CR-134004

NASA-JSC
CONTRACT NAS9-7644

THE ENVIRONMENTAL HEAT FLUX ROUTINE, VERSION 4 (EHFR-4) AND MULTIPLE REFLECTIONS ROUTINE (MRR)

FINAL REPORT
VOLUME 2
PROGRAMMERS REFERENCE MANUAL
REPORT NO. T155-01

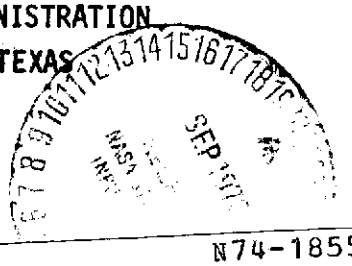
14 June 1973

SUBMITTED BY

VOUGHT MISSILES AND SPACE COMPANY - TEXAS
LTV AEROSPACE CORPORATION
P. O. BOX 6267 - DALLAS, TEXAS 75222

TO

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER - HOUSTON, TEXAS



N74-18553

NASA-CR-134004) THE ENVIRONMENTAL HEAT FLUX ROUTINE, VERSION 4 (EHFR-4) AND MULTIPLE REFLECTIONS ROUTINE (MRR). VOLUME 2: PROGRAMMERS REFERENCE (LTV Aerospace Corp.) 186 p HC $12.50 CSCL 20M G3/33 Unclas 13201

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FOREWARD

The Environmental Heat Flux Routine Version 4, (EHFR-4), is a generalized computer program which calculates the steady state and/or transient thermal environments experienced by a system during lunar surface, deep space, or thermal vacuum chamber operation. The EHFR analytical approach/techniques, system geometric thermal models, and users instructions are documented in Volume 1 of this report. Volume 2, presented herein, contains the detailed EHFR program reference information necessary for future programming changes and additions. The EHFR was written in FORTRAN V for use on the NASA-MSC Univac 1108 computer system employing an EXEC II Processor. Operation on the MSC Univac 1108 system requires the use of overlay provisions, magnetic tape drives, and high speed storage drums. The peripheral equipment units used by the EHFR are shown in Table 5-1 of Volume 1.

The EHFR program reference information contained in this volume consists of the following subprogram detailed data: purpose-description of the routine, a list of the calling programs, an argument list description, nomenclature definition, flow charts, and a compilation listing of each subprogram. Each of the EHFR subprograms were developed specifically for this routine and do not have an applicability of a general nature. Single precision accuracy available on the Univac 1108 is used exclusively in all but two of the 31 EHFR subprograms. The double precision variables required are identified in the nomenclature definition of the two subprograms that require them.

A concise definition of the purpose, function, and capabilities is made in the subprogram description. The description references the appropriate Volume 1 sections of the report which contain the applicable detailed definitions, governing equations, and assumptions used. The detailed equations are not, therefore, presented in each subprogram description. The compilation listing of each subprogram defines the program/data storage requirements, identifies the labeled block common data required, and identifies other subprograms called during execution.

TABLE OF CONTENTS

* Denotes Labeled Block Common

I N D E X

SUBPROGRAM NAME: EHFR MAP

SEGMENT NAME: PROG

PURPOSE: Specify EHFR program structural plan for use by allocator of the EXEC II processor.

DESCRIPTION: The memory allocation processor (MAP) is a special program which produces the EHFR structural plan. During execution, the allocator uses the MAP to set up the required element/subprogram overlay and the assign program/data storage for each element. The EHFR MAP specified storage allocation and element overlay are shown on pages 2 through 6.

The overlay is structured so that only one of the major EHFR environment option segments (i.e., lunar plain, or thermal vacuum chamber) occupies the core at any time. The segment program and data storage requirements are approximately the same resulting in efficient use of the overlay capabilities.

The details of MAP programs may be found in the EXEC II Processor users manual.

MAP LISTING:

```
@ MAP,* PROG,PROG                                                    27 APR 71          10:26:25

    1.        BLK MR,GF1,GF2,GF3,C01,C02,C03,C04,C06
    2.        SEG SUBM1-SUBM2-SUBM3-SUBM4-SUBM5-SUBM6-M-*(1,S,C,LPR,TCR,TVF)
    3.      M SEG MR-GF1
    4.      C SEG SUBC1-SUBC2-SUBC4-SUBC6-GF2-GF3
    5.      L SEG SUBL1-*(SUBL2,SUBL3,SUBL4,SUBL5,SUBL6)
    6.      S SEG SUBS10-S3-S4-*(SUBS1,SUBS2,SUBS6,S2)
    7.      S2 SEG SUBS8-SUBS11
    8.      S3 SEG C01-C02-C03-C04-C06
    9.      S4 SEG SUBS3-SUBS4-SUBS5-SUBS7-SUBS9

MAP IXX 1104 0036
    PROG            SYMBOLIC                    27 APR 71  10:24:43   0  02316520   14    9  (DELETED)
    PROG    (XXX    PROCESSED MAP               27 APR 71  10:24:42   1  02316716  660    1  (DELETED)
                                                            62  02320142   12    1
```

EHFR MAP STORAGE ALLOCATION

STARTING ADDRESS 014000

CORE LIMITS 014000 031261 032224 163771 163772 163777

```
SUBMI /CODE
0    032224-032326
1    014000-014175

NFINPS/CODE
1    014176-014436
2    032327-032327

ATAN  /CODE
1    014437-014535
2    032330-032401

NRWNDS/CODE
1    014536-014630

FPACKS/CODE
1    014631-014674

DEPTH /******
0    032402-032407

NTABS /CODE
0    032410-032536

NFOUTS/CODE
1    014675-015117
2    032537-032540

NBUFFS/CODE
1    015120-015141
2    032541-033551

NIOINS/CODE
1    015142-015210
2    033552-033602

NOUTS /CODE
0    033603-033606
1    015211-016072
2    033607-033624
```

```
NFMTS /CODE
1    016073-016756
2    033625-033640

NCNVTS/CODE
1    016757-017166
2    033641-033724

NOTINS/CODE
1    017167-017560
2    033725-033767

NFTVS /CODE
1    017561-017603

NBDCVS/CODE
0    033770-034154

NERRS /CODE
0    034155-034315
1    017604-020212

NIERS /CODE
0    034316-034316
1    020213-020511
2    034317-034410

NINPTS/CODE
0    034411-034412
1    020512-021431
2    034413-034445

NININS/CODE
1    021432-021606
2    034446-034475

NSTOPS/CODE
1    021607-021624

MAUTOS/CODE
1    021625-022263

SUBM2 /CODE
0    034476-034513
1    022264-022344

SUBM3 /CODE
0    034514-034532
1    022345-022430

NEXPES/CODE
1    022431-022442
2    034533-034533

NXPAFS/CODE
1    022443-022565
2    034534-034540
```

```
NXPAXS/CODE
1    022566-022610
2    034541-034541

EXP    /CODE
1    022611-022701
2    034542-034561

ALOG   /CODE
1    022702-022763
2    034562-034630

MESG3 /CODE
2    034631-034640

MESG12/CODE
2    034641-034660

SUBM4 /CODE
0    034661-034710
1    022764-023325

SINCOS/CODE
1    023326-023415
2    034711-034744

SUBM5 /CODE
0    034745-034756
1    023416-023530

SQRT   /CODE
0    034757-035013
2    035014-035055

SUBM6 /CODE
0    035056-035207
1    023531-023750

MR     /******
0    035210-110412

GE1    /******
0    110413-110455

                    :*SUBI1 /CODE
                       0    110456-111603
                       1    023751-026406

                                          :*SUBI2 /CODE
                                            0    111604-145615
                                            1    026407-026564

                                          :*SUBI3 /CODE
                                            0    111604-132372
                                            1    026407-030046

                                          :*SUBI4 /CODE
```

```
                                    0    111604-145617
                                    1    026407-026576

                                  :*SUBI5 /CODE
                                    0    111604-145606
                                    1    026407-026533

                                  :*SUBI6 /CODE
                                    0    111604-145615
                                    1    026407-026564

:*SUBS10/CODE
   0    110456-111417
   1    023751-025611

 *CH1    /******
   0    111420-147173

 *CH2    /******
   0    147174-147631

 *CH3    /******
   0    147632-154772

 *CH4    /******
   0    154773-155054

 *CH6    /******
   0    155055-155244

 *SUBS3 /CODE
   0    155245-155310
   1    025612-026023

 *SUBS4 /CODE
   0    155311-155331
   1    026024-026150

 *SUBS5 /CODE
   0    155332-155431
   1    026151-026532

 *SUBS7 /CODE
   0    155432-155457
   1    026533-026666

 *SUBS9 /CODE
   0    155460-155477
   1    026667-027022

                                  :*SUBS1 /CODE
                                    0    155500-156161
                                    1    027023-030276

                                  :*SUBS2 /CODE
                                    0    155500-155545
                                    1    027023-027231
```

```
                                        :*SUBS6 /CODE
                                          0    155500-157033
                                          1    027023-031205

                                        :*SUBS8 /CODE
                                          0    155500-161147
                                          1    027023-030722

                                          DSQRT /CODE
                                          2    161150-161252

                                         *SUBS11/CODE
                                          0    161253-161342
                                          1    030723-031261

                    :*SUBC1 /CODE
                       0    110456-111256
                       1    023751-025470

                     *SUBC2 /CODE
                       0    111257-111373
                       1    025471-026425

                     *SUBC4 /CODE
                       0    111374-117565
                       1    026426-027717

                     *SUBC6 /CODE
                       0    117566-117622
                       1    027720-030354

                      ASIN  /CODE
                       1    030355-030411
                       2    117623-117631

                     *GE2   /******
                       0    117632-120625

                     *GE3   /******
                       0    120626-161033

                    :*LPR   /CODE
                       0    110456-163226
                       1    023751-027421

                      TAN   /CODE
                       1    027422-027461
                       2    163227-163246

                    :*TCR   /CODE
                       0    110456-116014
                       1    023751-025400

                    :*IVE   /CODE
                       0    110456-163671
                       1    023751-026033

DRUM LENGTH 404202
```

PROGRAM NAME: Main Program

SEGMENT NAME: SUBM1

PURPOSE: Read the environment selection index and call the appropriate environmental subprogram.

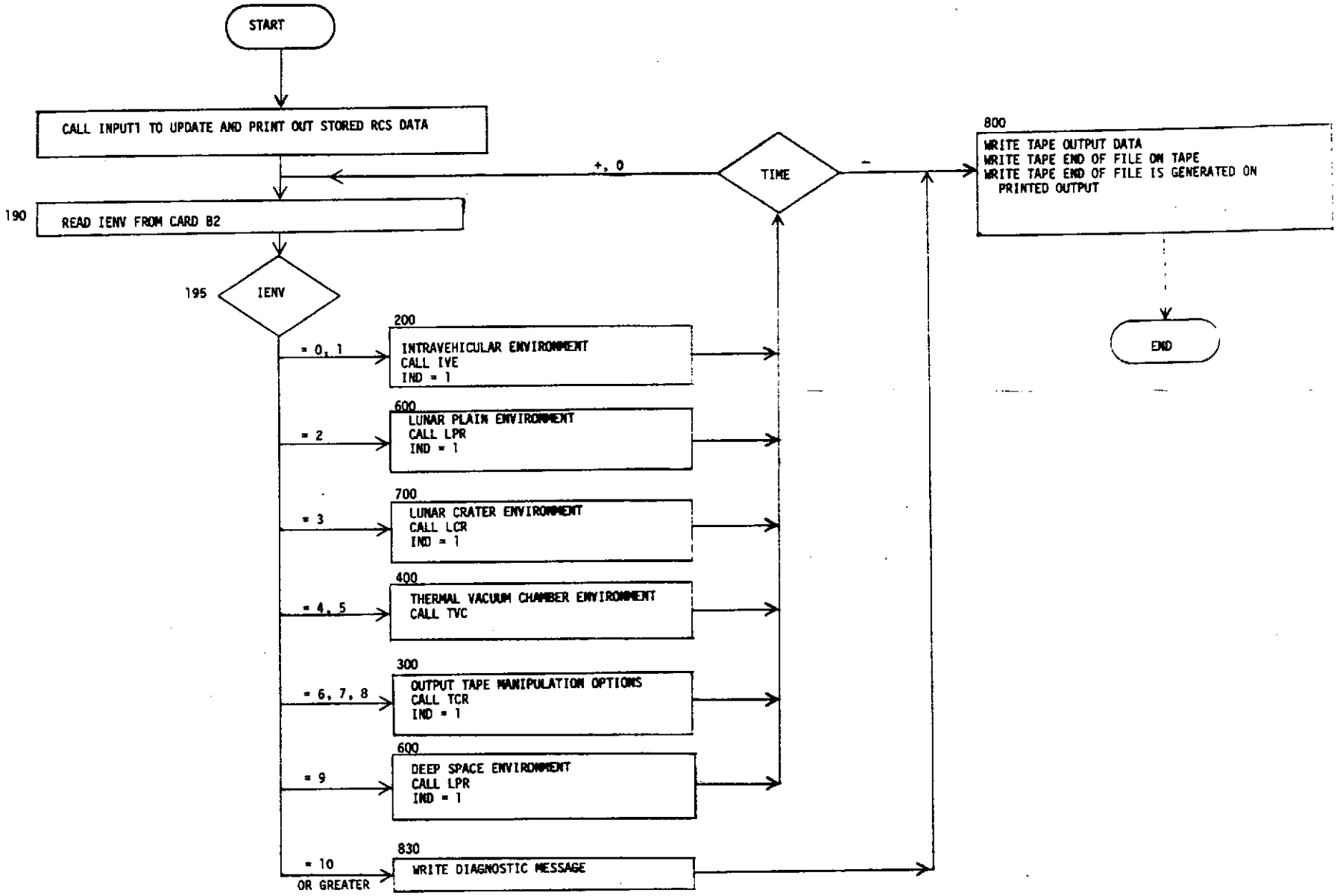
DESCRIPTION: The main program has no calculation functions but controls the calling of the various environmental subprograms for the nine EHFR options available. Overlay of the environmental subprograms is specified by the memory allocation processor in PROG (EHFR MAP)

PROGRAM NOMENCLATURE: The following FORTRAN variables are used in SUBM1 (main program) of the EHFR.

IENV	Environment index number (see Section 5.4.2 of Volume I and SUBM1 flow chart)
IND	Thermal vacuum chamber environment input indicator

The MR and GE1 block common statements are used by most of the EHFR subprograms and are in the same segment as SUBM1. The MR and GE1 common statement nomenclature are defined following the SUBM1 flow chart.

MAIN PROGRAM FLOW CHART



MR BLOCK COMMON NOMENCLATURE

The following is a dictionary of FORTRAN nomenclature for the variables contained in the MR block common statement. The MR block common: transfers output titles, indices, and constants between programs; stores all Reference Coordinate System (RCS) nodal data; and stores nodal incident and absorbed heat values. The MR block common is used by many of the EHFR subprograms and is contained in segment M of the EHFR map.

AL(N)	Absorptivity of RCS node N to chamber solar lamps
ALFMAT(I, J)	Absorptivity values for the curve of absorptance versus temperature for material I, curve point J
ANAME(J)	The name, in A format, of region J of the RCS for which environmental heat subtotals are made
AR(N)	Equivalent absorptivity of RCS node N to all infrared radiation sources
AS(N)	Absorptivity of RCS node N to incident solar energy
DTIME	Length of time RCS node remains in a given environmental position, hrs.
GENODE(N)	RCS node name in A format
IA(N)	Index of region in which RCS node N is located (for environmental heat subtotal calculations)
ICARD	Number of input data cards read by the EHFR
IN(I)	Input array (dummy)
IOUT	Tape unit on which EHFR output is written
IPAGE	Page number for printed output
IPRINT	Print index for printed output
IREF	Reference Coordinate System index (see Table 5-2)
M	RCS mode index
MAX	Maximum number of nodes for the RCS
MODE(M) MODEM	RCS mode name in A format
MOLD	Previous time point mode index

MTRL(N) MTRLN	Material index for RCS node N
NAME	Number of regions for which RCS environmental heat subtotals are made
NEMU	Number of EMU nodes in the EMU-LRV model
NMODE	Number of modes for which RCS data is available
NVM	Multiple reflections index. If o or -, then no multiple reflection calculations have been made
PI	π , 3.14159
PI180	π /180°, 0.0174533
Q(1, N)	Total heat abosrbed by RCS node N, Btu/hr.
Q(2, N)	Total incident heat on RCS node N, Btu/hr
Q(3, N) to Q(12, N)	See each environmental subprogram for definition
QR(N)	Total incident infrared energy on RCS node N, Btu/hr
QS(N)	Total incident solar energy on RCS node N, Btu/hr
QT(I, J)	Environmental heat subtotals for source I and RCS region J, Btu/hr
REF(I) REF1, REF2	Reference coordinate system name in A format
SIG	Stefan Boltzmann Constant, 0.1713 x 10^{-8} Btu/hr-ft^2°R^4
TCON(N)	Adiabatic wall temperature of RCS node N, °R
TCONT	Environment contact temperature of RCS system, °R
TEMAT(I, J)	Temperature values for the curve of absorptance versus temperature for material I, curve point J.
TIME	Time of current timeline point, hrs.
TIMEO	Time of previous timeline point, hrs.
TITLE	Title of this run in A format
XN(I) or XM(I)	Previous timepoint RCS location in environment, ft.

XO(I)	Current timepoint RCS location with respect to local environment where I=1 RCS X position, ft. =2 RCS Y position, ft. =3 RCS Z position above local surface, ft =4 RCS azimuth angle, deg.
XR(M, N, I)	RCS geometric configuration for mode M and node N where I=1 Node X coordinate =2 Node Y coordinate =3 Node Z coordinate =4 Node azimuth angle =5 Node Inclination angle =6 Nodal area =7,8,9,10 Node unblocked view to space from RCS node to quadrants 1 thru 4 respectively

GE1 BLOCK COMMON NOMENCLATURE

The following is a dictionary of FORTRAN nomenclature for the variables contained in the GE1 block common statement. The GE1 block common contains transformed RCS nodal data, unit normal vector components, self-blockage data, and radiosity subtotals. GE1 is used by most of EHFR subprograms and is contained in segment M of the EHFR map.

ASE	RCS node area, ft^2
BX	X component of transformed RCS node unit normal vector
BXX	Cosine of RCS node transformed azimuth angle
BY	Y Component of transformed RCS node unit normal vector
BYY	Sine of RCS node transformed azimuth angle
BZ	Z component of transformed RCS node unit normal vector
COSP	Cosine of RCS azimuth angle, PHI
COSSUN	Cosine of the solar vector angle
COST	Cosine of angle between RCS unit normal vector and solar vector
COST1	Cosine of RCS node inclination angle
DX	X component of vector between an energy source and RCS node, ft
DY	Y component of vector between an energy source and RCS node, ft
DZ	Z component of vector between an energy source and RCS node, ft
FATOT	Geometric form factor from RCS node to infinite lunar plain
FSE(IQ)	Percent unblocked view to space from RCS node to quadrant IQ (self-blockage term)
FSE(5)	Total unblocked view to space from all RCS node quadrants
IQ	Quadrant index of energy source (for IQ=5 no blockage exists)
PHI	RCS azimuth angle with respect to the local environment, rad.
PHI1	Transformed RCS node azimuth angle (with respect to the local environment), rad.

SINP	Sine of RCS azimuth angle PHI
SINSUN	Sine of solar vector angle
SUN	Solar vector angle measured from -X axis, radians
SUND	Solar vector angle, deg.
THT1	RCS node inclination angle, rad.
XSE	Transformed RCS node X position, ft.
YSE	Transformed RCS node Y position, ft.
ZSE	Transformed RCS node Z position, ft.
GOFIR GOFIRP GOSOL GOSOLD GOSOLA	Defined separately in each EHFR subprogram, BTU/hr-ft^2

```
@ FOR,* SUBMI,SUBMI                                                    11 MAR 71          14:18:49
UNIVAC 1108 FORTRAN V LEVEL   7206 D01# F501401
THIS COMPILATION WAS DONE ON 11 MAR 71 AT 14:18:40

   MAIN PROGRAM

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE    000176
        0000   *DATA    000103
        0002   *BLANK   000000
        0003   MR       011477


   EXTERNAL REFERENCES (BLOCK, NAME)

        0004   INPUT1
        0005   IVE
        0006   TCR
        0007   TVC
        0010   LPR
        0011   LCR
        0012   EXIT
        0013   NRDU$
        0014   NIO1$
        0015   NIO2$
        0016   NERR2$
        0017   NWDU$
        0020   NWBU$
        0021   NWEF$
        0022   NSTOP$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

  0001    000156 166G      0001    000004 190L      0001    000050 200L      0001    000061 300L      0001    000073 400L
  0001    000104 600L      0001    000116 700L      0001    000147 800L      0001    000127 830L      0000    000003 901F
  0000    000004 920F      0000    000031 930F      0000    000057 932F      0003 R 001007 ALPMAT     0003 R 000041 ANAME
  0003 R 001326 DTIME      0003 I 000013 ICARD      0000 I 000001 IENV       0003 I 000442 IN         0000 I 000000 IND
  0003 I 000007 IOUT       0003 I 000014 IPAGE      0003 I 000024 IPRINT     0003 I 000010 IREF       0003 I 000012 ISC
  0000 I 000002 IS         0003 I 000000 M          0003 I 000001 MAX        0003 I 000430 MODE       0003 I 000002 MODEM
  0003 I 000003 MOLD       0003 I 000023 MTRLN      0003 I 000006 NAME       0003 I 000022 NEMU       0003 I 000004 NMODE
  0003 I 000005 NVM        0003 R 000015 PI         0003 R 000016 PI180      0003 R 000067 QT         0003 R 000025 REF
  0003 R 000017 SIG        0003 R 000011 TCONT      0003 R 000477 TEMAT      0003 R 000021 TIME       0003 R 000020 TIMEO
  0003 R 000461 TITLE      0003 R 001327 X          0003 R 001317 XN         0003 R 000060 XO


00100     1*   C
00101     2*          COMMON / MR / M,MAX,MODEM,MOLD,NMODE,NVM,NAME,IOUT,IREF,TCONT,
00101     3*         1     ISC,ICARD,IPAGE,PI,PI180,SIG,TIMEO,TIME,NEMU,MTRLN,IPRINT,
00101     4*         2     REF(12),ANAME(15),XO(7),QT(15,15),MODE(10),IN(15),TITLE(14),
00101     5*         3     TEMAT(20,10),ALPMAT(20,10),XN(7),DTIME,
00101     6*         6     X(4200)
00101     7*   C
00103     8*          CALL INPUT1
00104     9*          IND = 1
00105    10*      190 READ (5,901) IENV,ISC
```

```
00111    11*          ICARD = ICARD + 1
00112    12*          IF (IENV-9) 195,600,830
00115    13*      195 CONTINUE
00116    14*          IF (IENV.GT.5) GO TO 300
00120    15*          IF (IENV.LE.0) GO TO 200
00122    16*          GO TO (200,600,700,400,400),IENV
00122    17*    C
00122    18*    C     SECTION 200, INTRAVEHICULAR ENVIRONMENT.
00123    19*      200 CALL IVE
00124    20*          IND = 1
00125    21*          IF (TIME) 800,190,190
00125    22*    C
00125    23*    C     SECTION 300, TAPE COMBINING ROUTINE.
00130    24*      300 CALL TCR(IENV)
00131    25*          IND = 1
00132    26*          IF (TIME) 800,190,190
00132    27*    C
00132    28*    C     SECTION 400, CHAMBER SIMULATOR ENVIRONMENT CALCULATIONS
00135    29*      400 CALL TVC(IENV,IND)
00136    30*          IF (TIME) 800,190,190
00136    31*    C
00136    32*    C     SECTION 600, LUNAR PLAIN ENVIRONMENT INPUT AND ICIDENT HEAT CALCULATIONS
00141    33*      600 CALL LPR(IENV)
00142    34*          IND = 1
00143    35*          IF (TIME) 800,190,190
00143    36*    C
00143    37*    C     SECTION 700, LUNAR CRATER ENVIRONMENT INPUT AND ICIDENT HEAT CALCULATIONS
00146    38*      700 CALL LCR
00147    39*          IND = 1
00150    40*          IF (TIME) 800,190,190
00150    41*    C
00150    42*    C     SECTION 800, INPUT ERROR DIAGNOSTIC MESSAGES
00153    43*      830 WRITE (6,920) ICARD
00156    44*          WRITE (6,930) IENV
00161    45*      890 TIME = -100.
00162    46*      900 CONTINUE
00163    47*          WRITE (IOUT) TIME,X
00172    48*          END FILE IOUT
00173    49*          WRITE (6,932)
00175    50*          CALL EXIT
00175    51*    C
00175    52*    C     SECTION 900, FORMAT STATEMENTS
00176    53*      901 FORMAT (2014)
00177    54*      920 FORMAT (////47H FATAL ERROR IN DATA INPUT FOUND ON CARD NUMBER,
00177    55*         1 I4 , //    52H PROGRAM WILL CALL EXIT AFTER THE FOLLOWING MESSAGE
00177    56*         2. ////)
00200    57*      930 FORMAT (68H ENVIRONMENT SPECIFICATION INDEX, IENV, IS TOO LARGE OR
00200    58*         1IS TOO SMALL. // 17H IENV IS INPUT AS, I5 , 30X,
00200    59*         2 22H MAXIMUM ALLOWED IS 9  )
00201    60*      932 FORMAT (///65H TAPE END OF FILE HAS BEEN GENERATED FOR THE DATA CA
00201    61*         1LCULATED.      )
00202    62*          END

    END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUBMI            SYMBOLIC                              31 MAR 71  14:17:05   0  02164464    14    62  (DELETED)
SUBMI    CODE    RELOCATABLE                           31 MAR 71  14:17:05   1  02166230    36     1  (DELETED)
                                                                              0  02166274    14    20
```

SUBPROGRAM NAME: Subroutine ALPHA1 (T, A)

SEGMENT NAME: SUBM2

PURPOSE: Calculate the absorptivity of a Reference Coordinate System (RCS) node to energy at a given source temperature.

DESCRIPTION: The absorptivity of a RCS node is necessary to calculate the amount of energy absorbed from a given energy source. The ALPHA1 subprogram determines the absorptivity by linear interpolation of the absorptivity - temperature curve for the material comprising the RCS node. Ten absorptivity-temperature values define each curve. If the source temperature is greater than the last value on the curve, the last value of absorptivity is returned by ALPHA1.

CALLING PROGRAMS: TABW, IVE, LPR, LCR, CHB, CHR, INPUT1

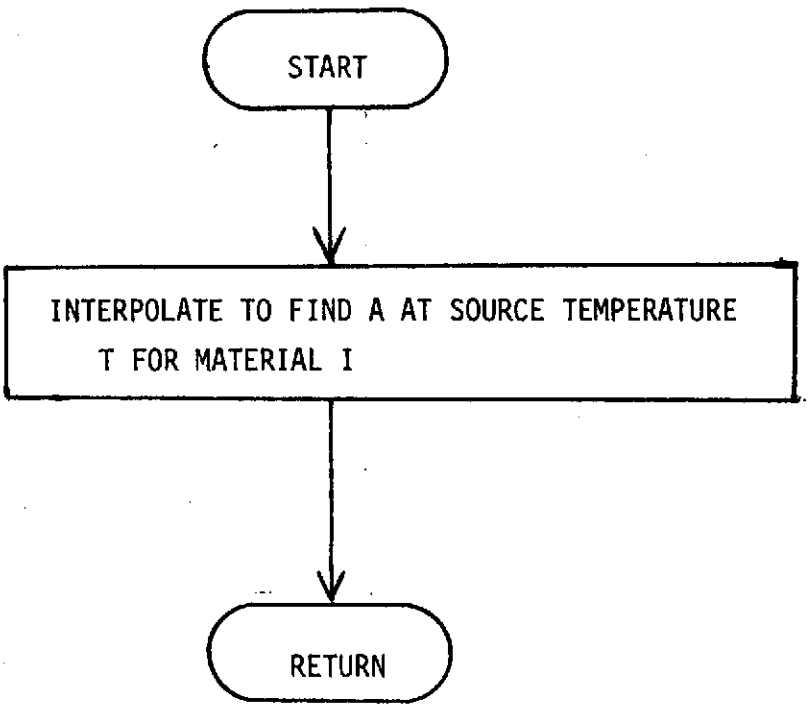
ARGUMENT LIST:

T	Energy source temperature (input), °R
A	RCS node absorptivity (output)

NOMENCLATURE: The following FORTRAN nomenclature is used in the ALPHA1 subprogram.

A	RCS node absorptivity
ALFMAT (I,J)	Apsorptivity of material I for curve point J
DT	Temperature difference for interpolation, °R
T	Energy source temperature, °R
TEMAT (I,J)	Temperature value of material I,curve point J, °R
I, MTRLN	Material index for RCS node N
J	Material curve point index

ALPHA1 SUBPROGRAM FLOW CHART



```
@ FOR,* SUBM2,SUBM2                                                    31 MAR 71          14:14:41
UNIVAC 1108 FORTRAN V LEVEL   2206 001R F501RH
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:14:41


   SUBROUTINE ALPHA1     ENTRY POINT 000046

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001    *CODE   000061
         0000    *DATA   000016
         0002    *BLANK  000000
         0003    MR      001327


   EXTERNAL REFERENCES (BLOCK, NAME)

         0004    NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000006 106G       0001    000030 5L.        0003 R 001007 ALFMAT     0003 R 000041 ANAME      0000 R 000001 DT
    0003 R 001326 DTIME       0003 I 000023 I           0003 I 000013 ICARD      0003 I 000442 IN         0003 I 000007 IOUT
    0003 I 000014 IPAGE       0003 I 000024 IPRINT      0003 I 000010 IREF       0003 I 000012 ISC        0000 I 000000 J
    0003 I 000000 M           0003 I 000001 MAX         0003 I 000430 MODE       0003 I 000002 MODEM      0003 I 000003 MOLD
    0003 I 000023 MTRLN       0003 I 000006 NAME        0003 I 000022 NEMU       0003 I 000004 NMODE      0003 I 000005 NVM
    0003 R 000015 PI          0003 R 000016 PI180       0003 R 000067 QT         0003 R 000025 REF        0003 R 000017 SIG
    0003 R 000011 TCONT       0003 R 000477 TEMAT       0003 R 000021 TIME       0003 R 000020 TIMED      0003 R 000461 TITLE
    0003 R 001317 XN          0003 R 000060 XO


00101     1*          SUBROUTINE ALPHA1(T,A)
00101     2*   C
00103     3*          COMMON / MR / M,MAX,MODEM,MOLD,NMODE,NVM,NAME,IOUT,IREF,TCONT,
00103     4*         1     ISC,ICARD,IPAGE,PI,PI180,SIG,TIMED,TIME,NEMU,MTRLN,IPRINT,
00103     5*         2     REF(12),ANAME(15),XO(7),QT(15,15),MODE(10),IN(15),TITLE(14),
00103     6*         3     TEMAT(20,10),ALFMAT(20,10),XN(7),DTIME
00104     7*          EQUIVALENCE (I,MTRLN)
00105     8*          DO 5 J = 2,10
00110     9*          DT = T - TEMAT(I,J)
00111    10*          IF (DT.GT.0.0) GO TO 5
00113    11*          A = (ALFMAT(I,J)-ALFMAT(I,J-1))/(TEMAT(I,J)-TEMAT(I,J-1))
00114    12*          A = ALFMAT(I,J) + DT*A
00115    13*          RETURN
00116    14*        5 CONTINUE
00120    15*          A = ALFMAT(I,10)
00121    16*          RETURN
00122    17*          END

      END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
   SUBM2            SYMBOLIC                                  09 MAR 71  14:47:41   0  01650670    14    17  (DELETED)
   SUBM2    CODE    RELOCATABLE                               09 MAR 71  14:47:41   1  01651246    24     1  (DELETED)
                                                                                    0  01651276    14     6
```

SUBPROGRAM NAME: Subroutine TABW (Q, T)

SEGMENT NAME: SUBM3

PURPOSE: Calculate the adiabatic wall temperature of Reference Coordinate System (RCS) nodes.

DESCRIPTION: The adiabatic wall temperature for each RCS node is required for tape output and desired for the printed output for the various EHFR environment options. Using the total absorbed heat, the RCS adiabatic wall temperature and its corresponding emissivity are calculated using an iterative technique. The equation defining adiabatic wall temperature is:

$$T = [Q/\epsilon\sigma \text{ FSE } (5)]^{1/4}$$

where ϵ and σ are the emissivity (at temperature T) and Stefan Boltzmann constant. T, Q and FSE (5) are defined below.

CALLING PROGRAMS: IVE, LPR, LCR, CHB.

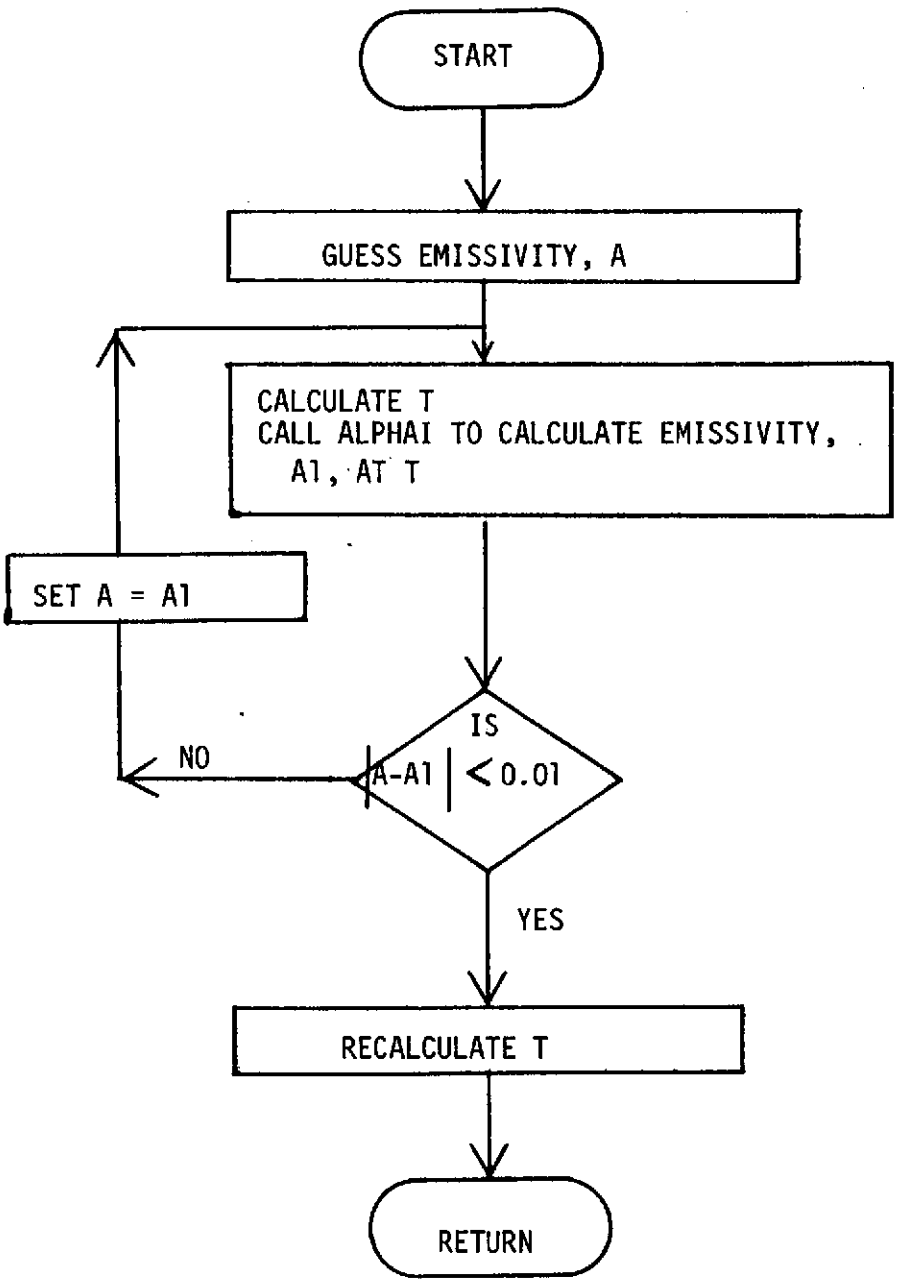
ARGUMENT LIST:

Q	Total heat absorbed by RCS node (input), Btu/hr-ft^2
T	Adiabatic wall temperature (output), °R

NOMENCLATURE: The following FORTRAN nomenclature is used in TABW subprogram.

A	Estimate of RCS node emissivity at temperature T
A1	Calculated RCS node emissivity at temperature T
B	Intermediate variable (T at A1 = 1.0), °R
FSE (5)	RCS node unblocked view to all quadrants
Q	Total heat absorbed by RCS node, Btu/hr-ft^2
SIG	Stefan-Boltzmann constant, 0.1713 x 10^{-8} Btu/hr-ft^2°R^4
T	Adiabatic wall temperature, °R

TABW SUBPROGRAM FLOW CHART



```
@ FOR,* SUBM3,SUBM3                                                    31 MAR 71          14:17:42
UNIVAC 1108 FORTRAN V LEVEL   2206 001A F501M0
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:17:43

   SUBROUTINE TABW       ENTRY POINT 000056

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000064
        0000   *DATA   000017
        0002   *BLANK  000000
        0003   GE1     000043


   EXTERNAL REFERENCES (BLOCK, NAME)

        0004   ALPHA1
        0005   NEXP6S
        0006   NERR3S


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000014 SL          0000 R 000003 A           0003 R 000003 ASE         0000 R 000001 A1          0000 R 000002 B
    0003 R 000006 BX           0003 R 000021 BXX         0003 R 000007 BY          0003 R 000022 BYY         0003 R 000010 BZ
    0003 R 000011 COSP         0003 R 000042 COSSUN      0003 R 000031 COST        0003 R 000023 COST1       0003 R 000024 DX
    0003 R 000025 DY           0003 R 000026 DZ          0003 R 000032 FATOT       0003 R 000014 FSE         0003 R 000033 GOFIR
    0003 R 000030 GOFIRP       0003 R 000034 GOSOL       0003 R 000036 GOSOLA      0003 R 000035 GOSOLD      0003 I 000027 IQ
    0003 R 000013 PHI          0003 R 000004 PHI1        0000 R 000000 SIG         0003 R 000012 SINP        0003 R 000041 SINSUN
    0003 R 000037 SUN          0003 R 000040 SUND        0003 R 000005 THT1        0003 R 000000 XSE         0003 R 000001 YSE
    0003 R 000002 ZSE


00101     1*          SUBROUTINE TABW(Q,T)
00101     2*    C
00103     3*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI,
00103     4*         1    FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,GOFIRP,                    09-
00103     5*         1    COST,FATOT,GOFIR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00104     6*          DATA SIG / 0.1713E-08 /
00106     7*          A1 = .9
00107     8*          B = (Q / (SIG*FSE(5)))**0.25
00110     9*        5 A = A1
00111    10*          T = B/A**0.25
00112    11*          CALL ALPHA1(T,A1)
00113    12*          IF (ABS(A1-A).GE.0.01) GO TO 5
00115    13*          T = B/A1**0.25
00116    14*          RETURN
00117    15*          END

      END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
   SUBM3           SYMBOLIC                                  31 MAR 71  14:17:07   0  02166724    14    15  (DELETED)
   SUBM3    CODE   RELOCATABLE                               31 MAR 71  14:17:07   1  02167246    24     1  (DELETED)
                                                                                    0  02167276    14     1
```

SUBPROGRAM NAME: Subroutine TRANS (N)

SEGMENT NAME: SUBM4

PURPOSE: Transform the Reference Coordinate System (RCS) nodal coordinate and unit normal vector data for the timeline point RCS environment location and orientation. Determine the cosine of the angle between the RCS node normal vector and the solar vector. Calculate the amount of RCS self-blockage of the solar vector.

DESCRIPTION: The TRANS routine transforms the RCS nodal coordinates and normal vector data based on the timeline point information read in on Card B2 in the various environmental subprograms and the data calculated in the TRANR (SUBM6) subprogram. The self-blockage quadrant index (IQ) is set either to -1, 0, 1, or 5 depending on the environmental self-blockage data:

-1	there is no change in environment for this IREF = 2 RCS node, use previous environment calculations
0	indicates that there is 100% nodal self-blockage, no heat absorbed by this node
5	there is no nodal self-blockage for this node

For the IREF = 2 RCS, the timeline point location and orientation data does not differ from the previous data for N > NEMU and M > 1. The nodal coordinate/normal vector data transformations are based on the previous RCS location information for these conditions.

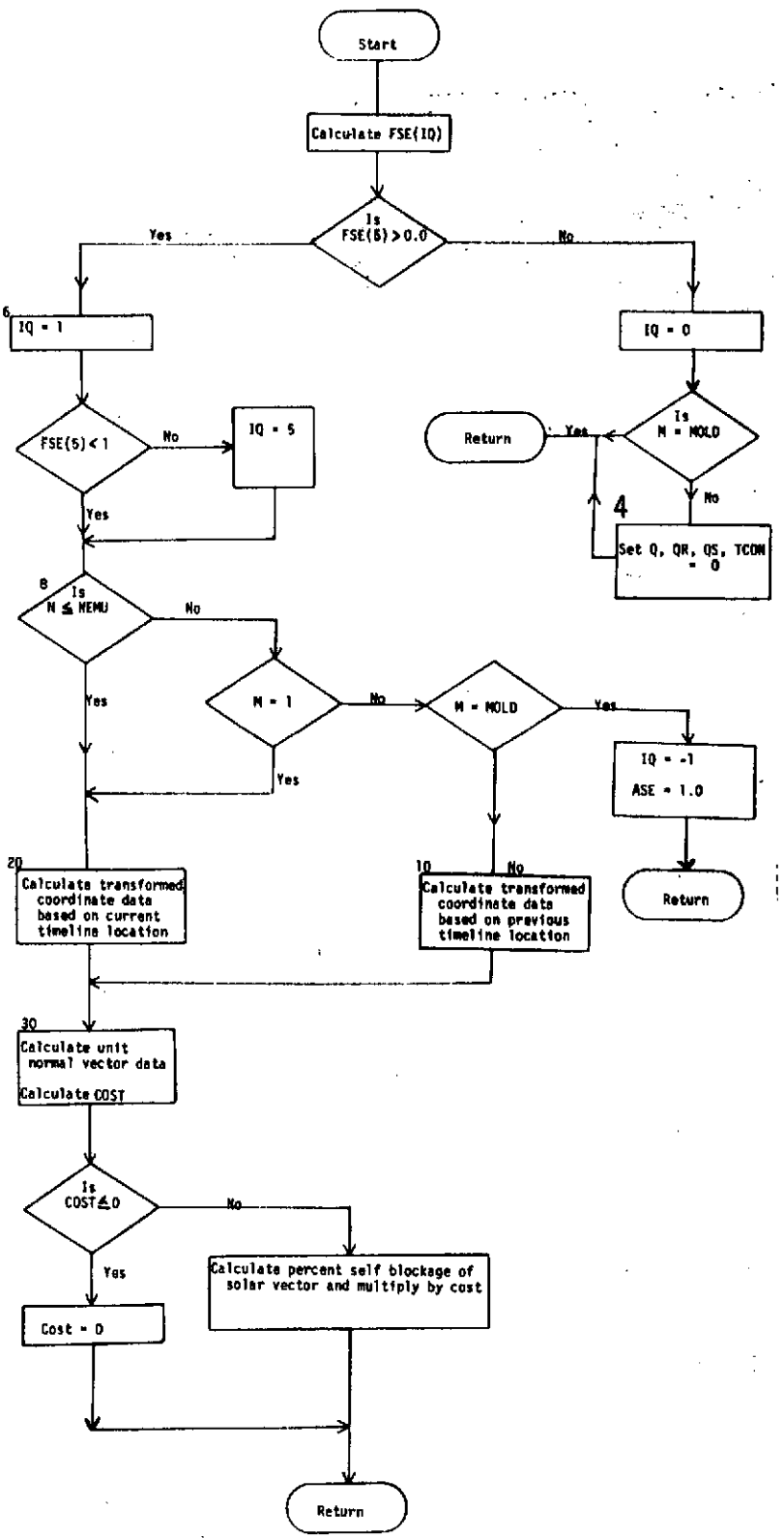
CALLING PROGRAMS: IVE, LPR, LCR, CHB, CHR

ARGUMENT LIST:

N	RCS Node Number (input)

NOMENCLATURE: The FORTRAN nomenclature used by the TRANS subprogram consists of the variables of the MR and GE1 block common statements. The MR and GE1 nomenclature is defined with the SUBM1 (main program) nomenclature.

TRANS SUBPROGRAM FLOW CHART



UNIVAC 1108 FORTRAN V LEVEL 2206 0018 P5018H
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:14:44

SUBROUTINE TRANS ENTRY POINT 000121

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000342
0000	*DATA	000040
0002	*BLANK	000000
0003	MR	054203
0004	GE1	000041

EXTERNAL REFERENCES (BLOCK, NAME)

0005	BLOCK
0006	COS
0007	SIN
0010	XERR3$$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000303 1L	0001	000131 10L	0001	000053 122G	0001	000172 20L	0001	000216 30L
0001	000067 6L	0001	000105 8L	0003 R	001327 AL	0003 R	001007 ALPMAT	0003 R	000041 ANAME
0003 R	002173 AR	0003 R	003017 AS	0004 R	000001 ASE	0004 R	000006 BX	0004 R	000021 BXX
0004 R	000007 BY	0004 R	000022 BYY	0004 R	000010 BZ	0004 R	000011 COSP	0004 R	000042 COSSUN
0004 R	000031 COST	0004 R	000023 COST1	0003 R	001326 DTIME	0004 R	000024 DX	0004 R	000025 DY
0004 R	000026 DZ	0004 R	000032 FATOT	0004 R	000014 FSE	0003 R	001703 GENODE	0004 R	000033 GOFIR
0004 R	000030 GOFIRP	0004 R	000034 GOSOL	0004 R	000036 GOSOLA	0004 R	000035 GOSOLD	0000 I	000000 I
0003 I	004547 IA	0003 I	000013 ICARD	0003 I	000442 IN	0003 I	000007 IOUT	0003 I	000014 IPAGE
0003 I	000024 IPRINT	0004 I	000021 IQ	0003 I	000010 IREP	0003 I	000012 ISC	0003 I	000000 M
0003 I	000001 MAX	0003 I	000430 MODE	0003 I	000002 MODEM	0003 I	000003 MOLD	0003 I	052437 MTRL
0003 I	000023 MTRLN	0003 I	000006 NAME	0003 I	000022 NEMU	0003 I	000004 NMODE	0003 I	000005 NVM
0004 R	000013 PHI	0004 R	000004 PHI1	0003 R	000015 PI	0003 R	000016 PI1#0	0003 R	006257 Q
0003 R	020137 QR	0003 R	021003 QS	0003 R	000067 QT	0003 R	000025 REF	0003 R	000017 SIG
0004 R	000012 SINP	0004 R	000041 SINSUN	0004 R	000037 SUN	0004 R	000040 SUND	0003 R	005413 TCON
0003 R	000011 TCONT	0003 R	000477 TEMAT	0004 R	000005 THT1	0003 R	000021 TIME	0003 R	000020 TIMED
0003 R	000461 TITLE	0003 R	001317 XN	0003 R	000060 XO	0003 R	021647 XR	0004 R	000000 XSE
0004 R	000001 YSE	0004 R	000002 ZSE						

```
00101     1*          SUBROUTINE TRANS(N)
00103     2*          PARAMETER MMAX=3,NMAX=420
00104     3*          COMMON / MR / M,MAX,MODEM,MOLD,MMODE,NVM,NAME,IOUT,IREP,TCONT,
00104     4*         1     ISC,ICARD,IPAGE,PI,PI1#0,SIG,TIMED,TIME,NEMU,MTRLN,IPRINT,
00104     5*         2     REF(12),ANAME(15),XO(7),QT(15,15),MODE(10),IN(15),TITLE(14),
00104     6*         3     TEMAT(20,10),ALPMAT(20,10),XN(7),DTIME,
00104     7*         4     AL(NMAX),AR(NMAX),AS(NMAX),GENODE(NMAX),IA(NMAX),TCON(NMAX),
00104     8*         5     Q(12,NMAX),QR(NMAX),QS(NMAX),XR(MMAX,NMAX,10),MTRL(NMAX)
00105     9*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI,
00105    10*         1    FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,GOFIRP,
00105    11*         1    COST,FATOT,GOFIR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00106    12*          FSE(1) = XR(M,N,7)
00107    13*          FSE(2) = XR(M,N,8)
```

```
00110    14*          FSE(3) = XR(M,N,9)
00111    15*          FSE(4) = XR(M,N,10)
00112    16*          FSE(5) =(FSE(1)+FSE(2)+FSE(3)+FSE(4)+0.0001)*0.25
00113    17*          MTRLN = MTRL(N)
00114    18*          IF (FSE(5).GT.0.0001) GO TO 6
00116    19*          IQ = 0
00117    20*          IF (M.EQ.MOLD) RETURN
00121    21*          DO  4 I=1,12
00124    22*        4 Q(I,N)  = 0.0
00126    23*          QS(N) = 0.0
00127    24*          QR(N) = 0.0
00130    25*          AR(N) = ALFMAT(MTRLN,1)
00131    26*          TUON(N) = 0.0
00132    27*          RETURN
00133    28*        6 CONTINUE
00134    29*          IQ = 1
00135    30*          MTRLN = MTRL(N)
00136    31*          IF (FSE(5).LT.1.00) GO TO 8
00140    32*          IQ = 5
00141    33*          FSE(5) = 1.0
00142    34*        8 CONTINUE
00143    35*          IF (N.LE.NEMO) GO TO 20
00145    36*          IF (M.EQ.1)    GO TO 20
00147    37*          IF (M.NE.MOLD) GO TO 10
00151    38*          ASE = 1.0
00152    39*          IQ = -1
00153    40*          RETURN
00154    41*       10 PHI = XN(4)*PI180
00155    42*          COSP= COS(PHI)
00156    43*          SINP= SIN(PHI)
00157    44*          XSE = XN(1)+ XR(M,N,1)*COSP - XR(M,N,2)*SINP
00160    45*          YSE = XN(2)+ XR(M,N,1)*SINP + XR(M,N,2)*COSP
00161    46*          ZSE = XN(3)+ XR(M,N,3)
00162    47*          GO TO 30
00163    48*       20 CONTINUE
00164    49*          XSE = XO(1)+ XR(M,N,1)*COSP - XR(M,N,2)*SINP
00165    50*          YSE = XO(2)+ XR(M,N,1)*SINP + XR(M,N,2)*COSP
00166    51*          ZSE = XO(3)+XR(M,N,3)
00167    52*       30 ASE = XR(M,N,8)
00170    53*          PHI1 = XR(M,N,4) + PHI
00171    54*          THT1 = XR(M,N,5)
00172    55*          COST1 = COS(THT1)
00173    56*          BXX = COS(PHI1)
00174    57*          BYY = SIN(PHI1)
00175    58*          BX = COST1*BXX
00176    59*          BY = COST1*BYY
00177    60*          BZ = SIN(THT1)
00200    61*          COST = -BX*COSSUN+BZ*SINSUN
00201    62*          IF (COST.LE.0.0) GO TO 1
00203    63*          DX = -COSSUN
00204    64*          DY = 0.
00205    65*          DZ = SINSUN
00206    66*          CALL BLOCK
00207    67*          COST = COST*FSE(IQ)
00210    68*          RETURN
00211    69*        1 COST = 0.0
00212    70*          RETURN
00213    71*          END

     END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
S1BM4              SYMBOLIC                                  23 MAR 71  10:06:45   0  01721332    14    71  (DELETED)
S1BM4    CODE      RELOCATABLE                               23 MAR 71  10:06:45   1  01723274    36     1  (DELETED)
                                                                                     0  01723340    14    25
```

SUBPROGRAM NAME: Subroutine Block

SEGMENT NAME: SUBM5

PURPOSE: Calculate the self-blockage quadrant index of an energy source incident on a Reference Coordinate System (RCS) node.

DESCRIPTION: The quadrant index in which the energy to RCS node vector originates is necessary to determine amount of self-blockage and, thusly, the amount of energy incident on the RCS node. If the self-blockage quadrant index IQ is set to 5 in the TRANS subprogram, there is no self-blockage of incident energy and, therefore no calculations are necessary from BLOCK. The governing equations used to determine the energy source quadrant are presented in Volume I.

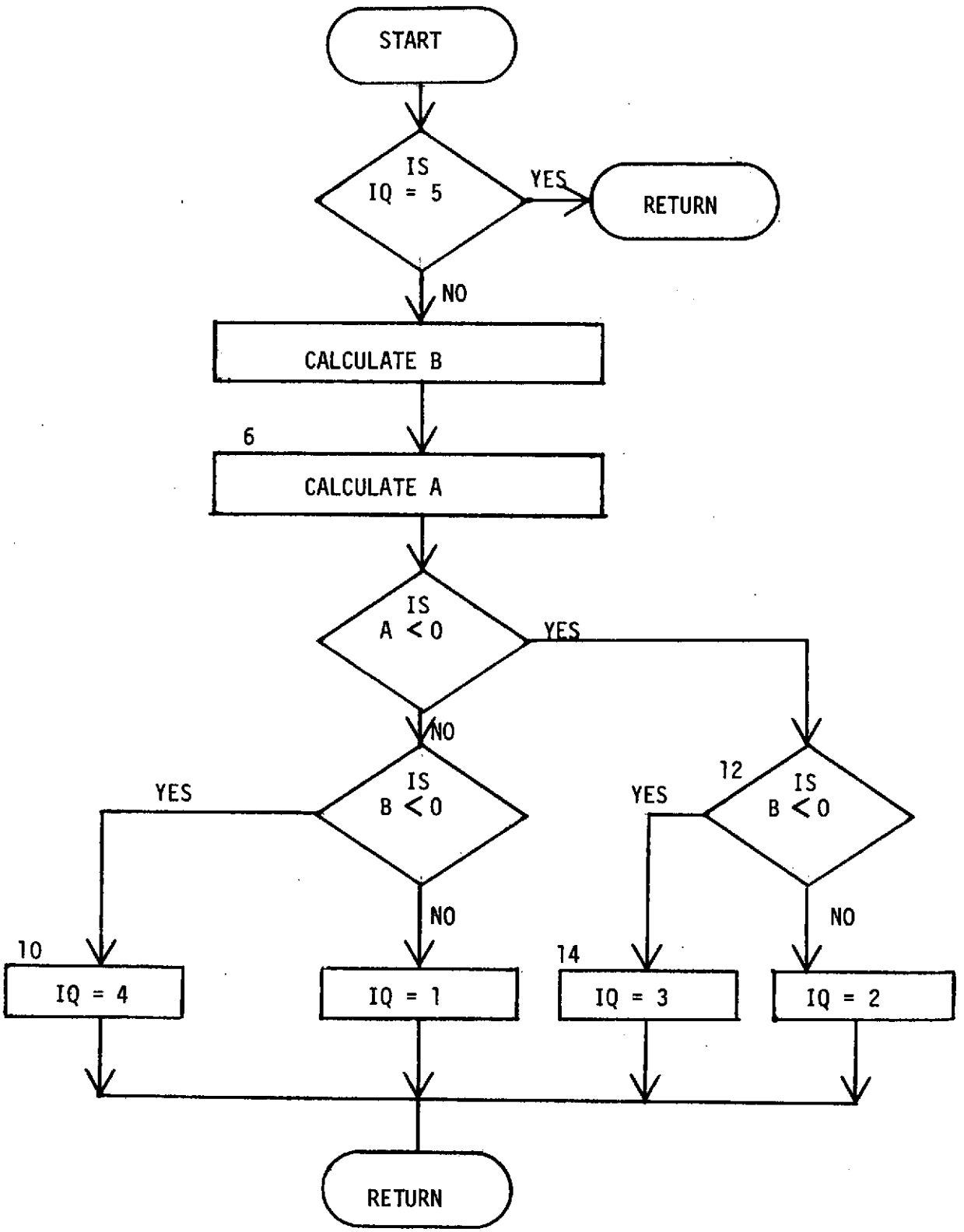
CALLING PROGRAMS: TRANS, IVE, LPR, SUBDFF, FFLMPZ, FFFZ

ARGUMENT LIST: None, all data required is transferred into and out of this routine via the GE1 block common.

NOMENCLATURE: The following FORTRAN nomenclature is used by the BLOCK subprogram. Also used in the BLOCK routine are the variables of the GE1 block common statement which are defined with the SUBM1 (main program) nomenclature.

A	Cosine of the projected angle in the X-Y plane between the RCS node normal vector and the RCS node to energy source vector
B	Cosine of the projected angle from the Z axis between the RCS node normal vector and the RCS node to energy source vector
IQ	Self-blockage quadrant index in which the RCS node to energy source vector originates

BLOCK SUBPROGRAM FLOW CHART



```
@ FOR,* SUBM5,SUBM5                                                    11 MAR 71          14:18:46
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 8501=H
THIS COMPILATION WAS DONE ON 11 MAR 71 AT 14:18:46

   SUBROUTINE BLOCK      ENTRY POINT 000111

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000113
        0000   *DATA   000012
        0002   *BLANK  000000
        0003   GE1     000043


   EXTERNAL REFERENCES (BLOCK, NAME)

        0004   SQRT
        0005   NERR35


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000062 10L        0001   000067 12L        0001   000100 14L        0001   000022 4L         0001   000040 6L
    0000 R 000001 A          0003 R 000003 ASE        0000 R 000000 B          0003 R 000006 BX         0003 R 000021 BXX
    0003 R 000007 BY         0003 R 000022 BYY        0003 R 000010 BZ         0003 R 000011 COSP       0003 R 000042 COSSUN
    0003 R 000031 COST       0003 R 000023 COST1      0003 R 000024 DX         0003 R 000025 DY         0003 R 000026 DZ
    0003 R 000032 FATOT      0003 R 000014 FSE        0003 R 000031 GOFIR      0003 R 000030 GOFIRP     0003 R 000034 GOSOL
    0003 R 000036 GOSOLA     0003 R 000035 GOSOLD     0001 I 000027 IQ         0003 R 000013 PHI        0003 R 000004 PHI1
    0003 R 000012 SINP       0003 R 000041 SINSUN     0003 R 000037 SUN        0003 R 000040 SUND       0003 R 000005 THT1
    0003 R 000000 XSE        0003 R 000001 YSE        0003 R 000002 ZSE


00101     1*          SUBROUTINE BLOCK
00101     2*   C
00103     3*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI,
00103     4*         1   FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,GOFIRP,
00103     5*         1   COST,FATOT,GOFIR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00103     6*   C
00104     7*          IF (IQ.EQ.5) RETURN
00106     8*          IF (COST1) 4,2,4
00111     9*        2 B = -BZ*(BXX*DX + BYY*DY)
00112    10*          GO TO 6
00113    11*        4 B = COST1*DZ - SQRT(DX**2 + DY**2)*BZ
00114    12*        6 A = DX*BYY-DY*BXX
00115    13*          IF (A.LT.0.0) GO TO 12
00117    14*          IF (B.LT.0.0) GO TO 10
00121    15*          IQ = 1
00122    16*          RETURN
00123    17*       10 IQ = 4
00124    18*          RETURN
00125    19*       12 IF (B.LT.0.0) GO TO 14
00127    20*          IQ = 2
00130    21*          RETURN
00131    22*       14 IQ = 3
00132    23*          RETURN
00133    24*          END

     END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUBM5           SYMBOLIC                                  30 JAN 70  09:43:07   0  01441612    14    24  (DELETED)
SUBM5   CODE    RELOCATABLE                               30 JAN 70  09:43:07   1  01442332    24     1  (DELETED)
                                                                                 0  01442362    14     9
```

SUBPROGRAM NAME: Subroutine TRANR

SEGMENT NAME: SUBM6

PURPOSE: Read RCS timeline - environment location/orientation input data on Card B2, check input data for errors, and initialize the environmental subtotal array.

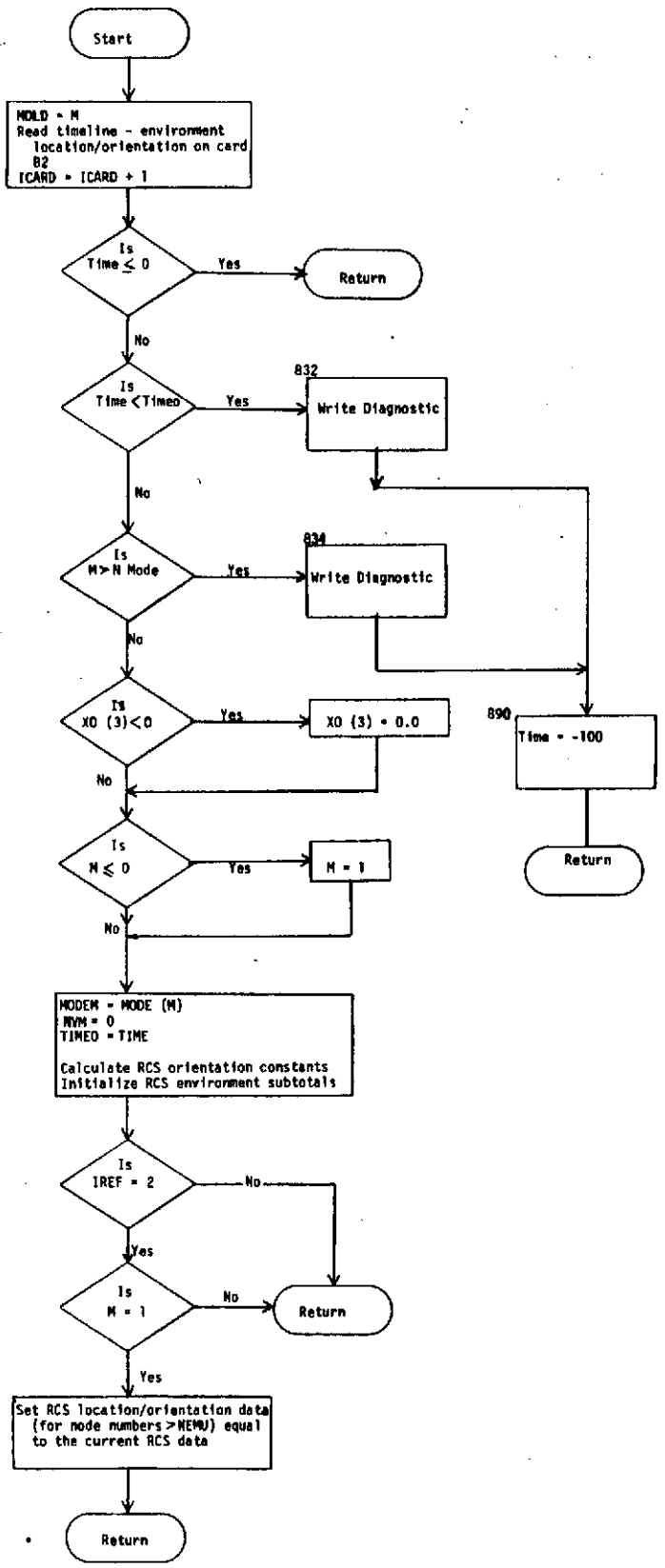
DESCRIPTION: The RCS timeline environment location/orientation input is read by TRANR and checked to assure: time is greater than the previous time point; the RCS mode index is not greater than allowed and is positive; and the RCS Z distance above the local environment surface is not negative. Additionally, TRANR initializes NVM, TIMEO, MOLD, and the RCS environmental subtotal array.

CALLING PROGRAMS: IVE, LPR, LCR, CHB, CHR

ARGUMENT LIST: None, all data required is transferred into and out of TRANR via the MR and GE1 block common.

NOMENCLATURE: The FORTRAN nomenclature used by the TRANR subprogram consists of the variables of the MR and GE1 block common statements. The MR and GEI is defined with the SUBM1 (main program) nomenclature.

