CTTM1 - A FORTRAN PACKAGE FOR POWER SYSTEM CONTINGENCY ANALYSIS

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Abstract

This document contains a listing of the package CTTM1 described in [1] for power system contingency analysis. Outages of transmission lines are simulated one at a time. The package employs the fast decoupled method and sparse matrix techniques for solving the load flow problem.

The package CTTM1 has been developed for the CDC 170/730 system with the NOS 1.4 level 552 operating system and the Fortran Extended (FTN) version 4.8 compiler. The listing contains a total of 168 lines (including 36 comments) constituting three subroutines. The listing does not include packages TTM1 and MA28 used for solving load flow problems.

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I. INTRODUCTION

CTTM1 is a package for power system contingency analysis. Outages of transmission lines are simulated one at a time. The package implements the fast decoupled method [2] and also employs sparse matrix techniques for solving load flow problems by appropriate calls to packages TTM1 [3] and MA28 [4].

The package CTTM1 and documentation have been developed in Fortran IV for use on the CDC 170/730 system with the NOS 1.4 level 552 operating system. The package is available at McMaster University in the form of a library of binary relocatable subroutines. The library is in the group indirect file LIBCTM1 accessible under the charge RJWBAND. The package calls subroutines FORMYT and LFLFD1M of the package TTM1. Subsequently, subroutines MA28A and MA28C of the Harwell package MA28 for solving sparse linear equations are used. Packages TTM1 and MA28 must thus be available when CTTM1 is used; this document includes neither of these packages.

The CTTM1 package contains 168 lines of which 36 are comments.

II. REFERENCES

[1] J.W. Bandler, M.A. El-Kady and J. Wojciechowski, "CTTM1 - A Fortran package for power system contingency analysis", Department of Electrical and Computer Engineering, McMaster University, Hamilton, Canada, Report SOS-83-10-U, 1983.

[2] B. Stott and O. Alsac, "Fast decoupled load flow", IEEE Trans. Power Apparatus and Systems, vol. PAS-93, 1974, pp. 859-869.

[3] J.W. Bandler, M.A. El-Kady and J. Wojciechowski, "TTM1 - A Fortran implementation of the Tellegen theorem method to power system simulation and design", Department of Electrical and Computer Engineering, McMaster University, Hamilton, Canada, Report SOS-82-12-U2, 1983.

[4] I.S. Duff, "MA28 - A set of Fortran subroutines for sparse unsymmetric linear equations", Computer Science and Systems Division, AERE Harwell, Oxfordshire, England, Report R.8730, 1980.

