ภาคผนวก ก

โปรแกรม Load Flow Study (LFS)

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      DIMENSION YGM(400),YBM(400),BBSH(400),RATING(400),YGS(200),
     1YBS(200),NSE(200),NRE(200),NTYP(200),BNAM1(200),BNAM2(200),
     2PPG(200),QQG(200),PPL(200),QQL(200),VP(200),VQ(200),AKLP(200),
     3BKLP(200),BUSP(200),BUS2(200),NAREA(200),BBER(100),NBSR(100),
     4LTRA(50),TAP(50),TMIN(50),TMAX(50),QMI(50),QMAX(50),LOKS(50),
     5NGEN(50),VMGE(50),VMTC(50),TTOL(50),NSLACK(10),ANAME1(10),
     6ANAME2(10),DFLOW(10),DTOL(10),ALOSS(10),TITLE(19),REMARK(19)
 4000 FORMAT (I3)
 2000 FORMAT (I4,19A4)
 2001 FORMAT (2I3)
 2002 FORMAT (2I3,3F8.3,3F6.4,I2,4F5.2,F7.2)
 2003 FORMAT (2I3,2A4,I2,2F5.3,6F6.2,F8.5)
 2004 FORMAT (2I3,2A4,2F8.3)
 2005 FORMAT (2F5.1,F8.5,4I5)
 3000 FORMAT (10X,19A4)
 3001 FORMAT (T11,'TRANSMISSION LINE AND TRANSFORMER DATA ASSEMBLY'//)
 3033 FORMAT (T41,'INPUT BASE',T81,'CONVERTED BASE')
 3002 FORMAT (40X,F6.1,4H  KV,32X,F6.1,4H  KV/40X,F6.1,5H  MVA,31X,F6.1,
     15H  MVA//)
 3030 FORMAT  (/T9,'LINE',T69,'MVA      TAP      TAP - LIMITS'/T8,
     2'NP   NQ      R(PU)      X(PU)      BSH          G          B      RATIN
     3G  RATIO      TMIN    TMAX    LREF'/)
 3003 FORMAT (4X,2I5,1X,5F10.5,F8.2)
 3004 FORMAT (4X,2I5,1X,5F10.5,F8.2,3F8.4,I4)
 3005 FORMAT (//,  T11,'BASE CASE BUS-DATA ENTERED'//T8,'BUS TYPE   NAME
     1   AREA    EA      E3       PG          QG          PL          QL        QMI
     2N       QMAX      BSR(MVAR)'/)
 3006 FORMAT (4X,2I5,2X,2A4,2X,I4,F6.3,1X,F5.2,7F10.2)
 3007 FORMAT (///,T11,'AREA-INTERCHANGE DATA FOLLOW'//T8,'BUS  AREA   AR
     1EA            DFLOW      DTOL'/T9,'NO.  CODE   NAME.           ....
     2    ....'/)
 3008 FORMAT (5X,2I5,2X,2A4,4X,F10.3,2X,F8.3)
 3009 FORMAT (//T6,'ACC. FACT. TOLERANCES  MINTC  MAXIC  MAXTC. MAXIT'//
     15X,2F5.2,1X,F10.6,4(2X,I5)//)
 3010 FORMAT (T20,'END OF LISTING FOR LOAD-FLOW DATA TABLES')
 3032 FORMAT (1H1,T113,'PAGE',I3)
    1 READ (1,4000) LCASE
      NOISL = 0
      NOBSW = 0
      NOARE = 0
      NEL = 0
      NOBUS = 0
      NOTRA = 0
      NOGEN = 0
      NOLTC = 0
      MAXNB = 0
      DO 5 I = 1,400
      CBFT = 0.0
      YGM(I) = 0.0
      YBM(I) = 0.0
      NSE(I) = 0.0
      NRE(I) = 0.0
    5 CONTINUE
      DO 10 I = 1,200
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      YGS(I) = 0.0
      YBS(I) = 0.0
      VP(I) = 0.0
      VQ(I) = 0.0
   10 CONTINUE
      NPAGE = 1
      NLINE = 1
      WRITE (4,3032) NPAGE
C     READ IN TITLE CARD
   11 READ (1,2000) LT,(TITLE(I),I=1,19)
      WRITE (4,3000) (TITLE(I),I=1,19)
      NLINE = NLINE + 1
      IF (LT) 11,11,12
   12 READ (1,2000) LR,(REMARK(I),I=1,19)
      WRITE (4,3000) (REMARK(I),I=1,19)
      NLINE = NLINE + 1
      IF (LR) 12,12,15
   15 READ (1,2001) ITCRD,LAOM
      GO TO (20,115,170,195),ITCRD
C     READ IN LINE AND TRANSFORMER DATA
   20 WRITE (4,3001)
      WRITE (4,3033)
   25 READ (1,2002) NS,NR,R,X,BSH,TAP1,TMIN1,TMAX1,LREF,TTOL1,BOLD,
     1BNEW,BMVA,RATIN1
      IF (NLINE - 56) 27,27,26
   26 NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
      WRITE (4,3001)
      WRITE (4,3030)
      NLINE = 7
   27 CONTINUE
      IF (NS - 999) 30,15,15
   30 NEL = NEL + 1
      NLINE = NLINE + 1
      NSE(NEL) = NS
      NRE(NEL) = NR
      BBSH(NEL) = BSH/2
      RATING(NEL) = RATIN1
      IF (LAOM) 35,35,40
   35 G = R/(R**2+X**2)
      B = -X/(R**2+X**2)
      GO TO 45
   40 G = R
      B = -X
   45 IF (BNEW) 50,50,46
   46 RBSV = BOLD/BNEW
      GO TO 65
   50 IF (CBFT) 70,55,70
   55 BNEW = BOLD
      RBSV = 1.
      IF (BMVA) 60,60,65
   60 BMVA = 100
      CBFT = 1.