TRANR SUBPROGRAM FLOW CHART




```
@ FOR,* SUBM6,SUBM6
UNIVAC 1108 FORTRAN V LEVEL   2206 001@ F501@H
THIS COMPILATION WAS DONE ON 11 MAR 71 AT 14:18:4@

   SUBROUTINE TRANR      ENTRY POINT 000213

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE    000220
        0000   *DATA    000132
        0002   *BLANK   000000
        0003   MR       001327
        0004   GE1      000043


   EXTERNAL REFERENCES (BLOCK, NAME)

        0005   NRDUS
        0006   NIO1S
        0007   NIO2S
        0010   COS
        0011   SIN
        0012   NWDUS
        0013   NERR3S


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

   0001    000020 114G      0001    000106 142G      0001    000106 145G      0001    000140 157G      0001    000136 132L
   0001    000157 134L      0001    000177 190L      0000    000003 005F      0000    000005 020F      0000    000042 036F
   0000    000055 037F      0003 R 001007 ALPMAT      0003 R 000041 ANAME      0004 R 000003 ASE        0004 R 000006 BX
   0004 R 000021 BXX        0004 R 000007 BY         0004 R 000022 BYY        0004 R 000010 BZ         0004 R 000011 COSP
   0004 R 000042 COSSUN     0004 R 000031 COST       0004 R 000023 COST1      0003 R 001326 DTIME      0004 R 000024 DX
   0004 R 000025 DY         0004 R 000026 DZ         0004 R 000032 FATOT      0004 R 000014 FSE        0004 R 000033 GOFIR
   0004 R 000030 GOFIRP     0004 R 000034 GOSOL      0004 R 000036 GOSOLA     0004 R 000035 GOSOLD     0000 I 000002 I
   0003 I 000013 ICARD      0003 I 000442 IN         0003 I 000007 IOUT       0003 I 000014 IPAGE      0003 I 000024 IPRINT
   0004 I 000027 IQ         0003 I 000010 IREF       0003 I 000012 ISC        0000 I 000000 IS         0000 I 000001 J
   0003 I 000000 M          0003 I 000001 MAX        0003 I 000430 MODE       0003 I 000002 MODEM      0003 I 000003 MOLD
   0003 I 000023 MTRIN      0003 I 000006 NAME       0003 I 000022 NEMO       0003 I 000004 NMODE      0003 I 000005 NVM
   0004 R 000013 PHI        0004 R 000004 PHI1       0003 R 000015 PI         0003 R 000016 PI180      0003 R 000067 QT
   0003 R 000025 REF        0003 R 000017 SIG        0004 R 000012 SINP       0004 R 000041 SINSUN     0004 R 000037 SUN
   0004 R 000040 SUND       0003 R 000011 TCONT      0003 R 000477 TEMAT      0004 R 000005 THT1       0003 R 000021 TIME
   0003 R 000020 TIMED      0003 R 000461 TITLE      0003 R 001317 XN         0003 R 000060 XO         0004 R 000000 XSE
   0004 R 000001 YSE        0004 R 000002 ZSE


00101     1*          SUBROUTINE TRANR
00101     2*    C
00103     3*          COMMON / MR / M,MAX,MODEM,MOLD,NMODE,NVM,NAME,IOUT,IREF,TCONT,
00103     4*         1     ISC,ICARD,IPAGE,PI,PI180,SIG,TIMED,TIME,NEMO,MTRIN,IPRINT,
00103     5*         2     REF(12),ANAME(15),XO(7),QT(15,15),MODE(10),IN(15),TITLE(14),
00103     6*         3     TEMAT(20,10),ALPMAT(20,10),XN(7),DTIME
00104     7*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI,
00104     8*         1     FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,GOFIRP,
00104     9*         1     COST,FATOT,GOFIR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00104    10*    C
00105    11*          MOLD = M
```

```
00106    12*          READ (5,905) IPRINT,M,TIME,DTIME,XO
00120    13*          ICARD = ICARD + 1
00121    14*          IF (TIME.LE.0.0) RETURN
00123    15*          IF (TIME.LT.TIMEO) GO TO 832
00125    16*          IF (M.GT.NMODE) GO TO 834
00127    17*          IF (XO(3).LT.0.0) XO(3) = 0.0
00131    18*          IF (M.LE.0) M=1
00133    19*          MODEM = MODE(M)
00134    20*          NVM = 0
00135    21*          TIMEO = TIME
00136    22*          PHI = XO(4)*PI180
00137    23*          COSP = COS(PHI)
00140    24*          SINP = SIN(PHI)
00141    25*          DO 10 J =1,15
00144    26*          DO 10 I =1,15
00147    27*       10 OT(I,J) = 0.0
00152    28*          IF (IREF.NE.2) RETURN
00154    29*          IF (M.NE.1)    RETURN
00156    30*          DO 50 I=1,7
00161    31*          XN(I) = XO(I)
00162    32*       50 CONTINUE
00164    33*          RETURN
00164    34*    C
00164    35*    C     SECTION 800, INPUT ERROR DIAGNOSTIC MESSAGES
00165    36*      832 WRITE (6,920) ICARD
00170    37*          WRITE (6,936) TIMEO,TIME
00174    38*          GO TO 890
00175    39*      834 WRITE (6,920) ICARD
00200    40*          WRITE (6,937) M,NMODE
00204    41*      890 TIME = -100.
00205    42*          RETURN
00205    43*    C
00205    44*    C     SECTION 900, FORMAT STATEMENTS
00206    45*      905 FORMAT (214,9F8.3)
00207    46*      920 FORMAT (////47H FATAL ERROR IN DATA INPUT FOUND ON CARD NUMBER,
00207    47*         1 I4 , //    52H PROGRAM WILL CALL EXIT AFTER THE FOLLOWING MESSAGE
00207    48*         2. ////)
00210    49*      936 FORMAT (56H TIME INCRIMENT BETWEEN ASTRONAUT POSITIONS IS NEGATIVE
00210    50*         1. // 14H FIRST TIME  =,F10.2,30X,14H SECOND TIME =,F10.2 )
00211    51*      937 FORMAT(121H VARIABLE M WHICH SPECIFIES THE ASTRONAUT MODE FOR REFE
00211    52*         1RENCE COORDINATE SYSTEM FOR PROCESSING IS TOO LARGE OR TOO SMALL.
00211    53*         2//11H M INPUT = ,I5, 30X,16H MAXIMUM ALLOWED =,I4 )
00211    54*    C
00212    55*          END

   END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUBM6            SYMBOLIC                                  09 MAR 71  14:47:47   0  01651422    14    55  (DELETED)
SUBM6    CODE    RELOCATABLE                               09 MAR 71  14:47:47   1  01653024    36     1  (DELETED)
                                                                                   0  01653070    14    23
```

SUBPROGRAM NAME: Subroutine TCR (IE)

SEGMENT NAME: TCR

PURPOSE: Execute any of the three tape manipulation options available to the EHFR user.

DESCRIPTION: The three tape manipulation options available in the TCR program are the output tape combining option (TCO), the parametric properties evaluation option (PPEO), and the tape read and print option (TRPO). These three tape options enable the EHFR user to effectively utilize a library of previously generated RCS timelines which are available on magnetic tape. Details of the tape manipulation option are presented in Section 5.3 of Volume I.

LIMITATIONS: TCR tape drive limitations are defined in Section 5.3 of Volume I.

CALLING PROGRAM: SUBM1 (Main Program)

ARGUMENT LIST:

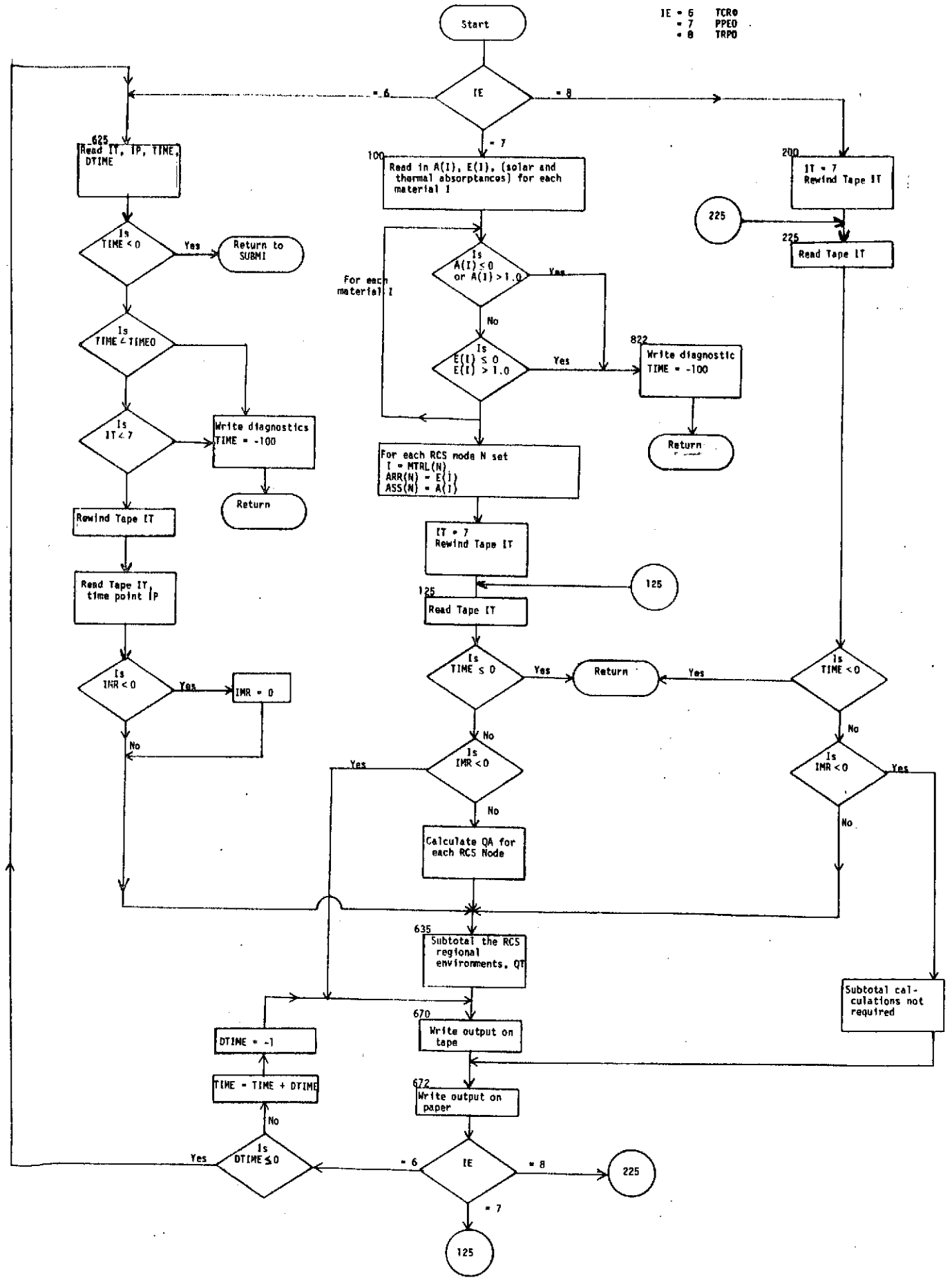
IE	Tape manipulation index (read into EHFR as IENV on Card B1 in SUBM1) - (input) IE = 6 is TCO IE = 7 is PPEO IE = 8 is TRPO

NOMENCLATURE: The following is a dictionary of FORTRAN nomenclature used in the TCR program. The variables of the MR and GE1 block common statements also used in the TCR program are defined with the SUBM1 (main program) nomenclature.

A(I)	Solar absorptivity of material I
ARR(N)	Thermal absorptivity of RCS node N
ASS(N)	Solar absorptivity of RCS node N
E(I)	Thermal absorptivity of material I
ENV1, ENV2	Environment name in A format
IE	Output tape manipulation index = 6, TCO = 7, PPEO = 8, TRPO
IENV	Environment index number on output tape
I, J	Indices

IMR	Index for multiple reflections + Multiple reflections have been calculated 0 multiple reflections have not been calculated - multiple reflections have not been calculated
IP	Tape point number for tape combining
IT	Tape mounting unit number for tape combining
I3, I5, I6	Print indices
MAT	Dummy variable
N	RCS node number
QA(N)	Absorbed heat by RCS node N, Btu/hr
SUND	Sun vector angle above -X axis, deg.
X	Dummy variable

TCR SUBPROGRAM FLOW CHART



@ FOR,* TCR.TCR
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 FS01RH
THIS COMPILATION WAS DONE ON 27 APR 71 AT 10:27:22

SUBROUTINE TCR ENTRY POINT 001412

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	001430
0000	*DATA	005337
0002	*BLANK	000000
0003	MR	053203

EXTERNAL REFERENCES (BLOCK, NAME)

0004	EXIT
0005	NRDU$
0006	NIO1$
0007	NIO2$
0010	NREW$
0011	NRBU$
0012	NWBU$
0013	NWDU$
0014	NERR3$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000016	117G	0001	000023	123G	0001	000112	125L	0001	000034	131G	0001	000075	143G
0001	000132	161G	0001	000153	173G	0001	000221	200L	0001	000211	213G	0001	000226	225L
0001	000246	231G	0001	000267	243G	0001	000375	302G	0001	000413	312G	0001	000434	324G
0001	000472	345G	0001	000473	350G	0001	000503	356G	0001	000557	403G	0001	000600	415G
0001	000641	436G	0001	000707	463G	0001	000718	467G	0001	000723	473G	0001	000775	517G
0001	001006	525G	0001	001025	536G	0001	001055	552G	0001	001060	555G	0001	001104	567G
0001	001154	612G	0001	000321	625L	0001	001225	634G	0001	000465	635L	0001	000537	670L
0001	000616	672L	0001	000701	676L	0001	000730	678L	0001	000735	680L	0001	001013	684L
0001	001033	685L	0001	001067	689L	0001	001137	695L	0001	001250	699L	0001	001274	802L
0001	001313	810L	0001	001334	822L	0001	001353	832L	0001	001373	890L	0000	004630	902F
0000	004632	905F	0000	004634	920F	0000	004661	922F	0000	004676	924F	0000	004713	926F
0000	004737	936F	0000	004762	950F	0000	005011	951F	0000	005051	952F	0000	005102	953F
0000	005105	954F	0000	005111	955F	0000	005125	956F	0000	005153	957F	0000	005177	958F
0000	005212	959F	0000	005223	960F	0000	005242	965F	0000	005244	971F	0000 R	004540	A
0003 R	001327	AL	0003 R	001007	ALFMAT	0003 R	000041	ANAME	0003 R	002173	AR	0000 R	000000	ARR
0003 R	003037	AS	0000 R	001440	ASS	0003 R	001326	DTIME	0000 R	004564	E	0000 R	004617	ENV1
0000 R	004620	ENV2	0003 R	003703	GENODE	0000 I	004612	I	0003 I	004547	IA	0003 I	000013	ICARD
0000 I	004616	IENV	0000 I	004622	IMR	0003 I	000442	IN	0003 I	000007	IOUT	0000 I	004624	IP
0003 I	000014	IPAGE	0003 I	000024	IPRINT	0003 I	000010	IREF	0003 I	000012	ISC	0000 I	004613	IT
0000 I	004611	I$	0000 I	004610	J3	0000 I	004626	J5	0000 I	004627	J6	0000 I	004625	J
0003 I	000000	M	0000 I	004615	MAT	0003 I	000001	MAX	0003 I	000430	MODE	0003 I	000002	MODEM
0003 I	000003	MOLD	0003 I	052337	MTRL	0003 I	000023	MTRLN	0000 I	004614	N	0003 I	000006	NAME
0003 I	000022	NEMU	0003 I	000004	NMODE	0003 I	000005	NVM	0003 R	000015	PI	0003 R	000016	PI180
0003 R	006257	Q	0000 R	003100	QA	0003 R	020137	QR	0003 R	021003	QS	0003 R	000067	QT
0003 R	000025	REF	0003 R	000025	REF1	0003 R	000026	REF2	0003 R	000017	SIG	0000 R	004621	SUND
0003 R	005413	TCON	0003 R	000011	TCONT	0003 R	000477	TEMAT	0003 R	000021	TIME	0003 R	000020	TIMED
0003 R	000461	TITLE	0000 R	004623	X	0003 R	001317	XN	0003 R	000060	XO	0003 R	021647	XR

```
00101     1*          SUBROUTINE TCR(IE)
00101     2*    C
00103     3*          PARAMETER MMAX=3,NMAX=420
00104     4*          COMMON / MR / M,MAX,MODEM,MOD,MODE,NVM,NAME,IOUT,IREF,TCONT,
00104     5*         1    ISC,ICARD,IPAGE,PI,PI1=0,SIG,TIMED,TIME,NEM,MIREN,IPRINT,
00104     6*         2    REF(12),ANAME(15),NO(7),QT(15,15),MODE(10),IN(15),TITLE(14),
00104     7*         3    TEMAT(20,10),ALFMAT(20,10),XN(7),DTIME,
00104     8*         4    AL(NMAX),AR(NMAX),AS(NMAX),GENODE(NMAX),IA(NMAX),TCON(NMAX),
00104     9*         5    Q(12,NMAX),QR(NMAX),QS(NMAX),XR(MMAX,NMAX,10),MIREL(NMAX)
00105    10*          DIMENSION ARR(*00),ASS(*00),QA(*00),A(20),E(20)
00106    11*          EQUIVALENCE (REF1,REF(1)),(REF2,REF(2))
00107    12*          DATA 13 / 135 /
00107    13*    C
00111    14*          IF (IE-7) 625,100,200
00114    15*      100 CONTINUE
00115    16*          READ (5,902) A,E
00127    17*          ICARD = ICARD + 4
00130    18*          DO 102 I=1,20
00133    19*          IT = 1
00134    20*          IF (A(I) .LE. 0.0 .OR. A(I) .GT. 1.0) GO TO *22
00136    21*          IF (E(I) .LE. 0.0 .OR. E(I) .GT. 1.0) GO TO *22
00140    22*      102 CONTINUE
00142    23*          DO 110 N=1,MAX
00145    24*          I= MIREL(N)
00146    25*          ARR(N) = E(I)
00147    26*      110 ASS(N) = A(I)
00151    27*          IT = 7
00152    28*          REWIND IT
00153    29*      125 READ (IT)TIME,M,MODEM,MAT,XO,IENV,ENV1,ENV2,SUND,TCONT,IMR,
00153    30*         1                  (X,QS(N),QR(N),TCON(N),X,X,N=1,MAX)
00204    31*          IF (TIME.LE.0.0) RETURN
00206    32*          IPRINT = -2
00207    33*          IF (IMR.LT.0) GO TO 670
00211    34*          IMR = 0
00212    35*          DO 135 N=1,MAX
00215    36*          QA(N) = QS(N)*ASS(N) + QR(N)*ARR(N)
00216    37*      135 CONTINUE
00220    38*          GO TO 635
00220    39*    C
00221    40*      200 IT = 7
00222    41*          REWIND IT
00223    42*      225 READ (IT) TIME,M,MODEM,MAT,XO,IENV,ENV1,ENV2,SUND,TCONT,IMR,
00223    43*         1    ( QA(N),QS(N),QR(N),TCON(N),X,X,N=1,MAX)
00254    44*          IF (TIME.LE.0.0) CALL EXIT
00256    45*          IPRINT = -2
00257    46*          IF (IMR) 672,635,635
00257    47*    C
00262    48*      625 CONTINUE
00263    49*          READ (5,905) IT,IP,TIME,DTIME
00271    50*          ICARD = ICARD + 1
00272    51*          IF (TIME.LE.0.0) RETURN
00274    52*          IF (TIME.LT.TIMED) GO TO 832
00276    53*          IF (IT.LT.7) GO TO 802
00300    54*          REWIND IT
00301    55*          DO 630 I=1,IP
00304    56*          READ (IT) X,M,MODEM,MAT,XO,IENV,ENV1,ENV2,SUND,TCONT,IMR,
00304    57*         1    (QA(N),QS(N),QR(N),TCON(N),ASS(N),ARR(N),N=1,MAX)
00335    58*          IF (X.LT.0.) GO TO *10
00337    59*      630 CONTINUE
00337    60*    C
00341    61*          IF (IMR.LT.0) IMR = 0
00343    62*      635 CONTINUE
00344    63*          DO 640 I=1,3
```

```
00347    64*          DO 640 J=1,15
00352    65*      640 QT(1,J) = 0.
00352    66*    C
00355    67*          DO 650 N=1,MAX
00360    68*          J = IA(N)
00361    69*          QT(1,J) = QT(1,J) + QA(N)
00362    70*          QT(2,J) = QT(2,J) + QS(N)
00363    71*          QT(3,J) = QT(3,J) + QR(N)
00364    72*          QT(1,1) = QT(1,1) + QA(N)
00365    73*          QT(2,1) = QT(2,1) + QS(N)
00366    74*          QT(3,1) = QT(3,1) + QR(N)
00367    75*      650 CONTINUE
00367    76*    C
00371    77*          IPRINT = 0
00372    78*          IF (IE.GT.7) GO TO 672
00374    79*      670 CONTINUE
00375    80*          WRITE (IOUT) TIME,M,MODEM   ,MAX,XO,IENV,ENV1,ENV2,SUND,TCONT,IMR,
00375    81*         1    (QA(N),QS(N),QR(N),TCON(N),ASS(N),ARR(N),N=1,MAX)
00426    82*      672 CONTINUE
00427    83*          I5 = 1
00430    84*          I6 = 33
00431    85*          IF (I6.GT.MAX) I6 = MAX
00433    86*          IPAGE = IPAGE + 1
00434    87*          WRITE (6,950) TITLE,IPAGE,TIME,REF1,REF2,MODEM,ENV1,ENV2
00451    88*          IF (IE-7) 674,676,678
00454    89*      674 WRITE (6,955) IT,IP
00460    90*          GO TO 680
00461    91*      676 WRITE (6,956) (I,I=1,20),A,E
00477    92*          GO TO 680
00500    93*      678 WRITE (6,958)
00502    94*      680 CONTINUE
00503    95*          IF (IMR.GT.0) WRITE (6,960)
00506    96*          IF (IENV.NE.1) WRITE(6,959) SUND
00512    97*          IF (IREF.NE.2) GO TO 684
00514    98*          WRITE (6,971) REF1,(XO(I),I=1,4),TCONT,REF2,(XO(I),I=5,7)
00531    99*          GO TO 685
00532   100*      684 WRITE (6,951) REF1,REF2,(XO(I),I=1,4),TCONT
00543   101*      685 CONTINUE
00544   102*          WRITE (6,952)
00546   103*          IF (NAME.LE.0) GO TO 689
00550   104*          WRITE (6,953) (ANAME(J),(QT(I,J),I=1,3),J=2,NAME)
00562   105*      689 WRITE (6,953)
00564   106*          WRITE (6,953) ANAME(1),(QT(I,1),I=1,3)
00573   107*          WRITE (6,965)
00575   108*          IF (IPRINT.NE.-2) GO TO 695
00577   109*          WRITE (6,957) REF1,REF2
00603   110*          IF (IE-7) 625,125,225
00606   111*      695 WRITE (6,952)
00610   112*          WRITE (6,954) (N,GENODE(N),QA(N),QS(N),QR(N),TCON(N),N=15,16)
00623   113*      698 IF (I6.EQ.MAX) GO TO 699
00625   114*          I5 = I6+1
00626   115*          I6 = I6 + I3
00627   116*          IF (I6.GT.MAX) I6 = MAX
00631   117*          IPAGE = IPAGE + 1
00632   118*          WRITE (6,950) TITLE,IPAGE,TIME,REF1,REF2,MODEM,ENV1,ENV2
00647   119*          GO TO 695
00650   120*      699 IF (IE-7) 700,125,225
00653   121*      700 CONTINUE
00654   122*          IF (DTIME.LE.0.0) GO TO 625
00656   123*          TIME = TIME + DTIME
00657   124*          TIMEO= TIME
00660   125*          DTIME= -1.
00661   126*          IPRINT = -2
```

```
00662   127*          IF (IMR.EQ.0) IMR = -2
00664   128*          GO TO 670
00664   129*    C
00664   130*    C     SECTION #00, INPUT ERROR DIAGNOSTIC MESSAGES
00664   131*    C
00665   132*      #02 WRITE (6,920) ICARD
00670   133*          WRITE (6,922) IT
00673   134*          GO TO #90
00674   135*      #10 WRITE (6,920) ICARD
00677   136*          WRITE (6,924) IT,IP
00703   137*          GO TO #90
00704   138*      #22 WRITE (6,920) ICARD
00707   139*          WRITE (6,926) IT
00712   140*          GO TO #90
00713   141*      #32 WRITE (6,920) ICARD
00716   142*          WRITE (6,936) TIMEO,TIME
00722   143*      #90 TIME = -100.
00723   144*          RETURN
00723   145*    C
00723   146*    C     SECTION 900, FORMAT STATEMENTS
00723   147*    C
00724   148*      902 FORMAT (10F8.3)
00725   149*      905 FORMAT (2I4,9F8.3)
00726   150*      920 FORMAT (////47H FATAL ERROR IN DATA INPUT FOUND ON CARD NUMBER,
00726   151*         1 I4 , //    52H PROGRAM WILL CALL EXIT AFTER THE FOLLOWING MESSAGE
00726   152*         2. ////)
00727   153*      922 FORMAT (12H TAPE NUMBER,I5,    51H  IS NOT ALLOWABLE.  USE ANOTHER
00727   154*         1 INPUT TAPE DRIVE.  )
00730   155*      924 FORMAT (12H TAPE NUMBER,I5,10H ,  POINT , I5,32H IS BEYOND THE END
00730   156*         1 OF FILE MARK.  )
00731   157*      926 FORMAT(66H EITHER THE SOLAR ABSORPTIVITY OR THERMAL EMISSIVITY FOR
00731   158*         1 MATERIAL ,I4,3X,35H IS NEGATIVE OR GREATER THAN UNITY.  )
00732   159*      936 FORMAT (56H TIME INCREMENT BETWEEN ASTRONAUT POSITIONS IS NEGATIVE
00732   160*         1. // 14H FIRST TIME  =,F10.2,30X,14H SECOND TIME =,F10.2 )
00733   161*      950 FORMAT (9H1    TIME,21X,14A5,12X,4HPAGE,I4  /9H     (HR),/F10.3/
00733   162*         1 30X,2A5,   8H  IN A  ,A5,29HING  MODE  IS LOCATED IN A
00733   163*         2 ,2A6,15H  ENVIRONMENT.  // )
00734   164*      951 FORMAT (2H0 ,2A5,16X,1HX,9X,1HY,9X, 2SHZ     AZIMUTH   CONTACT  /
00734   165*         1 10H  LOCATION,16X,  45H(FT)       (FT)       (FT)     (DEG)      TE
00734   166*         2MP / 20X,3F10.2,2F10.1 ///
00734   167*         3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.   / )
00735   168*      952 FORMAT (3(42H                    Q      Q      Q     AD W)   /
00735   169*         1        3(42H    NODE  NODE  TOTAL  SOLAR   I.R.   TEMP)   /
00735   170*         2        3(42H     NO.  NAME  ABSOR  INCID  INCID  DEG R)   )
00736   171*      953 FORMAT (9X,A5,3F7.1)
00737   172*      954 FORMAT  (3(I8,1X,A5,4F7.1))
00740   173*      955 FORMAT (     30X,31H TAPE COMBINING OPTION.    TAPE, I3, 20X,
00740   174*         1 15H TIMELINE POINT , I5 // )
00741   175*      956 FORMAT (     30X,50H PARAMETRIC MATERIALS PROPERTY EVALUATION OPTI
00741   176*         1ON.  //  12H  MATERIAL  ,I3,19I5  /12H SOLAR ABSOR,20F5.3/
00741   177*         2         12H I.R.  ABSOR, 20F5.3  //)
00742   178*      957 FORMAT (//// 2X,2A5,102H  ENVIRONMENT IS THE SAME AS THE PREVIOUS
00742   179*         1TIME POINT.  SEE THAT PRINTOUT FOR DETAILED NODAL FLUX DATA. )
00743   180*      958 FORMAT (30X,50H TAPE READ OPTION.    NO NEW OUTPUT TAPE GENERATED.
00743   181*         1  //)
00744   182*      959 FORMAT (13H  ENVIRONMENT ,16X,18HSUN ANGLE (DEG) = ,F7.2 /)
00745   183*      960 FORMAT (76H  THE RESULTS FOR THIS TIME POINT INCLUDE MULTIPLE REFL
00745   184*         1ECTIONS CALCULATIONS.   //)
00746   185*      965 FORMAT (1H  ///)
00747   186*      971 FORMAT (12H0 LOCATION   ,16X,1HX,9X,1HY,9X,2SHZ     AZIMUTH   CONT
00747   187*         1ACT   /26X,45H(FT)       (FT)       (FT)     (DEG)     TEMP R /
00747   188*         2  12X,A5,3X,5F10.2 / 12X,A5,3X,3F10.2 ///
00747   189*         3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.    /)
00750   190*          END

    END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
TOR             SYMBOLIC                                  24 APR 71  22:56:27   0  02306250   14   190  (DELETED)
TOR     CODE    RELOCATABLE                               24 APR 71  22:56:27   1  02313414   16     1  (DELETED)
                                                                                 0  02313460   14   112
```

SUBPROGRAM NAME: Subroutine IVE

SEGMENT NAME: IVE

PURPOSE: Calculate the intravehicular thermal environment on the Reference Coordinate System.

DESCRIPTION: The intravehicular thermal environment is simulated by a rectangular enclosure which emits energy in the infrared spectrum. The surface temperatures for each of the six enclosure surfaces, the enclosure size, and enclosure surface i.r. emittance are input to the IVE program. The governing equations used to determine the intravehicular thermal environment are presented in Section 4.1 of Volume I.

CALLING PROGRAM: SUBM1 (Main Program)

ARGUMENT LIST: None, all data required are transferred into and out of this subprogram via block common.

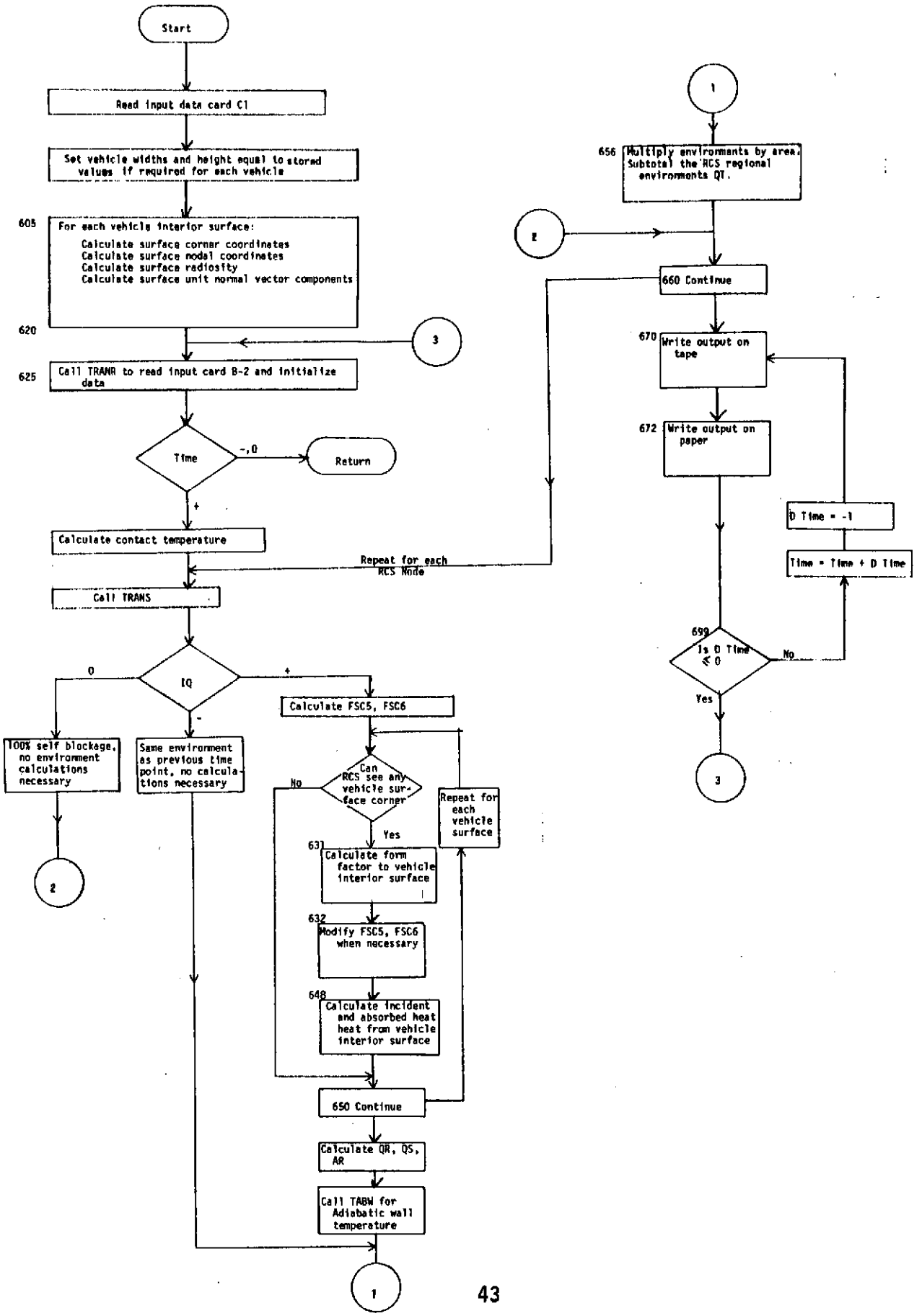
NOMENCLATURE: The following is a dictionary of FORTRAN nomenclature used in the IVE program. Also used in the IVE program but not included below are the variables of the MR and GE1 block common statements. The MR and GE1 variables are defined in the SUBM1 program nomenclature.

AA	Form factor term from RCS node to vehicle surface node
ALPHA	Absorptance of RCS node to incident radiation
B1	Cosine of angle between RCS node normal vector and vehicle energy source
B2	Cosine of angle between vehicle energy source normal vector and RCS node
DA(K)	Node area of vehicle interior surface K, ft^2
DL, DS	Node length variables used for node center point calculations, ft.
DYN (K)	Node Y 1/2 length magnitude of vehicle interior surface K, ft.
DZN(K)	Node Z 1/2 length magnitude of vehicle interior sufrace K, ft.
ECN	Infrared emissivity of vehicle interior surfaces
ENV1, ENV2	Environment name in A format
FA	Form factor from RCS node to vehicle surface node

FSC	Form factor from RCS node to vehicle interior surface
FSC5	Form factor from RCS node to vehicle interior deck
FSC6	Form factor from RCS node to vehicle interior overhead
H(K)	Height of vehicle interior surface K, ft.
IENV	Environment Index number
I1, I2, I3	Print indices
I, J, K, KL, L, ISC	Indices
N	RCS node number
NN	Number of vehicle interior surfaces for which nodal data are required
NW	Number of vehicle interior surface node widths
NH	Number of vehicle interior surface node heights
NN2	Number of vehicle interior surfaces
PHIC(K)	Azimuth angle of vehicle interior surface K, Deg.
Q(K+2, N)	RCS node absorbed heat from vehicle interior surface K, Btu/hr
Q(1, N)	Total energy absorbed by RCS node N, Btu/hr
Q(2, N)	Total energy incident on RCS node N, Btu/hr
QIR(K)	Infrared radiosity of vehicle surface K
R4	$(\text{Distance})^4$ between RCS node and vehicle source
THTC(K)	Inclination angle of vehicle interior surface K, Deg.
TSC(K)	Temperature of vehicle interior surface K, °R
TSCF(K)	Temperature of vehicle interior surface K, °F
W(K)	Width of vehicle interior surface K, ft.
WX	Vehicle interior width in X direction, ft.
WXX	Stored vehicle interior width in X direction, ft.

WY	Vehicle interior width in Y direction, ft.
WYY	Stored vehicle interior width in Y direction, ft.
WZ	Vehicle interior height in Z direction, ft.
WZZ	Stored vehicle interior width in Z direction, ft.
X	Node center point X coordinate of vehicle surface K, Ft.
XC(K)	Center point X coordinate of vehicle surface K, ft.
XN(K)	Surface K unit normal vector magnitude along X axis
XSH(I, K)	X coordinate of corner i, vehicle surface K, ft.
Y	Node center point Y coordinate of vehicle surface K, ft.
YC(K)	Center point Y coordinate of vehicle surface K, ft.
YN(K)	Surface K unit normal vector magnitude along Y axis
YSH(I, K)	Y coordinate of corner i, vehicle surface K, ft.
Z	Node center point Z coordinate of vehicle surface K, ft.
ZC(K)	Z center point coordinate of vehicle surface k, ft.
ZN(K)	Surface K unit normal vector magnitude along Z axis
ZSH(I, K)	Z coordinate of corner i, vehicle surface K, ft.

IVE SUBPROGRAM FLOW CHART



@ FOR,* IVF,IVF 27 APR 11 10:26:26
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F501PH
THIS COMPILATION WAS DONE ON 27 APR 11 AT 10:26:27

SUBROUTINE IVF ENTRY POINT 002040

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	002063
0000	*DATA	053214
0002	*BLANK	000000
0003	MH	053203
0004	GE1	000043

EXTERNAL REFERENCES (BLOCK, NAME)

0005	TRANR
0006	TRANS
0007	BLOCK
0010	ALPHA1
0011	TABW
0012	FRDU$
0013	NIO1$
0014	NIO2$
0015	COS
0016	SIN
0017	SQRT
0020	NWDU$
0021	NWDU$
0022	NERR3$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000006	134G	0001	000126	172G	0001	000357	236G	0001	000365	243G	0001	000411	252G
0001	000536	304G	0001	000622	326G	0001	000642	336G	0001	000701	353G	0001	000707	357G
0001	001162	451G	0001	001234	476G	0001	001256	510G	0001	001306	525G	0001	001336	542G
0001	001345	546G	0001	001375	563G	0001	001406	571G	0001	001425	602G	0001	001461	620G
0001	001464	623G	0001	000506	625L	0001	000571	627L	0001	000610	628L	0001	000671	631L
0001	001005	633L	0001	001016	634L	0001	001510	635G	0001	001021	635L	0001	001036	637L
0001	001050	644L	0001	001053	646L	0001	001055	648L	0001	001110	650L	0001	001145	656L
0001	001173	660L	0001	001211	670L	0001	001274	672L	0001	001413	674L	0001	001433	675L
0001	001622	677G	0001	001473	679L	0001	001545	682L	0001	001553	685L	0001	001561	686L
0001	001600	691L	0001	001642	695L	0001	001701	698L	0001	001762	699L	0001	001630	703G
0001	001663	716G	0001	001734	737G	0001	002000	A38L	0000	052552	902F	0000	052554	940F
0000	052626	950F	0000	052655	951F	0000	052715	952F	0000	052733	953F	0000	052737	957F
0000	052763	959F	0000	053015	962F	0000	053054	963F	0000	053057	964F	0000	053062	965F
0000	053064	971F	0000 R	052544	AA	0003 R	001327	AL	0003 R	001007	ALFMAT	0000 R	052550	ALPHA
0003 R	000041	ANAME	0003 R	002173	AR	0003 R	003037	AS	0004 R	000003	ASE	0004 R	000006	BX
0004 R	000021	BXX	0004 R	000007	BY	0004 R	000022	BYY	0004 R	000010	BZ	0000 R	052541	B1
0000 R	052542	B2	0004 R	000011	COSP	0004 R	003042	COSSUN	0004 R	000031	COST	0004 R	000023	COST1
0000 R	000066	DA	0003 R	052527	DL	0000 R	052532	DS	0003 R	001326	DTIME	0004 R	000024	DX
0004 R	000025	DY	0000 R	000034	DYN	0004 R	000026	DZ	0000 R	000040	DZN	0000 R	052525	ECN
0000 R	052513	ENV1	0000 R	052514	ENV2	0000 R	052545	FA	0004 R	000032	FATUT	0000 R	052540	FSC
0000 R	052534	FSC5	0000 R	052535	FSC6	0004 R	000014	FSE	0003 R	003703	GENODE	0004 R	000033	GOFIR
0004 R	000030	GOFIRP	0004 R	000034	GOSOL	0004 R	000036	GOSOLA	0004 R	000035	GOSOLD	0000 R	000030	H
0000 I	052530	I	0003 I	004547	IA	0003 I	000013	ICARD	0000 I	052512	IENV	0003 I	000442	IN
0003 I	000007	IOUT	0003 I	000014	IPAGE	0003 I	000024	IPRINT	0004 I	000027	IQ	0003 I	000010	IREF

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0003 I 000012 ISC       0000 I 052521 IX        0000 I 052546 II        0000 I 052551 IZ        0000 I 052547 IY
0000 I 052533 J         0000 I 052516 K         0000 I 052531 KI        0000 I 052547 L         0003 I 000001 M
0003 I 000001 MAX       0003 I 000410 MODE      0003 I 000002 MODEM     0003 I 000003 MOLD      0003 I 052443 MORE
0003 I 000023 MTRLN     0000 I 052520 N         0003 I 000006 NAME      0003 I 000022 NFM       0003 I 000004 NMODE
0003 I 000005 NVM       0004 R 000313 PHI       0000 R 000020 PHIC      0004 R 000004 PHI1      0003 R 000015 PI
0003 R 000016 PI180     0003 R 006257 Q         0000 R 000060 QIR       0004 R 020137 QR        0003 R 021004 QS
0003 R 000067 QT        0003 R 000025 REF       0003 R 000025 REF1      0004 R 000026 REF2      0000 R 052543 R4
0003 R 000017 SIG       0004 R 000012 SINP      0004 R 000041 SINSUN    0000 R 052526 SINT      0004 R 000047 SUN
0004 R 000040 SUND      0003 R 005413 TCON      0003 R 000011 TCONT     0003 R 000477 TEMAT     0000 R 000014 THTC
0004 R 000005 TMT1      0003 R 000021 TIME      0004 R 000020 TIMED     0003 R 000461 TITLE     0000 R 000044 TSC
0000 R 000052 TSCF      0000 R 000024 W         0000 R 052522 WX        0000 R 052515 WXX       0000 R 052523 WY
0000 R 052516 WYY       0000 R 052524 WZ        0000 R 052517 WZZ       0000 R 000166 X         0000 R 000000 XC
0003 R 001317 XM        0000 R 000152 XN        0003 R 000060 XO        0003 R 021647 XR        0004 R 000000 XSE
0000 R 000072 XSH       0000 R 025146 Y         0000 R 000004 YC        0000 R 000156 YN        0004 R 000001 YSE
0000 R 000112 YSH       0000 R 052126 Z         0000 R 000010 ZC        0000 R 000162 ZN        0004 R 000002 ZSE
0000 R 000132 ZSH
```

```
00101    1*          SUBROUTINE IVE
00101    2*    C
00103    3*          PARAMETER MMAX=3,NMAX=420
00104    4*          COMMON / MR / M,MAX,MODEM,MOLD,NMODE,NVM,NAME,IOUT,IREF,TCONT,
00104    5*         1     ISC,ICARD,IPAGE,PI,PI180,SIG,TIMED,TIME,NEMI,MTRLN,IPRINT,
00104    6*         2     REF(12),ANAME(15),XO(7),QT(15,15),MODE(10),IN(15),TITLE(14),
00104    7*         3     TEMAT(20,10),ALEMAT(20,10),XM(7),DTIME,
00104    8*         4     AL(NMAX),AR(NMAX),AS(NMAX),GENODE(NMAX),IA(NMAX),TCON(NMAX),
00104    9*         5     Q(12,NMAX),QR(NMAX),QS(NMAX),XR(MMAX,NMAX,10),MTRL(NMAX)
00105   10*          EQUIVALENCE (REF1,REF(1)),(REF2,REF(2))
00106   11*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,TMT1,BX,BY,BZ,COSP,SINP,PHI,
00106   12*         1    FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,COEIRP,
00106   13*         1    COST,FATOT,GCFIR,GCNOL,GCNOLD,GCNOLA,SUN,SUND,SINSUN,COSSUN
00107   14*          PARAMETER KN=4,NW=44,NH=61,NN2=6
00110   15*          DIMENSION XC(NN),YC(NN),ZC(NN),THTC(NN),PHIC(NN),W(NN),H(NN),
00110   16*         1           DYN(NN),DZN(NN),TSC(NN2),TSCF(NN2),QIR(NN2),DA(NN),
00110   17*         1           XSH(4,NN),YSH(4,NN),ZSH(4,NN),
00110   18*         2           XN(NN),YN(NN),ZN(NN),XCN(NN,NH,NW),YCN(NN,NH,NW),ZCN(NN,NH)
00111   19*          DATA IENV,ENV1,ENV2 / 1, 6HINTRA ,6HVEHIC. /
00115   20*          DATA WXX,WYY,WZZ / 4.0,7.0,6.5 /
00121   21*          DATA (PHIC(N),N=1,4)/ 180.,-90.,0.,90. /
00123   22*          DATA (THTC(N),N=1,4)/4*0.0 /
00125   23*          DATA XC(2),XC(4),YC(1),YC(3)/ 4*0.0 /
00125   24*    C
00132   25*          READ (5,902) TSCF,WX,WY,WZ,ECN
00144   26*          ICARD = ICARD + 1
00145   27*          IF (ECN.LE.0.0.OR.ECN.GT.1.0) ECN = 0.85
00147   28*          IF (WX.LE.0.0) WX = WXX
00151   29*          IF (WY.LE.0.0) WY = WYY
00153   30*          IF (WZ.LE.0.0) WZ = WZZ
00155   31*          W(1) = WY
00156   32*          W(2) = WX
00157   33*          W(3) = WY
00160   34*          W(4) = WX
00161   35*          XC(1) = WX*0.5
00162   36*          XC(3) =-WX*0.5
00163   37*          YC(2) = WY*0.5
00164   38*          YC(4) =-WY*0.5
00165   39*          ISC = 4
00166   40*          SUND = 0.
00167   41*          SINSUN = 0.0
00170   42*          COSSUN = 0.0
00171   43*      605 DO 620 N=1,ISC
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00174    44*          H(N) = WZ
00175    45*          ZC(N)= WZ*0.5
00176    46*          TSC(N) = TSCF(N) + 460.
00177    47*          IF (TSC(N).LT.0.0) TSC(N) = 0.
00201    48*          COSP = COS(PHIC(N)*PI1*0)
00202    49*          SINP = SIN(PHIC(N)*PI1*0)
00203    50*          COST = COS(THTC(N)*PI1*0)
00204    51*     60*  SINT = SIN(THTC(N)*PI1*0)
00205    52*          DX = -W(N)*SINP*0.5
00206    53*          DY = W(N)*COSP*0.5
00207    54*          DL = H(N)*SINT*0.5
00210    55*          DZ = H(N)*COST*0.5
00211    56*          XSH(1,N) = XC(N) + DX - DL*COSP
00212    57*          YSH(1,N) = YC(N) + DY - DL*SINP
00213    58*          ZSH(1,N) = ZC(N) + DZ
00214    59*          XSH(2,N) = XC(N) - DX - DL*COSP
00215    60*          YSH(2,N) = YC(N) - DY - DL*SINP
00216    61*          ZSH(2,N) = ZSH(1,N)
00217    62*          XSH(3,N) = XC(N) + DX + DL*COSP
00220    63*          YSH(3,N) = YC(N) + DY + DL*SINP
00221    64*          ZSH(3,N) = ZC(N) - DZ
00222    65*          XSH(4,N) = XC(N) - DX + DL*COSP
00223    66*          YSH(4,N) = YC(N) - DY + DL*SINP
00224    67*          ZSH(4,N) = ZSH(3,N)
00225    68*          DA(N) = W(N)*H(N)/(NW*NH)
00226    69*          DX = -W(N)*SINP/NW
00227    70*          DY =  W(N)*COSP/NW
00230    71*          DZ =  H(N)*COST/NH
00231    72*          DL = DL/NH
00232    73*          DYN(N) = 0.5*ABS(DY)
00233    74*          DZN(N) = 0.5*ABS(DZ)
00234    75*          Z(N,1)   = ZC(N)-H(N)*COST*.5+DZ*.5
00235    76*          DO 610 I=2,NH
00240    77*     610  Z(N,I) = Z(N,I-1) + DZ
00242    78*          DO 614 I=1,NH
00245    79*          KL = NH+1-2*I
00246    80*          DS = DL*KL
00247    81*          X(N,I,1) = XC(N)+DS*COSP +.5*(W(N)*SINP+DX)
00250    82*          Y(N,I,1) = YC(N)+DS*SINP +.5*(-W(N)*COSP+DY)
00251    83*          DO 612 J=2,NW
00254    84*          X(N,I,J) = X(N,I,J-1) + DX
00255    85*     612  Y(N,I,J) = Y(N,I,J-1) + DY
00257    86*     614  CONTINUE
00261    87*          QIR(N) = ECN*TSC(N)**4*SIG*DA(N)/PI
00262    88*          XN(N) = COST*COSP
00263    89*          YN(N) = COST*SINP
00264    90*          ZN(N) = SINT
00265    91*     620  CONTINUE
00267    92*          TSC(5) = TSCF(5) + 460.
00270    93*          TSC(6) = TSCF(6) + 460.
00271    94*          QIR(5) = ECN*SIG*TSC(5)**4
00272    95*          QIR(6) = ECN*SIG*TSC(6)**4
00273    96*          ISC = 6
00273    97*  C
00274    98*     625  CONTINUE
00275    99*          CALL TRANR
00276   100*          IF (TIME.LE.0.0) RETURN
00300   101*          TCONT = TSC(5)
00301   102*          IF (XO(7).GT.0.0) TCONT = XO(7)
00301   103*  C
00301   104*  C
00303   105*          DO 660 N = 1,MAX
00306   106*          CALL TRANS(N)
```

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00307   107*          IF (IQ) 656,660,626
00312   108*      626 CONTINUE
00313   109*          IF (BZ.LT.0.0) GO TO 627
00315   110*          FSC5 = (FSE(3)+FSE(4))*(1.-BZ)*0.25
00316   111*          FSC6 = (FSE(1)+FSE(2)+BZ*(FSE(3)+FSE(4)))*0.25
00317   112*          GO TO 628
00320   113*      627 FSC5 = (FSE(3)+FSE(4)-BZ*(FSE(1)+FSE(2)))*0.25.
00321   114*          FSC6 = (FSE(1)+FSE(2))*(1.+BZ)*0.25
00322   115*      628 CONTINUE
00323   116*          Q(1,N) = 0.
00324   117*          QOFIR = 0.
00325   118*          DO 650 K=1,ISC
00330   119*          L = K+2
00331   120*          FSC= 0.
00332   121*          IF (K-5) 629,644,646
00335   122*      629 DO 630 I=1,4
00340   123*          DX = XSH(I,K)-XSE
00341   124*          DY = YSH(I,K)-YSE
00342   125*          DZ = ZSH(I,K)-ZSE
00343   126*          B1 = BX*DX + BY*DY + BZ*DZ
00344   127*          IF (B1.GT.0.) GO TO 631
00346   128*      630 CONTINUE
00350   129*          GO TO 650
00351   130*      631 CONTINUE
00352   131*          DO 639 I=1,NH
00355   132*          DZ = Z(K,I)-ZSE
00356   133*          DO 638 J=1,NW
00361   134*          DX = X(K,I,J) - XSE
00362   135*          DY = Y(K,I,J) - YSE
00363   136*          B1 = BX*DX + BY*DY + BZ*DZ
00364   137*          IF (B1.LE.0.0) GO TO 637
00366   138*          B2 = -(XN(K)*DX + YN(K)*DY + ZN(K)*DZ)
00367   139*          IF (B2.LE.0.0) GO TO 637
00371   140*          R4 = (DX**2 + DY**2 + DZ**2)**2
00372   141*          CALL BLOCK
00373   142*          AA = B1*B2*FSE(IQ)/R4
00374   143*          FSC = FSC + AA
00375   144*          FA = AA*DA(K)/PI
00376   145*          IF (DZ) 632,633,634
00401   146*      632 FSC5 = FSC5-FA
00402   147*          GO TO 635
00403   148*      633 FSC5 = FSC5-FA*0.5
00404   149*          FSC6 = FSC6-FA*0.5
00405   150*          GO TO 635
00406   151*      634 FSC6 = FSC6-FA
00407   152*      635 CONTINUE
00410   153*          IF (DA(K).LT.0.04*SQRT(R4)) GO TO 637
00412   154*          I1 =-1
00413   155*          I3 = K
00414   156*          GO TO 672
00415   157*      637 CONTINUE
00416   158*      638 CONTINUE
00420   159*      639 CONTINUE
00422   160*          GO TO 648
00423   161*      644 FSC = FSC5
00424   162*          GO TO 648
00425   163*      646 FSC = FSC6
00426   164*      648 IF (FSC.LT.0.0) FSC = 0.0
00430   165*          CALL ALPHA1(TSC(K),ALPHA)
00431   166*          QOFIRP = FSC*QIR(K)
00432   167*          QOFIR  = QOFIR + QOFIRP
00433   168*          Q(L,N) = QOFIRP*ALPHA
00434   169*          Q(1,N) = Q(1,N) + QOFIRP*ALPHA
```

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00415   170*      650 CONTINUE
00417   171*          Q(2,N) = QOFIR
00440   172*          QR(N)  = QOFIR*ASF
00441   173*          QS(N)  = 0.
00442   174*          AR(N)  = Q(1,N)/QOFIR
00443   175*          CALL TABW(Q(1,N),TCON(N))
00444   176*          IF (AR(N).LE.0.0) CALL ALPHA1(TCONT,AR(N))
00446   177*      656 CONTINUE
00447   178*          J = IA(N)
00450   179*          DO 658 I=1,12
00453   180*          Q(I,N) = Q(I,N)*ASF
00454   181*          QT(I,1)= QT(I,1)+Q(I,N)
00455   182*      658 QT(I,J)=QT(I,J)+Q(I,N)
00457   183*      660 CONTINUE
00461   184*          IF (IREF.NE.2) GO TO 670
00463   185*          XO(5) = XM(1)
00464   186*          XO(6) = XM(2)
00465   187*          XO(7) = XM(3)
00465   188*  C
00466   189*      670 CONTINUE
00467   190*          I1= 1
00470   191*          WRITE (IOUT) TIME,M,MODE(M),MAX,XO,IENV,ENV1,ENV2,SUND,TCONT,NVM,
00470   192*         1    (Q(I,N),QS(N),QR(N),TCON(N),AS(N),AR(N),N=1,MAX)
00521   193*      672 CONTINUE
00522   194*          IPAGE = IPAGE + 1
00523   195*          WRITE (6,950) TITLE,IPAGE,TIME,REF(1),REF(2),MODE(M),ENV1,ENV2
00540   196*          WRITE (6,959)(I,I=1,6),TSCF,WX,WY,WZ,FCN
00556   197*          IF (IREF.NE.2) GO TO 674
00560   198*          WRITE (6,971) REF1,(XO(I),I=1,4),TCONT,REF2,(XM(I),I=1,4)
00575   199*          GO TO 675
00576   200*      674 WRITE (6,951) REF1,REF2,(XO(I),I=1,4),TCONT
00607   201*      675 CONTINUE
00610   202*          IF (I1.LT.0) GO TO 838
00612   203*          WRITE (6,962)
00614   204*          IF (NAME.LE.0) GO TO 679
00616   205*          WRITE (6,963) (ANAME(J),(QT(I,J),I=1,8),J=2,NAME)
00630   206*      679 WRITE (6,963)
00632   207*          WRITE (6,963) ANAME(1),(QT(I,1),I=1,8)
00641   208*          IF (IPRINT.EQ.-2) WRITE(6,957) REF(1),REF(2)
00646   209*      680 IF (IPRINT) 699,681,682
00651   210*      681 I3 = 180
00652   211*          I2 =  92-4*(ISC+NAME)
00653   212*          GO TO 685
00654   213*      682 I3 = 45
00655   214*          I2 = 23 -(ISC+NAME)
00656   215*      685 CONTINUE
00657   216*          IF (I2.GT.0)  GO TO 686
00661   217*          I2 = 0
00662   218*          GO TO 698
00663   219*      686 CONTINUE
00664   220*          IF (I2.GT.MAX) I2 = MAX
00666   221*          WRITE (6,965)
00670   222*          IF (IPRINT) 699,695,691
00673   223*      691 WRITE (6,962)
00675   224*          WRITE (6,964) (N,GENODE(N),(Q(I,N),I=1,8),TCON(N),N=I1,I2)
00711   225*          GO TO 698
00712   226*      695 WRITE (6,952)
00714   227*          WRITE (6,953) (N,GENODE(N),Q(1,N),Q(2,N),TCON(N),N=I1,I2)
00726   228*      698 IF (I2.EQ.MAX) GO TO 699
00730   229*          I1 = I2+1
00731   230*          I2 = I2+I3
00732   231*          IF (I2.GT.MAX) I2 = MAX
00734   232*          IPAGE = IPAGE + 1
```

```
00751   233*          WRITE (6,950) TITLE,IPAGE,TIME,REF(1),REF(2),MODE(M),ENV1,ENV2
00752   234*          IF (IPRINT) 699,695,691
00755   235*      699 IF (DTIME.LE.0.0) GO TO 625
00757   236*          TIME = TIME + DTIME
00760   237*          TIMEO= TIME
00761   238*          DTIME= -1.
00762   239*          IPRINT = -2
00763   240*          NAM = -2
00764   241*          GO TO 670
00765   242*      838 WRITE (6,940) I3
00770   243*          GO TO 625
00770   244*   C
00770   245*   C      SECTION 900, FORMAT STATEMENTS
00770   246*   C
00771   247*      902 FORMAT (10F8.3 )
00772   248*      940 FORMAT (65HOREFERENCE COORDINATE SYSTEM IS TOO CLOSE TO SPACE CRAF
00772   249*         1T SURFACE  ,I5 ,31H  FOR FORM FACTOR CALCULATIONS. ///
00772   250*         2 51H MOVE REFERENCE COORDINATE SYSTEM AWAY FROM SURFACE //10X,
00772   251*         3  6H- OR - //35H REDUCE SPACE CRAFT SURFACE SIZE.  ///
00772   252*         4 23H GO TO NEXT TIME POINT. )
00773   253*      950 FORMAT (9H1     TIME,21X,1A5,12X,4HPAGE,I4  /9H      (HR),/F10.3/
00773   254*         1 30X,2A5,   8H  IN A  ,A5,29HING  MODE  IS LOCATED IN A
00773   255*         2,2A6,15H  ENVIRONMENT.  //)
00774   256*      951 FORMAT (2H0 ,2A5,16X,1HX,9X,1HY,9X, 2HZ      AZIMUTH   CONTACT  /
00774   257*         1 10H  LOCATION,16X,  4SH(FT)       (FT)       (FT)      (DEG)      TE
00774   258*         2MP / 20X,3F10.2,2F10.1 ///
00774   259*         3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.   / )
00775   260*      952 FORMAT (4(32H     NODE  NODE    O      O    AD W )/
00775   261*         1         4(32H      NO.  NAME ABSOR INCID  TEMP ))
00776   262*      953 FORMAT (4(5X,I3,1X,A5,3F6.1) )
00777   263*      957 FORMAT (//// 2X,2A5,102H  ENVIRONMENT IS THE SAME AS THE PREVIOUS
00777   264*         1TIME POINT.  SEE THAT PRINTOUT FOR DETAILED NODAL FLUX DATA. )
01000   265*      959 FORMAT (13H  ENVIRONMENT,7X,6(6X,4HITEMP),5X,5HVEH X,5X,5HVEH Y,6X,
01000   266*         1  4H VEH,6X,4HSURF/ 21X, 6(4X,4HSURF,I2), 2(4X,6HENGIN),4X,
01000   267*         2  6HRCIGHT,4X,5HMISS / 20X,9F10.1,F10.3 /)
01001   268*      962 FORMAT (40X,25HABSORBED HEAT,  BTU/HR.  ,22X,4HAD W
01001   269*         1 /2HH       NODE     TOTAL     TOTAL ,6(5X,4HSURF),5X,4HTEMP
01001   270*         2 /2HH NO.   NAME     ABSOR     INCID ,7X,1H1,8X,1H2,8X,1H3,8X,1H4,
01001   271*         3 8X,1H5,8X,1H6,5HDEG R  )
01002   272*      963 FORMAT (5X,A5,8F9.1)
01003   273*      964 FORMAT (I4,1X,A5,9F9.1)
01004   274*      985 FORMAT (1H  ///)
01005   275*      971 FORMAT (12H0 LOCATION    ,16X,1HX,9X,1HY,9X,2HZ     AZIMUTH   CONT
01005   276*         1ACT   /26X,4SH(FT)       (FT)       (FT)      (DEG)      TEMP R /
01005   277*         2  12X,A5,3X,5F10.2 / 12X,A5,3X,4F10.2 ///
01005   278*         3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.     /)
01006   279*          END

