APÊNDICE D

PROGRAMA AM3D

Jorge Pinheiro da Costa Veiga

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            B6700  F O R T R A N  C O M P I L A T I O N  M A R K  2.9.004

                                                        A M 3 D / D B J
                                                        = = = = = = = =

FILE  20=UM/PVPA,UNIT=DISKPACK,RECORD=3360,AREA=1*1                          00000100

FILE  30=UM/ARCOH,UNIT=DISKPACK,RECORD=3367,AREA=1*1                         00000200

FILE  40=DOIS/MOV,UNIT=DISKPACK,RECORD=13,AREA=600*3,BLOCKING=600            00000300

FILE  50=DOIS/LOAD,UNIT=DISKPACK,RECORD=11,AREA=600*75,BLOCKING=300          00000400

FILE  60=DOIS/EXC,UNIT=DISKPACK,RECORD=13,AREA=600*6,BLOCKING=600            00000500

FILE  55=TRES/FEXC,UNIT=DISKPACK,RECORD=6                                    00000600

FILE  65=TRES/ABC3D,UNIT=DISKPACK,RECORD=36                                  00000700

FILE  70=DOIS/ROLL,UNIT=DISKPACK,RECORD=4,AREA=600*3,BLOCKING=600            00000800


      COMMON WWW(3078)                                                       00000900
      COMMON/LODPRN/ZZZ(289)                                                 00001000
      DIMENSION GMU(6,6)                                                     00001100
      REWIND 30                                                              00001200
      REWIND 20                                                              00001300
      READ(30) WWW ,ZZZ                                                      00001400
      CALL SPRG4 (GMU)                                                       00001500
      CALL SPRG5 (GMU)                                                       00001600
      LOCK 40                                                                00001700
      LOCK 50                                                                00001800
      LOCK 60                                                                00001900
      LOCK 70                                                                00002000
      STOP                                                                   00002100
      END                                                                    00002200
      002;0019;0  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
                                                                             SE
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C                                                                            00002300
C                                                                            00002400

      SUBROUTINE SPRG4(GMU)                                                  00002500
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM     00002600
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,IP     00002700
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10)     00002800
     3,FN(5),BAM(30),CDG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40),     00002900
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7),     00003000
     5UN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP         00003100
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,DMAX,IBR,ML,IEND,IBILGE,IPRES,      00003200
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25),    00003300
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)                  00003400
      COMMON NWSTP,INWSTP(12)                                                00003500
      DIMENSION GMU(6,6)                                                     00003600
      DO 111 I=1,6                                                           00003700
      DO 111 J=1,6                                                           00003800
  111 GMU(I,J)=0.0                                                           00003900
      GMU(1,1)=1.0                                                           00004000
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      GMU(2,2)=1.0                                                          00004100
      GMU(3,3)=1.0                                                          00004200
      GMU(4,4)=EI44                                                         00004300
      GMU(4,6)=EI46                                                         00004400
      GMU(5,5)=EI55                                                         00004500
      GMU(6,6)=EI66                                                         00004600
      GMU(4,2)=-ZG/ELL                                                      00004700
      GMU(2,4)=-ZG/ELL                                                      00004800
      GMU(1,5)=ZG/ELL                                                       00004900
      GMU(5,1)=ZG/ELL                                                       00005000
      RETURN                                                                00005100
      END                                                                   00005200
                                                                              SE
*=====================================================================================
C                                                                           00005300
C                                                                           00005400

      SUBROUTINE SPRG5(GMU)                                                 00005500
      DIMENSION THCAL(30)                                                   00005600
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM    00005700
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP    00005800
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10)    00005900
     3,FN(5),BAM(30),CDG(10),SDG(10),OMAX,OMIN,NER,NOK,NOB,NOH,OMEN(40),    00006000
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7),    00006100
     5UN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP        00006200
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES,     00006300
     2VNY,GRAV,AMODL,MOD,AKEFLL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25)    00006400
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)                 00006500
      COMMON NWSTP,INWSTP(12)                                               00006600
      COMMON /LODPRN/STLD(24),WORD2,WORD3,IDAMP,IPRCNT,B2(5),B3(5),         00006700
     2PB2(25,5),PB3(25,5),ICLASS                                            00006800
      DIMENSION A(3360)                                                     00006900
      INTEGER PRNTOP,H                                                      00007000
      COMPLEX CFAC(6),CSUM(6),DODD,DEVEN,DUM3,DUM2,CRET,PP,QQ,II            00007100
      COMPLEX CFX(6)                                                        00007200
      COMPLEX DEF(6)                                                        00007300
      COMMON /TEMP/ PDFR(6,25),PDFI(6,25),RMO(6,30),AIMO(6,30),             00007400
     2DA1(11),DB1(11),PEXR(6,25),PEXI(6,25),DADS(10,26),DDDS(10,26),       00007500
     2TDA(6,6),TDB(6,6),SRF33(27),SRM35(27),SRM55(27),SC44(27),             00007600
     2PAV(25,7,6),PAA(25,7,6),DA(6,6),DB(6,6),TEV(6,6),BEV(6,1),            00007700
     2TOD(6,6),BOD(6,1),INDEX(6,3),AR1(42),AR2(42),AI1(42),AI2(42),         00007800
     2VD(25),SBKD(27),EDDY(27),RGB(27),PPERE(8,14),PREIM(8,14),             00007900
     2FZRSG(25),BVRSG(25),BVISG(25),FZISG(25),FYRSG(25),FYISG(25),          00008000
     2TMRSG(25),TMISG(25),BLRSG(25),BLISG(25),RHMD(50),WE(30),ZN(30),       00008100
     2XL1LMD(30),IHMD(50),WAVAMP(30),DUM4(76)                               00008200
      COMMON /TMP1/ FACT,JJ,HDIG1,VKNOTS,KSLOPE,WSTP,IWSTP,LL,GXI           00008300
      COMMON /TMP2/ SHM(30,6,2)                                             00008400
      COMMON /TMP3/ RLO(5,30,25),AILO(5,30,25),STATN(24)                    00008500
      COMMON /TMP4/ HMD(5,50,2),NHF,EPS                                     00008600
      COMMON /TMP5/ BDV(30,6,2)                                             00008700
      COMMON/RRR/PNLI(30),RMASS(30),RDAMP(30),RREST(30)                     00008800
      DIMENSION GMU(6,6)                                                    00008900
      DATA MIN /3HMIN/                                                      00009000
      NOSM1=NOS-1                                                           00009100
      WRITE(40) NOB,NOH,NOK,ML,NOSM1                                        00009200
      WRITE(40) (FN(I),I=1,NOB)                                             00009300
      WRITE(40) (HDG1(I),I=1,NOH)                                           00009400
C                                                                           00009500
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C BY CALLING PREST THE RESTORING FORCES AND MOMENTS FOR THE VARIOUS SECT 00009600
C OF THE SHIP ARE CALCULED.                                             00009700
C     SRF33(K)=RESTORING COEFFICIENT(HEAVE-HEAVE) UP TO STATION K       00009800
C     SRF35(K)=RESTORING COEFFICIENT(HEAVE-PITCH) UP TO STATION         00009900
C     SRF55(K)=RESTORING COEFFICIENT(PITCH-PITCH) UP TO STATION K       00010000
C     SC44(K)=METACENTRIC HEIGHT OVER THE WATERPLANE FOR THE PART OF THE 00010100
C       UP TO STATION K                                                 00010200
C  THESE VARIABLES ARE USED FOR THE CALCULATION OF LOADS                00010300
C                                                                       00010400
      DO 687 K=1,NOS                                                    00010500
      CALL PREST(PRF33,PRM35,PRM55,PC44)                                00010600
      SRF33(K)=PRF33                                                    00010700
      SRM35(K)=PRM35                                                    00010800
      SRM55(K)=PRM55                                                    00010900
      SC44(K)=PC44                                                      00011000
  687 CONTINUE                                                          00011100
      II=(0.,1.)                                                        00011200
      FACT=57.295779                                                    00011300
      PI=3.141593                                                       00011400
      C33=RF33                                                          00011500
      C35=RM35                                                          00011600
      C55=RM55                                                          00011700
      C44=DGM                                                           00011800
      REWIND 55                                                         00011900
      REWIND 65                                                         00012000
C     IPRES=1 WE WANT TO CALCULATE PRESSURE                             00012100
C     IPRES=2 WE DO NOT WANT CALCULATE PRESSURE                         00012200
C                                                                       00012300
C                                                                       00012400
C     IEND=1  ENDTERMS IN THE EQUATIONS OF MOTION                       00012500
C     IEND=2  NO ENDTERMS IN THE EQUATIONS OF MOTION                    00012600
C   IBILGE=1  MEANS THAT THE SHIP HAS BILGEKEEL                         00012700
C   IBILGE=2  MEANS THAT THE SHIP HAS NOT BILGEKEEL                     00012800
C                                                                       00012900
C                                                                       00013000
C   MOD=1 MEANS MODEL WITHOUT BILGEKEEL                                 00013100
C   MOD=2 THE OTHER CASES                                               00013200
C   THM IS A FIRST APPROXIMATION TO MEAN MAXIMUN ROLL-AMPLITUDE (RADIANS 00013300
C   VNY=KINEMATIC VISCOSITY                                             00013400
C   GRAV=ACCELATION OF GRAVITY                                          00013500
C                                                                       00013600
C  AMODL= THE LENGTH OF THE MODEL FOR REYNOLDS NUMBER                   00013700
C                                                                       00013800
C                                                                       00013900
C  RD(K)='BILGERADIUS' FOR STATION K                                    00014000
C                                                                       00014100
C                                                                       00014200
C  ITS(K)=1 FORESECTION WHERE  KG/B#1.2                                 00014300
C  ITS(K)=2 MIDSECTION                                                  00014400
C  ITS(K)=3 AFTSECTION  WHERE  B/KF#1.0                                 00014500
C  ITS(K)=4 OTHER CASES                                                 00014600
C                                                                       00014700
C                                                                       00014800
C     EDDY(K)=COEFFICIENTE OF EDDY MAKING DAMPING FOR STATION K         00014900
C                                                                       00015000
C  ML=1  CALCULATE MOTIONS                                              00015100
C     ML=2  CALCULATE MOTIONS AND LOADS                                 00015200
C                                                                       00015300
C                                                                       00015400
C     SET STPR(K)=0.0 IF WE NOT WANT PRESSURE ON STATION K              00015500
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C     SET STPR(K)=1.0 IF WE WANT PRESSURES ON THE STATION K                00015600
C     IT IS NOT POSSIBLE TO GET PRESSURE ON THE FIRST AND LAST STATION     00015700
C                                                                          00015800
      VNY=VNY/SQRT(GRAV*ELL**3)                                            00015900
      NOSHAL=NOS                                                           00016000
      SGL=SQRT(GRAV/ELL)                                                   00016100
      SLG=1./SGL                                                           00016200
      NHF= NOH*NOB*NWSTP                                                   00016300
      KTH=0                                                                00016400
C                                                                          00016500
C  THIS IS WHERE THE LOOPS FOR THE CALCULATION OF MOTIONS AND LOADS BEGI   00016600
C   THE OUTER LOOP IS FOR HEADING AND FROUDE NUMBER AND THE INNER LOOP I   00016700
C     WAVE LENGTH.                                                         00016800
C                                                                          00016900
      EPS= .017453293                                                      00017000
      FCT= .75                                                             00017100
      DO 999 MM=1,NOH                                                      00017200
      IF(MM.EQ.1)MM=MM+1                                                   00017300
      IF(MM.EQ.NOH) GO TO 999                                              00017400
      IF(SDG(MM)+1.) 4001,4002,4001                                        00017500
 4001 CONTINUE                                                             00017600
      HDIG=ARCOS(CDG(MM))*FACT                                             00017700
      GO TO 4003                                                           00017800
 4002 CONTINUE                                                             00017900
      HDIG=180.                                                            00018000
 4003 CONTINUE                                                             00018100
      DO 999 JJ=1,NOB                                                      00018200
      VKNOTS = SQRT(ELL*GRAV)*FN(JJ)/1.689                                 00018300
      DO 999 IWSTP=1,NWSTP                                                 00018400
      IF(INWSTP(IWSTP) .LE. 0) INWSTP(IWSTP)=90                            00018500
      WSTP=1./FLOAT(INWSTP(IWSTP))                                         00018600
      WSLOPE= 180.*WSTP                                                    00018700
      KTH= KTH+1                                                           00018800
      ITERAT=0                                                             00018900
       IF (THMD(KTH) .GT. 0.) GO TO 1500                                   00019000
       IF (HDG1(MM) .EQ. 180. .OR. HDG1(MM) .EQ. 0.) THMD(KTH)= .00175     00019100
       IF (HDG1(MM) .EQ. 90. .OR. HDG1(MM) .EQ. 270.) THMD(KTH)= .2        00019200
       IF (THMD(KTH) .LE. 0.) THMD(KTH) = .2                               00019300
 1500 ITERAT = ITERAT + 1                                                  00019400
      THM=THMD(KTH)                                                        00019500
C                                                                          00019600
C  BY CALLING TANAKA THE EDDYMAKING COEFFICIENTS FOR THE STATIONS ARE      00019700
C      CALCULATED                                                          00019800
C                                                                          00019900
      CALL TANAKA(THM,EDDY,RGB)                                            00020000
      DO 612 LL=1,NOK                                                      00020100
      HDIG1 = 180.0 - HDIG                                                 00020200
      TOP=6.283185                                                         00020300
      GXI=ABS(SQRT(TOP/BAM(LL))+TOP*FN(JJ)*CDG(MM)/BAM(LL))                00020400
C                                                                          00020500
C  GXI IS THE NON-DIMENSIONALIZED FREQUENCY OF ENCOUNTER. IT IS            00020600
C     DIMENSIONALIZED BY MULTIPLICATION WITH SQRT(GIL)                     00020700
C                                                                          00020800
      IF(GXI-0.05) 5002,5002,5003                                          00020900
C                                                                          00021000
C  THE ABOVE TEST IS MADE TO EXCLUDE THE CASE OF GXI=0.0.  THIS HAS        00021100
C  IMPORTANCE FOR THE FOLLOWING SEA CASE.                                  00021200
C                                                                          00021300
 5002 CONTINUE                                                             00021400
      GXI=0.05                                                             00021500
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 5003 CONTINUE                                                          00021600
      WE(LL)= GXI*SGL                                                   00021700
      ZN(LL)=GXI                                                        00021800
      WVLNTH = BAM(LL)*ELL                                              00021900
      WAVAMP(LL)=WSTP*WVLNTH/2.                                         00022000
      XL1LMD(LL)=1./BAM(LL)                                             00022100
      UN=0.5*GXI**2                                                     00022200
      DO 200 L=1,6                                                      00022300
      DO 200 M=1,6                                                      00022400
      DA(L,M)=0.0                                                       00022500
  200 DB(L,M)=0.0                                                       00022600
      DO 1 N=2,NFR                                                      00022700
      ITEMP = N                                                         00022800
      DIFF=OMEN(N)-GXI*SQRT(0.5)                                        00022900
      IF(DIFF)  1,3,3                                                   00023000
    1 CONTINUE                                                          00023100
    3 CONTINUE                                                          00023200
      N=ITEMP                                                           00023300
      DELT1 = OMEN(N)-OMEN(N-1)                                         00023400
      NON=NUT-1                                                         00023500
      NUMB=6*NON                                                        00023600
      K1=NUMB                                                           00023700
      K2=2*NUMB                                                         00023800
      K3=3*NUMB                                                         00023900
      NSKIP=2*(N-2)*NUMB                                                00024000
      NELEM=2*NFR*NUMB                                                  00024100
      DELT0=GXI*SQRT(0.5)-OMEN(N-1)                                     00024200
      TERM=DELT0/DELT1                                                  00024300
C                                                                       00024400
C  THE FOLLOWING PROCEDURE READS IN FROM DRUM STORAGE THE PRESSURE,     00024500
C  CALCULATED IN SPRG2, NECESSARY TO CALCULATE THE PRESSURE THE GXI     00024600
C  FREQUENCY, PRESSURE MEANS PRESSURE PER UNIT MOTION  PAA AND PAV A    00024700
C  PRESSURES                                                            00024800
C                                                                       00024900
      DO 350 K=1,NOSHAL                                                 00025000
      READ(20) (A(I),I=1,NELEM)                                         00025100
      DO 350 J=1,NON                                                    00025200
      KM=(J-1)*6 + NSKIP                                                00025300
      DO 350 M=1,6                                                      00025400
      KM= KM + 1                                                        00025500
      AAA=A(KM)                                                         00025600
      BBB=A(KM+K1)                                                      00025700
      CCC=A(KM+K2)                                                      00025800
      DDD=A(KM+K3)                                                      00025900
      DELT4=CCC-AAA                                                     00026000
      DELT5=DDD-BBB                                                     00026100
      PAA(K,J,M)=AAA+ DELT4*TERM                                        00026200
      PAV(K,J,M)=BBB+ DELT5*TERM                                        00026300
  350 CONTINUE                                                          00026400
      REWIND 20                                                         00026500
      DO 202 L=1,10                                                     00026600
      DELT2=(ALFA(N,L)-ALFA(N-1,L))/DELT1                               00026700
      DELT3=(BETA(N,L)-BETA(N-1,L))/DELT1                               00026800
      DA1(L)=ALFA(N-1,L)+DELT2*(GXI*SQRT(0.5)-OMEN(N-1))                00026900
      DB1(L)=BETA(N-1,L)+DELT3*(GXI*SQRT(0.5)-OMEN(N-1))                00027000
  202 CONTINUE                                                          00027100
C                                                                       00027200
C   VISC IS CALLED TO CALCULATE SKIN FRICTION AND EDDYMAKING DAMPING.   00027300
C                                                                       00027400
      CALL VISC(GXI,VD,TVD,THM,EDDY,RGB)                                00027500
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      TBKD=0.0                                                          00027600
      DO 4 K=1,NOS                                                      00027700
      SBKD(K)=0.0                                                       00027800
    4 CONTINUE                                                          00027900
      GO TO(3003,3004),IBILGE                                           00028000
 3003 CONTINUE                                                          00028100
C                                                                       00028200
C   BILGEK IS CALLED TO CALCULATE ROLL DAMPING DUE TO BILGEKEELS.       00028300
C                                                                       00028400
      CALL BILGEK(GXI,THM,SBKD,TBKD)                                    00028500
 3004 CONTINUE                                                          00028600
C                                                                       00028700
C     DA ARE ADDED MASS COEFFICIENTS. DB ARE DAMPING COEFFICIENTS.  BOTH-00028800
C     ARE FOR THE WHOLE SHIP.                                           00028900
C                                                                       00029000
C                                                                       00029100
      DA(1,1)=DA1(1)                                                    00029200
      DB(1,1)=DB1(1)                                                    00029300
      DA(2,2)=DA1(2)                                                    00029400
      DB(2,2)=DB1(2)                                                    00029500
      DA(3,3)=DA1(3)                                                    00029600
      DB(3,3)=DB1(3)                                                    00029700
      DA(2,4)=DA1(9)                                                    00029800
      DB(2,4)=DB1(9)                                                    00029900
      DA(2,6)=DA1(8)-FN(JJ)/GXI**2*DB1(2)                               00030000
      DB(2,6)=DB1(8)+FN(JJ)*DA1(2)                                      00030100
      DA(3,5)=DA1(7)+FN(JJ)/GXI**2*DB1(3)                               00030200
      DB(3,5)=DB1(7)-FN(JJ)*DA1(3)                                      00030300
      DA(4,4)=DA1(4)                                                    00030400
      DB(4,4)=DB1(4)                                                    00030500
      DB(4,4)=DB(4,4)+TVD+TBKD                                          00030600
      DA(4,2)=DA(2,4)                                                   00030700
      DB(4,2)=DB(2,4)                                                   00030800
      DA(4,6)=DA1(10)-FN(JJ)/GXI**2*DB1(9)                              00030900
      DB(4,6)=DB1(10)+FN(JJ)*DA1(9)                                     00031000
      DA(5,3)=DA1(7)-FN(JJ)/GXI**2*DB1(3)                               00031100
      DB(5,3)=DB1(7)+FN(JJ)*DA1(3)                                      00031200
      DA(5,5)=DA1(5)+(FN(JJ)/GXI)**2*DA1(3)                             00031300
      DB(5,5)=DB1(5)+(FN(JJ)/GXI)**2*DB1(3)                             00031400
      DA(6,2)=DA1(8)+FN(JJ)/GXI**2*DB1(2)                               00031500
      DB(6,2)=DB1(8)-FN(JJ)*DA1(2)                                      00031600
      DA(6,4)=DA1(10)+FN(JJ)/GXI**2*DB1(9)                              00031700
      DB(6,4)=DB1(10)-FN(JJ)*DA1(9)                                     00031800
      DA(6,6)=DA1(6)+(FN(JJ)/GXI)**2*DA1(2)                             00031900
      DB(6,6)=DB1(6)+(FN(JJ)/GXI)**2*DB1(2)                             00032000
      GO TO(3001,3002),IEND                                             00032100
 3001 CONTINUE                                                          00032200
C                                                                       00032300
C     ENDSEP CALCULATES THE ADDED-MASS AND DAMPING TERMS THAT ARISE FROM 00032400
C     SEPARATION OF THE FLOW ABOUT THE HULL.                            00032500
C                                                                       00032600
      CALL ENDSEP(DA,DB,GXI,PAA,PAV,JJ).                                00032700
 3002 CONTINUE                                                          00032800
C                                                                       00032900
C     THE FOLLOWING PROCEDURE CREATES THE COEFFICIENT MATRICIES TOD AND  00033000
C     THESE MATRICIES ARE USED TO SOLVE THE TWO SETS OF COUPLED DIFFERENT 00033100
C     EQUATIONS FOR THE MOTIONS. IN MATRIX FORM THEY ARE-    TOD*X=BOD  A 00033200
C     TEV*X=BEV.  THE FIRST EQUATION IS FOR THE SURGE, HEAVE, AND PITCH. 00033300
C     THE SECOND EQUATION IS FOR THE SWAY, ROLL AND YAW.                00033400
C                                                                       00033500
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      DO 109 I=1,3                                                          00033600
      DO 110 J=1,3                                                          00033700
      IEV=I+I                                                               00033800
      JEV=J+J                                                               00033900
      IOD=IEV-1                                                             00034000
      JOD=JEV-1                                                             00034100
      TOD(I,J)=-GXI**2*(GMU(IOD,JOD)+DA(IOD,JOD))                           00034200
      TOD(I,J+3)=GXI*DB(IOD,JOD)                                            00034300
      TOD(I+3,J+3)=TOD(I,J)                                                 00034400
      TOD(I+3,J)=-TOD(I,J+3)                                                00034500
      TEV(I,J)=-GXI**2*(GMU(IEV,JEV)+DA(IEV,JEV))                           00034600
      TEV(I,J+3)=GXI*DB(IEV,JEV)                                            00034700
      TEV(I+3,J+3)=TEV(I,J)                                                 00034800
      TEV(I+3,J)=-TEV(I,J+3)                                                00034900
  110 CONTINUE                                                              00035000
  109 CONTINUE                                                              00035100
      PNLI(LL)=TVD+TBKD                                                     00035200
      RMASS(LL)=GMU(4,4)+DA(4,4)                                            00035300
      RDAMP(LL)=DB(4,4)-TVD-TBKD                                            00035400
      RREST(LL)=C44                                                         00035500
      TOD(2,2)=TOD(2,2)+C33                                                 00035600
      TOD(2,3)=TOD(2,3)+C35                                                 00035700
      TOD(3,2)=TOD(3,2)+C35                                                 00035800
      TOD(3,3)=TOD(3,3)+C55                                                 00035900
      TOD(5,5)=TOD(2,2)                                                     00036000
      TOD(5,6)=TOD(2,3)                                                     00036100
      TOD(6,5)=TOD(3,2)                                                     00036200
      TOD(6,6)=TOD(3,3)                                                     00036300
      TEV(2,2)=TEV(2,2)+C44                                                 00036400
      TEV(5,5)=TEV(2,2)                                                     00036500
      DO 1010 L=1,6                                                         00036600
      CFX(L)=(0.0,0.0)                                                      00036700
 1010 CONTINUE                                                              00036800
      INOS=0                                                                00036900
      WRITE(65)((TEV(I,J),I=1,6),J=1,6)                                     00037000
C                                                                           00037100
C     THE EXCITING FORCES AND MOMENTS FOR THE WHOLE SHIP (ROAD AND BEV) A   00037200
C     NON CALCULATED.  PEXR AND PEXI ARE THE FORCES AND MOMENTS FOR SECTI   00037300
C                                                                           00037400
      DO 32 K=1,NOS                                                         00037500
      KO=K                                                                  00037600
      WN=TOP/BAM(LL)/2.                                                     00037700
      CP=WN*(ST(K)-TPST)*CDG(MM)                                            00037800
      CP1=COS(CP)                                                           00037900
      CP2=SIN(CP)                                                           00038000
      CPET=(CP1+II*CP2)*DS(K)                                               00038100
      DIP=ST(K)-TPST                                                        00038200
      DO 1643 I=1,NON                                                       00038300
      FR(I,1)=EN1(K,I)                                                      00038400
      FR(I,2)=-SNE(K,I)                                                     00038500
      FR(I,3)=CSE(K,I)                                                      00038600
      FR(I,4)=XX(K,I)*CSE(K,I)-YY(K,I)*FR(I,2)                              00038700
      FR(I,5)=-DIP*FR(I,3)                                                  00038800
      FR(I,6)=DIP*FR(I,2)                                                   00038900
 1643 CONTINUE                                                              00039000
      DO 1001 L=1,6                                                         00039100
 1001 CSUM(L)=(0.0,0.0)                                                     00039200
      DO 610 L=1,6                                                          00039300
      DEF(L)=(0.,0.)                                                        00039400
  610 CONTINUE                                                              00039500
```

```
      DO 71 J=1,NON                                                          00039600
      PET=EXP(WN*YY(K,J))                                                    00039700
      ARG=WN*XX(K,J)*SDG(MM)                                                 00039800
      FC=COS(ARG)                                                            00039900
      FS=SIN(ARG)                                                            00040000
      CFAC(3)=CMPLX(FC*FR(J,3),0.)                                           00040100
      CFAC(5)=CMPLX(FC*FR(J,5),0.)                                           00040200
      CFAC(1)=CMPLX(FC*FR(J,1),0.)                                           00040300
      CFAC(2)=II*FS*FR(J,2)                                                  00040400
      CFAC(4)=II*FS*FR(J,4)                                                  00040500
      CFAC(6)=II*FS*FR(J,6)                                                  00040600
      PP=CMPLX(FR(J,3),0.)                                                   00040700
      QQ=II*FR(J,2)*SDG(MM)                                                  00040800
      DODD=(PP*FC+II*QQ*FS)*(GXI*SQRT(0.5*WN)/UN)                            00040900
      DEVEN=(QQ*FC+II*PP*FS)*(GXI*SQRT(0.5*WN)/UN)                           00041000
      DUM3=CFAC(3)                                                           00041100
      DUM2=CFAC(2)                                                           00041200
      CFAC(1)=CFAC(1)-DODD*CMPLX(PAA(K,J,1),PAV(K,J,1))                      00041300
      CFAC(3)=CFAC(3)-DODD*CMPLX(PAA(K,J,3),PAV(K,J,3))                      00041400
      CFAC(5)=CFAC(5)-DODD*CMPLX(PAA(K,J,5),PAV(K,J,5))                      00041500
      CFAC(2)=CFAC(2)-DEVEN*CMPLX(PAA(K,J,2),PAV(K,J,2))                     00041600
      CFAC(4)=CFAC(4)-DEVEN*CMPLX(PAA(K,J,4),PAV(K,J,4))                     00041700
      CFAC(6)=CFAC(6)-DEVEN*CMPLX(PAA(K,J,6),PAV(K,J,6))                     00041800
      CFAC(5)=CFAC(5)+(2.*II*FN(JJ)/GXI)*(CFAC(3)-DUM3)                      00041900
      CFAC(6)=CFAC(6)-(2.*II*FN(JJ)/GXI)*(CFAC(2)-DUM2)                      00042000
      DO 1002 L=1,6                                                          00042100
1002  CSUM(L)=CSUM(L)+PET*DEL(K,J)*CFAC(L)                                   00042200
      DEF(3)=DEF(3)-DODD*CMPLX(PAA(K,J,3),PAV(K,J,3))*DEL(K,J)*4.*PET        00042300
      DEF(5)=DEF(5)-DODD*CMPLX(PAA(K,J,5),PAV(K,J,5))*PET*DEL(K,J)*2.        00042400
      DEF(2)=DEF(2)-DEVEN*CMPLX(PAA(K,J,2),PAV(K,J,2))*PET*DEL(K,J)*4.       00042500
      DEF(4)=DEF(4)-DEVEN*CMPLX(PAA(K,J,4),PAV(K,J,4))*PET*DEL(K,J)*2.       00042600
      DEF(6)=DEF(6)-DEVEN*CMPLX(PAA(K,J,6),PAV(K,J,6))*PET*DEL(K,J)*2.       00042700
   71 CONTINUE                                                               00042800
      DO 10 L=1,6                                                            00042900
      PEXR(L,KO)=REAL(CSUM(L)*CPET)/TVOL                                     00043000
      PEXI(L,KO)=AIMAG(CSUM(L)*CPET)/TVOL                                    00043100
   10 CONTINUE                                                               00043200
      PEXR(1,KO)=4.0*PEXR(1,KO)                                              00043300
      PEXR(2,KO)=4.0*PEXR(2,KO)                                              00043400
      PEXR(3,KO)=4.0*PEXR(3,KO)                                              00043500
      PEXR(4,KO)=2.0*PEXR(4,KO)                                              00043600
      PEXR(5,KO)=2.0*PEXR(5,KO)                                              00043700
      PEXR(6,KO)=2.0*PEXR(6,KO)                                              00043800
      PEXI(6,KO)=2.0*PEXI(6,KO)                                              00043900
      PEXI(5,KO)=2.0*PEXI(5,KO)                                              00044000
      PEXI(4,KO)=2.0*PEXI(4,KO)                                              00044100
      PEXI(3,KO)=4.0*PEXI(3,KO)                                              00044200
      PEXI(2,KO)=4.0*PEXI(2,KO)                                              00044300
      DO 611 L=1,6                                                           00044400
      PDFR(L,K)=REAL(DEF(L)*CPET*II)/TVOL/GXI/DS(K)*2.*FN(JJ)                00044500
      PDFI(L,K)=AIMAG(DEF(L)*CPET*II)/TVOL/GXI/DS(K)*2.*FN(JJ)               00044600
  611 CONTINUE                                                               00044700
      DO 1003 L=1,6                                                          00044800
1003  CFX(L)=CFX(L)+CPET*CSUM(L)                                             00044900
   32 CONTINUE                                                               00045000
      DO 103 L=1,3                                                           00045100
      LEV=L+L                                                                00045200
      LOD=LEV-1                                                              00045300
      BOD(L,1)=REAL(CFX(LOD))/TVOL                                           00045400
      BOD(L+3,1)=AIMAG(CFX(LOD))/TVOL                                        00045500
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      BEV(L,1)=REAL(CFX(LEV))/TVOL                                          00045600
      BEV(L+3,1)=AIMAG(CFX(LEV))/TVOL                                       00045700
  103 CONTINUE                                                              00045800
      BOD(1,1)=4.0*BOD(1,1)                                                 00045900
      BOD(2,1)=4.0*BOD(2,1)                                                 00046000
      BOD(3,1)=2.0*BOD(3,1)                                                 00046100
      BOD(4,1)=4.0*BOD(4,1)                                                 00046200
      BOD(5,1)=4.0*BOD(5,1)                                                 00046300
      BOD(6,1)=2.0*BOD(6,1)                                                 00046400
      BEV(1,1)=4.0*BEV(1,1)                                                 00046500
      BEV(2,1)=2.0*BEV(2,1)                                                 00046600
      BEV(3,1)=2.0*BEV(3,1)                                                 00046700
      BEV(4,1)=4.0*BEV(4,1)                                                 00046800
                                                                            00046900
                                                                            00047000
      BEV(5,1)=2.0*BEV(5,1)                                                 00047100
      BEV(6,1)=2.0*BEV(6,1)                                                 00047200
C                                                                           00047300
C     BOD(1,1)=REAL PART(SURGE/H)          BOD(4,1)=IMAGINARY PART(SURG     00047400
C     BEN(1,1)=REAL PART(SWAY/H)           BEV(4,1)=IMAGINARY PART(SWAY     00047500
C    BOD(2,1)=REAL PART(HEAVE/H)           BOD(4,1)=IMAGINARY PART(HEAV     00047600
C    BEV(2,1)=REAL PART(ROLL*L/H)          BEV(5,1)=IMAGINARY PART(ROLL     00047700
C    BOD(3,1)=REAL PART(PITCH*L/H)         BOD(6,1)=IMAGINARY PART(PITC     00047800
C    BEV(3,1)=REAL PART(YAW*L/H)           BEV(6,1)=IMAGINARY PART(YAW*     00047900
      WRITE(55)(BEV(I,1),I=1,6)                                             00048000
      WRITE(6,8888)((TEV(I,J),I=1,6),J=1,6),(BEV(I,1),I=1,6)                00048100

 8888 FORMAT(1X,8E10.4)                                                     00048200
      BDV(LL,1,1)= BOD(1,1)                                                 00048300
      BDV(LL,1,2)= BOD(4,1)                                                 00048400
      BDV(LL,2,1)= BEV(1,1)                                                 00048500
      BDV(LL,2,2)= BEV(4,1)                                                 00048600
      BDV(LL,3,1)= BOD(2,1)                                                 00048700
      BDV(LL,3,2)= BOD(5,1)                                                 00048800
      BDV(LL,4,1)= BEV(2,1)                                                 00048900
      BDV(LL,4,2)= BEV(5,1)                                                 00049000
      BDV(LL,5,1)= BOD(3,1)                                                 00049100
      BDV(LL,5,2)= BOD(6,1)                                                 00049200
      BDV(LL,6,1)= BEV(3,1)                                                 00049300
      BDV(LL,6,2)= BEV(6,1)                                                 00049400
C     APOS GERAR 65  55  ANULAR OS COMANDOS  A SEGUIR   LOCK NAO            00049500
      GO TO 612                                                             00049600
C                                                                           00049700
C  MATINS IS USED TO SOLVE THE EQUATION OF MOTION.                          00049800
C                                                                           00049900
      CALL MATINS(TOD,6,6,BOD,1,1,DTRM,ID,INDEX)                            00050000
      GO TO(501,502),ID                                                     00050100
  501 CALL MATINS(TEV,6,6,BEV,1,1,DTRM,ID,INDEX)                            00050200
      GO TO(503,502),ID                                                     00050300
  502 DO 105 L=1,6                                                          00050400
  105 CFX(L)=(0.0,0.0)                                                      00050500
      GO TO 999                                                             00050600
  503 CONTINUE                                                              00050700
      RMO(1,LL)=BOD(1,1)                                                    00050800
      RMO(2,LL)=BEV(1,1)                                                    00050900
      RMO(3,LL)=BOD(2,1)                                                    00051000
      RMO(4,LL)=BEV(2,1)                                                    00051100
      RMO(5,LL)=BOD(3,1)                                                    00051200
      RMO(6,LL)=BEV(3,1)                                                    00051300
      AIMO(1,LL)=BOD(4,1)                                                   00051400
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      AIMO(2,LL)=BEV(4,1)                                                00051500
      AIMO(3,LL)=BOD(5,1)                                                00051600
      AIMO(4,LL)=BEV(5,1)                                                00051700
      AIMO(5,LL)=BOD(6,1)                                                00051800
      AIMO(6,LL)=BEV(6,1)                                                00051900
      RMO(4,LL)=RMO(4,LL)*BAM(LL)                                        00052000
      RMO(5,LL)=RMO(5,LL)*BAM(LL)                                        00052100
      RMO(6,LL)=RMO(6,LL)*BAM(LL)                                        00052200
      AIMO(4,LL)=AIMO(4,LL)*BAM(LL)                                      00052300
      AIMO(5,LL)=AIMO(5,LL)*BAM(LL)                                      00052400
      AIMO(6,LL)=AIMO(6,LL)*BAM(LL)                                      00052500
      THCAL(LL)=SQRT(RMO(4,LL)**2+AIMO(4,LL)**2)*WAVAMP(LL)/WVLNTH       00052600
      GO TO(5202,5203),IPRES                                             00052700
 5202 CONTINUE                                                           00052800
C                                                                        00052900
C     HYDPRE CALCULATES THE TOTAL HYDRODINAMIC PRESSURE.                 00053000
C                                                                        00053100
      CALL HYDPRE(WN,BOD,BEV,PAA,PAV,GXI,PRERE,PREIM,JJ,MM)              00053200
      IRMD = LL-(LL/2)*2                                                 00053300
      IF (IRMD .EQ.1) WRITE (6,700)                                      00053400
  700 FORMAT ('1PRESSURE DISTRIBUITION ON THE HULL FOR THE SPECIFIED '    00053500
     2'CONDITIONS')                                                      00053600
      WRITE(6,698) HDIG1,FN(JJ),BAM(LL)                                  00053700
  698  FORMAT(///12H CONDITIONS-/9HOHEADING=F10.4,5X,                    00053800
     2 15H FROUDE-NUMBER=F10.4,5X,14H WAVELENGTH/L=F10.4)                00053900
      WRITE(6,697)                                                       00054000
  697 FORMAT(//)                                                         00054100
      WRITE(6,550)                                                       00054200
  550 FORMAT(40X,22H PRESSURE DISTRIBUTION)                              00054300
      KPA=0                                                              00054400
      DO 5204 K=1,NOS                                                    00054500
      IF(STPR(K)) 5205,5204,5205                                         00054600
 5205 CONTINUE                                                           00054700
      KPA=KPA+1                                                          00054800
      WRITE (6,5206)K                                                    00054900
 5206 FORMAT(73HOAMPLITUDE AND PHASE OF THE PRESSURE FOR THE SPECIFIED P 00055000
     1OINTS ON SECTION I2)                                               00055100
      WRITE(6,5207)                                                      00055200
 5207 FORMAT(25X,13H Y-COORDINATE,8X,13H Z-COORDINATE,7X,10H AMPLITUDE,1 00055300
     12X,6H PHASE)                                                       00055400
      DO 5208 JS=1,2                                                     00055500
      GO TO (6222,6223),JS                                               00055600
 6222 CONTINUE                                                           00055700
      CSP=1.0                                                            00055800
      WRITE(6,6224)                                                      00055900
 6224 FORMAT(16H STARBOARD SIDE )                                        00056000
      GO TO 6225                                                         00056100
 6223 CONTINUE                                                           00056200
      CSP=-1.0                                                           00056300
      WRITE(6,6226)                                                      00056400
 6226 FORMAT(11H PORT SIDE )                                             00056500
 6225 CONTINUE                                                           00056600
      DO 5209 J=1,NON                                                    00056700
      JM=J+NON*(JS-1)                                                    00056800
      YPRES=XX(K,J)*EL*CSP                                               00056900
      ZPRES=YY(K,J)*EL                                                   00057000
      AV=SQRT(PRERE(KPA,JM)**2+PREIM(KPA,JM)**2)                         00057100
      IF(PREIM(KPA,JM)) 751,752,751                                      00057200
  752 IF(PRERE(KPA,JM)) 751,753,751                                      00057300
  753 PH=0.0                                                             00057400
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      GO TO 754                                                                 00057500
  751 PH=ATAN2(PREIM(KPA,JM),PRERE(KPA,JM))*FACT                                00057600
  754 CONTINUE                                                                  00057700
      WRITE(6,5210) YPRES,ZPRES,AV,PH                                           00057800
 5210 FORMAT(25X,F10.4,10X,F10.4,10X,F10.4,10X,F10.4)                           00057900
 5209 CONTINUE                                                                  00058000
 5208 CONTINUE                                                                  00058100
 5204 CONTINUE                                                                  00058200
 5203 CONTINUE                                                                  00058300
      IF(ML .EQ. 2) CALL LOADS                                                  00058400
  612 CONTINUE                                                                  00058500
C                    PROVISORIO                                               00058600
      GO TO 999                                                                 00058700
C     TEST FOR CONVERGENCE OF ROLL ANGLE                                        00058800
      RHMD(KTH)=BMAX(NOK,IHCAL)                                                 00058900
      THDIFF = THMD(KTH)-RHMD(KTH)                                              00059000
      THDRAD = ABS(THDIFF)                                                      00059100
      IHMD(KTH)=ITERAT                                                          00059200
      HMD(ITERAT,KTH,1) = THMD(KTH)                                             00059300
      HMD(ITERAT,KTH,2) = RHMD(KTH)                                             00059400
      IF (THDRAD .LE. EPS) GO TO 1505                                           00059500
      IF (ITERAT .EQ. 1) GO TO 1505                                             00059600
      THMD(KTH) = THMD(KTH)-SIGN(1.,THDIFF)*FCT*THDRAD                          00059700
      GO TO 1500                                                                00059800
 1505 IF (IWSTP .EQ. 1) CALL EXCFM                                              00059900
      CALL MOTOUT                                                               00060000
      IF(ML.EQ.1) GO TO 781                                                     00060100
      ITEMP = PRNTOP                                                            00060200
      NOSM1 = NOS-1                                                             00060300
      DO 780 ISTAT =1,NOSM1                                                     00060400
      PRNTOP = MIN                                                              00060500
      IF(STLD(ISTAT) .GT. 0.) PRNTOP = ITEMP                                    00060600
      CALL LODOUT(ISTAT)                                                        00060700
  780 CONTINUE                                                                  00060800
      PRNTOP = ITEMP                                                            00060900
  781 CONTINUE                                                                  00061000
  998 CONTINUE                                                                  00061100
  999 CONTINUE                                                                  00061200
      *LOCK 55                                                                  00061300
      LOCK 65                                                                   00061400
      STOP                                                                      00061500
      CALL RCTABL                                                               00061600
      RETURN                                                                    00061700
      END                                                                       00061800
      004;0611;5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      004;0613;1  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      004;0614;3  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      004;0615;5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      004;0617;1  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      004;0618;3  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
                                                                              S

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C                                                                               00061900
C                                                                               00062000