      WRITE (4,3002) BOLD,BNEW,BMVA
      WRITE (4,3030)
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      GO TO 75
   65 CBFT = (RBSV)**2*100./BMVA
      WRITE (4,3002) BOLD,BNEW,BMVA
      WRITE (4,3030)
   70 G = G*CBFT
      B = B*CBFT
   75 IF (TAP1) 85,80,85
      LINE DATA
   80 WRITE (4,3003) NS,NR,R,X,BSH,G,B,RATIN1
      SG = 0
      RG = 0
      SB = BSH/2
      RB = SB
      GO TO 110
      TRANSFORMER DATA
   85 NOTRA = NOTRA + 1
      WRITE (4,3004) NS,NR,R,X,BSH,G,B,RATIN1,TAP1,TMIN1,TMAX1,LREF
      LOWS(NOTRA) = LREF
      LTRA(NOTRA) = NEL
      TAP(NOTRA) = TAP1
      TMIN(NOTRA) = TMIN1
      TMAX(NOTRA) = TMAX1
      TN = TAP(NOTRA)
      IF (TTOL1) 86,86,87
   86 TTOL(NOTRA) = 0.01
       GO TO 88
   87 CONTINUE
      TTOL(NOTRA) = TTOL1
   88 CONTINUE
      SG = (1./TN)*(1./TN-1.)*G
      SB = (1./TN)*(1./TN-1.)*B
      C1 = (1.-1./TN)*G
      C2 = (1.-1./TN)*B
      IF (LREF) 90,95,90
   90 RG = SG
      RB = SB
      SG = C1
      SB = C2
      GO TO 100
   95 CONTINUE
      RG = C1
      RB = C2
  100 G = G/TN
      B = B/TN
      IF (TMIN(NOTRA)) 105,110,105
  105 NOLTC = NOLTC + 1
      STORE DATA FOR OUTPUT
  110 YGS(NS) = YGS(NS) + SG + G
      YBS(NS) = YBS(NS) + SB + B
      YGS(NR) = YGS(NR) + RG + G
      YBS(NR) = YBS(NR) + RB + B
      YGM(NEL) = G
      YBM(NEL) = B
      GO TO 25
      READ IN BUS DATA
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  115 NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
      WRITE (4,3005)
      NLINE = 5
  120 READ (1,2003) NBUS,ITYP,A1,A2,ICODE,EA,EB,PG,QG,PL,QL,QMIN1,
     1QMAX1,BSR
      NLINE = NLINE + 1
      IF (NBUS -999) 125,15,15
  125 CONTINUE
      IF (NLINE - 56) 127,127,126
  126 NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
      WRITE (4,3005)
      NLINE = 6
  127 WRITE(4,3006) NBUS,ITYP,A1,A2,ICODE,EA,EB,PG,QG,PL,QL,QMIN1,
     1QMAX1,BSR
      NOBUS = NOBUS + 1
C     STORE BUS DATA FOR OUTPUT
      IF (ICODE) 130,135,130
  130 NAREA(NBUS) = ICODE
  135 CONTINUE
      NTYP(NBUS) = ITYP
      BNAM1(NBUS) = A1
      BNAM2(NBUS) = A2
      PPG(NBUS) = PG*0.01
      QQG(NBUS) = QG*0.01
      PPL(NBUS) = PL*0.01
      QQL(NBUS) = QL*0.01
      EB = EB*3.1416/180
      VP(NBUS) = EA*COS(EB)
      VQ(NBUS) = EA*SIN(EB)
      IF (BSR) 140,145,140
  140 NOBSR = NOBSR + 1
      NBSR(NOBSR) = NBUS
      BBSR(NOBSR) = BSR*0.01
      YBS(NBUS) = YBS(NBUS) - BBSR(NOBSR)
  145 CONTINUE
      IF (ITYP - 1) 155,150,154
  150 NOGEN = NOGEN + 1
      VMGE(NOGEN) = SQRT(EA**2 + EB**2)
      NGEN(NOGEN) = NBUS
      QMIN(NOGEN) = QMIN1*0.01
      QMAX(NOGEN) = QMAX1*0.01
      GO TO 155
  154 NSB = NBUS
  155 CONTINUE
      IF (NBUS - MAXNB) 165,165,160
  160 MAXNB = NBUS
  165 CONTINUE
      GO TO 120
C     READ POWER INTERCHANGE BETWEEN AREAS DATA
  170 NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
      WRITE (4,3007)
      READ (1,2004) ISLACK,ICODE,CPNY1,CPNY2,FLOW,TOL
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      WRITE (4,3008) ISLACK,ICODE,CPNY1,CPNY2,FLOW,TOL
      IF (ISLACK - 999) 180,15,15
  180 NSLACK(ICODE) = ISLACK
      IF (ISLACK) 190,190,185
  185 NOISL = NOISL + 1
  190 CONTINUE
      ANAME1(ICODE) = CPNY1
      ANAME2(ICODE) = CPNY2
      DFLOW(ICODE) = FLOW
      DTOL(ICODE) = TOL
      NOARE = NOARE + 1
      GO TO 175
C     READ MISCELLANEOUS DATA
  195 READ (1,2005) CONP,CONQ,EACC,MINTC,ISKIP,MAXTC,MAXIT
      WRITE (4,3009) CONP,CONQ,EACC,MINTC,ISKIP,MAXTC,MAXIT
      WRITE (4,3010)
      DO 205 J = 1,NOTRA
      IF (TMIN(J)) 200,205,200
  200 LNEL = LTRA(J)
      NR = NRE(LNEL)
      VMTC(J) = SQRT(VP(NR)**2 + VQ(NR)**2)
  205 CONTINUE
C     VOLTAGE SOLUTION ROUTINE
 3011 FORMAT (T44,'AUTOMATIC TAP SELECTION TO CONTROL VOLTAGE'///,
     1             T88,'PARAMETER CHANGE'/T22,'ITERATION     IK       BUS
     1  V MAGNITUDE    OLD TAP     NEW TAP        AKLP            BKLP'/)
 3012 FORMAT (22X,3(I5,4X),F10.6,2(4X,F7.4),4X,F10.5,4X,F10.5)
 3013 FORMAT (///,T100,'NO. OF ADJUSTMENT = ',I3,///T50,'SUMMARY OF AREA
     1 INTERCHANGE'//T40,'(NEGATIVE FLOW DENOTES POWER RECIEVED BY AREA)
     2'//T13,'.............. L I N E  ..............     DESIRED
     3S L A C K   BUS      .........AREA TOTAL MW......'/T2,'    AREA
     4 FROM            TO              FLOW       FLOW        TOL      NAME
     5       GEN     GENERATION     LOAD     LOSSES'/)
 3014 FORMAT (10X,2(2X,I3,2A4),2X,F8.3)
 3015 FORMAT (T15,'TIE-LINE LOSSES',9X,F8.3)
 3016 FORMAT (/2X,2A4,28X,F8.3,43X,3(2X,F8.3))
 3017 FORMAT (/2X,2A4,26X,3(2X,F8.3),2X,I3,2A4,4(2X,F8.3)/)
 3018 FORMAT (1H1,T20,'THE SOLUTION OF THIS PROBLEM IS NOT CONVERGE')
 3019 FORMAT (//T20,'THE POWER INTERCHANGE BETWEEN AREAS SHOWN ABOVE IS
     1SATISFIED DESIRED FLOW')
 3020 FORMAT (//T20,'THE POWER INTERCHANGE BETWEEN AREAS SHOWN ABOVE IS
     1NOT SATISFIED DESIRED FLOW')
      IT = 0
      IK = 0
      NOADJ = 0
      JJ = 0
C     FORM PARAMETER
      DO 210 I = 1,MAXNB
      IF (VP(I)) 206,210,206
  206 CONTINUE
      G = YGS(I)
      B = YBS(I)
      ALP = 1./(G**2+B**2)
      PNET = PPG(I) - PPL(I)
      QNET = QQG(I) - QQL(I)
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      AKLP(I) = (PNET*G-QNET*B)*ALP
      BKLP(I) = -(QNET*G + PNET*B)*ALP
  210 CONTINUE
  215 ECMAX = 0.0
      ETMAX = 0.0
      IT = IT + 1
      IK = IK + 1
      DO 325 I = 1,MAXNB
      IF (VP(I)) 220,325,220
  220 CONTINUE
      IF (NTYP(I) -2) 225,325,225
  225 AYE = 0
      BYE = 0
      G = YGS(I)
      B = YBS(I)
      ALP = 1./(G**2 + B**2)
      DO 235 J = 1,NEL
      IF (NSE(J)-I) 235,230,235
  230 M = NRE(J)
      AYE = AYE+VP(M)*YGM(J)-VQ(M)*YBM(J)
      BYE = BYE+VQ(M)*YGM(J)+VP(M)*YBM(J)
  235 CONTINUE
      DO 245 J = 1,NEL
      IF (NRE(J)-I) 245,240,245
  240 M = NSE(J)
      AYE = AYE+VP(M)*YGM(J)-VQ(M)*YBM(J)
      BYE = BYE+VQ(M)*YGM(J)+VP(M)*YBM(J)
  245 CONTINUE
      AYLE = (AYE*G+BYE*B)*ALP
      BYLE = (BYE*G-AYE*B)*ALP
      MM = NTYP(I) + 1
      GO TO (300,250),MM
C     CONTROLLED VOLTAGE OR GENERATOR BUS
  250 DO 255 J = 1,NOGEN
      IF (NGEN(J) - I) 255,260,255
  255 CONTINUE
  260 CONTINUE
      RATIO = VMGE(J)/SQRT(VP(I)**2 + VQ(I)**2)
      EA = RATIO*VP(I)
      EB = RATIO*VQ(I)
      QNET = -(VMGE(J)**2)*B + BYE*EA - AYE*EB
      QQG(I) = QNET + QQL(I)
