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12. สมเกียรติ ผลประการ. วิศวกรรมการส่งและจ่ายไฟฟ้า ไทยวัฒนาพานิช, 2516

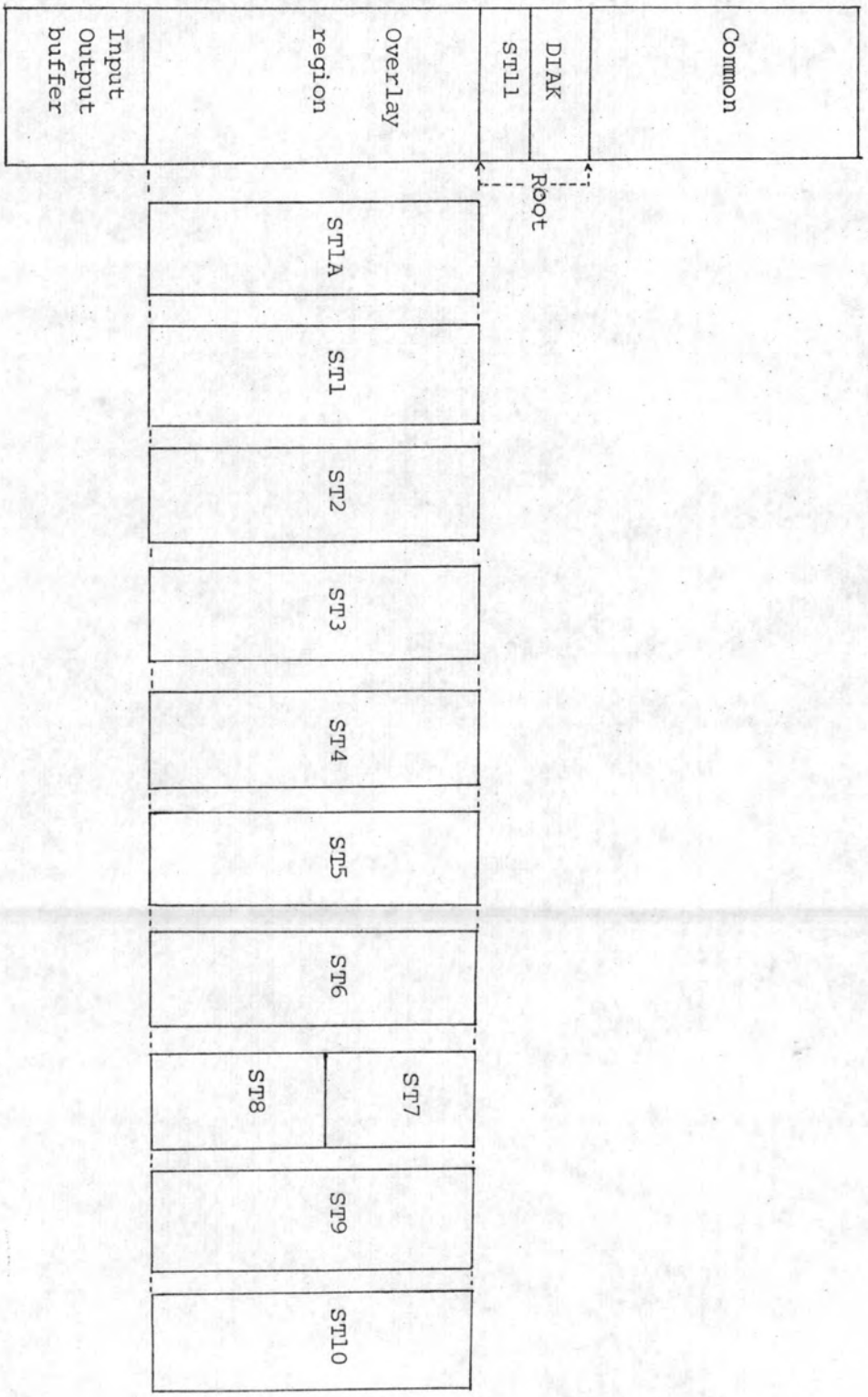
ภาคผนวก ก.

การจัดโปรแกรมและการใช้เนื้อที่ในหน่วยความจำ

โปรแกรมวิเคราะห์เสถียรภาพฯ ที่เขียนขึ้นนี้มีขนาดยาวมาก จึงต้องแบ่งออกเป็นไฟล์ (file) ย่อย ๆ ตามตารางข้างล่าง

ชื่อไฟล์	โปรแกรมที่อยู่ในไฟล์
DIAK	โปรแกรมหลัก (Main Program)
ST1A	โปรแกรมย่อย INPUT
ST1	โปรแกรมย่อย STEP1A และ STEP1B
ST2	โปรแกรมย่อย STEP2A และ STEP2B
ST3	โปรแกรมย่อย STEP3 และ STEP4
ST4	โปรแกรมย่อย STEP5 และ STEP6
ST5	โปรแกรมย่อย STEP7
ST6	โปรแกรมย่อย STEP8
ST7	โปรแกรมย่อย SOLVE
ST8	โปรแกรมย่อย STATE
ST9	โปรแกรมย่อย MODIFY
ST10	โปรแกรมย่อย PLOT
ST11	โปรแกรมย่อย STEP9

โดยที่ตัวแปรต่าง ๆ ที่ใช้ร่วมกันจัดให้อยู่ในเนื้อที่หน่วยความจำร่วม (Common) การลิงค์ (Link) โปรแกรมต่าง ๆ กระทำแบบโอเวอร์เลย์ (Overlay) ซึ่งโปรแกรมหลักเรียกโปรแกรมย่อยที่ละไฟล์บันทึกในหน่วยความจำและทับโปรแกรมย่อยเดิมที่เรียกใช้แล้ว โดยที่ไฟล์ DIAK และ ST11 จัดให้อยู่ในส่วนรูท (Root) และจัดโปรแกรมย่อยอื่นไว้เป็นส่วน (Sector) โดยให้ไฟล์ ST7 และ ST8 อยู่ในส่วนเดียวกันดังที่ได้แสดงในรูปหน้า 135



ผังการจัดหน่วยความจำ

```
      C     ...TRANSIENT STABILITY PROGRAM BY PIECEWISE SOLUTION METHOD
0001          INTEGER BLANK(8000)
0002          INTEGER BK(180)
0003          INTEGER BIN(15)
0004          INTEGER SPAC1(450)
0005          INTEGER SPAC2(1660)
0006          COMMON/COM/SPAC1
0007          COMMON/BUFF/BLANK
0008          COMMON/DIK/BK
0009          COMMON/INT/BIN
0010          COMMON/TUB/SPAC2
0011          DO 10 I=1,8000
0012          BLANK(I)=0
0013    10    CONTINUE
0014          DO 30 I=1,180
0015          BK(I)=0
0016    30    CONTINUE
0017          DO 40 I=1,15
0018          BIN(I)=0
0019    40    CONTINUE
0020          DO 60 I=1,450
0021          SPAC1(I)=0
0022    60    CONTINUE
0023          DO 70 I=1,1660
0024          SPAC2(I)=0
0025    70    CONTINUE
0026          CALL INPUT
0027          DO 100 I=1,8000
0028          BLANK(I)=0
0029    100   CONTINUE
```

```
0030            CALL STEP1A
0031            CALL STEP2A
0032            CALL STEP2B
0033            CALL STEP3
0034            CALL STEP4
0035            CALL STEP5
0036            CALL STEP6
0037            CALL STEP7
0038            CALL STEP8
0039            CALL STEP9
0040            DO 50 I=1,8000
0041            BLANK(I)=0
0042   50       CONTINUE
0043            CALL PLOT
0044            STOP
0045            END
```

```
      C     ....SUBROUTINE INPUT
0001          SUBROUTINE INPUT
      C
0002          INTEGER NOZONE,NOBUS,NOLINE,MAXITE,OPTION(15),BUS(20),LINE(40)
0003          INTEGER NP(40),NQ(40),ZONE(20),TYPE(20)
0004          REAL ACC,TOR,BASMVA,BC(40),T(40),BASEKV(20),BUSNAM(20),BCS(20)
0005          REAL VOLT(20),VARMAX(20),VARMIN(20),STATC(20)
0006          COMPLEX ZPRI(40),GEN(20),LOAD(20)
      C
0007          INTEGER NGEN,NLBUS,LBUS(20),NOMT,IMGN(20),BGEN(20),IMET(10),FBUS
0008          INTEGER GNO(5,4),MON,ITSTOP,NOPLOT,NMAC(5),ITS,NST,LIOP(3,3)
0009          INTEGER LICL(3,3)
0010          REAL    XDI(20),XQI(20),XDPI(20),TOI(20),HI(20),MUI(20),TEI(20)
0011          REAL    F,RI(20),TCI(20),TSI(20),PMAXI(20),EFMAXI(20),EFMINI(20)
0012          REAL    ETMIN,TT,TCF,TSTOP,NETA,EPLON,OMGA,DT,TITS(3)
0013          COMPLEX ROD1(10),ROD2(10),ROD3(10)
0014          COMMON/BUFF/NOZONE,NOBUS,NOLINE,MAXITE,OPTION,BUS,LINE
             X  ,            NP,NQ,ZONE,TYPE
             X  ,            ACC,TOR,BASMVA,BC,T,BASEKV,BUSNAM,BCS
             X  ,            VOLT,VARMAX,VARMIN,STATC
             X  ,            ZPRI,GEN,LOAD
             X  ,            NGEN,NLBUS,LBUS,NOMT,IMGN,BGEN,IMET,FBUS
             X  ,            GNO,MON,ITSTOP,NOPLOT,NMAC,ITS,NST,LIOP,LICL
             X  ,            XDI,XQI,XDPI,TOI,HI,MUI,TEI
             X  ,            F,RI,TCI,TSI,PMAXI,EFMAXI,EFMINI
             X  ,            ETMIN,TT,TCF,TSTOP,NETA,EPLON,OMGA,DT,TITS
             X  ,            ROD1,ROD2,ROD3
0015          DATA MM/1HY/
      C
```

```
0016  50     TYPE 1
0017  1      FORMAT(' ',///10X,':TRANSIENT STABILITY PROGRAM BY DIAKOPTICAL M
              XETHOD:')
0018         TYPE 2
0019  2      FORMAT(' ',9X,     '-----------------------------------------
              X---+--')
0020         TYPE 3
0021  3      FORMAT(' ',//7X,'TYPE THE LINE NUMBER OF THE FOLLOWING LIST TO E
              XNTER DATA')
0022         TYPE 4
0023  4      FORMAT(' ',/7X,'TYPE '0' IF NONE OF DATA BE ENTERED')
              C
0024         TYPE 5
0025         TYPE 6
0026         TYPE 7
0027         TYPE 8
0028         TYPE 9
0029         TYPE 10
0030         TYPE 11
0031  5      FORMAT(' ',/11X,'1. BUS DATA')
0032  6      FORMAT(' ',10X,'2. LINE DATA')
0033  7      FORMAT(' ',10X,'3. CONTROL DATA')
0034  8      FORMAT(' ',10X,'4. GENERATOR DATA')
0035  9      FORMAT(' ',10X,'5. NON-IMPEDANCE TYPE LOAD DATA')
0036  10     FORMAT(' ',10X,'6. SEQUENCE OF SWITCHING OPERATION')

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0037  11     FORMAT(' ',10X,'7. OTHER DATA')
0038         TYPE 12
0039  12     FORMAT(' ',/7X,'WHICH DATA TO BE ENTERED ?  ',$)
0040         ACCEPT 13, ICH
0041  13     FORMAT(I2)
0042         IF(ICH.EQ.0) GO TO 900
0044         IF(ICH.EQ.1) GO TO 100
0046         IF(ICH.EQ.2) GO TO 200
0048         IF(ICH.EQ.3) GO TO 300
0050         IF(ICH.EQ.4) GO TO 400
```

```
0052          IF(ICH.EQ.5) GO TO 500
0054          IF(ICH.EQ.6) GO TO 600
0056          IF(ICH.EQ.7) GO TO 700
0058          GO TO 50
      C       ENTER BUS DATA
0059  100     TYPE101
0060  101     FORMAT(' ',/10X,':ENTER BUS DATA:  ARE YOU SURE? (Y OR N)  ',$)
0061          ACCEPT 102,MY
0062  102     FORMAT(A1)
0063          IF(MM.NE.MY) GO TO 160
0065          TYPE 103
0066  103     FORMAT(' ',/7X,':ENTER THE NUMBER OF BUSES (40 BUSES MAX.)',$)
0067          ACCEPT 104,NOBUS
0068          TYPE 105
0069  105     FORMAT(' ',7X,':ENTER THE NUMBER OF ZONES (4 ZONES MAX.)',$)
0070          ACCEPT 104,NOZONE
0071  104     FORMAT(I5)
0072          TYPE 106
0073  106     FORMAT(' ',7X,':ENTER BUS DATA')
0074          DO 107 I=1,NOBUS
0075          TYPE 108
0076          ACCEPT 109,BUSNAM(I)
0077          TYPE 110
0078          ACCEPT 111,BUS(I)
0079          TYPE 112
0080          ACCEPT 111,ZONE(I)
0081          TYPE 114
0082          ACCEPT 111,TYPE(I)
0083          TYPE 115
0084          ACCEPT 116,BASEKV(I)
0085          TYPE 117
0086          ACCEPT 116,VOLT(I)
0087          TYPE 118
0088          ACCEPT 116,GEN(I)
0089          TYPE 119
0090          ACCEPT 116,LOAD(I)
0091          TYPE 120
0092          ACCEPT 116,VARMAX(I)
0093          TYPE 121
0094          ACCEPT 116,VARMIN(I)
0095          TYPE 122
0096          ACCEPT 116,STATC(I)
0097  107     CONTINUE
0098  108     FORMAT(' ',7X,'BUS NAME  ',$)
```

```
0099   110    FORMAT(' ',7X,'BUS NO.    ',$)
0100   112    FORMAT(' ',7X,'ZONE       ',$)
0101   114    FORMAT(' ',7X,'BUS TYPE   ',$)
0102   115    FORMAT(' ',7X,'BASE VOLTAGE (KV)  ',$)
0103   117    FORMAT(' ',7X,'SPECIFIED VOLTAGE (KV)  ',$)
0104   118    FORMAT(' ',7X,'GENERATED POWER (MW+JMVAR)   ',$)
0105   119    FORMAT(' ',7X,'LOAD (MW+JMVAR)   ',$)
0106   120    FORMAT(' ',7X,'MAXIMUM VAR (MVAR)   ',$)
0107   121    FORMAT(' ',7X,'MINIMUM VAR (MVAR)   ',$)
0108   122    FORMAT(' ',7X,'STATIC VAR (MVAR)   ',$)
0109   111    FORMAT(I5)
0110   116    FORMAT(2F8.0)
0111   109    FORMAT(A8)
0112          OPEN(UNIT=1,NAME='DY1:BUS.DAT',TYPE='NEW')
0113          WRITE(1,140) NOZONE,NOBUS
0114   140    FORMAT(2I5)
0115          DO 150 I=1,NOBUS
0116          WRITE(1,123) BUSNAM(I),BUS(I),ZONE(I),TYPE(I),BASEKV(I),VOLT(I)
             X  ,              GEN(I),LOAD(I),VARMAX(I),VARMIN(I),STATC(I)
0117   123    FORMAT(A8,3I4,12F8.3)
0118   150    CONTINUE
0119          CALL CLOSE(1)
0120   160    GO TO 50
       C      ENTER LINE DATA
0121   200    TYPE 201
0122   201    FORMAT(' ',/20X,':ENTER LINE DATA: ARE YOU SUER? (Y OR N)  ',$)
0123          ACCEPT 202,MY
0124   202    FORMAT(A1)
0125          IF(MM.NE.MY) GO TO 250
0127          TYPE 203
0128   203    FORMAT(' ',/7X,':ENTER THE NUMBER OF LINES   ',$)
0129          ACCEPT 204,NOLINE
```

```
0130  204   FORMAT(I5)
0131        TYPE 205
0132  205   FORMAT(' ',/7X,':ENTER LINE DATA')
0133        DO 206 I=1,NOLINE
0134        TYPE 208
0135        ACCEPT 209,LINE(I)
0136        TYPE 210
0137        ACCEPT 209,NP(I)
0138        TYPE 211
0139        ACCEPT 209,NQ(I)
0140        TYPE 212
0141        ACCEPT 213,ZPRI(I)
0142        TYPE 214
0143        ACCEPT 213,BC(I)
0144        TYPE 215
0145        ACCEPT 213,T(I)
0146  206   CONTINUE
0147  208   FORMAT(' ',7X,'LINE NO.    ',$)
0148  210   FORMAT(' ',7X,'FROM BUS NO.  ',$)
0149  211   FORMAT(' ',7X,'TO BUS NO.    ',$)
0150  212   FORMAT(' ',7X,'IMPEDANCE IN PU. ( R+JX)  ',$)
0151  214   FORMAT(' ',7X,'Y SHUNT IN PU.    ',$)
```

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```
0152  215   FORMAT(' ',7X,'TRANSFORMER RATIO  ',$)
0153  209   FORMAT (I3)
0154  213   FORMAT(2F10.4)
0155        OPEN(UNIT=2,NAME='DY1:LINE.DAT',TYPE='NEW')
0156        WRITE(2,220) NOLINE
0157  220   FORMAT(I5)
0158        DO 225 I=1,NOLINE
0159        WRITE(2,223) LINE(I),NP(I),NQ(I),ZPRI(I),BC(I),T(I)
0160  223   FORMAT(3I5,4F10.4)
0161  225   CONTINUE
0162        CALL CLOSE(2)
0163  250   GO TO 50
```

```
      C     ... CONTROL DATA
0164  300    TYPE 391
0165  391    FORMAT(' ',//10X,':ENTER CONTROL DATA: ARE YOU SURE? (Y OR N) '
             X ,$)
0166          ACCEPT 202,MY
0167          IF(MM.NE.MY) GO TO 399
0169          TYPE 301
0170          ACCEPT 302,ACC
0171          TYPE 303
0172          ACCEPT 382,MAXITE
0173          TYPE 304
0174          ACCEPT 302,BASMVA
0175          TYPE 306
0176          ACCEPT 302,TOR
0177          DO 308 I=1,15
0178          TYPE 309,I
0179  309     FORMAT(' ',7X,'OPTION(',I2,')=' ,$)
0180          ACCEPT 310,OPTION(I)
0181  310     FORMAT(I1)
0182  308     CONTINUE
0183          TYPE 360
0184          ACCEPT 202,MY
0185          IF(MM.EQ.MY) GO TO 361
0187          IWRITE=7
0188          GO TO 362
0189  361     IWRITE=6
0190  362     CONTINUE
0191  360     FORMAT(' ',7X,'PRINT RESULT ON LINE PRINTER (Y OR N)' ,$)
0192  301     FORMAT(' ',7X,'ACCELERATION FACTOR  ',$)
0193  303     FORMAT(' ',7X,'MAXIMUM ITERATION  ',$)
0194  304     FORMAT(' ',7X,'BASE MVA  ',$)
0195  306     FORMAT(' ',7X,'TOLERANCES ',$)
0196  302     FORMAT(F10.4)
0197  382     FORMAT(I5)
0198          OPEN(UNIT=3,NAME='DY1:CON.DAT',TYPE='NEW')
0199          WRITE(3,350)IWRITE, MAXITE,BASMVA,ACC,TOR,(OPTION(I),I=1,15)
0200  350     FORMAT(2I5,3F10.5,15I1)
0201          CALL CLOSE(3)
0202  399     GO TO 50
      C     ...ENTER GENERATOR DATA
0203  400     TYPE 480
0204  480     FORMAT(' ',10X,':ENTER GENERATOR DATA: ARE YOU SURE?(Y OR N)',$)
```

```
0205          ACCEPT 102,MY
0206          IF(MM.NE.MY) GO TO 499
0208          TYPE 403
0209    403   FORMAT(' ',10X,':ENTER THE NUMBER OF GENERATORS (NOT MORE THAN
             X20)  ',$)
0210          ACCEPT 404,NGEN
0211    404   FORMAT(I2)
0212          TYPE 406
0213    406   FORMAT(' ',10X,':ENTER GENERATOR DATA')
0214          DO 407 I=1,NGEN
0215          TYPE 408
0216          ACCEPT 409,IMGN(I)
0217          TYPE 410
0218          ACCEPT 409,BGEN(I)
0219          TYPE 411
0220          ACCEPT 412,XDI(I)
0221          TYPE 413
0222          ACCEPT 412,XQI(I)
0223          TYPE 414
0224          ACCEPT 412,XDPI(I)
0225          TYPE 415
0226          ACCEPT 412,HI(I)
0227          TYPE 416
0228          ACCEPT 412,TOI(I)
0229          TYPE 417
0230          ACCEPT 412,TEI(I)
0231          TYPE 418
0232          ACCEPT 412,MUI(I)
0233          TYPE 419
0234          ACCEPT 412,TCI(I)
0235          TYPE 420
0236          ACCEPT 412,TSI(I)
0237          TYPE 421
0238          ACCEPT 412,RI(I)
```

```
0239          TYPE 422
0240          ACCEPT 412,PMAXI(I)
0241          TYPE 423
0242          ACCEPT 412,EFMAXI(I)
0243          TYPE 424
0244          ACCEPT 412,EFMINI(I)
0245    407   CONTINUE
0246    408   FORMAT(' ',8X,'GENERATOR NUMBER  ',$)
0247    410   FORMAT(' ',8X,'CONNECTED AT BUS  ',$)
0248    411   FORMAT(' ',8X,'DIRECT-AXIS SYNCHRONOUS REACTANCE(XD) ',$)
0249    413   FORMAT(' ',8X,'QUADRATURE-AXIS REACTANCE (XQ)  ',$)
0250    414   FORMAT(' ',8X,'TRANSIENT REACTANCE (XDP)  ',$)
0251    415   FORMAT(' ',8X,'H CONSTANT (H)  ',$)
0252    416   FORMAT(' ',8X,'OPEN-CIRCUIT FIELD TIME CONSTANT (TO) ',$)
0253    417   FORMAT(' ',8X,'EXCITATION SYSTEM TIME CONSTANT (TE)  ',$)
0254    418   FORMAT(' ',8X,'GAIN OF REGULATOR-EXCITATION (MU)  ',$)
0255    419   FORMAT(' ',8X,'CONTROL SYSTEM TIME CONSTANT (TC)  ',$)
0256    420   FORMAT(' ',8X,'STEAM SYSTEM TIME CONSTANT (TS) ',$)
0257    421   FORMAT(' ',8X,'SPEED REGULATION (R)  ',$)
0258    422   FORMAT(' ',8X,'MAXIMUM MECHANICAL POWER (PMAX)  ',$)
```



```
0259    423   FORMAT(' ',8X,'CEILING EXCITATION VOLTAGE (EFMAX)  ',$)
0260    424   FORMAT(' ',8X,'MINIMUM EXCITATION VOLTAGE (EFMIN)  ',$)
0261    409   FORMAT(I3)
0262    412   FORMAT(F10.5)
0263          OPEN(UNIT=4,NAME='DY1:GEN.DAT',TYPE='NEW')
0264          WRITE(4,450) NGEN
0265    450   FORMAT(I2)
0266          DO 470 I=1,NGEN
0267          WRITE(4,451) IMGN(I),BGEN(I),XDI(I),XQI(I),XDPI(I),HI(I)
             X  ,TOI(I)
0268          WRITE(4,452) TEI(I),MUI(I),TCI(I),TSI(I),RI(I),PMAXI(I)
             X  ,EFMAXI(I),EFMINI(I)
```

```
0269  451   FORMAT(2I3,5F10.5)
0270  452   FORMAT(8F10.5)
0271  470   CONTINUE
0272        CALL CLOSE(4)
0273  499   GO TO 50
      C     ... DATA OF NON-IMPEDANCE TYPE LOAD
0274  500   TYPE 590
0275  590   FORMAT(' ',//10X,':ENTER LOAD DATA: ARE YOU SURE? (Y OR N)  ',$)
0276        ACCEPT 102,MY
0277        IF(MY.NE.MM) GO TO 599
0279        TYPE 502
0280        ACCEPT 503,NLBUS
0281  502   FORMAT(' ',8X,'ENTER THE NUMBER OF NON-IMPEDANCE TYPE LOADS  '
           X,$)
0282  503   FORMAT(I2)
0283        IF(NLBUS.EQ.0) GO TO 515
0285        DO 504 I=1,NLBUS
0286        TYPE 505
0287        ACCEPT 506,LBUS(I)
0288        TYPE 510
0289        ACCEPT 507,ROD1(I)
0290        TYPE 508
0291        ACCEPT 507,ROD2(I)
0292        TYPE 509
0293        ACCEPT 507,ROD3(I)
0294  504   CONTINUE
0295  506   FORMAT(I3)
0296  507   FORMAT(2F10.2)
0297  515   OPEN(UNIT=9,NAME='DY1:LOAD.DAT',TYPE='NEW')
0298        WRITE(9,550) NLBUS
0299  550   FORMAT(I2)
0300        IF(NLBUS.EQ.0) GO TO 516
0302        DO 560 I=1,NLBUS
0303        WRITE(9,561) LBUS(I),ROD1(I),ROD2(I),ROD3(I)
0304  561   FORMAT(I3,6F10.2)
0305  560   CONTINUE
0306  516   CALL CLOSE(9)
0307  505   FORMAT(' ',8X,'BUS NO.  ',$)
0308  510   FORMAT(' ',8X,'CONSTANT IMPEDANCE LOAD (PZ+JQZ)  ',$)
0309  508   FORMAT(' ',8X,'CONSTANT CURRENT LOAD  (PI+JQI)  ',$)
0310  509   FORMAT(' ',8X,'CONSTANT MVA LOAD (PKVA+JQKVA)  ',$)
0311  599   GO TO 50
```

```
      C     ...SWITCHING OPERATION DATA
0312  600    TYPE 690
0313  690    FORMAT(' ',//8X,':ENTER SWITCHING DATA: ARE YOU SURE? (Y OR N) '
     X   ,$)
0314          ACCEPT 102,MY
0315          IF(MM.NE.MY) GO TO 699
0317          TYPE 602
0318  602    FORMAT(' ',8X,'ENTER THE NUMBER OF SWITCHING OPERATIONS  ',$)
0319          ACCEPT 603,NST
0320  603    FORMAT(I2)
0321          DO 604 IS=1,NST
0322          TYPE 605
0323          ACCEPT 606,TITS(IS)
0324          DO 607 KK=1,3
0325          TYPE 608
0326          ACCEPT 609,LIOP(KK,IS)
0327          TYPE 611
0328          ACCEPT 609,LICL(KK,IS)
0329  607    CONTINUE
0330  604    CONTINUE
0331  606    FORMAT(F10.4)
0332  609    FORMAT(I4)
0333  605    FORMAT(' ',8X,'AT TIME T=  ',$)
0334  608    FORMAT(' ',8X,'LINE OPENED ,LINE NO.  ',$)
0335  611    FORMAT(' ',8X,'LINE CLOSED ,LINE NO.  ',$)
0336          TYPE 620
0337          ACCEPT 622,NOMT
0338          IF(NOMT.EQ.0) GO TO 660
0340          DO 624 I=1,NOMT
0341          TYPE 625
```

```
0342          ACCEPT 622,IMET(I)
0343    624   CONTINUE
0344    622   FORMAT(I4)
0345    620   FORMAT(' ',8X,'ENTER THE NUMBER OF BUSES CONNECTED BY SWITCHING
             X LINES  ',$)
0346    625   FORMAT(' ',8X,'BUS NO.  ',$)
0347    660   TYPE 650
0348          ACCEPT 631,NOPLOT
0349          DO 632 I=1,NOPLOT
0350          TYPE 633
0351          ACCEPT 622,NMAC(I)
0352    632   CONTINUE
0353    630   FORMAT(' ',8X,'ENTER NUMBER OF CURVE TO BE PLOTED (NOT MORE THAN
             X 5)   ',$)
0354    631   FORMAT(I4)
0355    633   FORMAT(' ',8X,'GENERATOR TO BE PLOTED :  GEN NO.  ',$)
0356          TYPE 635
0357          ACCEPT 636,ETMIN
0358    635   FORMAT(' ',8X,'TIME SCALE ,(1.0 OR 2.0 OR 3.0 SEC)  ',$)
0359    636   FORMAT (F5.0)
0360          TYPE 637
0361          ACCEPT 636,ESC
0362    637   FORMAT(' ',8X,'VERTICAL SCALE,(1.0 OR 2.0)  ',$)
0363          OPEN(UNIT=10,NAME='DY1:SWIT.DAT',TYPE='NEW')

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0364          WRITE(10,640)NST
0365          DO 641 IS=1,NST
0366          WRITE(10,643) TITS(IS),(LIOP(KK,IS),KK=1,3),(LICL(KK,IS),KK=1,3)
0367    641   CONTINUE
0368    640   FORMAT(I5)
0369    643   FORMAT(F10.4,6I4)
0370          WRITE(10,650) NOMT
0371          IF(NOMT.EQ.0) GO TO 665
0373          DO 663 I=1,NOMT
0374          WRITE(10,650) IMET(I)
0375    663   CONTINUE
0376    650   FORMAT(10I5)
0377    665   WRITE(10,655) NOPLOT,(NMAC(L),L=1,NOPLOT)
0378    655   FORMAT(10I5)
```

```
0379            WRITE(10,656) ETMIN,ESC
0380    656     FORMAT(2F5.0)
0381            CALL CLOSE(10)
0382    699     GO TO 50
        C       ...OTHER DATA
0383    700     TYPE 790
0384    790     FORMAT(' ',//10X,':ENTER OTHER DATA: ARE YOU SURE? (Y OR N) ',$)
0385            ACCEPT 102,MY
0386            IF(MM.NE.MY) GO TO 799
0388            TYPE 720
0389            ACCEPT 702,F
0390            TYPE 701
0391            ACCEPT 702,DT
0392            TYPE 703
0393            ACCEPT 702,TCF
0394            TYPE 704
0395            ACCEPT 702,TSTOP
0396            TYPE 705
0397            ACCEPT 702,NETA
0398            TYPE 706
0399            ACCEPT 702,EPLON
0400            TYPE 707
0401            ACCEPT 702,OMGA
0402            TYPE 708
0403            ACCEPT 709,FBUS
0404            TYPE 710
0405            ACCEPT 709,MON
0406            TYPE 711
0407            ACCEPT 709,MON1
0408            OPEN(UNIT=11,NAME='DY1:OTH.DAT',TYPE='NEW')
0409            WRITE(11,750) FBUS,MON,MON1,F,DT,TCF,TSTOP,NETA,EPLON,OMGA
0410    750     FORMAT(3I5,7F10.4)
0411    702     FORMAT(F10.4)
0412    709     FORMAT(I5)
0413    720     FORMAT(' ',8X,'SYSTEM FREQUENCY (HZ)  ',$)
0414    701     FORMAT(' ',8X,'TIME STEP (SEC) ',$)
0415    703     FORMAT(' ',8X,'FAULT CLEARED AT TIME  ',$)
0416    704     FORMAT(' ',8X,'END OF CASE AT TIME  ',$)
0417    705     FORMAT(' ',8X,'TOLERANCES OF LOOP 1.  ',$)
0418    706     FORMAT(' ',8X,'TOLERANCES OF LOOP 2.  ',$)
```

```
0419  707   FORMAT(' ',8X,'TOLERANCES OF LOOP 3.  ',$)
0420  708   FORMAT(' ',8X,'FAULT AT BUS  '.$)
0421  710   FORMAT(' ',8X,'MONITOR  ',$)
0422  711   FORMAT(' ',8X,'MONITOR1 ',$)
0423        CALL CLOSE(11)
0424  799   GO TO 50
0425  900   RETURN
0426        END
```



```
0001        SUBROUTINE STEP1A
            C
            C
0002        INTEGER IREAD,IWRITE,NOZONE,NOBUS,NOLINE,NOCUT,ISWB,ISBZ
           X  ,       NOBUSZ(4),NOLINZ(4),MAXITE,OPTION(15)
0003        INTEGER CUTP(10),CUTQ(10),CUTF(10)
0004        INTEGER BUS(40),BUSZON(10,4),NODE(10,4),LINE(60),NP(60),NQ(60)
0005        INTEGER ZONE(40),NPD(60),NQD(60)
0006        INTEGER TYPE(40),NPZ(15,4),NQZ(15,4)
0007        INTEGER CUTPB(10),CUTQB(10),CUTPZ(10),CUTQZ(10),TYPEZ(10,4)
0008        REAL    ACC,TOR,BASMVA
0009        REAL    BC(60),T(60),BASEKV(40)
0010        DOUBLE PRECISION    BUSNAM(40)
0011        REAL    BCS(40)
0012        REAL    VOLT(40),VARMAX(40),VARMIN(40),STATC(40)
0013        REAL    VOLTZ(10,4),VAMXZ(10,4),VAMNZ(10,4),STATZ(10,4)
0014        COMPLEX CUTZ(10),AA
0015        COMPLEX ZPRI(60)
0016        COMPLEX ZPRID(60),YT(40)
0017        COMPLEX GEN(40),LOAD(40),ZRX(15,4)
0018        COMPLEX GENZ(10,4),LOADZ(10,4)
0019        COMPLEX Z1(10,10,4),Z2(10,10,4),Z4(10,10),Y4(10,10),ZS(10,4)
0020        COMPLEX ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0021        COMPLEX ZG(10,4),YMOD(10,4),YL(10,4),YO(10,4),ZMOD(10,4),DM
0022        COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4),DACUT(10,4)
0023        COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ET1,DAN,DAS,DD
0024        COMPLEX FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
```

```
      C
      C
0025        COMMON/BUFF/NOBUS,NOLINE
           X    ,              AA
           X  ,               BUS,BUSZON,NODE,LINE,NP,NQ,ZPRI
           X  ,               ZPRID
           X  ,               GEN,LOAD,ZRX
           X  ,               VOLTZ,GENZ,LOADZ
           X  ,               Z1,Z2,Z4,Y4,ZS,D,VECTOR
           X  ,               ZQ,YMOD,YL,YQ,ZMOD,DM
           X  ,               EC,AC,A,ACUT,DACUT,ET,ECUT,SUM,ET0,ET1,DAN,DAS,DD
           X  ,               FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
      C
      C
0026        COMMON/COM/IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
           X  ,               NOBUSZ,NOLINZ,CUTP,CUTQ,CUTPB,CUTQB
           X  ,               CUTPZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
      C
0027        COMMON/TUB/MAXITE,OPTION,ZONE,NPD,NQD,TYPE,NPZ,NQZ,TYPEZ
           X  ,               ACC,TOR,BC,T,BASEKV,BUSNAM,BCS,VOLT,VARMAX
           X  ,               VARMIN,STATC,VAMXZ,VAMNZ,STATZ,YT
      C
0028        OPEN(UNIT=1,NAME='DY1:BUS.DAT',TYPE='OLD')
0029        READ(1,105) NOZONE,NOBUS
0030  105   FORMAT(2I5)
0031        DO 110 I=1,NOBUS
0032        READ(1,107)BUSNAM(I),BUS(I),ZONE(I),TYPE(I),BASEKV(I),VOLT(I)

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           X  ,                    GEN(I),LOAD(I),VARMAX(I),VARMIN(I),STATC(I)
0033  107   FORMAT(A8,3I4,12F8.3)
0034        VOLT(I)=VOLT(I)/BASEKV(I)
0035        IF(VOLT(I).EQ.0.0) VOLT(I)=1.0
0037  110   CONTINUE
0038        DO 120 J=1,NOZONE
0039        NOBUSZ(J)=0
0040        DO 120 I=1,NOBUS
0041        IF(ZONE(I).NE.J) GO TO 120
0043        NOBUSZ(J)=NOBUSZ(J)+1
0044        K=NOBUSZ(J)
0045        BUSZON(K,J)=BUS(I)
0046  120     CONTINUE
```

