TOTDB(I)

ANBTPR(61,I)=ANBTPR(61,I)+ANBTPR(IROW,I)

431 CONTINUE

C

GO TO 9990

C

1400 CONTINUE

C

C--TOTAL WEATHER STATISTICS.

C

DO 1420 I = 1, 10

DO 1410 J = 1,6

K = 6 * I - 6 + J

TOWDBT(I) = TOWDBT(I) + TOTH(K)

TOWRHT(J) = TOWRHT(J) + TOTH(K)

TOWDBS(I) = TOWDBS(I) + SOLH(K)

TOWRHS(J) = TOWRHS(J) + SOLH(K)

TOWDRD(I) = TOWDRD(I) + DKH(K)

TOWRHD(J) = TOWRHD(J) + DKH(K)

1410 CONTINUE

1420 CONTINUE

C

9990 CONTINUE

RETURN

END

SUBROUTINE TSMS(IWHERE)

C

C*****

C

C THERMOSTAT MODEL MASTER SUBROUTINE.

C

C R. J. RETTBERG 14 JAN 1980.

C

C*****

C

C NOTES:

C

C 1) THIRD MODEL (ITERATIVE 50% DUTY FACTOR PARAB.) ADDED.
C [12-1-81]

C

C 2) ARRANGED FOR COOLING AND HEATING SPM (HCB, 3-15-82).

C

C*****

C

C--START EXECUTABLE STMTS.

C

GO TO (1100, 1200, 1300) IWHERE

C

C 1100 CONTINUE

C

C--3 CPH @ 50% DUTY FACTOR PARABOLA.

C

CALL TSSA

GO TO 9990

C

C 1200 CONTINUE

C

C--ITERATIVE 50% DUTY FACTOR PARABOLA WITH CYCLIC DEGRADATION.

C

CALL TSITT

GOTO 9990

C

C 1300 CONTINUE

C

C--OLD T-STAT BASED ON TODB & BALANCE POINT TEMPERATURE.

C

CALL TSSB

C

C 9990 CONTINUE

RETURN

END

SUBROUTINE TSSA

C

C*****

C

C "CYCMAX" CPH • 50% DUTY FACTOR PARABOLIC THERMOSTAT MODEL.

C
C R. J. RETTBERG 14 JAN 1980.

C
C *****

C
C MODIFIED TO INCLUDE VARIABLE MAXIMUM CYCLE RATE.
C [11-81]

C
C MODIFIED TO CALCULATE: TCYC, TON, TOFF. [12-81]

C
C ++++++

C
C INCLUDE 'CPWID.COM'

C
C --START EXECUTABLE STMTS.

C
C
C FCY = CYCMAX - ((100. * FONI - 50.) ** 2) * (CYCMAX / 2500.)
C FCY = AMAX1(FCY, 1.E-6)
C TCYC=1.0/FCY*60.0
C IF(FONI.GE.0.5) TON=(1.0+(1.0-FCY/CYCMAX)**0.5)/(2.0*FCY)*60.0
C IF(FONI.LT.0.5) TON=(1.0-(1.0-FCY/CYCMAX)**0.5)/(2.0*FCY)*60.0
C IF(TCYC.GT.601.0) TCYC=601.0
C IF(TON.GT.600.0) TON=600.0
C TOFF=TCYC-TON

C
C 9990 CONTINUE
C RETURN
C END
C SUBROUTINE TSSB

C
C *****

C
C OLD THERMOSTAT MODEL.

C
C THIS SUBROUTINE SELECTS A THERMOSTAT FOR THE SITE
C AND PRODUCT BASED ON THE BALANCE POINT TEMPERATURE
C ASSUMING THE T-STAT WAS SELECTED FOR A 70 DEG-F
C TIDB.

C
C *****

C
C INCLUDE 'BALPT.COM'

C
C INCLUDE 'CPWID.COM'

C
C INCLUDE 'TSTAT.COM'

C
C --START GENERAL EQUATIONS.