      IF (QMAX(J) - QMIN(J)) 270,265,270
  265 CONTINUE
      GO TO 291
  270 IF (QQG(I) - QMAX(J)) 280,280,275
  275 QQG(I) = QMAX(J)
      QNET = QQG(I) - QQL(I)
      IRCON = 1
      GO TO 295
  280 IF (QQG(I) - QMIN(J)) 285,290,290
  285 QQG(I) = QMIN(J)
      QNET = QQG(I) - QQL(I)
      IRCON = 1
      GO TO 295
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  290 CONTINUE
  291 VP(I) = EA
      VQ(I) = EB
  295 PNET = PPG(I) - PPL(I)
      ALP = 1./(G**2+B**2)
      AKLP(I) = (PNET*G-QNET*B)*ALP
      BKLP(I) = -(QNET*G + PNET*B)*ALP
C     CALCULATE THE VALUE OF EA AND EB
  300 C1 = 1./(VP(I)**2+VQ(I)**2)
      EA = (AKLP(I)*VP(I)-BKLP(I)*VQ(I))*C1+AYLE
      EB = (BKLP(I)*VP(I)+AKLP(I)*VQ(I))*C1+BYLE
      EP = EA - VP(I)
      SI = EB-VQ(I)
      ECMAG = SQRT(EP**2+SI**2)
      IF (ABS(ECMAG)-ECMAX) 310,310,305
  305 ECMAX = ABS(ECMAG)
  310 CONTINUE
      MM = NTYP(I) + 1
      GO TO (320,315),MM
  315 VP(I) = EA
      VQ(I) = EB
      GO TO 325
  320 VP(I) = VP(I) + CONP*EP
      VQ(I) = VQ(I) + CONQ*SI
  325 CONTINUE
      IF (IT - MINTC) 215,330,330
  330 IF (NOLTC) 385,385,335
  335 IF (IT - MINTC) 345,340,345
  340 NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
      WRITE (4,3011)
      GO TO 415
  345 IF (IT - MAXTC) 346,385,385
  346 CONTINUE
      IF (ECMAX - 0.001) 355,355,350
  350 IF (IK - ISKIP) 390,355,355
  355 DO 365 J = 1,NOTRA
      IF (TMIN(J)) 365,365,360
  360 CONTINUE
      LNEL = LTRA(J)
      NR = NRE(LNEL)
      DELV = SQRT(VP(NR)**2 + VQ(NR)**2) - VMTC(J)
      IF (ABS(DELV) - TTOL(J)) 365,365,375
  365 CONTINUE
      GO TO 385
  375 IF (IT - MAXIT) 380,380,395
  380 GO TO 415
  385 IF (ECMAX - EACC) 400,400,390
  390 IF (IT - MAXIT) 215,395,395
  395 WRITE (4,3018)
      GO TO 750
  400 IF (NOARE) 405,405,540
  405 IF (IT - MAXIT) 406,406,750
  406 IF (NOLTC) 410,410,415
  410 GO TO 750
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C       AUTOMATIC TAP CHANGING TO CONTROL VOLTAGE
  415 IC = 0
      DO 505 J = 1,NOTRA
      LNEL = LTRA(J)
      NS = NSE(LNEL)
      NR = NRE(LNEL)
      IF (NTYP(NR) - 1) 425,420,425
  420 IF (IRCON) 425,505,425
  425 IF (TMIN(J)) 430,505,430
  430 TN = TAP(J)
      C1 = SQRT(VP(NR)**2 + VQ(NR)**2)
      DELV = C1 - VMTC(J)
      IF (DELV) 435,505,440
  435 IF (ABS(DELV) - TTOL(J)) 505,505,450
  440 IF (ABS(DELV) - TTOL(J)) 505,505,445
  445 IF (LOWS(J)) 455,470,455
  450 IF (LOWS(J)) 470,455,470
  455 IF (TN-TMIN(J)) 460,460,465
  460 TAP(J) = TMIN(J)
      IC = 1
      GO TO 485
  465 TAP(J) = TAP(J) - (5./8.)/100
      IC = 1
      GO TO 485
  470 IF (TN-TMAX(J)) 480,475,475
  475 TAP(J) = TMAX(J)
      IC = 1
      GO TO 485
  480 TAP(J) = TAP(J) + (5./8.)/100
      IC = 1
  485 CONTINUE
C       CHANGE PARAMETER
      G = YGM(LNEL)*TN
      B = YBM(LNEL)*TN
      SG = (1./TAP(J)**2 -1./TAP(J) -1./TN**2 + 1./TN)*G
      SB = (1./TAP(J)**2 -1./TAP(J) -1./TN**2 + 1./TN)*B
      CR1 = (1./TN - 1./TAP(J))*G
      CR2 = (1./TN - 1./TAP(J))*B
      IF (LOWS(J)) 490,495,490
  490 RG = SG
      RB = SB
      SG = CR1
      SB = CR2
      GO TO 500
  495 CONTINUE
      RG = CR1
      RB = CR2
  500 CONTINUE
      G = G/TAP(J)
      B = B/TAP(J)
      YGS(NS) = YGS(NS) - YGM(LNEL) + SG + G
      YBS(NS) = YBS(NS) - YBM(LNEL) + SB + B
      YGS(NR) = YGS(NR) - YGM(LNEL) + RG + G
      YBS(NR) = YBS(NR) - YBM(LNEL) + RB + B
      YGM(LNEL) = G
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      YBM(LNEL) = B
      G = YGS(NS)
      B = YBS(NS)
      ALP = 1./(G**2+B**2)
      PNET = PPG(NS) - PPL(NS)
      QNET = QQG(NS) - QQL(NS)
      AKLP(NS) = (PNET*G - QNET*B)*ALP
      BKLP(NS) = -(QNET*G + PNET*B)*ALP
      G = YGS(NR)
      B = YBS(NR)
      ALP = 1./(G**2+B**2)
      PNET = PPG(NR) - PPL(NR)
      QNET = QQG(NR) - QQL(NR)
      AKLP(NR) = (PNET*G - QNET*B)*ALP
      BKLP(NR) = -(QNET*G + PNET*B)*ALP
      WRITE (4,3012) IT,IK,NR,C1,TN,TAP(J),AKLP(NR),BKLP(NR)
  505 CONTINUE
      IF (IC) 510,510,520
  510 IF (ECMAX - EACC) 515,515,520
  515 GO TO 530
  520 IK = 0
      IF (IT - MAXIT) 525,525,750
  525 GO TO 215
C     POWER INTERCHANGE BETWEEN AREAS
  530 IF (NOARE) 535,535,540
  535 GO TO 750
  540 NOADJ = NOADJ + 1
      IF (NOADJ - 3) 550,550,545
  545 GO TO 750
  550 JJ = 0
      NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
      WRITE (4,3013) NOADJ
      PPG(NSB) = 0.0
      DO 730 K = 1,NOARE
      ALOSS(K) = 0.0
      TLOSS = 0.0
      AFLOW = 0.0
      ALOAD = 0.0
      AGEN = 0.0
      NBUS = NSLACK(K)
      DO 710 I = 1,MAXNB
      IF (VP(I)) 555,710,555
  555 CONTINUE
      IF (NAREA(I) -K) 710,560,710
  560 DO 705 J = 1,NEL
      IF (NSE(J) - I) 570,565,570
  565 M = NRE(J)
      J1 = 0
      GO TO 580
  570 IF (NRE(J) - I) 705,575,705
  575 M = NSE(J)
      J1 = 1
  580 C1 = VP(I) - VP(M)
      C2 = VQ(I) - VQ(M)
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      AYE = YGM(J)*C1 -YBM(J)*C2
      BYE = YBM(J)*C1 + YGM(J)*C2
      SG = 0.0
      SB = BBSH(J)
      RG = 0
      RB = SB
      IF (BBSH(J)) 680,585,680
  585 IF (NOTRA) 680,680,590
  590 CONTINUE
      DO 595 KK = 1,NOTRA
      IF (LTRA(KK)-J) 595,600,595
  595 CONTINUE
      GO TO 680
  600 SG = (1./TAP(KK) - 1)*YGM(J)
      SB = (1./TAP(KK) - 1)*YBM(J)
      C1 = (TAP(KK) - 1)*YGM(J)
      C2 = (TAP(KK) - 1)*YBM(J)
      IF (LOWS(KK)) 665,670,665
  665 RG = SG
      RB = SB
      SG = C1
      SB = C2
      GO TO 675
  670 CONTINUE
      RG = C1
      RB = C2
  675 IF (J1) 685,680,685
  680 SIR = VP(I)*SG - VQ(I)*SB + AYE
      SII = VQ(I)*SG + VP(I)*SB + BYE
      RIR = VP(M)*RG - VQ(M)*RB - AYE
      RII = VQ(M)*RG + VP(M)*RB - BYE
      GO TO 690
  685 SIR = VP(I)*RG - VQ(I)*RB + AYE
      SII = VQ(I)*RG + VP(I)*RB + BYE
      RIR = VP(M)*SG - VQ(M)*SB - AYE
      RII = VQ(M)*SG + VP(M)*SB - BYE
C     CALCULATION OF POWER FLOW
  690 C1 = 100.*(VP(I)*SIR + VQ(I)*SII)
      C3 = 100.*(VP(M)*RIR + VQ(M)*RII)
      IF (NTYP(I) - 2) 692,691,692
  691 PPG(I) = PPG(I) + C1*0.01 + PPL(I)
  692 CONTINUE
      VLOSS = C1 + C3
      IF(NAREA(M)-K) 700,695,700
  695 ALOSS(K) = ALOSS(K) + C1
      GO TO 705
  700 TLOSS = TLOSS - VLOSS/2
      AFLOW = AFLOW + C1 - VLOSS/2
      WRITE (4,3014) I,BNAM1(I),BNAM2(I),M,BNAM1(M),BNAM2(M),C1
  705 CONTINUE
      AGEN = AGEN + PPG(I)*100.