      SUBROUTINE LOADS                                                          00062100
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM        00062200
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP        00062300
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     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10)  00062400
     3,FN(5),BAM(30),CDG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40),  00062500
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7),  00062600
     5SUN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP     00062700
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,OMAX,IRR,ML,IEND,IBILGE,IPRES,   00062800
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25)  00062900
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)               00063000
      COMMON NWSTP,INWSTP(12)                                             00063100
      COMMON /TEMP/ PDFR(6,25),PDFI(6,25),RMO(6,30),AIMO(6,30),           00063200
     2DA1(11),DB1(11),PEXR(6,25),PEXI(6,25),DADS(10,26),DDDS(10,26),     00063300
     2TDA(6,6),TDB(6,6),SRF33(27),SRM35(27),SRM55(27),SC44(27),           00063400
     2PAV(25,7,6),PAA(25,7,6),DA(6,6),DB(6,6),TEV(6,6),BEV(6,1),          00063500
     2TOD(6,6),BOD(6,1),INDEX(6,3),AR1(42),AR2(42),AT1(42),AT2(42),       00063600
     2VD(25),SRKD(27),EDDY(27),RGB(27),PRERE(8,14),PREIM(8,14),           00063700
     2FZRSG(25),BVRSG(25),BVISG(25),FZISG(25),FYRSG(25),FYISG(25),        00063800
     2TMRSG(25),THISG(25),BLRSG(25),BLISG(25),RHMD(50),WE(30),ZN(30),     00063900
     2XLILMD(30),IHMD(50),WAVAMP(30),DUM4(76)                            00064000
      COMMON /TMP1/ FACT,JJ,DM1(5),LL,GXI                                 00064100
      COMMON /TMP3/ RLO(5,30,25),AILO(5,30,25),STATN(24)                  00064200
C                                                                         00064300
C     AFTER FIRST CALCULATING THE ADDED-MASS AND DAMPING FOR EACH SECTION 00064400
C     THE SHEARING FORCES AND BENDING AND TORSIONAL MOMENTS ARE DETERMINE 00064500
C                                                                         00064600
      DO 16 K=1,NOS                                                       00064700
      DIP=ST(K)-TPST                                                      00064800
      DO 54 I=1,NON                                                       00064900
      FR(I,1)=EN1(K,I)                                                    00065000
      FR(I,2)=-SNE(K,I)                                                   00065100
      FR(I,3)=CSE(K,I)                                                    00065200
      FR(I,4)=XX(K,I)*CSE(K,I)-YY(K,I)*FR(I,2)                            00065300
      FR(I,5)=-DIP*FR(I,3)                                                00065400
      FR(I,6)=DIP*FR(I,2)                                                 00065500
   54 CONTINUE                                                            00065600
      DO 55 LK=1,10                                                       00065700
      GO TO(613,613,613,613,613,613,614,615,616,617),LK                   00065800
  613 CONTINUE                                                            00065900
      L=LK                                                                00066000
      M=LK                                                                00066100
      GO TO 618                                                           00066200
  614 CONTINUE                                                            00066300
      L=5                                                                 00066400
      M=3                                                                 00066500
      GO TO 618                                                           00066600
  615 CONTINUE                                                            00066700
      L=2                                                                 00066800
      M=6                                                                 00066900
      GO TO 618                                                           00067000
  616 CONTINUE                                                            00067100
      L=2                                                                 00067200
      M=4                                                                 00067300
      GO TO 618                                                           00067400
  617 CONTINUE                                                            00067500
      L=6                                                                 00067600
      M=4                                                                 00067700
  618 CONTINUE                                                            00067800
      DADS(LK,K)=0.0                                                      00067900
      DDDS(LK,K)=0.0                                                      00068000
      DO 619 J=1,NON                                                      00068100
      DADS(LK,K)=DADS(LK,K)+DEL(K,J)*FR(J,L)*PAA(K,J,M)                   00068200
      DDDS(LK,K)=DDDS(LK,K)+DEL(K,J)*FR(J,L)*PAV(K,J,M)                   00068300
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  619 CONTINUE                                                          00068400
      DADS(LK,K)=2.0*DADS(LK,K)*DS(K)                                   00068500
      DDDS(LK,K)=2.0*DDDS(LK,K)*DS(K)                                   00068600
   55 CONTINUE                                                          00068700
      DO 620 L=1,10                                                     00068800
      DADS(L,K)=DADS(L,K)/TVOL/UN                                       00068900
      DDDS(L,K)=DDDS(L,K)/TVOL/SQRT(UN)*SQRT(2.)                        00069000
  620 CONTINUE                                                          00069100
      DO 621 L=4,10                                                     00069200
      DADS(L,K)=DADS(L,K)*0.5*0.5                                       00069300
      DDDS(L,K)=DDDS(L,K)*0.5*0.5                                       00069400
  621 CONTINUE                                                          00069500
      DO 622 L=7,9                                                      00069600
      DADS(L,K)=DADS(L,K)*2.                                            00069700
      DDDS(L,K)=DDDS(L,K)*2.                                            00069800
  622 CONTINUE                                                          00069900
   16 CONTINUE                                                          00070000
C                                                                       00070100
C     THE POSSIBILITY THAT THERE MAY BE MASS FORWARD OF THE F.P. IS NOW  00070200
C     ACCOUNTED FOR.                                                    00070300
C                                                                       00070400
      NOS1=NOS+1                                                        00070500
      DA(2,2)=PMAS(NOS1)/TMAS*(-GXI**2)                                 00070600
      DA(2,4)=-ZMAS(NOS1)/ELL*PMAS(NOS1)/TMAS*(-GXI**2)                 00070700
      DA(2,6)=XMAS(NOS1)*DA(2,2)/ELL                                    00070800
      DA(3,3)=DA(2,2)                                                   00070900
      DA(3,5)=-DA(2,6)                                                  00071000
      DA(4,2)=DA(2,4)                                                   00071100
      ZD2=ZMAS(NOS1)**2                                                 00071200
      DA(4,4)=PMAS(NOS1)/TMAS*(ZD2+RRG(NOS1)**2)/ELL/ELL*(-GXI**2)      00071300
      DA(4,6)=XMAS(NOS1)/ELL*DA(4,2)                                    00071400
      DA(6,2)=DA(2,6)                                                   00071500
      DA(6,4)=DA(4,6)                                                   00071600
      DA(6,6)=(PMAS(NOS1)/TMAS*(XMAS(NOS1)/ELL)**2)*(-GXI**2)           00071700
      DA(6,6)=DA(6,6)+PMAS(NOS1)/TMAS*(YMAS(NOS1)/ELL)**2*(-GXI**2)     00071800
      DA(5,3)=DA(3,5)                                                   00071900
      DA(5,5)=PMAS(NOS1)/TMAS*(ZD2+XMAS(NOS1)**2)/ELL/ELL*(-GXI**2)     00072000
      FYR=-DA(2,2)*BEV(1,1)-DA(2,4)*BEV(2,1)-DA(2,6)*BEV(3,1)           00072100
      FYI=-DA(2,2)*BEV(4,1)-DA(2,4)*BEV(5,1)-DA(2,6)*BEV(6,1)           00072200
      FZR=-DA(3,3)*BOD(2,1)-DA(3,5)*BOD(3,1)                            00072300
      FZI=-DA(3,3)*BOD(5,1)-DA(3,5)*BOD(6,1)                            00072400
      BLR=-DA(6,2)*BEV(1,1)-DA(6,4)*BEV(2,1)-DA(6,6)*BEV(3,1)           00072500
      BLI=-DA(6,2)*BEV(4,1)-DA(6,4)*BEV(5,1)-DA(6,6)*BEV(6,1)           00072600
      DA(5,1)=(ZMAS(NOS1)/ELL*PMAS(NOS1)/TMAS)*(-GXI**2)                00072700
      BVR=-DA(5,3)*BOD(2,1)-DA(5,5)*BOD(3,1)-DA(5,1)*BOD(1,1)           00072800
      BVI=-DA(5,3)*BOD(5,1)-DA(5,5)*BOD(6,1)-DA(5,1)*BOD(4,1)           00072900
      TMR=-DA(4,2)*BEV(1,1)-DA(4,4)*BEV(2,1)-DA(4,6)*BEV(3,1)           00073000
      TMI=-DA(4,2)*BEV(4,1)-DA(4,4)*BEV(5,1)-DA(4,6)*BEV(6,1)           00073100
      NOSM1=NOS-1                                                       00073200
      NOS2=NOS+2                                                        00073300
      DO 53 K=1,NOSM1                                                   00073400
      PRF33=SRF33(K)                                                    00073500
      PRM35=SRM35(K)                                                    00073600
      PRM55=SRM55(K)                                                    00073700
      PC44=SC44(K)                                                      00073800
      DA(2,2)=(DADS(2,K)+PMAS(K)/TMAS)*(-GXI**2)                        00073900
      DB(2,2)=DDDS(2,K)*GXI                                             00074000
      DA(2,4)=(-ZMAS(K)/ELL*PMAS(K)/TMAS+DADS(9,K))*(-GXI**2)           00074100
      DB(2,4)=DDDS(9,K)*GXI                                             00074200
      DA(2,6)=(DADS(8,K)+XMAS(K)/ELL*PMAS(K)/TMAS-FN(JJ)/GXI**2*DDDS(2,K 00074300
```

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1))*(-GXI**2)                                                                   00074400
 DB(2,6)=(DDDS(8,K)+FN(JJ)*DADS(2,K))*GXI                                       00074500
 DA(3,3)=(DADS(3,K)+PMAS(K)/TMAS)*(-GXI**2)                                     00074600
 DB(3,3)=DDDS(3,K)*GXI                                                          00074700
 DA(3,5)=(DADS(7,K)-XMAS(K)/ELL*PMAS(K)/TMAS+FN(JJ)/GXI**2*DDDS(3,K             00074800
1))*(-GXI**2)                                                                   00074900
 DB(3,5)=(DDDS(7,K)-FN(JJ)*DADS(3,K))*GXI                                       00075000
 DA(4,2)=(-ZMAS(K)/ELL*PMAS(K)/TMAS+DADS(9,K))*(-GXI**2)                        00075100
 DB(4,2)=DDDS(9,K)*GXI                                                          00075200
 ZD2=ZMAS(K)**2                                                                 00075300
 DA(4,4)=(PMAS(K)/TMAS*(ZD2+RRG(K)**2)/ELL/ELL+DADS(4,K))*(-GXI**2)             00075400
 DB(4,4)=DDDS(4,K)*GXI                                                          00075500
 DB(4,4)=DB(4,4)+VD(K)*GXI+SBKD(K)*GXI                                          00075600
 DA(4,6)=(-PMAS(K)/TMAS*ZMAS(K)/ELL*XMAS(K)/ELL+DADS(10,K)-FN(JJ)/G             00075700
1XI**2*DDDS(9,K))*(-GXI**2)                                                     00075800
 DB(4,6)=(DDDS(10,K)+FN(JJ)*DADS(9,K))*GXI                                      00075900
 DA(4,4)=DA(4,4)+PMAS(K)/TMAS*(-ZMAS(K)/ELL)                                    00076000
 DA(6,2)=(XMAS(K)/ELL*PMAS(K)/TMAS+DADS(8,K)+FN(JJ)/GXI**2*DDDS(2,K             00076100
1))*(-GXI**2)                                                                   00076200
 DB(6,2)=(DDDS(8,K)-FN(JJ)*DADS(2,K))*GXI                                       00076300
 DA(6,4)=(-PMAS(K)/TMAS*ZMAS(K)/ELL*XMAS(K)/ELL+DADS(10,K)+FN(JJ)/G             00076400
1XI**2*DDDS(9,K))*(-GXI**2)                                                     00076500
 DB(6,4)=(DDDS(10,K)-FN(JJ)*DADS(9,K))*GXI                                      00076600
 DA(6,6)=(PMAS(K)/TMAS*(XMAS(K)/ELL)**2+DADS(6,K)+(FN(JJ)/GXI)**2*D             00076700
1ADS(2,K))*(-GXI**2)                                                            00076800
 DA(6,6)=DA(6,6)+PMAS(K)/TMAS*(YMAS(K)/ELL)**2*(-GXI**2)                        00076900
 DB(6,6)=(DDDS(6,K)+(FN(JJ)/GXI)**2*DDDS(2,K))*GXI                              00077000
 DA(5,1)=(ZMAS(K)/ELL*PMAS(K)/TMAS)*(-GXI**2)                                   00077100
 DA(5,3)=(DADS(7,K)-XMAS(K)/ELL*PMAS(K)/TMAS-FN(JJ)/GXI**2*DDDS(3,K             00077200
1))*(-GXI**2)                                                                   00077300
 DB(5,3)=(DDDS(7,K)+FN(JJ)*DADS(3,K))*GXI                                       00077400
 DA(5,5)=(PMAS(K)/TMAS*(ZD2+XMAS(K)**2)/ELL/ELL+DADS(5,K)+(FN(JJ)/G             00077500
1XI)**2*DADS(3,K))*(-GXI**2)                                                    00077600
 DB(5,5)=(DDDS(5,K)+(FN(JJ)/GXI)**2*DDDS(3,K))*GXI                              00077700
 TDA(2,2)=(-FN(JJ)/GXI**2/DS(K)*(DDDS(2,K)+DDDS(2,K+1)))*(-GXI**2)              00077800
 TDB(2,2)=(FN(JJ)/DS(K)*(DADS(2,K)+DADS(2,K+1)))*GXI                            00077900
 TDA(2,4)=(-FN(JJ)/GXI**2/DS(K)*(DDDS(9,K)+DDDS(9,K+1)))*(-GXI**2)              00078000
 TDB(2,4)=(FN(JJ)/DS(K)*(DADS(9,K)+DADS(9,K+1)))*GXI                            00078100
 TDA(2,6)=(-FN(JJ)/GXI**2/DS(K)*(DDDS(8,K)+DDDS(8,K+1))-(FN(JJ)/GXI             00078200
1)**2/DS(K)*(DADS(2,K)+DADS(2,K+1)))*(-GXI**2)                                  00078300
 TDB(2,6)=(FN(JJ)/DS(K)*(DADS(8,K)+DADS(8,K+1))-(FN(JJ)/GXI)**2/DS(             00078400
1K)*(DDDS(2,K)+DDDS(2,K+1)))*GXI                                                00078500
 TDA(4,2)=TDA(2,4)                                                              00078600
 TDB(4,2)=TDB(2,4)                                                              00078700
 TDA(4,4)=(-FN(JJ)/GXI**2/DS(K)*(DDDS(4,K)+DDDS(4,K+1)))*(-GXI**2)              00078800
 TDB(4,4)=(FN(JJ)/DS(K)*(DADS(4,K)+DADS(4,K+1)))*GXI                            00078900
 TDA(4,6)=(-FN(JJ)/GXI**2/DS(K)*(DDDS(10,K)+DDDS(10,K+1))-(FN(JJ)/G             00079000
1XI)**2/DS(K)*(DADS(9,K)+DADS(9,K+1)))*(-GXI**2)                                00079100
 TDB(4,6)=(FN(JJ)/DS(K)*(DADS(10,K)+DADS(10,K+1))-(FN(JJ)/GXI)**2/D             00079200
1S(K)*(DDDS(9,K)+DDDS(9,K+1)))*GXI                                              00079300
 TDA(6,2)=(-FN(JJ)/GXI**2/DS(K)*(DDDS(8,K)+DDDS(8,K+1)))*(-GXI**2)              00079400
 TDB(6,2)=(FN(JJ)/DS(K)*(DADS(8,K)+DADS(8,K+1)))*GXI                            00079500
 TDA(6,4)=(-FN(JJ)/GXI**2/DS(K)*(DDDS(10,K)+DDDS(10,K+1)))*(-GXI**2             00079600
1)                                                                              00079700
 TDB(6,4)=(FN(JJ)/DS(K)*(DADS(10,K)+DADS(10,K+1)))*GXI                          00079800
 TDA(6,6)=(-FN(JJ)/GXI**2/DS(K)*(DDDS(6,K)+DDDS(6,K+1))-(FN(JJ)/GXI             00079900
1)**2/DS(K)*(DADS(8,K)+DADS(8,K+1)))*(-GXI**2)                                  00080000
 TDB(6,6)=(FN(JJ)/DS(K)*(DADS(6,K)+DADS(6,K+1))-(FN(JJ)/GXI)**2/DS(             00080100
1K)*(DDDS(8,K)+DDDS(8,K+1)))*GXI                                                00080200
 TDA(3,3)=(-FN(JJ)/GXI**2/DS(K)*(DDDS(3,K)+DDDS(3,K+1)))*(-GXI**2)              00080300
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      TDB(3,3)=(FN(JJ)/DS(K)*(DADS(3,K)+DADS(3,K+1)))*GXI                    00080400
      TDA(5,3)=(-FN(JJ)/GXI**2/DS(K)*(DDDS(7,K)+DDDS(7,K+1)))*(-GXI**2)      00080500
      TDB(5,3)=(FN(JJ)/DS(K)*(DADS(7,K)+DADS(7,K+1)))*GXI                    00080600
      TDA(3,5)=TDA(5,3)+(FN(JJ)/GXI)**2/DS(K)*(DADS(3,K)+DADS(3,K+1))*(-     00080700
     1GXI**2)                                                                00080800
      TDB(3,5)=TDB(5,3)+(FN(JJ)/GXI)**2/DS(K)*(DDDS(3,K)+DDDS(3,K+1))*GX     00080900
     1I                                                                      00081000
      TDA(5,5)=(-FN(JJ)/GXI**2/DS(K)*(DDDS(5,K)+DDDS(5,K+1))+(FN(JJ)/GXI     00081100
     1)**2/DS(K)*(DADS(7,K)+DADS(7,K+1)))*(-GXI**2)                          00081200
      TDB(5,5)=(FN(JJ)/DS(K)*(DADS(5,K)+DADS(5,K+1))+(FN(JJ)/GXI)**2/DS(     00081300
     1K)*(DDDS(7,K)+DDDS(7,K+1)))*GXI                                        00081400
      RVM=PEXR(5,K)-DA(5,1)*BOD(1,1)-DA(5,3)*BOD(2,1)-DA(5,5)*BOD(3,1)-D     00081500
     1B(5,3)*BOD(5,1)-DB(5,5)*BOD(6,1)                                       00081600
      AIVM=PEXI(5,K)+DB(5,3)*BOD(2,1)+DB(5,5)*BOD(3,1)-DA(5,1)*BOD(4,1)-     00081700
     1DA(5,3)*BOD(5,1)-DA(5,5)*BOD(6,1)                                      00081800
      RTM=PEXR(4,K)-DA(4,2)*BEV(1,1)-DA(4,4)*BEV(2,1)-DA(4,6)*BEV(3,1)-D     00081900
     1B(4,2)*BEV(4,1)-DB(4,4)*BEV(5,1)-DB(4,6)*BEV(6,1)                      00082000
      AITM=PEXI(4,K)+DB(4,2)*BEV(1,1)+DB(4,4)*BEV(2,1)+DB(4,6)*BEV(3,1)-     00082100
     1DA(4,2)*BEV(4,1)-DA(4,4)*BEV(5,1)-DA(4,6)*BEV(6,1)                     00082200
      RLM=PEXR(6,K)-DA(6,2)*BEV(1,1)-DA(6,4)*BEV(2,1)-DA(6,6)*BEV(3,1)-D     00082300
     1B(6,2)*BEV(4,1)-DB(6,4)*BEV(5,1)-DB(6,6)*BEV(6,1)                      00082400
      AILM=PEXI(6,K)+DB(6,2)*BEV(1,1)+DB(6,4)*BEV(2,1)+DB(6,6)*BEV(3,1)-     00082500
     1DA(6,2)*BEV(4,1)-DA(6,4)*BEV(5,1)-DA(6,6)*BEV(6,1)                     00082600
      RFY=PEXR(2,K)-DA(2,2)*BEV(1,1)-DA(2,4)*BEV(2,1)-DA(2,6)*BEV(3,1)-D     00082700
     1B(2,2)*BEV(4,1)-DB(2,4)*BEV(5,1)-DB(2,6)*BEV(6,1)                      00082800
      AIFY=PEXI(2,K)+DB(2,2)*BEV(1,1)+DB(2,4)*BEV(2,1)+DB(2,6)*BEV(3,1)-     00082900
     1DA(2,2)*BEV(4,1)-DA(2,4)*BEV(5,1)-DA(2,6)*BEV(6,1)                     00083000
      RFZ=PEXR(3,K)-DA(3,3)*BOD(2,1)-DA(3,5)*BOD(3,1)-DB(3,3)*BOD(5,1)-D     00083100
     1B(3,5)*BOD(6,1)                                                        00083200
      AIFZ=PEXI(3,K)+DB(3,3)*BOD(2,1)+DB(3,5)*BOD(3,1)-DA(3,3)*BOD(5,1)-     00083300
     1DA(3,5)*BOD(6,1)                                                       00083400
      FYR=FYR+RFY                                                            00083500
      FYI=FYI+AIFY                                                           00083600
      FZR=FZR+RFZ                                                            00083700
      FZI=FZI+AIFZ                                                           00083800
      BLR=BLR+RLM                                                            00083900
      BLI=BLI+AILM                                                           00084000
      BVR=BVR+RVM                                                            00084100
      BVI=BVI+AIVM                                                           00084200
      TMR=TMR+RTM                                                            00084300
      TMI=TMI+AITM                                                           00084400
      EVR= (PDFR(5,K)+PDFR(5,K+1))/2.-TDA(5,3)*BOD(2,1)-TDA(5,5)*BOD(3,1     00084500
     1)-TDB(5,3)*BOD(5,1)-TDB(5,5)*BOD(6,1)                                  00084600
      EVI=(PDFI(5,K)+PDFI(5,K+1))/2.+TDB(5,3)*BOD(2,1)+TDB(5,5)*BOD(3,1)     00084700
     1-TDA(5,3)*BOD(5,1)-TDA(5,5)*BOD(6,1)                                   00084800
      ETR=(PDFR(4,K)+PDFR(4,K+1))/2.-TDA(4,2)*BEV(1,1)-TDA(4,4)*BEV(2,1)     00084900
     1-TDA(4,6)*BEV(3,1)-TDB(4,2)*BEV(4,1)-TDB(4,4)*BEV(5,1)-TDB(4,6)*BE     00085000
     2V(6,1)                                                                 00085100
      ETI=(PDFI(4,K)+PDFI(4,K+1))/2.+TDB(4,2)*BEV(1,1)+TDB(4,4)*BEV(2,1)     00085200
     1+TDB(4,6)*BEV(3,1)-TDA(4,2)*BEV(4,1)-TDA(4,4)*BEV(5,1)-TDA(4,6)*BE     00085300
     2V(6,1)                                                                 00085400
      ELR=(PDFR(6,K)+PDFR(6,K+1))/2.-TDA(6,2)*BEV(1,1)-TDA(6,4)*BEV(2,1)     00085500
     1-TDA(6,6)*BEV(3,1)-TDB(6,2)*BEV(4,1)-TDB(6,4)*BEV(5,1)-TDB(6,6)*BE     00085600
     2V(6,1)                                                                 00085700
      ELI=(PDFI(6,K)+PDFI(6,K+1))/2.+TDB(6,2)*BEV(1,1)+TDB(6,4)*BEV(2,1)     00085800
     1+TDB(6,6)*BEV(3,1)-TDA(6,2)*BEV(4,1)-TDA(6,4)*BEV(5,1)-TDA(6,6)*BE     00085900
     2V(6,1)                                                                 00086000
      EYR=(PDFR(2,K)+PDFR(2,K+1))/2.-TDA(2,2)*BEV(1,1)-TDA(2,4)*BEV(2,1)     00086100
     1-TDA(2,6)*BEV(3,1)-TDB(2,2)*BEV(4,1)-TDB(2,4)*BEV(5,1)-TDB(2,6)*BE     00086200
     2V(6,1)                                                                 00086300
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      EYI=(PDFI(2,K)+PDFI(2,K+1))/2.+TDB(2,2)*BEV(1,1)+TDB(2,4)*BEV(2,1) 00086400
     1+TDB(2,6)*BEV(3,1)-TDA(2,2)*BEV(4,1)-TDA(2,4)*BEV(5,1)-TDA(2,6)*BE 00086500
     2V(6,1)                                                             00086600
      EZR=(PDFR(3,K)+PDFR(3,K+1))/2.-TDA(3,3)*BOD(2,1)-TDA(3,5)*BOD(3,1) 00086700
     1-TDB(3,3)*BOD(5,1)-TDB(3,5)*BOD(6,1)                               00086800
      EZI=(PDFI(3,K)+PDFI(3,K+1))/2.+TDB(3,3)*BOD(2,1)+TDB(3,5)*BOD(3,1) 00086900
     1-TDA(3,3)*BOD(5,1)-TDA(3,5)*BOD(6,1)                               00087000
      FYRS=FYR+EYR                                                       00087100
      FYIS=FYI+EYI                                                       00087200
      FZRS=FZR+EZR-PRF33*BOD(2,1)-PRM35*BOD(3,1)                         00087300
      FZIS=FZI+EZI-PRF33*BOD(5,1)-PRM35*BOD(6,1)                         00087400
      TMRS=TMR+ETR                                                       00087500
      TMIS=TMI+ETI                                                       00087600
      TMRS=TMRS-PC44*BEV(2,1)                                            00087700
      TMIS=TMIS-PC44*BEV(5,1)                                            00087800
      BLRS=BLR+ELR-(ST(K)-TPST+0.5*DS(K))*0.5*FYRS                       00087900
      BLIS=BLI+ELI-(ST(K)-TPST+0.5*DS(K))*0.5*FYIS                       00088000
      BVRS=BVR+EVR+(ST(K)-TPST+0.5*DS(K))*0.5*FZRS                       00088100
      BVIS=BVI+EVI+(ST(K)-TPST+0.5*DS(K))*0.5*FZIS                       00088200
      BVRS=BVRS-PRM35*BOD(2,1)-PRM55*BOD(3,1)                            00088300
      BVIS=BVIS-PRM35*BOD(5,1)-PRM55*BOD(6,1)                            00088400
      FAC=TVOL/8.*ELL/BEAM                                               00088500
      FYRS=FYRS*FAC                                                      00088600
      FYIS=FYIS*FAC                                                      00088700
      FZRS=FZRS*FAC                                                      00088800
      FZIS=FZIS*FAC                                                      00088900
      TMRS=TMRS*FAC                                                      00089000
      TMIS=TMIS*FAC                                                      00089100
      BLRS=BLRS*FAC                                                      00089200
      BLIS=BLIS*FAC                                                      00089300
      BVRS=BVRS*FAC                                                      00089400
      BVIS=BVIS*FAC                                                      00089500
      FYRSG(K)=FYRS                                                      00089600
      FYISG(K)=FYIS                                                      00089700
      TMRSG(K)=TMRS                                                      00089800
      TMISG(K)=TMIS                                                      00089900
      BLRSG(K)=BLRS                                                      00090000
      BLISG(K)=BLIS                                                      00090100
      FZRSG(K)=FZRS                                                      00090200
      FZISG(K)=FZIS                                                      00090300
      BVRSG(K)=BVRS                                                      00090400
      BVISG(K)=BVIS                                                      00090500
      RLO(1,LL,K)= FYRS                                                  00090600
      AILO(1,LL,K)=FYIS                                                  00090700
      RLO (2,LL,K)=FZRS                                                  00090800
      AILO(2,LL,K)=FZIS                                                  00090900
      RLO (3,LL,K)=TMRS                                                  00091000
      AILO(3,LL,K)=TMIS                                                  00091100
      RLO (4,LL,K)=BVRS                                                  00091200
      AILO(4,LL,K)=BVIS                                                  00091300
      RLO (5,LL,K)=BLRS                                                  00091400
      AILO(5,LL,K)=BLIS                                                  00091500
      STATN(K) = ST1(K+1) + 0.5*DS(K+1)*10.                              00091600
   53 CONTINUE                                                           00091700
      RETURN                                                             00091800
      END                                                                00091900
                                                                              SE
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C                                                                        00092000
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C                                                                       00092100

                                                                          FC
      SUBROUTINE EXCFM                                                  00092200
      COMMON DM1(1496),FN(5),BAM(30),DM3(23),NOK,DM4(1137),TITO(12),    00092300
     2DM5(16),PRNTOP,DM6(356)                                           00092400
      COMMON/RRR/PNLI(30),RMASS(30),RDAMP(30),RREST(30)                 00092500
      INTEGER PRNTOP,H                                                  00092600
      COMMON /TEMP/ DM7(4784),ZN(30),DM8(186)                           00092700
      COMMON /TMP1/ FACT,JJ,HDIG1,VKNOTS,DM9(5)                         00092800
      COMMON /TMP5/ BDV(30,6,2)                                         00092900
      DATA MIN /3HMIN/                                                  00093000
      L=0                                                               00093100
      N=1                                                               00093200
      IF(BAM(1) .LE. BAM(NOK)) L= NOK +1                                00093300
      IF(BAM(1) .LE. BAM(NOK)) N= -1                                    00093400
      IF( PRNTOP .EQ. MIN ) GO TO 5614                                  00093500
      WRITE (6,5608) TITO,HDIG1,VKNOTS,FN(JJ)                           00093600
 5608 FORMAT(41H1  EXCITING FORCES AND MOMENTS  ***      ,12A6,15X,3H*** 00093700
     2///17X,9HHEADING =,F5.0,4H DEG,7X,12HSHIP SPEED =,F6.2,6H KNOTS/  00093800
     2 18X,15H(HEAD SEAS=180),9X,15HFROUDE NUMBER =,F7.4)               00093900
C      PRINT EXCITING FORCES AND MOMENTS                                00094000
      WRITE(6,5610)                                                     00094100
 5610 FORMAT (//47X,33HNONDIMENSIONAL TRANSFER FUNCTIONS//              00094200
     2 16X,13HSURGE FORCE /,8X,12HSWAY FORCE /,7X,13HHEAVE FORCE /,7X,  00094300
     2 13HROLL MOMENT /,6X,14HPITCH MOMENT /,8X,12HYAW MOMENT /,/7X,    00094400
     2 3(13X,7HM*G*R/L),3(13X,5HM*G*P,2X),/5X,6HWE(ND),                 00094500
     2 6(20H  AMPL. RATIO  PHASE)/11X,6(16X,4HDEG )/)                   00094600
      K=L                                                               00094700
      DO 5612 IL=1,NOK                                                  00094800
      K=K+N                                                             00094900
C      COMPUTE AMPLITUDE AND PHASE                                      00095000
      DO 5600 I=1,6                                                     00095100
      RL= BDV(K,I,1)                                                    00095200
      AI= BDV(K,I,2)                                                    00095300
      BDV(K,I,1)= SQRT(RL**2 + AI**2)                                   00095400
 5600 BDV(K,I,2)= ATAN2D(AI,RL)                                         00095500
 5604 CONTINUE                                                          00095600
      WRITE(6,5611) ZN(K),((BDV(K,I,J),J=1,2),I=1,6)                    00095700
      WRITE ( 60 )  ZN(K),((BDV(K,I,J),J=1,2),I=1,6)                    00095800
      WRITE ( 70 ) (PNLI(K),RMASS(K),RDAMP(K),RREST(K) )                00095900
 5611 FORMAT (4X,F7.3,6(1PE13.4,0PF7.1))                                00096000
 5612 CONTINUE                                                          00096100
 5614 CONTINUE                                                          00096200
C     CALL SEPART (2)                                                   00096300
      RETURN                                                            00096400
      END                                                               00096500
      010;0087:5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
      010;0089:1  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
                                                                          SE
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C                                                                       00096600
C                                                                       00096700

                                                                          FO
      SUBROUTINE MOTOUT                                                 00096800
C     MOTION OUTPUT SUBROUTINE                                          00096900
C     MOTIONS ARE SURGE (X1), SWAY (X2), HEAVE (X2), ROLL (X4))         00097000
```

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C     PITCH (X5), YAW(X6)                                                    00097100
      INTEGER PRNTOP,H                                                       00097200
      COMMON DM1(81),ELL,DM2(1414),FN(5),BAM(30),DM3(23),NOK,DM4(1137),      00097300
     2TITO(12),WORD,DM5(15),PRNTOP,DM6(344),INWSTP(12)                       00097400
      COMMON /TEMP/ DM7(300),RMO(6,30),AIMO(6,30),DM8(4094),WE(30),          00097500
     2ZN(30),XL1LMD(30),DM9(50),WAVAMP(30),DMO(76)                           00097600
      COMMON /TMP1/ FACT,JJ,HDIG1,VKNOTS,WSLOPE,WSTP,IWSTP,DMA(2)            00097700
      COMMON /TMP2/ SHM(30,6,2)                                              00097800
      DATA MIN /3HMIN/                                                       00097900
      DO 10 I=1,NOK                                                          00098000
      WVLNTH =BAM(I)*ELL                                                     00098100
C     TERM1 SCALES NONDIMENSIONAL DISPLACEMENTS BY-                          00098200
C                 WAVAMP                                                   00098300
      TERM1= WAVAMP(I)                                                       00098400
C     TERM2 SCALES NONDIMENSIONAL ANGLES BY-                                 00098500
C                 WAVAMP * 57.3 / WVLNTH                                   00098600
      TERM2= TERM1*FACT/WVLNTH                                               00098700
      DO 10 J=1,6                                                            00098800
C     COMPUTE SINGLE AMPLITUDES                                              00098900
      TERM=TERM1                                                             00099000
      IF(J .GT. 3) TERM=TERM2                                                00099100
      SHM(I,J,1)= TERM*SQRT(RMO(J,I)**2 + AIMO(J,I)**2)                      00099200
C     COMPUTE PHASES                                                         00099300
      SHM(I,J,2)= ATAN2D(AIMO(J,I),RMO(J,I))                                 00099400
   10 CONTINUE                                                               00099500
      L=0                                                                    00099600
      N=1                                                                    00099700
      IF(BAM(1) .LE. BAM(NOK)) L= NOK+1                                      00099800
      IF(BAM(1) .LE. BAM(NOK)) N=-1                                          00099900
C     CALL SEPART (1)                                                        00100000
      IF( PRNTOP  .EQ. MIN ) GO TO 35                                        00100100
      WRITE(6,1000)TITO,HDIG1,VKNOTS,WSLOPE,FN(JJ),INWSTP(IWSTP)             00100200
C     PRINT SINGLE AMPLITUDES                                                00100300
      WRITE (6,1010) (WORD,I=1,4)                                            00100400
      K=L                                                                    00100500
      DO 15 LL=1,NOK                                                         00100600
      K=K+N                                                                  00100700
      WRITE(6,1020) WE(K),XL1LMD(K),BAM(K),ZN(K),WAVAMP(K),                  00100800
     2(SHM(K,I,1),I=1,6)                                                     00100900
   15 CONTINUE                                                               00101000
   35 CONTINUE                                                               00101100
C     CALL SEPART (2)                                                        00101200
      IF(PRNTOP .EQ. MIN) GO TO 80                                           00101300
C     PRINT RESPONSE AMPLITUDE OPERATORS                                     00101400
      WRITE(6,1050)                                                          00101500
      K=L                                                                    00101600
      DO 50 LL=1,NOK                                                         00101700
      K=K+N                                                                  00101800
      DO 40 I=1,6                                                            00101900
      SHM(K,I,1)=SHM(K,I,1)/WAVAMP(K)                                        00102000
   40 SHM(K,I,1)=SHM(K,I,1)**2                                               00102100
      WRITE(6,1060) WE(K),((SHM(K,I,J),J=1,2),I=1,6)                         00102200
   50 CONTINUE                                                               00102300
C     PRINT NONDIMENSIONAL TRANSFER FUNCTIONS                                00102400
      WRITE(6,1070)                                                          00102500
      K=L                                                                    00102600
      WSCON= ELL/360.                                                        00102700
      DO 70 LL=1,NOK                                                         00102800
      K=K+N                                                                  00102900
      DO 60 I=1,6                                                            00103000
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      SHM(K,I,1)=SQRT(SHM(K,I,1))                                          00103100
      IF(I.GT. 3) SHM(K,I,1)=WSCON*SHM(K,I,1)/XL1LMD(K)                    00103200
   60 CONTINUE                                                             00103300
      WRITE(6,1060) XL1LMD(K),((SHM(K,I,J),J=1,2),I=1,6)                   00103400
      WRITE( 40 )   XL1LMD(K),((SHM(K,I,J),J=1,2),I=1,6)                   00103500
   70 CONTINUE                                                             00103600
   80 CONTINUE                                                             00103700
      RETURN                                                               00103800
 1000 FORMAT(41HSHIP MOTIONS IN REGULAR WAVES  ***       ,12A6,15X,3H*** 00103900
     2///17X,'HEADING =',F5.0,' DEG',7X,'SHIP SPEED =',F6.2,' KNOTS',5X, 00104000
     2'WAVE SLOPE (360',1H*,'R/LAMBDA); K',1H*,'R, =',F5.2,' DEG'/18X,   00104100
     2'(HEAD SEAS=180)',9X,'FROUDE NUMBER =',F7.4,7X,'WAVE STEEPNESS (2' 00104200
     21H*,'R/LAMBDA) = 1 /'I3)                                            00104300
 1010 FORMAT(//58X,17HSINGLE AMPLITUDES,                                  00104400
     2//6X,'  WE  L/LAM LAM/L WE(ND)    '                               00104500
     2 'WAVE AMPL.(R)    SURGE(X1)      SWAY(X2)    HEAVE(X3)'           00104600
     2 '      ROLL(X4)     PITCH(X5)       YAW(X6)',                     00104700
     2 /7X,3HRPS,18X,4(7X,A6),10X,3HDEG,9X,3HDEG,11X,3HDEG/)             00104800
 1020 FORMAT(5X,2F6.3,F6.2,F7.3,2X,1P7E13.4)                              00104900
 1030 FORMAT(//6X,'WE FS',24X,'PHASES IN DEGREES'//)                      00105000
 1040 FORMAT(4X,F7.3,6F10.3)                                              00105100
 1050 FORMAT(//50X,'RESPONSE AMPLITUDE OPERATORS'//                       00105200
     2 15X,14H(SURGE / R)**2,7X,13H(SWAY / R)**2,6X,14H(HEAVE / R)**2,    00105300
     2 7X,13H(ROLL / R)**2,6X,14H(PITCH / R)**2,7X,12H(YAW / R)**2/       00105400
     26X,'  WE',                                                          00105500
     26(20H  AMPL. RATIO  PHASE)/7X,4HRPS ,6(20H    SQUARED     DEG )/)  00105600
 1060 FORMAT(4X,F7.3,6(1PE13.4,0PF7.1))                                   00105700
 1070 FORMAT(//47X,'NONDIMENSIONAL TRANSFER FUNCTIONS'//                  00105800
     2 17X,9HSURGE / R,12X,8HSWAY / R,11X,9HHEAVE / R,11X,                00105900
     2 10HROLL / K*R,10X,11HPITCH / K*R,10X,9HYAW / K*R,                  00106000
     2 /6X,'L/LAM',6(20H  AMPL. RATIO  PHASE)/11X,6(16X,4HDEG )/)         00106100
      END                                                                 00106200
      011:00F9:5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT (
                                                                          St
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C                                                                         00106300
C                                                                         00106400
                                                                            F(
      SUBROUTINE LODOUT (ISTAT)                                           00106500
C     LOAD OUTPUT SUBROUTINE                                              00106600
C     LOADS ARE HORIZONTAL SHEAR FORCE (V2), VERTICAL SHEAR FORCE (V3),-  00106700
C     TORSIONAL MOMENT (V4), VERTICAL BENDING MOMENT (V5), HORIZONTAL     00106800
C     BENDING MOMENT (V6)                                                 00106900
      INTEGER PRNTOP,H                                                    00107000
      COMMON DM1(80),EL,ELL,DM2(510),TMAS,DM3(12),TVOL,DM4(890),FN(5),    00107100
     28AM(30),DM5(23),NOK,DM6(1137),TITO(12),WORD,DM7(15),PRNTOP,         00107200
     2DM8(54),BEAM,DM9(8),GRAV,DM90(280),INWSTP(12)                       00107300
      COMMON /TEMP/ DM0(4754),WE(30),ZN(30),XL1LMD(30),DMA(50),           00107400
     2WAVAMP(30),DMB(76)                                                  00107500
      COMMON /TMP1/ FACT,JJ,HDIG1,VKNOTS,WSLOPE,WSTP,IWSTP,DMC(2)         00107600
      COMMON /TEMP2/ SLD(30,6,2)                                          00107700
      COMMON /TMP3/ RLO(5,30,25),AILO(5,30,25),STATN(24)                  00107800
      COMMON /LODPRN/ DM10(24),WORD2,WORD3,DM11(263)                      00107900
      DATA MIN /3HMIN/                                                    00108000
      K=ISTAT                                                             00108100
C     RO EQUALS SHIP MASS DIVIDED BY DISPLACED VOLUME                     00108200
      RO=TMAS/(TVOL*EL **3)                                               00108300
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      CON= RO*GRAV*BEAM*ELL                                              00108400
      DO 10 I=1,NOK                                                      00108500
C     TERM1 SCALES NONDIMENSIONAL FORCES BY-                             00108600
C                 RO * GRAV * BEAM * ELL *WAVAMP                         00108700
      TERM1= WAVAMP(I)*CON                                               00108800
C     TERM2 SCALES NONDIMENSIONAL MOMENTS BY-                            00108900
C                 RO * GRAV * BEAM * ELL * ELL * WAVAMP                  00109000
      TERM2=TERM1*ELL                                                    00109100
      DO 10 J=1,5                                                        00109200
C     COMPUTE SINGLE AMPLITUDES FOR PARTICULAR STATION                   00109300
      TERM= TERM1                                                        00109400
      IF(J.GT.2) TERM = TERM2                                            00109500
      SLD(I,J,1) = TERM*SQRT(RLO(J,I,K)**2  + AILO(J,I,K)**2)            00109600
C     COMPUTE PHASES                                                     00109700
      SLD(I,J,2)= ATAN2D(AILO(J,I,K),RLO(J,I,K))                         00109800
   10 CONTINUE                                                           00109900
      L=0                                                                00110000
      N=1                                                                00110100
      IF(BAM(1) .LE. BAM(NOK)) L= NOK+1                                  00110200
      IF(BAM(1) .LE. BAM(NOK)) N= -1                                     00110300
C     CALL SEPART (1)                                                    00110400
      IF( PRNTOP .EQ. MIN ) GO TO 35                                     00110500
      WRITE (6,1000) TITO,HDIG1,VKNOTS,WSLOPE,FN(JJ),INWSTP(IWSTP)       00110600
C     PRINT SINGLE AMPLITUDES                                            00110700
      WRITE(6,1010) STATN(ISTAT),WORD,(WORD2,I=1,2),(WORD3,I=1,3)        00110800
      K=L                                                                00110900
      DO 15 LL=1,NOK                                                     00111000
      K=K+N                                                              00111100
      WRITE (6,1020) WE(K),XL1LMD(K),BAM(K),ZN(K),WAVAMP(K),             00111200
     2(SLD(K,I,1),I=1,5)                                                 00111300
   15 CONTINUE                                                           00111400
   35 CONTINUE                                                           00111500
C     CALL SEPART (2)                                                    00111600
      IF(PRNTOP .EQ. MIN) GO TO 55                                       00111700
C     PRINT RESPONSE AMPLITUDE OPERATORS                                 00111800
      WRITE(6,1050)                                                      00111900
      K=L                                                                00112000
      DO 50 LL=1,NOK                                                     00112100
      K=K+N                                                              00112200
      DO 40 I=1,5                                                        00112300
      SLD(K,I,1) = SLD(K,I,1)/WAVAMP(K)                                  00112400
   40 SLD(K,I,1) = SLD(K,I,1)**2                                         00112500
      WRITE (6,1060) WE(K),((SLD(K,I,J),J=1,2),I=1,5)                    00112600
   50 CONTINUE                                                           00112700
C     PRINT NONDIMENSIONAL TRANSFER FUNCTIONS                            00112800
      WRITE (6,1070)                                                     00112900
   55 K=L                                                                00113000
      DO 70 LL=1,NOK                                                     00113100
      K=K+N                                                              00113200
      DO 60 I=1,5                                                        00113300
      SLD(K,I,1) = SQRT(SLD(K,I,1))/CON                                  00113400
      IF(I .GT. 2) SLD(K,I,1)= SLD(K,I,1)/ELL                            00113500
   60 CONTINUE                                                           00113600
      IF( PRNTOP .EQ. MIN ) GO TO 65                                     00113700
      WRITE (6,1060) XL1LMD(K),((SLD(K,I,J),J=1,2),I=1,5)                00113800
   65 WRITE ( 50 )   XL1LMD(K),((SLD(K,I,J),J=1,2),I=1,5)                00113900
   70 CONTINUE                                                           00114000
   80 CONTINUE                                                           00114100
      RETURN                                                             00114200
 1000 FORMAT(41H1   SEA LOADS IN REGULAR WAVES  ***      ,12A6,15X,3H*** 00114300
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     2///17X,'HEADING =',F5.0,' DEG',7X,'SHIP SPEED =',F6.2,' KNOTS',5X,  00114400
     2'WAVE SLOPE (360',1H*,'R/LAMBDA), K',1H*,'R =', F5.2,' DEG'/18X,    00114500
     2'(HEAD SEAS=180)',9X,'FROUDE NUMBER =',F7.4,7X,'WAVE STEEPNESS (2'  00114600
     21H*,'R/LAMBDA) = 1 /'I3)                                            00114700
 1010 FORMAT(//49X,'SINGLE AMPLITUDES   (STATION',F6.2,1H),               00114800
     2//6X,'  WE  L/LAM LAM/L WE(ND)   '                                  00114900
     2 'WAVE AMPL.(R)  H.SHEAR(V2)  V.SHEAR(V3)  T.MON.(V4)'              00115000
     2'   V.MOM.(V5)   H.MOM.(V6)'/7X,3HRPS,25X,A6,2(7X,A6),4X,           00115100
     2 3(3X,A8,2X)/)                                                     00115200
 1020 FORMAT(5X,2F6.3,F6.2,F7.3,2X,1P7E13.4)                             00115300
 1030 FORMAT(//6X,'WE FS',24X,'PHASES IN DEGREES'//)                     00115400
 1040 FORMAT(4X,F7.3,6F10.3)                                             00115500
 1050 FORMAT(//50X,28HRESPONSE AMPLITUDE OPERATORS//                     00115600
     21X,'(H.SHEAR / R)',2H**,'2    (V.SHEAR / R)',2H*',2    (T.MOH.'  00115700
     2' / R)',2H**,'2    (V.MOM. / R)',2H**,'2    (H.MOM. / R)',3H**2/  00115800
     26X,'  WE ',                                                        00115900
     25(20H  AMPL. RATIO  PHASE)/7X,4HRPS ,5(20H    SQUARED     DEG )/)  00116000
 1060 FORMAT(4X,F7.3,6(1PE13.4,0PF7.1))                                  00116100
 1070 FORMAT(//47X,33HNONDIMENSIONAL TRANSFER FUNCTIONS//                00116200
     21X,'H.SHEAR /          V.SHEAR /          T.MOM. /       '        00116300
     2'     V.MOM. /          H.MOM. /'/15X,2(2X,10HRO*G*B*L*R,8X),     00116400
     23(12HRO*G*B*L*L*R,8X)/6X,'L/LAM'                                   00116500
     25(20H  AMPL. RATIO  PHASE)/11X,5(16X,4HDEG )/)                     00116600
      END                                                                00116700
      012;010D:4  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
                                                                         SE(
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C                                                                        00116800
C                                                                        00116900

      SUBROUTINE RCTABL                                                  00117000
      COMMON DM1(81),ELL,DM2(1414),FN(5),BAM(30),DM3(24),NOB,NOH,        00117100
     2DM4(1150),HDG1(10),DM5(67),GRAV,DM6(229),THMD(50),NWSTP,           00117200
     2INWSTP(12)                                                         00117300
      COMMON /TEMP/ DM7(4844),IHMD(50),DM8(106)                          00117400
      COMMON /TMP1/ FACT,DMP(8)                                          00117500
      COMMON /TMP4/ HMD(5,50,2),NHF,EPS                                  00117600
      WRITE (6,5500)                                                     00117700
 5500 FORMAT(1H1,18X,32HROLL AMPLITUDE CONVERGENCE TABLE)                00117800
      KTH=0                                                              00117900
      DO 5340 I=1,NOH                                                    00118000
      HDIG1= HDG1(I)                                                     00118100
      DO 5340 J=1,NOB                                                    00118200
      VKNOTS = SQRT(ELL*GRAV)*FN(J)/1.689                                00118300
      DO 5340 N=1,NWSTP                                                  00118400
      KTH=KTH+1                                                          00118500
      WSTP= 1./FLOAT(INWSTP(N))                                          00118600
      WSLOPE = 180.*WSTP                                                 00118700
      WRITE (6,5503) HDIG1,VKNOTS,FN(J),WSLOPE,INWSTP(N)                 00118800
 5503 FORMAT (//10H HEADING =,F5.0,                                      00118900
     220H DEG    SHIP SPEED =,F6.2,25H KNOTS    FROUDE NUMBER =,F7.4,    00119000
     216H    WAVE SLOPE =,F5.2,4H DEG,24H    WAVE STEEPNESS = L /,I3)    00119100
      ITERAT = IHMD(KTH)                                                 00119200
      DO 5335 L=1,ITERAT                                                 00119300
      K=L-1                                                              00119400
      THERAD=HMD(L,KTH,1)                                                00119500
      THCRAD= HMD(L,KTH,2)                                               00119600
      THEDEG= THERAD*FACT                                                00119700
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      THCDEG = THCRAD*FACT                                                    00119800
      THDRAD = ABS(THERAD-THCRAD)                                             00119900
      THDDEG = THDRAD*FACT                                                    00120000
 5335 WRITE (6,5505) K,THERAD,THEDEG,THCRAD,THCDEG,THDRAD,THDDEG              00120100
 5505 FORMAT (12H0  ITERATION,I3,4X,17HROLL AMPL. EST. =,F7.4,                00120200
     26H RAD (,F5.2,5H DEG)/19X,17HROLL AMPL. CAL. =,F7.4,6H RAD (,F5.2,      00120300
     25H DEG)/19X,17H  DIFERENCE     =,F7.4,6H RAD (,F5.2,5H DEG))            00120400
 5340 IF(ITERAT .EQ. 5 .AND. THDRAD .GT. EPS) WRITE (6,5510)                  00120500
 5510 FORMAT (78H0JUST CAN NOT GET ROLL AMPLITUDE TO CONVERGE. FIVE ATTE      00120600
     2MPTS AND FIVE FAILUTES./45H C-EST LA VIE. WILL TRY OTHER CONDITION      00120700
     2S NOW.)                                                                 00120800
      WRITE (6,5513)                                                          00120900
 5513 FORMAT(//33H ROLL AMPLITUDE ESTIMATES (RAD) =)                          00121000
      WRITE (6,5515) (THMD(I),I=1,NHF)                                        00121100
 5515 FORMAT (8F10.4)                                                         00121200
      RETURN                                                                  00121300
      END                                                                     00121400
                                                                              SEE

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C                                                                             00121500
C                                                                             00121600

      SUBROUTINE TANAKA(THM,EDDY,RGB)                                         00121700
C                                                                             00121800
C PROGRAMMER- O, FALTINSEN,DNV                                                00121900
C                                                                             00122000
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PH      00122100
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,FI44,FI55,FI66,FI46,TP      00122200
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10)      00122300
     3,FN(5),BAM(30),COG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40),      00122400
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EPI(25,7),      00122500
     5UN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP          00122600
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES,       00122700
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25)      00122800
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)                   00122900
      COMMON NWSTP,INWSTP(12)                                                 00123000
      DIMENSION FDDY(27),RGB(27),F1(15),BDKG(15),GKDB(6),RFORE(6              00123100
     1),BAFT(5),CAFT(5),XI(8),YI(8)                                           00123200
      DIMENSION ALF2(5),F2(5)                                                 00123300
      ALF2(1)=0.0                                                             00123400
      ALF2(2)=0.0873                                                          00123500
      ALF2(3)=0.1745                                                          00123600
      ALF2(4)=0.3491                                                          00123700
      ALF2(5)=0.5235                                                          00123800
      F2(1)=1.                                                                00123900
      DO 1 I=1,5                                                              00124000
      BDKG(I)=1./(60.-I*10.)                                                  00124100
    1 CONTINUE                                                                00124200
      BDKG(6)=1./5                                                            00124300
      DO 2 I=7,13                                                             00124400
      BDKG(I)=0.5+0.5*(I-7)                                                   00124500
    2 CONTINUE                                                                00124600
      IF(THM-0.1745) 3,3,4                                                    00124700
    3 CONTINUE                                                                00124800
      F1(1)=0.455                                                             00124900
      F1(2)=0.52                                                              00125000
      F1(3)=0.42                                                              00125100
      F1(4)=0.35                                                              00125200
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      F1(5)=0.52                                                        00125300
      GO TO 5                                                           00125400
    4 CONTINUE                                                          00125500
      IF(THM-0.2618) 6,6,7                                              00125600
    6 CONTINUE                                                          00125700
      FAC=(THM-0.1745)/(0.2618-0.1745)                                  00125800
      F1(1)=(0.32-0.455)*FAC +0.455                                     00125900
      F1(2)=(0.34-0.52)*FAC +0.52                                       00126000
      F1(3)=(0.29-0.42)*FAC +0.42                                       00126100
      F1(4)=(0.31-0.35)*FAC+0.35                                        00126200
      F1(5)=(0.48-0.52)*FAC+0.52                                        00126300
      GO TO 5                                                           00126400
    7 CONTINUE                                                          00126500
      IF(THM-0.3491) 8,9,9                                              00126600
    8 CONTINUE                                                          00126700
      FAC=(THM-0.2618)/(0.3491-0.2618)                                  00126800
      F1(1)=(0.25-0.32)*FAC+0.32                                        00126900
      F1(2)=(0.25-0.34)*FAC+0.34                                        00127000
      F1(3)=(0.22-0.29)*FAC+0.29                                        00127100
      F1(4)=(0.28-0.31)*FAC+0.31                                        00127200
      F1(5)=(0.45-0.48)*FAC+0.48                                        00127300
      GO TO 5                                                           00127400
    9 CONTINUE                                                          00127500
      F1(1)=0.25                                                        00127600
      F1(2)=0.25                                                        00127700
      F1(3)=0.22                                                        00127800
      F1(4)=0.28                                                        00127900
      F1(5)=0.45                                                        00128000
    5 CONTINUE                                                          00128100
      F1(6)=0.63                                                        00128200
      F1(7)=0.63                                                        00128300
      F1(8)=0.59                                                        00128400
      F1(9)=0.53                                                        00128500
      F1(10)=0.4                                                        00128600
      F1(11)=0.35                                                       00128700
      F1(12)=0.32                                                       00128800
      F1(13)=0.3                                                        00128900
      IF(THM-0.0873) 10,10,11                                           00129000
   10 CONTINUE                                                          00129100
      AEX=10.6                                                          00129200
      GO TO 12                                                          00129300
   11 CONTINUE                                                          00129400
      IF(THM-0.1745) 13,13,14                                           00129500
   13 CONTINUE                                                          00129600
      AEX=(7.66-10.6)/(0.1745-0.0873)*(THM-0.0873)+10.6                 00129700
      GO TO 12                                                          00129800
   14 CONTINUE                                                          00129900
      IF(THM-0.2618) 15,15,16                                           00130000
   15 CONTINUE                                                          00130100
      AEX=(6.34-7.66)/(0.2618-0.1745)*(THM-0.1745)+7.66                 00130200
      GO TO 12                                                          00130300
   16 CONTINUE                                                          00130400
      AEX=(5.28-6.34)/(0.3491-0.2618)*(THM-0.2618)+6.34                 00130500
   12 CONTINUE                                                          00130600
      GKDB(1)=1.2                                                       00130700
      GKDB(2)=1.4                                                       00130800
      GKDB(3)=1.6                                                       00130900
      GKDB(4)=1.8                                                       00131000
      GKDB(5)=2.0                                                       00131100
      GKDB(6)=2.05                                                      00131200
```

```
      RFORE(1)=1.0                                                          00131300
      RFORE(2)=0.6                                                          00131400
      RFORE(3)=0.34                                                         00131500
      RFORE(4)=0.15                                                         00131600
      RFORE(5)=0.04                                                         00131700
      RFORE(6)=0.0                                                          00131800
      BAFT(1)=1.0                                                           00131900
      BAFT(2)=1.25                                                          00132000
      BAFT(3)=1.5                                                           00132100
      BAFT(4)=2.0                                                           00132200
      BAFT(5)=2.25                                                          00132300
      CAFT(1)=0.22                                                          00132400
      CAFT(2)=0.24                                                          00132500
      CAFT(3)=0.3                                                           00132600
      CAFT(4)=0.5                                                           00132700
      CAFT(5)=0.63                                                          00132800
      DO 17 K=1,NOS                                                         00132900
      ITSU=ITS(K)                                                           00133000
      GO TO(18,19,20,21),ITSU                                               00133100
   18 CONTINUE                                                              00133200
      RGB(K)=ABS(Y(K,NUT)*EL-ZG)                                            00133300
      IF(X(K,1)) 60,60,61                                                   00133400
   60 CONTINUE                                                              00133500
      EDDY(K)=0.63                                                          00133600
      GO TO 29                                                              00133700
   61 CONTINUE                                                              00133800
      GDB=RGB(K)/2./X(K,1)/EL                                               00133900
      IF(GDB-2.05) 22,23,23                                                 00134000
   23 CONTINUE                                                              00134100
      RBIL=0.0                                                              00134200
      GO TO 24                                                              00134300
   22 CONTINUE                                                              00134400
      DO 25 J=2,6                                                           00134500
      ITEMP= J                                                              00134600
      IF(GDB-GKDB(J)) 26,26,25                                              00134700
   25 CONTINUE                                                              00134800
   26 CONTINUE                                                              00134900
      J=ITEMP                                                               00135000
      RBIL=(RFORE(J)-RFORE(J-1))/(GKDB(J)-GKDB(J-1))*(GDB-GKDB(J-1))+RFO    00135100
     1RE(J-1)                                                               00135200
      RBIL=RBIL*X(K,1)*EL                                                   00135300
   24 CONTINUE                                                              00135400
      BDG=1./GDB                                                            00135500
      DO 27 J=2,13                                                          00135600
      ITEMP=J                                                               00135700
      IF(BDG-BDKG(J)) 28,28,27                                              00135800
   27 CONTINUE                                                              00135900
   28 CONTINUE                                                              00136000
      J=ITEMP                                                               00136100
      FONE=(F1(J)-F1(J-1))/(BDKG(J)-BDKG(J-1))*(BDG-BDKG(J-1))+F1(J-1)      00136200
      F2ALF=1.                                                              00136300
      EDDY(K)=F2ALF*FONE*EXP(-AEX*RBIL/ABS(Y(K,NUT))/EL)                    00136400
      GO TO 29                                                              00136500
   19 CONTINUE                                                              00136600
      DO 30 J=1,NUT                                                         00136700
      XI(J)=X(K,J)*EL                                                       00136800
      YI(J)=Y(K,J)*EL                                                       00136900
   30 CONTINUE                                                              00137000
      RBIL=RD(K)                                                            00137100
      RGB(K)=SQRT((YI(NUT)-ZG)**2+XI(1)**2)-RBIL*(SQRT(2.)-1.)              00137200
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      BDG=2.*XI(1)/ABS(YI(NUT)-ZG)                                          00137300
      DO 31 J=2,13                                                          00137400
      ITEMP=J                                                               00137500
      IF(BDG-BDKG(J)) 32,32,31                                              00137600
   31 CONTINUE                                                              00137700
   32 CONTINUE                                                              00137800
      J=ITEMP                                                               00137900
      FONE=(F1(J)-F1(J-1))/(BDKG(J)-BDKG(J-1))*(BDG-BDKG(J-1))+F1(J-1)      00138000
      EDDY(K)=FONE*EXP(-AEX*RBIL/ABS(YI(NUT)))                              00138100
      GO TO 29                                                              00138200
   20 CONTINUE                                                              00138300
      RGB(K)=ABS(Y(K,NUT)*EL-ZG)                                            00138400
      BDG=2.*X(K,1)*EL/RGB(K)                                               00138500
      DO 33 J=2,5                                                           00138600
      ITEMP=J                                                               00138700
      IF(BDG-BAFT(J)) 34,34,33                                              00138800
   33 CONTINUE                                                              00138900
   34 CONTINUE                                                              00139000
      J=ITEMP                                                               00139100
      EDDY(K)=(CAFT(J)-CAFT(J-1))/(BAFT(J)-BAFT(J-1))*(BDG-BAFT(J-1))+CA    00139200
     1FT(J-1)                                                               00139300
      GO TO 29                                                              00139400
   21 CONTINUE                                                              00139500
      RGB(K)=0.0                                                            00139600
      EDDY(K)=0.0                                                           00139700
   29 CONTINUE                                                              00139800
      GO TO (40,40,43,43),ITSU                                              00139900
   40 CONTINUE                                                              00140000
      IF(X(K,2)-X(K,1)) 42,43,43                                            00140100
   42 CONTINUE                                                              00140200
      BR=(X(K,1)-X(K,2))/(-Y(K,2))                                          00140300
      ALF=ATAN(BR)                                                          00140400
      RDD=RBIL/ABS(Y(K,NUT))/EL                                             00140500
      IF(RDD) 44,44,45                                                      00140600
   44 CONTINUE                                                              00140700
      F2(2)=0.855                                                           00140800
      F2(3)=0.765                                                           00140900
      F2(4)=0.682                                                           00141000
      F2(5)=0.646                                                           00141100
      GO TO 46                                                              00141200
   45 CONTINUE                                                              00141300
      IF(RDD-0.0571) 47,47,48                                               00141400
   47 CONTINUE                                                              00141500
      F2(2)=(0.745-0.855)/0.0571*RDD+0.855                                  00141600
      F2(3)=(0.670-0.765)/0.0571*RDD+0.765                                  00141700
      F2(4)=(0.745-0.682)/0.0571*RDD+0.682                                  00141800
      F2(5)=(0.915-0.646)/0.0571*RDD+0.646                                  00141900
      GO TO 46                                                              00142000
   48 CONTINUE                                                              00142100
      IF(RDD-0.1142) 49,49,50                                               00142200
   49 CONTINUE                                                              00142300
      F2(2)=0.74                                                            00142400
      F2(3)=(0.72-0.670)/(0.1142-0.0571)*(RDD-0.0571)+0.670                 00142500
      F2(4)=(0.89-0.745)/(0.1142-0.0571)*(RDD-0.0571)+0.745                 00142600
      F2(5)=(1.34-0.915)/(0.1142-0.0571)*(RDD-0.0571)+0.915                 00142700
      GO TO 46                                                              00142800
   50 CONTINUE                                                              00142900
      IF(RDD-0.1713) 51,51,52                                               00143000
   51 CONTINUE                                                              00143100
      F2(2)=(0.70-0.74)/(0.1713-0.1142)*(RDD-0.1142)+0.74                   00143200
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      F2(3)=0.72                                                        00143300
      F2(4)=(1.20-0.89)/(0.1713-0.1142)*(RDD-0.1142)+0.89               00143400
      F2(5)=(1.94-1.34)/(0.1713-0.1142)*(RDD-0.1142)+1.34               00143500
      GO TO 46                                                          00143600
   52 CONTINUE                                                          00143700
      F2(2)=0.7                                                         00143800
      F2(3)=0.72                                                        00143900
      F2(4)=1.2                                                         00144000
      F2(5)=1.94                                                        00144100
   46 CONTINUE                                                          00144200
      DO 53 J=2,5                                                       00144300
      ITEMP=J                                                           00144400
      IF(ALF-ALF2(J)) 54,54,53                                          00144500
   53 CONTINUE                                                          00144600
   54 CONTINUE                                                          00144700
      J=ITEMP                                                           00144800
      F2ALF=(F2(J)-F2(J-1))/(ALF2(J)-ALF2(J-1))*(ALF-ALF2(J-1))+F2(J-1) 00144900
      EDDY(K)=EDDY(K)*F2ALF                                             00145000
   43 CONTINUE                                                          00145100
   17 CONTINUE                                                          00145200
      RETURN                                                            00145300
      END                                                               00145400
                                                                           SEG
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C                                                                       00145500
C                                                                       00145600