C
C
C FCY105(A)=3.-(A-90.4)**2/142.11+MIN0(1,IFIX(A/65.))
C 1 *MAX0(0,MIN0(1,IFIX(70.-A)))*(1.540-(A-65.)/
C 2 (70.-65.)*(1.540-0.518))+MIN0(1,IFIX(A/70.))
C 3 *MAX0(0,MIN0(1,IFIX(75.8-A)))*(0.518-(A-70.)
C 4 /(75.8-70.)*0.518)
C FCY95(A)=3.-(A-85.4)**2/86.64+MIN0(1,IFIX(A/65.))
C 1 *MAX0(0,MIN0(1,IFIX(70.-A)))*(1.8033-(A-65.)/

```
2      (70.-65.)*(1.8033-0.4373))+MIN0(1,IFIX(A/70.))
3      *MAX0(0,MIN0(1,IFIX(74.0-A)))*(0.4373-(A-70.))
4      /(74.0-70.)*0.4373)
FCY85(A)=3.-(A-79.15)**2/38.00+MIN0(1,IFIX(A/65.))
1      *MAX0(0,MIN0(1,IFIX(70.-A)))*(2.2690-(A-65.))/
2      (70.-65.)*(2.2690-0.2332))+MIN0(1,IFIX(A/70.))
3      *MAX0(0,MIN0(1,IFIX(71.6-A)))*(0.2332-(A-70.))
4      /(71.6-70.)*0.2332)
FCY100(A)=3.-(A-87.9)**2/117.
FCY90(A)=3.-(A-82.275)**2/63.
FCY80(A)=3.-(A-75.4)**2/25.
```

C

C--END GENERAL EQUATIONS.

C

C--START EXECUTABLE STMTS.

C

```
      IF(IESTAT.GT.1) GO TO 10
      X = 65. - TBPNOB = 5.
      IF(ABS(X-15.).LT.0.1)ASSIGN 80 TO KCAL
      IF(ABS(X-20.).LT.0.1)ASSIGN 85 TO KCAL
      IF(ABS(X-25.).LT.0.1)ASSIGN 90 TO KCAL
      IF(ABS(X-30.).LT.0.1)ASSIGN 95 TO KCAL
      IF(ABS(X-35.).LT.0.1)ASSIGN 100 TO KCAL
      IF(ABS(X-40.).LT.0.1)ASSIGN 105 TO KCAL
      TODB1 = 999.
      IF(IESTAT.EQ.1) RETURN
10  CONTINUE
      TODB2=TODB
      IF(ABS(TODB2-TODB1).LT.0.1)GO TO 200
      X=130.-TODB
      GO TO KCAL
80  CONTINUE
      FCYTEM=FCY80(X)
      IF(ABS(X-67.).LT.0.1)FCYTEM=0.6
      GO TO 200
85  CONTINUE
      FCYTEM=FCY85(X)
      GO TO 200
90  CONTINUE
      FCYTEM=FCY90(X)
      IF(X.LT.72.63)FCYTEM=(FCY95(X)+FCY85(X))/2.
      GO TO 200
95  CONTINUE
      FCYTEM=FCY95(X)
      GO TO 200
100 CONTINUE
      FCYTEM=FCY100(X)
      IF(X.LT.74.65)FCYTEM=(FCY105(X)+FCY95(X))/2.
      GO TO 200
105 CONTINUE
      FCYTEM=FCY105(X)
200 CONTINUE
      FCY=FCYTEM
      TODB1=TODB
      FCY = AMAX1(FCY, 1.E-6)
      RETURN
```

```
C+++++  
C  
C ITERATIVE 50% DUTY FACTOR PARABOLIC THERMOSTAT WHICH INCLUDES  
C CYCLIC DEGRADATION. T-STAT 'TSSA' IS CALLED AS THE T-STAT  
C MODEL. ACTUAL HEAT PUMP ON TIME IS THEN CALCULATED USING THE  
C TIME CONSTANT METHOD. THE ON TIME IS THEN ITERATED UNTIL BOTH  
C THE T-STAT MODEL AND DEGRADATION CALCULATIONS AGREE.  
C  
C HCB [12-1-81]  
C+++++  
C  
C NOTES:  
C  
C 1) MODIFIED FROM CACSPM VERSION FOR COMBINED HEATING AND COOLING  
C MODEL (2-82).  
C  
C 2) DESIGNED FOR AN EXTERNAL BIN LOOP.  
C-----  
C  
C INCLUDE 'BIN.COM'  
C INCLUDE 'BINA.COM'  
C INCLUDE 'CASES.COM'  
C INCLUDE 'CPWID.COM'  
C INCLUDE 'HTWEAT.COM'  
C INCLUDE 'QL.COM'  
C INCLUDE 'QLC.COM'  
  
C  
C INCLUDE 'RW.COM'  
  
C  
C TOLER = TOLERANCE FOR AGREEMENT BETWEEN T-STAT MODEL ON TIME AND  
C CALCULATED EQUIVALENT ON TIME DUE TO CYCLIC DEGRADATION  
C IN HRS.  
  
C  
C TOLER=0.001  
C ITI=50  
  
C  
C START BIN LOOP (DELETED FOR THE COOLING MODEL)  
  
C  
C ITRY=0  
C ISWCNV=0  
  
C  
C FONTST=FONI  
C IF(FONI.GE.1.0) GOTO 200  
  
C  
C CALL TSMS(1)  
  
C  
C PWI=FONI/FCY*60.0  
C IF (PWI.GT.600) PWI=600  
C IF(ICYLE.EQ.0) GOTO 250  
  
C  
C FONI=FONI+TAUON*FCY/60.0
```