      ALOAD = ALOAD + PPL(I)*100.
  710 CONTINUE
      ALOSS(K) = ALOSS(K) - TLOSS
      WRITE (4,3015) TLOSS
```

```
27/04/70              FORTMAIN
      IF (NSLACK(K)) 720,715,720
  715 WRITE (4,3016) ANAME1(K),ANAME2(K),AFLOW,AGEN,ALOAD,ALOSS(K)
      GO TO 730
  720 PPG(NBUS) = PPG(NBUS)*100.
      WRITE (4,3017) ANAME1(K),ANAME2(K),AFLOW,DFLOW(K),DTOL(K),
     1NSLACK(K),BNAM1(NBUS),BNAM2(NBUS),PPG(NBUS),AGEN,ALOAD,ALOSS(K)
      PPG(NBUS) = PPG(NBUS)*0.01
      DELP = DFLOW(K) - AFLOW
      IF (ABS(DELP) - DTOL(K)) 730,730,725
  725 PPG(NBUS) = PPG(NBUS) + DELP*0.01
      JJ = 1
      NPAGE = NPAGE -1
  730 CONTINUE
  735 IF (JJ) 740,740,745
  740 WRITE (4,3019)
      GO TO 750
  745 IK = 0
      WRITE (4,3020)
      GO TO 215
  750 CONTINUE
C     OUTPUT ROUTINE
 3021 FORMAT (//T20,'THE COMPONENT OF BUS VOLTAGE'//T21,'BUS     REAL
     1     IMAGINARY'/)
 3022 FORMAT (20X,I4,3X,F8.5,5X,F8.5)
 3023 FORMAT (///,T37,'GENERATOR',T57,'LOAD',T69,'REACTOR CAPACITOR FROM
     1  TO      L I N E  F L O W     PCT      TAP'/T2,'BUS     NAME     VOLTA
     2GE    ANGLE     MW        MVAR        MW        MVAR     MVAR       MVAR
     1BUS  BUS      MW          MVAR      CAP.'/)
 3024 FORMAT (85X,2I4,2(2X,F9.3),2X,F6.2,2X,F7.5)
 3034 FORMAT (84X,I4,1X,I4,2(2X,F9.3),10X,F7.5)
 3025 FORMAT (I4,2X,2A4,F8.5,1X,F7.3,5(2X,F7.3)/)
 3026 FORMAT (I4,2X,2A4,F8.5,1X,F7.3,4(2X,F7.3),9X,F7.3/)
 3035 FORMAT (I4,2X,2A4,F8.5,1X,F7.3,4(2X,F7.3)/)
 3027 FORMAT (///,T20,'SUMMARY OF MISMATCH'//T25,'BUS'/)
 3028 FORMAT (22X,I4,2(4X,F8.5))
 3029 FORMAT (///,T6,'SUMMARY'//T6,'LINE AND BUS TOTAL       ACTUAL  MAX'
     1,T73,'MW            MVAR              MISCELLANEOUS CONSTANTS'/T6,
     2'.............',T30,'......  ...',T69,'..........   ..........',
     3T100,'.........................'/T6,'TRANSMISSION LINES',6X,I5,
     4T38,'400',T49,'TOTAL LOAD',10X,F10.3,3X,F10.3,8X,T100,'ACTUAL ITER
     5ATIONS    ',I6/T6,'TRANSFORMERS - FIXED',4X,I5,T38,' 50',T49,'TOTA
     6L LOSSES',8X,F10.3,3X,F10.3,T100,'MAXIMUM ITERATIONS   ',I6/T19,
     7'- LTC',6X,I5,T38,' 50',T49,'LINE CHARGING',20X,F10.3,8X,T100,
     8'TOLERANCE',12X,F8.6)
 3031 FORMAT (T3,'TOTAL LINES  .............',I5,T38,
     9'400',8X,T49,'FIXED CAPACITOR',18X,F10.3,T100,'ACC. FACT. - REAL
     A ',F4.1/T55,'REACTOR',20X,F10.3,T111,'- IMAG   ',F4.1/T6,'ACTIVE B
     BUSES - NON REG  ',
     B       I5,T38,'200',T100,'LTC START',12X,I3,/T19,'- GENERATOR',I5,
     CT38,' 50',T49,'SYSTEM MISMATCH',5X,F10.3,3X,F10.3,T104,'SKIP',
     D12X,I4/T3,'TOTAL BUSES  .............',I5,T38,'200'/T6,'CAPACITOR
     ES OR REACTORS  ',I5,T38,'100',T49,'TOTAL  GENERATION',3X,F10.3,
     F3X,F10.3)
      NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
```

```
27/04/70              FORTMAIN
      WRITE (4,3021)
      DO 760 I = 1,MAXNB
      IF (VP(I)) 755,760,755
  755 WRITE (4,3022) I,VP(I),VQ(I)
  760 CONTINUE
      IP = 0
      SGENP = 0.
      SGENQ = 0.
      SLODP = 0.
      SLODQ = 0.
      PMIS = 0.
      QMIS = 0.
      SPLOSS = 0.
      SQLOSS = 0.
      CAPAC = 0.
      REACT = 0.
      TBSH = 0.
      NLINE = 6
      NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
      WRITE (4,3023)
      DO 980 I = 1,MAXNB
      IF (VP(I)) 765,980,765
  765 CONTINUE
      BUSP(I) = 0.
      BUSQ(I) = 0.
      BLIN = 0.
      DO 840 J = 1,NEL
      IF (NSE(J)-I) 775,770,775
  770 M = NRE(J)
      J1 = 0
      GO TO 785
  775 IF (NRE(J) - I) 840,780,840
  780 M = NSE(J)
      J1 = 1
  785 C1 = VP(I) -VP(M)
      C2 = VQ(I) - VQ(M)
      AYE = YGM(J)*C1 - YBM(J)*C2
      BYE = YBM(J)*C1 + YGM(J)*C2
      SG = 0.
      SB = BBSH(J)
      RG = 0.