    END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
IVE             SYMBOLIC                                  27 APR 71  10:24:52   0  02320156    14   279  (DELETED)
IVE     CODE    RELOCATABLE                               27 APR 71  10:24:52   1  02327660    36     1  (DELETED)
                                                                                  0  02327724    14   140
```

SUBPROGRAM NAME: Subroutine LPR (IENV)

SEGMENT NAME: LPR

PURPOSE: (1) Calculate the thermal environment experienced by the reference coordinate system (RCS) located on a lunar plain.

(2) Calculate the thermal environment by the RCS located in deep space.

DESCRIPTION: The lunar plain thermal environment consists of direct solar energy, albedo and infrared energy emitted from lunar plain and shadow areas, and albedo and infrared energy coming from spacecraft surfaces. The governing equations describing the incident and absorbed energy calculations on the RCS from the plain, shadow, and spacecraft surfaces are presented in Section 4.2 of the report. Input to the routine consists of solar elevation data, lunar plain thermal properties, and shadow/spacecraft location, orientation, and temperature data.

The deep space thermal environment consist of direct solar energy, and albedo and infrared energy from spacecraft surfaces. The input to the routine for this option is similar to the lunar plain option. The governing equations describing the energy calculations are presented in Section 4.5 of the report.

CALLING PROGRAM: SUBM1 (Main Program)

ARGUMENT LIST:

IENV	Environment index as read on Card B1 in SUBM1 - (input) IENV=2 is Lunar Plain Environment IENV=9 is Deep Space Environment

All other data required by the LPR subprogram is transferred to the routine via block common statements.

LPR SUBPROGRAM NOMENCLATURE

The following is a dictionary of FORTRAN nomenclature used in the LPR routine. Also used in the LPR program are the variables of the MR and GE1 block common statements which are defined with the SUBM1 (Main Program) nomenclature.

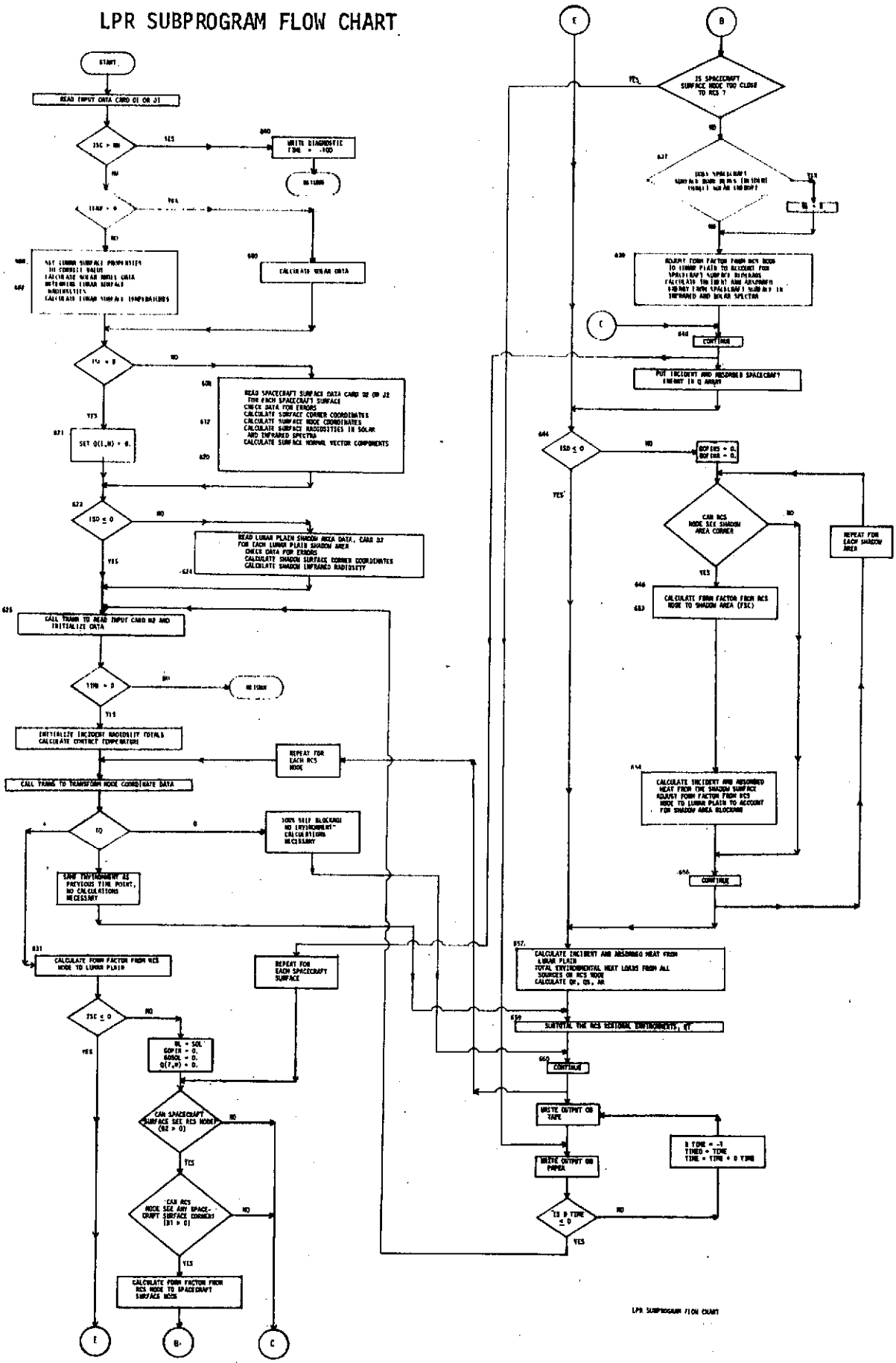
AA	Form factor term from RCS node to spacecraft surface node
AC(K)	Spacecraft surface K solar absorptivity
ALBP	Lunar plain albedo, Btu/hr-ft^2
ALPHA	Absorptance of RCS node to incident radiation
AMOON	Absorptance of moon to direct solar energy
BL	Spacecraft solar blockage of the RCS term = 0 for blockage, = 442 for no solar blockage
BM	Lunar radiosity in infrared region, Btu/hr-ft^2
BS	Direct solar energy incident on lunar surface, Btu/hr-ft^2
BXZDXZ	(BX)(DX)+(BZ)(DZ) in shadow area form factor calculations
B1	Cosine of angle between RCS node normal vector and energy source
B2	Cosine of angle between energy source normal vector and RCS node
COSS	Direct solar energy on Y-Z plane (which is perpendicular to lunar surface), BTU/hr-ft^2
DA(K)	Node area of spacecraft surface K, ft^2
DL	Node length variable used for spacecraft node point calculations, ft.
DM	Differential maximum length used for form factor calculations from RCS to shadow area, ft.
DS	Remaining Y distance in shadow area form factor calculations, ft.
DXDZ2	DX^2+DZ^2 in shadow area form factor calculations, ft^2
DXS	Shadow area increment length in X direction for form factor calculation, ft.

DYN(K)	Node Y 1/2 length magnitude of spacecraft surface K, ft.
DYS	Shadow area increment length in Y direction for form factor calculations, ft.
DZN(K)	Node Z 1/2 length magnitude of spacecraft surface K, ft.
DZP	Differential height at which a spacecraft surface will block solar energy from the RCS, ft.
DZ2	DZ^2, ft^2
EC(K)	Spacecraft surface K thermal emissivity
EMOON	Lunar plain thermal emissivity
ENV(I), ENV1, ENV2	Environment name in A format
FATOT	Geometric form factor from RCS to infinite lunar plain
FI	Form factor from RCS to spacecraft surface which blocks lunar plain energy
FSC	Form factor from RCS to a spacecraft surface or lunar shadow area
GOFIR	Total infrared energy from spacecraft incident on RCS, BTU/hr-ft
GOFIRA	Total infrared energy from lunar shadow areas absorbed by RCS node, $BTU/hr\text{-}ft^2$
GOFIRS	Total infrared energy from lunar shadow areas incident on the RCS node, $BTU/hr\text{-}ft^2$
GOSOL	Total albedo from spacecraft surfaces incident on the RCS node, $BTU/hr\text{-}ft^2$
GOSOLD	Total direct solar energy on the RCS node, $BTU/hr\text{-}ft^2$
H(K)	Spacecraft surface height, ft.
I, J, K, KL	Indices
IENV	Environment index
ISC	Number of spacecraft surfaces for the environment calculations

ISD	Number of lunar shadow areas for the environment
I1, I2, I3	Print indices
N	RCS node number
NX	Number of X increments for lunar shadow area form factor calculation
NN	Maximum number of spacecraft surfaces allowed
NH	Number of spacecraft surface node heights
NW	Number of spacecraft surface node widths
NS	Maximum number of shadow areas allowed
PHIC(K)	Azimuth angle of spacecraft surface K, Deg.
Q(1, N)	Total absorbed heat by RCS node N, Btu/hr
(2, N)	Total incident heat on RCS node N, Btu/hr
(3, N)	Total direct solar absorbed by RCS node N, Btu/hr
(4, N)	Lunar albedo absorbed by RCS node N, Btu/hr
(5, N)	Lunar infrared absorbed by RCS node N, Btu/hr
(6, N)	Spacecraft albedo absorbed by RCS node N, Btu/hr
(7, N)	Spacecraft infrared absorbed by RCS node N, Btu/hr
(8, N)	Direct solar incident on RCS node N, Btu/hr
(9, N)	Lunar albedo incident on RCS node N, Btu/hr
(10, N)	Lunar infrared incident on RCS node N, Btu/hr
(11, N)	Spacecraft albedo incident on RCS node N, Btu/hr
(12, N)	Spacecraft infrared incident on RCS node N, Btu/hr
QIR(K)	Infrared radiosity of spacecraft surface K, BTU/hr-ft^2
QSH(K)	Infrared radiosity of lunar shadow area K, BTU/hr-ft^2
QSOL(K)	Spacecraft surface albedo, BTU/hr-ft^2
QZERO	Minimum infrared radiosity of lunar plain, BTU/hr-ft^2
R4	(Distance)^4 between RCS node and energy source, ft^4
SOL	Solar constant, BTU/hr-ft^2
TANSUN	Tangent of solar angle SUN
TCONN	Lunar plain adiabatic surface temp, °R
THTC(K)	Inclination angle of spacecraft surface K, Deg.
TSC(K)	Temperature of spacecraft surface K, °R
TSCF(K)	Temperature of spacecraft surface K, °F

TSD(K)	Temperature of lunar shadow area K, °R
TSDF(K)	Temperature of lunar shadow area K, °F
W(K)	Width of spacecraft surface K, ft.
WX(K)	Width of lunar shadow area K in the X axis direction, ft.
WY(K)	Width of lunar shadow area K in the Y axis direction, ft.
X	Node center point X coordinate of spacecraft surface, K, ft.
XC(K)	Center point X coordinate of spacecraft surface K, ft.
XN(K)	Spacecraft surface K unit normal vector X axis component
XS(K)	Center point X coordinate of lunar shadow area K, ft.
XSH(I, K)	X coordinate of corner i, spacecraft surface or shadow area K, ft.
XX	X coordinate of lunar shadow area incrimental element, ft.
Y	Node center point Y coordinate of spacecraft surface K, ft.
YC(K)	Center point Y coordinate of spacecraft surface K, ft.
YN(K)	Spacecraft surface K unit normal vector Y axis component
YS(K)	Center point Y coordinate of lunar shadow area K, ft.
YSH (I,K)	Y coordinate of corner i, spacecraft surface of shadow area K, ft.
YY	Y coordinate of lunar shadow area incremental element, ft.
Z	Node center point Z coordinate of spacecraft surface K, ft.
ZC(K)	Center point Z coordinate of spacecraft surface K, ft.
ZN(K)	Spacecraft surface K unit normal vector Z axis component
ZSH(I, K)	Z coordinate of corner i, spacecraft surface K, ft.

LPR SUBPROGRAM FLOW CHART



LPR SUBPROGRAM FLOW CHART

@ FOR,* LPR,LPR
UNIVAC 1108 FORTRAN V LEVEL 2206 001R 8501PH 27 APR 71 10:26:36
THIS COMPILATION WAS DONE ON 27 APR 71 AT 10:26:36

SUBROUTINE LPR ENTRY POINT 003422

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	003451
0000	*DATA	052551
0002	*BLANK	000000
0003	MR	053203
0004	GE1	000043

EXTERNAL REFERENCES (BLOCK, NAME)

0005	TRANR
0006	TRANS
0007	BLOCK
0010	ALPHA1
0011	TAHW
0012	NUD1$
0013	NIO1$
0014	NIO2$
0015	COS
0016	SIN
0017	TAN
0020	MXP6$
0021	SQRT
0022	NMU$
0023	NMD$
0024	NRR3$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	002315 1001G	0001	002337 1013G	0001	002367 1030G	0001	002454 1062G	0001	002523 1103G
0001	002560 1121G	0001	002573 1127G	0001	002612 1140G	0001	002646 1156G	0001	002651 1161G
0001	002675 1173G	0001	003011 1235G	0001	003017 1241G	0001	003051 1254G	0001	003122 1275G
0001	000231 202G	0001	000550 270G	0001	000556 275G	0001	000602 304G	0001	000754 342G
0001	000755 345G	0001	001001 357G	0001	001025 371G	0001	001100 413G	0001	001173 446G
0001	001236 465G	0001	001310 511G	0001	001342 522G	0001	001403 541G	0001	001411 545G
0001	000170 590L	0001	000213 600L	0001	000123 602L	0001	000677 616L	0001	000714 618L
0001	000750 621L	0001	000761 623L	0001	001133 624L	0001	001140 625L	0001	001221 627L
0001	001223 628L	0001	001226 629L	0001	001230 630L	0001	001646 633G	0001	001260 634L
0001	001267 635L	0001	001371 636L	0001	001662 637G	0001	001520 637L	0001	001544 638L
0001	001605 640L	0001	001617 644L	0001	001705 646L	0001	001764 648L	0001	002054 653L
0001	002103 656L	0001	001741 657G	0001	002106 657L	0001	002226 659L	0001	002254 660L
0001	002272 670L	0001	002355 671L	0001	002431 672L	0001	002440 673L	0001	002600 674L
0001	002620 675L	0001	002660 679L	0001	002733 682L	0001	002742 685L	0001	002750 686L
0001	002767 691L	0001	003030 695L	0001	003067 698L	0001	003150 699L	0001	002243 754G
0001	003166 838L	0001	003176 840L	0001	003227 842L	0001	003246 844L	0001	003265 846L
0001	003307 848L	0001	003331 852L	0001	003350 854L	0001	003370 890L	0000	051543 902F
0000	051545 905F	0000	051547 920F	0000	051574 931F	0000	051630 932F	0000	051644 933F
0000	051660 934F	0000	051673 935F	0000	051706 940F	0000	051760 942F	0000	051776 944F
0000	052007 950F	0000	052036 951F	0000	052076 952F	0000	052114 953F	0000	052120 957F
0000	052144 958F	0000	052155 959F	0000	052204 960F	0000	052260 961F	0000	052310 962F
0000	052401 963F	0000	052404 964F	0000	052407 965F	0000	052411 971F	0000 R	051524 AA

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0000 R 000160 AC          0003 R 001327 AL          0000 R 051500 ALBP        0001 R 001007 ALEMAT      0000 R 051540 ALPHA
0000 R 051473 AMOON       0003 R 000041 ANAME       0003 R 002173 AR          0003 R 003037 AS          0004 R 000003 ASE
0000 R 051516 BE          0000 R 051503 BM          0000 R 051477 BS          0004 R 000006 BX          0004 R 000021 BXX
0000 R 051536 BXZDXZ      0004 R 000007 BY          0004 R 000022 BYY         0004 R 000010 BZ          0000 R 051520 BI
0000 R 051517 B2          0004 R 000011 COSP        0000 R 051501 COSS        0004 R 000042 COSSUN      0004 R 000011 COST
0004 R 000023 COST1       0000 R 000250 DA          0000 R 051507 DE          0000 R 051471 DM          0000 R 051511 DS
0003 R 001326 DTIME       0004 R 000024 DX          0000 R 051535 DXDZ2       0000 R 051513 DXS         0004 R 000025 DY
0000 R 000304 DYN         0000 R 051537 DYS         0004 R 000026 DZ          0000 R 000122 DZN         0000 R 051527 DZP
0000 R 051531 DZ2         0000 R 000142 EC          0000 R 051474 EMOON       0000 R 051462 ENV         0000 R 051475 ENV1
0000 R 051476 ENV2        0004 R 000032 FATOT       0000 R 051521 FI          0000 R 051522 FSC         0004 R 000014 FSE
0003 R 003703 GENODE      0004 R 000031 GOFIR       0000 R 051514 GOFIRA      0004 R 000030 GOFIRP      0000 R 051515 GOFIRS
0004 R 000034 GOSOL       0004 R 000036 GOSOLA      0004 R 000035 GOSOLD      0000 R 000124 H           0000 R 051470 I
0003 I 004547 IA          0003 I 000013 ICARD       0003 I 000442 IN          0003 I 000007 IOUT        0004 I 000014 IPAGE
0003 I 000024 IPRINT      0004 I 000027 IQ          0003 I 000010 IREF        0003 I 000012 ISC         0000 I 051472 ISD
0000 I 051541 IS          0000 I 051525 I1          0000 I 051542 I2          0000 I 051526 I3          0000 I 051512 J
0000 I 051513 K           0000 I 051510 KL          0003 I 000000 M           0003 I 000001 MAX         0003 I 000430 MODE
0003 I 000002 MODEM       0003 I 000003 MOLD        0003 I 052337 MTRL        0003 I 000023 MTRLN       0000 I 051505 N
0003 I 000006 NAME        0003 I 000022 NEMI        0003 I 000004 NMODE       0003 I 000005 NVM         0000 I 051532 NX
0004 R 000013 PHI         0000 R 000070 PHIC        0004 R 000004 PHI1        0003 R 000015 PI          0003 R 000016 PI180
0003 R 006257 Q           0000 R 000214 QIR         0003 R 020137 QR          0003 R 021003 QS          0000 R 051424 QSH
0000 R 000232 QSOL        0003 R 000067 QT          0000 R 051466 QZERO       0003 R 000025 REF         0003 R 000025 REF1
0003 R 000026 REF2        0000 R 051523 R4          0003 R 000017 SIG         0004 R 000012 SINP        0004 R 000041 SINSUN
0000 R 051506 SINT        0000 R 051467 SOL         0004 R 000037 SUN         0004 R 000040 SUND        0000 R 051502 TANSUN
0003 R 005413 TCON        0000 R 051504 TCONN       0003 R 000011 TCONT       0003 R 000477 TEMAT       0000 R 000052 THTC
0004 R 000005 THT1        0003 R 000021 TIME        0003 R 000020 TIMED       0003 R 000461 TITLE       0000 R 000176 TSC
0000 R 000268 TSCF        0000 R 051400 TSD         0000 R 051412 TSDF        0000 R 000106 W           0000 R 051436 WX
0000 R 051450 WY          0000 R 001012 X           0000 R 000000 XC          0003 R 001317 XM          0000 R 000740 XN
0003 R 000060 XO          0003 R 021647 XR          0000 R 051354 XS          0004 R 000000 XSE         0000 R 000340 XSH
0000 R 051534 XX          0000 R 024660 Y           0000 R 000016 YC          0000 R 000756 YN          0000 R 051366 YS
0004 R 000001 YSE         0000 R 000504 YSH         0000 R 051540 YY          0000 R 050526 Z           0000 R 000034 ZC
0000 R 000774 ZN          0004 R 000002 ZSE         0000 R 000650 ZSH
```

```
00101     1*          SUBROUTINE LPR(IENV)
00101     2*    C
00103     3*          PARAMETER MMAX=3,NMAX=420
00104     4*          COMMON / MR / M,MAX,MODEM,MOLD,NMODE,NVM,NAME,IOUT,IREF,TCONT,
00104     5*         1     ISC,ICARD,IPAGE,PI,PI180,SIG,TIMED,TIME,NEMI,MTRLN,IPRINT,
00104     6*         2     REF(12),ANAME(15),XO(7),QT(15,15),MODE(10),IN(15),TITLE(14),
00104     7*         3     TEMAT(20,10),ALEMAT(20,10),XM(7),DTIME,
00104     8*         4     AL(NMAX),AR(NMAX),AS(NMAX),GENODE(NMAX),IA(NMAX),TCON(NMAX),
00104     9*         5     Q(12,NMAX),QR(NMAX),QS(NMAX),XR(MMAX,NMAX,10),MTRL(NMAX)
00105    10*          EQUIVALENCE (REF1,REF(1)),(REF2,REF(2))
00106    11*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI,
00106    12*         1    FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,GOFIRP,
00106    13*         1    QOST,FATOT,GOFIR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00107    14*          PARAMETER NS=10,NN=14,NW=25,NH=29,NR=25
00110    15*          DIMENSION XC(NN),YC(NN),ZC(NN),THTC(NN),PHIC(NN),W(NN),H(NN),
00110    16*         1          EC(NN),AC(NN),TSC(NN),QIR(NN),QSOL(NN),DA(NN),
00110    17*         1          TSCF(NN) ,DYN(NN),DZN(NN),XSH(4,NR),YSH(4,NR),ZSH(4,NN),
00110    18*         2          XN(NN),YN(NN),ZN(NN),X(NN,NH,NW),Y(NN,NH,NW),Z(NN,NH)
00111    19*          DIMENSION XS(NS),YS(NS),TSD(NS),TSDF(NS),QSH(NS),WX(NS),WY(NS)
00112    20*          DIMENSION ENV(4)
00113    21*          DATA QZERO,SOL,(ENV(I),I=1,4),DM/1.5,442.,6HLUNAR  ,6H PLAIN,
00113    22*         1  6H DEEP , 6H SPACE  ,10. /
00113    23*    C
00120    24*          READ (5,905) ISC,ISD,SUND,AMOON,EMOON
00127    25*          ICARD = ICARD + 1
00130    26*          SUN = SUND*PI180
00131    27*          COSSUN = COS(SUN)
00132    28*          SINSUN = SIN(SUN)
```

```
00131    29*          IF (ISC.GT.NS) GO TO 640
00135    30*          IF (IENV-9) 580,590,590
00140    31*      580 IF (ISD.GT.NS) GO TO 640
00142    32*          ENV1= ENV(1)
00143    33*          ENV2= ENV(2)
00144    34*          IF (AMOON.LE.0.0.OR.AMOON.GT.1.0) AMOON = 0.93
00146    35*          IF (EMOON.LE.0.0.OR.EMOON.GT.1.0) EMOON = 0.93
00150    36*          IF (SINSUN.GE.0.0) GO TO 602
00152    37*          SINSUN = 0.0
00153    38*          COSSUN = 0.0
00154    39*      602 BS = SOL*SINSUN
00155    40*          ALBP = BS*(1.-AMOON)
00156    41*          COSS = SOL*COSSUN
00157    42*          TANSUN = TAN(SUN)
00160    43*          BM = BS*AMOON
00161    44*          IF (BM.LT.OZERO*EMOON) BM = OZERO*EMOON
00163    45*          TOONN = (BM/(SIG*EMOON))**.25
00164    46*          GO TO 600
00165    47*      590 ENV1= ENV(3)
00166    48*          ENV2= ENV(4)
00167    49*          ISD = 0
00170    50*          ALBP= 0.
00171    51*          BM  = 0.
00172    52*          BS  = SOL*SINSUN
00173    53*          TANSUN = TAN(SUN)
00174    54*          COSS= SOL*COSSUN
00175    55*          TOONN = 1.0
00176    56*      600 CONTINUE
00176    57*  C
00177    58*          IF (ISC.LE.0) GO TO 621
00201    59*      605 DO 620 N=1,ISC
00204    60*          READ (5,902) XC(N),YC(N),ZC(N),PHIC(N),THTC(N),W(N),H(N),EC(N),
00204    61*         1                 AC(N),TSC(N)
00220    62*          ICARD = ICARD + 1
00221    63*          IF (H(N).LE.0.) GO TO 642
00223    64*          IF (W(N).LE.0.) GO TO 644
00225    65*          IF (EC(N).LT.0..OR.EC(N).GT.1.0) GO TO 646
00227    66*          IF (AC(N).LT.0..OR.AC(N).GT.1.0) GO TO 648
00231    67*          TSCF(N) = TSC(N)
00232    68*          TSC(N) = TSC(N) + 460.
00232    69*  C
00233    70*          COSP = COS(PHIC(N)*PI180)
00234    71*          SINP = SIN(PHIC(N)*PI180)
00235    72*          COST = COS(THTC(N)*PI180)
00236    73*      608 SINT = SIN(THTC(N)*PI180)
00237    74*          DX = -W(N)*SINP*0.5
00240    75*          DY = W(N)*COSP*0.5
00241    76*          DZ = H(N)*COST*0.5
00242    77*          DL = H(N)*SINT*0.5
00243    78*          XSH(1,N) = XC(N) + DX - DL*COSP
00244    79*          YSH(1,N) = YC(N) + DY - DL*SINP
00245    80*          ZSH(1,N) = ZC(N) + DZ
00246    81*          XSH(2,N) = XC(N) - DX - DL*COSP
00247    82*          YSH(2,N) = YC(N) - DY - DL*SINP
00250    83*          ZSH(2,N) = ZSH(1,N)
00251    84*          XSH(3,N) = XC(N) + DX + DL*COSP
00252    85*          YSH(3,N) = YC(N) + DY + DL*SINP
00253    86*          ZSH(3,N) = ZC(N) - DZ
00254    87*          XSH(4,N) = XC(N) - DX + DL*COSP
00255    88*          YSH(4,N) = YC(N) - DY + DL*SINP
00256    89*          ZSH(4,N) = ZSH(3,N)
00257    90*          DA(N) = W(N)*H(N)/(NW*NH)
00260    91*          DX = -W(N)*SINP/NW
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```
00261    92*          DY =  W(N)*COSP/NW
00262    93*          DZ =  H(N)*COST/NH
00263    94*          DL = DL/NH
00264    95*          DYN(N) = 0.5*ABS(DY)
00265    96*          DZN(N) = 0.5*ABS(DZ)
00266    97*          Z(N,1)    = ZC(N)-H(N)*COST*.5+DZ*.5
00267    98*          DO 610 I=2,NH
00272    99*      610 Z(N,I) = Z(N,I-1) + DZ
00274   100*          DO 614 I=1,NH
00277   101*          KL = NH+1-2*I
00300   102*          DS = DL*KL
00301   103*          X(N,I,1) = XC(N)+DS*COSP +.5*(W(N)*SINP+DY)
00302   104*          Y(N,I,1) = YC(N)+DS*SINP +.5*(-W(N)*COSP+DY)
00303   105*          DO 612 J=2,NW
00306   106*          X(N,I,J) = X(N,I,J-1) + DX
00307   107*      612 Y(N,I,J) = Y(N,I,J-1) + DY
00311   108*      614 CONTINUE
00313   109*          FATOT = 0.5*(1.-SINT)
00314   110*          COSOL = (BS*SINT-COST*COSP*COSS)
00315   111*          IF (COSOL.LT.0.) COSOL = 0.
00317   112*          COSOL = COSOL + FATOT*ALBP
00320   113*          COFIR = FATOT*HM
00321   114*          IF (TSC(N).GT.0.0) GO TO 616
00323   115*          QIR(N) = (AC(N)*COSOL+COFIR)*DA(N)/PI
00324   116*          TSC(N) = ((AC(N)*COSOL+EC(N)*COFIR)/(SIG*EC(N)))**.25
00325   117*          TSCF(N) = TSC(N) - 460.
00326   118*          GO TO 618
00327   119*      616 CONTINUE
00330   120*          QIR(N) = (EC(N)* SIG*TSC(N)**4 + (1.-EC(N))*COFIR)*DA(N)/PI
00331   121*      618 CONTINUE
00332   122*          QSOL(N) = (1.-AC(N))*COSOL*DA(N)/PI
00333   123*          XN(N) = COST*COSP
00334   124*          YN(N) = COST*SINP
00335   125*          ZN(N) = SINT
00336   126*      620 CONTINUE
00340   127*          GO TO 623
00341   128*      621 DO 622 N=1,MAX
00344   129*          DO 622 I=6,12
00347   130*          Q(I,N) = 0.
00350   131*      622 CONTINUE
00353   132*      623 IF (ISD.LE.0) GO TO 625
00355   133*          READ (5,902) (XS(K),YS(K),WX(K),WY(K),TSDF(K),K=1,ISD)
00367   134*          ICARD = ICARD +(ISD+1)/2
00370   135*          DO 624 K=1,ISD
00373   136*          IF (WX(K).LE.0.) GO TO 852
00375   137*          IF (WY(K).LE.0.) GO TO 852
00377   138*          TSD(K) = TSDF(K) + 460.
00400   139*          QSH(K) = EMCON*SIG*TSD(K)**4
00401   140*          J = NN+K
00402   141*          XSH(1,J) = WX(K)*0.5 + XS(K)
00403   142*          XSH(2,J) = XSH(1,J)
00404   143*          XSH(3,J) =-WX(K)*0.5 + XS(K)
00405   144*          XSH(4,J) = XSH(3,J)
00406   145*          YSH(1,J) = WY(K)*0.5 + YS(K)
00407   146*          YSH(2,J) =-WY(K)*0.5 + YS(K)
00410   147*          YSH(3,J) = YSH(2,J)
00411   148*          YSH(4,J) = YSH(1,J)
00412   149*          DO 624 I=1,ISD
00415   150*          IF (K.EQ.I) GO TO 624
00417   151*          DX = (WX(K)+WX(I))*0.5
00420   152*          IF (ABS(XS(I)-XS(K)) .GE. DX) GO TO 624
00422   153*          DX = (WY(K)+WY(I))*0.5
00423   154*          IF (ABS(YS(K)-YS(I)).LT.DX) GO TO 854
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00425   155*      624 CONTINUE
00430   156*      625 CONTINUE
00431   157*          CALL TRANR
00432   158*          IF (TIME.LE.0.0) RETURN
00434   159*          COSOL = 0.0
00435   160*          COFIRA = 0.
00436   161*          COFIRS = 0.
00437   162*          COFIR  = 0. /
00440   163*          BL = SOL
00441   164*          IF (XO(7).GT.0.) GO TO 629
00443   165*          IF (ISD.LE.0) GO TO 628
00445   166*          DO 627 K=1,ISD
00450   167*          IF (ABS(XO(1)-XS(K)).GT.WX(K)*0.5) GO TO 627
00452   168*          IF (ABS(XO(2)-YS(K)).GT.WY(K)*0.5) GO TO 627
00454   169*          TCONT = YSD(K)
00455   170*          GO TO 630
00456   171*      627 CONTINUE
00460   172*      628 TCONT = TCOON
00461   173*          GO TO 630
00462   174*      629 TCONT = XO(7)
00463   175*      630 CONTINUE
00463   176*  C
00463   177*  C
00464   178*          DO 660 N = 1,MAX
00467   179*          CALL TRANS(N)
00470   180*          IF (IQ) 659,660,631
00473   181*      631 CONTINUE
00474   182*          IF (HZ.LT.0.0) GO TO 634
00476   183*          FATOT = (FSE(3)+FSE(4))*(1.-HZ)
00477   184*          GO TO 635
00500   185*      634 FATOT = FSE(3)+FSE(4)-HZ*(FSE(1)+FSE(2))
00501   186*      635 FATOT = FATOT*0.25
00501   187*  C
00502   188*          IF (ISC.LE.0) GO TO 644
00504   189*          BL = SOL
00505   190*          COFIR = 0.
00506   191*          COSOL = 0.0
00507   192*          Q(7,N) = 0.
00510   193*          DO 640 K=1,ISC
00513   194*          DX = XC(K)-XSE
00514   195*          DY = YC(K)-YSE
00515   196*          DZ = ZC(K)-ZSE
00516   197*          B2 = -(DX*XN(K) + DY*YN(K) + DZ*ZN(K))
00517   198*          IF (B2.LE.0.) GO TO 640
00521   199*          DO 632 I=1,4
00524   200*          DX = XSH(I,K)-XSE
00525   201*          DY = YSH(I,K)-YSE
00526   202*          DZ = ZSH(I,K)-ZSE
00527   203*          B1 = BX*DX + BY*DY + BZ*DZ
00530   204*          IF (B1.GT.0.) GO TO 636
00532   205*      632 CONTINUE
00534   206*          GO TO 640
00535   207*      636 CONTINUE
00536   208*          FI = 0.
00537   209*          FSC= 0.
00540   210*          DO 639 I=1,NH
00543   211*          DZ = Z(K,I)-ZSE
00544   212*          DO 638 J=1,NW
00547   213*          DX = X(K,I,J) - XSE
00550   214*          DY = Y(K,I,J) - YSE
00551   215*          B1 = BX*DX + BY*DY + BZ*DZ
00552   216*          IF (B1.LE.0.0) GO TO 637
00554   217*          B2 = -(XN(K)*DX + YN(K)*DY + ZN(K)*DZ)
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00555   218*          IF (B2.LE.0.0) GO TO 637
00557   219*          R4 = (DX**2 + DY**2 + DZ**2)**2
00560   220*          CALL BLOCK
00561   221*          AA = B1*B2*FSE(IQ)/R4
00562   222*          IF (DZ.LT.0.) FI = FI + AA
00564   223*          FSC = FSC + AA
00565   224*          IF (DA(K).LT.0.04*SQRT(R4)) GO TO 637
00567   225*          I1 =-1
00570   226*          I3 = K
00571   227*          GO TO 671
00572   228*      637 CONTINUE
00573   229*          IF (ABS(DY).GT.DYN(K)) GO TO 638
00575   230*          IF (DX*COSS.GE.0.0) GO TO 638
00577   231*          DZP = -DX*TANSN
00600   232*          IF (ABS(DZ-DZP).GT.DZN(K)) GO TO 638
00602   233*          BL = 0.0
00603   234*      638 CONTINUE
00605   235*      639 CONTINUE
00607   236*          FATOT = FATOT - FI*DA(K)/PI
00610   237*          COFIR = COFIR + FSC*QIR(K)
00611   238*          COSOL = COSOL + FSC*QSOL(K)
00612   239*          CALL ALPHA1(TSC(K),ALPHA)
00613   240*          Q(7,N) = Q(7,N)+FSC*ALPHA*QIR(K)
00614   241*      640 CONTINUE
00616   242*          Q( 6,N)= COSOL*AS(N)
00617   243*          Q(11,N) = COSOL
00620   244*          Q(12,N)= COFIR
00621   245*      644 CONTINUE
00622   246*          IF (ISD.LE.0) GO TO 657
00624   247*          DZ = -ZSE
00625   248*          IF (DZ.GT.-1.0) DZ=-1.0
00627   249*          DZ2 = DZ**2
00630   250*          COFIRS = 0.
00631   251*          COFIRA = 0.
00632   252*          DO 656 K=1,ISD
00635   253*          J = NN+K
00636   254*          DO 645 I=1,4
00641   255*          DX = XSH(I,J)-XSE
00642   256*          DY = YSH(I,J)-YSE
00643   257*          B1 = BX*DX + BY*DY + BZ*DZ
00644   258*          IF (B1.GT.0.) GO TO 648
00646   259*      645 CONTINUE
00650   260*          GO TO 656
00651   261*      648 NX = WX(K) + 5.
00652   262*          DXS= WX(K)/NX
00653   263*          DL = -DXS*DZ/PI
00654   264*          XX =XS(K)-(WX(K)+DXS)*0.5
00655   265*          FSC = 0.
00656   266*          DO 654 I=1,NX
00661   267*          XX = XX+DXS
00662   268*          DX = XX-XSE
00663   269*          DXDZ2 = DX**2 + DZ2
00664   270*          BXZDXZ= BX*DX + BZ*DZ
00665   271*          DS = WY(K)
00666   272*          DYS = 0.
00667   273*          YY = YS(K)-(WY(K)*0.5)
00670   274*      648 CONTINUE
00671   275*          YY = YY + DYS*0.5
00672   276*          R4 = DXDZ2 + DY**2
00673   277*          DYS = 0.03*R4/DXS
00674   278*          IF (DYS.GT.DS) DYS = DS
00676   279*          IF (DYS.GT.DM) DYS = DM
00700   280*          YY = YY + DYS*0.5
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00701   281*          DS = DS-DYS
00702   282*          DY = YY-YSE
00703   283*          BI = BX2DXZ+ BY*DY
00704   284*          IF (BI.LE.0.) GO TO 653
00706   285*          R4 = (DXD72 + DY**2)**2
00707   286*          CALL BLOCK
00710   287*          FSC = BI*DL*DYS*FSE(ID)/R4 + FSC
00711   288*      653 CONTINUE
00712   289*          IF (DS.GT.0.) GO TO 648
00714   290*      654 CONTINUE
00716   291*          CALL ALPHA1(TSD(K),ALPHA)
00717   292*          GOFIRS = GOFIRS    + FSC*OSH(K)
00720   293*          GOFIRA = GOFIRA    + FSC*OSH(K)*ALPHA
00721   294*          FATOT = FATOT - FSC
00722   295*      656 CONTINUE
00724   296*      657 CONTINUE
00725   297*          IF (FATOT.LT.0.0) FATOT = 0.
00727   298*          O( 9,N)= FATOT*ALBP
00730   299*          O(10,N)= FATOT*BM + GOFIRS
00731   300*          GOSOLD = BL*COST
00732   301*          O( 8,N)= GOSOLD
00733   302*          O( 2,N) = GOSOL + GOFIR + GOSOLD + O(9,N) + O(10,N)
00734   303*          O( 3,N)= GOSOLD*AS(N)
00735   304*          O( 4,N)= O(9,N)*AS(N)
00736   305*          CALL ALPHA1(TOONN ,ALPHA)
00737   306*          O( 5,N)= FATOT*BM*ALPHA + GOFIRA
00740   307*          O( 1,N)= O(3,N)+O(4,N)+O(5,N)+O(6,N)+O(7,N)
00741   308*          OS(N) = (GOSOLD + O(9,N) + GOSOL)*ASE
00742   309*          QR(N) =(O(10,N)+GOFIR)*ASE
00743   310*          IF (QR(N).LE.0.0) QR(N) = 0.000001
00745   311*          AR(N) =(O(5,N)+O(7,N))*ASE/QR(N)
00746   312*          IF (AR(N).LE.0.0) CALL ALPHA1(TOONT,AR(N))
00750   313*          CALL TAIW(O(1,N),TOON(N))
00751   314*      659 CONTINUE
00752   315*          J = IA(N)
00753   316*          DO 658 I=1,12
00756   317*          O(I,N) = O(I,N)*ASE
00757   318*          OT(1,1)= OT(I,1)+O(I,N)
00760   319*      658 OT(1,J)=OT(I,J)+O(I,N)
00762   320*      660 CONTINUE
00762   321*  C
00764   322*          IF (IREF.NE.2) GO TO 670
00766   323*          XO(5) = XM(1)
00767   324*          XO(6) = XM(2)
00770   325*          XO(7) = XM(3)
00771   326*      670 CONTINUE
00772   327*          II= 1
00773   328*          WRITE (IOUT) TIME,M,MODE(M),MAX,XO,IENV,ENV1,ENV2,SUND,TOONT,NVM,
00773   329*         1    (O(I,N),OS(N),QR(N),TOON(N),AS(N),AR(N),N=1,MAX)
01024   330*      671 CONTINUE
01025   331*          IPAGE = IPAGE + 1
01026   332*          WRITE (6,950) TITLE,IPAGE,TIME,REF(1),REF(2),MODE(M),ENV1,ENV2
01043   333*          IF (IENV.EQ.9) GO TO 672
01045   334*          WRITE (6,959) SUND,AMOON,EMOON
01052   335*          GO TO 673
01053   336*      672 WRITE (6,958) SUND
01056   337*      673 CONTINUE
01057   338*          IF (ISC.GT.0) WRITE (6,960) (N,TSCF(N),XC(N),YC(N),ZC(N),THTC(N),
01057   339*         1                    PHIC(N),W(N),H(N),EC(N),AC(N),N=1,ISC)
01100   340*          IF (ISD.GT.0) WRITE (6,961) (N,TSDF(N),XS(N),YS(N),WX(N),WY(N),
01100   341*         1                    N=1,ISD)
01114   342*          IF (IREF.NE.2) GO TO 674
01116   343*          WRITE (6,971) REF1,(XO(I),I=1,4),TOONT,REF2,(XM(I),I=1,4)
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01133   344*          GO TO 675
01134   345*      674 WRITE (6,951) REF1,REF2,(XO(I),I=1,4),TOUNT
01145   346*      675 CONTINUE
01146   347*          IF (I1.LT.0) GO TO 838
01150   348*          WRITE (6,962)
01152   349*          IF (NAME.LE.0) GO TO 679
01154   350*          WRITE (6,963) (ANAME(J),(QT(I,J),I=1,12),J=2,NAME)
01166   351*      679 WRITE (6,963)
01170   352*          WRITE (6,964) ANAME(1),(QT(I,1),I=1,12)
01177   353*          IF (IPRINT.NE.-2) WRITE(6,957) REF(1),REF(2)
01204   354*      680 IF (IPRINT) 699,681,682
01207   355*      681 I3 = 180
01210   356*          I2 = 80-(ISC+ISD+NAME)*4
01211   357*          GO TO 685
01212   358*      682 I3 = 45
01213   359*          I2 = 20-(ISC+ISD+NAME)
01214   360*      685 CONTINUE
01215   361*          IF (I2.GT.0)  GO TO 686
01217   362*          I2 = 0
01220   363*          GO TO 698
01221   364*      686 CONTINUE
01222   365*          IF (I2.GT.MAX) I2 = MAX
01224   366*          WRITE (6,965)
01226   367*          IF (IPRINT) 699,695,691
01231   368*      691 WRITE (6,962)
01233   369*          WRITE (6,964) (N,GENDER(N),(Q(I,N),I=1,12),TOUN(N),N=11,12)
01241   370*          GO TO 698
01250   371*      695 WRITE (6,952)
01252   372*          WRITE (6,953) (N,GENDER(N),Q(1,N),Q(2,N),TOUN(N),N=11,12)
01264   373*      698 IF (I2.NE.MAX) GO TO 699
01266   374*          I1 = I2+1
01267   375*          I2 = I2+13
01270   376*          IF (I2.GT.MAX) I2 = MAX
01272   377*          IPAGE = IPAGE + 1
01273   378*          WRITE (6,950) TITLE,IPAGE,TIME,REF(1),REF(2),MODE(M),ENV1,ENV2
01310   379*          IF (IPRINT) 699,695,691
01313   380*      699 IF (DTIME.LE.0.0) GO TO 625
01315   381*          TIME = TIME + DTIME
01316   382*          TIMEO= TIME
01317   383*          DTIME= -1.
01320   384*          IPRINT = -2
01321   385*          NVM = -2
01322   386*          GO TO 670
01322   387*  C
01322   388*  C       SECTION 800, INPUT ERROR DIAGNOSTIC MESSAGES
01322   389*  C
01323   390*      838 WRITE (6,940) I3
01326   391*          GO TO 625
01327   392*      840 WRITE (6,920) ICARD
01332   393*          I1 = NN
01333   394*          I2 = NS
01334   395*          WRITE (6,931) ISC,I1,ISD,I2
01342   396*          GO TO 890
01343   397*      842 WRITE (6,920) ICARD
01346   398*          WRITE (6,932) N
01351   399*          GO TO 890
01352   400*      844 WRITE (6,920) ICARD
01355   401*          WRITE (6,933) N
01360   402*          GO TO 890
01361   403*      846 WRITE (6,920) ICARD
01364   404*          WRITE (6,934) N,EC(N)
01370   405*          GO TO 890
01371   406*      848 WRITE (6,920) ICARD
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01399   407*          WRITE (6,915) N,AC(N)
01400   408*          GO TO 890
01401   409*      852 WRITE (6,920) ICARD
01404   410*          WRITE (6,942) K
01407   411*          GO TO 890
01410   412*      854 WRITE (6,920) ICARD
01413   413*          WRITE (6,944) K,I
01417   414*      890 TIME = -100.
01420   415*          RETURN
01420   416*      C
01420   417*      C     SECTION 900, FORMAT STATEMENTS
01420   418*      C
01421   419*        902 FORMAT (10F8.3 )
01422   420*        905 FORMAT (2I4,9F8.1)
01423   421*        920 FORMAT (////47H FATAL ERROR IN DATA INPUT FOUND ON CARD NUMBER,
01423   422*           1 I4 , //     52H PROGRAM WILL CALL EXIT AFTER THE FOLLOWING MESSAGE
01423   423*           2. ////)
01424   424*        931 FORMAT (79H THE NUMBER OF SHADOW AREAS OR SPACE CRAFT SURFACES  AS
01424   425*           1 INPUT IS TOO LARGE.  // 6H ISC = ,I5,10X,19H MAXIMUM ALLOWED = ,
01424   426*           2 I5 // 6H ISD = ,I5,30X,19H MAXIMUM ALLOWED = ,I5 )
01425   427*        932 FORMAT (39H SPACE CRAFT SURFACE HEIGTH OF SURFACE ,I3,
01425   428*           1 17H IS NOT POSITIVE.  )
01426   429*        933 FORMAT (39H SPACE CRAFT SURFACE WIDTH OF SURFACE  ,I3,
01426   430*           1 17H IS NOT POSITIVE.  )
01427   431*        934 FORMAT (43H SPACE CRAFT SURFACE EMISSIVITY OF SURFACE ,I3,
01427   432*           1  4H IS , F10.4 )
01430   433*        935 FORMAT (44H SPACE CRAFT SURFACE ABSORBTIVITY OF SURFACE ,I3,
01430   434*           1 4H IS ,  F10.4 )
01431   435*        940 FORMAT (65H0REFERENCE COORDINATE SYSTEM IS TOO CLOSE TO SPACE CRAF
01431   436*           1T SURFACE  ,I5 ,31H  FOR FORM FACTOR CALCULATIONS. ///
01431   437*           2 51H MOVE REFERENCE COORDINATE SYSTEM AWAY FROM SURFACE //10X,
01431   438*           3  6H- OR - //35H REDUCE SPACE CRAFT SURFACE SIZE.  ///
01431   439*           4 23H GO TO NEXT TIME POINT. )
01432   440*        942 FORMAT (13H0SHADOW AREA ,I4,3X,54HWIDTH IN EITHER THE X OR Y DIREC
01432   441*           1TION IS NOT POSITIVE.  )
01433   442*        944 FORMAT (13H0SHADOW AREAS,I4,3X, 3HAND,I4,3X,10H OVERLAP. )
01434   443*        950 FORMAT (9H1     TIME,21X,14A5,12X,4HPAGE,I4  /9H      (HR),/F10.3/
01434   444*           1 30X,2A5,   8H  IN A  ,A5,29HING  MODE  IS LOCATED IN A
01434   445*           2,2A6,15H  ENVIRONMENT.  //)
01435   446*        951 FORMAT (2H0 ,2A5,16X,1HX,9X,1HY,9X, 2HZ      AZIMUTH   CONTACT  /
01435   447*           1 10H  LOCATION,16X,  4SH(FT)       (FT)       (FT)      (DEG)       TE
01435   448*           2MP / 20X,3F10.2,2F10.1 ///
01435   449*           3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.    / )
01436   450*        952 FORMAT (4(32H    NODE  NODE    Q      Q   AD W )/
01436   451*           1         4(32H      NO.  NAME ABSOR INCID  TEMP ))
01437   452*        953 FORMAT (4(5X,I3,1X,A5,3F6.1) )
01440   453*        957 FORMAT (//// 2X,2A5,102H  ENVIRONMENT IS THE SAME AS THE PREVIOUS
01440   454*           1TIME POINT.  SEE THAT PRINTOUT FOR DETAILED NODAL FLUX DATA. )
01441   455*        958 FORMAT (13H  ENVIRONMENT, 16X, 18HSUN ANGLE (DEG) =  ,F7.2 //)
01442   456*        959 FORMAT (13H  ENVIRONMENT,14X,23HSUN      LUNAR     LUNAR/  26X,
01442   457*           1 25HANGLE    SOLAR       I.R. /26X,  25H(DEG)    ABSOR     ABSOR /
01442   458*           2 20X,F10.2,2F10.3 /)
01443   459*        960 FORMAT (13H0 SPACE CRAFT,13X, 4HTEMP,8X,1HX,9X,1HY,9X,1HZ, 6X,
01443   460*           1 55HINCLN    AZIMUTH    WIDTH     HEIGHT     I.R       SOLAR    /
01443   461*           2  9H  SURFACE,16X,5HDEG F, 3(6X,4H(FT)),2(5X,5H(DEG)),
01443   462*           3  2(6X,4H(FT)),5X, 5HEMISS,4X,6HABSORB  /15H  SPECIFICATION,I5,
01443   463*           4  8F10.2,2F10.3 / (10X,I10,8F10.2,2F10.3 ) )
01444   464*        961 FORMAT ( 8H0 SHADOW,16X, 4HTEMP,8X,1HX,9X,1HY,5X,17HX WIDTH   Y WI
01444   465*           1DTH /    9H  SURFACE,16X,5HDEG F,4(6X,4H(FT)) /15H  SPECIFICATION,
01444   466*           2 I5,5F10.1 / (10X,I10,5F10.1) )
01445   467*        962 FORMAT (40X,22HABSORBED HEAT, BTU/HR    ,23X,
01445   468*           1 23HINCIDENT ENERGY, BTU/HR ,15X, 4HAD W
01445   469*           2/12TH       NODE     TOTAL     TOTAL    DIRECT     SOLAR       ENV     VE
```

```
01445   470*          3HIC    VEHIC   DIRECT    SOLAR       ENV     VEHIC     VEHIC      TEMP
01445   471*          4/12TH NO.  NAME    AHSOR     INCID     SOLAR   ABSRD       I.R.     ALB
01445   472*          5HDD      I.R.     SOLAR    ALBEDO      I.R.    ALBEDO      I.R.     DEG R
01445   473*          6 )
01446   474*       963 FORMAT (5X,A5,12F9.1)
01447   475*       964 FORMAT (14,1X,A5,13F9.1)
01450   476*       965 FORMAT (1H ///)
01451   477*       971 FORMAT (12HO LOCATION    ,16X,10HX,9X,10Y,9X,25HZ      AZIMUTH    CENT
01451   478*          1ACT   /26X,45H(FT)       (FT)       (FT)      (DEG)      TEMP R /
01451   479*          2  12X,A5,3X,5F10.2 / 12X,A5,3X,4F10.2 ///
01451   480*          3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.     //
01452   481*           END

     END OF UNIVAC 1108 FORTRAN-V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
LPR              SYMBOLIC                                        27 APR 71   10:25:05   0  02333574     14    481   (DELETED)
LPR      CODE:   RELOCATABLE                                     27 APR 71   10:25:05   1  02350712     48      1   (DELETED)
                                                                                        0  02350772     14    239
```

SUBPROGRAM NAME: Subroutine LCR

SEGMENT NAME: SUBC1

PURPOSE: Calculate the thermal environment experienced by the Reference Coordinate System (RCS) located in or near lunar crater surfaces.

DESCRIPTION: The EHFR lunar crater thermal environment consists of albedo and infrared energy originating from lunar craters, albedo and infrared energy from the lunar plain surrounding the lunar craters, and direct solar energy. The governing equations describing incident and absorbed energy calculations on the RCS are presented in Section 4.2 and 4.3 of the Volume I. Input to the routine consists of solar vector elevation data, lunar surface thermal properties, and lunar crater location and configuration data.

CALLING PROGRAM: SUBM1 (Main Program)

ARGUMENT LIST: None, all data required is transferred into and out of the LCR subprogram via block common statements.

NOMENCLATURE: Listed below is a dictionary of FORTRAN nomenclature used by the LCR program. Also used in the LCR routine are the variables of the MR, GE1, GE2, and GE3 block common statements. The MR and GE1 variables are defined with the SUBM1 program nomenclature. The GE2 and GE3 block common variables are defined following the LCR nomenclature.

ALPHA	Absorptivity of an RCS node to incident energy
DC	(Distance)^2 between craters, ft^2
ENV1, ENV2	Environment name in A format
FAINP	Form factor of RCS node to the infinite lunar plain
FAP	Form factor of RCS node to lunar plain (adjusted for lunar crater form factors)
FATOT	Form factor of RCS node to all lunar craters
GOFIR	Total lunar crater infrared energy incident on an RCS node, Btu/hr-ft^2
GOFIRP	Total lunar plain infrared energy incident on an RCS node, Btu/hr-ft^2
GOSOL	Total lunar crater albedo energy incident on an RCS node, Btu/hr-ft^2
GOSOLA	Total lunar plain albedo energy incident on an RCS node, Btu/hr-ft^2

GOSOLD	Total direct solar energy incident on an RCS node, Btu/hr-ft^2
IENV	Environment option index
I, J, K	Indices
INC	Number of lunar craters for the current environment
I1, I2, I3	Print indices
N	RCS node number
Q(1, N)	Total absorbed heat by RCS node N, Btu/hr
(2, N)	Total incident heat on RCS node N, Btu/hr
(3, N)	Total direct solar energy absorbed by RCS node N, Btu/hr
(4, N)	Total crater albedo energy absorbed by RCS node N, Btu/hr
(5, N)	Total crater infrared energy absorbed by RCS node N, Btu/hr
(6, N)	Total plain albedo energy absorbed by RCS node N, Btu/hr
(7, N)	Total plain infrared energy absorbed by RCS node N, Btu/hr
(8, N)	Total direct solar energy incident on RCS node N, Btu/hr
(9, N)	Total crater albedo energy incident by RCS node N, Btu/hr
(10, N)	Total crater infrared energy incident on RCS node N, Btu/hr
(11, N)	Total plain albedo energy incident on RCS node N, Btu/hr
(12, N)	Total plain infrared energy incident on RCS node N, Btu/hr
SOL	Solar constant, BTU/hr-ft^2
TA	Verticle distance from crater rim to an RCS node, ft.
TB	Horizontal distance along solar vector from the crater rim to an RCS node, ft
XRMN3	RCS node distance to 1.5 feet above local lunar surface, ft

GE2 BLOCK COMMON NOMENCLATURE

Listed below is a dictionary of FORTRAN nomenclature for the variables contained in the GE2 block common statement. GE2 is used by the lunar crater environment subprograms and is contained in segment C of the EHFR map.

AMOON	Absorptance of the moon to direct solar energy
ASP(K)	Aspect ratio (diameter:depth) of lunar crater K
DEPTH(K)	Depth of lunar crater K, ft.
DIA(K)	Diameter of lunar crater K, ft.
EMOON	Lunar surface thermal emissivity
INC	Number of lunar craters for this environment.
INCRAT	Crater number in which the RCS is located
RAD	Crater spherical segment $(\text{radius})^2$, ft^2
RTOPIN	$(\text{Radius of top})^2$ of crater in which the RCS is located, ft^2
RTOP2	$(\text{Radius of top})^2$ of crater, ft^2
XK(K)	Center point X coordinate location of crater K, ft
YK(K)	Center point Y coordinate location of crater K, ft

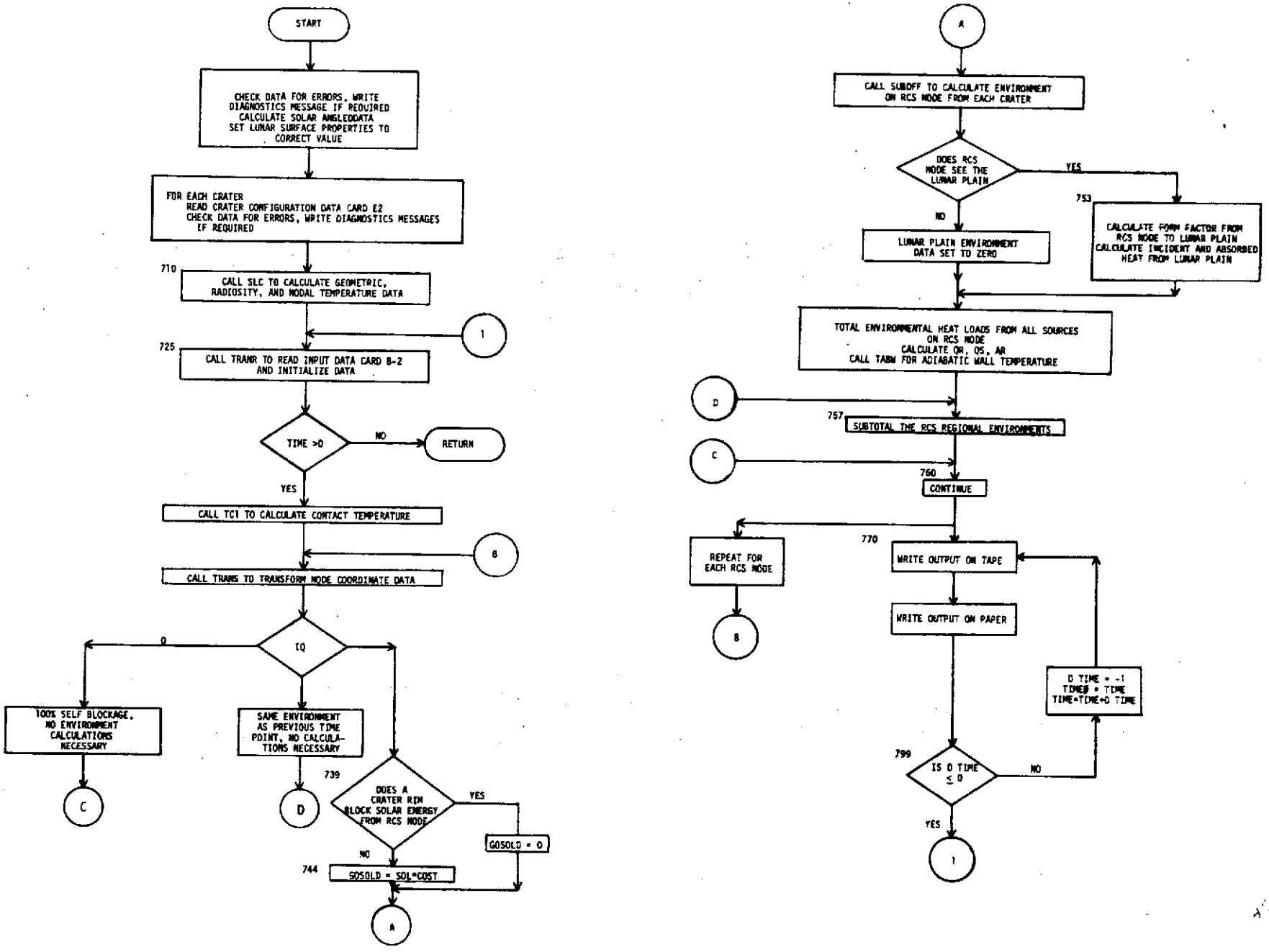
GE3 BLOCK COMMON NOMENCLATURE

Listed below is a dictionary of FORTRAN nomenclature for the variables contained in the GE3 block common statement. The GE3 is used by all of the lunar crater environment subprograms and is contained in segment C of the EHFR map.