C BEGIN ITERATION LOOP

C
100 CONTINUE

C
CALL TSMS(1)
IF(TON.EQ.600.0) GOTO 200

C	VARIABLE	DEFINITION
C	ETON	EQUIVALENT ON-TIME FOR 1-CYC ON-TIME HP OUTPUT
C		DUE TO CYCLIC DEGRADATION (MIN/CYC)
C	ERTOFF	EQUIVALENT OFF-TIME FOR 1-CYC OFF-TIME HP OUTPUT
C		DUE TO CYCLIC DEGRADATION (MIN/CYC)
C	EMAX	FRACTION OF SS CAPACITY AT END OF ON-TIME
C	TOTEON	TOTAL EQUIVALENT (DEGRADED) ON-TIME (HR/HR)
C	ERROR	DELTA USED FOR ITERATION TEST (HR/HR)
C	FONI	GUESS AT HP ON-TIME (HR/HR)

C
EXON=TON/TAUON
EXOFF=TOFF/TAUOFF
IF(EXON.GT.75) EXON=75
IF(EXOFF.GT.75) EXOFF=75
ETON=TON-TAUON*(1-EXP(-EXON))
EMAX=1-EXP(-EXON)
ERTOFF=EMAX*TAUOFF*(1-EXP(-EXOFF))
TOTEON=(ETON+ERTOFF)*FCY/60.0
IF(IAF.EQ.1) TOTEON=ETON*FCY/60.0

C
ERROR=TOTEON-FONTST
IF(ABS(ERROR).LE.TOLER) GOTO 1000
FONI=FONI-ERROR
ITRY=1+ITRY

C
IF(ITRY.GE.ITT) WRITE (ITTY,5000) ITT
5000 FORMAT(' *** T-STAT "ITT" DID NOT CONVERGE AFTER ',I2,
1 ' ITERATIONS. ***'/)
IF(ITRY.GE.ITT) GOTO 999

C
GOTO 100

C
C
END ITERATIVE LOOP

C
1000 CONTINUE
PWACT=TON
FONA=TON*FCY/60.0
IF(FONA.GT.1.0) FONA=1.0
GOTO 300

C
200 CONTINUE
FCY=1.0E-6
PWACT=600.0
PWI=600.0
FONA=1.0
GOTO 300

C
250 CONTINUE

PWACT=PWI
FONA=FONTST

C
300 CONTINUE
FONI=FONTST

C
C
999 CONTINUE
RETURN
END
SUBROUTINE FRENCH(XR,YR,N,XI,YO)

C
C+++++

C
C T A B U L A R I N T E R P O L A T I O N

C THIS ROUTINE FINDS YO, CORRESPONDING TO XI IN ARRAYS XR AND YR,
C USING A 3 POINT LAGRANGE CURVE FITTING SCHEME. THE XR ARRAY MUST BE
C MONOTONICALLY ASCENDING AND BOTH ARRAYS MUST BE OF DIMENSION N.

C
C+++++

C
C DIMENSION XR(50), YR(50)
C IF(N.GT.2) GO TO 40
C IF(N.GT.1) GO TO 30
C YO = YR(1)
C GO TO 140
C 30 YO = YR(1) + (YR(2) - YR(1))*(XI - XR(1))/(XR(2) - XR(1))
C GO TO 140
C 40 IF(XI.LT.XR(1)) GO TO 90
C IF(XI.GT.XR(N)) GO TO 110

C
C SCAN TABLE ENTRIES

C
C 50 DO 60 I = 1, N
C ISAV = I
C IF(XI - XR(I)) 80,70,60
C 60 CONTINUE
C GO TO 140
C 70 YO = YR(ISAV)
C GO TO 140
C 80 IF(ISAV.GT.2) GO TO 100
C 90 CALL PARAB(XR,YR,XI,YO)
C GO TO 140
C 100 IF(ISAV.LT.N) GO TO 120
C 110 CALL PARAB(XR(N-2),YR(N-2),XI,YO)
C GO TO 140