      RB = SB
      IF (BBSH(J)) 825,790,825
  790 IF (NOTRA) 825,825,795
  795 CONTINUE
      DO 800 K = 1,NOTRA
      IF (LTRA(K)-J) 800,805,800
  800 CONTINUE
      GO TO 825
  805 SG = (1./TAP(K) - 1)*YGM(J)
      SB = (1./TAP(K) - 1)*YBM(J)
      C1 = (TAP(K) - 1.)*YGM(J)
      C2 = (TAP(K) -1.)*YBM(J)
      IP = 1
```

```
27/04/70              FORTMAIN
      IF (LOWS(K)) 810,815,810
  810 RG = SG
      RB = SB
      SG = C1
      SB = C2
      GO TO 820
  815 CONTINUE
      RG = C1
      RB = C2
  820 IF (J1) 830,825,830
  825 SIR = VP(I)*SG - VQ(I)*SB + AYE
      SII = VQ(I)*SG + VP(I)*SB + BYE
      RIR = VP(M)*RG - VQ(M)*RB - AYE
      RII = VQ(M)*RG + VP(M)*RB - BYE
      GO TO 835
  830 SIR = VP(I)*RG - VQ(I)*RB + AYE
      SII = VQ(I)*RG + VP(I)*RB + BYE
C     CALCULATION OF POWER FLOW
  835 C1 = 100.*(VP(I)*SIR + VQ(I)*SII)
      C2 = 100.*(VQ(I)*SIR - VP(I)*SII)
      IF (RATING(J)) 831,832,831
  831 VA = SQRT(C1**2 + C2**2)
      PLC = VA*100./RATING(J)
  832 CONTINUE
      NLINE = NLINE + 1
      IF (NLINE - 56) 827,827,826
  826 NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
      WRITE (4,3023)
      NLINE = 7
  827 CONTINUE
      IF (IP) 838,838,836
  836 IF (J1 - LOWS(K)) 838,837,838
  837 IF (RATING(J)) 833,834,833
  833 WRITE (4,3024) I,M,C1,C2,PLC,TAP(K)
      GO TO 839
  834 WRITE (4,3034) I,M,C1,C2,TAP(K)
      GO TO 839
  838 IF (RATING(J)) 841,842,841
  841 WRITE (4,3024) I,M,C1,C2,PLC
      GO TO 839
  842 WRITE (4,3034) I,M,C1,C2
  839 CONTINUE
      IP = 0
      SPLOSS = SPLOSS + C1
      SQLOSS = SQLOSS - C2
      BUSP(I) = BUSP(I) + C1
      BUSQ(I) = BUSQ(I) + C2
      BLIN = BLIN + BBSH(J)*(VP(I)**2 + VQ(I)**2)
  840 CONTINUE
      NLINE = NLINE + 2
      IF (NLINE - 56) 847,847,846
  846 NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