```
0047          CALL CLOSE(1)
0048          OPEN(UNIT=2,NAME='DY1:LINE.DAT',TYPE='OLD')
0049          READ(2,1300) NOLINE
0050   1300   FORMAT(I5)
0051          DO 130 I=1,NOLINE
0052          READ(2,125)LINE(I),NP(I),NQ(I),ZPRI(I),BC(I),T(I)
0053   125    FORMAT(3I5,4F10.4)
0054          IF(T(I).EQ.0.0) T(I)=1.0
0056   130    CONTINUE
0057          CALL CLOSE(2)
0058          OPEN(UNIT=3,NAME='DY1:CON.DAT',TYPE='OLD')
0059          READ(3,1255)IWRITE, MAXITE,BASMVA,ACC,TOR,(OPTION(I),I=1,15)
0060   1255   FORMAT(2I5,3F10.5,15I1)
0061          CALL CLOSE(3)
      C
0062          WRITE(IWRITE,1)
0063   1      FORMAT('1',24X,'TRANSIENT STABILITY ANALYSIS BY DIAKOPTICAL METH
              XOD')
0064          IREAD=OPTION(5)
0065          IL=0
0066          NOCUT=0
0067   132    CONTINUE
0068          DO 150 I=1,NOLINE
0069          DO 134 IP=1,NOBUS
0070          IF(NP(I).EQ.BUS(IP)) GO TO 136
0072   134    CONTINUE
0073   136    CONTINUE
0074          DO 138 IQ=1,NOBUS
0075          IF(NQ(I).EQ.BUS(IQ)) GO TO 140
0077   138    CONTINUE
0078   140    CONTINUE
0079          IF(ZONE(IP).NE.ZONE(IQ)) GO TO 146
0081          IL=IL+1
```

```
0082          NPD(IL)=NP(I)
0083          NQD(IL)=NQ(I)
0084          IF(T(I).NE.1.0) GO TO 148
0086          ZPRID(IL)=ZPRI(I)
0087    145   CONTINUE
0088          BCS(IP)=BCS(IP)+BC(I)/2.0
0089          BCS(IQ)=BCS(IQ)+BC(I)/2.0
0090          GO TO 150
```

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```
0091    146   CONTINUE
0092          NOCUT=NOCUT+1
0093          CUTP(NOCUT)=NP(I)
0094          CUTQ(NOCUT)=NQ(I)
0095          IF(T(I).NE.1.0) GO TO 147
0097          CUTZ(NOCUT)=ZPRI(I)
0098          GO TO 145
0099    147   CONTINUE
0100          CUTZ(NOCUT)=ZPRI(I)*T(I)
0101          GO TO 149
0102    148   CONTINUE
0103          ZPRID(IL)=ZPRI(I)*T(I)
0104    149   CONTINUE
0105          YT(IP)=YT(IP)+(1.0-T(I))/T(I)**2/ZPRI(I)
0106          YT(IQ)=YT(IQ)+(T(I)-1.0)/T(I)/ZPRI(I)
0107    150   CONTINUE
0108          DO 190 J=1,NOZONE
0109          NPZ(1,J)=0
0110          NQZ(1,J)=BUSZON(1,J)
0111          ZRX(1,J)=CMPLX(1.0,1.0)
0112          NH=1
0113          II=1
0114          JJ=1
0115          KK=1
0116    160   CONTINUE
```

```
      IL=1
  161 CONTINUE
      IF(NPD(IL).EQ.9999) GO TO 180
      IF(NPD(IL).NE.0.AND.NQD(IL).NE.0) GO TO 168
      II=II+1
      NPZ(II,J)=0
      NQZ(II,J)=BUSZON(NH,J)
      DO 162 IQ=1,NOBUS
      IF(BUS(IQ).EQ.NQZ(II,J)) GO TO 164
  162 CONTINUE
  164 CONTINUE
      ZRX(II,J)=1.0/((CONJG(LOAD(IQ)+CMPLX(0.0,STATC(IQ)))*BASEVA
     X          /VOLT(IQ)/VOLT(IQ)+YT(IQ)+CMPLX(0.0,BCS(I
      NH=NH+1
      JJ=NH
      IF(BUSZON(NH,J).EQ. 0)GO TO 185
      GO TO 160
  168 CONTINUE
      IF(NQD(IL).EQ.BUSZON(NH,J)) GO TO 170
      IF(NPD(IL).NE.BUSZON(NH,J)) GO TO 180
      ND=NPD(IL)
      NPD(IL)=NQD(IL)
      NQD(IL)=ND
  170 CONTINUE
      DO 172 M=1,KK
      IF(NPD(IL).EQ.BUSZON(M,J) ) GO TO 182
  172 CONTINUE
      KK=KK+1
      BUSZON(KK,J)=NPD(IL)
```

```
0152  180   CONTINUE
0153        IL=IL+1
0154        GO TO 161
0155  182   CONTINUE
0156        IF(M.GE.JJ) GO TO 180
0158        II=II+1
0159        NPZ(II,J)=NPD(IL)
0160        NQZ(II,J)=NQD(IL)
0161        ZRX(II,J)=ZPRID(IL)
0162        NPD(IL)=9999
0163        GO TO 160
0164  185   CONTINUE
0165        II=II+1
0166        NPZ(II,J)=0
0167        NQZ(II,J)=NQZ(1,J)
0168        ZRX(II,J)=CMPLX(-1.0,-1.0)
0169        NOLINZ(J)=II
0170  190   CONTINUE
0171        IF(OPTION(1).EQ.0) GO TO 1991
0173        WRITE(IWRITE,1911)
0174        WRITE(IWRITE,1912)
0175        WRITE(IWRITE,1913)
0176        WRITE(IWRITE,1914)
0177        WRITE(IWRITE,1915)
0178        WRITE(IWRITE,1916)
0179        DO 191 I=1,NOBUS
0180        WRITE(IWRITE,1918) BUS(I),ZONE(I),TYPE(I),VOLT(I),GEN(I),
           X                   VARMAX(I),VARMIN(I),LOAD(I),STATC(I)
0181        IF(OPTION(13).NE.0) WRITE(IWRITE,1917)
0183  191   CONTINUE
```

```
0184          WRITE(IWRITE,1916)
0185    1911  FORMAT(' ',//42X,'BUS  INPUT DATA')
0186    1912  FORMAT('0',6X,':-----:----:----:-------:-----------------:--------
             X---------:------------------:---------:')
0187    1913  FORMAT(' ',6X,': BUS :     :     :         :    GENERATION    :   MVAR
             X LIMIT   :      LOAD        : SHUNT    :')
0188    1914  FORMAT(' ',6X,':     :ZONE:TYPE: VOLT   :-----------------:--------
             X---------:------------------:          :')
0189    1915  FORMAT(' ',6X,': NO. :     :     :         :   MW    : MVAR  :   MAX
             X:   MIN   :    MW    :  MVAR  :CAPACITOR:')
0190    1916  FORMAT(' ',6X,':-----:----:----:-------:--------:--------:--------
             X:--------:--------:--------:---------:')
0191    1917  FORMAT(' ',6X,':     :     :     :         :        :        :
             X:         :         :         :')
0192    1918  FORMAT(' ',6X,':',I3,'  :',2(I3,' :'),F6.3,' :',6(F7.2,' :'),F8.2,
             X' :')
0193    1991  IF(OPTION(2).EQ.0) GO TO 1992
0195          WRITE(IWRITE,1921)
0196          WRITE(IWRITE,1922)
0197          WRITE(IWRITE,1923)
0198          WRITE(IWRITE,1924)
0199          WRITE(IWRITE,1925)
0200          WRITE(IWRITE,1926)
0201          DO 192 I=1,NOLINE
```

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```
0202          WRITE(IWRITE,1928) LINE(I),NP(I),NQ(I),ZPRI(I),BC(I),T(I)
0203          IF(OPTION(13).NE.0) WRITE(IWRITE,1927)
0205    192   CONTINUE
0206          WRITE(IWRITE,1926)
0207    1921  FORMAT('1',//24X,'                    LINE  LIST                  ')
0208    1922  FORMAT('0',20X,':------:-----:-----:-----------------:--------:---
             X----:')
0209    1923  FORMAT(' ',20X,': LINE : BUS : BUS :    IMPEDANCE    :   Y    :TRA
             XNFS.:')
0210    1924  FORMAT(' ',20X,':      :     :     :-----------------:        :
             X    :')
0211    1925  FORMAT(' ',20X,':  NO. :  P  :  Q  :    R    :    X    : SHUNT : RA
             XTIO :')
0212    1926  FORMAT('_',20X,':------:-----:-----:---------:---------:--------:---
```

```
      X----:')
1927  FORMAT(' ',20X,':          :       :       :           :          :
     X     :')
1928  FORMAT(' ',20X,':',I4,'  :',2(I3,'  :'),3(F7.4,' :'),F6.3,' :')
1992  IF(OPTION(3).EQ.0) GO TO 1993
      WRITE(IWRITE,1931)
      WRITE(IWRITE,1932)
      WRITE(IWRITE,1933)
      WRITE(IWRITE,1934)
      WRITE(IWRITE,1935)
      WRITE(IWRITE,1936)
      WRITE(IWRITE,1937)
      DO 193 I=1,NOCUT
      WRITE(IWRITE,1939) CUTP(I),CUTQ(I),CUTZ(I)
      IF(OPTION(13).NE.0) WRITE(IWRITE,1938)
193   CONTINUE
      WRITE(IWRITE,1937)
1931  FORMAT(' ',//31X,'                CUT LINE                ')
1932  FORMAT('0',30X,':-----------:-------------------:')
1933  FORMAT(' ',30X,':  BETWEEN  :      IMPEDANCE     :')
1934  FORMAT(' ',30X,':-----------:-------------------:')
1935  FORMAT(' ',30X,': BUS : BUS :         :         :')
1936  FORMAT(' ',30X,': NO. : NO. :    R    :    X    :')
1937  FORMAT(' ',30X,':-----:-----:---------:---------:')
1938  FORMAT(' ',30X,':     :     :         :         :')
1939  FORMAT(' ',30X,':',2(I3,'  :'),2(F8.4,' :'))
1993  IF(OPTION(4).EQ.0) GO TO 1994
      DO 195 J=1,NOZONE
      WRITE(IWRITE,1941) J
      WRITE(IWRITE,1942)
      WRITE(IWRITE,1943)
      WRITE(IWRITE,1944)
      WRITE(IWRITE,1945)
      WRITE(IWRITE,1946)
```

```
0248          L=NOLINZ(J)
0249          DO 194 I=1,L
0250          WRITE(IWRITE,1948) NPZ(I,J),NQZ(I,J),ZRX(I,J)
0251          IF(OPTION(13).NE.0) WRITE(IWRITE,1947)
0253   194    CONTINUE
0254          WRITE(IWRITE,1946)
```



```
0255   195    CONTINUE
0256   1941   FORMAT(' ',//30X,'LINE LIST AFTER ORDERING-ZONE',I2)
0257   1942   FORMAT('0',30X,':-----:-----:--------------------:')
0258   1943   FORMAT(' ',30X,': BUS : BUS :     IMPEDANCE      :')
0259   1944   FORMAT(' ',30X,':     :     :--------------------:')
0260   1945   FORMAT(' ',30X,':  P  :  Q  :     R    :     X    :')
0261   1946   FORMAT(' ',30X,':-----:-----:----------:----------:')
0262   1947   FORMAT(' ',30X,':     :     :          :          :')
0263   1948   FORMAT(' ',30X,':',2(I3,'  :'),2(F8.4,' :'))
0264   1994   CONTINUE
0265          RETURN
0266          END
```

```
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0001          SUBROUTINE STEP2A
      C
      C
0002          INTEGER IREAD,IWRITE,NOZONE,NOBUS,NOLINE,NOCUT,ISWB,ISBZ
             X  ,       NOBUSZ(4),NOLINZ(4),MAXITE,OPTION(15)
0003          INTEGER CUTP(10),CUTQ(10),CUTF(10)
0004          INTEGER BUS(40),BUSZON(10,4),NODE(10,4),LINE(60),NP(60),NQ(60)
0005          INTEGER ZONE(40),NPD(60),NQD(60)
0006          INTEGER TYPE(40),NPZ(15,4),NQZ(15,4)
0007          INTEGER CUTPB(10),CUTQB(10),CUTPZ(10),CUTQZ(10),TYPEZ(10,4)
0008          REAL    ACC,TOR,BASMVA
0009          REAL    BC(60),T(60),BASEKV(40)
0010          DOUBLE PRECISION   BUSNAM(40)
0011          REAL    BCS(40)
0012          REAL    VOLT(40),VARMAX(40),VARMIN(40),STATC(40)
0013          REAL    VOLTZ(10,4),VAMXZ(10,4),VAMNZ(10,4),STATZ(10,4)
0014          COMPLEX CUTZ(10),AA
0015          COMPLEX ZPRI(60)
0016          COMPLEX ZPRID(60),YT(40)
0017          COMPLEX GEN(40),LOAD(40),ZRX(15,4)
0018          COMPLEX GENZ(10,4),LOADZ(10,4)
0019          COMPLEX Z1(10,10,4),Z2(10,10,4),Z4(10,10),Y4(10,10),ZS(10,4)
0020          COMPLEX ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0021          COMPLEX ZG(10,4),YMOD(10,4),YL(10,4),YD(10,4),ZMOD(10,4),DM
0022          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4),DACUT(10,4)
0023          COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ET1,DAN,DAS,DD
0024          COMPLEX FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
      C
```

```
0025          COMMON/BUFF/NOBUS,NOLINE
             X    ,            AA
             X   ,             BUS,BUSZON,NODE,LINE,NP,NQ,ZPRI
             X   ,             ZPRID
             X   ,             GEN,LOAD,ZRX
             X   ,             VOLTZ,GENZ,LOADZ
             X   ,             Z1,Z2,Z4,Y4,ZS,D,VECTOR
             X   ,             ZG,YMOD,YL,YO,ZMOD,DM
             X   ,             EC,AC,A,ACUT,DACUT,ET,ECUT,SUM-ETO,ET1,DAN,DAS,DD
             X   ,             FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
      C
0026          COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
             X   ,             NOBUSZ,NOLINZ,CUTP,CUTQ,CUTF,CUTPB,CUTQB
             X   ,             CUTPZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
      C
0027          COMMON/TUB/MAXITE,OPTION,ZONE,NPD,NQD,TYPE,NPZ,NQZ,TYPEZ
             X   ,             ACC,TOR,BC,T,BASEKV,BUSNAM,BCS,VOLT,VARMAX
             X   ,             VARMIN,STATC,VAMXZ,VAMNZ,STATZ,YT
      C
0028          DO 240 J=1,NOZONE
0029          K=1
0030          N=1
0031          Z1(K,K,J)=ZRX(N,J)
0032          NODE(K,J)=NQZ(N,J)
0033    205   N=N+1
0034          IF(NPZ(N,J).EQ.0) GO TO 230
```

```
0036          IFP=0
0037          IFQ=0
0038          DO 206 I=1,K
0039          IF(NPZ(N,J).NE.NODE(I,J)) GO TO 206
0041          IFP=I
0042          GO TO 207
0043    206   CONTINUE
0044    207   CONTINUE
0045          DO 209 I=1,K
0046          IF(NQZ(N,J).NE.NODE(I,J)) GO TO 209
0048          IFQ=I
0049          GO TO 210
0050    209   CONTINUE
0051    210   CONTINUE
0052          IF(IFP.EQ.0) GO TO 220
0054          IF(IFQ.EQ.0) GO TO 225
0056          L=K+1
0057          DO 213 I=1,K
0058          Z1(I,L,J)=Z1(I,IFP,J)-Z1(I,IFQ,J)
0059          Z1(L,I,J)=Z1(I,L,J)
0060    213   CONTINUE
0061          Z1(L,L,J)=Z1(IFP,L,J)-Z1(IFQ,L,J)+ZRX(N,J)
0062    214   CONTINUE
0063          DO 215 I=1,K
0064          DO 215 M=1,K
0065          Z1(I,M,J)=Z1(I,M,J)-Z1(I,L,J)/Z1(L,L,J)*Z1(L,M,J)
0066    215   CONTINUE
0067          DO 216 I=1,L
0068          Z1(I,L,J)=CMPLX(0.0,0.0)
0069          Z1(L,I,J)=CMPLX(0.0,0.0)
0070    216   CONTINUE
0071          GO TO 205
```

```
0072  220   K=K+1
0073        NODE(K,J)=NPZ(N,J)
0074        L=K-1
0075        DO 222 I=1,L
0076        Z1(I,K,J)=Z1(I,IFQ,J)
0077        Z1(K,I,J)=Z1(I,K,J)
0078  222   CONTINUE
0079        Z1(K,K,J)=Z1(IFQ,IFQ,J)+ZRX(N,J)
0080        GO TO 205
0081  225   K=K+1
0082        NODE(K,J)=NQZ(N,J)
0083        L=K-1
0084        DO 228 I=1,L
0085        Z1(I,K,J)=Z1(I,IFP,J)
0086        Z1(K,I,J)=Z1(I,K,J)
0087  228   CONTINUE
0088        Z1(K,K,J)=Z1(IFP,IFP,J)+ZRX(N,J)
0089        GO TO 205
0090  230   CONTINUE
0091        IF(NQZ(N,J).EQ.0) GO TO 240
0093        DO 231 I=1,K
0094        IF(NQZ(N,J).NE.NODE(I,J)) GO TO 231
```

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```
0096        IFQ=I
0097        GO TO 232
0098  231   CONTINUE
0099  232   L=K+1
0100        DO 233 I=1,K
0101        Z1(I,L,J)=-Z1(IFQ,I,J)
0102        Z1(L,I,J)=Z1(I,L,J)
0103  233   CONTINUE
0104        Z1(L,L,J)=-Z1(IFQ,L,J)+ZRX(N,J)
0105        GO TO 214
0106  240   CONTINUE
```

```
0107            DO 245 IC=1,NOCUT
0108            DO 244 J=1,NOZONE
0109            K=NOBUSZ(J)
0110            DO 244 I=1,K
0111            IF(CUTP(IC).NE.NODE(I,J)) GO TO 243
0113            CUTPB(IC)=I
0114            CUTPZ(IC)=J
0115            GO TO 244
0116  243       IF(CUTQ(IC).NE.NODE(I,J)) GO TO 244
0118            CUTQB(IC)=I
0119            CUTQZ(IC)=J
0120  244       CONTINUE
0121  245       CONTINUE
0122            DO 255 N=1,NOBUS
0123            DO 254 J=1,NOZONE
0124            K=NOBUSZ(J)
0125            DO 254 I=1,K
0126            IF(BUS(N).NE.NODE(I,J)) GO TO 254
0128            TYPEZ(I,J)=TYPE(N)
0129            VOLTZ(I,J)=VOLT(N)
0130            VAMXZ(I,J)=VARMAX(N)
0131            VAMNZ(I,J)=VARMIN(N)
0132            STATZ(I,J)=STATC(N)
0133            GENZ(I,J)=GEN(N)
0134            LOADZ(I,J)=LOAD(N)
0135            GO TO 255
0136  254       CONTINUE
0137  255       CONTINUE
0138            DO 257 J=1,NOZONE
0139            K=NOBUSZ(J)
0140            DO 257 I=1,K
0141            IF(TYPEZ(I,J).NE.3) GO TO 257
0143            ISWB=I
0144            ISWZ=J
0145            GO TO 258
0146  257       CONTINUE
0147  258       CONTINUE
0148            RETURN
0149            END
```

```
0001          SUBROUTINE STEP2B
              C
              C
0002          INTEGER IREAD,IWRITE,NOZONE,NOBUS,NOLINE,NOCUT,ISWB,ISBZ
             X  ,        NOBUSZ(4),NOLINZ(4),MAXITE,OPTION(15)
0003          INTEGER CUTP(10),CUTQ(10),CUTF(10)
0004          INTEGER BUS(40),BUSZON(10,4),NODE(10,4),LINE(60),NP(60),NQ(60)
0005          INTEGER ZONE(40),NPD(60),NQD(60)
0006          INTEGER TYPE(40),NPZ(15,4),NQZ(15,4)
0007          INTEGER CUTPB(10),CUTQB(10),CUTPZ(10),CUTQZ(10),TYPEZ(10,4)
0008          REAL    ACC,TOR,BASMVA
0009          REAL    BC(60),T(60),BASEKV(40)
0010          DOUBLE PRECISION    BUSNAM(40)
0011          REAL    BCS(40)
0012          REAL    VOLT(40),VARMAX(40),VARMIN(40),STATC(40)
0013          REAL    VOLTZ(10,4),VAMXZ(10,4),VAMNZ(10,4),STATZ(10,4)
0014          COMPLEX CUTZ(10),AA
0015          COMPLEX ZPRI(60)
0016          COMPLEX ZPRID(60),YT(40)
0017          COMPLEX GEN(40),LOAD(40),ZRX(15,4)
0018          COMPLEX GENZ(10,4),LOADZ(10,4)
0019          COMPLEX Z1(10,10,4),Z2(10,10,4),Z4(10,10),Y4(10,10),ZS(10,4)
0020          COMPLEX ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0021          COMPLEX ZG(10,4),YMOD(10,4),YL(10,4),YO(10,4),ZMOD(10,4),DM
0022          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4),DACUT(10,4)
0023          COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ET1,DAN,DAS,DD
0024          COMPLEX FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
              C
0025          COMMON/BUFF/NOBUS,NOLINE
             X  ,          AA
             X  ,        BUS,BUSZON,NODE,LINE,NP,NQ,ZPRI
             X  ,        ZPRID
             X  ,        GEN,LOAD,ZRX
             X  ,        VOLTZ,GENZ,LOADZ
             X  ,        Z1,Z2,Z4,Y4,ZS,D,VECTOR
             X  ,        ZG,YMOD,YL,YO,ZMOD,DM
             X  ,        EC,AC,A,ACUT,DACUT,ET,ECUT,SUM,ET0,ET1,DAN,DAS,DD
             X  ,        FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
```

```
0026          COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
             X  ,           NOBUSZ,NOLINZ,CUTP,CUTQ,CUTF,CUTPB,CUTQB
             X  ,           CUTPZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
      C
0027          COMMON/TUB/ MAXITE,OPTION,ZONE,NPD,NQD,TYPE,NPZ,NQZ,TYPEZ
             X  ,           ACC,TOR,BC,T,BASEKV,BUSNAM,BCS,VOLT,VARMAX
             X  ,           VARMIN,STATC,VAMXZ,VAMNZ,STATZ,YT
      C
0028          DATA BB/3HBUS/
0029          DO 267 J=1,NOZONE
0030          K=NOBUSZ(J)
0031          DO 266 IC=1,NOCUT
0032          DO 260 I=1,K
0033          IF(CUTF(IC).EQ.NODE(I,J)) GO TO 261
0035          IF(CUTQ(IC).EQ.NODE(I,J)) GO TO 261
```



```
0037   260    CONTINUE
0038          GO TO 266
0039   261    IF(CUTF(IC).EQ.9999) GO TO 264
0041          DO 262 L=1,K
0042          Z2(L,IC,J)=Z1(L,I,J)
0043   262    CONTINUE
0044          CUTF(IC)=9999
0045          GO TO 266
0046   264    CONTINUE
0047          DO 265 L=1,K
0048          Z2(L,IC,J)=-Z1(L,I,J)
0049   265    CONTINUE
0050   266    CONTINUE
0051   267    CONTINUE
0052          IF(OPTION(5).EQ.0) GO TO 2991
0054          DO 291 J=1,NOZONE
0055          K=NOBUSZ(J)
0056          WRITE(IWRITE,2911) J
0057          WRITE(IWRITE,2912)(BB,NODE(I,J),I=1,K)
```

```
0058          DO 291 I=1,L
0059          WRITE(IWRITE,2923)NODE(I,J),(Z1(I,L,J),L=1,K)
0060   291    CONTINUE
0061   2911   FORMAT('0',40X,'Z1 MATRIX FOR ZONE',I2/41X,20('='))
0062   2912   FORMAT('0',14X,4(4X,A4,I3,11X),10(/15X,4(4X,A4,I3,11X)))
0063   2991   IF(OPTION(6).EQ.0) GO TO 2992
0065          DO 292 J=1,NOZONE
0066          K=NOBUSZ(J)
0067          WRITE(IWRITE,2921) J
0068          WRITE(IWRITE,2922)((CUTP(I),CUTQ(I)),I=1,NOCUT)
0069          DO 292 L=1,K
0070          WRITE(IWRITE,2923) NODE(L,J),(Z2(L,IC,J),IC=1,NOCUT)
0071   292    CONTINUE
0072   2921   FORMAT('0',40X,'Z2 MATRIX FOR ZONE',I2/41X,20('='))
0073   2922   FORMAT('0',2X,'CUT BUS LINE',4(5X,I2,'-',I2,12X),10(/ 15X,4(5X,
              X    I2,'-',I2,12X)))
0074   2923   FORMAT('0',4X,'BUS',I3,4(1X,2F10.6,'J'),10(/ 11X,4(1X,2F10.6,'J'
              X  )))
0075   2992   CONTINUE
0076          RETURN
0077          END
```

```
0001          SUBROUTINE STEP3
      C
      C
0002          INTEGER IREAD,IWRITE,NOZONE,NOBUS,NOLINE,NOCUT,ISWB,ISBZ
             X  ,       NOBUSZ(4),NOLINZ(4),MAXITE,OPTION(15)
0003          INTEGER CUTP(10),CUTQ(10),CUTF(10)
0004          INTEGER BUS(40),BUSZON(10,4),NODE(10,4),LINE(60),NP(60),NQ(60)
0005          INTEGER ZONE(40),NPD(60),NQD(60)
0006          INTEGER TYPE(40),NPZ(15,4),NQZ(15,4)
0007          INTEGER CUTPB(10),CUTQB(10),CUTPZ(10),CUTQZ(10),TYPEZ(10,4)
0008          REAL    ACC,TOR,BASMVA
0009          REAL    BC(60),T(60),BASEKV(40)
0010          DOUBLE PRECISION    BUSNAM(40)
0011          REAL    BCS(40)
0012          REAL    VOLT(40),VARMAX(40),VARMIN(40),STATC(40)
0013          REAL    VOLTZ(10,4),VAMXZ(10,4),VAMNZ(10,4),STATZ(10,4)
0014          COMPLEX CUTZ(10),AA
0015          COMPLEX ZPRI(60)
0016          COMPLEX ZPRID(60),YT(40)
0017          COMPLEX GEN(40),LOAD(40),ZRX(15,4)
0018          COMPLEX GENZ(10,4),LOADZ(10,4)
0019          COMPLEX Z1(10,10,4),Z2(10,10,4),Z4(10,10),Y4(10,10),ZS(10,4)
0020          COMPLEX ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0021          COMPLEX ZG(10,4),YMOD(10,4),YL(10,4),YD(10,4),ZMOD(10,4),DM
0022          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4),DACUT(10,4)
0023          COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ET1,DAN,DAS,DD
0024          COMPLEX FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
      C
0025          COMMON/BUFF/NOBUS,NOLINE
             X    ,          AA
             X  ,          BUS,BUSZON,NODE,LINE,NP,NQ,ZPRI
             X  ,          ZPRID
             X  ,          GEN,LOAD,ZRX
             X  ,          VOLTZ,GENZ,LOADZ
             X  ,          Z1,Z2,Z4,Y4,ZS,D,VECTOR
             X  ,          ZG,YMOD,YL,YD,ZMOD,DM
             X  ,          EC,AC,A,ACUT,DACUT,ET,ECUT,SUM,ET0,ET1,DAN,DAS,DD
             X  ,          FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
```

```
      C
0026        COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
           X  ,           NOBUSZ,NOLINZ,CUTP,CUTQ,CUTF,CUTPB,CUTQB
           X  ,           CUTPZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
      C
0027        COMMON/TUB/ MAXITE,OPTION,ZONE,NPD,NQD,TYPE,NPZ,NQZ,TYPEZ
           X  ,           ACC,TOR,BC,T,BASEKV,BUSNAM,BCS,VOLT,VARMAX
           X  ,           VARMIN,STATC,VAMXZ,VAMNZ,STATZ,YT
      C
0028        DO 300 I=1,NOLINE
0029        DO 300 J=1,NOLINE
0030        Z4(I,J)=CMPLX(0.0,0.0)
0031        Y4(I,J)=CMPLX(0.0,0.0)
0032  300   CONTINUE
0033        DO 320 J=1,NOZONE
0034        K=NOBUSZ(J)
```



```
0035        DO 318 IC=1,NOCUT
0036        DO 310 I=1,K
0037        IF(CUTP(IC).EQ.NODE(I,J)) GO TO 311
0039        IF(CUTQ(IC).EQ.NODE(I,J)) GO TO 311
0041  310   CONTINUE
0042        GO TO 318
0043  311   CONTINUE
0044        IF(CUTF(IC).EQ.8888) GO TO 316
0046        DO 315 L=1,NOCUT
0047        Z4(IC,L)=Z4(IC,L)+Z2(I,L,J)
0048  315   CONTINUE
0049        CUTF(IC)=8888
0050        GO TO 318
0051  316   CONTINUE
0052        DO 317 L=1,NOCUT
0053        Z4(IC,L)=Z4(IC,L)-Z2(I,L,J)
0054  317   CONTINUE
0055  318   CONTINUE
0056  320   CONTINUE
```

```
0057            DO 325 I=1,NOCUT
0058            Z4(I,I)=Z4(I,I)+CUTZ(I)
0059     325    CONTINUE
0060            Y4(1,1)=1.0/Z4(1,1)
0061            DO 344 N=2,NOCUT
0062            K=N-1
0063            DO 341 I=1,K
0064            D(I)=CMPLX(0.0,0.0)
0065            DO 341 J=1,K
0066            D(I)=D(I)+Y4(I,J)*Z4(J,N)
0067     341    CONTINUE
0068            DD=CMPLX(0.0,0.0)
0069            DO 342 I=1,K
0070            DD=DD+Z4(N,I)*D(I)
0071     342    CONTINUE
0072            Y4(N,N)=1.0/(Z4(N,N)-DD)
0073            DO 343 I=1,K
0074            Y4(I,N)=-D(I)*Y4(N,N)
0075            Y4(N,I)=Y4(I,N)
0076     343    CONTINUE
0077            DO 344 I=1,K
0078            DO 344 J=1,K
0079            Y4(I,J)=Y4(I,J)-D(I)*Y4(N,J)
0080     344    CONTINUE
0081            DO 352 IC=1,NOCUT
0082            VECTOR(IC)=CMPLX(0.0,0.0)
0083            DO 352 L=1,NOCUT
0084            VECTOR(IC)=VECTOR(IC)+Y4(IC,L)*Z2(ISWB,L,ISWZ)
0085     352    CONTINUE
0086            DO 353 J=1,NOZONE
0087            K=NOBUSZ(J)
0088            DO 353 I=1,K
0089            ZS(I,J)=CMPLX(0.0,0.0)
0090            DO 353 L=1,NOCUT
0091            ZS(I,J)=ZS(I,J)+Z2(I,L,J)*VECTOR(L)
```

```
0092  353   CONTINUE
0093        DO 360 J=1,NOZONE
0094        K=NOBUSZ(J)
0095        IF(J.EQ.ISWZ) GO TO 356
0097        DO 355 I=1,K
0098        ZS(I,J)=-ZS(I,J)
0099  355   CONTINUE
0100        GO TO 360
0101  356   CONTINUE
0102        DO 357 I=1,K
0103        ZS(I,J)=Z1(ISWB,I,J)-ZS(I,J)
0104  357   CONTINUE
0105  360   CONTINUE
0106        DO 365 J=1,NOZONE
0107        K=NOBUSZ(J)
0108        DO 365 I=1,K
0109        ZDD(I,J)=CMPLX(0.0,0.0)
0110        DO 362 IC=1,NOCUT
0111        VECTOR(IC)=CMPLX(0.0,0.0)
0112        DO 362 L=1,NOCUT
0113        VECTOR(IC)=VECTOR(IC)+Y4(IC,L)*Z2(I,L,J)
0114  362   CONTINUE
0115        DO 363 L=1,NOCUT
0116        ZDD(I,J)=ZDD(I,J)+Z2(I,L,J)*VECTOR(L)
0117  363   CONTINUE
0118  365   CONTINUE
0119        DO 370 J=1,NOZONE
0120        K=NOBUSZ(J)
0121        DO 370 I=1,K
0122  367   ZDD(I,J)=Z1(I,I,J)-ZDD(I,J)
0123  369   ZDD(I,J)=ZDD(I,J)-ZS(I,J)*ZS(I,J)/ZS(ISWB,ISWZ)
0124  370   CONTINUE
0125        IF(OPTION(7).EQ.0) GO TO 3991
0127        WRITE(IWRITE,3911)
0128        WRITE(IWRITE,3912)((CUTP(I),CUTQ(I)),I=1,NOCUT)
0129        DO 391 I=1,NOCUT
0130        WRITE(IWRITE,3913)CUTP(I),CUTQ(I),(Z4(I,J),J=1,NOCUT)
```

```
0131   391    CONTINUE
0132   3911   FORMAT('0',//44X,'Z4 MATRIX'/44X,9('='))
0133   3912   FORMAT('0',2X,'CUT BUS LINE',4(5X,I2,'-',I2,12X),10(/15X,4(5X,
              X    I2,'-',I2,12X)))
0134   3913   FORMAT('0',5X,I2,'-',I2,4(1X,2F10.6,'J'),10(/11X,4(1X,2F10.6,
              X  'J')))
0135   3991   IF(OPTION(8).EQ.0) GO TO 3992
0137          WRITE(IWRITE,3921)
0138          WRITE(IWRITE,3912)((CUTP(I),CUTQ(I)),I=1,NOCUT)
0139          DO 392 I=1,NOCUT
0140          WRITE(IWRITE,3913) CUTP(I),CUTQ(I),(Y4(I,J),J=1,NOCUT)
0141   392    CONTINUE
0142   3921   FORMAT('0',//44X,'Y4 MATRIX'/44X,9('='))
0143   3992   CONTINUE
0144          RETURN
0145          END
```

```
0001          SUBROUTINE STEP4
      C
      C
0002          INTEGER IREAD,IWRITE,NOZONE,NOBUS,NOLINE,NOCUT,ISWB,ISBZ
             X  ,       NOBUSZ(4),NOLINZ(4),MAXITE,OPTION(15)
0003          INTEGER CUTP(10),CUTQ(10),CUTF(10)
0004          INTEGER BUS(40),BUSZON(10,4),NODE(10,4),LINE(60),NP(60),NQ(60)
0005          INTEGER ZONE(40),NPD(60),NQD(60)
0006          INTEGER TYPE(40),NPZ(15,4),NQZ(15,4)
0007          INTEGER CUTPB(10),CUTQB(10),CUTPZ(10),CUTQZ(10),TYPEZ(10,4)
0008          REAL    ACC,TOR,BASMVA
0009          REAL    BC(60),T(60),BASEKV(40)
0010          DOUBLE PRECISION    BUSNAM(40)
0011          REAL    BCS(40)
0012          REAL    VOLT(40),VARMAX(40),VARMIN(40),STATC(40)
0013          REAL    VOLTZ(10,4),VAMXZ(10,4),VAMNZ(10,4),STATZ(10,4)
0014          COMPLEX CUTZ(10),AA
0015          COMPLEX ZPRI(60)
0016          COMPLEX ZPRID(60),YT(40)
0017          COMPLEX GEN(40),LOAD(40),ZRX(15,4)
0018          COMPLEX GENZ(10,4),LOADZ(10,4)
0019          COMPLEX Z1(10,10,4),Z2(10,10,4),Z4(10,10),Y4(10,10),ZS(10,4)
0020          COMPLEX ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0021          COMPLEX ZG(10,4),YMOD(10,4),YL(10,4),YO(10,4),ZMOD(10,4),DM
0022          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4),DACUT(10,4)
0023          COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ET1,DAN,DAS,DD
0024          COMPLEX FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
      C
0025          COMMON/BUFF/NOBUS,NOLINE
             X  ,          AA
             X  ,        BUS,BUSZON,NODE,LINE,NP,NQ,ZPRI
             X  ,        ZPRID
             X  ,        GEN,LOAD,ZRX
             X  ,        VOLTZ,GENZ,LOADZ
             X  ,        Z1,Z2,Z4,Y4,ZS,D,VECTOR
             X  ,        ZG,YMOD,YL,YO,ZMOD,DM
             X  ,        EC,AC,A,ACUT,DACUT,ET,ECUT,SUM,ET0,ET1,DAN,DAS,DD
             X  ,        FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
```

```
0026          COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
             X  ,            NOBUSZ,NOLINZ,CUTP,CUTQ,CUTF,CUTPB,CUTQB
             X  ,            CUTPZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
      C
0027          COMMON/TUB/ MAXITE,OPTION,ZONE,NPD,NQD,TYPE,NPZ,NQZ,TYPEZ
             X  ,  ,         ACC,TOR,BC,T,BASEKV,BUSNAM,BCS,VOLT,VARMAX
             X  ,            VARMIN,STATC,VAMXZ,VAMNZ,STATZ,YT
      C
0028          DO 416 J=1,NOZONE
0029          K=NOBUSZ(J)
0030          DO 415 I=1,K
0031          AB=CABS(LOADZ(I,J))
0032          IF(AB.EQ.0.0) GO TO 300
0034          ET(I,J)=CMPLX(VOLTZ(I,J),0.0)
0035          ZLN(I,J)=ET(I,J)*ET(I,J)*BASMVA/CONJG(LOADZ(I,J))
```