      SUBROUTINE BILGEK(GXI,THM,SBKD,TBKD)                              00145700
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PH 00145800
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00145900
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10) 00146000
     3,FN(5),BAM(30),CDG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40), 00146100
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7), 00146200
     5UN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP     00146300
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES, 00146400
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25) 00146500
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)             00146600
      COMMON NWSTP,INWSTP(12)                                           00146700
C                                                                       00146800
C   THIS CALCULATION METHOD IS A MODIFICATION OF KATOS METHOD           00146900
C   R=RADIUS OF BILGE CIRCLE AT STATION K                               00147000
C   RF=RISE OF FLOOR AT STATION K                                       00147100
C   DELTAL=LENGTH OF THAT PART OF BILGEKEEL WICH IS AT STATION K        00147200
C   RK=DISTANCE OF MIIDDLE OF BILGEKEEL FROM THE MOMENTAXIS IN WATERPLA 00147300
C  S=LENGTH FROM THE ROOT OF BILGEKEEL TO THE WATERSURFACE              00147400
C               AT STATION K                                           00147500
C    COSPHI=COSINUS  TO THE ANGLE MADE BY THE PLANE OF BILGEKEEL WITH RK 00147600
C    PHI=ANGLE BETWEEN RK AND WATERPLANE                                00147700
C    BEAMKL=BREADTH OF BILGE KEEL                                       00147800
C    AKELL=LENGTH OF BILGEKEEL                                          00147900
C                                                                       00148000
      DIMENSION SBKD(27)                                                00148100
      DO 703 K=1,NOS                                                    00148200
      R=RD(K)                                                           00148300
      RF=RFD(K)                                                         00148400
      DELTAL=DELTAD(K)                                                  00148500
      IF (DELTAL .LE. 0.) GO TO 703                                     00148600
      RK=RKD(K)                                                         00148700
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      S=SD(K)                                                                   00148800
      COSPHI=COSPHD(K)                                                          00148900
      PHI=PHID(K)                                                               00149000
      SHBEAM=2.*X(K,1)*EL                                                       00149100
      GK=ABS(Y(K,NUT))*EL                                                       00149200
      T=6.283185*SQRT(ELL/GRAV)/GXI                                             00149300
      DRAUGT=GK                                                                 00149400
      TETAM=THM                                                                 00149500
      AKAPPA=R*(1.+RF/SHBEAM)**2./SQRT(0.5*SHBEAM*GK)                           00149600
      CK=1.+3.5*EXP(-9.*AKAPPA)                                                 00149700
      CO= 1000.*(1.440+03.8*PHI**3.)                                            00149800
      ALABDA= R/(DRAUGT-(RF/SHBEAM)*(SHBEAM-2.*R) )                             00149900
      FUNLAB= 1.34*  SIN(3.1416*ALABDA/3.6)/(1.+0.162* SIN(3.1416*(ALABD        00150000
     1A-0.9)/1.8))                                                              00150100
      EPSIL=ATAN(2.*RF/SHBEAM)                                                  00150200
      Q= (0.5*SHBEAM *  TAN(3.1416/4. -EPSIL/2.)+RF-GK)*SIN(3.1416/4.+EP        00150300
     1SIL/2.)                                                                   00150400
      PO= GK- DRAUGT/3. -2.*RF/3.                                               00150500
      PONE=0.88*(GK-DRAUGT-0.54*(SHBEAM/2.-(DRAUGT-RF)*TAN(3.1416/4.+EPS        00150600
     1IL/2.)))                                                                  00150700
      BCIRC = COSPHI + S*(0+PO-(PO-PONE)*FUNLAB)/2./BEAMKL/RK                   00150800
      ZETA = BEAMKL/(RK*PHI**.75)                                               00150900
      AN= 1.4 + 2.03*EXP(-25.*ZETA)                                             00151000
      ALPHA= 2.-AN                                                              00151100
      REYN=8.*BEAMKL*RK*THM*GXI/ELL/ELL/VNY/6.2832*(AMODL/ELL)**2               00151200
      IF(REYN-10.**3) 10,10,11                                                  00151300
   10 CA=1.95-0.25*ALOG(REYN)/ALOG(10.)+0.2*SIN(3.1416*(ALOG(REYN)/ALOG(        00151400
     110.)-2.19)/0.54)                                                          00151500
      GO TO 7                                                                   00151600
   11 CA=1.                                                                     00151700
    7 CONTINUE                                                                  00151800
      F=RK*TETAM*PHI**1.70/(T * SQRT(BEAMKL))                                   00151900
      FALFA=F**ALPHA                                                            00152000
      CN= 1.98*EXP(-11.*BEAMKL/AKEELL)                                          00152100
      CS=CO/2.68/1000./FALFA                                                    00152200
      SBKD(K)=GXI*2.*(PK/EL)**3*THM*2.*DELTAL*BEAMKL/ELL/ELL/3./3.141593        00152300
     1*CS*CA*CK*CN*BCIRC/TVOL                                                   00152400
      SBKD(K)=2.*SBKD(K)                                                        00152500
      TBKD=TBKD+SBKD(K)                                                         00152600
  410 FORMAT(12E10.4)                                                           00152700
  703 CONTINUE                                                                  00152800
      RETURN                                                                    00152900
      END                                                                       00153000
                                                                                SEG
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C       VERSAO 4  -  CDC 6700  -  E N D S E P  -  JUNHO, 1972                   00153100
C                                                                               00153200
      SUBROUTINE ENDSEP (DA,DB,GXI,PAA,PAV,JJ)                                  00153300
C                                                                               00153400
C PROGRAMMER - O. FALTINSEN,DNV                                                 00153500
C                                                                               00153600
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM        00153700
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP        00153800
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10)        00153900
     3,FN(5),BAH(30),COG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40),        00154000
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7),        00154100
     5UN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP            00154200
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      COMMON ST1(27),YMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES,  00154300
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25) 00154400
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)              00154500
      COMMON NWSTP,INWSTP(12)                                            00154600
      DIMENSION DA(6,6),DB(6,6),PAA(25,7,6),PAV(25,7,6),DADS(10),DDDS(10 00154700
     1)                                                                  00154800
C                                                                        00154900
C  NOS IS TEMPORARILY CHANGED TO IXAST IN THIS ROUTINE                   00155000
C                                                                        00155100
      NOSH=NOS                                                           00155200
      NOS=IXAST                                                          00155300
      DIP=ST(NOS)-TPST                                                   00155400
      DO 54 I=1,NON                                                      00155500
      FR(I,1)=EN1(NOS,I)                                                 00155600
      FR(I,2)=-SNE(NOS,I)                                                00155700
      FR(I,3)=CSE(NOS,I)                                                 00155800
      FR(I,4)=XX(NOS,I)*CSE(NOS,I)-YY(NOS,I)*FR(I,2)                     00155900
      FR(I,5)=-DIP*FR(I,3)                                               00156000
      FR(I,6)=DIP*FR(I,2)                                                00156100
   54 CONTINUE                                                           00156200
      DO 55 LK=1,10                                                      00156300
      GO TO (613,613,613,613,613,613,614,615,616,617),LK                 00156400
  613 CONTINUE                                                           00156500
      L=LK                                                               00156600
      M=LK                                                               00156700
      GO TO 618                                                          00156800
  614 CONTINUE                                                           00156900
      L=5                                                                00157000
      M=3                                                                00157100
      GO TO 618                                                          00157200
  615 CONTINUE                                                           00157300
      L=2                                                                00157400
      M=6                                                                00157500
                                                                         00157600
                                                                         00157700
      GO TO 618                                                          00157800
  616 CONTINUE                                                           00157900
      L=2                                                                00158000
      M=4                                                                00158100
      GO TO 618                                                          00158200
  617 CONTINUE                                                           00158300
      L=6                                                                00158400
      M=4                                                                00158500
  618 CONTINUE                                                           00158600
      DADS(LK)=0.0                                                       00158700
      DDDS(LK)=0.0                                                       00158800
      DO 619 J=1,NON                                                     00158900
      DADS(LK)=DADS(LK)+DEL(NOS,J)*FR(J,L)*PAA(NOS,J,M)                  00159000
      DDDS(LK)=DDDS(LK)+DEL(NOS,J)*FR(J,L)*PAV(NOS,J,M)                  00159100
  619 CONTINUE                                                           00159200
      DADS(LK)=2.0*DADS(LK)*DS(NOS)                                      00159300
      DDDS(LK)=2.0*DDDS(LK)*DS(NOS)                                      00159400
   55 CONTINUE                                                           00159500
      DO 620 L=1,10                                                      00159600
      DADS(L)=DADS(L)/TVOL/UN                                            00159700
      DDDS(L)=DDDS(L)/TVOL/SQRT(UN)*SQRT(2.)                             00159800
  620 CONTINUE                                                           00159900
      DO 621 L=4,10                                                      00160000
      DADS(L)=DADS(L)*0.5*0.5                                            00160100
      DDDS(L)=DDDS(L)*0.5*0.5                                            00160200
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  621 CONTINUE                                                          00160300
      DO 622 L=7,9                                                      00160400
      DADS(L)=DADS(L)*2.                                                00160500
      DDDS(L)=DDDS(L)*2.                                                00160600
  622 CONTINUE                                                          00160700
      DA(2,2)=DA(2,2)-FN(JJ)/GXI**2/DS(NOS)*2.*DDDS(2)                  00160800
      DB(2,2)=DB(2,2)+FN(JJ)/DS(NOS)*2.*DADS(2)                         00160900
      DA(2,4)=DA(2,4)-FN(JJ)/GXI**2/DS(NOS)*2.*DDDS(9)                  00161000
      DB(2,4)=DB(2,4)+FN(JJ)/DS(NOS)*2.*DADS(9)                         00161100
      DA(2,6)=DA(2,6)-FN(JJ)/GXI**2/DS(NOS)*2.*DDDS(8)-(FN(JJ)/GXI)**2/D 00161200
     1S(NOS)*2.*DADS(2)                                                 00161300
      DB(2,6)=DB(2,6)+FN(JJ)/DS(NOS)*2.*DADS(8)-(FN(JJ)/GXI)**2/DS(NOS)* 00161400
     12.*DDDS(2)                                                        00161500
      DA(4,2)=DA(2,4)                                                   00161600
      DB(4,2)=DB(2,4)                                                   00161700
      DA(4,4)=DA(4,4)-FN(JJ)/GXI**2/DS(NOS)*DDDS(4)*2.                  00161800
      DB(4,4)=DB(4,4)+FN(JJ)/DS(NOS)*2.*DADS(4)                         00161900
      DA(4,6)=DA(4,6)-FN(JJ)/GXI**2/DS(NOS)*2.*DDDS(10)-(FN(JJ)/GXI)**2/ 00162000
     1DS(NOS)*2.*DADS(9)                                                00162100
      DB(4,6)=DB(4,6)+FN(JJ)/DS(NOS)*2.*DADS(10)-(FN(JJ)/GXI)**2/DS(NOS) 00162200
     1*2.*DDDS(9)                                                       00162300
      DA(6,2)=DA(6,2)-FN(JJ)/GXI**2/DS(NOS)*2.*DDDS(8)                  00162400
      DB(6,2)=DB(6,2)+FN(JJ)/DS(NOS)*2.*DADS(8)                         00162500
      DA(6,4)=DA(6,4)-FN(JJ)/GXI**2/DS(NOS)*2.*DDDS(10)                 00162600
      DB(6,4)=DB(6,4)+FN(JJ)/DS(NOS)*DADS(10)*2.                        00162700
      DA(6,6)=DA(6,6)-FN(JJ)/GXI**2/DS(NOS)*2.*DDDS(6)-(FN(JJ)/GXI)**2/D 00162800
     1S(NOS)*2.*DADS(8)                                                 00162900
      DB(6,6)=DB(6,6)+FN(JJ)/DS(NOS)*2.*DADS(6)-(FN(JJ)/GXI)**2/DS(NOS)* 00163000
     12.*DDDS(8)                                                        00163100
      DA(3,3)=DA(3,3)-FN(JJ)/GXI**2/DS(NOS)*2.*DDDS(3)                  00163200
      DB(3,3)=DB(3,3)+FN(JJ)/DS(NOS)*2.*DADS(3)                         00163300
      DA(5,3)=DA(5,3)-FN(JJ)/GXI**2/DS(NOS)*2*DDDS(7)                   00163400
      DB(5,3)=DB(5,3)+FN(JJ)/DS(NOS)*2.*DADS(7)                         00163500
      DA(3,5)=DA(3,5)+(FN(JJ)/GXI)**2/DS(NOS)*2.*DADS(3)-FN(JJ)/GXI**2/D 00163600
     1S(NOS)*2.*DDDS(7)                                                 00163700
      DB(3,5)=DB(3,5)+(FN(JJ)/GXI)**2/DS(NOS)*2.*DDDS(3)+FN(JJ)/DS(NOS)* 00163800
     12.*DADS(7)                                                        00163900
      DA(5,5)=DA(5,5)-FN(JJ)/GXI**2/DS(NOS)*2.*DDDS(5)+(FN(JJ)/GXI)**2/D 00164000
     1S(NOS)*2.*DADS(7)                                                 00164100
      DB(5,5)=DB(5,5)+FN(JJ)/DS(NOS)*2.*DADS(5)+(FN(JJ)/GXI)**2/DS(NOS)* 00164200
     22.*DDDS(7)                                                        00164300
      NOS=NOSH                                                          00164400
      RETURN                                                            00164500
      END                                                               00164600
                                                                          SE
=======================================================================
C                                                                       00164700
C                                                                       00164800
      SUBROUTINE HYDPRE(WN,BOD,BEV,PAA,PAV,GXI,PRERE,PREIM,JJ,MM)       00164900
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM 00165000
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00165100
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10) 00165200
     3,FN(5),BAM(30),CDG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40), 00165300
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7), 00165400
     5UN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP    00165500
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES, 00165600
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25) 00165700
```

```
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)                    00165800
      COMMON NWSTP,INWSTP(12)                                                  00165900
      DIMENSION BOD(6,1),BEV(6,1),PAA(25,7,6),PAV(25,7,6),REP(1                00166000
     14,3),AIP(14,3),PRERE(8,14),PREIM(8,14)                                   00166100
      COMPLEX PDIFR,CPET,II                                                    00166200
      COMPLEX PP,QQ,DODD,DEVEN                                                 00166300
      II=(0.0,1.0)                                                             00166400
      KPA=0                                                                    00166500
      DO 1 K1=1,NOS                                                            00166600
      IF(STPR(K1)) 2,1,2                                                       00166700
    2 CONTINUE                                                                 00166800
      KM=K1-1                                                                  00166900
      KP=K1+1                                                                  00167000
      KPA=KPA+1                                                                00167100
      DO 3 K=KM,KP                                                             00167200
      CP=WN*(ST(K)-TPST)*CDG(MM)                                               00167300
      CP1=COS(CP)                                                              00167400
      CP2=SIN(CP)                                                              00167500
      CPET=(CP1+II*CP2)                                                        00167600
      DIP=ST(K)-TPST                                                           00167700
      DO 4 JS=1,2                                                              00167800
      GO TO (5,6),JS                                                           00167900
    5 CONTINUE                                                                 00168000
      CSP=1.0                                                                  00168100
      GO TO 7                                                                  00168200
    6 CONTINUE                                                                 00168300
      CSP=-1.0                                                                 00168400
    7 CONTINUE                                                                 00168500
      DO 8 J=1,NON                                                             00168600
      FR(J,1)=EN1(K,J)                                                         00168700
      FR(J,2)=-SNE(K,J)*CSP                                                    00168800
      FR(J,3)=CSE(K,J)                                                         00168900
      FR(J,4)=XX(K,J)*CSE(K,J)*CSP-YY(K,J)*FR(J,2)                             00169000
      FR(J,5)=-DIP*FR(J,3)                                                     00169100
      FR(J,6)=DIP*FR(J,2)                                                      00169200
      PET=EXP(WN*YY(K,J))                                                      00169300
      ARG=WN*XX(K,J)*CSP*SDG(MM)                                               00169400
      FC=COS(ARG)                                                              00169500
      FS=SIN(ARG)                                                              00169600
      PP=CMPLX(FR(J,3),0.)                                                     00169700
      PP=PP+II*FR(J,1)*CDG(MM)                                                 00169800
      QQ=II*FR(J,2)*SDG(MM)                                                    00169900
      DODD=(PP*FC+II*QQ*FS)*(GXI*SQRT(0.5*WN)/UN)                              00170000
      DEVEN=(QQ*FC+II*PP*FS)*(GXI*SQRT(0.5*WN)/UN)                             00170100
      PDIFR=-(DEVEN*CMPLX(PAA(K,J,2),PAV(K,J,2))*CSP*FR(J,2)+DODD*CMPLX(       00170200
     1PAA(K,J,3),PAV(K,J,3))*FR(J,3))*PET*CPET                                 00170300
      PDIFR=PDIFR- ODD*CMPLX(PAA(K,J,1),PAV(K,J,1))*FR(J,1)*PET*CPET           00170400
      RPDIF=REAL(PDIFR)                                                        00170500
      AIPDF=AIMAG(PDIFR)                                                       00170600
      REPMO=PAA(K,J,1)*BOD(1,1)+CSP*PAA(K,J,2)*BEV(1,1)+PAA(K,J,3)*BOD(2       00170700
     1,1)+0.5*(CSP*PAA(K,J,4)*BEV(2,1)+PAA(K,J,5)*BOD(3,1)+CSP*PAA(K,J,6       00170800
     2)*BEV(3,1))-PAV(K,J,1)*BOD(4,1)-CSP*PAV(K,J,2)*BEV(4,1)-PAV(K,J,3)       00170900
     3*BOD(5,1)-0.5*(CSP*PAV(K,J,4)*BEV(5,1)+PAV(K,J,5)*BOD(6,1)+CSP*PAV       00171000
     4(K,J,6)*BEV(6,1))                                                        00171100
      AIPMO=PAV(K,J,1)*BOD(1,1)+CSP*PAV(K,J,2)*BEV(1,1)+PAV(K,J,3)*BOD(2       00171200
     1,1)+0.5*(CSP*PAV(K,J,4)*BEV(2,1)+PAV(K,J,5)*BOD(3,1)+CSP*PAV(K,J,6       00171300
     2)*BEV(3,1))+PAA(K,J,1)*BOD(4,1)+CSP*PAA(K,J,2)*BEV(4,1)+PAA(K,J,3)       00171400
     3*BOD(5,1)+0.5*(CSP*PAA(K,J,4)*BEV(5,1)+PAA(K,J,5)*BOD(6,1)+CSP*PAA       00171500
     4(K,J,6)*BEV(6,1))                                                        00171600
      JM=J+NON*(JS-1)                                                          00171700
```

```
      KKM=K-KM+1                                                        00171800
      REP(JM,KKM)=RPDIF+REPMO                                           00171900
      AIP(JM,KKM)=AIPDF+AIPMO                                           00172000
    8 CONTINUE                                                          00172100
    4 CONTINUE                                                          00172200
    3 CONTINUE                                                          00172300
      DO 9 JS=1,2                                                       00172400
      GO TO(10,11),JS                                                   00172500
   10 CONTINUE                                                          00172600
      CSP=1.0                                                           00172700
      GO TO 12                                                          00172800
   11 CONTINUE                                                          00172900
      CSP=-1.0                                                          00173000
   12 CONTINUE                                                          00173100
      K=K1                                                              00173200
      DO 13 J=1,NON                                                     00173300
      JM=J+(JS-1)*NON                                                   00173400
      M=MM                                                              00173500
      PRERE(KPA,JM)=REP(JM,2)-FN(JJ)/GX1/DS(K1)*(AIP(JM,3) -AIP(JM,1)  ) 00173600
     1+EXP(WN*YY(K,J))*COS(WN*(ST(K)-TPST)*CDG(MM)+CSP*WN*XX(K,J)*SDG(M) 00173700
     2)-(BOD(2,1)+CSP*XX(K,J)/2.*BEV(2,1)-0.5*(ST(K)-TPST)*BOD(3,1))    00173800
      PREIM(KPA,JM)=AIP(JM,2) +FN(JJ)/GX1/DS(K1)*(REP(JM,3) -REP(JM,1) ) 00173900
     1+EXP(WN*YY(K,J))*SIN(WN*(ST(K)-TPST)*CDG(MM)+CSP*WN*XX(K,J)*SDG(M) 00174000
     2)-(BOD(5,1)+CSP*XX(K,J)/2.*BEV(5,1)-0.5*(ST(K)-TPST)*BOD(6,1))    00174100
   13 CONTINUE                                                          00174200
    9 CONTINUE                                                          00174300
    1 CONTINUE                                                          00174400
      RETURN                                                            00174500
      END                                                               00174600
                                                                        SE
```

```
C                                                                       00174700
C                                                                       00174800

      SUBROUTINE  PREST(PRF33,PRM35,PRM55,PC44)                         00174900
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM 00175000
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00175100
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10) 00175200
     3,FN(5),BAM(30),CDG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOH,NOH,OMEN(40), 00175300
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7), 00175400
     5SUN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP    00175500
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRFS,  00175600
     2VNY,GRAV,AMODL,MOD,AKEFLL,BEAMKL,ITS(25),RO(25),RFD(25),DELTAD(25) 00175700
     2,RKD(25),SD(25),COSPHD(25),PHID(25),SIPR(25),THMD(50)             00175800
      COMMON NWSTP,INWSTP(12)                                           00175900
      DIMENSION SS(27),HBM(27),SHB(27),HSB(27)                          00176000
      DIMENSION HB3(27)                                                 00176100
      NMAD=K+1                                                          00176200
      NMUD=K+2                                                          00176300
      HB3(1)=0.0                                                        00176400
      SS(1) = ST1(1)/10.                                                00176500
      SS(NMUD)=ST(K)+0.5*DS(K)                                          00176600
      HBM(1)=0.0                                                        00176700
      IF(K-NOS) 2,3,3                                                   00176800
    2 CONTINUE                                                          00176900
      HB3(NMUD)=2.*X(K,1)**3                                            00177000
      HBM(NMUD)=X(K,1)                                                  00177100
      GO TO 4                                                           00177200
```

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    3 CONTINUE                                                          00177300
      HBM(NMUD)=0.0                                                     00177400
      HB3(NMUD)=0.0                                                     00177500
    4 CONTINUE                                                          00177600
      DO 1 J=2,NMAD                                                     00177700
      IP1=J-1                                                           00177800
      SS(J)=ST(IP1)                                                     00177900
      HBM(J)=X(IP1,1)                                                   00178000
      HB3(J)=2.*X(IP1,1)**3                                             00178100
    1 CONTINUE                                                          00178200
      DO 5 J=1,NMUD                                                     00178300
      SPD=SS(J)-TPST                                                    00178400
      SHB(J)=SPD*HBM(J)                                                 00178500
      HSB(J)=SPD*SHB(J)                                                 00178600
    5 CONTINUE                                                          00178700
      PPCM=SIMPUN(SS,HB3,NMUD)                                          00178800
      PC8V=0.5*SIMPUN(SS,AM,NMUD)/TVOL                                  00178900
      PC44=PC8V+PPCM/3.0/TVOL*0.5                                       00179000
      PRF33=4.0*SIMPUN(SS,HBM,NMUD)/TVOL                                00179100
      PRM35=-2.0*SIMPUN(SS,SHB,NMUD)/TVOL                               00179200
      PRM55=SIMPUN(SS,HSB,NMUD)/TVOL                                    00179300
      RETURN                                                            00179400
      END                                                               00179500
                                                                          SE(
==========================================================================:
C                                                                       00179600
C      VERSAO 4  -  CDC 6700  -  V I S C  -  JUNHO, 1972                00179700
C                                                                       00179800
      SUBROUTINE VISC(GXI,VD,TVD,THM,EDDY,RGB)                          00179900
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM 00180000
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,FI66,EI46,TP 00180100
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10) 00180200
     3,FN(5),BAM(30),CDG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40), 00180300
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),FN1(25,7), 00180400
     5UN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP    00180500
     *COMMON ST1(27),YMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES, 00180600
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25) 00180700
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)             00180800
      COMMON NWSTP,INWSTP(12)                                           00180900
      DIMENSION  VD(27)                                                 00181000
      DIMENSION  EDDY(27)                                               00181100
      DIMENSION  RGB(27)                                                00181200
      DIMENSION  XI(8),YI(8)                                            00181300
C                                                                       00181400
C  THIS SUBROUTINE CALCULATES SKIN-FRICTIONAL AND EDDYMAKING ROLL-DAMP  00181500
C                                                                       00181600
      PI=3.141593                                                       00181700
      TVD=0.0                                                           00181800
      DO 2 K=1,NOS                                                      00181900
      RG=RGB(K)/EL                                                      00182000
      PSUR=0.0                                                          00182100
      DO 3 J=1,NON                                                      00182200
      PSUR=PSUR+DEL(K,J)                                                00182300
    3 CONTINUE                                                          00182400
      PSUR=PSUR*DS(K)*2.                                                00182500
      DO 11 J=1,NUT                                                     00182600
      XI(J)=X(K,J)                                                      00182700
```

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      YI(J)=Y(K,J)                                                    00182800
   11 CONTINUE                                                        00182900
      SQAR=2.*ABS(SIMPUN(YI,XI,NUT))                                  00183000
      DK=ABS(Y(K,NUT))                                                00183100
      BMK=2.*BMAX(NUT,XI)                                             00183200
      CA=SQAR/BMK/DK                                                  00183300
      RS=1./PI*((0.887+0.145*CA)*(1.7*DK+CA*BMK)+2.*ZG/EL)            00183400
      PMOAR=RS**3*PSUR                                                00183500
      PARM=RS**2                                                      00183600
      RN=3.22/8./PI*GXI*PARM*THM**2/VNY*(AMODL/ELL)**2                00183700
      VA2=0.0                                                         00183800
      GO TO(4,5),MOD                                                  00183900
    5 CONTINUE                                                        00184000
      VA2=0.014*RN**(-0.114)                                          00184100
    4 CONTINUE                                                        00184200
      VA=1.328*RN**(-0.5)+VA2                                         00184300
      VD(K)=1./6./PI*PMOAR*THM*GXI/TVOL*VA                            00184400
      VD(K)=VD(K)+1./6./PI*PSUR*RG**3*THM*GXI/TVOL*EDDY(K)            00184500
      VD(K)=2.*VD(K)                                                  00184600
      TVD=TVD+VD(K)                                                   00184700
    2 CONTINUE                                                        00184800
      RETURN                                                          00184900
      END                                                             00185000
                                                                        SE
```

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C                                                                     00185100
C      VERSAO 4  -  CDC 6700  -  A T A N 2 D  -  JUNHO, 1972          00185200
C                                                                     00185300

      FUNCTION ATAN2D (B,A)                                           00185400
C      ARCTANGENT FUNCTION TO COMPUTE ANGLES (IN DEGREES) IN ANY      00185500
C      QUADRANT.  THE B ARGUMENT IS THE IMAGINARY VECTOR.  THE A      00185600
C      ARGUMENT IS THE REAL VECTOR.                                   00185700
C                                                                     00185800
      DATA EPS /1.E-10/                                               00185900
      IF(B .EQ. 0.) ATAN2D =  0.                                      00186000
      IF(B .GT. 0.) ATAN2D = 90.                                      00186100
      IF(B .LT. 0.) ATAN2D =-90.                                      00186200
      IF(ABS(A) .GT. EPS) ATAN2D = ATAN2(B,A)*57.295779               00186300
      RETURN                                                          00186400
      END                                                             00186500
                                                                        SE
```

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C                                                                     00186600

      FUNCTION BMAX(NUT,XI)                                           00186700
      DIMENSION XI(1)                                                 00186800
      A=XI(1)                                                         00186900
      IF(NUT .EQ. 1) GO TO 20                                         00187000
      DO 10 I=2,NUT                                                   00187100
      IF(XI(I).GT.A) A=XI(I)                                          00187200
   10 CONTINUE                                                        00187300
   20 BMAX=A                                                          00187400
      RETURN                                                          00187500
      END                                                             00187600
                                                                        SE
```

```
      SUBROUTINE MATINS(A,NR,N1,B,NC,M1,DETERM,ID,INDEX)                00187700
C                                                                       00187800
C                                                                       00187900
      EQUIVALENCE (IROW,JROW),(ICOLUM,JCOLUM),(AMAX,T,SWAP)             00188000
      DIMENSION A(NR,NR),B(NR,NC),INDEX(NR,3)                           00188100
C                                                                       00188200
C     INITIALIZATION                                                    00188300
C                                                                       00188400
      N=N1                                                              00188500
      M=M1                                                              00188600
      DETERM=0.0                                                        00188700
      DO 20 J=1,N                                                       00188800
   20 INDEX(J,3)=0                                                      00188900
      DO 550 I=1,N                                                      00189000
C                                                                       00189100
C     SEARCH FOR PIVOT ELEMENT                                          00189200
C                                                                       00189300
      AMAX=0.0                                                          00189400
      DO 105 J=1,N                                                      00189500
      IF(INDEX(J,3)-1) 60,105,60                                        00189600
   60 DO 100 K=1,N                                                      00189700
      IF(INDEX(K,3)-1) 80,100,715                                       00189800
   80 IF(AMAX- ABS(A(J,K))) 85,100,100                                  00189900
   85 IROW=J                                                            00190000
      ICOLUM=K                                                          00190100
      AMAX= ABS(A(J,K))                                                 00190200
  100 CONTINUE                                                          00190300
  105 CONTINUE                                                          00190400
      INDEX(ICOLUM,3)=INDEX(ICOLUM,3)+1                                 00190500
      INDEX(I,1)=IROW                                                   00190600
      INDEX(I,2)=ICOLUM                                                 00190700
C                                                                       00190800
C     INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL                 00190900
C                                                                       00191000
      IF(IROW-ICOLUM) 140,310,140                                       00191100
  140 DETERM=-DETERM                                                    00191200
      DO 200 L=1,N                                                      00191300
      SWAP=A(IROW,L)                                                    00191400
      A(IROW,L)=A(ICOLUM,L)                                             00191500
  200 A(ICOLUM,L)=SWAP                                                  00191600
      IF(M) 310,310,210                                                 00191700
  210 DO 250 L=1,M                                                      00191800
      SWAP=B(IROW,L)                                                    00191900
      B(IROW,L)=B(ICOLUM,L)                                             00192000
  250 B(ICOLUM,L)=SWAP                                                  00192100
C                                                                       00192200
C     DIVIDE PIVOT ROW BY PIVOT ELEMENT                                 00192300
C                                                                       00192400
  310 PIVOT=A(ICOLUM,ICOLUM)                                            00192500
      DETERM=DETERM*PIVOT                                               00192600
  330 A(ICOLUM,ICOLUM)=1.0                                              00192700
      DO 350 L=1,N                                                      00192800
  350 A(ICOLUM,L)=A(ICOLUM,L)/PIVOT                                     00192900
      IF(M) 380,380,360                                                 00193000
  360 DO 370 L=1,M                                                      00193100
  370 B(ICOLUM,L)=B(ICOLUM,L)/PIVOT                                     00193200
```

```
C                                                                       00193300
C     REDUCE NON-PIVOT ROWS                                             00193400
C                                                                       00193500
  380 DO 550 L1=1,N                                                     00193600
      IF(L1-ICOLUM) 400,550,400                                         00193700
  400 T=A(L1,ICOLUM)                                                    00193800
      A(L1,ICOLUM)=0.0                                                  00193900
      DO 450 L=1,N                                                      00194000
  450 A(L1,L)=A(L1,L)-A(ICOLUM,L)*T                                     00194100
C                                                                       00194200
C                                                                       00194300
      IF(M) 550,550,460                                                 00194400
  460 DO 500 L=1,M                                                      00194500
  500 B(L1,L)=B(L1,L)-B(ICOLUM,L)*T                                     00194600
  550 CONTINUE                                                          00194700
C                                                                       00194800
C     INTERCHANGE COLUMNS                                               00194900
C                                                                       00195000
      DO 710 I=1,N                                                      00195100
      L=N+1-I                                                           00195200
      IF( INDEX(L,1)-INDEX(L,2) ) 630,710,630                           00195300
  630 JROW=INDEX(L,1)                                                   00195400
      JCOLUM=INDEX(L,2)                                                 00195500
      DO 705 K=1,N                                                      00195600
      SWAP=A(K,JROW)                                                    00195700
      A(K,JROW)=A(K,JCOLUM)                                             00195800
      A(K,JCOLUM)=SWAP                                                  00195900
  705 CONTINUE                                                          00196000
  710 CONTINUE                                                          00196100
      DO 730 K=1,N                                                      00196200
      IF(INDEX(K,3)-1) 715,720,715                                      00196300
  720 CONTINUE                                                          00196400
  730 CONTINUE                                                          00196500
      ID=1                                                              00196600
  810 RETURN                                                            00196700
  715 ID=2                                                              00196800
      GO TO 810                                                         00196900
      END                                                               00197000
                                                                              SEC
================================================================================

      FUNCTION SIMPUN (X,Y,N)                                           00197100
      DIMENSION X(1),Y(1)                                               00197200
      IF( N-2 ) 7,5,4                                                   00197300
    5 S=(Y(1)+Y(2) )*(X(2)-X(1))/2.                                     00197400
      GO TO 6                                                           00197500
    7 S=0.                                                              00197600
      GO TO 6                                                           00197700
    4 M=N-1                                                             00197800
      S=(X(2)-X(1))/6.*(Y(1)*((X(2)-X(3))/(X(1)-X(3))+2.)+Y(2)*((X(1)-X( 00197900
     K3))/(X(2)-X(3))+2.)-Y(3)*(X(2)-X(1))**2/((X(1)-X(3))*(X(2)-X(3)))) 00198000
      LB=2                                                              00198100
      IF( N.EQ.3) GO TO 8                                               00198200
      S=S+(X(3)-X(2))/6.*(Y(2)*((X(3)-X(4))/(X(2)-X(4))+2.)+Y(3)*((X(2)- 00198300
     KX(4))/(X(3)-X(4))+2.)-Y(4)*(X(3)-X(2))**2/((X(2)-X(4))*(X(3)-X(4)) 00198400
     K))                                                                00198500
      LB=3                                                              00198600
    8 DO 1 K=LB,M                                                       00198700
```

```
      IF(ABS(X(K+1)-X(1)).GE.ABS(X(K)-X(1))) GO TO 1                    00198800
      GO TO 7                                                           00198900
    1 S=S+(X(K+1)-X(K))/6.*(Y(K)*((X(K+1)-X(K-1))/(X(K)-X(K-1))+2.)+Y(K+ 00199000
     M1)*((X(K)-X(K-1))/(X(K+1)-X(K-1))+2.)-Y(K-1)*(X(K+1)-X(K))**2/((X( 00199100
     NK)-X(K-1))*(X(K+1)-X(K-1))))                                      00199200
    6 SIMPUN=S                                                          00199300
      RETURN                                                            00199400
      END                                                               00199500
                                                                          SE
=======================================================================
                                                                          FC
                                                                          SE
      NO ERRORS DETECTED.  NUMBER OF CARDS = 1997.
      COMPILATION TIME = 55 SECONDS ELAPSED,  29.33 SECONDS PROCESSING.
      D2 STACK SIZE = 87 WORDS.  FILESIZE = 56488 WORDS.  ESTIMATED CORE STORAGE F
      TOTAL PROGRAM CODE = 6464 WORDS.  ARRAY STORAGE = 8111 WORDS.
      NUMBER OF PROGRAM SEGMENTS = 37.  NUMBER OF DISK SEGMENTS = 379.
      PROGRAM CODE FILE = (117PNV)AM3D/OBJ ON PACK.
      COMPILER COMPILED ON 09/07/79 (FORTRAN ON PACK).
```

APÊNDICE E

PROGRAMA ML3D

```
B6700  F O R T R A N  C O M P I L A T I O N  M A R K  2.9.004  TI
                                M L 3 D / O B J
                                = = = = = = = =
FILE  20=UM/PYPA,UNIT=DISK PACK,RECORD=3360,AREA=1*1                    00000100
FILE  30=UM/ARCOM,UNIT=DISK PACK,RECORD=3367,AREA=1*1                   00000200
FILE  40=TRES/YAW,UNIT=DISK PACK,RECORD=3                               00000300
FILE  50=TRES/SWAY,UNIT=DISK PACK,RECORD=3                              00000400
FILE  95=TRES/ROLL,UNIT=DISK PACK,RECORD=3                              00000500

      COMMON WWW(3078)                                                  00000600
      COMMON/LODPRN/ZZZ(269)                                            00000700
      DIMENSION GMU(6,6).                                               00000800
      REWIND 30                                                         00000900
      REWIND 40                                                         00001000
      REWIND 50                                                         00001100
      REWIND 20                                                         00001200
      REWIND 95                                                         00001300
      READ(30) WWW ,ZZZ                                                 00001400
      CALL SPRG4 (GMU)                                                  00001500
      CALL SPRG5 (GMU)                                                  00001600
      LOCK 40                                                           00001700
      LOCK 50                                                           00001800
      LOCK 95                                                           00001900
      STOP                                                              00002000
      END                                                               00002100
      0021001B:3  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
                                                                        SE
=======================================================================
C                                                                       00002200
C                                                                       00002300
      SUBROUTINE SPRG4(GMU)                                             00002400
      COMMON AM(27),NJ,NMAS,NDS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM 00002500
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00002600
     2ST,RF33,RM35,RM55,DG4,DIP,K,N,IVOL,ALFA(40,11),BETA(40,11),HDG(10) 00002700
     3,FN(5),BAM(30),GUG(10),SDG(10),DMAX,DMIN,NFR,NOK,NOB,NOH,OMEN(40), 00002800
     4FR(7,6),XX(25,7),YY(25,7),UEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7), 00002900
     5UN,OMEGA,ID,TITU(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP    00003000
      COMMON ST1(27),TMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES, 00003100
     2VNT,GRAV,AMODL,MOD,ASEELL,BEAMML,ITS(25),RD(25),RFD(25),DELTAD(25) 00003200
     2,RKD(25),SD(25),COSHD(25),PMIU(25),STPR(25),THMD(50)              00003300
      COMMON NESTP,INESTP(12)                                           00003400
      DIMENSION GMU(6,6)                                                00003500
      DO 111 I=1,6                                                      00003600
      DO 111 J=1,6                                                      00003700
  111 GMU(I,J)=0.0                                                      00003800
      GMU(1,1)=1.0                                                      00003900
      GMU(2,2)=1.0                                                      00004000
      GMU(3,3)=1.0                                                      00004100
      GMU(4,4)=EI44                                                     00004200
      GMU(4,6)=EI46                                                     00004300
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      GMU(5,5)=EI55                                                    00004400
      GMU(6,6)=EI66                                                    00004500
      GMU(4,2)=-ZG/ELL                                                 00004600
      GMU(2,4)=-ZG/ELL                                                 00004700
      GMU(1,5)=ZG/ELL                                                  00004800
      GMU(5,1)=ZG/ELL                                                  00004900
      RETURN                                                           00005000
      END                                                              00005100
                                                                          SL
C*****************************************************************************
C                                                                      00005200
C                                                                      00005300
      SUBROUTINE SPRG2(GMU)                                            00005400
      REAL LPP                                                         00005500
      DIMENSION THCAL(30)                                              00005600
      COMMON AP(27),NOT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PH 00005700
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00005800
     2ST,RF33,RM35,RM55,DGM,DAP,R,N,IVOL,ALFA(40,11),BETA(40,11),HDG(10) 00005900
     3,FN(5),BAR(30),GLG(10),SDG(10),DMAX,DMIN,NFR,NGR,NOB,NOH,DMEN(40), 00006000
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7), 00006100
     5UN,OMEGA,ID,TITU(12),NORD,NGN,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP     00006200
      COMMON ST1(27),TMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRE,   00006300
     2VNT,GRAV,AMODL,MOD,ASEELL,BEAMRL,ITS(25),RD(25),RFD(25),DELTAD(25) 00006400
     2,RKD(25),SD(25),COSHD(25),PHID(25),STPR(25),THMD(50)               00006500
      COMMON NBSTP,INBSTP(12)                                          00006600
      COMMON /LOPRN/ILD(24),NORD2,NORD3,IDAMP,IPRCNT,B2(5),B3(5),      00006700
     2PB2(25,5),PB3(25,5),ICLASS                                       00006800
      DIMENSION A(3360)                                                00006900
      INTEGER PRNTOP,R                                                 00007000
      COMPLEX CFAC(6),CSUM(6),DUDD,DEVEN,DUM3,DUM2,CPET,PP,QQ,II       00007100
      COMPLEX CFX(6)                                                   00007200
      COMPLEX DEF(6)                                                   00007300
      COMMON /TEMP/ PDFR(6,25),PDFI(6,25),RMD(6,30),AIMD(6,30),        00007400
     2DA1(11),DB1(11),PEXR(6,25),PEXI(6,25),DADS(10,26),DDDS(10,26),   00007500
     2TDA(6,6),TDB(6,6),SRM33(27),SRM35(27),SRM55(27),SC44(27),        00007600
     2PAV(25,7,6),PAA(25,7,6),DA(6,6),DB(6,6),TEV(6,6),BEV(6,1),       00007700
     2TDD(6,6),BDD(6,1),INDEX(6,3),AM1(42),AP2(42),AT1(42),AT2(42),    00007800
     2VD(25),SBKD(27),CDDY(27),RGB(27),PRERE(8,14),PREIM(8,14),        00007900
     2FZRSG(25),BVRSG(25),BVISG(25),FZISG(25),FYRSG(25),FYISG(25),     00008000
     2TMRSG(25),TMISG(25),BLRSG(25),BLISG(25),RHMD(50),ME(30),ZN(30),  00008100
     2XLILMD(30),IHMD(30),AVAMP(30),DUM4(76)                          00008200
      COMMON /TMP1/ FACT,JJ,MDIGI,VKNOTS,NSLOPE,NSTP,IWSTP,LL,GXI.     00008300
      COMMON /TMP2/ SMP(30,6,2)                                        00008400
      COMMON /TMP3/ RLU(5,30,25),AILU(5,30,25),STATN(24)               00008500
      COMMON /TMP4/ RMU(5,30,2),NHF,EPS                                00008600
      COMMON /TMP5/ BUY(30,6,2)                                        00008700
      COMMON/RRR/PNLI(30),RMASS(30),RDAMP(30),RREST(30)                00008800
      DIMENSION FEAR(6),FDAR(6)                                        00008900
      DIMENSION GMU(6,6)                                               00009000
      DATA MIN /3HMIN/                                                 00009100
      NOSM1=NOS-1                                                      00009200
      READ(5,9001)IRR                                                  00009300

 9001 FORMAT(16I5)                                                     00009400
      IF(IRR.EQ.0) GO TO 658                                           00009500
      READ(5,9002)AREA,R,FI,XFIN,CLIFT,XK1,XK2                         00009600
      FI=FI*FACT                                                       00009700
```

```
9002 FORMAT(6F10.4)                                                    00009800
 686 CONTINUE                                                          00009900
     DO 687 K=1,NOS                                                    00010000
     CALL PREST(PBF33,PRM35,PRM55,PC44)                                00010100
     SRF33(K)=PRF33                                                    00010200
     SRM35(K)=PRM35                                                    00010300
     SRM55(K)=PRM55                                                    00010400
     SC44(K)=PC44                                                      00010500
 687 CONTINUE                                                          00010600
     II=(0.,1.)                                                        00010700
     FACT=57.295779                                                    00010800
     PI=3.141593                                                       00010900
     C33=RF33                                                          00011000
     C35=RM35                                                          00011100
     C55=RM55                                                          00011200
     C44=DGM                                                           00011300
     VNT=VNT/SQRT(GRAV*ELL**3)                                         00011400
     NOSHAL=NOS                                                        00011500
     SGL=SQRT(GRAV/ELL)                                                00011600
     SLG=1./SGL                                                        00011700
     NHF= NOH*NOB*NWSIP                                                00011800
     KTH=0                                                             00011900
     LPP=ELL                                                           00012000
     EL3=(ELL/2.)**3                                                   00012100
     TVOL2=TVOL*ELL*ELL*EL3                                            00012200
     TVOL4=TVOL2*SGL                                                   00012300
     EPS= .017453293                                                   00012400
     FCI= .75                                                          00012500
     DO 999 MM=1,NOH                                                   00012600
     IF(MM.EQ.1)MM=MM+1                                                00012700
     IF(MM.EQ.NOH) GO TO 999                                           00012800
     IF(SDG(MM)+1.) 4001,4002,4001                                     00012900
4001 CONTINUE                                                          00013000
     HDIG=ARCOS(CDG(MM))*FACT                                          00013100
     GO TO 4003                                                        00013200
4002 CONTINUE                                                          00013300
     HDIG=180.                                                         00013400
4003 CONTINUE                                                          00013500
     JJ=3                                                              00013600
     DO 999 JJ=1,NOB                                                   00013700
     IF(IRR.EQ.0) GO TO 4004                                           00013800
     XMLA=AREA*VANOTS*VKNJTS*R*CLIFT*2.8527                            00013900
     XMDA=AREA*VANOTS*R*R*CLIFT*1.689                                  00014000
4004 CONTINUE                                                          00014100
     DO 999 INSTP=1,NWSTP                                              00014200
     IF(INWSTP(INSTP) .LE. 0) INWSTP(INWSTP)=90                        00014300
     WSTP=1./FLOAT(INWSTP(INWSTP))                                     00014400
     WSLOPE= 180.*WSTP                                                 00014500
     KTH= KTH+1                                                        00014600
     ITERAT=0                                                          00014700
      IF (THMD(KTH) .GT. 0.) GO TO 1500                                00014800
      IF (HDG1(MM) .GE. 180. .OR. HDG1(MM) .EQ. 0.) THMD(KTH)= .0017  00014900
      IF (HDG1(MM) .GE. 90. .OR. HDG1(MM) .EQ. 270.) THMD(KTH)= .2     00015000
      IF (THMD(KTH) .LE. 0.) THMD(KTH) = .2                            00015100
1500 ITERAT = ITERAT + 1                                               00015200
     THM=THMD(KTH)                                                     00015300
     CALL TANAKA(THM,CODY,RGB)                                         00015400
     DO 612 LL=1,NOK                                                   00015500
     HDIG1 = 180.0 - HDIG                                              00015600
     TOP=6.283185                                                      00015700
```

```
      GXI=ABS(SQRT(TOP/BAM(LL))+TOP*FN(JJ)*COG(MM)/BAM(LL))                00015800
      IF(GXI-0.05) 5002,5002,5003                                          00015900
 5002 CONTINUE                                                             00016000
      GXI=0.05                                                             00016100
 5003 CONTINUE                                                             00016200
      HE(LL)= GXI*SGL                                                      00016300
      ZN(LL)=GXI                                                           00016400
      HVLNTH = BAM(LL)*ELL                                                 00016500
      HAVAMP(LL)=HSTP*HVLNTH/2.                                            00016600
      XLILMD(LL)=1./BAM(LL)                                                00016700
      GN=0.5*GXI**2                                                        00016800
      DO 200 L=1,6                                                         00016900
      DO 200 M=1,6                                                         00017000
      DA(L,M)=0.0                                                          00017100
  200 DB(L,M)=0.0                                                          00017200
      DO 1 N=2,NFR                                                         00017300
      ITEMP = N                                                            00017400
      DIFF=OMEN(N)-GXI*SQRT(0.5)                                           00017500
      IF(DIFF) 1,3,3                                                       00017600
    1 CONTINUE                                                             00017700
    3 CONTINUE                                                             00017800
      N=ITEMP                                                              00017900
      DELT1 = OMEN(N)-OMEN(N-1)                                            00018000
      NON=NUT-1                                                            00018100
      NUMB=6*NON                                                           00018200
      K1=NUMB                                                              00018300
      K2=2*NUMB                                                            00018400
      K3=3*NUMB                                                            00018500
      NSKIP=2*(N-2)*NUMB                                                   00018600
      NELEM=2*NFR*NUMB                                                     00018700
      DELT0=GXI*SQRT(0.5)-OMEN(N-1)                                        00018800
      TERM=DELT0/DELT1                                                     00018900
      DO 350 K=1,NOSHAL                                                    00019000
      READ(20) (A(I),I=1,NELEM)                                            00019100
      DO 350 J=1,NON                                                       00019200
      KM=(J-1)*6 + NSKIP                                                   00019300
      DO 350 M=1,6                                                         00019400
      KM= KM + 1                                                           00019500
      AAA=A(KM)                                                            00019600
      BBB=A(KM+K1)                                                         00019700
      CCC=A(KM+K2)                                                         00019800
      DDD=A(KM+K3)                                                         00019900
      DELT4=CCC-AAA                                                        00020000
      DELT5=DDD-BBB                                                        00020100
      PAA(K,J,M)=AAA+ DELT4*TERM                                           00020200
      PAV(K,J,M)=BBB+ DELT5*TERM                                           00020300
  350 CONTINUE                                                             00020400
      REWIND 20                                                            00020500
      DO 202 L=1,10                                                        00020600
      DELT2=(ALFA(N,L)-ALFA(N-1,L))/DELT1                                  00020700
      DELT3=(BETA(N,L)-BETA(N-1,L))/DELT1                                  00020800
      DA1(L)=ALFA(N-1,L)+DELT2*(GXI*SQRT(0.5)-OMEN(N-1))                   00020900
      DB1(L)=BETA(N-1,L)+DELT3*(GXI*SQRT(0.5)-OMEN(N-1))                   00021000
  202 CONTINUE                                                             00021100
      CALL VISC(GXI,VU,TVU,THM,CUDY,HGB)                                   00021200
      TBKU=0.0                                                             00021300
      DO 4 K=1,NOS                                                         00021400
      SBKU(K)=0.0                                                          00021500
    4 CONTINUE                                                             00021600
      GO TO(3003,3004),IBLADE                                              00021700
```

```
3003 CONTINUE                                                          00021800
     CALL BLGEK(GXI,IHM,SBKD,TBKD)                                     00021900
3004 CONTINUE                                                          00022000
     DA(1,1)=DA1(1)                                                    00022100
     DB(1,1)=DB1(1)                                                    00022200
     DA(2,2)=DA1(2)                                                    00022300
     DB(2,2)=DB1(2)                                                    00022400
     DA(3,3)=DA1(3)                                                    00022500
     DB(3,3)=DB1(3)                                                    00022600
     DA(2,4)=DA1(9)                                                    00022700
     DB(2,4)=DB1(9)                                                    00022800
     DA(2,6)=DA1(8)-FN(JJ)/GXI**2*DB1(2)                               00022900
     DB(2,6)=DB1(8)+FN(JJ)*DA1(2)                                      00023000
     DA(3,5)=DA1(7)+FN(JJ)/GXI**2*DB1(3)                               00023100
     DB(3,5)=DB1(7)-FN(JJ)*DA1(3)                                      00023200
     DA(4,4)=DA1(4)                                                    00023300
     DB(4,4)=DB1(4)                                                    00023400
     DB(4,4)=DB(4,4)+TVD+TBKD                                          00023500
     DA(4,2)=DA(2,4)                                                   00023600
     DB(4,2)=DB(2,4)                                                   00023700
     DA(4,6)=DA1(10)-FN(JJ)/GXI**2*DB1(9)                              00023800
     DB(4,6)=DB1(10)+FN(JJ)*DA1(9)                                     00023900
     DA(5,3)=DA1(7)-FN(JJ)/GXI**2*DB1(3)                               00024000
     DB(5,3)=DB1(7)+FN(JJ)*DA1(3)                                      00024100
     DA(5,5)=DA1(5)+(FN(JJ)/GXI)**2*DA1(3)                             00024200
     DB(5,5)=DB1(5)+(FN(JJ)/GXI)**2*DB1(3)                             00024300
     DA(6,2)=DA1(8)+FN(JJ)/GXI**2*DB1(2)                               00024400
     DB(6,2)=DB1(8)-FN(JJ)*DA1(2)                                      00024500
     DA(6,4)=DA1(10)+FN(JJ)/GXI**2*DB1(9)                              00024600
     DB(6,4)=DB1(10)-FN(JJ)*DA1(9)                                     00024700
     DA(6,6)=DA1(6)+(FN(JJ)/GXI)**2*DA1(2)                             00024800
     DB(6,6)=DB1(6)+(FN(JJ)/GXI)**2*DB1(2)                             00024900
     GO TO(3001,3002),IEND                                             00025000
3001 CONTINUE                                                          00025100
     CALL ENDSEP(DA,DB,GXI,PAA,PAV,JJ)                                 00025200
3002 CONTINUE                                                          00025300
     DO 109 I=1,3                                                      00025400
     DO 110 J=1,3                                                      00025500
     IEV=I+I                                                           00025600
     JEV=J+J                                                           00025700
     IOD=IEV-1                                                         00025800
     JOD=JEV-1                                                         00025900
     TOD(I,J)=-GXI**2*(GMJ(IOD,JOD)*DA(IOD,JOD))                       00026000
     TOD(I,J+3)=GXI*DB(IOD,JOD)                                        00026100
     TOD(I+3,J+3)=TOD(I,J)                                             00026200
     TOD(I+3,J)=-TOD(I,J+3)                                            00026300
     TEV(I,J)=-GXI**2*(GMJ(IEV,JEV)*DA(IEV,JEV))                       00026400
     TEV(I,J+3)=GXI*DB(IEV,JEV)                                        00026500
     TEV(I+3,J+3)=TEV(I,J)                                             00026600
     TEV(I+3,J)=-TEV(I,J+3)                                            00026700
 110 CONTINUE                                                          00026800
 109 CONTINUE                                                          00026900
     PNLI(LL)=TVD+TBKD                                                 00027000
     RMASS(LL)=GMJ(4,4)+DA(4,4)                                        00027100
     RDAMP(LL)=DB(4,4)-TVD-TBKD                                        00027200
     RREST(LL)=C44                                                     00027300
     TOD(2,2)=TOD(2,2)+C33                                             00027400
     TOD(2,3)=TOD(2,3)+C35                                             00027500
     TOD(3,2)=TOD(3,2)+C35                                             00027600
     TOD(3,3)=TOD(3,3)+C55                                             00027700
```