      WRITE (4,3023)
```

```
27/04/70              FORTMAIN
      NLINE = 7
  847 CONTINUE
      PPG(I) = PPG(I)*100.
      QQG(I) = QQG(I)*100.
      PPL(I) = PPL(I)*100.
      QQL(I) = QQL(I)*100.
      C1 = VP(I)**2 + VQ(I)**2
      C2 = SQRT(C1)
      IF (NOBSR) 860,860,845
  845 DO 850 K = 1,NOBSR
      IF (NBSR(K) - I) 850,855,850
  850 CONTINUE
      GO TO 860
  855 BBSR(K) = C1*BBSR(K)*100.
  860 CONTINUE
      C1 = ABS(VQ(I)/VP(I))
      C1 = ATAN(C1)*57.296
      IF (VP(I)) 865,890,890
  865 IF (VQ(I)) 870,885,885
  870 C1 = C1 - 180
      GO TO 900
  885 C1 = 180 - C1
      GO TO 900
  890 IF (VQ(I)) 895,900,900
  895 C1 = -C1
  900 IF (NTYP(I) - 2) 930,905,930
  905 PPG(I) = BUSP(I) + PPL(I)
      IF (NOBSR) 925,925,910
  910 DO 920 K = 1,NOBSR
      IF (NBSR(K) - I) 920,915,920
  915 QQG(I) = BUSQ(I) + QQL(I) + BBSR(K)
      GO TO 930
  920 CONTINUE
  925 QQG(I) = BUSQ(I) + QQL(I)
  930 BUSP(I) = BUSP(I) - PPG(I) + PPL(I)
      IF (NOBSR) 950,950,935
  935 DO 945 K = 1,NOBSR
      IF (NBSR(K) - I) 945,940,945
  940 BUSQ(I) = BUSQ(I) - QQG(I) + QQL(I) + BBSR(K)
      GO TO 955
  945 CONTINUE
  950 BUSQ(I) = BUSQ(I) - QQG(I) + QQL(I)
  955 SGENP = SGENP + PPG(I)
      SGENQ = SGENQ + QQG(I)
      SLODP = SLODP + PPL(I)
      SLODQ = SLODQ + QQL(I)
      PMIS = PMIS + BUSP(I)
      QMIS = QMIS + BUSQ(I)
      TBSH = TBSH + BLIN*100.
      IF (NOBSR) 975,975,960
  960 DO 965 K = 1,NOBSR
      IF (NBSR(K) - I) 965,970,965
  965 CONTINUE
      GO TO 975
  970 IF (BBSR(K)) 971,972,972
```

```
27/04/70              FORTMAIN
  971 CBSR = -BBSR(K)
      BBSR(K) = CBSR
      CAPAC = CAPAC + BBSR(K)
      WRITE (4,3026) I,BNAM1(I),BNAM2(I),C2,C1,PPG(I),QQG(I),PPL(I),
     1QQL(I),BBSR(K)
      GO TO 980
  972 REACT = REACT + BBSR(K)