III. LISTING OF THE CTTM1 PACKAGE

Subroutine	Number of lines (source text)	Number of words (compiled code)	Listing from page
CONTA	41	342	4
CONTB	42	271	5
CONTC	85	371	6

```
C                                                                       A    1
C                                                                       A    2
C                                                                       A    3
      SUBROUTINE CONTA (LBINP,LBOUT,LINPG,LINPB,LG,LB,LOUTG,LOUTB,LTAP,B A    4
     1TYP,BSTL,BCV,V,W,LW,NB,NTL,NLB,ITER,TOLV,TIME,INPT,OTPT)           A    5
C                                                                       A    6
C     SUBROUTINE CONTA IS THE HIGHEST LEVEL SUBROUTINE FOR POWER        A    7
C     SYSTEM CONTINGENCY ANALYSIS USING INTERACTIVE MODE OF WORK        A    8
C                                                                       A    9
      INTEGER LBINP(1),LBOUT(1),BTYP(1),OTPT                            A   10
      REAL LINPG(1),LINPB(1),LG(1),LB(1),LOUTG(1),LOUTB(1),LTAP(1),BSTL( A   11
     11),W(1)                                                           A   12
      COMPLEX BCV(1),V(1)                                               A   13
C                                                                       A   14
      ICALL=1                                                           A   15
   10 WRITE (OTPT,50)                                                   A   16
      READ (INPT,*) ICONT                                               A   17
      IF (ICONT.EQ."YES") GO TO 20                                      A   18
      IF (ICONT.NE."STOP") GO TO 10                                     A   19
      RETURN                                                            A   20
   20 WRITE (OTPT,80)                                                   A   21
      READ (INPT,*) IWRITE                                              A   22
      WRITE (OTPT,90)                                                   A   23
      READ (INPT,*) ISTART                                              A   24
   30 WRITE (OTPT,60)                                                   A   25
      READ (INPT,*) LN                                                  A   26
      IF (LN.GE.1.AND.LN.LE.NTL) GO TO 40                               A   27
      WRITE (OTPT,70) NTL                                               A   28
      GO TO 30                                                          A   29
   40 CALL CONTB (LBINP,LBOUT,LINPG,LINPB,LG,LB,LOUTG,LOUTB,LTAP,BTYP,BS A   30
     1TL,BCV,V,W,LW,NB,NTL,NLB,ITER,TOLV,TIME,LN,ISTART,ICALL,OTPT,IWRIT A   31
     2E)                                                                A   32
      GO TO 10                                                          A   33
   50 FORMAT (//40(".-")/1X,53HTYPE "YES" FOR CONTINGENCY ANALYSIS OR "S A   34
     1TOP" TO STOP)                                                     A   35
   60 FORMAT (/" ENTER LINE INDEX")                                     A   36
   70 FORMAT (/" LINE INDEX MUST BE GREATER THAN 1 AND LESS THAN ",I3)  A   37
   80 FORMAT (/" SELECT PRINTOUT LEVEL (0,1,2,3 OR 4)")                 A   38
   90 FORMAT (/" SELECT STARTING POINT (0-INITIAL POINT,1-LAST SOLUTION) A   39
     1 ")                                                               A   40
      END                                                               A   41
```

```
C                                                                       B    1
C                                                                       B    2
C                                                                       B    3
      SUBROUTINE CONTB (LBINP,LBOUT,LINPG,LINPB,LC,LB,LOUTG,LOUTB,LTAP,B  B    4
     1TYP,BSTL,BCV,V,W,LW,NB,NTL,NLB,ITER,TOLV,TIME,LN,ISTART,ICALL,OTPT  B    5
     2,IWRITE)                                                          B    6
C                                                                       B    7
C     SUBROUTINE  CONTB  IS THE HIGHEST LEVEL SUBROUTINE  FOR  POWER    B    8
C     SYSTEM CONTINGENCY ANALYSIS USING NON-INTERACTIVE MODE OF WORK     B    9
C                                                                       B   10
      INTEGER LBINP(1),LBOUT(1),BTYP(1),OTPT                            B   11
      REAL LINPG(1),LINPB(1),LG(1),LB(1),LOUTG(1),LOUTB(1),LTAP(1),BSTL(B   12
     11),W(1)                                                           B   13
      COMPLEX BCV(1),V(1)                                               B   14
      COMMON /C1/ JIRYT,JICYT,JYT,JVI,JWS,LWS,JMAX                      B   15
C                                                                       B   16
      IF (ICALL.GT.1) GO TO 30                                          B   17
      NYT=NB+NTL+NTL                                                    B   18
      NZ2=(NYT*(NLB**2))/((NB-1)**2)                                    B   19
      LWS=MAX0(10*NB+5*NLB+6*NYT+6*NZ2,6*NB+16*NLB+6*NYT+7*NZ2,17*NB+7*N  B   20
     1YT)-1                                                             B   21
      JIRYT=1                                                           B   22
      JICYT=JIRYT+NB+1                                                  B   23
      JYT=JICYT+2*(NB+NTL)                                              B   24
      JVI=JYT+2*(NB+2*NTL)                                              B   25
      JWS=JVI+2*NB                                                      B   26
      JMAX=JWS+LWS-1                                                    B   27
      IF (JMAX.LT.LW) GO TO 10                                          B   28
      WRITE (OTPT,40) JMAX                                              B   29
      STOP                                                              B   30
   10 DO 20 I=1,NB                                                      B   31
      J=JVI+I+I-2                                                       B   32
      W(J)=REAL(V(I))                                                   B   33
      W(J+1)=AIMAG(V(I))                                                B   34
   20 CONTINUE                                                          B   35
   30 CALL CONTC (LBINP,LBOUT,LINPG,LINPB,LC,LB,LOUTG,LOUTB,LTAP,BTYP,BS  B   36
     1TL,BCV,V,W(JVI),W(JWS),W(JYT),W(JIRYT),W(JICYT),NB,NTL,NLB,ITER,TO  B   37
     2LV,TIME,LN,ISTART,OTPT,IWRITE)                                    B   38
      ICALL=ICALL+1                                                     B   39
      RETURN                                                            B   40
   40 FORMAT (//" LENGTH OF WORKSPACE NEEDED:",I5)                      B   41
      END                                                               B   42