```
      TDD(5,5)=TDD(2,2)                                                 00027800
      TDD(5,6)=TDD(2,3)                                                 00027900
      TDD(6,5)=TDD(3,2)                                                 00028000
      TDD(6,6)=TDD(3,3)                                                 00028100
      TEV(2,2)=TEV(2,2)+C48                                             00028200
      TEV(5,5)=TEV(2,2)                                                 00028300
      DO 1010 L=1,6                                                     00028400
      CFX(L)=(0.0,0.0)                                                  00028500
 1010 CONTINUE                                                          00028600
      INUS=0                                                            00028700
      IF(IRR.EQ.0) GO TO 257                                            00028800
  203 FEAR(2)=-XMEA/(TVOL2*GRAV*R)*SIN(FI)*LPP*LPP                      00028900
      FEAR(4)=-XMEA/(TVOL2*GRAV)*LPP                                    00029000
      FEAR(6)=-XMEA*SIN(FI)*XPIN*LPP/(TVOL2*GRAV)                       00029100
      FDAR(2)=-XMDA*SIN(FI)*LPP/(R*TVOL4)                               00029200
      FDAR(4)=-XMDA/TVOL4                                               00029300
      FDAR(6)=-XMDA*SIN(FI)*XPIN/(R*TVOL4)                              00029400
      DO 250 I=1,3                                                      00029500
      TEV(I,2)=TEV(I,2)-FEAR(2*I)*XK1                                   00029600
      TEV(I+3,5)=TEV(I+3,2)-FEAR(2*I)*XK1                               00029700
      TEV(I,5)=TEV(I,5)+GX1*(FEAR(2*I)*XK2*SQGL+FDAR(2*I))              00029800
  250 TEV(I+3,2)=TEV(I+3,2)-GX1*(FEAR(2*I)*XK2*SQGL+FDAR(2*I))          00029900
  257 DO 32 K=1,NUS                                                     00030000
      KD=K                                                              00030100
      RN=TOP/BAR(LL)/2.                                                 00030200
      CP=RN*(ST(K)-TPSI)*DEG(MM)                                        00030300
      CP1=COS(CP)                                                       00030400
      CP2=SIN(CP)                                                       00030500
      CPET=(CP1+II*CP2)*DS(K)                                           00030600
      DIP=ST(K)-TPST                                                    00030700
      DO 1643 I=1,NON                                                   00030800
      FR(I,1)=ENI(K,I)                                                  00030900
      FR(I,2)=-SNE(K,I)                                                 00031000
      FR(I,3)=CSE(K,I)                                                  00031100
      FR(I,4)=XX(K,I)*CSE(K,I)-YY(K,I)*FR(I,2)                          00031200
      FR(I,5)=-DIP*FR(I,3)                                              00031300
      FR(I,6)=DIP*FR(I,2)                                               00031400
 1643 CONTINUE                                                          00031500
      DO 1001 L=1,6                                                     00031600
 1001 CSUM(L)=(0.0,0.0)                                                 00031700
      DO 610 L=1,6                                                      00031800
      DEF(L)=(0.,0.)                                                    00031900
  610 CONTINUE                                                          00032000
      DO 71 J=1,NON                                                     00032100
      PEI=EXP(RN*YY(K,J))                                               00032200
      ARG=RN*XX(K,J)*DEG(MM)                                            00032300
      FC=COS(ARG)                                                       00032400
      FS=SIN(ARG)                                                       00032500
      CFAC(3)=CMPLX(FC*FR(J,3),0.)                                      00032600
      CFAC(5)=CMPLX(FC*FR(J,5),0.)                                      00032700
      CFAC(1)=CMPLX(FC*FR(J,1),0.)                                      00032800
      CFAC(2)=II*FS*FR(J,2)                                             00032900
      CFAC(4)=II*FS*FR(J,4)                                             00033000
      CFAC(6)=II*FS*FR(J,6)                                             00033100
      PP=CMPLX(FR(J,3),0.)                                              00033200
      QQ=II*FR(J,2)*SNG(MM)                                             00033300
      DODD=(PP*FC+II*QQ*FS)*(GX1*SQRT(0.5*RN)/UN)                       00033400
      DEVEN=(QQ*FC+II*PP*FS)*(GX1*SQRT(0.5*RN)/UN)                      00033500
      DUM3=CFAC(3)                                                      00033600
      DUM2=CFAC(2)                                                      00033700
```

```
      CFAC(1)=CFAC(1)-DODD*CMPLX(PAA(K,J,1),PAV(K,J,1))                 00033800
      CFAC(3)=CFAC(3)-DODD*CMPLX(PAA(K,J,3),PAV(K,J,3))                 00033900
      CFAC(5)=CFAC(5)-DODD*CMPLX(PAA(K,J,5),PAV(K,J,5))                 00034000
      CFAC(2)=CFAC(2)-DEVEN*CMPLX(PAA(K,J,2),PAV(K,J,2))                00034100
      CFAC(4)=CFAC(4)-DEVEN*CMPLX(PAA(K,J,4),PAV(K,J,4))                00034200
      CFAC(6)=CFAC(6)-DEVEN*CMPLX(PAA(K,J,6),PAV(K,J,6))                00034300
      CFAC(5)=CFAC(5)+(2.*II*FN(JJ)/GXI)*(CFAC(3)-DUM3)                 00034400
      CFAC(6)=CFAC(6)-(2.*II*FN(JJ)/GXI)*(CFAC(2)-DUM2)                 00034500
      DO 1002 L=1,6                                                     00034600
 1002 CSUM(L)=CSUM(L)+FET*DEL(K,J)*CFAC(L)                              00034700
      DEF(3)=DEF(3)-DODD*CMPLX(PAA(K,J,3),PAV(K,J,3))*DEL(K,J)*4.*FET   00034800
      DEF(5)=DEF(5)-DODD*CMPLX(PAA(K,J,5),PAV(K,J,5))*FET*DEL(K,J)*2.   00034900
      DEF(2)=DEF(2)-DEVEN*CMPLX(PAA(K,J,2),PAV(K,J,2))*FET*DEL(K,J)*4.  00035000
      DEF(4)=DEF(4)-DEVEN*CMPLX(PAA(K,J,4),PAV(K,J,4))*FET*DEL(K,J)*2.  00035100
      DEF(6)=DEF(6)-DEVEN*CMPLX(PAA(K,J,6),PAV(K,J,6))*FET*DEL(K,J)*2.  00035200
   71 CONTINUE                                                          00035300
      DO 10 L=1,6                                                       00035400
      PEXR(L,KD)=REAL(CSUM(L)*CFET)/TVOL                                00035500
      PEXI(L,KD)=AIMAG(CSUM(L)*CFET)/TVOL                               00035600
   10 CONTINUE                                                          00035700
      PEXR(1,KD)=4.0*PEXR(1,KD)                                         00035800
      PEXR(2,KD)=4.0*PEXR(2,KD)                                         00035900
      PEXR(3,KD)=4.0*PEXR(3,KD)                                         00036000
      PEXR(4,KD)=2.0*PEXR(4,KD)                                         00036100
      PEXR(5,KD)=2.0*PEXR(5,KD)                                         00036200
      PEXR(6,KD)=2.0*PEXR(5,KD)                                         00036300
      PEXI(6,KD)=2.0*PEXI(5,KD)                                         00036400
      PEXI(5,KD)=2.0*PEXI(5,KD)                                         00036500
      PEXI(4,KD)=2.0*PEXI(4,KD)                                         00036600
      PEXI(3,KD)=4.0*PEXI(3,KD)                                         00036700
      PEXI(2,KD)=4.0*PEXI(2,KD)                                         00036800
      DO 611 L=1,6                                                      00036900
      PDFR(L,K)=REAL(DEF(L)*CFET*II)/TVOL/GXI/DS(K)*2.*FN(JJ)           00037000
      PDFI(L,K)=AIMAG(DEF(L)*CFET*II)/TVOL/GXI/DS(K)*2.*FN(JJ)          00037100
  611 CONTINUE                                                          00037200
      DO 1003 L=1,6                                                     00037300
 1003 CFX(L)=CFX(L)+CFET*CSUM(L)                                        00037400
   32 CONTINUE                                                          00037500
      DO 103 L=1,3                                                      00037600
      LEV=L+L                                                           00037700
      LOD=LEV-1                                                         00037800
      BOD(L,1)=REAL(CFX(LOD))/TVOL                                      00037900
      BOD(L+3,1)=AIMAG(CFX(LOD))/TVOL                                   00038000
      BEV(L,1)=REAL(CFX(LEV))/TVOL                                      00038100
      BEV(L+3,1)=AIMAG(CFX(LEV))/TVOL                                   00038200
  103 CONTINUE                                                          00038300
      BOD(1,1)=4.0*BOD(1,1)                                             00038400
      BOD(2,1)=4.0*BOD(2,1)                                             00038500
      BOD(3,1)=2.0*BOD(3,1)                                             00038600
      BOD(4,1)=4.0*BOD(4,1)                                             00038700
      BOD(5,1)=4.0*BOD(5,1)                                             00038800
      BOD(6,1)=2.0*BOD(6,1)                                             00038900
      BEV(1,1)=4.0*BEV(1,1)                                             00039000
      BEV(2,1)=2.0*BEV(2,1)                                             00039100
      BEV(3,1)=2.0*BEV(3,1)                                             00039200
      BEV(4,1)=4.0*BEV(4,1)                                             00039300
                                                                        00039400
      BEV(5,1)=2.0*BEV(5,1)                                             00039500
      BEV(6,1)=2.0*BEV(6,1)                                             00039600
                                                                        00039700
```

```
  501 CALL MATINS(TEV,6,6,BEV,1,1,DTMM,ID,INDEX)                          00039800
      GO TO(503,502),ID                                                   00039900
  502 DO 105 L=1,6                                                        00040000
  105 CFX(L)=(0.0,0.0)                                                    00040100
      GO TO 999                                                           00040200
  503 CONTINUE                                                            00040300
      RMU(1,LL)=BOD(1,1)                                                  00040400
      RMU(2,LL)=BEV(1,1)                                                  00040500
      RMU(3,LL)=BOD(2,1)                                                  00040600
      RMU(4,LL)=BEV(2,1)                                                  00040700
      RMU(5,LL)=BOD(3,1)                                                  00040800
      RMU(6,LL)=BEV(3,1)                                                  00040900
      AIMU(1,LL)=DOD(1,1)                                                 00041000
      AIMU(2,LL)=DEV(1,1)                                                 00041100
      AIMU(3,LL)=DOD(2,1)                                                 00041200
      AIMU(4,LL)=DEV(2,1)                                                 00041300
      AIMU(5,LL)=DOD(3,1)                                                 00041400
      AIMU(6,LL)=DEV(3,1)                                                 00041500
      RMU(4,LL)=RMO(4,LL)*BAM(LL)                                         00041600
      RMU(5,LL)=RMO(5,LL)*BAM(LL)                                         00041700
      RMU(6,LL)=RMO(6,LL)*BAM(LL)                                         00041800
      AIMU(4,LL)=AIMO(4,LL)*BAM(LL)                                       00041900
      AIMU(5,LL)=AIMO(5,LL)*BAM(LL)                                       00042000
      AIMU(6,LL)=AIMO(6,LL)*BAM(LL)                                       00042100
      THCAL(LL)=SQRT(RMO(4,LL)**2+AIMO(4,LL)**2)*AVAMP(LL)/AVLNTH         00042200
  612 CONTINUE                                                            00042300
      RHMO(KTH)=AMAX(NOK,THCAL)                                           00042400
      THDIFF = THMO(KTH)-RHMO(KTH)                                        00042500
      THDRAD = ABS(THDIFF)                                                00042600
      IHMO(KTH)=ITERAT                                                    00042700
      HMO(ITERAT,KTH,1) = IHMO(KTH)                                       00042800
      HMO(ITERAT,KTH,2) = RHMO(KTH)                                       00042900
      IF (THDRAD .LE. EPS) GO TO 1505                                     00043000
      IF (ITERAT .EQ. 1) GO TO 1505                                       00043100
      THMO(KTH) = THMO(KTH)-SIGN(1.,THDIFF)*FCT*THDRAD                    00043200
      GO TO 1500                                                          00043300
 1505 WRITE(6,8500)MO(MM)                                                 00043400

 8500 FORMAT('1',4X,'CURVAS DE TRANSFERENCIA COM TRES GRAUS DE LIBERDAD   00043500
     1E'//15X,'APROAMENTO',F6.1,' GRAUS'//16X,'DERIVA',14X,'BALANCO',14   00043600
     2X,'GUINADA'/2X,'LAM/L',3X,3('AMPLITUDE    FASE     '))             00043700
      DO 1510 LL=1,NOK                                                    00043800
      TERM=1.                                                             00043900
      IF(J.GT.2)TERM=TERM*FACT/BAM(LL)/ELL                                00044000
      DO 1510 IJ=1,3                                                      00044100
      J=2*IJ                                                              00044200
      FASAUX=ATAN2D(AIMO(J,LL),RMO(J,LL))                                 00044300
      MAUX=TERM*SQRT(RMO(J,LL)*RMO(J,LL)+AIMO(J,LL)*AIMO(J,LL))           00044400
      GO TO(1502,1504,1506),IJ                                            00044500
 1502 WRITE(6,8600)BAM(LL),MAUX,FASAUX                                    00044600
 8600 FORMAT(1X,F5.1,3X,E11.5,F7.1)                                       00044700
      GO TO 1507                                                          00044800
 1504 WRITE(6,8700)MAUX,FASAUX                                            00044900
 8700 FORMAT('+',30X,E11.5,F7.1)                                          00045000
      GO TO 1507                                                          00045100
 1506 WRITE(6,8800)MAUX,FASAUX                                            00045200
 8800 FORMAT('+',51X,E11.5,F7.1)                                          00045300
 1507 IF(J.GT.2)MAUX=MAUX/TERM/360.                                       00045400
      IF(J.EQ.2)WRITE(30)BAM(LL),MAUX,FASAUX                              00045500
      IF(J.EQ.4)WRITE(35)BAM(LL),MAUX,FASAUX                              00045600
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      IF(J.EQ.6)WRITE(40)BAM(LL),HAUX,FASAUX                                00045700
 1510 CONTINUE                                                              00045800
  998 CONTINUE                                                              00045900
  999 CONTINUE                                                              00046000
      LOCK 20                                                               00046100
      LOCK 30                                                               00046200
      RETURN                                                                00046300
      END                                                                   00046400
      004:05C6:5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT U
      004:05CA:1  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT U
      004:05CE:3  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT U
      004:05CC:5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT U
                                                                              SL

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C                                                                       00046500
C                                                                       00046600
      SUBROUTINE TANAKA(THM,EDDY,RGB)                                   00046700
C                                                                       00046800
C PROGRAMMER- D. PALTIESEN,DNV                                          00046900
C                                                                       00047000
      COMMON AM(27),NUT,NMAS,NUS,ST(45),DS(25),EL,ELL,X(25,8),Y(25,8),PH 00047100
     1AS(27),XMAS(27),YMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00047200
     2ST,RF33,RM33,RM55,DUM,DIP,K,N,IVOL,ALFA(40,11),BETA(40,11),HDG(40) 00047300
     3,FN(5),BAM(30),GUG(10),SUG(10),UMAX,UMIN,NFR,NCR,NOB,NOH,OMEN(40), 00047400
     4FR(7,6),XX(45,7),YY(25,7),CEL(45,7),SNE(25,7),CSE(25,7),EN1(25,7), 00047500
     5UN,OMEGA,ID,TITU(12),RORU,RON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP    00047600
      COMMON ST1(27),TMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES,  00047700
     2VNT,GRAV,AMUDL,RUD,AREELL,BEAMBL,ITS(25),RD(25),RFD(25),DELTAD(45) 00047800
     2,RRD(25),SD(25),COSPHD(25),PHIU(25),STPR(25),THMD(50)             00047900
      COMMON NRSTP,INRSTP(12)                                           00046000
      DIMENSION EDDY(27),RGB(27),F1(15),BDKG(15),GKDB(6),RFORE(6        00048100
     1),BAFT(5),CAFT(5),XI(8),YI(6)                                     00048200
      DIMENSION ALF2(5),F2(5)                                           00048300
      ALF2(1)=0.0                                                       00048400
      ALF2(2)=0.0073                                                    00048500
      ALF2(3)=0.1745                                                    00048600
      ALF2(4)=0.3491                                                    00048700
      ALF2(5)=0.5235                                                    00048800
      F2(1)=1.                                                          00048900
      DO 1 I=1,5                                                        00049000
      BDKG(I)=1./(60.-I*10.)                                            00049100
    1 CONTINUE                                                          00049200
      BDKG(6)=1./5                                                      00049300
      DO 2 I=7,13                                                       00049400
      BDKG(I)=0.5+0.5*(I-7)                                             00049500
    2 CONTINUE                                                          00049600
      IF(THM-0.1745) 3,3,4                                              00049700
    3 CONTINUE                                                          00049800
      F1(1)=0.455                                                       00049900
      F1(2)=0.52                                                        00050000
      F1(3)=0.42                                                        00050100
      F1(4)=0.35                                                        00050200
      F1(5)=0.52                                                        00050300
      GO TO 5                                                           00050400
    4 CONTINUE                                                          00050500
      IF(THM-0.2618) 6,6,7                                              00050600
    6 CONTINUE                                                          00050700
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      FAC=(THM-0.1745)/(0.2618-0.1745)                                  00050800
      F1(1)=(0.32-0.455)*FAC +0.455                                     00050900
      F1(2)=(0.34-0.52)*FAC +0.52                                       00051000
      F1(3)=(0.29-0.42)*FAC +0.42                                       00051100
      F1(4)=(0.31-0.35)*FAC+0.35                                        00051200
      F1(5)=(0.48-0.52)*FAC+0.52                                        00051300
      GO TO 5                                                           00051400
    7 CONTINUE                                                          00051500
      IF(THM-0.3491) 8,9,9                                              00051600
    8 CONTINUE                                                          00051700
      FAC=(THM-0.2618)/(0.3491-0.2618)                                  00051800
      F1(1)=(0.25-0.32)*FAC+0.32                                        00051900
      F1(2)=(0.25-0.34)*FAC+0.34                                        00052000
      F1(3)=(0.22-0.29)*FAC+0.29                                        00052100
      F1(4)=(0.28-0.31)*FAC+0.31                                        00052200
      F1(5)=(0.45-0.48)*FAC+0.48                                        00052300
      GO TO 5                                                           00052400
    9 CONTINUE                                                          00052500
      F1(1)=0.25                                                        00052600
      F1(2)=0.25                                                        00052700
      F1(3)=0.22                                                        00052800
      F1(4)=0.28                                                        00052900
      F1(5)=0.45                                                        00053000
    5 CONTINUE                                                          00053100
      F1(6)=0.63                                                        00053200
      F1(7)=0.63                                                        00053300
      F1(8)=0.59                                                        00053400
      F1(9)=0.53                                                        00053500
      F1(10)=0.4                                                        00053600
      F1(11)=0.35                                                       00053700
      F1(12)=0.32                                                       00053800
      F1(13)=0.3                                                        00053900
      IF(THM-0.0873) 10,10,11                                           00054000
   10 CONTINUE                                                          00054100
      AEX=10.6                                                          00054200
      GO TO 12                                                          00054300
   11 CONTINUE                                                          00054400
      IF(THM-0.1745) 13,13,14                                           00054500
   13 CONTINUE                                                          00054600
      AEX=(7.66-10.6)/(0.1745-0.0873)*(THM-0.0873)+10.6                 00054700
      GO TO 12                                                          00054800
   14 CONTINUE                                                          00054900
      IF(THM-0.2618) 15,15,16                                           00055000
   15 CONTINUE                                                          00055100
      AEX=(6.34-7.66)/(0.2618-0.1745)*(THM-0.1745)+7.66                 00055200
      GO TO 12                                                          00055300
   16 CONTINUE                                                          00055400
      AEX=(5.28-6.34)/(0.3491-0.2618)*(THM-0.2618)+6.34                 00055500
   12 CONTINUE                                                          00055600
      GKDB(1)=1.2                                                       00055700
      GKDB(2)=1.4                                                       00055800
      GKDB(3)=1.6                                                       00055900
      GKDB(4)=1.8                                                       00056000
      GKDB(5)=2.0                                                       00056100
      GKDB(6)=2.05                                                      00056200
      RFORE(1)=1.0                                                      00056300
      RFORE(2)=0.8                                                      00056400
      RFORE(3)=0.34                                                     00056500
      RFORE(4)=0.15                                                     00056600
      RFORE(5)=0.04                                                     00056700
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      RFORE(6)=0.0                                                          00056600
      BAPT(1)=1.0                                                           00056900
      BAPT(2)=1.25                                                          00057000
      BAPT(3)=1.5                                                           00057100
      BAPT(4)=2.0                                                           00057200
      BAPT(5)=2.25                                                          00057300
      CAPT(1)=0.22                                                          00057400
      CAPT(2)=0.24                                                          00057500
      CAPT(3)=0.3                                                           00057600
      CAPT(4)=0.5                                                           00057700
      CAPT(5)=0.63                                                          00057800
      DO 17 K=1,NOS                                                         00057900
      ITSU=ITS(K)                                                           00058000
      GO TO(18,19,20,21),ITSU                                               00058100
   18 CONTINUE                                                              00058200
      RGB(K)=ABS(Y(K,NUT)*EL-ZG)                                            00058300
      IF(X(K,1)) 60,60,61                                                   00058400
   60 CONTINUE                                                              00058500
      EDDY(K)=0.63                                                          00058600
      GO TO 29                                                              00058700
   61 CONTINUE                                                              00058800
      GDB=RGB(K)/ZG/X(K,1)/EL                                               00058900
      IF(GDB-2.05) 22,23,23                                                 00059000
   23 CONTINUE                                                              00059100
      RBIL=0.0                                                              00059200
      GO TO 24                                                              00059300
   22 CONTINUE                                                              00059400
      DO 25 J=2,6                                                           00059500
      ITEMP=J                                                               00059600
      IF(GDB-GKDB(J)) 26,25,25                                              00059700
   25 CONTINUE                                                              00059800
   26 CONTINUE                                                              00059900
      J=ITEMP                                                               00060000
      RBIL=(RFORE(J)-RFORE(J-1))/(GKDB(J)-GKDB(J-1))*(GDB-GKDB(J-1))+RFO    00060100
     1RE(J-1)                                                               00060200
      RBIL=RBIL*X(K,1)*EL                                                   00060300
   24 CONTINUE                                                              00060400
      BDG=1.7/GDB                                                           00060500
      DO 27 J=2,13                                                          00060600
      ITEMP=J                                                               00060700
      IF(BDG-BDKG(J)) 28,28,27                                              00060800
   27 CONTINUE                                                              00060900
   28 CONTINUE                                                              00061000
      J=ITEMP                                                               00061100
      FONE=(F1(J)-F1(J-1))/(BDKG(J)-BDKG(J-1))*(BDG-BDKG(J-1))+F1(J-1)      00061200
      F2ALF=1.                                                              00061300
      EDDY(K)=F2ALF*FONE*EXP(-ALX*RBIL/ABS(Y(K,NUT))/EL)                    00061400
      GO TO 29                                                              00061500
   19 CONTINUE                                                              00061600
      DO 30 J=1,NUT                                                         00061700
      XI(J)=X(K,J)*EL                                                       00061800
      YI(J)=Y(K,J)*EL                                                       00061900
   30 CONTINUE                                                              00062000
      RBIL=RO(K)                                                            00062100
      RGB(K)=SQRT((YI(NUT)-ZG)**2+XI(1)**2)-RBIL*(SQRT(2.)-1.)              00062200
      BDG=2.*XI(1)/ABS(YI(NUT)-ZG)                                          00062300
      DO 31 J=2,13                                                          00062400
      ITEMP=J                                                               00062500
      IF(BDG-BDKG(J)) 32,32,31                                              00062600
   31 CONTINUE                                                              00062700
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 32 CONTINUE                                                                    00062800
    J=ITEMP                                                                     00062900
    FONE=(F1(J)-F1(J-1))/(BDKG(J)-BDKG(J-1))*(BDG-BDKG(J-1))+F1(J-1)            00063000
    EDDY(K)=FONE*EXP(-ALK*RBIL/ABS(YI(NUT)))                                    00063100
    GO TO 29                                                                    00063200
 20 CONTINUE                                                                    00063300
    RGB(K)=ABS(Y(K,NUT)*EL-ZO)                                                  00063400
    BDG=2.*X(K,1)*EL/RGB(K)                                                     00063500
    DO 33 J=2,5                                                                 00063600
    ITEMP=J                                                                     00063700
    IF(BDG-BAFT(J)) 34,34,33                                                    00063800
 33 CONTINUE                                                                    00063900
 34 CONTINUE                                                                    00064000
    J=ITEMP                                                                     00064100
    EDDY(K)=(CAFT(J)-CAFT(J-1))/(BAFT(J)-BAFT(J-1))*(BDG-BAFT(J-1))+CA          00064200
   1FT(J-1)                                                                     00064300
    GO TO 29                                                                    00064400
 21 CONTINUE                                                                    00064500
    RGB(K)=0.0                                                                  00064600
    EDDY(K)=0.0                                                                 00064700
 29 CONTINUE                                                                    00064800
    GO TO (40,40,43,43),ITSU                                                    00064900
 40 CONTINUE                                                                    00065000
    IF(X(K,2)-X(K,1)) 42,43,43                                                  00065100
 42 CONTINUE                                                                    00065200
    BR=(X(K,1)-X(K,2))/(-Y(K,2))                                                00065300
    ALP=ATAN(BR)                                                                00065400
    RDD=RBIL/ABS(Y(K,NUT))/EL                                                   00065500
    IF(RDD) 44,44,45                                                            00065600
 44 CONTINUE                                                                    00065700
    F2(2)=0.855                                                                 00065800
    F2(3)=0.765                                                                 00065900
    F2(4)=0.682                                                                 00066000
    F2(5)=0.646                                                                 00066100
    GO TO 46                                                                    00066200
 45 CONTINUE                                                                    00066300
    IF(RDD-0.0571) 47,47,48                                                     00066400
 47 CONTINUE                                                                    00066500
    F2(2)=(0.745-0.855)/0.0571*RDD+0.855                                        00066600
    F2(3)=(0.670-0.765)/0.0571*RDD+0.765                                        00066700
    F2(4)=(0.745-0.682)/0.0571*RDD+0.682                                        00066800
    F2(5)=(0.915-0.646)/0.0571*RDD+0.646                                        00066900
    GO TO 46                                                                    00067000
 48 CONTINUE                                                                    00067100
    IF(RDD-0.1142) 49,49,50                                                     00067200
 49 CONTINUE                                                                    00067300
    F2(2)=0.74                                                                  00067400
    F2(3)=(0.72-0.670)/(0.1142-0.0571)*(RDD-0.0571)+0.670                       00067500
    F2(4)=(0.89-0.745)/(0.1142-0.0571)*(RDD-0.0571)+0.745                       00067600
    F2(5)=(1.34-0.915)/(0.1142-0.0571)*(RDD-0.0571)+0.915                       00067700
    GO TO 46                                                                    00067800
 50 CONTINUE                                                                    00067900
    IF(RDD-0.1713) 51,51,52                                                     00068000
 51 CONTINUE                                                                    00068100
    F2(2)=(0.70-0.74)/(0.1713-0.1142)*(RDD-0.1142)+0.74                         00068200
    F2(3)=0.72                                                                  00068300
    F2(4)=(1.20-0.89)/(0.1713-0.1142)*(RDD-0.1142)+0.89                         00068400
    F2(5)=(1.94-1.34)/(0.1713-0.1142)*(RDD-0.1142)+1.34                         00068500
    GO TO 46                                                                    00068600
 52 CONTINUE                                                                    00068700
```

```
      F2(2)=0.7                                                          00068800
      F2(3)=0.72                                                         00066900
      F2(4)=1.2                                                          00069000
      F2(5)=1.94                                                         00069100
   46 CONTINUE                                                           00069200
      DO 53 J=2,5                                                        00069300
      ITEMP=J                                                            00069400
      IF(ALF.ALF2(J)) 54,54,53                                           00069500
   53 CONTINUE                                                           00069600
   54 CONTINUE                                                           00069700
      J=ITEMP                                                            00069800
      F2ALF=(F2(J)-F2(J-1))/(ALF2(J)-ALF2(J-1))*(ALF-ALF2(J-1))+F2(J-1)  00069900
      EDDY(K)=EDDY(K)*F2ALF                                              00070000
   43 CONTINUE                                                           00070100
   17 CONTINUE                                                           00070200
      RETURN                                                             00070300
      END                                                                00070400
                                                                          SL
*********************************************************************
C                                                                        00070500
C                                                                        00070600
      SUBROUTINE BILGER(GXI,THM,SBKD,TBKD)                               00070700
      COMMON AM(27),NOI,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM 00070800
     1AS(27),XMAS(27),YMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00070900
     2ST,RF33,RM33,RM55,DG44,DIP,R,N,IVOL,ALFA(40,11),BETA(40,11),HDG(10) 00071000
     3,FN(5),BAM(30),GUG(10),SUG(10),DMAX,DMIN,NFR,NGK,NOB,NOM,OMEN(40), 00071100
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7), 00071200
     5UN,OMEGA,ID,TITU(12),WORD,NON,XAST,HDG1(10),IT,CBV,CMC,PRNTOP      00071300
      COMMON ST1(27),TMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES, 00071400
     2VNY,GRAV,AMODL,MOD,ASKELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25) 00071500
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)              00071600
      COMMON NRSTP,INRSTP(12)                                            00071700
C                                                                        00071800
C    THIS CALCULATION METHOD IS A MODIFICATION OF KATOS METHOD           00071900
C    R=RADIUS OF BILGE CIRCLE AT STATION K                               00072000
C    RF=RISE OF FLOOR AT STATION K                                       00072100
C    DELTAL=LENGTH OF THAT PART OF BILGEKEEL WICH IS AT STATION K        00072200
C    RK=DISTANCE OF MIDDLE OF BILGEKEEL FROM THE MOMENTAXIS IN WATERPLA  00072300
C   S=LENGTH FROM THE ROOT OF BILGEKEEL TO THE WATERSURFACE              00072400
C                AT STATION K                                            00072500
C     COSPHI=COSINUS  OF THE ANGLE MADE BY THE PLANE OF BILGEKEEL WITH RK 00072600
C     PHI=ANGLE BETWEEN RK AND WATERPLANE                                00072700
C     BEAMKL=BREADTH OF BILGE KEEL                                       00072800
C     AKELL=LENGTH OF BILGEKEEL                                          00072900
C                                                                        00073000
      DIMENSION SBKD(27)                                                 00073100
      DO 703 K=1,NOS                                                     00073200
      R=RD(K)                                                            00073300
      RF=RFD(K)                                                          00073400
      DELTAL=DELTAD(K)                                                   00073500
      IF (DELTAL .LE. 0.) GO TO 703                                      00073600
      RK=RKD(K)                                                          00073700
      S=SD(K)                                                            00073800
      COSPHI=COSPHD(K)                                                   00073900
      PHI=PHID(K)                                                        00074000
      SHBEAM=2.*X(K,1)*EL                                                00074100
      GK=ABS(Y(K,NOT))*EL                                                00074200
```

```
      T=6.28318S*SQRT(ELL/GRAV)/GXI                                          00074300
      DRAUGT=GK                                                              00074400
      TETAM=THM                                                              00074500
      AKAPPA=R*(1.+RF/SHBEAM)**2./SQRT(0.5*SHBEAM*GK)                        00074600
      CK=1.+3.5*EXP(-9.*AKAPPA)                                              00074700
      CD= 1000.*(1.44D+03.5*PHI**3.)                                         00074800
      ALABDA= P/(DRAUGT-(RF/SHBEAM)*(SHBEAM-2.*R) )                          00074900
      FUNLAB= 1.34*  SIN(3.1416*ALABDA/3.6)/(1.+0.162* SIN(3.1416*(ALABD     00075000
     1A-0.9)/1.8))                                                           00075100
      EPSIL=ATAN(2.*RF/SHBEAM)                                               00075200
      Q= (0.5*SHBEAM *  TAN(3.1416/4. -EPSIL/2.)+RF-GK)*SIN(3.1416/4.+EP     00075300
     1SIL/2.)                                                                00075400
      PO= GK- DRAUGT/3. -2.*RF/3.                                            00075500
      PONE=0.88*(GK-DRAUGT-0.54*(SHBEAM/2.-(DRAUGT-RF)*TAN(3.1416/4.+EPS     00075600
     1IL/2.)))                                                               00075700
      BCIRC = COSPHI + S*(Q+PO-(PO-PONE)*FUNLAB)/2./BEAMKL/RK                00075800
      ZETA = BEAMKL/(RK*PHI**.75)                                            00075900
      AN= 1.4 + 2.03*EXP(-25.*ZETA)                                          00076000
      ALPHA= 2.-AN                                                           00076100
      REYN=8.*BEAMKL*RK*THM*GAI/ELL/ELL/VNY/6.2832*(AMODL/ELL)**2            00076200
      IF(REYN-10.**3) 10,10,11                                               00076300
   10 CA=1.95-0.25*ALOG(REYN/ALOG(10.)+0.2*SIN(3.1416*(ALOG(REYN)/ALOG(      00076400
     1 10.)-2.19)/0.54)                                                      00076500
      GO TO 7                                                                00076600
   11 CA=1.                                                                  00076700
    7 CONTINUE                                                               00076800
      F=RK*TETAM*PHI**1.70/(T * SQRT(BEAMKL))                                00076900
      FALFA=F**ALPHA                                                         00077000
      CN= 1.68*EXP(-11.*BEAMKL/AKEELL)                                       00077100
      CS=CD/2.66/1000./FALFA                                                 00077200
      SBKD(K)=GXI*2.*(RK/EL)**3*THM*2.*DELTAL*BEAMKL/ELL/ELL/3./3.141593     00077300
     1*CS*CA*CK*CN*BCIRC/TVOL                                                00077400
      SBKD(K)=2.*SBKD(K)                                                     00077500
      TBKD=TBKD+SBKD(K)                                                      00077600
  410 FORMAT(12E10.4)                                                        00077700
  703 CONTINUE                                                               00077800
      RETURN                                                                 00077900
      END                                                                    00078000
                                                                             SE
*********************************************************************************
C       VERSAO 4  -  CDC 6700  -  E N D S E P  -  JUNHO, 1972                  00078100
C                                                                              00078200
      SUBROUTINE ENDSEP (DA,DB,GXI,PAA,PAV,JJ)                                 00078300
C                                                                              00078400
C PROGRAMMER - G. FALTINSEN, DNV                                               00078500
C                                                                              00078600
      COMMON AM(27),NOI,NMAS,NDS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM       00078700
     1AS(27),XMAS(27),ZMAS(27),RKG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP       00078800
     2ST,RF33,RM35,RM53,DGM,DIP,R,NIVOL,ALFA(40,11),BETA(40,11),HDG(10)        00078900
     3,FN(5),BAR(30),GOG(10),SOG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40),       00079000
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7),       00079100
     5SUN,OMEGA,ID,TITU(12),NORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP          00079200
      COMMON ST1(27),TMAS(27),BEAM,DRAFT,OMAX,IRR,ML,IEND,IBILGE,IPRES,       00079300
     2VNT,GRAV,AMODL,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25)           00079400
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)                    00079500
      COMMON NRSTP,INRSTP(12)                                                  00079600
      DIMENSION DA(6,6),DB(6,6),PAA(25,7,6),PAV(25,7,6),DADS(10),DDDS(10       00079700
```

```
     1)                                                                 00079800
C                                                                       00079900
C  NOS IS TEMPORARILY CHANGED TO IXAST IN THIS ROUTINE                 00080000
C                                                                       00080100
      NOSH=NOS                                                          00080200
      NOS=IXAST                                                         00080300
      DIP=ST(NOS)*TPSI                                                  00080400
      DO 54 I=1,NON                                                     00080500
      FR(I,1)=EN1(NOS,I)                                                00080600
      FR(I,2)=-SNE(NOS,I)                                               00080700
      FR(I,3)=CSE(NOS,I)                                                00080800
      FR(I,4)=XX(NOS,I)*CSE(NOS,I)+Y1(NOS,I)*FR(I,2)                    00080900
      FR(I,5)=-DIP*FR(I,3)                                              00081000
      FR(I,6)=DIP*FR(I,2)                                               00081100
   54 CONTINUE                                                          00081200
      DO 55 LK=1,10                                                     00081300
      GO TO (613,613,613,613,613,613,614,615,616,617),LK                00081400
  613 CONTINUE                                                          00081500
      L=LK                                                              00081600
      M=LK                                                              00081700
      GO TO 618                                                         00081800
  614 CONTINUE                                                          00081900
      L=5                                                               00082000
      M=3                                                               00082100
      GO TO 618                                                         00082200
  615 CONTINUE                                                          00082300
      L=2                                                               00082400
      M=6                                                               00082500
                                                                        00082600
                                                                        00082700
      GO TO 618                                                         00082800
  616 CONTINUE                                                          00082900
      L=2                                                               00083000
      M=4                                                               00083100
      GO TO 618                                                         00083200
  617 CONTINUE                                                          00083300
      L=6                                                               00083400
      M=4                                                               00083500
  618 CONTINUE                                                          00083600
      DADS(LK)=0.0                                                      00083700
      DDDS(LK)=0.0                                                      00083800
      DO 619 J=1,NON                                                    00083900
      DADS(LK)=DADS(LK)+DEL(NOS,J)*FR(J,L)*PAA(NOS,J,M)                 00084000
      DDDS(LK)=DDDS(LK)+DEL(NOS,J)*FR(J,L)*PAV(NOS,J,M)                 00084100
  619 CONTINUE                                                          00084200
      DADS(LK)=2.0*DADS(LK)*DS(NOS)                                     00084300
      DDDS(LK)=2.0*DDDS(LK)*DS(NOS)                                     00084400
   55 CONTINUE                                                          00084500
      DO 620 L=1,10                                                     00084600
      DADS(L)=DADS(L)/IVOL/UN                                           00084700
      DDDS(L)=DDDS(L)/IVOL/SQRT(UN)*SQRT(2.)                            00084800
  620 CONTINUE                                                          00084900
      DO 621 L=4,10                                                     00085000
      DADS(L)=DADS(L)*0.5*0.5                                           00085100
      DDDS(L)=DDDS(L)*0.5*0.5                                           00085200
  621 CONTINUE                                                          00085300
      DO 622 L=7,9                                                      00085400
      DADS(L)=DADS(L)*2.                                                00085500
      DDDS(L)=DDDS(L)*2.                                                00085600
  622 CONTINUE                                                          00085700
```

```
      DA(2,2)=DA(2,2)-FN(JJ)/GX1**2/DS(NOS)*2.*DDDS(2)                  00085800
      DB(2,2)=DB(2,2)+FN(JJ)/DS(NOS)*2.*DADS(2)                         00085900
      DA(2,4)=DA(2,4)-FN(JJ)/GX1**2/DS(NOS)*2.*DDDS(9)                  00086000
      DB(2,4)=DB(2,4)+FN(JJ)/DS(NOS)*2.*DADS(9)                         00086100
      DA(2,6)=DA(2,6)-FN(JJ)/GX1**2/DS(NOS)*2.*DDDS(8)-(FN(JJ)/GXI)**2/D 00086200
     1S(NOS)*2.*DADS(2)                                                 00086300
      DB(2,6)=DB(2,6)+FN(JJ)/DS(NOS)*2.*DADS(8)-(FN(JJ)/GXI)**2/DS(NOS)* 00086400
     12.*DDDS(2)                                                        00086500
      DA(4,2)=DA(2,4)                                                   00086600
      DB(4,2)=DB(2,4)                                                   00086700
      DA(4,4)=DA(4,4)-FN(JJ)/GX1**2/DS(NOS)*DDDS(4)*2.                  00086800
      DB(4,4)=DB(4,4)+FN(JJ)/DS(NOS)*2.*DADS(4)                         00086900
      DA(4,6)=DA(4,6)-FN(JJ)/GX1**2/DS(NOS)*2.*DDDS(10)-(FN(JJ)/GXI)**2/ 00087000
     1DS(NOS)*2.*DADS(4)                                                00087100
      DB(4,6)=DB(4,6)+FN(JJ)/DS(NOS)*2.*DADS(10)-(FN(JJ)/GXI)**2/DS(NOS) 00087200
     1*2.*DDDS(9)                                                       00087300
      DA(6,2)=DA(6,2)-FN(JJ)/GX1**2/DS(NOS)*2.*DDDS(8)                  00087400
      DB(6,2)=DB(6,2)+FN(JJ)/DS(NOS)*2.*DADS(8)                         00087500
      DA(6,4)=DA(6,4)-FN(JJ)/GX1**2/DS(NOS)*2.*DDDS(10)                 00087600
      DB(6,4)=DB(6,4)+FN(JJ)/DS(NOS)*DADS(10)*2.                        00087700
      DA(6,6)=DA(6,6)-FN(JJ)/GX1**2/DS(NOS)*2.*DDDS(6)-(FN(JJ)/GXI)**2/D 00087800
     1S(NOS)*2.*DADS(6)                                                 00087900
      DB(6,6)=DB(6,6)+FN(JJ)/DS(NOS)*2.*DADS(6)-(FN(JJ)/GXI)**2/DS(NOS)* 00088000
     12.*DDDS(8)                                                        00088100
      DA(3,3)=DA(3,3)-FN(JJ)/GX1**2/DS(NOS)*2.*DDDS(3)                  00088200
      DB(3,3)=DB(3,3)+FN(JJ)/DS(NOS)*2.*DADS(3)                         00088300
      DA(5,3)=DA(5,3)-FN(JJ)/GX1**2/DS(NOS)*2*DDDS(7)                   00088400
      DB(5,3)=DB(5,3)+FN(JJ)/DS(NOS)*2.*DADS(7)                         00088500
      DA(3,5)=DA(3,5)+(FN(JJ)/GX1)**2/DS(NOS)*2.*DADS(3)-FN(JJ)/GXI**2/D 00088600
     1S(NOS)*2.*DDDS(7)                                                 00088700
      DB(3,5)=DB(3,5)+(FN(JJ)/GX1)**2/DS(NOS)*2.*DDDS(3)+FN(JJ)/DS(NOS)* 00088800
     12.*DADS(7)                                                        00088900
      DA(5,5)=DA(5,5)-FN(JJ)/GX1**2/DS(NOS)*2.*DDDS(5)+(FN(JJ)/GXI)**2/D 00089000
     1S(NOS)*2.*DADS(7)                                                 00089100
      DB(5,5)=DB(5,5)+FN(JJ)/DS(NOS)*2.*DADS(5)+(FN(JJ)/GXI)**2/DS(NOS)* 00089200
     22.*DDDS(7)                                                        00089300
      NOS=NOSH                                                          00089400
      RETURN                                                            00089500
      END                                                               00089600
                                                                          Sec
C*****************************************************************************
C                                                                       00089700
C                                                                       00089800
      SUBROUTINE  PRES1(PRF33,PRM35,PRM55,PC44)                         00089900
      COMMON AM(27),NJ1,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM 00090000
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00090100
     2ST,RF33,PM35,RM55,DUM,DIP,K,N,IVOL,ALFA(40,11),BETA(40,11),HDG(10) 00090200
     3,FN(5),BAM(30),BUG(10),SUG(10),OMAX,OMIN,NFR,NGR,NOB,NOH,OMEN(40), 00090300
     4FR(7,6),XX(25,7),YY(25,7),ELL(25,7),SNE(25,7),CSE(25,7),EN1(25,7), 00090400
     5UN,OMEGA,ID,TITU(12),HORD,HON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP    00090500
      COMMON ST1(27),TMAS(27),BEAM,DRAFT,OMAX,IRR,ML,IEND,IBILGE,IPRES, 00090600
     2VNT,GRAV,AMUDL,MUD,AREELL,BEAMBL,ITS(25),RD(25),RFD(25),DELTAD(25) 00090700
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)             00090800
      COMMON NWSTP,INWSTP(12)                                           00090900
      DIMENSION SS(27),HBM(27),SMB(27),HSB(27)                          00091000
      DIMENSION HB3(27)                                                 00091100
      NMAD=K+1                                                          00091200
```