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```
0036          IF(TYPEZ(I,J).EQ.3) GO TO 415
0038          A(I,J)=CONJG(GENZ(I,J))/CONJG(ET(I,J))/BASMVA
0039          GO TO 415
0040  300     CONTINUE
0041          ET(I,J)=CMPLX(VOLTZ(I,J),0.0)
0042          ZLN(I,J)=CMPLX(1.0E20,1.0E20)
0043          IF(TYPEZ(I,J).EQ.3) GO TO 415
0045          A(I,J)=CONJG(GENZ(I,J))/CONJG(ET(I,J))/BASMVA
0046  415     CONTINUE
0047  416     CONTINUE
0048          SUM=CMPLX(0.0,0.0)
0049          DO 420 J=1,NOZONE
0050          K=NOBUSZ(J)
0051          DO 420 I=1,K
0052          IF(TYPEZ(I,J).EQ.3) GO TO 420
0054          SUM=SUM+ZS(I,J)*A(I,J)
0055  420     CONTINUE
0056          A(ISWB,ISWZ)=(ET(ISWB,ISWZ)-SUM)/ZS(ISWB,ISWZ)
0057          DO 426 J=1,NOZONE
```

```
0058          K=NOBUSZ(J)
0059          DO 425 I=1,K
0060          ECUT(I,J)=CMPLX(0.0,0.0)
0061          DO 425 L=1,K
0062          ECUT(I,J)=ECUT(I,J)+Z1(I,L,J)*A(L,J)
0063    425   CONTINUE
0064    426   CONTINUE
0065          DO 435 IC=1,NOCUT
0066          IP=CUTPB(IC)
0067          IQ=CUTQB(IC)
0068          JP=CUTPZ(IC)
0069          JQ=CUTQZ(IC)
0070          IF(JP.GT.JQ) GO TO 433
0072          EC(IC)=ECUT(IQ,JQ)-ECUT(IP,JP)
0073          GO TO 435
0074    433   EC(IC)=ECUT(IP,JP)-ECUT(IQ,JQ)
0075    435   CONTINUE
0076          DO 440 J=1,NOZONE
0077          K=NOBUSZ(J)
0078          DO 440 I=1,K
0079          ACUT(I,J)=CMPLX(0.0,0.0)
0080    440   CONTINUE
0081          DO 448 IC=1,NOCUT
0082          AC(IC)=CMPLX(0.0,0.0)
0083          DO 442 I=1,NOCUT
0084          AC(IC)=AC(IC)+Y4(IC,I)*EC(I)
0085    442   CONTINUE
0086          IP=CUTPB(IC)
0087          IQ=CUTQB(IC)
0088          JP=CUTPZ(IC)
0089          JQ=CUTQZ(IC)
0090          IF(JP.GT.JQ) GO TO 445
0092          ACUT(IP,JP)=ACUT(IP,JP)+AC(IC)
0093          ACUT(IQ,JQ)=ACUT(IQ,JQ)-AC(IC)
0094          GO TO 448
```

```
0095  445   ACUT(IP,JP)=ACUT(IP,JP)-AC(IC)
0096        ACUT(IQ,JQ)=ACUT(IQ,JQ)+AC(IC)
0097  448   CONTINUE
0098        IF(OPTION(14).EQ.0) GO TO 460
0100        WRITE(IWRITE,4601)
0101        WRITE(IWRITE,4602)
0102        DO 450 J=1,NOZONE
0103        K=NOBUSZ(J)
0104        DO 450 I=1,K
0105        WRITE(IWRITE,4603)NODE(I,J),J,ET(I,J),ECUT(I,J),A(I,J),ACUT(I,J)
0106  450   CONTINUE
0107        WRITE(IWRITE,4604)
0108        DO 455 IC=1,NOCUT
0109        WRITE(IWRITE,4605)CUTP(IC),CUTQ(IC),EC(IC),AC(IC)
0110  455   CONTINUE
0111  4601  FORMAT('1',5X,'INITIAL')
0112  4602  FORMAT('0',3X,'BUS ZONE',9X,'ET',19X,'ET(0)',18X,'IT',20X,3HIT')
0113  4603  FORMAT(' ',2I5,4(1X,2F10.6,'J'))
0114  4604  FORMAT('0',2X,'CUT BUS LINE',7X,'EC',20X,'IC')
0115  4605  FORMAT(' ',5X,I2,'-',I2,2(1X,2F10.6,'J'))
0116  460   CONTINUE
0117        RETURN
0118        END
```

```
0001          SUBROUTINE STEP5
      C
      C
0002          INTEGER IREAD,IWRITE,NOZONE,NOBUS,NOLINE,NOCUT,ISWB,ISBZ
             X  ,       NOBUSZ(4),NOLINZ(4),MAXITE,OPTION(15)
0003          INTEGER CUTP(10),CUTQ(10),CUTF(10)
0004          INTEGER BUS(40),BUSZON(10,4),NODE(10,4),LINE(60),NP(60),NQ(60)
0005          INTEGER ZONE(40),NPD(60),NQD(60)
0006          INTEGER TYPE(40),NPZ(15,4),NQZ(15,4)
0007          INTEGER CUTPB(10),CUTQB(10),CUTPZ(10),CUTQZ(10),TYPEI(10,4)
0008          REAL    ACC,TOR,BASMVA
0009          REAL    BC(60),T(60),BASEKV(40)
0010          DOUBLE PRECISION    BUSNAM(40)
0011          REAL    BCS(40)
0012          REAL    VOLT(40),VARMAX(40),VARMIN(40),STATC(40)
0013          REAL    VOLTZ(10,4),VAMXZ(10,4),VAMNZ(10,4),STATZ(10,4)
0014          COMPLEX CUTZ(10),AA
0015          COMPLEX ZPRI(60)
0016          COMPLEX ZPRID(60),YT(40)
0017          COMPLEX GEN(40),LOAD(40),ZRX(15,4)
0018          COMPLEX GENZ(10,4),LOADZ(10,4)
0019          COMPLEX Z1(10,10,4),Z2(10,10,4),Z4(10,10),Y4(10,10),ZS(10,4)
0020          COMPLEX ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0021          COMPLEX ZG(10,4),YMOD(10,4),YL(10,4),YO(10,4),ZMOD(10,4),DM
0022          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4),DACUT(10,4)
0023          COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ET1,DAN,DAS,DD
0024          COMPLEX FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
      C
0025          COMMON/BUFF/NOBUS,NOLINE
             X  ,          AA
             X  ,          BUS,BUSZON,NODE,LINE,NP,NQ,ZPRI
             X  ,          ZPRID
             X  ,          GEN,LOAD,ZRX
             X  ,          VOLTZ,GENZ,LOADZ
             X  ,          Z1,Z2,Z4,Y4,ZS,D,VECTOR
             X  ,          ZG,YMOD,YL,YO,ZMOD,DM
             X  ,          EC,AC,A,ACUT,DACUT,ET,ECUT,SUM,ET0,ET1,DAN,DAS,DD
             X  ,          FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
```

```
      C
0026        COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
           X   ,            NOBUSZ,NOLINZ,CUTP,CUTQ,CUTF,CUTPB,CUTQB
      C                   CUTFZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
0027        COMMON/TUB/ MAXITE,OPTION,ZONE,NPD,NQD,TYPE,NPZ,NQZ,TYPEZ
           X   ,            ACC,TOR,BC,T,BASEKV,BUSNAM,BCS,VOLT,VARMAX
      C                   VARMIN,STATC,VAMXZ,VAMNZ,STATZ,YT
0028        IF(OPTION(9).EQ.0)GO TO 502
0030        WRITE(IWRITE,5001)
0031        DO 500 J=1,NOZONE
0032        I=NOLINZ(J)-NOBUSZ(J)-2
0033        WRITE(IWRITE,5002) J,NOBUSZ(J),I
0034  500   CONTINUE
0035        WRITE(IWRITE,5003) NOCUT

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0036        WRITE(IWRITE,5004) NOZONE,NOBUS,NOLINE
0037        WRITE(IWRITE,5005) BASMVA
0038        WRITE(IWRITE,5006) ACC
0039        WRITE(IWRITE,5007) TOR
0040  5001  FORMAT('0',//9X,'SOLUTION MONITOR'/11X,16('='))
0041  5002  FORMAT('0',26X,'ZONE',I2,6X,I6,' BUSSES',I6,' BRANCHES')
0042  5003  FORMAT('0',51X,I6,' CUT LINES')
0043  5004  FORMAT('0',26X,'TOTAL',I2,' ZONES',I5,' BUSSES',I6,' BRANCH')
0044  5005  FORMAT('0',26X,'BASE MVA    =',F8.2)
0045  5006  FORMAT('0',26X,'ACCELERATION=',F8.2)
0046  5007  FORMAT('0',26X,'TOLERANCE   =',F12.6)
0047        WRITE(IWRITE,5010)
0048        WRITE(IWRITE,5011)
0049        WRITE(IWRITE,5012)
0050        WRITE(IWRITE,5013)
0051        WRITE(IWRITE,5014)
0052  5010  FORMAT('0',20X,':---------:-------------------------:----------:'
           X)
0053  5011  FORMAT(' ',20X,':ITERATION:SWING MACHINE GENERATION :CHANGES IN :'
```

```
          X)
0054  5012  FORMAT(' ',20X,':          :-------------------------:  SWING BUS:'
          X)
0055  5013  FORMAT(' ',20X,':  COUNT  :      MW      :    MVAR    :CURRENT(PU):'
          X)
0056  5014  FORMAT(' ',20X,':---------:--------------:------------:-----------:'
          X)
0057  5015  FORMAT(' ',20X,':          :              :            :           :'
          X)
0058  5016  FORMAT(' ',20X,':',I6,'    :',2(F11.4,' :'),F10.6,' :')
0059  5017  FORMAT('0',10X,'SUCCESSFUL SOLUTION REACHED')
0060  5018  FORMAT('0',10X,'CONVERGENCE NOT OBTAINED')
0061  502   CONTINUE
0062        ITERN=0
0063  501   DASSUM=0.0
0064        DO 560 J=1,NOZONE
0065        K=NOBUSZ(J)
0066        DO 560 N=1,K
0067        IF(TYPEZ(N,J).EQ.3) GO TO 560
0069        ET0=CMPLX(0.0,0.0)
0070        ET1=CMPLX(0.0,0.0)
0071        DO 510 I=1,K
0072        ET0=ET0+Z1(N,I,J)*A(I,J)
0073        ET1=ET1+Z1(N,I,J)*ACUT(I,J)
0074  510   CONTINUE
0075        ET(N,J)=ET0+ET1
0076        ECUT(N,J)=ET0
0077        IF(TYPEZ(N,J).NE.2) GO TO 528
0079        ET0=VOLTZ(N,J)/CABS(ET(N,J))*ET(N,J)
0080        DAN=(ET0-ET(N,J))/ZDD(N,J)
0081        QGN=AIMAG((ET0*CONJG(A(N,J)+DAN)-CABS(ET0)**2
          X     /CONJG(ZLN(N,J)))*BASMVA+LOADZ(N,J))
0082        IF(QGN.LE.VAMXZ(N,J).AND.QGN.GE.VAMNZ(N,J))GO TO 527
0084        IF(QGN.GT.VAMXZ(N,J)) QGN=VAMXZ(N,J)
0086        IF(QGN.LT.VAMNZ(N,J)) QGN=VAMNZ(N,J)
```

```
0088          GENZ(N,J)=CMPLX(REAL(GENZ(N,J)),QGN)
0089          GO TO 528
0090    527   CONTINUE
0091          ET(N,J)=ETO
0092          GENZ(N,J)=CMPLX(REAL(GENZ(N,J)),QGN)
0093    528   CONTINUE
0094          DAN=CONJG((GENZ(N,J)-LOADZ(N,J))/BASMVA/
             X         ET(N,J)+CONJG(ET(N,J))/CONJG(ZLN(N,J)))-A(N,J)
0095    529   CONTINUE
0096          DAN=ACC*DAN
0097          A(N,J)=A(N,J)+DAN
0098          DAS=-ZS(N,J)/ZS(ISWB,ISWZ)*DAN
0099          A(ISWB,ISWZ)=A(ISWB,ISWZ)+DAS
0100          DO 532 I=1,K
0101          ECUT(I,J)=ECUT(I,J)+Z1(N,I,J)*DAN
0102    532   CONTINUE
0103          KK=NOBUSZ(ISWZ)
0104          DO 533 I=1,KK
0105          ECUT(I,ISWZ)=ECUT(I,ISWZ)+Z1(ISWB,I,ISWZ)*DAS
0106    533   CONTINUE
0107          DO 540 IC=1,NOCUT
0108          IP=CUTPB(IC)
0109          IQ=CUTQB(IC)
0110          JP=CUTPZ(IC)
0111          JQ=CUTQZ(IC)
0112          IF(JP.GT.JQ) GO TO 538
0114          EC(IC)=ECUT(IQ,JQ)-ECUT(IP,JP)
0115          GO TO 540
0116    538   EC(IC)=ECUT(IP,JP)-ECUT(IQ,JQ)
0117    540   CONTINUE
0118          DO 541 JJ=1,NOZONE
0119          KK=NOBUSZ(JJ)
0120          DO 541 I=1,KK
0121          DACUT(I,JJ)=CMPLX(0.0,0.0)
0122    541   CONTINUE
0123          DO 546 IC=1,NOCUT
0124          AC(IC)=CMPLX(0.0,0.0)
0125          DO 542 I=1,NOCUT
0126          AC(IC)=AC(IC)+Y4(IC,I)*EC(I)
```

```
0127   542   CONTINUE
0128         IP=CUTPB(IC)
0129         IQ=CUTQB(IC)
0130         JP=CUTPZ(IC)
0131         JQ=CUTQZ(IC)
0132         IF(JP.GT.JQ) GO TO 544
0134         DACUT(IP,JP)=DACUT(IP,JP)+AC(IC)
0135         DACUT(IQ,JQ)=DACUT(IQ,JQ)-AC(IC)
0136         GO TO 546
0137   544   DACUT(IP,JP)=DACUT(IP,JP)-AC(IC)
0138         DACUT(IQ,JQ)=DACUT(IQ,JQ)+AC(IC)
0139   546   CONTINUE
0140         DO 550 JJ=1,NOZONE
0141         KK=NOBUSZ(JJ)
0142         DO 550 I=1,KK
```



```
0143         DACUT(I,JJ)=DACUT(I,JJ)-ACUT(I,JJ)
0144         ACUT(I,JJ)=ACUT(I,JJ)+DACUT(I,JJ)
0145   550   CONTINUE
0146         DO 552 I=1,K
0147         ET(N,J)=ET(N,J)+Z1(N,I,J)*DACUT(I,J)
0148   552   CONTINUE
0149         ET(N,J)=ET(N,J)+Z1(N,N,J)*DAN
0150         IF(J.EQ.ISWZ) ET(N,J)=ET(N,J)+Z1(N,ISWB,J)*DAS
0152         DASSUM=DASSUM+CABS(DAS)
0153   560   CONTINUE
0154         DD=ET(ISWB,ISWZ)*CONJG(A(ISWB,ISWZ))*BASMVA
0155         ITERN=ITERN+1
0156         IF(OPTION(9).EQ.0) GO TO 562
0158         WRITE(IWRITE,5016) ITERN,DD,DASSUM
0159         IF(OPTION(13).NE.0) WRITE(IWRITE,5015)
0161   562   CONTINUE
0162         IF(OPTION(14).EQ.0) GO TO 570
0164         WRITE(IWRITE,5701) ITERN
0165         WRITE(IWRITE,5702)
```

```
0166          DO 565 J=1,NOZONE
0167          K=NOBUSZ(J)
0168          DO 565 I=1,K
0169          WRITE(IWRITE,5703)NODE(I,J),J,ET(I,J),ECUT(I,J),A(I,J),ACUT(I,J)
0170    565   CONTINUE
0171          WRITE(IWRITE,5704)
0172          DO 567 IC=1,NOCUT
0173          WRITE(IWRITE,5705) CUTP(IC),CUTQ(IC),EC(IC),AC(IC)
0174    567   CONTINUE
0175    5701  FORMAT('0',5X,'ITERATION',I3)
0176    5702  FORMAT('0',3X,'BUS  ZONE',9X,'ET',19X,'ET(0)',18X,'IT',20X,3HI3'
             X  )
0177    5703  FORMAT(' ',2I5,4(1X,2F10.6,'J'))
0178    5704  FORMAT('0',2X,'CUT BUS LINE',7X,'EC',20X,'IC')
0179    5705  FORMAT(' ',5X,I2,'-',I2,2(1X,2F10.6,'J'))
0180    570   CONTINUE
0181          IF(DASSUM.LT.TOR) GO TO 590
0183          IF(ITERN.LT.MAXITE) GO TO 501
0185          IF(OPTION(9).EQ.0) RETURN
0187          WRITE(IWRITE,5014)
0188          WRITE(IWRITE,5018)
0189          RETURN
0190    590   GENZ(ISWB,ISWZ)=DD
0191          IF(OPTION(9).EQ.0) RETURN
0193          WRITE(IWRITE,5014)
0194          WRITE(IWRITE,5017)
0195          RETURN
0196          END
```

```
0001          SUBROUTINE STEP6
      C
      C
0002          INTEGER IREAD,IWRITE,NOZONE,NOBUS,NOLINE,NOCUT,ISWB,ISBZ
     X  ,       NOBUSZ(4),NOLINZ(4),MAXITE,OPTION(15)
0003          INTEGER CUTP(10),CUTQ(10),CUTF(10)
0004          INTEGER BUS(40),BUSZON(10,4),NODE(10,4),LINE(60),NP(60),NQ(60)
0005          INTEGER ZONE(40),NPD(60),NQD(60)
0006          INTEGER TYPE(40),NPZ(15,4),NQZ(15,4)
0007          INTEGER CUTPB(10),CUTQB(10),CUTPZ(10),CUTQZ(10),TYPEZ(10,4)
0008          REAL    ACC,TOR,BASMVA
0009          REAL    BC(60),T(60),BASEKV(40)
0010          DOUBLE PRECISION    BUSNAM(40)
0011          REAL    BCS(40)
0012          REAL    VOLT(40),VARMAX(40),VARMIN(40),STATC(40)
0013          REAL    VOLTZ(10,4),VAMXZ(10,4),VAMNZ(10,4),STATZ(10,4)
0014          COMPLEX CUTZ(10),AA
0015          COMPLEX ZPRI(60)
0016          COMPLEX ZPRID(60),YT(40)
0017          COMPLEX GEN(40),LOAD(40),ZRX(15,4)
0018          COMPLEX GENZ(10,4),LOADZ(10,4)
0019          COMPLEX Z1(10,10,4),Z2(10,10,4),Z4(10,10),Y4(10,10),ZS(10,4)
0020          COMPLEX ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0021          COMPLEX ZG(10,4),YMOD(10,4),YL(10,4),YO(10,4),ZMOD(10,4),DM
0022          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4),DACUT(10,4)
0023          COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ET1,DAN,DAS,DD
0024          COMPLEX FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
      C
0025          COMMON/BUFF/NOBUS,NOLINE
     X  ,           AA
     X  ,         BUS,BUSZON,NODE,LINE,NP,NQ,ZPRI
     X  ,         ZPRID
     X  ,         GEN,LOAD,ZRX
     X  ,         VOLTZ,GENZ,LOADZ
     X  ,         Z1,Z2,Z4,Y4,ZS,D,VECTOR
     X  ,         ZG,YMOD,YL,YO,ZMOD,DM
     X  ,         EC,AC,A,ACUT,DACUT,ET,ECUT,SUM,ET0,ET1,DAN,DAS,DD
     X  ,         FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
```

```
      C
0026        COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
           X  ,           NOBUSZ,NOLINZ,CUTP,CUTQ,CUTF,CUTPB,CUTQB
           X  ,           CUTPZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
      C
0027        COMMON/TUB/ MAXITE,OPTION,ZONE,NPD,NQD,TYPE,NPZ,NQZ,TYPEZ
           X  ,           ACC,TOR,BC,T,BASEKV,BUSNAM,BCS,VOLT,VARMAX
           X  ,           VARMIN,STATC,VAMXZ,VAMNZ,STATZ,YT
      C
0028        SUMGEN=CMPLX(0.0,0.0)
0029        SUMLOD=CMPLX(0.0,0.0)
0030        SUMSTC=0.0
0031        IF(OPTION(10).EQ.0) GO TO 6991
0033        WRITE(IWRITE,6001)
0034        WRITE(IWRITE,6002)
0035        WRITE(IWRITE,6003)
```



```
0036        WRITE(IWRITE,6004)
0037        WRITE(IWRITE,6005)
0038        WRITE(IWRITE,6006)
0039  6001  FORMAT('1',35X,'OUTPUT BUS VOLTAGE AND GENERATION')
0040  6002  FORMAT('0', 3X,':------------------------:-------------------------
           X-:-----------------:-----------------:--------:')
0041  6003  FORMAT(' ', 3X,':  BUS IDENTIFICATION   :       BUS VOLTAGE
           X :    GENERATION   :      LOAD       : STATICS:')
0042  6004  FORMAT(' ', 3X,':------------------------:-------------------------
           X-:-----------------:-----------------:--------:')
0043  6005  FORMAT(' ', 3X,':  NAME  : NO.:ZONE:TYPE:   PU   :   KV   :   DEG
           X :   MW   :  MVAR  :   MW   :  MVAR  :  MVAR  :')
0044  6006  FORMAT(' ', 3X,':--------:----:----:----:--------:--------:-------
           X-:--------:--------:--------:--------:--------:')
0045  6007  FORMAT(' ', 3X,':        :    :    :    :        :        :
           X :        :        :        :        :        :')
0046  6008  FORMAT(' ',3X,':',A8,':',3(I3,' :'),F7.4,' :',7(F7.2,' :'))
0047  6991  CONTINUE
0048        DO 610 N=1,NOBUS
```

```
0049          DO 608 J=1,NOZONE
0050          K=NOBUSZ(J)
0051          DO 608 I=1,K
0052          IF(BUS(N).NE.NODE(I,J)) GO TO 608
0054          VOLTPU=CABS(ET(I,J))
0055          VOLTKV=VOLTPU*BASEKV(N)
0056          IF(REAL(ET(I,J)).EQ.0.0) PHASE=90.0
0058          PHASE=ATAN2(AIMAG(ET(I,J)),REAL(ET(I,J)))*57.29578
0059          SUMGEN=SUMGEN+GENZ(I,J)
0060          SUMLOD=SUMLOD+LOADZ(I,J)
0061          SUMSTC=SUMSTC+STATZ(I,J)
0062          IF(OPTION(10).EQ.0) GO TO 610
0064          WRITE(IWRITE,6008)BUSNAM(N),BUS(N),J,TYPEZ(I,J),VOLTPU,
             X             VOLTKV,PHASE,GENZ(I,J),LOADZ(I,J),STATZ(I,J)
0065          IF(OPTION(13).NE.0) WRITE(IWRITE,6007)
0067          GO TO 610
0068  608     CONTINUE
0069  610     CONTINUE
0070          IF(OPTION(10).NE.0) WRITE(IWRITE,6006)
0072          IF(OPTION(11).EQ.0) GO TO 6992
0074          WRITE(IWRITE,6011)
0075          WRITE(IWRITE,6012)
0076          WRITE(IWRITE,6013)
0077          WRITE(IWRITE,6014)
0078          WRITE(IWRITE,6015)
0079          WRITE(IWRITE,6016)
0080  6011    FORMAT('1',45X,'LINE FLOWS')
0081  6012    FORMAT('0', 3X,':----:-------------:-------------:---------------
             X-:-----------------:-----------------:--------:')
0082  6013    FORMAT(' ', 3X,':LINE: FROM BUS P  :  TO BUS Q    : FROM BUS P
             X :  FLOW TO BUS Q  :     LOSSES      :CHARGING:')
0083  6014    FORMAT(' ', 3X,':    :-------------:-------------:---------------
             X-:-----------------:-----------------:--------:')
0084  6015    FORMAT(' ', 3X,': NO.:  NAME  : NO.:  NAME  : NO.:  MW    :  MVAR
             X :   MW   :  MVAR  :   MW   :  MVAR  :  MVAR  :')
```

```
0085  6016  FORMAT(' ', 3X,':----:--------:----:--------:----:--------:--------
             X-:--------:--------:--------:--------:--------:')
0086  6017  FORMAT(' ', 3X,':    :        :    :        :    :        :
             X :        :        :        :        :        :')
0087  6018  FORMAT(' ', 3X,':',I3,' :',2(A8,':',I3,' :'),7(F7.2,' :'))
0088  6992  CONTINUE
0089        SUMCHG=0.0
0090        SUMLOS=CMPLX(0.0,0.0)
0091        DO 660 L=1,NOLINE
0092        DO 620 JP=1,NOZONE
0093        K=NOBUSZ(JP)
0094        DO 620 IP=1,K
0095        IF(NP(L).EQ.NODE(IP,JP)) GO TO 622
0097  620   CONTINUE
0098  622   CONTINUE
0099        DO 630 JQ=1,NOZONE
0100        K=NOBUSZ(JQ)
0101        DO 630 IQ=1,K
0102        IF(NQ(L).EQ.NODE(IQ,JQ)) GO TO 632
0104  630   CONTINUE
0105  632   CONTINUE
0106        DO 640 I=1,NOBUS
0107        IF(NP(L).EQ.BUS(I)) GO TO 642
0109  640   CONTINUE
0110  642   CONTINUE
0111        DO 650 J=1,NOBUS
0112        IF(NQ(L).EQ.BUS(J)) GO TO 652
0114  650   CONTINUE
0115  652   CONTINUE
0116        FLOWP=ET(IP,JP)*CONJG((ET(IP,JP)-ET(IQ,JQ)*T(L))/ZPRI(L)/T(L)
           X  /T(L)+ET(IP,JP)*CMPLX(0.0,BC(L))/2.0)*BASMVA
0117        FLOWQ=ET(IQ,JQ)*CONJG((ET(IQ,JQ)*T(L)-ET(IP,JP))/ZPRI(L)/T(L)
           X       +ET(IQ,JQ)*CMPLX(0.0,BC(L))/2.0)*BASMVA
0118        CHARG=(CABS(ET(IP,JP))**2+CABS(ET(IQ,JQ))**2)*BC(L)/2.0*BASMVA
0119        FLOSS=FLOWP+FLOWQ+CMPLX(0.0,CHARG)
0120        SUMCHG=SUMCHG+CHARG
0121        SUMLOS=SUMLOS+FLOSS
```