ALBP	Lunar plain albedo, Btu/hr ft^2
AREA(I)	Lunar crater node area, ft^2
COSPHC	Cosine of PHC
COSPHI	Cosine of PHI
COSTHC	cosine of THC
COSTHT	Cosine of THT
DCSQ	$(Distance)^2$ between an RCS node and crater K center, ft^2
DGMXSQ	Diagonal $(distance)^2$ of largest crater node, ft^2
DPHI	Differential azimuth angle of crater node, radians
DTHT	Differential elevation angle of crater node, radians
NPHID	Number of crater azimuth divisions
NPHID1	NPHID + 1
NPHID2	Half the number of crater azimuth divisions
NTHTD	Number of crater elevation division
NTHTC	Number of crater corner point elevation data required.
PATI	0.1/R
PHC	Azimuth angle of crater node corner point, radians
PHI	Azimuth angle of crater node center point, radians
PSMAX	Crater node (at top) dimension, ft
R	Spherical radius of crater, ft
RTOP	Radius of crater top, ft.
SINPHC	Sine of PHC
SINPHI	Sine of PHI
SINTHC	Sine of THC
SINTHT	Sine of THT
SOLFLX	Albedo of lunar crater node, Btu/hr ft^2
TC	Temperature of lunar crater node, °R
TCONN	Temperature of lunar plain,°R
THC	Elevation angle of crater node corner point, radians
THT	Elevation angle of crater node center point, radians

W	Infrared radiosity of lunar crater node, Btu/hr ft^2
WP	Infrared radiosity of lunar plain, Btu/hr ft^2
ZCNTR	Z coordinate of spherical center of crater, ft
ZK	Z coordinate of lunar crater node corner point, ft
ZN	Z coordinate of lunar crater node center point, ft

LCR SUBPROGRAM FLOW CHART



@ FOR,* SUBCT,SUBCT 15 MAY 71
UNIVAC 1100 FORTRAN V LEVEL 2206.0018.E501EH
THIS COMPILATION WAS DONE ON 15 MAY 71 AT 05:00:12

SUBROUTINE COR ENTRY POINT 001504

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	001520
0000	*DATA	000601
0002	*BLANK	000000
0003	SR	053203
0004	GE1	000044
0005	GE3	040206
0006	GE2	000774

EXTERNAL REFERENCES (BLOCK, NAME)

0007	SIN
0010	TRANH
0011	TC1
0012	TRANS
0013	SUBOFF
0014	ALPHAI
0015	TAHW
0016	NBOLS
0017	NIOLS
0020	NIO2S
0021	SJS
0022	COS
0023	SQRT
0024	ATAN
0025	NWIRS
0026	NWIOS
0027	NBBR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001		000120	145G	0001		000164	170G	0001		000167	173G	0001	000254	217G
0001		000542	418G	0001		000616	343G	0001		000640	355G	0001	000667	371G
0001		000725	411G	0001		000761	427G	0001		000772	435G	0001	001011	446G
0001		001041	462G	0001		001070	477G	0001		001201	540G	0001	001207	544G
0001		001241	557G	0001		001304	576G	0001		001455	662G	0001	000777	674L
0001		001017	675L	0001		000223	709L	0001		000231	725L	0001	000327	744L
0001		000343	745L	0001		000360	753L	0001		000373	754L	0001	000402	755L
0001		000423	756L	0001		000525	757L	0001		000553	760L	0001	000570	770L
0001		001053	779L	0001		001131	7#2L	0001		001136	785L	0001	001144	790L
0001		001220	795L	0001		001257	798L	0001		001330	799L	0001	001346	#46L
0001		001367	#48L	0001		001406	850L	0001		001423	852L	0001	001440	#54L
0001		001461	890L	0000		000024	902F	0000		000026	905F	0000	000030	920F
0000		000055	93#F	0000		000064	939F	0000		000075	940F	0000	000111	941F
0000		000125	942F	0000		000153	950F	0000		000202	951F	0000	000242	952F
0000		000260	953F	0000		000264	957F	0000		000310	959F	0000	000461	963F
0000		000464	964F	0000		000467	965F	0000		000471	971F	0000	000475	982F
0003	R	001327	AL	0005	R	000013	ALBP	0003	R	001007	ALPHAT	0000	R 000016	ALPHA
0006	R	000006	ANDON	0003	R	000041	ANAME	0003	R	002173	AR	0005	R 040042	AREA
0003	R	003037	AS	0004	R	000033	ASF	0006	R	000630	ASP	0004	R 000006	BX
0004	R	000007	BY	0004	R	000022	BYY	0004	R	000010	BZ	0004	R 000011	COSP
0005	R	001456	COSPHC	0005	R	000326	COSPHI	0004	R	000042	COSSUM	0004	R 000031	COST
0005	R	002134	COSTHC	0005	R	001002	COSTHT	0004	R	000023	COST1	0000	R 000006	DC

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0005 R 000014 DCSQ        0006 R 000154 DEPTH       0005 R 000010 DESNSQ      0006 R 000010 DEX         0005 R 000001 DFFQ
0005 R 000004 DIFF        0004 R 001424 DIFMF       0004 R 000024 DX          0004 R 000025 DY          0004 R 000021 DZ
0006 R 000007 ENDON       0000 R 000001 ENV1        0000 R 000002 ENV2        0000 R 000014 EXISP       0000 R 000015 EXP
0004 R 000032 FATOT       0004 R 000014 FSE         0003 R 001703 GENODE      0004 R 000014 GOFTR       0004 R 000030 GOFTRP
0004 R 000034 GOSOL       0004 R 000046 GOSOLA      0004 R 000045 GOSOLD      0000 I 000004 I           0004 I 003547 IA
0003 I 000013 ICARD       0000 I 000000 IENV        0003 I 000442 IN          0006 I 000001 INC         0004 I 000004 INCRAT
0003 I 000007 IOUT        0003 I 000014 IPAGE       0003 I 000024 IPRINT      0004 I 000027 IQ          0004 I 000010 IREF
0003 I 000012 ISC         0000 I 000021 IX          0000 I 000020 IY          0000 I 000023 IZ          0004 I 000022 IX
0000 I 000017 J           0000 I 000005 K           0004 I 000000 M           0004 I 000001 MAX         0004 I 000430 MDOF
0004 I 000002 MODESM      0004 I 060001 MOLD        0004 I 052447 MORE        0004 I 000023 MOREN       0000 I 000010 N
0004 I 000006 NAME        0004 I 000022 NEMC        0004 I 000004 NMODE       0005 I 000015 NPHID       0004 I 000005 NSO
0005 R 000011 PATI        0005 R 001146 PHC         0005 R 000016 PHI         0004 R 066664 PICI        0004 R 000011 PHI2
0003 R 000015 PI          0003 R 000016 PI180       0005 R 000007 PSMAX       0004 R 000257 Q           0004 R 020147 QF
0003 R 021004 QS          0004 R 000007 QT          0005 R 000000 R           0006 R 000000 RAD         0004 R 000025 REF
0004 R 000025 REF1        0003 R 000026 REF2        0000 R 000007 REM         0005 R 000001 RTOP        0006 R 000002 RTOPIN
0006 R 000001 RTOP2       0004 R 000017 SIG         0004 R 000012 SINP        0005 R 001412 SINPHC      0005 R 000162 SINPHI
0004 R 000041 SINSUN      0005 R 001767 SINTHC      0005 R 000646 SINTHI      0000 R 000004 SOL         0005 R 002401 SOLFLX
0004 R 000047 SUN         0004 R 000040 SUND        0005 R 000012 TCONN       0005 R 014111 TC          0003 R 005414 TCON
0005 R 000472 THT         0004 R 000005 THTI        0004 R 000021 TIME        0004 R 000477 TEMVT       0005 R 001622 THC
0005 R 000006 TSMAX       0005 R 025721 W           0005 R 000005 WP          0006 R 000464 XK          0004 R 000461 TITLE
0003 R 000060 XO          0004 R 021647 XR          0000 R 000013 XRNNJ       0004 R 000000 XSE         0004 R 001417 XX
0006 R 000005 YNORAT      0004 R 000001 YSE         0005 R 000002 ZUNIR       0005 R 047675 ZK          0005 R 037541 ZX
0004 R 000002 ZSF
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00101     1*          SUBROUTINE IER
00101     2*    C
00103     3*          PARAMETER NTHID=100,NPHID=100,NPHID2=50,NTHIC=101
00104     4*          PARAMETER MMAX=3,NMAX=420
00105     5*          COMMON / MR / M,MAX,MODEN,MOLD,NMODE,NXM,NAME,IOUT,IREF,TCONT,
00105     6*         1      ISC,ICARD,IPAGE,PI,PI180,SIG,TIMED,TIME,NESC,MIRLN,IPRINT,
00105     7*         2      REF(12),ANAME(15),MO(7),QT(15,15),MODE(10),IN(15),TITLE(14),
00105     8*         3      TEMAT(20,10),ALENMT(20,10),XN(7),DFINE,
00105     9*         4      AL(NMAX),AR(NMAX),AS(NMAX),GENODE(NMAX),IA(NMAX),TCON(NMAX),
00105    10*         5      Q(12,NMAX),QR(NMAX),QS(NMAX),XR(NMAX,NMAX,10),MORE(NMAX)
00106    11*          EQUIVALENCE (REF1,REF(1)),(REF2,REF(2))
00107    12*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI2,
00107    13*         1    FSE(5),BXX,BYY,COST),DX,DY,DZ,IQ,GOFTRP,
00107    14*         1    COST,FATOT,GOFTR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00110    15*          COMMON /GE4 / R,RTOP,ZUNIR,DTHT,DPHI,WP,
00110    16*         1      TSMAX,PSMAX,TCONSQ,PATI,TCONN,ALBP,DCSQ,NPHID1,
00110    17*         3      PHI(NPHID),SINPHI(NPHID),COSPHI(NPHID),
00110    18*         4      THT(NTHID),SINTHT(NTHID),COSTHT(NTHID),
00110    19*         5      PHC(NPHID),SINPHC(NPHID),COSPHC(NPHID),
00110    20*         6      THC(NTHIC),SINTHC(NTHIC),COSTHC(NTHIC),
00110    21*         7      SOLFLX(NTHID,NPHID2),TCONTH(D,NPHID2),W(NTHID,NPHID2),
00110    22*         8      ZN(NTHID),ZK(NTHIC),AREA(NTHID)
00111    23*          COMMON / GE2 / RAD,RTOP2,RTOPIN,INC,INCRAT,YNCRAT, AMOON,EMOON,
00111    24*         1      DIA(100),DEPTH(100),YK(100),XK(100),ASP(100)
00112    25*          DATA IENV,ENV1,ENV2,SOL /3,6HUNAR  ,6HORATER,442.0 /
00112    26*    C
00117    27*          READ (5,905) I,INC,SUND,AMOON,EMOON
00126    28*          ICARD = ICARD + 1
00127    29*          IF (INC.LE.0) INC = 1
00131    30*          IF (INC.GT.10) GO TO 948
00133    31*          IF (SUND.LT.0.0) SUND = 0.
00135    32*          SUN = SUND*PI180
00136    33*          SINSUN = SIN(SUN)
00137    34*          COSSUN = COS(SUN)
00140    35*          IF (AMOON.LE.0.0.OR.AMOON.GT.1.0) AMOON = 0.93
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00142    36*          IF (ESEON.LE.0.0.OR.ESEON.GE.1.0) ESEON = 0.93
00144    37*          DO 705 I=1,INC
00147    38*          READ (5,902)   DIACI),DEPTHCI),XKCI),YKCI)
00155    39*          ICARD = ICARD + 1
00156    40*          IF (DIACI)   .LE.0.0) GO TO *50
00160    41*          IF (DEPTHCI).LE.0.0) GO TO *52
00162    42*          ASPCI) = DIACI)/DEPTHCI)
00163    43*          IF (ASPCI).LT.2.0) GO TO *54
00165    44*      705 CONTINUE
00167    45*          DO 710 I=1,INC
00172    46*          DO 709 K=1,INC
00175    47*          IF (K.EQ.I) GO TO 709
00177    48*          DC = 0.25*(DIACI)+DIACK))**2
00200    49*          DX =(XKCI)-XKCK))**2 +(YKCI)-YKCK))**2
00201    50*          IF (DX.LT.DC) GO TO *46
00203    51*      709 CONTINUE
00205    52*      710 CONTINUE
00207    53*          CALL SUC
00210    54*      720 CONTINUE
00211    55*      725 CONTINUE
00212    56*          CALL TRANR
00213    57*          IF (TIM*.LE.0.0) RETURN
00215    58*          CALL TCI(XO),RESC,IUNIT)
00215    59*  C
00216    60*          DO 760 N = 1,MAX
00221    61*          CALL TRANS(N)
00222    62*          IF (ID) 757,760,749
00225    63*      749 CONTINUE
00226    64*          QOSOLD = SOLACOST
00227    65*          IF(CSMRAT.LE.0) GO TO 745
00231    66*          IF (ZSE .GE. 0.0) GO TO 744
00233    67*          TA = -ZSE
00234    68*          TB = SQRT(ORIOPIN-(ZSE-YMORVT)**2) + XSE
00235    69*          IF (SUN.GE.ATAN(TA/TB)) GO TO 744
00237    70*          QOSOLD = 0.0
00240    71*      744 CONTINUE.
00241    72*          XRSN1 = XR(M,N,I)-1.5
00242    73*          IF (XRSN1.LT.0.0) ZSE = ZSE-XRSN1
00244    74*      745 CONTINUE
00245    75*          CALL SUBEFF(Q(5,N))
00246    76*          IF (ZSE.GT.0.0) GO TO 753
00250    77*          QOFTRP = 0.
00251    78*          QOSOLA = 0.0
00252    79*          Q( 7,N) = 0.
00253    80*          GO TO 756
00254    81*      753 CONTINUE
00255    82*          IF (BZ.LT.0.0) GO TO 754
00257    83*          FAINP = (FSE(3)+FSE(4))*(1.-BZ)
00260    84*          GO TO 755
00261    85*      754 FAINP = (FSE(3)+FSE(4)-BZ*(FSE(1)+FSE(2)))
00262    86*      755 FAINP = FAINP*0.25
00263    87*          FAP = FAINP - FATOT
00264    88*          QOFTRP = WP*FAP
00265    89*          QOSOLA = ALBP*FAP
00266    90*          CALL ALPHAI(TCONN,ALPHA)
00267    91*          Q( 7,N) = QOFTRP*ALPHA
00270    92*      756 CONTINUE
00271    93*          Q( 2,N) = QOSOL+QOSOLD+QOSOLA+QOFIR+QOFTRP
00272    94*          Q( 3,N)= QOSOLD*AS(N)
00273    95*          Q( 4,N) = QOSOL*AS(N)
00274    96*          Q( 6,N) = QOSOLA*AS(N)
00275    97*          Q( 8,N)= QOSOLD
00276    98*          Q( 9,N) = QOSOL.
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00377    99*          Q(10,N)= QOFIR
00400   100*          Q(11,N) = QDSOLA
00401   101*          Q(12,N) = QOFIRP
00402   102*          Q( 1,N) = Q(3,N)+Q(4,N)+Q(5,N)+Q(6,N)+Q(7,N)
00403   103*          QS(N) =(QDSOL + QDSOLD + QDSOLA)*ASE
00404   104*          QR(N) =(QOFIR+QOFIRP)*ASE
00405   105*          IF (QR(N).LE.0.0)  QR(N) = 0.000001
00407   106*          AR(N) =(Q(5,N)+Q(7,N))*ASE/QR(N)
00410   107*          IF (AR(N).LE.0.0) CALL ALPHA(TCONT,AR(N))
00412   108*          CALL TABM(Q(1,N),TCON(N))
00413   109*      757 CONTINUE
00414   110*          J = IAC(N)
00415   111*          DO 758 I=1,12
00420   112*          Q(I,N) = Q(I,N)*ASE
00421   113*          QT(I,J)= QT(I,J)+Q(I,N)
00422   114*      758 QT(I,J) = QT(I,J)+Q(I,N)
00424   115*      760 CONTINUE
00424   116*    C
00426   117*          IF (IREF.NE.2) GO TO 770
00430   118*          XO(5) = XN(1)
00431   119*          XO(6) = XN(2)
00432   120*          XO(7) = XN(3)
00433   121*      770 CONTINUE
00434   122*          I1 = 1
00435   123*          WRITE (IOUT) TIME,M,MODE(M),MAX,XO,IFNV,FNV1,FNV2,SUND,TCONT,NVM,
00435   124*         1    (Q(I,N),QS(N),QR(N),TCON(N),AS(N),AR(N),N=1,MAX)
00466   125*          IPAGE = IPAGE +1
00467   126*          WRITE (6,950) TITLE,IPAGE,TIME,REF(1),REF(2),MODE(M),FNV1,FNV2
00404   127*          WRITE (6,959) SUND,AMAX,FMAX,(K,XK(K),YK(K),DIA(K),DPID(K),
00404   128*         1    ASP(K),K=1,INC)
00422   129*          IF (IREF.NE.2) GO TO 674
00424   130*          WRITE (6,971) REF1,(XQ(I),I=1,4),TCONT,REF2,(XN(I),I=1,4)
00441   131*          GO TO 675
00442   132*      674 WRITE (6,951) REF1,REF2,(XQ(I),I=1,4),TCONT
00451   133*      675 CONTINUE
00454   134*          WRITE (6,962)
00456   135*          IF (NAME.LE.0) GO TO 779
00460   136*          WRITE (6,964) (ANAME(J),(QT(I,J),I=1,12),J=2,NAME)
00472   137*      779 WRITE (6,963)
00474   138*          WRITE (6,963) ANAME(1),(QT(I,1),I=1,12)
00503   139*          IF (IPRINT.EQ.-2) WRITE(6,957) REF(1),REF(2)
00510   140*          WRITE (6,965)
00512   141*      780 IF (IPRINT) 799,781,782
00515   142*      781 I3 = 180
00516   143*          I2 = 64-4*INC
00517   144*          GO TO 785
00520   145*      782 I3 = 45
00521   146*          I2 = 16-INC
00522   147*      785 IF (I2.GT.0) GO TO 790
00524   148*          I2 = 0
00525   149*          GO TO 798
00526   150*      790 CONTINUE
00527   151*          IF (I2.GT.MAX) I2 = MAX
00531   152*          IF (IPRINT) 799,795,791
00534   153*      791 WRITE (6,962)
00536   154*          WRITE (6,964) (N,GENODE(N),(Q(I,N),I=1,12),TCON(N),N=11,I2)
00552   155*          GO TO 798
00553   156*      795 WRITE (6,952)
00555   157*          WRITE (6,953) (N,GENODE(N),Q(1,N),Q(2,N),TCON(N),N=11,I2)
00567   158*      798 IF (I2.EQ.MAX) GO TO 799
00571   159*          I1 = I2+1
00572   160*          I2 = I2+13
00573   161*          IPAGE = IPAGE + 1
```

```
00610   162*          WRITE (6,950) TITLE,IPAGE,TIME,REFC(1),REFC(2),MODE(M),ENVI,ENV2
00611   163*          GO TO 790
00612   164*      799 IF (DTIME.LE.0.0) GO TO 725
00614   165*          TIME = TIME + DTIME
00615   166*          TIMEO= TIME
00616   167*          DTIME= -1.
00617   168*          IPRINT = -2
00620   169*          NNN = -2
00621   170*          GO TO 770
00621   171*    C
00621   172*    C     SECTION 800, INPUT ERROR DIAGNOSTIC MESSAGES
00621   173*    C
00622   174*      846 WRITE (6,920) ICARD
00625   175*          WRITE (6,918) I,K
00631   176*          GO TO 890
00632   177*      848 WRITE (6,920) ICARD
00635   178*          WRITE (6,919) INC
00640   179*          GO TO 890
00641   180*      850 WRITE (6,920) ICARD
00644   181*          WRITE (6,940)
00646   182*          GO TO 890
00647   183*      852 WRITE (6,920) ICARD
00652   184*          WRITE (6,941)
00654   185*          GO TO 890
00655   186*      854 WRITE (6,920) ICARD
00660   187*          WRITE (6,942) ASP
00666   188*      890 TIME = -100.
00667   189*          RETURN
00667   190*    C
00667   191*    C     SECTION 900, FORMAT STATEMENTS
00667   192*    C
00670   193*      902 FORMAT (10F8.3 )
00671   194*      905 FORMAT (214,9F8.4)
00672   195*      920 FORMAT (////47H FATAL ERROR IN DATA INPUT FOUND ON CARD NUMBER,
00672   196*     1 I4 , //     52H PROGRAM WILL CALL EXIT AFTER THE FOLLOWING MESSAGE
00672   197*     2. ////)
00673   198*      938 FORMAT (10H CRATERS   ,I5, 5H  AND,I5,   9H OVERLAP.  )
00674   199*      939 FORMAT (I10,44H CRATERS SPECIFIED.  MAXIMUM ALLOWED IS 10.  )
00675   200*      940 FORMAT (63H DIAMETER OF CRATER FOR A CRATER ENVIRONMENT IS NOT POS
00675   201*     1ISITIVE. )
00676   202*      941 FORMAT (66H DEPTH OF CRATER FOR A LUNAR CRATER ENVIRONMENT IS NOT
00676   203*     1POSSITIVE.    )
00677   204*      942 FORMAT (24H CRATER ASPECT RATIO OF ,F5.2,17H  HAS NO MEANING. //
00677   205*     172H EITHER CRATER DIAMETER SHOULD BE INCREASED, OR CRATER DEPTH DE
00677   206*     2CREASED.  )
00700   207*      950 FORMAT (9H1    TIME,21X,14A5,12X,4HPAGE,I4  /9H     (HR),/F10.3/
00700   208*     1 30X,2A5,   8H  IN A  ,A5,29HING  MODE  IS LOCATED IN A
00700   209*     2,2A6,15H  ENVIRONMENT.  //)
00701   210*      951 FORMAT (2H0 ,2A5,16X,1HX,9X,1HY,9X, 2HZ     AZIMUTH   CONTACT  /
00701   211*     1 10H  LOCATION,16X,  45H(FT)      (FT)      (FT)     (DEG)      TE
00701   212*     2MP / 20X,3F10.2,2F10.1 ///
00701   213*     3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.   / )
00702   214*      952 FORMAT (4(32H    NODE  NODE    Q      Q    AD W )/
00702   215*     1        4(32H     NO.  NAME ABSOR INCID  TEMP ))
00703   216*      953 FORMAT (4(5X,I3,1X,A5,3F6.1) )
00704   217*      957 FORMAT (//// 2X,2A5,102H  ENVIRONMENT IS THE SAME AS THE PREVIOUS
00704   218*     1TIME POINT.  SEE THAT PRINTOUT FOR DETAILED NODAL FLUX DATA. )
00705   219*      959 FORMAT (13H  ENVIRONMENT,14X,  23HSUN      LUNAR      LUNAR,15X,
00705   220*     1 35HCENTER  PT. LOC.   CRATER     CRATER  /26X, 15HANGLE    SOLAR
00705   221*     2    I.R.       CRATER       X          Y          DIA      DEPTH     /
00705   222*     3 26X, 85H(DEG)      ABSOR      ABSOR          NO.      (FT)       (FT)
00705   223*     4    (FT)       (FT)     ASPECT  / 20X,F10.2,2F10.3,I10,5F10.2/
00705   224*     5 (50X,I10,5F10.2))
```

```
00706  225*   962 FORMAT (41X,24HABSORBED HEAT,  BTU/HR.,16X,25HINCIDENT ENERGY,  BTU
00706  226*      U/HR.,16X,  4HAND W
00706  227*      2/17H       NODE    TOTAL      TOTAL   DIRECT,2(4X,6HCRATER),
00706  228*      3    2(4X,5HPLAIN),
00706  229*      2    3X, 6HDIRECT, 2(3X,6HCRATER),2(4X,5HPLAIN),5X,4HTEMP  /
00706  230*      4 37H NO.  NAME    ABSOR    INCID    SOLAR,2(3X,15HALBEDO     I.R.
00706  231*      4 ),4X,5HSOLAR,2(4X,15HALBEDO     I.R.),4X,5HDEG R )
00707  232*   963 FORMAT (5X,A5,12F9.1)
00710  233*   964 FORMAT (I4,1X,A5,13F9.1)
00711  234*   965 FORMAT (1H  ////)
00712  235*   971 FORMAT (120H LOCATION   ,16X,1HX,9X,1HY,9X,25HZ     AZIMUTH   CONT
00712  236*      1ACT   /26X,45H(FT)          (FT)          (DEG)      TEMP R /
00712  237*      2  12X,A5,3X,5F10.2 / 12X,A5,3X,4F10.2 ///
00712  238*      3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.     /)
00713  239*       END

     END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUBC1          SYMBOLIC                     15 MAY 71  04:58:56   0  02166646   14   239  (DELETED)
SUBC1    CODE  RELOCATABLE                  15 MAY 71  04:58:56   1  02175270   48     1  (DELETED)
                                                                  0  02175350   14   123
```

SUBPROGRAM NAME: Subroutine SLC

SEGMENT NAME: SUBC2

PURPOSE: Calculate the lunar crater nodal geometric data, solar and infrared radiosity data, and the nodal temperatures. Also calculate the lunar plain radiosities and temperature.

DESCRIPTION: The SLC subprogram divides each of the lunar craters into spherical shaped segment nodes, calculates the associated geometric data, and calculates nodal radiosities/temperature for use in the calculation of the lunar crater thermal environment. The geometric data calculated include: node areas, node center point coordinates, node corner point coordinates, and crater sphere radius and center point data. The lunar crater and plain radiosities are determined in SLC using the governing equations in Section 4.2 and 4.3 of Volume I. Storage of the crater nodal geometric/radiosity data for use in the other crater environmental subprograms (TC1 and SUBDFF) is accomplished using a high speed drum (logical unit 2).

CALLING PROGRAM: LCR

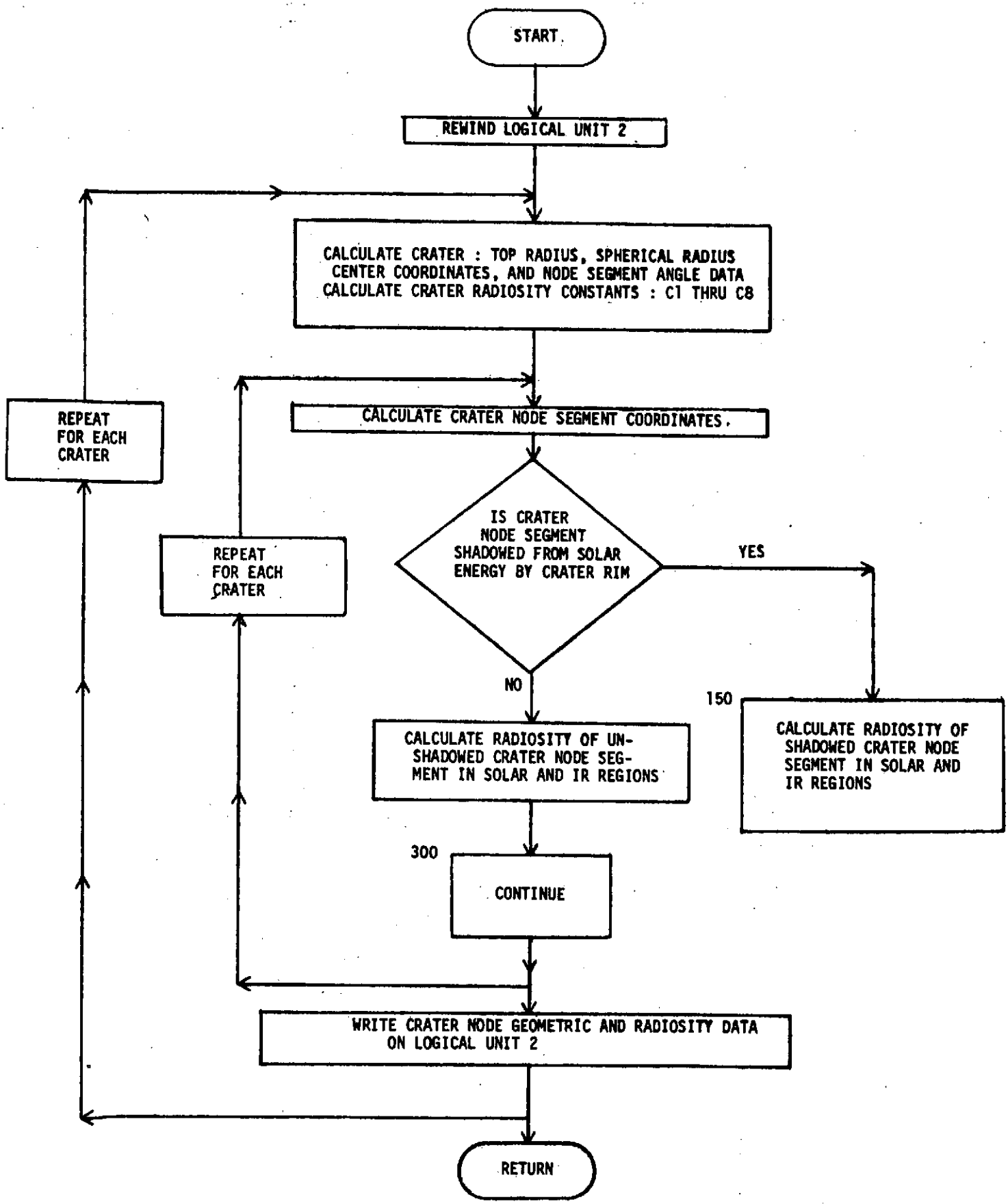
ARGUMENT LIST: None, all data required/generated are transferred into and out of this subprogram via block common and high speed drum.

NOMENCLATURE: Listed below is a dictionary of the FORTRAN nomenclature used by the SLC subprogram. Also used by the SLC subprogram are the variables of the GE1, GE2, and GE3 block common statements. The GE1 block common variables are defined with the SUBM1 program nomenclature, and the GE2 and GE3 variables are defined with the LCR (SUBC1) nomenclature.

ALBC	Reflectance of lunar surface to solar energy
CONST1	Intermediate constant
C1,C2,C3,C4 C5,C6,C7,C8	Crater constants used in the calculation of crater node radiosities and temperature
INC	Number of craters for this environment
I, J, K	Indices
QZERO	Minimum lunar surface infrared emittance, Btu/hr ft^2
RI, RJ	Radius increments, ft
RIMANG	Rim angle between top of crater and crater node measured parallel with solar vector from -X direction rim, radians
SOL	Solar constant, BTU/hr-ft^2
SOLI	Direct solar incident energy on a crater node, Btu/hr ft^2
TA	Verticle distance from crater rim to crater node, ft
TB	Horizontal distance along solar vector from crater rim to crater node, ft

TMIN	Minimum lunar surface temperature, °R
XN	X coordinate of crater node center point, ft
YN	Y coordinate of crater node center point, ft
ZN	Z coordinate of crater node center point, ft

SLC SUBPROGRAM FLOW CHART



@ FOR,* SUBC2,SUBC2 15 MAY 71 5.0
UNIVAC 1108 FORTRAN V LEVEL 2206.0018.F501P01
THIS COMPILATION WAS DONE ON 15 MAY 71 AT 05:00:17

SUBROUTINE SUBC ENTRY POINT 000716

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000745
0000	*DATA	000115
0002	*BLANK	000000
0003	GE1	000043
0004	GE2	000774
0005	GE3	040206

EXTERNAL REFERENCES (BLOCK, NAME)

0006	NREWS
0007	ATAN2
0010	COS
0011	SIN
0012	NEXP6S
0013	SQRT
0014	NWRUS
0015	NIOIS
0016	NIO2S
0017	NERR1S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000030 113G	0001	000071 127G	0001	000417 150L	0001	000247 162G	0001	000440 200G					
0001	000531 253G	0001	000544 262G	0001	000551 266G	0001	000556 272G	0001	000563 276G					
0001	000425 299L	0001	000570 302G	0001	000575 306G	0001	000602 312G	0001	000607 316G					
0001	000614 322G	0001	000621 326G	0001	000626 332G	0001	000633 336G	0001	000640 342G					
0001	000645 346G	0001	000652 352G	0001	000657 356G	0001	000664 362G	0001	000670 500L					
0000 P	000007 ALHC	0005 R	000013 ALHP	0004 R	000006 AMOON	0005 R	040042 AREA	0003 R	000003 ASE					
0004 R	000630 ASP	0003 R	000006 BX	0003 R	000021 BXX	0003 R	000007 BY	0003 R	000022 BYY					
0003 R	000010 BZ	0000 R	000002 CONST1	0003 R	000011 COSP	0005 R	001456 COSPHC	0005 R	000326 COSPHI					
0003 R	000042 COSSUN	0003 R	000031 COST	0005 R	002134 COSTHC	0005 R	001002 COSTHT	0003 R	000021 COST1					
0000 R	000010 C1	0000 R	000011 C2	0000 R	000012 C3	0000 R	000013 C4	0000 R	000014 C5					
0000 R	000015 C6	0000 R	000016 C7	0000 R	000017 C8	0005 R	000014 DCSQ	0004 R	000154 DEPTH					
0005 R	000016 DEMASQ	0004 R	000010 DIA	0005 R	000004 DPHI	0005 R	000001 DTHT	0001 R	000024 DX					
0003 R	000025 DY	0003 R	000026 DZ	0004 R	000007 EMOON	0003 R	000032 FATDT	0003 R	000014 FSE					
0003 R	000033 GOFIR	0003 R	000030 GOFIRP	0003 R	000034 GOSOL	0003 R	000036 GOSOLA	0003 R	000035 GOSOLD					
0000 I	000020 I	0004 I	000003 INC	0004 I	000004 INCRAT	0003 I	000027 IQ	0000 I	000030 IS					
0000 I	000003 J	0000 I	000001 K	0005 I	000015 NPHID1	0005 R	000011 PAT1	0005 R	001146 PHC					
0005 R	000016 PHI	0003 R	000004 PHI1	0003 R	000013 PHI2	0005 R	000007 PSMAX	0000 R	000006 QZERO					
0005 R	000000 R	0004 R	000000 RAD	0000 R	000021 RI	0000 R	000026 RIMANG	0000 R	000004 RJ					
0005 R	000001 RTOP	0004 R	000002 RTOPIN	0004 R	000001 RTOP2	0003 R	000012 SINP	0005 R	001312 SINPHC					
0005 R	000162 SINPHI	0003 R	000041 SINSUN	0005 R	001767 SINTHC	0005 R	000636 SINTHT	0000 R	000000 SOL					
0005 R	002301 SOLPLX	0000 R	000027 SOLI	0003 R	000037 SUN	0003 R	000040 SUND	0000 R	000022 TA					
0000 R	000025 TB	0005 R	014111 TC	0005 R	000012 TCOSN	0005 R	001622 THC	0005 R	000472 THT					
0003 R	000005 THT1	0000 R	000005 TMIN	0005 R	000006 TSMAX	0005 R	025721 W	0005 R	000005 WP					
0004 R	000464 XK	0000 R	000023 XN	0003 R	000000 XSE	0004 R	000320 YK	0000 R	000024 YN					
0004 R	000005 YNCRAT	0003 R	000001 YSE	0005 R	000002 ZCNTR	0005 R	037675 ZK	0005 R	037531 ZN					
0003 R	000002 ZSE													

```
00101     1*          SUBROUTINE SLC
00103     2*          PARAMETER NTHID=100,NPHID=100,NPHID2=50,NTHC=101
00104     3*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHIE,DIFI,BX,BY,BZ,COSP,SINP,PHI2,
00104     4*         1    ESE(5),BXX,BYY,COST1,DX,DY,DZ,IO,COFIRP,
00104     5*         1    COST,FATUF,COFIR,COSOLI,COSOLD,COSOLA,SUN,SUND,SINSUN,COSSUN
00105     6*          COMMON / GE2 / RAD,RTOP2,RTOPIN,INC,INCRAT,YNCRAT,  AMOON,EMOON,
00105     7*         1     DIAC(100),DEPTHC(100),XKC(100),XKC(100),ASPC(100)
00106     8*          COMMON /GE3 / R,RTOP,ZCNTR,DIFF,DPHI,WP,
00106     9*         1       TSMIN,PSMIN,TOMNSQ,PATI,TOONN,ALBP,DCSQ,NPHID1,
00106    10*         3       PHI(NPHID),SINPHI(NPHID),COSPHI(NPHID),
00106    11*         4       THT(NTHID),SINTHC(NTHID),COSTHC(NTHID),
00106    12*         5       PHC(NPHID),SINPHC(NPHID),COSPHC(NPHID),
00106    13*         6       THC(NTHC),SINTHC(NTHC),COSTHC(NTHC),
00106    14*         7       SOLFLX(NTHID,NPHID2),TCONTHD,NPHID2),WONTHD,NPHID2),
00106    15*         8       ZN(NTHID),ZK(NTHC),AREA(NTHID)
00107    16*          DATA SOL / 442.0 /
00107    17*    C
00111    18*          REWIND 2
00112    19*          DO 500 K=1,INC
00115    20*          RTOP = 0.5*DIAC(K)
00116    21*          R = 0.5*DEPTH(K) + 0.125*ASPC(K)*DIAC(K)
00117    22*          RAD = R**2
00120    23*          RTOP2=RTOP**2
00121    24*          ZCNTR = R - DEPTHC(K)
00122    25*          DIFF = ATAN2(RTOP,ZCNTR) /NTHID
00123    26*          DPHI = 6.2831/NPHID
00124    27*          NPHID1 = NPHID + 1
00125    28*          COSST1 = RAD*DIFF*DPHI
00126    29*          DO 75 J=1,NPHID
00131    30*          RJ = J
00132    31*          PHI(J) = RJ*DPHI
00133    32*          COSPHC(J) = COS( PHC(J) )
00134    33*          SINPHC(J) = SIN( PHC(J) )
00135    34*          PHI(J) = (RJ - 0.5)*DPHI
00136    35*          COSPHI(J) = COS( PHI(J) )
00137    36*       75 SINPHI(J) = SIN( PHI(J) )
00141    37*          TMIN = 170.0
00142    38*          WP = SOL*SINSUN*AMOON
00143    39*          TOONN = (WP/(EMOON*0.1713E-08))**0.25
00144    40*          QZERO = 0.1713E-08*(TMIN**4)*(1.0+ 4.0/ASPC(K)**2)
00145    41*          ALBP = SOL*SINSUN - WP
00146    42*          ALBC = 1.-AMOON
00147    43*          C1 = DEPTH(K)/R
00150    44*          C2 = (2.-C1)*ALBC
00151    45*          C3 = SOL*SINSUN*C1*0.5/(2.-ALBC*C1)
00152    46*          C4 = C1*ALBC*C2
00153    47*          C5 = C3*(2.+C2)*AMOON
00154    48*          C6 = AMOON/(EMOON*0.1713E-08)
00155    49*          C7 = C3*(2.*EMOON+C2)*C6
00156    50*          C8 = C7**0.25
00157    51*          IF (C5.LT.QZERO*EMOON) C5 = QZERO*EMOON
00157    52*    C
00161    53*          DO 300 I=1,NTHID
00164    54*          RI = I
00165    55*          THT(I) = (RI - 0.5)*DTHT - 1.5708
00166    56*          THC(I) =(RI-1.0)*DTHT - 1.5708
00167    57*          COSTHC(I) = COS( THC(I) )*R
00170    58*          SINTHC(I) = SIN( THC(I) )
00171    59*          ZK(I) = R*SINTHC(I) + ZCNTR
00172    60*          COSTHT(I) = COS( THT(I) )
00173    61*          SINTHT(I) = SIN( THT(I) )
```

```
00174    47*          W(ACT) = CONST1*COSTH(CT)
00175    48*       50 ZN(CT) = R*SINTH(CT) + ZUNIR
00176    49*          TA = -ZN(CT)
00177    50*          DO 299 J=1,NPHID2
00202    51*          XX = COSTH(CT)*COSPH(CJ)*R
00203    52*          YY = COSTH(CT)*SINPH(CJ)*R
00204    53*          TH = SQRT(RTOP2-YY**2) + XX
00205    54*          RISANG = ATAN2(TA,TB)
00206    55*          IF (SUN.LT.RISANG) GO TO 150
00210    56*          SOLI = SOL*(COSSUN*COSTH(CT)+SINSUN*SINTH(CT)*
00211    57*          SOLFLX(CT,J) = ALBC*SOLI + C4
00212    58*          W(CT,J) = SOLI*AMOD + C5
00213    59*          T(CT,J) = (SOLI*C6 + C7)**0.25
00214    60*          GO TO 299
00215    61*       150 SOLFLX(CT,J) = C4
00216    62*          W(CT,J) = C5
00217    63*          T(CT,J) = C8
00220    64*       299 CONTINUE
00222    65*          COSTH(CT) = COSTH(CT)*R
00223    66*       300 CONTINUE
00225    67*          TH(CNTH(C) = TH(CNTH(C-1) + DTH(C
00226    68*          COSTH(CNTH(C) = COS( TH(CNTH(C) )*R
00227    69*          SINTH(CNTH(C) = SIN( TH(CNTH(C) )
00230    70*          ZK(CNTH(C) = R*SINTH(CNTH(C) + ZUNIR
00230    71*    C
00231    72*          TSMAX = R*DTHC
00232    73*          PSMAX = RTOP*DPH
00233    74*          DGMAG = TSMAX*PSMAX + PSMAX*PSMAX
00234    75*          PAT1 = (0.1)/(R)
00235    76*          IF (INC.EQ.1) GO TO 500
00237    77*          WRITE (2) R,RAD,RTOP,RTOP2,ZUNIR,DATE,DPH,TSMAX,PSMAX,DGMAG,
00237    78*         1       AREA,PAT1,DCSO,NPHID1,PHI,SINPHI,COSPHI,THC,SINTHC,COSTHC,
00237    79*         2      ZN,ZK,PHC,SINPHC,COSPHC,THC,SINTHC,COSTHC,SOLFLX,TC,W
00166    80*       500 CONTINUE
00370    81*          RETURN
00371    82*          END

     END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUBC2              SYMBOLIC                                    15 MAY 71  04:58:58   0  02200642   14   97  (DELETED)
SUBC2    CODE      RELOCATABLE                                 15 MAY 71  04:58:58   1  02203360   36    1  (DELETED)
                                                                                     0  02203424   14   54
```

SUBPROGRAM NAME: Subroutine SUBDFF (QA)

SEGMENT NAME: SUBC4

PURPOSE: Calculate the lunar crater environment on a Reference Coordinate System (RCS) node.

DESCRIPTION: Using the lunar crater node geometric data and radiosities calculated in the SLC subprogram, the SUBDFF calculates the form factors and incident/absorbed energy on an RCS node from each of the lunar craters. The RCS node to crater node form factors are calculated using governing equations of Section 3.0. If a lunar crater node is too large for the form factor analyses, the SUBDFF program subdivides the crater node automatically so that the calculations are valid. The incident/absorbed energies on the RCS node consist of the lunar crater albedo and infrared radiosities. The governing equations for the crater radiosities are presented in Section 4.3 of Volume I.

CALLING PROGRAM: LCR

ARGUMENT LIST:

QA	Lunar Crater infrared energy absorbed by an RCS node (output), Btu/hr ft^2

All other data required by the SUBDFF subprogram is transferred into and out of the routine via block common and high speed drum files.

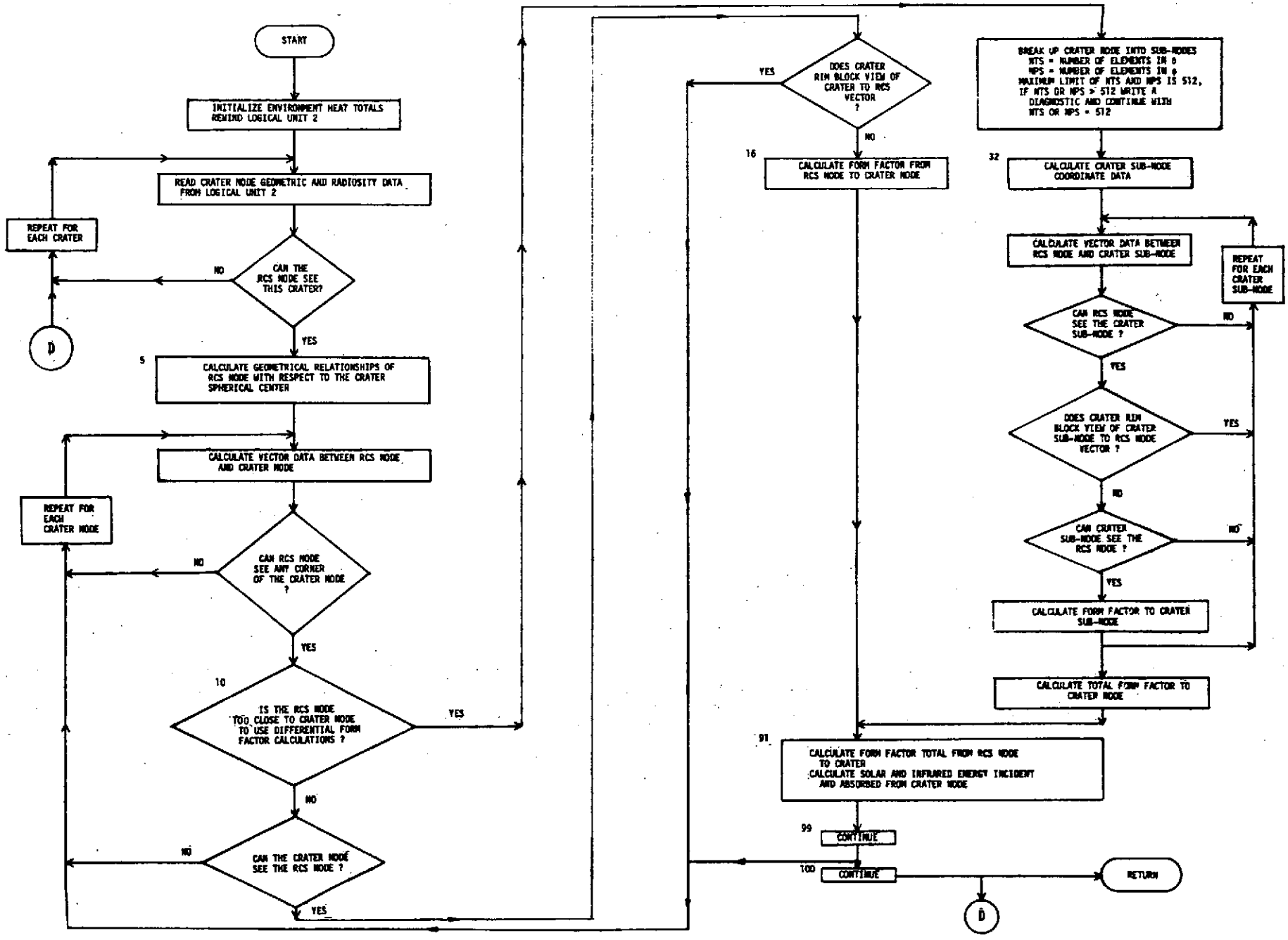
NOMENCLATURE: A dictionary of FORTRAN nomenclature used by SUBDFF is listed below. Also used in the routine are the GE1, GE2, and GE3 block common statements. The GE2 and GE3 block common variables are defined with the LCR nomenclature, and the GE1 block common with the SUBM1 (main program) variables.

ALPHA	Absorptivity of an RCS node to incident energy
ASN	Area of subdivided lunar crater node, ft^2
BZC(I)	BZ*DZ of crater node corner point I
BZDZ	BZ*DZ of crater node center point
CONST2	Constant used in form factor calculation of a subdivided lunar crater node
COSBIS	Cosine of angle between lunar crater node normal and a RCS to crater vector
COSB2S	Cosine of angle between RCS node normal and a RCS to crater vector
COSPSN	Cosine of PSN
COSTSN	Cosine of TSN

DISMIN	Minimum distance from RCS node to crater node used for crater node subdivision calculations, ft^2
DISTSQ	$(Distance)^2$ from RCS node to a crater node, ft^2
DMAXP	Maximum subdivided crater node azimuth angle allowed, radians
DMAXT	Maximum subdivided crater node elevation angle allowed, radians
DP	Subdivided crater node azimuth angle legnth, radians
DPSEN	$(Distance)^2$ value used to determine whether the RCS node can see a crater node when the RCS is located away from the crater, ft^2
DSQSN	$(Distance)^2$ from RCS node to a subdivided crater node, ft^2
DT	Subdivided crater node elevation angle length, radians
DX,DXSN	X component of vector from a RCS node to a crater node, ft
DY,DYSN	Y component of vector from a RCS node to a crater node, ft
DZ, DZA, DZSN	Z component of vector from a RCS node to a crater node, ft
DZSNBZ	DZSN*BZ
DZSNSQ	$(DZSN)^2$, ft^2
DZSQ	$(DZ)^2$, ft^2
FAIJ	Form factor from an RCS node to a crater node
FASN	Form factor from an RCS node to a subdivided crater node element
FATOT	Form factor from an RCS node to all lunar craters
GOFIR	Total lunar crater infrared energy incident on an RCS node, Btu/hr ft^2
GOFIRN	Infrared energy from lunar crater node incident on an RCS node, Btu/hr ft^2
GOSOL	Total lunar crater albedo energy incident on an RCS node, Btu/hr ft^2
I,J,K,KK, IS,JS,L	Indices

INC	Total number of lunar craters for this environment
INCRAT	Crater number in which the RCS is located.
NPS	Number of azimuth division for the subdivided crater node.
NTS	Number of elevation angle divisions for the subdivided crater node.
PHIR	Crater node edge azimuth angle, radians
PSN	Azimuth angle of subdivided crater node center point, radians
RADSE	Radius of RCS node from crater sherical center, ft
RIS,RJS RNP,RNT	Real number values of IS, JS, NPS, and NTS
SDSQMN	9 X maximum crater node diagonal $+(SESPD)^2$, ft^2
SESPD	R-RADSE, ft
SINPSN	Sine of PSN
SINTSN	Sine of TSN
THTB	Elevation angle of crater node lower corner point, radians
TSN	Elevation angle of subdivided crater node center point, radians
XC(I)	X coordinate of crater node corner point I, ft
XN,XSN	X coordinate of crater node center point, ft
XPSEN	X value used for DPSEN calculations, ft
YC(I)	Y coordinate of crater node corner point I, ft
YN,YSN	Y coordinate of crater node center point, ft
YPSEN	Y value used for DPSEN calculations, ft
ZDZ	ZSN/DZSN
ZN,ZSN	Z coordinate of crater node center point, ft

SUBOFF SUBPROGRAM FLOW CHART



15 NOV 71

@ FOR,* SUBC4,SUBC4
UNIVAC 1100 FORTRAN V LEVEL 2206.001* 1501PD
THIS COMPILATION WAS DONE ON 15 NOV 71 AT 05:00:20

SUBROUTINE SUB**F ENTRY POINT 001242

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	001272
0000	*DATA	006172
0002	*BLANK	000000
0003	GE1	000043
0004	GE2	000774
0005	GE3	040206

EXTERNAL REFERENCES (BLOCK, NAME)

0006	BLOCK
0007	ALPHA1
0010	NEWS
0011	NBLS
0012	NIOLS
0013	NIOZS
0014	SQRT
0015	SMOLS
0016	UDS
0017	SIN
0020	SEBBLS

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001		000401	10L	0001		001201	100L	0001		001206	110L	0001	000015	120G
0001		000066	147G	0001		000073	153G	0001		000100	157G	0001	000477	16L
0001		000112	167G	0001		000117	173G	0001		000124	177G	0001	000212	2L
0001		000131	204G	0001		000136	207G	0001		000543	211L	0001	000143	213G
0001		000155	223G	0001		000162	227G	0001		000167	233G	0001	000174	237G
0001		000201	243G	0001		000206	247G	0001		000552	25L	0001	000261	265G
0001		000617	31L	0001		000657	32L	0001		000356	320G	0001	000701	431G
0001		000764	456G	0001		001007	467G	0001		000222	5L	0001	001067	76L
0001		001127	81L	0000		006075	901F	0000		006106	902F	0001	001137	91L
0005	R	000013	ALBP	0000	R	006074	ALPHA	0004	R	000006	AMXN	0005	R	040042	AREA
0000	R	006061	ASN	0004	R	000630	ASP	0003	R	000006	BX	0003	R	000021	BXX
0003	R	000022	BYY	0003	R	000010	BZ	0000	R	006010	BZC	0000	R	006026	BZDZ
0000	R	006040	COSBIS	0000	R	006031	COSBZS	0003	R	000011	COSP	0005	R	001456	COSPHC
0000	R	004000	COSPSN	0003	R	000042	COSSUN	0003	R	000031	COST	0005	R	002134	COSTHC
0000	R	002000	COSTSN	0003	R	000023	COSTI	0005	R	000014	DCSQ	0004	R	000154	DEPTH
0004	R	000010	DIA	0000	R	006042	DISMIN	0000	R	006034	DISTSQ	0000	R	006045	DMAXP
0000	R	006053	DP	0005	R	000004	DPHI	0000	R	006037	DPSEN	0000	R	006070	DSQSN
0005	R	000003	DPHT	0003	R	000024	DX	0003	R	000024	DXSN	0003	R	000025	DY
0003	R	000026	DZ	0000	R	006024	DZA	0003	R	000026	DZSN	0000	R	006065	DZSNBZ
0000	R	006025	DZSQ	0004	R	000007	EMXN	0000	R	006041	FAIJ	0000	R	006071	FASN
0003	R	000014	FSE	0003	R	000033	GOF1R	0000	R	006073	GOF1RN	0003	R	000030	GOF1RP
0003	R	000036	GOSOLA	0003	R	000035	GOSOLD	0000	I	006021	I	0004	I	000003	INC
0003	I	000027	IO	0000	I	006055	IS	0000	I	006015	IS	0000	I	006027	J
0000	I	006030	K	0000	I	006014	KK	0000	I	006072	L	0005	I	000015	NPHID1
0000	I	006046	NTS	0000	R	006022	PAPI	0005	R	000011	PATI	0005	R	001146	PHC
0000	R	006043	PHIR	0003	R	000004	PHI1	0003	R	000013	PHI2	0005	R	000007	PSMAX

0001		000051	140G	0001		000105	163G	0001		000527	20L	0001		000150	217G
0001		000546	24L	0001		000323	305G	0001		000732	441G	0001		001126	80L
0001		001201	99L	0003	R	000003	ASF	0003	R	000007	BY	0000	R	006054	CONST2
0005	R	000326	COSPHI	0005	R	001002	COSTHI	0005	R	000010	DCSSQ	0000	R	006044	DMANT
0000	R	006050	DT	0003	R	000025	DYSN	0000	R	006063	DZSNSQ	0003	R	000032	FAIDT
0003	R	000034	GOSOL	0004	I	000004	INCRVT	0000	I	006057	JS	0000	I	006051	NPS
0005	R	000016	PHI	0000	R	001000	PSN								

```
0005 R 000000 R          0004 R 000000 RAD        0000 R 006016 RADSE      0000 R [illegible] RIS      [illegible] R [illegible] RTS
0000 R 006052 RNP        0000 R 006047 RNT        0005 R 000004 RTOP       [illegible] R [illegible] RTOPIN   [illegible] R [illegible] RTOP2
0000 R 006020 SDCOMN     0000 R 006017 SESPD      0004 R 000012 SINP       [illegible] R [illegible] SINPHI   [illegible] R [illegible] SINPHC
0000 R 005000 SINPSN     0004 R 000041 SINSUN     0005 R 001767 SINTHC     [illegible] R [illegible] SINTHT   [illegible] R [illegible] SINTSN
0005 R 002301 SOLFLX     0004 R 000047 SUN        0004 R 000040 SUND       [illegible] R [illegible] TC       [illegible] R [illegible] TCONS
0005 R 031622 THC        0005 R 000472 THT        0000 R 006021 THTH       [illegible] R [illegible] TPHI     [illegible] R [illegible] TSMAX
0000 R 000000 TSN        0005 R 025721 W          0005 R 000005 WP         0000 R [illegible] XC       [illegible] R [illegible] XK
0000 R 006012 XX         0000 R 006035 XPSEN      0004 R 000000 XSE        0000 R [illegible] XSS      [illegible] R [illegible] YC
0004 R 000120 YK         0000 R 006011 YY         0004 R 000005 YSCRAT     0000 R [illegible] YPSEN    [illegible] R [illegible] YSE
0000 R 006067 YSS        0005 R 000002 ZCNTR      0000 R 006064 ZDZ        0005 R [illegible] ZK       0005 R [illegible] ZN
0004 R 000002 ZSE        0000 R 006062 ZSS
```

```
00101         SUBROUTINE SUBEE (OA)
00103         PARAMETER NTHTD=100,NPHID=100,NPHID2=50,NTHTC=101
00104         DIMENSION TSN(512),PSN(512),COSTSN(512),SINTSN(512),COSPSN(512),
00104        2     SINPSN(512)
00105         COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI2,
00105        1   FSE(5),PXX,BYY,COST1,DX,DY,DZ,IO,COFIBP,
00105        1   COST,FATOT,COFIR,COSOL,COSOLD,COSOLA,SUN,SUND,SINSUN,COSSUN
00106         COMMON / GE2 / RAD,RTOP2,RTOPIN,INC,INCRAT,YSCRAT,  ASCON,ESCON,
00106        1     DIA(100),DEPTH(100),YK(100),XK(100),ASP(100)
00107         COMMON /GE1 / R,RTOP,ZCNTR,DTHT,DPHI,WP,
00107        1      TSMAX,PSMAX,DDNNSQ,PATI,TCONS,ADBP,DCSQ,NPHID1,
00107        3      PHI(NPHID),SINPHI(NPHID),COSPHI(NPHID),
00107        4      THT(NTHTD),SINTHT(NTHTD),COSTHT(NTHTD),
00107        5      PHC(NPHID),SINPHC(NPHID),COSPHC(NPHID),
00107        6      THC(NTHTC),SINTHC(NTHTC),COSTHC(NTHTC),
00107        7      SOLFLX(NTHTD,NPHID2),TC(NTHTD,NPHID2),W(NTHTD,NPHID2),
00107        8      ZN(NTHTD),ZK(NTHTC),AREA(NTHTD)
00110         EQUIVALENCE (DX,DXSS),(DY,DYSS),(DZ,DZSS)
00111         DIMENSION XC(4),YC(4),BZC(4)
00112         OA = 0.
00113         COSOL = 0.
00114         COFIR = 0.0
00115         FATOT = 0.
00116         REWIND 2
00117         DO 110 KK=1,INC
00122         IF (INC.EQ.1) GO TO 2
00124         READ (2) R,RAD,RTOP,RTOP2,ZCNTR,DTHT,DPHI,TSMAX,PSMAX,DDNNSQ,
00124        1     AREA,PATI,DCSQ,NPHID1,PHI,SINPHI,COSPHI,THT,SINTHT,COSTHT,
00124        2    ZN,ZK,PHC,SINPHC,COSPHC,THC,SINTHC,COSTHC,SOLFLX,TC,W
00253       2 IF (ZSE.GT.0.0) GO TO 5
00255         IF (KK.NE.INCRAT) GO TO 110
00257       5 DCSQ = (XSE-XK(KK))**2 + (YSE-YK(KK))**2
00260         RADSE = SQRT(DCSQ + (ZSE-ZCNTR)**2)
00261         SESPD = R - RADSE
00262         SDCOMN = 9.0*DDNNSQ + SESPD**2
00263         BZC(1) = (-DEPTH(KK)-ZSE)*BZ
00264         DO 100 I=1,NTHTD
00267         BZC(3) = BZC(1)
00270         BZC(4) = BZC(1)
00271         BZC(1) = (ZK(I+1) - ZSE)*BZ
00272         BZC(2) = BZC(1)
00273         XC(2) = COSTHC(I+1)+XK(KK)
00274         XC(4) = COSTHC(I)   +XK(KK)
00275         YC(2) = YK(KK)
00276         YC(4) = YK(KK)
00277         PAPI = 0.1/COSTHT(I)
00300         THTH = THC(I)
00301         DZA= ZN(I)-ZSE
```

```
00302   49*          DZSQ = DZA**2
00303   50*          BZDZ = BZ*DZA
00304   51*          DO 100 J=1,NPHID
00307   52*          XC(1) = XC(2)
00310   53*          XC(3) = XC(4)
00311   54*          XC(2) = (SINPHC(J)*COSTHC(1+1) +YK(KK)
00312   55*          XC(4) = (COSPHC(J)*COSTHC(1)   +XK(KK)
00313   56*          YC(1) = YC(2)
00314   57*          YC(3) = YC(4)
00315   58*          YC(2) = SINPHC(J)*COSTHC(1+1) +YK(KK)
00316   59*          YC(4) = SINPHC(J)*COSTHC(1)   +YK(KK)
00317   60*          DO 9 K=1,4
00322   61*          DX = XC(K)-XSE
00323   62*          DY = YC(K)-YSE
00324   63*          COSB2S = BX*DX + BY*DY + BZC(K)
00325   64*          IF (COSB2S.GT.0.0) GO TO 10
00327   65*        9 CONTINUE
00331   66*          GO TO 100
00332   67*       10 CONTINUE
00333   68*          XN = COSTHC(1)*COSPHC(J)
00334   69*          YN = COSTHC(1)*SINPHC(J)
00335   70*          DX = XN-XSE
00336   71*          DY = YN-YSE
00337   72*          DX = DX+XK(KK)
00340   73*          DY = DY+YK(KK)
00341   74*          DISTSQ = DX**2 + DY**2 + DZSQ
00342   75*          IF (DISTSQ*0.04.LT.AREA(1)) GO TO 20
00344   76*          COSB2S = DX*BX + DY*BY + BZDZ
00345   77*          IF (COSB2S.LE.0.0) GO TO 99
00347   78*          DZ = DZA
00350   79*          IF (INCRAT.EQ.KK) GO TO 16
00352   80*          XPSEN = XN - DX*ZN(1)/DZ
00353   81*          YPSEN = YN - DY*ZN(1)/DZ
00354   82*          DPSEN = XPSEN**2 + YPSEN**2
00355   83*          IF (DPSEN.GE.RTOP2) GO TO 99
00357   84*       16 COSBIS = (DX*XN + DY*YN + DZ*(ZN(1)-ZUNIB))/R
00360   85*          CALL BLOCK
00361   86*          FAIJ = COSBIS*COSB2S*AREA(1)*ESE(IQ)/(3.14159*DISTSQ**2)
00362   87*          GO TO 91
00363   88*       20 CONTINUE
00364   89*          IF (DISTSQ .GT. SDSQMN)  GO TO 24
00366   90*          IF (INCRAT.EQ.KK) GO TO 21
00370   91*          DISMIN = ZSE
00371   92*          GO TO 25
00372   93*       21 DISMIN = SESPD
00373   94*          GO TO 25
00374   95*       24 DISMIN = SQRT(DISTSQ)
00375   96*       25 CONTINUE
00376   97*          FAIJ = 0.
00377   98*          PHIR = PHI(J) - 0.5*DPHI
00400   99*          DMAXT = (DISMIN)*(PATI)
00401  100*          DMAXP = (DISMIN)*(PAPI)
00402  101*          NTS = (DTHT/DMAXT) + 1
00403  102*          IF (NTS .LT. 512)  GO TO 31
00405  103*          WRITE(6,901) NTS,I,J
00412  104*      901 FORMAT(5X,5HNTS =,I5,13H      FOR  I =,I3,9H,      J =,I4)
00413  105*          NTS = 512
00414  106*       31 CONTINUE
00415  107*          RNT = NTS
00416  108*          DT = DTHT/RNT
00417  109*          NPS = (DPHI/DMAXP) + 1
00420  110*          IF (NPS .LT. 512)  GO TO 32
00422  111*          WRITE(6,902) NPS,I,J
```

```
  902 FORMAT(5X,5HNPS =,I5,[illegible] [illegible] I =,I4,9H, [illegible] J =,I4)
      NPS = 512
   12 CONTINUE
      RNP = NPS
      DP = DPHI/RNP
      CONST2 = RAD*DT*DP
      DO 70 IS=1,NTS
      RIS = IS
      TSN(IS) = THOB + (RIS - 0.5)*(DT)
      COSTSN(IS) = COS(TSN(IS))
   70 SINTSN(IS) = SIN(TSN(IS))
      DO 75 JS=1,NPS
      RJS = JS
      PSN(JS) = PHIB + (RJS - 0.5)*(DP)
      COSPSN(JS) = COS(PSN(JS))
   75 SINPSN(JS) = SIN(PSN(JS))
      DO 90 IS=1,NTS
      ASN = COSTSN(IS)*CONST2
      ZSN = R*SINTSN(IS) + ZCNTR
      DZSN = ZSN - ZSE
      DZSNSQ = DZSN**2
      ZDZ = (ZSN)/(DZSN)
      DZSNBZ = DZSN*BZ
      DO 90 JS=1,NPS
      XSN = R*COSTSN(IS)*COSPSN(JS)
      YSN = R*COSTSN(IS)*SINPSN(JS)
      DXSN = XSN - XSE
      DYSN = YSN - YSE
      DXSN = DXSN + XK(KK)
      DYSN = DYSN + YK(KK)
      COSB2S = DXSN*BX + DYSN*BY + DZSNBZ
      IF (COSB2S.LE.0.0) GO TO 80
      IF (ISCRAT.EQ.KK) GO TO 78
      XPSEN = XSN - DXSN*ZDZ
      YPSEN = YSN - DYSN*ZDZ
      DPSEN = XPSEN*XPSEN + YPSEN*YPSEN
      IF (DPSEN.GT.RTOP2) GO TO 80
   78 CONTINUE
      COSB1S = (DXSN*XSN + DYSN*YSN + DZSN*(ZSN - ZCNTR))/(R)
      DSQSN = DXSN**2 + DYSN**2 + DZSNSQ
      FASN = (COSB1S*COSB2S*ASN)/(3.1416*DSQSN**2)
      CALL BLOCK
      FASN = FASN*FSE(IQ)
      GO TO 81
   80 FASN = 0.0
   81 CONTINUE
   90 FAIJ = FAIJ + FASN
   91 CONTINUE
      L = J
      IF (J.GT.NPHID2) L = NPHID1 - J
      FATOT = FATOT + FAIJ
      COFIRN = W(I,L)*FAIJ
      COFIR = COFIR + COFIRN
      COSOL = COSOL + SOLFLX(I,L)*FAIJ
      CALL ALPHA1(TC(I,L),ALPHA)
      QA = COFIRN*ALPHA  + QA
   99 CONTINUE
  100 CONTINUE
  110 CONTINUE
      RETURN
      END
```

END OF UNIVAC 1108 FORTRAN V COMPILATION.   0 *DIAGNOSTIC* MESSAGE(S)

SUBC4		SYMBOLIC	15 MAY 71	04:59:02	0	02205016	14	172 (DELETED)
SUBC4	CODE	RELOCATABLE	15 MAY 71	04:59:02	1	02211560	16	1 (DELETED)
					0	02211624	14	78

SUBPROGRAM NAME: Subroutine TC1 (XO, REMU,TCON)

SEGMENT NAME: SUBC6

PURPOSE: Determine the crater in which the Reference Coordinate System (RCS) is located and calculate the RCS contact temperature with the lunar surface.

DESCRIPTION: The TC1 subprogram determines which crater the RCS is located (if any) based on input RCS timeline coordinates (XO array on Card B2). The subprogram then determines the crater node on which the RCS positioned and uses that crater temperature as the contact temperature. If the RCS is not located in a crater, the subprogram uses the lunar plain temperature. In the event the contact temperature is input (TCONT on Card B2) the routine sets the contact temperature to that specified by the user.

CALLING PROGRAM: LCR

ARGUMENT LIST:

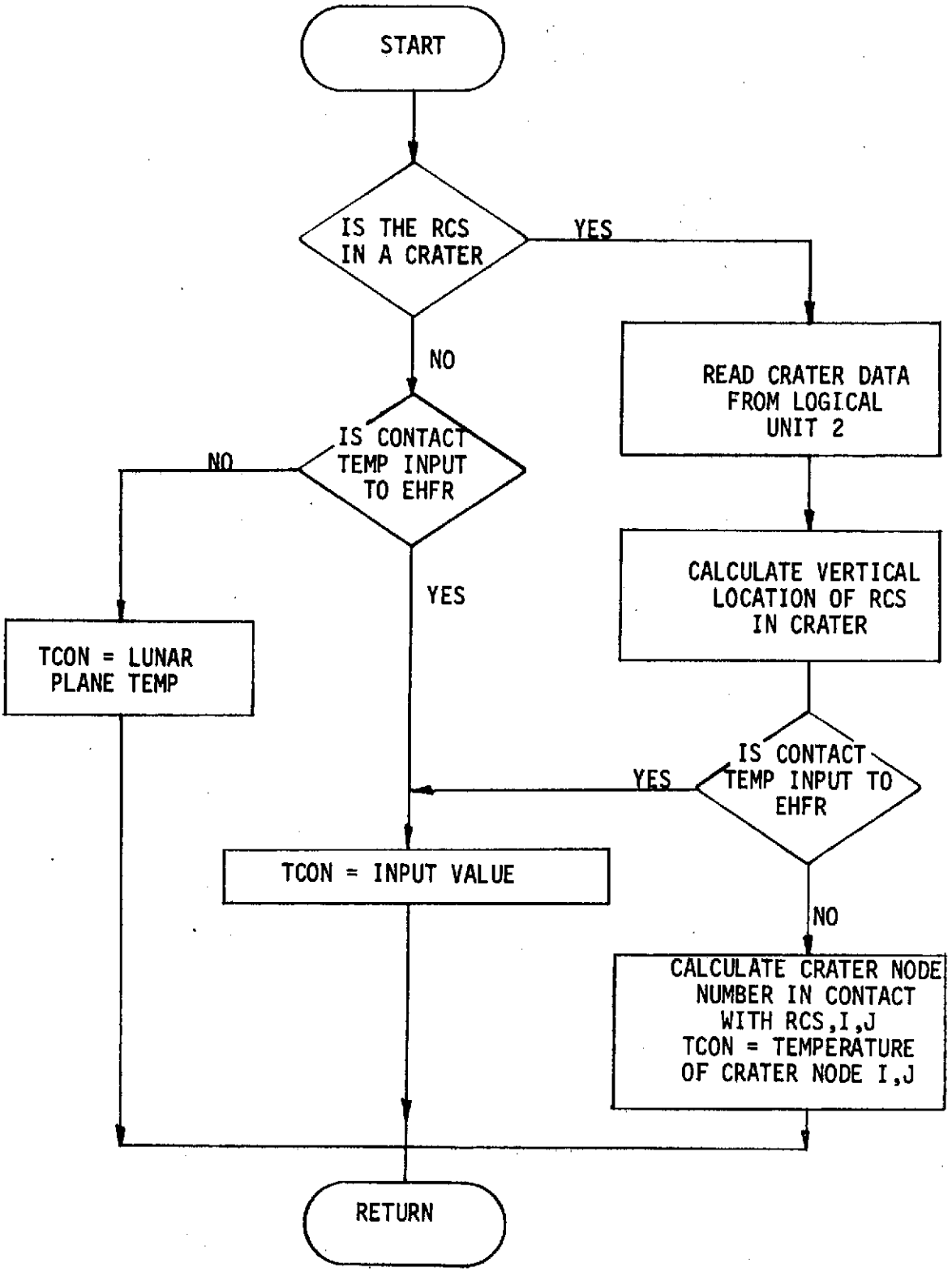
XO	Current timepoint RCS location as defined in the MR block common (input)
REMU	$(\text{Distance})^2$ of the RCS from the crater center in which it is located (output), ft^2
TCON	RCS contact temperature (output), °R

All other data required by the TC1 subprogram is transferred into the routine via block common and high speed drum files.

NOMENCLATURE: A dictionary of FORTRAN nomenclature used by the TC1 subprogram is listed below.

DIA(K)	Diameter of crater K, ft
DPHI	Crater node anizuth angle length, radians
DTHT	Crater node elevation angle length, radians
DX	X distance from RCS to crater center, ft
DY	Y distance from RCS to crater center, ft
INC	Number of lunar craters in current environment
INCRAT	Crater number in which RCS is located
I,J,K	Indices
PHI3	Azimuth angle of RCS crater location, radians
RAD	Spherical $(\text{radius})^2$ of crater, ft^2
RCRA, RTOP2	$(\text{Radius of top})^2$ of crater, ft^2
RTOPIN	$(\text{Radius of top})^2$ of crater in which RCS is located, ft^2
TC	Crater node temperature, °R

TCONN	Lunar plain temperature, °R
TCON	RCS contact temperature, °R
XK(K)	X Coordinate of crater K center point, ft
XO(1)	RCS X position, ft
XO(2)	RCS Y position, ft
XO(3)	RCS Z position, ft
XO(7)	RCS input contact temperature, °R
YK(K)	Y coordinate of crater K center point, Ft
ZCNTR	Z coordinate of crater spherical center, Ft


START
IS THE RCS IN A CRATER
YES
NO
READ CRATER DATA FROM LOGICAL UNIT 2
IS CONTACT TEMP INPUT TO EHFR
NO
YES
CALCULATE VERTICAL LOCATION OF RCS IN CRATER
TCON = LUNAR PLANE TEMP
IS CONTACT TEMP INPUT TO EHFR
YES
TCON = INPUT VALUE
NO
CALCULATE CRATER NODE NUMBER IN CONTACT WITH RCS,I,J
TCON = TEMPERATURE OF CRATER NODE I,J
RETURN

@ FOR,Y SUBC6,SUBC6
UNIVAC 1108 FORTRAN V LEVEL 2206 0015 150150
THIS COMPILATION WAS DONE ON 15 MAY 71 AT 05:00:24

15 MAY 71 5: 0 24

SUBROUTINE TC1 ENTRY POINT 000415

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000435
0000	*DATA	000035
0002	*BLANK	000000
0003	GE2	000774
0004	GE3	040206

EXTERNAL REFERENCES (BLOCK, NAME)

0005	NEWS
0006	NBUS
0007	NIO1S
0010	NIO2S
0011	SQRT
0012	ASIN
0013	ATAN2
0014	NBUFS

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001		000304	10L	0001		000005	110G	0001		000063	130G	0001		000174	15L	0001		000114	150G
0001		000127	160G	0001		000134	164G	0001		000141	170G	0001		000146	174G	0001		000035	20I
0001		000153	200G	0001		000160	204G	0001		000165	210G	0001		000172	214G	0001		000051	22L
0001		000177	220G	0001		000204	224G	0001		000211	230G	0001		000216	234G	0001		000223	240G
0001		000230	244G	0001		000245	250G	0001		000242	254G	0001		000254	26L	0001		000247	260G
0001		000277	30L	0004	R	000013	ALBP	0003	R	000006	AMOON	0004	R	040042	AREA	0003	R	000630	ASP
0004	R	001456	COSPHC	0004	R	000326	COSPHI	0004	R	002134	COSTHC	0004	R	001002	COSTHT	0004	R	000014	DCSQ
0003	R	000154	DEPTH	0004	R	000010	DGNSQ	0003	R	000010	DIA	0004	R	000004	DPHI	0004	R	000003	DTHT
0000	R	000005	DX	0000	R	000006	DY	0003	R	000007	EMOON	0000	I	000003	I	0003	I	000003	INC
0003	I	000004	INCRAT	0000	I	000002	IS	0000	I	000004	J	0000	I	000000	K	0004	I	000015	NPHID1
0004	R	000011	PATI	0004	R	001146	PHC	0004	R	000016	PHI	0000	R	000007	PHI3	0004	R	000007	PSMAX
0004	R	000000	R	0003	R	000000	RAD	0000	R	000001	RCRA	0004	R	000001	RTOP	0003	R	000002	RTOPIN
0003	R	000001	RTOP2	0004	R	001312	SINPHC	0004	R	000162	SINPHI	0004	R	001767	SINTHC	0004	R	000636	SINTHT
0004	R	002301	SOLFLX	0004	R	014111	TC	0004	R	000012	TCOSN	0004	R	001622	THC	0004	R	000472	THT
0004	R	000006	TSMAX	0004	R	025721	W	0004	R	000005	WP	0003	R	000464	XK	0003	R	000320	YK
0003	R	000005	YNCRAT	0004	R	000002	ZCNTR	0004	R	037675	ZK	0004	R	037531	ZN				