```
      NMOD=K*2                                                          00091300
      HB3(1)=0.0                                                        00091400
      SS(1) = ST1(1)/12.                                                00091500
      SS(NMOD)=ST(K)+0.5*DS(K)                                          00091600
      HBM(1)=0.0                                                        00091700
      IF(K-NDS) 2,3,3                                                   00091800
    2 CONTINUE                                                          00091900
      HB3(NMOD)=2.*X(K,1)**3                                            00092000
      HBM(NMOD)=X(K,1)                                                  00092100
      GO TO 4                                                           00092200
    3 CONTINUE                                                          00092300
      HBM(NMOD)=0.0                                                     00092400
      HB3(NMOD)=0.0                                                     00092500
    4 CONTINUE                                                          00092600
      DO 1 J=2,NMAD                                                     00092700
      IP1=J-1                                                           00092800
      SS(J)=ST(IP1)                                                     00092900
      HBM(J)=X(IP1,1)                                                   00093000
      HB3(J)=2.*X(IP1,1)**3                                             00093100
    1 CONTINUE                                                          00093200
      DO 5 J=1,NMOD                                                     00093300
      SPD=SS(J)-TPST                                                    00093400
      SHB(J)=SPD*HBM(J)                                                 00093500
      HSB(J)=SPD*SHB(J)                                                 00093600
    5 CONTINUE                                                          00093700
      PPCM=SIMPUN(SS,HB3,NMOD)                                          00093800
      PCBV=0.5*SIMPUN(SS,AM,NMOD)/TVOL                                  00093900
      PC44=PCBV+PPCM/3.0/TVOL*0.5                                       00094000
      PRM33=4.0*SIMPUN(SS,HBM,NMOD)/TVOL                                00094100
      PRM35=-2.0*SIMPUN(SS,SHB,NMOD)/TVOL                               00094200
      PRM55=SIMPUN(SS,HSB,NMOD)/TVOL                                    00094300
      RETURN                                                            00094400
      END                                                               00094500
                                                                          SE.
```

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C                                                                       00094600
C      VERSAO 4  -  CDC 6700  -  V I S C  -  JUNHO 1972                 00094700
C                                                                       00094800
      SUBROUTINE VISC(GXI,VD,TVO,THM,EDDY,RGB)                          00094900
      COMMON AM(27),NJ1,NMAS,NDS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM 00095000
     1AS(27),XMAS(27),ZMAS(27),RKG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00095100
     2ST,RF33,RM35,RM55,DG4,DIP,K,N,IVOL,ALFA(40,11),BETA(40,11),HDG(40) 00095200
     3,FN(5),BAM(30),GG(10),SDG(10),OMAX,OMIN,NFR,NCK,NOB,NOH,OMEN(40), 00095300
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7), 00095400
     5UN,OMEGA,ID,TITU(12),HORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP    00095500
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,OMAX,IRR,ML,IEND,IBILGE,IPRES, 00095600
     2VNT,GRAV,AMUDL,RUD,AREELL,BEAMML,ITS(25),RD(25),RFD(25),DELTAD(25) 00095700
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)             00095800
      COMMON NKSTP,INKSTP(12)                                           00095900
      DIMENSION  VD(27)                                                 00096000
      DIMENSION  EDDY(27)                                               00096100
      DIMENSION  RGB(27)                                                00096200
      DIMENSION  XI(8),YI(8)                                            00096300
C                                                                       00096400
C  THIS SUBROUTINE CALCULATES SKIN-FRICTIONAL AND EDDYMAKING ROLL-DAMP  00096500
C                                                                       00096600
      PI=3.141593                                                       00096700
```

```
      TVD=0.0                                                          00096800
      DO 2 K=1,NOS                                                     00096900
      RG=RGB(K)/EL                                                     00097000
      PSUR=0.0                                                         00097100
      DO 3 J=1,NON                                                     00097200
      PSUR=PSUR+DEL(K,J)                                               00097300
    3 CONTINUE                                                         00097400
      PSUR=PSUR*DS(K)**2.                                              00097500
      DO 11 J=1,NUT                                                    00097600
      XI(J)=X(K,J)                                                     00097700
      YI(J)=Y(K,J)                                                     00097800
   11 CONTINUE                                                         00097900
      SQAR=2.*ABS(SIMPSN(YI,XI,NUT))                                   00098000
      DK=ABS(Y(K,NUT))                                                 00098100
      BMK=2.*BMAX(NUT,AI)                                              00098200
      CA=SQAR/BMK/DK                                                   00098300
      RS=1./PI*((0.887+0.145*CA)*(1./DK+CA*BMK)+2.*ZG/EL)              00098400
      PMUAR=RS**3*PSUR                                                 00098500
      PARM=RS**2                                                       00098600
      RN=3.22/8./PI*GAI*PARM*THM**2/VNY*(AMOOL/ELL)**2                 00098700
      VA2=0.0                                                          00098800
      GO TO(4,5),MOD                                                   00098900
    5 CONTINUE                                                         00099000
      VA2=0.014*RN**(-0.114)                                           00099100
    4 CONTINUE                                                         00099200
      VA=1.328*RN**(-0.5)+VA2                                          00099300
      VD(K)=1./6./PI*PMUAR*THM*GXI/TVOL*VA                             00099400
      VD(K)=VD(K)+1./6./PI*PSUR*RG**3*THM*GX1/TVOL*EDDY(K)             00099500
      VD(K)=2.*VD(K)                                                   00099600
      TVD=TVD+VD(K)                                                    00099700
    2 CONTINUE                                                         00099800
      RETURN                                                           00099900
      END                                                              00100000
                                                                          $ENT
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C                                                                      00100100
C     VERSAO A  -  CDC 6700  -  A T A N 2 D  -  JUNHO, 1972            00100200
C                                                                      00100300
      FUNCTION ATAN2D (B,A)                                            00100400
C     ARCTANGENT FUNCTION TO COMPUTE ANGLES (IN DEGREES) IN ANY        00100500
C     QUADRANT.  THE B ARGUMENT IS THE IMAGINARY VECTOR.  THE A        00100600
C     ARGUMENT IS THE REAL VECTOR.                                     00100700
C                                                                      00100800
      DATA EPS /1.E-10/                                                00100900
      IF(B .EQ. 0.) ATAN2D =  0.                                       00101000
      IF(B .GT. 0.) ATAN2D = 90.                                       00101100
      IF(B .LT. 0.) ATAN2D =-90.                                       00101200
      IF(ABS(A) .GT. EPS) ATAN2D = ATAN2(B,A)*57.295779                00101300
      RETURN                                                           00101400
      END                                                              00101500
                                                                          $ENT
```

```
C                                                                      00101600
      FUNCTION BMAX(NJ1,X1)                                            00101700
```

```
      DIMENSION XI(1)                                                   00101800
      A=XI(1)                                                           00101900
      IF(NUT .EQ. 1) GO TO 20                                           00102000
      DO 10 I=2,NUT                                                     00102100
      IF(XI(I).GT.A) A=XI(I)                                            00102200
   10 CONTINUE                                                          00102300
   20 BMAX=A                                                            00102400
      RETURN                                                            00102500
      END                                                               00102600
                                                                        SE(
*****************************************************************************
      SUBROUTINE MATINS(A,NR,N1,B,NC,M1,DETERM,ID,INDEX)                00102700
C                                                                       00102800
C                                                                       00102900
      EQUIVALENCE (IROW,JROW),(ICOLUM,JCOLUM),(AMAX,T,SWAP)             00103000
      DIMENSION A(NR,NR),B(NR,NC),INDEX(NR,3)                           00103100
C                                                                       00103200
C     INITIALIZATION                                                    00103300
C                                                                       00103400
      N=N1                                                              00103500
      M=M1                                                              00103600
      DETERM=1.0                                                        00103700
      DO 20 J=1,N                                                       00103800
   20 INDEX(J,3)=0                                                      00103900
      DO 550 I=1,N                                                      00104000
C                                                                       00104100
C     SEARCH FOR PIVOT ELEMENT                                          00104200
C                                                                       00104300
      AMAX=0.0                                                          00104400
      DO 105 J=1,N                                                      00104500
      IF(INDEX(J,3)-1) 60,105,60                                        00104600
   60 DO 100 K=1,N                                                      00104700
      IF(INDEX(K,3)-1) 80,100,715                                       00104800
   80 IF(AMAX- ABS(A(J,K))) 85,100,100                                  00104900
   85 IROW=J                                                            00105000
      ICOLUM=K                                                          00105100
      AMAX= ABS(A(J,K))                                                 00105200
  100 CONTINUE                                                          00105300
  105 CONTINUE                                                          00105400
      INDEX(ICOLUM,3)=INDEX(ICOLUM,3)+1                                 00105500
      INDEX(I,1)=IROW                                                   00105600
      INDEX(I,2)=ICOLUM                                                 00105700
C                                                                       00105800
C     INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL                 00105900
C                                                                       00106000
      IF(IROW-ICOLUM) 140,310,140                                       00106100
  140 DETERM=-DETERM                                                    00106200
      DO 200 L=1,N                                                      00106300
      SWAP=A(IROW,L)                                                    00106400
      A(IROW,L)=A(ICOLUM,L)                                             00106500
  200 A(ICOLUM,L)=SWAP                                                  00106600
      IF(M) 310,310,210                                                 00106700
  210 DO 250 L=1,M                                                      00106800
      SWAP=B(IROW,L)                                                    00106900
      B(IROW,L)=B(ICOLUM,L)                                             00107000
  250 B(ICOLUM,L)=SWAP                                                  00107100
C                                                                       00107200
```

```
C     DIVIDE PIVOT ROW BY PIVOT ELEMENT                                  00107300
C                                                                        00107400
  310 PIVOT=A(ICOLUM,ICOLUM)                                             00107500
      DETERM=DETERM*PIVOT                                                00107600
  330 A(ICOLUM,ICOLUM)=1.0                                               00107700
      DO 350 L=1,N                                                       00107800
  350 A(ICOLUM,L)=A(ICOLUM,L)/PIVOT                                      00107900
      IF(M) 380,360,360                                                  00108000
  360 DO 370 L=1,M                                                       00108100
  370 B(ICOLUM,L)=B(ICOLUM,L)/PIVOT                                      00108200
C                                                                        00108300
C     REDUCE NON-PIVOT ROWS                                              00108400
C                                                                        00108500
  380 DO 550 L1=1,N                                                      00108600
      IF(L1-ICOLUM) 400,550,400                                          00108700
  400 T=A(L1,ICOLUM)                                                     00108800
      A(L1,ICOLUM)=0.0                                                   00108900
      DO 450 L=1,N                                                       00109000
  450 A(L1,L)=A(L1,L)-A(ICOLUM,L)*T                                      00109100
C                                                                        00109200
C                                                                        00109300
      IF(M) 550,550,460                                                  00109400
  460 DO 500 L=1,M                                                       00109500
  500 B(L1,L)=B(L1,L)-B(ICOLUM,L)*T                                      00109600
  550 CONTINUE                                                           00109700
C                                                                        00109800
C     INTERCHANGE COLUMNS                                                00109900
C                                                                        00110000
      DO 710 I=1,N                                                       00110100
      L=N+1-I                                                            00110200
      IF( INDEX(L,1)-INDEX(L,2) ) 630,710,630                            00110300
  630 JROW=INDEX(L,1)                                                    00110400
      JCOLUM=INDEX(L,2)                                                  00110500
      DO 705 K=1,N                                                       00110600
      SWAP=A(K,JROW)                                                     00110700
      A(K,JROW)=A(K,JCOLUM)                                              00110800
      A(K,JCOLUM)=SWAP                                                   00110900
  705 CONTINUE                                                           00111000
  710 CONTINUE                                                           00111100
      DO 730 K=1,N                                                       00111200
      IF(INDEX(K,3)-1) 715,720,715                                       00111300
  720 CONTINUE                                                           00111400
  730 CONTINUE                                                           00111500
      ID=1                                                               00111600
  810 RETURN                                                             00111700
  715 ID=2                                                               00111800
      GO TO 810                                                          00111900
      END                                                                00112000
                                                                           SL
*************************************************************************
      FUNCTION SIMPUN (X,Y,N)                                            00112100
      DIMENSION X(1),Y(1)                                                00112200
      IF( N-2 ) 7,5,4                                                    00112300
    5 S=(Y(1)+Y(2) )*(X(2)-X(1))/2.                                      00112400
      GO TO 6                                                            00112500
    7 S=0.                                                               00112600
      GO TO 6                                                            00112700
```

```
      TVD=0.0                                                          00096800
      DO 2 K=1,NOS                                                     00096900
      RG=RGB(K)/EL                                                     00097000
      PSUR=0.0                                                         00097100
      DO 3 J=1,NON                                                     00097200
      PSUR=PSUP+DEL(K,J)                                               00097300
    3 CONTINUE                                                         00097400
      PSUR=PSUR*DS(K)*2.                                               00097500
      DO 11 J=1,NUT                                                    00097600
      XI(J)=X(K,J)                                                     00097700
      YI(J)=Y(K,J)                                                     00097800
   11 CONTINUE                                                         00097900
      SQAR=2.*ABS(SIMPUN(YI,XI,NUT))                                   00098000
      DK=ABS(Y(K,NUT))                                                 00098100
      BMK=2.*BMAX(NUT,XI)                                              00098200
      CA=SQAR/BMK/DK                                                   00098300
      RS=1./PI*(((0.687+0.145*CA)*(1./*DK+CA*BMK)+2.*ZG/EL)            00098400
      PMOAR=RS**3*PSUR                                                 00098500
      PARM=RS**2                                                       00098600
      RN=3.22/8./PI*GXI*PARM*TMM**2/VNY*(AMODL/ELL)**2                 00098700
      VA2=0.0                                                          00098800
      GO TO(4,5),MOD                                                   00098900
    5 CONTINUE                                                         00099000
      VA2=0.014*RN**(-0.118)                                           00099100
    4 CONTINUE                                                         00099200
      VA=1.328*RN**(-0.5)+VA2                                          00099300
      VD(K)=1./6./PI*PMOAR*TMM*GXI/TVOL*VA                             00099400
      VD(K)=VD(K)+1./8./PI*PSUR*RG**3*TMM*GXI/TVOL*EDDY(K)            00099500
      VD(K)=2.*VD(K)                                                   00099600
      TVD=TVD+VD(K)                                                    00099700
    2 CONTINUE                                                         00099800
      RETURN                                                           00099900
      END                                                              00100000
                                                                          SE(
*****************************************************************************
C                                                                      00100100
C     VERSAO A  -  CDC 6700  -  A T A N 2 D  -  JUNHO, 1972            00100200
C                                                                      00100300
      FUNCTION ATAN2D (B,A)                                            00100400
C     ARCTANGENT FUNCTION TO COMPUTE ANGLES (IN DEGREES) IN ANY        00100500
C     QUADRANT.  THE B ARGUMENT IS THE IMAGINARY VECTOR.  THE A        00100600
C     ARGUMENT IS THE REAL VECTOR.                                     00100700
C                                                                      00100800
      DATA EPS /1.E-10/                                                00100900
      IF(B .EQ. 0.) ATAN2D = 0.                                        00101000
      IF(B .GT. 0.) ATAN2D = 90.                                       00101100
      IF(B .LT. 0.) ATAN2D =-90.                                       00101200
      IF(ABS(A) .GT. EPS) ATAN2D = ATAN2(B,A)*57.295779                00101300
      RETURN                                                           00101400
      END                                                              00101500
                                                                          SE(
*****************************************************************************
C                                                                      00101600
      FUNCTION BMAX(NJ,XI)                                             00101700
```

```
      M=N-1                                                                  00112800
        S=(X(2)-X(1))/6.*(Y(1)*((X(2)-X(3))/(X(1)-X(3))+2.)+Y(2)*((X(1)-X(  00112900
       K3))/(X(2)-X(3))+2.)-Y(3)*(X(2)-X(1))**2/((X(1)-X(3))*(X(2)-X(3))))  00113000
        LB=2                                                                 00113100
        IF( N.EQ.3) GO TO 8                                                  00113200
        S=S+(X(3)-X(2))/6.*(Y(2)*((X(3)-X(4))/(X(2)-X(4))+2.)+Y(3)*((X(2)-  00113300
       KX(4))/(X(3)-X(4))+2.)-Y(4)*(X(3)-X(2))**2/((X(2)-X(4))*(X(3)-X(4)))  00113400
       K))                                                                   00113500
        LB=3                                                                 00113600
      6 DO 1 K=LB,M                                                          00113700
        IF(ABS(X(K+1)-X(1)).GE.ABS(X(K)-X(1))) GO TO 1                       00113800
        GO TO 7                                                              00113900
      1 S=S+(X(K+1)-X(K))/6.*(Y(K)*((X(K+1)-X(K-1))/(X(K)-X(K-1))+2.)+Y(K+  00114000
       K1)*((X(K)-X(K-1))/(X(K+1)-X(K-1))+2.)-Y(K-1)*(X(K+1)-X(K))**2/((X(  00114100
       NK)-X(K-1))*(X(K+1)-X(K-1))))                                         00114200
      6 SIMFUN=S                                                             00114300
        RETURN                                                               00114400
        END                                                                  00114500
                                                                                Sel

*****************************************************************************

                                                                                Fu

                                                                                Sel

        NO ERRORS DETECTED.  NUMBER OF CARDS = 1147.
        COMPILATION TIME = 191 SECONDS ELAPSED.  18.85 SECONDS PROCESSING.
        D2 STACK SIZE = 70 WORDS.  FILESIZE = 13782 WORDS.  ESTIMATED CORE STORAGE RE
        TOTAL PROGRAM CODE = 3640 WORDS.  ARRAY STORAGE = 7679 WORDS.
        NUMBER OF PROGRAM SEGMENTS = 28.  NUMBER OF DISK SEGMENTS = 214.
        PROGRAM CODE FILE = (117PNV)ML3D/OBJ ON PACK.
        COMPILED COMPILED ON 09/07/79 (FORTRAN ON PACK).
```

APÊNDICE F

PROGRAMA CONT3D

```
            B6700  F O R T R A N  C O M P I L A T I O N  M A R K  2.9.004
                                                  C O N T 3 D / O B J
                                                  = = = = = = = = = =
FILE  55=TRES/FEXC,UNIT=DISKPACK,RECORD=6                                    00000100
FILE  65=TRES/ABC3D,UNIT=DISKPACK,RECORD=36                                  00000200
FILE  85=TRES/FOBJ,UNIT=DISKPACK,RECORD=9,AREA=140*1                         00000300
FILE  90=TRES/HIDRO,UNIT=DISKPACK,RECORD=270,AREA=1*1                        00000400
FILE  95=TRES/ROLE,UNIT=DISKPACK,RECORD=3,AREA=300                           00000500

      REAL MIO,LAM,LPP,MI,LFO                                                00000600
      COMMON/AAA/HEAD(20),H13(10),FN(5),LAM(30),T13(10),XLAM(30)             00000700
      COMMON/BBB/PI,GRAV,MIO,LPP,NFN,NOH,NLAM,NH13                           00000800
      COMMON/CCC/JJ                                                          00000900
      COMMON/FFF/H(20,5,30,8),FASE(20,5,30,8)                                00001000
      COMMON/SPEC/KSPEC,NSPEC,AN                                             00001100
      COMMON/EFIC/BAL(10),EF(10),NPEF                                        00001200
      DIMENSION SS(27),DS(27),HBM(27),SWAR(27),AM(27),SAS(27),HB3(27)        00001300
      DIMENSION TEV(6,6),BEV(6,6),FEAR(6),FDAR(6),INDEX(6,3)                 00001400
      DIMENSION XMIO(36),PROB(10,36),PRON(10,19),PRRU(36)                    00001500
      DIMENSION  SIG0(10),SIG1(10),SIG2(10)                                  00001600
      DIMENSION FO(11,11),LFO(11,11,4)                                       00001700
      DATA FO,LFO/605*0./                                                    00001800
C                                  LEITURA DE ARQUIVOS                       00001900
      REWIND 85                                                              00002000
      REWIND 90                                                              00002100
      REWIND 95                                                              00002200
      READ(55)NST,LPP,BOCA,NLAM,NFN,NOH,NWSTP,(HEAD(I),I=1,NOH),(FN(I),I     00002300
     1=1,NFN),(LAM(I),I=1,NLAM),DRAFT,EI44,(SS(K),DS(K),HBM(K),SWAR(K),A     00002400
     2M(K),SAS(K),HB3(K),K=1,NST-2),TVOL,TPST,TPCM,CBV,CMC,ZG,XG,VNY,GRA     00002500
     3V,NFR                                                                  00002600
      READ(5,9050)NMIO,NH13,NPEF                                             00002700

 9050 FORMAT(16I5)                                                           00002800
C         DIRECOES PREDOMINANTES A CONSIDERAR                                00002900
      READ(5,9060)(XMIO(I),I=1,NMIO)                                         00003000
 9060 FORMAT(8F10.4)                                                         00003100
C                    CARACTERISTICAS DO ESPECTRO                            00003200
      READ(5,9070)KSPEC,NSPEC,AN                                             00003300
 9070 FORMAT(2I5,F10.4)                                                      00003400
      READ(5,9060)(H13(I),I=1,NH13)                                          00003500
      IF(KSPEC.NE.2.AND.KSPEC.NE.4) GO TO 110                                00003600
      READ(5,9060)(T13(I),I=1,NH13)                                          00003700
C       CORRESPONDE A TABELA A1                                              00003800
  110 DO 120 I=1,NH13                                                        00003900
  120 READ(5,9060)(PRON(I,J),J=1,NMIO)                                       00004000
C       OS RUMOS TEM QUE CORRESPONDER AS DIRECOES PREDOMINANTES              00004100
C              CORRESPONDE A FIGURA A1                                       00004200
      READ(5,9060)(PRRU(J),J=1,NMIO)                                         00004300
      READ(5,9060)(BAL(I),I=1,NPEF)                                          00004400
      READ(5,9060)(EF(I),I=1,NPEF)                                           00004500
      READ(5,9060)BETMAX,VBEMAX                                              00004600
      DO 150 I=1,NH13                                                        00004700
      IL=-1                                                                  00004800
```

```
      DO 150 J=1,NMIO                                                    00004900
      IL=IL+1                                                            00005000
      SOMA=0.                                                            00005100
      DO 130 K=1,NMIO                                                    00005200
      IDIR=K-IL                                                          00005300
      IF(IDIR.LE.0)IDIR=IDIR+NMIO                                        00005400
  130 SOMA=SOMA+PROB(I,IDIR)*PROU(K)                                     00005500
      IF(2*J.LE.NMIO+2) GO TO 140                                        00005600
      PROB(I,NMIO-J+2)=PROB(I,NMIO-J+2)+SOMA                             00005700
      GO TO 150                                                          00005800
  140 PROB(I,J)=SOMA                                                     00005900
  150 CONTINUE                                                           00006000
      WRITE(6,9100)(XMIO(J),J=1,NMIO/2+1)                                00006100

 9100 FORMAT('1',5X,'FREQUENCIA DE OCURRENCIA DE DIRECOES PREDOMINANTES' 00006200
     1///2X,'H13',3X,'T13',19(2X,F4.0)//)                                00006300
      DO 160 I=1,NH13                                                    00006400
  160 WRITE(6,9200)H13(I),T13(I),(PROB(I,J),J=1,NMIO/2+1)                00006500
 9200 FORMAT(1X,F4.1,2X,F4.1,2X,F5.4,18(1X,F5.4))                        00006600
      TOP=6.283185308                                                    00006700
      EL=LPP/2.                                                          00006800
      SQGL=SQRT(GRAV/LPP)                                                00006900
      EL2=EL*EL                                                          00007000
      EL3=EL2*EL                                                         00007100
      TVOL2=TVOL*LPP*LPP*EL3                                             00007200
      TVOL4=TVOL2*SQGL                                                   00007300
      C44=TVOL*EL3*(LPP*CMC-ZG)*GRAV                                     00007400
C      LEITURA DAS CARACT. ALETA E CAMPO VARIACAO GANHOS DO CONTROLE      00007500
      READ(5,9002)A,R,FI,XFIN,CLIFT                                      00007600
      FI=FI*TOP/360.                                                     00007700
      READ(5,9003)XK1MIN,XK1MAX,K1LIM,XK2MIN,XK2MAX,K2LIM                00007800
 9002 FORMAT(8F10.0)                                                     00007900
 9003 FORMAT(2F10.0,I5,2F10.0,I5)                                        00008000
      K1LIM=K1LIM+1                                                      00008100
      K2LIM=K2LIM+1                                                      00008200
      DO 400 K1=1,K1LIM                                                  00008300
      DK1LIM=K1LIM-1                                                     00008400
      XK1=K1                                                             00008500
      XK1=(XK1-1.)*(XK1MAX-XK1MIN)/DK1LIM+XK1MIN                         00008600
      LFO(K1,K2,3)=XK1                                                   00008700
      DO 400 K2=1,K2LIM                                                  00008800
      DK2LIM=K2LIM-1                                                     00008900
      XK2=K2                                                             00009000
      XK2=(XK2-1.)*(XK2MAX-XK2MIN)/DK2LIM+XK2MIN                         00009100
      LFO(K1,K2,4)=XK2                                                   00009200
      WRITE(85)XK1MIN,XK1MAX,K1LIM,XK2MIN,XK2MAX,K2LIM                   00009300
      REWIND 55                                                          00009400
      REWIND 65                                                          00009500
      DO 300 MM=1,NOH                                                    00009600
      HRAD=HEAD(MM)*.017453292                                           00009700
      COSOH=COS(HRAD)                                                    00009800
      SINOH=SIN(HRAD)                                                    00009900
      DO 300 JJ=1,NFN                                                    00010000
      V=FN(JJ)*SQRT(LPP*GRAV)                                            00010100
      XMEA=A*V*V*R*CLIFT                                                 00010200
      XMDA=A*V*R*R*CLIFT                                                 00010300
      DO 300 LL=1,NLAM                                                   00010400
      READ(55)(BEV(I,1),I=1,6)                                           00010500
      XLAM(LL)=1./LAM(LL)                                                00010600
      READ(65)((TEV(I,J),I=1,6),J=1,6)                                   00010700
```

```
      GXI=ABS(SQRT(TOP/LAM(LL))-FN(JJ)*TOP*COSOH/LAM(LL))                    00010800
C               EVITA O CALCULO PARA GXI=0.,QUANDO SO HA BANDA               00010900
      IF(GXI-.05)202,202,203                                                 00011000
  202 CONTINUE                                                               00011100
      GXI=0.05                                                               00011200
  203 FEAR(2)=-XMEA/(TVOL2*GRAV*R)*SIN(FI)*LPP*LPP                           00011300
      FEAR(4)=-XMEA/(TVOL2*GRAV)*LPP                                         00011400
      FEAR(6)=-XMEA*SIN(FI)*XFIN*LPP/(TVOL2*GRAV)                            00011500
      FDAR(2)=-XMDA*SIN(FI)*LPP/(R*TVOL4)                                    00011600
      FDAR(4)=-XMDA/TVOL4                                                    00011700
      FDAR(6)=-XMDA*SIN(FI)*XFIN/(R*TVOL4)                                   00011800
      DO 250 I=1,3                                                           00011900
      TEV(I,2)=TEV(I,2)-FEAR(2*I)*XK1                                        00012000
      TEV(I+3,5)=TEV(I+3,2)-FEAR(2*I)*XK1                                    00012100
      TEV(I,5)=TEV(I,5)+GXI*(FEAR(2*I)*XK2*SOGL+FDAR(2*I))                   00012200
  250 TEV(I+3,2)=TEV(I+3,2)-GXI*(FEAR(2*I)*XK2*SOGL+FDAR(2*I))               00012300
      IF(LL.EQ.9)WRITE(6,9999)((TEV(I,J),J=1,6),I=1,6),(BEV(I,1),I=1,6)      00012400
 9999 FORMAT(1X,6(4X,E12.4))                                                 00012500
      CALL MATINS(TEV,6,6,BEV,1,1,DTRM,ID,INDEX)                             00012600
      DO 280 I=1,3                                                           00012700
      AUX=SQRT(BEV(I,1)*BEV(I,1)+BEV(I+3,1)*BEV(I+3,1))                      00012800
      IF(I.EQ.1)H(MM,JJ,LL,2)=AUX                                            00012900
      IF(I.NE.1)H(MM,JJ,LL,2*I)=AUX*360./TOP/LPP                             00013000
      FASE(MM,JJ,LL,2*I)=ATAN2(BEV(I+3,1),BEV(I,1))                          00013100
  280 CONTINUE                                                               00013200
      WRITE(6,9999)(BEV(I,1),I=1,6)                                          00013300
      H(MM,JJ,LL,4)=H(MM,JJ,LL,4)*LPP/360.*LAM(LL)*TOP/360.                  00013400
      WRITE(95)LAM(LL),H(MM,JJ,LL,4),FASE(MM,JJ,LL,4)                        00013500
  300 CONTINUE                                                               00013600
      DO 305 MM=1,NOH                                                        00013700
      MAUX=NOH+1-MM                                                          00013800
  305 HEAD(MAUX+1)=HEAD(MAUX)                                                00013900
      HEAD(1)=0.                                                             00014000
      HEAD(NOH+2)=180.                                                       00014100
  308 DO 320 JJ=1,NFN                                                        00014200
      DO 320 LL=1,NLAM                                                       00014300
      DO 310 MM=1,NOH                                                        00014400
      MAUX=NOH+1-MM                                                          00014500
  310 H(MAUX+1,JJ,LL,4)=H(MAUX,JJ,LL,4)                                      00014600
      H(1,JJ,LL,4)=0.                                                        00014700
  320 H(NOH+2,JJ,LL,4)=0.                                                    00014800
C          INTRODUZ OS HEAD DE 0 A 180                                       00014900
C                  OS HEAD(I) TEM QUE ESTAR EM ORDEM CRESCENTE               00015000
      NOH=NOH+2                                                              00015100
      DO 350 JJ=1,NFN                                                        00015200
      IW=0                                                                   00015300
      DO 350 I=1,NMIO/2+1                                                    00015400
      MIO=XMIO(I)                                                            00015500
      IW=IW+1                                                                00015600
      IF(IW.EQ.1)WRITE(6,8100)                                               00015700
 8100 FORMAT('1',15X,'RESULTADOS PARCIAIS DO SISTEMA DE CONTROLE'//)         00015800
      IF(IW.EQ.5)IW=0                                                        00015900
      CALL SPECTR(SIG0,SIG1,SIG2,0,I,NOMA)                                   00016000
      WRITE(6,8200)XMIO(I),XK1,XK2                                           00016100
 8200 FORMAT(//3X,'APROAMENTO:',F6.1,' GRAUS',7X,'XK1=',F5.1,7X,'XK2=',F     00016200
     15.1/2X,'H13   T13',5X,'SIG0',5X,'SIG1',5X,'SIG2',4X,'PBETA',4X,'PV     00016300
     2BETA',4X,'EFIC'/)                                                      00016400
      DO 350 K13=1,NH13                                                      00016500
      PBETA=0.                                                               00016600
      BAUX=(SIG0(K13)*XK1)**2+(SIG1(K13)*XK2)**2                             00016700
```

```
      IF(BAUX.EQ.0.)GO TO 330                                                   00016800
      PBETA=EXP(-BETMAX**2/2./BAUX)*100.                                        00016900
  330 LFO(K1,K2,1)=LFO(K1,K2,1)+PBETA*PROB(K13,I)                               00017000
      PVBETA=0.                                                                 00017100
      VAUX=(SIG1(K13)*XK1)**2+(SIG2(K13)*XK2)**2                                00017200
      IF(VAUX.EQ.0.) GO TO 340                                                  00017300
      PVBETA=EXP(-VBFMAX**2/2./VAUX)*100.                                       00017400
  340 LFO(K1,K2,2)=LFO(K1,K2,2)+PVBETA*PROB(K13,I)                              00017500
      EAUX=EFIC(SIGO(K13))*100.                                                 00017600
      FO(K1,K2)=FO(K1,K2)+PROB(K13,I)*EAUX                                      00017700
      WRITE(6,8300)H13(K13),T13(K13),SIGO(K13),SIG1(K13),SIG2(K13),PBETA        00017800
     1,PVBETA,EAUX                                                              00017900
 8300 FORMAT(1X,F4.1,2X,F4.1,6(2X,F7.2))                                        00018000
      WRITE(85)XK1,XK2,FO(K1,K2),LFO(K1,K2,1),LFO(K1,K2,2)                      00018100
  350 CONTINUE                                                                  00018200
  360 NOH=NOHA-2                                                                00018300
      DO 370 I=1,NOH                                                            00018400
  370 HEAD(I)=HEAD(I+1)*360./TOP                                                00018500
  400 CONTINUE                                                                  00018600
      WRITE(6,8400)((LFO(K1,K2,3),LFO(K1,K2,4),FO(K1,K2),LFO(K1,K2,1),LF        00018700
     10(K1,K2,2),K2=1,K2LIM),K1=1,K1LIM)                                        00018800
 8400 FORMAT('1',6X,'RESULTADOS GLOBAIS DO SISTEMA DE CONTROLE'//2(5X,'X        00018900
     1K1  XK2',4X,'FO',4X,'PBETA PVBETA')/2(' **',2(1X,F4.1),1X,3(1X,F6.        00019000
     22)))                                                                      00019100
      LOCK 55                                                                   00019200
      LOCK 65                                                                   00019300
      LOCK 85                                                                   00019400
      LOCK 90                                                                   00019500
      LOCK 95                                                                   00019600
      STOP                                                                      00019700
      END                                                                       00019800
      002:0341:1  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0(
      002:0342:3  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0(
      002:0343:5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0(
      002:0345:1  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0(
      002:0346:3  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0(
      002:0347:5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0(
                                                                                SE(
```

==========

```
      SUBROUTINE SPECTR(SIGO,SIG1,SIG2,IRL,KHTOT,NOHA)                          00019900
      REAL MIO,LPP,LAM,MI                                                       00020000
C                                                                               00020100
      COMMON/AAA/HEAD(20),H13(10),FN(5),LAM(30),T13(10)                         00020200
      COMMON/BBB/PI,G,MIO,LPP,NFN,NOH,NLAH,NH13                                 00020300
      COMMON/CCC/JJ,M,IM,Z,KM,L1,L2,I68,LAUX1,LAUX2                             00020400
      COMMON/FFF/H(20,5,30,8),FASE(20,5,30,8)                                   00020500
      COMMON/SPEC/KSPEC,NSPEC,AN                                                00020600
      COMMON/ZZZ/W(10),MI(10),CX(10),CL(30),CM(10,10,5,30,2)                    00020700
      DIMENSION  SIGO(10),SIG1(10),SIG2(10)                                     00020800
      DIMENSION Y(30)                                                           00020900
      RO=104.6                                                                  00021000
      PI=3.14159265359                                                          00021100
      FC=PI/180.                                                                00021200
      MIO=MIO*FC                                                                00021300
      IF(KHTOT.NE.1) GO TO 21                                                   00021400
      NOHA=NOH                                                                  00021500
      NOH=2*NOH-1                                                               00021600
```

```
      DO 10 L=1,NOHA                                                    00021700
      LL=NOH-L+1                                                        00021800
      HEAD(LL)=360.-HEAD(L)                                             00021900
      DO 10 K=1,NFN                                                     00022000
      DO 10 J=1,NLAM                                                    00022100
      DO 8 I=1,3                                                        00022200
      II=2*I                                                            00022300
      IF(IRL.EQ.0) II=4                                                 00022400
      H(LL,K,J,II)=H(L,K,J,II)                                          00022500
      IF(IRL.EQ.0) GO TO 10                                             00022600
    8 CONTINUE                                                          00022700
   10 CONTINUE                                                          00022800
   15 DO 20 I=1,NOH                                                     00022900
   20 HEAD(I)=HEAD(I)*FC                                                00023000
   21 PI2=PI/2                                                          00023100
      X1=MI0                                                            00023200
      X2=MI0                                                            00023300
      KM=2                                                              00023400
      IF(KSPEC.LE.2)GO TO 201                                           00023500
      IF( ABS(MI0-PI2) .GT. 0.001) GO TO 101                            00023600
      KM=1                                                              00023700
      X1=MI0+PI2                                                        00023800
      X2=MI0+3.*PI2                                                     00023900
      GO TO 201                                                         00024000
  101 X1=MI0-PI2                                                        00024100
      X2=MI0+PI2                                                        00024200
      IF(X1.LT.0.)X1=X1+2*PI                                            00024300
  201 DO 401 L1=1,NOH                                                   00024400
      IF( HEAD(L1)-X1 ) 301,501,501                                     00024500
  301 IF( X1-HEAD(L1)-0.001 ) 701,701,401                               00024600
  401 CONTINUE                                                          00024700
  501 IF( HEAD(L1)-X1-0.001 ) 701,701,601                               00024800
  601 IF( KM .EQ. 1 ) L1=L1-1                                           00024900
  701 DO 901 L2=L1,NOH                                                  00025000
      IF( HEAD(L2)-X2 ) 801,1001,1001                                   00025100
  801 IF( X2-HEAD(L2) - 0.001 ) 1201,1201,901                           00025200
  901 CONTINUE                                                          00025300
 1001 IF( HEAD(L2)-X2-0.001 ) 1201,1101,1101                            00025400
 1101 IF( KM .EQ. 2 ) L2=L2-1                                           00025500
 1201 LAUX1=L1                                                          00025600
      LAUX2=L2                                                          00025700
      IF(KSPEC.LT.3)GO TO 1951                                          00025800
      GO TO (1601,1951),KM                                              00025900
 1601 LQ=0                                                              00026000
      LL=0                                                              00026100
      IF( HEAD(1) .LT. 0.001 ) LQ=1                                     00026200
      LMAX=NOH+L1-LQ                                                    00026300
      DO 1901 L=L2,LMAX                                                 00026400
      LL=LL+1                                                           00026500
      IF(L-NOH) 1801, 1801,1701                                         00026600
 1701 LQ=LQ+1                                                           00026700
      W(LL)=HEAD(LQ)                                                    00026800
      MI(LL)=W(LL)-MI0                                                  00026900
      GO TO 1901                                                        00027000
 1801 W(LL)=HEAD(L)-2.*PI                                               00027100
      MI(LL)=W(LL)-MI0                                                  00027200
 1901 CONTINUE                                                          00027300
      GO TO 2201                                                        00027400
 1951 LL=0                                                              00027500
      IF(L2.GE.L1) GO TO 2001                                           00027600
```

```
      LAUX1=1                                                          00027700
      DO 1971 L=L1,NOH-1                                               00027800
      LL=LL+1                                                          00027900
      CX(LL)=HEAD(L)-2.*PI                                             00028000
      W(LL)=HEAD(L)                                                    00028100
 1971 MI(LL)=W(LL)-MI0                                                 00028200
 2001 DO 2101 L=LAUX1,L2                                               00028300
      LL=LL+1                                                          00028400
      W(LL)=HEAD(L)                                                    00028500
      MI(LL)=W(LL)-MI0                                                 00028600
 2101 CONTINUE                                                         00028700
 2201 LT=LL                                                            00028800
 9100 FORMAT(1X,4I5,8E10.4)                                            00028900
      CALL MOMEN                                                       00029000
      INL=0                                                            00029100
      DO 5000 IM=1,3                                                   00029200
      IF(IRL.EQ.0) IM=4                                                00029300
      IMI=2*IM                                                         00029400
      II=1                                                             00029500
      IF(IMI.GT.3)II=2                                                 00029600
      I68=1                                                            00029700
      Z=0.                                                             00029800
      IF(II.EQ.2)Z=1.                                                  00029900
      DO 4000 M=1,NH13                                                 00030000
      CALL SIGMA(SIG0(M),SIG1(M),SIG2(M))                              00030100
 4000 CONTINUE                                                         00030200
 5000 CONTINUE                                                         00030300
      RETURN                                                           00030400
      END                                                              00030500
                                                                          SE
```

```
      SUBROUTINE SIGMA(SIG0,SIG2,SIG4)                                 00030600
      REAL LPP,MI,MI0,LAM,MOM                                          00030700
      COMMON/AAA/HEAD(20),H13(10),FN(5),LAM(30),T13(10),XLAM(30)       00030800
      COMMON/BBB/PI,G,MI0,LPP,NFN,NOH,NLAM,NH13                        00030900
      COMMON/CCC/K,M,IM,Z,KM,L1,L2,I68,LAUX1,LAUX2                     00031000
      COMMON/FFF/H(20,5,30,8),PHASE(20,5,30,8)                         00031100
      COMMON/ZZZ/W(10),MI(10),CX(10),CL(30),CM(10,10,5,30,3)           00031200
      DIMENSION MOM(5,10),SIG(5)                                       00031300
      NMAX=3                                                           00031400
      IZ=Z +1                                                          00031500
      SIG0=0.                                                          00031600
      SIG2=0.                                                          00031700
      SIG4=0.                                                          00031800
      FC=180./PI                                                       00031900
      IF(H13(M).EQ.0.) GO TO 2000                                      00032000
      IF(L2.GE.L1) GO TO 700                                           00032100
      DO 500 L=L1,NOH-1                                                00032200
      LL=LL+1                                                          00032300
      DO 500 NN=1,NMAX                                                 00032400
      MOM(NN,LL)=0.                                                    00032500
C       SE HEAD=0,180,OU 360   CONTINUE                                00032600
      IF(L.EQ.1.OR.2*L.EQ.NOH+1.OR.L.EQ.NOH) GO TO 500                 00032700
      DO 400 J=1,NLAM                                                  00032800
  400 CL(J)=H(L,K,J,IM)**2*CM(M,LL,NN,J,IZ)                            00032900
      MOM(NN,LL)=-SIMPUN(XLAM,CL,NLAM)                                 00033000
  500 CONTINUE                                                         00033100
```

```
  700 DO 900 L=LAUX1,L2                                                          00033200
      LL=LL+1                                                                    00033300
      DO 900 NN=1,NMAX                                                           00033400
      MOM(NN,LL)=0.                                                              00033500
      IF(L.EQ.1.OR.2*L.EQ.NOH+1.OR.L.EQ.NOH) GO TO 900                           00033600
      DO 800 J=1,NLAM                                                            00033700
  800 CL(J)=H(L,K,J,IM)**2*CM(M,LL,NN,J,IZ)                                      00033800
      MOM(NN,LL)=-SIMPUN(XLAM,CL,NLAM)                                           00033900
  900 CONTINUE                                                                   00034000
      IF(KSPEC.LT.3) GO TO 1210                                                  00034100
 1000 DO 1200 NN=1,NMAX                                                          00034200
 1100 CL(L)=MOM(NN,L)                                                            00034300
      SIG(NN)=SIMPUN(CX,CL,LL)                                                   00034400
 1200 CONTINUE                                                                   00034500
      GO TO 1250                                                                 00034600
 1210 DO 1220 NN=1,NMAX                                                          00034700
      IF(L1.EQ.L2)SIG(NN)=MOM(NN,LL)                                             00034800
      IF(L1.NE.L2)SIG(NN)=MOM(NN,L1)+(MI0-HEAD(L1))*(MOM(NN,2)-MOM(NN,1)         00034900
     1)/(HEAD(L2)-HEAD(L1))                                                      00035000
 1220 CONTINUE                                                                   00035100
 1250 SIG0=SQRT(SIG(1))*FC                                                       00035200
      SIG2=SQRT(SIG(2))*FC                                                       00035300
      SIG4=SQRT(SIG(3))*FC                                                       00035400
 2000 RETURN                                                                     00035500
      END                                                                        00035600
                                                                                      SE
```

```
      SUBROUTINE MOMEN                                                           00035700
      REAL LPP,LAM,MI0,MI                                                        00035800
      COMMON/AAA/HEAD(20),H13(10),FN(5),XLAM(30),T13(10),LAM(30)                 00035900
      COMMON/BBB/PI,G,MI0,LPP,NFN,NOH,NLAM,NH13                                  00036000
      COMMON/CCC/K,M,IM,Z,KM,L1,L2,LT,I68                                        00036100
      COMMON/ZZZ/X(10),MI(10),CX(10),CL(30),CM(10,10,5,30,3)                     00036200
      COMMON/SPEC/KSPEC,NSPEC,AN                                                 00036300
      DIMENSION AUX2(30),AUX3(30),AUX4(30),C11(30),C3(10),C5(10),C1(5)           00036400
      IF(KSPEC.EQ.1.OR.KSPEC.EQ.3)A=G*G*.0081                                    00036500
      C2=2.*PI                                                                   00036600
      C6=360./LPP                                                                00036700
      C7=LPP*LPP/(4.*PI*PI*G*G)                                                  00036800
      C9=G/LPP                                                                   00036900
      C10=FN(K)*C2                                                               00037000
      DO 100 J=1,NLAM                                                            00037100
      AL2=LAM(J)*LAM(J)                                                          00037200
      AUX2(J)=AL2*LAM(J)                                                         00037300
      AUX4(J)=C6*C6*AL2                                                          00037400
  100 C11(J)=SQRT(C2*LAM(J))                                                     00037500
      DO 200 L=1,LT                                                              00037600
      C3(L)=C10*COS( X(L) )                                                      00037700
      IF(KSPEC.LT.3)C5(L)=1.                                                     00037800
      IF(KSPEC.GE.3)C5(L)=AN*(COS(MI(L)))**NSPEC                                 00037900
  200 CONTINUE                                                                   00038000
      DO 500 M=1,NH13                                                            00038100
      IF(KSPEC.EQ.2.OR.KSPEC.EQ.4)B=691.17/T13(M)**4                             00038200
      IF(KSPEC.EQ.1.OR.KSPEC.EQ.3)B=3.11/(H13(M)*H13(M))                         00038300
      IF(KSPEC.EQ.2.OR.KSPEC.EQ.4)A=172.79*H13(M)*H13(M)/T13(M)**4               00038400
      C8=A*C7/2.                                                                 00038500
      C4=B*C7                                                                    00038600
```

```
      DO 300 NN=1,3                                                     00038700
      N=NN+NN-2                                                         00038800
  300 C1(NN)=C8*C9**(N/2)                                               00038900
      DO 400 J=1,NLAM                                                   00039000
  400 AUX3(J)=EXP( -C4/(LAM(J)*LAM(J)) )                                00039100
      DO 500 NN=1,3                                                     00039200
      DO 500 L=1,LT                                                     00039300
      DO 500 J=1,NLAM                                                   00039400
      AUX1=( C11(J)-C3(L)*LAM(J) )**N                                   00039500
      C12=AUX1/AUX2(J)*AUX3(J)*C1(NN)*C5(L)                             00039600
      CM(M,L,NN,J,1)=C12                                                00039700
      CM(M,L,NN,J,2)=C12*AUX4(J)                                        00039800
  500 CONTINUE                                                          00039900
      RETURN                                                            00040000
       END                                                              00040100
                                                                          S
```

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```
                                                                        00040200
      FUNCTION SIMPUN (X,Y,N)                                           00040300
      DIMENSION X(40),Y(40)                                             00040400
      IF( N-2 ) 7,5,4                                                   00040500
    5 S=(Y(1)+Y(2) )*(X(2)-X(1))/2.                                     00040600
      GO TO 6                                                           00040700
    7 S=0.                                                              00040800
      GO TO 6                                                           00040900
    4 M=N-1                                                             00041000
      S=(X(2)-X(1))/6.*(Y(1)*((X(2)-X(3))/(X(1)-X(3))+2.)+Y(2)*((X(1)-X( 00041100
     K3))/(X(2)-X(3))+2.)-Y(3)*(X(2)-X(1))**2/((X(1)-X(3))*(X(2)-X(3)))) 00041200
      LB=2                                                              00041300
      IF( N.EQ.3) GO TO 8                                               00041400
      S=S+(X(3)-X(2))/6.*(Y(2)*((X(3)-X(4))/(X(2)-X(4))+2.)+Y(3)*((X(2)- 00041500
     KX(4))/(X(3)-X(4))+2.)-Y(4)*(X(3)-X(2))**2/((X(2)-X(4))*(X(3)-X(4)) 00041600
     K))                                                                00041700
      LB=3                                                              00041800
    8 DO 1 K=LB,M                                                       00041900
      IF(ABS(X(K+1)-X(1)).GE.ABS(X(K)-X(1))) GO TO 1                    00042000
      GO TO 7                                                           00042100
    1 S=S+(X(K+1)-X(K))/6.*(Y(K)*((X(K+1)-X(K-1))/(X(K)-X(K-1))+2.)+Y(K+ 00042200
     M1)*((X(K)-X(K-1))/(X(K+1)-X(K-1))+2.)-Y(K-1)*(X(K+1)-X(K))**2/((X( 00042300
     NK)-X(K-1))*(X(K+1)-X(K-1))))                                      00042400
    6 SIMPUN=S                                                          00042500
      RETURN                                                            00042600
      END                                                               00042700
                                                                          S
```

==========

```
                                                                        00042800
      FUNCTION EFIC(SIG)                                                00042900
      COMMON/EFIC/S(10),E(10),NPEF                                      00043000
      EFIC=0.                                                           00043100
      SIG0=SIG*2.                                                       00043200
      IF(SIG0.LE.S(1)) GO TO 50                                         00043300
      IF(SIG0.GT.S(NPEF))GO TO 90                                       00043400
      DO 10 I=2,NPEF                                                    00043500
      IF(S(I).GT.SIG0) GO TO 20                                         00043600
   10 CONTINUE
```

```
   20 EFIC=E(I-1)+(SIGO-S(I-1))/(S(I)-S(I-1))*(E(I)-E(I-1))                00043700
      GO TO 90                                                            00043800
   50 EFIC=1.                                                             00043900
   90 RETURN                                                              00044000
      END                                                                 00044100
                                                                             SI
=============================================================================:

      SUBROUTINE MATINS(A,NR,N1,B,NC,M1,DETERM,ID,INDEX)                  00044200
C                                                                         00044300
C                                                                         00044400
      EQUIVALENCE (IROW,JROW),(ICOLUM,JCOLUM),(AMAX,T,SWAP)               00044500
      DIMENSION A(NR,NR),B(NR,NC),INDEX(NR,3)                             00044600
C                                                                         00044700
C     INITIALIZATION                                                      00044800
C                                                                         00044900
      N=N1                                                                00045000
      M=M1                                                                00045100
      DETERM=0.0                                                          00045200
      DO 20 J=1,N                                                         00045300
   20 INDEX(J,3)=0                                                        00045400
      DO 550 I=1,N                                                        00045500
C                                                                         00045600
C     SEARCH FOR PIVOT ELEMENT                                            00045700
C                                                                         00045800
      AMAX=0.0                                                            00045900
      DO 105 J=1,N                                                        00046000
      IF(INDEX(J,3)-1) 60,105,60                                          00046100
   60 DO 100 K=1,N                                                        00046200
      IF(INDEX(K,3)-1) 80,100,715                                         00046300
   80 IF(AMAX- ABS(A(J,K))) 85,100,100                                    00046400
   85 IROW=J                                                              00046500
      ICOLUM=K                                                            00046600
      AMAX= ABS(A(J,K))                                                   00046700
  100 CONTINUE                                                            00046800
  105 CONTINUE                                                            00046900
      INDEX(ICOLUM,3)=INDEX(ICOLUM,3)+1                                   00047000
      INDEX(I,1)=IROW                                                     00047100
      INDEX(I,2)=ICOLUM                                                   00047200
C                                                                         00047300
C     INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL                   00047400
C                                                                         00047500
      IF(IROW-ICOLUM) 140,310,140                                         00047600
  140 DETERM=-DETERM                                                      00047700
      DO 200 L=1,N                                                        00047800
      SWAP=A(IROW,L)                                                      00047900
      A(IROW,L)=A(ICOLUM,L)                                               00048000
  200 A(ICOLUM,L)=SWAP                                                    00048100
      IF(M) 310,310,210                                                   00048200
  210 DO 250 L=1,M                                                        00048300
      SWAP=B(IROW,L)                                                      00048400
      B(IROW,L)=B(ICOLUM,L)                                               00048500
  250 B(ICOLUM,L)=SWAP                                                    00048600
C                                                                         00048700
C     DIVIDE PIVOT ROW BY PIVOT ELEMENT                                   00048800
C                                                                         00048900
  310 PIVOT=A(ICOLUM,ICOLUM)                                              00049000
      DETERM=DETERM*PIVOT                                                 00049100
```

```
  330 A(ICOLUM,ICOLUM)=1.0                                              00049200
      DO 350 L=1,N                                                      00049300
  350 A(ICOLUM,L)=A(ICOLUM,L)/PIVOT                                     00049400
      IF(M) 380,380,360                                                 00049500
  360 DO 370 L=1,M                                                      00049600
  370 B(ICOLUM,L)=B(ICOLUM,L)/PIVOT                                     00049700
C                                                                       00049800
C     REDUCE NON-PIVOT ROWS                                             00049900
C                                                                       00050000
  380 DO 550 L1=1,N                                                     00050100
      IF(L1-ICOLUM) 400,550,400                                         00050200
  400 T=A(L1,ICOLUM)                                                    00050300
      A(L1,ICOLUM)=0.0                                                  00050400
      DO 450 L=1,N                                                      00050500
  450 A(L1,L)=A(L1,L)-A(ICOLUM,L)*T                                     00050600
C                                                                       00050700
C                                                                       00050800
      IF(M) 550,550,460                                                 00050900
  460 DO 500 L=1,M                                                      00051000
  500 B(L1,L)=B(L1,L)-B(ICOLUM,L)*T                                     00051100
  550 CONTINUE                                                          00051200
C                                                                       00051300
C     INTERCHANGE COLUMNS                                               00051400
C                                                                       00051500
      DO 710 I=1,N                                                      00051600
      L=N+1-I                                                           00051700
      IF( INDEX(L,1)-INDEX(L,2) ) 630,710,630                           00051800
  630 JROW=INDEX(L,1)                                                   00051900
      JCOLUM=INDEX(L,2)                                                 00052000
      DO 705 K=1,N                                                      00052100
      SWAP=A(K,JROW)                                                    00052200
      A(K,JROW)=A(K,JCOLUM)                                             00052300
      A(K,JCOLUM)=SWAP                                                  00052400
  705 CONTINUE                                                          00052500
  710 CONTINUE                                                          00052600
      DO 730 K=1,N                                                      00052700
      IF(INDEX(K,3)-1) 715,720,715                                      00052800
  720 CONTINUE                                                          00052900
  730 CONTINUE                                                          00053000
      ID=1                                                              00053100
  810 RETURN                                                            00053200
  715 ID=2                                                              00053300
      GO TO 810                                                         00053400
      END.                                                              00053500
                                                                          SEC
================================================================================

                                                                          FOR

                                                                          SEG
      NO ERRORS DETECTED.  NUMBER OF CARDS = 542.
      COMPILATION TIME = 36 SECONDS ELAPSED,  9.04 SECONDS PROCESSING.
      D2 STACK SIZE = 61 WORDS.  FILESIZE = 958 WORDS.  ESTIMATED CORE STORAGE REQ
      TOTAL PROGRAM CODE = 1998 WORDS.  ARRAY STORAGE = 3431 WORDS.
      NUMBER OF PROGRAM SEGMENTS = 18.  NUMBER OF DISK SEGMENTS = 157.
      PROGRAM CODE FILE = (117PNV)CONT3D/OBJ ON PACK.
      COMPILER COMPILED ON 09/07/79 (FORTRAN ON PACK).
```

APÊNDICE G

PROGRAMA AMROLL

```
            B6700  F O R T R A N  C O M P I L A T I O N  M A R K  2.9.004  THU
                                                A M R O L L / O B J
                                                = = = = = = = = = =
FILE  20=UM/PVPA,UNIT=DISKPACK,RECORD=3360,AREA=1*1                          00000100
FILE  30=UM/ARCOM,UNIT=DISKPACK,RECORD=3367,AREA=1*1                         00000200
FILE  80=TRES/AB,UNIT=DISKPACK,RECORD=57,AREA=600*3,BLOCKING=600             00000300
FILE  90=TRES/HIDRO,UNIT=DISKPACK,RECORD=270,AREA=1*1                        00000400
C                                                                            00000500
C                                                                            00000600
                                                                          FOR
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM     00000700
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP     00000800
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10)     00000900
     3,FN(5),BAM(30),COG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40),     00001000
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7),     00001100
     5UN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP         00001200
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES,      00001300
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25)     00001400
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)                  00001500
      COMMON NMSTP,INMSTP(12)                                                00001600
       COMMON /TEMP/ ST2(29),DS1(27),XMAS1(27),SOAR(27),SAS(27),HBM(27),     00001700
     2 HB3(27),SS(27),XI(8),YI(8),XY(8),SMB(27),HSB(27),DUM3(4704)           00001800
       COMMON /LODPRN/ STLD(24),WORD2,WORD3,IDAMP,IPRCNT,B2(5),B3(5),        00001900
     2 PB2(25,5),PB3(25,5),ICLASS                                            00002000
      COMMON/PPP/IPROC                                                       00002100
      DIMENSION WWW(3076),ZZZ(289)                                           00002200
      EQUIVALENCE (WWW(1),AM(1) ),(ZZZ(1),STLD(1))                           00002300
C                                                                            00002400
C READ AND PRINT ALL DATA CARD INPUT                                         00002500
C                                                                            00002600
  299 FORMAT (1H1,12A6)                                                      00002700
 1000 FORMAT (10X,'SHIP DATA CARD INPUT TO HANSEL')                          00002800
 8005 FORMAT (1H1,40X,31HLISTING OF ALL INPUT DATA CARDS/)                   00002900
 8007 FORMAT (21X,1H1,9X,1H2,9X,1H3,9X,1H4,9X,1H5,9X,1H6,9X,1H7,9X,1H8/     00003000
     24X,8HCOLUMNS ,8(10H1234567890)/)                                       00003100
 8008 FORMAT (//24H  END OF DATA CARD INPUT)                                 00003200
 8009 FORMAT ( /27H ...CONTINUED ON NEXT PAGE.)                              00003300
 8002 FORMAT (5X,A3,8X,A3)                                                   00003400
 8004  FORMAT (    2A6,A8)                                                  00003500
 8006  FORMAT (12X,2A6,A8)                                                  00003600
 8000 FORMAT (    12A6)                                                      00003700
 8010 FORMAT (12X,12A6)                                                      00003800
 8030 FORMAT (12X,12I6)                                                      00003900
 8020 FORMAT (    12I6)                                                      00004000
 8032 FORMAT (    F10.4,4F10.6,F10.4)                                        00004100
 8034 FORMAT (12X,F10.4,4F10.6,F10.4)                                        00004200
 8040 FORMAT (    8F10.4)                                                    00004300
 8050 FORMAT (12X,8F10.4)                                                    00004400
 8060 FORMAT (   I5,2F10.4)                                                  00004500
 8070 FORMAT (12X,I5,2F10.4)                                                 00004600
 8080 FORMAT (    F10.8,2F10.4,I6)                                           00004700
 8090 FORMAT (12X,F10.8,2F10.4,I6)                                           00004800
 8100 FORMAT (    1615)                                                      00004900
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 8110 FORMAT (12X,16I5)                                                 00005000
      WRITE  (6,8005)                                                   00005100

      WRITE  (6,8007)                                                   00005200
      READ(5,8060) IPROC                                                00005300