```
0122          IF(OPTION(11).EQ.0) GO TO 660
0124          WRITE(IWRITE,6018) LINE(L),BUSNAM(I),NP(L),BUSNAM(J),NQ(L),
             X                           FLOWP,FLOWQ,FLOSS,CHARG
0125          IF(OPTION(13).NE.0) WRITE(IWRITE,6017)
0127   660    CONTINUE
0128          IF(OPTION(11).NE.0) WRITE(IWRITE,6016)
0130          MISMAT=SUMGEN+CMPLX(0.0,(SUMSTC+SUMCHG))-SUMLOD-SUMLOS
0131          IF(OPTION(12).EQ.0) RETURN
0133          WRITE(IWRITE,6701)
0134          WRITE(IWRITE,6702) SUMGEN
0135          WRITE(IWRITE,6703) SUMLOD
0136          WRITE(IWRITE,6704) SUMSTC
0137          WRITE(IWRITE,6705) SUMLOS
0138          WRITE(IWRITE,6706) MISMAT
0139   6701   FORMAT('1',40X,'SYSTEM TOTALS'/41X,'=============='//51X,'MW
             X  MVAR')
0140   6702   FORMAT('0',30X,'GENERATION',5X,2F9.2)
```

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0141   6703   FORMAT('0',30X,'LOAD',11X,2F9.2)
0142   6704   FORMAT('0',30X,'STATIC CAPACITOR',8X,F9.2)
0143   6705   FORMAT('0',30X,'LOSSES',9X,2F9.2)
0144   6706   FORMAT('0',30X,'MISMATCH',7X,2F9.2)
0145   6707   FORMAT('0',30X,'LINE CHARGING',11X,F9.2)
0146          RETURN
0147          END
```

```
0001          SUBROUTINE STEP7
      C
      C
0002          INTEGER IREAD,IWRITE,NOZONE,NOBUS,NOLINE,NOCUT,ISWB,ISWZ
             X  ,       NOBUSZ(4),NOLINZ(4)
0003          INTEGER CUTF(10),CUTQ(10),CUTF(10)
0004          INTEGER BUS(40),BUSZON(10,4),NODE(10,4),LINE(60),NP(60),NQ(60)
0005          INTEGER CUTFB(10),CUTQB(10),CUTFZ(10),CUTQZ(10)
0006          REAL    BASMVA
0007          REAL    VOLTZ(10,4)
0008          COMPLEX CUTZ(10),AA
0009          COMPLEX ZPRI(60)
0010          COMPLEX ZPRID(60)
0011          COMPLEX GEN(40),LOAD(40),ZPRZ(15,4)
0012          COMPLEX GENZ(10,4),LOADZ(10,4)
0013          COMPLEX Z1(10,10,4),Z2(10,10,4),Z4(10,10),Y4(10,10),ZS(10,4)
0014          COMPLEX ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0015          COMPLEX ZG(10,4),YMOD(10,4),YL(10,4),YO(10,4),ZMOD(10,4),DM
0016          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4),DACUT(10,4)
0017          COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ETI,DAN,DAS,DD
0018          COMPLEX FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
      C
0019          INTEGER NGEN,NLBUS,LBUS(20),NOMT,IMGN(20),BGEN(20),NOBZ(4)
0020          INTEGER IMET(10),FBUS,NN(10),GNO(5,4)
0021          INTEGER NOGEN(4),NOLOD1(4),NOLOD2(4),NOLOD3(4),NOMET(4),MON
0022          INTEGER MGEN(5,4),LOD1(5,4),LOD2(5,4),LOD3(5,4),MET(5,4)
0023          INTEGER N,NELOP(4,4),NNODE(10,4,4)
0024          REAL XDI(20),XQI(20),XDPI(20),TOI(20)
0025          REAL XD(5,4),XQ(5,4),XDP(5,4),TO(5,4)
0026          REAL TI,TCF,TSTOP,NETA,EPLON,OMGA,DT,WO
0027          COMPLEX ROD1(10),ROD2(10),ROD3(10),RODZ2(5,4),RODZ3(5,4)
0028          REAL HI(20),MUI(20),TEI(20),F,RI(20)
0029          REAL TCI(20),TSI(20),PMAXI(20)
0030          REAL EFMAXI(20),EFMINI(20),ETMIN
0031          REAL WW(5,60),DELTA(5,60),TCFF,DTT,SC
0032          REAL INANG(5,1)
0033          INTEGER JJ,ISET,MBUSZ(3),ITSTOP,NZON
0034          INTEGER NOPLOT,NMAC(5),KPOT(5),JPOT(5)
```

```
0035        INTEGER ITS,NST,LIOP(3,3),LICL(3,3),NLSW(3),BUSP(6,3),BUSQ(6,3)
0036        REAL TITS(3)
0037        COMPLEX IMP(6,3)
0038        INTEGER CHECK(6,3)
      C
0039        COMMON/BUFF/NOBUS,NOLINE
           X    ,            AA
           X  ,             BUS,BUSZON,NODE,LINE,NP,NQ,ZPRI
           X  ,             ZPRID
           X  ,             GEN,LOAD,ZRX
           X  ,             VOLTZ,GENZ,LOADZ
           X  ,             Z1,Z2,Z4,Y4,Z5,D,VECTOR
           X  ,             ZG,YMOI,YL,YD,ZMOD,DM
           X  ,             EC,AC,A,ACUT,DACUT,ET,ECUT,SUM,ET0,ET1,DAN,DAS,DD
           X  ,             FLOWP,FLOWQ,FLOSS,SUMLOS,SUMGEN,SUMLOD,MISMAT
```



```
      C
0040        COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
           X  ,             NOBUSZ,NOLINZ,CUTP,CUTQ,CUTF,CUTPB,CUTQB
           X  ,             CUTPZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
      C
0041        COMMON/TUB/NGEN,NLBUS,LBUS,NOMT,IMGN,BGEN,NOBZ
           X  ,            IMET,FBUS,NN,GNO,NOGEN,NOLOD1,NOLOD2
           X  ,            NOLOD3,NOMET,MON,MGEN,LOD1,LOD2,LOD3,MET
           X  ,            XDI,XQI,XDPI,TOI
           X  ,            TT,TCF,TSTOP,NETA,EPLON,OMGA,DT,WO
           X  ,            HI,MUI,TEI,F,RI,TCI,TSI,PMAXI,EFMAXI,EFMINI,ETMIN
           X  ,            ROD1,ROD2,ROD3,RODZ2,RODZ3
0042        COMMON/INT/INANG,MON1
0043        COMMON/DIK/N,NELOP,NNODE
0044        COMMON/MOD/ITS,NST,LIOP,LICL,NLSW,BUSP,BUSQ,TITS,IMP
0045        COMMON/STA/JJ,ISET,WW,DELTA,MBUSZ,ITSTOP,TCFF,NZON,DTT,SC,EIM
           X  ,            NOPLOT,NMAC,KPOT,JPOT,ESC
0046        OPEN(UNIT=4,NAME='DY1:GEN.DAT',TYPE='OLD')
0047        READ(4,7000) NGEN
```

```
0048  7000  FORMAT(I2)
0049        IF(NGEN.EQ.0) GO TO 701
0051        DO 7470 I=1,NGEN
0052        READ(4,7451) IMGN(I),BGEN(I),XDI(I),XQI(I),XDPI(I),HI(I),TOI(I)
0053        READ(4,7452) TEI(I),MUI(I),TCI(I),TSI(I),RI(I),PMAXI(I)
           X  ,EFMAXI(I),EFMINI(I)
0054  7451  FORMAT(2I3,5F10.5)
0055  7452  FORMAT(8F10.5)
0056  7470  CONTINUE
0057  701   CALL CLOSE(4)
0058        OPEN(UNIT=9,NAME='DY1:LOAD.DAT',TYPE='OLD')
0059        READ(9,7550) NLBUS
0060  7550  FORMAT(I2)
0061        IF(NLBUS.EQ.0) GO TO 7516
0063        DO 705 N=1,NLBUS
0064  705   READ(9,706) LBUS(N),ROD1(N),ROD2(N),ROD3(N)
0065  706   FORMAT(I3,6F10.2)
0066  7516  CALL CLOSE(9)
0067        OPEN(UNIT=10,NAME='DY1:SWIT.DAT',TYPE='OLD')
0068        READ(10,7640) NST
0069        DO 7641 IS=1,NST
0070        READ(10,7643)TITS(IS),(LIOP(KK,IS),KK=1,3),(LICL(KK,IS),KK=1,3)
0071  7641  CONTINUE
0072  7640  FORMAT(I5)
0073  7643  FORMAT(F10.4,6I4)
0074        READ(10,7650) NOMT
0075  7650  FORMAT(10I5)
0076        IF(NOMT.EQ.0) GO TO 7665
0078        DO 7663 I=1,NOMT
0079        READ(10,7650) IMET(I)
0080  7663  CONTINUE
0081  7665  READ(10,7650) NOPLOT,(NMAC(L),L=1,NOPLOT)
0082        READ(10,7656) ETMIN,ESC
0083  7656  FORMAT(2F5.0)
0084        CALL CLOSE(10)
```

```
0085          OPEN(UNIT=11,NAME='DY1:OTH.DAT',TYPE='OLD')
0086          READ(11,7750)FBUS,MON,MON1,F,DT,TCF,TSTOP,NETA,EPLON,OMGA
0087    7750  FORMAT(3I5,7F10.4)
0088          CALL CLOSE(11)
      C
0089          DO 10 J=1,NOZONE
0090          NOGEN(J)=0
0091          K=0
0092          DO 20 N=1,NGEN
0093          M=NOBUSZ(J)
0094          DO 30 I=1,M
0095          IF(BGEN(N).EQ.NODE(I,J)) GO TO 18
0097    30    CONTINUE
0098          GO TO 20
0099    18    K=K+1
0100          NOGEN(J)=NOGEN(J)+1
0101          MGEN(K,J)=BGEN(N)
0102          XQ(K,J)=XQI(N)
0103    20    CONTINUE
0104    10    CONTINUE
      C     ...SWITCHING LINE
0105          DO 1000 IS=1,NST
0106          K=0
0107          DO 1010 KK=1,3
0108          IF(LIOP(KK,IS).EQ.0) GO TO 1030
0110          DO 1020 N=1,NOLINE
0111          IF(LIOP(KK,IS).NE.LINE(N)) GO TO 1020
0113          K=K+1
0114          BUSP(K,IS)=NP(N)
0115          BUSQ(K,IS)=NQ(N)
0116          IMP(K,IS)=-ZPRI(N)
0117          CHECK(K,IS)=1
0118          GO TO 1010
0119    1020  CONTINUE
0120    1010  CONTINUE
```

```
0121   1030   DO 1040 KKK=1,3
0122          IF(LICL(KKK,IS).EQ.0) GO TO 1060
0124          DO 1050 N=1,NOLINE
0125          IF(LICL(KKK,IS).NE.LINE(N)) GO TO 1050
0127          K=K+1
0128          BUSP(K,IS)=NP(N)
0129          BUSQ(K,IS)=NQ(N)
0130          IMP(K,IS)=ZPRI(N)
0131          CHECK(K,IS)=0
0132          GO TO 1040
0133   1050   CONTINUE
0134   1040   CONTINUE
0135   1060   NLSW(IS)=K
0136   1000   CONTINUE
0137          WRITE(IWRITE,1550)
0138          WRITE(IWRITE,1551)
0139          WRITE(IWRITE,1552)
0140          DO 1500 IS=1,NST
0141          IF(TITS(IS).EQ.0.0) GO TO 1501
```



```
0143          IF(TITS(IS).NE.TCF) GO TO 1502
0145          WRITE(IWRITE,1554) TITS(IS),FBUS
0146   1502   IF(NLSW(IS).EQ.0) GO TO 1500
0148          L=NLSW(IS)
0149          DO 1503 K=1,L
0150          IF(CHECK(K,IS).EQ.0) GO TO 1504
0152          WRITE(IWRITE,1556) TITS(IS),BUSP(K,IS),BUSQ(K,IS)
0153          GO TO 1503
0154   1504   WRITE(IWRITE,1555) TITS(IS),BUSP(K,IS),BUSQ(K,IS)
0155   1503   CONTINUE
0156          GO TO 1500
0157   1501   WRITE(IWRITE,1553) TITS(IS),FBUS
0158   1500   CONTINUE
0159   1550   FORMAT(' ',////20X,':SEQUENCE OF SYSTEM OPERATION:')
0160   1551   FORMAT(' ',20X,  '--------------------------')
0161   1552   FORMAT(' ',/20X, ' TIME(SEC)        OPERATION   ')
0162   1553   FORMAT(' ',/20X,F6.4,9X,' FAULT ON        BUS',I2)
0163   1554   FORMAT(' ',19X,F6.4,10X, 'FAULT CLEARED  BUS',I2)
0164   1555   FORMAT(' ',19X,F6.4,10X, 'LINE CLOSED    BUS',I2,2X,'TO BUS',I2)
```

```
0165  1556  FORMAT(' ',19X,F6.4,10X,'LINE OPENED   BUS ',I2,2X,'TO BUS',I2)
      C     ...LOAD TYPE
0166        DM=CMPLX(0.0,0.0)
0167        DO 15 J=1,NOZONE
0168        NOLOD1(J)=0
0169        NOLOD2(J)=0
0170        NOLOD3(J)=0
0171        K=0
0172        KK=0
0173        KKK=0
0174        M=NOBUSZ(J)
0175        DO 15 I=1,M
0176        IF(LOADZ(I,J).EQ.DM) GO TO 15
0178        IF(NLBUS.EQ.0) GO TO 35
0180        DO 35 N=1,NLBUS
0181        IF(NODE(I,J).NE.LBUS(N)) GO TO 35
0183        IF(ROD1(N).EQ.DM) GO TO 38
0185        NOLOD1(J)=NOLOD1(J)+1
0186        K=K+1
0187        LOD1(K,J)=NODE(I,J)
0188  38    IF(ROD2(N).EQ.DM) GO TO 39
0190        NOLOD2(J)=NOLOD2(J)+1
0191        KK=KK+1
0192        LOD2(KK,J)=NODE(I,J)
0193        RODZ2(KK,J)=ROD2(N)
0194  39    IF(ROD3(N).EQ.DM) GO TO 37
0196        NOLOD3(J)=NOLOD3(J)+1
0197        KKK=KKK+1
0198        LOD3(KKK,J)=NODE(I,J)
0199        RODZ3(KKK,J)=ROD3(N)
0200  37    GO TO 15
0201  35    CONTINUE
0202        NOLOD1(J)=NOLOD1(J)+1
0203        K=K+1
0204        LOD1(K,J)=NODE(I,J)
```

```
0205  15    CONTINUE
0206        DO 45 J=1,NOZONE
0207        NOMET(J)=0
0208        IF(NOMT.EQ.0) GO TO 45
0210        K=0
0211        DO 55 N=1,NOMT
0212        M=NOBUSZ(J)
0213        DO 65 I=1,M
0214        IF(IMET(N).EQ.NODE(I,J)) GO TO 56
0216  65    CONTINUE
0217        GO TO 55
0218  56    K=K+1
0219        NOMET(J)=NOMET(J)+1
0220        MET(K,J)=IMET(N)
0221  55    CONTINUE
0222  45    CONTINUE
0223        DO 70 J=1,NOZONE
0224        M=NOGEN(J)
0225        IF(M.EQ.0) GO TO 70
0227        DO 70 K=1,M
0228        ZG(K,J)=CMPLX(0.0,XG(K,J))
0229        IF(MON.EQ.0) GO TO 70
0231        WRITE(IWRITE,600)K,J,ZG(K,J)
0232  600   FORMAT(10X,'ZG(',I2,',',I2,')=',2F10.4)
0233  70    CONTINUE
0234        IF(NLBUS.EQ.0) GO TO 16
0236        WRITE(IWRITE,840)
0237        WRITE(IWRITE,860)
0238  840   FORMAT(' ',////20X,':DATA OF NON-IMPEDANCE TYPE LOAD:')
0239  860   FORMAT(' ',20X,'-------------------------------')
0240        DO 841 J=1,NOZONE
0241        M=NOBUSZ(J)
0242        DO 841 I=1,M
0243        DO 842 N=1,NLBUS
0244        IF(NODE(I,J).NE.LBUS(N)) GO TO 842
0246        WRITE(IWRITE,850) LBUS(N)
0247        SUM=LOADZ(I,J)-ROD2(N)-ROD3(N)
0248        WRITE(IWRITE,851)SUM
```

```
0249          WRITE(IWRITE,852) ROD2(N)
0250          WRITE(IWRITE,853) ROD3(N)
0251    842   CONTINUE
0252    841   CONTINUE
0253    850   FORMAT(' ',/8X,':BUS NO.',I2,' :',4X,'MW',5X,' :',3X,'MVAR',5X
             X  ,':')
0254    851   FORMAT(' ',18X,':',2X,F7.2,3X,':',2X,F7.2,3X,': CONSTANT IMEPDAN
             XCE LOAD')
0255    852   FORMAT(' ',18X,':',2X,F7.2,3X,':',2X,F7.2,3X,': CONSTANT CURRENT
             X LOAD')
0256    853   FORMAT(' ',18X,':',2X,F7.2,3X,':',2X,F7.2,3X,': CONSTANT KVA LOA
             XD')
0257    16    WRITE(IWRITE,861)FBUS
0258    861   FORMAT(' ',//8X,' FAULT AT BUS',I3)
0259          WRITE(IWRITE,862) TCF
0260    862   FORMAT(' ',/8X,' FAULT DURATION OF',F7.4,'SECOND')
```

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```
      C     ...UPDATE Z1 MATRIX
0261          DO 100 J=1,NOZONE
0262          IF(MON.EQ.0) GO TO 602
0264          WRITE(IWRITE,601)J,NOLOD1(J),NOLOD2(J),NOLOD3(J),NOMET(J)
0265    601   FORMAT(' ','ZONE',I2,2X,'NOLOD1=',I2,2X,'NOLOD2=',I2,
             X  2X,'NOLOD3=',I2,2X,'NOMET=',I2)
0266    602   KK=NOBUSZ(J)
0267          DO 100 I=1,KK
0268          YMOD(I,J)=DM
0269          IF(LOADZ(I,J).EQ.DM) GO TO 115
0271          SUM=LOADZ(I,J)
0272          YO(I,J)=CONJG(LOADZ(I,J))/VOLTZ(I,J)/VOLTZ(I,J)/BASMVA
0273          YMOD(I,J)=-YO(I,J)
0274          L2=NOLOD2(J)
0275          IF(L2.EQ.0) GO TO 101
0277          DO 101 K=1,L2
0278          IF(NODE(I,J).NE.LOD2(K,J)) GO TO 101
0280          ZDD(K,J)=CONJG(RODZ2(K,J))/CABS(ET(I,J))**2/BASMVA
0281          SUM=SUM-RODZ2(K,J)
```

```
0282          GO TO 102
0283   101    CONTINUE
0284   102    L3=NOLOD3(J)
0285          IF(L3.EQ.0) GO TO 103
0287          DO 103 K=1,L3
0288          IF(NODE(I,J).NE.LOD3(K,J)) GO TO 103
0290          ZLN(K,J)=CONJG(RODZ3(K,J))/CABS(ET(I,J))**2/BASMVA
0291          SUM=SUM-RODZ3(K,J)
0292          GO TO 105
0293   103    CONTINUE
0294   105    YL(I,J)=CONJG(SUM)/CABS(ET(I,J))**2/BASMVA
0295          YMOD(I,J)=YMOD(I,J)+YL(I,J)
0296          ZMOD(I,J)=1.0/YMOD(I,J)
0297   115    LG=NOGEN(J)
0298          IF(LG.EQ.0) GO TO 100
0300          DO 130 K=1,LG
0301          IF(NODE(I,J).NE.NGEN(K,J)) GO TO 130
0303          YMOD(I,J)=YMOD(I,J)+1.0/ZG(K,J)
0304          ZMOD(I,J)=1.0/YMOD(I,J)
0305          GO TO 100
0306   130    CONTINUE
0307   100    CONTINUE
0308          IF(MON.EQ.0) GO TO 666
0310          DO 605 J=1,NOZONE
0311          K=NOBUSZ(J)
0312          DO 605 I=1,K
0313          WRITE(IWRITE,606)I,J,ZMOD(I,J),I,J,YMOD(I,J)
0314   606    FORMAT(' ',5X,'ZMOD(',I2,',',I2,')=',2F10.5,3X,'YMOD(',I2,',',I2
              X  ,')=',2F10.5)
0315   605    CONTINUE
0316   666    DO 200 J=1,NOZONE
0317          K=NOBUSZ(J)
0318          L=K+1
0319          DO 200 IFQ=1,K
0320          IF(YMOD(IFQ,J).EQ.DM) GO TO 200
```

```
0322          DO 250 I=1,K
0323          Z1(I,L,J)=-Z1(IFQ,I,J)
0324          Z1(L,I,J)=Z1(I,L,J)
0325   250    CONTINUE
0326          Z1(L,L,J)=-Z1(IFQ,L,J)-ZMOD(IFQ,J)
0327          DO 200 I=1,K
0328          DO 200 M=1,K
0329          Z1(I,M,J)=Z1(I,M,J)-Z1(I,L,J)/Z1(L,L,J)*Z1(L,M,J)
0330   200    CONTINUE
      C     ...SAVE GENZ(I,J),ET(I,J)
0331          DO 900 J=1,NOZONE
0332          M=NOBUSZ(J)
0333          DO 900 I=1,M
0334          ZMOD(I,J)=GENZ(I,J)
0335          YMOD(I,J)=ET(I,J)
0336   900    CONTINUE
      C     ...EXTRACT SMALL MATRIX
0337          DO 300 J=1,NOZONE
0338          L=0
0339          M=NOBUSZ(J)
0340          DO 310 I=1,M
0341          NG=NOGEN(J)
0342          IF(NG.EQ.0) GO TO 320
0344          DO 320 K=1,NG
0345          IF(NODE(I,J).EQ.MGEN(K,J)) GO TO 350
0347   320    CONTINUE
0348          NL2=NOLOD2(J)
0349          IF(NL2.EQ.0) GO TO 330
0351          DO 330 K=1,NL2
0352          IF(NODE(I,J).EQ.LOD2(K,J)) GO TO 350
0354   330    CONTINUE
0355          NL3=NOLOD3(J)
0356          IF(NL3.EQ.0) GO TO 340
0358          DO 340 K=1,NL3
0359          IF(NODE(I,J).EQ.LOD3(K,J)) GO TO 350
0361   340    CONTINUE
```