```
00101    1*          SUBROUTINE TC1(XD,REMG,TCOS)
00101    2*    C
00103    3*          PARAMETER NTHTD=100,NPHID=100,NPHID2=50,NTHTC=101
00104    4*          COMMON / GE2 / RAD,RTOP2,RTOPIN,INC,INCRAT,YNCRAT, AMOON,EMOON,
00104    5*         I     DIA(100),DEPTH(100),YK(100),XK(100),ASP(100)
00105    6*          COMMON /GE3 / R,RTOP,ZCNTR,DTHT,DPHI,WP,
00105    7*         1       TSMAX,PSMAX,DCSQ,PATI,TCOSN,ALBP,DCSQ,NPHID1,
00105    8*         3       PHI(NPHID),SINPHI(NPHID),COSPHI(NPHID),
00105    9*         4       THT(NTHTD),SINTHT(NTHTD),COSTHT(NTHTD),
00105   10*         5       PHC(NPHID),SINPHC(NPHID),COSPHC(NPHID),
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```
00105    11*          6       THCNTH(IC),STNTHC(NTH(IC),COSTHC(NTH(IC),
00105    12*          7       SOLFLX(NTH(I),SPHI(I2),ZUCNTH(I),SPHI(I2),WCNTH(I),SPHI(I2),
00105    13*          8       ZN(NTH(I),ZK(NTH(IC),AREA(NTH(I)
00106    14*           DIMENSION XO(7)
00106    15*     C
00107    16*           DO 20 K=1,INC
00112    17*           RESC = (XO(1)-XK(K))**2 + (XO(2)-YK(K))**2
00113    18*           RCRA = 0.25*DIAK)**2
00114    19*           IF (RESC.GE.RCRA) GO TO 20
00116    20*           INCRAT = K
00117    21*           GO TO 22
00120    22*        20 CONTINUE
00122    23*           INCRAT = 0
00123    24*           IF (XO(1).GT.0.0) GO TO 30
00125    25*           TCON = TCONA
00126    26*           RETURN
00127    27*        22 IF (INC.EQ.1) GO TO 26
00131    28*           REWIND 2
00132    29*           DO 24 K=1,INCRAT
00135    30*           READ (2) R,RAD,RTOP,RTOP2,ZCNTR,DIAC,DPHI,TSMAX,PSMAX,DGMSQ,
00135    31*          1       AREA,PATI,IDSQ,NPHIDI,PHI,STNPHI,COSPHI,THC,STNTHC,COSTHC,
00135    32*          2       ZN,ZK,PHC,STNPHC,COSPHC,THC,STNTHC,COSTHC,SOLFLX,TC,W
00264    33*        24 CONTINUE
00266    34*        26 CONTINUE
00267    35*           RTOPIN = RTOP2
00270    36*           YNCRAT = YK(INCRAT)
00271    37*           XO(3) = XO(3) + ZCNTR-SORTORAD-RESC)
00272    38*           IF (XO(7).LE.0.0) GO TO 10
00274    39*        30 TCON = XO(7)
00275    40*           RETURN
00276    41*        10 I =(ASIN(XO(3)-ZCNTR)/R)+1.57081/DPHI + 1.0
00277    42*           IF (I.GT.NTHD) I=NTHD
00301    44*           J = 1
00302    44*           IF (RESC.LE.0.0) GO TO 15
00304    45*           DX = XO(1)-XK(INCRAT)
00305    46*           DY = XO(2)-YK(INCRAT)
00306    47*           PHI3 = ATAN2(DY,DX)
00307    48*           IF (PHI3.LT.0.) PHI3 = -PHI3
00311    49*           J = PHI3/DPHI + 1.0
00312    50*        15 TCON = TC(I,J)
00313    51*           RETURN
00314    52*           END

     END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUBC6            SYMBOLIC                                  15 MAY 71  04:59:04   0  02213730    14    52  (DELETED)
SUBC6    CODE    RELOCATABLE                               15 MAY 71  04:59:04   1  02215260    36     1  (DELETED)
                                                                                  0  02215324    14    31
```

SUBPROGRAM NAME: Subroutine TVC (IENV, IND)

SEGMENT NAME: SUBS10

PURPOSE: Read and print thermal vacuum chamber environment input data, initialize chamber parameters, and call the appropriate EHFR thermal vacuum chamber option subprogram (CHB or CHR).

DESCRIPTION: The TVC subprogram reads initial input and data update cards describing the thermal vacuum chamber environment and configuration. These include: solar lamp grid screen configuration and heat fluxes; chamber floor configuration and either node or thermocouple temperatures; infrared and solar albedo background energy data; and Lunar Surface Thermal Simulator (LSTS) heater element zone temperatures and tier angles. LSTS configuration data updated in the SUBI3 subprogram is transferred to TVC via a high speed drum (logical unit 4). For the LESTER option (IENV=5), TVC rewinds the current output tape (on logical unit 3) for use as input into the CHR routine. The TVC program prints out all input data cards read during subprogram execution and calls the appropriate EHFR chamber option subprogram.

CALLING PROGRAM: SUBM1 (Main program)

ARGUMENT LIST:

IENV	Environment option index as read on Card B1 in SUBM1 (input) IENV = 4 chamber environment timeline to be generated IENV = 5 LESTER option, chamber LSTS zone powers to be matched for the real environments input
IND	LSTS heater element configuration index (input) IND = 1 Read configuration data on logical unit 4 IND = 0 Configuration data already stored, reading logical unit 4 is to be omitted.

All other data required/generated by the TVC subprogram is transferred into and out of the routine via the block common statements.

NOMENCLATURE: The FORTRAN nomenclature used by the TVC subprogram is listed below. Used by the TVC routine are the variables of the CH1, CH2, CH3, CH4, and CH6 block common statements. The nomenclature for these block common statements are defined following the TVC nomenclature. The MR and GE1 block common nomenclature also used in TVC routine are defined with the SUBM1 (main program) nomenclature.

ALAMP	Perpendicular distance of pivot from LSTS heater element center, ft
BLAMP	Parallel distance of pivot from LSTS heater element center, ft

ENVP(IC), ENV1, ENV2	Environment name of chamber IC in A format
EPSLMP	LSTS heater element emissivity
I, J, K	Indices
IC	Chamber index
IENV	Environment option index
IFLR	Chamber floor data input index
ILAMP	LSTS heater element data input index
IND	Stored LSTS data tape input index
IN(5)	Chamber background data input index
IN(6)	LESTER option absorbed heat data input index
ISOLAR	Solar lamp data input index
IT	LSTS heater element zone tier index
IZ	LSTS heater element zone index
I1, I2	Print indices
N	RCS node number
NGRID1	Maximum number of solar screen grid nodes
NTC	Number of thermocouples
NTOT	Total number of chamber floor nodes or total number of solar screen grid nodes
NZ	Number of LSTS heater element power zones for this chamber
RADIUS	Chamber floor radius, ft.
THT(J)	Inclination values of the background data (for printed output), deg.

CH_1, CH2, CH4, AND CH6 BLOCK COMMON NOMENCLATURE

Listed below is a dictionary of FORTRAN nomenclature for the variables contained in the CH2, CH4, and CH6 block common statements. These block commons are located in segment S of the EHFR map.

CH_1 Block Common

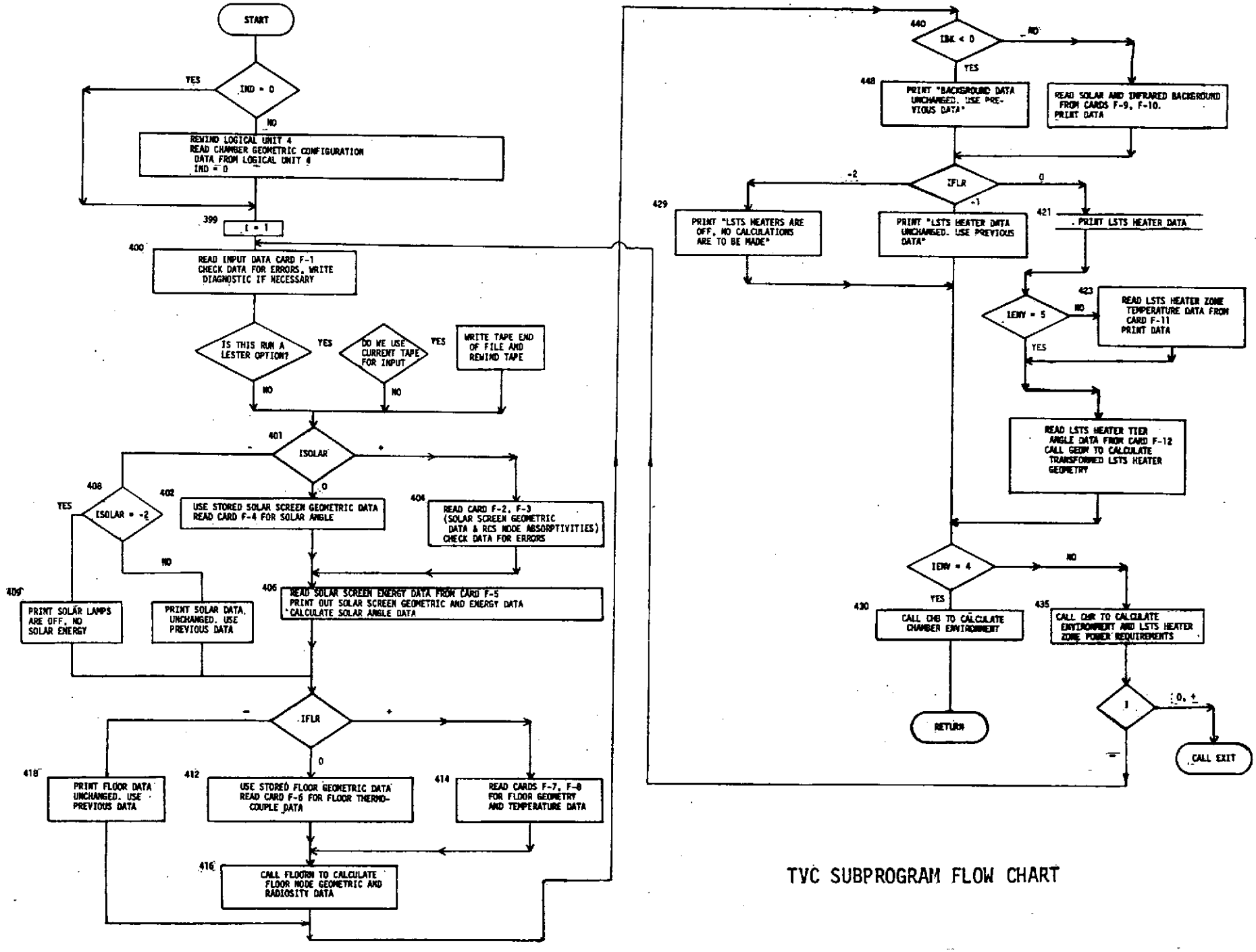
FL(N, IZ)	Form factor from RCS node N to LSTS heater zone IZ
IC	Chamber index =1 MSC chamber =2 LTV chamber
NC(IC, J)	Stored chamber constants for Chamber IC J=1 Number of solar screen lengths J=2 Number of solar screen widths J=3 Number of chamber floor radial divisions (for nodal breakup calculations) J=4 Number of chamber floor angular divisions J=5 Number of floor thermocouples
NCMB	Number of chambers for which data is stored
NLAMP(IC, IZ, IT)	Number of LSTS heater elements in tier IT, zone IZ, chamber IC
NTIER (IC, IZ)	Number of LSTS heater element tiers in zone IZ, chamber IC
NZONE (IC)	Number of LSTS heater zones in chamber IC
XL(IC, IZ, IT, IL, I)	Initial coordinate data for LSTS heater elements IL, in tier IT, in zone IZ, in chamber IC I=1 X position of heater element, ft. =2 Y position of heater element, ft. =3 Z position of heater element, ft. =4 Azimuth angle of heater element, radians =5 Inclination angle of heater element, radians =6 Heater element area, ft^2
XLO(IC, J)	Stored chamber values for chamber IC J=1 LSTS heater emissivity =2 Perpendicular distance of pivot from LSTS heater, ft =3 Parallel distance of pivot from LSTS heater element center, ft =4 Solar screen modulation =5 Solar screen height, ft. =6 Solar screen width, ft. =7 Chamber floor emissivity =8 Chamber floor radial division length, ft =11 to 30 Absorptivity of material I (I=J-10) to solar lamp energy

XLP(IZ, IT, IL, I)	Transformed (after rotation) coordinate data for LSTS heater elements I=1 X position, ft. =2 Y position, ft. =3 Z position, ft. =4 X component of heater unit normal vector =5 Y component of heater unit normal vector =6 Z component of heater unit normal vector
CH2	Block Common
ALFSOL	Solar screen modulation
HEIGS	Solar screen height, ft.
ML	Number of solar screen lengths
NGRID	Maximum number of solar screen nodes allowed
NW	Number of solar screen widths
SFLUX	Solar lamp flux incident on RCS node, Btu/hr-ft^2
SOL(I)	Solar lamp flux on solar screen node I, Btu/hr-ft^2
WIDTHS	Solar screen width, ft.
CH4	Block Common
A(I)	Absorptivity of material I to solar lamp radiation
B(IZ)	Radiosity of LSTS heater elements in zone IZ, Btu/hr-ft^2
T(IZ)	Temperature of LSTS heater elements in zone IZ, °F
TR(IZ)	Temperature of LSTS heater elements in zone IZ, °R
CH6	Block Common
QBR(I, J, K)	Background infrared energy array, Btu/hr-ft^2
QBS(I, J, K)	Chamber albedo background energy array, Btu/hr-ft^2

CH3 BLOCK COMMON NOMENCLATURE

Listed below is a dictionary of FORTRAN nomenclature for the variables contained in the CH3 block common statement. CH3 contains chamber floor data and is located in segment S of the EHFR map.

BF(I)	Radiosity of floor node I, Btu/hr
DR	Floor node radial length, ft.
EPSFLR	Floor emissivity
NB	Number of floor node angular divisions
NFLR	Maximum number of floor nodes allowed
NODE	Number of floor nodes
NUMZNS	Number of floor node radial divisions
TAV	Average floor node temperature, °F
TEMP(I)	Temperature of floor node I, °R
TEMTC(J)	Temperature reading of thermocouple J, °F
XF(I)	X coordinate of floor node I, ft.
YF(I)	Y coordinate of floor node I, ft.



TVC SUBPROGRAM FLOW CHART

UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F501PH
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:19:29

SUBROUTINE TVC ENTRY POINT 001615

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	001641
0000	*DATA	000742
0002	*BLANK	000000
0003	MR	053203
0004	GR1	000043
0005	CH1	035554
0006	CH2	000436
0007	CH3	005141
0010	CH4	000062
0011	CH6	000170

EXTERNAL REFERENCES (BLOCK, NAME)

0012	FLOORN
0013	GEOM
0014	CHR
0015	CHR
0016	EXIT
0017	NREW$
0020	NRBU$
0021	NIO1$
0022	NIO2$
0023	NRDU$
0024	NWBU$
0025	NWEF$
0026	NWDU$
0027	SIN
0030	COS
0031	NERR3$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000012 132G	0001	000021 137G	0001	000026 143G	0001	000033 147G	0001	000040 153G
0001	000045 157G	0001	000062 171G	0001	000136 214G	0001	000164 227G	0001	000225 252G
0001	000330 304G	0001	000347 314G	0001	000402 325G	0001	000436 342G	0001	000454 351G
0001	000475 361G	0001	000052 399L	0001	000054 400L	0001	000150 401L	0001	000252 404L
0001	000371 406L	0001	000504 408L	0001	000516 409L	0001	000523 410L	0001	000556 412G
0001	000625 414L	0001	000771 416L	0001	000776 418L	0001	001166 420L	0001	001204 421L
0001	001263 423L	0001	001374 428L	0001	001367 429L	0001	000620 431G	0001	001406 435L
0001	001003 440L	0001	001161 444L	0001	000723 457G	0001	000765 476G	0001	001015 512G
0001	001016 514G	0001	001017 516G	0001	001044 521G	0001	001045 531G	0001	001046 533G
0001	001077 546G	0001	001110 554G	0001	001115 561G	0001	001124 566G	0001	001130 572G
0001	001236 631G	0001	001253 640G	0001	001302 651G	0001	001333 660G	0001	001353 670G
0001	001421 810L	0001	001442 812L	0001	001465 814L	0001	001506 816L	0001	001531 818L
0001	001550 820L	0001	001564 890L	0000	000041 901F	0000	000042 902F	0000	000044 905F
0000	000046 920F	0000	000073 922F	0000	000116 924F	0000	000133 928F	0000	000151 926F
0000	000206 930F	0000	000227 932F	0000	000243 950F	0000	000272 952F	0000	000372 954F
0000	000411 956F	0000	000426 958F	0000	000430 960F	0000	000464 962F	0000	000475 964F
0000	000504 966F	0000	000522 970F	0000	000541 972F	0000	000562 974F	0000	000571 976F

```
0000   000576 9#0F      0000   000614 9#1F      0000   000641 9#2F      0000   000635 9#4F      0000   000652 9#6F
0000   000671 9#8F      0010 R 000000 A         0003 R 000041 ANAME     0004 R 001421 AL        0000 R 000611 ALAMP     0004 R 001007 ALPMAT
0006 R 000435 ALPSOL    0003 R 000041 ANAME     0004 R 002173 AR        0004 R 002017 AS        0004 R 000001 ASF       0004 R 000001 AX
0010 R 000024 B         0007 R 005140 BETA      0007 R 002514 BF        0000 R 000034 BLAMP     0004 R 000006 BN        0004 R 000011 COSP
0004 R 000021 BXX       0004 R 000007 BY        0004 R 000022 BYY       0004 R 000016 BZ        0004 R 000011 COSP      0004 R 001326 DTIME
0004 R 000042 COSSUN    0004 R 000031 COST      0004 R 000023 COST1     0007 R 000001 DR        0004 R 001326 DTIME     0000 R 000021 ENV1
0000 R 000024 DX        0004 R 000025 DY        0004 R 000026 DZ        0000 R 000012 ENVP      0000 R 000021 ENV1      0005 R 025404 FI
0000 R 000016 ENV2      0007 R 000005 EPSFLR    0000 R 000032 EPSLMP    0004 R 000042 FATOT     0005 R 025404 FI        0004 R 000034 GOSOL
0004 R 000014 FSE       0003 R 003703 GENODE    0004 R 000033 GOFIR     0004 R 000040 GOFIRP    0004 R 000034 GOSOL     0004 I 004541 IA
0004 R 000036 GOSOLA    0004 R 000035 GOSOLD    0006 R 000433 HEIGS     0000 I 000017 I         0004 I 004541 IA        0004 I 000442 IN
0005 I 000000 IC        0003 I 000013 ICARD     0004 I 000444 IFLR      0004 I 000445 ILAMP     0004 I 000442 IN        0004 I 000010 IREF
0003 I 000007 IOUT      0003 I 000014 IPAGE     0003 I 000024 IPRINT    0004 I 000027 IQ        0004 I 000010 IREF      0000 I 000020 IX
0003 I 000012 ISC       0003 I 000441 ISOLAR    0000 I 000037 IT        0000 I 000035 IZ        0000 I 000020 IX        0004 I 000000 M
0000 I 000024 I1        0000 I 000036 I2        0000 I 000023 J         0000 I 000040 K         0004 I 000000 M         0004 I 000001 MOLD
0003 I 000001 MAX       0006 I 000430 ML        0001 I 000430 MODE      0004 I 000002 MODEM     0004 I 000001 MOLD      0007 I 000000 NB
0003 I 052337 MTRL      0003 I 000023 MTRLN     0000 I 000025 N         0004 I 000006 NAME      0007 I 000000 NB        0005 I 000027 NLAMP
0005 I 000247 NC        0005 I 000001 NCMB      0003 I 000022 NEMI      0000 I 000040 NGRID1    0005 I 000027 NLAMP     0000 I 000022 NTOT
0003 I 000004 NMODE     0007 I 000002 NODE      0000 I 000026 NTC       0005 I 000005 NTIER     0000 I 000022 NTOT      0005 I 000002 NZONE
0007 I 000001 NUMZNS    0003 I 000005 NVM       0006 I 000431 NW        0000 I 000031 NZ        0005 I 000002 NZONE     0004 R 006257 Q
0004 R 000013 PHI       0004 R 000004 PHI1      0003 R 000015 PI        0003 R 000016 PI180     0004 R 006257 Q         0004 R 000067 QT
0011 R 000000 QBR       0011 R 000074 QBS       0003 R 020137 QR        0003 R 021003 QS        0004 R 000067 QT        0004 R 000012 SINP
0000 R 000027 RADIUS    0003 R 000025 REF       0006 R 000434 SFLUX     0003 R 000017 SIG       0004 R 000012 SINP      0010 R 000036 T
0004 R 000041 SINSUN    0006 R 000000 SOL       0004 R 000037 SUN       0004 R 000040 SUND      0010 R 000036 T         0007 R 003726 TEMP
0007 R 000004 TAV       0003 R 005413 TCON      0003 R 000011 TCONT     0003 R 000477 TEMAT     0007 R 003726 TEMP      0003 R 000020 TIMED
0007 R 000006 TEMTC     0000 R 000000 THT       0004 R 000005 THT1      0003 R 000021 TIME      0003 R 000020 TIMED     0005 R 005540 XL
0003 R 000461 TITLE     0010 R 000050 TR        0006 R 000432 WIDTHS    0007 R 000070 XF        0005 R 005540 XL        0003 R 021647 XR
0005 R 000115 XLO       0005 R 000324 XLP       0003 R 001317 XN        0003 R 000060 XO        0003 R 021647 XR
0004 R 000000 XSE       0007 R 001302 YF        0004 R 000001 YSE       0004 R 000002 ZSE
```

```
00101     1*          SUBROUTINE TVC(IENV,IND)
00101     2*    C
00103     3*          PARAMETER MMAX=3,NMAX=420
00104     4*          COMMON / MR / M,MAX,MODEM,MOLD,NMODE,NVM,NAME,IOUT,IREF,TCONT,
00104     5*         1     ISC,ICARD,IPAGE,PI,PI180,SIG,TIMED,TIME,NEMI,MTRLN,IPRINT,
00104     6*         2     REF(12),ANAME(15),XO(7),QT(15,15),MODE(10),IN(15),TITLE(14),
00104     7*         3     TEMAT(20,10),ALPMAT(20,10),XN(7),DTIME,
00104     8*         4     AL(MMAX),AR(MMAX),AS(MMAX),GENODE(MMAX),IA(MMAX),TCON(MMAX),
00104     9*         5     Q(12,MMAX),QR(MMAX),QS(MMAX),XR(MMAX,NMAX,10),MTRL(NMAX)
00105    10*          PARAMETER NGRID=280
00106    11*          PARAMETER NFLR=650
00107    12*          COMMON /GEI / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI,
00107    13*         1    FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,GOFIRP,
00107    14*         1    COST,FATOT,GOFIR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00110    15*          COMMON /CH1/ IC,NCMB,NZONE(3),NTIER(3,6),NLAMP(3,6,3),XLO(3,30),
00110    16*         1               NC(3,15),XLP(6,3,25,6),XL(3,6,3,25,6),FL(700,6)
00111    17*          COMMON /CH2 / SOL(NGRID),ML,NW,WIDTHS,HEIGS,SFLUX,ALPSOL
00112    18*          COMMON /CH3 / NB,NUMZNS,NODE,DR,TAV,EPSFLR,TEMTC(50)
00112    19*         1,XF(NFLR),YF(NFLR),BF(NFLR),TEMP(NFLR),BETA
00113    20*          COMMON /CH4 / A(20),B(10),T(10),TR(10)
00114    21*          COMMON /CH6/ QBR(3,4,5),QBS(3,4,5)
00115    22*          EQUIVALENCE (IN(2),ISOLAR),(IN(3),IFLR),(IN(4),ILAMP)
00116    23*          DIMENSION THT(10),ENVP(4)
00117    24*          DATA ENV2 / 6HCHAMBER /
00121    25*          DATA (ENVP(I),I=1,3) /6HMSC   C, 6HLTV   C, 6HNEW   C /
00123    26*          DATA(THT(I),I=1,10)/ -90.,-45.,0.,45.,90.,-90.,-45.,0.,45.,90. /
00123    27*    C
00125    28*          IF (IND.EQ.0) GO TO 399
00127    29*          REWIND 4
00130    30*          READ (4) XL,NCMB,NZONE,NTIER,NLAMP,NC,XLO
00163    31*          IND = 0
```

```
00164    32*     399 CONTINUE
00165    33*         I=1
00166    34*     400 CONTINUE
00167    35*         READ (5,901) IN
00175    36*         ICARD = ICARD + 1
00176    37*         IC = IN(1)
00177    38*         IF (IC.LE.0.OR.IC.GT.NCMB) GO TO 810
00201    39*         IF (IENV.EQ.4) GO TO 401
00203    40*         IF (IN(6).GT.0) GO TO 401
00205    41*         IF (I.LT.0) GO TO 401
00207    42*         M=1
00210    43*         TIME = -100.
00211    44*         WRITE (IOUT) TIME,Q
00220    45*         END FILE IOUT
00221    46*         REWIND IOUT
00222    47*     401 CONTINUE
00223    48*         ENV1 = ENVP(IC)
00224    49*         IPAGE = IPAGE + 1
00225    50*         WRITE (6,950) TITLE,IPAGE,REF(1),REF(2),ENV1,ENV2
00225    51*  C
00225    52*  C      READ SCREEN DATA
00240    53*         IF (ISOLAR) 404,402,404
00243    54*     402 ML = NC(IC,1)
00244    55*         NW = NC(IC,2)
00245    56*         NTOT = ML*NW
00246    57*         ALFSOL = XLO(IC,4)
00247    58*         HEIGS = XLO(IC,5)
00250    59*         WIDTHS= XLO(IC,6)
00251    60*         DO 403 I=1,20
00254    61*         J = I+10
00255    62*     403 A(I) = XLO(IC,J)
00257    63*         READ (5,902) SUND
00262    64*         ICARD = ICARD + 1
00263    65*         GO TO 406
00264    66*     404 READ (5,905) ML,NW,SUND,HEIGS,WIDTHS,ALFSOL
00274    67*         ICARD = ICARD + 1
00275    68*         NTOT = ML*NW
00276    69*         IF (NTOT.GT.NGRID.OR.NTOT.LE.0) GO TO 812
00300    70*         IF (HEIGS*WIDTHS.LE.0.0) GO TO 814
00302    71*         READ (5,902) A
00310    72*         ICARD = ICARD + 2
00311    73*         IF (ALFSOL.LE.0.) ISOLAR=-2
00313    74*         DO 405 I=1,20
00316    75*         II = I
00317    76*         IF (A(I).LE.0.0.OR.A(I).GT.1.0) GO TO 818
00321    77*     405 CONTINUE
00323    78*     406 READ (5,902) (SOL(I),I=1,NTOT)
00331    79*         ICARD = ICARD +(NTOT+9)/10
00332    80*         WRITE (6,952) SUND,ALFSOL,HEIGS,ML,WIDTHS,NW,(I,A(I),I=1,20)
00347    81*         WRITE (6,958) (SOL(I),I=1,NTOT)
00355    82*         SUN = SUND*PI180
00356    83*         SINSUN = SIN(SUN)
00357    84*         COSSUN = COS(SUN)
00360    85*         DO 407 N=1,NMAX
00363    86*         I = MTRL(N)
00364    87*         AL(N) = A(I)
00365    88*     407 CONTINUE
00367    89*         GO TO 410
00370    90*     408 IF (ISOLAR.EQ.-2) GO TO 409
00372    91*         WRITE (6,954)
00374    92*         GO TO 410
00375    93*     409 WRITE (6,956)
00375    94*  C
```

```
00375    95*  C      READ FLOOR  DATA
00377    96*       410 IF (IFLR) 418,412,414
00402    97*       412 NUMZNS = NC(IC,3)
00403    98*           NB = NC(IC,4)
00404    99*           NTC = NC(IC,5)
00405   100*           EPSFLR = XLOC(IC,1)
00406   101*           DR = XLOC(IC,2)
00407   102*           RADIUS = DR*NUMZNS
00410   103*           READ (5,902) (TEMIC(I),I=1,NTC)
00416   104*           ICARD = ICARD +(NTC+9)/10
00417   105*           WRITE (6,960) RADIUS,NUMZNS,NB,EPSFLR
00425   106*           WRITE (6,962)
00427   107*           WRITE (6,958) (TEMIC(I),I=1,NTC)
00435   108*           GO TO 416
00436   109*       414 READ (5,905) NUMZNS,NB,EPSFLR,RADIUS
00444   110*           ICARD = ICARD + 1
00445   111*           NTOT = NB*NUMZNS
00446   112*           IF (NTOT.GT.NFLR.OR.NTOT.LE.0) GO TO 416
00450   113*           IF (EPSFLR.LT.0.0.OR.EPSFLR.GT.1.0) GO TO 420
00452   114*           IF (RADIUS.LE.0.0) GO TO 420
00454   115*           DR = RADIUS/NUMZNS
00455   116*           READ (5,902) (TEMP(I),I=1,NTOT)
00463   117*           ICARD = ICARD + (NTOT + 9)/10
00464   118*           WRITE (6,960) RADIUS,NUMZNS,NB,EPSFLR
00472   119*           WRITE (6,964)
00474   120*           WRITE (6,958) (TEMP(I),I=1,NTOT)
00502   121*       416 CALL FLOORN(IC,IFLR)
00503   122*           GO TO 440
00504   123*       418 WRITE (6,966)
00504   124*  C
00504   125*  C      READ BACKGROUND DATA
00506   126*       440 IF (IN(5).LT.0) GO TO 448
00510   127*           READ (5,902) (((QBR(I,J,K),K=1,5),J=1,4),I=1,3)
00524   128*           ICARD = ICARD + 6
00525   129*           READ (5,902) (((QBS(I,J,K),K=1,5),J=1,4),I=1,3)
00541   130*           ICARD = ICARD + 6
00542   131*           WRITE (6,972)
00544   132*           ZSE =1.
00545   133*           DO 444 I=1,3
00550   134*           PHI1=0.
00551   135*           WRITE (6,974) ZSE,THT
00560   136*           DO 442 J=1,4
00563   137*           WRITE (6,976) PHI1,(QBR(I,J,K),K=1,5),(QBS(I,J,K),K=1,5)
00576   138*           PHI1 = PHI1+90.
00577   139*       442 CONTINUE
00601   140*           ZSE = ZSE + 2.
00602   141*       444 CONTINUE
00604   142*           GO TO 420
00605   143*       448 WRITE (6,970)
00605   144*  C
00605   145*  C      LAMP DATA
00607   146*       420 IF (ILAMP.GE.0) GO TO 421
00611   147*           IF (ILAMP.EQ.-2) GO TO 429
00613   148*           WRITE (6,980)
00615   149*           GO TO 428
00616   150*       421 CONTINUE
00617   151*           WRITE (6,982)
00621   152*           NZ = NZONE(IC)
00622   153*           EPSLMP = XLOC(IC,1)
00623   154*           ALAMP  = XLOC(IC,2)
00624   155*           BLAMP  = XLOC(IC,3)
00625   156*           IF (IENV.EQ.5) GO TO 423
00627   157*           READ (5,902) T
```

```
00635   158*          ICARD = ICARD + 1
00636   159*          WRITE (6,984) (I,T(I),I=1,NZ)
00645   160*      423 CONTINUE
00646   161*          WRITE (6,986)
00650   162*          DO 425 IZ=1,NZ
00653   163*          TR(IZ)= T(IZ) + 460.
00654   164*          B(IZ) = EPSLMP*SIG*TR(IZ)**4
00655   165*          I2 = NTIER(IC,IZ)
00656   166*          READ (5,902) (XL(IC,IZ,IT,1,5),IT=1,I2)
00664   167*          ICARD = ICARD + 1
00665   168*          WRITE(6,988) IZ,(XL(IC,IZ,IT,1,5),IT=1,I2)
00674   169*      425 CONTINUE
00676   170*          CALL GEOM(ALAMP,BLAMP)
00677   171*          GO TO 428
00700   172*      429 CONTINUE
00701   173*          WRITE (6,981)
00703   174*      428 CONTINUE
00704   175*          IF (IENV-4)430,430,435
00707   176*      430 CALL CHR(ENV1)
00710   177*          RETURN
00711   178*      435 CALL CHR(I,EPSLMP,ENV1)
00712   179*          IF (I.LT.0) GO TO 400
00714   180*          CALL EXIT
00714   181*  C
00714   182*  C       SECTION 800, INPUT ERROR DIAGNOSTIC MESSAGES
00715   183*      810 WRITE (6,920) ICARD
00720   184*          WRITE (6,922) IC,NCMB
00724   185*          GO TO 890
00725   186*      812 WRITE (6,920) ICARD
00730   187*          NGRID1 = NGRID
00731   188*          WRITE (6,924) NTOT,NGRID1
00735   189*          GO TO 890
00736   190*      814 WRITE (6,920) ICARD
00741   191*          WRITE (6,926) HEIGS,WIDTHS
00745   192*          GO TO 890
00746   193*      816 WRITE (6,920) ICARD
00751   194*          WRITE (6,928) NTOT,NB,NUMZNS
00756   195*          GO TO 890
00757   196*      818 WRITE (6,920) ICARD
00762   197*          WRITE (6,930) I1
00765   198*          GO TO 890
00766   199*      820 WRITE (6,920) ICARD
00771   200*          WRITE (6,932)
00773   201*      890 IF (IENV.EQ.5)CALL EXIT
00775   202*          TIME = -100.
00776   203*          RETURN
00776   204*  C
00776   205*  C       SECTION 900, FORMAT STATEMENTS
00777   206*      901 FORMAT (2014)
01000   207*      902 FORMAT (10F8.3 )
01001   208*      905 FORMAT (2I4,9F8.3)
01002   209*      920 FORMAT (////41H FATAL ERROR IN DATA INPUT FOUND ON CARD NUMBER,
01002   210*         1 I4 , //     52H PROGRAM WILL CALL EXIT AFTER THE FOLLOWING MESSAGE
01002   211*         2. ////)
01003   212*      922 FORMAT (50H CHAMBER NUMBER INPUT IS EITHER TOO LARGE OR ZERO.  //
01003   213*         1 15H NUMBER INPUT -,I4, 20X,   20H MAXIMUM AVAILABLE -,I4 )
01004   214*      924 FORMAT (38H NUMBER OF SOLAR SCREEN GRIDS INPUT IS,I5, 20X,
01004   215*         1 20H MAXIMUM ALLOWED IS ,I5 )
01005   216*      926 FORMAT (72H EITHER SOLAR SCREEN HEIGHT OR WIDTH HAS BEEN INPUT AS
01005   217*         NEGATIVE OR ZERO. // 10H HEIGHT = ,F10.3/ 9H WIDTH = ,F10.3 )
01006   218*      928 FORMAT (64H NUMBER OF FLOOR NODES REQUIRED IS ZERO OR GREATER THAN
01006   219*         1 ALLOWED. // 28H NUMBER OF NODES REQUIRED = ,I5 //  4H NB=,I5 /
01006   220*         2 10H NUMZNS = ,I5 )
```

```
01007   221*      930 FORMAT (24H ABSORPTIVITY OF COATING,F5,62H  TO SOLAR LAMP EMISSION
01007   222*         1 IS EITHER NEGATIVE OR GREATER THAN 1.  )
01010   223*      932 FORMAT (65H EITHER FLOOR RADIUS OR EMISSIVITY ARE INPUT AS ZERO OR
01010   224*         1 NEGATIVE.  )
01011   225*      950 FORMAT (1H1,29X,14A5,12X,4HPAGE,I4// 30X,2A5,2X,17H IS LOCATED IN
01011   226*         1A ,2A6,15H  ENVIRONMENT. //45H PRINT OF CHAMBER DATA INPUT OR DATA
01011   227*         2 UPDATE. // )
01012   228*      952 FORMAT (20H SOLAR SCREEN DATA.  //37H SOLAR LAMP COLUMNATION ANGLE
01012   229*         1 (DEG) =,F10.2, 20X, 26H SOLAR SCREEN MODULATION =,F7.3//
01012   230*         2                         21H SCREEN HEIGHT (FT) =,F10.2,10X,
01012   231*         3 32H NUMBER OF SCREEN HEIGHT NODES =,I5/ 21H SCREEN WIDTH  (FT) =,
01012   232*         4 F10.2,10X,32H NUMBER OF SCREEN WIDTH  NODES =,I5 //
01012   233*         5 37H COATING ABSORPTIVITY TO SOLAR LAMPS .,10X,
01012   234*         6 22H COATING  ABSORPTIVITY / 10(50X,I3,F12.3/) /
01012   235*         7 24H SOLAR SCREEN NODE DATA. /)
01013   236*      954 FORMAT ( 43H SOLAR SCREEN DATA NOT CHANGED OR UPDATED AT THIS TIME
01013   237*         1.  PREVIOUS DATA INPUT USED. //)
01014   238*      956 FORMAT ( 70H SOLAR LAMPS ARE NOT ON.  NO SOAR SCREEN CALCULATIONS
01014   239*         1ARE TO BE MADE. //)
01015   240*      958 FORMAT (10F12.3)
01016   241*      960 FORMAT(/20HOCHAMBER FLOOR DATA. //20H FLOOR RADIUS (FT) =,F10.2/
01016   242*         132H NUMBER OF RADIAL  FLOOR NODES =,I5/
01016   243*         232H NUMBER OF ANGULAR FLOOR NODES =,I5/
01016   244*         320H FLOOR EMISSIVITY = ,F7.3 / )
01017   245*      962 FORMAT (45H FLOOR THERMOCOUPLE TEMPERATURE DATA, DEG F. /)
01020   246*      964 FORMAT (33H FLOOR NODE TEMPERATURES, DEG R. /)
01021   247*      966 FORMAT(/25HOFLOOR DATA NOT CHANGED OR UPDATED AT THIS TIME.  PREVI
01021   248*         1OUS DATA INPUT USED.  //)
01022   249*      970 FORMAT(/#0HOBACKGROUND DATA NOT CHANGED OR UPDATED AT THIS TIME.
01022   250*         1PREVIOUS DATA INPUT USED.  //)
01023   251*      972 FORMAT(/17HOBACKGROUND DATA.//  30X,30H L.R. BACKGROUND, BTU/HR*FT
01023   252*         12  ,20X,   30H SOLAR BACKGROUND, BTU/HR*FT2   )
01024   253*      974 FORMAT (3H Z=,F3.1,1X,7HTHETA =, F6.1,9F10.1 )
01025   254*      976 FORMAT ( 6H PHI =,F5.1,F9.2,9F10.2 )
01026   255*      980 FORMAT(/25HOLSTS  DATA NOT CHANGED OR UPDATED AT THIS TIME.  PREVI
01026   256*         1OUS DATA INPUT USED.  //)
01027   257*      981 FORMAT(/69HOLSTS HEATERS ARE NOT ON.  NO LSTS HEAT CALCULATIONS AR
01027   258*         1E TO BE MADE. )
01030   259*      982 FORMAT (///13H LSTS  DATA.  /)
01031   260*      984 FORMAT (53HOLSTS  ZONE TEMPERATURES (DEG F).       ZONE      TEMP. /
01031   261*         1   (40X,I3,F10.1))
01032   262*      986 FORMAT (37HOLSTS  TIER INCLINATION ANGLES (DEG). /
01032   263*         1 40H ZONE      TIER 1    TIER 2    TIER 3    )
01033   264*      988 FORMAT (I3,F13.2,3F10.2 )
01034   265*          END

    END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUBS10          SYMBOLIC                                  09 MAR 71  14:48:03   0  01656136    14   265  (DELETED)
SUBS10  CODE    RELOCATABLE                               09 MAR 71  14:48:03   1  01665334    60     1  (DELETED)
                                                                                  0  01665430    14   140
```

SUBPROGRAM NAME: Subroutine CHB(ENV1)

SEGMENT NAME: SUBS1

PURPOSE: Calculate the thermal environment experienced by a Reference Coordinate System (RCS) located in a thermal vacuum chamber.

DESCRIPTION: The thermal vacuum chamber environment consists of direct solar lamp energy, infrared chamber floor energy, Lunar Surface Thermal Simulator (LSTS) infrared heater element thermal emission, solar albedo background, and infrared background. The CHB routine calls subprograms for: direct solar lamp energy calculations (SCREEN), LSTS infrared heater element form factor calculations (FFLMPZ), floor incident and absorbed infrared energy (FFFZ), and background energy calculations (BACK). Environment description data used by CHB is read into the EHFR by the TVC subprogram. The governing equations for thermal vacuum chamber energy calculations are presented in Section 4.4 of the main report.

CALLING PROGRAM: TVC

ARGUMENT LIST:

ENV1	Chamber environment name in A format (input)

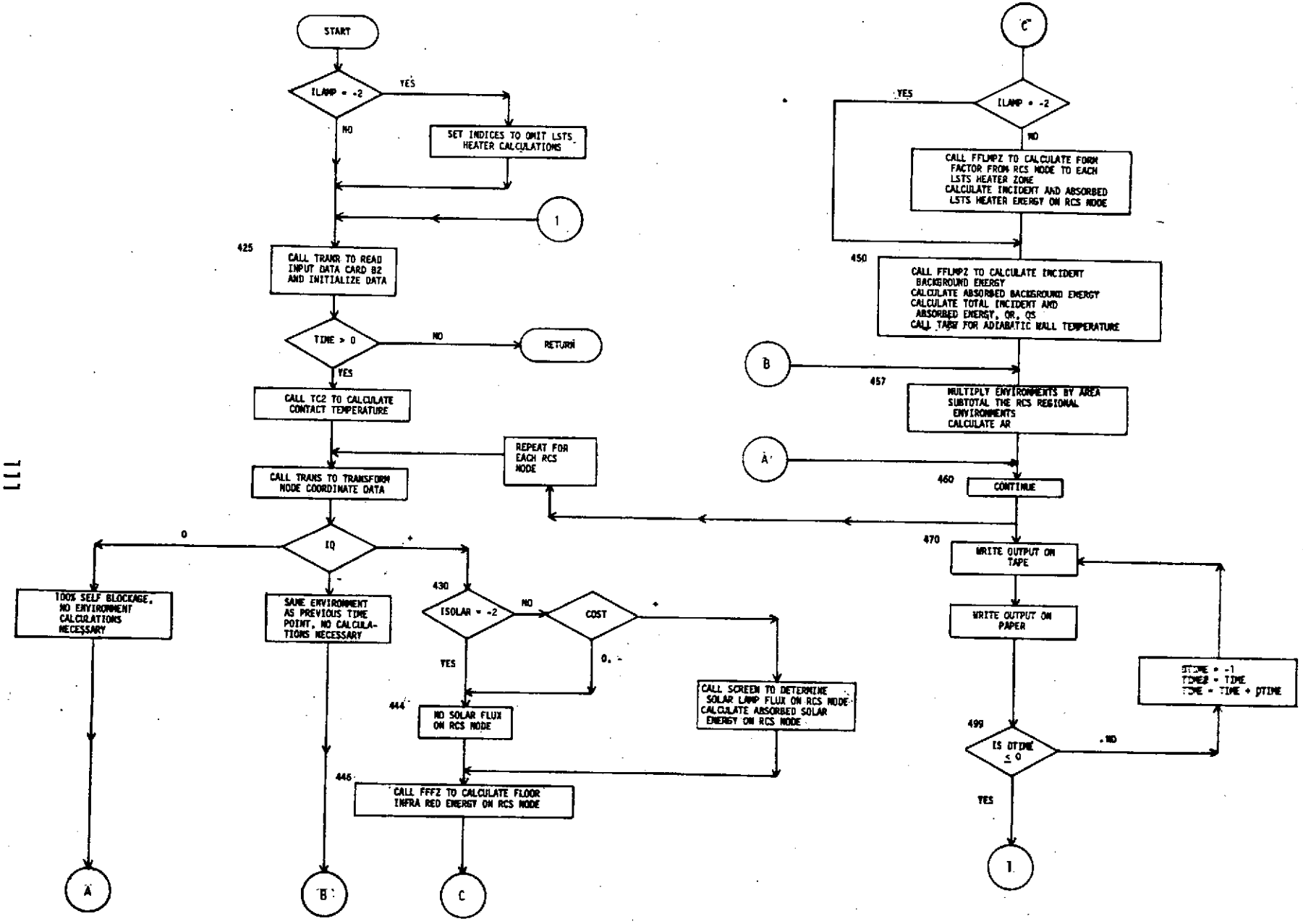
All other data required by the CHB subprogram is transferred to the routine via block common statements.

NOMENCLATURE: In addition to the dictionary of FORTRAN nomenclature listed below, the CHB subprogram uses the variables of the MR, GE1, CH1, CH2, CH3, CH4, and CH6 block common statements. These variables are defined with the SUBM1 (main program) and TVC subprogram nomenclature.

ALPHA	Absorptivity of RCS node to an incident energy source
ENV1, ENV2	Environment name in A format
GIR	Incident infrared energy from LSTS heater zone I or from infrared background on an RCS node, Btu/hr-ft^2
GOFIR	Total infrared energy incident on an RCS node, Btu/hr-ft^2
GOSOL	Background albedo incident on an RCS node, Btu/hr-ft^2
GOSOLD	Direct solar lamp energy incident on a RCS node, Btu/hr-ft^2
I, J, K	Indices
IC	Chamber index =1 MSC chamber =2 LTV chamber
IENV	Environment option index

ISOLAR	Solar lamp operation index =-2 solar lamps are off ≠-2 solar lamps are on
IT	LSTS heater zone tier index
IZ	LSTS heater zone index
I1, I2, I3, I5, I6	Print indices
N	RCS node number
NZ	Number of LSTS heater zones for chamber IC

CHB SUBPROGRAM FLOW CHART



CHB SUBPROGRAM FLOW CHART

SUBROUTINE CHB ENTRY POINT 001233

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	001254
0000	*DATA	000462
0002	*BLANK	000000
0003	MR	053203
0004	CE1	000043
0005	CH1	035554
0006	CH2	000436
0007	CH3	000070
0010	CH4	000062
0011	CH6	000170

EXTERNAL REFERENCES (BLOCK, NAME)

0012	THANR
0013	TC2
0014	TRANS
0015	SCREEN
0016	FFFZ
0017	FFLMPZ
0020	ALPHA1
0021	BACK
0022	TABW
0023	NWBU$
0024	NIO1$
0025	NIO2$
0026	NWIU$
0027	NERR3$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001		000040	135G	0001		000121	164G	0001		000215	210G	0001		000250	220G	0001		000337	247G
0001		000361	261G	0001		000414	277G	0001		000477	330G	0001		000526	340G	0001		000551	353G
0001		000562	361G	0001		000601	372G	0001		000625	402G	0001		000644	411G	0001		000653	416G
0001		000012	425L	0001		000704	430G	0001		000070	444L	0001		000072	446L	0001		000147	450L
0001		000231	457L	0001		000300	460L	0001		001011	463G	0001		001023	470G	0001		000316	470L
0001		000463	473L	0001		000535	475L	0001		001037	477G	0001		000664	479L	0001		000740	482L
0001		000745	485L	0001		000764	491L	0001		001051	495L	0001		001110	498L	0001		001171	499L
0001		001072	511G	0001		001143	532G	0001		000567	674L	0001		000607	675L	0000		000021	950F
0000		000050	951F	0000		000110	952F	0000		000126	953F	0000		000132	955F	0000		000160	956F
0000		000164	957F	0000		000210	958F	0000		000252	962F	0000		000321	964F	0000		000324	965F
0000		000326	966F	0000		000331	971F	0000		000372	981F	0010	R	000000	A	0003	R	001327	AL
0003	R	001007	ALPHAT	0006	R	000435	ALFSOL	0000	R	000007	ALPHA	0003	R	000041	ANAME	0003	R	002173	AR
0003	R	003037	AS	0004	R	000003	ASE	0010	R	000024	B	0004	R	000006	BX	0004	R	000021	BXX
0004	R	000007	BY	0004	R	000022	BYY	0004	R	000010	BZ	0004	R	000011	COSP	0004	R	000042	COSSUN
0004	R	000031	COST	0004	R	000023	COST1	0007	R	000003	DR	0003	R	001326	DTIME	0004	R	000024	DX
0004	R	000025	DY	0004	R	000026	DZ	0000	R	000001	ENV2	0007	R	000005	EPSFLR	0004	R	000032	FATOT
0005	R	025404	FL	0004	R	000014	FSE	0003	R	003703	GENODE	0000	R	000006	GIR	0004	R	000033	GOFIR
0004	R	000030	GOFIRP	0004	R	000034	GOSOL	0004	R	000036	GOSOLA	0004	R	000035	GOSOLD	0006	R	000433	HEIGS
0000	I	000005	I	0003	I	004547	IA	0005	I	000000	IC	0003	I	000013	ICARD	0000	I	000000	IENV

```
0001   000444 IFLR        0003 I 000445 ILAMP       0001 I 000442 IN          0004 I 000007 IOUT        0003 I 000014 IPAGE
0003 I 000024 IPRINT      0004 I 000027 IQ          0001 I 000010 IREF        0003 I 000012 ISC         0001 I 000444 ISOLAR
0000 I 000016 IT          0000 I 000014 IY          0000 I 000011 IZ          0000 I 000012 J1          0000 I 000020 J2
0000 I 000017 J3          0000 I 000013 J5          0000 I 000015 J6          0000 I 000010 J           0000 I 000001 K
0003 I 000000 M           0003 I 000001 MAX         0006 I 000440 ME          0004 I 000440 MERR        0004 I 000002 MERRM
0003 I 000004 MOLD        0003 I 052137 MTRL        0004 I 000024 MTRLN       0000 I 000004 N           0004 I 000006 NAME
0007 I 000000 NB          0005 I 000247 NC          0005 I 000001 NCMB        0003 I 000022 NENC        0005 I 000027 NLAMP
0003 I 000004 NMODE       0007 I 000002 NODE        0005 I 000005 NTIER       0007 I 000001 NUMZNS      0004 I 000005 NVM
0006 I 000431 NW          0000 I 000002 NZ          0005 I 000002 NZONE       0004 R 000011 PHI         0004 R 000004 PHI1
0003 R 000015 PI          0003 R 000016 PI180       0003 R 006257 Q           0011 R 000000 QBR         0011 R 000074 QBS
0003 R 020137 QR          0003 R 021003 QS          0004 R 000067 QT          0004 R 000025 REF         0004 R 000027 REF1
0003 R 000026 REF2        0006 R 000434 SFLUX       0003 R 000017 SIG         0004 R 000012 SINP        0004 R 000041 SINSUN
0006 R 000000 SOL         0004 R 000047 SUN         0004 R 000040 SUND        0010 R 000046 T           0007 R 000004 TAV
0003 R 005413 TCON        0003 R 000011 TCONT       0003 R 000477 TEMAT       0007 R 000006 TEMUC       0004 R 000005 THT1
0003 R 000021 TIME        0003 R 000020 TIMEO       0001 R 000461 TITLE       0010 R 000050 TH          0006 R 000412 WIDTHS
0005 R 005540 XL          0005 R 000115 XLO         0005 R 000424 XLP         0004 R 001417 XN          0004 R 000060 XO
0003 R 021647 XR          0004 R 000000 XSE         0004 R 000001 YSE         0004 R 000002 ZSF
```

```
00101     1*          SUBROUTINE CHR(ENV1)
00101     2*    C
00103     3*          PARAMETER NGRID=2*0
00104     4*          PARAMETER MMAX=3,NMAX=420
00105     5*          COMMON / NR / M,MAX,MODEM,MOLD,NMODE,NVM,NAME,IOUT,IREF,TCONT,
00105     6*         1     ISC,ICARD,IPAGE,PI,PI180,SIG,TIMEO,TIME,MENU,MTRLN,IPRINT,
00105     7*         2     REF(12),ANAME(15),XO(7),QT(15,15),NODE(10),IN(15),TITLE(14),
00105     8*         3     TEMAT(20,10),ALFMAT(20,10),XN(7),DTIME,
00105     9*         4     AL(NMAX),AR(NMAX),AS(NMAX),GENODE(NMAX),IA(NMAX),TCON(NMAX),
00105    10*         5     Q(12,NMAX),QR(NMAX),QS(NMAX),XR(MMAX,NMAX,10),MTRL(NMAX)
00106    11*          EQUIVALENCE (REF1,REF(1)),(REF2,REF(2))
00107    12*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI,
00107    13*         1    FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,COPTRP,
00107    14*         1    COST,FATOT,COPTR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00110    15*          COMMON /CH1/ IC,NCMB,NZONE(3),NTIER(3,6),NLAMP(3,6,3),XLO(3,30),
00110    16*         1               NC(3,15),XLP(6,3,25,6),XL(3,6,3,25,6),PI(700,6)
00111    17*          COMMON /CH2 / SOL(NGRID),NL,NW,WIDTHS,HEIGS,SFLUX,ALFSOL
00112    18*          COMMON /CH3 / NB,NUMZNS,NODE,DR,TAV,EPSFLR,TEMUC(50)
00113    19*          COMMON /CH4 / A(20),B(10),T(10),TR(10)
00114    20*          COMMON /CH6/ QBR(3,4,5),QBS(3,4,5)
00115    21*          EQUIVALENCE (IN(2),ISOLAR),(IN(3),IFLR),(IN(4),ILAMP)
00116    22*          DATA IENV / 4/
00120    23*          DATA ENV2 / 6HHAMBER /
00122    24*          NZ = NZONE(IC)
00123    25*          IF (ILAMP.NE.-2) GO TO 425
00125    26*          NZ = 0
00126    27*          K = 6
00126    28*    C
00127    29*      425 CONTINUE
00130    30*          CALL TRANR
00131    31*          IF (TIME.LE.0.0) RETURN
00133    32*          CALL TC2(XO,TCONT)
00133    33*    C
00134    34*          DO 460 N = 1,MAX
00137    35*          CALL TRANS(N)
00140    36*          IF (IQ) 457,460,430
00143    37*      430 CONTINUE
00143    38*    C
00144    39*          IF (ISOLAR.EQ.-2) GO TO 444
00146    40*          IF (COST.LE.0.) GO TO 444
00150    41*          CALL SCREEN
00151    42*          GOSOLD = SFLUX*COST*ALFSOL
```

```
00152    43*      442 Q(1,N) = AL(N)*GOSOLD
00153    44*          GO TO 446
00154    45*      444 GOSOLD = 0.
00155    46*          Q(3,N) = 0.
00156    47*      446 CONTINUE
00157    48*          CALL FEFZ(N,Q(5,N))
00157    49*  C
00160    50*          IF (ILAMP.EQ.-2) GO TO 450
00162    51*          CALL FFLMPZ(N)
00163    52*          DO 448 I=1,NZ
00166    53*          GIR    = FL(N,I)*B(I)
00167    54*          GOFIR = GOFIR + GIR
00170    55*          K = 6 + I
00171    56*          CALL ALPHA1(TH(I),ALPHA)
00172    57*      447 Q(K,N)= GIR*ALPHA
00173    58*      448 CONTINUE
00175    59*      450 CONTINUE
00176    60*          CALL BACK(GIR)
00177    61*          GOFIR = GOFIR + GIR
00200    62*          CALL ALPHA1(500.0,ALPHA)
00201    63*          Q(6,N) = GIR*ALPHA
00202    64*          Q(4,N) = AL(N)*GOSOL
00202    65*  C
00203    66*          QS(N) =(GOSOL + GOSOLD)*ASE
00204    67*          QR(N) = GOFIR*ASE
00205    68*          Q(1,N) = 0.
00206    69*          Q(2,N) = GOFIR+GOSOLD+GOSOL
00207    70*          DO 456 I=3,K
00212    71*      456 Q(1,N) = Q(1,N) + Q(I,N)
00214    72*          CALL TARW(Q(1,N),TCON(N))
00215    73*      457 CONTINUE
00216    74*          J = IA(N)
00217    75*          DO 458 I=1,K
00222    76*          Q(I,N) = Q(I,N)*ASE
00223    77*          QT(I,1)= QT(I,1)+Q(I,N)
00224    78*      458 QT(I,J)= QT(I,J)+Q(I,N)
00226    79*          AR(N) =(Q(1,N)-QS(N)*AL(N))/QR(N)
00227    80*          IF (AR(N).LE.0.0) CALL ALPHA1(TCONT,AR(N))
00231    81*      460 CONTINUE
00231    82*  C
00233    83*          IF (IREF.NE.2) GO TO 470
00235    84*          XO(5) = XN(1)
00236    85*          XO(6) = XN(2)
00237    86*          XO(7) = XN(3)
00240    87*      470 CONTINUE
00241    88*          WRITE (IOUT) TIME,M,MODE(M),MAX,XO,IFNV,ENV1,ENV2,SUND,TCONT,NVM,
00241    89*         1    (Q(1,N),QS(N),QR(N),TCON(N),AL(N),AR(N),N=1,MAX)
00272    90*          I1 = 1
00273    91*          I5 = 6+NZ
00274    92*          IPAGE = IPAGE + 1
00275    93*          WRITE (6,950) TITLE,IPAGE,TIME,REF(1),REF(2),MODE(M),ENV1,ENV2
00312    94*          WRITE (6,955) SUND,TAV,EPSFLR
00317    95*          IF (ILAMP.NE.-2) GO TO 473
00321    96*          WRITE (6,981)
00323    97*          GO TO 475
00324    98*      473 CONTINUE
00325    99*          WRITE (6,958)
00327   100*          DO 490 IZ=1,NZ
00332   101*          I6 = NTIER(IC,IZ)
00333   102*      490 WRITE (6,956) IZ,B(IZ),T(IZ),(XL(IC,IZ,IT,1,8),IT=1,I6)
00345   103*      475 CONTINUE
00346   104*          IF (IREF.NE.2) GO TO 674
00350   105*          WRITE (6,971) REF1,(XO(I),I=1,4),TCONT,REF2,(XN(I),I=1,4)
```

```
00365  106*          GO TO 675
00366  107*      674 WRITE (6,951) REF1,REF2,(XO(I),I=1,4),TCONT
00377  108*      675 CONTINUE
00400  109*          WRITE (6,962)(IZ,IZ=1,NZ)
00406  110*          IF (NAME.LE.0) GO TO 479
00410  111*          DO 477 J=2,NAME
00413  112*      477 WRITE (6,966) ANAME(J),(QT(I,J),I=1,15)
00423  113*      479 WRITE (6,966)
00425  114*          WRITE (6,966) ANAME(1),(QT(I,1),I=1,15)
00434  115*          IF (IPRINT.EQ.-2) WRITE(6,957) REF(1),REF(2)
00441  116*      480 IF (IPRINT) 499,481,482
00444  117*      481 I1 = 180
00445  118*          I2 = 52 - 49*NZ
00446  119*          GO TO 485
00447  120*      482 I1 = 45
00450  121*          I2 = 10-NZ
00451  122*      485 CONTINUE
00452  123*          IF (I2.GT.MAX) I2 = MAX
00454  124*          WRITE (6,965)
00456  125*          IF (IPRINT) 499,495,491
00461  126*      491 WRITE (6,962)(I,I=1,NZ)
00467  127*      492 DO 493 N=I1,I2
00472  128*      493 WRITE (6,964) N,GENODE(N),TCON(N),(Q(I,N),I=1,15)
00504  129*          GO TO 498
00505  130*      495 WRITE (6,952)
00507  131*          WRITE (6,953) (N,GENODE(N),Q(1,N),Q(2,N),TCON(N),N=I1,I2)
00521  132*      498 IF (I2.EQ.MAX) GO TO 499
00523  133*          I1 = I2+1
00524  134*          I2 = I2+I3
00525  135*          IF (I2.GT.MAX) I2 = MAX
00527  136*          IPAGE = IPAGE + 1
00530  137*          WRITE (6,950) TITLE,IPAGE,TIME,REF(1),REF(2),MODE(M),ENV1,ENV2
00545  138*          IF (IPRINT) 499,495,491
00550  139*      499 IF (DTIME.LE.0.0) GO TO 425
00552  140*          TIME = TIME + DTIME
00553  141*          TIMEO= TIME
00554  142*          DTIME= -1.
00555  143*          IPRINT = -2
00556  144*          NVM=-2
00557  145*          GO TO 470
00557  146*  C
00557  147*  C       SECTION 900, FORMAT STATEMENTS
00557  148*  C
00560  149*    950 FORMAT (9H1     TIME,21X,14A5,12X,4HPAGE,I4  /9H      (HR),/F10.3/
00560  150*       1 30X,2A5,    8H  IN A  ,A5,29HING  NODE  IS LOCATED IN A
00560  151*       2,2A6,15H  ENVIRONMENT.  ///)
00561  152*      951 FORMAT (2H0 ,2A5,16X,1HX,9X,1HY,8X, 25HZ      AZIMUTH   CONTACT  /
00561  153*       1 10H  LOCATION,16X,  45H(FT)       (FT)       (FT)      (DEG)       TE
00561  154*       2MP / 20X,3F10.2,2F10.1 ///
00561  155*       3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.    / )
00562  156*      952 FORMAT (4(32H     NODE  NODE     Q      Q    AD W )/
00562  157*       1          4(32H      NO.  NAME ABSOR INCID  TEMP ))
00563  158*      953 FORMAT (4(5X,I3,1X,A5,3F6.1) )
00564  159*      955 FORMAT (13H  ENVIRONMENT  , 17X,18HSUN ANGLE (DEG) = , F7.2 //
00564  160*       1 30X,       37HAVERAGE FLOOR TEMPERATURE  (DEG F)  =,
00564  161*       1 F7.2, 20X,18HFLOOR EMISSIVITY =
00564  162*       1 F6.3)
00565  163*      956 FORMAT (30X,I4,F11.1,5F10.1)
00566  164*      957 FORMAT (//// 2X,2A5,102H  ENVIRONMENT IS THE SAME AS THE PREVIOUS
00566  165*         1TIME POINT.  SEE THAT PRINTOUT FOR DETAILED NODAL FLUX DATA. )
00567  166*      958 FORMAT(//25X,67H       LAMP       POWER       LAMP       LAMP INCLINATI
00567  167*         1ON ANGLES, (DEG) /30X,55H ZONE   PER LAMP      TEMP       TIER
00567  168*         1TIER      TIER /  30X,55H  NO.  B/H/FT**2    DEG F         1
```