C
C WEIGHTED SECOND ORDER FIT

C
C 120 CALL PARAB(XR(ISAV-2),YR(ISAV-2),XI,Z1)
C CALL PARAB(XR(ISAV-1),YR(ISAV-1),XI,Z2)
C ZO = YR(ISAV-1) + (YR(ISAV) - YR(ISAV - 1))*(XISAV - XR(ISAV - 1))
C * /(XR(ISAV) - XR(ISAV - 1))
C DZ1 = ABS(Z1 - ZO)
C DZ2 = ABS(Z2 - ZO)

DZ = DZ1 + DZ2

IF(DZ.NE.0)

GO TO 130

YO = ZO

GO TO 140

130 YO = (DZ2*Z1 + DZ1*Z2)/DZ

140 RETURN

END

SUBROUTINE PARAB(XR,YR,XI,YO)

C

C+++++

C

C 3 POINT LAGRANGE INTERPOLATION

C

C+++++

C

DIMENSION XR(50), YR(50)

X12 = XR(1) - XR(2)

X13 = XR(1) - XR(3)

X23 = XR(2) - XR(3)

IF(X12.NE.0..AND.X13.NE.0..AND.X23.NE.0.) GO TO 20

GO TO 30

20 YO = YR(1)*(XI - XR(2))*(XI - XR(3))/(X12*X13) -

* YR(2)*(XI - XR(1))*(XI - XR(3))/(X12*X23) +

* YR(3)*(XI - XR(1))*(XI - XR(2))/(X13*X23)

30 RETURN

END

SUBROUTINE ZEROMS(IWHERE)

C

C*****

C

C ZEROING MASTER SUBROUTINE FOR RAC SPM-S.

C

C R. J. RETTBERG JAN 1980.

C

C*****

C

NOTES:

C

C 1) COMBINED WITH HPSPM 'ZERO.SPM' FOR HEATING AND COOLING MODEL
C [HCB, 3-15-82].

C

C 2) IWHERE

DESCRIPTION

C

1 ZERO STARTING VARIABLES

C

2 ZERO CASE VARIABLES

C

3 ZERO SOLAR & DARK HRS BELOW TMIN'S.

C

4 ZERO THERMOSTAT RELATED VARIABLES ONLY

C

5 ZERO DRY BULB VARIABLES

C

6 ZERO DUMMY VARIABLES

C

C+++++

C

INCLUDE 'AVGS.COM'

C

INCLUDE 'BIN.COM'

C

```
      INCLUDE 'BINA.COM'
C
      INCLUDE 'CASES.COM'
C
      INCLUDE 'CLWEAT.COM'
C
      INCLUDE 'CPWID.COM'
C
      INCLUDE 'DUMX.COM'
C
      INCLUDE 'QL.COM'
C
      INCLUDE 'QLC.COM'
C
      INCLUDE 'TOTS.COM'
C
C--START EXECUTABLE STMTS.
C
      GO TO (1100, 1200, 1300, 1400, 1500, 1600) IWHERE
C
1100 CONTINUE
C
      DO 30 I=1,6
      TOTPR(61,I)=0.
      AVGPRT(61,I)=0.
      30 CONTINUE
C
      DO 1060 I = 7, 10
      AVGPRT(61, I)=0.
1060 CONTINUE
C
      DO 31 I=1,4
      ANBTPT(61,I)=0.
      31 CONTINUE
      ANBAPT(61)=0.
      GO TO 9990
C
1200 CONTINUE
C
      ZERO OUT ALL VECTORS THAT DO NOT GET ZEROED AUTOMATICALLY
C      DURING THE RUN FOR EACH SEPERATE CASE
C
      DO 1110 I = 1, 30
      TOT(I) = 0.
      IF(I.LE.5) TOTDB(I)=0.
1110 CONTINUE
C
      DO 20 I=1,60
      EERS(I) = 0.
      EERD(I) = 0.
      EERT(I) = 0.
      RSBTU(I)=0.
      ROBTU(I)=0.
      RTBTU(I)=0.
      CPHRSS(I)=0.
      CPHRSD(I)=0.
```