```
0362          NM=NOMET(J)
0363          IF(NM.EQ.0) GO TO 341
0365          DO 341 K=1,NM
0366          IF(NODE(I,J).EQ.MET(K,J)) GO TO 350
0368    341   CONTINUE
0369          DO 342 IC=1,NOCUT
0370          IF(CUTP(IC).EQ.NODE(I,J)) GO TO 350
0372          IF(CUTQ(IC).EQ.NODE(I,J)) GO TO 350
0374    342   CONTINUE
0375          IF(NODE(I,J).EQ.FBUS) GO TO 350
0377          GO TO 310
0378    350   L=L+1
0379          NN(L)=I
0380    310   CONTINUE
0381          NOBZ(J)=L
0382          DO 400 I=1,L
0383          NI=NN(I)
0384          DO 410 K=1,L
```

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```
0385          NL=NN(K)
0386          Z1(I,K,J)=Z1(NI,NL,J)
0387    410   CONTINUE
0388          NODE(I,J)=NODE(NI,J)
0389          GENZ(I,J)=ZMOD(NI,J)
0390          ET(I,J)=YMOD(NI,J)
0391          IF(MON.EQ.0) GO TO 400
0393          WRITE(IWRITE,401)I,J,NODE(I,J),GENZ(I,J),ET(I,J)
0394    401   FORMAT(' ',10X,'NEW NODE',5X,'NODE(',I2,',',I2,')=',I2,'GENZ='
             X  ,2F10.5,2X,'ET',2F10.5)
0395    400   CONTINUE
0396    300   CONTINUE
      C       ...CHANGE NOBUSZ(J)
0397          DO 500 J=1,NOZONE
0398          NOBUSZ(J)=NOBZ(J)
0399          IF(MON.EQ.0) GO TO 500
0401          WRITE(IWRITE,501)J,NOBUSZ(J)
0402    501   FORMAT(' ',10X,'NEW NOBUSZ(',I2,')=',I2)
0403    500   CONTINUE
```

```
      C     ....CHANGE CUTPB,CUTPZ CORESPOND TO NEW NODE
0404          DO 245 IC=1,NOCUT
0405          DO 244 J=1,NOZONE
0406          K=NOBUSZ(J)
0407          DO 244 I=1,K
0408          IF(CUTP(IC).NE.NODE(I,J)) GO TO 243
0410          CUTPB(IC)=I
0411          CUTPZ(IC)=J
0412          GO TO 244
0413  243     IF(CUTQ(IC).NE.NODE(I,J)) GO TO 244
0415          CUTQB(IC)=I
0416          CUTQZ(IC)=J
0417  244     CONTINUE
0418          IF(MON.EQ.0) GO TO 245
0420          WRITE(IWRITE,1590) IC,CUTPB(IC),CUTPZ(IC),CUTQB(IC),CUTQZ(IC)
0421  1590    FORMAT(' ',5X,'IC=',I2,2X,'CUTPB=',I2,2X,'CUTPZ=',I2,2X,'CUTQB=
             X,I2,2X,'CUTQZ=',I2)
0422  245     CONTINUE
      C     ... FIND ISWB,ISWZ AS IFB,IFZ
0423          DO 257 J=1,NOZONE
0424          K=NOBUSZ(J)
0425          DO 257 I=1,K
0426          IF(NODE(I,J).NE.FBUS) GO TO 257
0428          ISWB=I
0429          ISWZ=J
0430          GO TO 258
0431  257     CONTINUE
0432  258     CONTINUE
      C     ....SAVE Z1,GENZ,ET,NODE
0433          OPEN(UNIT=20,NAME='DY1:SAVZ.DAT',TYPE='NEW')
0434          DO 2000 J=1,NOZONE
0435          L=NOBUSZ(J)
0436          DO 2000 I=1,L
0437          DO 2000 M=1,L
0438          WRITE(20,2001) Z1(I,M,J)
```

```
0439  2001  FORMAT(2F10.7)
0440  2000  CONTINUE
0441        CALL CLOSE(20)
0442        OPEN(UNIT=21,NAME='DY1:SAVG.DAT',TYPE='NEW')
0443        DO 2050 J=1,NOZONE
0444        L=NOBUSI(J)
0445        DO 2050 I=1,L
0446        WRITE(21,2051) NODE(I,J),GENZ(I,J),ET(I,J)
0447  2051  FORMAT(I5,2F10.5,2F10.7)
0448  2050  CONTINUE
0449        CALL CLOSE(21)
0450        OPEN(UNIT=22,NAME='DY1:SZG.DAT',TYPE='NEW')
0451        DO 2060 J=1,NOZONE
0452        M=NOGEN(J)
0453        DO 2060 K=1,M
0454        WRITE(22,2061) ZG(K,J)
0455  2061    FORMAT(2F10.7)
0456  2060  CONTINUE
0457        CALL CLOSE(22)
0458        RETURN
0459        END
```

```
0001          SUBROUTINE STEP6
      C
      C
0002          INTEGER IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
             X  ,       NOBUSZ(4),NOLINZ(4)
0003          INTEGER CUTP(10),CUTQ(10),CUTF(10),NODE(10,4)
0004          INTEGER CUTBB(10),CUTQB(10),CUTPZ(10),CUTQZ(10)
0005          REAL    BASMVA
0006          REAL    VOLTZ(10,4)
0007          COMPLEX CUTZ(10)
0008          COMPLEX GENZ(10,4)
0009          COMPLEX Z1(10,10,4),Z2(10,10,4),Z4(10,10),YA(10,10),ZB(10,4)
0010          COMPLEX ZG(5,3),ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0011          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4)
0012          COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ET1
      C
0013          INTEGER NGEN,NLBUS,LBUS(20),NOMT,IMGN(20),BGEN(20),NOBZ(4)
0014          INTEGER IMET(10),FBUS,NN(10),GNO(5,4)
0015          INTEGER NOGEN(4),NOLOD1(4),NOLOD2(4),NOLOD3(4),NOMET(4),MON
0016          INTEGER MGEN(5,4),LOD1(5,4),LOD2(5,4),LOD3(5,4),MET(5,4)
0017          INTEGER N,NELOP(4,4),NNODE(10,4,4)
0018          REAL XDI(20),XQI(20),XDPI(20),TOI(20)
0019          REAL XD(5,4),XQ(5,4),XDP(5,4),TO(5,4)
0020          REAL TT,TCF,TSTOP,NETA,EFLON,OMGA
0021          REAL EQP(5,4),EQBP(5,4),EQMB(5,4),ANG(5,4),CTAP(5,4)
0022          REAL AGI2(5,4),ALPA(5,4),CTA(5,4),ABL2(5,4)
0023          COMPLEX IQG(5,4),EQ(5,4),AG(5,4),ALOD2(5,4)
0024          COMPLEX ALOD3(5,4),IKVP(5,4)
0025          COMPLEX ROD1(10),ROD2(10),ROD3(10),RODZ2(5,4),RODZ3(5,4)
0026          REAL HI(20),H(5,4),MUI(20),MU(5,4),TEI(20),TE(5,4),F,RI(20)
0027          REAL R(5,4),TCI(20),TC(5,4),TSI(20),TS(5,4),PMAXI(20)
0028          REAL PMAX(5,4),EII(5,4),EFDP(5,4),EFDO(5,4),ETR(5,4)
0029          REAL ETOO(5,4),DT,WO,W(5,4),PE(5,4),PMO(5,4),PMPP(5,4)
0030          REAL PM(5,4),PMP(5,4),DEQP(5,4),DEFD(5,4),DPMP(5,4)
0031          REAL DPM(5,4),DW(5,4),DDEL(5,4),SDEQ(5,4),SDEF(5,4)
0032          REAL SDPMP(5,4),SDPM(5,4),SDW(5,4),SDDEL(5,4),EFD(5,4)
0033          REAL EFMAX(5,4),EFMAXI(20),EFMIN(5,4),EFMINI(20),ETMIN
0034          REAL WW(5,60),DELTA(5,60),TCFF,DTT,SC
0035          REAL INANG(5,1)
0036          INTEGER JJ,ISET,MBUSZ(3),ITSTOP,NZON
0037          INTEGER NOPLOT,NMAC(5),KBOI(5),JBOI(5)
```

```
      C
0038        INTEGER ITS,NST,LIOP(3,3),LICL(3,3),NLSW(3),BUSP(6,3),BUSQ(6,3)
0039        REAL TITS(3)
0040        COMPLEX IMP(6,3)
      C
0041        COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
           X  ,           NOBUSZ,NOLINZ,CUTP,CUTQ,CUTF,CUTPB,CUTQB
           X  ,           CUTPZ,CUTQZ,BASMVA,CUTI,IDD,ILN
      C
0042        COMMON/BUFF/XD,XQ,XDF,TD
           X  ,           ABLZ
           X  ,           IQG,EG,EGP,AG,ALOD1,ALOD3,EGBP,EGMB,ANG,CTAP
           X  ,           AGIZ,ALPA,CTA,IKVP
```



```
           X  ,           H,MU,TE,R,TC,TS,PMAX
           X  ,           EII,EFDP,EFDO,ETR,ETOO,W,PE,PMO,PMPP,PM,PMP
           X  ,           DEQP,DEFD,DPMP,DPM,DW,DDEL,SDEQ,SDEF,SDPMP,SDPM
           X  ,           SDW,SDDEL,EFD,EFMAX,EFMIN
           X  ,           VOLTZ,GENZ,NODE,Z1,Z2,Z4,Y4,ZS,D,VECTOR
           X  ,           EC,AC,A,ACUT,ET,ECUT,SUM,ET0,ET1,ZG
      C
0043        COMMON/TUB/ NGEN,NLBUS,LBUS,NOMT,IMGN,BGEN,NOBZ
           X  ,           IMET,FBUS,NN,GNO,NOGEN,NOLOD1,NOLOD2
           X  ,           NOLOD3,NOMET,MON,MGEN,LOD1,LOD2,LOD3,MET
           X  ,           XDI,XQI,XDPI,TOI
           X  ,           TT,TCF,TSTOP,NETA,EPLON,OMGA,DT,W0
           X  ,           HI,MUI,TEI,F,RI,TCI,TSI,PMAXI,EFMAXI,EFMINI,ETMIN
           X  ,           ROD1,ROD2,ROD3,RODZ2,RODZ3
0044        COMMON/INT/INANG,MON1
0045        COMMON/DIK/N,NELOP,NNODE
0046        COMMON/MOD/ITS,NST,LIOP,LICL,NLSW,BUSP,BUSQ,TITS,IMP
0047        COMMON/STA/JJ,ISET,WW,DELTA,MBUSZ,ITSTOP,TCFF,NZON,DTT,SC,ETM
           X  ,           NOPLOT,NMAC,KPOT,JPOT,ESC
```

```
      C     ...CLEAR Z1,GENZ,ET,NODE
0048          DO 1000 J=1,NOZONE
0049          M=NOBUSZ(J)
0050          DO 1000 I=1,M
0051          DO 1000 L=1,M
0052          Z1(I,L,J)=CMPLX(0.0,0.0)
0053    1000  CONTINUE
      C     ...EXTRACT Z1,GENZ,ET,NODE
0054          OPEN(UNIT=20,NAME='DY1:SAVZ.DAT',TYPE='OLD')
0055          DO 2000 J=1,NOZONE
0056          L=NOBUSZ(J)
0057          DO 2000 I=1,L
0058          DO 2000 M=1,L
0059          READ(20,2001) Z1(I,M,J)
0060    2001  FORMAT(2F10.0)
0061    2000  CONTINUE
0062          CALL CLOSE(20)
0063          OPEN(UNIT=21,NAME='DY1:SAVG.DAT',TYPE='OLD')
0064          DO 2050 J=1,NOZONE
0065          L=NOBUSZ(J)
0066          DO 2050 I=1,L
0067          READ(21,2051) NODE(I,J),GENZ(I,J),ET(I,J)
0068    2051  FORMAT(I5,2F10.0,2F10.0)
0069    2050  CONTINUE
0070          CALL CLOSE(21)
0071          OPEN(UNIT=22,NAME='DY1:SZG.DAT',TYPE='OLD')
0072          DO 2060 J=1,NOZONE
0073          M=NOGEN(J)
0074          DO 2060 K=1,M
0075          READ(22,2061) ZG(K,J)
0076    2061  FORMAT(2F10.0)
0077    2060  CONTINUE
0078          CALL CLOSE(22)
0079          DO 10 J=1,NOZONE
0080          NOGEN(J)=0
```

```
0081          K=0
0082          DO 20 N=1,NGEN
0083          M=NOBUSZ(J)
0084          DO 30 I=1,M
0085          IF(BGEN(N).EQ.NODE(I,J)) GO TO 18
0087    30    CONTINUE
0088          GO TO 20
0089    18    K=K+1
0090          NOGEN(J)=NOGEN(J)+1
0091          GNO(K,J)=IMGN(N)
0092          MGEN(K,J)=BGEN(N)
0093          XD(K,J)=XDI(N)
0094          XQ(K,J)=XQI(N)
0095          XDP(K,J)=XDPI(N)
0096          TO(K,J)=TOI(N)
0097          H(K,J)=HI(N)
0098          MU(K,J)=MUI(N)
0099          EFMAX(K,J)=EFMAXI(N)
0100          EFMIN(K,J)=EFMINI(N)
0101          TE(K,J)=TEI(N)
0102          TC(K,J)=TCI(N)
0103          TS(K,J)=TSI(N)
0104          R(K,J)=RI(N)
0105          PMAX(K,J)=PMAXI(N)
0106    20    CONTINUE
0107    10    CONTINUE
      C
0108          WRITE(IWRITE,835)
0109    835   FORMAT(' ',////20X,':DATA OF GENERATORS:')
0110          DO 800 J=1,NOZONE
0111          M=NOGEN(J)
0112          IF(M.EQ.0) GO TO 800
0114          DO 800 K=1,M
0115          WRITE(IWRITE,820) GNO(K,J)
0116          WRITE(IWRITE,805)
```

```
0117          WRITE(IWRITE,821) XD(K,J)
0118          WRITE(IWRITE,822) XQ(K,J)
0119          WRITE(IWRITE,823) XDP(K,J)
0120          WRITE(IWRITE,824) H(K,J)
0121          WRITE(IWRITE,825) TO(K,J)
0122          WRITE(IWRITE,826) TE(K,J)
0123          WRITE(IWRITE,827) MU(K,J)
0124          WRITE(IWRITE,828) TC(K,J)
0125          WRITE(IWRITE,829) TS(K,J)
0126          WRITE(IWRITE,830) R(K,J)
0127          WRITE(IWRITE,831) PMAX(K,J)
0128          WRITE(IWRITE,832) EFMAX(K,J)
0129          WRITE(IWRITE,833) EFMIN(K,J)
0130    800   CONTINUE
0131    820   FORMAT(' ',//20X,':GENERATOR NUMBER',I2,':')
0132    805   FORMAT(' ',20X,'-------------------')
0133    821   FORMAT(' ',8X,':DIRECT-AXIS SYNCHRONOUS REACTANCE(XD)=',F8.5)
0134    822   FORMAT(' ',8X,':QUADRATURE-AXIS REACTANCE(XQ)=',F8.5)
0135    823   FORMAT(' ',8X,':TRANSIENT REACTANCE(XDP)=',F8.5)
```



```
0136    824   FORMAT(' ',8X,':INERTIA CONSTANT(H)=',F10.4)
0137    825   FORMAT(' ',8X,':OPEN-CIRCUIT FIELD TIME CONSTANT(TO)=',F8.5)
0138    826   FORMAT(' ',8X,':EXCITATION SYSTEM TIME CONSTANT(TE)=',F8.5)
0139    827   FORMAT(' ',8X,':GAIN OF REGULATOR-EXCITATION  (MU)=',F10.5)
0140    828   FORMAT(' ',8X,':SPEED REGULATION  TIME CONSTANT(TC)=',F8.5)
0141    829   FORMAT(' ',8X,':STEAM SYSTEM TIME CONSTANT (TS)=',F8.5)
0142    830   FORMAT(' ',8X,':SPEED REGULATION (R)=',F10.5)
0143    831   FORMAT(' ',8X,':MAXIMUM MECHANICAL POWER (PMAX)=',F8.5)
0144    832   FORMAT(' ',8X,':CEILING EXCITATION VOLTAGE (EFMAX)=',F10.5)
0145    833   FORMAT(' ',8X,':MINIMUM EXCITATION VOLTAGE (EFMIN)=',F10.5)
      C
```

```
      C     ...FIND INITIAL CONDITION
0146          WO=2.0*3.14159*F
0147          DO 910 J=1,NOZONE
0148          M=NOBUSZ(J)
0149          L=NOGEN(J)
0150          IF(L.EQ.0) GO TO 910
0152          DO 910 I=1,M
0153          DO 910 K=1,L
0154          IF(NODE(I,J).NE.MGEN(K,J)) GO TO 910
0156          IQQ(K,J)=CONJG(GENZ(I,J))/CONJG(ET(I,J))/BASMVA
0157          EQ(K,J)=ET(I,J)+ZG(K,J)*IGG(K,J)
0158          ETDO(K,J)=CABS(ET(I,J))
0159          PMO(K,J)=REAL(GENZ(I,J))/BASMVA
0160          W(K,J)=WO
0161          PM(K,J)=PMO(K,J)
0162          PMP(K,J)=PMO(K,J)
      C     ...FIND EQP(K,J)
0163          SAVE=ABS(AIMAG(EQ(K,J))*REAL(IQQ(K,J))-REAL(EQ(K,J))
     X       *AIMAG(IQQ(K,J)))
0164          EQP(K,J)=CABS(EQ(K,J))-(XQ(K,J)-XDP(K,J))*SAVE/CABS(EQ(K,J))
0165          EQBP(K,J)=EQP(K,J)
0166          ANG(K,J)=ATAN2(AIMAG(EQ(K,J)),REAL(EQ(K,J)))
      C       INANG(K,1,J)=ANG(K,J)
      C     ...FIND INITIAL OF VOLTAGE REGULATOR
0167          IF(XQ(K,J).EQ.XDP(K,J)) GO TO 1914
0169  1913    EFDO(K,J)=(XD(K,J)-XDP(K,J))*CABS(EQ(K,J))/(XQ(K,J)-XDP(K,J))+
     X                (XQ(K,J)-XD(K,J))*EQP(K,J)/(XQ(K,J)-XDP(K,J))
0170          EFD(K,J)=EFDO(K,J)
      C     ... FIND NORTON CURRENT
0171  1914    AG(K,J)=EQ(K,J)/ZG(K,J)
0172          IF(MON.EQ.0) GO TO 910
0174          WRITE(IWRITE,915)K,J,IQQ(K,J),EQ(K,J),EQP(K,J),AG(K,J)
0175  915     FORMAT(' ',20X,'FOR K=',I2,2X,'AND J=',I2/10X,'IQQ=',
     X    2F10.4,3X,'EQ=',2F10.4,3X,'EQP=',F10.4,3X,'AG=',2F10.4)
0176  910     CONTINUE
```

```
      C     ... FIND ALOD2(K,J)
0177          DO 920 J=1,NOZONE
0178          M=NOBUSZ(J)
0179          L=NOLOD2(J)
0180          IF(L.EQ.0) GO TO 920
0182          DO 920 I=1,M
0183          DO 920 K=1,L
0184          IF(NODE(I,J).NE.LOD2(K,J)) GO TO 920
```



```
0186          ALOD2(K,J)=CONJG(RODZ2(K,J))/CONJG(ET(I,J))/BASMVA
0187          ALPA(K,J)=ATAN2(AIMAG(RODZ2(K,J)),REAL(RODZ2(K,J)))
0188          ABL2(K,J)=CABS(ALOD2(K,J))
0189          IF(MON.EQ.0) GO TO 920
0191          WRITE(IWRITE,916)K,J,ALOD2(K,J),ALPA(K,J),ABL2(K,J)
0192    916   FORMAT(' ',5X,'FOR K=',I2,1X,'AND J=',I2,1X,'ALOD2=',2F10.4,
             X  1X,'ALPA=',F10.5,1X,'ABL2=',F7.5)
0193    920   CONTINUE
      C     ... FIND ALOD3(K,J)
0194          DO 930 J=1,NOZONE
0195          M=NOBUSZ(J)
0196          L=NOLOD3(J)
0197          IF(L.EQ.0) GO TO 930
0199          DO 930 I=1,M
0200          DO 930 K=1,L
0201          IF(NODE(I,J).NE.LOD3(K,J)) GO TO 930
0203          ALOD3(K,J)=CONJG(RODZ3(K,J))/CONJG(ET(I,J))/BASMVA
0204          IF(MON.EQ.0) GO TO 930
0206          WRITE(IWRITE,917)K,J,ALOD3(K,J)
0207    917   FORMAT(' ',20X,'FOR K=',I2,2X,'AND J=',I2,5X,'ALOD3=',2F10.4)
0208    930   CONTINUE
      C     ... FIND NELOP(N,J),NNODE(K,N,J)
0209          DO 960 N=1,4
0210          DO 950 J=1,NOZONE
0211            L=0
0212          NELOP(N,J)=0
0213          NOB=NOBUSZ(J)
0214          DO 950 I=1,NOB
```

```
0215          IF(N.EQ.1) GO TO 911
0217          IF(N.EQ.2) GO TO 912
0219          IF(N.EQ.3) GO TO 913
0221          IF(N.EQ.4) GO TO 914
0223    911   M1=NOGEN(J)
0224          IF(M1.EQ.0) GO TO 964
0226          DO 955 K=1,M1
0227          IF(NODE(I,J).EQ.MGEN(K,J)) GO TO 965
0229    955   CONTINUE
0230          GO TO 964
0231    912   M2=NOLOD2(J)
0232          IF(M2.EQ.0) GO TO 964
0234          DO 956 K=1,M2
0235          IF(NODE(I,J).EQ.LOD2(K,J)) GO TO 965
0237    956   CONTINUE
0238          GO TO 964
0239    913   M3=NOLOD3(J)
0240          IF(M3.EQ.0) GO TO 964
0242          DO 957 K=1,M3
0243          IF(NODE(I,J).EQ.LOD3(K,J)) GO TO 965
0245    957   CONTINUE
0246          GO TO 964
0247    914   M4=NOMET(J)
0248          IF(M4.EQ.0) GO TO 964
0250          DO 958 K=1,M4
0251          IF(NODE(I,J).EQ.MET(K,J)) GO TO 965
```

```
0253  958   CONTINUE
0254        GO TO 964
0255  964   DO 963 IC=1,NOCUT
0256        IF(NODE(I,J).EQ.CUTP(IC)) GO TO 965
0258        IF(NODE(I,J).EQ.CUTQ(IC)) GO TO 965
0260  963   CONTINUE
0261        IF(NODE(I,J).EQ.FBUS) GO TO 965
0263        GO TO 950
0264  965   L=L+1
0265        NELOP(N,J)=NELOP(N,J)+1
0266        NNODE(L,N,J)=I
0267        IF(MON.EQ.0) GO TO 950
0269        WRITE(IWRITE,970)N,J,NELOP(N,J),L,N,J,NNODE(L,N,J)
0270  970   FORMAT(' ','NELOP(',I2,',',I2,')=',I2,5X,'NNODE(',
     X  I2,',',I2,',',I2,')=',I2)
0271  950   CONTINUE
0272  960   CONTINUE
0273        DO 700 L=1,NOPLOT
0274        DO 701 J=1,NOZONE
0275        M=NOGEN(J)
0276        IF(M.EQ.0) GO TO 701
0278        DO 702 K=1,M
0279        IF(NMAC(L).NE.GNO(K,J)) GO TO 702
0281        KPOT(L)=K
0282        JPOT(L)=J
0283        INANG(L,1)=ANG(K,J)
0284        GO TO 701
0285  702   CONTINUE
0286  701   CONTINUE
0287  700   CONTINUE
0288        WRITE(IWRITE,750)
0289        WRITE(IWRITE,751)
0290  750   FORMAT(' ',////20X,':SWING CURVE:')
0291  751   FORMAT(' ',20X,'------------',/)
0292        DO 760 L=1,NOPLOT
0293        WRITE(IWRITE,752) L,NMAC(L)
0294  752   FORMAT(' ',20X,'CURVE NO.',I2,' ---:--- GENERATOR NO.',I2)
0295  760   CONTINUE
0296        RETURN
0297        END
```

```
0001          SUBROUTINE STEPS
      C
      C
0002          INTEGER IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
             X  ,       NOBUSZ(4),NOLINZ(4)
0003          INTEGER CUTP(10),CUTQ(10),CUTF(10),NODE(10,4)
0004          INTEGER CUTPB(10),CUTQB(10),CUTPZ(10),CUTQZ(10)
0005          REAL    BASMVA
0006          REAL    VOLTZ(10,4)
0007          COMPLEX CUTZ(10)
0008          COMPLEX GENZ(10,4)
0009          COMPLEX Z1(10,10,4),Z2(10,10,4),Z4(10,10),Y4(10,10),ZS(10,4)
0010          COMPLEX ZG(5,3),ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0011          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4)
0012          COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ET1
      C
0013          INTEGER NGEN,NLBUS,LBUS(20),NOMT,IMGN(20),BGEN(20),NOBZ(4)
0014          INTEGER IMET(10),FBUS,NN(10),GND(5,4)
0015          INTEGER NOGEN(4),NOLOD1(4),NOLOD2(4),NOLOD3(4),NOMET(4),MON
0016          INTEGER MGEN(5,4),LOD1(5,4),LOD2(5,4),LOD3(5,4),MET(5,4)
0017          REAL XDI(20),XQI(20),XDPI(20),TDI(20)
0018          REAL XD(5,4),XQ(5,4),XDP(5,4),TD(5,4)
0019          REAL TT,TCF,TSTOP,NETA,EPLON,OMGA
0020          REAL EQP(5,4),EQBP(5,4),EQMB(5,4),ANG(5,4),CTAP(5,4)
0021          REAL AGI2(5,4),ALPA(5,4),CTA(5,4),ABL2(5,4)
0022          COMPLEX IQG(5,4),EQ(5,4),AG(5,4),ALOD2(5,4)
0023          COMPLEX ALOD3(5,4),IKVP(5,4)
0024          COMPLEX ROD1(10),ROD2(10),ROD3(10),RODZ2(5,4),RODZ3(5,4)
0025          INTEGER N,NELOP(4,4),NNODE(10,4,4)
0026          REAL HI(20),H(5,4),MUI(20),MU(5,4),TEI(20),TE(5,4),F,RI(20)
0027          REAL R(5,4),TCI(20),TC(5,4),TSI(20),TS(5,4),PMAXI(20)
0028          REAL PMAX(5,4),EII(5,4),EFDP(5,4),EFDO(5,4),ETR(5,4)
0029          REAL ETQO(5,4),DT,WO,W(5,4),PE(5,4),PMO(5,4),PMPP(5,4)
0030          REAL PM(5,4),PMP(5,4),DEQP(5,4),DEFD(5,4),DPMP(5,4)
0031          REAL DPM(5,4),DW(5,4),DDEL(5,4),SDEQ(5,4),SDEF(5,4)
0032          REAL SDPMP(5,4),SDPM(5,4),SDW(5,4),SDDEL(5,4),EFD(5,4)
0033          REAL EFMAX(5,4),EFMAXI(20),EFMIN(5,4),EFMINI(20),ETMIN
```

```
0034          REAL WW(5,60),DELTA(5,60),TCFF,DTT,SC
0035          INTEGER JJ, ISET,MBUSZ(3),ITSTOP,NZON
0036          INTEGER NOPLOT,NMAC(5),KPOT(5),JPOT(5)
0037          REAL INANG(5,1)
      C
0038          INTEGER ITS,NST,LIOP(3,3),LICL(3,3),NLSW(3),BUSP(6,3),BUSQ(6,3)
0039          REAL TITS(3)
0040          COMPLEX IMP(6,3)
      C
0041            COMMON/BUFF/XD,XQ,XDP,TD
               X  ,            ABL2
               X  ,            IQQ,EQ,EQP,AG,ALOD2,ALOD3,EQBP,EQMB,ANG,CTAP
               X  ,            AGI2,ALPA,CTA,C,DP
               X  ,            H,MU,TE,R,TC,TS,PMAX
               X  ,            EII,EFDP,EFDQ,ETP,ETQQ,W,PE,PMQ,PMPP,PM,PMF
               X  ,            DEGP,DEFD,DPMP,DPM,DW,DDEL,SDEG,SDEF,SDPMP,SDPM
               X  ,            SDW,SDDEL,EFD,EFMAX,EFMIN
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               X  ,            VOLTZ,GENZ,NODE,Z1,Z2,Z4,Y4,ZS,D,VECTOR
               X  ,            EC,AC,A,ACUT,ET,ECUT,SUM,ET0,ET1,ZG
0042          COMMON/DIK/N,NELOP,NNODE
0043          COMMON/STA/JJ,ISET,WW,DELTA,MBUSZ,ITSTOP,TCFF,NZON,DTT,SC,ETM
              X  ,           NOPLOT,NMAC,KPOT,JPOT
0044          COMMON/INT/INANG,MON1
0045          COMMON/MOD/ITS,NST,LIOP,LICL,NLSW,BUSP,BUSQ,TITS,IMP
0046          COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
               X  ,            NOBUSZ,NOLINZ,CUTP,CUTQ,CUTF,CUTPB,CUTQB
               X  ,            CUTFZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
0047          COMMON/TUB/ NGEN,NLBUS,LBUS,NOMT,IMGN,BGEN,NOBZ
               X  ,            IMET,FBUS,NN,GNO,NOGEN,NOLOD1,NOLOD2
               X  ,            NOLOD3,NOMET,MON,MGEN,LOD1,LOD2,LOD3,MET
               X  ,            XDI,XQI,XDPI,TOI
               X  ,            TT,TCF,TSTOP,NETA,EPLON,OMGA,DT,WO
               X  ,            HI,MUI,TEI,F,RI,TCI,TSI,PMAXI,EFMAXI,EFMINI,ETMIN
               X  ,            ROD1,ROD2,ROD3,RODZ2,RODZ3
0048          COMMON/MOD1/TTM,KRON
```

```
      C
0049          TCFF=TCF
0050          ETM=ETMIN
0051          DTT=DT
0052          ITS=1
0053          NZON=NOZONE
0054          DO 1 J=1,NOZONE
0055          MBUSZ(J)=NOGEN(J)
0056    1     CONTINUE
0057          DO 3 L=1,NOPLOT
0058          DELTA(L,1)=INANG(L,1)*57.2957
0059          WW(L,1)=1.0
0060    3     CONTINUE
0061    2     CONTINUE
      C       SET TT=0.0
0062          TT=0.0
0063          SC=0.0
0064          ISET=1
      C     ...IS THERE A SWITCHING OPERATION
0065    48    KSW1=TITS(ITS)/DT
0066          KSW2=TT/DT
0067          TTM=TT
0068          IF(KSW2.EQ.KSW1) GO TO 61
0070          GO TO 80
0071    61    CALL MODIFY
0072          ITS=ITS+1
0073    60    JJ=0
0074    65    CALL SOLVE
0075          IF(KRON.EQ.1) GO TO 91
      C     ...CALCULATE MACHINE TERMINAL POWER
0077          DO 10 J=1,NOZONE
0078          L=NOGEN(J)
0079          IF(L.EQ.0) GO TO 10
0081          DO 11 K=1,L
0082          PE(K,J)=REAL(EQ(K,J)*CONJG(IQQ(K,J)))
0083          IF(MON1.EQ.0) GO TO 11
```

```
0085          WRITE(IWRITE,12)  TT,K,J,PE(K,J)
0086    12    FORMAT(' ','FOR TT=',F5.3/10X,'K=',I2,2X,'J=',I2,5X,'PE=',F10.6)
0087    11    CONTINUE
0088    10    CONTINUE
      C     ...TEST JJ
0089          IF(JJ.EQ.0) GO TO 80
0091          IF(JJ.EQ.1) GO TO 84
0093          TT=TT+DT
0094          IF(TT.GE.TSTOP) GO TO 88
0096          IF(ITS.GT.NST) GO TO 80
0098          GO TO 48
      C     ...CALCULATE INITIAL ESTIMATE STATE
0099    80    CALL STATE
      C     ... SET JJ=1
0100          JJ=1
0101          GO TO 65
      C     ...CALCULATE FINAL ESTIMATE STATE
0102    84    CALL STATE
0103          JJ=2
0104          GO TO 65
0105    88    ITSTOP=TSTOP/DT/ETMIN+1
0106          IF(MON1.EQ.0) GO TO 91
0108          DO 90 L=1,NOPLOT
0109          WRITE(IWRITE,120) L
0110    120   FORMAT(' ',10X,'FOR L=',I2)
0111          DO 92 I=1,ITSTOP
0112          WRITE(IWRITE,122) I,DELTA(L,I),I,WW(L,I)
0113    122   FORMAT(' ',10X,'DELTA(',I2,')=',F10.5,5X,'WW(',I2,')=',F10.5)
0114    92    CONTINUE
0115    90    CONTINUE
0116    91    RETURN
0117          END
```

```
0001          SUBROUTINE SOLVE
      C
      C
0002          INTEGER IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
             X  ,       NOBUSZ(4),NOLINZ(4)
0003          INTEGER CUTP(10),CUTQ(10),CUTF(10),NODE(10,4)
0004          INTEGER CUTPB(10),CUTQB(10),CUTFZ(10),CUTQZ(10)
0005          REAL    BASMVA
0006          REAL    VOLTZ(10,4)
0007          COMPLEX CUTZ(10)
0008          COMPLEX GENZ(10,4)
0009          COMPLEX Z1(10,10,4),ZZ(10,10,4),Z4(10,10),Y4(10,10),IB(10,4)
0010          COMPLEX ZC(5,3),ZDD(10,4),D(10),VECTOR(10),ZLN(10,4
0011          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4)
0012          COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ET1
      C
      C
0013          INTEGER NGEN,NLBUS,LBUS(20),NOMT,IMGN(20),BGEN(20),NOBZ(4)
0014          INTEGER IMET(10),FBUS,NN(10),GNO(5,4)
0015          INTEGER NOGEN(4),NOLOD1(4),NOLOD2(4),NOLOD3(4),NOMET(4),MON
0016          INTEGER MGEN(5,4),LOD1(5,4),LOD2(5,4),LOD3(5,4),MET(5,4)
0017          REAL XDI(20),XQI(20),XDPI(20),TDI(20)
0018          REAL XD(5,4),XQ(5,4),XDP(5,4),TD(5,4)
0019          REAL TT,TCF,TSTOP,NETA,EPLON,OMGA
0020          REAL EQP(5,4),EQBP(5,4),EQMB(5,4),ANG(5,4),CTAP(5,4)
0021          REAL AGI2(5,4),ALPA(5,4),CTA(5,4),ABL2(5,4)
0022          COMPLEX IQQ(5,4),EQ(5,4),AG(5,4),ALOD2(5,4)
0023          COMPLEX ALOD3(5,4),IKVP(5,4)
0024          COMPLEX ROD1(10),ROD2(10),ROD3(10),RODZ2(5,4),RODZ3(5,4)
0025          INTEGER N,NELOP(4,4),NNODE(10,4,4)
0026          REAL HI(20),H(5,4),MUI(20),MU(5,4),TEI(20),TE(5,4),F,RI(20)
0027          REAL R(5,4),TCI(20),TC(5,4),TSI(20),TS(5,4),PMAXI(20)
0028          REAL PMAX(5,4),EII(5,4),EFDP(5,4),EFDO(5,4),ETR(5,4)
0029          REAL ETOO(5,4),DT,WO,W(5,4),PE(5,4),PMO(5,4),PMPP(5,4)
0030          REAL PM(5,4),PMP(5,4),DEQP(5,4),DEFD(5,4),DPMP(5,4)
0031          REAL DPM(5,4),DW(5,4),DDEL(5,4),SDEQ(5,4),SDEF(5,4)
0032          REAL SDPMP(5,4),SDPM(5,4),SDW(5,4),SDDEL(5,4),EFD(5,4)
0033          REAL EFMAX(5,4),EFMAXI(20),EFMIN(5,4),EFMINI(20),ETMIN
```

```
0034          COMMON/BUFF/XD,XQ,XDP,TD
             X  ,            ABL2
             X  ,            IQQ,EQ,EQP,AG,ALOD2,ALOD3,EQBP,EQMB,ANG,CTAP
             X  ,            AGIZ,ALPA,CTA,IKVP
             X  ,            H,MU,TE,R,TC,TS,PMAX
             X  ,            EII,EFDP,EFDO,ETR,ETOO,W,PE,PMO,PMPF,PM,PMP
             X  ,            DEQP,DEFD,DPMP,DPM,DW,DDEL,SDEQ,SDEF,SDPMP,SDPM
             X  ,            SDW,SDDEL,EFD,EFMAX,EFMIN
             X  ,            VOLTZ,GENZ,NODE,Z1,Z2,Z4,Y4,ZS,D,VECTOR
             X  ,            EC,AC,A,ACUT,ET,ECUT,SUM,ET0,ET1,ZG
0035          COMMON/DIK/N,NELOP,NNODE
0036          COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
             X  ,            NOBUSZ,NOLINZ,CUTP,CUTQ,CUTF,CUTPB,CUTQB
             X  ,            CUTPZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
0037          COMMON/TUB/ NGEN,NLBUS,LBUS,NOMT,IMGN,BGEN,NOBZ
```



```
             X  ,            IMET,FBUS,NN,GNO,NOGEN,NOLOD1,NOLOD2
             X  ,            NOLOD3,NOMET,MON,MGEN,LOD1,LOD2,LOD3,MET
             X  ,            XDI,XQI,XDPI,TOI
             X  ,            TT,TCF,TSTOP,NETA,EPLON,OMGA,DT,WO
             X  ,            HI,MUI,TEI,F,RI,TCI,TSI,PMAXI,EFMAXI,EFMINI,ETMIN
             X  ,            ROD1,ROD2,ROD3,RODZ2,RODZ3
0038          COMMON/MOD1/TTM,KRON
      C
0039          KRON=0
      C     ...SET N=1
0040  1       N=1
0041          NIT1=0
0042          NIT2=0
0043          NIT3=0
      C     ..ADJUST CURRENT
0044  5       DO 10 J=1,NOZONE
0045          M=NOBUSZ(J)
0046          DO 10 I=1,M
0047          A(I,J)=CMPLX(0.0,0.0)
```

```
0048          L=NOGEN(J)
0049          DO 15 K=1,L
0050          IF(NODE(I,J).EQ.MGEN(K,J)) A(I,J)=A(I,J)+AG(K,J)
0052    15    CONTINUE
0053          L=NOLOD2(J)
0054          DO 16 K=1,L
0055          IF(NODE(I,J).EQ.LOD2(K,J)) A(I,J)=A(I,J)-ALOD2(K,J)
0057    16    CONTINUE
0058          L=NOLOD3(J)
0059          DO 17 K=1,L
0060          IF(NODE(I,J).EQ.LOD3(K,J)) A(I,J)=A(I,J)-ALOD3(K,J)
0062    17    CONTINUE
0063          IF(MON.EQ.0) GO TO 10
0065          WRITE(IWRITE,900)I,J,A(I,J)
0066    900   FORMAT(' ',20X,'A(',I2,',',I2,')=',2F10.4)
0067    10    CONTINUE
0068          KSW=TOF/DT
0069          KSW1=TT/DT
0070          IF(KSW1.GE.KSW) GO TO 20
      C     ... FIND FAULT CURRENT
0072          ET(ISWB,ISWZ)=CMPLX(0.0,0.0)
0073          SUM=CMPLX(0.0,0.0)
0074          DO 420 J=1,NOZONE
0075          M=NOBUSZ(J)
0076          DO 420 I=1,M
0077          IF(I.EQ.ISWB.AND.J.EQ.ISWZ) GO TO 420
0079          SUM=SUM+ZS(I,J)*A(I,J)
0080    420   CONTINUE
0081          A(ISWB,ISWZ)=(ET(ISWB,ISWZ)-SUM)/ZS(ISWB,ISWZ)
0082          IF(MON.EQ.0) GO TO 20
0084          WRITE(IWRITE,901)ISWB,ISWZ,A(ISWB,ISWZ)
0085    901   FORMAT(' ',20X,'FAULT BUS=',I2,2X,'FAULT ZONE=',I2,5X,
             X  'FAULT CURRENT=',2F10.4)
      C     ....SOLVE NETWORK BY DIAKOPTIC METHOD
      C
```

```
      C
0086  20    DO 426 J=1,NOZONE
0087        NBZ=NOBUSZ(J)
0088        M=NELOF(N,J)
0089        DO 425 K=1,M
0090        NNL=NNODE(K,N,J)
0091        ECUT(NNL,J)=CMPLX(0.0,0.0)
0092        DO 425 L=1,NBZ
0093        ECUT(NNL,J)=ECUT(NNL,J)+Z1(NNL,L,J)*A(L,J)
0094  425   CONTINUE
0095  426   CONTINUE
0096        DO 435 IC=1,NOCUT
0097        IP=CUTPB(IC)
0098        IQ=CUTQB(IC)
0099        JP=CUTPZ(IC)
0100        JQ=CUTQZ(IC)
0101        IF(JP.GT.JQ) GO TO 433
0103        EC(IC)=ECUT(IQ,JQ)-ECUT(IP,JP)
0104        GO TO 435
0105  433   EC(IC)=ECUT(IP,JP)-ECUT(IQ,JQ)
0106  435   CONTINUE
0107        DO 440 J=1,NOZONE
0108        K=NOBUSZ(J)
0109        DO 440 I=1,K
0110        ACUT(I,J)=CMPLX(0.0,0.0)
0111  440   CONTINUE
0112        DO 448 IC=1,NOCUT
0113        AC(IC)=CMPLX(0.0,0.0)
0114        DO 442 I=1,NOCUT
0115        AC(IC)=AC(IC)+Y4(IC,I)*EC(I)
0116  442   CONTINUE
0117        IP=CUTPB(IC)
0118        IQ=CUTQB(IC)
0119        JP=CUTPZ(IC)
0120        JQ=CUTQZ(IC)
0121        IF(JP.GT.JQ) GO TO 445
```

```
0123            ACUT(IP,JP)=ACUT(IP,JP)+AC(IC)
0124            ACUT(IQ,JQ)=ACUT(IQ,JQ)-AC(IC)
0125            GO TO 448
0126  445       ACUT(IP,JP)=ACUT(IP,JP)-AC(IC)
0127            ACUT(IQ,JQ)=ACUT(IQ,JQ)+AC(IC)
0128  448       CONTINUE
0129            IF(MON.EQ.0)GO TO 700
0131            WRITE(IWRITE,600)N
0132  600       FORMAT(' ',30X,'LOOP',I1)
0133  700       DO 560 J=1,NOZONE
0134            NBZ=NOBUSZ(J)
0135            M=NELOP(N,J)
0136            DO 560 K=1,M
0137            NNL=NNODE(N,K,J)
0138            ET0=CMPLX(0.0,0.0)
0139            ET1=CMPLX(0.0,0.0)
0140            DO 510 L=1,NBZ
0141            ET0=ET0+Z1(NNL,L,J)*A(L,J)
```

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```
0142            ET1=ET1+Z1(NNL,L,J)*ACUT(L,J)
0143  510       CONTINUE
0144            ET(NNL,J)=ET0+ET1
0145            IF(MON.EQ.0) GO TO 560
0147            WRITE(IWRITE,601) NNL,J,ET(NNL,J)
0148  601       FORMAT(' ',10X,'ET(',I2,',',I2,')=',2F10.4)
0149  560       CONTINUE
      C
      C
0150            IF(N.EQ.1) GO TO 25
0152            IF(N.EQ.2) GO TO 26
0154            IF(N.EQ.3) GO TO 27
0156            GO TO 80
      C     ...TEST LOOP1
0157  25        TESM=0.0
0158            IF(MON.EQ.0) GO TO 100
0160            WRITE(IWRITE,904)N
0161  904       FORMAT(' ',30X,'TEST FOR LOOP',I2)
0162  100       DO 31 J=1,NOZONE
```

```
0163          M=NOBUSZ(J)
0164          L=NOGEN(J)
0165          IF(L.EQ.0) GO TO 31
0167          DO 30 I=1,M
0168          DO 35 K=1,L
0169          IF(NODE(I,J).NE.MGEN(K,J)) GO TO 35
0171          IQG(K,J)=(EG(K,J)-ET(I,J))/ZG(K,J)
0172          ETR(K,J)=CABS(ET(I,J))
0173          SAVE=ABS(AIMAG(EG(K,J))*REAL(IQG(K,J))-REAL(EG(K,J))
             X  *AIMAG(IQG(K,J)))
0174          EGP(K,J)=CABS(EG(K,J))-(XG(K,J)-XDP(K,J))*SAVE/CABS(EG(K,J))
0175          TEST1=ABS(EGBP(K,J)-EGP(K,J))
0176          IF(TEST1.GT.TESM) TESM=TEST1
0178          IF(MON.EQ.0) GO TO 35
0180          WRITE(IWRITE,906)K,J,IQG(K,J),EGBP(K,J),EGP(K,J),TEST1,TESM
0181   906    FORMAT(' ',10X,'K=',I2,2X,'I=',I2,2X,'IQG=',2F10.4/10X,'EGBP=
              =  ',F10.4,2X,'EGP=',F10.4,/10X,'TEST1=',F10.4,2X,'TESM=',F10.4)
0182   35     CONTINUE
0183   30     CONTINUE
0184   31     CONTINUE
       C      ...TEST LOOP1
0185          IF(TESM.LT.NETA) GO TO 41
       C      ....MODIFY
0187          DO 40 J=1,NOZONE
0188          L=NOGEN(J)
0189          IF(L.EQ.0) GO TO 40
0191          DO 42 K=1,L
0192          EGMB(K,J)=CABS(EG(K,J))*EGBP(K,J)/EGP(K,J)
       C      ...FIND ANGLE OF EG(K,J)
0193          ER=EGMB(K,J)*COS(ANG(K,J))
0194          EI=EGMB(K,J)*SIN(ANG(K,J))
       C      ..ADJUST EG(K,J),AG(K,J)
0195          EG(K,J)=CMPLX(ER,EI)
0196          AG(K,J)=EG(K,J)/ZG(K,J)
0197          IF(MON.EQ.0) GO TO 42
```

```
0199          WRITE(IWRITE,908)K,J,EQMB(K,J),ANG(K,J),EQ(K,J),AG(K,J)
0200    908   FORMAT(' ',5X,'K=',I2,2X,'J=',I2,/5X,'EQMB=',F10.4,3X
             X  ,'ANG=',F10.4/5X,'ADJUST EQ=',2F10.4,3X,'AG=',2F10.4)
0201    42    CONTINUE
0202    40    CONTINUE
0203          NIT1=NIT1+1
0204          IF(NIT1.GT.100) GO TO 75
0206          GO TO 5
0207    41    N=1
        C     GO TO 5
        C     ...TEST LOOP2
0208    26    TESM=0.0
0209          IF(MON.EQ.0) GO TO 110
0211          WRITE(IWRITE,910)N
0212    910   FORMAT(' ',30X,'TEST LOOP',I2)
0213    110   DO 43 J=1,NOZONE
0214          M=NOBUSZ(J)
0215          L=NOLOD2(J)
0216          IF(L.EQ.0) GO TO 43
0218          DO 44 I=1,M
0219          DO 45 K=1,L
0220          IF(NODE(I,J).NE.LOD2(K,J)) GO TO 45
0222          IF(KSW1.LT.KSW.AND.LOD2(K,J).EQ.FBUS) GO TO 45
0224          IF(KSW1.LT.KSW) GO TO 76
        C     ...FIND ANGLE OF ET(I,J)
0226          CTAP(K,J)=ATAN2(AIMAG(ET(I,J)),REAL(ET(I,J)))
0227          AGI2(K,J)=ATAN2(AIMAG(ALOD2(K,J)),REAL(ALOD2(K,J)))
0228          CTA(K,J)=AGI2(K,J)+ALPA(K,J)
0229          TEST2=ABS(ABS(CTAP(K,J))-ABS(CTA(K,J)))
0230          IF(TEST2.GT.TESM) TESM=TEST2
```

```
0232          IF(MON.EQ.0) GO TO 45
0234          WRITE(IWRITE,912)K,J,CTAP(K,J),CTA(K,J),AGI2(K,J),TEST2,TESM
0235   912    FORMAT(' ',5X,'K=',I2,5X,'J=',I2/5X,'CTAP=',F10.4,3X,'CTA='
              X  ,F10.4,3X,'AGI2=',F10.4/5X,'TEST2=',F10.4,3X,'TESM=',F10.4)
0236          GO TO 45
0237   76     IKVP(K,J)=ET(I,J)*ZDD(K,J)
0238          TEST2=CABS(IKVP(K,J)-ALOD2(K,J))
0239          IF(TEST2.GT.TESM) TESM=TEST2
0241   45     CONTINUE
0242   44     CONTINUE
0243   43     CONTINUE
       C     ...TEST LOOP2
0244          IF(TESM.LT.EPLON) GO TO 50
       C     ..MODIFY
0246          DO 51 J=1,NOZONE
0247          L=NOLOD2(J)
0248          IF(L.EQ.0) GO TO 51
0250          DO 52 K=1,L
0251          IF(KSW1.LT.KSW.AND.LOD2(K,J).EQ.FBUS) GO TO 57
0253          IF(KSW1.LT.KSW) GO TO 77
0255          CTA(K,J)=CTAP(K,J)
0256          AGI2(K,J)=CTA(K,J)-ALPA(K,J)
0257          AR=ABL2(K,J)*COS(AGI2(K,J))
0258          AI=ABL2(K,J)*SIN(AGI2(K,J))
```



```
       C     ...ADJUST ALOD2(K,J)
0259          ALOD2(K,J)=CMPLX(AR,AI)
0260          IF(MON.EQ.0) GO TO 52
0262          WRITE(IWRITE,914)K,J,CTA(K,J),AGI2(K,J),ALOD2(K,J)
0263   914    FORMAT(' ',5X,'K=',I2,5X,'J=',I2/5X,'MODIFY CTA=',F10.4
              X  ,3X,'AGI2=',F10.4,3X,'ALOD2=',2F10.4)
0264          GO TO 52
```

```
0265  77     ALOD2(K,J)=IKVP(K,J)
0266  52     CONTINUE
0267  51     CONTINUE
0268         NIT2=NIT2+1
0269         IF(NIT2.GT.100) GO TO 75
0271         GO TO 5
0272  50     N=3
      C      GO TO 5
      C     ...TEST LOOP3
0273  27     TESM=0.0
0274         IF(MON.EQ.0) GO TO 120
0276         WRITE(IWRITE,918)N
0277  918    FORMAT(' ',30X,'TEST LOOP',I2)
0278  120    DO 60 J=1,NOZONE
0279         M=NOBUSZ(J)
0280         L=NOLOD3(J)
0281         IF(L.EQ.0) GO TO 60
0283         DO 62 I=1,M
0284         DO 61 K=1,L
0285         IF(NODE(I,J).NE.LOD3(K,J)) GO TO 61
0287         IF(KSW1.LT.KSW.AND.LOD3(K,J).EQ.FBUS) GO TO 61
0289         IF(KSW1.LT.KSW) GO TO 63
0291         IKVP(K,J)=CONJG(RODZ3(K,J))/CONJG(ET(I,J))/BASMVA
0292         GO TO 64
0293  63     IKVP(K,J)=ET(I,J)*ZLN(K,J)
0294  64     TEST3=CABS(IKVP(K,J)-ALOD3(K,J))
0295         IF(TEST3.GT.TESM) TESM=TEST3
0297         IF(MON.EQ.0) GO TO 65
0299         WRITE(IWRITE,918)K,J,IKVP(K,J),ALOD3(K,J),TEST3,TESM
0300  918    FORMAT(' ',5X,'K=',I2,5X,'J=',I2/5X,'IKVP=',2F10.4,3X
     X   ,'ALOD3=',2F10.4/5X,'TEST3=',F10.4,5X,'TESM=',F10.4)
0301  65     ALOD3(K,J)=IKVP(K,J)
```