```

```
C                                                                       C   1
C                                                                       C   2
C                                                                       C   3
      SUBROUTINE CONTC (LBINP,LBOUT,LINPG,LINPB,LG,LB,LOUTG,LOUTB,LTAP,B C   4
     1TYP,BSTL,BCV,V,VI,WS,YT,JRYT,ICYT,NB,NTL,NLB,ITER,TOLV,TIME,LN,IST C   5
     2ART,OTPT,IWRITE)                                                  C   6
C                                                                       C   7
C     SUBROUTINE CONTC SIMULATES TRANSMISSION LINE OUTAGE AND SOLVES    C   8
C     THE LOAD FLOW PROBLEM                                             C   9
C                                                                       C  10
      INTEGER LBINP(1),LBOUT(1),BTYP(1),JRYT(1),ICYT(1),OTPT            C  11
      REAL LINPG(1),LINPB(1),LG(1),LB(1),LOUTG(1),LOUTB(1),LTAP(1),BSTL( C  12
     11),WS(1)                                                          C  13
      COMPLEX BCV(1),VI(1),V(1),YT(1)                                   C  14
      COMMON /C1/ JIRYT,JICYT,JYT,JVI,JWS,LWS,JMAX/C2/IFLAG             C  15
C                                                                       C  16
      NYT=NB+NTL+NTL                                                    C  17
      DO 10 I=1,NB                                                      C  18
      JRYT(I)=1                                                         C  19
   10 CONTINUE                                                          C  20
      DO 20 I=1,NTL                                                     C  21
      J=LBINP(I)                                                        C  22
      JRYT(J)=JRYT(J)+1                                                 C  23
      J=LBOUT(I)                                                        C  24
      JRYT(J)=JRYT(J)+1                                                 C  25
   20 CONTINUE                                                          C  26
      IX=JRYT(1)                                                        C  27
      JRYT(1)=1                                                         C  28
      JRYT(NB+1)=0                                                      C  29
      DO 30 I=1,NB                                                      C  30
      J=I+1                                                             C  31
      IY=JRYT(J)                                                        C  32
      JRYT(J)=JRYT(I)+IX                                                C  33
      IX=IY                                                             C  34
   30 CONTINUE                                                          C  35
C                                                                       C  36
C     VECTORS DESCRIBING TRANSMISSION LINES ARE UPDATED                 C  37
C                                                                       C  38
      R1=LINPG(LN)                                                      C  39
      R2=LINPB(LN)                                                      C  40
      R3=LG(LN)                                                         C  41
      R4=LB(LN)                                                         C  42
      R5=LOUTG(LN)                                                      C  43
      R6=LOUTB(LN)                                                      C  44
      LINPG(LN)=0.                                                      C  45
      LINPB(LN)=0.                                                      C  46
      LG(LN)=0.                                                         C  47
      LB(LN)=0.                                                         C  48
      LOUTG(LN)=0.                                                      C  49
      LOUTB(LN)=0.                                                      C  50
C                                                                       C  51
C     THE NODAL ADDMITTANCE MATRIX OF UPDATED SYSTEM IS FORMULATED      C  52
C                                                                       C  53
      CALL FORMYT (LBINP,LBOUT,LINPG,LINPB,LG,LB,LOUTG,LOUTB,LTAP,BSTL,J C  54
     1RYT,ICYT,YT,NB,NTL,NYT,OTPT,IWRITE)                               C  55
      IF (IWRITE.GE.1) WRITE (OTPT,70) LBINP(LN),LBOUT(LN)              C  56
      IF (ISTART.NE.0) GO TO 50                                         C  57
      DO 40 I=1,NB                                                      C  58
      V(I)=VI(I)                                                        C  59
   40 CONTINUE                                                          C  60
   50 VEPS=TOLV                                                         C  61
      TIMEL=TIME                                                        C  62
      ITEL=ITER                                                         C  63
      MODE=0                                                            C  64
C                                                                       C  65
```

```
C      LOAD FLOW EQUATIONS ARE SOLVED USING THE FAST DECOUPLED METHOD      C  66
C                                                                          C  67
       CALL LFLFD1M (NB,NLB,NYT,JRYT,ICYT,BTYP,YT,V,BCV,WS,LWS,ITEL,VEPS,  C  68
      1ITIMEL,MODE,IFLAG,OTPT,IWRITE)                                      C  69
       IF (IFLAG.GE.0) GO TO 60                                            C  70
       WRITE (OTPT,80) IFLAG                                               C  71
       STOP                                                                C  72
C                                                                          C  73
C      ORIGINAL DATA IS RECONSTRUCTED                                      C  74
C                                                                          C  75
   60  LINPG(LN)=R1                                                        C  76
       LINPB(LN)=R2                                                        C  77
       LG(LN)=R3                                                           C  78
       LB(LN)=R4                                                           C  79
       LOUTG(LN)=R5                                                        C  80
       LOUTB(LN)=R6                                                        C  81
       RETURN                                                              C  82
   70  FORMAT (/" LINE REMOVED. TERMINAL BUSES:",I4,",",I4)                C  83
   80  FORMAT (//" RETURN FLAG FROM LFLFD1M :",I3)                         C  84
       END                                                                 C  85
```