      WRITE (4,3025) I,BNAM1(I),BNAM2(I),C2,C1,PPG(I),QQG(I),PPL(I),
     1QQL(I),BBSR(K)
      GO TO 980
  975 CONTINUE
      WRITE (4,3035) I,BNAM1(I),BNAM2(I),C2,C1,PPG(I),QQG(I),PPL(I),
     1QQL(I)
  980 CONTINUE
C     SYSTEM SUMMARY
      NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
      WRITE (4,3027)
      DO 990 I = 1,MAXNB
      IF (VP(I)) 985,990,985
  985 WRITE (4,3028) I,BUSP(I),BUSQ(I)
  990 CONTINUE
C     CALCULATE ACTUAL NUMBER OF ANY ELEMENTS
      NOLIN = NEL - NOTRA
      NOFIX = NOTRA - NOLTC
      NOLBUS = NUBUS - NOGEN
      NPAGE = NPAGE + 1
      WRITE (4,3032) NPAGE
      WRITE (4,3029) NOLIN,SLODP,SLODQ,IT,NOFIX,SPLOSS,SQLOSS,MAXIT,
     1NOLTC,TBSH,EACC
      WRITE (4,3031) NEL,CAPAC,CONP,REACT,CONQ,NOLBUS,MINTC,NOGEN,PMIS,
     2QMIS,ISKIP,NUBUS,NOBSR,SGENP,SGENQ
      IF (LCASE) 995,995,1000
  995 GO TO 1
 1000 CALL EXIT
      END
```

ภาคผนวก ข

Load Flow Pattern ของระบบไฟฟ้าเชื่อมโยงในเขตภาคตะวันออกเฉียงเหนือ

อักษรย่อของชื่อของ Power Station และPower Substation

Power Station

LDH	=	Lam Dom Noi Hydro
NGH	=	Nam Ngum Hydro
NPRH	=	Nam Phrom Hydro
NPH	=	Nam Pung Hydro
URH	=	Ubolratana Hydro
NRG	=	Nakornrajsima or Korat Gas Turbine
UDG	=	Udorn Thani Gas Turbine

Power Sub-Station

AT	=	Angthong
KK	=	Khonkaen
MK	=	Mahasarakarm
NRI	=	Nakornrajasima (NEEA เดิม)
NR2	=	Nakornrajasima (YEA เดิม)
NaK	=	Nakae
NK	=	Nongkhai
NN	=	Nakornphanom
SB	=	Saraburi
PC	=	Pakchong
PL	=	Phol
SK	=	Sakolnakorn
SR	=	Surin
TL	=	Thalan
TP	=	Thatphanom
UB	=	Ubolrajathani
UD	=	Udornthani
VT	=	Vientiane
WR	=	Warin Chamrap
YT	=	Yasothorn

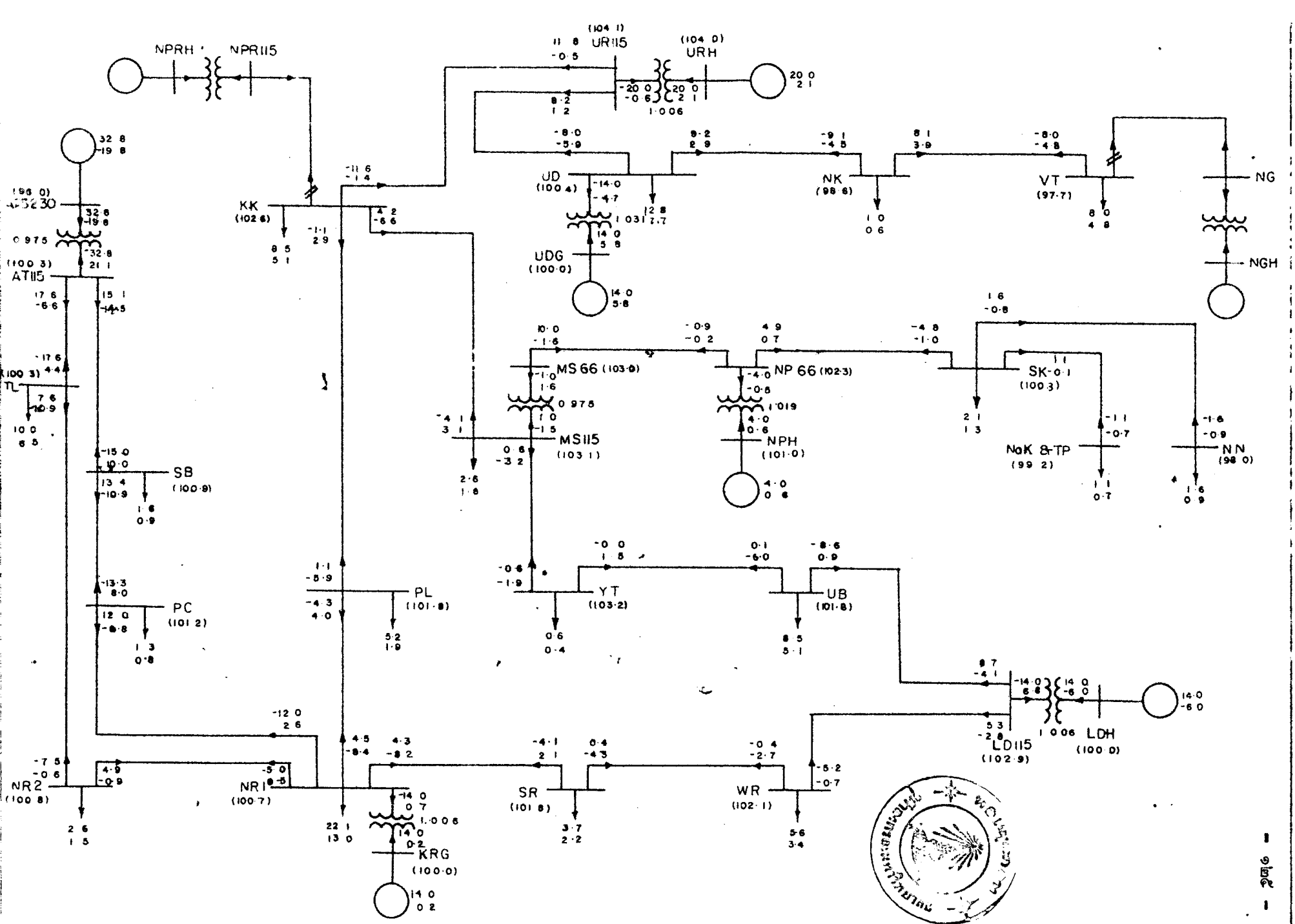
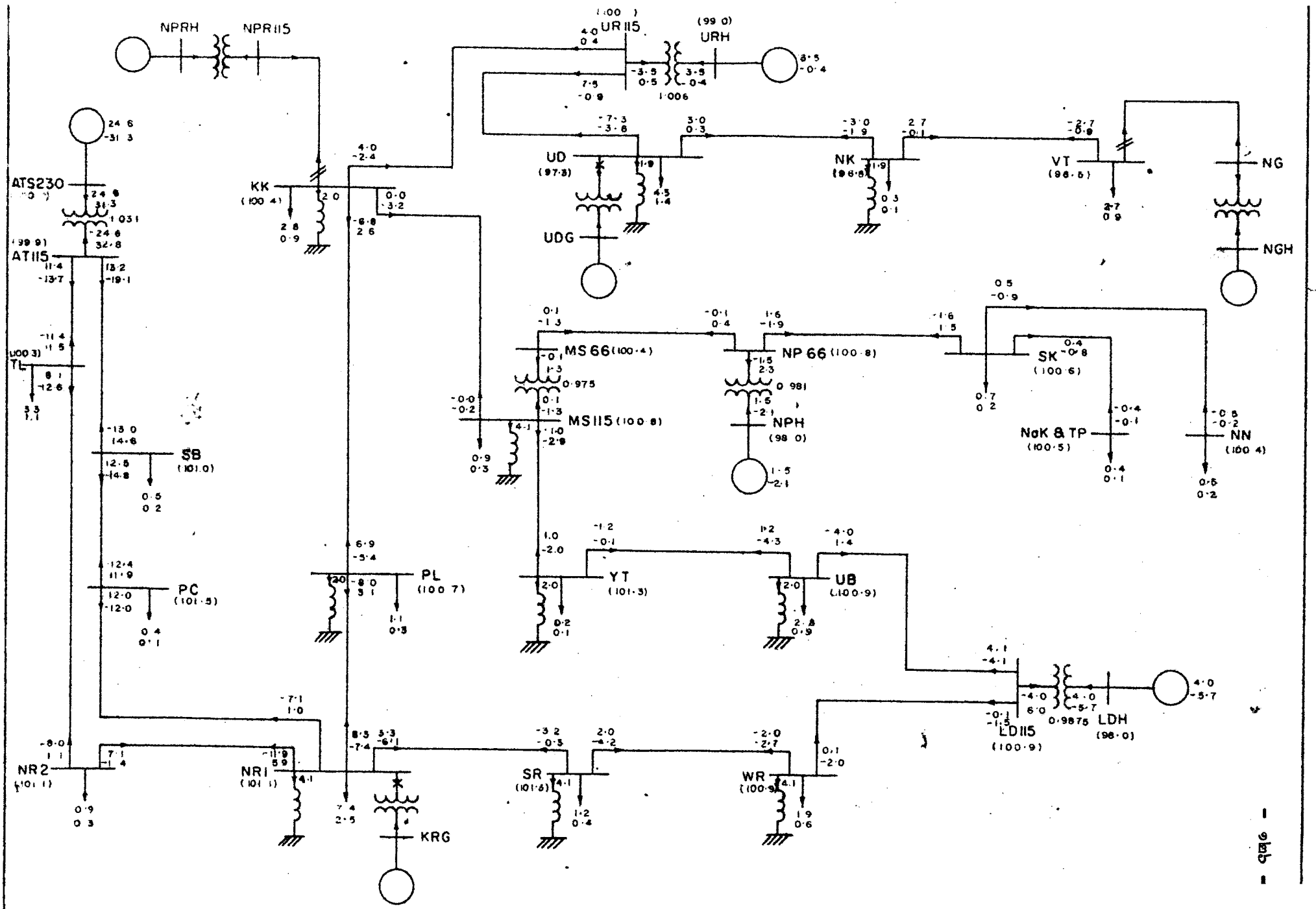


Fig. A1 Case 971 PEAK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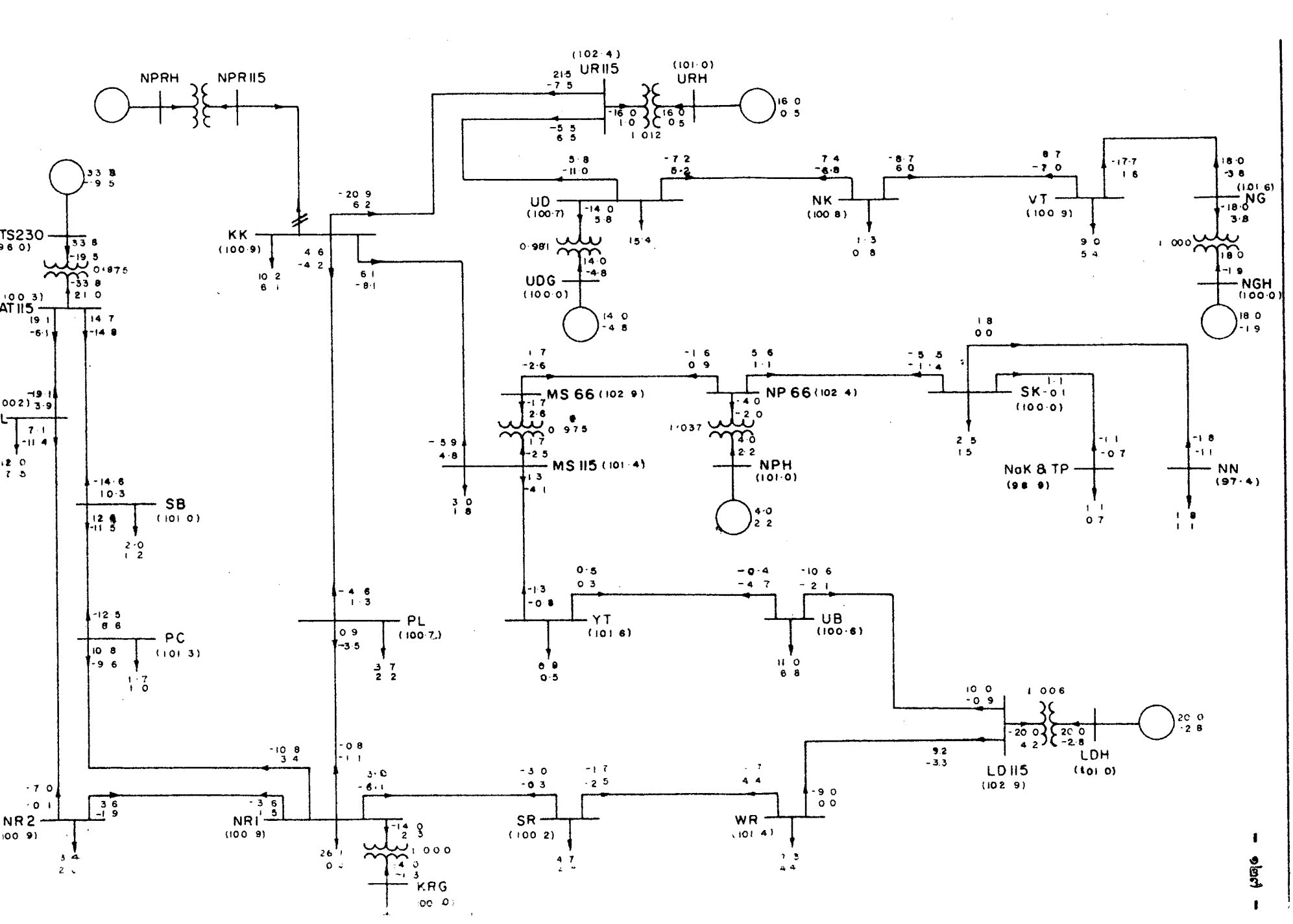
UR115
URH
UD
UDG
NK
VT
NG
NGH
ATS230
AT115
KK
TL
SB
PC
PL