```
0302   61     CONTINUE
0303   62     CONTINUE
0304   60     CONTINUE
       C     ...TEST LOOP3
0305          IF(TESM.LT.OMGA) GO TO 70
0307          NIT3=NIT3+1
0308          IF(NIT3.GT.100) GO TO 75
0310          GO TO 5
0311   70     IF(NIT2.EQ.0.AND.NIT3.EQ.0) GO TO 80
0313          GO TO 1
0314   75     WRITE(IWRITE,930) M,TT
0315   930    FORMAT(' ',10X,' CONVERGENCE NOT OBTAINED IN LOOP',I2,2X,'AT TIME
              X ',F5.3,1X,'SECOND')
0316          KRON=1
0317   80     RETURN
```

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```
0318          END
```

```
0001          SUBROUTINE STATE
      C
      C
0002          INTEGER IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
             X  ,       NOBUSZ(4),NOLINZ(4)
0003          INTEGER CUTP(10),CUTQ(10),CUTF(10),NODE(10,4)
0004          INTEGER CUTPB(10),CUTQB(10),CUTPZ(10),CUTQZ(10)
0005          REAL    BASMVA
0006          REAL    VOLTZ(10,4)
0007          COMPLEX CUTZ(10)
0008          COMPLEX GENZ(10,4)
0009          COMPLEX Z1(10,10,4),ZZ(10,10,4),Z4(10,10),Y4(10,10),ZS(10,4)
0010          COMPLEX ZG(5,3),ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0011          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4)
0012          COMPLEX ET(10,4),ECUT(10,4),SUM,ETO,ET1
      C
0013          INTEGER NGEN,NLBUS,LBUS(20),NOMT,IMGN(20),BGEN(20),NOBZ(4)
0014          INTEGER IMET(10),FBUS,NN(10),GNO(5,4)
0015          INTEGER NOGEN(4),NOLOD1(4),NOLOD2(4),NOLOD3(4),NOMET(4),MON
0016          INTEGER MGEN(5,4),LOD1(5,4),LOD2(5,4),LOD3(5,4),MET(5,4)
0017          REAL XDI(20),XQI(20),XDPI(20),TOI(20)
0018          REAL XD(5,4),XQ(5,4),XDP(5,4),TO(5,4)
0019          REAL TT,TCF,TSTOP,NETA,EPLON,OMGA
0020          REAL EQP(5,4),EQBP(5,4),EQMB(5,4),ANG(5,4),CTAP(5,4)
0021          REAL AGI2(5,4),ALPA(5,4),CTA(5,4),ABL2(5,4)
0022          COMPLEX IQQ(5,4),EQ(5,4),AG(5,4),ALOD2(5,4)
0023          COMPLEX ALOD3(5,4),IKVP(5,4)
0024          COMPLEX ROD1(10),ROD2(10),ROD3(10),RODZ2(5,4),RODZ3(5,4)
0025          INTEGER N,NELOP(4,4),NNODE(10,4,4)
0026            REAL HI(20),H(5,4),MUI(20),MU(5,4),TEI(20),TE(5,4),F,RI(20)
0027            REAL R(5,4),TCI(20),TC(5,4),TSI(20),TS(5,4),PMAXI(20)
0028          REAL PMAX(5,4),EII(5,4),EFDP(5,4),EFDO(5,4),ETR(5,4)
0029          REAL ETDO(5,4),DT,W(5,4),WO,PE(5,4),PMO(5,4),PMPP(5,4)
0030          REAL PM(5,4),PMP(5,4),DEQP(5,4),DEFD(5,4),DPMP(5,4)
0031          REAL DPM(5,4),DW(5,4),DDEL(5,4),SDEQ(5,4),SDEF(5,4)
```

```
0032          REAL SDPMP(5,4),SDPM(5,4),SDW(5,4),SDDEL(5,4),EFD(5,4)
0033          REAL EFMAX(5,4),EFMAXI(20),EFMIN(5,4),EFMINI(20),ETMIN
0034          REAL EQP1(5,4),EFD1(5,4),PMP1(5,4),PM1(5,4),W1(5,4),AANG1(5,4)
0035          REAL WW(5,60),DELTA(5,60),TCFF,DTT,SC
0036          REAL INANG(5,1)
0037          INTEGER JJ,ISET,MBUSZ(3),ITSTOP,NZON
0038          INTEGER NOPLOT,NMAC(5),KPOT(5),JPOT(5)
      C
0039             COMMON/BUFF/XD,XQ,XDP,TD
             X  ,           ABL2
             X  ,           IQQ,EQ,EQP,AG,ALOD2,ALOD3,EQBP,EQMB,ANG,CTAP
             X  ,           AGI2,ALPA,CTA,IKVP
             X  ,           H,MU,TE,P,TC,TS,PMAX
             X  ,           EII,EFDP,EFDQ,ETR,ETQQ,W,PE,PMQ,PMPP,PM,PMP
             X  ,           DEQP,DEFD,DPMP,DPM,DW,DDEL,SDEQ,SDEF,SDPMP,SDPM
             X  ,           SDW,SDDEL,EFD,EFMAX,EFMIN
             X  ,           VOLTZ,GENZ,NODE,Z1,Z2,Z4,Y4,ZS,D,VECTOR
             X  ,           EC,AC,A,ACUT,ET,ECUT,SUM,ET0,ET1,ZG
0040          COMMON/STA/JJ,ISET,WW,DELTA,MBUSZ,ITSTOP,TCFF,NZON,DTT,SC,ETM

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             X  ,           NOPLOT,NMAC,KPOT,JPOT,ESC
0041          COMMON/INT/INANG,MON1
0042          COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWZ
             X  ,           NOBUSZ,NOLINZ,CUTP,CUTQ,CUTE,CUTPB,CUTQB
             X  ,           CUTPZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
0043          COMMON/TUB/ NGEN,NLBUS,LBUS,NOMT,IMGN,BGEN,NOBZ
             X  ,           IMET,FBUS,NN,GNO,NOGEN,NOLOD1,NOLOD2
             X  ,           NOLOD3,NOMET,MON,MGEN,LOD1,LOD2,LOD3,MET
             X  ,           XDI,XQI,XDPI,TDI
             X  ,           TT,TCF,TSTOP,NETA,EPLON,OMGA,DT,WO
             X  ,           HI,MUI,TEI,F,RI,TCI,TSI,PMAXI,EFMAXI,EFMINI,ETMIN
             X  ,           ROD1,ROD2,ROD3,RODZ2,RODZ3
```

```
      C
0044          IISET=ISET+1
0045          DO 1 J=1,NOZONE
0046          M=NOGEN(J)
0047          IF(M.EQ.0) GO TO 1
0049          DO 111 K=1,M
0050          IF(XQ(K,J).EQ.XDP(K,J)) GO TO 25
0052    30    EII(K,J)=(XD(K,J)-XDP(K,J))*CABS(EQ(K,J))/(XQ(K,J)-XDP(K,J))+
             X                (XQ(K,J)-XD(K,J))*EQP(K,J)/(XQ(K,J)-XDP(K,J))
0053          EFDP(K,J)=EFDO(K,J)-MU(K,J)*(ETR(K,J)-ETOO(K,J))
0054          IF(EFDP(K,J).GE.EFMAX(K,J)) EFDP(K,J)=EFMAX(K,J)
0056          IF(EFDP(K,J).LE.EFMIN(K,J)) EFDP(K,J)=EFMIN(K,J)
0058    25    IF(R(K,J).EQ.0.0) GO TO 26
0060          PMPP(K,J)=PMO(K,J)-(WO-W(K,J))/2.0/3.14159/F/R(K,J)
0061          IF(PMPP(K,J).GE.PMAX(K,J)) PMPP(K,J)=PMAX(K,J)
0063          IF(PMPP(K,J).LE.0.0)       PMPP(K,J)=0.0
      C         ...CLEAR
0065    26    DEQP(K,J)=0.0
0066          DEFD(K,J)=0.0
0067          DPMP(K,J)=0.0
0068          DPM(K,J)=0.0
0069          DW(K,J)=0.0
0070          DDEL(K,J)=0.0
      C     ...CALCULATE STATE EQUATION
0071          IF(XQ(K,J).EQ.XDP(K,J)) GO TO 27
0073          DEQP(K,J)=(EFD(K,J)-EII(K,J))/TO(K,J)
0074          DEFD(K,J)=(EFDP(K,J)-EFD(K,J))/TE(K,J)
0075    27    IF(R(K,J).EQ.0.0) GO TO 28
0077          DPMP(K,J)=(PMPP(K,J)-PMP(K,J))/TC(K,J)
0078          DPM(K,J)=(PMP(K,J)-PM(K,J))/TS(K,J)
0079    28    DW(K,J)=3.14159*F*(PM(K,J)-PE(K,J))/H(K,J)
0080          DDEL(K,J)=W(K,J)-WO
0081          IF(MON1.EQ.0) GO TO 111
```

```
0083          WRITE(IWRITE,16) JJ
0084    16    FORMAT(' ',10X,'JJ=',I2)
0085          WRITE(IWRITE,10)K,J,DEQP(K,J),EFD(K,J),EII(K,J),TO(K,J)
0086    10    FORMAT(' ',5X,'FOR K=',I2,2X,'AND J=',I2/5X,'DEQP=',F10.4,2X,
             X  'EFD=',F7.4,2X,'EII=',F7.4,2X,'TO=',F7.4)
0087          WRITE(IWRITE,11)DEFD(K,J),EFDP(K,J),EFD(K,J),TE(K,J)
0088    11    FORMAT(' ',5X,'DEFD=',F7.4,2X,'EFDP=',F7.4,2X,'EFD=',F7.4,2X,
             X  'TE=',F7.4)
0089          WRITE(IWRITE,12)DPMP(K,J),PMPP(K,J),PMP(K,J),TC(K,J)

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0090    12    FORMAT(' ',5X,'DPMP=',F7.4,2X,'PMPP=',F7.4,2X,'PMP=',F7.4,2X,
             X  'TC=',F7.4)
0091          WRITE(IWRITE,13)DPM(K,J),PMP(K,J),PM(K,J),TS(K,J)
0092    13    FORMAT(' ',5X,'DPM=',F7.4,2X,'PMP=',F7.4,2X,'PM=',F7.4,2X,
             X  'TS=',F7.4)
0093          WRITE(IWRITE,14)DW(K,J),PM(K,J),PE(K,J),H(K,J)
0094    14    FORMAT(' ',5X,'DW=',F7.4,2X,'PM=',F7.4,2X,'PE=',F7.4,2X,
             X  'H=',F7.4)
0095          WRITE(IWRITE,15)DDEL(K,J),W(K,J),WO
0096    15    FORMAT(' ',5X,'DDEL=',F7.4,2X,'W=',F7.1,2X,'WO=',F7.1)
0097    111   CONTINUE
0098    1     CONTINUE
0099          IF(JJ.EQ.1) GO TO 2
        C     ...SAVE STATE
0101          DO 3 J=1,NOZONE
0102          M=NOGEN(J)
0103          IF(M.EQ.0) GO TO 3
0105          DO 333 K=1,M
0106          SDEQ(K,J)=DEQP(K,J)
```

```
0107          SDEF(K,J)=DEFD(K,J)
0108          SDPMP(K,J)=DPMP(K,J)
0109          SDPM(K,J)=DPM(K,J)
0110          SDW(K,J)=DW(K,J)
0111          SDDEL(K,J)=DDEL(K,J)
0112          EQP1(K,J)=EQP(K,J)
0113          EFD1(K,J)=EFD(K,J)
0114          PMP1(K,J)=PMP(K,J)
0115          PM1(K,J)=PM(K,J)
0116          W1(K,J)=W(K,J)
0117          AANG1(K,J)=ANG(K,J)
0118  333     CONTINUE
0119  3       CONTINUE
0120          GO TO 5
      C     ...FIND X DOT AT TIME T=T+DT
0121  2       DO 4 J=1,NOZONE
0122          M=NOGEN(J)
0123          IF(M.EQ.0) GO TO 4
0125          DO 444 K=1,M
0126          DEQP(K,J)=(DEQP(K,J)+SDEQ(K,J))/2.0
0127          DEFD(K,J)=(DEFD(K,J)+SDEF(K,J))/2.0
0128          DPMP(K,J)=(DPMP(K,J)+SDPMP(K,J))/2.0
0129          DPM(K,J)=(DPM(K,J)+SDPM(K,J))/2.0
0130          DW(K,J)=(DW(K,J)+SDW(K,J))/2.0
0131          DDEL(K,J)=(DDEL(K,J)+SDDEL(K,J))/2.0
0132          EQP(K,J)=EQP1(K,J)
0133          EFD(K,J)=EFD1(K,J)
0134          PMP(K,J)=PMP1(K,J)
0135          PM(K,J)=PM1(K,J)
0136          W(K,J)=W1(K,J)
0137          ANG(K,J)=AANG1(K,J)
0138  444     CONTINUE
0139  4       CONTINUE
      C     ..FIND X AT T+DT
0140  5       DO 6J=1,NOZONE
```

```
0141          M=NOGEN(J)
0142          IF(M.EQ.0) GO TO 6
0144          DO 666 K=1,M
0145          EQP(K,J)=EQP(K,J)+DEQP(K,J)*DT
0146          EFD(K,J)=EFD(K,J)+DEFD(K,J)*DT
0147          PMP(K,J)=PMP(K,J)+DPMP(K,J)*DT
0148          PM(K,J)=PM(K,J)+DPM(K,J)*DT
0149          W(K,J)=W(K,J)+DW(K,J)*DT
0150          ANG(K,J)=ANG(K,J)+DDE_ (K,J)*DT
0151    666   CONTINUE
0152    6     CONTINUE
0153          DO 7 J=1,NOZONE
0154          M=NOGEN(J)
0155          IF(M.EQ.0) GO TO 7
0157          DO 777 K=1,M
0158          ER=CABS(EQ(K,J))*COS(ANG(K,J))
0159          EI=CABS(EQ(K,J))*SIN(ANG(K,J))
0160          EQ(K,J)=CMPLX(ER,EI)
0161          AG(K,J)=EQ(K,J)/ZG(K,J)
0162          EQBP(K,J)=EQP(K,J)
0163    777   CONTINUE
0164    7     CONTINUE
0165          IF(JJ.NE.1) RETURN
0167          SC=SC+1.0
0168          IF(SC.NE.ETMIN) RETURN
0170          DO 888 L=1,NOPLOT
0171          K=KPOT(L)
0172          J=JPOT(L)
0173          WW(L,IISET)=W(K,J)/2.0/3.14159/F
0174          DELTA(L,IISET)=ANG(K,J)*57.29578
0175    888   CONTINUE
0176    8     CONTINUE
0177          ISET=ISET+1
0178          SC=0.0
0179          RETURN
0180          END
```

```
0001          SUBROUTINE MODIFY
      C/
      C
0002          INTEGER IREAD,IWRITE,NOZONE,NOCUT,ISWE,ISWI
             X  ,       NOBUSZ(4),NOLINZ(4)
0003          INTEGER CUTP(10),CUTQ(10),CUTF(10),NODE(10,4)
0004          INTEGER CUTPB(10),CUTQB(10),CUTPZ(10),CUTQZ(10)
0005          REAL    BASMVA
0006          REAL    VOLTZ(10,4)
0007          COMPLEX CUTZ(10)
0008          COMPLEX GENZ(10,4)
0009          COMPLEX Z1(10,10,4),ZZ(10,10,4),Z4(10,10),Y4(10,10),ZB(10,4)
0010          COMPLEX ZG(5,3),ZDD(10,4),D(10),VECTOR(10),ZLN(10,4)
0011          COMPLEX EC(10),AC(10),A(10,4),ACUT(10,4)
0012          COMPLEX ET(10,4),ECUT(10,4),SUM,ET0,ET1,DD
      C
0013          INTEGER ITS,NST,LIOP(3,3),LICL(3,3),NLSW(3),BUSP(6,3),BUSQ(6,3)
0014          REAL TITS(3)
0015          COMPLEX IMP(6,3)
      C
0016          REAL XD(5,4),XQ(5,4),XDP(5,4),TO(5,4)
0017          REAL  EQP(5,4),EQBP(5,4),EQMB(5,4),ANG(5,4),CTAP(5,4)
0018            REAL  AGI2(5,4),ALPA(5,4),CTA(5,4),ABL2(5,4)
0019            COMPLEX IQQ(5,4),EQ(5,4),AG(5,4),ALOD2(5,4)
0020          COMPLEX ALOD3(5,4),IKVP(5,4)
0021          REAL H(5,4),MU(5,4),TE(5,4),R(5,4),TC(5,4),TS(5,4)
0022          REAL PMAX(5,4),EII(5,4),EFDP(5,4),EFDO(5,4),ETR(5,4)
0023          REAL ETOO(5,4),W(5,4),PE(5,4),PMO(5,4),PMPP(5,4)
0024          REAL PM(5,4),PMP(5,4),DEQP(5,4),DEFD(5,4),DPMP(5,4)
0025          REAL DPM(5,4),DW(5,4),DDEL(5,4),SDEQ(5,4),SDEF(5,4)
0026          REAL SDPMP(5,4),SDPM(5,4),SDW(5,4),SDDEL(5,4),EFD(5,4)
0027          REAL EFMAX(5,4),EFMIN(5,4)
      C
```

```
0028          COMMON/BUFF/XD,XQ,XDP,TO
             X  ,           ABLZ
             X  ,           IQQ,EQ,EQP,AG,ALOD2,ALOD3,EQBP,EQMB,ANG,CTAP
             X  ,           AGIZ,ALPA,CTA,IKVP
             X  ,           H,MU,TE,R,TC,TS,PMAX
             X  ,           EII,EFDP,EFDO,ETR,ETOO,W,PE,PMO,PMPF,PM,PMP
             X  ,           DEQP,DEFD,DPMP,DPM,DW,DDEL,SDEQ,SDEF,SDPMP,SDPM
             X  ,           SDW,SDDEL,EFD,EFMAX,EFMIN
             X  ,           VOLTZ,GENZ,NODE,Z1,Z2,Z4,Y4,ZS,D,VECTOR
             X  ,           EC,AC,A,ACUT,ET,ECUT,SUM,ET0,ET1,ZG
      C
0029          COMMON/MOD/ITS,NST,LIOP,LIOL,NLSW,BUSP,BUSQ,TITS,IMP
0030          COMMON/COM/ IREAD,IWRITE,NOZONE,NOCUT,ISWB,ISWI
             X  ,           NOBUSZ,NOLINZ,CUTP,CUTQ,CUTF,CUTPB,CUTQB
             X  ,           CUTPZ,CUTQZ,BASMVA,CUTZ,ZDD,ZLN
0031          COMMON/MOD1/TT,VRON
      C
0032          DATA BB/3HBUS/
0033          KG=NLSW(ITS)
0034          IF(KG.EQ.0) GO TO 200
0036          DO 20 K=1,6
```



```
0037          IFFP=BUSP(K,ITS)
0038          IFFQ=BUSQ(K,ITS)
0039          IF(IFFP.EQ.0) GO TO 20
0041          DO 21 JZ=1,NOZONE
0042          KK=NOBUSZ(JZ)
0043          DO 22 I=1,KK
0044          IF(IFFP.NE.NODE(I,JZ)) GO TO 22
0046          IFP=I
0047          J=JZ
0048          GO TO 19
0049    22    CONTINUE
0050    21    CONTINUE
0051    19    DO 23 JZ=1,NOZONE
```

```
0052          KK=NOBUSZ(JZ)
0053          DO 24 I=1,KK
0054          IF(IFFQ.NE.NODE(I,JZ)) GO TO 24
0056          IFQ=I
0057          J1=JZ
0058          GO TO 25
0059    24    CONTINUE
0060    23    CONTINUE
0061    25    L=KK+1
0062          DO 213 I=1,KK
0063          Z1(I,L,J)=Z1(I,IFF,J)-Z1(I,IFQ,J)
0064          Z1(L,I,J)=Z1(I,L,J)
0065    213   CONTINUE
0066          Z1(L,L,J)=Z1(IFF,L,J)-Z1(IFQ,L,J)+IMP(K,ITS)
0067    214   CONTINUE
0068          DO 215 I=1,KK
0069          DO 215 M=1,KK
0070          Z1(I,M,J)=Z1(I,M,J)-Z1(I,L,J)/Z1(L,L,J)*Z1(L,M,J)
0071    215   CONTINUE
0072          DO 216 I=1,L
0073          Z1(I,L,J)=CMPLX(0.0,0.0)
0074          Z1(L,I,J)=CMPLX(0.0,0.0)
0075    216   CONTINUE
0076    20    CONTINUE
              C     ... FIND Z2
0077    200   DO 400 J=1,NOZONE
0078          DO 400 K=1,10
0079          DO 400 I=1,10
0080          Z2(I,K,J)=CMPLX(0.0,0.0)
0081    400   CONTINUE
0082          DO 267 J=1,NOZONE
0083          K=NOBUSZ(J)
0084          DO 266 IC=1,NOCUT
0085          DO 260 I=1,K
```

```
0086          IF(CUTP(IC).EQ.NODE(I,J)) GO TO 261
0088          IF(CUTQ(IC).EQ.NODE(I,J)) GO TO 261
0090    260   CONTINUE
0091          GO TO 266
0092    261   IF(CUTF(IC).EQ.9999) GO TO 264
0094          DO 262 L=1,K
0095          Z2(L,IC,J)=Z1(L,I,J)
```



```
0096    262   CONTINUE
0097          CUTF(IC)=9999
0098          GO TO 266
0099    264   CONTINUE
0100          DO 265 L=1,K
0101          Z2(L,IC,J)=-Z1(L,I,J)
0102    265   CONTINUE
0103    266   CONTINUE
0104    267   CONTINUE
0105          IF(IREAD.EQ.0) GO TO 2992
0107          DO 291 J=1,NOZONE
0108          K=NOBUSZ(J)
0109          WRITE(IWRITE,2911) J,TT
0110          WRITE(IWRITE,2912)((BB,NODE(I,J)),I=1,K)
0111          DO 291 I=1,K
0112          WRITE(IWRITE,2923)NODE(I,J),(Z1(I,L,J),L=1,K)
0113    291   CONTINUE
0114    2911  FORMAT(' ',///15X,'MODIFIED Z1 FOR ZONE',I2,1X,'AT TIME ',F5.3,'
              XSECOND'/15X,44('='))
0115    2912  FORMAT('0',14X,4(4X,A4,I3,11X),10(/15X,4(4X,A4,I3,11X)))
0116          DO 292 J=1,NOZONE
0117          K=NOBUSZ(J)
0118          WRITE(IWRITE,2921) J,TT
0119          WRITE(IWRITE,2922)((CUTP(I),CUTQ(I)),I=1,NOCUT)
```

```
0120          DO 292 L=1,K
0121          WRITE(IWRITE,2923) NODE(L,J),(Z2(L,IC,J),IC=1,NOCUT)
0122    292   CONTINUE
0123    2921  FORMAT(' ',//15X,'MODIFIED Z2 MATRIX FOR ZONE',I2,1X,'AT TIME  ',
              X F5.3,' SECOND'/15X,51('='))
0124    2922  FORMAT('0',2X,'CUT BUS LINE',4(5X,I2,'-',I2,12X),10(/ 15X,4(5X,
              X  I2,'-',I2,12X)))
0125    2923  FORMAT('0',4X,'BUS',I3,4(1X,2F10.6,'J'),10(/ 11X,4(1X,2F10.6,'J'
              X  )))
0126    2992  CONTINUE
C             ...FIND NEW Z4 AND Y4
0127          DO 300 I=1,NOCUT
0128          DO 300 J=1,NOCUT
0129          Z4(I,J)=CMPLX(0.0,0.0)
0130          Y4(I,J)=CMPLX(0.0,0.0)
0131    300   CONTINUE
0132          DO 320 J=1,NOZONE
0133          K=NOBUSZ(J)
0134          DO 318 IC=1,NOCUT
0135          DO 310 I=1,K
0136          IF(CUTP(IC).EQ.NODE(I,J)) GO TO 311
0138          IF(CUTQ(IC).EQ.NODE(I,J)) GO TO 311
0140    310   CONTINUE
0141          GO TO 318
0142    311   CONTINUE
0143          IF(CUTF(IC).EQ.8888) GO TO 316
0145          DO 315 L=1,NOCUT
0146          Z4(IC,L)=Z4(IC,L)+Z2(I,L,J)
0147    315   CONTINUE
0148          CUTF(IC)=8888
```

```
0149          GO TO 318
0150    316   CONTINUE
0151          DO 317 L=1,NOCUT
0152          Z4(IC,L)=Z4(IC,L)-Z2(I,L,J)
0153    317   CONTINUE
0154    318   CONTINUE
0155    320   CONTINUE
0156          DO 325 I=1,NOCUT
0157          Z4(I,I)=Z4(I,I)+CUTZ(I)
0158    325   CONTINUE
0159          Y4(1,1)=1.0/Z4(1,1)
0160          DO 344 N=2,NOCUT
0161          K=N-1
0162          DO 341 I=1,K
0163          D(I)=CMPLX(0.0,0.0)
0164          DO 341 J=1,K
0165          D(I)=D(I)+Y4(I,J)*Z4(J,N)
0166    341   CONTINUE
0167          DD=CMPLX(0.0,0.0)
0168          DO 342 I=1,K
0169          DD=DD+Z4(N,I)*D(I)
0170    342   CONTINUE
0171          Y4(N,N)=1.0/(Z4(N,N)-DD)
0172          DO 343 I=1,K
0173          Y4(I,N)=-D(I)*Y4(N,N)
0174          Y4(N,I)=Y4(I,N)
0175    343   CONTINUE
0176          DO 344 I=1,K
0177          DO 344 J=1,K
0178          Y4(I,J)=Y4(I,J)-D(I)*Y4(N,J)
0179    344   CONTINUE
```

```
0180          DO 352 IC=1,NOCUT
0181          VECTOR(IC)=CMPLX(0.0,0.0)
0182          DO 352 L=1,NOCUT
0183          VECTOR(IC)=VECTOR(IC)+Y4(IC,L)*Z2(ISWB,L,ISWZ)
0184    352   CONTINUE
0185          DO 353 J=1,NOZONE
0186          K=NOBUSZ(J)
0187          DO 353 I=1,K
0188          ZS(I,J)=CMPLX(0.0,0.0)
0189          DO 353 L=1,NOCUT
0190          ZS(I,J)=ZS(I,J)+Z2(I,L,J)*VECTOR(L)
0191    353   CONTINUE
0192          DO 360 J=1,NOZONE
0193          K=NOBUSZ(J)
0194          IF(J.EQ.ISWZ) GO TO 356
0196          DO 355 I=1,K
0197          ZS(I,J)=-ZS(I,J)
0198    355   CONTINUE
0199          GO TO 360
0200    356   CONTINUE
0201          DO 357 I=1,K
0202          ZS(I,J)=Z1(ISWB,I,J)-ZS(I,J)
0203    357   CONTINUE
```

```
0204  360   CONTINUE
0205        IF(IREAD.EQ.0) GO TO 3992
0207        WRITE(IWRITE,3911) TT
0208        WRITE(IWRITE,3912)(CUTP(I),CUTQ(I),I=1,NOCUT)
0209        DO 391 I=1,NOCUT
0210        WRITE(IWRITE,3913)CUTP(I),CUTQ(I),(Y4(I,J),J=1,NOCUT)
0211  391   CONTINUE
0212  3911  FORMAT(' ',//15X,'NEW Y4 MATRIX AT TIME ',F5.3,' SECOND'/15X,
           X34('='))
0213  3912  FORMAT('0',2X,'CUT BUS LINE',4(5X,I2,'-',I2,12X),10(/15X,4(5X,
           X    I2,'-',I2,12X)))
0214  3913  FORMAT('0',5X,I2,'-',I2,4(1X,2F10.6,'J'),10(/11X,4(1X,2F10.6,
           X  'J')))
0215        WRITE(IWRITE,3921)TT
0216        WRITE(IWRITE,3912)((CUTP(I),CUTQ(I)),I=1,NOCUT)
0217        DO 392 I=1,NOCUT
0218        WRITE(IWRITE,3913) CUTP(I),CUTQ(I),(Y4(I,J),J=1,NOCUT)
0219  392   CONTINUE
0220  3921  FORMAT(' ',//15X,'NEW Y4 MATRIX AT TIME ',F5.3,' SECOND'/15X,
           X34('='))
0221  3992  CONTINUE
0222  1000  RETURN
0223        END
```

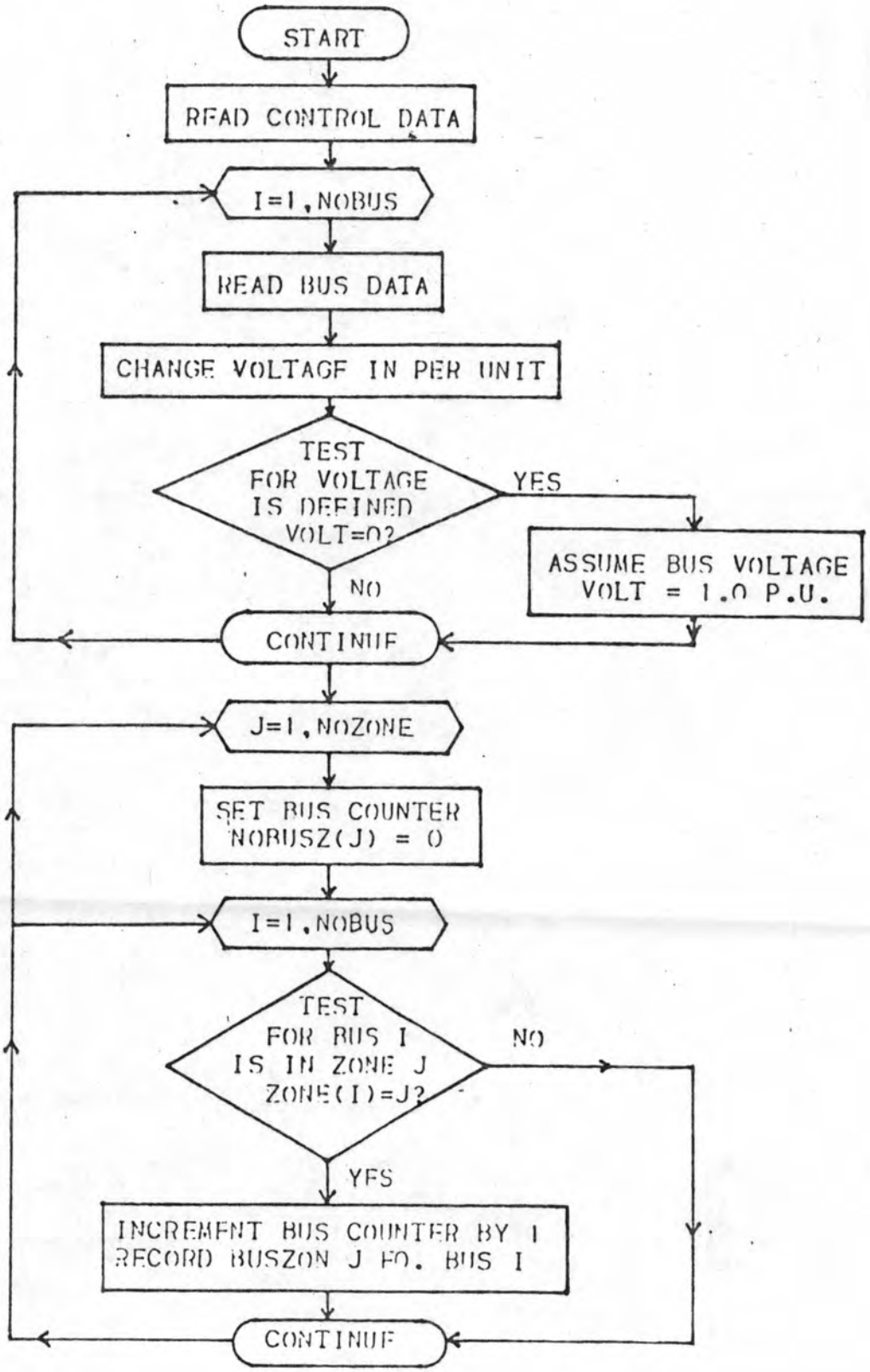
```
0001          SUBROUTINE PLOT
0002          DIMENSION MAP(54,130),LPLOT(11),MP(5),RPLOT(11)
0003          REAL W(5,60),DELL(5,60),TCF,DT
0004          INTEGER JJ,ISET,MBUSZ(3),NOZONE
0005          INTEGER NOPLOT,NMAC(5),KPOT(5),JPOT(5)
0006          COMMON/COM/IREAD,IWRITE
0007          COMMON/BUFF/MAP,LPLOT,MP,RPLOT
0008          COMMON/STA/JJ,ISET,W,DELL,MBUSZ,ITSTOP,TCF,NOZONE,DT,SC,ETMIN
             X  ,              NOPLOT,NMAC,KPOT,JPOT,ESC
0009          DATA M1/1H1/,M2/1H2/,M3/1H3/,M4/1H4/,M5/1H5/
0010          DATA NHL/11/,NBH/4/,NVL/11/,NBV/9/
0011          DATA IBANK/1H /,IHOR/1H-/,IVER/1H:/,ICROSS/1H+/
0012          MP(1)=M1
0013          MP(2)=M2
0014          MP(3)=M3
0015          MP(4)=M4
0016          MP(5)=M5
      C      ...PLOT
0017          DO 91 I=1,11
0018          RRLL=(2.0*FLOAT(I))/100.0
0019    91    RPLOT(I)=0.92+RRLL
0020          DO 93 I=1,11
0021    93    LPLOT(I)=(20*I-60)*ESC
0022          WRITE(IWRITE,216)TCF
0023          WRITE(IWRITE,217)(LPLOT(I),I=1,11)
0024   216      FORMAT('1',10X,'INTERNAL VOLTAGE ANGLE OF MACHINE WITH
             X  RESPECT TO TIME FOR A FAULT DURATION OF',F5.2,'SEC',)
0025   217    FORMAT(' ',10X,109('-'),/12X,'TIME',50X,'DEGREE',/
             X  12X,'SEC',1X,11(I4,6X))
0026          IDELL=0
0027   100    CONTINUE
```

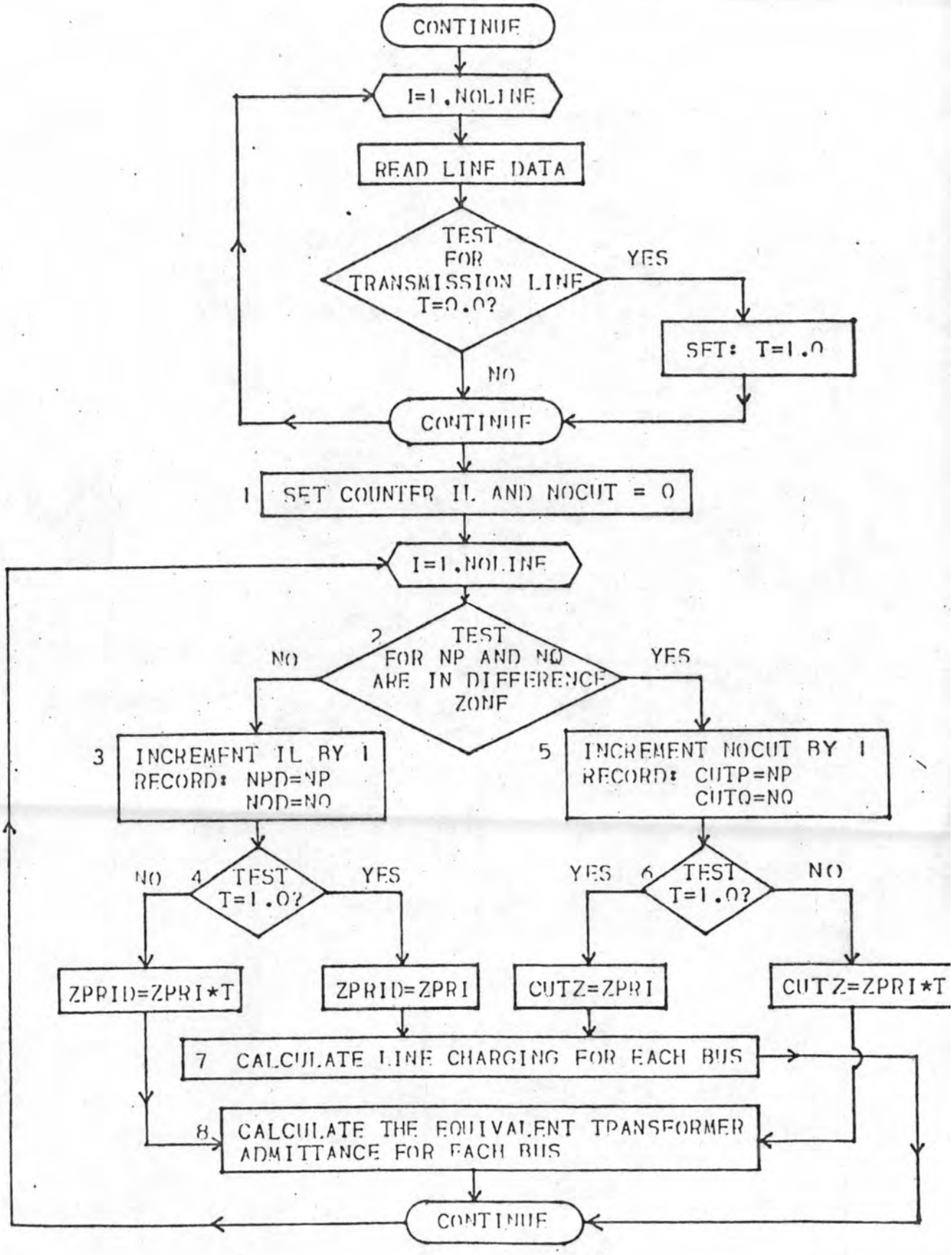
```
      C     ...GRID
0028          NNV=NHL*NBH+10
0029          DO 1 I=1,NNV
0030          DO 1 J=1,130
0031    1     MAP(I,J)=IBANK
0032          NA=NHL-1
0033          NNA=NA*NBH+NHL
0034          NAA=NBH+1
0035          NB=NVL-1
0036          NNB=NB*NBV+NVL
0037          NBB=NBV+1
0038          DO 2 I=1,NNA,NAA
0039          DO 2 J=1,NNB
0040    2     MAP(I,J)=IHOR
0041          DO 3 J=1,NNB,NBB
0042          DO 3 I=1,NNA
0043    3     MAP(I,J)=IVER
0044          DO 4I=1,NNA,NAA
0045          DO 4 J=1,NNB,NBB
0046    4     MAP(I,J)=ICROSS
0047          DO 95 I=1,ITSTOP
0048          DO 95 L=1,NOPLOT
0049          IF(IDELL.EQ.0) INDEX=DELL(L,I)/ESC/2.0+21.49999
```