```
00567   169*          1  2          3      )
00570   170*       962 FORMAT (52X,22HABSORBED  HEAT, BTU/HR                /
00570   171*          1110H       NODE  AD WALL     TOTAL     TOTAL     SOLAR     SOLAR     CHA
00570   172*          2MB      I.R.      ZONE      ZONE      ZONE      ZONE     /
00570   173*          3 64H NO.  NAME     TEMP      ABSOR     INCID     LAMPS    ALBEDO     FLO
00570   174*          2OR ,3X,7HBCK GND,17,6I9)
00571   175*       964 FORMAT (I4,1X,A5,13F9.1)
00572   176*       965 FORMAT (1H  ///)
00573   177*       966 FORMAT (5X,A5,9X,12F9.1)
00574   178*       971 FORMAT (12H0 LOCATION    ,16X,1HX,9X,1HY,9X,2HZ      AZIMUTH   CONT
00574   179*          1ACT    /26X,45H(FT)       (FT)      (FT)      (DEG)      TEMP R /
00574   180*          2  12X,A5,3X,5F10.2 / 12X,A5,3X,4F10.2 ///
00574   181*          3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.     /)
00575   182*       981 FORMAT(/69H0LSTS HEATERS ARE NOT ON.  NO LSTS HEAT CALCULATIONS AR
00575   183*          1E TO BE MADE. )
00576   184*           END

      END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
   SUBS1            SYMBOLIC                                  31 MAR 71  14:17:10   0  02167440    14    184  (DELETED)
   SUBS1    CODE    RELOCATABLE                               31 MAR 71  14:17:10   1  02174460    60      1  (DELETED)
                                                                                     0  02174554    14     97
```

SUBPROGRAM NAME: Subroutine GEOM (ALAMP, BLAMP)

SEGMENT NAME: SUBS2

PURPOSE: Transform the LSTS heater element coordinate data and calculate the LSTS heater element unit normal vector components.

DESCRIPTION: The GEOM uses the LSTS heater element zone inclination angles (read into the program by the TVC subprogram on Card F12) to transform the coordinates and calculate unit normal vector data for use in form factor calculations.

CALLING PROGRAM: TVC

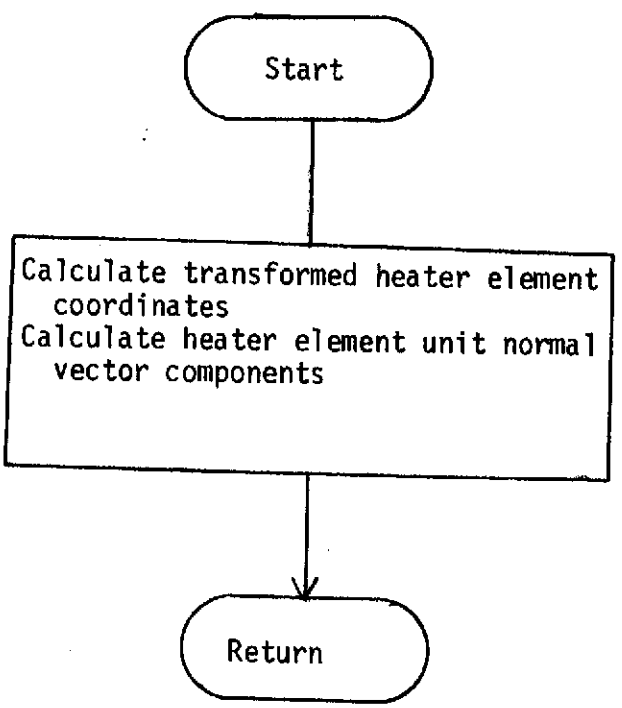
ARGUMENT LIST:

ALAMP	Perpendicular distance of pivot from heater element center (input)
BLAMP	Parallel distance of pivot from heater element center (input)

NOMENCLATURE: The FORTRAN nomenclature listed below is used by the GEOM subprogram. Also used by the GEOM program are the variables of the CH1 block common statement which are defined with the TVC nomenclature.

COST	Cosine of THT2
DELD	Radial distance difference from chamber origin
DELZ	Heater element height difference
I, J, K	Indices
IL	Heater element index
IT	Heater zone tier index
IZ	Power zone index
PHI2	Heater element azimuth angle, radians
SINT	Sine of THT2
THT2	Transformed heater element inclination angle, radians

GEOM SUBPROGRAM FLOW CHART



```
@ FOR,* SUBS2,SUBS2                                                    31 MAR 71          14:19:
UNIVAC 1108 FORTRAN V LEVEL   2206 001@ F501=H
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:19:09


   SUBROUTINE GEOM      ENTRY POINT 000170

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000207
        0000   *DATA   000046
        0002   *BLANK  000000
        0003   CHI     035554


   EXTERNAL REFERENCES (BLOCK, NAME)

        0004   COS
        0005   SIN
        0006   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000012 106G      0001   000026 112G      0001   000104 123G      0000 R 000005 COST      0000 R 000007 DELD
    0000 R 000010 DELZ      0003 R 025404 FL        0000 I 000000 I         0003 I 000000 IC        0000 I 000012 IL
    0000 I 000003 IT        0000 I 000001 IZ        0000 I 000002 J         0000 I 000011 K         0003 I 000247 NC
    0003 I 000001 NCMB      0003 I 000027 NLAMP     0003 I 000005 NTIER     0003 I 000002 NZONE     0000 R 000013 PHI2
    0000 R 000006 SINT      0000 R 000004 THT2      0003 R 005540 XL        0003 R 000115 XLD       0003 R 000324 XLP


00101    1*          SUBROUTINE GEOM(ALAMP,BLAMP)                                    00003740
00101    2*   C
00103    3*         COMMON /CHI/ IC,NCMB,NZONE(3),NTIER(3,6),NLAMP(3,6,3),XLD(3,30),
00103    4*        1              NC(3,15),XLP(6,3,25,6),XL(3,6,3,25,6),FL(700,6)
00103    5*   C
00104    6*          I=NZONE(IC)                                                     00003810
00105    7*          DO 1 IZ=1,I                                                     00003820
00110    8*          J=NTIER(IC,IZ)                                                  00003830
00111    9*          DO 1 IT=1,J                                                     00003840
00114   10*          THT2=XL(IC,IZ,IT,1,5)/57.2958                                   00003880
00115   11*         COST = COS(THT2)
00116   12*         SINT = SIN(THT2)
00117   13*         DELD = BLAMP*SINT+ALAMP*(1.-COST)
00120   14*         DELZ = ALAMP*SINT-BLAMP*(1.-COST)
00121   15*          K=NLAMP(IC,IZ,IT)                                              00003850
00122   16*           DO 1 IL=1,K                                                   00003860
00125   17*         PHI2 = XL(IC,IZ,IT,IL,4)
00126   18*         XLP(IZ,IT,IL,1)=XL(IC,IZ,IT,IL,1)-DELD*COS(PHI2)
00127   19*         XLP(IZ,IT,IL,2)=XL(IC,IZ,IT,IL,2)-DELD*SIN(PHI2)
00130   20*         XLP(IZ,IT,IL,3) = XL(IC,IZ,IT,IL,3) + DELZ
00131   21*         XLP(IZ,IT,IL,4) = COST*COS(PHI2)
00132   22*         XLP(IZ,IT,IL,5) = COST*SIN(PHI2)
00133   23*         XLP(IZ,IT,IL,6) = SINT
00134   24*        1 CONTINUE
00140   25*          RETURN                                                         00004020
00141   26*          END                                                            00004030

     END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
  SUBS2          SYMBOLIC                                  09 MAR 71  14:47:53   0  01653572   14   26  (DELETED)
  SUBS2   CODE   RELOCATABLE                               09 MAR 71  14:47:53   1  01654146   24    1  (DELETED)
                                                                                 0  01654476   14   15
```

SUBPROGRAM NAME: Subroutine FFLMPZ(N)

SEGMENT NAME: SUBS3

PURPOSE: Calculate the form factor from a Reference Coordinate System (RCS) node to each power zone of an LSTS heater element array.

DESCRIPTION: The FFLMPZ subprogram uses the transformed coordinate/normal vector data calculated in GEOM and calculates the form factors from a RCS node to each LSTS power zone. The form factor calculation techniques presented in Volume I are used in this subprogram.

CALLING PROGRAMS: CHB, CHR

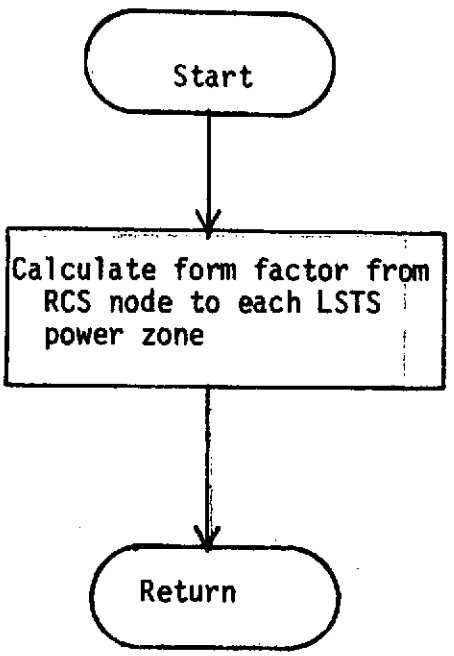
ARGUMENT LIST:

N	RCS node number (input)

NOMENCLATURE: In addition to the following FORTRAN nomenclature, the FFLMPZ subprogram uses the GE1 and CH1 block common variables. These variables are defined with the SUBM1 (GE1) and TVC (CH1) nomenclature.

B1	Cosine of angle between RCS node normal vector and heater element energy source
B2	Cosine of angle between heater element normal vector and RCS node
FA	Form factor from RCS node to LSTS heater zone
I, J, K	Indices
IL	Heater element index
IT	Zone LSTS heater tier index
IZ	Power zone index
R4	$(\text{Distance})^4$ from the RCS node to a heater element, ft^4

FFLMPZ SUBPROGRAM FLOW CHART



```
@ FOR,* SUBS3,SUBS3                                                    31 MAR 71          14:19:[redacted]
UNIVAC 1108 FORTRAN V LEVEL   2206 001@ F5018@
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:19:11


   SUBROUTINE FFLMPZ    ENTRY POINT 000200

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000212
        0000   *DATA   000044
        0002   *BLANK  000000
        0003   GE1     000043
        0004   CH1     035554


   EXTERNAL REFERENCES (BLOCK, NAME)

        0005   BLOCK
        0006   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

   0001   000150 IL          0001   000013 107G        0001   000031 114G        0001   000055 120G        0003 R 000001 ASE
   0003 R 000006 BX          0003 R 000021 BXX         0003 R 000007 BY          0003 R 000022 BYY         0003 R 000010 BZ
   0000 R 000007 B1          0000 R 000010 B2          0003 R 000011 COSP        0003 R 000042 COSSUN      0003 R 000031 COST
   0003 R 000023 COST1       0003 R 000024 DX          0003 R 000025 DY          0003 R 000026 DZ          0000 R 000002 FA
   0003 R 000032 FATOT       0004 R 025404 FL          0003 R 000014 FSE         0003 R 000033 GOFIR       0003 R 000030 GOFIRP
   0003 R 000034 GOSOL       0003 R 000036 GOSOLA      0003 R 000035 GOSOLD      0000 I 000000 I           0004 I 000000 IC
   0000 I 000006 IL          0003 I 000027 IQ          0000 I 000004 IT          0000 I 000001 IZ          0000 I 000003 J
   0000 I 000005 K           0004 I 000247 NC          0004 I 000001 NCMB        0004 I 000027 NLAMP       0004 I 000005 NTIER
   0004 I 000002 NZONE       0003 R 000011 PHI         0003 R 000004 PHI1        0000 R 000011 R4          0003 R 000012 SINP
   0003 R 000041 SINSUN      0003 R 000037 SUN         0003 R 000040 SUND        0003 R 000005 THT1        0004 R 005540 XL
   0004 R 000115 XLO         0004 R 000324 XLP         0003 R 000000 XSE         0003 R 000001 YSE         0003 R 000002 ZSE


00101     1*          SUBROUTINE FFLMPZ(N)
00101     2*    C
00103     3*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI,
00103     4*         1    FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,GOFIRP,                          09-
00103     5*         1    COST,FATOT,GOFIR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00104     6*          COMMON /CH1/ IC,NCMB,NZONE(3),NTIER(3,6),NLAMP(3,6,3),XLO(3,30),
00104     7*         1              NC(3,15),XLP(6,3,25,6),XL(3,6,3,25,6),FL(700,6)
00104     8*    C
00105     9*          I = NZONE(IC)
00106    10*          DO 3 IZ=1,I
00111    11*          FA = 0.
00112    12*          J = NTIER(IC,IZ)
00113    13*          DO 2 IT=1,J
00116    14*          K = NLAMP(IC,IZ,IT)
00117    15*          DO 1 IL=1,K
00122    16*          DX = XLP(IZ,IT,IL,1)-XSE
00123    17*          DY = XLP(IZ,IT,IL,2)-YSE
00124    18*          DZ = XLP(IZ,IT,IL,3)-ZSE
00125    19*          B1 = BX*DX + BY*DY + BZ*DZ
00126    20*          IF (B1.LE.0.0) GO TO 1
00130    21*          B2 = -(DX*XLP(IZ,IT,IL,4)+DY*XLP(IZ,IT,IL,5)+DZ*XLP(IZ,IT,IL,6))
```

```
00131     22*          IF (R2.LE.0.0) GO TO 1
00133     23*          R4 = (DX**2+DY**2+DZ**2)**2
00134     24*          CALL BLOCK
00135     25*          PA = PA + B1*B2*XLOC(IC,IZ,IT,IL,6)*FSEC(IQ)/(R4*3.14159)
00136     26*        1 CONTINUE
00140     27*        2 CONTINUE
00142     28*        3 FLUX(IZ) = PA
00144     29*          RETURN                                                    00004300
00145     30*          END                                                       00004400

     END OF UNIVAC 1108 FORTRAN V COMPILATION.    0 *DIAGNOSTIC* MESSAGE(S)
SUBS3            SYMBOLIC                          09 MAR 71  14:47:54   0  01654720   14   30  (DELETED)
SUBS3    CODE    RELOCATABLE                       09 MAR 71  14:47:54   1  01655564   24    1  (DELETED)
                                                                          0  01655614   14   15
```

SUBPROGRAM NAME: Subroutine FFFZ(N, QT)

SEGMENT NAME: SUBS4

PURPOSE: Calculate the incicent and absorbed energy on a Reference Coordinate System (RCS) node due to emissions from the thermal vacuum chamber floor.

DESCRIPTION: Using the floor nodal coordinate and radiosity data calculated in the FLOORN subprogram, FFFZ calculates the form factors, and incident/ absorbed energy on an RCS node from the floor. The program requires minimum distance of 6" from an RCS node to the floor and sets it to th value if it is not.

CALLING PROGRAMS: CHB, CHR

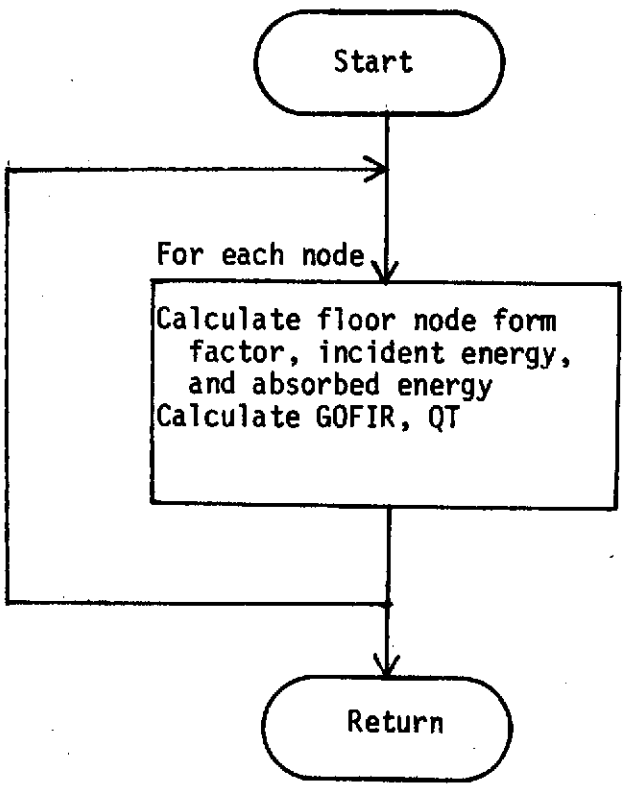
ARGUMENT LIST:

N	RCS node number (input)
QT	Total floor energy abosrbed by the RCS node (output), Btu/hr-ft^2

NOMENCLATURE: In addition to the FORTRAN nomenclature listed below, the FFFZ subprogram uses the variables located in the GE1 and CH3 block common. These variables are defined with the SUBM1 (GE1) and TVC (CH3) nomenclature.

ALPHA	Absorptivity of RCS node to floor node energy
B1	Cosine of angle between the RCS node normal and floor nodes
DQ	Floor node energy incident on RCS node, BTU/hr-ft^2
GOFIR	Incident energy from floor on RCS node, Btu/hr-ft^2
I	Floor node number
RR	(Distance)^4 between RCS node and floor nodes, ft^4
QT	Total floor energy heat absorbed by RCS node, Btu/hr-ft^2

FFFZ SUBPROGRAM FLOW CHART



```
@ FOR,* SUBS4,SUBS4                                                    31 MAR 71          14:19:12
UNIVAC 1108 FORTRAN V LEVEL   2206 001@ FS01@@
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:19:12

   SUBROUTINE FFFZ       ENTRY POINT 000114

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000125
        0000   *DATA   000021
        0002   *BLANK  000000
        0003   GE1     000043
        0004   CH3     005140


   EXTERNAL REFERENCES (BLOCK, NAME)

        0005   BLOCK
        0006   ALPHA1
        0007   NERR35


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000100 IL          0001    000011 I14G        0000 R 000004 ALPHA       0003 R 000003 ASE         0004 R 002514 BF
    0003 R 000006 BX           0003 R 000021 BXX          0003 R 000007 BY          0003 R 000022 BYY         0003 R 000010 BZ
    0000 R 000001 BI           0003 R 000011 COSP         0003 R 000042 COSSUN      0003 R 000031 COST        0003 R 000023 COST1
    0000 R 000003 DQ           0004 R 000003 DR           0003 R 000024 DX          0003 R 000025 DY          0003 R 000026 DZ
    0004 R 000005 EPSFLR       0003 R 000032 FATOT        0003 R 000014 FSE         0003 R 000033 GOFIR       0003 R 000030 GOFIRP
    0003 R 000034 GOSOL        0003 R 000036 GOSOLA       0003 R 000035 GOSOLD      0000 I 000000 I           0003 I 000027 IQ
    0004 I 000000 NB           0004 I 000002 NODE         0004 I 000001 NUMZNS      0003 R 000013 PHI         0003 R 000004 PHI1
    0000 R 000002 RR           0003 R 000012 SINP         0003 R 000041 SINSUN      0003 R 000037 SUN         0003 R 000040 SUND
    0004 R 000004 TAV          0004 R 003726 TEMP         0004 R 000006 TEMTC       0003 R 000005 THT1        0004 R 000070 XF
    0003 R 000000 XSE          0004 R 001302 YF           0003 R 000001 YSE         0003 R 000002 ZSE


00101     1*          SUBROUTINE FFFZ(N,OT)
00101     2*    C
00103     3*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI,
00103     4*         1    FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,GOFIRP,
00103     5*         1    COST,FATOT,GOFIR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00104     6*          PARAMETER NFLR=650
00105     7*          COMMON /CH3 / NB,NUMZNS,NODE,DR,TAV,EPSFLR,TEMTC(50)
00105     8*         1,XF(NFLR),YF(NFLR),BF(NFLR),TEMP(NFLR)
00105     9*    C
00106    10*          DZ = -ZSE
00107    11*          IF (DZ.GT.-0.5)  DZ = -0.5
00111    12*          OT = 0.0
00112    13*          GOFIR = 0.0
00113    14*          DO 1 I=1,NODE
00116    15*          DX = XF(I)-XSE
00117    16*          DY = YF(I)-YSE
00120    17*          BI = BX*DX + BY*DY + BZ*DZ
00121    18*          IF (BI.LE.0.0) GO TO 1
00123    19*          RR = (DX**2 + DY**2 + DZ**2)**2
00124    20*          CALL BLOCK
00125    21*          DQ = -BI*DZ*BF(I)*FSE(IQ)/RR
```

```
00126     22*           GOFIR = GOFIR + IXJ
00127     23*           CALL ALPHA1(TEMP(I),ALPHA)
00130     24*           QT = QT + IXJ*ALPHA
00131     25*     1     CONTINUE
00133     26*           RETURN
00134     27*           END                                                    00004*00

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
    SUBS4              SYMBOLIC                          31 MAR 71  14:17:11   0  02177272    14    27  (DELETED)
    SUBS4    CODE      RELOCATABLE                       31 MAR 71  14:17:11   1  02200064    24     1  (DELETED)
                                                                                 0  02200114    14    10
```

SUBPROGRAM NAME: Subroutine BACK (QR)

SEGMENT NAME: SUBS5

PURPOSE: Calculate the infrared and albedo background energy incident on a Reference Coordinate System (RCS) node.

DESCRIPTION: The BACK subprogram interpolates the QBR and QBS arrays to determine the background energy incident on a RCS node. The background energy is considered completely diffuse and assumed to originate from no identifiable direction. The total unblocked view to space, FSE(5), is used to account for RCS self-blockage.

CALLING PROGRAMS: CHR, CHB

ARGUMENT LIST:

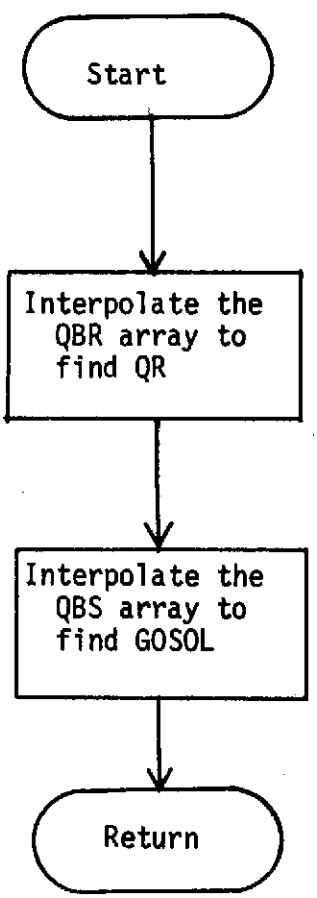
QR	Infrared energy incident on an RCS node (output) Btu/hr

NOMENCLATURE: In addition to the FORTRAN nomenclature listed below, the BACK subprogram uses the variables of the GE1 block common. These variables are defined with those of the SUBM1 (main program) nomenclature.

DPHI	Azimuth coordinate difference for PHI(J) values
DQDP, DQDT, DQDZ	Intermediate values of albedo background interpolation
DTHT	Inclination coordinate difference for THT(K) values, radians
DZZ	Z coordinate difference for Z(I) values, ft
GOSOL	Albedo background energy incident on an RCS node, BTU/hr-ft^2
I1, I2	Z coordinate interpolation indices for point 1 and 2
J1, J2	Azimuth coordinate indices for point 1 and 2
K1, K2	Inclination coordinate indices for point 1 and 2
PHI(J)	Azimuth coordinate values for QBR and QBS, radians
PHI2	Azimuth angle of RCS node, radians
QS, QB, Q1, Q2, Q3, Q4, Q5	Intermediate values of the background energy interpolation
QBR(I, J, K)	Infrared background energy values array, BTU/hr-ft^2
QBS(I, J, K)	Albedo background energy values array, BTU/hr-ft^2

THT(K)	Inclination coordinate values for QBR and QBS, radians
Z(I)	Z coordinate values for QBR and QBS, ft.

BACK SUBPROGRAM FLOW CHART



```
@ FOR,* SUBS5,SUBS5                                                    31 MAR 71          14 19 [redacted]4
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:19:14

   SUBROUTINE BACK       ENTRY POINT 000340

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000362
        0000   *DATA   000100
        0002   *BLANK  000000
        0003   GE1     000043
        0004   CH6     000170


   EXTERNAL REFERENCES (BLOCK, NAME)

        0005   NERR35


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

 0001    000005 1L.        0001    000121 111.       0001    000132 131.       0001    000013 3L.        0003    000047 5L.
 0001    000064 7L.        0001    000074 9L.        0003 R 000003 ASE        0003 R 000006 BX         0003 R 000021 BXX
 0003 R 000007 BY         0003 R 000022 BYY         0003 R 000010 BZ         0003 R 000011 COSP       0003 R 000042 COSSUN
 0003 R 000031 COST       0003 R 000023 COST1       0000 R 000016 DPHI       0000 R 000037 DQDP       0000 R 000040 DQDT
 0000 R 000036 DQDZ       0000 R 000017 DTHT        0003 R 000024 DX         0003 R 000025 DY         0003 R 000026 DZ
 0000 R 000015 DZZ        0003 R 000032 FATOT       0003 R 000014 FSE        0003 R 000033 GOFTR      0003 R 000030 GOFTRP
 0003 R 000034 GOSOL      0003 R 000036 GOSOLA      0003 R 000035 GOSOLD     0000 I 000014 I          0003 I 000027 IQ
 0000 I 000023 I1         0000 I 000024 I2          0000 I 000021 J1         0000 I 000022 J2         0000 I 000025 K1
 0000 R 000026 K2         0000 R 000003 PHI         0003 R 000013 PHI1       0003 R 000004 PHI1       0000 R 000020 PHI2
 0000 R 000035 Q0         0004 R 000000 QBR         0004 R 000074 QBS        0000 R 000041 Q5         0000 R 000027 Q1
 0000 R 000030 Q2         0000 R 000031 Q3          0000 R 000032 Q4         0000 R 000033 Q5         0000 R 000034 Q6
 0003 R 000012 SINP       0003 R 000041 SINSUN      0003 R 000017 SUN        0003 R 000040 SUND       0000 R 000007 THT
 0003 R 000005 THT1       0003 R 000000 XSE         0003 R 000001 YSE        0000 R 000000 Z          0003 R 000002 ZSE


00101     1*          SUBROUTINE BACK(QR)
00103     2*          DIMENSION Z(3),PHI(4),THT(5)
00104     3*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI1,
00104     4*         1   FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,GOFTRP,
00104     5*         1   COST,FATOT,GOFTR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00105     6*          COMMON /CH6/ QBR(3,4,5),QBS(3,4,5)
00106     7*          DATA (Z(I),I=1,3)/ 1.,3.,5./
00110     8*          DATA (PHI(I),I=1,4) / 0.,1.5708,3.14159,4.71239 /
00112     9*          DATA (THT(I),I=1,5) / -1.5708,-.7854,0., .7854,1.5708 /
00114    10*          DATA DZZ,DPHI,DTHT / 2.,1.5708,0.7854 /
00114    11*   C
00120    12*          PHI2 = PHI1
00121    13*          IF (PHI2.GE.0.) GO TO 3
00123    14*        1 PHI2 = PHI2+6.28318
00124    15*          IF (PHI2.LT.0.) GO TO 1
00126    16*        3 J1 = PHI2/DPHI + 1.
00127    17*          J2 = J1 + 1
00130    18*          IF (J1.LT.4) GO TO 5
00132    19*          J1 = 4
00133    20*          J2 = 1
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00134    21*        5 I1 =(ZSE-1.)/DZZ + 1.0
00135    22*          I2 = I1 + 1
00136    23*          IF (I1.GE.1) GO TO 7
00140    24*          I1 = 1
00141    25*          I2 = 1
00142    26*          GO TO 9
00143    27*        7 IF (I1.LT.3) GO TO 9
00145    28*          I1 = 3
00146    29*          I2 = 3
00147    30*        9 K1 = (THT1+DPHI)/DTHT + 1.
00150    31*          K2 = K1 + 1
00151    32*          IF (K1.GT.0) GO TO 11
00153    33*          K1 = 1
00154    34*          K2 = 2
00155    35*          GO TO 13
00156    36*       11 IF (K1.LT.5) GO TO 13
00160    37*          K1 = 4
00161    38*          K2 = 5
00162    39*       13 CONTINUE
00163    40*          Q1=QBR(I1,J1,K1)+(QBR(I1,J1,K2)-QBR(I1,J1,K1))*(THT1-THT(K1))/DTHT
00164    41*          Q2=QBR(I1,J2,K1)+(QBR(I1,J2,K2)-QBR(I1,J2,K1))*(THT1-THT(K1))/DTHT
00165    42*          Q3=Q1+(Q2-Q1)*(PHI2-PHI(J1))/ DPHI
00166    43*          Q4=QBR(I2,J1,K1)+(QBR(I2,J1,K2)-QBR(I2,J1,K1))*(THT1-THT(K1))/DTHT
00167    44*          Q5=QBR(I2,J2,K1)+(QBR(I2,J2,K2)-QBR(I2,J2,K1))*(THT1-THT(K1))/DTHT
00170    45*          Q6=Q4+(Q5-Q4)*(PHI2-PHI(J1))/DPHI
00171    46*          QR=(Q6-Q3)*(ZSE-Z(I1))/DZZ+Q3
00172    47*          QB = QBS(I1,J1,K1)
00173    48*          DQDZ =(QBS(I2,J1,K1) - QB)/DZZ
00174    49*          DQDP =(QBS(I1,J2,K1) - QB)/DPHI
00175    50*          DQDT =(QBS(I1,J1,K2) - QB)/DTHT
00176    51*          QS = DQDZ*(ZSE-Z(I1)) + DQDP*(PHI2-PHI(J1)) + DQDT*(THT1-THT(K1))
00177    52*          QQSOL = QS + QB
00200    53*          QR = QR*FSE(5)
00201    54*          QQSOL = FSE(5)*QQSOL
00202    55*          RETURN
00203    56*          END

     END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
S1RS5              SYMBOLIC                                    10 MAR 70  10:17:33   0  01443616    14    56  (DELETED)
S1RS5    CODE      RELOCATABLE                                 10 MAR 70  10:17:33   1  01445216    24     1  (DELETED)
                                                                                     0  01445266    14    27
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SUBPROGRAM NAME: Subroutine FLOORN (IC, IFLR)

SEGMENT NAME: SUBS6

PURPOSE: Calculate the chamber floor node coordinates, temperature, radiosity, and average floor node temperature.

DESCRIPTION: The FLOORN subprogram divides a circular chamber floor into polar coordinate nodal areas, determines the node coordinates, assigns node temperatures, and calculates the nodal radiosities. The node temperatures are either input (via card F8 in the TVC routine) or are calculated based thermocouple data input with linear interpolation for the node temperature - location. The exact thermocouple locations are defined for the MSC and LTV chambers in Appendix D of Volume I. The chamber origin and floor origin are assumed identical.

CALLING PROGRAM: TVC

ARGUMENT LIST:

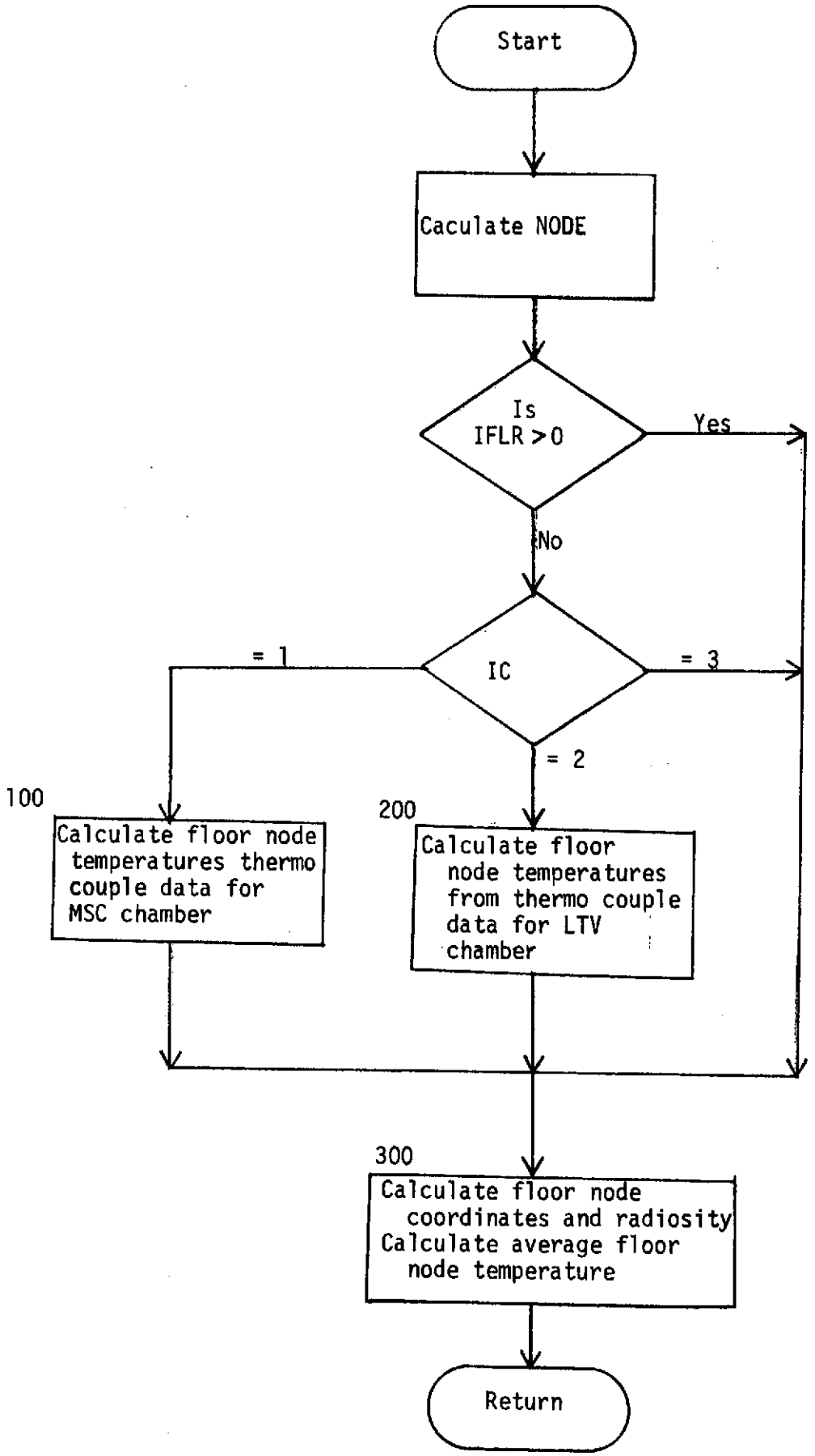
IC	Chamber index (input) =1 MSC chamber =2 LTV chamber
IFLR	Floor node input index (input) =0 thermocouple temperatures are input, stored floor data to be used =1 Node and node temperatures are input

NOMENCLATURE: In addition to the FORTRAN nomenclature dictionary listed below, the FLOORN subprogram uses the variables of the CH3 block common statement. These variables are defined with the TVC subprogram nomenclature.

A	Floor node area, ft^2
ANGLE	Floor node azimuth angle location from chamber origin, radians
GRAD GRAD1, GRAD2, GRAD3, GRAD4, GRAD5, GRAD6, GRAD7, GRAD8	Floor node temperature gradients used in linear interpolation of floor thermocouple data to find floor node temperatures
IC	Chamber index
IFLR	Chamber floor input index
I, J, JL, K, KL, ML, N, NL	Indices

NODE	Number of floor nodes for this chamber floor
PI	π
R	Floor node division radius from chamber origin, ft.
RAD	Floor node center point radius from chamber origin, ft.
SIG	Stefan-Boltzmann constant, Btu/hr-ft^2°R^4
TAV	Average floor node temperature, °F
TDUM	Dummy temperature array used in interpolation of thermocouple data to find floor node temperatures
TEMTC(J)	Thermocouple temperature data, °F
TEMP5, TEMP6 TEXTi, TEXi, XT, YT	Dummy temperature values used in interpolation of thermocouple data, °F

FLOORN SUBPROGRAM FLOW CHART



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@ FOR,* SUBS6,SUBS6                                                    31 MAR 71          14:19
UNIVAC 1108 FORTRAN V LEVEL   2206 001R P501M0
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:19:16

   SUBROUTINE FLOORN     ENTRY POINT 002142

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE    002163
        0000   *DATA    001334
        0002   *BLANK   000000
        0003   CH3      005141


   EXTERNAL REFERENCES (BLOCK, NAME)

        0004   COS
        0005   SIN
        0006   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000024 122G       0001    001542 124L.      0001    001545 126L.      0001    001552 200I.      0001    002005 300I.
    0001    001272 316G       0001    001335 331G       0001    001515 357G       0001    001522 364G       0001    001525 367G
    0001    001554 407G       0001    001724 441G       0001    001741 445G       0001    002024 470G       0001    002045 475G
    0000 R 001210 A           0000 R 001211 ANGLE       0003 R 005140 BETA        0003 R 002514 BF          0003 R 000003 DR
    0003 R 000005 EPSFLR      0000 R 001201 GRAD        0000 R 001165 GRAD1       0000 R 001166 GRAD2       0000 R 001167 GRAD3
    0000 R 001170 GRAD4       0000 R 001171 GRAD5       0000 R 001172 GRAD6       0000 R 001173 GRAD7       0000 R 001174 GRAD8
    0000 I 001207 I           0000 I 001144 J           0000 I 001202 JL          0000 I 001164 K           0000 I 001203 KL
    0000 I 001204 ML          0000 I 001176 N           0003 I 000000 NB          0000 I 001175 NL          0003 I 000002 NODE
    0003 I 000001 NUMZNS      0000 R 001143 PI          0000 R 001205 R           0000 R 001206 RAD         0000 R 001142 SIG
    0003 R 000004 TAV         0000 R 000000 TDUM        0003 R 003726 TEMP        0000 R 001177 TEMP5       0000 R 001200 TEMP6
    0003 R 000006 TEMTC       0000 R 001154 TEXT1       0000 R 001155 TEXT2       0000 R 001156 TEXT3       0000 R 001157 TEXT4
    0000 R 001160 TEXT5       0000 R 001161 TEXT6       0000 R 001162 TEXT7       0000 R 001163 TEXT8       0000 R 001150 TEX21
    0000 R 001152 TEX22       0000 R 001145 TEX41       0000 R 001151 TEX42       0000 R 001153 TEX81       0003 R 000070 XF
    0000 R 001146 XT          0003 R 001302 YF          0000 R 001147 YT


00101     1*          SUBROUTINE FLOORN(IC,IFLR)
00101     2*    C
00103     3*          PARAMETER NFLR=650
00104     4*          COMMON /CH3 / NB,NUMZNS,NODE,DR,TAV,EPSFLR,TEMTC(50)
00104     5*         1,XF(NFLR),YF(NFLR),BF(NFLR),TEMP(NFLR),BETA
00105     6*          DIMENSION TDUM(610)
00106     7*          DATA SIG,PI/0.1713E-08,3.14159 /
00106     8*    C
00111     9*           TAV = 0.0
00112    10*           NODE = NB*NUMZNS
00113    11*          IF (IFLR.GT.0) GO TO 300
00115    12*          IF(IC-2) 100,200,300
00120    13*      100 CONTINUE
00121    14*          DO 103 J=1,32
00124    15*      103 TEMTC(J)=TEMTC(J)+460.
00126    16*          TEMTC(33)=(TEMTC(31)+TEMTC(12))/2.
00127    17*          TEMTC(34)=(TEMTC(18)+TEMTC(32))/2.
00130    18*          TEMTC(35)=(TEMTC(25)+TEMTC(26))/2.
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00131   19*         TEMTC(36)=(TEMTC(9)+TEMTC(27))/2.
00132   20*         TEMTC(37)=(TEMTC(15)+TEMTC(28))/2.
00133   21*         TEMTC(38)=(TEMTC(30)+TEMTC(29))/2.
00134   22*         TEX41=((TEMTC(20)-TEMTC(35))/2.)*.66+TEMTC(35)
00135   23*         XT=(((TEMTC(3)-TEMTC(34))/62.7)*45.+TEMTC(34))
00136   24*         YT=(((TEMTC(3)-TEX41)/27.3)*45.+TEX41)
00137   25*         TEMTC(41)=(XT+YT)/2.
00140   26*         TEX21=((TEMTC(19)-TEMTC(34))/1.92)*.75+TEMTC(34)
00141   27*         TEX42=((TEMTC(20)-TEMTC(35))/2.)*1.83+TEMTC(35)
00142   28*         XT=(((TEMTC(2)-TEX21)/57.)*45.+TEX21)
00143   29*         YT=((TEMTC(2)-TEX42)/31.)*45.+TEX41
00144   30*         TEMTC(42)=(XT+YT)/2.
00145   31*         TEX22=(((TEMTC(24)-TEMTC(19))/.92)*.75+TEMTC(19))
00146   32*         XT=(((TEMTC(1)-TEX22)/53.)*45.+TEX22)
00147   33*         YT=((TEMTC(1)-TEMTC(21))/37.)*45.+TEMTC(21)
00150   34*         TEMTC(43)=(XT+YT)/2.
00151   35*         TEX61=((TEMTC(36)-TEMTC(17))/1.17)*1.50+TEMTC(17)
00152   36*         XT=(((TEMTC(4)-TEMTC(37))/66.3)*45.+TEMTC(37))
00153   37*         YT=((TEMTC(4)-TEX61)/23.7)*45.+TEX61
00154   38*         TEMTC(44)=(XT+YT)/2.
00155   39*         XT=((TEMTC(5)-TEMTC(16))/57.)*45.+TEMTC(16)
00156   40*         YT=((TEMTC(5)-TEMTC(17))/33.)*45.+TEMTC(17)
00157   41*         TEMTC(45)=(XT+YT)/2.
00160   42*         XT=((TEMTC(6)-TEMTC(22))/53.)*37.+TEMTC(22)
00161   43*         YT=((TEMTC(6)-TEMTC(23))/37.)*45.+TEMTC(23)
00162   44*         TEMTC(46)=(XT+YT)/2.
00163   45*         TEXT1=((TEMTC(11)-TEMTC(33))/1.25)*1.83+TEMTC(33)
00164   46*         TEXT2=((TEMTC(34)-TEMTC(19))/1.92)*3.75+TEMTC(19)
00165   47*         TEXT3=((TEMTC(41)-TEMTC(42))/1.17)*3.00+TEMTC(42)
00166   48*         TEXT4=((TEMTC(35)-TEMTC(20))/2.58)*3.75+TEMTC(20)
00167   49*         TEXT5=((TEMTC(10)-TEMTC(36))/1.5)*3.+TEMTC(36)
00170   50*         TEXT6=((TEMTC(37)-TEMTC(16))/1.5)*3.+TEMTC(16)
00171   51*         TEXT7=((TEMTC(44)-TEMTC(45))/1.5)*3.+TEMTC(45)
00172   52*         TEXT8=((TEMTC(38)-TEMTC(17))/1.17)*3.+TEMTC(17)
00173   53*         TEMTC(40)=(TEXT1+TEXT2+TEXT3+TEXT4+TEXT5+TEXT6+TEXT7+TEXT8)/8.
00174   54*         TEMP(1)=((TEMTC(11)-TEMTC(40))/.58)*.25+TEMTC(40)
00175   55*         TEMP(61)=((TEMTC(33)-TEMTC(11))/1.25)*.17+TEMTC(11)
00176   56*         TEMP(121)=((TEMTC(33)-TEMTC(11))/1.25)*.67+TEMTC(11)
00177   57*         TEMP(181)=((TEMTC(33)-TEMTC(11))/1.25)*1.07+TEMTC(11)
00200   58*         TEMP(241)=((TEMTC(13)-TEMTC(33))/1.17)*.42+TEMTC(33)
00201   59*         TEMP(301)=((TEMTC(13)-TEMTC(33))/1.17)*.92+TEMTC(33)
00202   60*         TEMP(361)=((TEMTC(14)-TEMTC(13))/1.67)*.25+TEMTC(13)
00203   61*         TEMP(421)=((TEMTC(14)-TEMTC(13))/1.67)*.75+TEMTC(13)
00204   62*         TEMP(481)=((TEMTC(14)-TEMTC(13))/1.67)*1.25+TEMTC(13)
00205   63*         TEMP(541)=((TEMTC(14)-TEMTC(13))/1.67)*1.75+TEMTC(13)
00206   64*         TEMP(9)=((TEMTC(34)-TEMTC(40))/1.83)*.25+TEMTC(40)
00207   65*         TEMP(69)=((TEMTC(34)-TEMTC(40))/1.83)*.75+TEMTC(40)
00210   66*         TEMP(129)=((TEMTC(34)-TEMTC(40))/1.83)*1.25+TEMTC(40)
00211   67*         TEMP(189)=((TEMTC(34)-TEMTC(40))/1.83)*1.75+TEMTC(40)
00212   68*         TEMP(249)=((TEMTC(19)-TEMTC(34))/1.92)*.42+TEMTC(34)
00213   69*         TEMP(309)=((TEMTC(19)-TEMTC(34))/1.92)*.92+TEMTC(34)
00214   70*         TEMP(369)=((TEMTC(19)-TEMTC(34))/1.92)*1.42+TEMTC(34)
00215   71*         TEMP(429)=TEMTC(19)
00216   72*         TEMP(489)=((TEMTC(24)-TEMTC(19))/.92)*.50+TEMTC(19)
00217   73*         TEMP(549)=((TEMTC(24)-TEMTC(19))/.92)*1.+TEMTC(19)
00220   74*         TEMP(16)=((TEMTC(41)-TEMTC(40))/1.83)*.25+TEMTC(40)
00221   75*         TEMP(76)=((TEMTC(41)-TEMTC(40))/1.83)*.75+TEMTC(40)
00222   76*         TEMP(136)=((TEMTC(41)-TEMTC(40))/1.83)*1.25+TEMTC(40)
00223   77*         TEMP(196)=((TEMTC(41)-TEMTC(40))/1.83)*1.75+TEMTC(40)
00224   78*         TEMP(256)=((TEMTC(42)-TEMTC(41))/1.17)*.42+TEMTC(41)
00225   79*         TEMP(316)=((TEMTC(42)-TEMTC(41))/1.17)*.92+TEMTC(41)
00226   80*         TEMP(376)=((TEMTC(43)-TEMTC(42))/1.5)*.25+TEMTC(42)
00227   81*         TEMP(436)=((TEMTC(43)-TEMTC(42))/1.5)*.75+TEMTC(42)
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00230   82*         TEMP(496)=((TEMTC(43)-TEMTC(42))/1.5)*1.25+TEMTC(42)
00231   83*         TEMP(556)=((TEMTC(43)-TEMTC(42))/1.5)*1.75+TEMTC(42)
00232   84*         TEMP(24)=((TEMTC(35)-TEMTC(40))/1.17)*.25+TEMTC(40)
00233   85*         TEMP(84)=((TEMTC(35)-TEMTC(40))/1.17)*.75+TEMTC(40)
00234   86*         TEMP(144)=((TEMTC(20)-TEMTC(35))/2.)*.0*+TEMTC(45)
00235   87*         TEMP(204)=((TEMTC(20)-TEMTC(35))/2.)*.5*+TEMTC(45)
00236   88*         TEMP(264)=((TEMTC(20)-TEMTC(35))/2.)*1.0*+TEMTC(45)
00237   89*         TEMP(324)=((TEMTC(20)-TEMTC(35))/2.)*1.5*+TEMTC(45)
00240   90*         TEMP(384)=((TEMTC(21)-TEMTC(20))/1.11)*.0*+TEMTC(20)
00241   91*         TEMP(444)=((TEMTC(21)-TEMTC(20))/1.11)*.5*+TEMTC(20)
00242   92*         TEMP(504)=((TEMTC(21)-TEMTC(20))/1.11)*1.0*+TEMTC(20)
00243   93*         TEMP(564)=((TEMTC(21)-TEMTC(20))/1.11)*1.5*+TEMTC(20)
00244   94*         TEMP(31)=((TEMTC(10)-TEMTC(40))/.5*)*.25+TEMTC(40)
00245   95*         TEMP(91)=((TEMTC(16)-TEMTC(10))/.92)*.17+TEMTC(10)
00246   96*         TEMP(151)=((TEMTC(36)-TEMTC(10))/.92)*.67+TEMTC(10)
00247   97*         TEMP(211)=((TEMTC(8)-TEMTC(36))/1.5)*.25+TEMTC(36)
00250   98*         TEMP(271)=((TEMTC(8)-TEMTC(36))/1.5)*.75+TEMTC(36)
00251   99*         TEMP(331)=((TEMTC(8)-TEMTC(36))/1.5)*1.25+TEMTC(36)
00252  100*         TEMP(391)=((TEMTC(7)-TEMTC(8))/1.5)*.25+TEMTC(8)
00253  101*         TEMP(451)=((TEMTC(7)-TEMTC(8))/1.5)*.75+TEMTC(8)
00254  102*         TEMP(511)=((TEMTC(7)-TEMTC(8))/1.5)*1.25+TEMTC(8)
00255  103*         TEMP(571)=((TEMTC(7)-TEMTC(8))/1.5)*1.75+TEMTC(8)
00256  104*         TEMP(39)=((TEMTC(37)-TEMTC(40))/1.5)*.25+TEMTC(40)
00257  105*         TEMP(99)=((TEMTC(37)-TEMTC(40))/1.5)*.75+TEMTC(40)
00260  106*         TEMP(159)=((TEMTC(37)-TEMTC(40))/1.5)*1.25+TEMTC(40)
00261  107*         TEMP(219)=((TEMTC(16)-TEMTC(37))/1.5)*.25+TEMTC(37)
00262  108*         TEMP(279)=((TEMTC(16)-TEMTC(37))/1.5)*.75+TEMTC(37)
00263  109*         TEMP(339)=((TEMTC(16)-TEMTC(37))/1.5)*1.25+TEMTC(37)
00264  110*         TEMP(399)=((TEMTC(21)-TEMTC(16))/1.5)*.25+TEMTC(16)
00265  111*         TEMP(459)=((TEMTC(21)-TEMTC(16))/1.5)*.75+TEMTC(16)
00266  112*         TEMP(519)=((TEMTC(21)-TEMTC(16))/1.5)*1.25+TEMTC(16)
00267  113*         TEMP(579)=((TEMTC(21)-TEMTC(16))/1.5)*1.75+TEMTC(16)
00270  114*         TEMP(46)=((TEMTC(44)-TEMTC(40))/1.5)*.25+TEMTC(40)
00271  115*         TEMP(106)=((TEMTC(44)-TEMTC(40))/1.5)*.75+TEMTC(40)
00272  116*         TEMP(166)=((TEMTC(44)-TEMTC(40))/1.5)*1.25+TEMTC(40)
00273  117*         TEMP(226)=((TEMTC(45)-TEMTC(44))/1.5)*.25+TEMTC(44)
00274  118*         TEMP(286)=((TEMTC(45)-TEMTC(44))/1.5)*.75+TEMTC(44)
00275  119*         TEMP(346)=((TEMTC(45)-TEMTC(44))/1.5)*1.25+TEMTC(44)
00276  120*         TEMP(406)=((TEMTC(46)-TEMTC(45))/1.5)*.25+TEMTC(45)
00277  121*         TEMP(466)=((TEMTC(46)-TEMTC(45))/1.5)*.75+TEMTC(45)
00300  122*         TEMP(526)=((TEMTC(46)-TEMTC(45))/1.5)*1.25+TEMTC(45)
00301  123*         TEMP(586)=((TEMTC(46)-TEMTC(45))/1.5)*1.75+TEMTC(45)
00302  124*         TEMP(54)=((TEMTC(38)-TEMTC(40))/1.83)*.25+TEMTC(40)
00303  125*         TEMP(114)=((TEMTC(38)-TEMTC(40))/1.83)*.75+TEMTC(40)
00304  126*         TEMP(174)=((TEMTC(38)-TEMTC(40))/1.83)*1.25+TEMTC(40)
00305  127*         TEMP(234)=((TEMTC(38)-TEMTC(40))/1.83)*1.75+TEMTC(40)
00306  128*         TEMP(294)=((TEMTC(17)-TEMTC(38))/1.17)*.42+TEMTC(38)
00307  129*         TEMP(354)=((TEMTC(17)-TEMTC(38))/1.17)*.92+TEMTC(38)
00310  130*         TEMP(414)=((TEMTC(23)-TEMTC(17))/1.5)*.25+TEMTC(17)
00311  131*         TEMP(474)=((TEMTC(23)-TEMTC(17))/1.5)*.75+TEMTC(17)
00312  132*         TEMP(534)=((TEMTC(23)-TEMTC(17))/1.5)*1.25+TEMTC(17)
00313  133*         TEMP(594)=((TEMTC(23)-TEMTC(17))/1.5)*1.75+TEMTC(17)
00314  134*         TEMP(601)=TEMP(541)
00315  135*         DO 105 K=1,600,60
00320  136*         GRAD1=(TEMP(K+8)-TEMP(K))/7.5
00321  137*         GRAD2=(TEMP(K+15)-TEMP(K+8))/7.5
00322  138*         GRAD3=(TEMP(K+23)-TEMP(K+15))/7.5
00323  139*         GRAD4=(TEMP(K+30)-TEMP(K+23))/7.5
00324  140*         GRAD5=(TEMP(K+38)-TEMP(K+30))/7.5
00325  141*         GRAD6=(TEMP(K+45)-TEMP(K+38))/7.5
00326  142*         GRAD7=(TEMP(K+53)-TEMP(K+45))/7.5
00327  143*         GRAD8=(TEMP(K+60)-TEMP(K+53))/7.5
00330  144*         DO 106 J=1,8
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00333   145*          NL=(K+J-1)
00334   146*          TEMP(NL)=TEMP(K)+GRAD1*(J-1)
00335   147*          NL=(K+J+7)
00336   148*          TEMP(NL)=TEMP(K+8)+GRAD2*(J-1)
00337   149*          NL=(K+J+14)
00340   150*          TEMP(NL)=TEMP(K+15)+GRAD3*(J-1)
00341   151*          NL=(K+J+22)
00342   152*          TEMP(NL)=TEMP(K+23)+GRAD4*(J-1)
00343   153*          NL=(K+J+29)
00344   154*          TEMP(NL)=TEMP(K+30)+GRAD5*(J-1)
00345   155*          NL=(K+J+37)
00346   156*          TEMP(NL)=TEMP(K+38)+GRAD6*(J-1)
00347   157*          NL=(K+J+44)
00350   158*          TEMP(NL)=TEMP(K+45)+GRAD7*(J-1)
00351   159*          NL=(K+J+52)
00352   160*      106 TEMP(NL)=TEMP(K+53)+GRAD8*(J-1)
00354   161*      105 CONTINUE
00356   162*          DO 127 N=1,600
00361   163*      127 TDUM(N)=TEMP(N)
00363   164*          DO 125 J=1,600,60
00366   165*          DO 126 K=1,60
00371   166*          NL=K+J-1
00372   167*          IF(56-K)124,123,123
00375   168*      123 TEMP(NL)=TDUM(NL+4)
00376   169*          GO TO 126
00377   170*      124 TEMP(NL)=TDUM(NL-56)
00400   171*      126 CONTINUE
00402   172*      125 CONTINUE
00404   173*          GO TO 300
00405   174*      200 CONTINUE
00406   175*          DO 203 J=1,8
00411   176*      203 TEMTC(J)=TEMTC(J)+460.
00413   177*          TDUM(4)=TEMTC(7)
00414   178*          TDUM(5)=TEMTC(8)
00415   179*          TDUM(6)=TEMTC(1)
00416   180*          TDUM(7)=TEMTC(2)
00417   181*          TDUM(8)=TEMTC(3)
00420   182*          TDUM(9)=TEMTC(4)
00421   183*          TEMP5=(((TDUM(7)-TDUM(6))/.71)*.27)+TDUM(6)
00422   184*          TDUM(2)=(((TEMTC(5)-TEMP5)/.66)*.54)+TEMTC(5)
00423   185*          TEMP6=(TDUM(7)+TDUM(8))/2.
00424   186*          TDUM(3)=(((TEMTC(6)-TEMP6)/2.00)*.52)+TEMTC(6)
00425   187*          TDUM(1)=(((TDUM(7)-TDUM(6))/(-.75))*1.21+TDUM(7)
00426   188*          TEMP(7)=(((TDUM(8)-TDUM(1))/.5)*.25+TDUM(1)
00427   189*          TEMP(30)=(((TDUM(2)-TDUM(1))/.77)*.25+TDUM(1)
00430   190*          TEMP(37)=(((TDUM(7)-TDUM(6))'.71)*.25+TDUM(6)
00431   191*          TEMP(60)=(((TDUM(2)-TDUM(1))/.77)*.75+TDUM(1)
00432   192*          TEMP(67)=(((TDUM(8)-TDUM(7))/.75)*.04+TDUM(7)
00433   193*          TEMP(90)=(((TDUM(3)-TDUM(2))/.81)*.48+TDUM(2)
00434   194*          TEMP(97)=(((TDUM(8)-TDUM(7))/.75)*.54+TDUM(7)
00435   195*          TEMP(120)=(((TDUM(4)-TDUM(3))/.31)*.17+TDUM(3)
00436   196*          TEMP(127)=(((TDUM(9)-TDUM(8))/.45)*.29+TDUM(8)
00437   197*          TEMP(150)=(((TDUM(5)-TDUM(4))/.45)*.25+TDUM(4)
00440   198*          DO 243 K=1,150,30
00443   199*          GRAD=(TEMP(K+6)-TEMP(K+29))/1.5
00444   200*          DO 241 J=1,7
00447   201*          JL=(K+J-1)
00450   202*          TEMP(JL)=TEMP(K+29)+GRAD*J
00451   203*          KL=(K+14-J)
00452   204*          TEMP(KL)=TEMP(JL)
00453   205*          TEMP(K+14)=TEMP(K+29)
00454   206*          NL=(K+14+J)
00455   207*          TEMP(NL)=TEMP(JL)
```

```
00456   206*          ML=(K+29-J)
00457   209*      241 TEMP(ML)=TEMP(JL)
00461   210*      243 CONTINUE
00463   211*      300 CONTINUE
00464   212*          R = 0.
00465   213*          BETA = 2.*PI/NB
00466   214*          RAD = 0.6666*DR
00467   215*          DO 8 I=1,NUMZNS
00472   216*          A = BETA*(R+DR*0.5)*DR
00473   217*          ANGLE = 0.
00474   218*           DO 7 J=1,NB                                          00005520
00477   219*          ANGLE = ANGLE + BETA
00500   220*           K =(I-1)*NB + J
00501   221*           XP(K) = RAD*COS(ANGLE)
00502   222*           YP(K) = RAD*SIN(ANGLE)
00503   223*          HF(K) = FPSFTR*SIG*A*TEMP(K)**4/PI
00504   224*           TAV = TAV + TEMP(K)
00505   225*   7       CONTINUE                                             00005550
00507   226*          R = R + DR
00510   227*          RAD = R + DR*0.5
00511   228*   8      CONTINUE
00513   229*          TAV = TAV/NODE - 460.
00514   230*           RETURN                                              00005630
00515   231*          END

     END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUBS6            SYMBOLIC                          10 MAR 70  10:17:39   0  01446060    14   231  (DELETED)
SUBS6    CODE    RELOCATABLE                       10 MAR 70  10:17:39   1  01454422    24     1  (DELETED)
                                                                          0  01454352    14   129
```

SUBPROGRAM NAME: Subroutine SCREEN

SEGMENT NAME: SUBS7

PURPOSE: Calculate the amount of columniated solar lamp flux incident on a Reference Coordinate System (RCS) node.

DESCRIPTION: Direct solar lamp radiation is modeled as columniated flux passing through an imaginary grid perpendicular to the solar vector. The SCREEN routine sets up this imaginary nodal grid, assigns solar flux data to the grid, and calculates the columniated solar flux incident on an RCS node. The solar lamp grid geometric data and flux intensity information are input to the TVC subprogram and transmitted to the SCREEN routine via the CH2 block common.

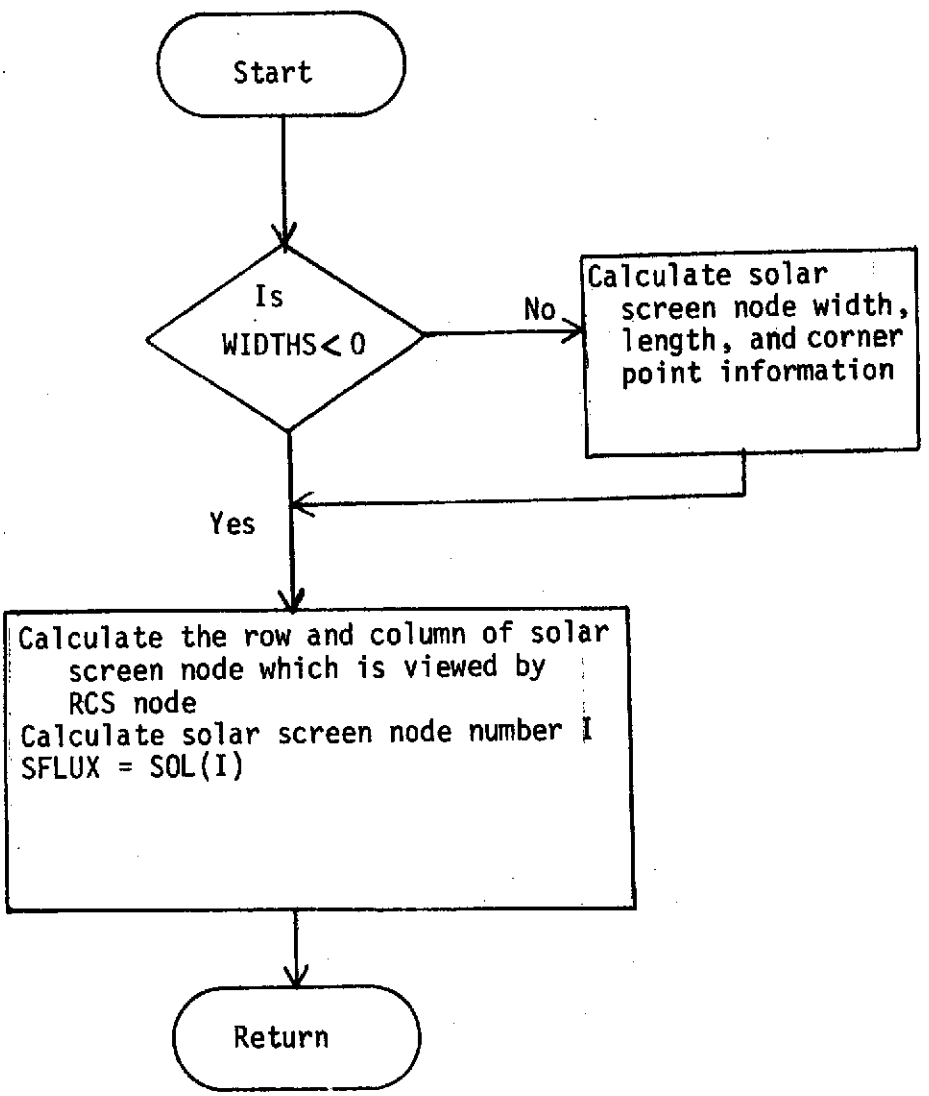
CALLING PROGRAMS: CHB, CHR

ARGUMENT LIST: None, all data is transmitted into and out of the SCREEN subprogram via the GE1 and CH2 block common statements.

NOMENCLATURE: In addition to the FORTRAN nomenclature listed below, the SCREEN subprogram uses the variables of the GE1 block common. The GE1 block common variables are defined with the SUBM1 (main program) nomenclature.

D	Solar screen 1/2 length, ft.
DD	Solar screen (grid) node length, ft.
DW	Solar screen grid nodes per width
HEIGS	Solar screen grid height, ft.
J	Solar screen width node number
K	Solar screen height node number
ML	Number of solar screen node lengths
NW	Number of solar screen node widths
NGRID	Total number of solar screen nodes
SFLUX	Solar lamp flux incident on RCS node, Btu/hr-ft^2
SOL(K)	Screen grid K solar lamp flux, Btu/hr-ft^2
WIDTHS	Solar screen width, ft.
Y	Y coordinate of solar screen node 1 edge

SCREEN SUBPROGRAM FLOW CHART



```
@ FOR,* SUBST,SUBS7                                                    31 MAR 71          14:19
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:19:21

   SUBROUTINE SCREEN     ENTRY POINT 000127

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000134
        0000   *DATA   000026
        0002   *BLANK  000000
        0003   CH1     000043
        0004   CH2     000436