C-----------------------------------------------------------------------00005400
C     DATA CARD SET 3                                                   00005500
C-----------------------------------------------------------------------00005600
      READ  (5,8000) TITO                                               00005700
      WRITE (6,8010) TITO                                               00005800
C-----------------------------------------------------------------------00005900
C     DATA CARD SET 4                                                   00006000
C-----------------------------------------------------------------------00006100
      READ  (5,8004) WORD,WORD2,WORD3                                   00006200
      WRITE(6,8006) WORD,WORD2,WORD3                                    00006300
C-----------------------------------------------------------------------00006400
C     DATA CARD SET 5                                                   00006500
C-----------------------------------------------------------------------00006600
      READ  (5,8020) NUT,NST,NMAS,IT                                    00006700
      WRITE (6,8030) NUT,NST,NMAS,IT                                    00006800
       NOS= NST - 2                                                     00006900
       M2 = NST                                                         00007000
C-----------------------------------------------------------------------00007100
C     DATA CARD SET 6                                                   00007200
C-----------------------------------------------------------------------00007300
      READ  (5,8040) (ST1(I),I=1,M2)                                    00007400
      WRITE (6,8050) (ST1(I),I=1,M2)                                    00007500
C-----------------------------------------------------------------------00007600
C     DATA CARD SET 7                                                   00007700
C-----------------------------------------------------------------------00007800
      READ  (5,8040) ELL,BEAM                                           00007900
      WRITE (6,8050) ELL,BEAM                                           00008000
      DO 9010 I=1,NOS                                                   00008100
C-----------------------------------------------------------------------00008200
C     DATA CARD SET 8                                                   00008300
C-----------------------------------------------------------------------00008400
      READ  (5,8040) (X(I,J),J=1,NUT)                                   00008500
      WRITE (6,8050) (X(I,J),J=1,NUT)                                   00008600
      READ  (5,8040) (Y(I,J),J=1,NUT)                                   00008700
      WRITE (6,8050) (Y(I,J),J=1,NUT)                                   00008800
 9010 CONTINUE                                                          00008900
      IF(IT .EQ. 0) GO TO 9020                                          00009000
C-----------------------------------------------------------------------00009100
C     DATA CARD SET 9                                                   00009200
C-----------------------------------------------------------------------00009300
      READ  (5,8032) TMAS,EI44,EI55,EI66,EI46,ZG                        00009400
      WRITE (6,8034) TMAS,EI44,EI55,EI66,EI46,ZG                        00009500
       WRITE (6,8009)                                                   00009600
       WRITE (6,299)                                                    00009700
       WRITE(6,8007)                                                    00009800
      GO TO 9030                                                        00009900
C                                                                       00010000
C     DATA CARD SET 10                                                  00010100
C                                                                       00010200
 9020 READ  (5,8040)  (PMAS(I),I=1,NMAS)                                00010300
      WRITE (6,8050)  (PMAS(I),I=1,NMAS)                                00010400
C                                                                       00010500
C     DATA CARD SET 11                                                  00010600
C                                                                       00010700
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      READ  (5,8040)  (XMAS(I),I=1,NMAS)                              00010800
      WRITE (6,8050)  (XMAS(I),I=1,NMAS)                              00010900
C                                                                     00011000
C     DATA CARD SET 12                                                00011100
C                                                                     00011200
      READ  (5,8040)  (YMAS(I),I=1,NMAS)                              00011300
      WRITE (6,8050)  (YMAS(I),I=1,NMAS)                              00011400
C                                                                     00011500
C     DATA CARD SET 13                                                00011600
C                                                                     00011700
       WRITE (6,8009)                                                 00011800
       WRITE (6,299)                                                  00011900
       WRITE (6,8007)                                                 00012000
      READ  (5,8040) (ZMAS(I),I=1,NMAS)                               00012100
      WRITE (6,8050) (ZMAS(I),I=1,NMAS)                               00012200
C                                                                     00012300
C     DATA CARD SET 14                                                00012400
C                                                                     00012500
      READ  (5,8040) (RRG(I),I=1,NMAS)                                00012600
      WRITE (6,8050)  (RRG(I),I=1,NMAS)                               00012700
C                                                                     00012800
C     DATA CARD SET 15                                                00012900
C                                                                     00013000
 9030 READ  (5,8020) IXAST                                            00013100
      WRITE (6,8030) IXAST                                            00013200
C                                                                     00013300
C     DATA CARD SET 16                                                00013400
C                                                                     00013500
      READ (5,8020) NOK,NOB,NOH,NWSTP                                 00013600
      WRITE (6,8030) NOK,NOB,NOH,NWSTP                                00013700
C                                                                     00013800
C     DATA CARD SET 17                                                00013900
C                                                                     00014000
      READ (5,8020)(INWSTP(I),I=1,NWSTP)                              00014100
      WRITE(6,8030) (INWSTP(I),I=1,NWSTP)                             00014200
C                                                                     00014300
C     DATA CARD SET 18                                                00014400
C                                                                     00014500
      READ  (5,8040) (HDG1(I),I=1,NOH)                                00014600
      WRITE (6,8050) (HDG1(I),I=1,NOH)                                00014700
C                                                                     00014800
C     DATA CARD SET 19                                                00014900
C                                                                     00015000
      READ  (5,8040) (FN(I),I=1,NOB)                                  00015100
      WRITE (6,8050) (FN(I),I=1,NOB)                                  00015200
C                                                                     00015300
C     DATA CARD SET 20                                                00015400
C                                                                     00015500
      READ (5,8040) (BAM(I),I=1,NOK)                                  00015600
      WRITE (6,8050) (BAM(I),I=1,NOK)                                 00015700
C                                                                     00015800
C     DATA CARD SET 21                                                00015900
C                                                                     00016000
      READ  (5,8060) NFR,OMIN,OMAX                                    00016100
      WRITE (6,8070) NFR,OMIN,OMAX                                    00016200
C                                                                     00016300
C     DATA CARD SET 22                                                00016400
C                                                                     00016500
      READ  (5,8020) IRR                                              00016600
      WRITE (6,8030) IRR                                              00016700
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C                                                                       00016800
C     DATA CARD SET 23                                                  00016900
C                                                                       00017000
      READ (5,8020) ML,IEND,IBILGE,IPRES,IDAMP,IPRCNT                   00017100
      WRITE (6,8030) ML,IEND,IBILGE,IPRES,IDAMP,IPRCNT                  00017200
C                                                                       00017300
C     DATA CARD SET 24                                                  00017400
C                                                                       00017500
      READ  (5,8080) VNY,GRAV,AMODL,MUD                                 00017600
      WRITE (6,8090) VNY,GRAV,AMODL,MUD                                 00017700
      IF(IDAMP .EQ. 2) GO TO 9045                                       00017800
C                                                                       00017900
C     DATA CARD SET 25                                                  00018000
C                                                                       00018100
      READ  (5,8100) (ITS(I),I=1,NOS)                                   00018200
      WRITE (6,8110) (ITS(I),I=1,NOS)                                   00018300
C                                                                       00018400
C     DATA CARD SET 26                                                  00018500
C                                                                       00018600
      READ  (5,8040) (RD(I),I=1,NOS)                                    00018700
      WRITE (6,8050) (RD(I),I=1,NOS)                                    00018800
      IF(IBILGE .EQ.2)GO TO 9050                                        00018900
C                                                                       00019000
C     DATA CARD SET 27                                                  00019100
C                                                                       00019200
      READ  (5,8040) AKEELL,BEAMKL                                      00019300
      WRITE (6,8050) AKEELL,BEAMKL                                      00019400
      DO 9040 I=1,NOS                                                   00019500
C                                                                       00019600
C     DATA CARD SET 28                                                  00019700
C                                                                       00019800
      READ  (5,8040) RFD(I),DELTAD(I),RKD(I),SD(I),COSPHD(I),PHID(I)    00019900
      WRITE (6,8050) RFD(I),DELTAD(I),RKD(I),SD(I),COSPHD(I),PHID(I)    00020000
 9040 CONTINUE                                                          00020100
 9045 CONTINUE                                                          00020200
C                                                                       00020300
C     DATA CARD SET 29                                                  00020400
C                                                                       00020500
 9050 IF(IPRES. EQ. 1) READ  (5,8040) (STPR(I),I=1,NOS)                 00020600
      IF(IPRES .EQ. 1) WRITE (6,8050) (STPR(I),I=1,NOS)                 00020700
       NOSM1 = NOS -1                                                   00020800
C                                                                       00020900
C     DATA CARD SET 30                                                  00021000
C                                                                       00021100
      IF(IT. EQ. 0) READ  (5,8040) (STLD(I),I=1,NOSM1)                  00021200
      IF(IT .EQ. 0) WRITE (6,8050) (STLD(I),I=1,NOSM1)                  00021300
      NHF = NOH*NOB*NWSTP                                               00021400
      IF(IDAMP .EQ. 2) GO TO 9052                                       00021500
C                                                                       00021600
C     DATA CARD SET 31                                                  00021700
C                                                                       00021800
      READ  (5,8040) (THMD(I),I=1,NHF)                                  00021900
      WRITE (6,8050) (THMD(I),I=1,NHF)                                  00022000
 9052 CONTINUE                                                          00022100
      IF (IDAMP .LE. 0) IDAMP=1                                         00022200
      GO TO (9090,9055,9080),IDAMP                                      00022300
 9055 CONTINUE                                                          00022400
C                                                                       00022500
C     DATA CARD SET 32                                                  00022600
C                                                                       00022700
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      READ  (5,8040)(B2(I),B3(I),I=1,NOB)                                00022800
      WRITE (6,8050) (B2(I),B3(I),I=1,NOB)                               00022900
      IF(IPRCNT .NE. 1) GO TO 9090                                       00023000
      DO 9070 I=1,NOS                                                    00023100
C                                                                        00023200
C     DATA CARD SET 33                                                   00023300
C                                                                        00023400
      READ  (5,8040) (PB2(I,J),PB3(I,J),J=1,NOB)                         00023500
      WRITE (6,8050) (PB2(I,J),PB3(I,J),J=1,NOB)                         00023600
 9070 CONTINUE                                                           00023700
      GO TO 9090                                                         00023800
 9080 CONTINUE                                                           00023900
C                                                                        00024000
C     DATA CARD SET 34                                                   00024100
C                                                                        00024200
      READ (5,8020) ICLASS                                               00024300
      WRITE(6,8030) ICLASS                                               00024400
 9090 CONTINUE                                                           00024500
      WRITE (6,8008)                                                     00024600
      XG = 0.                                                            00024700
      FACT=0.017453293                                                   00024800
C     ALGORITHM TO COMPUTE SECTION WIDTHS                                00024900
      EPS=0.001                                                          00025000
      K = 2                                                              00025100
      SECTB = ST1(1)                                                     00025200
      DIFF = ST1 (2) - SECTB                                             00025300
      SECTE = ST1(2) + DIFF.                                             00025400
      IF (SECTE .GT. (ST1(3)+EPS)) GO TO 956                             00025500
      IF (ABS(SECTE-ST1(3)) .LE. EPS) SECTB = ST1(2) - 0.5*DIFF          00025600
      NOS = NST - 2                                                      00025700
      DO 955 N=1,NOS                                                     00025800
      K= N + 1                                                           00025900
      ST(N) = ST1(K)                                                     00026000
      DIFF = ST1(K) - SECTB                                              00026100
      SECTE = ST1(K) + DIFF                                              00026200
      IF ((K+1).EQ.NST .AND. SECTE.GT.(ST1(NST)+EPS)) GO TO 956          00026300
      IF ((K+1).LT.NST .AND. SECTE.GE.(ST1(K+1)-EPS)) GO TO 956          00026400
      DS(N) = SECTE - SECTB                                              00026500
      SECTB = SECTE                                                      00026600
  955 CONTINUE                                                           00026700
      GO TO 957                                                          00026800
  956 WRITE (6,2000) ST1(K),ST1(K+1),SECTE                               00026900
 2000 FORMAT ('1    STATION NUMBER ERROR -'/13X,'SECTION ASSOCIATED '    00027000
     2'WITH STATION',F8.3,' INCLUDES STATION',F8.3,','/13X,              00027100
     2'END OF SECTION =',F8.3,'.  CORRECT STATION NUMBERS AND RERUN.'/   00027200
     228X,'- PROGRAM STOP -')                                            00027300
      STOP                                                               00027400
  957 CONTINUE                                                           00027500
C                                                                        00027600
C NUT=NUMBER OF OFFSETPOINTS FOR EACH SECTION                            00027700
C NMAS=NUMBER OF MASSPOINTS                                              00027800
C NOS=NUMBER OF STATIONS                                                 00027900
C OT=0 MEANSOINERTIAMOMENTS,MASS AND CENTER OF GRAVITY FOR EACH SECTION  00028000
C      IS INPUT                                                          00028100
C ST= THE DISTANCE FROM FORWARD PERPENDICULAR TO THE STATIONS            00028200
C DS= THE LENGTH OF THE STATIONS                                         00028300
C  BEAM=THE BEAM OF THE SHID                                             00028400
C                                                                        00028500
      EL=ELL/2.0                                                         00028600
      EL2=EL*EL                                                          00028700
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      EL3=EL2*EL                                                        00028800
      DRAFT=ABS(Y(10,NUT))                                              00028900
      DO 9060 I=1,M2                                                    00029000
      J= ST1(I)+ 0.0001                                                 00029100
 9060 IF (J .EQ. 10) DRAFT= ABS(Y(I-1,NUT))                             00029200
      DMAX = DRAFT                                                      00029300
      DO 5 K=1,NOS                                                      00029400
      DO 5 J=1,NUT                                                      00029500
      TERM = ABS(Y(K,J))                                                00029600
    5 IF(DMAX .LT. TERM) DMAX= TERM                                     00029700
      DO 200 K=1,NOS                                                    00029800
      DS(K) = DS(K)*ELL/20.                                             00029900
      ST(K)=ST(K)*ELL/20.                                               00030000
  200 CONTINUE                                                          00030100
      IF (IT) 70,71,70                                                  00030200
   70 CONTINUE                                                          00030300
C                                                                       00030400
C ZG=Z-COORDINATE OF CENTER OF GRAVITY WITH RESPECT TO THE CHOSEN       00030500
C     COORDINATE-SYSTEM IN WATERPLANE                                   00030600
      GO TO 72                                                          00030700
   71 CONTINUE                                                          00030800
C                                                                       00030900
C  CALCULATE TOTAL MASS=TMAS                                            00031000
C  CALCULATE CENTER OF GRAVITY                                          00031100
C  CALCULATE MOMENTS OF INERTIA AND CENTRIFUGAL MOMENTS                 00031200
C                                                                       00031300
      TMAS = 0.0                                                        00031400
      XG=0.0                                                            00031500
      ZG=0.0                                                            00031600
      DO 9 I=1,NMAS                                                     00031700
      TMAS=TMAS + PMAS(I)                                               00031800
      XG=XG+PMAS(I)*XMAS(I)                                             00031900
      ZG=ZG+PMAS(I)*ZMAS(I)                                             00032000
    9 CONTINUE                                                          00032100
      XG=XG/TMAS                                                        00032200
      ZG=ZG/TMAS                                                        00032300
      EI44=0.0                                                          00032400
      EI55=0.0                                                          00032500
      EI66=0.0                                                          00032600
      EI46=0.0                                                          00032700
      DO 10 I=1,NMAS                                                    00032800
      XMAS(I)=XMAS(I)-XG                                                00032900
   10 CONTINUE                                                          00033000
      DO 11 I=1,NMAS                                                    00033100
      ZD2=ZMAS(I)**2                                                    00033200
      EI44=EI44+PMAS(I)*(ZD2+RRG(I)**2)                                 00033300
      EI55=EI55+PMAS(I)*(ZD2+XMAS(I)**2)                                00033400
      EI66=EI66+PMAS(I)*(XMAS(I)**2+YMAS(I)**2)                         00033500
      EI46=EI46+PMAS(I)*XMAS(I)*ZMAS(I)                                 00033600
   11 CONTINUE                                                          00033700
      EI44=EI44/TMAS/ELL/ELL                                            00033800
      EI55=EI55/TMAS/ELL/ELL                                            00033900
      EI66=EI66/TMAS/ELL/ELL                                            00034000
      EI46=EI46/TMAS/ELL/ELL*(-1.)                                      00034100
   72 CONTINUE                                                          00034200
C                                                                       00034300
C  EI44=(ROLL-RADIUS OF GYRATIONAL/L)**2                                00034400
C EI55=(PITCH-RADIUS OF GYRATIONAL/L)**2                                00034500
C  EI66=(YAW-RADIUS OF GYRATIONAL/L)**2                                 00034600
C  EI46=CNETRIFUGAL-MOMENT-X-Z/MASS/L/L                                 00034700
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C                                                                       00034800
C                                                                       00034900
C  CALCULATION OF HIDROSTATIC QUANTITIES                                00035000
C                                                                       00035100
      SQAR(1)=0.0                                                       00035200
      AM(1)=0.0                                                         00035300
      SAS(1)=0.0                                                        00035400
      HBM(1)=0.0                                                        00035500
      HB3(1)=0.0                                                        00035600
      MOM=NOS                                                           00035700
      MAD=NOS+1                                                         00035800
      MUD=MAD+1                                                         00035900
      SQAR(MUD)=0.0                                                     00036000
      AM(MUD)=0.0                                                       00036100
      SAS(MUD)=0.0                                                      00036200
      HBM(MUD)=0.0                                                      00036300
      HB3(MUD)=0.0                                                      00036400
      SS(1)=ST1(1)/10.                                                  00036500
      SS(MUD)=ST1(NST)/10.                                              00036600
      DO 13 K=2,MAD                                                     00036700
      IP1=K-1                                                           00036800
      SS(K)=ST(IP1)/EL                                                  00036900
      DO 17 J=1,NUT                                                     00037000
      XI(J)=X(IP1,J)/EL                                                 00037100
      YI(J)=Y(IP1,J)/EL                                                 00037200
      XY(J)=XI(J)*YI(J)                                                 00037300
   17 CONTINUE                                                          00037400
      SQAR(K)=2.0*ABS(SIMPUN(YI,XI,NUT))                                00037500
      AM(K)=-2.0*SIMPUN(YI,XY,NUT)                                      00037600
      SAS(K)=SS(K)*SQAR(K)                                              00037700
      HB3(K)=2.*X(IP1,1)**3/EL3                                         00037800
   13 CONTINUE                                                          00037900
      TVOL=SIMPUN(SS,SQAR,MUD)                                          00038000
      TPST=SIMPUN(SS,SAS,MUD)/TVOL                                      00038100
      TPCM=SIMPUN(SS,HB3,MUD)                                           00038200
      CBV=0.5*SIMPUN(SS,AM,MUD)/TVOL                                    00038300
      CMC=CBV+TPCM/3.0/TVOL*0.5                                         00038400
C                                                                       00038500
C TVOL=VOLUME OF THE HULL/(L/2)**3                                      00038600
C TPST=LONGITUDINAL CNETER OF BOYANCY/(L/2)                             00038700
C CBV=VERTICAL CNNTER OF BOYANCY/L                                      00038800
C CMC=METACENTER HEIGHT OVER WATERPLANE/L                               00038900
C                                                                       00039000
C                                                                       00039100
C CALCULATION OF HEAVE-HEAVE,PITCH-PITCH,HEAVE-PITCH RESTORING COEFFI   00039200
C                                                                       00039300
      DO 22 K=2,MAD                                                     00039400
      IP1=K-1                                                           00039500
      SS(K)=ST(IP1)/EL                                                  00039600
      HBM(K)=X(IP1,1)/EL                                                00039700
   22 CONTINUE                                                          00039800
      DO 26 K=1,MUD                                                     00039900
      SPD=SS(K)-TPST                                                    00040000
      SPD=-SPD                                                          00040100
      SHB(K)=SPD*HBM(K)*(-1.)                                           00040200
      HSB(K)=SPD*SHB(K)*(-1.)                                           00040300
   26 CONTINUE                                                          00040400
      RF33=4.0*SIMPUN(SS,HBM,MUD)/TVOL                                  00040500
      RM35=-2.0*SIMPUN(SS,SHB,MUD)/TVOL                                 00040600
      RM55=SIMPUN(SS,HSB,MUD)/TVOL                                      00040700
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      DGM=ABS(ZG/ELL-CMC)                                                    00040800
      NON=NUT-1                                                              00040900
C                                                                            00041000
C    IXAST=NUMBER OF STATION WHERE SEPARATION IN WATERPLANE BEGIN            00041100
      REWIND 90                                                              00041200
      WRITE(90)NST,ELL,BEAM,NOK,NOB,NOH,NWSTP,(HDG1(I),I=1,NOH),(FN(I),I     00041300
     1=1,NOB),(BAM(I),I=1,NOK),DRAFT,EI44,(SS(K),DS(K),HHM(K),SQAR(K),AM     00041400
     2(K),SAS(K),HB3(K),K=1,MUD),TVOL,TPST,TPCM,CBV,CMC,ZG,XG,VNY,GRAV,N     00041500
     3FR,RF33,RM35,RM55,DGM,NOS                                              00041600
      LOCK 90                                                                00041700
      WRITE(6,9600)ELL,NOB,TVOL,BEAM,NOK,CMC,DRAFT,NOH,EI44,EL,NWSTP,VNY     00041800
     1,ZG,XG,GRAV,(K,SS(K),DS(K),SQAR(K),AM(K),HB3(K),K=2,MAD)               00041900
 9600 FORMAT('1'///28X,'ARQUIVO      TNES/HIDRO '/22X,'CONDICOES DE OPERA     00042000
     1CAO / HIDROSTATICA DO NAVIO'//2X,'COMPRIMENTO   ',F8.2,' M',7X,'NO     00042100
     2 DE VELOCIDADES',I9,5X,'VOLUME/(EL)**3',4X,E14.6/2X,'BOCA',10X, F8     00042200
     3.2,' M',7X,'NO DE LAMBDA/L',I12,5X,'ZM/LPP',12X,E14.6/2X,'CALADO',     00042300
     48X,F8.2,' M',7X,'NO DE APROAMENTOS',I9,5X,'EI44',14X,E14.6/2X,'EL'     00042400
     5,12X,F8.2,' M',7X,'NO DE DECLIVIDADES',I8,5X,'VISCOSIDADE',4X,E9.3     00042500
     6,'  M**2/S'/2X,'ZG',12X,F8.2,' M',7X,'XG',18X,F6.2,5X,'GRAVIDADE',     00042600
     710X,F6.3,' M/S**2'///                                                  00042700
     81X,'BALISA',6X,'DISTANCIA',7X,'ESPACAMENTO',7X,'AREA/EL**2',6X,'MO     00042800
     9MENTO VERTICAL',4X,'2*MEIA-BOCA'/                                      00042900
     113X,'A PROA/L',10X,'BALISAS',30X,'/EL**3',12X,'/EL**3'//               00043000
     2(1X,I4,5X,5(E12.6,6X),1X))                                             00043100
      CALL SPRG1                                                             00043200
      CALL SPRG2                                                             00043300
      RQ2=SQRT(2.)                                                           00043400
      IF( IPROC .EQ. 0) WRITE(6,8112) (OMEN(I)*RQ2,I=1,NFR)                  00043500
 8112 FORMAT(//10X,' FREQUENCIAS ADIMENSIONAIS ,(WE*SQRT(L/G) QUE SERAO      00043600
     *USADAS NO CALC. DE MASSAS ADICIONAIS'/10X,(8F10.4))                    00043700
      REWIND 30                                                              00043800
      WRITE(30) WWW,ZZZ                                                      00043900
      LOCK 20                                                                00044000
      LOCK 30                                                                00044100
      LOCK 80                                                                00044200
      STOP                                                                   00044300
      END                                                                    00044400
      002:0600:5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 00
      002:0602:1  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 00
                                                                             SLG
================================================================================

C                                                                            00044500

       SUBROUTINE SPRG1                                                      00044600
C                                                                            00044700
C                                                                            00044800
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,6),Y(25,8),PM     00044900
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,IP     00045000
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10)     00045100
     3,FN(5),BAM(30),CDG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40),     00045200
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7),     00045300
     5UN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP         00045400
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,OMAX,IRR,ML,IEND,IBILGE,IPRES,      00045500
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25)     00045600
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)                  00045700
      COMMON NWSTP,INWSTP(12)                                                00045800
       COMMON /TEMP/ HDR(10),IK(27),DUM3(4963)                               00045900
      COMMON/PPP/IPROC                                                       00046000
```

```
      MOM=NOS-1                                                          00046100
      NIX=NOS-2                                                          00046200
      TOP=6.283185                                                       00046300
      NOSHAL=NOS                                                         00046400
      DO 22 K=1,NOSHAL                                                   00046500
      ST(K)=ST(K)/EL                                                     00046600
      DO 20 J=1,NUT                                                      00046700
      X(K,J)=X(K,J)/EL                                                   00046800
      Y(K,J)=Y(K,J)/EL                                                   00046900
   20 CONTINUE                                                           00047000
      DS(K)=DS(K)/EL                                                     00047100
   22 CONTINUE                                                           00047200
      DO 110 JJ=1,NOH                                                    00047300
      HDG(JJ)=180.0-HDG1(JJ)                                             00047400
  110 CONTINUE                                                          00047500
      DO 168 JJ=1,NOH                                                    00047600
      HDR(JJ)=0.017453293*HDG(JJ)                                        00047700
      SDG(JJ)=SIN(HDR(JJ))                                               00047800
  168 CDG(JJ)=COS(HDR(JJ))                                               00047900
C                                                                        00048000
C CALCULATION OF NON-DIMENSIONAL FREQUENCY RANGES                        00048100
C                                                                        00048200
      OTMIN = 99999.                                                     00048300
      OTMAX=0.                                                           00048400
      DO 6000 N=1,NOH                                                    00048500
      DO 6000 M=1,NOB                                                    00048600
      TERM=FN(M)*CDG(N)                                                  00048700
      DO 6000 K=1,NOK                                                    00048800
      FACT = 6.283185/BAM(K)                                             00048900
      OTEMP = ABS(SQRT(FACT) + FACT*TERM)                                00049000
      IF(OTEMP .LT. OTMIN) OTMIN = OTEMP                                 00049100
 6000 IF(OTEMP .GT. OTMAX) OTMAX = OTEMP                                 00049200
      EPS=.0001                                                          00049300
      SRLG = SQRT(ELL/GRAV)                                              00049400
      SRDG = SQRT(DMAX/GRAV)                                             00049500
      SRLD = SQRT(ELL/DMAX)                                              00049600
      WEMAX = OTMAX/SRLG                                                 00049700
      FACT = WEMAX*SRDG                                                  00049800
      IF (FACT .GE. 1.) GO TO 6010                                       00049900
C  IRREGULAR FREQUENCIES DO NOT EXIST                                    00050000
      IRR=1                                                              00050100
      OMAX = OTMAX + EPS                                                 00050200
      KFR = 10                                                           00050300
      GO TO 6020                                                         00050400
C IRREGULAR FREQUENCIES EXIST                                            00050500
 6010 IRR=2                                                              00050600
      BT = BEAM/DRAFT                                                    00050700
      IF(BT.LE.4) CON= .35                                               00050800
      IF(BT.GT.4.) CON= .60                                              00050900
      OMAX = (WEMAX*SRDG + CON)*SRLD                                     00051000
 6020 OMIN = OTMIN - EPS                                                 00051100
      CRIT = .7*SRLD                                                     00051200
      IF(OMIN. GE. CRIT) OMIN = CRIT -EPS                                00051300
      IF(IRR .EQ. 2) KFR= (OMAX-OMIN)/(.05*SRLD) + .9999999              00051400
      KFR=MIN0(KFR,40)                                                   00051500
      IF (NFR .LE. 0) NFR=KFR                                            00051600
      IF (OMIN .LE. 0..OR. OMIN .GT. OMIN) OMIN = OMIN                   00051700
      IF (OMAX .LE. 0..OR. OMAX .LT. OMAX) OMAX = OMAX                   00051800
      OMAX = OMAX*SQRT(0.5)                                              00051900
      OMIN = OMIN*SQRT(0.5)                                              00052000
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      IF( IPROC .EQ. 0 ) RETURN                                          00052100
      DO 18 N=1,NFR                                                      00052200
      DO 18 L=1,11                                                       00052300
      ALFA(N,L)=0.0                                                      00052400
      BETA(N,L)=0.0                                                      00052500
   18 CONTINUE                                                           00052600
      DO 19 K=1,NOSHAL                                                   00052700
      DO 21 J=1,NON                                                      00052800
      XX(K,J)=.5*(X(K,J)+X(K,J+1))                                       00052900
      YY(K,J)=.5*(Y(K,J)+Y(K,J+1))                                       00053000
      XINT=X(K,J)-X(K,J+1)                                               00053100
      YINT=Y(K,J)-Y(K,J+1)                                               00053200
      DEL(K,J)=SQRT(XINT**2 + YINT**2)                                   00053300
      SNE(K,J)=YINT/DEL(K,J)                                             00053400
   21 CSE(K,J)=XINT/DEL(K,J)                                             00053500
   19 CONTINUE                                                           00053600
      IK(1)=1                                                            00053700
      DO 15 K=2,MOM                                                      00053800
   15 IK(K)=2                                                            00053900
      IK(NOS)=3                                                          00054000
      DO 35 K=1,NOS                                                      00054100
      LIK=IK(K)                                                          00054200
      GO TO(36,27,28),LIK                                                00054300
   36 CALL PQRT(ST(3),ST(1),ST(2),P,Q,R,T)                               00054400
      DO 29 J=1,NON                                                      00054500
   29 EN1(K,J)=(SNE(1,J)*(Q*XX(3,J)-P*XX(2,J)+R*XX(1,J))-CSE(1,J)*(Q*YY( 00054600
     13,J)-P*YY(2,J)+R*YY(1,J)))/T                                       00054700
      GO TO 35                                                           00054800
   27 CALL PQRT(ST(K+1),ST(K),ST(K-1),P,Q,R,T)                           00054900
      DO 30 J=1,NON                                                      00055000
   30 EN1(K,J)=(SNE(K,J)*(Q*XX(K+1,J)-P*XX(K-1,J)+R*XX(K,J))-CSE(K,J)*(Q 00055100
     1*YY(K+1,J)-P*YY(K-1,J)+R*YY(K,J)))/T                               00055200
      GO TO 35                                                           00055300
   28 CALL PQRT(ST(NIX),ST(NOS),ST(MOM),P,Q,R,T)                         00055400
      DO 31 J=1,NON                                                      00055500
   31 EN1(K,J)=(SNE(NOS,J)*(Q*XX(NIX,J)-P*XX(MOM,J)+R*XX(NOS,J))-CSE(NOS 00055600
     1,J)*(Q*YY(NIX,J)-P*YY(MOM,J)+R*YY(NOS,J)))/T                       00055700
   35 CONTINUE                                                           00055800
      DO 101 K=1,NOS                                                     00055900
      DO 102 J=1,NON                                                     00056000
      EN1(K,J)=EN1(K,J)/SQRT(1.+EN1(K,J)**2)                             00056100
  102 CONTINUE                                                           00056200
  101 CONTINUE                                                           00056300
   77 RETURN                                                             00056400
      END                                                                00056500
                                                                            SE
```

```
C                                                                        00056600
C                                                                        00056700

      SUBROUTINE MATINS(A,NR,N1,B,NC,M1,DETERM,ID,INDEX)                 00056800
C     SUBROUTINE MATINS(A,NR,N1,B,NC,M1,DETERM,ID,INDEX)                 00056900
C                                                                        00057000
      EQUIVALENCE (IROW,JROW),(ICOLUM,JCOLUM),(AMAX,T,SWAP)              00057100
      DIMENSION A(NR,NR),B(NR,NC),INDEX(NR,3)                            00057200
C                                                                        00057300
C     INITIALIZATION                                                     00057400
C                                                                        00057500
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```
      N=N1                                                              00057600
      M=M1                                                              00057700
      DETERM=0.0                                                        00057800
      DO 20 J=1,N                                                       00057900
   20 INDEX(J,3)=0                                                      00058000
      DO 550 I=1,N                                                      00058100
C                                                                       00058200
C     SEARCH FOR PIVOT ELEMENT                                          00058300
C                                                                       00058400
      AMAX=0.0                                                          00058500
      DO 105 J=1,N                                                      00058600
      IF(INDEX(J,3)-1) 60,105,60                                        00058700
   60 DO 100 K=1,N                                                      00058800
      IF(INDEX(K,3)-1) 80,100,715                                       00058900
   80 IF(AMAX- ABS(A(J,K))) 85,100,100                                  00059000
   85 IROW=J                                                            00059100
      ICOLUM=K                                                          00059200
      AMAX= ABS(A(J,K))                                                 00059300
  100 CONTINUE                                                          00059400
  105 CONTINUE                                                          00059500
      INDEX(ICOLUM,3)=INDEX(ICOLUM,3)+1                                 00059600
      INDEX(I,1)=IROW                                                   00059700
      INDEX(I,2)=ICOLUM                                                 00059800
C                                                                       00059900
C     INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL                 00060000
C                                                                       00060100
      IF(IROW-ICOLUM) 140,310,140                                       00060200
  140 DETERM=-DETERM                                                    00060300
      DO 200 L=1,N                                                      00060400
      SWAP=A(IROW,L)                                                    00060500
      A(IROW,L)=A(ICOLUM,L)                                             00060600
  200 A(ICOLUM,L)=SWAP                                                  00060700
      IF(M) 310,310,210                                                 00060800
  210 DO 250 L=1,M                                                      00060900
      SWAP=B(IROW,L)                                                    00061000
      B(IROW,L)=B(ICOLUM,L)                                             00061100
  250 B(ICOLUM,L)=SWAP                                                  00061200
C                                                                       00061300
C     DIVIDE PIVOT ROW BY PIVOT ELEMENT                                 00061400
C                                                                       00061500
  310 PIVOT=A(ICOLUM,ICOLUM)                                            00061600
      DETERM=DETERM*PIVOT                                               00061700
  330 A(ICOLUM,ICOLUM)=1.0                                              00061800
      DO 350 L=1,N                                                      00061900
  350 A(ICOLUM,L)=A(ICOLUM,L)/PIVOT                                     00062000
      IF(M) 380,380,360                                                 00062100
  360 DO 370 L=1,M                                                      00062200
  370 B(ICOLUM,L)=B(ICOLUM,L)/PIVOT                                     00062300
C                                                                       00062400
C     REDUCE NON-PIVOT ROWS                                             00062500
C                                                                       00062600
  380 DO 550 L1=1,N                                                     00062700
      IF(L1-ICOLUM) 400,550,400                                         00062800
  400 T=A(L1,ICOLUM)                                                    00062900
      A(L1,ICOLUM)=0.0                                                  00063000
      DO 450 L=1,N                                                      00063100
  450 A(L1,L)=A(L1,L)-A(ICOLUM,L)*T                                     00063200
C                                                                       00063300
C                                                                       00063400
      IF(M) 550,550,460                                                 00063500
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```
  460 DO 500 L=1,M                                                      00063600
  500 B(L1,L)=B(L1,L)-B(ICOLUM,L)*T                                     00063700
  550 CONTINUE                                                          00063800
C                                                                       00063900
C     INTERCHANGE COLUMNS                                               00064000
C                                                                       00064100
      DO 710 I=1,N                                                      00064200
      L=N+1-I                                                           00064300
      IF(INDEX(L,1)-INDEX(L,2)) 630,710,630                             00064400
  630 JROW=INDEX(L,1)                                                   00064500
      JCOLUM=INDEX(L,2)                                                 00064600
      DO 705 K=1,N                                                      00064700
      SWAP=A(K,JROW)                                                    00064800
      A(K,JROW)=A(K,JCOLUM)                                             00064900
      A(K,JCOLUM)=SWAP                                                  00065000
  705 CONTINUE                                                          00065100
  710 CONTINUE                                                          00065200
      DO 730 K=1,N                                                      00065300
      IF(INDEX(K,3)-1) 715,720,715                                      00065400
  720 CONTINUE                                                          00065500
  730 CONTINUE                                                          00065600
      ID=1                                                              00065700
  810 RETURN                                                            00065800
  715 ID=2                                                              00065900
      GO TO 810                                                         00066000
      END                                                               00066100
                                                                          SEG
```

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C                                                                       00066200
C                                                                       00066300

      FUNCTION SIMPUN (X,Y,N)                                           00066400
      DIMENSION X(1),Y(1)                                               00066500
      IF( N-2 ) 7,5,4                                                   00066600
    5 S=(Y(1)+Y(2) )*(X(2)-X(1))/2.                                     00066700
      GO TO 6                                                           00066800
    7 S=0.                                                              00066900
      GO TO 6                                                           00067000
    4 M=N-1                                                             00067100
      S=(X(2)-X(1))/6.*(Y(1)*((X(2)-X(3))/(X(1)-X(3))+2.)+Y(2)*((X(1)-X(  00067200
     K3))/(X(2)-X(3))+2.)-Y(3)*(X(2)-X(1))**2/((X(1)-X(3))*(X(2)-X(3))))  00067300
      LB=2                                                              00067400
      IF( N.EQ.3) GO TO 8                                               00067500
      S=S+(X(3)-X(2))/6.*(Y(2)*((X(3)-X(4))/(X(2)-X(4))+2.)+Y(3)*((X(2)-  00067600
     KX(4))/(X(3)-X(4))+2.)-Y(4)*(X(3)-X(2))**2/((X(2)-X(4))*(X(3)-X(4))  00067700
     K))                                                                00067800
      LB=3                                                              00067900
    8 DO 1 K=LB,M                                                       00068000
      IF(ABS(X(K+1)-X(1)).GE.ABS(X(K)-X(1))) GO TO 1                    00068100
      GO TO 7                                                           00068200
    1 S=S+(X(K+1)-X(K))/6.*(Y(K)*((X(K+1)-X(K-1))/(X(K)-X(K-1))+2.)+Y(K+  00068300
     M1)*((X(K)-X(K-1))/(X(K+1)-X(K-1))+2.)-Y(K-1)*(X(K+1)-X(K))**2/((X(  00068400
     NK)-X(K-1))*(X(K+1)-X(K-1))))                                      00068500
    6 SIMPUN=S                                                          00068600
      RETURN                                                            00068700
      END                                                               00068800
                                                                          SEG
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      SUBROUTINE SPRG2                                                  00068900
C                                                                       00069000
C                                                                       00069100
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM 00069200
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00069300
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10) 00069400
     3,FN(5),BAM(30),CDG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40), 00069500
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),FN1(25,7), 00069600
     5UN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP    00069700
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,OMAX,IRR,ML,IEND,IBILGE,IPRES, 00069800
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25) 00069900
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THND(50)             00070000
      COMMON NWSTP,INWSTP(12)                                           00070100
      COMMON /TEMP/ BLOG(2,7,7),YLOG(2,7,7),PRA(7,6),PRV(7,6),          00070200
     2DUM3(1116),AR1(42),AR2(42),AI2(40),AI3(40),C(40),WD(40),A(3360)   00070300
      COMMON/PPP/IPROC                                                  00070400
      DIMENSION ALF(40,27),BET(40,27)                                   00070500
      DATA MIN /3HMIN/                                                  00070600
      FM=1                                                              00070700
      VOL=TVOL                                                          00070800
      NFM=NFR-1                                                         00070900
      DOME=(OMAX-OMIN)/(NFR-1)                                          00071000
      OMEN(1)=OMIN                                                      00071100
      DO 27 N=2,NFR                                                     00071200
   27 OMEN(N)=OMEN(N-1)+DOME                                            00071300
      IF( IPROC .EQ. 0 ) RETURN                                         00071400
      L1=1                                                              00071500
      L2=1                                                              00071600
      NUMB=(NUT-1)*6                                                    00071700
      NELEM=NFR*NUMB*2                                                  00071800
      REWIND 20                                                         00071900
      DO 37 K=1,NOS                                                     00072000
      CALL FINV                                                         00072100
      DIP=ST(K)-TPST                                                    00072200
      KI=0                                                              00072300
      KM=-NUMB                                                          00072400
      DO 53 N=1,NFR                                                     00072500
      OMEGA=OMEN(N)                                                     00072600
      UN=OMEGA**2                                                       00072700
      CALL KERN                                                         00072800
      GO TO(34,35),ID                                                   00072900
   35 WRITE(6,14)K,N                                                    00073000
   14 FORMAT(29H0      MATRIX IS SINGULAR, K= I2,6H, N = I2)            00073100
      GO TO 777                                                         00073200
   34 CONTINUE                                                          00073300
      IF(IRR-1) 311,54,311                                              00073400
  311 CONTINUE                                                          00073500
C                                                                       00073600
C  IRR=1 MEANS NO INTERPOLATION BECAUSE OF IRREGULAR FREQUENCIES        00073700
C                                                                       00073800
      YK=Y(K,1)+0.0001                                                  00073900
      IF(YK) 54,2222,2222                                               00074000
 2222 CONTINUE                                                          00074100
      YKN=Y(K,NUT)                                                      00074200
      DAFT=ABS(YKN)                                                     00074300
      WDR=OMEGA*SQRT(DAFT)                                              00074400
      IF(WDR-0.7) 54,55,55                                              00074500
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 54 CONTINUE                                                            00074600
    LK=4                                                                00074700
    GO TO(70,70,70,70,70,70,71,72,73,74),LK                             00074800
 70 CONTINUE                                                            00074900
    L=LK                                                                00075000
    M=LK                                                                00075100
    GO TO 75                                                            00075200
 71 CONTINUE                                                            00075300
    L=5                                                                 00075400
    M=3                                                                 00075500
    GO TO 75                                                            00075600
 72 CONTINUE                                                            00075700
    L=2                                                                 00075800
    M=6                                                                 00075900
    GO TO 75                                                            00076000
 73 CONTINUE                                                            00076100
    L=2                                                                 00076200
    M=4                                                                 00076300
    GO TO 75                                                            00076400
 74 CONTINUE                                                            00076500
    L=6                                                                 00076600
    M=4                                                                 00076700
 75 CONTINUE                                                            00076800
 42 DADS        =0.0                                                    00076900
    DDDS        =0.0                                                    00077000
    DO 43 J=1,NON                                                       00077100
    DADS        =DADS       +DEL(K,J)*FR(J,L)*PRA(J,M)                  00077200
 43 DDDS        =DDDS       +DEL(K,J)*FR(J,L)*PRV(J,M)                  00077300
    DADS        =2.0*DADS                                               00077400
    DDDS        =2.0*DDDS                                               00077500
    ALF(N,K)=DADS                                                       00077600
    BET(N,K)=DDDS                                                       00077700
    ALFA(N,LK)=ALFA(N,LK)+DS(K)*DADS*FM                                 00077800
    BETA(N,LK)=BETA(N,LK)+DS(K)*DDDS*FM                                 00077900
 41 CONTINUE                                                            00078000
    GO TO 76                                                            00078100
 55 CONTINUE                                                            00078200
    KI=KI+1                                                             00078300
    WD(KI)=WDR                                                          00078400
    AI2(KI)=0.0                                                         00078500
    AI3(KI)=0.0                                                         00078600
    DO 52  J=1,NON                                                      00078700
    AI2(KI)=AI2(KI)+DEL(K,J)*FR(J,2)*PRA(J,2)                           00078800
    AI3(KI)=AI3(KI)+DEL(K,J)*FR(J,3)*PRA(J,3)                           00078900
 52 CONTINUE                                                            00079000
    FC1=2./DAFT/DAFT/UN/1.57                                            00079100
    AI2(KI)=AI2(KI)*FC1                                                 00079200
    AI3(KI)=AI3(KI)*FC1                                                 00079300
 76 CONTINUE                                                            00079400
    KM=KM + NUMB                                                        00079500
    DO 220 J=1,NON                                                      00079600
    DO 220 M=1,6                                                        00079700
    KM=KM+1                                                             00079800
    A(KM) = PRA(J,M)                                                    00079900
    A(KM+NUMB) = PRV(J,M)                                               00080000
220 CONTINUE                                                            00080100
    NON=NUT-1                                                           00080200
    NUMB=6*NON                                                          00080300
 53 CONTINUE                                                            00080400
C                                                                       00080500
```

```
C  INTERPOLATION BECAUSE OF IRREGULAR FREQUENCIES                    00080600
C                                                                    00080700
C  FIRST WE WRITE OUT FROM THE DRUM ALL PRESSURES FROM OMEGA*SQRT(DAFT/ 00080800
C  GRAV)=0.7                                                         00080900
      IF(KI-2) 32,32,77                                              00081000
   77 CONTINUE                                                       00081100
      KID=NFR-KI                                                     00081200
      DO 78 N12=1,NFR                                                00081300
      ITEMP=N12                                                      00081400
      FAC=OMEN(N12)*SQRT(DAFT)                                       00081500
      IF(FAC-0.7) 78,79,79                                           00081600
   78 CONTINUE                                                       00081700
   79 CONTINUE                                                       00081800
      N12=ITEMP                                                      00081900
      NUMB=6*NON                                                     00082000
      NSKIP = 2*(N12-1)*NUMB                                         00082100
      NDO = 2*(NFR-N12+1)                                            00082200
      C(NFR)=-1.                                                     00082300
      C(KID+1)=-1.                                                   00082400
      KIM=KI-1                                                       00082500
      DO 21 N=2,KIM                                                  00082600
      NN=KID+N                                                       00082700
      AL1=AI2(N+1)-AI2(N)                                            00082800
      AL2=AI2(N+1)-AI2(N-1)                                          00082900
      AL3=AI2(N)-AI2(N-1)                                            00083000
      CL1=WD(N+1)-WD(N)                                              00083100
      CL2=WD(N+1)-WD(N-1)                                            00083200
      CL3=WD(N)-WD(N-1)                                              00083300
      C(NN)=(AL1**2+CL1**2+AL3**2+CL3**2-AL2**2-CL2**2)/2./SQRT(AL1**2+C 00083400
     1L1**2)/SQRT(AL3**2+CL3**2)                                     00083500
   21 CONTINUE                                                       00083600
      DO 320 N13=1,NFR                                               00083700
      ITEMP=N13                                                      00083800
      FAC=OMEN(N13)*SQRT(DAFT)                                       00083900
      IF(FAC-0.95) 320,321,321                                       00084000
  320 CONTINUE                                                       00084100
  321 CONTINUE                                                       00084200
      N13=ITEMP                                                      00084300
      DO 322 N=1,N13                                                 00084400
      C(N)=-1.0                                                      00084500
  322 CONTINUE                                                       00084600
      DO 811 N=2,NFM                                                 00084700
      IF(C(N)-(-0.5)) 811,811,24                                     00084800
   24 NV=IFIX(0.3/DOME/SQRT(DAFT))                                   00084900
      IF(NV) 9998,9998,9999                                          00085000
 9998 NV=1                                                           00085100
 9999 CONTINUE                                                       00085200
      KN=N-NV                                                        00085300
      IF(KN-1) 531,532,532                                           00085400
  531 KN=1                                                           00085500
  532 CONTINUE                                                       00085600
      KS=N+NV                                                        00085700
      ISUM=0                                                         00085800
 4301 CONTINUE                                                       00085900
      KS=KS+ISUM                                                     00086000
      IF(KS-NFR) 431,431,432                                         00086100
  432 KS=NFR                                                         00086200
  431 CONTINUE                                                       00086300
      JR=KS+IFIX(0.1/DOME/SQRT(DAFT))                                00086400
      IF(JR-NFR) 4303,4303,4302                                      00086500
```

```
4302 JR=NFR                                                                    00086600
4303 CONTINUE                                                                  00086700
     DO 4305 JM=KS,JR                                                          00086800
     IF(C(JM)-(-0.5)) 4305,4306,4306                                           00086900
4305 CONTINUE                                                                  00087000
     GO TO 4307                                                                00087100
4306 ISUM=NV                                                                   00087200
     IF(JR-NFR) 4308,4307,4307                                                 00087300
4308 GO TO 4301                                                                00087400
4307 CONTINUE                                                                  00087500
     DNO=FLOAT(KS-KN)                                                          00087600
     DO 350 IR=1,2                                                             00087700
     DO 350 J=1,NON                                                            00087800
     DO 350 M=2,6,2                                                            00087900
     NU1=(KN-N12)*NUMB*2+(IR-1)*NON*6+(J-1)*6+M                                00088000
     NU2=(KS-N12)*NUMB*2+(IR-1)*NON*6+(J-1)*6+M                                00088100
     NU1= NU1 + NSKIP                                                          00088200
     NU2= NU2 + NSKIP                                                          00088300
     DELT1=A(NU2)-A(NU1)                                                       00088400
     DO 350 JK=KN,KS                                                           00088500
     NU=(JK-N12)*NUMB*2+(IR-1)*NON*6+(J-1)*6+M                                 00088600
     NU= NU+ NSKIP                                                             00088700
     A(NU)=A(NU1)+DELT1*(JK-KN)/DNO                                            00088800
     C(JK)=-1.                                                                 00088900
 350 CONTINUE                                                                  00089000
 811 CONTINUE                                                                  00089100
     DO 121 N=2,KIM                                                            00089200
     NN=KID+N                                                                  00089300
     AL1=AI3(N+1)-AI3(N)                                                       00089400
     AL2=AI3(N+1)-AI3(N-1)                                                     00089500
     AL3=AI3(N)-AI3(N-1)                                                       00089600
     CL1=WD(N+1)-WD(N)                                                         00089700
     CL2=WD(N+1)-WD(N-1)                                                       00089800
     CL3=WD(N)-WD(N-1)                                                         00089900
     C(NN)=(AL1**2+CL1**2+AL3**2+CL3**2-AL2**2-CL2**2)/2./SQRT(AL1**2+C        00090000
    1L1**2)/SQRT(AL3**2+CL3**2)                                                00090100
 121 CONTINUE                                                                  00090200
     DO 323 N=1,N13                                                            00090300
     C(N)=-1.0                                                                 00090400
 323 CONTINUE                                                                  00090500
     DO 821 N=2,NFM                                                            00090600
     IF(C(N)-(-0.5)) 821,821,124                                               00090700
 124 NV=IFIX(0.3/DOME/SQRT(DAFT))                                              00090800
     IF(NV) 9996,9996,9997                                                     00090900
9996 NV=1                                                                      00091000
9997 CONTINUE                                                                  00091100
     KN=N-NV                                                                   00091200
     IF(KN-1) 511,512,512                                                      00091300
 511 KN=1                                                                      00091400
 512 CONTINUE                                                                  00091500
     KS=N+NV                                                                   00091600
     ISUM=0                                                                    00091700
4311 CONTINUE                                                                  00091800
     KS=KS+ISUM                                                                00091900
     IF(KS-NFR) 411,411,412                                                    00092000
 412 KS=NFR                                                                    00092100
 411 CONTINUE                                                                  00092200
     JR=KS+IFIX(0.1/DOME/SQRT(DAFT))                                           00092300
     IF(JR-NFR) 4313,4313,4312                                                 00092400
4312 JR=NFR                                                                    00092500
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```
 4313 CONTINUE                                                          00092600
      DO 4315 JM=KS,JR                                                  00092700
      IF(C(JM)-(-0.5)) 4315,4316,4316                                   00092800
 4315 CONTINUE                                                          00092900
      GO TO 4317                                                        00093000
 4316 ISUM=NV                                                           00093100
      IF(JR-NFR) 4318,4317,4317                                         00093200
 4318 GO TO 4311                                                        00093300
 4317 CONTINUE                                                          00093400
      DNO=FLOAT(KS-KN)                                                  00093500
      DO 351 IR=1,2                                                     00093600
      DO 351 J=1,NON                                                    00093700
      DO 351 M=1,5,2                                                    00093800
      NU1=(KN-N12)*NUMB*2+(IR-1)*NON*6+(J-1)*6+M                        00093900
      NU2=(KS-N12)*NUMB*2+(IR-1)*NON*6+(J-1)*6+M                        00094000
      NU1= NU1 + NSKIP                                                  00094100
      NU2= NU2 + NSKIP                                                  00094200
      DELT1=A(NU2)-A(NU1)                                               00094300
      DO 351 JK=KN,KS                                                   00094400
      NU=(JK-N12)*NUMB*2+(IR-1)*NON*6+(J-1)*6+M                         00094500
      NU=NU+ NSKIP                                                      00094600
      A(NU)=A(NU1)+DELT1*(JK-KN)/DNO                                    00094700
      C(JK)=-1.                                                         00094800
  351 CONTINUE                                                          00094900
  821 CONTINUE                                                          00095000
C                                                                       00095100
C  WE HAVE NOW ADJUSTED IF NECESSARY THE PRESSURES FROM OMEGA*SQRT(DAFT  00095200
C     /GRAV)=0.7,AND ARE NOW GOING TO CALCULATE THE CORRESPONDING ADDED  00095300
C     MASS AND DAMPING                                                  00095400
C                                                                       00095500
      DO 58 N=N12,NFR                                                   00095600
      LK=4                                                              00095700
      GO TO(80,80,80,80,80,80,81,82,83,84),LK                           00095800
   80 CONTINUE                                                          00095900
      L=LK                                                              00096000
      M=LK                                                              00096100
      GO TO 85                                                          00096200
   81 CONTINUE                                                          00096300
      L=5                                                               00096400
      M=3                                                               00096500
      GO TO 85                                                          00096600
   82 CONTINUE                                                          00096700
      L=2                                                               00096800
      M=6                                                               00096900
      GO TO 85                                                          00097000
   83 CONTINUE                                                          00097100
      L=2                                                               00097200
      M=4                                                               00097300
      GO TO 85                                                          00097400
   84 CONTINUE                                                          00097500
      L=6                                                               00097600
      M=4                                                               00097700
   85 CONTINUE                                                          00097800
      DADS=0.0                                                          00097900
      DDDS=0.0                                                          00098000
      DO 60 J=1,NON                                                     00098100
      NU1=(N-N12)*NUMB*2+((J-1)*6+M)                                    00098200
      NU2=(N-N12)*NUMB*2 + NON*6+(J-1)*6 +M                             00098300
      NU1=NU1+NSKIP                                                     00098400
      NU2=NU2+NSKIP                                                     00098500
```