MS66
MS115
NP66
NPH
SK
NaK & TP
NN
YT
UB
LD115
LDH
NR2
NR1
SR
WR
KRG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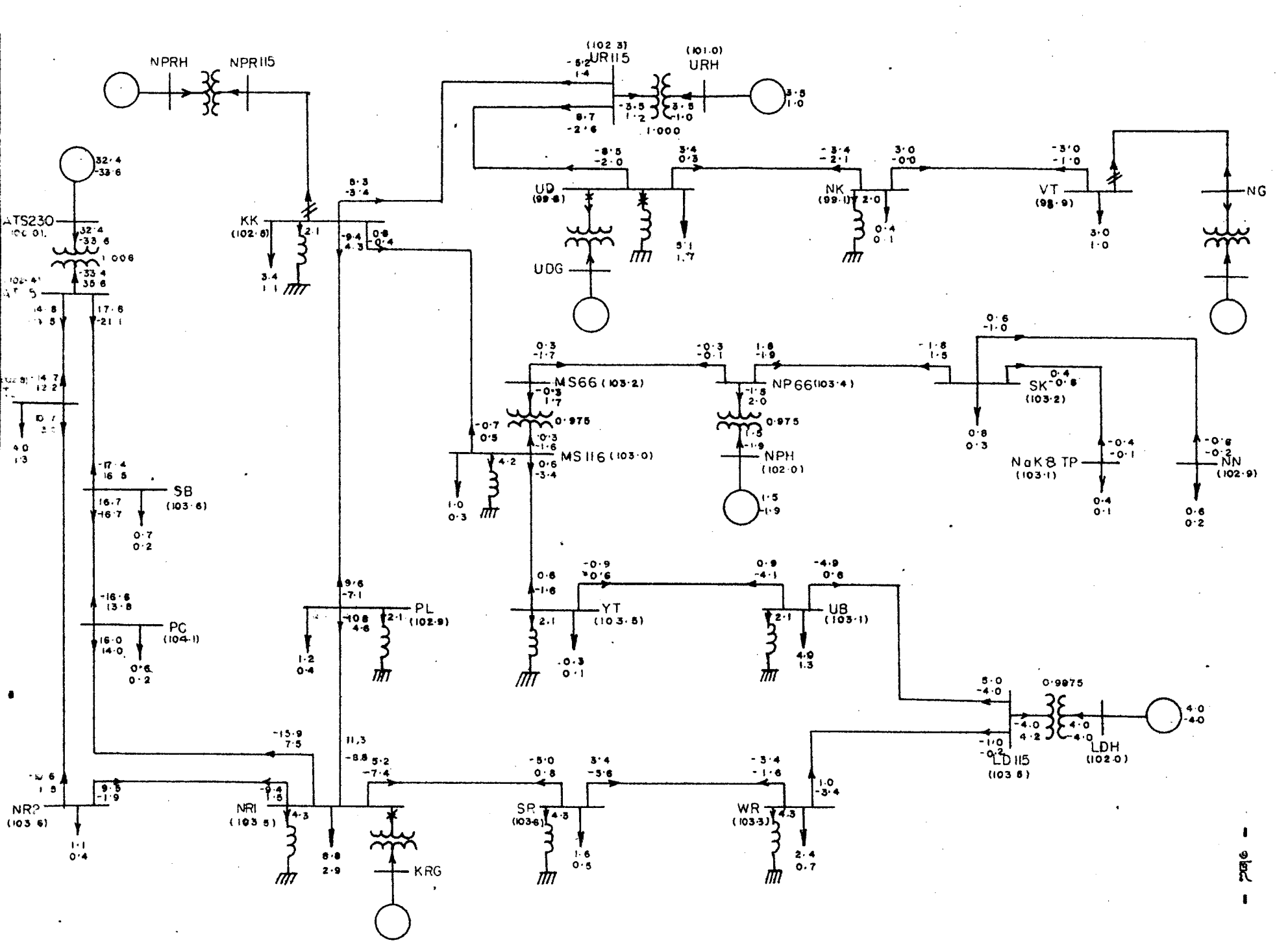
NG
(101·6)
NGH
(100·0)
UDG
(100·0)
KK
(100·9)
TS230
AT115
MS 66 (102·9)
NP 66 (102·4)
SK·01
(100·0)
MS 115 (101·4)
NPH
(101·0)
NaK & TP
(98·9)
NN
(97·4)
SB
(101·0)
PC
(101·3)
PL
(100·7)
YT
(101·6)
UB
(100·6)
LD115
(102·9)
LDH
(101·0)
NR2
NR1
(100·9)
SR
(100·2)
WR
(101·4)
KRG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NG
ATS230
KK
(102·8)
MS66 (103·2)
NP66(103·4)
SK
(103·2)
MS116 (103·0)
NPH
(102·0)
NaK8 TP
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NN
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SB
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PC
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PL
(102·9)
YT
(103·5)
UB
(103·1)
0·9975
LDH
(102·0)
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NRP
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NRI
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SR
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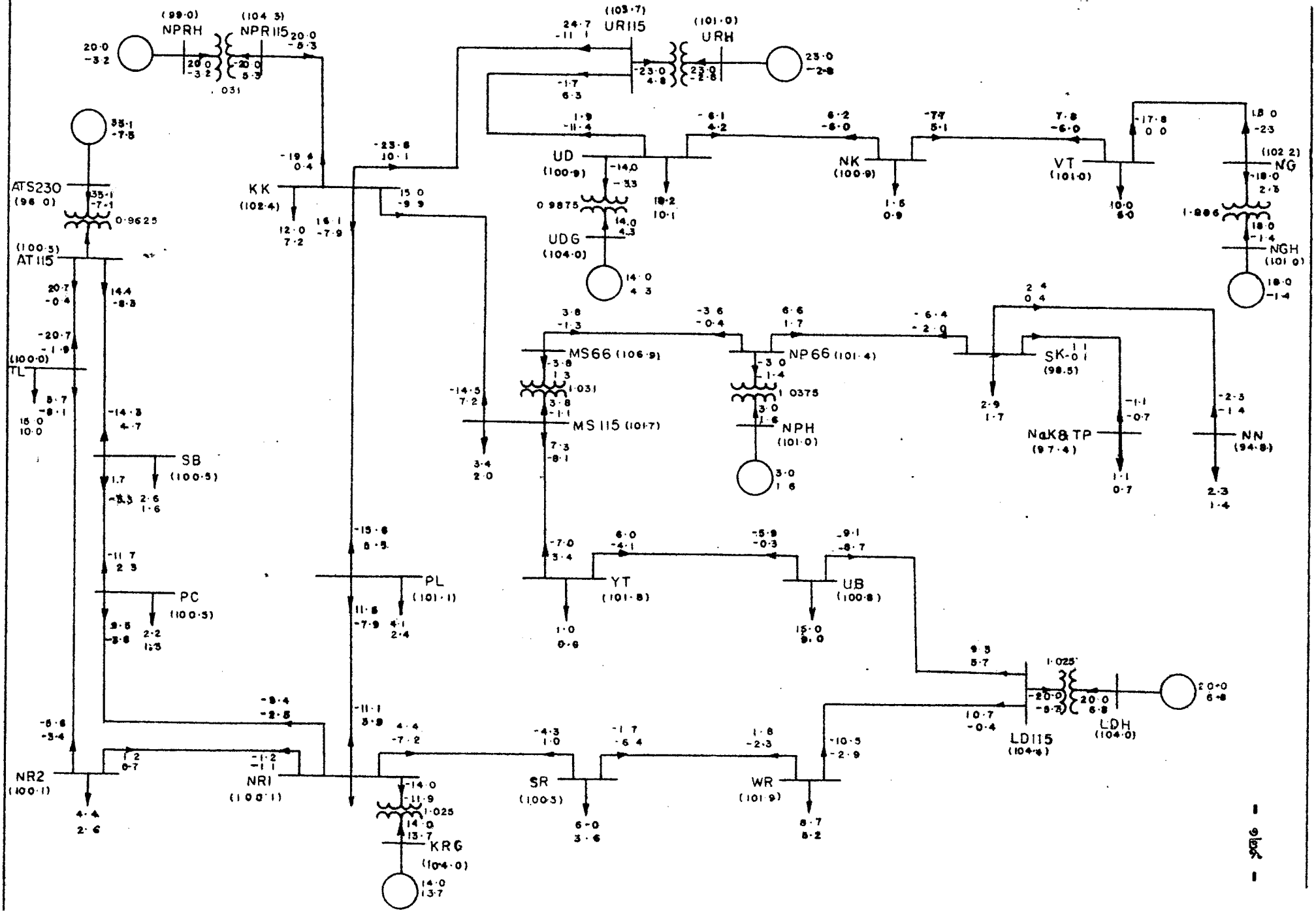
WR
(103·3)
KRG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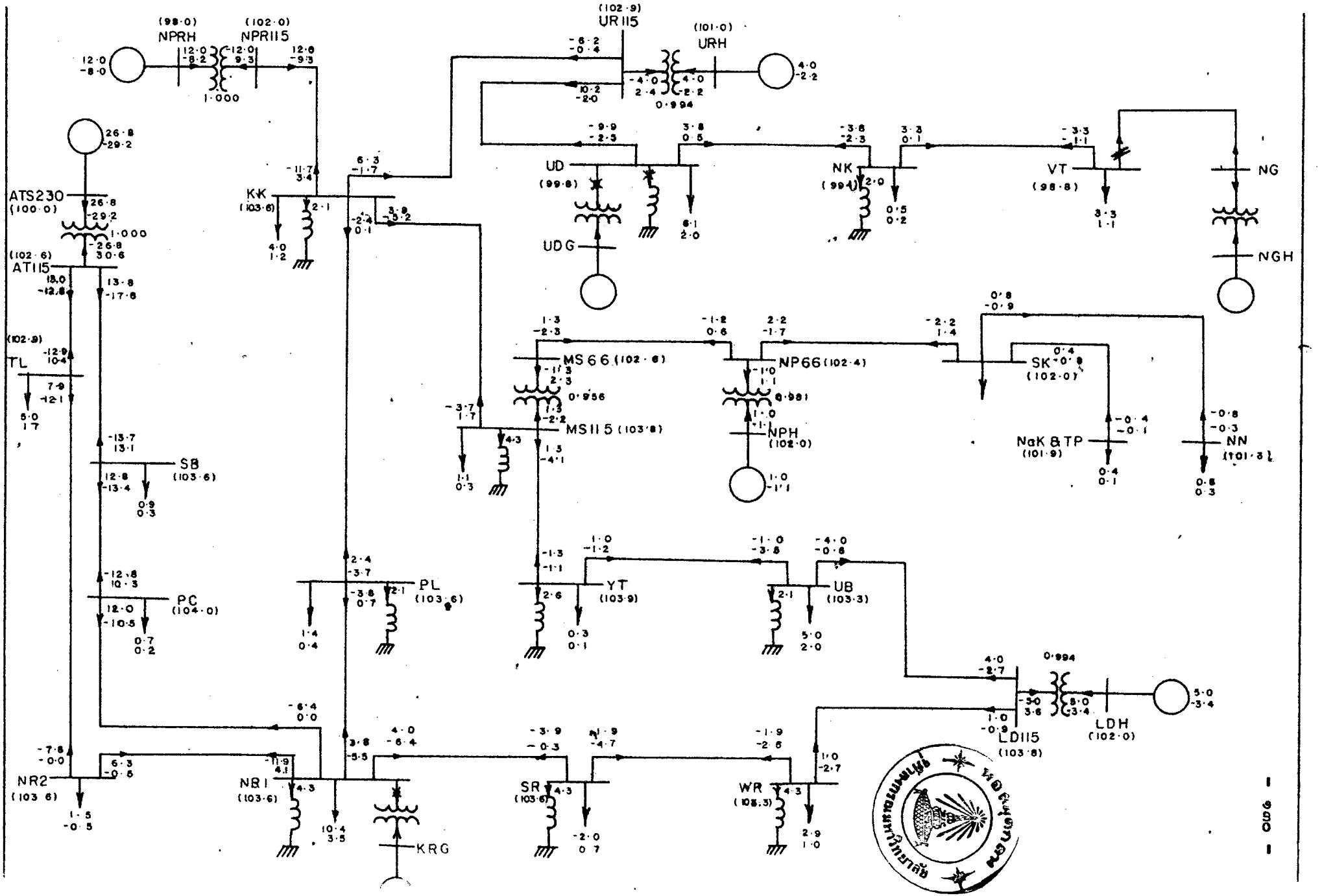
LD115
NR2
NR1
SR
WR
KRG
UDG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KK
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MS115 (103·8)
NP66 (102·4)
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NaK & TP
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YT
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UB
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NR2
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NB1
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WR
(103·3)

บรรณานุกรม

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