CPHRST(I)=0.
RSKWH(I)=0.
ROKWH(I)=0.
RTKWH(I)=0.
ALSBTU(I)=0.
ALDBTU(I)=0.
ALBTU(I)=0.
SSBTU(I)=0.
SOBTU(I)=0.
STBTU(I)=0.
RHIS(I)=0.
RHID(I)=0.
PWSOL(I)=0.
PWDRK(I)=0.
SRATS(I) = 0.
SRATD(I) = 0.
SRATT(I) = 0.
FCYS(I)=0.
FCYD(I)=0.
FONISM(I) = 0.
FONIDM(I) = 0.
FONASM(I) = 0.
FONADM(I) = 0.
FONAAM(I) = 0.
HRH65S(I)=0.
HRH65D(I)=0.
HRH65T(I)=0.
HRH20S(I)=0.
HRH20D(I)=0.
HRH20T(I)=0.
RHIAVG(I) = 0.
FCYAVG(I) = 0.
PMAVG(I) = 0.
QWICSM(I) = 0.
QWICDM(I) = 0.
QWACSM(I) = 0.
QWACDM(I) = 0.
QCCSM(I) = 0.
QCCDM(I) = 0.
QSUNSM(I) = 0.
QSUNDM(I) = 0.
BNASM(I) = 0.
BNADM(I) = 0.
QINF(S) = 0.
QILATS(I) = 0.
QTOTS(I) = 0.
QMOIRS(I) = 0.
QCONNS(I) = 0.
QTOIS(I) = 0.
QINF(D) = 0.
QILATD(I) = 0.
QTOTD(I) = 0.
QMOIRD(I) = 0.
QCONND(I) = 0.
QTOID(I) = 0.

20 CONTINUE

C

RHIACS = 0.
RHIACD = 0.
RHIACT = 0.
RHOACS = 0.
RHOACD = 0.
RHOACT = 0.
RHIWAS=0.
RHIWAD=0.
RHIWAT=0.
RHOWAS = 0.
RHOWAD = 0.
RHOWAT = 0.
FCYWAS=0.
FCYWAD=0.
FCYWAT=0.
FONAAS = 0.
FONAAD = 0.
FONAAT = 0.
PWWAS=0.
PWWAD=0.
PWWAT=0.

C
C
C

THIS DO LOOP IS FROM 'ZERO.SPM' OF THE HEATING MODEL.

DO 1250 I=1,51
 ANPCPM(I) = 0.
 ANDEFM(I) = 0.
 BNACHM(I) = 0.
 DCPHM(I) = 0.
 DFCAPM(I)=0.
 QHLM(I) = 0.
 QINFM(I) = 0.
 QIIM(I) = 0.
 QTRANM(I) = 0.
 SHBTU(I) = 0.
 TEMHIM(I) = 0.
 TEMHOM(I) = 0.
 TIMPSM(I) = 0.
 TIMTHM(I) = 0.

1250 CONTINUE
C--END HEATING MODEL ADDITION

1400 CONTINUE
 FCY=0.
 FONA=0.
 FONI=0.
 PWACT=0.
 PWI=0.
GO TO 9990

C

1300 CONTINUE

C
C
C
C
C

ELIMINATE TEMPERATURE BINS BELOW TMINS AND TMIND BY
SETTING APPROPRIATE HOURS = 0.

SHTOT = 0.

DHTOT = 0.

THTOT = 0.

C

DO 15 I=1,60

TODB=TODRCM(I)

IF(TODB.LT.TMINS)SOLH(I)=0.

IF(TODB.LT.TMIND)DKH(I)=0.

TOTH(I)=SOLH(I)+DKH(I)

SHTOT = SHTOT + SOLH(I)

DHTOT = DHTOT + DKH(I)

THTOT = THTOT + TOTH(I)

15 CONTINUE

C

GO TO 9990

C

1500 CONTINUE

C

DO 1220 I = 1, 5

TOTODB(I) = 0.

1220 CONTINUE

C

DO 1230 I = 1, 10

TOWDBT(I) = 0.

TOWDBS(I) = 0.

TOWDBD(I) = 0.

1230 CONTINUE

C

DO 1240 I = 1, 6

TOWRHT(I) = 0.

TOWRHS(I) = 0.

TOWRHD(I) = 0.

1240 CONTINUE

C

RHOAHS = 0.

RHOAHD = 0.

RHOAHT = 0.

GO TO 9990

C

1600 CONTINUE

C

C--ZERO DUMX.COM

C

DO 1620 I = 1, 20

DDUMA(I) = 0.

DDUMB(I) = 0.

DDUMC(I) = 0.

DDUMD(I) = 0.

DDUME(I) = 0.

DDUMF(I) = 0.

IIDUMA(I) = 0

IIDUMB(I) = 0

IIDUMC(I) = 0

IIDUMD(I) = 0

IIDUME(I) = 0

IIDUMF(I) = 0

1620 CONTINUE

C

IDUMA = 0
IDUMB = 0
IDUMC = 0
IDUMD = 0
IDUME = 0
IDUMF = 0
DUMA = 0.
DUMB = 0.
DUMC = 0.
DUMD = 0.
DUME = 0.
DUMF = 0.

C

9990 CONTINUE
RETURN
END