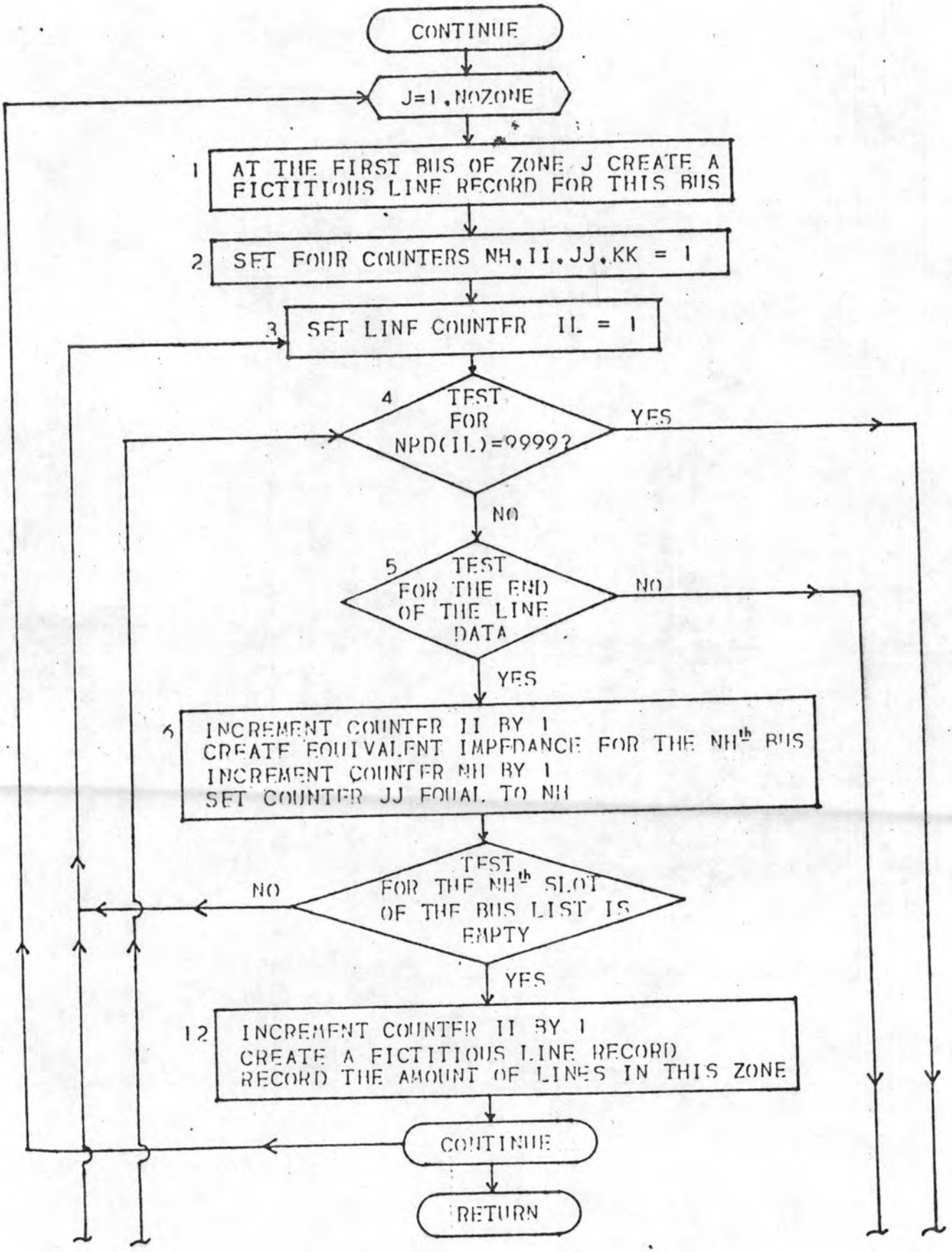
```
0051          IF(IDELL.EQ.1) INDEX=(W(L,I)*100.0-100.0)*5.0+31.499999
0053          IF(INDEX.LE.1.OR.INDEX.GE.100) GO TO 95
0055          MAP(I,INDEX)=MP(L)
0056    95    CONTINUE
0057          DTS=DT*ETMIN
0058          T=0.0
0059          ITT=4
0060          DO 96 I=1,ITSTOP
0061          ITT=ITT+1
0062          IF(ITT.EQ.5) GO TO 97
0064          WRITE(IWRITE,218)(MAP(I,J),J=1,101)
0065          GO TO 98
0066    97    WRITE(IWRITE,219) T,(MAP(I,J),J=1,101)
0067          ITT=0
0068    98    T=T+DTS
0069    96    CONTINUE
0070   218    FORMAT(' ',18X,101A1)
0071   219    FORMAT(' ',10X,F6.3,2X,101A1)
0072          IDELL=IDELL+1
0073          IF(IDELL.GT.1) GO TO 11
0075          WRITE(IWRITE,221)TCF
0076          WRITE(IWRITE,222)(RPLOT(I),I=1,11)
0077          GO TO 100
0078   221    FORMAT('1',10X,'RATIO OF ACTUAL TO RATED SPEED OF MACHINE WITH
              X  RESPECT TO TIME FOR A FAULT DURATION OF',F5.2,'SEC')
0079   222    FORMAT(' ',10X,109('-'),//12X,'TIME',40X,'RATIO OF ACTUAL TO
              X  RATED SPEED',/12X,'SEC',1X,11(F5.2,5X))
0080    11    RETURN
0081          END
```

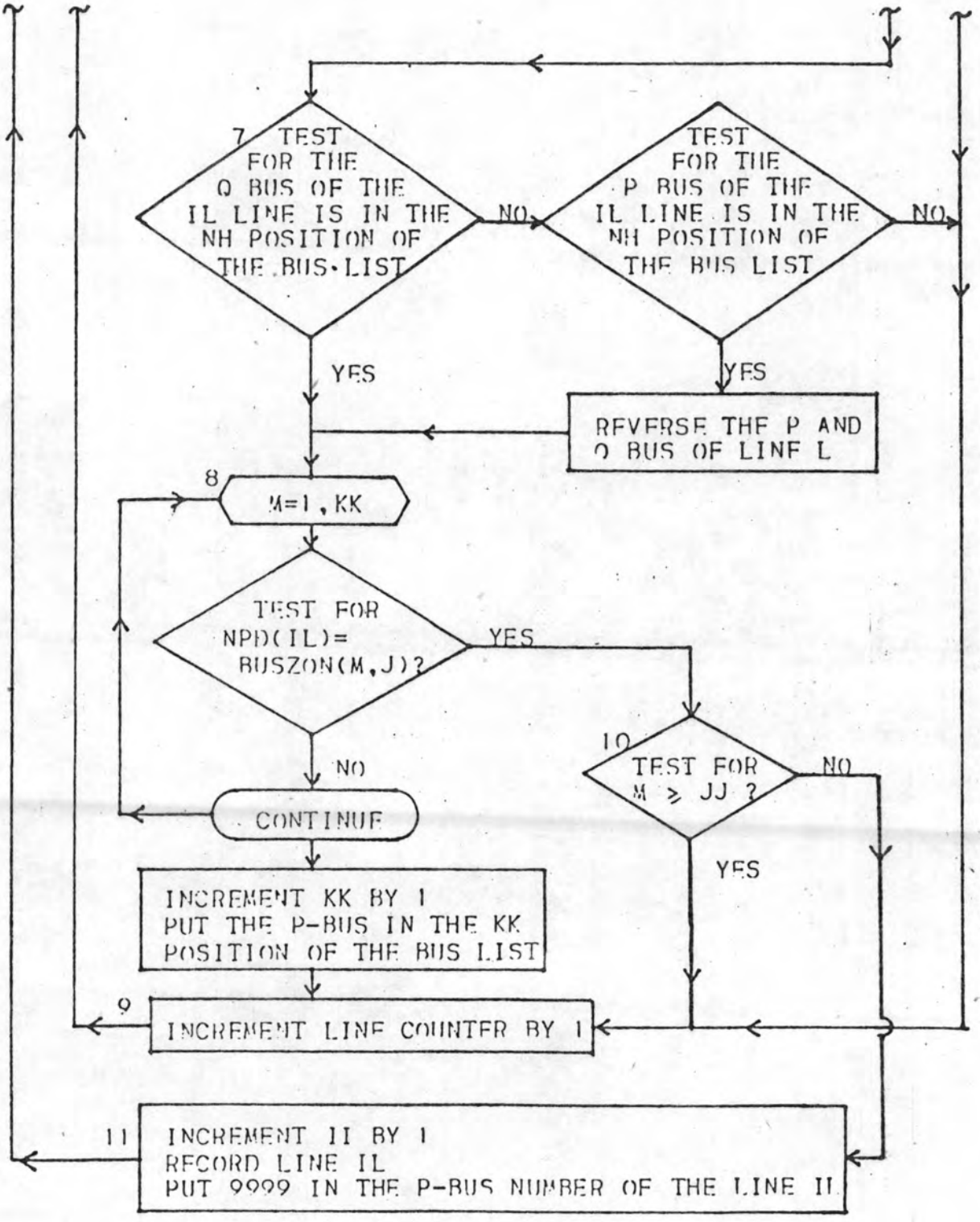
ภาคผนวก ค.

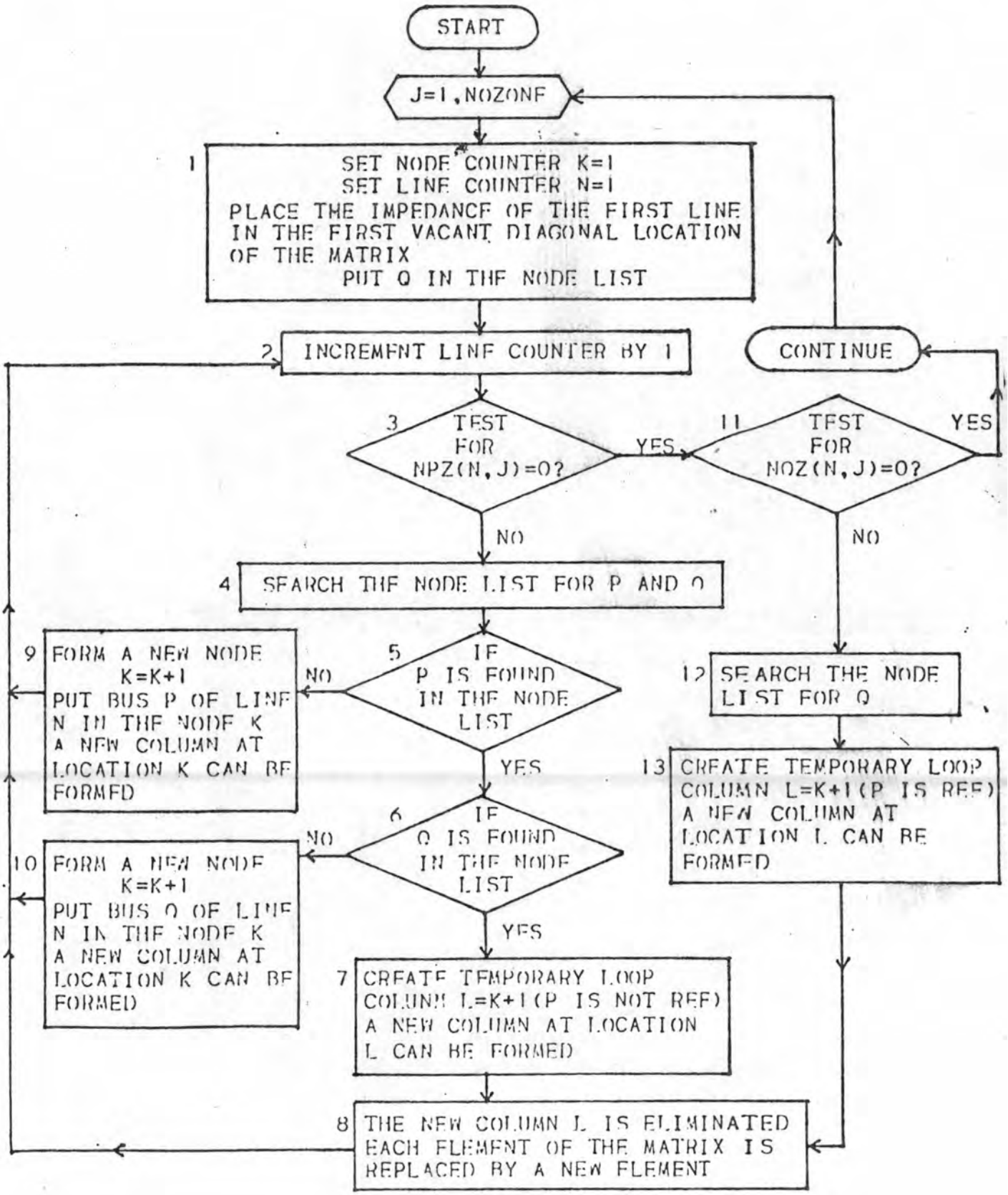
โฟลว์ชาร์ตของการคำนวณโหลดโฟลว์

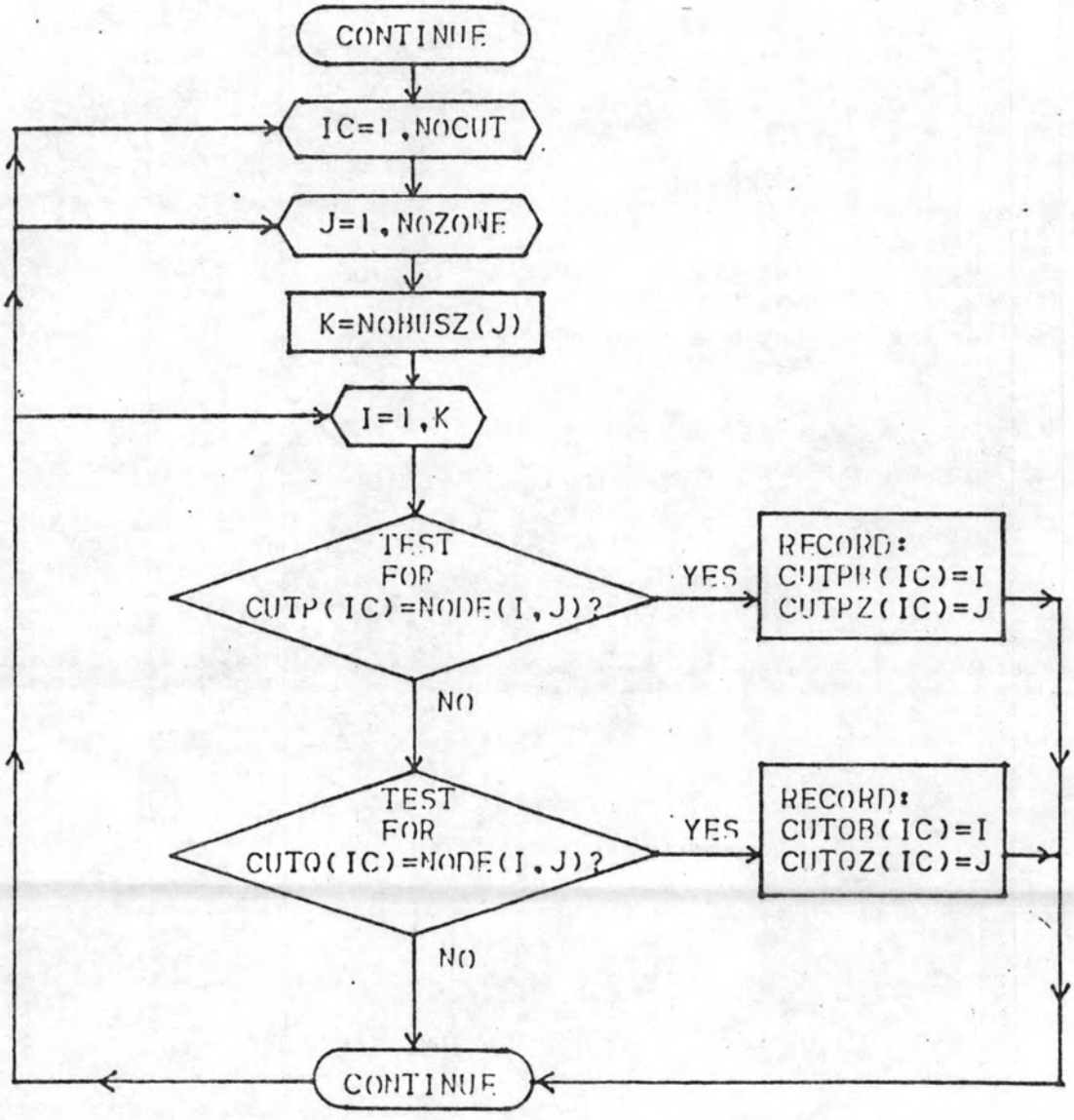

START
READ CONTROL DATA
I=1,NOBUS
READ BUS DATA
CHANGE VOLTAGE IN PER UNIT
TEST FOR VOLTAGE IS DEFINED VOLT=0?
YES
ASSUME BUS VOLTAGE VOLT = 1.0 P.U.
NO
CONTINUE
J=1,NOZONE
SET BUS COUNTER NOBUSZ(J) = 0
I=1,NOBUS
TEST FOR BUS I IS IN ZONE J ZONE(I)=J?
NO
YES
INCREMENT BUS COUNTER BY 1 RECORD BUSZON J FO. BUS I
CONTINUE

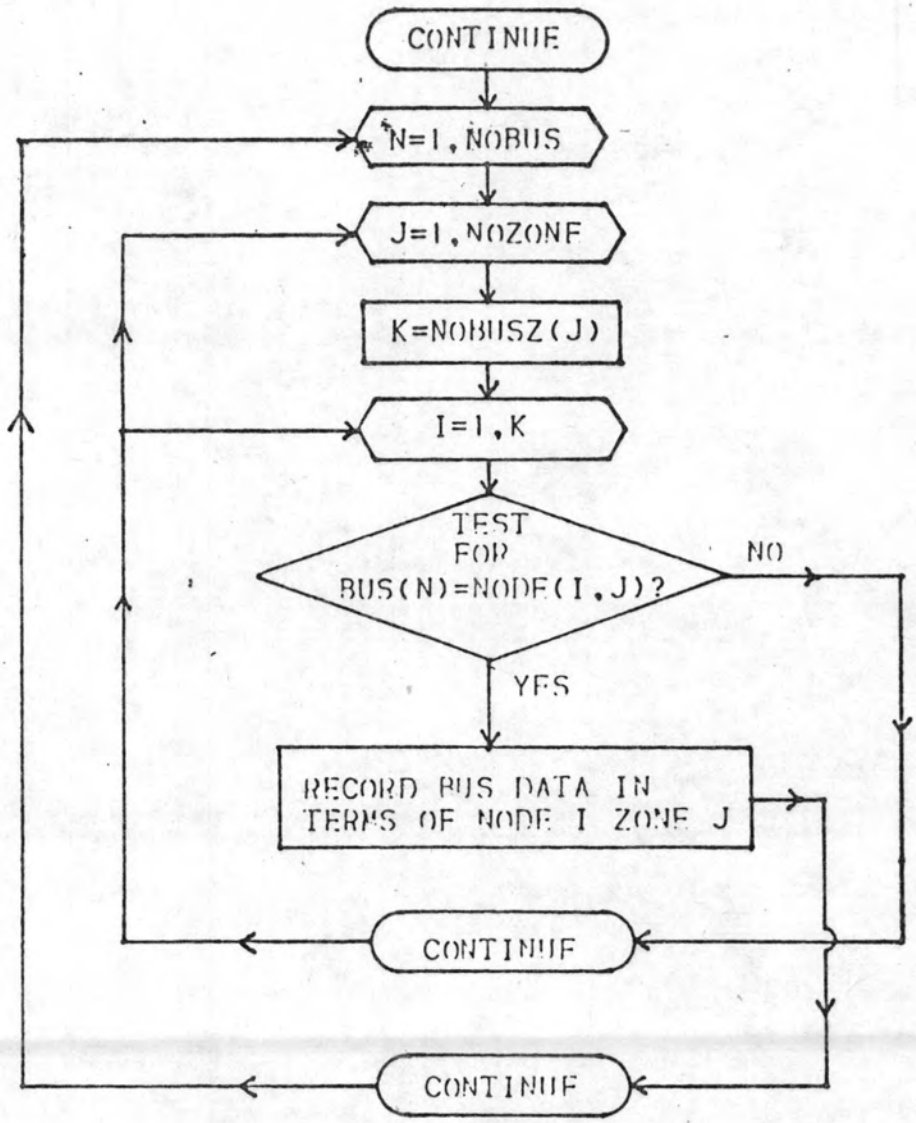

CONTINUE
I=1,NOLINE
READ LINE DATA
TEST FOR TRANSMISSION LINE T=0.0?
YES
SET: T=1.0
NO
CONTINUE
1 SET COUNTER IL AND NOCUT = 0
I=1,NOLINE
2 TEST FOR NP AND NQ ARE IN DIFFERENCE ZONE
NO
YES
3 INCREMENT IL BY 1
RECORD: NPD=NP
NOD=NQ
5 INCREMENT NOCUT BY 1
RECORD: CUTP=NP
CUTQ=NQ
NO 4 TEST T=1.0?
YES
YES 6 TEST T=1.0?
NO
ZPRID=ZPRI*T
ZPRID=ZPRI
CUTZ=ZPRI
CUTZ=ZPRI*T
7 CALCULATE LINE CHARGING FOR EACH BUS
8 CALCULATE THE EQUIVALENT TRANSFORMER ADMITTANCE FOR EACH BUS
CONTINUE

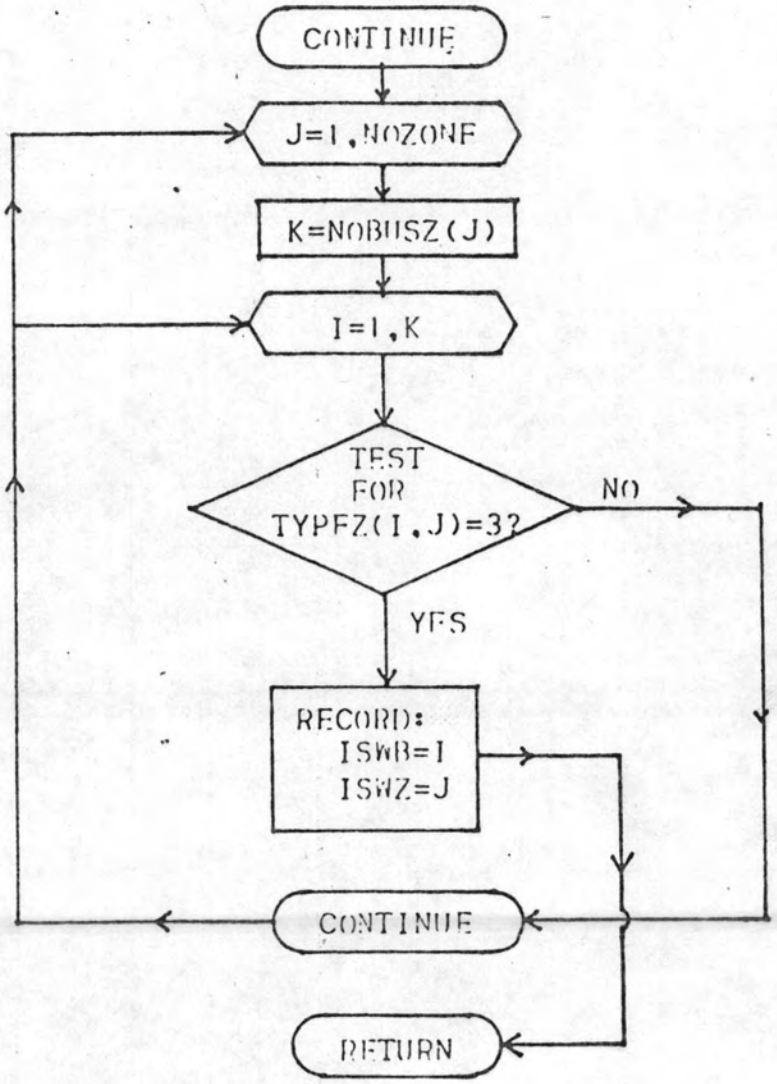

CONTINUE
J=1,NOZONE
1
AT THE FIRST BUS OF ZONE J CREATE A FICTITIOUS LINE RECORD FOR THIS BUS
2
SET FOUR COUNTERS NH,II,JJ,KK = 1
3
SET LINE COUNTER IL = 1
4
TEST FOR NPD(IL)=9999?
YES
NO
5
TEST FOR THE END OF THE LINE DATA
NO
YES
6
INCREMENT COUNTER II BY 1
CREATE EQUIVALENT IMPEDANCE FOR THE NHth BUS
INCREMENT COUNTER NH BY 1
SET COUNTER JJ EQUAL TO NH
TEST FOR THE NHth SLOT OF THE BUS LIST IS EMPTY
NO
YES
12
INCREMENT COUNTER II BY 1
CREATE A FICTITIOUS LINE RECORD
RECORD THE AMOUNT OF LINES IN THIS ZONE
CONTINUE
RETURN

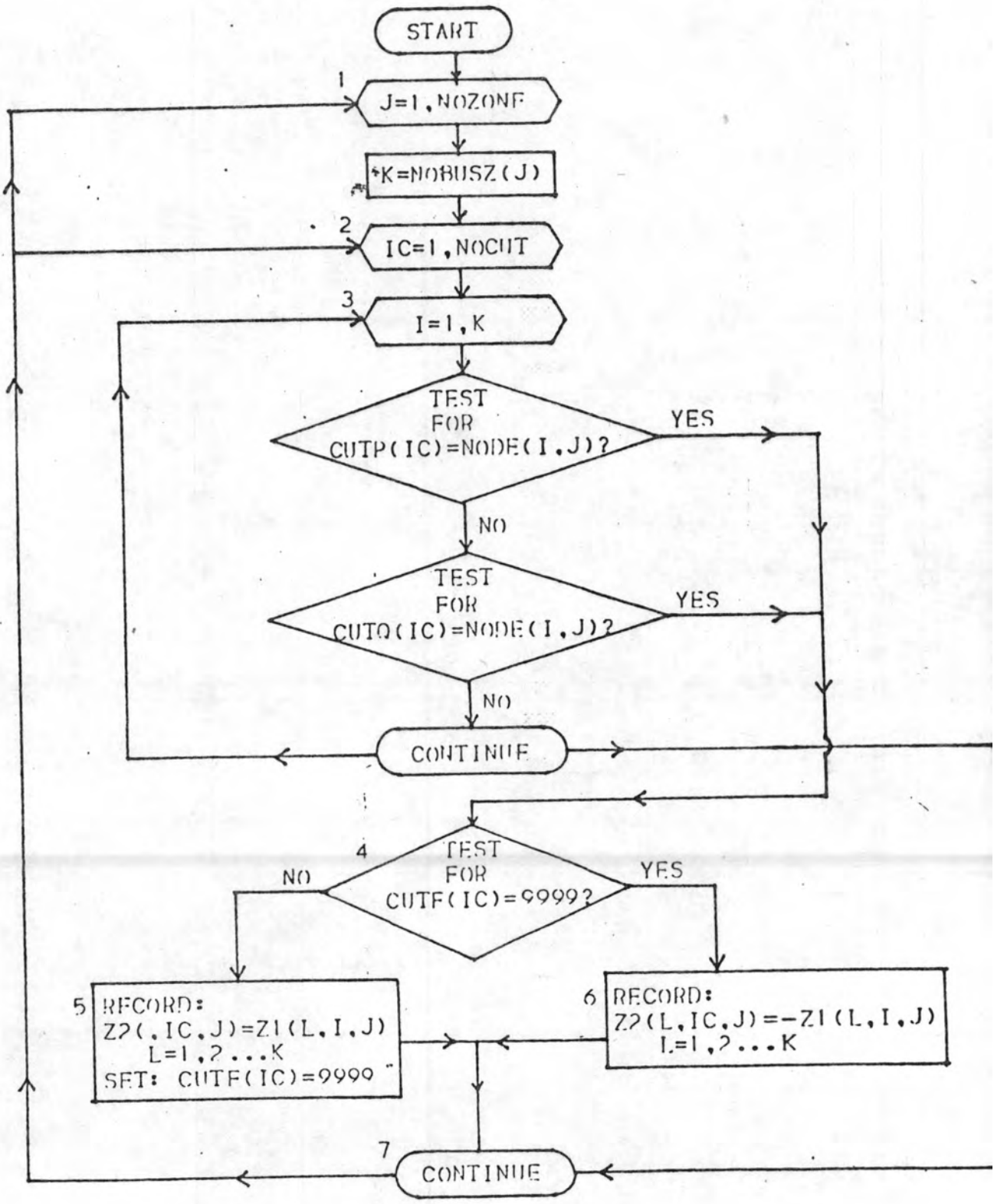

7
TEST FOR THE Q BUS OF THE IL LINE IS IN THE NH POSITION OF THE BUS LIST
NO
TEST FOR THE P BUS OF THE IL LINE IS IN THE NH POSITION OF THE BUS LIST
NO
YES
YES
REVERSE THE P AND Q BUS OF LINE L
8
M=1, KK
TEST FOR NPD(IL)= BUSZON(M,J)?
YES
NO
CONTINUE
10
TEST FOR M ≥ JJ ?
NO
YES
INCREMENT KK BY 1
PUT THE P-BUS IN THE KK POSITION OF THE BUS LIST
9
INCREMENT LINE COUNTER BY 1
11
INCREMENT II BY 1
RECORD LINE IL
PUT 9999 IN THE P-BUS NUMBER OF THE LINE II

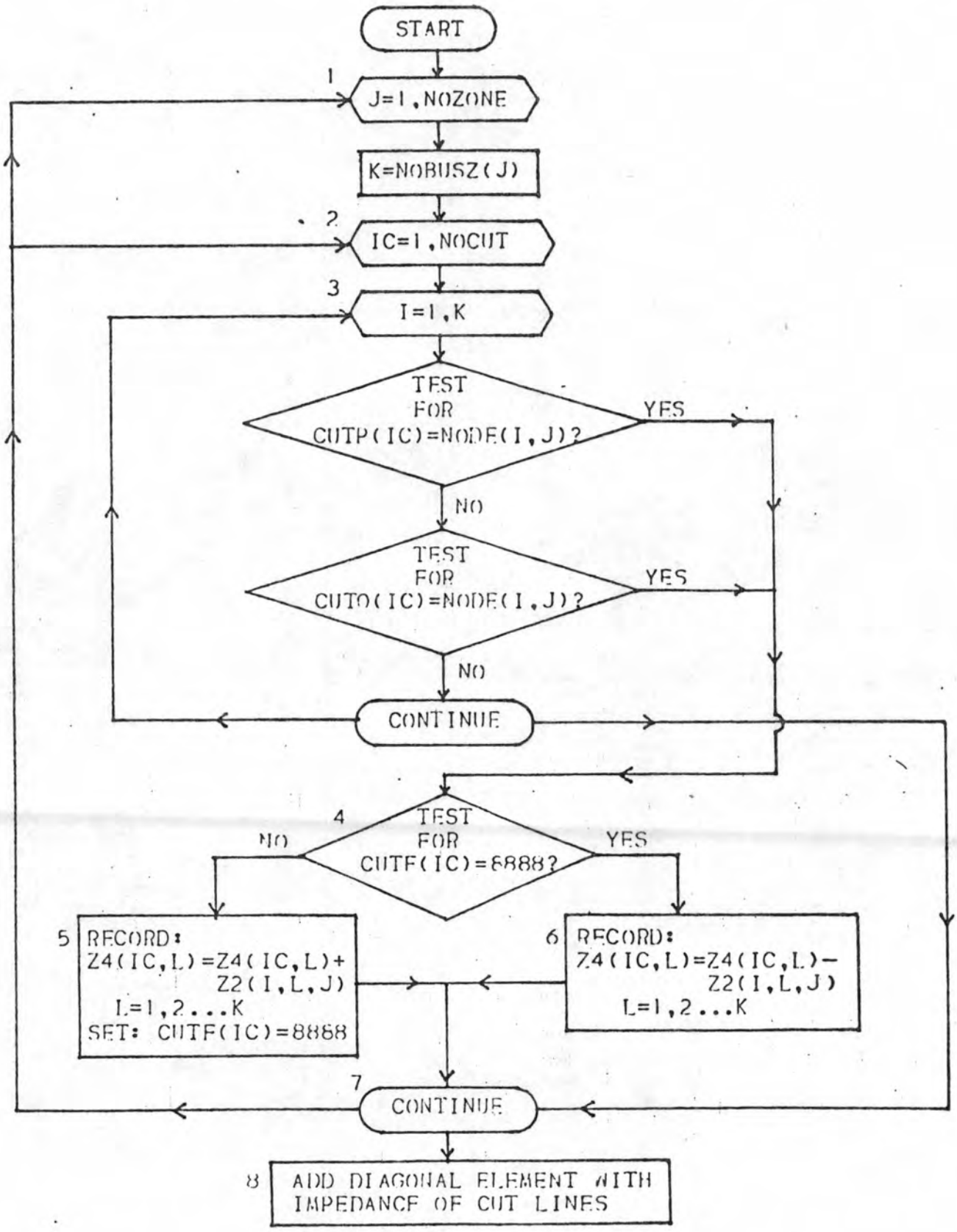

START
J=1,NOZONE
1
SET NODE COUNTER K=1
SET LINE COUNTER N=1
PLACE THE IMPEDANCE OF THE FIRST LINE IN THE FIRST VACANT DIAGONAL LOCATION OF THE MATRIX
PUT Q IN THE NODE LIST
2
INCREMENT LINE COUNTER BY 1
3
TEST FOR NPZ(N,J)=0?
YES
11
TEST FOR NOZ(N,J)=0?
YES
CONTINUE
NO
NO
4
SEARCH THE NODE LIST FOR P AND Q
5
IF P IS FOUND IN THE NODE LIST
NO
9
FORM A NEW NODE K=K+1
PUT BUS P OF LINE N IN THE NODE K
A NEW COLUMN AT LOCATION K CAN BE FORMED
YES
6
IF Q IS FOUND IN THE NODE LIST
NO
10
FORM A NEW NODE K=K+1
PUT BUS Q OF LINE N IN THE NODE K
A NEW COLUMN AT LOCATION K CAN BE FORMED
YES
7
CREATE TEMPORARY LOOP COLUMN L=K+1 (P IS NOT REF)
A NEW COLUMN AT LOCATION L CAN BE FORMED
12
SEARCH THE NODE LIST FOR Q
13
CREATE TEMPORARY LOOP COLUMN L=K+1 (P IS REF)
A NEW COLUMN AT LOCATION L CAN BE FORMED
8
THE NEW COLUMN L IS ELIMINATED
EACH ELEMENT OF THE MATRIX IS REPLACED BY A NEW ELEMENT