   EXTERNAL REFERENCES (BLOCK, NAME)

        0005   NERR38


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000026 5L          0001    000114 9L          0004 R 000435 ALFSOL      0003 R 000003 ASE         0003 R 000006 BX
    0003 R 000021 BXX          0003 R 000007 BY           0003 R 000022 BYY         0003 R 000010 BZ          0003 R 000011 COSP
    0003 R 000042 COSSUN       0003 R 000031 COST         0003 R 000023 COST1       0000 R 000000 D           0000 R 000001 DD
    0000 R 000003 DW           0003 R 000024 DX           0003 R 000025 DY          0003 R 000026 DZ          0003 R 000032 FATOT
    0003 R 000014 FSE          0003 R 000033 GOFIR        0003 R 000030 GOFIRP      0003 R 000034 GOSOL       0003 R 000036 GOSOLA
    0003 R 000035 GOSOLD       0004 R 000433 HEIGS        0003 I 000027 IQ          0000 I 000005 J           0000 I 000004 K
    0004 I 000430 ML           0004 I 000431 NW           0003 R 000013 PHI         0003 R 000004 PHI1        0004 R 000434 SFLUX
    0003 R 000012 SINP         0003 R 000041 SINSUN       0004 R 000000 SOL         0003 R 000037 SUN         0003 R 000040 SUND
    0003 R 000005 THT1         0004 R 000432 WIDTHS       0003 R 000000 XSE         0000 R 000002 Y           0003 R 000001 YSE
    0003 R 000002 ZSE


00101     1*          SUBROUTINE SCREEN
00101     2*    C
00103     3*          PARAMETER NORID=280
00104     4*          COMMON /CH1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI,
00104     5*         1    FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,GOFIRP,
00104     6*         1    COST,FATOT,GOFIR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00105     7*          COMMON /CH2 / SOL(NORID),ML,NW,WIDTHS,HEIGS,SFLUX,ALFSOL
00105     8*    C
00106     9*          IF (WIDTHS.LT.0.) GO TO 5
00110    10*          D  = HEIGS*0.5
00111    11*          DD = HEIGS/FLOAT(ML)
00112    12*          Y  =-WIDTHS*0.5
00113    13*          DW= FLOAT(NW)/WIDTHS
00114    14*          WIDTHS = -100.
00115    15*        5 K = (D+XSE*SINSUN-COSSUN*(4.2-ZSE))/DD + 1.0
00116    16*          IF (K.LT.1) GO TO 9
00120    17*          IF (K.GT.ML)GO TO 9
00122    18*          J = (YSE-Y)*DW + 1.
00123    19*          IF (J.LT.1) GO TO 9
00125    20*          IF (J.GT.NW)GO TO 9
00127    21*          K = K + (J-1)*ML
00130    22*          SFLUX = SOL(K)
00131    23*           RETURN                                          00005130
00132    24*        9 SFLUX = 0.                                       00005900
00133    25*           RETURN                                          00005910
00134    26*           END

    END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
SUBST           SYMBOLIC                          30 JAN 70  09:44:57   0  01442560   1*    26  (DELETED)
SUBST   CODE    RELOCATABLE                       30 JAN 70  09:44:57   1  01441444   24*    1  (DELETED)
                                                                        0  01441464   1*    11
```

SUBPROGRAM NAME: Subroutine CHR (I, EPSLMP, ENV1)

SEGMENT NAME: SUBS8

PURPOSE: Calculate the thermal vacuum chamber Lunar Surface Thermal Simulator (LSTS) heater element zone power settings and temperatures to match the real environment energy absorbed by a Reference Coordinate System (RCS).

DESCRIPTION: Using a given set of environment conditions, the CHR routine calculates the thermal environment due to solar lamps, chamber floor, and chamber background (albedo and infrared). The CHR subprogram then uses a least squares technique to calculate the LSTS zone power settings and temperatures to provide the best match of the total chamber environment with the absorbed energy from a real environment (i.e., lunar plain, crater) on the sum of the RCS nodal surfaces. Environment description data for the solar lamps, background energy, and chamber floor are read into the EHFR by the TVC subprogram.

CALLING PROGRAM: TVC

ARGUMENT LIST:

I	Environment change update index (output)
EPSLMP	Thermal emissivity of LSTS heater elements (input)
ENV1	Chamber environment name in A format (input)

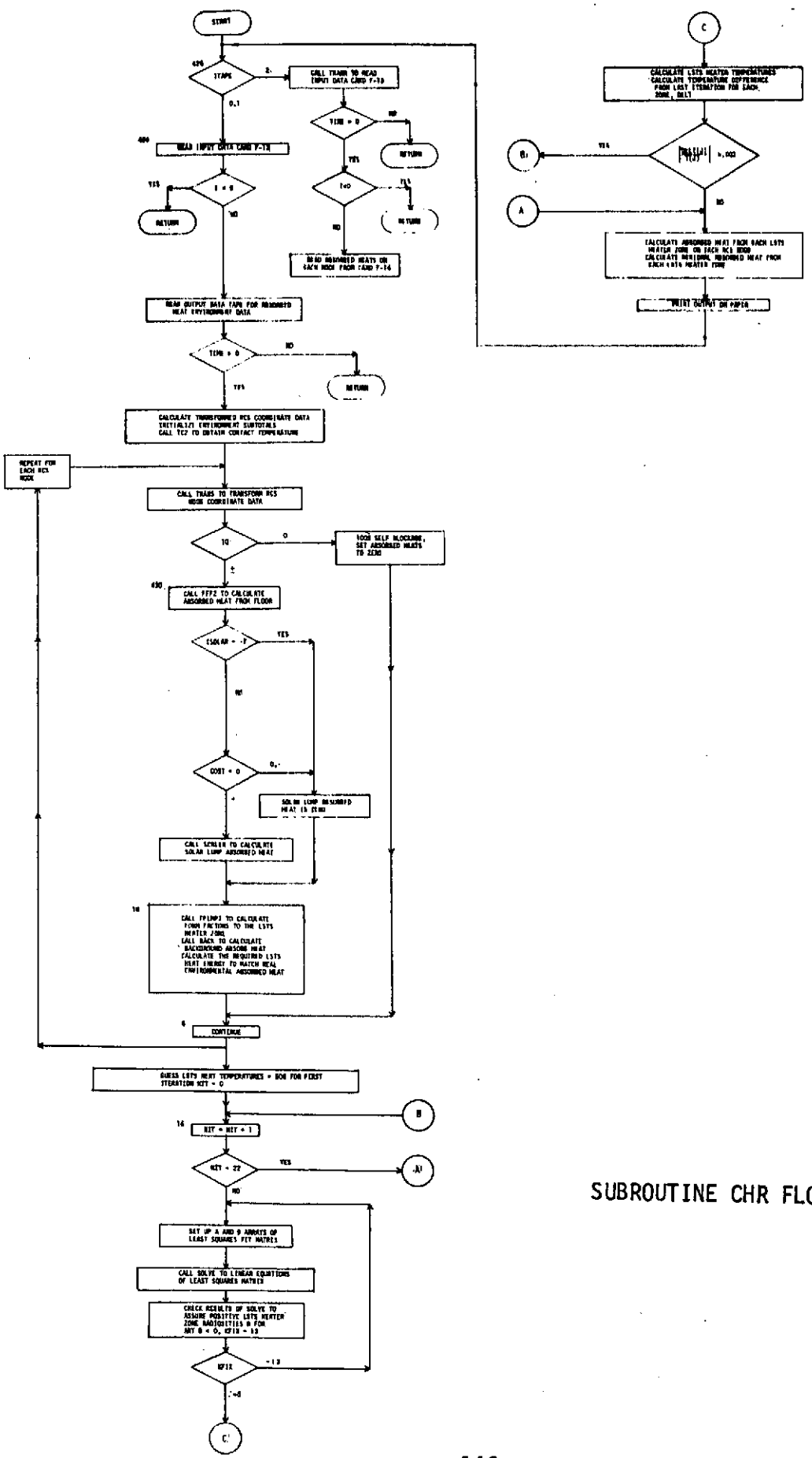
All other data required by the CHR subprogram are transferred to the routine via block common statements.

NOMENCLATURE: In addition to the dictionary of FORTRAN nomenclature listed below, the CHR subprogram uses the variables of the MR, GE1, CH1, CH2, CH3, and CH6 block common statements. These variables are defined with the SUBM1 (main program) and TVC subprogram nomenclature.

A(I, J)	Coefficients of LSTS heater element zone power (radiosity) linear equations (double precision)
ALPHA, ALPHA3	Absorptivity of an RCS node to an energy source
AT(I)	LSTS heater element zone temperature, °R
B(I)	Constants in LSTS heater element zone power linear equations (double precision)
BIG	Equation singularity indicator
DELT(IZ)	Temperature difference between two iterations for the LSTS heater element temperature for zone IZ, °R

ENV1, ENV2	Environment name in A format
ENV3, ENV4	Name for the real environment which is to be matched
GIR	Incident infrared background energy on an RCS node, Btu/hr-ft^2
GOSOL	Background albedo incident on an RCS node, Btu/hr-ft^2
GOSOLD	Direct solar lamp energy incident on an RCS node, Btu/hr-ft^2
IC	Chamber index =1 MSC Chamber =2 LTV chamber
ISOLAR	Solar lamp operation index =-2 solar lamps are off ≠-2 solar lamps are on
I	Environment change/update index
IT	LSTS heater zone tier index
IZ	Number of LSTS heater zones for chamber IC
I1, I2, I3, I5, I6	Print indices
J, K	Indices
KFIX	Linear equation solution indicator
MUM(IZ)	Index indicating the rows and columns which are to be omitted in the solution of the LSTS heater element zone power linear equations
N	RCS node number
NZ	Number of LSTS heater zones for Chamber IC
NIT	Iteration number for LSTS heater element zone temperature calculations
QA(N)	Real environment absorbed heat to be matched by the CHR routine, Btu/hr
QAC(N)	Total LSTS heater element energy absorbed by RCS node N as matched by CHR, Btu/hr

QALB(N)	Albedo background energy absorbed by RCS node N, Btu/hr
QB(N)	Infrared background energy absorbed by RCS node N, Btu/hr
QCALC(N)	Total energy absorbed from the "matched" chamber environment by RCS node N, Btu/hr
QF(N)	Infrared floor energy absorbed by RCS node N, Btu/hr
QL(N)	Total LSTS heater element energy needed to match the real environment absorbed energy for RCS node N, Btu/hr
QLZ(N, IZ)	LSTS heater element energy from zone IZ absorbed by RCS node N, Btu/hr
QS(N)	Direct solar lamp energy absorbed by RCS node N, Btu/hr
SUND2	Solar vector angle of the real environment to be matched by CHR, deg.
T(IZ)	LSTS heater element zone IZ temperature, °R
TCONT2	Contact temperature of RCS in real environment, °R
TESTT(IZ)	LSTS heater element zone IZ temperature for previous iteration calculation, °R
T4TH	$[T(IZ)]^4$, $°R^4$
X	Dummy variable



SUBROUTINE CHR FLOW CHART

@ FOR,N SUBS=,SUBS=
UNIVAC 1100 FORTRAN V LEVEL 2206.001= 15:01=10
THIS COMPILATION WAS DONE ON 15 NOV 71 AT 05:00:41

SUBROUTINE CHR ENTRY POINT 001641

STORAGE USED (BLOCK, NAME, LENGTH)

0001	=CODE	001700
0000	=DATA	003450
0002	=BLANK	000000
0003	MR	051203
0004	CH1	000043
0005	CH1	035554
0006	CH2	000436
0007	CH3	000070
0010	CH6	000170

EXTERNAL REFERENCES (BLOCK, NAME)

0011	TRANR
0012	EXIT
0013	TC2
0014	TRANS
0015	FFFZ
0016	SCREEN
0017	FFTMPZ
0020	BACK
0021	ALPHA1
0022	SOLVE
0023	NBDS
0024	NBDS
0025	NBZS
0026	NBRS
0027	COS
0030	SIN
0031	INSORT
0032	NMDS
0033	NBRDS

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000421	11L	0001	000042	131G	0001	000640	150L	0001	000070	151G	0001	000412	16L
0001	000323	17L	0001	000324	1+L	0001	000720	20L	0001	000155	203G	0001	000222	224G
0001	000223	227G	0001	000237	237G	0001	000255	246G	0001	000404	314G	0001	000444	322G
0001	000451	333G	0001	000465	341G	0001	000510	344G	0001	000545	353G	0001	000632	360G
0001	000654	402G	0001	000677	412G	0001	000742	425G	0001	000003	425L	0001	000047	426L
0001	000242	429L	0001	000270	430L	0001	000765	434G	0001	001067	451G	0001	001071	454G
0001	001137	473G	0001	001376	4=9L	0001	000642	49L	0001	001427	491L	0001	001205	516G
0001	001237	527G	0001	001263	541G	0001	001274	547G	0001	001313	560G	0001	001337	570G
0001	001356	577G	0001	000400	6L	0001	001365	604G	0001	001416	616G	0001	001451	626G
0001	001465	633G	0001	001517	651G	0001	001562	667G	0001	001301	674L	0001	001321	675L
0000	003026	902F	0000	003030	905F	0000	003032	950F	0000	003101	951F	0000	003141	955F
0000	003231	956F	0000	003235	962F	0000	003274	965F	0000	003276	966F	0000	003302	967F
0000	001307	971F	0000 D	000000	A	0003 R	001327	AL	0003 R	001007	ALPHAT	0006 R	000435	ALPSOL
0000 R	003012	ALPHA	0000 R	003016	ALPHA3	0003 R	000041	ANAME	0003 R	002173	AR	0003 R	001037	AS
0004 R	000003	ASE	0000 R	002764	AT	0000 D	000310	B	0000 D	000334	BIG	0004 R	000006	BX

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0004 R 000021 BXX        0004 R 000007 BY         0004 R 000022 BYY        0004 R 000010 BZ         0004 R 000011 COSP
0004 R 000042 COSSUN     0004 R 000031 COST       0004 R 000023 COST1      0000 R 002721 DEFT       0007 R 000004 DR
0003 R 001326 DTIME      0004 R 000024 DX         0004 R 000025 DY         0004 R 000026 DZ         0000 R 002776 ENV2
0000 R 003003 ENV3       0000 R 003004 ENV4       0007 R 000005 EPSILR     0004 R 000042 FATDT      0007 R 025404 FI
0004 R 000014 FSE        0007 R 003701 GENODE     0000 R 001011 GIR        0003 R 000011 IOFTR      0003 R 000030 IOFTRP
0004 R 000034 IOSOL      0004 R 000036 IOSOLA     0004 R 000035 IOSOLD     0000 R 000144 IRIGS      0004 I 004547 IX
0005 I 000000 IC         0003 I 000013 ICARD      0000 I 000007 INR        0004 I 000042 IN         0003 I 000007 IOUT
0003 I 000014 IPAGE      0003 I 000024 IPRINT     0004 I 000027 IQ         0003 I 000010 IREF       0003 I 000012 ISEC
0003 I 000444 ISOLAR     0000 I 004025 IT         0000 I 002777 IZ         0000 I 004001 IS         0000 I 004020 IT
0000 I 004021 IZ         0000 I 004022 I3         0000 I 004023 I5         0000 I 004024 I6         0000 I 005010 J
0000 I 004014 K          0000 I 004017 KFIX       0004 I 000000 M          0004 I 000001 MIN        0000 I 000430 MI
0004 I 000440 MODF       0004 I 000002 MODFM      0004 I 000003 MOD3       0004 I 052447 MOD6       0003 I 000024 MORIX
0000 I 002740 MUM        0000 I 004000 N          0004 I 000006 NANF       0007 I 000000 NB         0005 I 000247 NC
0005 I 000001 NCMB       0003 I 000022 NENL       0000 I 004014 NFT        0005 I 000027 NLAMP      0004 I 000004 NMODF
0007 I 000002 NODE       0005 I 000005 NTIER      0007 I 000001 NUMZNS     0004 I 000005 NVM        0006 I 000401 NW
0000 I 004015 NZ         0005 I 000002 NZONE      0004 R 000013 PHI        0004 R 000004 PHI1       0004 R 000015 PI
0004 R 000016 PI180      0004 R 006257 Q          0004 R 020137 QA         0004 R 004047 QAC        0004 R 005411 QALB
0003 R 002174 QB         0010 R 000000 QBR        0010 R 000074 QBS        0000 R 000140 QCALC      0000 R 001204 QF
0000 R 002050 QI         0003 R 006257 QLZ        0004 R 020137 QR         0004 R 021004 QS         0004 R 000067 QT
0003 R 000025 REF        0004 R 000025 REF1       0004 R 000026 REF2       0006 R 000434 SFLUX      0004 R 000017 SIG
0004 R 000012 SINP       0004 R 000041 SINSUN     0006 R 000000 SOL        0004 R 000037 SUN        0004 R 000040 SUND
0000 R 003005 SUND2      0000 R 002714 T          0007 R 000004 TAV        0003 R 005411 TDON       0004 R 000011 TCONST
0000 R 001006 TCONT2     0004 R 000477 TEMAT      0007 R 000006 TEMIC      0000 R 002752 TESTT      0004 R 000005 THFI
0003 R 000021 TIME       0003 R 000020 TIMEO      0004 R 000461 TITLE      0000 D 000146 TATH       0006 R 000432 WIDTHS
0000 R 003002 X          0005 R 005540 XL         0005 R 000115 XLO        0005 R 000424 XLP        0004 R 001417 XN
0003 R 000060 XO         0003 R 021647 XR         0004 R 000000 XSE        0004 R 000001 YSE        0004 R 000002 ZSE
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00101     1*          SUBROUTINE CIRC1,EPSLMP,ENV1)
00101     2*    C
00103     3*          PARAMETER MMAX=3,NMAX=420
00104     4*          COMMON / MC / M,MAX,NODEM,MOD3,NMODE,NAM,NANF,IOUT,IREF,ICONT,
00104     5*         1      ISC,ICARD,IPAGE,PI,PI180,SIG,TIMED,TIME,NSEQ,NORIX,IPRINT,
00104     6*         2      REF(12),ANAM(15),XO(7),QF(15,15),MODE(10),IN(15),TITLE(14),
00104     7*         3      TEMAT(20,10),ALEMAT(20,10),XN(7),DTIME,
00104     8*         4      AL(NMAX),AR(NMAX),AS(NMAX),GENODE(NMAX),IA(NMAX),TDON(NMAX),
00104     9*         5      Q(12,NMAX),QB(NMAX),QS(NMAX),XR(NMAX,NMAX,10),MIRI(NMAX)
00105    10*          EQUIVALENCE (REF1,REF(1)),(REF2,REF(2))
00106    11*          PARAMETER NORID=2*0
00107    12*          DOUBLE PRECISION A,B,BIG,TATH
00110    13*          DIMENSION QA(NMAX),QB(NMAX),QAC(NMAX),QALB(NMAX),QCALC(NMAX),
00110    14*         1 QF(NMAX),QL(NMAX),QLZ(NMAX,6),
00110    15*         2 A(10,10),B(10),T(10),DELT(10),NUM(10),TESTT(10),AT(10)
00111    16*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THF1,BX,BY,BZ,COSP,SINP,PHI,
00111    17*         1    FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,COFTRP,
00111    18*         1    COST,FATDT,QOFTR,COSOL,COSOLD,COSOLA,SUN,SUND,SINSUN,COSSUN
00112    19*          COMMON /CH1/ IC,NCMB,NZONE(3),NTIER(3,6),NLAMP(3,6,3),XLO(3,30),
00112    20*         1                 NC(3,15),XLP(6,3,25,6),XL(3,6,3,25,6),FL(700,6)
00113    21*          COMMON /CH2 / SOL(NGRID),ML,NW,WIDTHS,HEIGS,SFLUX,ALFSOL
00114    22*          COMMON /CH3 / NB,NUMZNS,NODE,DR,TAV,EPSILR,TEMIC(50)
00115    23*          EQUIVALENCE (QA,QR),(QB,AR),(IN(2),ISOLAR),(QAC,AS),(QLZ,Q),
00115    24*         1   (TDON,QALB)
00116    25*          DATA ENV2 / 6HHAMBER /
00120    26*          COMMON /CH6/ QBR(3,4,5),QBS(3,4,5)
00120    27*    C
00121    28*          IZ = NZONE(IC)
00121    29*    C
00122    30*      425 CONTINUE
00123    31*          M = 0
00124    32*          IF (IN(6).LT.2) GO TO 426
00126    33*          CALL TRANR
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00127    34*          I = IPHONE
00130    35*          IF (I.LT.0) RETURN
00132    36*          IF (TIME.LE.0.0) CALL EXIT
00134    37*          READ (5,902) (QA(N),N=1,MAX)
00142    38*          GO TO 429
00143    39*      426 READ (5,905) I,M,TIME,DTIME,NO
00155    40*          ICARD = ICARD + 1
00156    41*          IF (I.LT.0) RETURN
00160    42*          READ  (IOUT) TIME,M,X,X,X,X,X,XO(4),XO(5),XO(6),XO(7),
00160    43*         1     X,ENV3,ENV4,SUN2,TCONT2,INR,
00160    44*         1   (QA(N),X,X,X,X,X,N=1,MAX)
00214    45*          IF (TIME.LT.0.0) CALL EXIT
00216    46*          MODEM = MODE(NO)
00217    47*          PHI  = XO(4)*PI/180
00220    48*          COSP = COS(PHI)
00221    49*          SINP = SIN(PHI)
00222    50*          XO(7) = 0.
00223    51*          DO 427 I=1,15
00226    52*          DO 427 J=1,15
00231    53*      427 OT(I,J) = 0.0
00234    54*          IF (M.NE.1) GO TO 429
00236    55*          DO 428 I=1,4
00241    56*      428 XN(I) =XO(I)
00243    57*      429 CONTINUE
00244    58*          CALL TC2(XO,TCONT)
00245    59*           DO 6 N=1,MAX                                          00001040
00250    60*          CALL TRANS(N)
00251    61*          IF (IQ.NE.0) GO TO 430
00253    62*          QF(N) = 0.0
00254    63*          QS(N) = 0.0
00255    64*          QALB(N) = 0.0
00256    65*          QB(N) = 0.0
00257    66*          GO TO 6
00260    67*      430 CONTINUE
00261    68*          CALL FEFZ(N,QF(N))
00262    69*          QF(N) = QF(N)*ASE
00263    70*          IF (ISOLAR.LE.-2) GO TO 17
00265    71*           IF(COST.LE.0.0)GO TO 17                              00001230
00267    72*          CALL SCREEN
00270    73*          QS(N)= SELX*COST*AL(N)*ASE*ALFSOL
00271    74*           GOTO 18                                              00001250
00272    75*   17     QS(N)=0.0                                            00001260
00273    76*    18    CONTINUE
00274    77*          CALL FELMPZ(N)
00275    78*          CALL BACK(GIR)
00276    79*          QALB(N) = QSOL*AL(N)*ASE
00277    80*          CALL ALPHA1(500.0,ALPHA)
00300    81*          QB(N) = GIR*ALPHA*ASE
00301    82*          QL(N)    = QA(N)-QF(N)-QS(N)-QALB(N)-QB(N)
00302    83*           J = IA(N)
00303    84*          OT(1,J) = OT(1,J) + QA(N)
00304    85*           OT(3,J) = OT(3,J) + QF(N)
00305    86*           OT(4,J) = OT(4,J) + QL(N)
00306    87*           OT(5,J) = OT(5,J) + QS(N)
00307    88*           OT(6,J) = OT(6,J) + QALB(N)
00310    89*          OT(7 ,J) = OT( 7,J) + QB(N)
00311    90*   6       CONTINUE                                             00001380
00313    91*           DO 201 K=1,IZ
00316    92*           T(K) = 500.0
00317    93*   201     MEM(K)=1
00321    94*           NIT = 0
00322    95*    16     NIT = NIT + 1
00323    96*           IF (NIT.GT.21) GO TO 20
```

```
00325    97*    11      DO 10 N=1,IZ                                                                  00001630
00330    98*            TESTT(N)=T(N)                                                                 00001640
00331    99*            B(N)=0.000
00332   100*            DO 10 I=1,IZ
00335   101*    10      A(N,I)=0.000                                                                  00001700
00340   102*            DO 12 N=1,IZ                                                                  00001710
00343   103*            DO 12 I=1, MAX
00346   104*           MORE(N) = MORE(I)
00347   105*           CALL ALPHA1(T(N),ALPHA)
00350   106*            ASE  = XR(M,I,6)
00351   107*            B(N) = B(N) + FLUX(I,N)*QEXT(I)*ASE*ALPHA                                     00001760
00352   108*            DO 12 NZ=1,IZ
00355   109*           CALL ALPHA1(T(NZ),ALPHA1)
00356   110*           A(N,NZ) = A(N,NZ) + FLUX(I,N)*FLUX(I,NZ)*ASE**2* ALPHA*ALPHA1
00357   111*    12     CONTINUE
00361   112*            CALL SOLVE(A,B,IZ,BIG,NUM)
00364   113*            KFIX=0
00365   114*            DO 49 N=1,IZ
00370   115*            IF(B(N))149,150,49
00373   116*    149     KFIX=1J                                                                       152*
00374   117*    150     NUM(N)=-1
00375   118*    49      CONTINUE                                                                      1*0*
00377   119*            IF(KFIX.EQ.1)GOTO 11                                                          00001*40
00401   120*            DO 13 J=1,IZ
00404   121*           T4TH = B(J)/(SIG*EPSIMP)
00405   122*            T(J)=SNGL(DSQRT(DSQRT(T4TH)))
00406   123*            DELT(J)=TESTT(J)-T(J)                                                         00001*90
00407   124*    13      TESTT(J)=T(J)                                                                 00001930
00411   125*            DO 15 N=1,IZ                                                                  00001950
00414   126*            AT(N) = T(N)
00415   127*            IF (AT(N).LT.100.) AT(N) = 100.
00417   128*            IF (ABS(DELT(N))/AT(N).GT.0.001) GO TO 16
00421   129*    15      CONTINUE                                                                      00001990
00423   130*    20     CONTINUE
00424   131*            DO 76 N=1,MAX
00427   132*           MIREN = MIREG(N)
00430   133*           ASE = XR(M,N,6)
00431   134*            J= IA(N)
00432   135*            QAC(N)=0.0
00433   136*            DO 75 NZ=1,IZ
00436   137*           CALL ALPHA1(T(NZ),ALPHA)
00437   138*           QLZ(N,NZ) = ASE*ALPHA*FLUX(N,NZ)*B(NZ)
00440   139*           K = 8 + NZ
00441   140*            QT(K,J) = QT(K,J) + QLZ(N,NZ)
00442   141*    75      QAC(N)=QAC(N)+QLZ(N,NZ)
00444   142*           QT(8,J) = QT(8,J) + QAC(N)
00445   143*           QCALC(N)= QAC(N)+QF(N)+QS(N)+QB(N)+QALB(N)
00446   144*    76      QT(2,J) = QT(2,J)+QCALC(N)
00450   145*           DO 555 J=2,NAME
00453   146*            DO 555 I=1,K
00456   147*    555    QT(I,1) = QT(I,1) + QT(I,J)
00456   148*    C
00461   149*           NZ = NZONE(IC)
00462   150*           I1 = 1
00463   151*           I2 = 10-NZ
00464   152*           I3 = 45
00465   153*           I5 = 8+NZ
00466   154*           IF (I2.GT.MAX) I2 = MAX
00470   155*           IPAGE = IPAGE + 1
00471   156*           WRITE (6,950) TITLE,IPAGE,TIME,REF(1),REF(2),MODE(M),ENV1,ENV2
00471   157*          1,ENV3,ENV4
00510   158*           WRITE (6,955) SUND,TAV,EPSFLR
00515   159*           DO 490 IZ=1,NZ
```

```
00520   160*          I6 = NTIER(IC,IZ)
00521   161*          TCIZ) = TCIZ)+460.
00522   162*      490 WRITE (6,956) IZ,HCIZ),TCIZ),(ALCIC,IZ,IT,1,5),IC=1,16)
00534   163*          IF (IREF.NE.2) GO TO 674
00536   164*          WRITE (6,971) REF1,(XOCI),I=1,4),TCONT,REF2,(XNCI),I=1,4)
00553   165*          GO TO 675
00554   166*      674 WRITE (6,951) REF1,REF2,(XOCI),I=1,4),TCONT
00565   167*      675 CONTINUE
00566   168*          WRITE (6,962)(IZ,IZ=1,NZ)
00574   169*          IF (NAME.EQ.0) GO TO 499
00576   170*          DO 497 J=2,NAME
00601   171*      497 WRITE (6,966) ANAME(J),(QFC(I,J),I=1,15)
00611   172*      499 WRITE (6,966)
00613   173*          WRITE (6,966) ANAME(1),(QFC(I,1),I=1,15)
00622   174*          WRITE (6,965)
00624   175*      491 WRITE (6,962)(I,I=1,NZ)
00632   176*      494 DO 495 N=11,12
00635   177*      495 WRITE(6,967) N,GENODE(N),QX(N),QCALC(N),QF(N),QL(N),QS(N),QMLB(N),
00635   178*         1 QB(N),QAC(N),(QLZ(N,I),I=1,NZ)
00656   179*      498 IF (I2.EQ.MAX) GO TO 425
00660   180*          I1 = I2+1
00661   181*          I2 = I2+13
00662   182*          IF (I2.GT.MAX) I2 = MAX
00664   183*          IPAGE = IPAGE + 1
00665   184*          WRITE (6,950) TITLE,IPAGE,TIME,REF(1),REF(2),MODE(M),ENV1,ENV2
00665   185*         1,ENV3,ENV4
00704   186*          GO TO 491
00704   187*   C
00704   188*   C      SECTION 900, FORMAT STATEMENTS
00704   189*   C
00705   190*      902 FORMAT (10F8.3 )
00706   191*      905 FORMAT (2I4,9F8.3)
00707   192*      950 FORMAT (9H1     TIME,21X,14A5,12X,4HPAGE,I4  /9H      OHIO,/F10.3/  00001110
00707   193*         1 30X,2A5,    HH  IN A  ,A5,29HTHIS  MODE  IS LOCATED IN A
00707   194*         2,2A6,  15H  ENVIRONMENT.  // 30X,65HLEAST SOURCES FIT OF USTS I.R.
00707   195*         3LAMP TEMPERATURES  TO SIMULATE A  ,2A6,  15H  ENVIRONMENT.  ///)
00710   196*      951 FORMAT (2H0 ,2A5,16X,1HX,9X,1HY,9X, 2SHZ      AZIMUTH   CONTACT  /
00710   197*         1 10H  LOCATION,16X,  45H(FT)       (FT)       (FT)      (DEG)       TE
00710   198*         2HP / 20X,4F10.2,2F10.1 ///
00710   199*         3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.    / )
00711   200*      955 FORMAT (13H  ENVIRONMENT  , 17X,14HSUN ANGLE (DEG) = , F7.2 //
00711   201*         1 30X,      37HAVERAGE FLOOR TEMPERATURE  (DEG F)  =,
00711   202*         1 F7.2, 20X,14HFLOOR EMISSIVITY =
00711   203*         1 F6.3 //25X, 67H      LAMP      POWER      LAMP      LAMP INCLINATI
00711   204*         1ON ANGLES, (DEG) /30X,55H ZONE   PER LAMP     TEMP       TIER
00711   205*         1TIER      TIER /  30X,55H  NO.  B/H/FT**2    DEG F        I
00711   206*         1  2         3      )
00712   207*      956 FORMAT (30X,I4,F11.1,5F10.1)
00713   208*      962 FORMAT (9X,35H ABSORBED HEATS.  GIVEN IN BTU/HR.       /
00713   209*         1 10H       NODE,7(5X,3HQ  ),4X,3HQ   ,6(2X,6HQ ZONE ) /
00713   210*         2    77H NO.  NAME   DESRD   MATCH   FLOOR  LMP REQ  SOLAR  ALBEDO
00713   211*         3  IR BG    LMP ACT , I5,5I8 )
00714   212*      965 FORMAT (1H  ///)
00715   213*      966 FORMAT (5X,A5,7F8.1,3X,7F8.1)
00716   214*      967 FORMAT (I4,1X,A5,7F8.1,3X,7F8.1)
00717   215*      971 FORMAT (12H0 LOCATION    ,16X,1HX,9X,1HY,9X,2SHZ      AZIMUTH   CONT
00717   216*         1ACT   /26X,45H(FT)       (FT)       (FT)      (DEG)      TEMP R /
00717   217*         2  12X,A5,3X,5F10.2 / 12X,A5,3X,4F10.2 ///
00717   218*         3 40H  SUMMARY OF THE THERMAL ENVIRONMENT.     /)
00720   219*          END

    END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUBS#          SYMBOLIC                                  2# APR 71  09:11:44   0  02155266    14   219  (DELETED)
SUBS#   CODE   RELOCATABLE                               2# APR 71  09:11:44   1  02184240    66     1  (DELETED)
                                                                                 0  02184452    14   123
```

SUBPROGRAM NAME: Subroutine TC2(XO, TCON)

SEGMENT NAME: SUBS9

PURPOSE: Calculate the Reference Coordinate System (RCS) chamber floor contact temperature.

DESCRIPTION: The TC2 subprogram determines the node on which the RCS is located and uses that node temperature as the chamber floor contact temperature. In the event that the contact temperature is input (TCONT on Card B2), the routine sets the contact temperature to that specified by the user. If the RCS is positioned off of the chamber floor, the closest floor node temperature is used for the contact temperature.

CALLING PROGRAMS: CHB, CHR

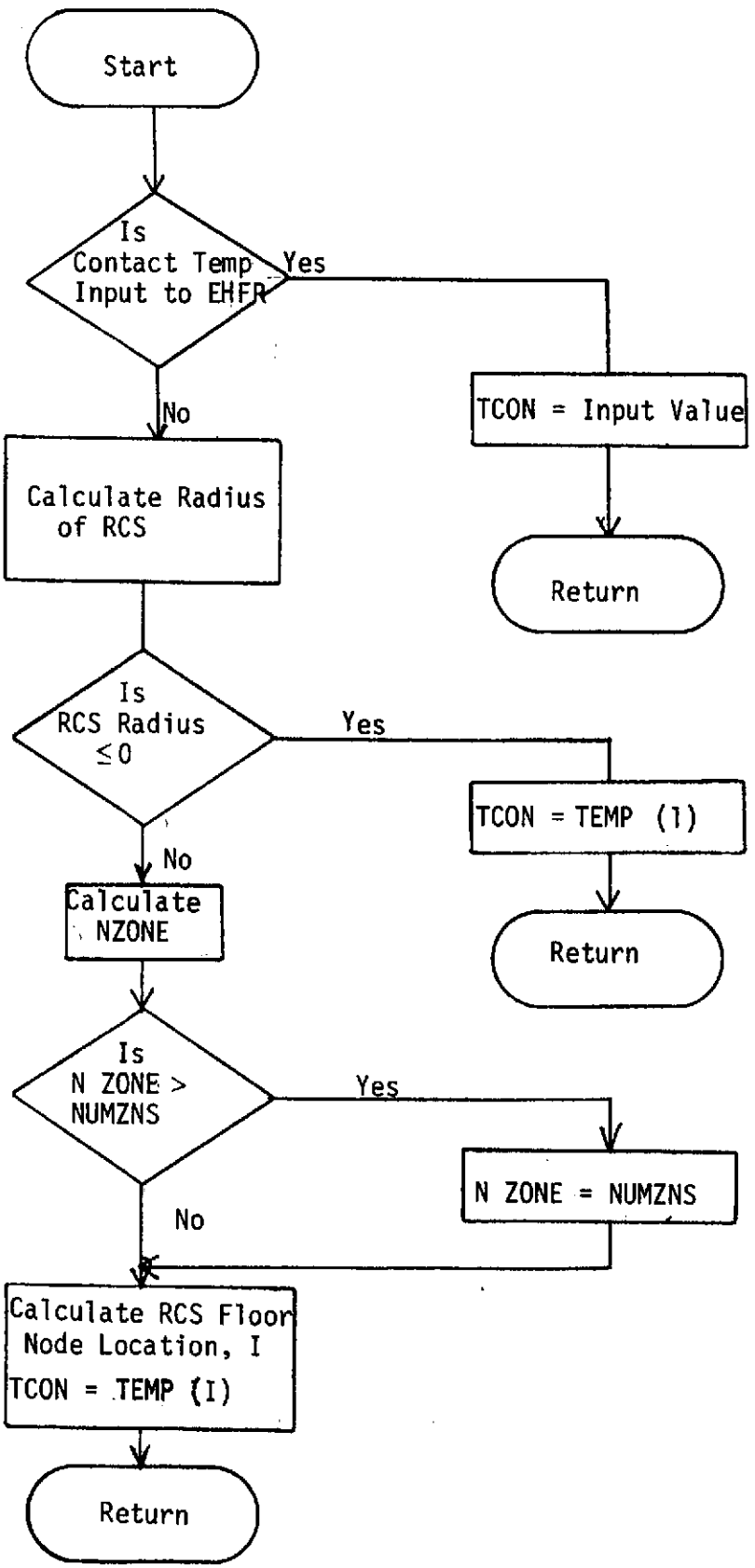
ARGUMENT LIST:

XO	Current timepoint RCS location as defined in the MR block common (input)
TCON	RCS floor contact temperature (output), °R

NOMENCLATURE: A dictionary of FORTRAN nomenclature used by the TC2 subprogram is listed below.

BETA	Angular width of a floor node division, radians
DR	Radial length of a floor node division, ft.
I	Contact node number
NB	Number of angular floor node divisions
NUMZNS	Number of radial floor node divisions
NZONE	Radial floor node index of RCS location
PHI2	Azimuth location of RCS on floor from chamber origin, radians
RMAN	Radius of RCS on floor from chamber origin, ft.
TCON	RCS floor contact temperature, °R
TEMP(I)	Floor node temperature, °R
XO(1)	RCS X position in chamber, ft.
XO(2)	RCS Y position in chamber, ft.
XO(7)	RCS contact temperature input, °R

TC2 SUBPROGRAM FLOW CHART



```
@ FOR,* SUBS9,SUBS9                                                    31 MAR 71          14:19:28
UNIVAC 1108 FORTRAN V LEVEL   2206 001@ F501@H
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:19:28


   SUBROUTINE TC2        ENTRY POINT 000124

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001   *CODE   000134
         0000   *DATA   000020
         0002   *BLANK  000000
         0003   CH3     005141


   EXTERNAL REFERENCES (BLOCK, NAME)

         0004   SORT
         0005   ATAN2
         0006   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000012 1L          0001   000034 5L          0003 R 005140 BETA       0003 R 002514 BF         0003 R 000003 DR
    0003 R 000005 EPSFLR      0000 I 000003 I           0003 I 000000 NB         0003 I 000002 NODE       0003 I 000001 NUMZNS
    0000 I 000001 NZONE       0000 R 000002 PHI2        0000 R 000000 RMAN       0003 R 000004 TAV        0003 R 003726 TEMP
    0003 R 000006 TEMTC       0003 R 000070 XF          0003 R 001302 YF


00101     1*          SUBROUTINE TC2(XO,TCON)
00101     2*    C
00103     3*          DIMENSION XO(7)
00104     4*          PARAMETER NFLR=650
00105     5*          COMMON /CH3 / NB,NUMZNS,NODE,DR,TAV,EPSFLR,TEMTC(50)
00105     6*         1,XF(NFLR),YF(NFLR),BF(NFLR),TEMP(NFLR),BETA
00105     7*    C
00106     8*          IF (XO(7).LE.0.0) GO TO 1
00110     9*          TCON = XO(7)
00111    10*          RETURN
00112    11*        1  RMAN = SORT(XO(1)**2 + XO(2)**2)
00113    12*          IF (RMAN.GT.0.0) GO TO 5
00115    13*          TCON = TEMP(1)
00116    14*          RETURN
00117    15*        5 CONTINUE
00120    16*          NZONE = RMAN/DR + 1.
00121    17*          IF (NZONE.GT.NUMZNS) NZONE = NUMZNS
00123    18*          PHI2 = ATAN2(XO(2),XO(1))
00124    19*          IF (PHI2.LT.0.0) PHI2 = PHI2 + 6.28318
00126    20*          I = PHI2 /BETA + 1.
00127    21*          I = (NZONE-1)*NB + I
00130    22*          TCON = TEMP(I)
00131    23*          RETURN
00132    24*           END .                                                    00004800

      END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
   SUBS9           SYMBOLIC                                  10 MAR 70  10:17:44    0  01457770    14    24  (DELETED)
   SUBS9    CODE   RELOCATABLE                               10 MAR 70  10:17:44    1  01460510    24     1  (DELETED)
```

SUBPROGRAM NAME: Subroutine SOLVE (A, B, N, BIG, MUM)

SEGMENT NAME: SUBS11

PURPOSE: Solve a set of linear equations to find the thermal vacuum chamber LSTS zone heater radiosity.

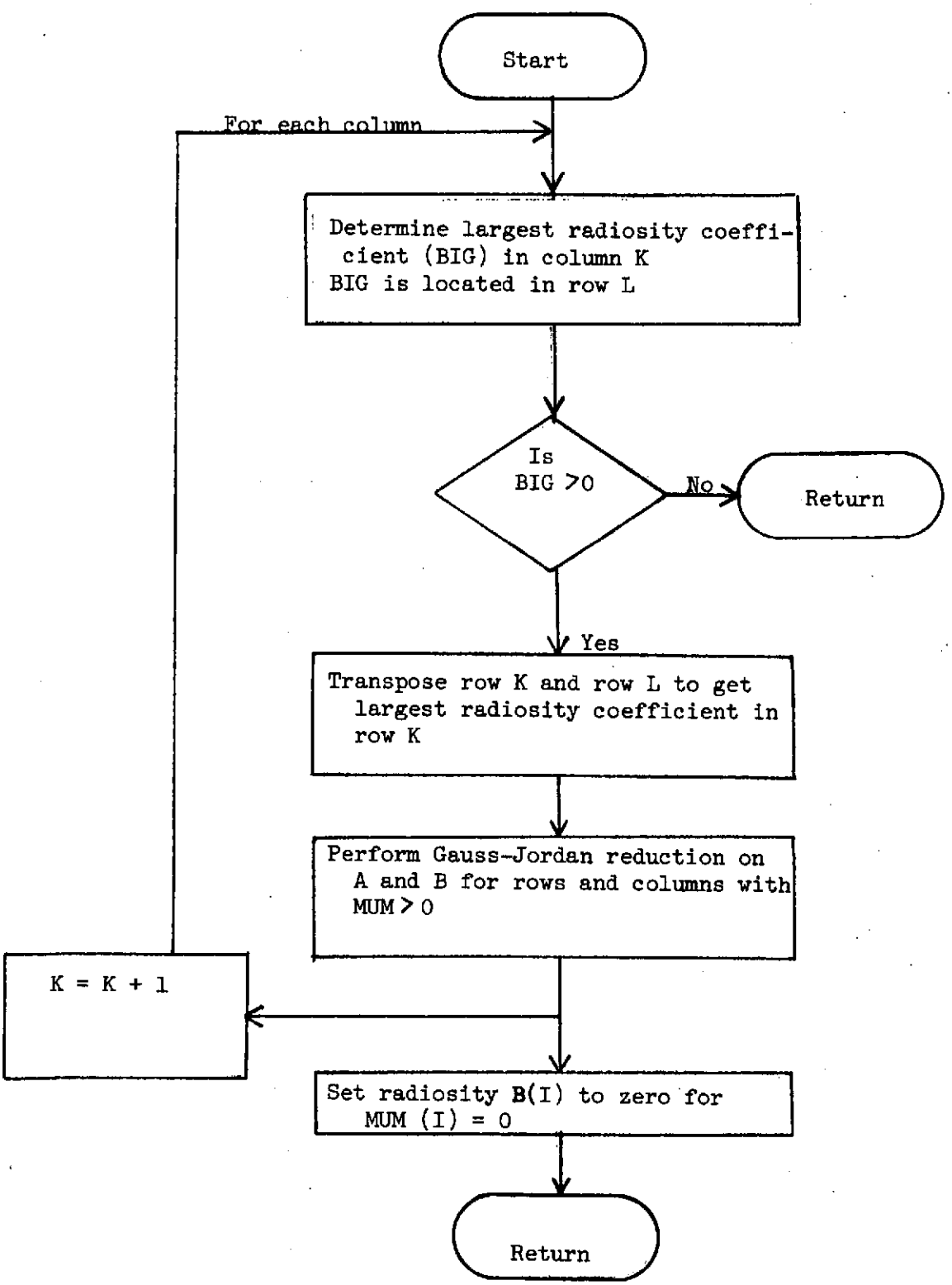
DESCRIPTION: The LSTS zone power settings and heater element temperatures calculations using a least squares match of real versus simulated absorbed heat environment results in a set of linear equations relating zone heater element radiosities, chamber configuration, and RCS thermal properties. The solution of these linear equations is determined by SOLVE using the Gauss-Jordan reduction technique. Rows and columns of the linear equations may be omitted to assure positive values of heater radiosity. All variables used in this subprogram require double precision accuracy.

CALLING PROGRAM: CHR (SUBS8)

ARGUMENT LIST AND NOMENCLATURE:

A(I, J)	Coefficients of the LSTS heater zone radiosity terms in linear equations (input)
B(I)	Constants in linear radiosity equations (input). LSTS heater zone radiosity (output)
N	Number of linear equations
BIG	Equation singularity indicator (output). If zero, a singular set of equations exists.
MUM(I)	Index indicating the rows and columns which are to be omitted in the solution process (input)
AIK, AKJ DIV, BK	Intermediate terms used during solution of equations

SOLVE SUBPROGRAM FLOW CHART



UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F501HH
THIS COMPILATION WAS DONE ON 31 MAR 71 AT 14:19:34

SUBROUTINE SOLVE ENTRY POINT 000301

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000337
0000	*DATA	000070
0002	*BLANK	000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003	NERR3$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000253	1L	0001	000211	10L	0001	000023	106G	0001	000222	111L
0001	000061	115G	0001	000227	12L	0001	000250	13L	0001	000132	136G
0001	000155	150G	0001	000200	161G	0001	000242	176G	0001	000077	5L
0000 D	000002	AKJ	0000 D	000004	BK	0000 D	000000	DIV	0000 I	000012	I
0000 I	000013	J	0000 I	000010	K	0000 I	000011	L			

```
00101     1*          SUBROUTINE SOLVE(A,B,N,BIG,MUM)                          06820
00103     2*           DIMENSION A(10,10),B(10),MUM(10)                        06830
00104     3*          DOUBLE PRECISION A,B,BIG,DIV,AKJ,BK,AIK                  06840
00105     4*          DO 12 K=1,N                                              06850
00110     5*          IF(MUM(K).LT.0) GOTO 12                                  06860
00112     6*          BIG=DABS(A(K,K))                                         06870
00113     7*          L=K                                                      06880
00114     8*          DO 5 I=K,N                                               06890
00117     9*          IF(MUM(I).LT.0) GOTO 5                                   06900
00121    10*          IF(BIG-DABS(A(I,K))) 4,5,5                               06910
00124    11*    4     BIG=DABS(A(I,K))                                         06920
00125    12*          L=I                                                      06930
00126    13*    5     CONTINUE                                                 06940
00130    14*          IF(BIG) 1,1,2                                            06950
00133    15*    2     CONTINUE                                                 06960
00134    16*          DIV=A(L,K)                                               06970
00135    17*         DO 6 J=K,N                                                06980
00140    18*          AKJ=A(L,J)                                               06990
00141    19*          A(L,J)=A(K,J)                                            07000
00142    20*    6     A(K,J)=AKJ/DIV                                           07010
00144    21*          BK=B(L)                                                  07020
00145    22*          B(L)=B(K)                                                07030
00146    23*          B(K)=BK/DIV                                              07040
00147    24*          DO 11 I=1,N                                              07050
00152    25*          IF(MUM(I).LT.0) GOTO 11                                  07060
00154    26*          IF (K-I) 9,11,9                                          07070
00157    27*    9     AIK=A(I,K)                                               07080
00160    28*          DO 10 J=K,N                                              07090
00163    29*          IF(MUM(J).LT.0)GOTO 10                                   07100
00165    30*          A(I,J)=A(I,J)-AIK*A(K,J)                                 07110
00166    31*   10     CONTINUE                                                 07120
```

```
00170    32*            B(I)=B(I)-A(K+B(K)                                    07140
00171    33*    11      CONTINUE                                              07150
00173    34*    12      CONTINUE                                              07160
00175    35*            DO 13 I=1,N                                           07170
00200    36*            IF(B(I).GT.0) GOTO 13                                 07180
00202    37*            B(I)=0.0                                              07190
00203    38*    13      CONTINUE                                      00006220
00205    39*    1       RETURN                                        00006230
00206    40*              END                                         00006240

      END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUBS11          SYMBOLIC                          26 APR 69  12:57:07   0  0140.670    14    40  (DELETED)
SUBS11  CODE    RELOCATABLE                       26 APR 69  12:57:07   1  0141.750    24     1  (DELETED)
                                                                        0  0144.000    14    24
```

SUBPROGRAM NAME: Subroutine INPUT1

SEGMENT NAME: SUBI1

PURPOSE: Select Reference Coordinate System (RCS) desired, read RCS data change/update cards, and print the RCS stored data used for this run.

DESCRIPTION: The INPUT1 subprogram selects the user specified RCS by calling the appropriate block data subprogram which transfers the data to INPUT1 via a high speed drum (logical unit 4). The routine then reads RCS data change/update cards specifying: node addition/change; individual node geometric data changes; node-material composition change; and/or material absorptivity-temperature curve data modification. The subprogram prints out the user specified RCS data.

CALLING PROGRAM: SUBM1 (Main Program)

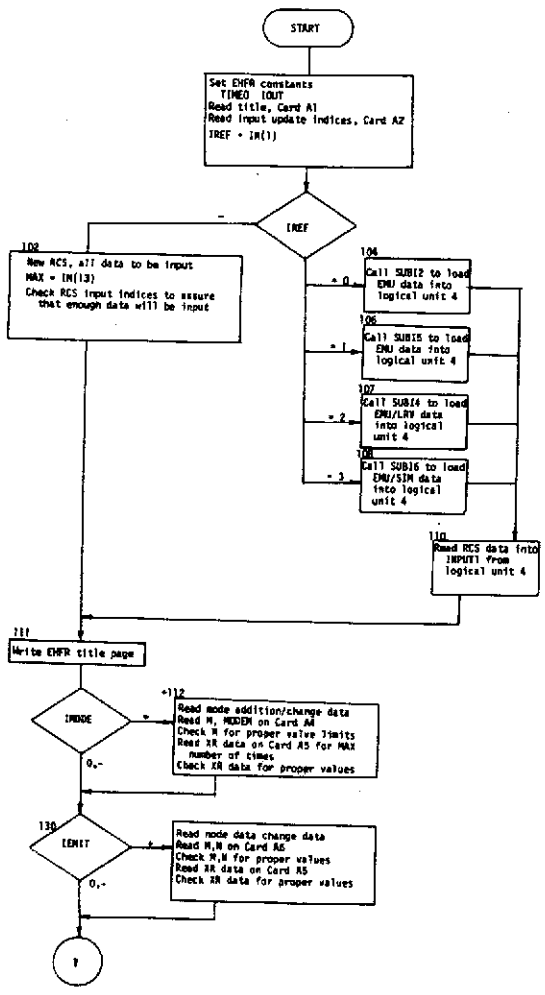
ARGUMENT LIST: None, all data required/generated by the INPUT1 subprogram is transferred into and out of the routine via block common statements and high speed drum (logical unit 4).

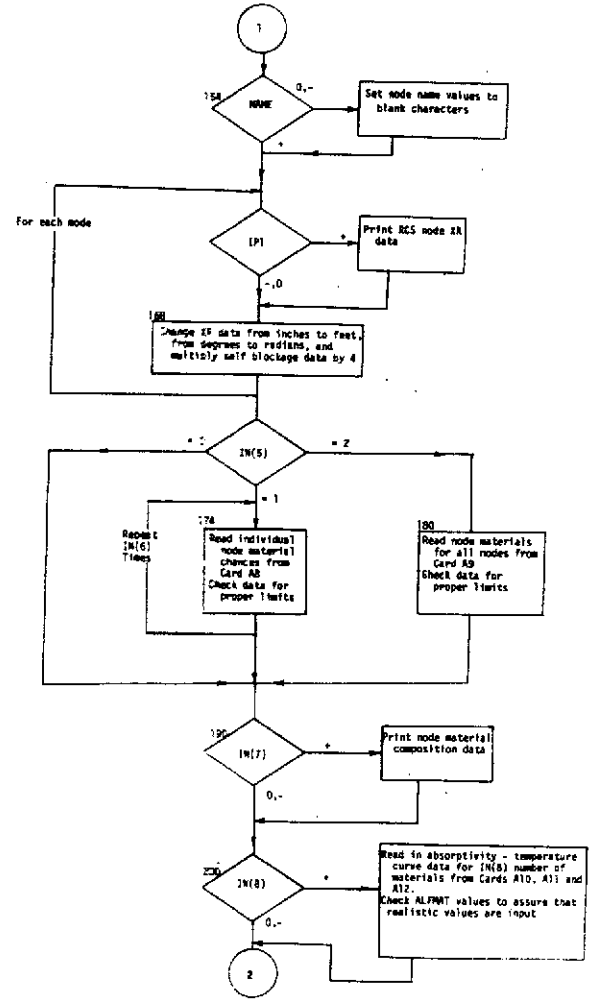
NOMENCLATURE: Listed below is a dictionary of FORTRAN nomenclature used by the INPUT1 subprogram. Also used by the INPUT1 routine are the variables of the MR and GE1 block common statements. The MR and GE1 variables are defined with the SUBM1 (main program) nomenclature.

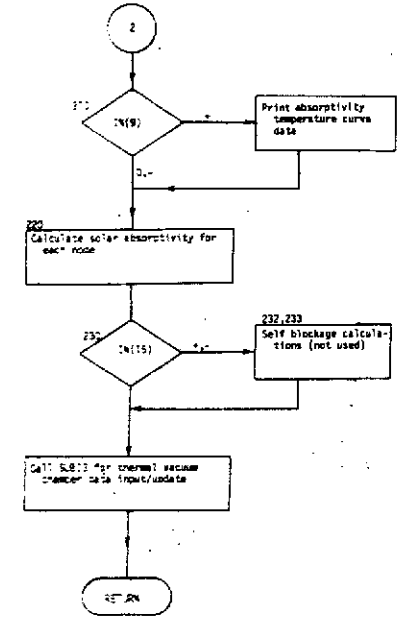
BLANK	6 blank characters in A format
B1, B2 CX,CY,CZ, FF,FFN,FT	Not currently used
I,J,K,L	Indices
IEMIT	Number of individual nodes for which data changes are to be input
IMAX	Constant
IMODE	Number of modes to be input as mode additions and/or complete changes
IN(5)	Node-material data change index
IN(6)	Number of nodes for which new material composition data is to be input
IN(7)	Node-material composition print index
IN(8)	Number of absorptivity curves to be added or changed
IN(9)	Absorptivity - temperature data print index

IP1	Print index for RCS geometric data
ITOT,IQQ, NEW	Not used
I1,I2,I3	Print indices
MAT(I)	Material I name in A format
N	RCS node number
PHI2, THT2, R2	Not Used
REFN(I)	Name of new Reference Coordinate System and A format
TOTAL	Word TOTAL in A format

INPUT 1 FLOW CHART







SUBROUTINE INPUT1 ENTRY POINT 002421

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	002436
0000	*DATA	001126
0002	*BLANK	000000
0003	MR	053203
0004	GE1	000043

EXTERNAL REFERENCES (BLOCK, NAME)