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      DADS=DADS+DEL(K,J)*FR(J,L)*A(NU1)                                 00098600
   60 DDDS=DDDS+DEL(K,J)*FR(J,L)*A(NU2)                                 00098700
      DADS=2.0*DADS                                                     00098800
      DDDS=2.0*DDDS                                                     00098900
      ALF(N,K)=DADS                                                     00099000
      BET(N,K)=DDDS                                                     00099100
      ALFA(N,LK)=ALFA(N,LK)+DS(K)*DADS*FM                               00099200
      BETA(N,LK)=BETA(N,LK)+DS(K)*DDDS*FM                               00099300
   58 CONTINUE                                                          00099400
   32 CONTINUE                                                          00099500
      WRITE(20) (A(I),I=1,NELEM)                                        00099600
   37 CONTINUE                                                          00099700
      IW=0                                                              00099800
      REWIND 80                                                         00099900
      DO 33 N=1,NFR                                                     00100000
      OMEGA=OMEN(N)                                                     00100100
      UN=OMEGA**2                                                       00100200
      ADM1=VOL*UN*4.                                                    00100300
      ADM2=VOL*OMEGA/1.4142136*4.                                       00100400
      ALFA(N,4)=ALFA(N,4)/ADM1                                          00100500
      BETA(N,4)=BETA(N,4)/ADM2                                          00100600
      DO 331 K=1,NOS                                                    00100700
      ALF(N,K)=ALF(N,K)/ADM1                                            00100800
      BET(N,K)=BET(N,K)/ADM2                                            00100900
  331 CONTINUE                                                          00101000
      IW=IW+1                                                           00101100
      IF(IW.EQ.1)WRITE(6,8100)                                          00101200
      GXI=OMEN(N)*1.4142136                                             00101300
 8100 FORMAT('1'/42X,'ARQUIVO TRES/AB'/23X,'MASSA ADICIONADA/ AMORTECIME 00101400
     1NTO ',4X,'(ADIMENSIONAIS)'/8X,'A44= MASSA ADICIONAL/(DESL*LPP**2)' 00101500
     2,9X,'B44= COEF.AMORTECIMENTO/(DESL*LPP**2*SQRT(G/LPP))'/)          00101600
      IF(IW.EQ.4)IW=0                                                   00101700
      WRITE(80)GXI,ALFA(N,4),BETA(N,4),(ALF(N,K),BET(N,K),K=1,NOS)      00101800
      WRITE(6,8200)GXI,ALFA(N,4),BETA(N,4),(K,ALF(N,K),BET(N,K),K=1,NOS) 00101900
 8200 FORMAT(/1X,'FREQ.ENCONTRO*SQRT(LPP/G):',F10.3,4X,'A44(GLOBAL)= ',E 00102000
     114.8,2X,'B44(GLOBAL)= ',E14.8/5X,'COEFICIENTES SECCIONAIS:'/3(1X,' 00102100
     2SEC',4X,'A44/LPP',7X,'B44/LPP',4X,'* ')/(3(I3,3X,E12.6,2X,E12.6,'  00102200
     3* '))) 00102300
   33 CONTINUE                                                          00102400
  777 RETURN                                                            00102500
      END                                                               00102600
      00C:0302:5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
      00C:0304:1  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
                                                                        SE
=======================================================================
C                                                                       00102700
C                                                                       00102800
      SUBROUTINE PQRT(A,B,C,P,Q,R,T)                                    00102900
                                                                        00103000
C                                                                       00103100
C                                                                       00103200
      P=(A-B)/(B-C)                                                     00103300
      Q=1.0/P                                                           00103400
      R=P-Q                                                             00103500
      T=A-C                                                             00103600
      RETURN                                                            00103700
      END                                                               SE
```

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C                                                                       00103800
C                                                                       00103900
      SUBROUTINE FINV                                                   00104000
C                                                                       00104100
C                                                                       00104200
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM 00104300
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00104400
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10) 00104500
     3,FN(5),BAM(30),COG(10),SDG(10),OMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40), 00104600
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7), 00104700
     5UN,OMEGA,ID,TITO(12),WORD,NON,IAAST,HDG1(10),IT,CBV,CMC,PRNTOP    00104800
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES, 00104900
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25) 00105000
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)             00105100
      COMMON NWSTP,INWSTP(12)                                           00105200
      COMMON /TEMP/BLOG(2,7,7),YLOG(2,7,7),DUM3(4804)                   00105300
      DO 10 I=1,NON                                                     00105400
      XM2=XX(K,I)-X(K,1)                                                00105500
      YM2=YY(K,I)-Y(K,1)                                                00105600
      XP2=XX(K,I)+X(K,1)                                                00105700
      YP2=YY(K,I)+Y(K,1)                                                00105800
      FPR2=.5*ALOG(XM2**2+YM2**2)                                       00105900
      FPL2=.5*ALOG(XP2**2+YM2**2)                                       00106000
      FCR2=.5*ALOG(XM2**2+YP2**2)                                       00106100
      FCL2=.5*ALOG(XP2**2+YP2**2)                                       00106200
      APR2=ATAN2(YM2,XM2)                                               00106300
      APL2=ATAN2(YM2,XP2)                                               00106400
      ACR2=ATAN2(YP2,XM2)                                               00106500
      ACL2=ATAN2(YP2,XP2)                                               00106600
      DO 10 J=1,NON                                                     00106700
      XM1=XX(K,I)-X(K,J+1)                                              00106800
      YM1=YY(K,I)-Y(K,J+1)                                              00106900
      XP1=XX(K,I)+X(K,J+1)                                              00107000
      YP1=YY(K,I)+Y(K,J+1)                                              00107100
      FPR1=0.5*ALOG(XM1**2+YM1**2)                                      00107200
      FPL1=0.5*ALOG(XP1**2+YM1**2)                                      00107300
      FCR1=0.5*ALOG(XM1**2+YP1**2)                                      00107400
      FCL1=0.5* ALOG(XP1**2+YP1**2)                                     00107500
      APR1=ATAN2(YM1,XM1)                                               00107600
      APL1=ATAN2(YM1,XP1)                                               00107700
      ACR1=ATAN2(YP1,XM1)                                               00107800
      ACL1=ATAN2(YP1,XP1)                                               00107900
      SIMJ=SNE(K,I)*CSE(K,J)-SNE(K,J)*CSE(K,I)                          00108000
      CIMJ=CSE(K,I)*CSE(K,J)+SNE(K,I)*SNE(K,J)                          00108100
      SIPJ=SNE(K,I)*CSE(K,J)+SNE(K,J)*CSE(K,I)                          00108200
      CIPJ=CSE(K,I)*CSE(K,J)-SNE(K,I)*SNE(K,J)                          00108300
      DPNR=SIMJ*(FPR1-FPR2)+CIMJ*(APR1-APR2)                            00108400
      PPR=CSE(K,J)*(XM1*FPR1-YM1*APR1-XM1-XM2*FPR2+YM2*APR2+XM2)+SNE(K,J 00108500
     1)*(YM1*FPR1+XM1*APR1-YM1-YM2*FPR2-XM2*APR2+YM2)                   00108600
      DPNL=SIPJ*(FPL2-FPL1)+CIPJ*(APL2-APL1)                            00108700
      PPL=CSE(K,J)*(XP2*FPL2-YM2*APL2-XP2-XP1*FPL1+YM1*APL1+XP1)+SNE(K,J 00108800
     1)*(YM1*FPL1+XP1*APL1+YM2-YM2*FPL2-XP2*APL2-YM1)                   00108900
      DCNR=SIPJ*(FCR1-FCR2)+CIPJ*(ACR1-ACR2)                            00109000
      PCR=CSE(K,J)*(XM1*FCR1-YP1*ACR1-XM1-XM2*FCR2+YP2*ACR2+XM2)+SNE(K,J 00109100
     1)*(YP2*FCR2+XM2*ACR2+YP1-YP1*FCR1-XM1*ACR1-YP2)                   00109200
      DCNL=SIMJ*(FCL2-FCL1)+CIMJ*(ACL2-ACL1)                            00109300
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      PCL=CSE(K,J)*(XP2*FCL2-YP2*ACL2-XP2-XP1*FCL1+YP1*ACL1+XP1)+SNE(K,J 00109400
     1)*(YP2*FCL2+XP2*ACL2-YP2-YP1*FCL1-XP1*ACL1+YP1)                    00109500
      BLOG(1,I,J)=DPNR+DPNL-DCNR-DCNL                                    00109600
      YLOG(1,I,J)=PPR+PPL-PCR-PCL                                        00109700
      BLOG(2,I,J)=DPNR-DPNL-DCNR+DCNL                                    00109800
      YLOG(2,I,J)=PPR-PPL-PCR+PCL                                        00109900
      IF(J-NON) 475,10,10                                                00110000
  475 XM2=XM1                                                            00110100
      YM2=YM1                                                            00110200
      XP2=XP1                                                            00110300
      YP2=YP1                                                            00110400
      FPR2=FPR1                                                          00110500
      FPL2=FPL1                                                          00110600
      FCR2=FCR1                                                          00110700
      FCL2=FCL1                                                          00110800
      APR2=APR1                                                          00110900
      APL2=APL1                                                          00111000
      ACR2=ACR1                                                          00111100
      ACL2=ACL1                                                          00111200
   10 CONTINUE                                                           00111300
      RETURN                                                             00111400
      END                                                                00111500
                                                                            SEG
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      SUBROUTINE KERN                                                    00111600
C                                                                        00111700
C                                                                        00111800
C                                                                        00111900
C                                                                        00112000
      COMMON AM(27),NUT,NMAS,NOS,ST(25),DS(25),EL,ELL,X(25,8),Y(25,8),PM 00112100
     1AS(27),XMAS(27),ZMAS(27),RRG(27),XG,ZG,TMAS,EI44,EI55,EI66,EI46,TP 00112200
     2ST,RF33,RM35,RM55,DGM,DIP,K,N,TVOL,ALFA(40,11),BETA(40,11),HDG(10) 00112300
     3,FN(5),BAM(30),CDG(10),SDG(10),UMAX,OMIN,NFR,NOK,NOB,NOH,OMEN(40), 00112400
     4FR(7,6),XX(25,7),YY(25,7),DEL(25,7),SNE(25,7),CSE(25,7),EN1(25,7), 00112500
     5UN,OMEGA,ID,TITO(12),WORD,NON,IXAST,HDG1(10),IT,CBV,CMC,PRNTOP     00112600
      COMMON ST1(27),YMAS(27),BEAM,DRAFT,DMAX,IRR,ML,IEND,IBILGE,IPRES,  00112700
     2VNY,GRAV,AMODL,MOD,AKEELL,BEAMKL,ITS(25),RD(25),RFD(25),DELTAD(25) 00112800
     2,RKD(25),SD(25),COSPHD(25),PHID(25),STPR(25),THMD(50)              00112900
      COMMON NWSTP,INWSTP(12)                                            00113000
      COMMON /TEMP/ BLOG(2,7,7),YLOG(2,7,7),PRA(7,6),PRV(7,6),           00113100
     2CON1(14,2),CON2(14,2),CT1(14,14),CT2(14,14),SOUR1(7,7),            00113200
     2SOUR2(7,7),WAVE1(7,7),WAVE2(7,7),INDEX(14,3),DUM3(4034)            00113300
      NOE=2*NON                                                          00113400
      DO 1 I=1,NON                                                       00113500
      NI=NON+I                                                           00113600
      FR(I,1)=EN1(K,I)                                                   00113700
      FR(I,2)=-SNE(K,I)                                                  00113800
      FR(I,3)=CSE(K,I)                                                   00113900
      FR(I,4)=XX(K,I)*CSE(K,I)-YY(K,I)*FR(I,2)                           00114000
      FR(I,5)=-DIP*FR(I,3)                                               00114100
      FR(I,6)=DIP*FR(I,2)                                                00114200
      CON1(I,1)=0.0                                                      00114300
      CON1(I,2)=0.0                                                      00114400
      CON2(I,1)=0.0                                                      00114500
      CON2(I,2)=0.0                                                      00114600
      CON1(NI,1)=OMEGA*FR(I,1)                                           00114700
      CON1(NI,2)=OMEGA*FR(I,3)                                           00114800
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```
      CON2(NI,1)=OMEGA*FR(I,2)                                          00114900
      CON2(NI,2)=OMEGA*FR(I,4)                                          00115000
      XR2=UN*(XX(K,I)-X(K,1))                                           00115100
      YR2=-UN*(YY(K,I)+Y(K,1))                                          00115200
      XL2=UN*(XX(K,I)+X(K,1))                                           00115300
      YL2=YR2                                                           00115400
      CALL DAVID(XR2,YR2,EJ2,CXR2,SXR2,RAR2,RBR2,CR2,SR2)               00115500
      CALL DAVID(XL2,YL2,EJ2,CXL2,SXL2,RAL2,RBL2,CL2,SL2)               00115600
      DO 1 J=1,NON                                                      00115700
      NJ=NON+J                                                          00115800
      SIPJ=SNE(K,I)*CSE(K,J)+SNE(K,J)*CSE(K,I)                          00115900
      CIPJ=CSE(K,I)*CSE(K,J)-SNE(K,I)*SNE(K,J)                          00116000
      SIMJ=SNE(K,I)*CSE(K,J)-SNE(K,J)*CSE(K,I)                          00116100
      CIMJ=CSE(K,I)*CSE(K,J)+SNE(K,I)*SNE(K,J)                          00116200
      XR1=UN*(XX(K,I)-X(K,J+1))                                         00116300
      YR1=-UN*(YY(K,I)+Y(K,J+1))                                        00116400
      XL1=UN*(XX(K,I)+X(K,J+1))                                         00116500
      YL1=YR1                                                           00116600
      CALL DAVID(XR1,YR1,EJ1,CXR1,SXR1,RAR1,RBR1,CR1,SR1)               00116700
      CALL DAVID(XL1,YL1,EJ1,CXL1,SXL1,RAL1,RBL1,CL1,SL1)               00116800
      DPR=2.*(SIPJ*(CR1-CR2)-CIPJ*(SR1-SR2))                            00116900
      DPL=2.*(CIMJ*(SL1-SL2)-SIMJ*(CL1-CL2))                            00117000
      PPR=2./UN*(SNE(K,J)*(RAR1-RAR2)+CSE(K,J)*(RBR1-RBR2))             00117100
      PPL=2./UN*(SNE(K,J)*(RAL1-RAL2)+CSE(K,J)*(RBL2-RBL1))             00117200
      DWR=6.2831853*(EJ2*(SXR2*CIPJ-CXR2*SIPJ)-EJ1*(SXR1*CIPJ-CXR1*SIPJ) 00117300
     1)                                                                 00117400
      DWL=6.2831853*(EJ1*(SXL1*CIMJ-CXL1*SIMJ)-EJ2*(SXL2*CIMJ-CXL2*SIMJ) 00117500
     1)                                                                 00117600
      PWR=6.2831853/UN*(EJ1*(SXR1*CSE(K,J)-CXR1*SNE(K,J))-EJ2*(SXR2*CSE( 00117700
     1K,J)-CXR2*SNE(K,J)))                                              00117800
      PWL=6.2831853/UN*(EJ2*(SXL2*CSE(K,J)+CXL2*SNE(K,J))-EJ1*(SXL1*CSE( 00117900
     1K,J)+CXL1*SNE(K,J)))                                              00118000
      CT1(I,J)=BLOG(1,I,J)+DPR+DPL                                      00118100
      CT2(I,J)=BLOG(2,I,J)+DPR-DPL                                      00118200
      CT1(NI,NJ)=CT1(I,J)                                               00118300
      CT2(NI,NJ)=CT2(I,J)                                               00118400
      CT1(I,NJ)=DWR+DWL                                                 00118500
      CT2(I,NJ)=DWR-DWL                                                 00118600
      CT1(NI,J)=-CT1(I,NJ)                                              00118700
      CT2(NI,J)=-CT2(I,NJ)                                              00118800
      SOUR1(I,J)=YLOG(1,I,J)+PPR+PPL                                    00118900
      SOUR2(I,J)=YLOG(2,1,J)+PPR-PPL                                    00119000
      WAVE1(I,J)=PWR+PWL                                                00119100
      WAVE2(I,J)=PWR-PWL                                                00119200
      IF(J-NON) 2,1,1                                                   00119300
    2 XR2=XR1                                                           00119400
      YR2=YR1                                                           00119500
      CXR2=CXR1                                                         00119600
      SXR2=SXR1                                                         00119700
      RAR2=RAR1                                                         00119800
      RBR2=RBR1                                                         00119900
      CR2=CR1                                                           00120000
      SR2=SR1                                                           00120100
      XL2=XL1                                                           00120200
      YL2=YL1                                                           00120300
      EJ2=EJ1                                                           00120400
      CXL2=CXL1                                                         00120500
      SXL2=SXL1                                                         00120600
      RAL2=RAL1                                                         00120700
      RBL2=RBL1                                                         00120800
```

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      CL2=CL1                                                          00120900
      SL2=SL1                                                          00121000
    1 CONTINUE                                                         00121100
      CALL MATINS(CT1,14,NOE,CON1,2,2,DTE,ID,INDEX)                    00121200
      GO TO(3,9),ID                                                    00121300
    3 CALL MATINS(CT2,14,NOE,CON2,2,2,DTO,ID,INDEX)                    00121400
      GO TO(4,9),ID                                                    00121500
    4 DO 5 I=1,NON                                                     00121600
      DO 6 L=1,4                                                       00121700
      PRA(I,L)=0.0                                                     00121800
    6 PRV(I,L)=0.0                                                     00121900
      DO 7 J=1,NON                                                     00122000
      NJ=NON+J                                                         00122100
      PRA(I,1)=PRA(I,1)+CON1(J,1)*WAVE1(I,J)-CON1(NJ,1)*SOUR1(I,J)     00122200
      PRA(I,2)=PRA(I,2)+CON2(J,1)*WAVE2(I,J)-CON2(NJ,1)*SOUR2(I,J)     00122300
      PRA(I,3)=PRA(I,3)+CON1(J,2)*WAVE1(I,J)-CON1(NJ,2)*SOUR1(I,J)     00122400
      PRA(I,4)=PRA(I,4)+CON2(J,2)*WAVE2(I,J)-CON2(NJ,2)*SOUR2(I,J)     00122500
      PRV(I,1)=PRV(I,1)+CON1(J,1)*SOUR1(I,J)+CON1(NJ,1)*WAVE1(I,J)     00122600
      PRV(I,2)=PRV(I,2)+CON2(J,1)*SOUR2(I,J)+CON2(NJ,1)*WAVE2(I,J)     00122700
      PRV(I,3)=PRV(I,3)+CON1(J,2)*SOUR1(I,J)+CON1(NJ,2)*WAVE1(I,J)     00122800
    7 PRV(I,4)=PRV(I,4)+CON2(J,2)*SOUR2(I,J)+CON2(NJ,2)*WAVE2(I,J)     00122900
      DO 8 L=1,4                                                       00123000
      PRA(I,L)=OMEGA*PRA(I,L)                                          00123100
    8 PRV(I,L)=OMEGA*PRV(I,L)                                          00123200
      PRA(I,5)=-DIP*PRA(I,3)                                           00123300
      PRA(I,6)=DIP*PRA(I,2)                                            00123400
      PRV(I,5)=-DIP*PRV(I,3)                                           00123500
    5 PRV(I,6)=DIP*PRV(I,2)                                            00123600
    9 RETURN                                                           00123700
      END                                                              00123800
                                                                         SEC
=======================================================================
      SUBROUTINE DAVID(X,Y,E,C,S,RA,RB,CIN,SON)                        00123900
C                                                                      00124000
C                                                                      00124100
C                                                                      00124200
C                                                                      00124300
      AT=ATAN2(X,Y)                                                    00124400
      ARG=AT-1.5707963                                                 00124500
      E=EXP(-Y)                                                        00124600
      C=COS(X)                                                         00124700
      S=SIN(X)                                                         00124800
      R=X**2+Y**2                                                      00124900
      TEST=0.00001                                                     00125000
      IF(R-1.0) 5,10,10                                                00125100
   10 TEST=0.1*TEST                                                    00125200
      IF(R-2.0) 5,20,20                                                00125300
   20 TEST=0.1*TEST                                                    00125400
      IF(R-4.0) 5,30,30                                                00125500
   30 TEST=0.1*TEST                                                    00125600
      IF(R-200.0) 5,31,31                                              00125700
   31 TEST=0.0001                                                      00125800
      AL=0.5*ALOG(R)                                                   00125900
      Y=-Y                                                             00126000
      SUMC=Y/SQRT(R)                                                   00126100
      SUMS=X/SQRT(R)                                                   00126200
      TC=SUMC                                                          00126300
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```
      TS=SUMS                                                          00126400
      DO 33 K=1,15                                                     00126500
      T0=TC                                                            00126600
      TC=-(TC*Y-X*TS)*K/R                                              00126700
      TS=-(TS*Y+X*T0)*K/R                                              00126800
      SUMC=SUMC+TC                                                     00126900
      SUMS=SUMS+TS                                                     00127000
      IF(K-15) 34,35,35                                                00127100
   34 IF((ABS(TC)+ABS(TS))-TEST) 35,35,33                              00127200
   35 SUMC=SUMC/SQRT(R)*(-1.)                                          00127300
      SUMS=SUMS/SQRT(R)*(-1.)                                          00127400
      SON=SUMS+3.141593*E*C                                            00127500
      SON=-SON                                                         00127600
      CIN=SUMC+3.141593*E*S                                            00127700
      RA=AL-CIN                                                        00127800
      RB=ARG+SON                                                       00127900
      GO TO 4                                                          00128000
   33 CONTINUE                                                         00128100
    5 AL=0.5*ALOG(R)                                                   00128200
      SUMC=0.57721566+AL+Y                                             00128300
      SUMS=AT+X                                                        00128400
      TC=Y                                                             00128500
      TS=X                                                             00128600
      DO 1 K=1,500                                                     00128700
      T0=TC                                                            00128800
      COX=K                                                            00128900
      CAY=K+1                                                          00129000
      FACT=COX/CAY**2                                                  00129100
      TC=FACT*(Y*TC-X*TS)                                              00129200
      TS=FACT*(Y*TS+X*T0)                                              00129300
   25 SUMC=SUMC+TC                                                     00129400
      SUMS=SUMS+TS                                                     00129500
      IF(K-500) 40,3,3                                                 00129600
   40 IF((ABS(TC)+ABS(TS))-TEST) 3,3,1                                 00129700
    3 CIN=E*(C*SUMC+S*SUMS)                                            00129800
      SON=E*(S*SUMC-C*SUMS)                                            00129900
      RA=AL-CIN                                                        00130000
      RB=ARG+SON                                                       00130100
      GO TO 4                                                          00130200
    1 CONTINUE                                                         00130300
    4 RETURN                                                           00130400
      END                                                              00130500
                                                                             SEG

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                                                                             FOR

                                                                             SEG
      NO ERRORS DETECTED.  NUMBER OF CARDS = 1306.
      COMPILATION TIME = 40 SECONDS ELAPSED,  18.27 SECONDS PROCESSING.
      D2 STACK SIZE = 30 WORDS.  FILESIZE = 82670 WORDS.  ESTIMATED CORE STORAGE RE
      TOTAL PROGRAM CODE = 4231 WORDS.  ARRAY STORAGE = 3986 WORDS.
      NUMBER OF PROGRAM SEGMENTS = 21.  NUMBER OF DISK SEGMENTS = 238.
      PROGRAM CODE FILE = (117PNV)AMROLL/OBJ ON PACK.
      COMPILER COMPILED ON 09/07/79 (FORTRAN ON PACK).
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APÊNDICE H

PROGRAMA MLROLL

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B6700  FORTRAN  COMPILATION  MARK  2.9.004  TH
                                  MLROLL/OBJ
FILE  45=THES/SPEC,UNIT=DISKPACK,RECORD=60                                    00000100
FILE  80=THES/AB,UNIT=DISKPACK,RECORD=57,AREA=600*3,BLOCKING=30               00000200
FILE  90=THES/HIDRO,UNIT=DISKPACK,RECORD=270,AREA=1*1                         00000300
FILE  95=THES/ROLL,UNIT=DISKPACK,RECORD=3,AREA=300                            00000400

      REAL MIO,LAM,LPP,MI                                                     00000500
      COMMON/AAA/HEAD(20),H13(10),FN(5),LAM(30),T13(10),XLAM(30)              00000600
      COMMON/BBB/PI,GRAV,MIO,LPP,NFN,NOH,NLAM,NH13,ISPEC                     00000700
      COMMON/CCC/JJ                                                           00000800
      COMMON/FFF/M(20,5,30,8),FASE(20,5,30,8)                                 00000900
      COMMON/SPEC/KSPEC,NSPEC,AN                                              00001000
      DIMENSION SS(27),DS(27),HBM(27),SOAR(27),AM(27),SAS(27),HB3(27)         00001100
      DIMENSION OMEN(40),ALFA(40),BETA(40),ALF(40,27),BET(40,27)              00001200
      DIMENSION SIG0(10),SIG1(10),SIG2(10),XMIO(30)                           00001300
      REWIND 45                                                               00001400
      REWIND 80                                                               00001500
      REWIND 90                                                               00001600
      REWIND 95                                                               00001700
      READ(90)NST,LPP,BOCA,NLAM,NFN,NOH,NWSTP,(HEAD(I),I=1,NOH),(FN(I),I      00001800
     1=1,NFN),(LAM(I),I=1,NLAM),DRAFT,E144,(SS(K),DS(K),HBM(K),SOAR(K),A      00001900
     2M(K),SAS(K),HB3(K),K=1,NST),TVOL,TPST,TPCM,CBV,CMC,ZG,XG,VNY,GRAV,      00002000
     3NFR                                                                     00002100
      NOS=NST*2                                                               00002200
      DO 100 N=1,NFR                                                          00002300
  100 READ(80)OMEN(N),ALFA(N),BETA(N),(ALF(N,K),BET(N,K),K=1,NOS)             00002400
      TOP=6.283185308                                                         00002500
      EL=LPP/2.                                                               00002600
      EL2=EL*EL                                                               00002700
      EL3=EL2*EL                                                              00002800
      TVOL2=TVOL*LPP*LPP*EL3                                                  00002900
      TVOL4=TVOL2*SQRT(GRAV/LPP)                                              00003000
      C44=TVOL*EL3*(LPP*CMC-ZG)*GRAV                                          00003100
C     IRR=0 SEM ALETA   IRR=1 COM ALETA   IRR=2 COM CONTROLE                  00003200
C         ISPEC=0  ESPECTRO NAO SERA LEVANTADO                                00003300
      READ(5,9001)IRR,ISPEC                                                   00003400

 9001 FORMAT(16I5)                                                            00003500
      IF(IRR.EQ.0) GO TO 110                                                  00003600
      READ(5,9002)A,R,CLIFT,BETA1,PSI,XK1,XK2                                 00003700
      BETA1=BETA1*TOP/360.                                                    00003800
      PSI=PSI*TOP/360.                                                        00003900
 9002 FORMAT(8F10.4)                                                          00004000
  110 DO 300 MM=1,NOH                                                         00004100
      HRAD=HEAD(MM)*.017453292                                                00004200
      COSOH=COS(HRAD)                                                         00004300
      SINOH=SIN(HRAD)                                                         00004400
      DO 300 JJ=1,NFN                                                         00004500
      V=FN(JJ)*SQRT(LPP*GRAV)                                                 00004600
      IF(IRR.EQ.0) GO TO 115                                                  00004700
      IF(IRR.EQ.2) BETA1=1.                                                   00004800
      XMLA=A*V*V*R*CLIFT*BETA1                                                00004900
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      XMDA=A*V*R*K*CLIFT                                                00005000
  115 DO 300 LL=1,NLAM                                                  00005100
      XLAM(LL)=1./LAM(LL)                                               00005200
      GXI=ABS(SQRT(TOP/LAM(LL))-FN(JJ)*TOP*COSOH/LAM(LL))               00005300
C             EVITA O CALCULO PARA GXI=0. QUANDO SO HA BANDA            00005400
      IF(GXI-.05)202,2,2,203                                            00005500
  202 CONTINUE                                                          00005600
      GXI=0.05                                                          00005700
  203 DO 210 N=2,NFR                                                    00005800
      ITEMP=N                                                           00005900
      DIFF=OMEN(N)-GXI                                                  00006000
      IF(DIFF)210,212,212                                               00006100
  210 CONTINUE                                                          00006200
  212 N=ITEMP                                                           00006300
      TERM=(GXI-OMEN(N-1))/(OMEN(N)-OMEN(N-1))                          00006400
      GXI=GXI*SQRT(GRAV/LPP)                                            00006500
      A44=(ALFA(N-1)+TERM*(ALFA(N)-ALFA(N-1)))*TVOL2                    00006600
      B44=(BETA(N-1)+TERM*(BETA(N)-BETA(N-1)))*TVOL4                    00006700
      C=C44-GXI*GXI*(EL44+TVOL2*A44)                                    00006800
      IF(IRR.EQ.2)C=C+XMEA*XK1                                          00006900
      D=GXI*B44                                                         00007000
      IF(IRR.EQ.2)D=D+GXI*(XMDA+XMEA*XK2)                               00007100
      E=SQRT(C*C+D*D)                                                   00007200
      IF(IRR.NE.1) GO TO 215                                            00007300
      F=D+GXI*XMDA                                                      00007400
      GG=SQRT(C*C+F*F)                                                  00007500
  215 G=0.                                                              00007600
      H1=0.                                                             00007700
      DO 220 K=1,NOS                                                    00007800
      B44S=(BET(N-1,K)+TERM*(BET(N,K)-BET(N-1,K)))*TVOL4/EL             00007900
      A44S=(ALF(N-1,K)+TERM*(ALF(N,K)-ALF(N-1,K)))*TVOL2/EL             00008000
      C44S=HB3(K)*EL3/3.-GG*SUAR(K)*EL2+AM(K)*EL3                       00008100
      FH=TOP*(SS(K)-1.)*COSOH/2./LAM(LL)                                00008200
      G=G+(GXI*B44S*COS(FH)+(GXI*GXI*A44S+SIN(FH)))*DS(K)               00008300
      H1=H1+(GXI*GXI*A44S*COS(FH)-GXI*B44S*SIN(FH))*DS(K)               00008400
      SAS(K)=C44S*GRAV*COS(FH)*EL                                       00008500
      HBM(K)=C44S*GRAV*SIN(FH)*EL                                       00008600
  220 CONTINUE                                                          00006700
      H1=H1-SIMPUN(SS,SAS,NST)                                          00008800
      G=G-SIMPUN(SS,HBM,NST)                                            00008900
      F4A=SQRT(G*G+H1*H1)*TOP*SINOH/LAM(LL)/LPP                         00009000
      GAMA=ATAN2(H1,G)                                                  00009100
      H(MM,JJ,LL,4)=F4A/E*LAM(LL)*LPP/360.                              00009200
      FASE(MM,JJ,LL,4)=(GAMA-ATAN2(D,C))*360./TOP                       00009300
      IF(FASE(MM,JJ,LL,4).GT.180.)FASE(MM,JJ,LL,4)=FASE(MM,JJ,LL,4)-300. 00009400
      IF(FASE(MM,JJ,LL,4).LT.-180.)FASE(MM,JJ,LL,4)=FASE(MM,JJ,LL,4)+360 00009500
     1.                                                                 00009600
      WRITE(95)LAM(LL),H(MM,JJ,LL,4),FASE(MM,JJ,LL,4)                   00009700
      H(MM,JJ,LL,4)=H(MM,JJ,LL,4)*360./(LAM(LL)*LPP)*360./TOP           00009800
      IF(IRR.NE.1) GO TO 300                                            00009900
      G=F4A-XMEA*COS(PSI)                                               00010000
      H1=-XMEA*SIN(PSI)                                                 00010100
      F4E=SQRT(G*G+H1*H1)                                               00010200
      DELTA=ATAN2(H1,G)                                                 00010300
      H(MM,JJ,LL,8)=F4E/GG*LAM(LL)*LPP/360.                             00010400
      FASE(MM,JJ,LL,8)=(GAMA+DELTA-ATAN2(F,C))*360./TOP                 00010500
      IF(FASE(MM,JJ,LL,4).GT.180.)FASE(MM,JJ,LL,4)=FASE(MM,JJ,LL,4)-360. 00010600
      IF(FASE(MM,JJ,LL,4).LT.-180.)FASE(MM,JJ,LL,4)=FASE(MM,JJ,LL,4)+360 00010700
     1.                                                                 00010800
      WRITE(95)LAM(LL),H(MM,JJ,LL,8),FASE(MM,JJ,LL,8)                   00010900
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```
      H(MM,JJ,LL,6)=H(MM,JJ,LL,6)*360./(LAM(LL)*LPP)*360./TOP                  00011000
  300 CONTINUE                                                                 00011100
      IWRI=4                                                                   00011200
      IF(IRR.EQ.1)IWRI=8                                                       00011300
      DO 350 JJ=1,NFN                                                          00011400
      V=FN(JJ)*SQRT(LPP*GRAV)*1.94384                                          00011500
      WRITE(6,8001)V,(HEAD(I),I=1,NOH)                                         00011600

 8001 FORMAT('1',6X,'FUNCOES DE TRANSFERENCIA EM BALANCO PARA V=',F4.1,'      00011700
     1NOS'/8X,'AMPLITUDE/FASE',11X,'(EM GRAUS)'/20X,'APROAMENTOS'/1X,'LA      00011800
     2M/L',F10.0,9(F13.0))                                                     00011900
      DO 350 LL=1,NLAM                                                         00012000
      WRITE(6,8002)LAM(LL),(H(MM,JJ,LL,IWRI),MM=1,NOH)                         00012100
      DO 345 MM=1,NOH                                                          00012200
  345 H(MM,JJ,LL,IWRI)=H(MM,JJ,LL,IWRI)*TOP/360.*LAM(LL)*LPP/360.              00012300
  350 WRITE(6,8003)(PHASE(MM,JJ,LL,IWRI),MM=1,NOH)                             00012400
 8002 FORMAT(1X,F4.1,1X,8(2X,E11.4))                                           00012500
      IF(ISPEC.EQ.0) GO TO 450                                                 00012600
 8003 FORMAT(12X,F6.1,/(7X,F6.1))                                              00012700
      READ(5,9001)NMIO,NH13                                                    00012800
      READ(5,9060)(XMIO(I),I=1,NMIO)                                           00012900
 9060 FORMAT(8F10.4)                                                           00013000
      READ(5,9070)KSPEC,NSPEC,AN                                               00013100
 9070 FORMAT(2I5,F10.4)                                                        00013200
      READ(5,9060)(H13(I),I=1,NH13)                                            00013300
      IF(KSPEC.EQ.1.OR.KSPEC.EQ.3) GO TO 1100                                  00013400
      READ(5,9060)(T13(I),I=1,NH13)                                            00013500
 1100 DO 305 MM=1,NOH                                                          00013600
      MAUX=NOH+1-MM                                                            00013700
  305 HEAD(MAUX+1)=HEAD(MAUX)                                                  00013800
      HEAD(1)=0.                                                               00013900
      HEAD(NOH+2)=180.                                                         00014000
  306 DO 320 JJ=1,NFN                                                          00014100
      DO 320 LL=1,NLAM                                                         00014200
      DO 310 MM=1,NOH                                                          00014300
      MAUX=NOH+1-MM                                                            00014400
  310 H(MAUX+1,JJ,LL,4)=H(MAUX,JJ,LL,4)                                        00014500
      H(1,JJ,LL,4)=0.                                                          00014600
  320 H(NOH+2,JJ,LL,4)=0.                                                      00014700
C         INTRODUZ OS HEAD DE 0 A 180                                        00014800
C                   OS HEAD(I) TEM QUE ESTAR EM ORDEM CRESCENTE              00014900
      NOH=NOH+2                                                                00015000
      DO 400 JJ=1,NFN                                                          00015100
      DO 400 I=1,NMIO                                                          00015200
      MIO=XMIO(I)                                                              00015300
      CALL SPECTR(SIGO,SIG1,SIG2,0,I,NOHA)                                     00015400
      LW=0                                                                     00015500
      IF(LW.GE.1) GO TO 370                                                    00015600
      WRITE(6,9700)                                                            00015700
      IF(IRL.EQ.0)WRITE(6,9701)                                                00015800
      IF(IRL.EQ.2)WRITE(6,9702)XK1,XK2                                         00015900
  370 WRITE(6,9703)XMIO(I)                                                     00016000
      LW=LW+1                                                                  00016100
      DO 380 M=1,NH13                                                          00016200
  380 WRITE(6,9704)H13(M),T13(M),SIGO(M),SIG1(M),SIG2(M)                       00016300
      IF(LW.EQ.3)LW=0                                                          00016400
      WRITE(6,9705)                                                            00016500
 9700 FORMAT('1',2X,'ALTURAS SIGNIFICATIVAS EM BALANCO')                       00016600
 9701 FORMAT('+',37X,'LIVRE'////)                                              00016700
 9702 FORMAT('+',37X,'ESTABILIZADO'/14X,'(K1=',F6.3,'  ; K2=',F6.3,')'//)      00016800
```

```
     1/)                                                                    00016900
9703 FORMAT(16X,'APROAMENTO= ',F5.0//2X,'H13   T13   SIG0',6X,'SIG1',6X    00017000
     1,'SIG2'/)                                                             00017100
9704 FORMAT(1X,F4.1,2X,F4.1,2X,3(F6.3,5X))                                  00017200
9705 FORMAT(///)                                                            00017300
 400 CONTINUE                                                               00017400
 450 LOCK 80                                                                00017500
     LOCK 45                                                                00017600
     LOCK 90                                                                00017700
     LOCK 95                                                                00017800
     STOP                                                                   00017900
     END                                                                    00018000
     002:030515  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
     002:030711  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
     002:030613  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
     002:030915  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
                                                                            SE

=====================================================================

      SUBROUTINE SPECIR(SIG0,SIG1,SIG2,IRL,KHTOT,NOHA)                      00018100
      REAL MIO,LPP,LAM,MI                                                   00018200
C                                                                           00018300
      COMMON/AAA/HEAD(20),H13(10),FN(5),LAM(30),T13(10)                     00018400
      COMMON/BBB/MI,G,MIO,LPP,NFN,NOH,NLAM,NH13                             00018500
      COMMON/CCC/JJ,M,IH,Z,KH,L1,L2,168,LAUX1,LAUX2                         00018600
      COMMON/FFF/H(20,5,30,8),PASE(20,5,30,8)                               00018700
      COMMON/SPEC/KSPEC,NSPEC,AN                                            00018800
      COMMON/ZZZ/N(10),MI(10),CX(10),CL(30),CM(10,10,5,30,2)                00018900
      DIMENSION  SIG0(10),SIG1(10),SIG2(10)                                 00019000
      DIMENSION Y(30)                                                       00019100
      RO=104.6                                                              00019200
      PI=3.1415926535                                                       00019300
      FC=PI/180.                                                            00019400
      MIO=MIO*FC                                                            00019500
      IF(KHTOT.NE.1) GO TO 21                                               00019600
      NOHA=NOH                                                              00019700
      NOH=2*NOH-1                                                           00019800
      DO 10 L=1,NOHA                                                        00019900
      LL=NOH-L+1                                                            00020000
      HEAD(LL)=360.-HEAD(L)                                                 00020100
      DO 10 K=1,NFN                                                         00020200
      DO 10 J=1,NLAM                                                        00020300
      DO 8 I=1,3                                                            00020400
      II=2*I                                                                00020500
      IF(IRL.EQ.0) II=4                                                     00020600
      H(LL,K,J,II)=H(L,K,J,II)                                              00020700
      IF(IRL.EQ.0) GO TO 10                                                 00020800
    8 CONTINUE                                                              00020900
   10 CONTINUE                                                              00021000
   15 DO 20 I=1,NOH                                                         00021100
   20 HEAD(I)=HEAD(I)*FC                                                    00021200
   21 PI2=PI/2                                                              00021300
      X1=MIO                                                                00021400
      X2=MIO                                                                00021500
      KM=2                                                                  00021600
      IF(KSPEC.LE.2)GO TO 201                                               00021700
      IF( ABS(MIO-PI2) .GT. 0.001) GO TO 101                                00021800
      KM=1                                                                  00021900
```

```
      X1=MIO*PI2                                                        00022000
      X2=MIO+3.*PI2                                                     00022100
      GO TO 201                                                         00022200
  101 X1=MIO-PI2                                                        00022300
      X2=MIO+PI2                                                        00022400
      IF(X1.LT.0.)X1=X1+2.*PI                                           00022500
  201 DO 401 L1=1,NOH                                                   00022600
      IF( HEAD(L1)-X1 ) 301,501,501                                     00022700
  301 IF( X1-HEAD(L1)-0.001 ) 701,701,401                               00022800
  401 CONTINUE                                                          00022900
  501 IF( HEAD(L1)-X1-0.001 ) 701,701,601                               00023000
  601 IF( KM .EQ. 1 ) L1=L1-1                                           00023100
  701 DO 901 L2=L1,NOH                                                  00023200
      IF( HEAD(L2)-X2 ) 801,1001,1001                                   00023300
  801 IF( X2-HEAD(L2) - 0.001 ) 1201,1201,901                           00023400
  901 CONTINUE                                                          00023500
 1001 IF( HEAD(L2)-X2-0.001 ) 1201,1101,1101                            00023600
 1101 IF( KM .EQ. 2 ) L2=L2-1                                           00023700
 1201 LAUX1=L1                                                          00023800
      LAUX2=L2                                                          00023900
      IF(KSPEC.LT.3)GO TO 1951                                          00024000
      GO TO (1601,1951),KM                                              00024100
 1601 LQ=0                                                              00024200
      LL=0                                                              00024300
      IF( HEAD(1) .LT. 0.001 )LQ=1                                      00024400
      LMAX=NOH+L1-LQ                                                    00024500
      DO 1901 L=L2,LMAX                                                 00024600
      LL=LL+1                                                           00024700
      IF(L-NOH) 1801, 1801,1701                                         00024800
 1701 LQ=LQ+1                                                           00024900
      H(LL)=HEAD(LQ)                                                    00025000
      MI(LL)=H(LL)-MIO                                                  00025100
      GO TO 1901                                                        00025200
 1801 H(LL)=HEAD(L)-2.*PI                                               00025300
      MI(LL)=H(LL)-MIO                                                  00025400
 1901 CONTINUE                                                          00025500
      GO TO 2201                                                        00025600
 1951 LL=0                                                              00025700
      IF(L2.GE.L1) GO TO 2001                                           00025800
      LAUX1=1                                                           00025900
      DO 1971 L=L1,NOH-1                                                00026000
      LL=LL+1                                                           00026100
      CX(LL)=HEAD(L)-2.*PI                                              00026200
      H(LL)=HEAD(L)                                                     00026300
 1971 MI(LL)=H(LL)-MIO                                                  00026400
 2001 DO 2101 L=LAUX1,L2                                                00026500
      LL=LL+1                                                           00026600
      H(LL)=HEAD(L)                                                     00026700
      MI(LL)=H(LL)-MIO                                                  00026800
 2101 CONTINUE                                                          00026900
 2201 LT=LL                                                             00027000
      CALL MOMEN                                                        00027100
      INL=0                                                             00027200
      DO 5000 IM=1,3                                                    00027300
      IF(IRL.EQ.0) IM=4                                                 00027400
      IMI=2*IM                                                          00027500
      II=1                                                              00027600
      IF(IMI.GT.3)II=2                                                  00027700
      I88=1                                                             00027800
      Z=0.                                                              00027900
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      IF(II.EQ.2)Z=1.                                                   00028000
      DO 4000 M=1,NH13                                                  00028100
      CALL SIGMA(SIGO(M),SIG1(M),SIG2(M))                               00028200
 4000 CONTINUE                                                          00028300
 5000 CONTINUE                                                          00028400
      RETURN                                                            00028500
      END                                                               00028600
                                                                          SE
C*****************************************************************************
                                                                          FU
      SUBROUTINE SIGMA(SIG0,SIG2,SIG4)                                  00028700
      REAL LPP,MI,MIO,LAM,MOM                                           00028800
      COMMON/AAA/HEAD(20),H13(10),FN(5),LAM(30),T13(10),XLAM(30)        00028900
      COMMON/BBB/PI,G,MIO,LPP,NEN,NOM,NLAM,NH13,ISPEC                   00029000
      COMMON/CCC/K,M,I,Z,KM,L1,L2,I68,LAUX1,LAUX2                       00029100
      COMMON/FFF/H(20,5,30,8),FASE(20,5,30,8)                           00029200
      COMMON/ZZZ/H(10),MI(10),GX(10),CL(30),CM(10,10,5,30,3)            00029300
      DIMENSION MOM(5,40),SIG(5)                                        00029400
      NMAX=3                                                            00029500
      IZ=Z +1                                                           00029600
      SIG0=0.                                                           00029700
      SIG2=0.                                                           00029800
      SIG4=0.                                                           00029900
      FC=180./PI                                                        00030000
      IF(H13(M).EQ.0.) GO TO 2000                                       00030100
      IF(L2.GE.L1) GO TO 700                                            00030200
      DO 500 L=L1,NOH-1                                                 00030300
      LL=LL+1                                                           00030400
      DO 500 NN=1,NMAX                                                  00030500
      MOM(NN,LL)=0.                                                     00030600
C       SE HEAD=0,180,00 350   CONTINUE                                 00030700
      IF(L.EQ.1.OR.2*L.EQ.NOH+1.OR.L.EQ.NOH) GO TO 500                  00030800
      DO 400 J=1,NLAM                                                   00030900
  400 CL(J)=H(L,K,J,IM)**2*CM(M,LL,NN,J,IZ)                             00031000
      MOM(NN,LL)=-SIMPON(XLAM,CL,NLAM)                                  00031100
      IF(ISPEC.EQ.0) GO TO 500                                          00031200
      IF(NN.NE.1) GO TO 500                                             00031300
      DO 450 J=1,NLAM                                                   00031400
      CL(J)=CL(J)*3282.806                                              00031500
      WRITE(45)(LAM(J),CL(J),J=1,NLAM)                                  00031600
      VAUX=FN(K)*SQRT(LPP*G)*1.9438                                     00031700
      HAUX=HEAD(L)*57.29578                                             00031800
      AUXMIO=MIO*57.29578                                               00031900
  450 WRITE(6,9500)VAUX,AUXMIO,HAUX,H13(M),(LAM(J),XLAM(J),CM(M,LL,NN,J,  00032000
     113),CL(J),J=1,NLAM)                                               00032100
 9500 FORMAT('1'///11X,'ESPECTRO DE BALANCO'//4X,'VELOCIDADE:',F5.1,'   00032200
     1 NOS'/4X,'DIRECAO PREDOMINANTE DO MAR:',F6.1,' GRAUS'/4X,'APROAMEN 00032300
     2TO DO MAR:',F6.1,' GRAUS'/4X,'ALTURA SIGNIFICATIVA:',F5.1,' METROS 00032400
     3'//2X,'LAMBDA/L   L/LAMBDA  HEADM     ORDENADA'/(1X,F7.3,F11.3,F9.  00032500
     43,3X,E12.6))                                                      00032600
  500 CONTINUE                                                          00032700
  700 DO 900 L=LAUX1,L2                                                 00032800
      LL=LL+1                                                           00032900
      DO 900 NN=1,NMAX                                                  00033000
      MOM(NN,LL)=0.                                                     00033100
      IF(L.EQ.1.OR.2*L.EQ.NOH+1.OR.L.EQ.NOH) GO TO 900                  00033200
      DO 600 J=1,NLAM                                                   00033300
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C       - PROVISORIO                                                    00033400
 9999 FORMAT(1X,3E10.4,1215)                                            00033500
  800 CL(J)=M(L,K,J,IM)**2*CM(M,LL,NN,J,IZ)                             00033600
      MOM(NN,LL)=SIMPUN(XLAM,CL,NLAM)                                   00033700
      IF(NN.NE.1) GO TO 900                                             00033800
      DO 850 J=1,NLAM                                                   00033900
      CL(J)=CL(J)*3282.806                                              00034000
      WRITE(45)(LAM(J),CL(J),J=1,NLAM)                                  00034100
      VAUX=FN(K)*SQRT(LPP*G)*1.9438                                     00034200
      HAUX=HEAD(L)*57.29578                                             00034300
      AUXMIO=MIO*57.29578                                               00034400
  850 WRITE(6,9500)VAUX,AUXMIO,HAUX,M13(M),(LAM(J),XLAM(J),CM(M,LL,NN,J,  00034500
     113),CL(J),J=1,NLAM)                                               00034600
  900 CONTINUE                                                          00034700
      IF(KSPEC.LT.3) GO TO 1210                                         00034800
 1000 DO 1200 NN=1,NMAX                                                 00034900
      DO 1100 L=1,LL                                                    00035000
 1100 CL(L)=MOM(NN,L)                                                   00035100
      SIG(NN)=SIMPUN(LX,CL,LL)                                          00035200
 1200 CONTINUE                                                          00035300
      GO TO 1250                                                        00035400
 1210 DO 1220 NN=1,NMAX                                                 00035500
      IF(L1.EQ.L2)SIG(NN)=MOM(NN,LL)                                    00035600
      IF(L1.NE.L2)SIG(NN)=MOM(NN,L1)*(MIO-HEAD(L1))*(MOM(NN,2)-MOM(NN,1) 00035700
     1)/(HEAD(L2)-HEAD(L1))                                             00035800
 1220 CONTINUE                                                          00035900
 1250 SIG0=SQRT(SIG(1))*FC                                              00036000
      SIG2=SQRT(SIG(2))*FC                                              00036100
      SIG4=SQRT(SIG(3))*FC                                              00036200
 2000 RETURN                                                            00036300
      END                                                               00036400
      00B:011715  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
      00B:011911  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
                                                                        SE

      SUBROUTINE MOMEN                                                  00036500
      REAL LPP,LAM,MIO,MI                                               00036600
      COMMON/AAA/HEAD(20),M13(10),FN(5),XLAM(30),T13(10),LAM(30)        00036700
      COMMON/BBB/PI,G,MIO,LPP,NFN,NOM,NLAM,NM13                         00036800
      COMMON/CCC/K,M,IM,Z,CM,LL,L2,L1,I68                               00036900
      COMMON/ZZZ/X(10),MI(10),CX(10),CL(30),CM(10,10,5,30,3)            00037000
      COMMON/SPEC/KSPEC,NSPEC,AN                                        00037100
      DIMENSION AUX2(30),AUX3(30),AUX4(30),C11(30),C3(10),C5(10),C1(5)  00037200
      IF(KSPEC.EQ.1.OR.KSPEC.EQ.3)A=G*G*.0081                           00037300
      C2=2.*PI                                                          00037400
      C6=360./LPP                                                       00037500
      C7=LPP*LPP/(4.*PI*PI*G*G)                                         00037600
      C9=G/LPP                                                          00037700
      C10=FN(K)*C2                                                      00037800
      DO 100 J=1,NLAM                                                   00037900
      AL2=LAM(J)*LAM(J)                                                 00038000
      AUX2(J)=AL2*LAM(J)                                                00038100
      AUX4(J)=C6*C6*AL2                                                 00038200
  100 C11(J)=SQRT(C2*LAM(J))                                            00038300
      DO 200 L=1,LT                                                     00038400
      C3(L)=C10*COS( X(L) )                                             00038500
      IF(KSPEC.LT.3)C3(L)=1.                                            00038600
```

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      IF(KSPEC.GE.3)C3(L)=AN*((COS(MI(L)))**NSPEC                          00038700
  200 CONTINUE                                                             00038800
      DO 500 M=1,NH13                                                      00038900
      IF(KSPEC.EQ.2.OR.KSPEC.EQ.4)B=691.17/T13(M)**4                       00039000
      IF(KSPEC.EQ.1.OR.KSPEC.EQ.3)B=3.11/(H13(M)*H13(M))                   00039100
      IF(KSPEC.EQ.2.OR.KSPEC.EQ.4)A=172.79*H13(M)*H13(M)/T13(M)**4         00039200
      C6=A*C7/2.                                                           00039300
      C4=B*C7                                                              00039400
      DO 300 NN=1,3                                                        00039500
      N=NN+NN-2                                                            00039600
  300 C1(NN)=C6*C9**(N/2)                                                  00039700
      DO 400 J=1,NLAM                                                      00039800
  400 AUX3(J)=EXP( -C4/(LAM(J)*LAM(J)) )                                   00039900
      DO 500 NN=1,3                                                        00040000
      N=NN+NN-2                                                            00040100
      DO 500 L=1,LT                                                        00040200
      DO 500 J=1,NLAM                                                      00040300
      AUX1=( C11(J)-C3(L)*LAM(J) )**N                                      00040400
      C12=AUX1/AUX2(J)*AUX3(J)*C1(NN)*C5(L)                                00040500
      CM(M,L,NN,J,1)=C12                                                   00040600
      CM(M,L,NN,J,2)=C12*AUX4(J)                                           00040700
      IF(NN.EQ.2)CM(M,L,1,J,3)=SQRT(AUX1*G/LPP)                            00040800
  500 CONTINUE                                                             00040900
      RETURN                                                               00041000
       END                                                                 00041100
                                                                           SL
*********************************************************************************

                                                                           00041200
      FUNCTION SIMPUN(X,Y,N)                                               00041300
      DIMENSION X(40),Y(40)                                                00041400
      IF( N-2 ) 7,5,4                                                      00041500
    5 S=(Y(1)+Y(2) )*(X(2)-X(1))/2.                                        00041600
      GO TO 6                                                              00041700
    7 S=0.                                                                 00041800
      GO TO 6                                                              00041900
    4 M=N-1                                                                00042000
      S=(X(2)-X(1))/6.*(Y(1)*((X(2)-X(3))/(X(1)-X(3))+2.)+Y(2)*((X(1)-X(   00042100
     K3))/(X(2)-X(3))+2.)-Y(3)*(X(2)-X(1))**2/((X(1)-X(3))*(X(2)-X(3))))   00042200
      LB=2                                                                 00042300
      IF( N.EQ.3) GO TO 8                                                  00042400
      S=S+(X(3)-X(2))/6.*(Y(2)*((X(3)-X(4))/(X(2)-X(4))+2.)+Y(3)*((X(2)-   00042500
     KX(4))/(X(3)-X(4))+2.)-Y(4)*(X(3)-X(2))**2/((X(2)-X(4))*(X(3)-X(4)))  00042600
     K))                                                                   00042700
      LB=3                                                                 00042800
    8 DO 1 K=LB,M                                                          00042900
      IF(ABS(X(K+1)-X(K)).GE.ABS(X(K)-X(1))) GO TO 1                       00043000
      GO TO 7                                                              00043100
    1 S=S+(X(K+1)-X(K))/6.*(Y(K)*((X(K+1)-X(K-1))/(X(K)-X(K-1))+2.)+Y(K+   00043200
     K1)*((X(K)-X(K-1))/(X(K+1)-X(K-1))+2.)-Y(K-1)*(X(K+1)-X(K))**2/((X(   00043300
     NK)-X(K-1))*(X(K+1)-X(K-1))))                                         00043400
    6 SIMPUN=S                                                             00043500
      RETURN                                                               00043600
      END                                                                  00043700
                                                                           SL
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                                                                           FU
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APÊNDICE I

PROGRAMA CONTROLL