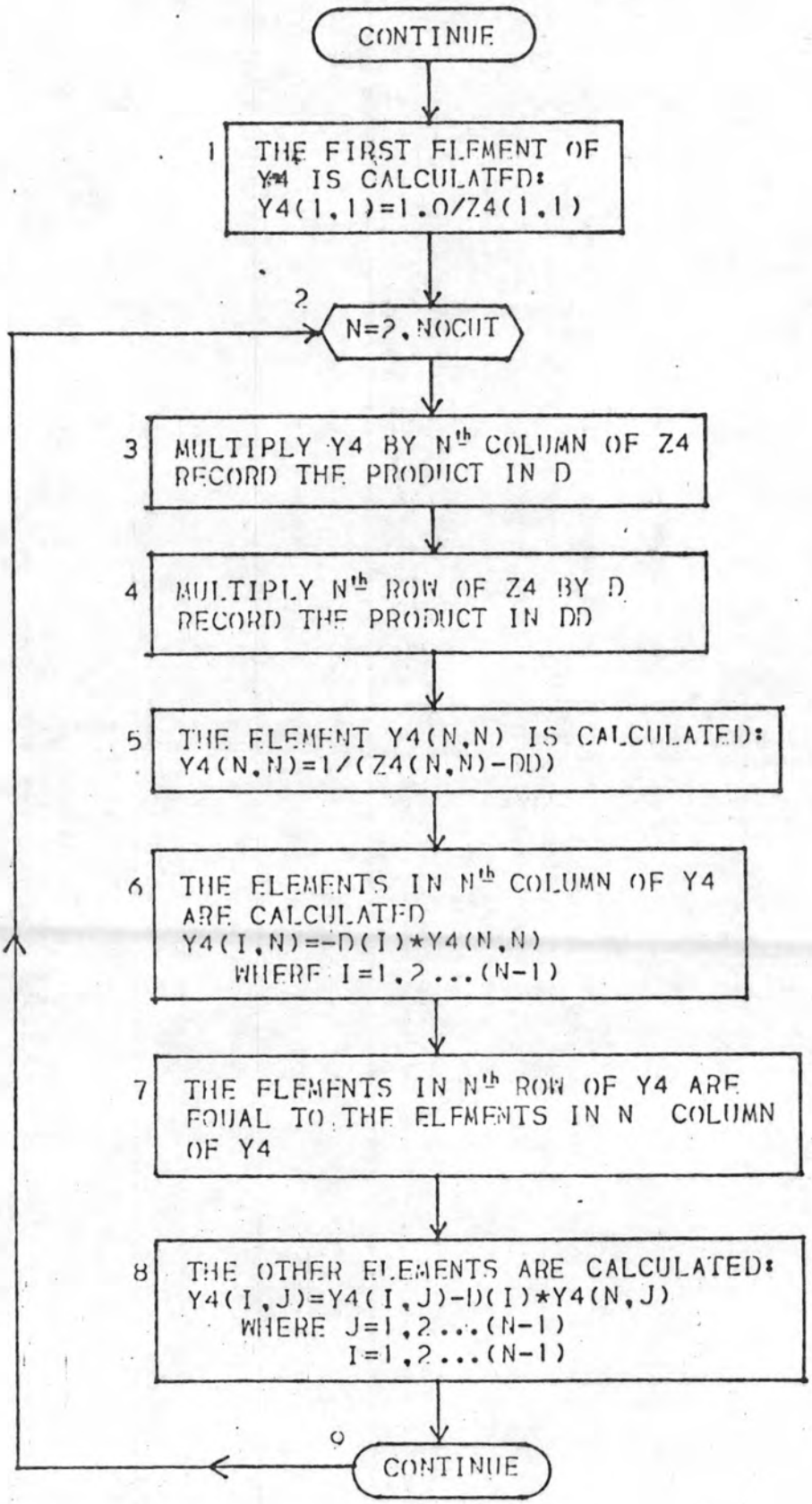

CONTINUE
IC=1,NOCUT
J=1,NOZONE
K=NOBUSZ(J)
I=1,K
TEST FOR CUTP(IC)=NODE(I,J)?
YES
RECORD: CUTPB(IC)=I CUTPZ(IC)=J
NO
TEST FOR CUTQ(IC)=NODE(I,J)?
YES
RECORD: CUTQB(IC)=I CUTQZ(IC)=J
NO
CONTINUE

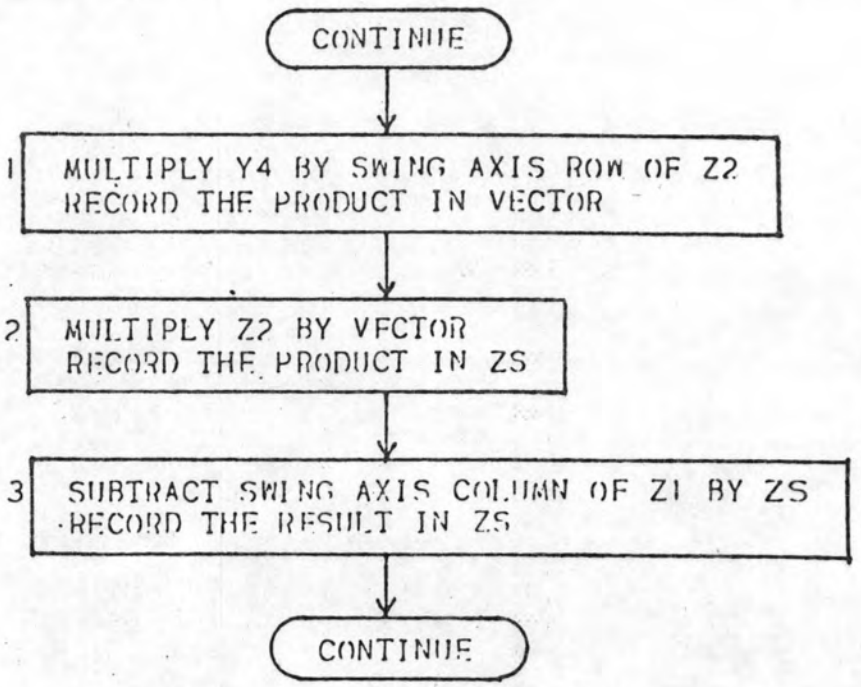

CONTINUE
N=1,NOBUS
J=1,NOZONE
K=NOBUSZ(J)
I=1,K
TEST FOR BUS(N)=NODE(I,J)?
NO
YES
RECORD BUS DATA IN TERMS OF NODE I ZONE J
CONTINUE
CONTINUE

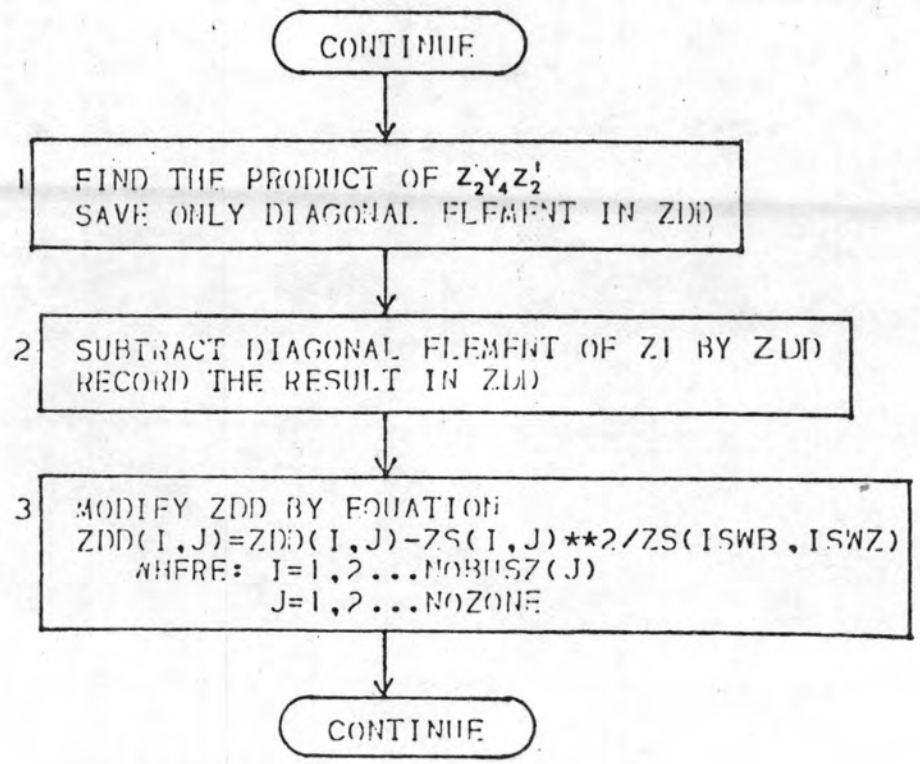

CONTINUE
J=1,NOZONE
K=NOBUSZ(J)
I=1,K
TEST FOR TYPEZ(I,J)=3?
NO
YES
RECORD:
ISWB=I
ISWZ=J
CONTINUE
RETURN

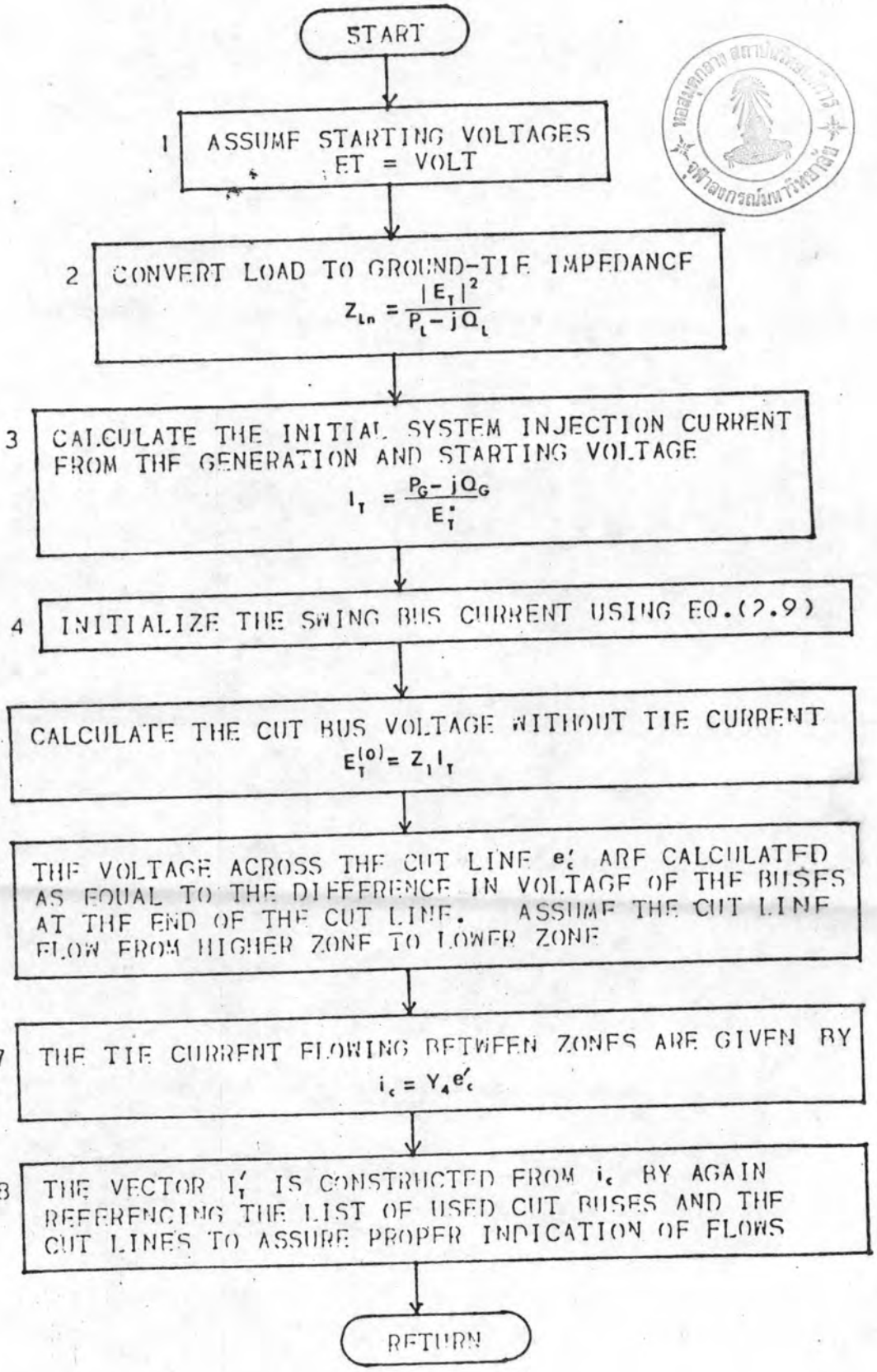

START
1
J=1,NOZONE
*K=NOBUSZ(J)
2
IC=1,NOCUT
3
I=1,K
TEST FOR CUTP(IC)=NODE(I,J)?
YES
NO
TEST FOR CUTQ(IC)=NODE(I,J)?
YES
NO
CONTINUE
4
TEST FOR CUTF(IC)=9999?
NO
YES
5
RECORD:
Z2(,IC,J)=Z1(L,I,J)
L=1,2...K
SET: CUTF(IC)=9999
6
RECORD:
Z2(L,IC,J)=-Z1(L,I,J)
L=1,2...K
7
CONTINUE

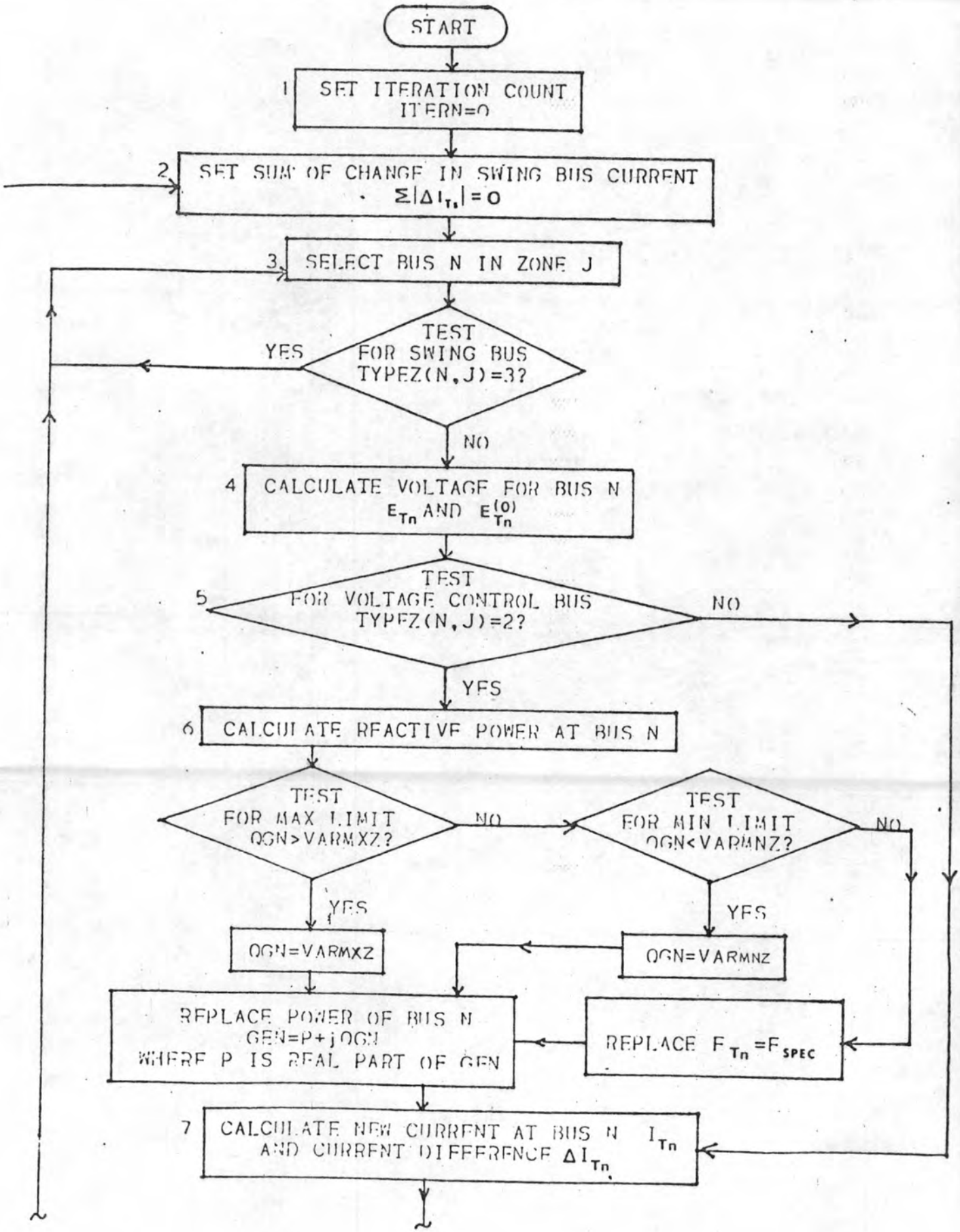

START
1
J=1,NOZONE
K=NOBUSZ(J)
2
IC=1,NOCUT
3
I=1,K
TEST FOR CUTP(IC)=NODE(I,J)?
YES
NO
TEST FOR CUTO(IC)=NODE(I,J)?
YES
NO
CONTINUE
4
TEST FOR CUTF(IC)=8888?
NO
YES
5
RECORD:
Z4(IC,L)=Z4(IC,L)+ Z2(I,L,J)
L=1,2...K
SET: CUTF(IC)=8888
6
RECORD:
Z4(IC,L)=Z4(IC,L)- Z2(I,L,J)
L=1,2...K
7
CONTINUE
8
ADD DIAGONAL ELEMENT WITH IMPEDANCE OF CUT LINES

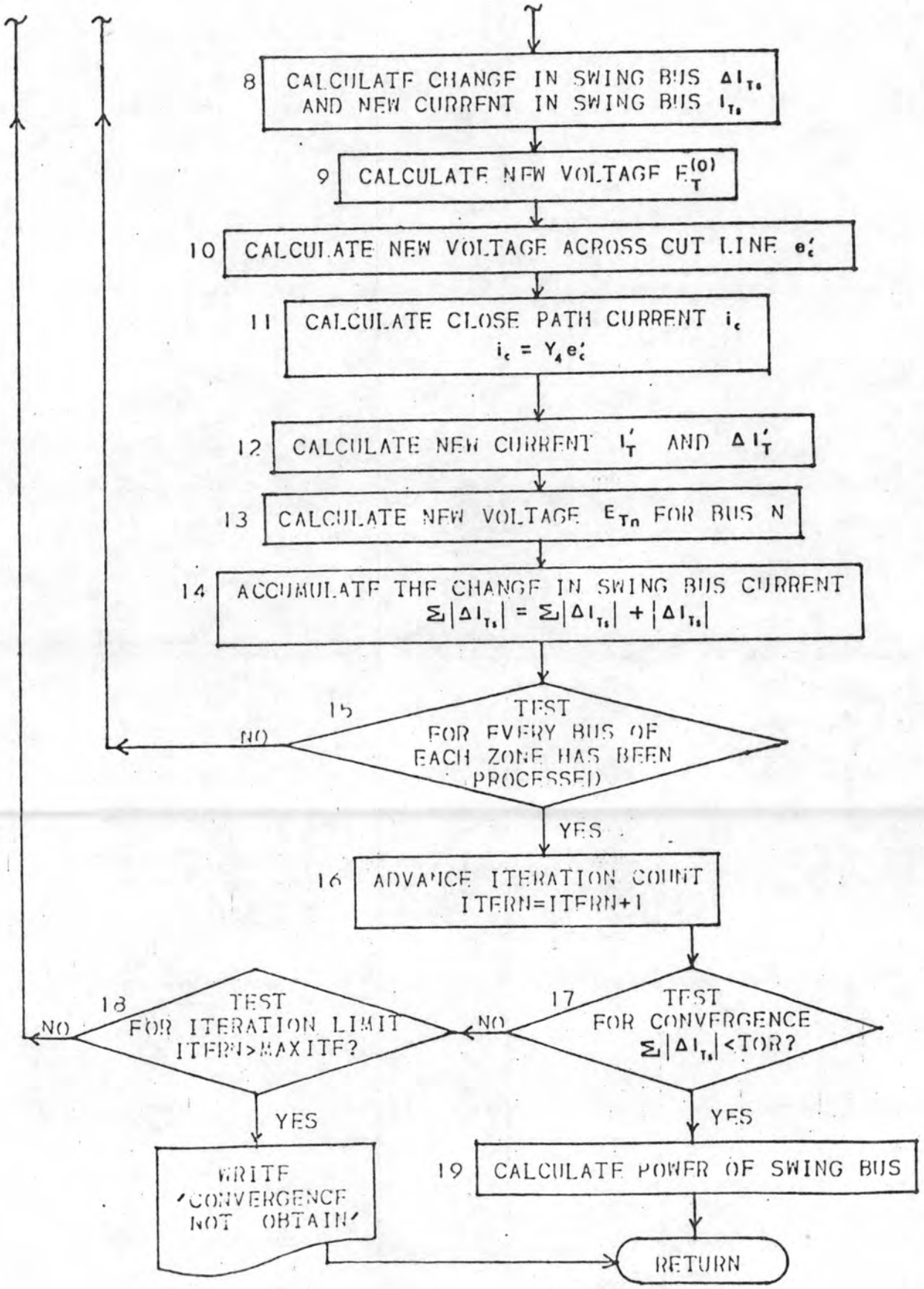

CONTINUE
1
THE FIRST ELEMENT OF Y4 IS CALCULATED:
Y4(1,1)=1.0/Z4(1,1)
2
N=2,NOCUT
3
MULTIPLY Y4 BY Nth COLUMN OF Z4
RECORD THE PRODUCT IN D
4
MULTIPLY Nth ROW OF Z4 BY D
RECORD THE PRODUCT IN DD
5
THE ELEMENT Y4(N,N) IS CALCULATED:
Y4(N,N)=1/(Z4(N,N)-DD)
6
THE ELEMENTS IN Nth COLUMN OF Y4 ARE CALCULATED
Y4(I,N)=-D(I)*Y4(N,N)
WHERE I=1,2...(N-1)
7
THE ELEMENTS IN Nth ROW OF Y4 ARE EQUAL TO THE ELEMENTS IN N COLUMN OF Y4
8
THE OTHER ELEMENTS ARE CALCULATED:
Y4(I,J)=Y4(I,J)-D(I)*Y4(N,J)
WHERE J=1,2...(N-1)
I=1,2...(N-1)
9
CONTINUE

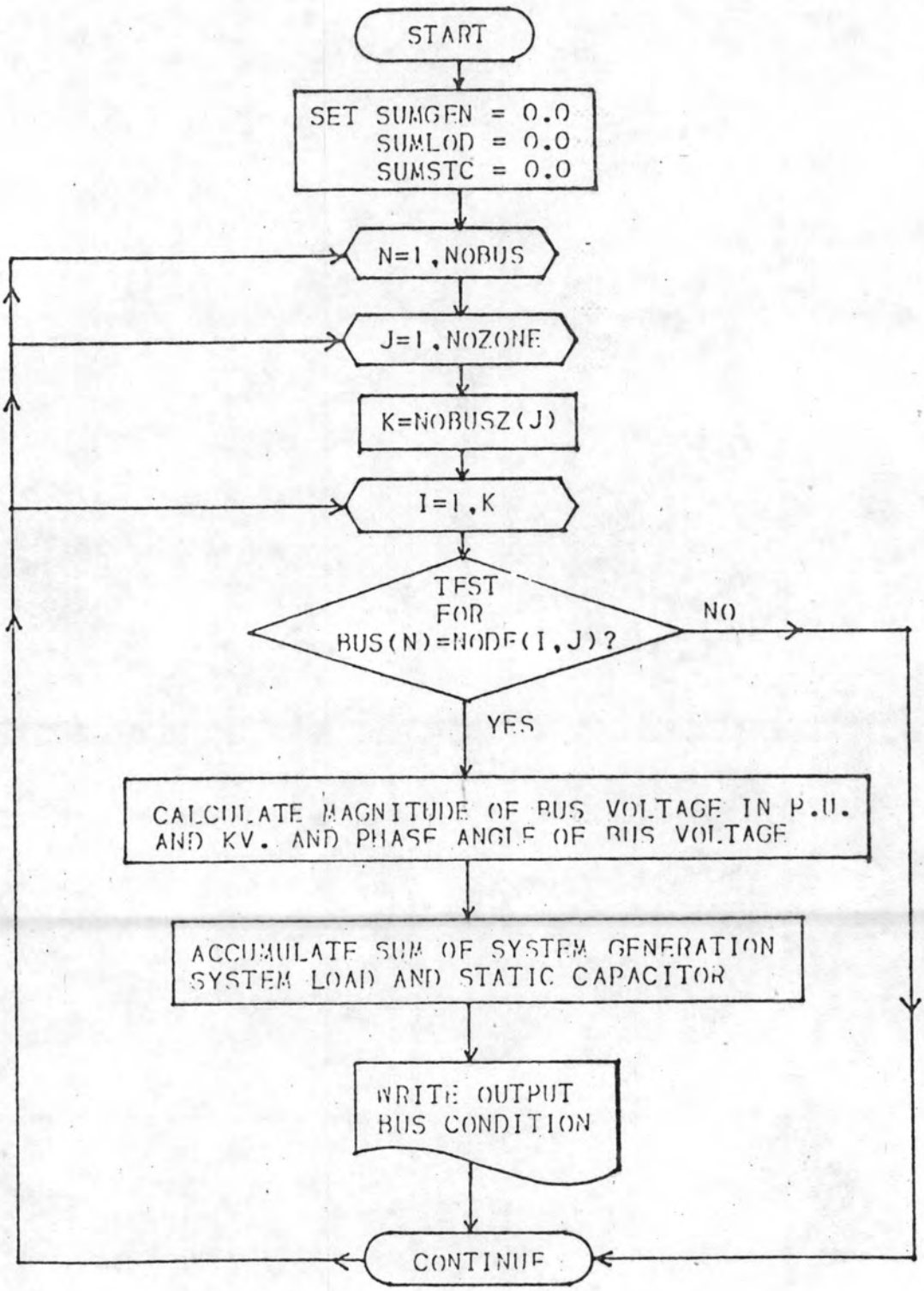

CONTINUE
1 MULTIPLY Y4 BY SWING AXIS ROW OF Z2
RECORD THE PRODUCT IN VECTOR
2 MULTIPLY Z2 BY VECTOR
RECORD THE PRODUCT IN ZS
3 SUBTRACT SWING AXIS COLUMN OF Z1 BY ZS
RECORD THE RESULT IN ZS
CONTINUE

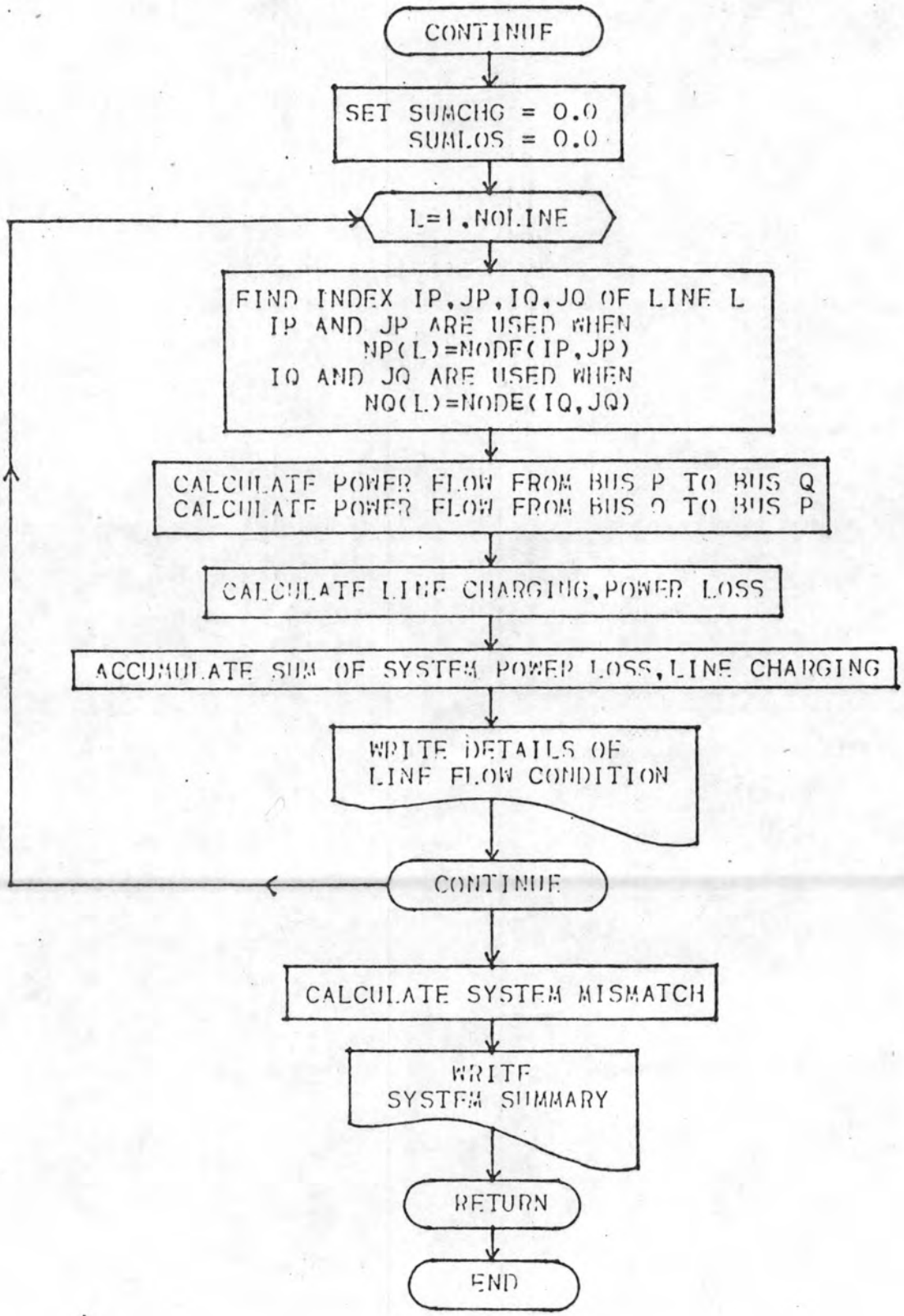

CONTINUE
1 FIND THE PRODUCT OF $Z_2Y_4Z_2'$
SAVE ONLY DIAGONAL ELEMENT IN ZDD
2 SUBTRACT DIAGONAL ELEMENT OF Z1 BY ZDD
RECORD THE RESULT IN ZDD
3 MODIFY ZDD BY EQUATION
ZDD(I,J)=ZDD(I,J)-ZS(I,J)**2/ZS(ISWB,ISWZ)
WHERE: I=1,2...NOBUSZ(J)
J=1,2...NOZONE
CONTINUE


START
1 ASSUME STARTING VOLTAGES
ET = VOLT
2 CONVERT LOAD TO GROUND-TIE IMPEDANCE
$Z_{Ln} = \frac{|E_T|^2}{P_L - jQ_L}$
3 CALCULATE THE INITIAL SYSTEM INJECTION CURRENT FROM THE GENERATION AND STARTING VOLTAGE
$I_T = \frac{P_G - jQ_G}{E_T^*}$
4 INITIALIZE THE SWING BUS CURRENT USING EQ.(2.9)
5 CALCULATE THE CUT BUS VOLTAGE WITHOUT TIE CURRENT
$E_T^{(0)} = Z_1 I_T$
6 THE VOLTAGE ACROSS THE CUT LINE e_c' ARE CALCULATED AS EQUAL TO THE DIFFERENCE IN VOLTAGE OF THE BUSES AT THE END OF THE CUT LINE. ASSUME THE CUT LINE FLOW FROM HIGHER ZONE TO LOWER ZONE
7 THE TIE CURRENT FLOWING BETWEEN ZONES ARE GIVEN BY
$i_c = Y_4 e_c'$
8 THE VECTOR I_T' IS CONSTRUCTED FROM i_c BY AGAIN REFERENCING THE LIST OF USED CUT BUSES AND THE CUT LINES TO ASSURE PROPER INDICATION OF FLOWS
RETURN


START
1 SET ITERATION COUNT ITERN=0
2 SET SUM OF CHANGE IN SWING BUS CURRENT $\Sigma|\Delta I_{T_s}| = 0$
3 SELECT BUS N IN ZONE J
TEST FOR SWING BUS TYPEZ(N,J)=3?
YES
NO
4 CALCULATE VOLTAGE FOR BUS N E_{Tn} AND $E_{Tn}^{(0)}$
5 TEST FOR VOLTAGE CONTROL BUS TYPEZ(N,J)=2?
NO
YES
6 CALCULATE REACTIVE POWER AT BUS N
TEST FOR MAX LIMIT QGN>VARMXZ?
NO
YES
QGN=VARMXZ
TEST FOR MIN LIMIT QGN<VARMNZ?
NO
YES
QGN=VARMNZ
REPLACE POWER OF BUS N GEN=P+jQGN WHERE P IS REAL PART OF GEN
REPLACE $E_{Tn}=E_{SPEC}$
7 CALCULATE NEW CURRENT AT BUS N I_{Tn} AND CURRENT DIFFERENCE ΔI_{Tn}


8 CALCULATE CHANGE IN SWING BUS ΔI_{T_s} AND NEW CURRENT IN SWING BUS I_{T_s}
9 CALCULATE NEW VOLTAGE $E_T^{(0)}$
10 CALCULATE NEW VOLTAGE ACROSS CUT LINE e_c'
11 CALCULATE CLOSE PATH CURRENT i_c $i_c = Y_4 e_c'$
12 CALCULATE NEW CURRENT I_T' AND $\Delta I_T'$
13 CALCULATE NEW VOLTAGE E_{Tn} FOR BUS N
14 ACCUMULATE THE CHANGE IN SWING BUS CURRENT $\Sigma|\Delta I_{T_s}| = \Sigma|\Delta I_{T_s}| + |\Delta I_{T_s}|$
15 TEST FOR EVERY BUS OF EACH ZONE HAS BEEN PROCESSED
NO
YES
16 ADVANCE ITERATION COUNT ITERN=ITERN+1
17 TEST FOR CONVERGENCE $\Sigma|\Delta I_{T_s}|$<TOR?
NO
YES
18 TEST FOR ITERATION LIMIT ITERN>MAXITE?
NO
YES
WRITE 'CONVERGENCE NOT OBTAIN'
19 CALCULATE POWER OF SWING BUS
RETURN


START
SET SUMGEN = 0.0
SUMLOD = 0.0
SUMSTC = 0.0
N=1,NOBUS
J=1,NOZONE
K=NOBUSZ(J)
I=1,K
TEST FOR BUS(N)=NODE(I,J)?
NO
YES
CALCULATE MAGNITUDE OF BUS VOLTAGE IN P.U. AND KV. AND PHASE ANGLE OF BUS VOLTAGE
ACCUMULATE SUM OF SYSTEM GENERATION SYSTEM LOAD AND STATIC CAPACITOR
WRITE OUTPUT BUS CONDITION
CONTINUE


CONTINUE
SET SUMCHG = 0.0
SUMLOS = 0.0
L=1,NOLINE
FIND INDEX IP,JP,IQ,JQ OF LINE L
IP AND JP ARE USED WHEN
NP(L)=NODE(IP,JP)
IQ AND JQ ARE USED WHEN
NQ(L)=NODE(IQ,JQ)
CALCULATE POWER FLOW FROM BUS P TO BUS Q
CALCULATE POWER FLOW FROM BUS Q TO BUS P
CALCULATE LINE CHARGING,POWER LOSS
ACCUMULATE SUM OF SYSTEM POWER LOSS,LINE CHARGING
WRITE DETAILS OF
LINE FLOW CONDITION
CONTINUE
CALCULATE SYSTEM MISMATCH
WRITE
SYSTEM SUMMARY
RETURN
END

ประวัติผู้เขียน

นายลุ่ยสันติ์ นุ่นงาม เกิดเมื่อวันที่ 9 มกราคม พ.ศ. 2502 ณ. จังหวัดอุทัยธานี สำเร็จการศึกษาวิศวกรรมศาสตรบัณฑิตจากคณะวิศวกรรมศาสตร์ สถาบันเทคโนโลยีพระจอมเกล้า พระนครเหนือ เมื่อปี พ.ศ. 2525 หลังจากสำเร็จการศึกษาแล้วได้เข้าทำงานที่สำนักงานมาตรฐานผลิตภัณฑ์อุตสาหกรรม เป็นเวลา 1 ปี หลังจากนั้นได้มาเป็นอาจารย์ภาควิชาวิศวกรรมไฟฟ้า คณะวิศวกรรมศาสตร์ สถาบันเทคโนโลยีพระจอมเกล้าพระนครเหนือ จนถึงปัจจุบัน