0005	SUBI2
0006	SUBI5
0007	SUBI4
0010	SUBI6
0011	ALPHA1
0012	TRANS
0013	BLOCK
0014	SUBI3
0015	EXIT
0016	NREW$
0017	NRDU$
0020	NIO1$
0021	NIO2$
0022	NRBU$
0023	NWDU$
0024	COS
0025	SIN
0026	NERR3$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000131	104L	0001	002022	1042G	0001	000134	105L	0001	002073	1067G
0001	000143	107L	0001	000146	108L	0001	000150	110L	0001	000252	111L
0001	000301	112L	0001	000341	116L	0001	000464	130L	0001	000025	132G
0001	000037	140G	0001	000631	154L	0001	000644	158L	0001	000671	162L
0001	000125	175G	0001	001151	180L	0001	001216	190L	0001	001227	191L
0001	001306	199L	0001	001431	210L	0001	001441	212L	0001	000181	220G
0001	001535	220L	0001	000170	225G	0001	000175	231G	0001	001556	232L
0001	001565	233L	0001	001567	234L	0001	001771	236L	0001	002012	238L
0001	002036	239L	0001	002044	240L	0001	000202	235G	0001	000211	242G
0001	000216	246G	0001	000223	252G	0001	000230	256G	0001	000235	262G
0001	000242	266G	0001	000264	301G	0001	000401	333G	0001	000407	337G
0001	000424	347G	0001	000477	365G	0001	000567	402G	0001	000606	412G
0001	000641	425G	0001	000657	433G	0001	000721	447G	0001	000755	465G
0001	000763	471G	0001	001026	505G	0001	001027	510G	0001	001034	515G
0001	001041	522G	0001	001073	536G	0001	001162	556G	0001	001176	564G
0001	001252	604G	0001	001261	611G	0001	001317	631G	0001	001366	645G
0001	001374	651G	0001	001406	657G	0001	001457	675G	0001	001467	702G
0001	001474	706G	0001	001504	712G	0001	001505	714G	0001	001541	731G
0001	001604	762G	0001	001613	766G	0001	001634	777G	0001	002051	800L
0001	002105	802L	0001	002131	804L	0001	002204	810L	0001	002227	812L
0001	002262	814L	0001	002302	816L	0001	002326	818L	0001	002351	820L
0000	000087	900F	0000	000070	901F	0000	000071	902F	0000	000073	903F
0000	000075	910F	0000	000207	911F	0000	000215	913F	0000	000313	914F
0000	000317	915F	0000	000350	916F	0000	000257	917F	0000	000381	918F
0000	000422	920F									

```
0000   000447 921F      0000   000466 922F      0000   000524 923F      0000   000561 924F      0000   000605 925F
0000   000646 926F      0000   000664 927F      0000   000717 928F      0000   000744 929F      0000   001006 930F
0003 R 001327 AL        0003 R 001007 ALFMAT     0003 R 000041 ANAME      0004 R 002173 AR        0004 R 001017 AS
0004 R 000003 ASE       0000 R 000042 BLANK      0004 R 000006 BX         0004 R 000021 BXX       0004 R 000007 BY
0004 R 000022 BYY       0004 R 000010 BZ         0000 R 000056 C1         0000 R 000064 C2        0004 R 000011 COSP
0004 R 000042 COSSUN    0004 R 000031 COST       0004 R 000023 COST1      0000 R 000061 CX        0000 R 000062 CY
0000 R 000063 CZ        0003 R 001126 DTIME      0004 R 000024 DX         0004 R 000025 DY        0004 R 000026 DZ
0004 R 000032 FATOT     0000 R 000017 FF         0000 R 000055 FFN        0004 R 000014 FSE       0000 R 000041 FT
0003 R 003703 GENODE    0004 R 000033 GOFIR      0004 R 000030 GOFIRP     0004 R 000034 GOSOL     0004 R 000036 GOSOLA
0004 R 000035 GOSOLD    0000 I 000040 I          0003 I 004547 IA         0003 I 000013 ICARD     0003 I 000444 IEMIT
0000 I 000044 IMAX      0003 I 000441 IMODE      0003 I 000442 IN         0003 I 000007 IOUT      0003 I 000014 IPAGE
0003 I 000024 IPRINT    0003 I 000445 IP1        0004 I 000027 IQ         0000 I 000046 IQQ       0003 I 000010 IREF
0003 I 000012 ISC       0000 I 000066 ITOT       0000 I 000045 IS         0000 I 000051 I1        0000 I 000053 I2
0000 I 000052 I3        0000 I 000050 J          0000 I 000054 L          0003 I 000000 M         0000 I 000012 MAT
0003 I 000001 MAX       0003 I 000430 MODE       0003 I 000002 MODEM      0003 I 000004 MOLD      0003 I 052317 MTRLN
0003 I 000023 MTRLN     0000 I 000046 N          0003 I 000005 NAM        0003 I 000022 NEMI      0000 I 000047 NEW
0003 I 000004 NMODE     0003 I 000005 NVM        0004 R 000013 PHI        0004 R 000004 PHI1      0000 R 000057 PHI2
0003 R 000015 PI        0003 R 000016 PI180      0003 R 006257 Q          0003 R 020137 QR        0003 R 021004 QS
0003 R 000067 QT        0003 R 000025 REF        0000 R 000000 REFN       0000 R 000065 R2        0004 R 000017 SIG
0004 R 000012 SINP      0004 R 000041 SINSUN     0004 R 000031 SUN        0004 R 000040 SUND      0004 R 005413 TCON
0003 R 000011 TCONT     0003 R 000477 TEMAT      0004 R 000005 THT1       0000 R 000060 THT2      0003 R 000021 TIME
0003 R 000020 TIMED     0003 R 000461 TITLE      0000 R 000041 TOTAL      0003 R 001317 XN        0003 R 000060 XO
0003 R 021647 XR        0004 R 000000 XSE        0004 R 000001 YSE        0004 R 000002 ZSE
```

```
00101     1*          SUBROUTINE INPUT1
00101     2*    C
00103     3*          PARAMETER MMAX=3,NMAX=420
00104     4*          COMMON / MR / M,MAX,MODEM,MOLD,NMODE,NVM,NAME,IOUT,IREF,TCONT,
00104     5*         1     ISC,ICARD,IPAGE,PI,PI180,SIG,TIMED,TIME,NEMI,MTRLN,IPRINT,
00104     6*         2     REF(12),ANAME(15),XO(7),QT(15,15),MODE(10),IN(15),TITLE(14),
00104     7*         3     TEMAT(20,10),ALFMAT(20,10),XN(7),DTIME,
00104     8*         4     AL(NMAX),AR(NMAX),AS(NMAX),GENODE(NMAX),IA(NMAX),TCON(NMAX),
00104     9*         5     Q(12,NMAX),QR(NMAX),QS(NMAX),XR(MMAX,NMAX,10),MTRL(NMAX)
00105    10*          DIMENSION REFN(10),MAT(20)
00106    11*          COMMON /GE1 / XSE,YSE,ZSE,ASE,PHI1,THT1,BX,BY,BZ,COSP,SINP,PHI,
00106    12*         1    FSE(5),BXX,BYY,COST1,DX,DY,DZ,IQ,GOFIRP,
00106    13*         1    COST,FATOT,GOFIR,GOSOL,GOSOLD,GOSOLA,SUN,SUND,SINSUN,COSSUN
00107    14*          DIMENSION IQQ(MAX),FF(MAX)
00110    15*          DATA (REFN(I),I=1,9) /5HCOORD,  5H SYST,  5HA NEW,  5H REFE,
00110    16*         1  5HRENCE,  5H COOR,  5HDINAT,  5HE SYS,  5HTEM   /
00112    17*          EQUIVALENCE (IN(2),IMODE),(IN(3),IEMIT),(IN(4),IP1)
00113    18*          DATA TOTAL / 5HTOTAL /, BLANK/ 5H      /
00116    19*          DATA PT / 0.0833333 /
00116    20*    C
00120    21*          IMAX = 10
00121    22*          NVM = 0
00122    23*          SIG   = 0.1713E-08
00123    24*          PI    = 3.14159
00124    25*          PI180 = 0.0174533
00125    26*          TIMED = 0.
00126    27*       95 IOUT = 3
00127    28*          REWIND IOUT
00130    29*      100 READ (5,900) TITLE
00136    30*          READ (5,901) IN
00144    31*          ICARD = 2
00144    32*    C
00145    33*          IREF = IN(1)
00146    34*          IF (IREF) 102,104,105
00151    35*      102 NAME = 0
00152    36*          NMODE= 0
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```
00153    37*          ANAME(1) = TOTAL
00154    38*          MAX = IN(13)
00155    39*          DO 101 I=1,9
00160    40*      101 REF(I) = REFN(I)
00162    41*          IF (MAX.LE.0.OR.MAX.GT.NMAX) GO TO 800
00164    42*          IF (IMODE.LE.0) GO TO 800
00166    43*          IF (IEMIT.GT.0) GO TO 800
00170    44*          IF (IN(5).NE.2) GO TO 800
00172    45*          IF (IN(6).LE.0) GO TO 800
00174    46*          DO 103 N=1,MAX
00177    47*      103 IA(N) = 2
00201    48*          GO TO 111
00202    49*      104 CALL SUBI2
00203    50*          GO TO 110
00204    51*      105 IF (IREF-2) 106,107,108
00207    52*      106 CALL SUBI5
00210    53*          GO TO 110
00211    54*      107 CALL SUBI4
00212    55*          GO TO 110
00213    56*      108 CALL SUBI6
00214    57*      110 READ (4) MAX,NMODE,MODE,NVM,IA,GENODE,ANAME,NAME,REF,
00214    58*         1   XR,MTRL,TEMAT,ALEMAT,MAT,NEMB,NEW
00274    59*      111 CONTINUE
00274    60*  C
00275    61*          IPAGE = 1
00276    62*          WRITE (6,913) IPAGE,(REF(I),I=3,9)
00305    63*          IF (IMODE.LE.0) GO TO 130
00307    64*          IF (IMODE.GT.MMAX) GO TO 802
00311    65*      112 READ (5,903) M,I,MODEM
00316    66*          ICARD = ICARD +1
00317    67*          IF (M.GT.MMAX) GO TO 804
00321    68*      114 IF (M.GT.0) GO TO 116
00323    69*          M = NMODE + 1
00324    70*          IF (M.GT.MMAX) M=MMAX
00326    71*      116 CONTINUE
00327    72*          MODE(M) = MODEM
00330    73*          IF (M.GT.NMODE)  NMODE= M
00332    74*          DO 126 N=1,MAX
00335    75*          READ (5,902) (XR(M,N,I),I=1,IMAX)
00343    76*          ICARD = ICARD + 1
00344    77*          IF (XR(M,N,6).LE.0.) GO TO 810
00346    78*          DO 126 I=7,10
00351    79*      126 IF (XR(M,N,I).GT.0.25.OR.XR(M,N,I).LT.0.0) GO TO 818
00354    80*      128 CONTINUE
00356    81*          IMODE = IMODE-1
00357    82*          IF (IMODE.GT.0) GO TO 112
00361    83*      130 CONTINUE
00362    84*          IF (IEMIT.LE.0)GO TO 154
00364    85*          DO 150 J = 1,IEMIT
00367    86*          READ (5,901) M,N
00373    87*          ICARD = ICARD + 1
00374    88*          IF (M.GT.NMODE.OR.M.LE.0)    GO TO 820
00376    89*          IF (N.GT.MAX.OR.N.LE.0) GO TO 820
00400    90*          READ (5,902) (XR(M,N,I),I=1,IMAX)
00406    91*          ICARD = ICARD + 1
00407    92*          IF (XR(M,N,6).LE.0.) GO TO 810
00411    93*          DO 146 I=7,10
00414    94*      146 IF (XR(M,N,I).GT.0.25.OR.XR(M,N,I).LT.0.0) GO TO 818
00417    95*      150 CONTINUE
00421    96*      154 CONTINUE
00422    97*          IF (NAME.GT.0) GO TO 158
00424    98*          DO 156 N=1,MAX
00427    99*      156 GENODE(N) = BLANK
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00431   100*     158 CONTINUE
00432   101*         DO 172 M=1,NMODE
00435   102*         IF (IPI.LE.0) GO TO 168
00437   103*         I1 = 1
00440   104*         I3 = 45
00441   105*         I2 = I3
00442   106*     162 IF (I2.GT.MAX) I2 = MAX
00444   107*         IPAGE = IPAGE + 1
00445   108*         WRITE (6,910) TITLE,IPAGE,REF(1),REF(2),REF(1),REF(2),MODE(M),
00445   109*        I                  M,MAX
00463   110*         WRITE (6,911) (N,GENODE(N),(XR(M,N,I),I=1,IMAX),N=I1,I2)
00476   111*     166 IF (I2.EQ.MAX) GO TO 168
00500   112*         I1 = I1 + I3
00501   113*         I2 = I2 + I3
00502   114*         GO TO 162
00503   115*     168 CONTINUE
00504   116*         DO 170 N=1,MAX
00507   117*         DO 171 I=7,10
00512   118*     171 XR(M,N,I) = XR(M,N,I)*4.0
00514   119*         DO 169 I=1,3
00517   120*     169 XR(M,N,I) = XR(M,N,I)*FT
00521   121*         DO 170 I=4,5
00524   122*     170 XR(M,N,I) = XR(M,N,I)*PI180
00527   123*     172 CONTINUE
00527   124*   C
00531   125*         IF (IN(5)-1) 190,174,180
00534   126*     174 I1 = IN(6)
00535   127*         DO 178 I=1,I1
00540   128*         READ (5,901) N,MTRL(N)
00544   129*         ICARD = ICARD + 1
00545   130*         IF (N.LE.0.OR.N.GT.NMAX) GO TO 820
00547   131*         IF (MTRL(N).LE.0.OR.MTRL(N).GT.20) GO TO 814
00551   132*     178 CONTINUE
00553   133*         GO TO 190
00554   134*     180 READ (5,901) (MTRL(N),N=1,MAX)
00562   135*         ICARD = ICARD + MAX/20 +1
00563   136*         DO 188 N=1,MAX
00566   137*         IF (MTRL(N).LE.0.OR.MTRL(N).GT.20) GO TO 814
00570   138*     188 CONTINUE
00572   139*     190 IF (IN(7).LE.0) GO TO 200
00574   140*         I1 = 1
00575   141*         I3 = 225
00576   142*         I2 = I3
00577   143*     191 IF (I2.GT.MAX) I2 = MAX
00601   144*         IPAGE = IPAGE + 1
00602   145*         WRITE (6,917) TITLE, IPAGE, (N,GENODE(N),MTRL(N),N=I1,I2)
00617   146*         IF (I2.EQ.MAX) GO TO 199
00621   147*         I1 = I1 + I3
00622   148*         I2 = I2 + I3
00623   149*         GO TO 191
00624   150*     199 CONTINUE
00624   151*   C
00625   152*     200 IF (IN(8).LE.0) GO TO 210
00627   153*         I1 = IN(8)
00630   154*         DO 208 I=1,I1
00633   155*         READ (5,903) J,N,MAT(J)
00640   156*         ICARD = ICARD + 1
00641   157*         IF (J.LE.0.OR.J.GT.20) GO TO 816
00643   158*         READ (5,902) (TMAT(J,N),N=1,10),(ALFMAT(J,N),N=1,10)
00655   159*         JCARD =ICARD + 2
00656   160*         DO 206 N=1,10
00661   161*         IF (ALFMAT(J,N).LT.0.0.OR.ALFMAT(J,N).GT.1.0) GO TO 812
00663   162*     206 CONTINUE
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00665   163*      208 CONTINUE
00665   164*    C
00667   165*      210 IF (IN(9).LE.0) GO TO 220
00671   166*          I1 =1
00672   167*          I2 =5
00673   168*      212 WRITE (6,918) TITLE,IPAGE,(MAT(I),I=I1,I2),
00673   169*         1       ,(I,I=I1,I2),
00673   170*         1         ((TEMAT(I,N),ALPMAT(I,N),I=I1,I2),N=1,10)
00722   171*          IF (I2.EQ.20) GO TO 220
00724   172*          I1=I1 + 5
00725   173*          I2=I2 + 5
00726   174*          IPAGE = IPAGE + 1
00727   175*          GO TO 212
00727   176*    C
00730   177*      220 DO 222 N=1,MAX
00733   178*          MTRLN = MTRL(N)
00734   179*          CALL ALPHA1(10460 0,AS(N))
00735   180*      222 CONTINUE
00735   181*    C
00737   182*      230 M = 0
00740   183*          IF (IN(15)) 232,240,233
00743   184*      232 M = M+1
00744   185*          IF (M-NMODE) 234,234,240
00747   186*      233 M = IN(15)
00750   187*      234 CONTINUE
00751   188*          COSSUN = 0.
00752   189*          SINSUN = 0.
00753   190*          XO(1) = 0.
00754   191*          XO(2) = 0.
00755   192*          XO(3) = 0.
00756   193*          PHI   = 0.
00757   194*          SINP = 0.
00760   195*          COSP = 1.0
00761   196*          DO 239 L=1,MAX
00764   197*          WRITE (6,915) TITLE,IPAGE,M,L
00775   198*          CALL TRANS(N)
00776   199*          DO 237 N=1,MAX
01001   200*          IQ = 0
01002   201*          FFN = 0.
01003   202*          DX = XR(M,N,1) - XSE
01004   203*          DY = XR(M,N,2) - YSE
01005   204*          DZ = XR(M,N,3) - ZSE
01006   205*          B1 = BX*DX + BY*DY + BZ*DZ
01007   206*          IF (B1.LE.0.0) GO TO 236
01011   207*          PHI2 = XR(M,N,4)
01012   208*          THT2 = XR(M,N,5)
01013   209*          CX = COS(THT2)*COS(PHI2)
01014   210*          CY = COS(THT2)*SIN(PHI2)
01015   211*          CZ = SIN(THT2)
01016   212*          B2 = -(CX*DX+CY*DY+CZ*DZ)
01017   213*          IF (B2.LE.0.0) GO TO 236
01021   214*          CALL BLOCK
01022   215*          ASE = XR(M,N,6)
01023   216*          R2 = DX**2 +DY**2 + DZ**2
01024   217*          IF ( ASE.GT.R2*0.04) GO TO 236
01026   218*          FFN = B1*B2*ASE/(PI*R2**2)
01027   219*      236 IOO(N) = IQ
01030   220*          ITOT = ITOT + IQ
01031   221*      237 FF(N) = FFN
01033   222*          IF (ITOT.GT.0) GO TO 238
01035   223*          WRITE (6,916)
01037   224*          GO TO 239
01040   225*      238 WRITE (6,914) (N,GENODE(N),IOO(N),FF(N),N=1,MAX)
```

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01051   226*      239 CONTINUE
01053   227*          IF (IN(15).LT.0) GO TO 242
01055   228*      240 CONTINUE
01056   229*          CALL SUB(4
01056   230*    C
01057   231*          RETURN
01057   232*    C
01057   233*    C     SECTION 800, INPUT ERROR DIAGNOSTIC MESSAGES
01057   234*    C
01060   235*      800 WRITE (6,920) ICARD
01063   236*          I1 = ICARD - 1
01064   237*          WRITE (6,930) I1,IN,MAX,NVM
01075   238*          CALL EXIT
01076   239*      802 WRITE (6,920) ICARD
01101   240*          I1 = MMAX
01102   241*          WRITE (6,921) IMODE,I1
01106   242*          CALL EXIT
01107   243*      804 WRITE (6,920) ICARD
01112   244*          I1 = MMAX
01113   245*          WRITE (6,922) M,I1
01117   246*          CALL EXIT
01120   247*      806 WRITE (6,920) ICARD
01123   248*          I1 = NMAX
01124   249*          WRITE (6,923) MODE(M),MAX,I1
01131   250*          CALL EXIT
01132   251*      810 WRITE (6,920) ICARD
01135   252*          WRITE (6,924) N,MODE(M)
01141   253*          CALL EXIT
01142   254*      812 WRITE (6,920) ICARD
01145   255*          WRITE (6,925)  J,N,ALPHAT(J,N),TENAT(J,N)
01153   256*          CALL EXIT
01154   257*      814 WRITE (6,920) ICARD
01157   258*          WRITE (6,926)  N
01162   259*          CALL EXIT
01163   260*      816 WRITE (6,920) ICARD
01166   261*          I1 = 20
01167   262*          WRITE (6,926) J,I1
01173   263*          CALL EXIT
01174   264*      818 WRITE (6,920) ICARD
01177   265*          WRITE (6,929) N,MODE(M)
01203   266*          CALL EXIT
01204   267*      820 WRITE (6,920) ICARD
01207   268*          WRITE (6,927) M,NMODE,N,MAX
01215   269*          CALL EXIT
01215   270*    C
01215   271*    C     SECTION 900, FORMAT STATEMENTS
01215   272*    C
01216   273*      900 FORMAT (16A5)
01217   274*      901 FORMAT (20I4)
01220   275*      902 FORMAT (10F8.3 )
01221   276*      903 FORMAT (2I4,14A5)
01222   277*      910 FORMAT (1H1,29X,14A5,12X,4HPAGE,I4
01222   278*         1 ///1X,2A5,30H REFERENCE COORDINATE SYSTEM,   //
01222   279*         2    1X,2A5,7H IN A  ,A5,  25HING  MODE,  (MODE NUMBER  ,
01222   280*         2  I3, 3H )., 10X,    10H THERE ARE,I6,22H  NODES FOR THIS MODE,
01222   281*         3 ///       50H      NODE       NODE         X          Y          Z
01222   282*         4 60H    AZIMUTH    INCLN       AREA       VIEW       VIEW       VIEW ,
01222   283*         4 10H      VIEW
01222   284*         5 /          50H    NUMBER       NAME       (IN)       (IN)       (IN)
01222   285*         6 60H      (DEG)      (DEG)    (FT**2)    QUAD 1     QUAD 2     QUAD  ,
01222   286*         7 11H3    QUAD 4    )
01223   287*      911 FORMAT (I10,5X,A5,5F10.3,F10.4,4F10.3)
01224   288*      913 FORMAT (1H1,111X,4HPAGE,I4 ////////////
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01224   289*          1    48X,35HTHE ENVIRONMENTAL HEAT FLUX ROUTINE          //
01224   290*          1     60X,    10H VERSION 4   //
01224   291*          2     60X,    10H (REV -4)   ///
01224   292*          3        54X,22HFOR THE CALCULATION OF   //
01224   293*          4        51X,25HRADIANT ENERGY ABSORPTION      //
01224   294*          5  62X,6HBY THE // 48X,7A5   )
01225   295*       917 FORMAT (1H1,29X,14A5,12X,4HPAGE,I4///
01225   296*          1 2HM NODE MATERIAL NUMBER DATA  ///
01225   297*          2 5(4X,4HNODE,3X,4HNODE,3X,9HMATERIAL)/
01225   298*          3 5(3X,6HNUMBER,2X,4HNAME,2X,6HNUMBER,3X)/
01225   299*          4 5(3X,I5,2X,A5,2X,I4,3X)   )
01226   300*       914 FORMAT ( 6(I4,1X,A5,I3,F6.4,1X))
01227   301*       915 FORMAT (////29X,14A5,12X,4HPAGE,I4 //56HQ RADIANT DETERMINATION FOR
01227   302*          1 SELF BLOCKAGE ANALYSIS, MODE ,I3,10X,14H VIEW FROM NODE,I5 //
01227   303*          2          6(20HNODE  NODE  Q     FF )   )
01230   304*       916 FORMAT ( //44H THIS NODE IS NOT BLOCKED BY ANY OTHER NODE.// )
01231   305*       918 FORMAT (1H1,29X,14A5,12X,4HPAGE,I4 ///
01231   306*          1 40H ABSORPTIVITY - TEMPERATURE CURVE DATA. //      5(19X,A6) /
01231   307*          2  5(9X,5H TEMP,6X,5HMATH)) / 5( 8X, 7H(DEG R), 1X,2X) /
01231   308*          3   ( F15.1,F10.4,F15.1,F10.4,F15.1,F10.4,F15.1,F10.4,F15.1,F10.4))
01232   309*       920 FORMAT (////47H FATAL ERROR IN DATA INPUT FOUND ON CARD NUMBER,
01232   310*          1 I4 , //    52H PROGRAM WILL CALL EXIT AFTER THE FOLLOWING MESSAGE
01232   311*          2. ////)
01233   312*       921 FORMAT (30H VARIABLE  IMODE IS TOO LARGE. //14H IMODE INPUT =,I5,
01233   313*          1 30X,19H MAXIMUM ALLOWED = ,I3 )
01234   314*       922 FORMAT(116H VARIABLE  M  WHICH SPECIFIES THE MODE FOR THE REFERENC
01234   315*          1E COORDINATE SYTEM AS INPUT IS GREATER THAN ALLOWED.          //
01234   316*          2 11H M  INPUT =,I5, 30X,18H MAXIMUM ALLOWED =,I4 )
01235   317*       923 FORMAT (36H NUMBER OF NODES SPECIFIED FOR THE  ,A5,6HING NODE IN
01235   318*          1THE INPUT OF A REFERENCE COORDINATE SYSTEM IS TOO LARGE.  //
01235   319*          2 24H NUMBER OF NODES INPUT =,I5,30X,18H MAXIMUM ALLOWED =,I5 )
01236   320*       924 FORMAT(26H NODAL AREA INPUT FOR NODE,I5,44H FOR THE REFERENCE COOR
01236   321*          1DINATE SYSTEM IN THE  ,A5,     26HING NODE  IS NOT POSITIVE.  )
01237   322*       925 FORMAT ( 49H THE ABSORPTIVITY CURVE BEING INPUT FOR MATERIAL  ,I4,
01237   323*          1  3X,56H HAS ABSORPTIVITY DATA EITHER NEGATIVE OR GREATER THAN ONE
01237   324*          2 //11H DATA POINT ,I4,20X,15H ABSORPTIVITY =,F10.4,20X,
01237   325*          3 14H TEMPERATURE =,F10.2   )
01240   326*       926 FORMAT ( 74H  THE MATERIAL NUMBER IS EITHER ZERO OR GREATER THAN A
01240   327*          1LLOWED FOR THE NODE ,I5 )
01241   328*       927 FORMAT (53H M  OR  N  ARE EITHER ZERO OR GREATER THAN ALLOWED.
01241   329*          1 ///11H M INPUT IS ,I5,20X,     18H MAXIMUM ALLOWED = , I5 //
01241   330*          2    11H N INPUT IS ,I5,20X,     18H MAXIMUM ALLOWED = , I5 //
01241   331*          3   )
01242   332*       928 FORMAT ( 82H MATERIAL NUMBER INPUT IS EITHER ZERO OR GREATER THAN
01242   333*          1ALLOWED. //24H MATERIAL NUMBER INPUT =,I5 ,20X,
01242   334*          2 14H MAX ALLOWED =,I6   )
01243   335*       929 FORMAT (50H NODAL UNBLOCKED VIEW TO THE ENVIRONMENT FOR NODE ,I5,
01243   336*          1 46H  FOR THE REFERENCE COORDINATE SYSTEM IN THE  , A5, 8HING MODE
01243   337*          2// 21X, 70H IS EITHER NEGATIVE OR GREATER THAN  0.25  FOR ONE OF T
01243   338*          3HE QUADRANTS.   )
01244   339*       930 FORMAT (76H ERROR IN SPECIFICATION OF NEW REFERENCE COORDINATE SYS
01244   340*          1TEM  (1 = NEGATIVE).  //22H THE  I  ARRAY ON CARD ,I5 // 15I5 //
01244   341*          2  6H MAX =,I5 , 20X,  6H NVM = ,I5 )
01245   342*           END

    END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUBI1           SYMBOLIC                                          14:17:33   0  02251650    14    342  (DELETED)
SUBI1   CODE    RELOCATABLE                                       14:17:33   1  02263134    40      1  (DELETED)
                                                                             0  02263214    14    185
```

SUBPROGRAM NAME: SUBI2

SEGMENT NAME: SUBI2

PURPOSE: To store and load the EHFR with the Apollo Extravehicular Mobility Unit (EMU) nodal data.

DESCRIPTION: The SUBI2 subprogram contains the Reference Coordinate System (RCS) nodal data for the Apollo EMU in the Bending, Walking and Kneeling mdoes. The routine consists of block data statements and a write statement to put the EMU data on a high speed drum (logical Unit 4) for input to the INPUT1 program. The RCS data stored in SUBI2 for the EMU is described in Appendix A of Volume I.

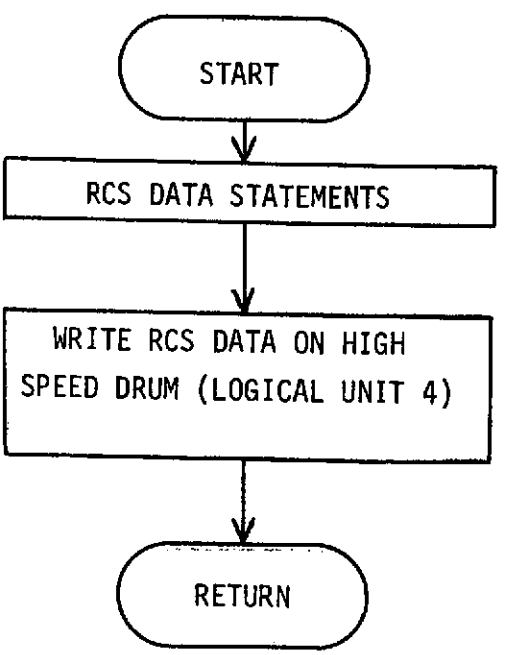
CALLING PROGRAM: INPUT1

ARGUMENT LIST: None

NOMENCLATURE: The MR block common contains all the variables of the SUBI2 subprogram. The variables of the MR block common are defined with the SUBM1 (main program) nomenclature.

PROGRAM LISTING: Since the SUBI2 subprogram contains only block data statements and a write statement no listing is presented here.

FLOW CHART:



SUBPROGRAM NAME: Subroutine SUBI3

SEGMENT NAME: SUBI3

PURPOSE: Change/update the EHFR stored program data for the Lunar Surface Thermal Simulator (LSTS) Models, and print the LSTS stored data used for this run.

DESCRIPTION: The SUBI3 subprogram stores the permanent LSTS configuration information, reads LSTS data change/update cards, prints out the final user specified data, and transfers the LSTS configuration data to the TVC program via output on a high speed drum (logical unit 4). The LSTS data stored includes: the number of power zones, the number of heater element tier arrays for each zone, the number of heater elements in each tier, heater element emissivity and heater element geometric data. A description of the data stored within the SUBI3 routine is presented in Appendix D of Volume I.

CALLING PROGRAM: SUBI1

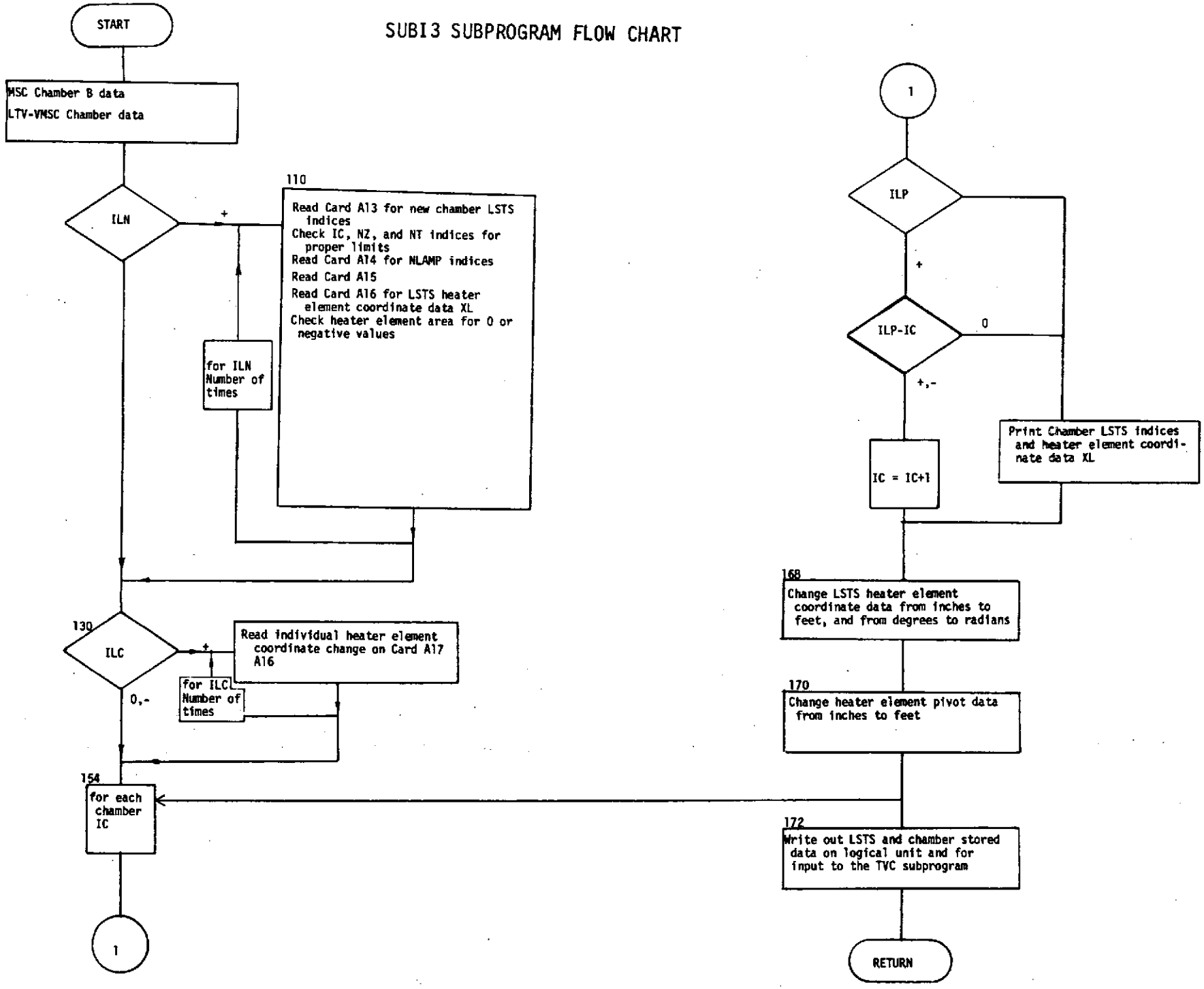
ARGUMENT LIST: None, all data required/generated by the SUBI3 subprogram is transferred into and out of the routine via a high speed drum (logical unit 4).

NOMENCLATURE: Listed below is a dictionary of FORTRAN nomenclature used by SUBI3 subprogram. Also used in SUBI3 are the output description variables and indicies of the MR block common. These variables are defined with the SUBM1 (main program) nomenclature.

ANL	The word LAMP in A format
ANT	The word TIER in A format
ANZ	The word ZONE in A format
ENV1, ENV2	Chamber name of Chamber IC in A format
FT	Conversion constant for inches to feet
I,J,K,1	Indices
IC	Chamber index = 1 MSC chamber = 2 LTV chamber
IL	Heater element index
ILC	Number of individual LSTS heater elements for which new coordinate data is to be input
ILN	Number of new LSTS systems to be input
ILP	LSTS system data print index

IT	Tier index
IZ	Zone index
I1, I2, I4	Print indices
NC(IC,J)	Stored chamber constants for Chamber IC J=1 Number of solar screen lengths J=2 Number of solar screen widths J=3 Number of chamber floor radial divisions (for nodal breakup calculations) J=4 Number of chamber floor angular divisions J-5 Number of floor thermocouples
NCMB	Number of chambers for which data is stored
NL,NLAMP(IC,IZ, IT)	Number of LSTS heater elements in tier IT, zone IZ, Chamber IC
NT, NTIER (IC, IZ)	Number of LSTS heater element tiers in zone IZ, Chamber IC
NZ,NZONE (IC)	Number of LSTS heater zones in Chamber IC
XL (IC, IZ, IT, IL, I)	Initial coordinate data for LSTS heater elements IL, in tier IT, in zone IZ, in chamber IC I=1 X position of heater element =2 Y position of heater element =3 Z position of heater element =4 Azimuth angle of heater element =5 Inclination angle of heater element =6 Heater element area
XLO(IC,J)	Stored chamber values for chamber IC J=1 LSTS heater emissivity =2 Perpendicular distance of pivot from LSTS heater =3 Parallel distance of pivot from LSTS heater element center =4 Solar screen modulation =5 Solar screen height, ft. =6 Solar screen width, ft =7 Chamber floor emissivity =8 Chamber floor radial division length, ft =11 To 30 Absorptivity of material I (I=J-10) to solar lamp energy

SUBI3 SUBPROGRAM FLOW CHART

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* FORTX SUBL1,SUBL1
UNIVAC 1108 FORTRAN V LEVEL   2266 0018 P501#0
THIS COMPILATION WAS DONE ON 15 MAY 71 AT 05:00:26

   SUBROUTINE SUBL4      ENTRY POINT 001416

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE    001440
        0000   *DATA    020567
        0002   *BLANK   000000
        0003   MR       000477


   EXTERNAL REFERENCES (BLOCK, NAME)

        0004   EXIT
        0005   NRDS
        0006   NIOS
        0007   NIOS
        0010   NWDS
        0011   NREWS
        0012   NWRS
        0013   NERRS


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

   0001    000004 110L.      0001    000054 114I       0001    000063 115L.      0001    000147 140L.      0001    000546 154I
   0001    000741 162L.      0001    000765 166L.      0001    000021 237G       0001    000114 265G       0001    000152 274G
   0001    000174 305G       0001    000224 315G       0001    000240 321G       0001    000404 327G       0001    000412 331G
   0001    000457 356G       0001    000540 401G       0001    000553 414G       0001    000574 423G       0001    000610 427G
   0001    000646 436G       0001    000703 450G       0001    000723 461G       0001    000761 473G       0001    000766 501G
   0001    001010 521G       0001    001047 526G       0001    001044 532G       0001    001051 538G       0001    001056 542G
   0001    001063 546G       0001    001072 #20L.      0001    001113 #21L.      0001    001141 #22L.      0001    001167 #23L.
   0001    001215 #24L.      0001    001233 #25L.      0001    001255 #26L.      0001    001302 #27L.      0001    001333 #28L.
   0000    020216 901F       0000    020217 902F       0000    020221 914F       0000    020347 915F       0000    020353 916F
   0000    020354 920F       0000    020401 921F       0000    020407 922F       0000    020432 924F       0000    020440 926F
   0000    020462 928F       0003 R  000041 ANAME       0000 R  020203 ANL        0000 R  020202 ANT        0000 R  020201 ANZ
   0000 R  020166 ENV1       0000 R  020205 ENV2       0000 R  020177 FT         0000 I  020173 I          0000 I  020206 IC
   0003 I  000013 ICARD      0000 I  020212 IL         0003 I  000454 ILC        0003 I  000453 ILN        0003 I  000455 ILP
   0003 I  000442 IN         0003 I  000007 IOUT       0003 I  000014 IPAGE      0003 I  000024 IPRINT     0003 I  000010 IREF
   0003 I  000012 ISC        0000 I  020172 IT         0000 I  020171 IZ         0000 I  020204 IS         0000 I  020213 I1
   0000 I  020214 I2         0000 I  020215 I4         0000 I  020175 J          0000 I  020174 K          0000 I  020176 L
   0003 I  000000 M          0003 I  000001 MAX        0003 I  000430 MODE       0003 I  000002 MODEM      0003 I  000003 MOLD
   0003 I  000023 MTRLN      0003 I  000006 NAME       0000 I  000245 NC         0000 I  020200 NCMB       0003 I  000022 NEMU
   0000 I  020211 NL         0000 I  000025 NLAMP      0003 I  000004 NMODE      0000 I  020210 NT         0000 I  000003 NTIER
   0003 I  000005 NVM        0000 I  020207 NZ         0000 I  000000 NZONE      0003 R  000015 PI         0003 R  000016 PI1#0
   0003 R  000067 QT         0003 R  000025 REF        0003 R  000017 SIG        0003 R  000011 TCONT      0003 R  000021 TIME
   0003 R  000020 TIMED      0003 R  000461 TITLE      0000 R  000322 XL         0000 R  000113 XLD        0003 R  000060 XO


00101     1*          SUBROUTINE SUBL3
00101     2*    C
00103     3*          COMMON / MR / M,MAX,MODEM,MOLD,NMODE,NVM,NAME,IOUT,IREF,TCONT,
00103     4*         1     ISC,ICARD,IPAGE,PI,PI1#0,SIG,TIMED,TIME,NEMU,MTRLN,IPRINT,
00103     5*         2     REF(12),ANAME(15),XO(7),QT(15,15),MODE(10),IN(15),TITLE(14)
```

```
00103     6*  C
00104     7*        DIMENSION NZONE(1),NTIER(1,6),NLAMP(1,6,1),NLOC(1,30),
00104     8*       1          NC(1,15),NL(1,6,1,25,6)
00105     9*        DIMENSION FN1(1)
00105    10*  C
00105    11*  C     COMMON 1,  MISC INTS  LAMP DATA
00106    12*        DATA  NZONE(1),(NTIER(1,IZ),IZ=1,4), ((NLAMP(1,IZ,IT),IT=1,2),
00106    13*       1       IZ=1,4)  /  4,4*2,4*24  /
00112    14*        DATA (NC(1,I),I=1,5) / 10,10,42/
00114    15*        DATA (XLOC(1,I),I=4,20) / 1.0,13.4,10.,0.95,0.5,200.0,
00114    16*       1 0.24,0.615,0.6,0.45,0.55,0.51,0.43,1.0,0.38,0.91/
00116    17*        DATA (XLOC(1,I),I=21,30)/ 0.72,0.88,0.52,0.24,0.90,0.92,0.91,3*0.1/
00120    18*        DATA (XLOC(1,I),I=1,3) /  0.85,6.617,0.0 /
00122    19*         DATA ((XLC(1,1,1,K,I),K=1,24),I=1,4)   /                    00006600
00122    20*      *   5.491, 13.215, 20.949, 28.673, 38.184, 43.841, 49.497, 55.154,
00122    21*      *  60.645, 62.716, 64.786, 66.857, 66.857, 64.786, 62.716, 60.645,
00122    22*      *  55.154, 49.497, 43.841, 38.184, 28.673, 20.949, 13.215,  5.491,
00122    23*      *   5.491, 13.215, 20.949, 28.673, 38.184, 43.841, 49.497, 55.154,
00122    24*      *  60.645, 62.716, 64.786, 66.857, 66.857, 64.786, 62.716, 60.645,
00122    25*      *  55.154, 49.497, 43.841, 38.184, 28.673, 20.949, 13.215,  5.491,
00122    26*      *  -5.491,-13.215,-20.949,-28.673,-38.184,-43.841,-49.497,-55.154,
00122    27*      * -60.645,-62.716,-64.786,-66.857,-66.857,-64.786,-62.716,-60.645,
00122    28*      * -55.154,-49.497,-43.841,-38.184,-28.673,-20.949,-13.215, -5.491,
00122    29*      *  -5.491,-13.215,-20.949,-28.673,-38.184,-43.841,-49.497,-55.154,
00122    30*      * -60.645,-62.716,-64.786,-66.857,-66.857,-64.786,-62.716,-60.645,
00122    31*      * -55.154,-49.497,-43.841,-38.184,-28.673,-20.949,-13.215, -5.491/
00124    32*         DATA ((XLC(1,1,2,K,I),K=1,24),I=1,4)   /                    00006730
00124    33*      *   5.491, 13.215, 20.949, 28.673, 38.184, 43.841, 49.497, 55.154,
00124    34*      *  60.645, 62.716, 64.786, 66.857, 66.857, 64.786, 62.716, 60.645,
00124    35*      *  55.154, 49.497, 43.841, 38.184, 28.673, 20.949, 13.215,  5.491,
00124    36*      *   5.491, 13.215, 20.949, 28.673, 38.184, 43.841, 49.497, 55.154,
00124    37*      *  60.645, 62.716, 64.786, 66.857, 66.857, 64.786, 62.716, 60.645,
00124    38*      *  55.154, 49.497, 43.841, 38.184, 28.673, 24.571, 20.495, 16.156,
00124    39*      *  -5.491,-13.215,-20.949,-28.673,-38.184,-43.841,-49.497,-55.154,
00124    40*      * -60.645,-62.716,-64.786,-66.857,-66.857,-64.786,-62.716,-60.645,
00124    41*      * -55.154,-49.497,-43.841,-38.184,-28.673,-20.949,-13.215, -5.491,
00124    42*      *  -5.491,-13.215,-20.949,-28.673,-38.184,-43.841,-49.497,-55.154,
00124    43*      * -60.645,-62.716,-64.786,-66.857,-66.857,-64.786,-62.716,-60.645,
00124    44*      * -55.154,-49.497,-43.841,-38.184,-28.673,-20.949,-13.215, -5.491/
00126    45*         DATA ((XLC(1,1,1,K,2),K=1,24),I=1,4)   /                    00006860
00126    46*      * -66.857,-64.786,-62.716,-60.645,-55.154,-49.497,-43.841,-38.184,
00126    47*      * -28.673,-20.949,-13.215, -5.491,  5.491, 13.215, 20.949, 28.673,
00126    48*      *  38.184, 43.841, 49.497, 55.154, 60.645, 62.716, 64.786, 66.857,
00126    49*      * -66.857,-64.786,-62.716,-60.645,-55.154,-49.497,-43.841,-38.184,
00126    50*      * -28.673,-20.949,-13.215, -5.491,  5.491, 13.215, 20.949, 28.673,
00126    51*      *  38.184, 43.841, 49.497, 55.154, 60.645, 62.716, 64.786, 66.857,
00126    52*      *  66.857, 64.786, 62.716, 60.645, 55.154, 49.497, 43.841, 38.184,
00126    53*      *  28.673, 20.949, 13.215,  5.491, -5.491,-13.215,-20.949,-28.673,
00126    54*      * -38.184,-43.841,-49.497,-55.154,-60.645,-62.716,-64.786,-66.857,
00126    55*      *  66.857, 64.786, 62.716, 60.645, 55.154, 49.497, 43.841, 38.184,
00126    56*      *  28.673, 20.949, 13.215,  5.491, -5.491,-13.215,-20.949,-28.673,
00126    57*      * -38.184,-43.841,-49.497,-55.154,-60.645,-62.716,-64.786,-66.857/
00130    58*         DATA ((XLC(1,1,2,K,2),K=1,24),I=1,4)   /                    00006990
00130    59*      * -66.857,-64.786,-62.716,-60.645,-55.154,-49.497,-43.841,-38.184,
00130    60*      * -28.673,-20.949,-13.215, -5.491,  5.491, 13.215, 20.949, 28.673,
00130    61*      *  38.184, 43.841, 49.497, 55.154, 60.645, 62.716, 64.786, 66.857,
00130    62*      * -66.857,-64.786,-62.716,-60.645,-55.154,-49.497,-43.841,-38.184,
00130    63*      * -28.673,-20.949,-13.215, -5.491,  5.491, 13.215, 20.949, 28.673,
00130    64*      *  38.184, 43.841, 49.497, 55.154, 60.645, 61.745, 62.845, 63.946,
00130    65*      *  66.857, 64.786, 62.716, 60.645, 55.154, 49.497, 43.841, 38.184,
00130    66*      *  28.673, 20.949, 13.215,  5.491, -5.491,-13.215,-20.949,-28.673,
00130    67*      * -38.184,-43.841,-49.497,-55.154,-60.645,-62.716,-64.786,-66.857,
00130    68*      *  66.857, 64.786, 62.716, 60.645, 55.154, 49.497, 43.841, 38.184,
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00130    69*        *  2*.671, 20.949, 13.215,  5.491, -5.491,-13.215,-20.949,-2*.671,
00130    70*        * -3*.184,-43.841,-49.497,-55.154,-60.645,-62.716,-64.7*6,-66.857/
00132    71*          DATA ((XL(1,I,J,K,3),K=1,24),I=1,4)   /                                00007120
00132    72*        *   24*18., 24*72., 24*18.,24*72. /
00134    73*          DATA ((XL(1,I,2,K,4),K=1,24),I=1,4)   /                                00007250
00134    74*        *   24*45., 24*99., 24*45.,24*99. /
00136    75*          DATA ((XL(1,I,1,K,4),K=1,24),I=1,4)   /                                00007380
00136    76*        * 105.000,105.000,105.000,105.000,145.000,145.000,145.000,145.000,     0*440
00136    77*        * 165.000,165.000,165.000,165.000,195.000,195.000,195.000,195.000,     0*450
00136    78*        * 225.000,225.000,225.000,225.000,255.000,255.000,255.000,255.000,     0*460
00136    79*        * 105.000,105.000,105.000,105.000,145.000,145.000,145.000,145.000,     0*470
00136    80*        * 165.000,165.000,165.000,165.000,195.000,195.000,195.000,195.000,     0*480
00136    81*        * 225.000,225.000,225.000,225.000,255.000,255.000,255.000,255.000,     0*490
00136    82*        * 285.000,285.000,285.000,285.000,315.000,315.000,315.000,315.000,     0*500
00136    83*        * 345.000,345.000,345.000,345.000, 15.000, 15.000, 15.000, 15.000,     0*510
00136    84*        *  45.000, 45.000, 45.000, 45.000, 75.000, 75.000, 75.000, 75.000,     0*400
00136    85*        * 285.000,285.000,285.000,285.000,315.000,315.000,315.000,315.000,
00136    86*        * 345.000,345.000,345.000,345.000, 15.000, 15.000, 15.000, 15.000,
00136    87*        *  45.000, 45.000, 45.000, 45.000, 75.000, 75.000, 75.000, 75.000,     0*410
00140    88*          DATA ((XL(1,I,2,K,4),K=1,24),I=1,4)   /                                00007510
00140    89*        * 105.000,105.000,105.000,105.000,135.000,135.000,135.000,135.000,     0*570
00140    90*        * 165.000,165.000,165.000,165.000,195.000,195.000,195.000,195.000,     0*450
00140    91*        * 225.000,225.000,225.000,225.000,255.000,255.000,255.000,255.000,     0*460
00140    92*        * 105.000,105.000,105.000,105.000,135.000,135.000,135.000,135.000,     0*600
00140    93*        * 165.000,165.000,165.000,165.000,195.000,195.000,195.000,195.000,     0*450
00140    94*        * 225.000,225.000,225.000,225.000,255.000,255.000,255.000,255.000,     0*460
00140    95*        * 285.000,285.000,285.000,285.000,315.000,315.000,315.000,315.000,
00140    96*        * 345.000,345.000,345.000,345.000, 15.000, 15.000, 15.000, 15.000,
00140    97*        *  45.000, 45.000, 45.000, 45.000, 75.000, 75.000, 75.000, 75.000,     0*530
00140    98*        * 285.000,285.000,285.000,285.000,315.000,315.000,315.000,315.000,
00140    99*        * 345.000,345.000,345.000,345.000, 15.000, 15.000, 15.000, 15.000,
00140   100*        *  45.000, 45.000, 45.000, 45.000, 75.000, 75.000, 75.000, 75.000,     0*560
00142   101*          DATA(((XL(1,I,J,K,6),K=1,25),J=1,2),I=1,4) / 200*0.4 /
00142   102*  C
00142   103*  C     CHANNEL 2,  LIV LSTS  LAMP DATA  (REF.
00144   104*          DATA  NZONE(2),(NFIXD(2,IZ),IZ=1,6), ((NLAMP(2,IZ,IT),IT=1,2),
00144   105*         1       IZ=1,6)  / 6,6*2, 20,20,10,10,14,14,14,14,4*10  /
00150   106*          DATA (NC(2,I),I=1,5) /18,12,5,30,8/
00152   107*          DATA (XLD(2,I),I=4,20) / 1.,.9,.6,..92,.5,2*0.  ,
00152   108*         1 0.29,0.640,0.6,0.62,0.55,0.51,0.33,1.0,0.36,0.91/
00154   109*          DATA (XLD(2,I),I=21,30)/ 0.77,0.*8,0.52,0.24,0.90,0.92,0.91,3*0.1/
00156   110*          DATA (XLD(2,I),I=1,3) / 0.9,0.0,5.06 /
00160   111*          DATA(((XL(2,I,J,K,6),K=1,20),J=1,2),I=1,6)  /  240*0.056* /
00162   112*          DATA(((XL(2,I,J,K,3),K=1,20),J=1,2),I=1,6)  /
00162   113*         1 20*2.06,20*15.06,20*28.06,20*41.06,20*54.06,20*67.06,
00162   114*         2 20*2.06,20*15.06,20*28.06,20*41.06,20*54.06,20*67.06/
00164   115*          DATA(((XL(2,1,J,K,L),J=1,2),K=1,20),L=1,2) /
00164   116*         1     2*3.138,  2*8.404,  2*13.766, 2*18.810, 2*23.380, 2*27.375,
00164   117*         1     2*30.695, 2*33.260, 2*35.005, 2*35.889,
00164   118*         1     2*35.889, 2*35.005, 2*33.260, 2*30.695, 2*27.375, 2*23.380,
00164   119*         1     2*18.810, 2*13.776, 2*8.404,  2*3.138,
00164   120*         1     2*-35.863,2*-35.005,2*-33.260,2*-30.695,2*-27.375,2*-23.380,
00164   121*         1     2*-18.810,2*-13.776,2*-8.404, 2*-2.825,
00164   122*         1     2*2.825,  2*8.404,  2*13.776, 2*18.810, 2*23.380, 2*27.375,
00164   123*         1     2*30.695, 2*33.260, 2*35.005, 2*35.863 /
00166   124*          DATA (((XL(2,1,J,K,4),J=1,2),K=1,20)        /
00166   125*         1     2*95.,    2*103.5,  2*112.5,  2*121.5,  2*130.5,
00166   126*         1     2*139.5,  2*148.5,  2*157.5,  2*166.5,  2*175.5,
00166   127*         1     2*-175.5, 2*-166.5, 2*-157.5, 2*-148.5, 2*-139.5,
00166   128*         1     2*-130.5, 2*-121.5, 2*-112.5, 2*-103.5, 2*-95.0  /
00170   129*          DATA (((XL(2,2,J,K,L),J=1,2),K=1,10),L=1,2)/
00170   130*         1     2*5.631,  2*16.344, 2*25.456, 2*32.076, 2*35.557,
00170   131*         1     2*35.557, 2*32.076, 2*25.456, 2*16.344, 2*5.631,
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00170   142*          1    2*-35.557,2*-32.076,2*-25.456,2*-16.344,2*-5.631,
00170   143*          1    2*5.631,  2*16.344, 2*25.456, 2*32.076, 2*35.557 /
00172   134*          DATA ((XL(2,2,J,K,4),J=1,2),K=1,10)          /
00172   135*          1    2*99.0,   2*117.0,  2*135.0,  2*154.0,  2*171.0,
00172   136*          1    2*-171.,  2*-154.00,2*-135.00,2*-117.00,2*-99.0/
00174   137*          DATA (((XL(2,3,J,K,L),J=1,2),K=1,14),L=1,2)/
00174   138*          1    2*3.451,  2*11.421, 2*18.810, 2*25.242, 2*30.362, 2*34.935,
00174   139*          1    4*35.769, 2*34.935, 2*30.362, 2*25.242, 2*18.810, 2*11.421,
00174   140*          1    2*3.451,
00174   141*          1    2*-35.834,2*-34.140,2*-30.695,2*-25.677,2*-19.344,2*-12.017,
00174   142*          1    2*-4.075, 2*4.075,  2*12.017, 2*19.344, 2*25.677, 2*30.695,
00174   143*          1    2*34.140, 2*35.834 /
00176   144*          DATA ((XL(2,3,J,K,4),J=1,2),K=1,14)  /
00176   145*          1    2*95.5,   2*108.5,  2*121.5,  2*134.5,  2*147.5,  2*160.5,
00176   146*          1    2*173.5,  2*-173.5, 2*-160.5, 2*-147.5, 2*-134.5, 2*-121.5,
00176   147*          1    2*-108.5, 2*-95.5  /
00200   148*          DATA (((XL(2,4,J,K,L),J=1,2),K=1,14),L=1,2)/
00200   149*          1    2*-3.451, 2*-11.423,2*-18.810,2*-25.242,2*-30.362,2*-34.935,
00200   150*          1    4*-35.769,2*-34.935,2*-30.362,2*-25.242,2*-18.810,2*-11.421,
00200   151*          1    2*-3.451,
00200   152*          1    2*-35.834,2*-34.140,2*-30.695,2*-25.677,2*-19.344,2*-12.017,
00200   153*          1    2*-4.075, 2*4.075,  2*12.017, 2*19.343, 2*25.677, 2*30.695,
00200   154*          1    2*34.140, 2*35.834 /
00202   155*          DATA ((XL(2,4,J,K,4),J=1,2),K=1,14)          /
00202   156*          1    2*84.5,   2*71.5,   2*58.5,   2*45.5,   2*32.5,   2*19.5,
00202   157*          1    2*6.5,    2*-6.5,   2*-19.5,  2*-32.5,  2*-45.5,  2*-58.5,
00202   158*          1    2*-71.5,  2*-84.5  /
00204   159*          DATA (((XL(2,I,J,K,L),J=1,2),I=5,6),K=1,10)/
00204   160*          1    4*-5.631, 4*-16.344,4*-25.456,4*-32.076,4*-35.557,
00204   161*          1    4*-35.557,4*-32.076,4*-25.456,4*-16.344,4*-5.631  /
00206   162*          DATA (((XL(2,I,J,K,2),J=1,2),I=5,6),K=1,10)/
00206   163*          1    4*-35.557,4*-32.076,4*-25.456,4*-16.344,4*-5.631,
00206   164*          1    4*5.631,  4*16.344, 4*25.456, 4*32.076, 4*35.557  /
00210   165*          DATA (((XL(2,I,J,K,4),J=1,2),I=5,6),K=1,10)/
00210   166*          1    4*81.0,   4*63.0,   4*45.0,   4*27.0,   4*9.0,
00210   167*          1    4*-9.0,   4*-27.0,  4*-45.0,  4*-63.0,  4*-81.0   /
00212   168*          DATA((((XL(I,J,K,L,5),I=1,3),J=1,6),K=1,3),L=1,25) / 1350*0.0 /
00214   169*          DATA PI / 0.0*3.1.1 /
00216   170*          DATA MSH /2/
00220   171*          DATA ANZ,ANT,ANL /  4HZONE ,  4HTIER ,  4HLAMP   /
00224   172*          DATA  ENV1, ENV2 / 6HNSC  C, 6HLTV  C, 6H     C, 6HWATER /
00227   173*          EQUIVALENCE (IN(10),IIN),(IN(11),IIC),(IN(12),IIP)
00227   174*    C
00227   175*    C     SECTION 100, INPUT AND OUTPUT OF LAMP COORDINATES
00227   176*    C
00230   177*          IF (IIN.LE.0) GO TO 130
00232   178*      110 CONTINUE
00233   179*          READ (5,901) IC,NZ,(NTIER(IC,I),I=1,6)
00243   180*          ICARD = ICARD + 1
00244   181*      112 IF (IC.GT.3) GO TO 625
00246   182*          IF (IC.GT.0) GO TO 114
00250   183*          IC = NOMB + 1
00251   184*          IF (IC.GT.3) GO TO 625
00253   185*          NOMB = NOMB + 1
00254   186*          GO TO 115
00255   187*      114 CONTINUE
00256   188*          IF (IC.GT.NOMB) NOMB = IC
00260   189*      115 CONTINUE
00261   190*          IF (NZ.GT.6.OR.NZ.LT.1) GO TO 621
00263   191*          NZONE(IC) = NZ
00264   192*          DO 116 IZ=1,NZ
00267   193*          NT = NTIER(IC,IZ)
00270   194*          IF (NT.GT.3.OR.NT.LT.1)GO TO 622
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00472   195*          READ (5,901) (NLAMP(IC,IZ,IT),IT=1,NT)
00100   196*          ICARD = ICARD + 1
00101   197*      110 CONTINUE
00103   198*          READ (5,902) (XLO(IC,I),I=1,6)
00111   199*          ICARD = ICARD + 1
00112   200*          IF (XLO(IC,1).LT.0.0.OR.XLO(IC,1).GT.1.0) GO TO *26
00114   201*          DO 120 IZ=1,NZ
00117   202*          NT = NTIER(IC,IZ)
00120   203*          DO 120 IT=1,NT
00121   204*          NL = NLAMP(IC,IZ,IT)
00124   205*          IF (NL.GT.25.OR.NL.LT.1)GO TO *24
00126   206*          DO 11* IL=1,NL
00131   207*          READ (5,902) (XL(IC,IZ,IT,IL,J),J=1,6)
00137   208*          ICARD = ICARD + 1
00140   209*          IF (XL(IC,IZ,IT,IL,6).LE.0.) GO TO *24
00142   210*      11* CONTINUE
00144   211*      120 CONTINUE
00147   212*          IIX = IIX - 1
00150   213*          IF (IIX.GT.0) GO TO 110
00152   214*      130 CONTINUE
00153   215*          IF (IIC.LE.0) GO TO 154
00155   216*          DO 150 I=1,IIC
00160   217*          READ (5,901) IC,IZ,IT,IL
00166   218*          ICARD = ICARD + 1
00167   219*          IF (IC.GT.NONB.OR.IC.LT.1) GO TO *25
00171   220*          IF (IZ.GT.NZONE(IC).OR.IZ.LT.1) GO TO *26
00173   221*          IF (IT .GT.NTIER(IC,IZ) OR IT.LT.1) GO TO *27
00175   222*          IF (IL.GT.NLAMP(IC,IZ,IT).OR.IL.LT.1)GO TO *2*
00177   223*          READ (5,902) (XL(IC,IZ,IT,IL,J),J=1,6)
00205   224*          ICARD = ICARD + 1
00206   225*          IF (XL(IC,IZ,IT,IL,6).LE.0.) GO TO *24
00210   226*      150 CONTINUE
00212   227*      154 CONTINUE
00213   228*          DO 172 IC=1,NONB
00216   229*          NZ = NZONE(IC)
00217   230*          I1 = 46
00220   231*          I2 = 42
00221   232*          I4 = IC+4
00222   233*          DO 170 IZ=1,NZ
00225   234*          NT = NTIER(IC,IZ)
00226   235*          DO 170 IT=1,NT
00231   236*          WRITE (6,916)
00233   237*          I1 = I1+1
00234   238*          NL = NLAMP(IC,IZ,IT)
00235   239*          DO 170 IL =1,NL
00240   240*          IF (ILP.GE.0.AND.ILP.NE.IC) GO TO 168
00242   241*          I1 = I1+1
00243   242*          IF (I1.LE.I2) GO TO 162
00245   243*          IPAGE = IPAGE + 1
00246   244*          WRITE (6,914) TITLE,IPAGE, ENV1(IC), ENV2,IC, NZ
00246   245*         1, (XLO(IC,I),I=1,3)
00265   246*          I1 = 1
00266   247*      162 WRITE (6,915) IZ,IT,IL,(XL(IC,IZ,IT,IL,I),I=1,6)
00277   248*      168 CONTINUE
00500   249*          DO 169 I=1,3
00503   250*      169 XL(IC,IZ,IT,IL,I) = XL(IC,IZ,IT,IL,I)*FT
00505   251*          XL(IC,IZ,IT,IL,4) = XL(IC,IZ,IT,IL,4)*PI1*0
00506   252*      170 CONTINUE
00512   253*          XLO(IC,2) = XLO(IC,2)*FT
00513   254*          XLO(IC,3) = XLO(IC,3)*FT
00514   255*      172 CONTINUE
00516   256*          REWIND 4
00517   257*          WRITE(4) XL,NONB,NZONE,NTIER,NLAMP,NC,XLO
```

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00552   258*          RETURN
00552   259*    C
00552   260*    C     SECTION 800, INPUT ERROR DIAGNOSTIC MESSAGES
00552   261*    C
00553   262*      820 WRITE (6,920) ICARD
00556   263*          WRITE (6,921) XLOC(IC,1)
00561   264*          CALL EXIT
00562   265*      821 WRITE (6,920) ICARD
00565   266*          IZ = 6
00566   267*          WRITE (6,922) ANZ,NZ,IZ
00571   268*          CALL EXIT
00574   269*      822 WRITE (6,920) ICARD
00577   270*          IT = 3
00600   271*          WRITE (6,922) ANT,NT,IT
00605   272*          CALL EXIT
00606   273*      823 WRITE (6,920) ICARD
00611   274*          IL = 25
00612   275*          WRITE (6,922) ANL,NL,IL
00617   276*          CALL EXIT
00620   277*      824 WRITE (6,920) ICARD
00623   278*          WRITE (6,924)
00625   279*          CALL EXIT
00626   280*      825 WRITE (6,920) ICARD
00631   281*          WRITE (6,926) IC,NCMB
00635   282*          CALL EXIT
00636   283*      826 WRITE (6,920) ICARD
00641   284*          WRITE (6,928) ANZ,IZ,NZONE(IC)
00646   285*          CALL EXIT
00647   286*      827 WRITE (6,920) ICARD
00652   287*          WRITE (6,928) ANT,IT,NTIER(IC,IZ)
00657   288*          CALL EXIT
00660   289*      828 WRITE (6,920) ICARD
00663   290*          WRITE (6,928) ANL,IL,NLAMP(IC,IZ,IT)
00670   291*          CALL EXIT
00670   292*    C
00670   293*    C     SECTION 900, FORMAT STATEMENTS
00670   294*    C
00671   295*      901 FORMAT (2014)
00672   296*      902 FORMAT (10F8.3 )
00673   297*      914 FORMAT (1HI,29X,14A5,12X,4HPAGE,I4 ///
00673   298*         1 31H LAMP COORDINATE DATA FOR THE  ,2A6, 17H  CHAMBER NUMBER,I3,
00673   299*         2 3H ). //10H THERE ARE,I3, 24H  ZONES IN THIS CHAMBER.
00673   300*         3 23X, 19H LAMP EMISSIVITY = ,F6.3 //40H LAMP PIVOT POSITION (FROM
00673   301*         4LAMP CENTER). ,10X  ,25H PERPENDICULAR DISTANCE = , F8.3,5H  IN./
00673   302*         5 50X, 25H PARALLEL      DISTANCE = ,F8.3, 5H  IN.  ///
00673   303*         3 60H       ZONE      TIER      LAMP       X          Y          Z ,
00673   304*         4 30H    AZIMUTH    INCLN      AREA       /
00673   305*         5 60H      NUMBER    NUMBER    NUMBER    (IN)       (IN)       (IN),
00673   306*         5 31H      (DEG)     (DEG)    (FT**2)      )
00674   307*      915 FORMAT (3I10,5F10.2,F10.4)
00675   308*      916 FORMAT (1H )
00676   309*      920 FORMAT (////47H FATAL ERROR IN DATA INPUT FOUND ON CARD NUMBER,
00676   310*         1 I4 , //    52H PROGRAM WILL CALL EXIT AFTER THE FOLLOWING MESSAGE
00676   311*         2. ////)
00677   312*      921 FORMAT (25H LAMP EMISSIVITY INPUT =  ,F8.4)
00700   313*      922 FORMAT (11H NUMBER OF ,A4,34HS DESIRED IS TOO LARGE OR IS ZERO.//
00700   314*         1 16H NUMBER INPUT = ,          I5,30X,16H MAXIMUM ALLOWED = ,I3)
00701   315*      924 FORMAT (29H LAMP AREA INPUT IS NEGATIVE.  )
00702   316*      926 FORMAT (37H CHAMBER NUMBER INPUT DOES NOT EXIST.///24H CHAMBER NUM
00702   317*         1BER INPUT = ,I3,30X, 19H MAXIMUM EXISTING =,I5)
00703   318*      928 FORMAT (1X,A4,40H NUMBER DESIRED IS TOO LARGE OR IS ZERO.///1X,
00703   319*         1 15H NUMBER INPUT =,I5,30X,35H MAXIMUM EXISTING IN THIS CHAMBER =
00703   320*         2,I3 )
00704   321*          END

      END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
SUB01           SYMBOLIC                                    15 NOV 71  04:59:0*   0  02216200   14   621  (DELETED)
SUB03   CODE    RELOCATABLE                                 15 NOV 71  04:59:0*   1  02227621   88     1  (DELETED)
                                                                                   0  02227070   14   502
```

SUBPROGRAM NAME: SUBI4

SEGMENT NAME: SUBI4

PURPOSE: To store and load the EHFR with the Apollo Extravehicular Mobility Unit/Lunar Rover Vehicle (EMU/LRV) nodal data.

DESCRIPTION: The SUBI4 subprogram contains the Reference Coordinate System (RCS) nodal data for the EMU/LRV in the driving and 2 parking modes. The routine consists of block data statements and a write statement to put the EMU/LRV data on a high speed drum (logical Unit 4) for input to the INPUT1 program. The RCS data stored in SUBI4 for the EMU/LRV is described in Appendix B of Volume I.

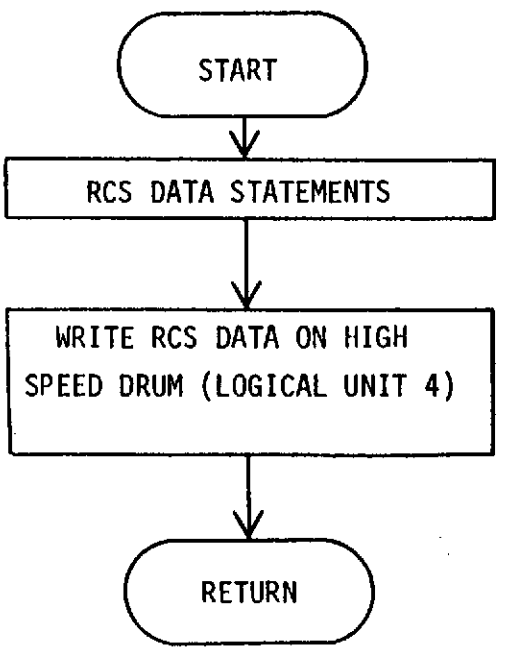
CALLING PROGRAM: INPUT1

ARGUMENT LIST: None

NOMENCLATURE: The MR block common contains all the variables of the SUBI4 subprogram. The variables of the MR block common are defined with the SUBM1 (main program) nomenclature.

PROGRAM LISTING: Since the SUBI4 subprogram contains only block data statements and a write statement, no listing is presented here.

FLOW CHART:



SUBPROGRAM NAME: SUBI5

SEGMENT NAME: SUBI5

PURPOSE: To store and load the EHFR with the Apollo Extravehicular Mobility Unit (EMU) nodal data.

DESCRIPTION: The SUBI5 subprogram contains the Reference Coordinate System (RCS) nodal data for the Apollo EMU in the standing and floating modes. The routine consists of block data statements and a write statement to put the EMU data on a high speed drum (logical Unit 4) for input to the INPUT1 program. The RCS data stored in SUBI5 for the EMU is described in Appendix A of Volume I.

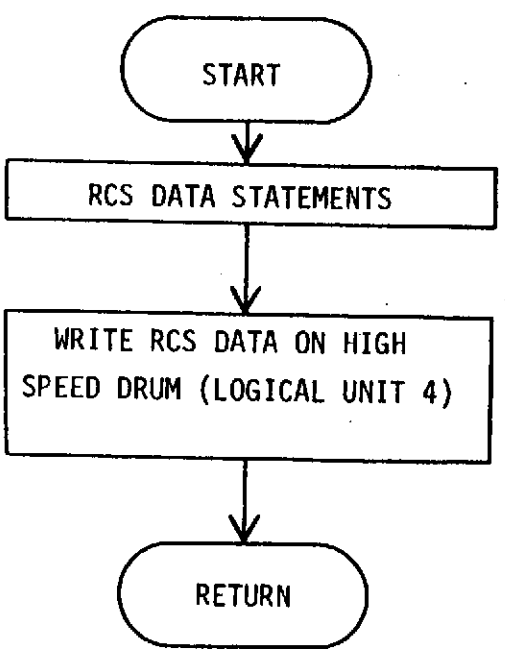
CALLING PROGRAM: INPUT1

ARGUMENT LIST: None

NOMENCLATURE: The MR block common contains all the variables of the SUBI5 subprogram. The variables of the MR block common are defined with the SUBM1 (main program) nomenclature.

PROGRAM LISTING: Since the SUBI5 subprogram contains only block data statements and a write statement, no listing is presented here.

FLOW CHART:



SUBPROGRAM NAME: SUBI6

SEGMENT NAME: SUBI6

PURPOSE: To store and load the EHFR with the Apollo Extravehicular Mobility Unit/Scientific Instruments Module Bay (EMU/SIM) nodal data.

DESCRIPTION: The SUBI6 subprogram contains the Reference Coordinate System (RCS) nodal data for the Apollo EMU/SIM in the egressing and retrieving modes. The routine consists of block data statements and a write statement to put the EMU/SIM data on a high speed drum (logical Unit 4) for input to the INPUT1 program. The RCS data stored in SUBI6 for the EMU/SIM is described in Appendix C of Volume I.

CALLING PROGRAM: INPUT1

ARGUMENT LIST: None

NOMENCLATURE: The MR block common contains all the variables of the SUBI6 subprogram. The variables of the MR block common are defined with the SUBM1 (main program) nomenclature.

PROGRAM LISTING: Since the SUBI6 subprogram contains only block data statements and a write statement, no listing is presented here.

FLOW CHART: