VOLUME II

APPENDICES TO THE

DOCUMENTATION
FOR
THE VIRGINIA STATE CORPORATION COMMISSION'S
PRODUCTION COST SIMULATION MODEL

Prepared by

The National Regulatory Research Institute
The Ohio State University
Columbus, Ohio

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FOREWORD

This report was prepared for the Virginia State Corporation Commission. Any opinions expressed herein are solely those of the authors and do not necessarily reflect the opinions nor the policies of the National Regulatory Research Institute or the Virginia State Corporation Commission.

The NRRI is making this report available to those concerned with state utility regulatory issues, since the subject matter presented here is believed to be of timely interest to regulatory agencies and to others concerned with utilities regulation.

The NRRI appreciates the cooperation of the staff of the Virginia State Corporation Commission with the authors in preparing this study.

Dr. Douglas N. Jones
Director

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PREFACE

Pursuant to recent legislation (code of Virginia, Section 55-249.6) the staff of the Virginia State Corporation Commission (VSCC) has been developing a reporting and monitoring system in order to evaluate the fuel purchase costs and fuel usage practices of the electric utilities serving the Commonwealth of Virginia.

Part of the development of this system has been carried out under contract with The National Regulatory Research Institute (NRRI). A portion of the work performed by the Institute has been the development of a Production Cost Simulation (PCS) computer mode. This manual contains a description and the documentation for the PCS model.

The PCS model projects energy production by generating unit as a function of the unit's equivalent availability, capacity, loading position and the energy supply demands on the system. From the projected energy generation values parameters such as thermal energy consumption, fuel expense, average heat rate, capacity factor and average fuel expense are calculated for each unit and totaled or averaged for the system. The results of these calculations are reported on a monthly, quarterly and study period basis.

The documentation for the PCS model is provided in two volumes.

Volume I is divided into two sections. The first section gives a description of the model. It is designed to provide the reader with an overview of the model's calculation methodology and uses. The second section provides a detailed description of the programming aspects of the model. It is designed for the user and programmer. Volume II contains three of five appendices to this manual.

Further information about the model can be obtained from:

NRRI
2130 Neil Avenue
Columbus, Ohio 43210

ACKNOWLEDGEMENT

The developers of the PCS model wish to acknowledge the Virginia State Corporation Commission staff for their valuable assistance.

The support of Commissioners Preston C. Shannon, Junie L. Bradshaw and Thomas P. Harwood, Jr., is gratefully acknowledged.

APPENDIX C

Listing of PCS Module

```
 DSN=TS0887.PCS.FORT,VOL=IRCC74

C=====================================================================00000010
C                                                                     00000020
C  ROUTINE:           **** M A I N ****                               00000030
C                                                                     00000040
C  REQUIREMENTS:                                                      00000050
C    I/O UNITS TO BE ALLOCATED BY JOB CONTROL:                        00000060
C    HYUNIT     LOGICAL UNIT (11) FROM WHICH TO READ HYDRO INFO       00000070
C    FFUNIT     LOGICAL UNIT (12) FROM WHICH TO READ FOSSIL INFO      00000080
C    PBUNIT     LOGICAL UNIT (13) FROM WHICH TO READ LOAD-PROBABILITIES 00000090
C    SUNIT      LOGICAL UNIT TO WHICH TO WRITE ALL REPORTS SELECTED   00000100
C               ACCORDING TO OPTION IN ROUTINE RDPARM;                00000110
C               LOGICAL UNITS MUNIT, QUNIT, AND AUNIT ARE SET EITHER  00000120
C               TO ZERO OR TO SUNIT ACCORDING TO OPTION               00000130
C                                                                     00000140
C  ROUTINES CALLED:                                                   00000150
C    RDPARM   UNIHYD   UNIFOS   RDPROB                                00000160
C    UNITON   CREDKD   ENERGY   ARRNGE   LPPLOT                       00000170
C    REPRT1   REPRT2   REPRT3   REPRT4   REPRT5                       00000180
C                                                                     00000190
C                                                                     00000200
C  AUTHOR:                                                            00000210
C    NATIONAL REGULATORY RESEARCH INSTITUTE, MARCH 1979               00000220
C                                                                     00000230
C  LAST REVISED:  10/79                                               00000240
C                                                                     00000250
C=====================================================================00000260
C                                                                     00000270
```

```
      IMPLICIT INTEGER (A-Z)                                                    00000280
C                                                                               00000290
C     *** R E A L ***                                                           00000300
C                                                                               00000310
      REAL FRAOWN(100),CAPCST(100)                                              00000320
      REAL UNGEN(10,12),FACONI(10,12),PUMPEN(10,12),APUMCT(10,12)               00000330
      REAL HEATR1(100,12),HEATR2(100,12),HEATR3(100,12),BLKCAP(100,12,3)        00000340
      REAL AUPAVL(100),CAVAIL(100,12),PBTUCT(100,12)                            00000350
      REAL ABTUCT(100,12),PGENFC(100,12)                                        00000360
      REAL PEAK(12),BASE(12),HRSIP(12),GENMO(12),LOLP(12)                       00000370
      REAL SYSENG(12),ELC(200),SYSCAP(12),ENRGEE(300)                           00000380
      REAL XAXIS(200),DELTA,MWBLOK(300),UNSERV(12)                              00000390
      REAL COMPNA(8),ENRGE2(100,4),HEAT(100,4)                                  00000400
      REAL QSUM1(100,3),QSUM2(10,3),QSUM3(4,3),ASUM1(100,3)                     00000410
      REAL ASUM2(10,3),ASUM3(4,3),MSUM2(12,11,3),TITLE(20)                      00000420
C                                                                               00000430
C     *** I N T E G E R*2 ***                                                   00000440
C                                                                               00000450
      INTEGER*2 ONL1MO(100),ONL1YR(100),OFL1MO(100),OFL1YR(100)                 00000460
      INTEGER*2 UNTYPE(100),UNLOAD(100),LAMDA1(100,12),LAMDA2(100,12)           00000470
      INTEGER*2 LAMDA3(100,12),UNETCP(100),LNETCP(100)                          00000480
      INTEGER*2 PRIFUL(100),ALTFUL(100),IGFUEL(100)                             00000490
      INTEGER*2 BLOCK(300),HYTYPE(10),UNIT(300)                                 00000500
      INTEGER*2 IDBASE(100),IDCYCL(100),IDPEAK(100),IDHYDR(10)                  00000510
C                                                                               00000520
C     *** I N T E G E R ***                                                     00000530
C                                                                               00000540
      INTEGER VSCCNO(100),UNAME(5,100)                                          00000550
C                                                                               00000560
C     *** L O G I C A L ***                                                     00000570
C                                                                               00000580
      LOGICAL HYDROS,AVAIL(100)                                                 00000590
C                                                                               00000600
C     *** I N I T I A L I Z E ***                                               00000610
C                                                                               00000620
      DATA ASUM1,QSUM1/600*0./,ASUM2,QSUM2/60*0./,ASUM3,QSUM3/24*0./            00000630
      DATA MSUM2/396*0./                                                        00000640
      NHYDRO=0                                                                  00000650
      NUNITS=0                                                                  00000660
```

```
C                                                                       00000670
      CALL RDPARM(HYDROS,HYUNIT,PFUNIT,                                 00000680
     +            PBUNIT,MUNIT,CUNIT,AUNIT,SUNIT,                       00000690
     +            MONTH1,MONTH2,YEAR1,YEAR2,NBSTEP,                     00000700
     +            NCSTEP,NPSTEP,COMPNA,NHSTEP,TITLE)                    00000710
C                                                                       00000720
C     *** READ HYDRO UNIT DATA ***                                      00000730
C                                                                       00000740
      IF(.NOT.HYDROS)GOTO 200                                           00000750
      CALL UNIHYD(HYUNIT,VSCCNO,UNAME,FRAOWN,UNTYPE,UNLOAD,             00000760
     +            HYTYPE,PRIFUL,UNLIMO,UNLIYR,OFLIMO,OFLIYR,CAPCST,     00000770
     +            UNETCP,LNETCP,LAMDA1,LAMDA2,LAMDA3,BLKCAP,YEAR1,NUNITS,00000780
     +            NHYDRO,IDHYDR,                                        00000790
     +            UNGEN,NHSTEP,EAVAIL,ALTFUL,IGFUEL,AUPAVL,             00000800
     +            HEATR1,HEATR2,HEATR3,PBTUCT,ABTUCT,PGENFC)            00000810
C                                                                       00000820
C     *** READ FOSSIL UNIT DATA ***                                     00000830
C                                                                       00000840
  200 CALL UNIFOS(PFUNIT,VSCCNO,UNAME,FRAOWN,UNTYPE,UNLOAD,             00000850
     +            PRIFUL,ALTFUL,IGFUEL,UNLIMO,UNLIYR,OFLIMO,OFLIYR,     00000860
     +            AUPAVL,CAPCST,UNETCP,LNETCP,HEATR1,HEATR2,HEATR3,     00000870
     +            EAVAIL,PBTUCT,ABTUCT,LAMDA1,LAMDA2,LAMDA3,BLKCAP,     00000880
     +            PGENFC,NBASE,IDBASE,NCYCL,IDCYCL,NPEAK,IDPEAK,        00000890
     +            NUNITS,YEAR1,NBSTEP,NCSTEP,NPSTEP)                    00000900
C                                                                       00000910
C     *** LOOP THROUGH ROUTINES BY MONTHS ***                           00000920
C                                                                       00000930
      DO 1000 MONTH=MONTH1,MONTH2                                       00000940
              CALL RDPROB(PBUNIT,XAXIS,ELC,ELCPTS,DELTA,BASE,           00000950
     +                    PEAK,HRSIP,FLAG,GENMO,YEAR1)                  00000960
C                                                                       00000970
```

```
C               IF FLAG=1 THEN DO NOT COMPUTE ANY MORE ENERGY                   00000980
C               PROFILES -- GO STRAIGHT TO THE ANNUAL REPORT                    00000990
C                                                                               00001000
                IF(FLAG.EQ.1)GOTO 875                                           00001010
C                                                                               00001020
C          *** MAKE AN ARRAY OF AVAILABLE UNITS ***                             00001030
C                                                                               00001040
           CALL UNITON(MONTH,YEAR1,MONTH,YEAR1,NUNITS,ONLIMO,                   00001050
     +                 ONLIYR,OFLIMO,OFLIYR,AVAIL)                            00001060
           CALL CREORD(AVAIL,LAMDA1,LAMDA2,LAMDA3,BLKCAP,NUNITS,                00001070
     +          UNIT,BLOCK,MWBLOK,NBLOCK,MONTH,SYSCAP(MONTH))                   00001080
C                                                                               00001090
C          *** CALCULATE ENERGY BY BLOCK, LOLP, UNSERVED ENERGY ***             00001100
C                                                                               00001110
           CALL ENERGY(ELC,XAXIS,ELCPTS,UNIT,BLOCK,MWBLOK,                      00001120
     +          EAVAIL,NBLOCK,SYSCAP(MONTH),LOLP(MONTH),                        00001130
     +          SYSENG(MONTH),UNSERV(MONTH),ENRGEE,HRSIP(MONTH),MONTH,          00001140
     +          HYDROS,NHYDRO,UNLOAD,UNGEN,NBSTEP,NCSTEP,NPSTEP,1)              00001150
C                                                                               00001160
C          *** REARRANGE ENRGEE AND COMPUTE THERMAL ENERGY BY UNIT ***          00001170
C                                                                               00001180
           CALL ARRNGE(NBLOCK,UNIT,BLOCK,ENRGEE,ENRGE2,NUNITS,                  00001190
     +          HEAT,IDBASE,NBASE,NBSTEP,IDCYCL,NCYCL,NCSTEP,IDPEAK,            00001200
     +          NPEAK,NPSTEP,HEATR1,HEATR2,HEATR3,MONTH)                        00001210
C                                                                               00001220
C      *** REUSE UNIT TO WRITE A REPORT ***                                     00001230
C                                                                               00001240
       ITEM=0                                                                   00001250
       DO 850 K=1,NBLOCK                                                        00001260
          IF(.NOT.(BLOCK(K).EQ.1))GOTO 850                                      00001270
             ITEM=ITEM+1                                                        00001280
             UNIT(ITEM)=UNIT(K)                                                 00001290
 850   CONTINUE                                                                 00001300
C                                                                               00001310
          CALL LPPLOT(MUNIT,XAXIS,ELC,ELCPTS,MONTH,YEAR1,COMPNA)                00001320
          CALL REPRT1(PGENFC,PBTUCT,ABTUCT,HEAT,ENRGE2,AVAIL,                   00001330
     +            BLKCAP,HRSIP,YEAR1,MONTH,ITEM,UNAME,                        00001340
```

```
     +            COMPNA,MUNIT,EAVAIL,UNIT,PRIFUL,UNSERV,SYSCAP,
     +            UNLOAD,QSUM1,TITLE,LAMDA1,LAMDA2,LAMDA3,SYSENG,
     +            TTHRML)
          CALL REPRT2(SYSCAP,PEAK,LOLP,HRSIP,UNSERV,PGENFC,
     +            PBTUCT,ABTUCT,PRIFUL,ALTFUL,MONTH,MUNIT,HEAT,
     +            ENRGE2,NUNITS,AVAIL,COMPNA,YEAR1,UNLOAD,
     +            BASE(MONTH),MSUM2,QSUM2,QSUM3,SYSENG,TTHRML)
C
C         *** WRITE A QUARTERLY REPORT ***
C
          IF(.NOT.(MONTH.EQ.3.OR.MONTH.EQ.6
     +            .OR.MONTH.EQ.9.OR.MONTH.EQ.12))GOTO 870
C         *IF REPORT OPTION ONE OR TWO
          IF (.NOT.(QUNIT.NE.0))GOTO 870
C            *THEN PRINT QUARTERLY REPORT
          MONTH3=MONTH-2
          IF(MONTH3.LT.MONTH1)MONTH3=MONTH1
          CALL REPRT3(BLKCAP,HRSIP,YEAR1,MONTH3,MONTH,ITEM,UNAME,COMPNA,
     +            QUNIT,EAVAIL,UNIT,PRIFUL,UNSERV,
     +            UNLOAD,QSUM1,TITLE,TELEC,TTHRML,SYSCAP)
          CALL REPRT4(MONTH3,MONTH,UNSERV,COMPNA,QSUM2,QSUM3,YEAR1,QUNIT,
     +            TELEC,TTHRML,FCOST,TAVCST,UNENGY)
          GOTO 875
C            *ELSE
  870  IF(.NOT.(MONTH.EQ.MONTH2))GOTO 900
C    ROLL ANNUAL TOTALS
  875  DO 899 J=1,3
            DO 894 I=1,100
            ASUM1(I,J)=ASUM1(I,J)+QSUM1(I,J)
            QSUM1(I,J)=0.0
  894       CONTINUE
            DO 896 I=1,10
            ASUM2(I,J)=ASUM2(I,J)+QSUM2(I,J)
            QSUM2(I,J)=0.0
  896       CONTINUE
```

```
          DO 898 I=1,4                                                          00001700
          ASUM3(I,J)=ASUM3(I,J)+QSUM3(I,J)                                      00001710
          QSUM3(I,J)=0.0                                                        00001720
  898     CONTINUE                                                              00001730
  899   CONTINUE                                                                00001740
  900   IF(FLAG.EQ.1)GOTO 1010                                                  00001750
 1000   CONTINUE                                                                00001760
C                                                                              00001770
C       *** WRITE AN ANNUAL REPORT ***                                         00001780
C                                                                              00001790
 1010   IF(MONTH.GT.MONTH2) MONTH=MONTH2                                        00001800
        CALL REPRT3(BLKCAP,HRSIP,YEAR1,MONTH1,MONTH,ITEM,                       00001810
       +         UNAME,COMPNA,AUNIT,EAVAIL,UNIT,                               00001820
       +         PRIFUL,UNSERV,UNLOAD,ASUM1,                                   00001830
       +         TITLE,TELEC,TTHRML,SYSCAP)                                    00001840
        CALL REPRT4(MONTH1,MONTH,UNSERV,COMPNA,ASUM2,                           00001850
       +         ASUM3,YEAR1,AUNIT,TELEC,TTHRML,FCOST,TAVCST,UNENGY)           00001860
        CALL REPRT5(MONTH1,MONTH,YEAR1,COMPNA,SUNIT,MSUM2,ASUM2,                00001870
       +              TELEC,FCOST,TAVCST,UNSERV,UNENGY)                        00001880
        STOP                                                                    00001890
        END                                                                     00001900
C=============================================================================00001910
C                                                                              00001920
C  ROUTINE:           **** A R R N G E ****                                    00001930
C                                                                              00001940
C  PURPOSE:                                                                    00001950
C    TO ARRANGE THE GENERATED ENERGY (WHICH IS IN ORDER BY LOADING BLOCK       00001960
C    IN ARRAY ENRGEE) BY UNIT IN ORDER OF LOADING, AND TO COMPUTE THE          00001970
C    THERMAL ENERGY REQUIREMENTS OF EACH BLOCK LOADED                          00001980
C                                                                              00001990
C  INPUT VARIABLES:                                                            00002000
C    NBLOCK     NUMBER OF BLOCKS LOADED                                        00002010
C    UNIT       LOADING ORDER OF UNITS                                         00002020
```

```
C     BLOCK      LOADING ORDER OF BLOCKS                                        00002030
C     ENRGEE     ENERGY GENERATED BY EACH BLOCK, IN MWH                         00002040
C     NUNITS     NUMBER OF UNITS LOADED                                         00002050
C     IDBASE     INDEX OF BASE-LOADED UNITS, IN THE ORDER READ                  00002060
C     NBASE      NUMBER OF BASE-LOADED UNITS LOADED                             00002070
C     NBSTEP     NUMBER OF LOADING-STEPS USED FOR BASE UNITS                    00002080
C     IDCYCL     INDEX OF CYCLING UNITS, IN THE ORDER READ                      00002090
C     NCYCL      NUMBER OF CYCLING UNITS LOADED                                 00002100
C     NCSTEP     NUMBER OF LOADING-STEPS USED FOR CYCLING UNITS                 00002110
C     IDPEAK     INDEX OF PEAKING UNITS, IN THE ORDER READ                      00002120
C     NPEAK      NUMBER OF PEAKING UNITS LOADED                                 00002130
C     NPSTEP     NUMBER OF LOADING-STEPS USED FOR PEAKING UNITS                 00002140
C     HEATR1     HEAT RATE IN BTU/KWH OF FIRST BLOCK, BY UNIT                   00002150
C     HEATR2     HEAT RATE IN BTU/KWH OF SECOND BLOCK, BY UNIT                  00002160
C     HEATR3     HEAT RATE IN BTU/KWH OF THIRD BLOCK, BY UNIT                   00002170
C                                                                               00002180
C  OUTPUT VARIABLES:                                                            00002190
C     ENRGE2     ENERGY GENERATED BY UNITS, BY COLUMNS:  1-FIRST BLOCK,         00002200
C                2-SECOND BLOCK, 3-THIRD BLOCK, 4-TOTAL FOR UNIT                00002210
C     HEAT       THERMAL ENERGY REQUIREMENTS BY UNITS, BY COLUMNS:              00002220
C                1-FIRST BLOCK, 2-SECOND BLOCK, 3-THIRD BLOCK,                  00002230
C                4-TOTAL FOR UNIT                                               00002240
C                                                                               00002250
C  ROUTINES CALLED:                                                             00002260
C     FINDHT                                                                    00002270
C                                                                               00002280
C  AUTHOR:                                                                      00002290
C     NATIONAL REGULATORY RESEARCH INSTITUTE                                    00002300
C                                                                               00002310
C  LAST REVISED:  10/79                                                         00002320
C                                                                               00002330
C===============================================================================00002340
C                                                                               00002350
```

```
      SUBROUTINE ARRNGE(NBLOCK,UNIT,BLOCK,ENRGEE,ENRGE2,NUNITS,          00002360
     +HEAT,IDBASE,NBASE,NBSTEP,IDCYCL,NCYCL,NCSTEP,IDPEAK,NPEAK,NPSTEP,  00002370
     +HEATR1,HEATR2,HEATR3,MONTH)                                        00002380
C                                                                        00002390
      IMPLICIT INTEGER (A-Z)                                             00002400
C                                                                        00002410
      REAL ENRGEE(300),ENRGE2(100,4)                                     00002420
      REAL HEATR1,HEATR2,HEATR3,HEAT(100,4)                              00002430
      REAL HEATR1(100,12),HEATR2(100,12),HEATR3(100,12)                  00002440
      INTEGER*2 UNIT(300),BLOCK(300)                                     00002450
      INTEGER*2 IDBASE(100),IDCYCL(100),IDPEAK(100)                      00002460
C                                                                        00002470
C     *** INITIALIZE ENRGE2 AND HEAT ARRAYS ***                          00002480
      DO 100 J=1,4                                                       00002490
      DO 100 K=1,NUNITS                                                  00002500
      ENRGE2(K,J)=0.                                                     00002510
  100 HEAT(K,J)=0.                                                       00002520
C                                                                        00002530
C     *** ASSIGN VALUES TO ENRGE2 ***                                    00002540
C                                                                        00002550
      DO 300 K=1,NBLOCK                                                  00002560
         ENRGE2(UNIT(K),BLOCK(K))=ENRGEE(K)                              00002570
  300 CONTINUE                                                           00002580
C                                                                        00002590
      DO 350 K=1,NUNITS                                                  00002600
         ENRGE2(K,4)=ENRGE2(K,1)+ENRGE2(K,2)+ENRGE2(K,3)                 00002610
  350 CONTINUE                                                           00002620
C                                                                        00002630
C     *** CALCULATE THERMAL ENERGY FOR EACH LOADING TYPE ***             00002640
C                                                                        00002650
      CALL FINDHT(HEATR1,HEATR2,HEATR3,HEAT,ENRGE2,IDBASE,               00002660
     +            NBASE,NBSTEP,MONTH)                                    00002670
      CALL FINDHT(HEATR1,HEATR2,HEATR3,HEAT,ENRGE2,IDCYCL,               00002680
     +            NCYCL,NCSTEP,MONTH)                                    00002690
      CALL FINDHT(HEATR1,HEATR2,HEATR3,HEAT,ENRGE2,IDPEAK,               00002700
```

```
     +            NPEAK,NPSTEP,MONTH)                                          00002710
      RETURN                                                                   00002720
      END                                                                      00002730
C=====================================================================       00002740
C                                                                              00002750
C  ROUTINE:           **** B U B B L E ****                                    00002760
C                                                                              00002770
C  PURPOSE:                                                                    00002780
C    GIVEN THE ARRAY VALUES, BUBBLE CREATES AN ARRAY TABLE,                    00002790
C    WHICH IS A POINTER TO EACH LOCATION IN THE VALUE ARRAY                    00002800
C                                                                              00002810
C  INPUT VARIABLES:                                                            00002820
C    VALUES     LAMBDA-VALUES TO BE SORTED                                     00002830
C    LENGTH     NUMBER OF VALUES                                               00002840
C    COL        COLUMN OF TABLE TO USE                                         00002850
C    MONTH      MONTH OF STUDY                                                 00002860
C                                                                              00002870
C  OUTPUT VARIABLES:                                                           00002880
C    TABLE      INDICES SHOWING SORTED ORDER OF THE ARRAY VALUES               00002890
C               (RANGES FROM 1 TO LENGTH)                                      00002900
C                                                                              00002910
C  AUTHOR:                                                                     00002920
C    NATIONAL REGULATORY RESEARCH INSTITUTE                                    00002930
C                                                                              00002940
C  LAST REVISED:  10/79                                                        00002950
C                                                                              00002960
C=====================================================================       00002970
C                                                                              00002980
      SUBROUTINE BUBBLE(VALUES,LENGTH,TABLE,COL,MONTH)                         00002990
C                                                                              00003000
      IMPLICIT INTEGER (A-Z)                                                   00003010
C                                                                              00003020
```

```
      INTEGER*2 VALUES(100,12), TABLE(100,3)                                    00003030
C                                                                               00003040
C     INITIALIZE TABLE                                                          00003050
C                                                                               00003060
      DO 100  I=1,LENGTH                                                        00003070
  100 TABLE(I,COL)=1                                                            00003080
      BOTTOM=LENGTH                                                             00003090
C     *UNTIL (BOTTOM=1)                                                         00003100
  110 CONTINUE                                                                  00003110
C        START SEARCH AT THE TOP OF STACK                                       00003120
C                                                                               00003130
         A=TABLE(1,COL)                                                         00003140
         I=2                                                                    00003150
C        *UNTIL  (BIGGEST VALUE AT THE BOTTOM)                                  00003160
  120    B=TABLE(I,COL)                                                         00003170
C              *IF(VALUES(A) > VALUES(B))                                       00003180
               IF(.NOT.(VALUES(A,MONTH).GT.VALUES(B,MONTH)))GOTO 130            00003190
C                 *THEN INTERCHANGE THEM                                        00003200
                  TEMP=A                                                        00003210
                  A=B                                                           00003220
                  B=TEMP                                                        00003230
                  TABLE(I-1,COL)=A                                              00003240
                  TABLE(I,COL)=B                                                00003250
C              *ENDIF                                                           00003260
C           INCREMENT TO COMPARE NEXT ITEM                                      00003270
C                                                                               00003280
  130       A=B                                                                 00003290
            I=I+1                                                               00003300
         IF (I.LE.BOTTOM)  GOTO 120                                             00003310
C        *ENDUNTIL                                                              00003320
         BOTTOM=BOTTOM-1                                                        00003330
      IF(BOTTOM.GT.1)GOTO 110                                                   00003340
C     *ENDUNTIL                                                                 00003350
      RETURN                                                                    00003360
      END                                                                       00003370
C=================================================================              00003380
```

```
C                                                                       00003390
C  ROUTINE:           **** C O L L A P S ****                           00003400
C                                                                       00003410
C  INPUT VARIABLES:                                                     00003420
C    MWBLOK     CAPACITY BY BLOCKS LOADED                              00003430
C    UNIT       LOADING ORDER OF UNITS                                 00003440
C    BLOCK      LOADING ORDER OF BLOCKS                                00003450
C    NBLOCK     NUMBER OF BLOCKS TO LOAD                               00003460
C                                                                       00003470
C  OUTPUT VARIABLES:                                                    00003480
C    UNCOL      COLLAPSED LOADING ORDER ARRAY                          00003490
C    NBKCOL     NUMBER OF BLOCKS IN THE COLLAPSED ORDER                00003500
C    SYSCAP     TOTAL SYSTEM CAPACITY IN MW                            00003510
C                                                                       00003520
C  AUTHOR:                                                              00003530
C    NATIONAL REGULATORY RESEARCH INSTITUTE, MAY 1979                   00003540
C                                                                       00003550
C  LAST REVISED:  10/79                                                 00003560
C                                                                       00003570
C=======================================================================00003580
C                                                                       00003590
      SUBROUTINE COLAPS(MWBLOK,UNIT,BLOCK,NBLOCK,UNCOL,NBKCOL,MWCOL)    00003600
      IMPLICIT INTEGER (A-Z)                                            00003610
      REAL MWBLOK(1),MWCOL(100),UNCAP(100)                              00003620
      INTEGER*2 UNIT(1),BLOCK(1),UNCOL(1)                               00003630
C                                                                       00003640
C     ZERO WORKING ARRAYS MWCOL AND UNCAP                               00003650
C                                                                       00003660
      DO 10 I=1,100                                                     00003670
      UNCAP(I)=0.                                                       00003680
   10 MWCOL(I)=0.                                                       00003690
C                                                                       00003700
```

```
      NBKCOL=0                                                                  00003710
      DO 30 I=1,NBLOCK                                                          00003720
         IF(.NOT.(BLOCK(I).EQ.1))GOTO 20                                        00003730
            NBKCOL=NBKCOL+1                                                     00003740
            UNCOL(NBKCOL)=UNIT(I)                                               00003750
C                                                                               00003760
C           ACCUMULATE LOADING BLOCK CAPACITIES IN UNCAP                        00003770
C                                                                               00003780
  20     UNCAP(UNIT(I))=UNCAP(UNIT(I))+MWBLOK(I)                                00003790
  30  CONTINUE                                                                  00003800
C                                                                               00003810
C     TRANSFER UNCAP TO MWCOL                                                   00003820
C                                                                               00003830
      DO 40 I =1,NBKCOL                                                         00003840
         MWCOL(I)=UNCAP(UNCOL(I))                                               00003850
  40  CONTINUE                                                                  00003860
C                                                                               00003870
      RETURN                                                                    00003880
      END                                                                       00003890
C=================================================================              00003900
C                                                                               00003910
C  ROUTINE:          **** C O N V O L ****                                      00003920
C                                                                               00003930
C  PURPOSE:                                                                     00003940
C    TO FORM THE NEXT EQUIVALENT LOAD-DURATION CURVE (Y) BY CONVOLUTION         00003950
C                                                                               00003960
C  INPUT VARIABLES:                                                             00003970
C   *Y          ORDINATES OF THE LOAD-PROBABILITY CURVE                         00003980
C    X          ABSCISSAS OF THE LOAD-PROBABILITY CURVE                         00003990
C    XMIN       MAXIMUM VALUE OF X FOR WHICH Y=1                                00004000
C    XNZERO     MAXIMUM VALUE OF X FOR WHICH Y IS NON-ZERO                      00004010
C    NPTS       LENGTH OF COLUMNS IN ARRAY Y                                    00004020
C    DELTA      STEP-SIZE FOR THE X-AXIS                                        00004030
C    CURRNT     1 IF CURRENT COLUMN OF ORDINATES IS IN Y(*,1)                   00004040
C               2 IF CURRENT COLUMN OF ORDINATES IS IN Y(*,2)                   00004050
C    NEXT       1 IF NEXT COLUMN OF ORDINATES IS IN Y(*,1)                      00004060
```

```
C                2 IF NEXT COLUMN OF ORDINATES IS IN Y(*,2)                    00004070
C     CAP        CAPACITY OF BLOCK INVOKING THE CONVOLUTION, IN MW             00004080
C     PAVAIL     AVAILABILITY PROBABILITY OF UNIT                              00004090
C     MAXPTS     MAXIMUM NUMBER OF ORDINATES TO COMPUTE FOR NEXT CURVE         00004100
C                                                                              00004110
C    *VARIABLE IS BOTH INPUT/OUTPUT                                            00004120
C                                                                              00004130
C  ALGORITHM:                                                                  00004140
C     CHRISTOS POSEIDON                                                        00004150
C     CHAPTER 4 OF PHD DISSERTATION (UNPUBLISHED 1979)                         00004160
C     THE OHIO STATE UNIVERSITY                                                00004170
C     DEPARTMENT OF NUCLEAR ENGINEERING                                        00004180
C                                                                              00004190
C  AUTHOR:                                                                     00004200
C     NATIONAL REGULATORY RESEARCH INSTITUTE, 2/16/79                          00004210
C                                                                              00004220
C  LAST REVISED:  10/79                                                        00004230
C                                                                              00004240
C==============================================================================00004250
C                                                                              00004260
      SUBROUTINE CONVOL(Y,X,XMIN,DELTA,CURRNT,NEXT,CAP,                        00004270
     +          PAVAIL,MAXPTS,XNZERO,NPTS)                                     00004280
      IMPLICIT INTEGER (A-Z)                                                   00004290
      REAL PAVAIL,X(1),XMIN,XTEMP,CAP,DELTA,XNZERO                             00004300
      REAL Y(NPTS,2),P,Q,YTEMP                                                 00004310
C                                                                              00004320
C     NO CONVOLUTION OR DECONVOLUTION IS REQUIRED FOR PAVAIL=1                 00004330
C                                                                              00004340
      IF(PAVAIL.GT.0.999999)GOTO 700                                           00004350
C                                                                              00004360
C     NO CONVOLUTION OR DECONVOLUTION WILL BE CONSIDERED FOR PAVAIL=0          00004370
C                                                                              00004380
      IF(PAVAIL.LT.0.0.0001)GOTO 700                                           00004390
C                                                                              00004400
      P=PAVAIL                                                                 00004410
      Q=1.-P                                                                   00004420
C                                                                              00004430
```

```
C                                                                       00004440
C     *** COMPUTE THE NUMBER OF POINTS IN Y(*,NEXT) ***                 00004450
C                                                                       00004460
      XNZERO=XNZERO+CAP                                                 00004470
      CALPTS=1+(XNZERO-XMIN)/DELTA                                      00004480
      IF(CALPTS.GT.MAXPTS) CALPTS=MAXPTS                                00004490
C                                                                       00004500
C     FORM NEXT EQUIVALENT LOAD DURATION CURVE (Y)                      00004510
C                                                                       00004520
      Y(1,NEXT)=1.                                                      00004530
      DO 500 K=2,CALPTS                                                 00004540
C                                                                       00004550
C        WHICH BOX DOES (X-CAP) GO IN?                                  00004560
C                                                                       00004570
         XTEMP=X(K)-CAP                                                 00004580
         BOX=1+(XTEMP-XMIN)/DELTA                                       00004590
C        *IF (BOX < 1)                                                  00004600
         IF(.NOT.(BOX.LT.1))GOTO 80                                     00004610
C           *THEN   SET POINT TO 1.00                                   00004620
               YTEMP=1.                                                 00004630
               GOTO 200                                                 00004640
C           *ELSE                                                       00004650
C              *IF  (IT IS NOT ON AN EDGE)                              00004660
   80          IF(.NOT.(X(BOX).NE.XTEMP))GOTO 100                       00004670
C                 *THEN  INTERPOLATE TO FIND Y-VALUE                    00004680
                  YTEMP=Y(BOX,CURRNT)+(Y(BOX+1,CURRNT)-Y(BOX,CURRNT))   00004690
     +                    *(XTEMP-X(BOX))/DELTA                         00004700
                  GOTO 200                                              00004710
C                 *ELSE Y-VALUE IS ON AN EDGE                           00004720
  100             YTEMP=Y(BOX,CURRNT)                                   00004730
C        *ENDIF                                                         00004740
```

```
 200      CONTINUE                                                              00004750
C         *ENDIF                                                                00004760
          Y(K,NEXT)=P*Y(K,CURRNT)+Q*YTEMP                                       00004770
C                                                                               00004780
C         *** GUARD AGAINST A POSSIBLE UNDERFLOW CONDITION ***                  00004790
C                                                                               00004800
          IF(Y(K,NEXT).LE.1.E-20)Y(K,NEXT)=0.                                   00004810
          IF(Y(K,NEXT).GT.1.)Y(K,NEXT)=1.                                       00004820
 500  CONTINUE                                                                  00004830
      K=NEXT                                                                    00004840
      NEXT=CURRNT                                                               00004850
      CURRNT=K                                                                  00004860
 700  RETURN                                                                    00004870
      END                                                                       00004880
C=================================================================              00004890
C                                                                               00004900
C  ROUTINE:          **** C R E O R D ****                                      00004910
C                                                                               00004920
C  PURPOSE:                                                                     00004930
C    TO CREATE A LOADING ORDER FOR THE SYSTEM AND TO FIND THE SYSTEM            00004940
C    CAPACITY.  THE LOADING ORDER IS CREATED BY LOADING THE NEXT                00004950
C    UNIT WHICH CORRESPONDS TO THE SMALLEST UNUSED LAMDA VALUE.                 00004960
C    AS BLOCKS OF UNITS ARE LOADED, THE UNIT LOADED IS RECORDED,                00004970
C    AN ARRAY OF BLOCK LOADING ORDER IS FORMED, THE BLOCK CAPACITY IS           00004980
C    RECORDED, AND THE TOTAL SYSTEM CAPACITY IS INCREMENTED.                    00004990
C                                                                               00005000
C  INPUT VARIABLES:                                                             00005010
C    AVAIL     .TRUE. IF UNIT IS AVAILABLE TO GO ON LINE                       00005020
C              .FALSE. IF UNIT IS NOT AVAILABLE TO GO ON LINE                  00005030
C    BLKCAP    BLOCK CAPACITIES FOR EACH UNIT, IN MW                           00005040
C    LAMDA1    FIRST BLOCK'S ORDINAL FOR LOADING                               00005050
C    LAMDA2    SECOND BLOCK'S ORDINAL FOR LOADING                              00005060
C    LAMDA3    THIRD BLOCK'S ORDINAL FOR LOADING                               00005070
C    NUNITS    LENGTH OF LAMDA1, LAMDA2, LAMDA3 & AVAIL                        00005080
C    MONTH     MONTH OF STUDY PERIOD                                           00005090
C                                                                               00005100
```

```
C  OUTPUT VARIABLES:                                                    00005110
C    UNIT       UNIT LOADING ORDER                                     00005120
C    BLOCK      BLOCK LOADING ORDER                                    00005130
C    MWBLOK     CAPACITY OF BLOCKS LOADED, IN MW                       00005140
C    K          NUMBER OF LOADING STEPS                                00005150
C    SYSCAP     SYSTEM CAPACITY IN MW                                  00005160
C                                                                      00005170
C                                                                      00005180
C  ROUTINES CALLED:                                                    00005190
C    BUBBLE    NXTBLK                                                 00005200
C                                                                      00005210
C                                                                      00005220
C  AUTHOR:                                                             00005230
C    NATIONAL REGULATORY RESEARCH INSTITUTE                            00005240
C                                                                      00005250
C  LAST REVISED:  10/79                                                00005260
C                                                                      00005270
C======================================================================00005280
C                                                                      00005290
      SUBROUTINE CREORD(AVAIL,LAMDA1,LAMDA2,LAMDA3,BLKCAP,NUNITS,      00005300
     +UNIT,BLOCK,MWBLOK,K,MONTH,SYSCAP)                                00005310
      IMPLICIT INTEGER (A-Z)                                           00005320
      INTEGER*2 UNIBLK(300),UNIT(300),BLOCK(300)                       00005330
      INTEGER*2 LAMDA1(100,12),LAMDA2(100,12),LAMDA3(100,12)           00005340
      INTEGER*2 TABLE(100,3),PNTR(3)                                   00005350
      REAL SYSCAP,MWBLOK(300),BLKCAP(100,12,3)                         00005360
      LOGICAL NEXT(3),DONE(3),AVAIL(1)                                 00005370
C                                                                      00005380
C     CREATE INDEX TABLES FOR LAMDA1, LAMDA2, LAMDA3                   00005390
C                                                                      00005400
      CALL BUBBLE(LAMDA1,NUNITS,TABLE,1,MONTH)                         00005410
      CALL BUBBLE(LAMDA2,NUNITS,TABLE,2,MONTH)                         00005420
```

```
      CALL BUBBLE(LAMDA3,NUNITS,TABLE,3,MONTH)                          00005430
C                                                                       00005440
C     INITIALIZE INDEX TABLE POINTERS AND LOGICALS                      00005450
C                                                                       00005460
      PNTR(1)=0                                                         00005470
      PNTR(2)=0                                                         00005480
      PNTR(3)=0                                                         00005490
      DONE(1)=.FALSE.                                                   00005500
      DONE(2)=.FALSE.                                                   00005510
      DONE(3)=.FALSE.                                                   00005520
      NEXT(1)=.TRUE.                                                    00005530
      NEXT(2)=.TRUE.                                                    00005540
      NEXT(3)=.TRUE.                                                    00005550
      K=0                                                               00005560
C                                                                       00005570
C     INITIALIZE BLOCK,UNIT,MWBLOK,AND UNIBLK                           00005580
C                                                                       00005590
      SYSCAP=0.0                                                        00005600
      DO 40 J=1,NUNITS                                                  00005610
         BLOCK(J)=0                                                     00005620
         UNIT(J)=0                                                      00005630
         UNIBLK(J)=0                                                    00005640
         MWBLOK(J)=0.0                                                  00005650
   40 CONTINUE                                                          00005660
C                                                                       00005670
C     FIND FIRST AVAILABLE BLOCK IN EACH LOADING-LEVEL                  00005680
C                                                                       00005690
      CALL NXTBLK(AVAIL,NUNITS,TABLE,LAMDA1,PNTR(1),                    00005700
     +            DONE(1),NEXT(1),1,ENTRY1,MONTH)                       00005710
      CALL NXTBLK(AVAIL,NUNITS,TABLE,LAMDA2,PNTR(2),                    00005720
     +            DONE(2),NEXT(2),2,ENTRY2,MONTH)                       00005730
      CALL NXTBLK(AVAIL,NUNITS,TABLE,LAMDA3,PNTR(3),                    00005740
     +            DONE(3),NEXT(3),3,ENTRY3,MONTH)                       00005750
C                                                                       00005760
```

```
C     *TEST TO SEE IF LOADING OF UNITS IS FINISHED                      00005770
  50   IF(DONE(1).AND.DONE(2).AND.DONE(3))GOTO 900                      00005780
       K=K+1                                                            00005790
C                                                                       00005830
C         *IF  *** LAMDAHL LESS THAN LAMDA3Q ***                        00005810
          IF(.NOT.(ENTRY1.LE.ENTRY2))GOTO 150                           00005820
C            *THEN IF LAMDAHL LESS THAN LAMDAFL                         00005830
                IF(.NOT.(ENTRY1.LE.ENTRY3))GOTO 100                     00005840
C                  *THEN LOAD FIRST BLOCK OF UNIT INTO SYSTEM           00005850
                      LOAD=1                                            00005860
                      GOTO 300                                          00005870
C                  *ELSE LOAD 3RD BLOCK OF UNIT INTO SYSTEM             00005880
 100                  LOAD=3                                            00005890
C                 *ENDIF                                                00005900
                  GOTO 300                                              00005910
C              *ELSE IF LAMDA3Q LESS THAN LAMDAFL                       00005920
 150              IF(.NOT.(ENTRY2.LE.ENTRY3))GOTO 200                   00005930
C                  *THEN LOAD SECOND BLOCK OF UNIT INTO SYSTEM          00005940
                   LOAD=2                                               00005950
                   GOTO 300                                             00005960
C                  *ELSE LOAD 3RD BLOCK OF UNIT INTO SYSTEM             00005970
 200                  LOAD=3                                            00005980
C                 *ENDIF                                                00005990
C         *ENDIF                                                        00006000
 300      NEXT(LOAD)=.TRUE.                                             00006010
C                                                                       00006020
C         *** INCREMENT #BLOCKS FOUND FOR THIS UNIT ***                 00006030
C                                                                       00006040
          KUNIT=TABLE(PNTR(LOAD),LOAD)                                  00006050
          UNIBLK(KUNIT)=UNIBLK(KUNIT)+1                                 00006060
C                                                                       00006070
C         *** UPDATE LOADING ORDER ARRAY ***                            00006080
C                                                                       00006090
          UNIT(K)=KUNIT                                                 00006100
```

```
C                                                                       00006110
C       *** UPDATE BLOCK LOADING ORDER ARRAY ***                        00006120
C                                                                       00006130
        BLOCK(K)=UNIBLK(KUNIT)                                          00006140
C                                                                       00006150
C       *** UPDATE ARRAY MWBLOK FOR MW LOADED PER BLOCK ***             00006160
C                                                                       00006170
C                                                                       00006180
C       *** ASSIGN FRACTIONS OF THE UNIT CAPACITY TO THE BLOCK LOADED   00006190
C                                                                       00006200
        GOTO (310,320,330),LOAD                                         00006210
  310       MWBLOK(K)=BLKCAP(KUNIT,MONTH,1)                           00006220
            GOTO 340                                                    00006230
  320       MWBLOK(K)=BLKCAP(KUNIT,MONTH,2)-BLKCAP(KUNIT,MONTH,1)     00006240
            GOTO 340                                                    00006250
  330       IF(LAMDA1(KUNIT,MONTH).LE.0)GOTO 334                      00006260
            IF(LAMDA2(KUNIT,MONTH).LE.0)GOTO 332                      00006270
            MWBLOK(K)=BLKCAP(KUNIT,MONTH,3)-BLKCAP(KUNIT,MONTH,2)     00006280
            GOTO 340                                                    00006290
  332       MWBLOK(K)=BLKCAP(KUNIT,MONTH,3)-BLKCAP(KUNIT,MONTH,1)     00006300
            GOTO 340                                                    00006310
  334       MWBLOK(K)=BLKCAP(KUNIT,MONTH,3)                           00006320
C                                                                       00006330
C     ADD MW LOADED THIS BLOCK TO TOTAL SYSTEM MW                       00006340
C                                                                       00006350
  340   SYSCAP=SYSCAP+MWBLOK(K)                                         00006360
C                                                                       00006370
C       FIND NEXT AVAILABLE UNIT (IF NEEDED)                            00006380
        IF(.NOT.DONE(1).AND.NEXT(1))                                    00006390
     +      CALL NXTBLK(AVAIL,NUNITS,TABLE,LAMDA1,PNTR(1),              00006400
     +      DONE(1),NEXT(1),1,ENTRY1,MONTH)                             00006410
        IF(.NOT.DONE(2).AND.NEXT(2))                                    00006420
     +      CALL NXTBLK(AVAIL,NUNITS,TABLE,LAMDA2,PNTR(2),              00006430
     +      DONE(2),NEXT(2),2,ENTRY2,MONTH)                             00006440
```

```
            IF(.NOT.DONE(3).AND.NEXT(3))                                        00006450
     +          CALL NXTBLK(AVAIL,NUNITS,TABLE,LAMDA3,PNTR(3),                 00006460
     +          DONE(3),NEXT(3),3,ENTRY3,MONTH)                                00006470
C                                                                               00006480
      GOTO 50                                                                   00006490
C     *ENDWHILE                                                                 00006500
  900 RETURN                                                                    00006510
      END                                                                       00006520
C=======================================================================        00006530
C                                                                               00006540
C  ROUTINE:            **** C U R V E ****                                      00006550
C                                                                               00006560
C  PURPOSE:                                                                     00006570
C    GIVEN THE LOAD-PROBABILITY CURVE ELC, TO CREATE THE CURVE                  00006580
C    ELCSVE WHICH IS UNIFORMLY SPACED ON THE X-AXIS BASED ON THE                00006590
C    SMALLEST LOADING BLOCK IN ARRAY MWBLOK                                     00006600
C                                                                               00006610
C  INPUT VARIABLES:                                                             00006620
C    ELC        ORDINATES OF UNMODIFIED LOAD-PROBABILITY CURVE                  00006630
C    XAXIS      VALUES FOR LOAD-PROBABILITY CURVE ABSCISSAS                     00006640
C    MWBLOK     CAPACITY OF BLOCKS LOADED, IN MW                                00006650
C    NBLOCK     NUMBER OF BLOCKS TO LOAD                                        00006660
C    ELOCPT     NUMBER OF POINTS IN ARRAYS ELCSVE AND XAXIS                     00006670
C   *NZPNTS     NUMBER OF NON-ZERO ORDINATES IN ELCSVE                          00006680
C                                                                               00006690
C   *VARIABLE IS BOTH INPUT/OUTPUT                                              00006700
C                                                                               00006710
C  OUTPUT VARIABLES:                                                            00006720
C    ELCSVE     LOAD-PROBABILITY ORDINATES ON THE NEW GRID,                     00006730
C               FOR ABSCISSAS BETWEEN BASE LOAD AND PEAK LOAD (INCL)            00006740
C    XAXIS      LOAD-PROBABILITY ABSCISSAS ON THE NEW GRID                      00006750
C    DELTA      STEP-SIZE FOR XAXIS ARRAY                                       00006760
C                                                                               00006770
C  INTERNAL VARIABLES:                                                          00006780
```

```
C     XLEFT,XRIGHT  X-AXIS INTERPOLATION END-POINTS                          00006790
C     YLEFT,YRIGHT  Y-AXIS INTERPOLATION END-POINTS                          00006800
C                                                                            00006810
C  AUTHOR:                                                                   00006820
C     NATIONAL REGULATORY RESEARCH INSTITUTE, MAY 1979                       00006830
C                                                                            00006840
C  LAST REVISED:  10/79                                                      00006850
C                                                                            00006860
C============================================================================00006870
C                                                                            00006880
      SUBROUTINE CURVE(ELC,XAXIS1,ELCSVE,XAXIS,MWBLOK,NZPNTS,                00006890
     +                 NBLOCK,DELTA,ELDCPT)                                  00006900
      IMPLICIT INTEGER (A-Z)                                                 00006910
      REAL ELC(1),XAXIS1(1),MWBLOK(1)                                        00006920
      REAL ELCSVE(ELDCPT),XAXIS(ELDCPT)                                      00006930
      REAL DELTA,XLEFT,XRIGHT,YLEFT,YRIGHT,XAXINC                            00006940
C                                                                            00006950
C     FIND SMALLEST LOADING BLOCK TO ESTABLISH XAXIS-INCREMENT DELTA         00006960
C                                                                            00006970
      DELTA=99999                                                            00006980
      DO 10 I=1,NBLOCK                                                       00006990
      IF(MWBLOK(I).LT.DELTA)DELTA=MWBLOK(I)                                  00007000
   10 CONTINUE                                                               00007010
C                                                                            00007020
C     RESTRICT (XAXINC/5).LE.DELTA.LE.XAXINC                                 00007030
C                                                                            00007040
      XAXINC=XAXIS1(2)-XAXIS1(1)                                             00007050
      IF(DELTA.GT.XAXINC)DELTA=XAXINC                                        00007060
      IF(DELTA.LT.XAXINC/5.)DELTA=XAXINC/5.                                  00007070
C                                                                            00007080
C     INITIALIZE STEP AND K                                                  00007090
C                                                                            00007100
      STEP=1                                                                 00007110
      K=1                                                                    00007120
C                                                                            00007130
```

```
C      INITIALIZE INTERPOLATION RANGE'S LEFT COORDINATES XLEFT, YLEFT      00007140
C                                                                         00007150
          XLEFT=XAXIS1(STEP)                                              00007160
          YLEFT=ELC(STEP)                                                 00007170
C                                                                         00007180
C      INITIALIZE INTERPOLATION RANGE'S RIGHT COORDINATES XRIGHT, YRIGHT  00007190
C                                                                         00007200
          XRIGHT=XAXIS1(STEP+1)                                           00007210
          YRIGHT=ELC(STEP+1)                                              00007220
C                                                                         00007230
C      ASSIGN FIRST VALUE OF ELCSVE AND XAXIS                             00007240
C                                                                         00007250
          ELCSVE(1)=ELC(1)                                                00007260
C         XAXIS(1)=XAXIS1(1)                                              00007270
          XAXIS(1)=XAXIS1(1)                                              00007280
C                                                                         00007290
   20     K=K+1                                                           00007300
          XAXIS(K)=XAXIS(K-1)+DELTA                                       00007310
C                                                                         00007320
C      **IF CURRENT VALUE OF XAXIS IS GT XRIGHT                           00007330
C                                                                         00007340
          IF(.NOT.(XAXIS(K).GT.XRIGHT))GOTO 30                           00007350
C         **THEN STEP THE INTERPOLATION-RANGE THROUGH THE SET OF          00007360
C           POINTS UNTIL IT BRACKETS THE CURRENT XAXIS VALUE;             00007370
C           STEP NEED BE INCREMENTED AT MOST ONCE SINCE                   00007380
C           (THE STEP-SIZE OF XAXIS1).GE.DELTA                            00007390
            STEP=STEP+1                                                   00007400
C           *IF STEP LESS THAN NZPNTS                                     00007410
            IF(.NOT.(STEP.LT.NZPNTS))GOTO 40                              00007420
C              *THEN ASSIGN VALUES FOR                                    00007430
               XLEFT=XAXIS1(STEP)                                         00007440
               YLEFT=ELC(STEP)                                            00007450
               XRIGHT=XAXIS1(STEP+1)                                      00007460
```

```
                YRIGHT=ELC(STEP+1)                                              00007470
C                                                                               00007480
C                                                                               00007490
C       **ELSE -- CURRENT VALUES ARE PROPER TO INTERPOLATION                    00007500
  30    CONTINUE                                                                00007510
        ELCSVE(K)=YLEFT+((YRIGHT-YLEFT)*(XAXIS(K)-XLEFT)                        00007520
     +                  /(XRIGHT-XLEFT))                                       00007530
        GOTO 20                                                                 00007540
C                                                                               00007550
C     **ELSE -- SET BALANCE OF ELCSVE TO ZERO AND                               00007560
C               CALCULATE REMAINING VALUES FOR XAXIS                            00007570
C                                                                               00007580
  40    NZPNTS=K-1                                                              00007590
        ELCSVE(K)=0.0                                                           00007600
        K=K+1                                                                   00007610
        DO 50 I=K,ELDCPT                                                        00007620
           XAXIS(I)=XAXIS(I-1)+DELTA                                            00007630
           ELCSVE(I)=0.0                                                        00007640
  50    CONTINUE                                                                00007650
      RETURN                                                                    00007660
      END                                                                       00007670
C=================================================================================00007680
C                                                                               00007690
C  ROUTINE:          **** D E C O N F ****                                      00007700
C                                                                               00007710
C  PURPOSE:                                                                     00007720
C    TO REMOVE THE EFFECTS OF PRIOR-LOADED BLOCKS OF THE SAME                   00007730
C    UNIT ON THE SHAPE OF THE LOAD-PROBABILITY CURVE, BY DECONVOLUTION          00007740
C    FROM LEFT TO RIGHT USING YNEXT(X)=(YLAST(X)-Q*YNEXT(X-CAP))/P              00007750
C                                                                               00007760
C  INPUT VARIABLES:                                                             00007770
C   *Y          ORDINATES OF THE LOAD-PROBABILITY CURVE                         00007780
C    X          ABSCISSAS OF THE LOAD-PROBABILITY CURVE                         00007790
C    XMIN       MAXIMUM VALUE OF X FOR WHICH Y=1                                00007800
C    DELTA      STEP-SIZE FOR THE X-AXIS                                        00007810
```

```
C     LAST       1 IF CURRENT COLUMN OF ORDINATES IS IN Y(*,1)                00007320
C                2 IF CURRENT COLUMN OF ORDINATES IS IN Y(*,2)                00007330
C     NEXT       1 IF NEXT COLUMN OF ORDINATES IS IN Y(*,1)                   00007340
C                2 IF NEXT COLUMN OF ORDINATES IS IN Y(*,2)                   00007350
C     CAP        CAPACITY OF PREVIOUS BLOCKS TO BE DECONVOLVED                00007360
C     P          AVAILABILITY OF UNIT                                         00007370
C     NPTS       LENGTH OF COLUMNS OF ARRAY Y                                 00007380
C     MAXPTS     MAXIMUM NUMBER OF ORDINATES TO COMPUTE FOR NEXT CURVE        00007390
C     XNZERO     MAXIMUM VALUE OF X FOR WHICH Y IS NON-ZERO                   00007400
C                                                                             00007410
C    *VARIABLE IS BOTH INPUT/OUTPUT                                           00007420
C                                                                             00007430
C  ALGORITHM:                                                                 00007440
C    (NUMERICALLY STABLE FOR P>0.5)                                           00007450
C    CHRISTOS POSEIDON                                                        00007460
C    CHAPTER 4 OF PHD DISSERTATION (UNPUBLISHED 1979)                         00007470
C    THE OHIO STATE UNIVERSITY                                                00007480
C    DEPARTMENT OF NUCLEAR ENGINEERING                                        00007490
C                                                                             00007500
C  AUTHOR:                                                                    00007510
C    NATIONAL REGULATORY RESEARCH INSTITUTE                                   00007520
C                                                                             00007530
C  LAST REVISED:  10/79                                                       00007540
C                                                                             00007550
C=============================================================================00007560
C                                                                             00007570
      SUBROUTINE DECONF(Y,X,XMIN,DELTA,LAST,NEXT,CAP,                         00007580
     +          P,MAXPTS,XNZERO,NPTS)                                         00007590
      IMPLICIT INTEGER (A-Z)                                                  00007600
      REAL Y(NPTS,2),P,Q,NUMER,DENOM,RATIO,YTEMP                              00007610
      REAL X(1),CAP,XMIN,DELTA,XTEMP,XNZERO                                   00007620
C                                                                             00007630
      IF(P.GT.0.999999)GOTO 400                                               00007640
```

```
C                                                                       00008150
C     FIND WHERE TO STOP THE CALCULATIONS                               00008160
C                                                                       00008170
      XNZERO=XNZERO-CAP                                                 00008180
      CALPTS=1+(XNZERO-XMIN)/DELTA                                      00008190
      IF(CALPTS.GT.MAXPTS)CALPTS=MAXPTS                                 00008200
C                                                                       00008210
C     FORM NEXT EQUIVALENT LOAD DURATION CURVE (Y)                      00008220
C                                                                       00008230
      Q=1.-P                                                            00008240
      Y(1,NEXT)=1.                                                      00008250
      DO 100 K=2,CALPTS                                                 00008260
C                                                                       00008270
C        WHICH BOX DOES (X-CAP) GO  IN?                                 00008280
C                                                                       00008290
         XTEMP=X(K)-CAP                                                 00008300
         BOX=1+(XTEMP-XMIN)/DELTA                                       00008310
C                                                                       00008320
C        *IF CAP < DELTA  &  BOX => 1                                   00008330
         IF(.NOT.(CAP.LT.DELTA.AND.BOX.GE.1))GOTO 50                    00008340
C           *THEN                                                       00008350
               DENOM=1.-Q*(CAP/DELTA)                                   00008360
               NUMER=Y(K,LAST)-(Q*CAP*Y(K-1,NEXT)/DELTA)                00008370
               GOTO 80                                                  00008380
C           *ELSE                                                       00008390
C              *IF BOX < 1                                              00008400
   50          IF(.NOT.(BOX.LT.1))GOTO 55                               00008410
C                 *THEN                                                 00008420
                     YTEMP=1.                                           00008430
                     GOTO 70                                            00008440
```

```
C                    *ELSE                                                      00008450
C                 *IF CAP=DELTA                                                 00008460
   55             IF(.NOT.(CAP.EQ.DELTA))GOTO 60                                00008470
C                    *THEN                                                      00008480
                        YTEMP=Y(K-1,NEXT)                                       00008490
                        GOTO 70                                                 00008500
C                    *ELSE                                                      00008510
   60                   YTEMP=Y(BOX,NEXT)+(Y(BOX+1,NEXT)-Y(BOX,NEXT))          00008520
     +                       *(XTEMP-X(BOX))/DELTA                              00008530
C                 *ENDIF                                                        00008540
C                                                                               00008550
   70             DENOM=P                                                       00008560
                  NUMER=Y(K,LAST)-Q*YTEMP                                       00008570
C                                                                               00008580
C              *** GUARD AGAINST UNDERFLOW ***                                  00008590
C                                                                               00008600
   80                RATIO=NUMER/DENOM                                          00008610
                     IF(RATIO.LE.1.E-20)GOTO 200                                00008620
                     IF(RATIO.GT.Y(K-1,NEXT))RATIO=Y(K-1,NEXT)                  00008630
                     Y(K,NEXT)=RATIO                                            00008640
  100   CONTINUE                                                                00008650
        IF(CALPTS.GE.MAXPTS)GOTO 300                                            00008660
        K=CALPTS+1                                                              00008670
C                                                                               00008680
C       ASSIGN TAIL OF NEW CURVE TO ZERO                                        00008690
C                                                                               00008700
  200   DO 220J=K,MAXPTS                                                        00008710
        Y(J,NEXT)=0.                                                            00008720
  220   CONTINUE                                                                00008730
  300   K=NEXT                                                                  00008740
        NEXT=LAST                                                               00008750
        LAST=K                                                                  00008760
  400   RETURN                                                                  00008770
        END                                                                     00008780
C=======================================================================        00008790
C                                                                               00008800
C  ROUTINE:           **** D E C O N K ****                                     00008810
C                                                                               00008820
```

```
C  PURPOSE:                                                                00008830
C    TO REMOVE THE EFFECTS OF PRIOR-LOADED BLOCKS OF THE SAME              00008840
C    UNIT ON THE SHAPE OF THE LOAD-PROBABILITY CURVE, BY DECONVOLUTION     00008850
C    FROM RIGHT TO LEFT USING YNEXT(X)=(YLAST(X+CAP)-P*YNEXT(X+CAP))/Q     00008860
C                                                                          00008870
C  INPUT VARIABLES:                                                        00008880
C   *Y          ORDINATES OF THE LOAD-PROBABILITY CURVE                    00008890
C    X          ABSCISSAS OF THE LOAD-PROBABILITY CURVE                    00008900
C    XMIN       MAXIMUM VALUE OF X FOR WHICH Y=1                           00008910
C    DELTA      STEP-SIZE FOR THE X-AXIS                                   00008920
C    LAST       1 IF CURRENT COLUMN OF ORDINATES IS IN Y(*,1)              00008930
C               2 IF CURRENT COLUMN OF ORDINATES IS IN Y(*,2)              00008940
C    NEXT       1 IF NEXT COLUMN OF ORDINATES IS IN Y(*,1)                 00008950
C               2 IF NEXT COLUMN OF ORDINATES IS IN Y(*,2)                 00008960
C    CAP        CAPACITY OF PREVIOUS BLOCKS TO BE DECONVOLVED              00008970
C    P          AVAILABILITY OF UNIT                                       00008980
C    NPTS       LENGTH OF COLUMNS OF ARRAY Y                               00008990
C    MAXPTS     MAXIMUM NUMBER OF ORDINATES TO COMPUTE FOR NEXT CURVE      00009000
C    XNZERO     MAXIMUM VALUE OF X FOR WHICH Y IS NON-ZERO                 00009010
C                                                                          00009020
C   *VARIABLE IS BOTH INPUT/OUTPUT                                         00009030
C                                                                          00009040
C  ALGORITHM:                                                              00009050
C    (NUMERICALLY STABLE FOR P<0.5)                                        00009060
C    COMPLEMENT OF THAT IN ROUTINE DECONF                                  00009070
C                                                                          00009080
C  AUTHOR:                                                                 00009090
C    NATIONAL REGULATORY RESEARCH INSTITUTE, OCTOBER 1979                  00009100
C                                                                          00009110
C==========================================================================00009120
C                                                                          00009130
      SUBROUTINE DECONR(Y,X,XMIN,DELTA,LAST,NEXT,CAP,                      00009140
     +          P,MAXPTS,XNZERO,NPTS)                                      00009150
      IMPLICIT INTEGER (A-Z)                                               00009160
      REAL Y(NPTS,2),P,Q,NUMER,DENOM,RATIO,YTEMPL,YTEMPN                   00009170
      REAL X(1),CAP,XMIN,DELTA,XTEMP,XNZERO                                00009180
C                                                                          00009190
```

```
C
      IF(P.LT.0.000001)GOTO 400                                          00009200
C                                                                        00009210
C     FIND WHERE TO STOP THE CALCULATIONS                                00009220
C                                                                        00009230
      XNZERO=XNZERO-CAP                                                  00009240
      CALPTS=2+(XNZERO-XMIN)/DELTA                                       00009250
C                                                                        00009260
C     ASSIGN TAIL OF NEW CURVE TO ZERO                                   00009270
C                                                                        00009280
   30 DO 32 K=CALPTS,MAXPTS                                              00009290
      Y(K,NEXT)=0.                                                       00009300
   32 CONTINUE                                                           00009310
C                                                                        00009320
C     FORM NEXT EQUIVALENT LOAD DURATION CURVE (Y)                       00009330
C                                                                        00009340
      Q=1.-P                                                             00009350
      DO 100 J=3,CALPTS                                                  00009360
      K=CALPTS+2-J                                                       00009370
C                                                                        00009380
C        WHICH BOX DOES (X+CAP) GO IN?                                   00009390
C                                                                        00009400
         XTEMP=X(K)+CAP                                                  00009410
         BOX=1+(XTEMP-XMIN)/DELTA                                        00009420
         YTEMPL=Y(BOX,LAST)+(Y(BOX+1,LAST)-Y(BOX,LAST))                  00009430
     +          *(XTEMP-X(BOX))/DELTA                                    00009440
C                                                                        00009450
C        *IF CAP < DELTA                                                 00009460
   42    IF(.NOT.(CAP.LT.DELTA))GOTO 50                                  00009470
C           *THEN                                                        00009480
               DENOM=1.-P*(CAP/DELTA)                                    00009490
               NUMER=YTEMPL-(P*CAP*Y(K+1,NEXT)/DELTA)                    00009500
```

```
                GOTO 80                                                          00009510
C             *ELSE                                                              00009520
C                *IF CAP=DELTA                                                   00009530
  50             IF(.NOT.(CAP.EQ.DELTA))GOTO 60                                 00009540
C                   *THEN                                                       00009550
                       YTEMPN=Y(K+1,NEXT)                                       00009560
                       GOTO 70                                                  00009570
C                   *ELSE                                                       00009580
  60                   YTEMPN=Y(BOX,NEXT)+(Y(BOX+1,NEXT)-Y(BOX,NEXT))          00009590
     +                      *(XTEMP-X(BOX))/DELTA                               00009600
C                *ENDIF                                                          00009610
C                                                                                00009620
  70             DENOM=Q                                                        00009630
                 NUMER=YTEMPL-P*YTEMPN                                          00009640
C                                                                                00009650
C             *** GUARD AGAINST UNDERFLOW ***                                    00009660
C                                                                                00009670
  80             RATIO=NUMER/DENOM                                              00009680
                 IF(RATIO.GT.1.)GOTO 200                                        00009690
                 IF(RATIO.LT.Y(K+1,NEXT))RATIO=Y(K+1,NEXT)                      00009700
                 Y(K,NEXT)=RATIO                                                00009710
 100   CONTINUE                                                                  00009720
       K=1                                                                       00009730
C      ASSIGN HEAD OF NEW CURVE TO UNITY                                         00009740
C                                                                                00009750
 200   DO 220 J=1,K                                                              00009760
       Y(J,NEXT)=1.                                                              00009770
 220   CONTINUE                                                                  00009780
       K=NEXT                                                                    00009790
       NEXT=LAST                                                                 00009800
       LAST=K                                                                    00009810
 400   RETURN                                                                    00009820
       END                                                                       00009830
```

```
C=====================================================================00009840
C                                                                     00009850
C  ROUTINE:           **** E N E R G Y ****                           00009860
C                                                                     00009870
C  PURPOSE:                                                           00009880
C    GIVEN A SYSTEM LOAD-PROBABILITY CURVE (ELC), TO PROJECT THE ENERGY 00009890
C    GENERATED BY EACH UNIT IN THE SYSTEM, RELIABILITY (LOLP),        00009900
C    AND THE AMOUNT OF PURCHASED POWER NEEDED TO MEET SYSTEM DEMANDS. 00009910
C                                                                     00009920
C  INPUT VARIABLES:                                                   00009930
C    ELC         ORDINATES OF UNMODIFIED LOAD-PROBABILITY CURVE       00009940
C    XAXIS1      VALUES FOR LOAD-PROBABILITY CURVE ABSCISSAS          00009950
C    ELCPTS      NUMBER OF POINTS IN ELC AND XAXIS1                   00009960
C    UNIT        LOADING ORDER OF UNITS                               00009970
C    BLOCK       LOADING ORDER OF BLOCKS                              00009980
C    MWBLOK      CAPACITY OF BLOCKS LOADED, IN MW                     00009990
C    EAVAIL      EFFECTIVE AVAILABILITY BY UNIT                       00010000
C    NBLOCK      NUMBER OF BLOCKS TO LOAD                             00010010
C    SYSCAP      TOTAL SYSTEM CAPACITY IN MW                          00010020
C    HOURS       NUMBER OF HOURS IN STUDY PERIOD                      00010030
C    MONTH       MONTH OF STUDY                                       00010040
C    HYDROS      LOGICAL FOR CONDITION OF HYDROS IN SYSTEM            00010050
C    UNTYPE      TYPE OF GENERATION UNIT: 1-STEAM FOSSIL, 2-STEAM NUCLEAR, 00010060
C                3-I.C. ENGINE, 4-GAS TURBINE, 5-JET ENGINE, 6-HYDRO,  00010070
C                7-PUMPED STORAGE                                     00010080
C    UNGEN       THE EXPECTED GENERATION BY EACH HYDRO UNIT           00010090
C    IDHYDRO     LOCATION OF THE HYDRO UNIT IN THE ORDER READ         00010100
C    NHYDRO      NUMBER OF HYDRO UNITS                                00010110
C    NSTEP       NUMBER OF LOADING STEPS FOR THE FOUR TYPES OF UNITS  00010120
C                                                                     00010130
C  OUTPUT VARIABLES:                                                  00010140
C    LOLP        LOSS OF LOAD PROBABILITY (0 < LOLP < 1)              00010150
C    SYSGEN      TOTAL SYSTEM ENERGY                                  00010160
C    UNSERV      UNSERVED ENERGY                                      00010170
C    ENRGEE      ENERGY BY BLOCK LOADED                               00010180
```

```
C                                                                       00010190
C  VARIABLES INTERNAL TO ENERGY AND THE SUBROUTINES IT CALLS:           00010200
C    ELDC       ORDINATES OF CALCULATED LOAD PROBABILITY CURVE         00010210
C    XAXIS      THE X AXIS DEMAND VALUES FOR ELDC & ELCSVE             00010220
C    ELCSVE     ORDINATES OF THE NEW LOAD PROBABILITY                  00010230
C               CURVE COMPUTED IN SUBROUTINE CURVE                     00010240
C    ELDCPT     NUMBER OF POINTS IN ARRAYS ELDC, XAXIS, AND ELCSVE     00010250
C    NZPNTS     NUMBER OF NON-ZERO ORDINATES IN ELCSVE                 00010260
C                                                                       00010270
C  ROUTINES CALLED:                                                     00010280
C    CURVE   LIMITS   INTGRB   GENERB   LOSLOD                          00010290
C                                                                       00010300
C                                                                       00010310
C  AUTHOR:                                                              00010320
C    NATIONAL REGULATORY RESEARCH INSTITUTE, 2/22/79                    00010330
C                                                                       00010340
C  LAST REVISED:  10/79                                                 00010350
C                                                                       00010360
C=======================================================================00010370
C                                                                       00010380
      SUBROUTINE ENERGY(ELC,XAXIS1,ELCPTS,UNIT,BLOCK,MWBLOK,            00010390
     +             EAVAIL,NBLOCK,SYSCAP,LOLP,SYSGEN,UNSERV,            00010400
     +             ENRGEE,HOURS,MONTH,HYDROS,                          00010410
     +             NHYDRO,UNLOAD,UNGEN,NSTEP)                          00010420
      IMPLICIT INTEGER (A-Z)                                            00010430
      INTEGER NSTEP(4)                                                  00010440
C                                                                       00010450
      REAL ELC(ELCPTS),XAXIS1(ELCPTS)                                   00010460
      REAL SYSCAP,SYSGEN,LOLP,UNSERV, UNGEN(10,12),ELCSVE(1000),ENGDEM  00010470
      REAL MWBLOK(1),EAVAIL(100,12),ENRGEE(300),HOURS                   00010480
      REAL XAXIS(1000),DELTA,LIMITA(100,3),LIMITB(100,3)                00010490
      REAL ELDC(1000,2)                                                 00010500
      INTEGER*2 UNIT(1),BLOCK(1),UNLOAD(1)                              00010510
      LOGICAL HYDROS                                                    00010520
C                                                                       00010530
```

```
      ELDCPT=1000                                                       00010540
      NZPNTS=ELCPTS                                                     00010550
C                                                                       00010560
C     RESTATE THE LOAD-PROBABILITY CURVE USING ELDCPT COORDINATES       00010570
C                                                                       00010580
      CALL CURVE(ELC,XAXIS1,ELCSVE,XAXIS,MWBLOK,NZPNTS,NBLOCK,          00010590
     +      DELTA,ELDCPT)                                               00010600
C                                                                       00010610
C     LOAD FIRST COLUMN OF ELDC FROM ARRAY ELCSVE                       00010620
C                                                                       00010630
      DO 10 I=1,ELDCPT                                                  00010640
      ELDC(I,1)=ELCSVE(I)                                               00010650
   10 ELDC(I,2)=0.                                                      00010660
C                                                                       00010670
C     FIND LIMITS OF INTEGRATION FOR EACH AVAILABLE LOADING BLOCK       00010680
C                                                                       00010690
      CALL LIMITS(MWBLOK,UNIT,NBLOCK,BLOCK,LIMITA,LIMITB,               00010700
     +           EAVAIL,MONTH,SYSCAP)                                   00010710
C                                                                       00010720
C     CALCULATE SYSTEM ENERGY REQUIREMENTS BY INTEGRATION               00010730
C                                                                       00010740
      CURRNT=1                                                          00010750
      CALL INTGR8(ELDC,CURRNT,XAXIS,XAXIS1(1),DELTA,0.0,                00010760
     +            XAXIS(NZPNTS),ENGDEM,ELDCPT)                          00010770
      ENGDEM=ENGDEM*HOURS                                               00010780
C                                                                       00010790
C     CALCULATE THE EXPECTED ENERGY GENERATION BY LOADING               00010800
C     BLOCK FOR EACH UNIT                                               00010810
C                                                                       00010820
      CALL GENER8(DELTA,ELDC,XAXIS,EAVAIL,MONTH,ENRGEE,UNIT,            00010830
     +           MWBLOK,BLOCK,NBLOCK,LIMITA,LIMITB,HOURS,               00010840
     +            ELDCPT,NZPNTS,SYSGEN,SYSCAP,UNLOAD,UNGEN,NSTEP)       00010850
C                                                                       00010860
```

```
C      CALCULATE UNSERVED ENERGY                                        00010870
C                                                                       00010880
       UNSERV=ENGDEM-SYSGEN                                             00010890
C                                                                       00010900
C      CALCULATE LOLP                                                   00010910
C                                                                       00010920
       DO 20 I=1,ELDCPT                                                 00010930
       ELDC(I,1)=ELCSVE(I)                                              00010940
   20  ELDC(I,2)=0.                                                     00010950
       CALL LOSLOD(DELTA,ELDC,XAXIS,EAVAIL,MONTH,BLOCK,                 00010960
      +            UNIT,MWBLOK,NBLOCK,ELDCPT,NZPNTS,LOLP,SYSCAP,       00010970
      +            UNLOAD)                                             00010980
C                                                                       00010990
       RETURN                                                           00011000
       END                                                              00011010
C=======================================================================00011020
C                                                                       00011030
C  ROUTINE:           **** F I N D H T ****                             00011040
C                                                                       00011050
C  PURPOSE:                                                             00011060
C    TO CALCULATE THE THERMAL ENERGY FOR BLOCKS OF A GIVEN LOADING      00011070
C    TYPE AND THE TOTAL THERMAL ENERGY FOR THE UNIT.                    00011080
C                                                                       00011090
C  INPUT VARIABLES:                                                     00011100
C    IDTYPE     INDEX OF UNITS OF SPECIFIED TYPE, IN THE ORDER READ     00011110
C    NTYPE      NUMBER OF UNITS LOADED OF SPECIFIED TYPE                00011120
C    NSTEP      NUMBER OF LOADING-STEPS USED FOR THIS LOADING TYPE       00011130
C    HEATR1     HEAT RATE IN BTU/KWH OF FIRST BLOCK, BY UNIT            00011140
C    HEATR2     HEAT RATE IN BTU/KWH OF SECOND BLOCK, BY UNIT           00011150
C    HEATR3     HEAT RATE IN BTU/KWH OF THIRD BLOCK, BY UNIT            00011160
C    ENRGE2     ENERGY GENERATED BY UNITS, BY COLUMNS:  1-FIRST BLOCK,  00011170
C               2-SECOND BLOCK, 3-THIRD BLOCK, 4-TOTAL FOR UNIT         00011180
C                                                                       00011190
```

```
C  OUTPUT VARIABLES:                                                    00011200
C    HEAT       THERMAL ENERGY REQUIREMENTS BY UNITS, BY COLUMNS:      00011210
C               1-FIRST BLOCK, 2-SECOND BLOCK, 3-THIRD BLOCK,          00011220
C               4-TOTAL FOR UNIT                                       00011230
C                                                                      00011240
C  AUTHOR:                                                             00011250
C    NATIONAL REGULATORY RESEARCH INSTITUTE                            00011260
C                                                                      00011270
C  LAST REVISED:  10/79                                                00011280
C                                                                      00011290
C======================================================================00011300
C                                                                      00011310
      SUBROUTINE FINDHT(HEATR1,HEATR2,HEATR3,HEAT,ENRGE2,              00011320
     +                  IDTYPE,NTYPE,NSTEP,MONTH)                      00011330
C                                                                      00011340
      IMPLICIT INTEGER (A-Z)                                           00011350
C                                                                      00011360
      REAL HEATR1(100,12),HEATR2(100,12),HEATR3(100,12),HEAT(100,4)    00011370
      REAL ENRGE2(100,4)                                               00011380
      INTEGER*2 IDTYPE(1)                                              00011390
C                                                                      00011400
      IF(NTYPE.LE.0)GOTO 700                                           00011410
C  CALCULATE THERMAL ENERGY ACCORDING TO THE NUMBER OF STEPS PER UNIT   00011420
      DO 500 I=1,NTYPE                                                 00011430
         UNITI=IDTYPE(I)                                               00011440
         GOTO(10,20,30),NSTEP                                          00011450
   10    HEAT(UNITI,1)=HEATR3(UNITI,MONTH)*0.001*ENRGE2(UNITI,1)       00011460
         GOTO 300                                                      00011470
   20    HEAT(UNITI,1)=HEATR1(UNITI,MONTH)*0.001*ENRGE2(UNITI,1)       00011480
         HEAT(UNITI,2)=HEATR3(UNITI,MONTH)*0.001*ENRGE2(UNITI,2)       00011490
         GOTO 300                                                      00011500
   30    HEAT(UNITI,1)=HEATR1(UNITI,MONTH)*0.001*ENRGE2(UNITI,1)       00011510
         HEAT(UNITI,2)=HEATR2(UNITI,MONTH)*0.001*ENRGE2(UNITI,2)       00011520
         HEAT(UNITI,3)=HEATR3(UNITI,MONTH)*0.001*ENRGE2(UNITI,3)       00011530
  300    HEAT(UNITI,4)=HEAT(UNITI,1)+HEAT(UNITI,2)+HEAT(UNITI,3)       00011540
```

```
  500  CONTINUE                                                          00011550
  700  RETURN                                                            00011560
       END                                                               00011570
C=======================================================================00011580
C                                                                       00011590
C  ROUTINE:           **** G E N E R 8 ****                             00011600
C                                                                       00011610
C  PURPOSE:                                                             00011620
C    TO CALCULATE GENERATION IN MWH FOR EACH BLOCK LOADED               00011630
C                                                                       00011640
C  INPUT VARIABLES:                                                     00011650
C    ELDC       ORDINATES OF CALCULATED LOAD-PROBABILITY CURVE         00011660
C    XAXIS      ORDINATES OF LOAD-PROBABILITY CURVE                    00011670
C    DELTA      STEP-SIZE FOR ARRAY XAXIS                              00011680
C    EAVAIL     EFFECTIVE AVAILABILITY BY UNIT                         00011690
C    MONTH      MONTH OF STUDY                                         00011700
C    UNIT       LOADING ORDER OF UNITS                                 00011710
C    MWBLOK     CAPACITY OF BLOCKS LOADED, IN MW                       00011720
C    BLOCK      LOADING ORDER OF BLOCKS                                00011730
C    NBLOCK     NUMBER OF BLOCKS TO LOAD                               00011740
C    LIMITA     LEFT-HAND INTEGRATION LIMITS BY BLOCK                  00011750
C    LIMITB     RIGHT-HAND INTEGRATION LIMITS BY BLOCK                 00011760
C    HOURS      NUMBER OF HOURS IN MONTH                               00011770
C    ELDCPT     NUMBER OF POINTS IN ARRAYS ELDC AND XAXIS              00011780
C    NZPNTS     NUMBER OF NON-ZERO ORDINATES IN ELDC'S COLUMNS         00011790
C    UNLOAD     LOADING TYPE OF UNIT:  1-BASE, 2-CYCLING, 3-PEAKING,   00011800
C               4-HYDRO                                                00011810
C    NSTEP      NUMBER OF LOADING STEPS FOR THE FOUR TYPES OF UNITS    00011820
C                                                                       00011830
C  OUTPUT VARIABLES:                                                    00011840
C    ENRGEE     GENERATION OF EACH BLOCK, IN MWH                       00011850
C    SYSGEN     TOTAL SYSTEM GENERATION, IN MWH                        00011860
C                                                                       00011870
C  ROUTINES CALLED:                                                     00011880
C    INTGR8   CONVOL   DECONF   DECONR                                  00011890
```

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C                                                                       00011900
C  AUTHOR:                                                              00011910
C    NATIONAL REGULATORY RESEARCH INSTITUTE, MAY 1979                   00011920
C                                                                       00011930
C  LAST REVISED:  10/79                                                 00011940
C                                                                       00011950
C=======================================================================00011960
C                                                                       00011970
      SUBROUTINE GENER8(DELTA,ELOC,XAXIS,EAVAIL,MONTH,ENRGEE,UNIT,      00011980
     +                  MWBLOK,BLOCK,NBLOCK,LIMITA,LIMITB,HOURS,        00011990
     +                  ELDCPT,NZPNTS,SYSGEN,SYSCAP,UNLOAD,UNGEN,NSTEP) 00012000
      IMPLICIT INTEGER (A-Z)                                            00012010
C                                                                       00012020
      REAL EAVAIL(100,12),LIMITA(100,3),LIMITB(100,3)                   00012030
      REAL XAXIS(ELDCPT),MWBLOK(1),ENRGEE(1),UNGEN(10,12)               00012040
      REAL SYSCAP,HOURS,XNZERO,LIMIT1,LIMIT2                            00012050
      REAL DELTA,AREA,AREA1,AREA2,PAVAIL,XMIN,SYSGEN,CAPCON,CAPREV      00012060
      REAL ELOC(ELDCPT,2)                                               00012070
      INTEGER*2 UNIT(1),BLOCK(1),UNLOAD(1)                              00012080
      INTEGER NSTEP(4)                                                  00012090
C                                                                       00012100
C     INITIALIZE VALUES                                                 00012110
C                                                                       00012120
      CURRNT=1                                                          00012130
      NEXT=2                                                            00012140
      SYSGEN=0.0                                                        00012150
      XMIN=XAXIS(1)                                                     00012160
C                                                                       00012170
C     **IF SYSCAP IS LESS THAN OR EQUAL TO XMIN                         00012180
      IF(.NOT.(SYSCAP.LE.XMIN))GOTO 12                                  00012190
C     **THEN THE CALCULATION IS SIMPLIFIED                              00012200
C       TO ENRGEE=HOURS*MWBLOK*EAVAIL                                   00012210
      DO 10 K=1,NBLOCK                                                  00012220
```

```
      ENRGEE(K)=HOURS*MWBLOK(K)*EAVAIL(UNIT(K),MONTH)                    00012230
   10 SYSGEN=SYSGEN+ENRGEE(K)                                            00012240
      GOTO 80                                                            00012250
C                                                                        00012260
C     **ELSE -- CALCULATE THE GENERATION FOR EACH                        00012270
C                 LOADING BLOCK OF EACH UNIT                             00012280
C                                                                        00012290
C                                                                        00012300
C       INITIALIZE THE CALCULATION LIMITING VALUE -- XNZERO              00012310
C                                                                        00012320
   12 XNZERO=XAXIS(NZPNTS)                                               00012330
C                                                                        00012340
C     CALCULATE THE SMALLEST INDEX FOR WHICH THE CORRESPONDING XAXIS     00012350
C     VALUE IS GREATER THAN THE SUM OF SYSTEM CAPACITY AND THE           00012360
C     CAPACITIES OF THE BLOCKS TO BE DECONVOLVED USING DECONR            00012370
C                                                                        00012380
      CAPREV=0.                                                          00012390
      DO 15 K=1,NBLOCK                                                   00012400
      LUNIT=UNIT(K)                                                      00012410
      IF(.NOT.(BLOCK(K).LT.NSTEP(UNLOAD(LUNIT))))GOTO 15                00012420
      IF(.NOT.(EAVAIL(LUNIT,MONTH).GT.0.00.001.AND.                      00012430
     +         EAVAIL(LUNIT,MONTH).LT.0.5))GOTO 15                       00012440
      CAPREV=CAPREV+MWBLOK(K)                                            00012450
   15 CONTINUE                                                           00012460
      MAXPTS=2+(SYSCAP+CAPREV-XMIN)/DELTA                                00012470
      IF(SYSCAP.LT.XNZERO)MAXPTS=2+(XNZERO+CAPREV-XMIN)/DELTA            00012480
      IF(MAXPTS.GT.ELDCPT)GOTO 90                                        00012490
C                                                                        00012500
C                                                                        00012510
      CAPCON=0.                                                          00012520
      K=0                                                                00012530
```

```
   20  K=K+1                                                                  00012540
       IF(.NOT.(K.LE.NBLOCK))GOTO 70                                          00012550
          LUNIT=UNIT(K)                                                       00012560
          PAVAIL=EAVAIL(LUNIT,MONTH)                                          00012570
C                                                                             00012580
C     CHECK TO SEE IF UNIT IS AVAILABLE                                       00012590
C                                                                             00012600
C     **IF PAVAIL EQUALS ZERO                                                 00012610
       IF(.NOT.(PAVAIL.LT.0.000001))GOTO 40                                   00012620
C     **THEN SET ENERGY GENERATION TO ZERO AND GOTO NEXT LOADING BLOCK        00012630
   30     ENRGEE(K)=0.0                                                       00012640
          GOTO 46                                                             00012650
C     **ELSE CALCULATE THE GENERATION FOR THE UNIT                            00012660
   40     CONTINUE                                                            00012670
          LIMIT1=LIMITA(LUNIT,BLOCK(K))                                       00012680
          LIMIT2=LIMITB(LUNIT,BLOCK(K))                                       00012690
          CALL INTGR8(ELDC,CURRNT,XAXIS,XMIN,DELTA,                           00012700
     +    LIMIT1,LIMIT2,AREA,ELDCPT)                                          00012710
          ENRGEE(K)=PAVAIL*AREA*HOURS                                         00012720
C                                                                             00012730
C LIMIT GENERATION BY HYDRO UNITS TO THAT PROJECTED                           00012740
C                                                                             00012750
       IF(.NOT.(UNLOAD(LUNIT).EQ.4))GOTO 45                                   00012760
       PAVAIL=1.                                                              00012770
       IF(ENRGEE(K).LE.1.E-20)GOTO 45                                         00012780
       PAVAIL=(UNGEN(LUNIT,MONTH))/ENRGEE(K)                                  00012790
       IF(PAVAIL.GE.1.)GOTO 45                                                00012800
       ENRGEE(K)=UNGEN(LUNIT,MONTH)                                           00012810
C                                                                             00012820
C     CALCULATE SYSTEM ENERGY GENERATION                                      00012930
C                                                                             00012840
   45     SYSGEN=SYSGEN+ENRGEE(K)                                             00012850
C                                                                             00012860
C                                                                             00012870
C     CALCULATE THE NEW CURVE ELDC (I+1) FROM ELDC(I)                         00012880
C                                                                             00012890
   46     CAPCON=CAPCON+MWBLOK(K)                                             00012900
```

```
            IF(K.EQ.NBLOCK)GOTO 70                                          00012910
            IF(UNIT(K+1).EQ.LUNIT)GOTO 60                                   00012920
            CALL CONVOL(ELDC,XAXIS,XMIN,DELTA,CURRNT,NEXT,                  00012930
     +                  CAPCON,PAVAIL,MAXPTS,XNZERO,ELDCPT)                 00012940
C                                                                           00012950
            CAPCON=0.                                                       00012960
   48       LUNIT=UNIT(K+1)                                                 00012970
C                                                                           00012980
C        **IF AVAILABILITY OF NEXT BLOCK IS ZERO                            00012990
            IF(.NOT.(EAVAIL(LUNIT,MONTH).LT.0.0001))GOTO 49                 00013000
C        ** THEN SKIP OVER THAT BLOCK                                       00013010
            K=K+1                                                           00013020
            ENRGEE(K)=0.0                                                   00013030
            IF(K.EQ.NBLOCK)GOTO 70                                          00013040
            GOTO 48                                                         00013050
C        ** ELSE CONTINUE CHECKING FOR FIRST BLOCKS                         00013060
   49       IF(BLOCK(K+1).EQ.1)GOTO 60                                      00013070
            DO 50 J=1,K                                                     00013080
            IF(UNIT(J).EQ.LUNIT)CAPCON=CAPCON+MWBLOK(J)                     00013090
   50       CONTINUE                                                        00013100
            IF(EAVAIL(LUNIT,MONTH).LT.0.5)GOTO 52                           00013110
            CALL DECONF(ELDC,XAXIS,XMIN,DELTA,CURRNT,NEXT,CAPCON,           00013120
     +      EAVAIL(LUNIT,MONTH),MAXPTS,XNZERO,ELDCPT)                       00013130
            GOTO 60                                                         00013140
   52       CALL DECONR(ELDC,XAXIS,XMIN,DELTA,CURRNT,NEXT,CAPCON,           00013150
     +      EAVAIL(LUNIT,MONTH),MAXPTS,XNZERO,ELDCPT)                       00013160
   60    CONTINUE                                                           00013170
         GOTO 20                                                            00013180
C                                                                           00013190
C                                                                           00013200
C        CHECK ACCURACY OF MULTI-BLOCK CONVOLUTION/DECONVOLUTION BY         00013210
C        COMPARING ORDINATES ON THE FINAL LOAD-DURATION CURVE WITH          00013220
C        THOSE COMPUTED IN LOSLOD USING SINGLE-BLOCK LOADING                00013230
```

```
C                                                                       00013240
C 70   IF(K.EQ.NBLOCK)CALL CONVOL(ELDC,XAXIS,XMIN,DELTA,CURRNT,NEXT,    00013250
C     +CAPCON,PAVAIL,MAXPTS,XNZERO,ELDCPT)                              00013260
C      WRITE(6,72)K                                                     00013270
C 72   FORMAT(' AFTER CONVOLUTION OF BLOCK ',I3)                        00013280
C      MAXPTS=2+(SYSCAP-XMIN)/DELTA                                     00013290
C      MAXP=MAXPTS-11                                                   00013300
C      WRITE(6,76)(ELDC(K,CURRNT),K=MAXP,MAXPTS)                        00013310
C 76   FORMAT(12F10.7)                                                  00013320
   70  CONTINUE                                                         00013330
   80  RETURN                                                           00013340
   90  STOP 1000                                                        00013350
       END                                                              00013360
C=======================================================================00013370
C                                                                       00013380
C  ROUTINE:          **** I N T G R 8 ****                              00013390
C                                                                       00013400
C  PURPOSE:                                                             00013410
C    TO FIND THE AREA UNDER THE CURVE Y(X) FROM LIMITA TO LIMITB        00013420
C                                                                       00013430
C  INPUT VARIABLES:                                                     00013440
C    Y          ORDINATES OF THE LOAD-PROBABILITY CURVE TO BE INTEGRATED 00013450
C    CURRNT     IF 1, USE THE CURVE IN Y(*,1)                           00013460
C               IF 2, USE THE CURVE IN Y(*,2)                           00013470
C    NPTS       NUMBER OF VALUES IN ONE COLUMN OF Y                     00013480
C    X          ABSCISSAS OF THE LOAD-PROBABILITY CURVE                 00013490
C    XMIN       MAXIMUM VALUE OF X FOR WHICH Y=1                        00013500
C    DELTA      STEP-SIZE FOR THE X-AXIS                                00013510
C    LIMITA     ABSCISSA WHERE INTEGRATION BEGINS                       00013520
C    LIMITB     ABSCISSA WHERE INTEGRATION ENDS                         00013530
C                                                                       00013540
C  OUTPUT VARIABLES:                                                    00013550
C    AREA       AREA UNDER Y FROM LIMITA TO LIMITB                      00013560
C                                                                       00013570
C  NOTES:                                                               00013580
```

```
C     ROUTINE WILL HANDLE THE FOLLOWING CONDITIONS DIFFERENTLY                00013590
C                                                                             00013600
C         LIMIT1 < LIMIT2                                                     00013610
C         LIMIT1 = LIMIT2                                                     00013620
C         LIMIT1 > LIMIT2                                                     00013630
C                                                                             00013640
C  AUTHOR:                                                                    00013650
C    NATIONAL REGULATORY RESEARCH INSTITUTE                                   00013660
C                                                                             00013670
C  LAST REVISED:  10/79                                                       00013680
C                                                                             00013690
C=============================================================================00013700
C                                                                             00013710
      SUBROUTINE INTGR8(Y,CURRNT,X,XMIN,DELTA,                                00013720
     +                  LIMITA,LIMITB,AREA,NPTS)                            00013730
      IMPLICIT INTEGER (A-Z)                                                  00013740
      REAL X(1),XMIN,DELTA,LIMITA,LIMITB,AREA                                 00013750
      REAL Y(NPTS,2)                                                          00013760
C                                                                             00013770
C                                                                             00013780
C     *** LOCAL PROGRAM VARIABLES ***                                         00013790
C                                                                             00013800
      REAL YLIM1,YLIM2,XDIFF,YEDGE1,YEDGE2,LIMIT1,LIMIT2,STORE,ASIGN          00013810
      REAL X1,Y1,X2,Y3,INTPL8                                                 00013820
      INTPL8(X1,X2,Y1,Y3)=Y1+(Y3-Y1)*(X2-X1)/DELTA                            00013830
C                                                                             00013840
C     TEST FOR ERROR CONDITIONS                                               00013850
C                                                                             00013860
      ASIGN=1.0                                                               00013870
      AREA=0.0                                                                00013880
      LIMIT1=LIMITA                                                           00013890
      LIMIT2=LIMITB                                                           00013900
```

```
      IF(LIMIT1.EQ.LIMIT2)GOTO 900                                      00013910
      IF(.NOT.(LIMIT1.GT.LIMIT2))GOTO 20                                00013920
      STORE=LIMIT1                                                      00013930
      LIMIT1=LIMIT2                                                     00013940
      LIMIT2=STORE                                                      00013950
      ASIGN=-1.0                                                        00013960
C                                                                       00013970
C     CHECK FOR SPECIAL CASES                                           00013980
C                                                                       00013990
C     *IF (LIMIT2 <= XMIN)                                              00014000
   20 IF(.NOT.(LIMIT2.LE.XMIN))GOTO 30                                  00014010
C        *THEN                                                          00014020
            AREA=LIMIT2-LIMIT1                                          00014030
            GOTO 800                                                    00014040
C        *ELSE                                                          00014050
   30       CONTINUE                                                   00014060
C              *IF(LIMIT1 < XMIN)                                       00014070
               IF(.NOT.(LIMIT1.LT.XMIN))GOTO 50                         00014080
C                 *THEN                                                00014090
                     AREA=XMIN-LIMIT1                                   00014100
                     LIMIT1=XMIN                                        00014110
                     GOTO 50                                            00014120
C                 *ELSE                                                00014130
   50          CONTINUE                                                00014140
C                                                                       00014150
      BOX1=1+(LIMIT1-XMIN)/DELTA                                        00014160
      BOX2=1+(LIMIT2-XMIN)/DELTA                                        00014170
C     *IF(X(BOX1)=LIMIT1)                                               00014180
      IF(.NOT.(X(BOX1).EQ.LIMIT1))GOTO 100                              00014190
C        *THEN                                                          00014200
            YLIM1=Y(BOX1,CURRNT)                                        00014210
            GOTO 200                                                    00014220
C        *ELSE INTERPOLATE TO FIND Y                                    00014230
  100       CONTINUE                                                  00014240
               YLIM1=INTPL8(X(BOX1),LIMIT1,Y(BOX1,CURRNT),              00014250
     +                      Y(BOX1+1,CURRNT))                          00014260
```

```
 200  CONTINUE                                                          00014270
C     *ENDIF                                                            00014280
C     *IF  (X-AXIS(BOX2)=LIMIT2)                                        00014290
      IF(.NOT.(X(BOX2).EQ.LIMIT2))GOTO 300                              00014300
C        *THEN                                                          00014310
            YLIM2=Y(BOX2,CURRNT)                                        00014320
            GOTO 400                                                    00014330
C        *ELSE INTERPOLATE TO FIND Y                                    00014340
 300     CONTINUE                                                       00014350
            YLIM2=INTPLB(X(BOX2),LIMIT2,Y(BOX2,CURRNT),                 00014360
     +                   Y(BOX2+1,CURRNT))                              00014370
C     *ENDIF                                                            00014380
C                                                                       00014390
C     FIND TOTAL AREA FROM LIMIT1 TO LIMIT2                             00014400
C                                                                       00014410
 400  EDGE1=BOX1+1                                                      00014420
C     *IF  (LIMIT2 < NEXT EDGE)                                         00014430
      IF(.NOT.(LIMIT2.LT.X(EDGE1)))GOTO 500                             00014440
C        *THEN   FIND AREA FROM LIMIT1 TO LIMIT2 ONLY                   00014450
            XDIFF=LIMIT2-LIMIT1                                         00014460
            AREA=AREA+0.5*XDIFF*(YLIM1+YLIM2)                           00014470
            GOTO 800                                                    00014480
C        *ELSE                                                          00014490
C           FIND AREA FROM LIMIT1 TO NEXT EDGE                          00014500
C                                                                       00014510
 500        YEDGE1=Y(EDGE1,CURRNT)                                      00014520
            XDIFF=X(EDGE1)-LIMIT1                                       00014530
            AREA=AREA+0.5*XDIFF*(YLIM1+YEDGE1)                          00014540
            EDGE2=EDGE1+1                                               00014550
 600        YEDGE2=Y(EDGE2,CURRNT)                                      00014560
C           *WHILE  (NEXT XEDGE2 < LIMIT2)                              00014570
            IF(.NOT.(X(EDGE2).LT.LIMIT2))GOTO 700                       00014580
```

```
C                                                                       00014590
C                FIND AREA FROM EDGE1 TO EDGE2                          00014600
C                                                                       00014610
                 AREA=AREA+0.5*DELTA*(YEDGE1+YEDGE2)                    00014620
                 YEDGE1=YEDGE2                                          00014630
                 EDGE2=EDGE2+1                                          00014640
                 GOTO 600                                               00014650
C             *ENDWHILE                                                 00014660
C                                                                       00014670
C             FIND AREA FROM LAST EDGE TO LIMIT2                        00014680
C                                                                       00014690
 700          XDIFF=LIMIT2-X(EDGE2)+DELTA                               00014700
              AREA=AREA+0.5*XDIFF*(YEDGE1+YLIM2)                        00014710
C       *ENDIF                                                          00014720
C       *ENDIF                                                          00014730
 800    AREA=ASIGN*AREA                                                 00014740
 900    RETURN                                                          00014750
        END                                                             00014760
C=======================================================================00014770
C                                                                       00014780
C  ROUTINE:            **** L I M I T S ****                            00014790
C                                                                       00014800
C  PURPOSE:                                                             00014810
C    TO FIND AND STORE THE LIMITS OF INTEGRATION FOR                    00014820
C    EACH LOADING BLOCK OF EACH UNIT                                    00014830
C                                                                       00014840
C  INPUT VARIABLES:                                                     00014850
C    MWBLOK     CAPACITY OF BLOCKS LOADED, IN MW                       00014860
C    NBLOCK     NUMBER OF BLOCKS TO LOAD                               00014870
C    UNIT       LOADING ORDER OF UNITS                                 00014880
C    BLOCK      LOADING ORDER OF BLOCKS                                00014890
C    EAVAIL     EFFECTIVE AVAILABILITY BY UNIT                         00014900
C    MONTH      MONTH OF STUDY                                         00014910
C    SYSCAP     TOTAL SYSTEM CAPACITY IN MW                            00014920
C                                                                       00014930
C  OUTPUT VARIABLES:                                                    00014940
```

```
C     LIMITA     LEFT-HAND INTEGRATION LIMIT                                  00014950
C     LIMITB     RIGHT-HAND INTEGRATION LIMIT                                 00014960
C                                                                             00014970
C  AUTHOR:                                                                    00014980
C     NATIONAL REGULATORY RESEARCH INSTITUTE, MAY 1979                        00014990
C                                                                             00015000
C  LAST REVISED:  10/79                                                       00015010
C                                                                             00015020
C=============================================================================00015030
C                                                                             00015040
      SUBROUTINE LIMITS(MWBLOK,UNIT,NBLOCK,BLOCK,LIMITA,LIMITB,               00015050
     *                  EAVAIL,MONTH,SYSCAP)                                  00015060
      IMPLICIT INTEGER (A-Z)                                                  00015070
      REAL MWBLOK(1),EAVAIL(100,12)                                           00015080
      INTEGER*2 UNIT(1),BLOCK(1)                                              00015090
      REAL LIMITA(100,3),LIMITB(100,3),LIM1,LIM2,SYSCAP                       00015100
C                                                                             00015110
C     INITIALIZE LIMITA AND LIMITB TO ZERO                                    00015120
C                                                                             00015130
C     ZERO LIMITS ARE ASSOCIATED WITH LOADING                                 00015140
C     BLOCKS THAT ARE COMBINED                                                00015150
C                                                                             00015160
      DO 10 I=1,100                                                           00015170
      DO 10 J=1,3                                                             00015180
      LIMITA(I,J)=0.                                                          00015190
   10 LIMITB(I,J)=0.                                                          00015200
      SYSCAP=0.0                                                              00015210
      LIM1=0.0                                                                00015220
      DO 30 I=1,NBLOCK                                                        00015230
C     *IF AVAILABILITY NOT LESS THAN OR EQUAL TO ZERO                         00015240
      IF(EAVAIL(UNIT(I),MONTH).LE.0.0)GOTO 30                                 00015250
```

```
C      **THEN                                                                  00015260
          LIM2=LIM1+MWBLOK(I)                                                  00015270
          LIMITA(UNIT(I),BLOCK(I))=LIM1                                        00015280
          LIMITB(UNIT(I),BLOCK(I))=LIM2                                        00015290
          LIM1=LIM2                                                            00015300
          SYSCAP=SYSCAP+MWBLOK(I)                                              00015310
C      **ELSE SKIP UNITS WITH ZERO AVAILABILITY                                00015320
   30  CONTINUE                                                                00015330
       RETURN                                                                  00015340
       END                                                                     00015350
C=====================================================================        00015360
C                                                                              00015370
C  ROUTINE:           **** L O S L O D ****                                    00015380
C                                                                              00015390
C  PURPOSE:                                                                    00015400
C    TO CALCULATE THE LOSS-OF-LOAD PROBABILITY FOR THE GENERATING SYSTEM       00015410
C                                                                              00015420
C  INPUT VARIABLES:                                                            00015430
C    ELDC       ORDINATES OF CALCULATED LOAD-PROBABILITY CURVE                 00015440
C    DELTA      STEP-SIZE FOR THE X-AXIS                                       00015450
C    XAXIS      VALUES FOR LOAD-PROBABILITY CURVE ABSCISSAS                    00015460
C    ELDCPT     NUMBER OF POINTS IN ARRAYS ELDC AND XAXIS                      00015470
C    NZPNTS     NUMBER OF NON-ZERO ORDINATES IN ELDC                           00015480
C    UNIT       LOADING ORDER OF UNITS                                         00015490
C    BLOCK      LOADING ORDER OF BLOCKS                                        00015500
C    MWBLOK     CAPACITY OF BLOCKS LOADED, IN MW                               00015510
C    EAVAIL     EFFECTIVE AVAILABILITY BY UNIT                                 00015520
C    NBLOCK     NUMBER OF BLOCKS TO LOAD                                       00015530
C    SYSCAP     TOTAL SYSTEM CAPACITY IN MW                                    00015540
C    MONTH      MONTH OF STUDY                                                 00015550
C    CURRNT     1 IF CURRENT COLUMN OF ORDINATES IS IN Y(*,1)                  00015560
C               2 IF CURRENT COLUMN OF ORDINATES IS IN Y(*,2)                  00015570
C    NEXT       1 IF NEXT COLUMN OF ORDINATES IS IN Y(*,1)                     00015580
C               2 IF NEXT COLUMN OF ORDINATES IS IN Y(*,2)                     00015590
C                                                                              00015600
C  OUTPUT VARIABLES:                                                           00015610
C    LOLP       LOSS OF LOAD PROBABILITY (0 < LOLP < 1)                        00015620
```

```
C                                                                       00015630
C  INTERNAL VARIABLES:                                                  00015640
C    UNCOL      LOADING ORDER ARRAY COLLAPSED BY SINGLE-BLOCK UNITS     00015650
C    NBKCOL     NUMBER OF BLOCKS IN THE COLLAPSED ORDER                 00015660
C    BOX        ARRAY POSITION WHERE SYSTEM CAPACITY FALLS              00015670
C    K          INDEX USED FOR BLOCK-LOOPING                            00015680
C    MAXPTS     MAXIMUM NUMBER OF ORDINATES TO BE CALCULATED            00015690
C    PAVAIL     UNIT AVAILABILITY                                       00015700
C    XNZERO     MAXIMUM ABSCISSA FOR WHICH Y IS NOT ZERO                00015710
C                                                                       00015720
C  ROUTINES CALLED:                                                     00015730
C    COLAPS   CONVOL                                                    00015740
C                                                                       00015750
C  AUTHOR:                                                              00015760
C    NATIONAL REGULATORY RESEARCH INSTITUTE, MAY 1979                   00015770
C                                                                       00015780
C  LAST REVISED:  10/79                                                 00015790
C                                                                       00015800
C=======================================================================00015810
C                                                                       00015820
      SUBROUTINE LOSLOD(DELTA,ELOC,XAXIS,EAVAIL,MONTH,BLOCK,            00015830
     +                  UNIT,MWBLOK,NBLOCK,ELOCPT,NZPNTS,LOLP,SYSCAP,   00015840
     +                  UNLOAD)                                         00015850
      IMPLICIT INTEGER (A-Z)                                            00015860
      REAL EAVAIL(10,12),XAXIS(ELOCPT),MWBLOK(1),MWCOL(100)             00015870
      REAL SYSCAP,LOLP,XNZERO,DELTA,PAVAIL,XMIN                         00015880
      REAL ELOC(ELOCPT,2)                                               00015890
      INTEGER*2 UNIT(1),BLOCK(1),UNCOL(100),UNLOAD(1)                   00015900
C                                                                       00015910
C     INITIALIZE PARAMETERS                                             00015920
C                                                                       00015930
      CURRNT=1                                                          00015940
      NEXT =2                                                           00015950
      XMIN=XAXIS(1)                                                     00015960
```

```
C
C       COLLAPSE THE LOADING ORDER                                      00015980
C                                                                       00015990
        CALL COLAPS(MWBLOK,UNIT,BLOCK,NBLOCK,UNCOL,NBKCOL,MWCOL)        00016000
C       *IF SYSCAP IS LESS THAN XMIN                                    00016010
        IF(.NOT.(SYSCAP.LE.XMIN))GOTO 10                                00016020
C       **THEN LOAD DEMANDS ARE NEVER MET                               00016030
           LOLP=1.0                                                     00016040
           RETURN                                                       00016050
C                                                                       00016060
C       **ELSE                                                          00016070
C                                                                       00016080
C       CALCULATE MAXIMUM NUMBER OF ORDINATE POINTS                     00016090
C                                                                       00016100
   10      MAXPTS=2+(SYSCAP-XMIN)/DELTA                                 00016110
           K=0                                                          00016120
           XNZERO=XAXIS(NZPNTS)                                         00016130
   20      K=K+1                                                        00016140
           IF(.NOT.(K.LE.NBKCOL))GOTO 30                                00016150
        PAVAIL=EAVAIL(UNCOL(K),MONTH)                                   00016160
        IF(UNLOAD(UNCOL(K)).EQ.4) PAVAIL=1.0                            00016170
C       *IF PAVAIL IS LESS THAN OR EQUAL TO ZERO                        00016180
        IF(.NOT.(PAVAIL.LT.0.000001))GOTO 25                            00016190
C       **THEN -- INCREMENT K                                           00016200
           GOTO 20                                                      00016210
C       **ELSE -- CALCULATE NEW CURVE                                   00016220
   25      CALL CONVOL(ELDC,XAXIS,XMIN,DELTA,CURRNT,NEXT,               00016230
     +                    MWCOL(K),PAVAIL,MAXPTS,XNZERO,ELDCPT)       00016240
           GOTO 20                                                      00016250
C                                                                       00016260
C       END OF CONVOLUTIONS;                                            00016270
C       CALCULATE LOLP AS THE ORDINATE OF THE FINAL LOAD-PROBABILITY     00016280
C       CURVE AT AN ABSCISSA OF SYSCAP                                  00016290
C                                                                       00016300
```

```
   30   BOX=1+(SYSCAP-XMIN)/DELTA                                          00016310
        LOLP=ELOC(BOX,CURRNT)+(ELOC(BOX+1,CURRNT)-ELOC(BOX,CURRNT))        00016320
       +      *(SYSCAP-XAXIS(BOX))/DELTA                                   00016330
C                                                                          00016340
C      COMPARE ORDINATES ON THE FINAL LOAD-DURATION CURVE WITH             00016350
C      THOSE COMPUTED IN GENER8                                            00016360
C                                                                          00016370
C      K=K-1                                                               00016380
C      WRITE(6,38)K                                                        00016390
C 38   FORMAT(' AFTER CONVOLUTION OF UNIT ',I3)                            00016400
C      MAXP=MAXPTS-11                                                      00016410
C      WRITE(6,40)(ELOC(K,CURRNT),K=MAXP,MAXPTS)                           00016420
C 40   FORMAT(12F10.7)                                                    00016430
       RETURN                                                              00016440
       END                                                                 00016450
C=================================================================================00016460
C                                                                          00016470
C  ROUTINE:            **** L P P L O T ****                               00016480
C                                                                          00016490
C  PURPOSE:                                                                00016500
C    TO PLOT THE LOAD-PROBABILITY CURVE USING NOPT POINTS                  00016510
C                                                                          00016520
C  INPUT VARIABLES:                                                        00016530
C    LODVAL     X-AXIS LOAD VALUES                                         00016540
C    PROB       Y-AXIS PROBABILITY VALUES                                  00016550
C    NOPT       NUMBER OF  (NON-ZERO) POINTS TO BE PLOTTED                 00016560
C    MONTH      MONTH OF STUDY (1-12)                                      00016570
C    IYEAR      YEAR OF STUDY                                              00016580
C    COMPNA     COMPANY NAME                                               00016590
C    FILE       LOGICAL UNIT ON WHICH POINTS ARE TO BE PLOTTED             00016600
C                                                                          00016610
C  NOTES:                                                                  00016620
C    ADAPTED FROM AN EARLIER VERSION FOR THE PUBLIC UTILITIES COMMISSION   00016630
C    OF OHIO                                                               00016640
```

```
C                                                                       00016650
C  AUTHOR:                                                              00016660
C    NATIONAL REGULATORY RESEARCH INSTITUTE                             00016670
C                                                                       00016680
C  LAST REVISED:  10/79                                                 00016690
C                                                                       00016700
C=======================================================================00016710
C                                                                       00016720
      SUBROUTINE LPPLOT(FILE,LODVAL,PROB,NOPT,MONTH,IYEAR,              00016730
     +                  COMPNA)                                         00016740
      REAL LODVAL(NOPT),PROB(NOPT),H(55),COMPNA(8)                      00016750
      DATA PLUS,STAR,DASH,BLANK/'+','*','-',' '/                        00016760
      INTEGER MONTHS(12)/'JAN','FEB','MAR','APR','MAY','JUN',           00016770
     +                   'JUL','AUG','SEP','OCT','NOV','DEC'/           00016780
      INTEGER FILE                                                      00016790
C                                                                       00016800
      H(1)=STAR                                                         00016810
      H(55)=STAR                                                        00016820
      H(54)=BLANK                                                       00016830
      WRITE(FILE,30) MONTHS(MONTH),IYEAR,COMPNA                         00016840
      WRITE(FILE,35)(STAR,I=1,55)                                       00016850
      DO 25 I=1,NOPT                                                    00016860
         IN=PROB(I)*52                                                  00016870
C        *IF    *** LESS THAN 2 POINTS ***                             00016880
         IF(IN.GE.2)GOTO 5                                              00016890
C           *THEN                                                       00016900
               IN=1                                                     00016910
               GOTO 15                                                  00016920
C           *ELSE                                                       00016930
    5          DO 10 J=2,IN                                           00016940
   10          H(J)=DASH                                              00016950
   15    CONTINUE                                                       00016960
C        *ENDIF                                                         00016970
         H(IN+1)=PLUS                                                   00016980
```

```
          IN=IN+2                                                              00016990
          IF(IN.GE.54)GOTO 24                                                  00017000
          DO 20 J=IN,53                                                        00017010
   20     H(J)=BLANK                                                           00017020
   24     WRITE(FILE,40) LODVAL(I),PROB(I),(H(J),J= 1,55)                      00017030
   25   CONTINUE                                                               00017040
        WRITE(FILE,45)(STAR,J=1,55)                                          00017050
        RETURN                                                               00017060
C                                                                            00017070
   30   FORMAT('1'///3X,'THE ',A3,',',I5,' LOAD PROBABILITY CURVE'           00017080
     +       ,' FOR ',6A4)                                                   00017090
   35   FORMAT(4X,'LOAD',4X,'PROB' /4X,' MW ',12X,55A1)                      00017100
   40   FORMAT(2X,F7.1,1X,F9.7,1X,55A1)                                      00017110
   45   FORMAT(20X,55A1)                                                     00017120
        END                                                                  00017130
C=============================================================================00017140
C                                                                            00017150
C  ROUTINE:            **** N X T B L K ****                                 00017160
C                                                                            00017170
C  PURPOSE:                                                                  00017180
C    TO FIND THE NEXT AVAILABLE BLOCK WHICH IS TO BE LOADED.                 00017190
C    THE CONDITIONS FOR BEING LOADED ARE THAT THE CORRESPONDING              00017200
C    LAMBDA VALUE MUST NOT EQUAL 0 AND THAT THE BLOCK MUST BE                00017210
C    AVAILABLE DURING THIS SECTION OF THE STUDY.                             00017220
C                                                                            00017230
C  INPUT VARIABLES:                                                          00017240
C    AVAIL      .TRUE. IF UNIT IS AVAILABLE                                  00017250
C               .FALSE. IF UNIT IS NOT AVAILABLE                             00017260
C    NUNITS     LENGTH OF AVAIL, TABLE & LAMBDA                              00017270
C    TABLE      INDEX TABLE TO BE SEARCHED                                   00017280
C    LAMBDA     BLOCKS' LOADING-ORDER INDICES                                00017290
C    POINTR     ROW IN TABLE WHERE THE SEARCH BEGINS                         00017300
C    COL        COLUMN OF TABLE TO USE                                       00017310
C    MONTH      MONTH OF STUDY PERIOD                                        00017320
```

```
C                                                                       00017330
C  OUTPUT VARIABLES:                                                    00017340
C    DONE       .TRUE. IF NO MORE BLOCKS TO LOOK FOR IN TABLE           00017350
C               .FALSE. IF MORE BLOCKS STILL UNLOADED                   00017360
C    NEXT       .FALSE. TO INDICATE THAT THIS ROUTINE WAS CALLED        00017370
C    POINTR     UPDATED ROW-LOCATION OF THE CURRENT BLOCK               00017380
C    ENTRY      VALUE OF THE LAMBDA FOR THE UNIT                        00017390
C                                                                       00017400
C  AUTHOR:                                                              00017410
C    NATIONAL REGULATORY RESEARCH INSTITUTE, FEBRUARY 1979              00017420
C                                                                       00017430
C  LAST REVISED:  10/79                                                 00017440
C                                                                       00017450
C=======================================================================00017460
C                                                                       00017470
      SUBROUTINE NXTBLK(AVAIL,NUNITS,TABLE,LAMBDA,POINTR,DONE,          00017480
     *                  NEXT,COL,ENTRY,MONTH)                           00017490
      IMPLICIT INTEGER (A-Z)                                            00017500
      LOGICAL AVAIL(1),DONE,NEXT                                        00017510
      INTEGER*2 LAMBDA(100,12),TABLE(100,3),POINTR                      00017520
C                                                                       00017530
C     PROCESS UNTIL WE HAVE FOUND AN AVAILABLE BLOCK OR THERE ARE NO    00017540
C     MORE BLOCKS TO BE BROUGHT ON LINE                                 00017550
C                                                                       00017560
  100    POINTR=POINTR+1                                                00017570
         IF(POINTR.GT.NUNITS)GOTO 200                                   00017580
         UNIT=TABLE(POINTR,COL)                                         00017590
C        *IF A BLOCK IS AVAILABLE                                       00017600
         IF((.NOT.AVAIL(UNIT)).OR.(LAMBDA(UNIT,MONTH).EQ.0))GOTO 100    00017610
C        *THEN ASSIGN THE LAMBDA VALUE                                  00017620
            ENTRY=LAMBDA(UNIT,MONTH)                                    00017630
            GOTO 250                                                    00017640
C        *ELSE TERMINATE THIS BLOCK-TYPE BY ASSIGNING A HIGH VALUE      00017650
  200       ENTRY=9999                                                  00017660
```

```
            DONE=.TRUE.                                                        00017670
C     *ENDIF                                                                   00017680
  250 NEXT=.FALSE.                                                             00017690
      RETURN                                                                   00017700
      END                                                                      00017710
C=======================================================================       00017720
C                                                                              00017730
C  ROUTINE:          **** R D P A R M ****                                     00017740
C                                                                              00017750
C  PURPOSE:                                                                    00017760
C    TO READ IN THE PROGRAM PARAMETERS DESCRIBED IN THE OUTPUT                 00017770
C    SECTION BELOW                                                             00017780
C                                                                              00017790
C  INPUT VARIABLES:                                                            00017800
C    NONE                                                                      00017810
C                                                                              00017820
C  OUTPUT VARIABLES:                                                           00017830
C    HYDRUS     .FALSE. IF NO HYDRO UNITS                                      00017840
C               .TRUE. IF HYDRO UNIT INFORMATION IS TO BE READ                 00017850
C    HYUNIT     LOGICAL UNIT FROM WHICH TO READ HYDRO INFO                     00017860
C    PFUNIT     LOGICAL UNIT FROM WHICH TO READ FOSSIL INFO                    00017870
C    PBUNIT     LOGICAL UNIT FROM WHICH TO READ LOAD-PROBABILITY CURVE         00017880
C    MUNIT      LOGICAL UNIT TO WHICH TO WRITE MONTHLY REPORT                  00017890
C    QUNIT      LOGICAL UNIT TO WHICH TO WRITE QUARTERLY REPORT                00017900
C    AUNIT      LOGICAL UNIT TO WHICH TO WRITE ANNUAL REPORT                   00017910
C    SUNIT      LOGICAL UNIT TO WHICH TO WRITE FUEL-USAGE SUMMARY              00017920
C    MONTH1     FIRST MONTH OF STUDY                                           00017930
C    MONTH2     LAST MONTH OF STUDY                                            00017940
C    YEAR1      FIRST YEAR OF STUDY                                            00017950
C    YEAR2      LAST YEAR OF STUDY                                             00017960
C    NBSTEP     NUMBER OF BASE UNIT LOADING STEPS                              00017970
C    NCSTEP     NUMBER OF CYCLE UNIT LOADING STEPS                             00017980
C    NPSTEP     NUMBER OF PEAKER UNIT LOADING STEPS                            00017990
C    COMPNA     COMPANY NAME                                                   00018000
C                                                                              00018010
```

```
C                                                                       00018020
C  AUTHOR:                                                              00018030
C    NATIONAL REGULATORY RESEARCH INSTITUTE                             00018040
C                                                                       00018050
C  LAST REVISED:  10/79                                                 00018060
C                                                                       00018070
C=======================================================================00018080
C                                                                       00018090
      SUBROUTINE KDPARM(HYDROS,HYUNIT,PFUNIT,                           00018100
     +          PBUNIT,MUNIT,QUNIT,AUNIT,SUNIT,                         00018110
     +          MONTH1,MONTH2,YEAR1,YEAR2,NBSTEP,                       00018120
     +          NCSTEP,NPSTEP,COMPNA,NHSTEP,TITLE)                      00018130
C                                                                       00018140
      IMPLICIT INTEGER (A-Z)                                            00018150
C                                                                       00018160
      LOGICAL HYDROS                                                    00018170
      REAL COMPNA(8),TITLE(20)                                          00018180
C                                                                       00018190
      IN=4                                                              00018200
      OUT=6                                                             00018210
      NHSTEP=1                                                          00018220
      HYUNIT=11                                                         00018230
      PFUNIT=12                                                         00018240
      PBUNIT=13                                                         00018250
C                                                                       00018260
C     *** STUDY-TITLE ***                                               00018270
C                                                                       00018280
      WRITE(OUT,2900)                                                   00018290
      READ(IN,3000) TITLE                                               00018300
C                                                                       00018310
C     *** COMPANY'S NAME ***                                            00018320
C                                                                       00018330
      WRITE(OUT,2600)                                                   00018340
```

```
      READ(IN,2700) COMPNA                                                    00018350
C                                                                             00018360
C     *** STUDY-PERIOD ***                                                    00018370
C                                                                             00018380
      WRITE(OUT,2000)                                                         00018390
      READ(IN,*) MONTH1                                                       00018400
      WRITE(OUT,2200)                                                         00018410
      READ(IN,*) YEAR1                                                        00018420
      WRITE(OUT,2100)                                                         00018430
      READ(IN,*) MONTH2                                                       00018440
      WRITE(OUT,2300)                                                         00018450
      READ(IN,*) YEAR2                                                        00018460
C                                                                             00018470
C     *** HYDRO-UNIT SWITCH ***                                               00018480
C                                                                             00018490
      WRITE(OUT,1300)                                                         00018500
      READ(IN,*) HYDROS                                                       00018510
C                                                                             00018520
C     *** LOADING STEPS ***                                                   00018530
C                                                                             00018540
      WRITE(OUT,2400)                                                         00018550
      READ(IN,*) NBSTEP,NCSTEP,NPSTEP                                        00018560
C                                                                             00018570
C     **** OUTPUT FILE UNIT NUMBER ****                                       00018580
C                                                                             00018590
      WRITE(OUT,2800)                                                         00018600
      READ(IN,*)SUNIT                                                         00018610
C                                                                             00018620
C     *** REPORT-WRITING OPTIONS ***                                          00018630
C           1=>ALL REPORTS ARE WRITTEN                                        00018640
C           2=>ONLY QUARTERLY AND ANNUAL REPORTS ARE WRITTEN                  00018650
C           3=>ONLY ANNUAL REPORT AND FUEL-USAGE SUMMARY ARE WRITTEN          00018660
C           4=>ONLY A MONTHLY FUEL-USAGE SUMMARY IS WRITTEN                   00018670
```

```
C                                                                       00018660
      MUNIT=0                                                           00018690
      QUNIT=0                                                           00018700
      AUNIT=0                                                           00018710
      WRITE(OUT,2500)                                                   00018720
      READ(IN,*) OPTION                                                 00018730
      IF(OPTION.NE.1)GOTO 90                                            00018740
      MUNIT=SUNIT                                                       00018750
      QUNIT=SUNIT                                                       00018760
      AUNIT=SUNIT                                                       00018770
   90 IF(OPTION.NE.2)GOTO 100                                           00018780
      QUNIT=SUNIT                                                       00018790
      AUNIT=SUNIT                                                       00018800
  100 IF(OPTION.NE.3)GOTO 110                                           00018810
      AUNIT=SUNIT                                                       00018820
  110 IF(OPTION.LT.1.OR.OPTION.GT.4)STOP                                00018830
  120 RETURN                                                            00018840
 1300 FORMAT('&ARE THERE HYDRO UNITS ? (T OR F) ')                      00018850
 2000 FORMAT('&ENTER FIRST MONTH OF STUDY (1-12) ')                     00018860
 2100 FORMAT('&ENTER LAST MONTH OF STUDY  (1-12) ')                     00018870
 2200 FORMAT('&ENTER FIRST YEAR OF STUDY ')                             00018880
 2300 FORMAT('&ENTER LAST YEAR OF STUDY  ')                             00018890
 2400 FORMAT('&ENTER # LOADING STEPS FOR BASE, CYCLE, & PEAK')          00018900
 2500 FORMAT('&REPORT OPTION ? (1-3)'/6X,'1 ALL REPORTS'/               00018910
     +       6X,'2 QUARTERLY AND ANNUAL REPORTS'/                       00018920
     +       6X,'3 ANNUAL REPORT AND MONTHLY FUEL SUMMARY'/             00018930
     +       6X,'4 MONTHLY FUEL SUMMARY ONLY')                          00018940
 2600 FORMAT('&ENTER COMPANY NAME ')                                    00018950
 2700 FORMAT(8A4)                                                       00018960
 2800 FORMAT('&ENTER FILE NUMBER FOR OUTPUT REPORTS')                   00018970
 2900 FORMAT('&ENTER THE STUDY TITLE')                                  00018980
 3000 FORMAT(20A4)                                                      00018990
      END                                                               00019000
C=======================================================================00019010
C                                                                       00019020
```

```
C  ROUTINE:          **** R D P R O B ****                                  00019030
C                                                                          00019040
C  PURPOSE:                                                                00019050
C    TO READ THE LOAD PROBABILITY DATA SUPPLIED BY THE COMPANY AND TO      00019060
C    CALCULATE THE LOAD VALUES FOR EACH INPUT VALUE.                       00019070
C                                                                          00019080
C  INPUT VARIABLES:                                                        00019090
C    PBUNIT    LOGICAL UNIT FROM WHICH TO READ THE LOAD-PROBABILITY DATA  00019100
C    HRSIP     HOURS IN EACH PERIOD COVERED                               00019110
C    GENMO     ENERGY GENERATION IN EACH PERIOD                           00019120
C                                                                          00019130
C  OUTPUT VARIABLES:                                                       00019140
C    LODVAL    X-AXIS LOAD VALUES                                         00019150
C    PROB      Y-AXIS PROB VALUES                                         00019160
C    NOPT      NUMBER OF DATA POINTS                                      00019170
C    BASE      BASE LOAD FOR EACH PERIOD                                  00019180
C    PEAK      PEAK LOAD FOR EACH PERIOD                                  00019190
C    DELTA     LOAD VALUE INCREMENT                                       00019200
C    IFLAG     0 IF CURVE WAS READ FROM PBUNIT                            00019210
C              1 IF CURVE WAS NOT ON UNIT PBUNIT                          00019220
C                                                                          00019230
C  NOTES:                                                                  00019240
C     THE PROGRAM WILL END ABNORMALLY IF AN END-OF-FILE IS                 00019250
C     ENCOUNTERED PREMATURELY.                                             00019260
C                                                                          00019270
C  AUTHOR:                                                                 00019280
C    NATIONAL REGULATORY RESEARCH INSTITUTE                                00019290
C                                                                          00019300
C  LAST REVISED:  10/79                                                    00019310
C                                                                          00019320
C=========================================================================00019330
C                                                                          00019340
```

```
C                                                                       00020080
C  OUTPUT VARIABLES:                                                    00020090
C    QSUM1      QUARTERLY TOTALS BY UNITS, BY COLUMNS:  1-FUEL COSTS,   00020100
C               2-THERMAL ENERGY, 3-ELECTRIC GENERATION                 00020110
C    TTHRML     TOTAL THERMAL ENERGY FOR THIS MONTH                     00020120
C                                                                       00020130
C  AUTHOR:                                                              00020140
C    NATIONAL REGULATORY RESEARCH INSTITUTE                             00020150
C                                                                       00020160
C  LAST REVISED:  10/79                                                 00020170
C                                                                       00020180
C=======================================================================00020190
C                                                                       00020200
      SUBROUTINE REPRT1(PGENFC,PBTUCT,ABTUCT,HEAT,ENRGE2,AVAIL,         00020210
     +                  BLKCAP,HRSIP,YEAR,MONTH,NUNITS,UNAME,COMPNA,    00020220
     +                  FILE,EAVAIL,UNIT,PRIFUL,UNSERV,SYSCAP,UNLOAD,   00020230
     +                  QSUM1,TITLE,LAMDA1,LAMDA2,LAMDA3,SYSENG,        00020240
     +                  TTHRML)                                         00020250
C                                                                       00020260
      IMPLICIT INTEGER (A-Z)                                            00020270
C                                                                       00020280
      LOGICAL AVAIL(100)                                                00020290
      REAL QSUM1(100,3),SYSENG(12)                                      00020300
      REAL PGENFC(100,12),PBTUCT(100,12),ABTUCT(100,12)                 00020310
      REAL HEAT(100,4),EAVAIL(100,12),ENRGE2(100,4),HRSIP(12)           00020320
      INTEGER UNAME(5,100)                                              00020330
      INTEGER*2 UNIT(100),PRIFUL(100),UNLOAD(100)                       00020340
      INTEGER*2 LAMDA1(100,12),LAMDA2(100,12),LAMDA3(100,12)            00020350
C                                                                       00020360
      INTEGER MONTHS(12) /'JAN','FEB','MAR','APR','MAY','JUN',          00020370
     +                    'JUL','AUG','SEP','OCT','NOV','DEC'/          00020380
```

```
      REAL UNSERV(12),SYSCAP(12),TITLE(20),BLKCAP(100,12,3)
      REAL UELEC,AVHEAT,THRMAL,CAPFAC,AVFUEL,WFCOST
      REAL UPAVL,COMPNA(8),PRIMRY,WCFUEL
      REAL TOTMW,TELEC,ZERO,TTHRML,TFUEL,TOTENG,HYELEC
C
      INTEGER LDTYP(4) /'BASE','CYCL','PEAK','HYDR'/
      INTEGER FUEL(7) /'COAL','NUCL','DOIL','HOIL','NGAS',
     +        'GASO','HYDR'/
      IF(FILE.EQ.0)GOTO 50
      WRITE(FILE,999)(TITLE(I),I=1,20)
      WRITE(FILE,1000)(COMPNA(I),I=1,8),MONTHS(MONTH),YEAR
      WRITE(FILE,1100)
      WRITE(FILE,1200)
C
   50 TOTMW=SYSCAP(MONTH)
      TELEC=SYSENG(MONTH)
      HYELEC=0.0
      ZERO=0.0
      TTHRML=0.0
      TFUEL=0.0
      INDEX=1
C     *UNTIL  *** WE ARE THROUGH ALL THE UNITS ***
  100 K=UNIT(INDEX)
C        *IF  *** UNIT WAS AVAILABLE ***
      IF(.NOT.AVAIL(K))GOTO 400
C
C           *** OPERATING AVAILABILITY ***
C
            UPAVL=100.*EAVAIL(K,MONTH)
            IF(UPAVL.LE.0.)GOTO 300
C           *THEN
C
C           *** CALCULATE WEIGHTED FUEL COST
C
            PRIMRY=PGENFC(K,MONTH)
            WFCOST=PRIMRY*PBTUCT(K,MONTH)+
     +                  (1.-PRIMRY)*APTUCT(K,MONTH)
```

```
C
C          *** CALCULATE TOTAL THERMAL ENERGY BY UNITS                    00020770
C                                                                         00020780
           THRMAL=HEAT(K,4)                                               00020790
           TTHRML=TTHRML+THRMAL                                           00020800
           QSUM1(K,2)=QSUM1(K,2)+THRMAL                                   00020810
C                                                                         00020820
C          *** CALCULATE TOTAL FUEL COST ***                              00020830
C                                                                         00020840
           WCFUEL=THRMAL*WFCOST*1.E-5                                     00020850
           TFUEL=TFUEL+WCFUEL                                             00020860
           QSUM1(K,1)=QSUM1(K,1)+WCFUEL                                   00020870
C                                                                         00020880
C          *** CALCULATE AVERAGE FUEL COST ***                            00020890
C                                                                         00020900
           UELEC=ENRGE2(K,4)                                              00020910
           AVFUEL=0.                                                      00020920
           AVHEAT=0.                                                      00020930
           IF(UELEC.LT.1.E-3)GOTO 120                                     00020940
           AVFUEL=1000.*WCFUEL/UELEC                                      00020950
C                                                                         00020960
C          *** TOTAL ELECTRIC ***                                         00020970
C                                                                         00020980
           IF(UNLOAD(K).EQ.4) HYELEC=HYELEC+UELEC                         00020990
           QSUM1(K,3)=QSUM1(K,3)+UELEC                                    00021000
C                                                                         00021010
C          *** AVERAGE HEAT RATE ***                                      00021020
C                                                                         00021030
           AVHEAT=1000.*THRMAL/UELEC                                      00021040
C                                                                         00021050
C          *** CAPACITY FACTOR ***                                        00021060
```

```
C
 120        CAPFAC=100.*UELEC/(BLKCAP(K,MONTH,3)*HRSIP(MONTH))
C
C           *** WRITE THE RESULTS ***
C
      IF(FILE.EQ.0)GOTO 400
            WRITE(FILE,1300)(UNAME(I,K),I=1,5),LDTYP(UNLOAD(K)),
     +                 FUEL(PRIFUL(K)),AVFUEL,WCFUEL,THRMAL,
     +                 UELEC,AVHEAT,CAPFAC,OPAVL,BLKCAP(K,MONTH,3),
     +                 WFCOST,LAMDA1(K,MONTH),
     +                 LAMDA2(K,MONTH),LAMDA3(K,MONTH)
            GOTO 400
 500     IF(FILE.EQ.0)GOTO 400
C           *ELSE
               WRITE(FILE,1350)(UNAME(I,K),I=1,5),LDTYP(UNLOAD(K)),
     +         FUEL(PRIFUL(K)),ZERO,ZERO,ZERO,OPAVL,BLKCAP(K,MONTH,3)
C        *ENDIF
 400     INDEX=INDEX+1
         IF(INDEX.LE.NUNITS)GOTO 100
      IF(FILE.EQ.0)GOTO 900
C     *ENDUNTIL
C
C     *** COMPUTE THE TOTALS
C
      AVHEAT=1000.*TTHRML/(TELEC-HYELEC)
      CAPFAC=100.*TELEC/(TOTMW*HRSIP(MONTH))
      AVFUEL=1000.*TFUEL/(TELEC-HYELEC)
      WFCOST=1.035*(TFUEL/TTHRML)
      TOTENG=UNSERV(MONTH)+TELEC
C
C     *** WRITE THE TOTALS
```

```
C                                                                       00021380
      WRITE(FILE,1400) AVFUEL,TFUEL,TTHRML,TELEC,AVHEAT,                00021390
     +           CAPFAC,TOTMW,WFCOST                                    00021400
      WRITE(FILE,1500) UNSERV(MONTH)                                    00021410
      WRITE(FILE,1600) TOTENG                                           00021420
  900 RETURN                                                            00021430
  999 FORMAT('1'//5X,'THE VIRGINIA STATE CORPORATION COMMISSION''S'/     00021440
     +     5X,'PRODUCTION COST SIMULATION (PCS) MODEL'//                00021450
     +     5X,'STUDY TITLE:  ',20A4///)                                 00021460
 1000 FORMAT(42X,8A4// 40X,'EXPECTED UNIT OPERATING'                    00021470
     +     ,' CHARACTERISTICS DURING'/ 57X,A3,',',I5)                   00021480
 1100 FORMAT('0',32X,'AVERAGE TOTAL',43X,'OPERATING',10X,'WEIGHTED'     00021490
     +/35X,'FUEL   FUEL   THERMAL    ELECTRIC   ',                     00021500
     +'AVERAGE  CAPACITY  AVAIL-    UNIT    AVERAGE',7X,'LAMDAS')       00021510
 1200 FORMAT(' ',21X,'LOAD  FUEL   COST   COST    ENERGY   GENERATION ',00021520
     +'HEAT RATE  FACTOR  ABILITY  CAPACITY FUEL COST    HL  3Q  FL'/   00021530
     + 5X,'UNIT NAME',8X,'TYPE  TYPE ($/MWH) ($000)  (MMBTU)',6X,       00021540
     +'(MWH)   (BTU/KWH)  (PCT)    (PCT)     (MW)  (CTS/MMBTU)'/)      00021550
 1300 FORMAT(' ',5A4,1X,A4,2X,A4,2X,F5.2,1X,F7.1,2X,F9.0,2X,F9.         00021560
     +     0,4X,F6.0,2X,F5.1,4X,F5.1,3X,F7.0,4X,F6.2,3X,3I4)            00021570
 1350 FORMAT(' ',5A4,1X,A4,2X,A4,2X,5X,1X,F7.1,2X,F9.0,2X,F9.0,         00021580
     +     4X,6X,2X,5X,4X,F5.1,3X,F7.0)                                 00021590
 1400 FORMAT('0','TOTALS',27X,F5.2,1X,F7.1,2(2X,F9.0),                  00021600
     +     4X,F6.0,2X,F5.1,12X,F7.0,4X,F6.2)                            00021610
 1500 FORMAT('-','UNSERVED ENERGY        (MWH)',2X,F10.0)               00021620
 1600 FORMAT(' ','TOTAL ENERGY REQUIRED (MWH)',2X,F10.0)                00021630
      END                                                               00021640
C=======================================================================00021650
C                                                                       00021660
C  ROUTINE:          **** R E P R T 2 ****                              00021670
C                                                                       00021680
C  PURPOSE:                                                             00021690
C    TO WRITE A REPORT THAT SUMMARIZES THE SYSTEM PARAMETERS            00021700
C    BY FUEL TYPE AND UNIT LOADING TYPE; ALSO, TO ROLL QUARTERLY        00021710
C    TOTALS BY FUEL TYPE AND LOADING TYPE INTO QSUM2 AND QSUM3          00021720
C    RESPECTIVELY.                                                      00021730
C                                                                       00021740
```

```
C  INPUT VARIABLES:                                                          00021750
C     SYSCAP     SYSTEM CAPACITY IN MW, BY MONTH                            00021760
C     PEAK       SYSTEM PEAK LOADS IN MW, BY MONTH                          00021770
C     LOLP       LOSS-OF-LOAD PROBABILITY, BY MONTH                         00021780
C     HRSIP      HOURS IN A STUDY MONTH                                     00021790
C     UNSERV     UNSERVED ENERGY IN MWH, BY MONTH                           00021800
C     PGENFC     FRACTION OF ENERGY GENERATED BY PRIMARY FUEL, BY MONTH      00021810
C     PBTUCT     COST OF PRIMARY FUEL, IN CENTS/MEGA-BTU                    00021820
C     ABTUCT     COST OF ALTERNATE FUEL, IN CENTS/MEGA-BTU                  00021830
C     PRIFUL     PRIMARY FUEL TYPE FOR UNIT                                 00021840
C     ALTFUL     ALTERNATE FUEL TYPE FOR UNIT                               00021850
C     MONTH      MONTH OF STUDY                                             00021860
C     FILE       LOGICAL UNIT TO WHICH REPORT IS TO BE WRITTEN              00021870
C     ENRGEZ     ENERGY GENERATED BY UNITS, BY COLUMNS:  1-FIRST BLOCK,     00021880
C                2-SECOND BLOCK, 3-THIRD BLOCK, 4-TOTAL FOR UNIT            00021890
C     HEAT       THERMAL ENERGY REQUIREMENTS BY UNITS, BY COLUMNS:          00021900
C                1-FIRST BLOCK, 2-SECOND BLOCK, 3-THIRD BLOCK,              00021910
C                4-TOTAL FOR UNIT                                           00021920
C     NUNITS     NUMBER OF UNITS IN STUDY                                   00021930
C     AVAIL      .TRUE. IF UNIT WAS AVAILABLE                               00021940
C                .FALSE. IF UNIT WAS NOT AVAILABLE                          00021950
C     COMPNA     NAME OF COMPANY                                            00021960
C     YEAR       YEAR OF STUDY                                              00021970
C     ITHRML     TOTAL THERMAL ENERGY FOR THIS MONTH                        00021980
C     UNTYPE     LOADING TYPE OF UNIT                                       00021990
C     XMIN       BASE LOAD IN MW                                            00022000
C                                                                           00022010
C  OUTPUT VARIABLES:                                                        00022020
C     MSUM2      MONTHLY ELECTRIC AND COST TOTALS BY FUEL TYPE              00022030
C     QSUM2      QUARTERLY THERMAL, ELECTRIC, AND COST TOTALS BY            00022040
C                FUEL TYPE                                                  00022050
C     WSUM3      QUARTERLY THERMAL, ELECTRIC, AND COST TOTALS BY            00022060
C                LOADING TYPE                                               00022070
```

```
C                                                                       00022080
C  AUTHOR:                                                              00022090
C    NATIONAL REGULATORY RESEARCH INSTITUTE                             00022100
C                                                                       00022110
C  LAST REVISED:  10/79                                                 00022120
C                                                                       00022130
C=======================================================================00022140
C                                                                       00022150
      SUBROUTINE REPRT2(SYSCAP,PEAK,LOLP,HRSIP,UNSERV,                  00022160
     +                  PGENFC,PBTUCT,ABTUCT,PRIFUL,ALTFUL,MONTH,       00022170
     +                  FILE,HEAT,ENRGE2,NUNITS,AVAIL,COMPNA,           00022180
     +                  YEAR,UNTYPE,XMIN,MSUM2,QSUM2,QSUM3,SYSENG,TTHRML) 00022190
C                                                                       00022200
      IMPLICIT INTEGER (A-Z)                                            00022210
C                                                                       00022220
      REAL ENRGE2(100,4),COMPNA(8),HEAT(100,4)                          00022230
      REAL SYSCAP(12),PEAK(12),LOLP(12),HRSIP(12),UNSERV(12)            00022240
      REAL PGENFC(100,12),PBTUCT(100,12),ABTUCT(100,12)                 00022250
      REAL MSUM2(12,11,3),QSUM2(10,3),QSUM3(4,3),SYSENG(12)             00022260
      INTEGER*2 PRIFUL(100),ALTFUL(100),UNTYPE(100)                     00022270
      LOGICAL AVAIL(100)                                                00022280
C                                                                       00022290
      REAL THRATE,AVCOST(10),TAVCST,TFCOST(10),PART                     00022300
      REAL FRAC(2),TTHRML,TELEC,FCOST,HRATE(10)                         00022310
      REAL CPBTU(2),THRMAL(10),ELEC(10),RESERV,DPREL,LODFAC             00022320
      REAL TOTENG,CAPFAC,XMIN                                           00022330
      INTEGER MONTHS(12), TYPE(2),FUEL(10)                              00022340
C                                                                       00022350
C     *** I N I T I A L I Z E ***                                       00022360
C                                                                       00022370
      DATA FUEL /'COAL','NUCL','LOIL','HOIL','NGAS',                   00022380
     +          'GASO','HYDR','  ','  ','  '/                         00022390
      DATA MONTHS /'JAN','FEB','MAR','APR','MAY','JUN',                00022400
     +             'JUL','AUG','SEP','OCT','NOV','DEC'/                00022410
      INTEGER LOADTP(4) /'BASE','CYCL','PEAK','HYDR'/                   00022420
```

```
      TELEC=SYSENG(MONTH)                                                       00022430
      FCOST=0.0                                                                 00022440
      THRATE=0.0                                                                00022450
      DO 100 FLTYPE=1,7                                                         00022460
      ELEC(FLTYPE)=0.                                                           00022470
      THRMAL(FLTYPE)=0.                                                         00022480
  100 TFCOST(FLTYPE)=0.                                                         00022490
C                                                                               00022500
C     *UNTIL   *** CALCULATED COST FOR ALL UNITS ***                            00022510
      DO 500 KU=1,NUNITS                                                        00022520
      IF(.NOT.(AVAIL(KU)))GOTO 500                                              00022530
         TYPE(1)=PRIFUL(KU)                                                     00022540
         TYPE(2)=ALTFUL(KU)                                                     00022550
         FRAC(1)=PCTNFC(KU,MONTH)                                               00022560
         FRAC(2)=1.-FRAC(1)                                                     00022570
         CPBTU(1)=PBTUCT(KU,MONTH)                                              00022580
         CPBTU(2)=ABTUCT(KU,MONTH)                                              00022590
         DO 400 FUELS=1,2                                                       00022600
            PART=FRAC(FUELS)                                                    00022610
            FLTYPE=TYPE(FUELS)                                                  00022620
C                                                                               00022630
C           *** CHECK FOR INVALID FUEL TYPE ***                                 00022640
C                                                                               00022650
         IF(FLTYPE.LT.1.OR.FLTYPE.GT.7)GOTO 40                                  00022660
C                                                                               00022670
C           *** THERMAL ENERGY ***                                              00022680
C                                                                               00022690
            THRMAL(FLTYPE)=THRMAL(FLTYPE)+                                      00022700
     +                     HEAT(KU,4)*PART                                      00022710
C                                                                               00022720
C           *** ELECTRIC ENERGY ***                                             00022730
C                                                                               00022740
            ELEC(FLTYPE)=ELEC(FLTYPE)+ENRGE2(KU,4)*PART                         00022750
C                                                                               00022760
C           *** WEIGHTED FUEL COST ***                                          00022770
C                                                                               00022780
            TFCOST(FLTYPE)=TFCOST(FLTYPE)+PART*CPBTU(FUELS)*HEAT(KU,4           00022790
     +                     *1.E-5                                               00022800
  400    CONTINUE                                                               00022810
  500 CONTINUE                                                                  00022820
```

```
C                                                                       00022830
C      *** WRITE PARAMETERS BY FUEL TYPE ***                            00022840
C                                                                       00022850
       IF (FILE.EQ.0)GOTO 510                                           00022860
       WRITE(FILE,1000) MONTHS(MONTH),YEAR,COMPNA                       00022870
       WRITE(FILE,1100)                                                 00022880
       WRITE(FILE,1200)                                                 00022890
C                                                                       00022900
C   CALCULATE TOTALS FOR COSTS, GENERATIONS, ETC.                       00022910
C                                                                       00022920
 510   DO 600 FLTYPE=1,7                                                00022930
          IF(ELEC(FLTYPE).LE.0.0)GOTO 600                               00022940
          IF(FLTYPE.EQ.7)GOTO 550                                       00022950
          FCOST=FCOST+TFCOST(FLTYPE)                                    00022960
          HRATE(FLTYPE)=1000.*THRMAL(FLTYPE)/ELEC(FLTYPE)               00022970
          AVCOST(FLTYPE)=1000.*TFCOST(FLTYPE)/ELEC(FLTYPE)              00022980
       IF(FILE.GT.0)                                                    00022990
      +WRITE(FILE,1200) FUEL(FLTYPE),THRMAL(FLTYPE),ELEC(FLTYPE),       00023000
      +         TFCOST(FLTYPE),HRATE(FLTYPE),AVCOST(FLTYPE)             00023010
 550      QSUM2(FLTYPE,1)=QSUM2(FLTYPE,1)+THRMAL(FLTYPE)                00023020
          QSUM2(FLTYPE,2)=QSUM2(FLTYPE,2)+ELEC(FLTYPE)                  00023030
          QSUM2(FLTYPE,3)=QSUM2(FLTYPE,3)+TFCOST(FLTYPE)                00023040
          MSUM2(MONTH,FLTYPE,1)=ELEC(FLTYPE)                            00023050
          MSUM2(MONTH,FLTYPE,2)=TFCOST(FLTYPE)                          00023060
          MSUM2(MONTH,FLTYPE,3)=AVCOST(FLTYPE)                          00023070
 600   CONTINUE                                                         00023080
       THRATE=1000.*THRML/(TELEC-ELEC(7))                               00023090
       TAVCST=1000.*FCOST/(TELEC-ELEC(7))                               00023100
```

```
      MSUM2(MONTH,11,1)=TELEC                                          00023110
      MSUM2(MONTH,11,2)=FCOST                                          00023120
      MSUM2(MONTH,11,3)=TAVCST                                         00023130
      IF(FILE.EQ.0)GOTO 705                                            00023140
      WRITE(FILE,2600)FUEL(7),ELEC(7)                                  00023150
C                                                                      00023160
C     *** CALCULATE SYSTEM LOAD PARAMETERS ***                         00023170
C                                                                      00023180
C     *** RESERVE MARGIN ***                                           00023190
C                                                                      00023200
      RESERV=100.*((SYSCAP(MONTH)-PEAK(MONTH))/PEAK(MONTH))            00023210
C                                                                      00023220
C     *** LOAD FACTOR ***                                              00023230
C                                                                      00023240
      LODFAC=100.*(TELEC+UNSERV(MONTH))/(PEAK(MONTH)*HRSIP(MONTH))     00023250
      CAPFAC=100.*TELEC/(SYSCAP(MONTH)*HRSIP(MONTH))                   00023260
C                                                                      00023270
C     *** DAYS/PERIOD RELIABILITY ***                                  00023280
C                                                                      00023290
      DPREL=(LOLP(MONTH)*HRSIP(MONTH))/24.0                            00023300
C                                                                      00023310
      WRITE(FILE,1300) THRMAL,TELEC,FCOST,INRATE,TAVCST                00023320
      WRITE(FILE,1001)                                                 00023330
      WRITE(FILE,1100)                                                 00023340
      WRITE(FILE,1200)                                                 00023350
C                                                                      00023360
C   REZERO VARIABLES FOR SUMMATION BY LOADING TYPE                     00023370
C                                                                      00023380
  705 DO 710 J=1,10                                                    00023390
        THRMAL(J) =0.0                                                 00023400
        ELEC(J)=0.0                                                    00023410
        TFCOST(J)=0.0                                                  00023420
  710 CONTINUE                                                         00023430
```

```
C                                                                       00023440
C     CALCULATE COSTS FOR ALL UNITS                                     00023450
C                                                                       00023460
      DO 800 KU=1,NUNITS                                                00023470
         IF(.NOT.AVAIL(KU))GOTO 800                                     00023480
         LDTYPE=UNTYPE(KU)                                              00023490
         IF(LDTYPE.LT.1.OR.LDTYPE.GT.4)GOTO 800                         00023500
         FRAC(1)=PGENFC(KU,MONTH)                                       00023510
         FRAC(2)=1.-FRAC(1)                                             00023520
         CPBTU(1)=PBTUCT(KU,MONTH)                                      00023530
         CPBTU(2)=ABTUCT(KU,MONTH)                                      00023540
C                                                                       00023550
C     ELECTRIC GENERATION                                               00023560
C                                                                       00023570
         ELEC(LDTYPE)=ELEC(LDTYPE)+ENRGE2(KU,4)                         00023580
         IF (LDTYPE.EQ.4)GOTO 800                                       00023590
C                                                                       00023600
C     CALCULATE TOTALS FOR EACH TYPE OF UNIT                            00023610
C                                                                       00023620
C     THERMAL                                                           00023630
         THRMAL(LDTYPE)=THRMAL(LDTYPE)+HEAT(KU,4)                       00023640
C                                                                       00023650
C     FUEL COST                                                         00023660
C                                                                       00023670
         TFCOST(LDTYPE)=TFCOST(LDTYPE)+(CPBTU(1)*FRAC(1)*               00023680
     *  HEAT(KU,4)*1.E-05)+(CPBTU(2)*FRAC(2)*HEAT(KU,4)*1.E-05)         00023690
  800  CONTINUE                                                         00023700
C                                                                       00023710
C     CALCULATE HEAT RATE AND AVERAGE FUEL COST                         00023720
C                                                                       00023730
      DO 850 LDTYPE=1,4                                                 00023740
      IF (ELEC(LDTYPE).LE.0.0)GOTO 850                                  00023750
      IF(LDTYPE.EQ.4)GOTO 810                                           00023760
         HRATE(LDTYPE)=1000.*THRMAL(LDTYPE)/ELEC(LDTYPE)                00023770
         AVCOST(LDTYPE)=1000.*TFCOST(LDTYPE)/ELEC(LDTYPE)               00023780
```

```
      IF(FILE.GT.0)                                                     00023790
     +   WRITE(FILE,1200) LOADTP(LDTYPE),THRMAL(LDTYPE),ELEC(LDTYPE),   00023800
     +        TFCOST(LDTYPE),HRATE(LDTYPE),AVCOST(LDTYPE)               00023810
 810    QSUM3(LDTYPE,1)=QSUM3(LDTYPE,1)+THRMAL(LDTYPE)                  00023820
        QSUM3(LDTYPE,2)=QSUM3(LDTYPE,2)+ELEC(LDTYPE)                    00023830
        QSUM3(LDTYPE,3)=QSUM3(LDTYPE,3)+TFCOST(LDTYPE)                  00023840
 850  CONTINUE                                                          00023850
C                                                                       00023860
C     IF NO PRINTING IS REQUIRED, RETURN                                00023870
C                                                                       00023880
      IF(FILE.EQ.0)GOTO 900                                             00023890
C                                                                       00023900
C     WRITE HYDRO GENERATION                                            00023910
C                                                                       00023920
      WRITE(FILE,2600) LOADTP(4),ELEC(4)                                00023930
C                                                                       00023940
C     PRINT TOTALS                                                      00023950
C                                                                       00023960
      WRITE(FILE,1300) TTHRML,TELEC,FCOST,THRATE,TAVCST                 00023970
C                                                                       00023980
C     WRITE SYSTEM LOAD PARAMETERS                                      00023990
C                                                                       00024000
      WRITE(FILE,1350)                                                  00024010
      WRITE(FILE,1400) SYSCAP(MONTH),PEAK(MONTH),XMIN,RESERV,           00024020
     +        TELEC,CAPFAC,LODFAC,LOLP(MONTH),DPREL,UNSERV(MONTH)       00024030
C                                                                       00024040
C     WRITE SYSTEM GENERATION PARAMETERS                                00024050
C                                                                       00024060
      WRITE(FILE,1900)                                                  00024070
      WRITE(FILE,2000) TTHRML                                           00024080
      WRITE(FILE,2100) TELEC                                            00024090
      WRITE(FILE,2200) FCOST                                            00024100
      WRITE(FILE,2300) UNSERV(MONTH)                                    00024110
      TOTENG=TELEC+UNSERV(MONTH)                                        00024120
      WRITE(FILE,2400) TOTENG                                           00024130
 900  RETURN                                                            00024140
C
```

```
C      *** F O R M A T S ***                                                    00024160
C                                                                               00024170
1000  FORMAT('1',A3,',',I5,' PROJECTED GENERATION AND ',                        00024180
     +       'FUEL USE SUMMARY'/' FOR ',8A4 // ' SYSTEM ',                     00024190
     +       'PARAMETERS BY FUEL TYPE:')                                       00024200
1001  FORMAT('0','SYSTEM PARAMETERS BY LOAD TYPE:')                             00024210
1100  FORMAT(' '/  15X,' THERMAL      ELECTRIC',16X,' AVERAGE ',                00024220
     +       '   AVERAGE'/15X,' ENERGY         ENERGY      FUEL COST',        00024230
     +       '  HEAT RATE    COST'/                                            00024240
     +      15X,' (MMBTU)        (MWH)        ($000)    (BTU/KWH)    ',      00024250
     +      '($/MWH)')                                                         00024260
1200  FORMAT(' ',6X,A4,1X,3(3X,F10.0),3X,F7.0,5X,F5.2)                          00024270
1300  FORMAT(' ',6X,'TOTALS',2X,F10.0,2(3X,F10.0),3X,F7.0,                      00024280
     +       5X,F5.2)                                                          00024290
1350  FORMAT(' '//' SYSTEM LOAD PARAMETERS:'//                                  00024300
     +      7X,'SYSTEM   PEAK    BASE  RESERVE  GENERATED ',                   00024310
     +         'CAPACITY  LOAD    GENERATION     UNSERVED'/                    00024320
     +    6X,'CAPACITY  LOAD    LOAD   MARGIN   ENERGY',                      00024330
     +    '    FACTOR  FACTOR   RELIABILITY     ENERGY'/                      00024340
     +    8X,'(MW)     (MW)     (MW)   (PCT)     (MWH)',                      00024350
     +  '      (PCT)   (PCT)    (PROB)(D/P)      (MWH)')                      00024360
1400  FORMAT(' ',6X,3(F6.0,2X),F5.2,2X,F10.0,2X,F5.1,                           00024370
     +       3X,F5.1,3X,F6.4,2X,F5.2,2X,F9.0)                                  00024380
1900  FORMAT(' '/' SYSTEM GENERATION PARAMETERS:'/)                             00024390
2000  FORMAT(' TOTAL THERMAL ENERGY      (MMBTU)',2X,F10.0)                     00024400
2100  FORMAT(' TOTAL ELECTRICAL GENERATION (MWH)',2X,F10.0)                     00024410
2200  FORMAT(' TOTAL FUEL COST             ($000)',2X,F10.0)                    00024420
2300  FORMAT(' TOTAL UNSERVED ENERGY        (MWH)',2X,F10.0)                    00024430
2400  FORMAT(' TOTAL ENERGY REQUIRED        (MWH)',2X,F10.0)                    00024440
2600  FORMAT(7X,A4,17X,F10.0)                                                   00024450
      END                                                                       00024460
```

```
C=======================================================================00024470
C                                                                       00024480
C  ROUTINE:           **** R E P R T 3 ****                             00024490
C                                                                       00024500
C  PURPOSE:                                                             00024510
C     TO WRITE A REPORT OF THE EXPECTED UNIT OPERATING CHARACTERISTICS   00024520
C     ON A QUARTERLY AND AN ANNUAL BASIS                                00024530
C                                                                       00024540
C  INPUT VARIABLES:                                                     00024550
C     SUM1        BY COLUMNS:  TOTAL FUEL COST, ELECTRIC AND THERMAL    00024560
C                 ENERGY GENERATION                                     00024570
C     WFCOST      WEIGHTED-AVERAGE FUEL COST, IN CENTS/MEGA-BTU         00024580
C     AVFUEL      AVERAGE FUEL COST, IN DOLLARS/MWH                     00024590
C     AVHEAT      AVERAGE HEAT RATE                                     00024600
C     CAPFAC      CAPACITY FACTOR                                       00024610
C     START       STARTING MONTH OF REPORT PERIOD                       00024620
C     BLKCAP      CUMULATIVE BLOCK CAPACITIES FOR EACH UNIT, IN MW      00024630
C     HRSIP       HOURS IN STUDY PERIOD                                 00024640
C     YEAR        YEAR OF STUDY                                         00024650
C     MONTH       MONTH OF STUDY                                        00024660
C     NUNITS      NUMBER OF UNITS IN STUDY                              00024670
C     UNAME       NAMES OF GENERATING UNITS                             00024680
C     COMPNA      COMPANY NAME                                          00024690
C     FILE        LOGICAL UNIT TO WHICH REPORT IS TO BE WRITTEN         00024700
C     EAVAIL      EFFECTIVE AVAILABILITY                                00024710
C     UNIT        LOADING ORDER OF UNITS                                00024720
C     PRIFUL      PRIMARY FUEL TYPE                                     00024730
C     UNLOAD      LOADING TYPE OF UNIT                                  00024740
C     TITLE       STUDY DESCRIPTION                                     00024750
C     SYSCAP      SYSTEM CAPACITY IN MW                                 00024760
C     UNSERV      UNSERVED ENERGY IN MWH                                00024770
C                                                                       00024780
C  OUTPUT VARIABLES:                                                    00024790
C     TELEC       CUMULATIVE GENERATION IN MWH                          00024800
C     THRML       CUMULATIVE THERMAL ENERGY IN MEGA-BTU                 00024810
```

```
C                                                                       00024820
C  AUTHOR:                                                              00024830
C    NATIONAL REGULATORY RESEARCH INSTITUTE                             00024840
C                                                                       00024850
C  LAST REVISED:  10/79                                                 00024860
C                                                                       00024870
C=======================================================================00024880
C                                                                       00024890
      SUBROUTINE REPRT3(BLKCAP,HRSIP,YEAR,START,MONTH,NUNITS,UNAME,     00024900
     +                  COMPNA,FILE,EAVAIL,UNIT,PRIFUL,UNSERV,          00024910
     +                  UNLOAD,SUM1,TITLE,TELEC,TTHRML,SYSCAP)          00024920
C                                                                       00024930
      IMPLICIT INTEGER (A-Z)                                            00024940
C                                                                       00024950
      INTEGER UNAME(5,100)                                              00024960
      INTEGER*2 UNIT(100),PRIFUL(100),UNLOAD(100)                       00024970
C                                                                       00024980
      INTEGER MONTHS(12) /'JAN','FEB','MAR','APR','MAY','JUN',          00024990
     +                    'JUL','AUG','SEP','OCT','NOV','DEC'/          00025000
      INTEGER LDTYP(4) /'BASE','CYCL','PEAK','HYDR'/                    00025010
      INTEGER FUEL(7) /'COAL','NUCL','LOIL','HOIL','NGAS',             00025020
     +       'GASO','HYDR'/                                             00025030
      REAL SUM1(100,3),EAVAIL(100,12),HRSIP(12)                         00025040
      REAL AVHEAT,CAPFAC,AVFUEL,MFCOST,HYELEC,ZERO                      00025050
      REAL COMPNA(8),TITLE(20),SYSCAP(12),UNSERV(12),BLKCAP(100,12,3)   00025060
      REAL OPAVL,CAPPER,TELEC,TTHRML,TFUEL,TOTENG                       00025070
      REAL CAPAVL,SUMHRS,CAPPRD,UNENGY,UNCAP                            00025080
C                                                                       00025090
      IF(FILE.EQ.0)GOTO 10                                              00025100
C                                                                       00025110
C     WRITE REPORT HEADINGS                                             00025120
C                                                                       00025130
      WRITE(FILE,999)(TITLE(I),I=1,20)                                  00025140
```

```
      WRITE(FILE,1000)(COMPNA(I),I= 1,6),MONTHS(START),YEAR,MONTHS      00025150
     +                        (MONTH),YEAR                             00025160
      WRITE(FILE,1100)                                                  00025170
      WRITE(FILE,1200)                                                  00025180
C                                                                       00025190
C                                                                       00025200
C     INITIALIZE VARIABLES                                              00025210
C                                                                       00025220
   10 HYELEC=0.0                                                        00025230
      ZERO =0.0                                                         00025240
      CAPPER=0.0                                                        00025250
      TELEC=0.0                                                         00025260
      TTHRML=0.0                                                        00025270
      TFUEL=0.0                                                         00025280
      INDEX=1                                                           00025290
      SUMHRS=0.0                                                        00025300
      UNENGY=0.0                                                        00025310
C                                                                       00025320
C     CALCULATE THE TOTAL HOURS IN THE PERIOD AND THE UNSERVED ENERGY   00025330
C                                                                       00025340
      DO 90 MO=START,MONTH                                              00025350
         SUMHRS= SUMHRS+HRSIP(MONTH)                                    00025360
         UNENGY=UNENGY+UNSERV(MONTH)                                    00025370
         IF(SYSCAP(MONTH).GT.CAPPER) CAPPER=SYSCAP(MONTH)               00025380
   90 CONTINUE                                                          00025390
  100 K=UNIT(INDEX)                                                     00025400
      CAPAVL=0.0                                                        00025410
      CAPPRO=0.0                                                        00025420
C                                                                       00025430
C     CALCULATE THE AVAILABILITY AND THE MWH FOR THE UNIT DURING        00025440
C     THE PERIOD                                                        00025450
C                                                                       00025460
      DO 102 MO=START,MONTH                                             00025470
         CAPAVL=CAPAVL+(SAVAIL(K,MO)*HRSIP(MO)*BLKCAP(K,MO,3))          00025480
         CAPPRO=CAPPRO+(BLKCAP(K,MO,3)*HRSIP(MO))                       00025490
  102 CONTINUE                                                          00025500
```

```
      OPAVL =100.*CAPAVL/CAPPRU                                          00025510
      UNCAP=CAPPRU/SUMHRS                                                00025520
      IF (OPAVL.LE.0.0)GOTO 300                                          00025530
C                                                                        00025540
C     CALCULATE WEIGHTED FUEL COST(WFCOST), AVERAGE FUEL COST            00025550
C     (AVFUEL), AVERAGE HEAT RATE(AVHEAT), CAPACITY FACTOR(CAPFAC),      00025560
C     AND THE TOTALS                                                     00025570
C                                                                        00025580
      WFCOST=0.0                                                         00025590
      IF(SUM1(K,2).LE.0.0)GOTO 103                                       00025600
      WFCOST=1.E05*SUM1(K,1)/SUM1(K,2)                                   00025610
      GOTO 104                                                           00025620
  103 WFCOST =0.0                                                        00025630
C                                                                        00025640
  104 TTHRML=TTHRML+SUM1(K,2)                                            00025650
C                                                                        00025660
      TFUEL=TFUEL+SUM1(K,1)                                              00025670
C                                                                        00025680
      AVFUEL=100.0*SUM1(K,1)/SUM1(K,3)                                   00025690
C                                                                        00025700
      TELEC=TELEC+SUM1(K,3)                                              00025710
C                                                                        00025720
      AVHEAT=1000.*SUM1(K,2)/SUM1(K,3)                                   00025730
C                                                                        00025740
      IF(UNLOAD(K).EQ.4) HYELEC=HYELEC+SUM1(K,3)                         00025750
      CAPFAC=100.*SUM1(K,3)/(UNCAP*SUMHRS)                               00025760
C                                                                        00025770
      IF(FILE.GT.0)WRITE(FILE,1300)(UNAME(I,K),I=1,5),LDTYP(UNLOAD(K)),  00025780
     +             FUEL(PRIFUL(K)),AVFUEL,(SUM1(K,I),                    00025790
     +             I=1,3),AVHEAT,CAPFAC,OPAVL,UNCAP,WFCOST               00025800
      GOTO 400                                                           00025810
  300 IF(FILE.GT.0)WRITE(FILE,1350)(UNAME(I,K),I=1,5),LDTYP(UNLOAD(K)),  00025820
```

```
     +                FUEL(PRIFUL(K)),ZERO,ZERO,ZERO,UPAVL,UNCAP,WFCOST      00025830
 400      INDEX=INDEX+1                                                      00025840
          IF(INDEX.LE.NUNITS)GOTO 100                                        00025850
          IF(FILE.EQ.0)GOTO 900                                              00025860
C                                                                            00025870
C     CALCULATE TOTAL AVERAGES                                               00025880
C                                                                            00025890
          AVHEAT=1000.*TTHRML/(TELEC-HYELEC)                                 00025900
          CAPFAC=100.0*TELEC/(CAPPER*SUMHRS)                                 00025910
          AVFUEL=1000.*TFUEL/(TELEC-HYELEC)                                  00025920
          WFCOST=1.205*(TFUEL/TTHRML)                                        00025930
          TOTENG=UNENGY+TELEC                                                00025940
C                                                                            00025950
C     WRITE TOTALS AND ENERGY PARAMETERS                                     00025960
C                                                                            00025970
          WRITE(FILE,1400) AVFUEL,TFUEL,TTHRML,TELEC,AVHEAT,                 00025980
     +               CAPFAC,CAPPER,WFCOST                                    00025990
          WRITE(FILE,1500) UNENGY                                            00026000
          WRITE(FILE,1600) TOTENG                                            00026010
 900      RETURN                                                             00026020
 909      FORMAT('1'//5X,'THE VIRGINIA STATE CORPORATION COMMISSION''S'/     00026030
     +       5X,'PRODUCTION COST SIMULATION (PCS) MODEL'//                   00026040
     +       5X,'STUDY TITLE:  ',20A4///)                                    00026050
1000     FORMAT(42X,8A4// 40X,'EXPECTED UNIT OPERATING'                      00026060
     +       ,' CHARACTERISTICS DURING'/ 51X,A3,',',I5,' -- ',A3,',',I5)    00026070
1100     FORMAT('0',32X,'AVERAGE   TOTAL',43X,'OPERATING',10X,'WEIGHTED'    00026080
     +/35X,'FUEL      FUEL     THERMAL     ELECTRIC    ',                   00026090
     +'AVERAGE  CAPACITY  AVAIL-     UNIT     AVERAGE')                      00026100
1200     FORMAT(' ',21X,'LOAD  FUEL   COST     COST      ENERGY   GENERATION00026110
     + ',','HEAT RATE  FACTOR  ABILITY  CAPACITY FUEL COST'/5X,              00026120
     +'UNIT NAME',3X,'TYPE  TYPE ($/MWH)   ($000)   (MMBTU)',6X,           00026130
     +'(MWH)   (BTU/KWH)  (PCT)    (PCT)      (MW)  (CTS/MMBTU)'/)          00026140
```

```
1300  FORMAT(' ',5A4,1X,A4,2X,A4,2X,F5.2,3X,F7.1,3X,F9.0,2X,F9.          00026150
     +     0,4X,F6.0,2X,F5.1,4X,F5.1,3X,F7.0,4X,F6.2)                   00026160
1350  FORMAT(' ',5A4,1X,A4,2X,A4,2X,5X,3X,F7.1,3X,F9.0,2X,F9.0,          00026170
     +     4X,6X,2X,5X,4X,F5.1,3X,F7.0,4X,F6.2)                        00026180
1400  FORMAT('0','TOTALS',27X,F5.2,1X,F9.1,2X,F10.0,2X,F9.0,             00026190
     +     4X,F6.0,2X,F5.1,12X,F7.0,4X,F6.2)                           00026200
1500  FORMAT('-','UNSERVED ENERGY        (MWH)',2X,F10.0)              00026210
1600  FORMAT(' ','TOTAL ENERGY REQUIRED (MWH)',2X,F10.0)               00026220
      END                                                              00026230
C=================================================================================00026240
C                                                                      00026250
C  ROUTINE:          **** R E P R T 4 ****                             00026260
C                                                                      00026270
C  PURPOSE:                                                            00026280
C    TO WRITE A REPORT SUMMARIZING GENERATION AND FUEL USAGE BY FUEL   00026290
C    TYPE AND LOADING TYPE ON A QUARTERLY AND ANNUAL BASIS.            00026300
C                                                                      00026310
C  INPUT VARIABLES:                                                    00026320
C    UNSERV     UNSERVED ENERGY BY MONTH                              00026330
C    START      FIRST MONTH OF STUDY PERIOD                           00026340
C    MONTH      FINAL MONTH OF STUDY PERIOD                           00026350
C    FILE       LOGICAL UNIT TO WHICH REPORT IS TO BE WRITTEN         00026360
C    SUM2       THERMAL, ELECTRIC, AND COST TOTALS BY FUEL TYPE       00026370
C    SUM3       THERMAL, ELECTRIC, AND COST TOTALS BY LOADING TYPE    00026380
C    COMPNA     COMPANY NAME                                          00026390
C    YEAR       YEAR OF STUDY                                         00026400
C    TELEC      TOTAL GENERATION IN MWH                               00026410
C    TTHRML     TOTAL THERMAL ENERGY IN MEGA-BTU                      00026420
C                                                                      00026430
C  OUTPUT VARIABLES:                                                   00026440
C    FCOST      TOTAL FUEL COST IN THOUSANDS OF DOLLARS               00026450
C    TAVCST     TOTAL AVERAGE FUEL COST IN DOLLARS/MWH                00026460
C    UNENGY     TOTAL UNSERVED ENERGY, IN MWH                         00026470
C                                                                      00026480
C  AUTHOR:                                                             00026490
C    NATIONAL REGULATORY RESEARCH INSTITUTE                            00026500
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C                                                                       00026510
C  LAST REVISED:  10/79                                                 00026520
C                                                                       00026530
C=======================================================================00026540
C                                                                       00026550
      SUBROUTINE REPRT4(START,MONTH,UNSERV,COMPNA,SUM2,SUM3,YEAR,FILE,  00026560
     +                  TELEC,TTHRML,FCOST,TAVCST,UNENGY)               00026570
C                                                                       00026580
      IMPLICIT INTEGER (A-Z)                                            00026590
C                                                                       00026600
      REAL COMPNA(8),UNSERV(12),SUM2(10,3),SUM3(4,3),                   00026610
     +     THRATE,AVCOST,TAVCST,HRATE,FCOST,                            00026620
     +     TELEC,TTHRML,TOTENG,UNENGY                                   00026630
      INTEGER FUEL (10) /'COAL','NUCL','OIL','NOIL','NGAS',            00026640
     +                   'GASO','HYDR',' ',' ',' '/                     00026650
      INTEGER MONTHS (12) /'JAN','FEB','MAR','APR','MAY','JUN',        00026660
     +                   'JUL','AUG','SEP','OCT','NOV','DEC'/          00026670
      INTEGER LOADTP(4) /'BASE','CYCL','PEAK','HYDR'/                   00026680
C                                                                       00026690
C     *** I N I T I A L I Z E ***                                       00026700
C                                                                       00026710
      FCOST=0.0                                                         00026720
      THRATE=0.0                                                        00026730
      UNENGY=0.0                                                        00026740
      IF(FILE.EQ.0)GOTO 200                                             00026750
      WRITE(FILE,1000) MONTHS(START),YEAR,                              00026760
     +      MONTHS(MONTH),YEAR,COMPNA                                   00026770
      WRITE(FILE,1100)                                                  00026780
      WRITE(FILE,1200)                                                  00026790
C                                                                       00026800
C    CALCULATE AND WRITE PARAMETERS ON THE BASIS OF FUEL TYPE           00026810
C                                                                       00026820
  200 DO 500 FLTYPE=1,8                                                 00026830
          IF(SUM2(FLTYPE,2).EQ.0.)GOTO 500                              00026840
          AVCOST=1000.*SUM2(FLTYPE,3)/SUM2(FLTYPE,2)                    00026850
          HRATE= 1000.*SUM2(FLTYPE,1)/SUM2(FLTYPE,2)                    00026860
          FCOST=FCOST+SUM2(FLTYPE,3)                                    00026870
          IF(FILE.GT.0)WRITE(FILE,1300) FUEL(FLTYPE),                   00026880
     +          (SUM2(FLTYPE,I),I=1,3),HRATE,AVCOST                     00026890
  500 CONTINUE                                                          00026900
```

```
C                                                                       00026910
C      WRITE HYDRO GENERATION                                           00026920
C                                                                       00026930
       IF(FILE.GT.0)WRITE(FILE,2500) FUEL(7),SUM2(7,2)                  00026940
C                                                                       00026950
C     CALCULATE AND WRITE TOTALS                                        00026960
C                                                                       00026970
       THRATE=1000.*TTHRML/(TELEC-SUM2(7,2))                            00026980
       TAVCST=1000.*FCOST/(TELEC-SUM2(7,2))                             00026990
       IF(FILE.EQ.0)GOTO 610                                            00027000
       WRITE(FILE,1300) TTHRML,TELEC,FCOST,THRATE,TAVCST                00027010
       WRITE(FILE,1001)                                                 00027020
       WRITE(FILE,1100)                                                 00027030
       WRITE(FILE,1200)                                                 00027040
C                                                                       00027050
C     CALCULATE AVERAGES AND WRITE PARAMETERS BY LOADING TYPE           00027060
C                                                                       00027070
       DO 600 LDTYPE=1,3                                                00027080
          IF(SUM3(LDTYPE,2).LE.0.)GOTO 600                              00027090
          AVCOST=1000.*SUM3(LDTYPE,3)/SUM3(LDTYPE,2)                    00027100
          HRATE=1000.*SUM3(LDTYPE,1)/SUM3(LDTYPE,2)                     00027110
          WRITE(FILE,1200) LOADTP(LDTYPE),(SUM3(LDTYPE,I),              00027120
      +          I=1,3),HRATE,AVCOST                                    00027130
  600  CONTINUE                                                         00027140
C                                                                       00027150
C      WRITE HYDRO GENERATION                                           00027160
C                                                                       00027170
       WRITE(FILE,2500) LOADTP(4),SUM3(4,2)                             00027180
```

```
      WRITE(FILE,1300) TTHRML,TELEC,FCOST,THKATE,TAVCST                  00027190
C                                                                        00027200
C     TOTAL UNSERVED ENERGY FOR THE PERIOD                               00027210
C                                                                        00027220
 610  DO 700 MO=START,MONTH                                              00027230
      UNENGY=UNENGY+UNSERV(MONTH)                                        00027240
 700  CONTINUE                                                           00027250
      IF(FILE.EQ.0)GOTO 900                                              00027260
C                                                                        00027270
C     WRITE SYSTEM TOTALS                                                00027280
C                                                                        00027290
      TOTENG=TELEC+UNENGY                                                00027300
      WRITE(FILE,1900)                                                   00027310
      WRITE(FILE,2000) TTHRML                                            00027320
      WRITE(FILE,2100) TELEC                                             00027330
      WRITE(FILE,2200) FCOST                                             00027340
      WRITE(FILE,2300) UNENGY                                            00027350
      WRITE(FILE,2400) TOTENG                                            00027360
 900  RETURN                                                             00027370
C                                                                        00027380
C     *** F O R M A T S ***                                              00027390
C                                                                        00027400
1000  FORMAT('1',A3,',',I5,' -- ',A3,',',I5,' PROJECTED GENERATION AND '00027410
     +      ,'FUEL USE SUMMARY'/' FOR ',8A4 // ' SYSTEM ',               00027420
     +      'PARAMETERS BY FUEL TYPE:')                                  00027430
1001  FORMAT('0','SYSTEM PARAMETERS BY LOAD TYPE:')                      00027440
1100  FORMAT(' '/  15X,' THERMAL       ELECTRIC',16X,' AVERAGE ',        00027450
     +      '   AVERAGE'/15X,' ENERGY        ENERGY       FUEL COST',   00027460
     +      '  HEAT RATE    COST'/                                       00027470
     +     15X,' (MMBTU)         (MWH)         ($000)    (BTU/KWH)    ',00027480
     +     '($/MWH)')                                                   00027490
1200  FORMAT(' ',6X,A4,1X,3(3X,F10.0),3X,F7.0,5X,F5.2)                   00027500
1300  FORMAT(' ',6X,'TOTALS',2X,F10.0,2(3X,F10.0),3X,F7.0,               00027510
     +      5X,F5.2)                                                     00027520
```

```
1900   FORMAT(' '/' SYSTEM GENERATION PARAMETERS:'/)                          00027530
2000   FORMAT(' TOTAL THERMAL ENERGY       (MMBTU)',2X,F10.0)                 00027540
2100   FORMAT(' TOTAL ELECTRICAL GENERATION (MWH)',2X,F10.0)                  00027550
2200   FORMAT(' TOTAL FUEL COST              ($000)',2X,F10.0)                00027560
2300   FORMAT(' TOTAL UNSERVED ENERGY         (MWH)',2X,F10.0)                00027570
2400   FORMAT(' TOTAL ENERGY REQUIRED         (MWh)',2X,F10.0)                00027580
2500   FORMAT(7X,A4,17X,F10.0)                                                00027590
       END                                                                    00027600
C=============================================================================00027610
C                                                                             00027620
C  ROUTINE:           **** R E P R T 5 ****                                   00027630
C                                                                             00027640
C  PURPOSE:                                                                   00027650
C    TO WRITE A REPORT SUMMARIZING MONTHLY FUEL USAGE.                        00027660
C                                                                             00027670
C  INPUT VARIABLES:                                                           00027680
C    UNSERV     UNSERVED ENERGY BY MONTH, IN MWH                             00027690
C    UNENGY     TOTAL UNSERVED ENERGY, IN MWH                                00027700
C    MONTH1     FIRST MONTH OF STUDY PERIOD                                  00027710
C    MONTH      FINAL MONTH OF STUDY PERIOD                                  00027720
C    FILE       LOGICAL UNIT TO WHICH REPORT IS TO BE WRITTEN                00027730
C    MSUM2      MONTHLY ELECTRIC AND COST TOTALS BY FUEL TYPE                00027740
C    ASUM2      ANNUAL THERMAL, ELECTRIC, AND COST TOTALS BY FUEL TYPE       00027750
C    COMPNA     COMPANY NAME                                                 00027760
C    YEAR       YEAR OF STUDY                                                00027770
C    TELEC      TOTAL GENERATION IN MWH                                      00027780
C    FCOST      TOTAL FUEL COST IN KILO DOLLARS                              00027790
C    TAVCST     RATIO OF TOTAL FUEL COST TO TOTAL GENERATION, IN $/MWH       00027800
C                                                                             00027810
C  AUTHOR:                                                                    00027820
C    NATIONAL REGULATORY RESEARCH INSTITUTE, OCTOBER 1979                     00027830
C                                                                             00027840
C=============================================================================00027850
C                                                                             00027860
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      SUBROUTINE RLPRTS(MONTH1,MONTH,YEAR,COMPNA,FILE,MSUM2,
     +                  ASUM2,TELEC,FCOST,TAVCST,UNSERV,UNENGY)
C
      REAL COMPNA(6),MSUM2(12,11,3),ASUM2(10,3),RLINE(13),UNSERV(12)
      INTEGER FUEL(7)/'COAL','NUCL','LOIL','HOIL','NGAS','GASO','HYDR'/
      INTEGER MONTHS(13)/'JAN ','FEB ','MAR ','APR ','MAY ','JUN ',
     +            'JUL ','AUG ','SEP ','OCT ','NOV ','DEC ','TOTL'/
      INTEGER FLTYPE,FILE,YEAR
      DATA RLINE/13*0./
C
      WRITE(FILE,100)MONTHS(MONTH1),YEAR,MONTHS(MONTH),YEAR,COMPNA,
     +               (MONTHS(I),I=MONTH1,MONTH),MONTHS(13)
C
C     WRITE ENERGY GENERATED, FUEL COST, AND COST PER UNIT ENERGY
C     FOR EACH FUEL TYPE
C
      DO 200 FLTYPE=1,7
      IF(ASUM2(FLTYPE,2).LE.0.)GOTO 200
      WRITE(FILE,110)FUEL(FLTYPE),(MSUM2(I,FLTYPE,1),I=MONTH1,MONTH),
     +               ASUM2(FLTYPE,2)
      WRITE(FILE,102)(MSUM2(I,FLTYPE,2),I=MONTH1,MONTH),ASUM2(FLTYPE,3)
      DO 100 I=MONTH1,MONTH
  100 RLINE(I)=1000.*MSUM2(I,FLTYPE,2)/MSUM2(I,FLTYPE,1)
      RLINE(13)=1000.*ASUM2(FLTYPE,3)/ASUM2(FLTYPE,2)
      WRITE(FILE,103)(RLINE(I),I=MONTH1,MONTH),RLINE(13)
  200 CONTINUE
C
C     WRITE TOTALS ACROSS FUEL TYPES
C
      WRITE(FILE,120)(MSUM2(I,11,1),I=MONTH1,MONTH),TELEC
      WRITE(FILE,102)(MSUM2(I,11,2),I=MONTH1,MONTH),FCOST
      WRITE(FILE,103)(MSUM2(I,11,3),I=MONTH1,MONTH),TAVCST
C
```

```
C
C     WRITE UNSERVED ENERGY                                                    00028260
C                                                                              00028210
      WRITE(FILE,1301)(UNSERV(I),I=MONTH1,MONTH),UNENGY                        00028220
C                                                                              00028230
C     WRITE TOTAL OF GENERATED AND UNSERVED ENERGY                             00028240
C                                                                              00028250
      DO 300 I=MONTH1,MONTH                                                    00028260
  300 RLINE(I)=MSUM2(1,11,I)+UNSERV(I)                                         00028270
      RLINE(13)=TELEC+UNENGY                                                   00028280
      WRITE(FILE,1302)(RLINE(I),I=MONTH1,MONTH),RLINE(13)                      00028290
      RETURN                                                                   00028300
C                                                                              00028310
C     FORMATS                                                                  00028320
C                                                                              00028330
1001  FORMAT('1',A3,',',I5,' -- ',A3,',',I5,' MONTHLY FUEL USAGE',            00028340
     +       ' SUMMARY'/' FOR ',8A4//15X,13(5X,A4))                            00028350
1101  FORMAT(/' ',A4/'   ENERGY  (GWH)',13(-3PF9.0))                           00028360
1102  FORMAT(         '   COST  (KILO$)',13F9.0)                               00028370
1103  FORMAT(         '   COST  ($/MWH)',13F9.2)                               00028380
1201  FORMAT(//' TOTALS FOR FUELS:'/'   GENERATED'                             00028390
     +        /'    ENERGY (GWH)',13(-3PF9.0))                                00028400
1301  FORMAT( /' UNSERVED'                                                     00028410
     +        /'   ENERGY  (GWH)',13(-3PF9.0))                               00028420
1302  FORMAT( /' TOTAL'                                                        00028430
     +        /'   ENERGY  (GWH)',13(-3PF9.0))                               00028440
      END                                                                      00028450
C=============================================================================00028460
C                                                                              00028470
C  ROUTINE:          **** U N I F O S ****                                     00028480
C                                                                              00028490
C  PURPOSE:                                                                    00028500
C    TO READ THE NUCLEAR- AND FOSSIL-FUELED UNITS' DATA FROM LOGICAL           00028510
C    UNIT PFUNIT.  THE OPERATION CHARACTERISTICS ARE READ AND STORED FOR       00028520
C    EACH MONTH OF THE STUDY.  ALSO THE UNIT CAPACITY AVAILABLE TO THE         00028530
C    COMPANY IS CALCULATED.                                                    00028540
```

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C                                                                               00028550
C  INPUT VARIABLES:                                                             00028560
C     PFUNIT     LOGICAL UNIT FROM WHICH UNIT INFORMATION IS READ               00028570
C     IYEAR      FOUR-DIGIT STUDY-YEAR                                          00028580
C     NBSTEP     NUMBER OF LOADING STEPS FOR BASE UNITS                         00028590
C     NCSTEP     NUMBER OF LOADING STEPS FOR CYCLING UNITS                      00028600
C     NPSTEP     NUMBER OF LOADING STEPS FOR PEAKING UNITS                      00028610
C                                                                               00028620
C  OUTPUT VARIABLES:                                                            00028630
C     AUPAVL     ANNUAL UNIT PRODUCTION AVAILABILITY                            00028640
C     CAPCST     CAPITAL COST OF UNIT IN DOLLARS PER INSTALLED KW               00028650
C     VSCCNO     UNIT NUMBER ASSIGNED BY VSCC                                   00028660
C     UNAME      UNIT NAME                                                      00028670
C     FRAOWN     FRACTION OF UNIT OWNED BY COMPANY                              00028680
C     UNTYPE     THE CLASSIFICATION OF THE UNIT:                                00028690
C                                1-STEAM FOSSIL, 2-STEAM NUCLEAR,             00028700
C                                3-I.C. ENGINE, 4-GAS TURBINE,                00028710
C                                5-JET ENGINE, 6-HYDRO,                       00028720
C                                7-PUMPED STORAGE                             00028730
C     UNLOAD     UNIT LOADING TYPE: 1-BASE, 2-CYCLING, 3-PEAKING, 4-HYDRO     00028740
C     PRIFUL     PRIMARY FUEL USED BY EACH UNIT:                              00028750
C                    1-COAL          5-NATURAL GAS                            00028760
C                    2-NUCLEAR       6-GASOLINE                               00028770
C                    3-LIGHT OIL     7-WATER                                  00028780
C                    4-HEAVY OIL     8-NONE                                   00028790
C     ALTFUL     ALTERNATE FUEL USED BY EACH UNIT, AS IN PRIFUL               00028800
C     IGFUEL     IGNITION FUEL USED BY EACH UNIT, AS IN PRIFUL                00028810
C     UNLIMO     THE MONTH THAT THE UNIT WENT INTO COMMERCIAL SERVICE         00028820
C     UNLIYR     THE YEAR THE UNIT WENT INTO SERVICE                          00028830
C     OPLIMO     THE LAST MONTH THE UNIT IS EXPECTED TO REMAIN IN SERVICE     00028840
C     OPLIYR     THE LAST YEAR THE UNIT IS EXPECTED TO REMAIN IN SERVICE      00028850
C     UNETCP     UNLIMITED NET CAPACITY OF UNIT                               00028860
C     LNETCP     LIMITED NET CAPACITY OF UNIT                                 00028870
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C     BLKCAP    CUMULATIVE BLOCK CAPACITIES FOR EACH UNIT, IN MW          00028880
C     HEATR1    HEAT RATE FOR FIRST BLOCK, IN BTU/KWH                     00028890
C     HEATR2    HEAT RATE FOR SECOND BLOCK, IN BTU/KWH                    00028900
C     HEATR3    HEAT RATE FOR THIRD BLOCK, IN BTU/KWH                     00028910
C     EAVAIL    EFFECTIVE AVAILABILITY                                    00028920
C     PBTUCT    PRIMARY FUEL COST IN CENTS/MEGA-BTU                       00028930
C     ABTUCT    COST OF ALTERNATE FUEL IN CENTS PER MEGA-BTU              00028940
C     LAMDA1    LOADING PRIORITY FOR THE UNIT'S FIRST BLOCK               00028950
C     LAMDA2    LOADING PRIORITY FOR THE UNIT'S SECOND BLOCK              00028960
C     LAMDA3    LOADING PRIORITY FOR THE UNIT'S THIRD BLOCK               00028970
C     PGENFC    FRACTION OF GENERATION USING PRIMARY FUEL                 00028980
C     IDBASE    LOCATION OF EACH BASE UNIT IN THE ORDER OF READING        00028990
C     IDCYCL    LOCATION OF EACH CYCLING UNIT IN THE ORDER OF READING     00029000
C     IDPEAK    LOCATION OF PEAKING UNITS IN THE ORDER OF READING         00029010
C     NBASE     THE NUMBER OF BASE UNITS                                  00029020
C     NCYCL     THE NUMBER OF CYCLING UNITS                               00029030
C     NPEAK     THE NUMBER OF PEAKING UNITS                               00029040
C     NUNITS    THE TOTAL NUMBER OF UNITS                                 00029050
C                                                                         00029060
C  NOTES:                                                                 00029070
C    PROGRAM WILL END ABNORMALLY SHOULD AN UNEXPECTED EOF                 00029080
C    OCCUR OR IF THE YEAR ON FILE DOES NOT MATCH THAT ANTICIPATED.        00029090
C                                                                         00029100
C  AUTHOR:                                                                00029110
C    NATIONAL REGULATORY RESEARCH INSTITUTE                               00029120
C                                                                         00029130
C  LAST REVISED:  10/79                                                   00029140
C                                                                         00029150
C=========================================================================00029160
C                                                                         00029170
      SUBROUTINE UNIFOS(PFUNIT,VSCCNO,UNAME,FRAOWN,UNTYPE,                00029180
     +          UNLOAD,PRIFUL,ALTFUL,IGFUEL,ONLIMO,ONLIYR,OFLIMO,          00029190
     +             OFLIYR,AUPAVL,CAPCST,UNETCP,LNETCP,HEATR1,HEATR2,       00029200
     +             HEATR3,EAVAIL,PBTUCT,ABTUCT,LAMDA1,LAMDA2,              00029210
     +             LAMDA3,BLKCAP,PGENFC,NBASE,IDBASE,NCYCL,IDCYCL,NPEAK,   00029220
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     +           IDPEAK,NUNITS,IYEAR,NBSTEP,NCSTEP,NPSTEP)                    00029230
C                                                                             00029240
      INTEGER*2 UNLIMO(100),OFLIMO(100),UNLIYR(100),OFLIYR(100)               00029250
      INTEGER*2 IDBASE(50),IDCYCL(50),IDPEAK(50)                              00029260
      INTEGER*2 UNTYPE(100),UNLOAD(100),UNETCP(100),LNETCP(100)               00029270
      INTEGER*2 PRIFUL(100),ALTFUL(100),IGFUEL(100)                           00029280
      INTEGER*2 LAMDA1(100,12),LAMDA2(100,12),LAMDA3(100,12)                  00029290
C                                                                             00029300
      INTEGER VSCCNO(100),UNAME(5,100),PFUNIT                                 00029310
      REAL HEATR1(100,12),HEATR2(100,12),HEATR3(100,12),BLKCAP(100,12,3)      00029320
      REAL FRAOWN(100),AUPAVL(100),CAPCST(100)                                00029330
      REAL EAVAIL(100,12),PBTUCT(100,12),ABTUCT(100,12)                       00029340
      REAL PGENFC(100,12),DISPCT(100,12)                                      00029350
C                                                                             00029360
C                                                                             00029370
C     *** INITIALIZE COUNTERS NBASE, NCYCL, NPEAK ***                         00029380
C                                                                             00029390
      NBASE=0                                                                 00029400
      NCYCL=0                                                                 00029410
      NPEAK=0                                                                 00029420
C                                                                             00029430
C     INCREMENT UNIT COUNTER                                                  00029440
C                                                                             00029450
   10 NUNITS=NUNITS+1                                                         00029460
C                                                                             00029470
C     *** READ FIRST LINE OF UNIT INFORMATION ***                             00029480
C                                                                             00029490
      READ(PFUNIT,90,END=99) VSCCNO(NUNITS),(UNAME(K,NUNITS),K=1,             00029500
     + 5),FRAOWN(NUNITS),UNTYPE(NUNITS),UNLOAD(NUNITS),PRIFUL(NUNITS),        00029510
     + ALTFUL(NUNITS),IGFUEL(NUNITS),UNLIMO(NUNITS),UNLIYR(NUNITS),           00029520
     + OFLIMO(NUNITS),OFLIYR(NUNITS),AUPAVL(NUNITS),CAPCST(NUNITS),           00029530
     + UNETCP(NUNITS),LNETCP(NUNITS)                                          00029540
```

```
C                                                                       00029550
C     *** READ MONTHLY UNIT DATA ***                                    00029560
C                                                                       00029570
      I=UNLOAD(NUNITS)                                                  00029580
      DO 28 K=1,12                                                      00029590
      READ(PFUNIT,100,END=70)MO,IYR,BLKCAP(NUNITS,MO,1),HEATR1(NUNITS00029600
     +,MO),BLKCAP(NUNITS,MO,2),HEATR2(NUNITS,MO),BLKCAP(NUNITS,MO,3),   00029610
     +HEATR3(NUNITS,MO),EAVAIL(NUNITS,MO),PBTUCT(NUNITS,MO),            00029620
     +ABTUCT(NUNITS,MO),PGENFC(NUNITS,MO),L1,L2,L3                      00029630
      IF((IYR+1900).NE.IYEAR)GOTO 80                                    00029640
C                                                                       00029650
C     *** REDUCE BLOCK CAPACITY TO THAT OWNED BY THE COMPANY ***        00029660
C                                                                       00029670
      BLKCAP(NUNITS,MO,1)=FRAOWN(NUNITS)*BLKCAP(NUNITS,MO,1)            00029680
      BLKCAP(NUNITS,MO,2)=FRAOWN(NUNITS)*BLKCAP(NUNITS,MO,2)            00029690
      BLKCAP(NUNITS,MO,3)=FRAOWN(NUNITS)*BLKCAP(NUNITS,MO,3)            00029700
C                                                                       00029710
C     *** MODIFY ZERO-VALUE LAMBDAS ***                                 00029720
C                                                                       00029730
      IF((L1.GT.0).AND.(L2.GT.0).AND.(L3.GT.0))GOTO 18                  00029740
      IF((L1.GT.0).OR.(L2.GT.0).OR.(L3.GT.0))GOTO 14                    00029750
      LAMDA1(NUNITS,MO)=999                                             00029760
      LAMDA2(NUNITS,MO)=999                                             00029770
      LAMDA3(NUNITS,MO)=999                                             00029780
      GOTO 20                                                           00029790
   14 IF((L1.LE.0).AND.(L1.LT.L2))L1=L2                                 00029800
      IF((L1.LE.0).AND.(L1.LT.L3))L1=L3                                 00029810
      IF((L2.LE.0).AND.(L2.LT.L1))L2=L1                                 00029820
      IF((L2.LE.0).AND.(L2.LT.L3))L2=L3                                 00029830
      IF((L3.LE.0).AND.(L3.LT.L1))L3=L1                                 00029840
      IF((L3.LE.0).AND.(L3.LT.L2))L3=L2                                 00029850
   18 LAMDA1(NUNITS,MO)=L1                                              00029860
      LAMDA2(NUNITS,MO)=L2                                              00029870
      LAMDA3(NUNITS,MO)=L3                                              00029880
C                                                                       00029890
C     *** MODIFY LAMBDAS AS REQUIRED TO USE THE ***                     00029900
```

```
C          SPECIFIED NUMBER OF LOADING STEPS
C
   20  IF(I.LT.1.OR.I.GT.3)GOTO 26
       GOTO (21,22,23),I
   21  NSTEP=NBSTEP
       GOTO 25
   22  NSTEP=NCSTEP
       GOTO 25
   23  NSTEP=NPSTEP
   25  IF(NSTEP.NE.1)GOTO 26
C      SINGLE-STEP LOADING
       LAMDA3(NUNITS,MD)=LAMDA1(NUNITS,MD)
       LAMDA1(NUNITS,MD)=0
       GOTO 27
   26  IF(NSTEP.NE.2)GOTO 28
C      TWO-STEP LOADING
       LAMDA3(NUNITS,MD)=LAMDA2(NUNITS,MD)
   27  LAMDA2(NUNITS,MD)=0
   28     CONTINUE
C
C         *LOAD UNIT ID ARRAYS
C
          GOTO (30,40,50),I
C
C            *** LOAD BASE ARRAY ***
C
   30         NBASE=NBASE+1
              IDBASE(NBASE)=NUNITS
              GOTO 10
C
C            *** LOAD CYCL ARRAY
C
   40         NCYCL=NCYCL+1
              IDCYCL(NCYCL)=NUNITS
              GOTO 10
```

```
C                                                                       00030260
C            *** LOAD PEAK ARRAY                                        00030270
C                                                                       00030280
  50         NPEAK=NPEAK+1                                              00030290
             IDPEAK(NPEAK)=NUNITS                                       00030300
             GOTO 10                                                    00030310
C                                                                       00030320
C          *** SET NUMBER OF UNITS                                      00030330
C                                                                       00030340
  60       NUNITS=NUNITS-1                                            00030350
       RETURN                                                           00030360
C                                                                       00030370
C      *** ERROR MESSAGES ***                                           00030380
C                                                                       00030390
  70   WRITE(6,110)                                                     00030400
       STOP 10                                                          00030410
  80   WRITE(6,120)IYEAR                                                00030420
       STOP 20                                                          00030430
C                                                                       00030440
C      *** F O R M A T S ***                                            00030450
C                                                                       00030460
  90   FORMAT(2X,I6,1X,5A4,1X,F4.2,5(1X,I1),2(1X,I2,1X,                 00030470
     +  I4),2(1X,F4.0),2(1X,I4))                                        00030480
 100   FORMAT(I2,1X,I2,7X,2(1X,F3.0,1X,F5.0),1X,F4.0,1X,F5.0,1X,F4.0,   00030490
     +       2(1X,F6.0),1X,F4.0,3(1X,I3))                               00030500
 110   FORMAT('0********* UNEXPECTED END-OF-FILE ENCOUNTERED *****',    00030510
     +      '*****'/'          WHILE READING MONTHLY FOSSIL DATA')      00030520
 120   FORMAT('0********FOSSIL DATA FILE''S YEAR DOES NOT MATCH STUDY YEA00030530
     +R ',I4,' ********')                                               00030540
       END                                                              00030550
C=======================================================================00030560
C                                                                       00030570
C  ROUTINE:          **** U N I H Y D ****                              00030580
```

```
C                                                                       00030590
C  PURPOSE: TO READ THE HYDRO UNIT DATA FROM UNIT HYUNIT AND STORE      00030600
C    THEM BY UNIT AND MONTH                                             00030610
C                                                                       00030620
C                                                                       00030630
C  INPUT VARIABLES:                                                     00030640
C    HYUNIT    LOGICAL UNIT FROM WHICH HYDRO INFORMATION IS READ       00030650
C    IYEAR     FOUR-DIGIT STUDY-YEAR                                   00030660
C    NHSTEP    NUMBER OF LOADING STEPS FOR HYDRO UNITS                 00030670
C                                                                       00030680
C  OUTPUT VARIABLES:                                                    00030690
C    VSCCNO    UNIT ID NUMBER                                          00030700
C    UNAME     NAME OF UNIT                                            00030710
C    FRAOWN    FRACTION OWNED BY COMPANY                               00030720
C    UNTYPE    TYPE OF GENERATION UNIT: 1-STEAM FOSSIL, 2-STEAM NUCLEAR,00030730
C              3-I.C. ENGINE, 4-GAS TURBINE, 5-JET ENGINE, 6-HYDRO,    00030740
C              7-PUMPED STORAGE                                        00030750
C    UNLOAD    LOADING TYPE OF UNIT:  1-BASE, 2-CYCLE, 3-PEAK, 4-HYDRO 00030760
C    HYTYPE    TYPE OF HYDRO UNIT:  1-RUN OF RIVER, 2-STORAGE, 3-PUMPED00030770
C              STORAGE                                                 00030780
C    PRIFUL    PRIMARY FUEL FOR UNIT:  1-COAL, 2-NUCLEAR, 3-LIGHT OIL, 00030790
C              4-HEAVY OIL, 5-NATURAL GAS, 6-GASOLINE, 7-WATER, 8-NONE 00030800
C    ONLIMO    ON-LINE MONTH FOR UNIT                                  00030810
C    ONLIYR    ON-LINE YEAR FOR UNIT                                   00030820
C    OFLIMO    OFF-LINE MONTH FOR UNIT                                 00030830
C    OFLIYR    OFF-LINE YEAR FOR UNIT                                  00030840
C    AUPAVL    ANNUAL UNIT PRODUCTION AVAILABILITY                     00030850
C    CAPCST    CAPACITY COST                                           00030860
C    UNETCP    UNLIMITED NET CAPACITY OF UNIT                          00030870
C    LNETCP    LIMITED NET CAPACITY OF UNIT                            00030880
C    LAMDA1    LOADING PRIORITY FOR THE UNIT'S FIRST BLOCK             00030890
C    LAMDA2    LOADING PRIORITY FOR THE UNIT'S SECOND BLOCK            00030900
C    LAMDA3    LOADING PRIORITY FOR THE UNIT'S THIRD BLOCK             00030910
```

```
C     NUNITS     CURRENT NUMBER OF UNITS IN SYSTEM                          00030920
C     NHYDRO     NUMBER OF HYDRO UNITS IN SYSTEM                            00030930
C     IDHYDR     LOCATION OF EACH UNIT IN THE ORDER OF READING              00030940
C     ALTFUL     ALTERNATE FUEL CODE, AS IN PRIFUL                          00030950
C     IGFUEL     IGNITION FUEL CODE, AS IN PRIFUL                           00030960
C     UNGEN      PROJECTED GENERATION OF EACH UNIT, IN MWHRS                00030970
C     BLKCAP     CUMULATIVE BLOCK CAPACITIES FOR EACH UNIT, IN MW           00030980
C     EAVAIL     EFFECTIVE AVAILABILITY                                     00030990
C     HEATR1     HEAT RATE FOR FIRST BLOCK, IN BTU/KWH                      00031000
C     HEATR2     HEAT RATE FOR SECOND BLOCK, IN BTU/KWH                     00031010
C     HEATR3     HEAT RATE FOR THIRD BLOCK, IN BTU/KWH                      00031020
C     PBTUCT     COST OF PRIMARY FUEL IN CENTS/MEGA-BTU                     00031030
C     ABTUCT     COST OF ALTERNATE FUEL IN CENTS/MEGA-BTU                   00031040
C     PGENFC     FRACTION OF GENERATION USING PRIMARY FUEL                  00031050
C                                                                           00031060
C  AUTHOR:                                                                  00031070
C    NATIONAL REGULATORY RESEARCH INSTITUTE                                 00031080
C                                                                           00031090
C  LAST REVISED:  10/79                                                     00031100
C                                                                           00031110
C===========================================================================00031120
C                                                                           00031130
      SUBROUTINE UNIHYD(HYUNIT,VSCCNO,UNAME,FRACWN,UNTYPE,                  00031140
     +                  UNLOAD,HYTYPE,PRIFUL,ONLIMO,UNLIYR,OFLIMO,          00031150
     +                  OFLIYR, CAPCST,UNETCP,LNETCP, LAMDA1,LAMDA2,        00031160
     +                  LAMDA3,BLKCAP,IYEAR,NUNITS,NHYDRO,IDHYDR,UNGEN,     00031170
     +                  NHSTEP,EAVAIL,ALTFUL,IGFUEL,                        00031180
     +                  AUPAVL,HEATR1,HEATR2,HEATR3,PBTUCT,                 00031190
     +                  ABTUCT,PGENFC)                                      00031200
C                                                                           00031210
      REAL FRACWN(100),CAPCST(100)                                          00031220
      REAL UNGEN(10,12),FACON1(10,12),PUMPEN(10,12)                         00031230
      REAL APUMCT(10,12)                                                    00031240
      REAL HEATR1(100,12),HEATR2(100,12),HEATR3(100,12),BLKCAP(100,12,3)    00031250
      REAL AUPAVL(100),EAVAIL(100,12)                                       00031260
```

```
      REAL PBTUCT(100,12),ABTUCT(100,12),PGENFC(100,12)                 00031270
      INTEGER VSCCNO(100),UNAME(5,100),HYUNIT                           00031280
      INTEGER*2 IDHYDR(10),HYTYPE(10),ONLIYR(100),OFLIYR(100)           00031290
      INTEGER*2 ONLIMO(100),OFLIMO(100),UNTYPE(100),UNLOAD(100)         00031300
      INTEGER*2 LAMDA1(100,12),LAMDA2(100,12),LAMDA3(100,12)            00031310
      INTEGER*2 UNETCP(100),LNETCP(100),PRIFUL(100)                     00031320
      INTEGER*2 ALTFUL(100),IGFUEL(100)                                 00031330
C                                                                       00031340
   10 NUNITS=NUNITS+1                                                   00031350
C                                                                       00031360
C     *** READ FIRST LINE OF HYDRO DATA ***                             00031370
C                                                                       00031380
      READ(HYUNIT,60,END=30) VSCCNO(NUNITS),(UNAME(K,NUNITS),K= 1,5),   00031390
     +     FRAOWN(NUNITS),                                              00031400
     +     UNTYPE(NUNITS),UNLOAD(NUNITS),HYTYPE(NUNITS),PRIFUL(NUNITS), 00031410
     +     ONLIMO(NUNITS),ONLIYR(NUNITS),OFLIMO(NUNITS),OFLIYR(NUNITS), 00031420
     +     CAPCST(NUNITS),UNETCP(NUNITS),LNETCP(NUNITS)                 00031430
      ALTFUL(NUNITS)=0                                                  00031440
      IGFUEL(NUNITS)=0                                                  00031450
      AUPAVL(NUNITS)=1.0                                                00031460
C                                                                       00031470
C     *** READ MONTHLY DATA FOR UNITS ***                               00031480
C                                                                       00031490
      DO 20 K=1,12                                                      00031500
         READ(HYUNIT,70,END=40) MO,IYR,(BLKCAP(NUNITS,MO,J),J=1,3),     00031510
     +     LAMDA1(NUNITS,MO),LAMDA2(NUNITS,MO),LAMDA3(NUNITS,MO),       00031520
     +     UNGEN(NUNITS,MO),PUMPEN(NUNITS,MO),APUMCT(NUNITS,MO)         00031530
C                                                                       00031540
C   *** TEST YEAR OF UNIT DATA AGAINST YEAR OF STUDY ***                00031550
C                                                                       00031560
C   *** SCALE DOWN EACH UNIT'S CAPACITY USING THE FRACTION ***          00031570
C       OF COMPANY OWNERSHIP IN UNIT                                    00031580
```

```
C                                                                       00031590
      IF(IYR+1900.NE.IYEAR)GOTO 50                                      00031600
C     SINGLE-STEP LOADING IS ASSUMED                                    00031610
      LAMDA3(NUNITS,MO)=LAMDA1(NUNITS,MO)                               00031620
      IF(LAMDA3(NUNITS,MO).LE.0)LAMDA3(NUNITS,MO)=999                   00031630
      LAMDA2(NUNITS,MO)=0                                               00031640
      LAMDA1(NUNITS,MO)=0                                               00031650
      BLKCAP(NUNITS,MO,3)=FRAOWN(NUNITS)*BLKCAP(NUNITS,MO,3)            00031660
      BLKCAP(NUNITS,MO,2)=0.                                            00031670
      BLKCAP(NUNITS,MO,1)=0.                                            00031680
      EAVAIL(NUNITS,MO)=1.0                                             00031690
      HEATR1(NUNITS,MO)=0.0                                             00031700
      HEATR2(NUNITS,MO)=0.0                                             00031710
      HEATR3(NUNITS,MO)=0.0                                             00031720
      PBTUCT(NUNITS,MO)=0.0                                             00031730
      ABTUCT(NUNITS,MO)=0.0                                             00031740
      PGENFC(NUNITS,MO)=1.0                                             00031750
   20 CONTINUE                                                          00031760
C                                                                       00031770
C     LOAD HYDRO POINTER ARRAY                                          00031780
C                                                                       00031790
      IDHYDR(NHYDRO)=NUNITS                                             00031800
      GOTO 10                                                           00031810
C                                                                       00031820
C     SET NUMBER OF UNITS                                               00031830
C                                                                       00031840
   30 NUNITS=NUNITS-1                                                   00031850
      NHYDRO=NUNITS                                                     00031860
      RETURN                                                            00031870
C                                                                       00031880
C     *** ERROR MESSAGES ***                                            00031890
C                                                                       00031900
   40 WRITE(6,80) HYUNIT                                                00031910
      STOP                                                              00031920
C                                                                       00031930
   50 WRITE(6,90) IYEAR                                                 00031940
```

```
      STOP                                                                      00031950
C                                                                               00031960
C     FORMAT STATEMENTS                                                         00031970
C                                                                               00031980
  60  FORMAT(2X,I6,1X,5A4,1X,F4.0,4(1X,I1),2(1X,I2,1X,I4),1X,F4.0,              00031990
     +     2(1X,I4))                                                          00032000
  70  FORMAT(I2,1X,I2,7X,3(1X,F4.0),3(1X,I3),2(1X,F7.0),1X,F6.3)                00032010
  80  FORMAT(///1X,'******** UNEXPECTED END OF FILE ENCOUNTERED ON UNIT ',I2,   00032020
     +',I2,' IN SUBROUTINE UNITHYD ********')                                   00032030
  90  FORMAT(///1X,'******** HYDRO DATA FILE''S YEAR DOES NOT MATCH STUDY YEAR 00032040
     +',I4,' ********')                                                         00032050
      END                                                                       00032060
C=======================================================================        00032070
C                                                                               00032080
C  ROUTINE:          **** U N I T O N ****                                      00032090
C                                                                               00032100
C  PURPOSE:                                                                     00032110
C    TO FILL AN ARRAY (AVAIL) WITH LOGICAL (TRUE/FALSE)                         00032120
C    VALUES INDICATING WHETHER A PARTICULAR UNIT IS ONLINE                      00032130
C    FOR THE MONTH OF STUDY.                                                    00032140
C                                                                               00032150
C  INPUT VARIABLES:                                                             00032160
C    MOLOW      BEGINNING MONTH OF STUDY                                        00032170
C    YRLOW      BEGINNING YEAR OF STUDY (LAST 2 DIGITS)                         00032180
C    MOHIGH     ENDING MONTH OF STUDY                                           00032190
C    YRHIGH     ENDING YEAR OF STUDY (LAST 2 DIGITS...I.E. 1976 => 76)          00032200
C    NUNITS     NUMBER OF UNITS TO CHECK                                        00032210
C    UNLIMO     MONTH THE UNIT WENT INTO SERVICE                                00032220
C    UNLIYR     YEAR THE UNIT WENT INTO SERVICE                                 00032230
C    OFLIMO     LAST MONTH THE UNIT IS EXPECTED IN SERVICE                      00032240
C    OFLIYR     LAST YEAR THE UNIT IS EXPECTED IN SERVICE                       00032250
C                                                                               00032260
C  OUTPUT VARIABLES:                                                            00032270
C    AVAIL      .TRUE. IF UNIT IS AVAILABLE                                     00032280
C               .FALSE. IF UNIT IS NOT AVAILABLE                                00032290
```

```
C                                                                       00032300
C  AUTHOR:                                                              00032310
C    NATIONAL REGULATORY RESEARCH INSTITUTE                             00032320
C                                                                       00032330
C  LAST REVISED:  10/79                                                 00032340
C                                                                       00032350
C=======================================================================00032360
C                                                                       00032370
      SUBROUTINE UNITON(MOLOW,YRLOW,MOHIGH,YRHIGH,NUNITS,               00032380
     +                  ONLIMO,ONLIYR,OFLIMO,OFLIYR,AVAIL)              00032390
C                                                                       00032400
      IMPLICIT INTEGER (A-Z)                                            00032410
C                                                                       00032420
      INTEGER*2 ONLIMO(1),ONLIYR(1),OFLIMO(1),OFLIYR(1)                 00032430
      LOGICAL AVAIL(100)                                                00032440
C                                                                       00032450
      DO 100 K=1,NUNITS                                                 00032460
C                                                                       00032470
C     DOES THE UNIT COME ONLINE                                         00032480
C     BEFORE THE STUDY BEGINS?                                          00032490
C                                                                       00032500
         IF(YRLOW.LT.ONLIYR(K))GOTO 99                                  00032510
         IF(MOLOW.LT.ONLIMO(K).AND.YRLOW.EQ.ONLIYR(K))                  00032520
     +      GOTO 99                                                     00032530
C                                                                       00032540
C     DOES UNIT GO OFF-LINE BEFORE STUDY ENDS?                          00032550
C                                                                       00032560
         IF(YRHIGH.GT.OFLIYR(K).AND.OFLIYR(K).NE.0)                     00032570
     +         GOTO 99                                                  00032580
         IF(MOHIGH.GT.OFLIMO(K).AND.OFLIYR(K).EQ.YRHIGH)                00032590
     +      GOTO 99                                                     00032600
C                                                                       00032610
C     ASSIGN UNIT'S ON-LINE STATUS                                      00032620
```

```
C
          AVAIL(K)=.TRUE.                                          00032630
          GOTO 100                                                 00032640
C                                                                  00032650
C       ASSIGN UNIT'S OFF-LINE STATUS                              00032660
C                                                                  00032670
   99     AVAIL(K)=.FALSE.                                         00032680
  100   CONTINUE                                                   00032690
        RETURN                                                     00032700
        END                                                        00032710
                                                                   00032720
```

APPENDIX D

Listing of DISPATCH Module

```
DSN=ISU287.DISPATCH.NEW.FORT,VOL=IRCC80

C                                                                       CCCCCC10
C               *** DISPATCH MODULE FOR THE PCS MODULE ***              CCCCC 20
C                                                                       CCCCC30
C                                                                       CCCCC40
C  PURPOSE:                                                             CCCCC50
C    CALCULATE A DISPATCHING ORDER BASED ON THE PRODUCTION              CCCCC60
C    COST OF EACH LOADING BLOCK                                         CCCCC70
C                                                                       CCCCC80
C  VARIABLE DEFINATIONS:                                                CCCCC90
C     NAME     TYPE    SIZE    DESCRIPTION                             CCCCC100
C                                                                       CCCCC110
C                                                                       CCCCC120
C                                                                       CCCCC130
C                                                                       CCCCC140
C                                                                       CCCCC150
C                                                                       CCCCC160
C                                                                       CCCCC170
C                                                                       CCCCC180
C                                                                       CCCCC190
C                                                                       CCCCC200
C                                                                       CCCCC210
C                                                                       CCCCC220
C                                                                       CCCCC230
C                                                                       CCCCC240
      IMPLICIT INTEGER*4(A-Z)                                           CCCCC250
C                                                                       CCCCC260
C     DIMENSION ARRAY VARIABLES                                         CCCCC270
C                                                                       CCCCC280
C      PCSNOL FILE VARIABLES--ANNUAL ARRAYS                             CCCCC290
C                                                                       CCCCC300
```

```
      DIMENSION VSCGNO(100), UNAME(5,100), UNTYPE(100), UNLOAD(100),
     1          PRIFUL(100), ALTFUL(100), IGFUEL(100),
     2          UNLMO(100), OPLMO(100), OPLYR(100), CAPCST(100),
     3          UNETCP(100), LNETCP(100), UNLYR(100)
      REAL FACOWN(100), AUPAVL(100)
C
C       FOSNUL FILE VARIABLES--MONTHLY ARRAYS
C
      DIMENSION MWLD1(100,12), MWLD2(100,12), MWLD3(100,12),
     *    UHRT1(100,12), UHRT2(100,12), UHRT3(100,12)
      REAL EAVAIL(100,12), PBTUCT(100,12), ABTUCT(100,12),
     *     PGENFC(100,12)
C
C       HYDRO FILE VARIABLES--ANNUAL ARRAYS
C
      DIMENSION HYTYPE(100)
C
C       HYDRO FILE VARIABLES--MONTHLY ARRAYS
C
      DIMENSION UNGEN(10,12), PUMPEN(10,12)
      REAL PUMPCT(10,12)
C
C       PROGRAM ARRAYS
C
      DIMENSION LORDR1(100), LORDR2(100), LORDR3(100), UNSTR(300),
     1          BKSTR(300), LAMDA(3,12,100), LORDER(300)
      REAL COST1(100), C(80), COST2(100), COST3(100), CTSTR(300)
      LOGICAL LOADED(100,3), HYDROS, RIVSTR, RUNRIV, LNTRAN, PUMPST
C       PROGRAM VARIABLES
C
      REAL RSIKLT, WFULLT
C
C     INITIALIZE ARRAYS
C
      DO 10 I=1, 100
        LORDR1(I) =I
```

```
        LORDR2(1) =1                                                    00000670
        LCRDR3(1) =1                                                    00000680
  10    CONTINUE                                                        00000690
        RSTRCT = 0.                                                     00000700
        NUNITS =0                                                       00000710
        RIVSTR = .FALSE.                                                00000720
        RUNRIV = .FALSE.                                                00000730
        CNTRAK = .FALSE.                                                00000740
        PUMPST = .FALSE.                                                00000750
C                                                                       00000760
C       DETERMINE IF HYDRO UNITS ARE IN THE GENERATING SYSTEM           00000770
C                                                                       00000780
        WRITE(6,1000)                                                   00000790
 1000 FORMAT(1X,'ARE HYDRO UNITS OR FIRM PURCHASE CONTRACTS IN THE',    00000800
     1' GENERATING SYSTEM?--TRUE OR FALSE')                             00000810
        READ(5, *) HYDROS                                               00000820
C       IF THERE ARE HYDRO UNITS                                        00000830
C                                                                       00000840
        IF( .NOT. HYDROS ) GOTO 40                                      00000850
C       XXXTHEN READ HYDRO FILE                                         00000860
           CALL RDTHYD(11, NSCCNO, UNAME, FACOWN, UNTYPE, UNLOAD,       00000870
     1                 HYTYPE, PRIFUL, UNLMO,  UNLYR, UFLMO, UFLYR,   00000880
     2                 CAPLST, UNETCP, LNETCP, MWLD1, MWLD2, MWLD3,   00000890
     3                 UNGEN, PUMPEN, PUMPCT, CAVAIL, NUNITS, NHYDRO) 00000900
C          CHECK FOR RIVER STORAGE HYDRO UNITS, RUN-OF-RIVER, PUMPED    00000910
C          STORAGE AND CONTRACT POWER                                   00000920
        DO 30 I= 1, NHYDRO                                              00000930
           IF( HYTYPE(I) .EQ. 1 ) RUNRIV = .TRUE.                       00000940
           IF(HYTYPE(I) .EQ. 2 ) PUMPST = .TRUE.                        00000950
           IF( HYTYPE(I) .EQ. 3 ) RIVSTR = .TRUE.                       00000960
             IF( HYTYPE(I) .EQ. 4) CNTRAK=.TRUE.                        00000970
  30       CONTINUE                                                     00000980
C                                                                       00000990
C       XXX ELSE READ RUNOFF FILE                                       00001000
C                                                                       00001010
```

```
 40       CALL  PLTFOS(12, VSCCNO, UNAME, FACOWN, UNTYPE, UNLOAD,          00001020
     1                  PRIFUL, ALTFUL, IGFUEL, UNLMO, UNLYR, OFLMO,      00001030
     2                  OFLYR, AUPAVL, CAPCST, UNETCP, LNETCP,            00001040
     3                  UHRT1, UHRT2, UHRT3, MWLD1, MWLD2, MWLD3,         00001050
     4                  EAVAIL, PBTUCT, ABTUCT, PGENFC, COMPNO, NUNITS,   00001060
     5                   YR)                                              00001070
C                                                                         00001080
C     CALCULATE THE NUMBER OF FOSNUL UNITS                                00001090
C                                                                         00001100
C                                                                         00001110
C     CALCULATE THE LOADING ORDER BY MONTH                                00001120
C                                                                         00001130
      DO 240     MO=1, 12                                                 00001140
      ICOL = 1                                                            00001150
C                                                                         00001160
C     ASK FOR ADDITIONAL INFORMATION FROM USER                            00001170
C                                                                         00001180
C                                                                         00001190
C     IF RIVER STORAGE UNITS EXISTS                                       00001200
      IF( .NOT. RIVSTR ) GO TO 50                                         00001210
C     *** THEN ASK FOR THE RELATIVE PRODUCTION COST OF RIVER STORAGE      00001220
          WRITE(6,1020)                                                   00001230
 1020 FORMAT(1X,'ENTER PRODUCTION COST OF RIVER STORAGE IN DOLLARS/MWH')  00001240
      READ(5, *) RSTRCT                                                   00001250
 50       CONTINUE                                                       00001260
C                                                                         00001270
C     XXX ELSE ASK FOR MINIMUM LOADING VALUE AND  RESERVE MARGIN          00001280
C                                                                         00001290
          WRITE(6,1040)                                                   00001300
 1040 FORMAT(1X,'ENTER MINIMUM LOADING CAPACITY AND  RESERVE MARGIN')     00001310
      READ(5, *) MWMIN, SPNREV                                            00001320
C                                                                         00001330
C     INITIALIZE LOADED ARRAY TO FALSE                                    00001340
```

```
C                                                                       00001350
      DO 60 J=1, 3                                                      00001360
       DO 60 I=1, 100                                                   00001370
         LOADED(I,J) = .FALSE.                                          00001380
 60   CONTINUE                                                          00001390
C                                                                       00001400
C     *** CALCULATE LOADING COST FOR THE HYDRO UNITS AND CONTRACTS ***   00001410
C                                                                       00001420
      IF(.NOT. HYDROS)  GOTO 135                                        00001430
      DO 130 I=1, NHYDRO                                                00001440
         BRANCH = HYTYPE(I)                                             00001450
         GO TO(70,80,110,120), BRANCH                                   00001460
C                                                                       00001470
C        COST OF RUN OF RIVER IS ZERO                                   00001480
C                                                                       00001490
 70             COST1(I) = 0.                                          00001500
                COST2(I) = 0.                                          00001510
                COST3(I) = 0.                                          00001520
         GOTO 130                                                       00001530
C                                                                       00001540
C     *** COST OF PUMPED STORAGE ***                                    00001550
C                                                                       00001560
C     IF NO GENERATION FOR UNIT IS LISTED ASSUME 33 PER CENT LOSS       00001570
C                                                                       00001580
C                                                                       00001590
 80      IF( .NOT. (UNGEN(I,MO) .EQ. 0 )) GO TO 90                      00001600
                COST1(I) = 1.33 * PUMPCT(I,MO)                         00001610
                COST2(I) = COST1(I)                                    00001620
                COST3(I) = COST1(I)                                    00001630
                GOTO 100                                               00001640
C                                                                       00001650
C     ***ELSE LOSS FACTOR IS PUMPING ENERGY DIVIDED BY UNIT GENERATION  00001660
C                                                                       00001670
 90             COST1(I) = PUMPEN(I,MO)/UNGEN(I,MO) * PUMPCT(I,MO)     00001680
                COST2(I) = COST1(I)                                    00001690
                COST3(I) = COST1(I)                                    00001700
```

```
C                                                                       00001710
C          IF PUMPING COST EQUALS ZERO SET COST1-COST3 EQUAL TO         00001720
C              A LARGE VALUE                                            00001730
C                                                                       00001740
C                                                                       00001750
 100       IF ( .NOT. (COST1(I) .EQ. 0.)) GO TO 130                     00001760
               COST1(I) = 200.00                                        00001770
               COST2(I) = 200.00                                        00001780
               COST3(I) = 200.00                                        00001790
               GO TO 130                                                00001800
C                                                                       00001810
C      END PUMPED STORAGE COST SECTION                                  00001820
C                                                                       00001830
C                                                                       00001840
C      RIVER STORAGE UNITS                                              00001850
C                                                                       00001860
 110         COST1(I) = RSTRCT                                          00001870
             COST2(I) = RSTRCT                                          00001880
             COST3(I) = RSTRCT                                          00001890
             GOTO 130                                                   00001900
C                                                                       00001910
C      SET PURCHASE CONTRACTS TO THEIR COST                             00001920
C                                                                       00001930
 120           COST1(I) = PUMPCT(I,MO)                                  00001940
               COST2(I) = COST1(I)                                      00001950
               COST3(I) = COST1(I)                                      00001960
 130   CONTINUE                                                         00001970
C                                                                       00001980
C      *** END OF HYDRO AND CONTRACT COST ASSIGNMENTS ***               00001990
C                                                                       00002000
C                                                                       00002010
C       *** CALCULATE COST FOR THE FOSSIL AND NUCLEAR UNITS ***         00002020
```

```
C                                                                       
C                                                                       
  135   ISTART = NMYUNO + 1                                             
        DO 140 I=ISTART, NUMUTS                                         
           WFULCT = PGENFC(I,MO) * PBTUCT(I,MO)                         
     1                       * (1. - PGENFC(I,MO)) * ABTUCT(I,MO)       
           COST1(I) = WFULCT * CHRT1(I,MO) / 10**5                      
           COST2(I) = WFULCT * CHRT2(I,MO) / 10**5                      
           COST3(I) = WFULCT * CHRT3(I,MO) / 10**5                      
  140   CONTINUE                                                        
C                                                                       
C       *** END COST CALCULATION FOR FOSSIL AND NUCLEAR UNITS ***       
C                                                                       
C                                                                       
C       ORDER UNITS BY LOADING BLOCK AND COST                           
C                                                                       
        CALL BUBBLE(COST1, NUNITS, LORDR1)                              
        CALL BUBBLE(COST2, NUNITS, LORDR2)                              
        CALL BUBBLE(COST3, NUNITS, LORDR3)                              
C                                                                       
C       START LOADING FIRST LOADING BLOCKS TO MEET THE MINIMUM LOAD     
C                                                                       
C       SET THE CAPACITY ON-LINE EQUAL TO ZERO                          
C                                                                       
        CAPONL = 0                                                      
        AVAILR = 0.                                                     
        I = 0                                                           
        POINTR = 1                                                      
  150   I = I + 1                                                       
        LUNIT = LORDR1(I)                                               
C                                                                       
C       IF THE COST OF THE UNIT                                         
C                                                                       
        IF (.NOT. (COST1(LUNIT) .EQ. 0)) GOTO 170                       
C                                                                       
C       ***THEN LOAD ALL OF THE UNIT'S BLOCKS                           
C                                                                       
```

```
          DO 160 J=1, 3                                                          00002400
             LORDER (POINTR) =LUNIT                                              00002410
             POINTR = POINTR + 1                                                 00002420
             LOADED(LUNIT,J) = .TRUE.                                            00002430
 160      CONTINUE                                                              00002440
          CAPONL = CAPONL + MWLD3(LUNIT, MO)                                    00002450
          GOTO 180                                                              00002460
C                                                                               00002470
C      ***ELSE LOAD ONE BLOCK                                                   00002480
C                                                                               00002490
 170      LORDER(POINTR) = LUNIT                                                00002500
          POINTR = POINTR + 1                                                   00002510
C      CHECK TO SEE IF UNIT IS ON-LINE                                          00002520
       IF( (YR+1900) - ONLYR(LUNIT)) 175,171,172                                00002530
 171      IF(MO .LT. ONLMO(LUNIT)) GOTO 175                                     00002540
          GOTO 174                                                              00002550
 172   IF((YR+1900) - OFLYR(LUNIT)) 174,173,175                                 00002560
 173      IF(MO .GT. OFLMO(LUNIT)) GOTO 175                                     00002570
 174   CONTINUE                                                                 00002580
          IF( .NOT. (EAVAIL(LUNIT, MO) .GT. 0.0)) GOTO 175                      00002590
                CAPONL = CAPONL + MWLD1(LUNIT, MO)                              00002600
                AVAILR = AVAILR + MWLD3(LUNIT, MO) - MWLD1(LUNIT, MO)           00002610
 175      LOADED(LUNIT,1) = .TRUE.                                              00002620
C                                                                               00002630
C      ENDIF                                                                    00002640
C                                                                               00002650
C      CHECK TO SEE IF CAPACITY ON LINE IS LESS THAN                            00002660
C      MINIMUM LOAD LEVEL                                                       00002670
C                                                                               00002680
 180   CONTINUE                                                                 00002690
       IF( .NOT. (CAPONL .LT. MWMIN)) GOTO 190                                  00002700
```

```
C       ***THEN GO TO 150 IF IT IS LESS THAN NUNITS                      00002710
          IF( I .LT. NUNITS) GO TO 150                                   00002720
C                                                                        00002730
C           ELSE AN ERROR HAS OCCURRED--PRINT ERROR MESSAGE              00002740
C                AND STOP PROGRAM                                        00002750
C                                                                        00002760
          WRITE(6, 1050)                                                 00002770
 1050 FORMAT(1X,'*** WARNING ** MINIMUM LOAD EXCEEDS THE CAPACITY OF THE'00002780
     1/15X,'TOTAL CAPACITY OF THE FIRST LOADING BLOCKS.')                00002790
C                                                                        00002800
C     *** ENDS LOADING FIRST BLOCKS TO MEET THE MINIMUM LOADING CRITERIA  00002810
C                                                                        00002820
 150  CONTINUE                                                          00002830
C                                                                        00002840
C                                                                        00002850
C       COMBINE THE BALANCE OF THE FIRST LOADING BLOCK ARRAY WITH        00002860
C         THE SECOND AND THIRD ARRAYS                                    00002870
C                                                                        00002880
C     LOAD BALANCE OF FIRST BLOCKS INTO STORAGE ARRAYS                   00002890
      PUTR = 0                                                           00002900
      BAL1 = A * I                                                       00002910
      DO 200 I=BAL1, NUNITS                                              00002920
        PUTR = PUTR + 1                                                  00002930
        LUNIT = LORDR1(I)                                                00002940
        UNSTR(PUTR) = LUNIT                                              00002950
       BKSTR(PUTR) = 1                                                   00002960
        DISTR(PUTR) = COST1(LUNIT)                                       00002970
 200  CONTINUE                                                          00002980
C                                                                        00002990
C     ADD SECOND LOADING GROUP                                           00003000
C                                                                        00003010
      DO 210 I=1, NUNITS                                                 00003020
         LUNIT = LORDR2(I)                                               00003030
         IF( .NOT. (LOGIC(LUNIT) .GT. 0.)) GOTO 210                      00003040
C     ***THEN LOAD THE STORAGE ARRAYS                                    00003050
C                                                                        00003060
```

```
            POTR = POTR + 1                                                    00003070
            UNSTR(POTR) = LUNIT                                                00003080
            BKSTR(POTR) = 2                                                    00003090
            CTSTR(POTR) = COST2(LUNIT)                                         00003100
  210   CONTINUE                                                               00003110
C                                                                            00003120
C       ADD THE THIRD LOADING GROUP                                          00003130
C                                                                            00003140
        DO 220 I=1, NUNITS                                                   00003150
           LUNIT = LORDR3(I)                                                 00003160
           IF( .NOT. (COST3(LUNIT) .GT. 0.)) GOTO 220                        00003170
             POTR = POTR + 1                                                 00003180
             UNSTR(POTR) = LUNIT                                             00003190
             BKSTR(POTR) = 3                                                 00003200
             CTSTR(POTR) = COST3(LUNIT)                                      00003210
  220    CONTINUE                                                            00003220
C                                                                            00003230
C       *** END COMBINING ARRAYS ***                                         00003240
C                                                                            00003250
C                                                                            00003260
C       ORDER UNITS AND BLOCK NUMBERS BY COST                                00003270
C                                                                            00003280
        CALL BUBBL2(CTSTR, POTR, UNSTR, BKSTR)                               00003290
C                                                                            00003300
C       THE REMAINING UNITS ARE NOW ORDERED BY COST                          00003310
C       THE CORRESPONDING BLOCK NUMBER IS CONTAINED IN BKSTR                 00003320
C                                                                            00003330
C       THE ARRAY MUST BE CHECKED TO ENSURE THAT THE PROPER LOADING          00003340
C       SEQUENCE OF EACH UNIT IS MAINTAINED                                  00003350
        CALL BLKORD(UNSTR, BKSTR, POTR, LOADED)                              00003360
C                                                                            00003370
C       ADJUST LOADING                                                       00003380
```

```
C     ADJUST UNIT LOADING POSITIONS BASED ON THE RESERVE MARGIN          00003390
C     CONSTRAINT                                                         00003400
      CALL MARGIN(UNSTR, BKSTR, POTR, AVAILR, SPNREV, MWLD1, MWLD2,      00003410
     +        MWLD3, EAVAIL, MO, NUNITS, ONLMO, ONLYR, OFLMO, OFLYR, YR)  00003420
C                                                                        00003430
C     SHIFT LOADING ORDER ARRAY TO LORDER                                00003440
C                                                                        00003450
      DO 230 I=1, POTR                                                   00003460
        LORDER(POINTR) = UNSTR(I)                                        00003470
        POINTR = POINTR + 1                                              00003480
  230 CONTINUE                                                           00003490
      POINTR = POINTR - 1                                                00003500
C                                                                        00003510
C     CALCULATE LAMDAS                                                   00003520
C                                                                        00003530
      CALL LAMLOD(LAMDA, LORDER, POINTR, MO)                             00003540
  240 CONTINUE                                                           00003550
C                                                                        00003560
C     END DO LOOP                                                        00003570
C                                                                        00003580
C                                                                        00003590
C     WRITE OUT HYDRO AND FOSNOL FILE                                    00003600
C                                                                        00003610
C                                                                        00003620
C                                                                        00003630
C                                                                        00003640
C                                                                        00003650
C                                                                        00003660
      CALL FOSOUT(20, COMPNO, VSCONO, ONAME, FACOWN, ONTYPE, ONLOAD,     00003670
     1      PRIFUL, ALTFUL, IGFUEL, ONLMO, ONLYR, OFLMO, OFLYR, AUPAVL,  00003680
     2      CAPCST, ONETCP, ENETCP, OHRT1, OHRT2, OHRT3, MWLD1, MWLD2,   00003690
```

```
     3      MWLD3, EAVAIL, PBTUCT, ABTUCT, LAMDA, PGENFC, NUNITS, YR,     00003700
     4      NHYDRO)                                                       00003710
      IF( HYDROS )                                                       00003720
     1    CALL HYDOUT(21, COMPNO, VSCONO, UNAME, FACOWN,                 00003730
     2         UNTYPE, UNLOAD, HYTYPE, PRIFUL, UNLMO, UNLYR, UFLMO,      00003740
     3      UFLYR, CAPCST, UNETCP, LNETCP, MWLD1, MWLD2, MWLD3,          00003750
     4      UNGEN, PUMPEN, PUMPCT, LAMDA, YR, NHYDRO)                    00003760
      STOP                                                               00003770
      END                                                                00003780
C     ROUTINE:    *** B L K O R D ***                                    00003790
C                                                                        00003800
C     CALL SEQUENCE:                                                     00003810
C        CALL BLKORD( UNSTR, BKSTR, PUTR, LOADED)                        00003820
C                                                                        00003830
C     PURPOSE:                                                           00003840
C                                                                        00003850
C        TO ARRANGE THE LOADING BLOCKS SUCH THAT THE BLOCKS ARE          00003860
C        LOADED IN THE CORRECT PHYSICAL MANNER                           00003870
C                                                                        00003880
C     INPUT;                                                             00003890
C        BKSTR   (I*4) ARRAY(300)    BLOCK NUMBER OF THE I-TH LOADING    00003900
C                                    STEP                                00003910
C        LOADED  (L*4) ARRAY(100,3) TRUE/FALSE  ARRAY STATING WHICH      00003920
C                                   BLOCKS HAVE BEEN LOADED              00003930
C        PUTR      I                  LENGHT OF ARRAYS BKSTR AND UNSTR   00003940
C        UNSTR   (I*4)  ARRAY(300)    ORDER OF UNITS BEING LOADED        00003950
C                                                                        00003960
C     OUTPUT:                                                            00003970
C        LOADED  (L*4)  ARRAY(100,3)  UPDATED LOADING TABLE              00003980
C        UNSTR   (I*4)  ARRAY(300)    NEW ORDER OF UNITS BEING LOADED    00003990
C                                                                        00004000
C     AUTHOR:                                                            00004010
C        THE NATIONAL RESEARCH INSTITUTE                                 00004020
C                                                                        00004030
C     LAST REVISED:  OCTOBER 10, 1979                                    00004040
C                                                                        00004050
C========================================================================00004060
```

```
C                                                                       00004070
      SUBROUTINE BLKORD( UNSTR, BKSTR, PTR, LOADED)                     00004080
C                                                                       00004090
      IMPLICIT INTEGER (A-Z)                                            00004100
C                                                                       00004110
      DIMENSION UNSTR(300), BKSTR(300)                                  00004120
      LOGICAL LOADED(100,3)                                             00004130
C                                                                       00004140
C     INITIALIZE VARIABLES                                              00004150
C                                                                       00004160
      I = 0                                                             00004170
 10   I = I + 1                                                         00004180
 15   LUNIT = UNSTR(I)                                                  00004190
C                                                                       00004200
C     CHECK BLOCK TO BE LOADED TO SEE IF IT IS THE FIRST BLOCK          00004210
C                                                                       00004220
      IF( .NOT. (BKSTR(I) .EQ. 1)) GOTO 20                              00004230
C     ***THEN UPDATE LOADED ARRAY                                       00004240
         LOADED(LUNIT, 1) = .TRUE.                                      00004250
         GOTO 80                                                        00004260
 20   CONTINUE                                                          00004270
C                                                                       00004280
C     ***ELSE CHECK TO SEE IF THE PREVIOUS BLOCK                        00004290
C        HAS BEEN LOADED                                                00004300
C                                                                       00004310
         IF( .NOT. (LOADED( LUNIT, BKSTR(I)-1))) GOTO 40                00004320
C           ***THEN UPDATE LOADED ARRAY                                 00004330
            LOADED(LUNIT, BKSTR(I)) = .TRUE.                            00004340
            IF( .NOT. (I .GE. PTR)) GOTO 30                             00004350
C           ***THEN                                                     00004360
               RETURN                                                   00004370
 30   CONTINUE                                                          00004380
C           ***ELSE                                                     00004390
               GOTO 80                                                  00004400
 40      CONTINUE                                                       00004410
```

```
C                                                                       00004420
C          ***ELSE-- FIND THE PREVIOUS LOADING BLOCK AND SHIFT THE CURRENT00004430
C             LOADING BLOCK TO A POSITION BEHIND THAT BLOCK              00004440
C                                                                       00004450
           BLKCK = BKSTR(I) - 1                                         00004460
           ISTOP = I + 1                                                00004470
  50       CONTINUE                                                     00004480
C          ***IF THE UNIT NUMBER IS THE SAME                            00004490
              IF( .NOT. (UNSTR(ISTOP) .EQ. LUNIT)) GOTO 70              00004500
C             ***THEN CHECK FOR THE CORRECT BLOCK NUMBER                00004510
              IF( .NOT. (BKSTR(ISTOP) .EQ. BLKCK)) GO TO70              00004520
C             *** THE CORRECT BLOCK HAS BEEN FOUND                      00004530
              ISTOP = ISTOP - 1                                         00004540
              DO 60 J =I, ISTOP                                         00004550
                 UNSTR(J) = UNSTR(J+1)                                  00004560
                 BKSTR(J) = BKSTR(J+1)                                  00004570
  60    CONTINUE                                                        00004580
              UNSTR(ISTOP+1) = LUNIT                                    00004590
              BKSTR(ISTOP+1) = BLKCK + 1                                00004600
C       A NEW LOADING BLOCK IS IN THE I-TH POSITION START AGAIN         00004610
           GOTO 15                                                      00004620
  70       ISTOP = ISTOP + 1                                           00004630
           GOTO 50                                                      00004640
C                                                                       00004650
  80    CONTINUE                                                        00004660
C       CHECK FOR I LESS THAN PUTR                                      00004670
        IF( I .LT. PUTR) GOTO 10                                        00004680
        RETURN                                                          00004690
        END                                                             00004700
C  ROUTINE:            **** B U B B L E 2 ****                          00004710
C                                                                       00004720
C  CALLING SEQUENCE:                                                    00004730
C     CALL BUBBLE2(VALUES, LENGTH, TABLE)                               00004740
```

```
C                                                                       00004750
C  PURPOSE:                                                             00004760
C    GIVEN AN ARRAY OF COST VALUES, SORT INDEX ARRAY TABLE              00004770
C    ON COST.                                                           00004780
C                                                                       00004790
C  INPUT:                                                               00004800
C    VALUES    ARRAY OF VALUES                                         00004810
C    LENGTH    LENGTH OF TABLE                                         00004820
C    TABLE     (INT*2) ARRAY OF INDICES                                00004830
C                                                                       00004840
C  OUTPUT:                                                              00004850
C    TABLE     (INT*2) ARRAY OF INDICES SHOWING SORTED ORDER           00004860
C              BASED ON COST                                           00004870
C                                                                       00004880
C  AUTHOR:                                                              00004890
C    THE NATION REGULATORY RESEARCH INSTITUTE   3/19/79                00004900
C                                                                       00004910
C  REVISED:                                                             00004920
C                                                                       00004930
C=======================================================================00004940
C                                                                       00004950
      SUBROUTINE BUBBL2(VALUES, LENGTH, TABLE1, TABLE2)                 00004960
      IMPLICIT INTEGER (A-Z)                                            00004970
      INTEGER  TABLE1(300), TABLE2(300)                                 00004980
      REAL VALUES(300), TEMPR                                           00004990
C                                                                       00005000
      IF(LENGTH .LE. 1) RETURN                                          00005010
      BOTTOM = LENGTH                                                   00005020
      TOP = 1                                                           00005030
C     *UNTIL (TOP = BOTTOM)                                             00005040
100   CONTINUE                                                          00005050
C        START SEARCH AT THE TOP OF STACK                               00005060
C                                                                       00005070
         COUNTR = 2                                                     00005080
         A = 1                                                          00005090
```

```
C          *UNTIL  (BIGGEST VALUE AT THE BOTTOM)                                00005100
120        CONTINUE                                                             00005110
           B = COUNTR                                                           00005120
C                *IF( VALUES(A) > VALUES(B))                                   00005130
                 IF(.NOT. (VALUES(A) .GT. VALUES(B))) GOTO 130                 00005140
C                   *THEN   SWITCH THEM                                        00005150
                    TEMP = TABLE1(A)                                          00005160
                    TABLE1(A) = TABLE1(B)                                     00005170
                    TABLE1(B) = TEMP                                          00005180
                    TEMP = TABLE2(A)                                          00005190
                    TABLE2(A) = TABLE2(B)                                     00005200
                    TABLE2(B) = TEMP                                          00005210
                    TEMPR = VALUES(A)                                         00005220
                    VALUES(A) = VALUES(B)                                     00005230
                    VALUES(B) = TEMPR                                         00005240
C                *ENDIF                                                       00005250
130              CONTINUE                                                     00005260
C             INCREMENT TO COMPARE NEXT ITEM                                  00005270
C                                                                             00005280
              A = B                                                           00005290
              COUNTR = COUNTR + 1                                             00005300
           IF (COUNTR .LE. BOTTOM)  GOTO 120                                  00005310
C          *ENDUNTIL                                                        00005320
           BOTTOM = BOTTOM - 1                                                00005330
        IF(TOP .LT. BOTTOM) GOTO 110                                          00005340
C       *ENDUNTIL                                                           00005350
        RETURN                                                                00005360
        END                                                                   00005370
C  ROUTINE:            **** B U B B L E ****                                  00005380
C                                                                             00005390
C  CALLING SEQUENCE:                                                          00005400
C    CALL BUBBLE(VALUES, LENGTH, TABLE)                                       00005410
C                                                                             00005420
```

```
C  PURPOSE:                                                              00005430
C    GIVEN AN ARRAY OF COST VALUES, SORT INDEX ARRAY TABLE              00005440
C    ON COST.                                                           00005450
C                                                                       00005460
C  INPUT:                                                               00005470
C    VALUES    ARRAY OF VALUES                                         00005480
C    LENGTH    LENGTH OF TABLE                                         00005490
C    TABLE     (INT*2) ARRAY OF INDICES                                00005500
C                                                                       00005510
C  OUTPUT:                                                              00005520
C    TABLE     (INT*2) ARRAY OF INDICES SHOWING SORTED ORDER           00005530
C              BASED ON COST                                           00005540
C                                                                       00005550
C  AUTHOR:                                                              00005560
C    THE NATION REGULATORY RESEARCH INSTITUTE   3/19/79                00005570
C                                                                       00005580
C  REVISED:                                                             00005590
C                                                                       00005600
C=======================================================================00005610
C                                                                       00005620
      SUBROUTINE BUBBLE1(VALUES, LENGTH, TABLE)                         00005630
      IMPLICIT INTEGER (A-Z)                                            00005640
      INTEGER  TABLE(300)                                               00005650
      REAL VALUES(300)                                                  00005660
C                                                                       00005670
      IF(LENGTH .LE. 1) RETURN                                          00005680
      BOTTOM = LENGTH                                                   00005690
      TOP = 1                                                           00005700
C     *UNTIL (TOP = BOTTOM)                                             00005710
110   CONTINUE                                                          00005720
C        START SEARCH AT THE TOP OF STACK                               00005730
C                                                                       00005740
         COUNTR = 2                                                     00005750
         A = TABLE(1)                                                   00005760
```

```
C          *UNTIL  (BIGGEST VALUE AT THE BOTTOM)                                00005770
120        CONTINUE                                                             00005780
           B = TABLE(COUNTR)                                                    00005790
C                *IF( VALUES(A) > VALUES(B))                                   00005800
                 IF(.NOT. (VALUES(A) .GT. VALUES(B))) GOTO 130                  00005810
C                   *THEN   SWITCH THEM                                         00005820
                    TEMP = A                                                    00005830
                    A = B                                                       00005840
                    B = TEMP                                                    00005850
                    TABLE(COUNTR - 1) = A                                       00005860
                    TABLE(COUNTR) = B                                           00005870
C                *ENDIF                                                        00005880
130              CONTINUE                                                     00005890
C             INCREMENT TO COMPARE NEXT ITEM                                  00005900
C                                                                             00005910
              A = B                                                           00005920
              COUNTR = COUNTR + 1                                             00005930
           IF (COUNTR .LE. BOTTOM)  GOTO 120                                  00005940
C          *ENDUNTIL                                                          00005950
           BOTTOM = BOTTOM - 1                                                00005960
        IF(TOP .LT. BOTTOM) GOTO 110                                          00005970
C       *ENDUNTIL                                                             00005980
        RETURN                                                                00005990
        END                                                                   00006000
C                                                                             00006010
C     SUBROUTINE FOSOUT                                                       00006020
C                                                                             00006030
C     THE PURPOSE OF THIS ROUTINE IS TO REWRITE THE FOSSIL PLANT              00006040
C     FILE WITH THE NEW LAMDA VALUES.                                         00006050
C                                                                             00006060
          SUBROUTINE FOSOUT(PFUNIT, COMPNO, VSCENO, UNAME, FACOWN, UNTYPE,    00006070
         1            UNLOAD, PRIFUL, ALTFUL, IGFUEL, CNLMO, CNLYR,CFLMO,    00006080
         2            CFLYR, AUPAVL, CAPCST, UNETCP, LNETCP, OHRT1, OHRT2,   00006090
         3            OHRT3, MWLD1, MWLD2, MWLD3, EAVAIL, PBTUCT, ABTUCT,    00006100
```

```
     4            LAMDA, PGENFC, NUNITS, YR, NHYDRO)                          00006110
C                                                                              00006120
      IMPLICIT INTEGER(A-Z)                                                    00006130
      DIMENSION UNLMO(100), UNLYR(100), OFLMO(100), OFLYR(100),                00006140
     1          UNTYPE(100), UNLOAD(100), UNETCP(100),                        00006150
     2          LNETCP(100), PRIFUL(100), ALTFUL(100), IGFUEL(100)            00006160
      DIMENSION LAMDA(3,12,100), VSCCNO(100), UHRT1(100,12),                   00006170
     1          UHRT2(100,12), UHRT3(100,12), CAPCST(100), UNAME(5,100)       00006180
      REAL FACOWN(100), AUPAVL(100), EAVAIL(100,12), PBTUCT(100,12),           00006190
     1     ABTUCT(100,12), PGENFC(100,12)                                      00006200
      DIMENSION MWLD1(100,12), MWLD2(100,12), MWLD3(100,12)                    00006210
C                                                                              00006220
C                                                                              00006230
      NSTART = NHYDRO + 1                                                      00006240
      DO 100 UNIT = NSTART, NUNITS                                             00006250
      IF(FACOWN(UNIT) .EQ. 1.0)                                                00006260
     +  WRITE(PFUNIT,1000) COMPNO, VSCCNO(UNIT), (UNAME(K,UNIT), K=1,5),       00006270
     1       FACOWN(UNIT), UNTYPE(UNIT), UNLOAD(UNIT), PRIFUL(UNIT),           00006280
     2       ALTFUL(UNIT), IGFUEL(UNIT), UNLMO(UNIT), UNLYR(UNIT),             00006290
     3       OFLMO(UNIT), OFLYR(UNIT), AUPAVL(UNIT), CAPCST(UNIT),             00006300
     4       UNETCP(UNIT), LNETCP(UNIT)                                        00006310
      IF(FACOWN(UNIT) .NE. 1.0)                                                00006320
     +  WRITE(PFUNIT,1005) COMPNO, VSCCNO(UNIT), (UNAME(K,UNIT), K=1,5),       00006330
     1       FACOWN(UNIT), UNTYPE(UNIT), UNLOAD(UNIT), PRIFUL(UNIT),           00006340
     2       ALTFUL(UNIT), IGFUEL(UNIT), UNLMO(UNIT), UNLYR(UNIT),             00006350
     3       OFLMO(UNIT), OFLYR(UNIT), AUPAVL(UNIT), CAPCST(UNIT),             00006360
     4       UNETCP(UNIT), LNETCP(UNIT)                                        00006370
C                                                                              00006380
C    WRITE OUT MONTHLY DATA                                                    00006390
C                                                                              00006400
      DO 50 MO=1,12                                                            00006410
C                                                                              00006420
      MWLD1(UNIT, MO) = MWLD1(UNIT, MO) / FACOWN(UNIT)                         00006430
      MWLD2(UNIT, MO) = MWLD2(UNIT, MO) / FACOWN(UNIT)                         00006440
      MWLD3(UNIT, MO) = MWLD3(UNIT, MO) / FACOWN(UNIT)                         00006450
```

```
      IF(EAVAIL(UNIT,MO) .EQ. 1.0 .AND. PGENFC(UNIT,MO) .EQ. 1.0)
     +  WRITE(PFUNIT,1010) MO, YR, VSCCNO(UNIT), MWLD1(UNIT, MO),
     +       OHRT1(UNIT, MO), MWLD2(UNIT, MO), OHRT2(UNIT, MO),
     +       MWLD3(UNIT, MO), OHRT3(UNIT, MO), EAVAIL(UNIT, MO),
     +        PBTOCT(UNIT, MO), ABTOCT(UNIT, MO), PGENFC(UNIT, MO),
     +       (LAMDA(B,MO,UNIT), B=1,3)
      IF(EAVAIL(UNIT,MO) .EQ. 1.0 .AND. PGENFC(UNIT,MO) .NE. 1.0)
     +  WRITE(PFUNIT,1020) MO, YR, VSCCNO(UNIT), MWLD1(UNIT, MO),
     +       OHRT1(UNIT, MO), MWLD2(UNIT, MO), OHRT2(UNIT, MO),
     +       MWLD3(UNIT, MO), OHRT3(UNIT, MO), EAVAIL(UNIT, MO),
     +        PBTOCT(UNIT, MO), ABTOCT(UNIT, MO), PGENFC(UNIT, MO),
     +       (LAMDA(B,MO,UNIT), B=1,3)
      IF(EAVAIL(UNIT,MO) .NE. 1.0 .AND. PGENFC(UNIT,MO) .EQ. 1.0)
     +  WRITE(PFUNIT,1030) MO, YR, VSCCNO(UNIT), MWLD1(UNIT, MO),
     +       OHRT1(UNIT, MO), MWLD2(UNIT, MO), OHRT2(UNIT, MO),
     +       MWLD3(UNIT, MO), OHRT3(UNIT, MO), EAVAIL(UNIT, MO),
     +        PBTOCT(UNIT, MO), ABTOCT(UNIT, MO), PGENFC(UNIT, MO),
     +       (LAMDA(B,MO,UNIT), B=1,3)
      IF(EAVAIL(UNIT,MO) .NE. 1.0 .AND. PGENFC(UNIT,MO) .NE. 1.0)
     +  WRITE(PFUNIT,1040) MO, YR, VSCCNO(UNIT), MWLD1(UNIT, MO),
     +       OHRT1(UNIT, MO), MWLD2(UNIT, MO), OHRT2(UNIT, MO),
     +       MWLD3(UNIT, MO), OHRT3(UNIT, MO), EAVAIL(UNIT, MO),
     +        PBTOCT(UNIT, MO), ABTOCT(UNIT, MO), PGENFC(UNIT, MO),
     +       (LAMDA(B,MO,UNIT), B=1,3)
   50 CONTINUE
  100 CONTINUE
C
C
 1000 FORMAT( I1,1X,I6,1X,5A4,1X,F4.2,5(1X,I1),2(1X,I2,1X,I4),
     1       1X,F4.3,3(1X,I4))
 1005 FORMAT( I1,1X,I6,1X,5A4,1X,F4.3,5(1X,I1),2(1X,I2,1X,I4),
     1       1X,F4.3,3(1X,I4))
 1010 FORMAT( I2,1X,I2,1X,I6,2(1X,I3,1X,I5), 1X, I4, 1X, I5, 1X,
```

```
     +       F4.2, 2(1X,F6.2), 1X, F4.2, 3(1X,I3))                          00006790
 1020 FORMAT( I2,1X,I2,1X,I6,2(1X,I3,1X,I5), 1X, I4, 1X, I5, 1X,            00006800
     +       F4.2, 2(1X,F6.2), 1X, F4.3, 3(1X,I3))                          00006810
 1030 FORMAT( I2,1X,I2,1X,I6,2(1X,I3,1X,I5), 1X, I4, 1X, I5, 1X,            00006820
     +       F4.3, 2(1X,F6.2), 1X, F4.2, 3(1X,I3))                          00006830
 1040 FORMAT( I2,1X,I2,1X,I6,2(1X,I3,1X,I5), 1X, I4, 1X, I5, 1X,            00006840
     +       F4.3, 2(1X,F6.2), 1X, F4.3, 3(1X,I3))                          00006850
      RETURN                                                                00006860
      END                                                                   00006870
C                                                                           00006880
C    SUBROUTINE HYDOUT                                                      00006890
C                                                                           00006900
C    THE PURPOSE OF THIS ROUTINE IS TO REWRITE THE HYDRO PLANT FILE.        00006910
C                                                                           00006920
      SUBROUTINE HYDOUT(HYUNIT, COMPNO, VSLCNO, UNAME,                      00006930
     1            FACOWN, UNTYPE, UNLOAD, HYTYPE, PRIFUL, UNLMO, UNLYR,   00006940
     2            OFLMO, OFLYR, CAPCST, UNETCP, LNETCP, MWLD1, MWLD2,     00006950
     3            MWLD3, UNGEN, PUMPEN, PUMPCT, LAMDA, YR,  NMHYDRO)      00006960
C                                                                           00006970
      IMPLICIT INTEGER(A-Z)                                                 00006980
      DIMENSION CAPCST(100), LAMDA(3,12,100), VSLCNO(100),                  00006990
     1         PUMPEN(10,12), UNAME(5,100), UNGEN(10,12)                    00007000
      REAL FACOWN(100), PUMPCT(10,12)                                       00007010
      INTEGER UNLMO(100), UNLYR(100), OFLMO(100), OFLYR(100),               00007020
     1          UNETCP(100), LNETCP(100), PRIFUL(100), HYTYPE(100),         00007030
     2          UNTYPE(100), UNLOAD(100)                                    00007040
      DIMENSION MWLD1(10,12), MWLD2(10,12), MWLD3(10,12)                    00007050
C                                                                           00007060
C                                                                           00007070
      DO 200 I=1,NMHYDRO                                                    00007080
C                                                                           00007090
      IF(FACOWN(I) .EQ. 100)                                                00007100
     +  WRITE(HYUNIT,1000) COMPNO, VSLCNO(I), (UNAME(K,I),                  00007110
     1      K=1,5), FACOWN(I), UNTYPE(I), UNLOAD(I),                        00007120
     2      HYTYPE(I), PRIFUL(I), UNLMO(I), UNLYR(I),                       00007130
     3      OFLMO(I), OFLYR(I), CAPCST(I),                                  00007140
     4      UNETCP(I), LNETCP(I)                                            00007150
```

```
      IF(FACOWN(I) .NE. 1.0)                                            00007160
     +  WRITE(HYUNIT,1005) COMPNO, VSCCNO(I), (UNAME(K,I),              00007170
     1      K=1,5), FACOWN(I), UNTYPE(I), UNLOAD(I),                    00007180
     2      HYTYPE(I), PRIFUL(I), ONLMO(I), ONLYR(I),                   00007190
     3      OFLMO(I), OFLYR(I), CAPCST(I),                              00007200
     4      UNETCP(I), LNETCP(I)                                        00007210
C                                                                       00007220
      DO 100 MO=1,12                                                    00007230
C                                                                       00007240
      MWLD1(I, MO) = MWLD1(I, MO) / FACOWN(I)                           00007250
      MWLD2(I, MO) = MWLD2(I, MO) / FACOWN(I)                           00007260
      MWLD3(I, MO) = MWLD3(I, MO) / FACOWN(I)                           00007270
      WRITE(6,1001) MO, YR, VSCCNO(I), MWLD1(I, MO), MWLD2(I, MO),      00007280
     1      MWLD3(I,MO), (LAMDA(J,MO,I), J=1,3), UNGEN(I,MO),           00007290
     2      PUMPEN(I,MO), PUMPCT(I,MO)                                  00007300
  100 CONTINUE                                                          00007310
  200 CONTINUE                                                          00007320
C                                                                       00007330
C                                                                       00007340
 1000 FORMAT(I1,1X,I6,1X,5A4,1X,F4.2,4(1X,I1),2(1X,I2,1X,I4),           00007350
     1      3(1X,I4))                                                   00007360
 1005 FORMAT(I1,1X,I6,1X,5A4,1X,F4.2,4(1X,I1),2(1X,I2,1X,I4),           00007370
     1      3(1X,I4))                                                   00007380
 1001 FORMAT(I2,1X,I2,1X,I6,3(1X,I4), 3(1X,I3), 2(1X,I7),1X, F6.3)      00007390
      RETURN                                                            00007400
      END                                                               00007410
C                                                                       00007420
C   SUBROUTINE LAMLOD                                                   00007430
C                                                                       00007440
C   THIS ROUTINE CREATES THE NEW LAMDA VALUES FOR THE FOSSIL            00007450
C   PLANTS THAT WERE ONLINE DURING THE STUDY PERIOD                     00007460
```

```
C                                                                       00007470
C                                                                       00007480
      SUBROUTINE LAMLOD(LAMDA, LORDER, POINTR, MONTH)                   00007490
      IMPLICIT INTEGER(A-Z)                                             00007500
      DIMENSION LAMDA(3,12,100), LORDER(300), BLOCK(100)                00007510
C                                                                       00007520
C                                                                       00007530
      DO 10 I=1,100                                                     00007540
         BLOCK(I) = 0                                                   00007550
 10   CONTINUE                                                          00007560
C                                                                       00007570
C                                                                       00007580
      DO 20 I = 1, POINTR                                               00007590
         PLANT = LORDER(I)                                              00007600
         BLOCK(PLANT) = BLOCK(PLANT) + 1                                00007610
         LAMDA(BLOCK(PLANT), MONTH, PLANT) = I * 5                      00007620
 20      CONTINUE                                                       00007630
      RETURN                                                            00007640
      END                                                               00007650
C     ROUTINE:     *** M A R G I N ***                                  00007660
C                                                                       00007670
C     CALLING SEQUENCE:                                                 00007680
C        CALL MARGIN(UNSTK, BKSTK, POIK, CAPONL, SPNREV,                00007690
C                    MM1, MM2, MM3, EAVAIL, MO, NUNITS)                 00007700
C                                                                       00007710
C     PURPOSE:                                                          00007720
C        TO ARRANGE THE LOADING ORDER SUCH THAT TO THE EXTENT POSSIBLE   00007730
C        A RESERVE MARGIN GREATER THAN OF EQUAL TO THE VALUE SPNREV     00007740
C        IS MAINTAINED                                                  00007750
C                                                                       00007760
C     INPUT:                                                            00007770
C        BKSTK    (I*4)  ARRAY(300)  THE BLOCK NUMBERS OF THE LOADING   00007780
C                                     ORDER                             00007790
C        EAVAIL   (R*4)  ARRAY(100,12)  THE EQUIVALENT AVAILABILITY OF  00007800
C                                       EACH UNIT                       00007810
C        CAPONL   (R)                   CAPACITY ON=LINE                00007820
```

```
C          MW1       (I*4)   ARRAY(100,12)   UNIT OUTPUT AT LOADING POINT ONE  00007830
C          MW2       (I*4)   ARRAY(100,12)   UNIT OUTPUT AT LOADING POINT TWO  00007840
C          MW3       (I*4)   ARRAY(100,12)   UNIT OUTPUT AT LOADING POINT THRE 00007850
C          POTR       (I)                    LENGHT OF ARRAYS BKSTR AND UNSTR  00007860
C          SPNREV     (R)                    RESERVE MARGIN                    00007870
C          UNSTR     (I*4)   ARRAY(300)      UNIT LOADING ORDER                00007880
C                                                                               00007890
C      OUTPUT:                                                                  00007900
C          BKSTR     (I*4)   ARRAY(300)      LOADING STEP INDICATER            00007910
C          UNSTR     (I*4)   ARRAY(300)      UNIT  LOADING ORDER               00007920
C                                                                               00007930
C      AUTHOR:                                                                  00007940
C          THE NATIONAL REGULATORY RESEARCH INSTITUTE                           00007950
C                                                                               00007960
C      LAST REVISED;  OCTOBER 16, 1979                                          00007970
C                                                                               00007980
C=======================================================================        00007990
C                                                                               00008000
      SUBROUTINE MARGIN(UNSTR, BKSTR, POTR, AVAILR, SPNREV, MWLD1,             00008010
     +          MWLD2, MWLD3, EAVAIL, MO, NUNITS, ONLMO, ONLYR,                00008020
     +           OFLMO, OFLYR, YR)                                             00008030
C                                                                               00008040
      IMPLICIT INTEGER (A-Z)                                                    00008050
      DIMENSION UNSTR(300), BKSTR(300), MWLD1(100,12), MWLD2(100,12),           00008060
     +          MWLD3(100,12), MWBLK(100,3), ONLMO(100), ONLYR(100),           00008070
     +          OFLMO(100), OFLYR(100)                                         00008080
      REAL EAVAIL(100,12)                                                       00008090
C                                                                               00008100
C     INITIALIZE VARIABLES                                                      00008110
C                                                                               00008120
      I = 0                                                                     00008130
C                                                                               00008140
```

```
C                                                                       00006150
C     INITIALIZE ARRAYS                                                 00006160
C                                                                       00006170
      DO 10 J = 1, NUNITS                                               00006180
         MWBLK(J , 1) = MWLD1(J , MO)                                   00006190
         MWBLK(J , 2) = MWLD2(J , MO)                                   00006200
         MWBLK(J , 3) = MWLD3(J , MO)                                   00006210
 10   CONTINUE                                                          00006220
 20   I = I + 1                                                         00006230
 25   LUNIT = UNSTR(I)                                                  00006240
      BLOCK = BKSTR(I)                                                  00006250
      BLKM1 = BLOCK -1                                                  00006260
C                                                                       00006270
C     IF THE UNIT IS NOT AVAILABEL DUE TO OUTAGES BY-PASS IT            00006280
C                                                                       00006290
      IF( EAVAIL(LUNIT , MO) .LE. 0.0) GOTO 90                          00006300
C     CHECK TO SEE IF UNIT IS ON-LINE                                   00006310
      IF( (YR+1900) - UNLYR(LUNIT)) 90,26,27                            00006320
 26     IF(MO .LT. UNLMO(LUNIT)) GOTO 90                               00006330
        GOTO 29                                                         00006340
 27   IF((YR+1900) - OFLYR(LUNIT)) 29,28,90                             00006350
 28     IF(MO .GT. OFLMO(LUNIT)) GOTO 90                               00006360
 29   CONTINUE                                                          00006370
C                                                                       00006380
C     IF BKSTR(I) = 1                                                   00006390
C                                                                       00006400
      IF( .NOT. (BLOCK .EQ. 1)) GOTO 30                                 00006410
C     ***THEN                                                           00006420
         AVAILR = AVAILR + MWBLK(LUNIT, 3) - MWBLK(LUNIT , 1)           00006430
         GOTO 90                                                        00006440
C                                                                       00006450
C     ***ELSE                                                           00006460
C                                                                       00006470
 30      CONTINUE                                                       00006480
C                                                                       00006490
```

```
C     CHECK TO SEE IF LOADING THE NEXT BLOCK KEEPS THE AVAILABLE          00008500
C           RESERVE ABOVE THE RESERVE MARGIN                              00008510
C                                                                         00008520
      TEMP = MWBLK(LUNIT, BLOCK) - MWBLK(LUNIT, BLKM1)                    00008530
      IF( .NOT. ((AVAILR - TEMP) .GT. SPNREV)) GOTO 40                    00008540
C     ***THEN LOAD THAT BLOCK                                             00008550
         AVAILR = AVAILR - TEMP                                           00008560
         GOTO 90                                                          00008570
C                                                                         00008580
 40   CONTINUE                                                            00008590
C     ***ELSE A FIRST LOADING BLOCK MUST BE FOUND                         00008600
C                                                                         00008610
      ISTOP = 1                                                           00008620
 50      CONTINUE                                                         00008630
         ISTOP = ISTOP + 1                                                00008640
         IF( BKSTR(ISTOP) .EQ. 1) GOTO 70                                 00008650
C        ***THEN CHECK FOR  THE END OF THE LOOP                           00008660
            IF( .NOT. (ISTOP .LE. PUTR)) GOTO 60                          00008670
            GOTO 50                                                       00008680
 60         CONTINUE                                                      00008690
C                                                                         00008700
C           ***ELSE END OF LOOP WAS REACHED WITH NO FIRST BLOCK BEING     00008710
C              FOUND THEREFORE NO FUTHER CHANGES NEED TO BE MADE          00008720
C                                                                         00008730
            RETURN                                                        00008740
C                                                                         00008750
 70   CONTINUE                                                            00008760
C                                                                         00008770
C     FIRST LOADING BLOCK OF A UNIT HAS BEEN FOUND.  MOVE IT UP           00008780
C        TO THE CURRENT LOADING POSITON                                   00008790
C                                                                         00008800
         LSTR = UNSTK(ISTOP)                                              00008810
C                                                                         00008820
```

```
C      NEED TO SHIFT THE STACK DOWN                                     00008830
C                                                                       00008840
 80        UNSTR(ISTOP) = UNSTR(ISTOP - 1)                             00008850
           BKSTR(ISTOP) = BKSTR(ISTOP - 1)                             00008860
           ISTOP = ISTOP - 1                                           00008870
           IF( ISTOP .GT. 1 ) GOTO 80                                  00008880
           UNSTR(ISTOP) = LSTR                                         00008890
           BKSTR(ISTOP) = 1                                            00008900
C                                                                      00008910
C          GO TO THE BEGINNING OF THE LOOP                             00008920
C                                                                      00008930
           GOTO 25                                                     00008940
 90    CONTINUE                                                        00008950
       IF( I .LT. PUTR ) GOTO 20                                       00008960
       RETURN                                                          00008970
       END                                                             00008980
C  ROUTINE:                    **** P L T F U S ****                   00008990
C                                                                      00009000
C  CALLING SEQUENCE:                                                   00009010
C    CALL PLTFUS(PFUNIT, VSSCCNO, UNAME, FACOWN, UNTYPE, UNLOAD,       00009020
C                PRIFUL, ALTFUL, TOFUEL, UNLMO, UNLYR, OFLMO,          00009030
C                OFLYR, AUPAVL, CAPCST, UNETCP, ENETCP, UHRT1,         00009040
C                UHRT2, UHRT3, MWLD1, MWLD2, MWLD3, EAVAIL,            00009050
C                PETUCT, ABTUCT, PGENFC, COMPNO, NUNITS)               00009060
C                                                                      00009070
C  PURPOSE:                                                            00009080
C    TO READ THE FOSSIL FUEL UNIT DATA FROM LOGICAL UNIT PFUNIT.       00009090
C    THE OPERATION CHARACTERISTICS ARE READ AND STORED FOR EACH        00009100
C    MONTH OF THE STUDY. ALSO THE UNIT CAPACITY AVAILABLE TO THE       00009110
C    COMPANY IS CALCULATED.                                            00009120
C                                                                      00009130
C  INPUT:                                                              00009140
C    PFUNIT    LOGICAL UNIT # TO READ INFORMATION FROM                 00009150
C                                                                      00009160
```

```
C  OUTPUT:                                                                00009170
C    ALTFUL     (I*2)  ARRAY(100)  WHICH IDENTIFIES THE ALTERNATE         00009180
C                                  FUEL USED BY EACH UNIT 1-COAL;         00009190
C                                  2-NUCLEAR; 3-LIGHT OIL; 4-HEAVY        00009200
C                                  OIL; 5-NATURAL GAS; 6-GASOLINE;        00009210
C                                  7-WATER; 0-NONE                        00009220
C    ABTUCT     (R*4)  ARRAY(100)  COST OF ALTERNATE FUEL IN CENTS PER     00009230
C                                  MMBTU                                  00009240
C    AUPAVL     (R*4)  ARRAY(100)  ANNUAL UNIT PRODUCTION AVAILABILITY     00009250
C    CAPCST     (R*4)  ARRAY(100)  CAPITAL COST OF UNIT IN DOLLARS         00009260
C                                  PER INSTALLED KW                       00009270
C    VSCCNO     (I*4)  ARRAY(100)  UNIT NUMBER ASSIGNED BY VSCC            00009280
C    UNAME      (I*4)  ARRAY(5,100)  UNIT NAME                             00009290
C    FACOWN     (R*4)  ARRAY(100)  FRACTION OF UNIT OWNED BY COMPANY       00009300
C    UNTYPE     (I*2)  ARRAY(100)  THE CLASSIFICATION OF THE UNIT.         00009310
C                                  1-STEAM FOSSIL; 2-STEAM NUCLEAR;       00009320
C                                  3-I.C. ENGINE; 4-GASTURBINE;           00009330
C                                  5-JET ENGINE; 6-HYDRO;                 00009340
C                                  7-PUMPED STORAGE                       00009350
C    UNLOAD     (I*2) ARRAY(100)  UNIT LOADING TYPE. 1-BASE;             00009360
C                                 2-CYCLING; 3-PEAKING; 4-HYDRO           00009370
C    PRIFUL     (I*2)  ARRAY(100)  INTEGER VALUE WHICH IDENTIFIES THE     00009380
C                                 PRIMARY FUEL USED BY EACH UNIT FOR      00009390
C                                 GENERATION.                             00009400
C                                      1-COAL          5-NATURAL GAS      00009410
C                                      2-NUCLEAR       6GASOLINE          00009420
C                                      3-LIGHT OIL     7-WATER            00009430
C                                      4-HEAVY OIL     0-NONE             00009440
C    IGFUEL     (I*2)  ARRAY(100)  INTEGER VALUE WHICH IDENTIFIES THE      00009450
C                                   IGNITION FUEL USED BY EACH UNIT.      00009460
C    ONLMO      (I*2)  ARRAY(100)  THE MONTH THAT THE UNIT WENT INTO       00009470
C                                  COMMERICIAL SERVICE                    00009480
C    UNLYR      (I*2)  ARRAY(100)  THE YEAR THE UNIT WENT INTO SERVICE     00009490
C    UFLMO      (I*2)  ARRAY(100)  THE MONTH THE UNIT IS EXPECTED          00009500
```

```
C                                    TO BE RETIRED FROM COMMERICIAL SERVICE
C
C     OFLYR      (I*2)  ARRAY(100   FOR DEFINITIONS OF THE FOLLOWING
C                                    VARIABLES PLEASE REFER TO THE FILE
C                                    WRITE-UPS
C     UNETCP     (R*4)  ARRAY(100)
C     LNETCP     (R*4)  ARRAY(100)
C     UHRT1      (R*4)  ARRAY(100,12)  HEAT RATE FIRST LOADING BLOCK
C     UHRT2      (R*4)  ARRAY(100,12)  HEAT RATE SECOND LOADING BLOCK
C     UHRT3      (R*4)  ARRAY(100,12)  HEAT RATE THIRD LOADING BLOCK
C     EAVAIL     (R*4)  ARRAY(100,12)  EQUIVALENT AVAILABILITY
C     PBTUCT     (R*4)  ARRAY(100,12)  BTU COST PRIMARY FUEL
C     PGENFC     (R*4)  ARRAY(100,12)  FRACTION OF GENERATION BY PRI-FUEL
C
C   NOTES:
C     PROGRAM WILL END ABNORMALLY SHOULD AN UNEXPECTED EOF OCCUR
C
C   AUTHOR:
C     NATIONAL REGULATORY RESEARCH INSTITUTE
C
C   LAST REVISED: OCTOBER 16, 1979
C
C=======================================================================
C
      SUBROUTINE PLTFUS(PFUNIT, VSCCNO, UNAME, FACOWN, UNTYPE,
     %          UNLOAD, PRIFUL, ALTFUL, IGFUEL, UNLMO, UNLYR, OFLMO,
     %             OFLYR, AUPAVL, CAPCST, UNETCP, LNETCP, UHRT1, UHRT2,
     %             UHRT3, MWLD1, MWLD2, MWLD3, EAVAIL, PBTUCT, ABTUCT,
     %           PGENFC, COMPNO, NUNITS, IYR)
C
      INTEGER UNLMO(100), OFLMO(100), UNLYR(100), OFLYR(100)
      INTEGER UNTYPE(100), UNLOAD(100), UNETCP(100), LNETCP(100)
      INTEGER PRIFUL(100), ALTFUL(100), IGFUEL(100)
      INTEGER MWLD1(100, 12), MWLD2(100, 12), MWLD3(100, 12)
C
      INTEGER VSCCNO(100), COMPNO, CAPCST(100)
C
```

```
C      *** D I M E N S I O N ***                                                00009380
C                                                                              00009890
       INTEGER OHRT1(100, 12), OHRT2(100, 12), OHRT3(100, 12)                  00009900
       DIMENSION FACOWN(100), AUPAVL(100)                                      00009910
       DIMENSION EAVAIL(100, 12), PBTUCT(100, 12), ABTUCT(100, 12)             00009920
       DIMENSION PGENFC(100, 12)                                               00009930
C                                                                              00009940
       INTEGER UNAME(5, 100), PFUNIT                                           00009950
C                                                                              00009960
C      INCREMENT PLANT COUNTER                                                 00009970
C                                                                              00009980
10     CONTINUE                                                                00009990
       NUNITS = NUNITS + 1                                                     00010000
C                                                                              00010010
C      *** READ FIRST LINE OF PLANT INFORMATION                                00010020
C                                                                              00010030
       READ (PFUNIT, 90, END=60) COMPNO,VSCCNO(NUNITS), (UNAME(K,NUNITS),00010040
      %  K=1,5),FACOWN(NUNITS),UNTYPE(NUNITS),UNLOAD(NUNITS),PRIFUL(NUNIT00010050
      %S),ALTFUL(NUNITS),IGFUEL(NUNITS),ONLMO(NUNITS),ONLYR(NUNITS),      00010060
      %OFLMO(NUNITS),OFLYR(NUNITS),AUPAVL(NUNITS),CAPCST(NUNITS),         00010070
      %  UNETCP(NUNITS),LNETCP(NUNITS)                                     00010080
C                                                                              00010090
C      *** READ MONTHLY UNIT DATA                                              00010100
C                                                                              00010110
          DO 20 K = 1, 12                                                      00010120
             READ(PFUNIT, 100, END=70) MO, IYR,                                00010130
     +       MWLD1(NUNITS, MO), OHRT1(NUNITS, MO), MWLD2(NUNITS, MO),          00010140
     +       OHRT2(NUNITS, MO), MWLD3(NUNITS, MO), OHRT3(NUNITS, MO),          00010150
     +       EAVAIL(NUNITS, MO), PBTUCT(NUNITS, MO), ABTUCT(NUNITS, MO),       00010160
     +        PGENFC(NUNITS, MO)                                               00010170
C                                                                              00010180
```

```
C              *** CALCULATE UNIT CAPACITY OWNED BY THE COMPANY                  00010190
C                                                                               00010200
               MWLD1(NUNITS, MO) = MWLD1(NUNITS,MO) * FACOWN(NUNITS)            00010210
               MWLD2(NUNITS, MO) = MWLD2(NUNITS,MO) * FACOWN(NUNITS)            00010220
               MWLD3(NUNITS, MO) = MWLD3(NUNITS,MO) * FACOWN(NUNITS)            00010230
20          CONTINUE                                                            00010240
C                                                                               00010250
C           *** SET NUMBER OF UNITS                                             00010260
C                                                                               00010270
        GOTO 10                                                                 00010280
60          CONTINUE                                                            00010290
            NUNITS = NUNITS - 1                                                 00010300
        RETURN                                                                  00010310
C                                                                               00010320
C       *** ERROR STATEMENTS (UNEXPECTED END-OF-FILE)                           00010330
C                                                                               00010340
70      WRITE(6, 110)                                                           00010350
        STOP                                                                    00010360
C                                                                               00010370
C       *** F O R M A T S ***                                                   00010380
C                                                                               00010390
90      FORMAT(I1,1X, I6, 1X, 5A4, 1X, F4.0, 5(1X, I1), 2(1X, I2, 1X,          00010400
     &    I4), 1X, F4.0, 3(1X, I4))                                           00010410
100     FORMAT(I2, 1X, I2,  7X, 2(1X, I3,  1X, I5), 1X, I4, 1X, I5,            00010420
     *         1X, F4.0, 2(1X, F6.0), 1X, F4.0)                                00010430
110     FORMAT('0******** UNEXPECTED END-OF-FILE ENCOUNTERED ****',            00010440
     &       '****'/'          WHILE READING MONTHLY FOSSIL DATA')              00010450
        END                                                                     00010460
C  ROUTINE:            **** P L T H Y D ****                                    00010470
C                                                                               00010480
C  CALLING SEQUENCE:                                                            00010490
C    CALL PLTHYD(HYUNIT, VSCONO, UNAME, FACOWN, UNTYPE, UNLOAD,                 00010500
C                HYTYPE, PRIFUL, UNLMO, UNLYR, UFLMO, UFLYR,                   00010510
C                CAPCST, UNETCP, UNETCP, MWLD1, MWLD2, MWLD3,                  00010520
C                UNGEN, PUMPEN, PUMPCT, LAVAIL, NUNITS, NHYDRO)                00010530
C                                                                               00010540
```

```
C  PURPOSE:                                                                  00010550
C    READ THE HYDRO UNIT DATA FROM LOGICAL UNIT HYUNIT AND STORE            00010560
C    DATA BY UNIT AND BY MONTH                                              00010570
C                                                                           00010580
C  INPUT:                                                                   00010590
C    HYUNIT    FILE # WHERE HYDRO INFORMATION IS CONTAINED                  00010600
C                                                                           00010610
C  OUTPUT:                                                                  00010620
C    VSCCNO     PLANT ID NUMBER                                            00010630
C    UNAME      UNIT NAME OF PLANT                                         00010640
C    FACOWN     PERCENT OWNED BY COMPANY                                   00010650
C    UNTYPE     TYPE OF GENERATION UNIT--STEAM FOSSIL,NUCLEAR,ETC.         00010660
C    UNLOAD     LOADING TYPE OF PLANT--BASE, CYCLE, PEAK                   00010670
C    HYTYPE     TYPE OF HYDRO UNIT--RUN OF RIVER, STORAGE, PUMPED STORAGE  00010680
C    PRIFUL     PRIMARY FUEL BY UNIT                                       00010690
C    ONLMO     ON LINE MONTH FOR UNIT                                      00010700
C    ONLYR     ON LINE YEAR FOR UNIT                                       00010710
C    OFLMO     OFF LINE MONTH FOR UNIT                                     00010720
C    OFLYR      OFF LINE YEAR FOR UNIT                                     00010730
C    CAPCST     CAPACITY COST                                              00010740
C    UNETCP     UNLIMITED NET CAPACITY OF UNIT                             00010750
C    LNETCP     LIMITED NET CAPACITY OF UNIT                               00010760
C    EAVAIL     HYDRO UNIT MAXUMUM CAPACITY                                00010770
C                                                                           00010780
C  AUTHOR:                                                                  00010790
C    THE NATIONAL REGULATORY RESEARCH INSTITUTE                             00010800
C                                                                           00010810
C  REVISED:                                                                 00010820
C                                                                           00010830
C===========================================================================00010840
C                                                                           00010850
      SUBROUTINE RLTHYD(HYUNIT, VSCCNO, UNAME, FACOWN, UNTYPE,              00010860
```

```
     %                    ONLOAD, HYTYPE, PRIFUL, ONLMO, ONLYR, OFLMO,     00010870
     %                    OFLYR,  CAPCST, ONETCP, LNETCP,  MWLD1, MWLD2,   00010880
     %                    MWLD3, UNGEN, PUMPEN, PUMPCT, CAVAIL,            00010890
     %                    NUNITS, NHYDRO)                                  00010900
C                                                                           00010910
      DIMENSION FACOWN(100)                                                 00010920
      INTEGER CAPCST(100)                                                   00010930
      INTEGER UNGEN(10,12), PUMPEN(10,12)                                   00010940
      DIMENSION CAVAIL(100,12), PUMPCT(10,12)                               00010950
      INTEGER VSCCNO(100), UNAME(5, 100)                                    00010960
      INTEGER HYUNIT                                                        00010970
      INTEGER HYTYPE(10), ONLYR(100), OFLYR(100)                            00010980
      INTEGER ONLMO(100), OFLMO(100), UNTYPE(100), UNLOAD(100)              00010990
      INTEGER MWLD1(100,12), MWLD2(100, 12), MWLD3(100,12)                  00011000
      INTEGER ONETCP(100), LNETCP(100), PRIFUL(100)                         00011010
C                                                                           00011020
C     *** INITIALIZE COUNTERS                                               00011030
C                                                                           00011040
      NHYDRO = 0                                                            00011050
      NUNITS = 0                                                            00011060
C                                                                           00011070
10    NUNITS = NUNITS + 1                                                   00011080
      NHYDRO = NHYDRO + 1                                                   00011090
C                                                                           00011100
C     *** READ FIRST LINE OF HYDRO DATA                                     00011110
C                                                                           00011120
      READ(HYUNIT, 60, END=30) VSCCNO(NUNITS), (UNAME(K,NUNITS),K=1,5),     00011130
     %   FACOWN(NUNITS), UNTYPE(NUNITS), UNLOAD(NUNITS), HYTYPE(NHYDRO),    00011140
     %   PRIFUL(NUNITS), ONLMO(NUNITS), ONLYR(NUNITS), OFLMO(NUNITS),       00011150
     %   OFLYR(NUNITS), CAPCST(NUNITS), ONETCP(NUNITS), LNETCP(NUNITS)      00011160
C                                                                           00011170
```

```
C      *** READ MONTHLY DATA FOR UNITS ***                                    00011180
C                                                                             00011190
       DO 20 K = 1, 12                                                        00011200
            READ(HYUNIT, 70, END=40) MO, IYR, MWLD1(NUNITS, MO),              00011210
     %         MWLD2(NUNITS, MO), MWLD3(NUNITS, MO), UNGEN(NUNITS, MO),       00011220
     %         PUMPEN(NUNITS,MO), PUMPCT(NUNITS,MO)                           00011230
       MWLD1(NUNITS,MO)=FACOWN(NUNITS)*MWLD1(NUNITS,MO)                       00011240
       MWLD2(NUNITS,MO)=FACOWN(NUNITS)*MWLD2(NUNITS,MO)                       00011250
       MWLD3(NUNITS,MO)=FACOWN(NUNITS)*MWLD3(NUNITS,MO)                       00011260
       EAVAIL(NUNITS,MO) = 1.0                                                00011270
20     CONTINUE                                                               00011280
C                                                                             00011290
C      SET NUMBER OF PLANTS                                                   00011300
C                                                                             00011310
       GOTO 10                                                                00011320
30     NUNITS = NUNITS-1                                                      00011330
       NHYDRO=NHYDRO-1                                                        00011340
       RETURN                                                                 00011350
C                                                                             00011360
C      **** ERROR MESSAGAES ***                                               00011370
C                                                                             00011380
40     WRITE(6,80) HYUNIT                                                     00011390
       STOP                                                                   00011400
C                                                                             00011410
C      FORMAT STATEMENTS                                                      00011420
C                                                                             00011430
60     FORMAT(2X,I6,1X,5A4,1X,F4.0,4(1X,I1),2(1X,I2,1X,I4), 3(1X, I4))        00011440
70     FORMAT(I2,1X,I2,7X, 3(1X, I4), I2X, 2(1X,I7), 1X, F6.0)                00011450
80     FORMAT(///1X,'******** UNEXPECTED END OF FILE ENCOUNTERED ON UNIT      00011460
     % ',I2,' IN SUBROUTINE PLTHYD ********')                                 00011470
       END                                                                    00011480
```

APPENDIX E

Listing of LOAD PROBABILITY Module

```
00010 C=======================================================================
00020 C
00030 C
00040 C      *** THE LOAD PROBABILITY MODULE OF THE PCS MODEL ***
00050 C
00060 C
00070 C=======================================================================
00080 C
00090       COMMON /PROBY/ LOAD
00100       INTEGER LOAD(24, 31, 12)
00110       INTEGER DEMAND(24)
00120       REAL PEAK(12), BASE(12), HRSIP(12), GENMO(12)
00130       INTEGER DA,HR, YR
00140       REAL LODVAL(200), LOADCK, PROB(200)
00150       INTEGER DAS, DAE, HRS, HRE
00160       LDUNIT = 10
00170       IOUT = 6
00180       NOPT = 50
00190       CALL  LODATA(LDUNIT, PEAK, BASE, HRSIP, GENMO, YR)
00200       DO 250 MO=1,12
00210       CALL LDPROB(LODVAL, PROB, NOPT, PEAK, BASE, MO)
00220       WRITE( IOUT, 40) MO, YR, NOPT, BASE(MO), PEAK(MO),
00230      %        HRSIP(MO), GENMO(MO)
00240  40   FORMAT(I2, 1X, I2, 1X, I3, F6.0, 1X, F6.0, 1X, F6.0, 1X,F8.0)
00250       WRITE( IOUT, 50) (PROB(I), I=1,NOPT)
00260  50   FORMAT(F8.6, 9F8.7/9(10F8.7/))
00270 250   CONTINUE
00280       STOP
00290       END
```

```
01070 C  ROUTINE:           **** L O D A T A ****
01080 C
01090 C  CALLING SEQUENCE:
01100 C    CALL LODATA(LDUNIT, PEAK, BASE, HRSIP, GENMO, IYEAR)
01110 C
01120 C  PURPOSE:
01130 C    TO READ THE HOURLY LOAD DATA FROM EDISON ELECTRIC
01140 C    INSTITUTE FORMATTED HOURLY LOAD CARDS, TO FIND AND STORE THE
01150 C    PEAK AND BASE LOAD FOR EACH MONTH, AND TO CALCULATE THE
01160 C    NUMBER OF HOURS IN EACH MONTH
01170 C
01180 C  INPUT:
01190 C    LDUNIT    THE UNIT THAT THE LOAD DATA IS READ FROM
01200 C    IYEAR     THE STUDY YEAR
01210 C
01220 C  OUTPUT:
01230 C    PEAK      (REAL) ARRAY(12) THE PEAK LOAD FOR EACH MONTH
01240 C    BASE      (REAL) ARRAY(12) THE BASE OR MIN LOAD FOR EA MONTH
01250 C    HRSIP     (REAL) ARRAY(12) THE NUMBER OF HOURS IN EACH MONTH
01260 C    GENMO     (REAL) ARRAY(12) THE NET GENERATION IN EACH MONTH
01270 C    LOAD      (INT) ARRAY(24,31,12) THE HOURLY LOADS
01280 C
01290 C  REQUIREMENTS:
01300 C    DATA FILE-   EDISON ELECTRIC HOURLY LOAD DATA
01310 C
01320 C  AUTHOR:
01330 C    MARK S. GERBER 3/4/79
01340 C
01350 C  REVISED:
01360 C
01370 C=======================================================================
01380 C
01390       SUBROUTINE  LODATA(LDUNIT, PEAK, BASE, HRSIP, GENMO, YR)
01400 C
01410       COMMON /PROBY/ LOAD
01420       INTEGER LOAD(24, 31, 12)
01430 C
01440       INTEGER DEMAND(24)
01450       REAL PEAK(12), BASE(12), HRSIP(12), GENMO(12)
```

```
      INTEGER DA, HR, YR
C
C     INITIALIZE VARIABLES AND ARRAYS
C
      DO 10 MO = 1,12
         BASE(MO) = 50000.0
         PEAK(MO) = 0.0
         HRSIP(MO) = 0.0
         GENMO(MO) = 0.0
         DO 10 DA = 1, 31
            DO 10 HR = 1, 24
               LOAD(HR, DA, MO) = 0
10    CONTINUE
C
C     READ HOURLY LOADS
C
20    READ(LDUNIT, 60, END=40) MO, DA, YR, DEMAND
      DO 30 HR = 1, 24
C
C        CHECK FOR BAD POINT
C
         IF(DEMAND(HR) .LE. 0) GOTO 30
         LOAD(HR, DA, MO) = DEMAND(HR)
         HRSIP(MO) = HRSIP(MO) + 1
         GENMO(MO) = GENMO(MO) + DEMAND(HR)
         RDEMD = DEMAND(HR)
         IF(RDEMD .GT. PEAK(MO)) PEAK(MO) = RDEMD
         IF(BASE(MO) .GT. RDEMD) BASE(MO) = RDEMD
30    CONTINUE
      GOTO 20
40    CONTINUE
      RETURN
C
C     FORMAT STMTS
C
60    FORMAT(3I2, 14X, 12I5/ 20X, 12I5)
      STOP
      END
```

```
00300         SUBROUTINE LDPROB(LODVAL, PROB, NOPT, PEAK, BASE, MONTH)
00310 C
00320         COMMON /PROBY/ LOAD
00330         INTEGER LOAD(24, 31, 12)
00340         REAL LODVAL(NOPT), LOADCK, PROB(NOPT), PEAK(12), BASE(12)
00350         INTEGER DA, DAS, DAE, HR, HRS, HRE
00360 C
00370 C       *** INITIALIZE VARIABLES AND ARRAYS ***
00380 C
00390         MOS = MONTH
00400         MOE = MONTH
00410         DAS = 1
00420         DAE = 31
00430         HRS = 1
00440         HRE = 24
00450 C
00460         DO 10 I = 1, NOPT
00470            PROB(I) = 0.0
00480 10      CONTINUE
00490         PDBASE = 50000.0
00500         PDPEAK = 0.0
00510 C
00520 C       FORM LOAD PROBABILITY CURVE BASED ON THE DEFINITION THAT THE
00530 C       LOAD PROB IS THE FRACTION OF TIME THE LOAD MEETS OR EXCEEDS
00540 C       A GIVEN LOAD VALUE.
00550 C
00560         DO 15 MO = MOS, MOE
00570            IF(BASE(MO) .LT. PDBASE) PDBASE = BASE(MO)
00580            IF(PEAK(MO) .GT. PDPEAK) PDPEAK = PEAK(MO)
00590 15      CONTINUE
00600 C
```

```
00610 C      *** CALCULATE THE LOAD STEP DELTA ***
00620 C
00630        DELTA = (PDPEAK - PDBASE) / (NOPT - 1)
00640        DO 50 MO = MOS, MOE
00650           DO 40 DA = DAS, DAE
00660 C
00670 C            ADDITIONAL LOGIC CAN GO HERE TO SELECT SPECIFIC DAYS
00680 C            OF THE WEEK TO FORM THE LOAD PROB CURVE FOR TIME OF DAY
00690 C            COST STUDIES.
00700 C
00710                 DO 30 HR = HRS, HRE
00720 C
00730 C                  ADDITIONAL LOGIC CAN GO HERE TO SELECT SPECIFIC HOURS OF
00740 C                  THE DAY TO FORM THE LOAD PROB CURVE
00750 C
00760 C                  ***CHECK FOR BAD DATA ***
00770 C
00780                    LOADCK = LOAD(HR, DA, MO)
00790                    IF(LOADCK .LT. PDBASE) GOTO 30
00800 C
00810 C                  *** CALCULATE THE INDEX OF THE LOAD POSITION
00820 C
00830                    INDEX = (LOADCK - PDBASE) / DELTA + 1
00840                    DO 20 I = 1, INDEX
00850                       PROB(I) = PROB(I) + 1
00860 20                 CONTINUE
00870 30                 CONTINUE
00880 40              CONTINUE
00890 50           CONTINUE
```

```
00900 C
00910 C      *** NORMALIZE THE PROB CURVE
00920 C
00930        DO 60 I = 2, NOPT
00940           PROB(I) = PROB(I) / PROB(1)
00950 60     CONTINUE
00960        PROB(1) = 1.0
00970 C
00980 C      *** DEFINE THE X-AXIS LOAD VALUES
00990 C
01000        LODVAL(1) = PDBASE
01010        DO 70 I = 2, NOPT
01020           LODVAL(I) = LODVAL(I - 1) + DELTA
01030 70     CONTINUE
01040        LODVAL(NOPT) = PDPEAK
01050        RETURN
01060        END
```