```
B6700  F O R T R A N  C O M P I L A T I O N  M A R K  2.9.004  T
                                C O N T R O L L / O B J
                                = = = = = = = = = = =
FILE  60=TRES/AB,UNIT=DISKPACK,RECORD=57,AREA=600*3,BLOCKING=30                00000100
FILE  65=TRES/FOBJ,UNIT=DISKPACK,RECORD=9,AREA=140*1                           00000200
FILE  90=TRES/HIDRO,UNIT=DISKPACK,RECORD=270,AREA=1*1                          00000300
FILE  95=TRES/ROLE,UNIT=DISKPACK,RECORD=3,AREA=300                             00000400

      REAL MIO,LAM,LPP,MI,LFO                                                  00000500
      COMMON/AAA/HEAD(20),H13(10),FN(5),LAM(30),T13(10),XLAM(30)               00000600
      COMMON/BBB/PI,GRAV,MIC,LPP,NFN,NOH,NLAM,NH13                             00000700
      COMMON/CCC/JJ                                                            00000800
      COMMON/FFF/H(20,5,30,8),FASE(20,5,30,8)                                  00000900
      COMMON/SPEC/KSPEC,NSPEC,AN                                               00001000
      COMMON/EFIC/BAL(10),EF(10),NEF                                           00001100
      DIMENSION SS(27),DS(27),HBM(27),SMAR(27),AM(27),SAS(27),HB3(27)          00001200
      DIMENSION OMEN(40),ALFA(40),BETA(40),ALF(40,27),BET(40,27)               00001300
      DIMENSION XMIO(36),PREP(10,36),PRDN(10,19),PRRO(36)                      00001400
      DIMENSION  SIGO(10),SIG1(10),SIG2(10)                                    00001500
      DIMENSION FO(11,11),LFO(11,11,4)                                         00001600
      DATA FO,LFO/605*0./                                                      00001700
      REWIND 60                                                                00001800
      REWIND 65                                                                00001900
      REWIND 90                                                                00002000
      REWIND 95                                                                00002100
      READ(90)NST,LPP,SOCA,NLAM,NFN,NOH,NMSTF,(HEAD(I),I=1,NOH),(FN(I),I      00002200
     1=1,NFN),(LAM(I),I=1,NLAM),DRAFT,ET44,(SS(K),DS(K),HBM(K),SMAR(K),A      00002300
     2M(K),SAS(K),HB3(K),K=1,NST),TVOL,TPST,TPOM,CHV,CMC,ZG,XG,YNY,GRAV,      00002400
     3NEF                                                                      00002500
      NOS=NST-2                                                                00002600
      DO 100 N=1,NFR                                                           00002700
  100 READ(90)OMEN(N),ALFA(N),BETA(N),(ALF(N,K),BET(N,K),K=1,NOS)              00002800
      READ(5,9050)NMIO,NH13,NPEF                                               00002900

 9050 FORMAT(16I5)                                                             00003000
C          DIRECOES PREDOMINANTES A CONSIDERAR                                00003100
      READ(5,9060)(XMIO(I),I=1,NMIO)                                           00003200
 9060 FORMAT(6F10.4)                                                           00003300
C                    CARACTERISTICAS DO ESPECTRO                             00003400
      READ(5,9070)KSPEC,NSPEC,AN                                               00003500
 9070 FORMAT(2I5,F10.4)                                                        00003600
      READ(5,9060)(H13(I),I=1,NH13)                                            00003700
      IF(KSPEC.NE.2.AND.KSPEC.NE.4) GO TO 110                                  00003800
      READ(5,9060)(T13(I),I=1,NH13)                                            00003900
  110 DO 120 I=1,NH13                                                          00004000
  120 READ(5,9060)(PRDN(I,J),J=1,NMIO)                                         00004100
C        OS RUMOS TEM QUE CORRESPONDER AS DIRECOES PREDOMINANTES               00004200
      READ(5,9060)(PRRO(J),J=1,NMIO)                                           00004300
      READ(5,9060)(BAL(I),I=1,NPEF)                                            00004400
      READ(5,9060)(EF(I),I=1,NPEF)                                             00004500
      READ(5,9060)BETMAX,VBEMAX                                                00004600
      DO 150 I=1,NH13                                                          00004700
      II=-1                                                                    00004800
      DO 150 J=1,NMIO                                                          00004900
```

```
      IL=IL+1                                                          00005000
      SOMA=0.                                                          00005100
      DO 130 K=1,NMIO                                                  00005200
      IDIR=K-IL                                                        00005300
      IF(IDIR.LE.0)IDIR=IDIR+NMIO                                      00005400
  130 SOMA=SOMA+PROB(I,IDIR)*PROB(K)                                   00005500
      IF(2*J.LE.NMIO+2) GO TO 140                                      00005600
      PROB(I,NMIO-J+2)=PROB(I,NMIO-J+2)+SOMA                           00005700
      GO TO 150                                                        00005800
  140 PROB(I,J)=SOMA                                                   00005900
  150 CONTINUE                                                         00006000
      WRITE(6,9100)(XMIO(J),J=1,NMIO/2+1)                              00006100

 9100 FORMAT('1',5X,'FREQUENCIA DE OCORRENCIA DE DIRECOES PREDOMINANTES' 00006200
     1///2X,'H13',3X,'T13',1X(2X,F4.0)//)                              00006300
      DO 160 I=1,NH13                                                  00006400
  160 WRITE(6,9200)H13(I),T13(I),(PROB(I,J),J=1,NMIO/2+1)              00006500
 9200 FORMAT(1X,F4.1,2X,F4.1,2X,F5.4,18(1X,F5.4))                      00006600
C                                CALCULOS DE C44,B44,A44               00006700
      TOP=6.283185308                                                  00006800
      EL=LPP/2.                                                        00006900
      EL2=EL*EL                                                        00007000
      EL3=EL2*EL                                                       00007100
      TVOL2=TVOL*LPP*LPP*EL3                                           00007200
      TVOL4=TVOL2*SQRT(GRAV/LPP)                                       00007300
      C44=TVOL*EL3*(LPP*CMC-ZG)*GRAV                                   00007400
C      LEITURA DAS CARACT. ALETA E CAMPO VARIACAO GANHOS DO CONTROLE    00007500
      READ(5,9002)A,R,CLIFT,XK1MIN,XK1MAX,K1LIM,XK2MIN,XK2MAX,K2LIM    00007600
 9002 FORMAT(5F10.4,I5,2F10.4,I5)                                      00007700
      K1LIM=K1LIM+1                                                    00007800
      K2LIM=K2LIM+1                                                    00007900
      DO 400 K1=1,K1LIM                                                00008000
      DK1LIM=K1LIM-1                                                   00008100
      XK1=K1                                                           00008200
      XK1=(XK1-1.)*(XK1MAX-XK1MIN)/DK1LIM+XK1MIN                       00008300
      DO 400 K2=1,K2LIM                                                00008400
      DK2LIM=K2LIM-1                                                   00008500
      XK2=K2                                                           00008600
      XK2=(XK2-1.)*(XK2MAX-XK2MIN)/DK2LIM+XK2MIN                       00008700
      LFD(K1,K2,3)=XK1                                                 00008800
      LFD(K1,K2,4)=XK2                                                 00008900
      WRITE(85)XK1MIN,XK1MAX,K1LIM,XK2MIN,XK2MAX,K2LIM                 00009000
      DO 300 MM=1,NOH                                                  00009100
      HRAD=HEAD(MM)*.017453292                                         00009200
      COSOH=COS(HRAD)                                                  00009300
      SINOH=SIN(HRAD)                                                  00009400
      DO 300 JJ=1,NFN                                                  00009500
      V=FN(JJ)*SQRT(LPP*GRAV)                                          00009600
      XMFA=A*V*V*R*CLIFT                                               00009700
      XMDA=A*V*R*R*CLIFT                                               00009800
      DO 300 LL=1,NLAM                                                 00009900
      XLAM(LL)=1./LAM(LL)                                              00010000
      GXI=ABS(SQRT(TOP/LAM(LL))-FN(JJ)*TOP*COSOH/LAM(LL))              00010100
C              EVITA O CALCULO PARA GXI=0., QUANDO SO HA BANDA          00010200
      IF(GXI-.05)202,202,203                                           00010300
  202 CONTINUE                                                         00010400
      GXI=0.05                                                         00010500
  203 DO 210 N=2,NFR                                                   00010600
      ITEMP=N                                                          00010700
      DIFF=OMEN(N)-GXI                                                 00010800
```

```
      IF(DIFF)210,212,212                                                    00010900
  210 CONTINUE                                                               00011000
  212 N=ITEMP                                                                00011100
      TERM=(GXI-OMEN(N-1))/(OMEN(N)-OMEN(N-1))                               00011200
      GXI=GXI+SQRT(GRAV/LPP)                                                 00011300
      A44=(ALFA(N-1)+TERM*(ALFA(N)-ALFA(N-1)))*TVOL2                         00011400
      B44=(BETA(N-1)+TERM*(BETA(N)-BETA(N-1)))*TVOL4                         00011500
      C=C44-GXI*GXI*(EI44+TVOL2+A44)+XMEA*XK1                                00011600
      D=GXI*(B44+XMDA+XMEA*XK2)                                              00011700
      E=SQRT(C*C+D*D)                                                        00011800
      G=0.                                                                   00011900
      H1=0.                                                                  00012000
      DO 220 K=1,NDS                                                         00012100
      AAAS=(ALF(N-1,K)+TERM*(ALF(N,K)-ALF(N-1,K)))*TVOL2/EL                  00012200
      BAAS=(BET(N-1,K)+TERM*(BET(N,K)-BET(N-1,K)))*TVOL4/EL                  00012300
      CAAS=HB3(K)+EL3/3.-ZG*SOAR(K)*EL2+AM(K)*EL3                            00012400
      FH=TOP*(SS(K)-1.)*COSCH/2./LAM(LL)                                     00012500
      G=G+(GXI*B44S*COS(FH)+(GXI*GXI*A44S*SIN(FH)))*DS(K)                    00012600
      H1=H1+(GXI*GXI*A44S*COS(FH)-GXI*B44S*SIN(FH))*DS(K)                    00012700
      SAS(K)=C44S*GRAV*COS(FH)*EL                                            00012800
      HBM(K)=C44S*GRAV*SIN(FH)*EL                                            00012900
  220 CONTINUE                                                               00013000
      H1=H1*SIMPUN(SS,SAS,NST)                                               00013100
      G=G-SIMPUN(SS,HBM,NST)                                                 00013200
      FAA=SQRT(G*G+H1*H1)*TOP*SINCH/LAM(LL)/LPP                              00013300
      GAMA=ATAN2(H1,G)                                                       00013400
      H(MM,JJ,LL,4)=FAA/E                                                    00013500
      FASE(MM,JJ,LL,4)=(GAMA-ATAN2(D,C))*360./TOP                            00013600
      IF(FASE(MM,JJ,LL,4).GT.180.)FASE(MM,JJ,LL,4)=FASE(MM,JJ,LL,4)-360.     00013700
      IF(FASE(MM,JJ,LL,4).LT.-180.)FASE(MM,JJ,LL,4)=FASE(MM,JJ,LL,4)+360     00013800
     1.                                                                      00013900
      WRITE(95)LAM(LL),H(MM,JJ,LL,4),FASE(MM,JJ,LL,4)                        00014000
      H(MM,JJ,LL,4)=H(MM,JJ,LL,4)*LPP/360.*LAM(LL)                           00014100
  300 CONTINUE                                                               00014200
      DO 305 MM=1,NOH                                                        00014300
      MAUX=NOH+1-MM                                                          00014400
  305 HEAD(MAUX+1)=HEAD(MAUX)                                                00014500
      HEAD(1)=0.                                                             00014600
      HEAD(NOH+2)=180.                                                       00014700
  308 DO 320 JJ=1,NFN                                                        00014800
      DO 320 LL=1,NLAM                                                       00014900
      DO 310 MM=1,NOH                                                        00015000
      MAUX=NOH+1-MM                                                          00015100
  310 H(MAUX+1,JJ,LL,4)=H(MAUX,JJ,LL,4)                                      00015200
      H(1,JJ,LL,4)=0.                                                        00015300
  320 H(NOH+2,JJ,LL,4)=0.                                                    00015400
C         INTRODUZ OS HEAD DE 0 A 180                                        00015500
C                 OS HEAD(I) TEM QUE ESTAR EM ORDEM CRESCENTE              00015600
      NOH=NOH+2                                                              00015700
      DO 355 JJ=1,NFN                                                        00015800
      IW=0                                                                   00015900
      DO 355 I=1,NMIO/2+1                                                    00016000
      MIO=XMIO(I)                                                            00016100
      IW=IW+1                                                                00016200
      IF(IW.EQ.1)WRITE(6,8100)                                               00016300
 8100 FORMAT('1',15X,'RESULTADOS PARCIAIS DO SISTEMA DE CONTROLE')           00016400
      IF(IW.EQ.4)IW=0                                                        00016500
      CALL SPECTR(SIGO,SIG1,SIG2,0,I,NOHA)                                   00016600
      WRITE(6,8200)XMIO(I),XK1,XK2                                           00016700
 8200 FORMAT(//3X,'APROAMENTO:',F6.1,' GRAUS',7X,'XK1=',F5.1,7X,'XK2=',F    00016800
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     15,1/2X,'H13    T13',5X,'SIG0',5X,'SIG1',5X,'SIG2',4X,'PBETA',4X,'PV 00016900
     2BETA',4X,'EFIC')                                                    00017000
      PMIO=0.                                                             00017100
      PBETG=0.                                                            00017200
      EFICG=0.                                                            00017300
      PVBETG=0.                                                           00017400
      DO 350 K13=1,NH13                                                   00017500
      PMIO=PMIO+PROB(K13,I)                                               00017600
      PBETA=0.                                                            00017700
      EAUX=(SIG0(K13)*XK1)**2+(SIG1(K13)*XK2)**2                          00017800
      IF(EAUX.EQ.0.0)GO TO 330                                            00017900
      PBETA=EXP(-BETMAX**2/2./EAUX)*100.                                  00018000
  330 LFD(K1,K2,1)=LFD(K1,K2,1)+PBETA*PROB(K13,I)                         00018100
      PBETG=PBETG+PBETA*PROB(K13,I)                                       00018200
      PVBETA=0.                                                           00018300
      VAUX=(SIG1(K13)*XK1)**2+(SIG2(K13)*XK2)**2                          00018400
      IF(VAUX.EQ.0.0) GO TO 340                                           00018500
      PVBETA=EXP(-VBEMAX**2/2./VAUX)*100.                                 00018600
  340 LFD(K1,K2,2)=LFD(K1,K2,2)+PVBETA*PROB(K13,I)                        00018700
      PVBETG=PVBETG+PVBETA*PROB(K13,I)                                    00018800
      EAUX=EFIC(SIG0(K13))*100.                                           00018900
      FD(K1,K2)=FD(K1,K2)+PROB(K13,I)*EAUX                                00019000
      WRITE(6,8300)H13(K13),T13(K13),SIG0(K13),SIG1(K13),SIG2(K13),PBETA  00019100
     1,PVBETA,EAUX                                                        00019200
 8300 FORMAT(1X,F4.1,2X,F4.1,6(2X,F7.2))                                  00019300
      WRITE(85)XK1,XK2,FD(K1,K2),LFD(K1,K2,1),LFD(K1,K2,2)                00019400
      EFICG=EFICG+EAUX*PROB(K13,I)                                        00019500
  350 CONTINUE                                                            00019600
      PBETG=PBETG/PMIO                                                    00019700
      PVBETG=PVBETG/PMIO                                                  00019800
      EFICG=EFICG/PMIO                                                    00019900
      PMIO=PMIO*100.                                                      00020000
      WRITE(6,8350)PMIO,PBETG,PVBETG,EFICG                                00020100
 8350 FORMAT(1X,'TOTAL NO APROAMENTO(OCORRENCIA:',F6.2,'%)',3(F7.2,2X))   00020200
  355 CONTINUE                                                            00020300
  360 NDH=NDHA-2                                                          00020400
      DO 370 I=1,NDH                                                      00020500
  370 HEAD(I)=HEAD(I+1)*360./TOP                                          00020600
  400 CONTINUE                                                            00020700
      WRITE(6,8400)((LFD(K1,K2,3),LFD(K1,K2,4),FD(K1,K2),LFD(K1,K2,1),LF 00020800
     1D(K1,K2,2),K2=1,K2LIM),K1=1,K1LIM)                                  00020900
 8400 FORMAT('1',5X,'RESULTADOS GLOBAIS DO SISTEMA DE CONTROLE'//2(5X,'X 00021000
     1K1  XK2',4X,'FD',4X,'PBETA PVBETA')/2(' **',2(1X,F4.1),1X,3(1X,F6. 00021100
     22)))                                                                00021200
      LOOK 50                                                             00021300
      LOOK 55                                                             00021400
      LOOK 90                                                             00021500
      LOOK 95                                                             00021600
      STOP                                                                00021700
      END                                                                 00021800
      002:036D:4  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
      002:03EF:0  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
      002:0370:2  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
      002:0371:4  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
      002:0373:0  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 0
                                                                          SE
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      SUBROUTINE SPECTR(SIG0,SIG1,SIG2,IRL,KPTOT,NOMA)                  00021900
      REAL MIO,LPP,LAM,MI                                               00022000
C                                                                       00022100
      COMMON/AAA/HEAD(20),H13(10),FN(5),LAM(30),T13(10)                 00022200
      COMMON/BBB/PI,G,MIG,LPP,NFN,NOH,NLAM,NH13                         00022300
      COMMON/CCC/JJ,M,IM,Z,KM,L1,L2,I68,LAUX1,LAUX2                     00022400
      COMMON/FFF/H(20,5,30,8),FASE(20,5,30,8)                           00022500
      COMMON/SPEC/KSPEC,NSPEC,AN                                        00022600
      COMMON/ZZZ/H(10),MI(10),CX(10),CL(30),CM(10,10,5,30,2)            00022700
      DIMENSION  SIG0(10),SIG1(10),SIG2(10)                             00022800
      DIMENSION Y(30)                                                   00022900
      RG=180.6                                                          00023000
      PI=3.14159265359                                                  00023100
      FC=PI/180.                                                        00023200
      MIG=MIG*FC                                                        00023300
      IF(KPTOT.NE.1) GO TO 21                                           00023400
      NOMA=NOH                                                          00023500
      NOH=2*NOH-1                                                       00023600
      DO 10 L=1,NOMA                                                    00023700
      LL=NOH-L+1                                                        00023800
      HEAD(LL)=360.-HEAD(L)                                             00023900
      DO 10 K=1,NFN                                                     00024000
      DO 10 J=1,NLAM                                                    00024100
      DO 8 I=1,3                                                        00024200
      II=2*I                                                            00024300
      IF(IFL.EQ.0) II=4                                                 00024400
      H(LL,K,J,II)=H(L,K,J,II)                                          00024500
      IF(IFL.EQ.0) GO TO 10                                             00024600
    8 CONTINUE                                                          00024700
   10 CONTINUE                                                          00024800
   15 DO 20 I=1,NOH                                                     00024900
   20 HEAD(I)=HEAD(I)*FC                                                00025000
   21 PI2=PI/2                                                          00025100
      X1=MIG                                                            00025200
      X2=MIG                                                            00025300
      KM=2                                                              00025400
      IF(KSPEC.LE.2)GO TO 201                                           00025500
      IF( ABS(MI(1)-PI2) .GT. 0.001) GO TO 101                          00025600
      KM=1                                                              00025700
      X1=MIG+PI2                                                        00025800
      X2=MIG+3.*PI2                                                     00025900
      GO TO 201                                                         00026000
  101 X1=MIG-PI2                                                        00026100
      X2=MIG+PI2                                                        00026200
      IF(X1.LT.0.)X1=X1+2*PI                                            00026300
  201 DO 401 L1=1,NOH                                                   00026400
      IF( HEAD(L1)-X1 ) 301,501,501                                     00026500
  301 IF( X1-HEAD(L1)-0.001 ) 701,701,401                               00026600
  401 CONTINUE                                                          00026700
  501 IF( HEAD(L1)-X1-0.001 ) 701,701,601                               00026800
  601 IF( KM .EQ. 1 ) L1=L1-1                                           00026900
  701 DO 901 L2=L1,NOH                                                  00027000
      IF( HEAD(L2)-X2 ) 801,1001,1001                                   00027100
  801 IF( X2-HEAD(L2) - 0.001 ) 1201,1201,901                           00027200
  901 CONTINUE                                                          00027300
 1001 IF( HEAD(L2)-X2-0.001 ) 1201,1101,1101                            00027400
 1101 IF( KM .EQ. 2 ) L2=L2-1                                           00027500
 1201 LAUX1=L1                                                          00027600
      LAUX2=L2                                                          00027700
      IF(KSPEC.LT.3)GO TO 1951                                          00027800
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      GO TO (1601,1951),KK                                                  00027900
 1601 LO=0                                                                  00028000
      LL=0                                                                  00028100
      IF( HEAD(1) .LT. 0.001 ) LO=1                                         00028200
      LMAX=NOH+L1-LO                                                        00028300
      DO 1901 L=L2,LMAX                                                     00028400
      LL=LL+1                                                               00028500
      IF(L-NOH) 1801, 1801,1701                                             00028600
 1701 LO=LO+1                                                               00028700
      H(LL)=HEAD(LO)                                                        00028800
      MJ(LL)=H(LL)-MIO                                                      00028900
      GO TO 1901                                                            00029000
 1801 H(LL)=HEAD(L)-2.*PI                                                   00029100
      MJ(LL)=H(LL)-MIO                                                      00029200
 1901 CONTINUE                                                              00029300
      GO TO 2201                                                            00029400
 1951 LL=0                                                                  00029500
      IF(L2.GE.L1) GO TO 2001                                               00029600
      LAUX1=1                                                               00029700
      DO 1971 L=L1,NOH-1                                                    00029800
      LL=LL+1                                                               00029900
      CX(LL)=HEAD(L)-2.*PI                                                  00030000
      H(LL)=HEAD(L)                                                         00030100
 1971 MJ(LL)=H(LL)-MIO                                                      00030200
 2001 DO 2101 L=LAUX1,L2                                                    00030300
      LL=LL+1                                                               00030400
      H(LL)=HEAD(L)                                                         00030500
      MJ(LL)=H(LL)-MIO                                                      00030600
 2101 CONTINUE                                                              00030700
 2201 LT=LL                                                                 00030800
 9100 FORMAT(1X,4I5,8E10.4)                                                 00030900
      CALL VOMEN                                                            00031000
      IML=0                                                                 00031100
      DO 5000 IM=1,3                                                        00031200
      IF(IPL.EQ.0) IM=4                                                     00031300
      IMJ=2*IM                                                              00031400
      II=1                                                                  00031500
      IF(IM1.GT.3)II=2                                                      00031600
      I68=1                                                                 00031700
      Z=0.                                                                  00031800
      IF(II.EQ.2)Z=1.                                                       00031900
      DO 4000 M=1,MH13                                                      00032000
      CALL SIGMA(SIGO(M),SIG1(M),SIG2(M))                                   00032100
 4000 CONTINUE                                                              00032200
 5000 CONTINUE                                                              00032300
      RETURN                                                                00032400
      END                                                                   00032500
                                                                              SE
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      SUBROUTINE SIGMA(SIGO,SIG2,SIG4)                                      00032600
      REAL LPP,MI,MIO,LAM,VOV                                               00032700
      COMMON/AAA/HEAD(20),H13(10),FN(5),LAM(30),T13(10),XLAM(30)            00032800
      COMMON/BBB/PI,G,MIO,LPP,NFM,NOH,NLAM,MH13                             00032900
      COMMON/CCC/K,M,IM,Z,KM,L1,L2,I68,LAUX1,LAUX2                          00033000
      COMMON/FFF/H(20,5,30,8),FASE(20,5,30,8)                               00033100
      COMMON/ZZZ/H(10),MI(10),CX(10),CL(30),CM(10,10,5,30,3)                00033200
      DIMENSION MJM(5,10),SIG(5)                                            00033300
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      NMAX=3                                                                    00033400
      I7=Z +1                                                                   00033500
      SIG0=0.                                                                   00033600
      SIG2=0.                                                                   00033700
      SIG4=0.                                                                   00033800
      FC=180./PI                                                                00033900
      IF(H13(M).EQ.0.) GO TO 2000                                               00034000
      IF(L2.GE.L1) GO TO 700                                                    00034100
      DO 500 L=L1,NOH-1                                                         00034200
      LL=LL+1                                                                   00034300
      DO 500 NN=1,NMAX                                                          00034400
      MOM(NN,LL)=0.                                                             00034500
C       SE HEAD=0,180,DU 360   CONTINUE                                         00034600
      IF(L*EQ.1.OR.2*L.EQ.NOH+1.OR.L.EQ.NOH) GO TO 500                          00034700
      DO 400 J=1,NLAM                                                           00034800
  400 CL(J)=H(L,K,J,IM)**2*CM(M,LL,NN,J,IZ)                                     00034900
      MOM(NN,LL)=-SIMPUN(NLAM,CL,XLAM)                                          00035000
  500 CONTINUE                                                                  00035100
  700 DO 900 L=LAUX1,L2                                                         00035200
      LL=LL+1                                                                   00035300
      DO 900 NN=1,NMAX                                                          00035400
      MOM(NN,LL)=0.                                                             00035500
      IF(L.EQ.1.OR.2*L.EQ.NOH+1.OR.L.EQ.NOH) GO TO 900                          00035600
      DO 800 J=1,NLAM                                                           00035700
  800 CL(J)=H(L,K,J,IM)**2*CM(M,LL,NN,J,IZ)                                     00035800
      MOM(NN,LL)=-SIMPUN(XLAM,CL,NLAM)                                          00035900
  900 CONTINUE                                                                  00036000
      IF(KSPEC.LT.3) GO TO 1210                                                 00036100
 1000 DO 1200 NN=1,NMAX                                                         00036200
 1100 CL(L)=MOM(NN,L)                                                           00036300
      SIG(NN)=SIMPUN(CX,CL,LL)                                                  00036400
 1200 CONTINUE                                                                  00036500
      GO TO 1250                                                                00036600
 1210 DO 1220 NN=1,NMAX                                                         00036700
      IF(L1.EQ.L2)SIG(NN)=MOM(NN,LL)                                            00036800
      IF(L1.NE.L2)SIG(NN)=MOM(NN,L1)+(MIO-HEAD(L1))*(MOM(NN,2)-MOM(NN,1)        00036900
     1)/(HEAD(L2)-HEAD(L1))                                                     00037000
 1220 CONTINUE                                                                  00037100
 1250 SIG0=SQRT(SIG(1))*FC                                                      00037200
      SIG2=SQRT(SIG(2))*FC                                                      00037300
      SIG4=SQRT(SIG(3))*FC                                                      00037400
 2000 RETURN                                                                    00037500
      END                                                                       00037600
                                                                              SE

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      SUBROUTINE MOMEN                                                          00037700
      REAL LPP,LAM,MIO,MI                                                       00037800
      COMMON/AAA/HEAD(20),H13(10),FN(5),XLAM(30),I13(10),LAM(30)                00037900
      COMMON/BBB/PI,G,MIO,LPP,NFN,NOH,NLAM,NH13                                 00038000
      COMMON/CCC/K,M,IM,Z,KP,L1,L2,LT,I68                                       00038100
      COMMON/ZZZ/X(10),MI(10),CX(10),CL(30),CM(10,10,5,30,3)                    00038200
      COMMON/SPEC/KSPEC,NSPEC,AN                                                00038300
      DIMENSION AUX2(30),AUX3(30),AUX4(30),C11(30),C3(10),C5(10),C1(5)          00038400
      IF(KSPEC.EQ.1.OR.KSPEC.EQ.3)A=G*G**0081                                   00038500
      C2=2.*PI                                                                  00038600
      C6=360./LPP                                                               00038700
      C7=LPP*LPP/(4.*PI*PI*G*G)                                                 00038800
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      C9=G/EPP                                                          00038900
      C10=FN(K)*C2                                                      00039000
      DO 100 J=1,NLAM                                                   00039100
      AL2=LAM(J)*LAM(J)                                                 00039200
      AUX2(J)=AL2+LAM(J)                                                00039300
      AUX4(J)=C6*C6*AL2                                                 00039400
  100 C11(J)=SQRT(C2*LAM(J))                                            00039500
      DO 200 L=1,LT                                                     00039600
      C3(L)=C10*COS( X(L) )                                             00039700
      IF(KSPEC.LT.3)C5(L)=1.                                            00039800
      IF(KSPEC.GE.3)C5(L)=AN*(COS(PHI(L)))**NSPEC                       00039900
  200 CONTINUE                                                          00040000
      DO 500 M=1,NM13                                                   00040100
      IF(KSPEC.EQ.2.OR.KSPEC.EQ.4)B=691.17/T13(M)**4                    00040200
      IF(KSPEC.EQ.1.OR.KSPEC.EQ.3)B=3.11/(H13(M)*H13(M))                00040300
      IF(KSPEC.EQ.2.OR.KSPEC.EQ.4)A=172.79*H13(M)*H13(M)/T13(M)**4      00040400
      CB=A*C7/2.                                                        00040500
      CA=B*C7                                                           00040600
      DO 300 NN=1,3                                                     00040700
      N=NN*NN-2                                                         00040800
  300 C1(NN)=CB*C9**(N/2)                                               00040900
      DO 400 J=1,NLAM                                                   00041000
  400 AUX3(J)=EXP( -C4/(LAM(J)*LAM(J)) )                                00041100
      DO 500 NN=1,3                                                     00041200
      DO 500 L=1,LT                                                     00041300
      DO 500 J=1,NLAM                                                   00041400
      AUX1=( C11(J)-C3(L)*LAM(J) )**N                                   00041500
      C12=AUX1/AUX2(J)*AUX3(J)*C1(NN)*C5(L)                             00041600
      CM(M,L,NN,J,1)=C12                                                00041700
      CM(M,L,NN,J,2)=C12*AUX4(J)                                        00041800
  500 CONTINUE                                                          00041900
      RETURN                                                            00042000
       END                                                              00042100
                                                                         SE
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```
      FUNCTION SIMPUN (X,Y,N)                                           00042200
      DIMENSION X(40),Y(40)                                             00042300
      IF( N-2 ) 7,5,4                                                   00042400
    5 S=(Y(1)+Y(2) )*(X(2)-X(1))/2.                                     00042500
      GO TO 6                                                           00042600
    7 S=0.                                                              00042700
      GO TO 6                                                           00042800
    4 M=N-1                                                             00042900
      S=(X(2)-X(1))/6.*(Y(1)*((X(2)-X(3))/(X(1)-X(3))+2.)+Y(2)*((X(1)-X(  00043000
     K3))/(X(2)-X(3))+2.)-Y(3)*(X(2)-X(1))**2/((X(1)-X(3))*(X(2)-X(3))))  00043100
      LP=2                                                              00043200
      IF( N.EQ.3) GO TO 8                                               00043300
      S=S+(X(3)-X(2))/6.*(Y(2)*((X(3)-X(4))/(X(2)-X(4))+2.)+Y(3)*((X(2)-  00043400
     KX(4))/(X(3)-X(4))+2.)-Y(4)*(X(3)-X(2))**2/((X(2)-X(4))*(X(3)-X(4))  00043500
     K))                                                                00043600
      LP=3                                                              00043700
    8 DO 1 K=LP,M                                                       00043800
      IF(ABS(X(K+1)-X(1)).GE.ABS(X(K)-X(1))) GO TO 1                    00043900
      GO TO 7                                                           00044000
    1 S=S+(X(K+1)-X(K))/6.*(Y(K)*((X(K+1)-X(K-1))/(X(K)-X(K-1))+2.)+Y(K+  00044100
     K1)*((X(K)-X(K-1))/(X(K+1)-X(K-1))+2.)-Y(K-1)*(X(K+1)-X(K))**2/((X(  00044200
                                                                        00044300
```

```
     NK)-X(K-1))*(X(K+1)-X(K-1))))                                      00044400
    6 SIMPUN=S                                                          00044500
      RETURN                                                            00044600
      END                                                               00044700
                                                                          S
*****************************************************************************

      FUNCTION EFIC(SIG)                                                00044800
      COMMON/EFIC/S(10),E(10),NPEF                                      00044900
      SIGO=SIG*2.                                                       00045000
      IF(SIGO.LE.S(1)) GO TO 50                                         00045100
      DO 10 I=2,NPEF                                                    00045200
      IF(S(I).GT.SIGO) GO TO 20                                         00045300
   10 CONTINUE                                                          00045400
      I=NPEF                                                            00045500
   20 EFIC=E(I-1)+(SIGO-S(I-1))/(S(I)-S(I-1))*(E(I)-E(I-1))             00045600
      IF(EFIC.LT.0.)EFIC=0.                                             00045700
      GO TO 90                                                          00045800
   50 EFIC=1.                                                           00045900
   90 RETURN                                                            00046000
      END                                                               00046100
                                                                          SE
*****************************************************************************
                                                                          FU
                                                                          SE

    NO ERRORS DETECTED.  NUMBER OF CARDS = 477.
    COMPILATION TIME = 29 SECONDS ELAPSED,  6.30 SECONDS PROCESSING.
    DB STACK SIZE = 59 WORDS.  FILESIZE = 4260 WORDS.  ESTIMATED DISK STORAGE RE
    TOTAL PROGRAM CODE = 1837 WORDS.  ARRAY STORAGE = 5609 WORDS.
    NUMBER OF PROGRAM SEGMENTS = 17.  NUMBER OF DISK SEGMENTS = 106.
    PROGRAM CODE FILE = (117PNV)CONTROLL/OBJ ON PACK.
    COMPILER COMPILED ON 09/07/79 (FORTRAN ON PACK).
```

APÊNDICE J

PROGRAMA SIMROLL

```
          B6700  F O R T R A N  C O M P I L A T I O N  M A R K  2.9.004

                                                    S I M R O L L / O B J
                                                    = = = = = = = = = = =

FILE  35=TRES/PLOT,UNIT=DISKPACK,RECORD=7                                    00000100

FILE  90=TRES/HIDRO,UNIT=DISKPACK,RECORD=270,AREA=1*1                        00000200

FILE  95=TRES/ROLL,UNIT=DISKPACK,RECORD=3,AREA=300                           00000300

FILE  98=TRES/ROLE,UNIT=DISKPACK,RECORD=3,AREA=300                           00000400


      REAL MIO,LAM,LPP,KAPA,MI                                               00000500
      COMMON/AAA/HEAD(20),HI3(10),FN(5),LAM(30),TI3(10),XLAM(30)             00000600
      COMMON/BBB/PI,GRAV,MIO,LPP,NFN,NOH,NLAM,NH13                           00000700
      COMMON/FFF/H(20,5,30,8),FASE(20,5,30,8)                                00000800
      COMMON/SPEC/KSPEC,AN,NSPEC                                             00000900
      COMMON/COEF/A(100,19),W(100),DEL(100,19),KAPA(19)                      00001000
      DIMENSION SS(27),DS(27),HBM(27),SQAR(27),AM(27),SAS(27),HB3(27)        00001100
      DIMENSION SIG0(10),SIG1(10),SIG2(10)                                   00001200
      DIMENSION MI(19),HA(100,19,2),FAS(100,19,2),OMEN(100,19)               00001300
      REWIND 35                                                              00001400
      REWIND 90                                                              00001500
      REWIND 95                                                              00001600
      REWIND 98                                                              00001700
      READ(90)NST,LPP,BOCA,NLAM,NFN,NOH,NWSTP,(HEAD(I),I=1,NOH),(FN(I),I     00001800
     1=1,NFN),(LAM(I),I=1,NLAM),DRAFT,EI44,(SS(K),DS(K),HBM(K),SQAR(K),A     00001900
     2M(K),SAS(K),HB3(K),K=1,NST-2),TVOL,TPST,TPCM,CBV,CMC,ZG,XG,VNY,GRA     00002000
     3V,NFR                                                                  00002100
      PI=3.141592654                                                         00002200
      FC=PI/180.                                                             00002300
 9080 FORMAT(1X,I4,15I5)                                                     00002400
      DO 100 MM=1,NOH                                                        00002500
      DO 100 JJ=1,NFN                                                        00002600
      DO 100 LL=1,NLAM                                                       00002700
      READ(95)LAM(LL),H(MM,JJ,LL,4),FASE(MM,JJ,LL,4)                         00002800
C              NO  SIMUL3D  INVERETR  O  LAM(LL)                             00002900
      FASE(MM,JJ,LL,4)=FASE(MM,JJ,LL,4)*FC                                   00003000
  100 H(MM,JJ,LL,4)=H(MM,JJ,LL,4)/FC*360./(LAM(LL)*LPP)                      00003100
      DO 150 MM=1,NOH                                                        00003200
      DO 150 JJ=1,NFN                                                        00003300
      DO 150 LL=1,NLAM                                                       00003400
      READ(98)LAM(LL),H(MM,JJ,LL,8),FASE(MM,JJ,LL,8)                         00003500
      FASE(MM,JJ,LL,8)=FASE(MM,JJ,LL,8)*FC                                   00003600
  150 H(MM,JJ,LL,8)=H(MM,JJ,LL,8)/FC*360./(LAM(LL)*LPP)                      00003700
      DO 200 MM=1,NOH                                                        00003800
      MAUX=NOH+1-MM                                                          00003900
  200 HEAD(MAUX+1)=HEAD(MAUX)                                                00004000
      HEAD(1)=0.                                                             00004100
      HEAD(NOH+2)=180.                                                       00004200
      DO 220 JJ=1,NFN                                                        00004300
      DO 220 LL=1,NLAM                                                       00004400
      DO 210 MM=1,NOH                                                        00004500
      MAUX=NOH+1-MM                                                          00004600
      H(MAUX+1,JJ,LL,8)=H(MAUX,JJ,LL,8)                                      00004700
      FASE(MAUX+1,JJ,LL,8)=FASE(MAUX,JJ,LL,8)                                00004800
      FASE(MAUX+1,JJ,LL,4)=FASE(MAUX,JJ,LL,4)                                00004900
  210 H(MAUX+1,JJ,LL,4)=H(MAUX,JJ,LL,4)                                      00005000
```

```
      NOH1=NOH+1                                                        00005100
      NOH2=NOH+2                                                        00005200
      DO 215 K=1,2                                                      00005300
      DO 215 IK=1,NOH2,NOH1                                             00005400
      H(IK,JJ,LL,4*K)=0.                                                00005500
  215 FASE(IK,JJ,LL,4*K)=0.                                             00005600
  220 CONTINUE                                                          00005700
  250 CONTINUE                                                          00005800
      NOH=NOH+2                                                         00005900
      READ(5,9070)NCOND                                                 00006000

      DO 999 N=1,NCOND                                                  00006100
      READ(5,9070)KSPEC,NSPEC,AN,H13D,T13D,MI0                          00006200
 9070 FORMAT(2I5,7F10.0)                                                00006300
      READ(5,9800)V,DT,TLIM,XK1,XK2,BETA1                               00006400
 9800 FORMAT(8F10.0)                                                    00006500
  300 CALL REGIST(NPONT,DT,H13D,T13D)                                   00006600
      WRITE(6,9000)                                                     00006700

 9000 FORMAT('1'//16X,'SIMULACAO DE BALANCO'///4X,'T',8X,'ZETA',6X,'ZE  00006800
     1TAP',5X,'DZETA',4X,'BALLIV',4X,'BALEST',4X,'BETA'//)              00006900
      V=V*.5144444444444                                                00007000
      FRN=V/SQRT(GRAV*LPP)                                              00007100
      DO 420 I=1,NFN                                                    00007200
      IF(ABS(FN(I)-FRN).LT..001)JJ=I                                    00007300
  420 CONTINUE                                                          00007400
      DO 500 IK=1,19                                                    00007500
      MI(IK)=MI0+KAPA(IK)                                               00007600
      IF(MI(IK).LT.0.) MI(IK)=MI(IK)+360.                               00007700
      DO 430 I=1,NOH                                                    00007800
      IF(HEAD(I).LT.MI(IK)) GO TO 430                                   00007900
      MM2=I                                                             00008000
      MM1=I-1                                                           00008100
      IF(HEAD(I).EQ.MI(IK))MM1=I                                        00008200
      GO TO 435                                                         00008300
  430 CONTINUE                                                          00008400
  435 PROH=0.                                                           00008500
      MI(IK)=MI(IK)*FC                                                  00008600
      IF(MM2.NE.MM1)PROH=(MI0-HEAD(MM1))/(HEAD(MM2)-HEAD(MM1))          00008700
      DO 490 IW=1,NPONT                                                 00008800
      OMEN(IW,IK)=W(IW)-W(IW)*H(IW)*V*COS(MI(IK))/GRAV                  00008900
      XLAMB=2.*PI*GRAV/(W(IW)*H(IW)*LPP)                                00009000
      LL1=NLAM+I                                                        00009100
      LL2=NLAM+1                                                        00009200
      DO 440 I=1,NLAM                                                   00009300
      IF(LAM(I).LT.XLAMB) GO TO 440                                     00009400
      LL2=I                                                             00009500
      LL1=I-1                                                           00009600
      IF(LAM(I).EQ.XLAMB)LL1=I                                          00009700
      IF(I.EQ.1.AND.LAM(I).LT.XLAMB)LL1=1                               00009800
      GO TO 450                                                         00009900
  440 CONTINUE                                                          00010000
  450 PROL=0.                                                           00010100
      IF(LL2.NE.LL1)PROL=(XLAMB-LAM(LL1))/(LAM(LL2)-LAM(LL1))           00010200
      IF(LL2.EQ.NLAM+1)PROL=0.                                          00010300
      DO 490 K=1,2                                                      00010400
      H11=H(MM1,JJ,LL1,4*K)                                             00010500
      H12=H(MM1,JJ,LL2,4*K)                                             00010600
      H21=H(MM2,JJ,LL1,4*K)                                             00010700
      H22=H(MM2,JJ,LL2,4*K)                                             00010800
```

```
      F11=FASE(MM1,JJ,LL1,4*K)                                          00010900
      F12=FASE(MM1,JJ,LL2,4*K)                                          00011000
      F21=FASE(MM2,JJ,LL1,4*K)                                          00011100
      F22=FASE(MM2,JJ,LL2,4*K)                                          00011200
      HINT1=H11+PROL*(H12-H11)                                          00011300
      HINT2=H21+PROL*(H22-H21)                                          00011400
      FINT1=F11+PROL*(F12-F11)                                          00011500
      FINT2=F21+PROL*(F22-F21)                                          00011600
      HA(IW,IK,K)=HINT1+PROH*(HINT2-HINT1)                              00011700
      FAS(IW,IK,K)=FINT1+PROH*(FINT2-FINT1)                             00011800
  490 CONTINUE                                                          00011900
      IF(KSPEC.LT.3)IK=20                                               00012000
  500 CONTINUE                                                          00012100
      ITLIM=TLIM/DT                                                     00012200
      WRITE(35)ITLIM,TLIM,DT                                            00012300
      DO 900 IT=1,ITLIM                                                 00012400
      XIT=IT                                                            00012500
      T=DT*XIT                                                          00012600
      ZETA=0.                                                           00012700
      ZETAP=0.                                                          00012800
      DZETA=0.                                                          00012900
      BALLIV=0.                                                         00013000
      BALEST=0.                                                         00013100
      DO 850 IK=1,19                                                    00013200
      DO 800 IW=1,NPONT                                                 00013300
      FH=OMEN(IW,IK)*T+DEL(IW,IK)                                       00013400
      ZETA=ZETA+A(IW,IK)*COS(FH)                                        00013500
      ZETAP=ZETAP-A(IW,IK)*OMEN(IW,IK)*SIN(FH)                          00013600
      DZETA=DZETA+A(IW,IK)*W(IW)*W(IW)/GRAV*SIN(MI(IK))*SIN(FH)         00013700
      BALLIV=BALLIV+HA(IW,IK,1)*A(IW,IK)*COS(FH+FAS(IW,IK,1))           00013800
      BALEST=BALEST+HA(IW,IK,2)*A(IW,IK)*COS(FH+FAS(IW,IK,2))           00013900
  800 CONTINUE                                                          00014000
      IF(KSPEC.LT.3) IK=20                                              00014100
  850 CONTINUE                                                          00014200
      BETA=(ZETA*XK1+ZETAP*XK2)/FC                                      00014300
      IF(ABS(BETA).GT.BETA1)BETA=BETA1*SIGN(1.,BETA)                    00014400
      WRITE(6,9100)T,ZETA,ZETAP,DZETA,BALLIV,BALEST,BETA                00014500
      WRITE(35)T,ZETA,ZETAP,DZETA,BALLIV,BALEST,BETA                    00014600
 9100 FORMAT(1X,F6.2,F11.3,5F10.3)                                      00014700
  900 CONTINUE                                                          00014800
  999 CONTINUE                                                          00014900
      LOCK 35                                                           00015000
      LOCK 90                                                           00015100
      LOCK 95                                                           00015200
      LOCK 98                                                           00015300
      END                                                               00015400
      002:026C:2  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT C
      002:026D:4  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT C
      002:026F:0  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT C
      002:0270:2  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT C
      002:0271:4  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT C
                                                                        $E
=======================================================================

      SUBROUTINE REGIST(NPONT,DT,H13,T1)                                00015500
      COMMON /SPEC/ KSPEC,NSPEC,AN                                      00015600
      COMMON /REG/ ZETA(1500),DZETA(1500)                               00015700
      COMMON/COEF/A(100,19),W(100),DEL(100,19),KAPA(19)                 00015800
```

```
      COMMON /CAUX/ KONTA,ZETAL(1500,8),NT,IDIV                          00015900
      DIMENSION C(13)                                                    00016000
      DIMENSION DELAUX(100,100)                                          00016100
      REAL NSPEC                                                         00016200
      DATA ALFA /0.0081/,G/9.8/                                          00016300
      PI=4.*ATAN(1.)                                                     00016400
      ASPEC=ALFA*G*G                                                     00016500
      BSPEC=3.11/(H13*H13)                                               00016600
      WP=1.2559/SQRT(H13)                                                00016700
      IF (KSPEC-3) 11,10,11                                              00016800
10    BSPEC=ASPEC/(H13*H13)                                              00016900
      GO TO 13                                                           00017000
11    IF(KSPEC-2) 13,12,13                                               00017100
12    ASPEC=172.79*H13*H13/T1**4.                                        00017200
      BSPEC=691.17/T1**4.                                                00017300
      WP=4.85/T1                                                         00017400
13    CONTINUE                                                           00017500
      GERA=1.E10                                                         00017600
      DW=WP/IDIV                                                         00017700
      DT=PI/DW/FLOAT(NPONT)                                              00017800
      DO 1 I=1,NPONT                                                     00017900
      Y=RANDOM(GERA)                                                     00018000
      W(I)=I*DW                                                          00018100
      AUX1=W(I)**4.                                                      00018200
      AUX=ASPEC/AUX1/W(I)*EXP(-BSPEC/AUX1)                               00018300
      A(I,1)=SQRT(AUX*DW)                                                00018400
      A(I,1)=A(I,1)/5.                                                   00018500
      DEL(I,1)=PI*Y*2.                                                   00018600
      DO 8 JJ=1,5                                                        00018700
      DELAUX(I,JJ)=2.*PI*RANDOM(GERA)                                    00018800
8     CONTINUE                                                           00018900
      IF(KSPEC-2) 1,1,14                                                 00019000
14    ANG=-PI/2.                                                         00019100
      DO 2 J=1,19                                                        00019200
      ANG=KAPA(J)*PI/180.                                                00019300
      IF (KSPEC.EQ.3) AN=2./ANG                                          00019400
      C(J)=AN*(COS(ANG))**NSPEC                                          00019500
      Y=RANDOM(GERA)                                                     00019600
      A(I,J)=C(J)*AUX*DW                                                 00019700
      A(I,J)=SQRT(A(I,J))                                                00019800
      DEL(I,J)=PI*Y*2.                                                   00019900
2     CONTINUE                                                           00020000
1     CONTINUE                                                           00020100
      NT=15*NPONT                                                        00020200
      IF (NT.GT.1500) NT=1500                                            00020300
      DO 4 I=1,NT                                                        00020400
      ZETA(I)=0.                                                         00020500
      IT=19                                                              00020600
      IF(KSPEC.LE.2) IT=1                                                00020700
      DO 5 II=1,NPONT                                                    00020800
      DO 3 J=1,IT                                                        00020900
      DO 6 JJ=1,5                                                        00021000
      ZETA(I)=ZETA(I)+A(II,J)*COS(W(II)*I*DT+DELAUX(II,JJ))              00021100
6     CONTINUE                                                           00021200
3     CONTINUE                                                           00021300
5     CONTINUE                                                           00021400
      ZETAL(I,KONTA)=ZETA(I)                                             00021500
4     CONTINUE                                                           00021600
      RETURN                                                             00021700
      END                                                                00021800
```

/ SE

```
      SUBROUTINE ALEAT (N,TR,DELT,M,IK,IN,IP,EX,DENS)                   00021900
      COMMON /REG/ R(1500),DR(1500)                                     00022000
      DIMENSION CORR(65),DENS(65)                                       00022100
      DIMENSION X(1002,65),XX(498,65),EX(65)                            00022200
      PI=ATAN(1.)*4.                                                    00022300
      DO 100 I=1,N                                                      00022400
      SOM=SOM+R(I)                                                      00022500
100   CONTINUE                                                          00022600
      SOM=SOM/FLOAT(N)                                                  00022700
      DO 101 I=1,N                                                      00022800
      R(I)=R(I)-SOM                                                     00022900
101   CONTINUE                                                          00023000
      DO 102 I=1,M+1                                                    00023100
      II=I-1                                                            00023200
      DO 103 J=1,1002                                                   00023300
      X(J,I)=R(J)*R(J+II)                                               00023400
103   CONTINUE                                                          00023500
      DO 104 J=1003,N-II                                                00023600
      XX(J-1002,I)=R(J)*R(J+II)                                         00023700
104   CONTINUE                                                          00023800
102   CONTINUE                                                          00023900
      DO 105 I=1,M+1                                                    00024000
      EX(I)=PI*FLOAT(I-1)/DELT/FLOAT(M)                                 00024100
105   CONTINUE                                                          00024200
      IN=IN*IP-IP+1                                                     00024300
      WRITE (6,1) N,TR,DELT,M,IK                                        00024400
1     FORMAT (1X,"N=",I4,5X,"TR=",I2,5X,"DELT=",F3.1,5X,"M=",I2,5X,     00024500
     *"IK=",I1,//)                                                      00024600
      N=N*IP                                                            00024700
      DO 2 I=1,M+1                                                      00024800
      II=I-1                                                            00024900
      CORR(I)=0.                                                        00025000
      IF(N-1002) 10,10,11                                               00025100
10    DO 3 J=IN,N-IP*II,IP                                              00025200
      CORR(I)=CORR(I)+X(J,I)                                            00025300
3     CONTINUE                                                          00025400
      GO TO 20                                                          00025500
11    DO 8 J=IN,1002,IP                                                 00025600
      CORR(I)=CORR(I)+X(J,I)                                            00025700
8     CONTINUE                                                          00025800
      DO 9 J=1003,N-IP*II,IP                                            00025900
      CORR(I)=CORR(I)+XX(J-1002,I)                                      00026000
9     CONTINUE                                                          00026100
20     CONTINUE                                                         00026200
      CORR(I)=2.*CORR(I)/(N/IP-II)                                      00026300
2     CONTINUE                                                          00026400
      IF (IK.EQ.3) CALL TRI(M,CORR)                                     00026500
      DO 5 I=1,M+1                                                      00026600
      II=I-1                                                            00026700
      DENS(I)=CORR(1)                                                   00026800
      DO 6 J=2,M                                                        00026900
      JJ=J-1                                                            00027000
      AUX=PI*JJ*II/M                                                    00027100
      DENS(I)=DENS(I)+CORR(J)*COS(AUX)*2.                               00027200
6     CONTINUE                                                          00027300
```

```
      DENS(I)=DENS(I)+CORR(M+1)*COS(PI*II)                              00027400
5     CONTINUE                                                          00027500
      IF (IK.EQ.1) CALL HANN (M,DENS)                                   00027600
      RETURN                                                            00027700
      END                                                               00027800
                                                                          S
*=================================================================================

      SUBROUTINE TRI (M,CORR)                                           00027900
      DIMENSION CORR(65)                                                00028000
      DO 1 I=1,M+1                                                      00028100
      CORR(I)=CORR(I)*(M-I+1)/M                                         00028200
1     CONTINUE                                                          00028300
      RETURN                                                            00028400
      END                                                               00028500
                                                                          S
*=================================================================================

      SUBROUTINE HANN (M,DENS)                                          00028600
      DIMENSION DENS (65)                                               00028700
      AUX=0.5*DENS(1)+0.5*DENS(2)                                       00028800
      DO 1 I=2,M                                                        00028900
      AUX1=0.25*DENS(I-1)+0.5*DENS(I)+0.25*DENS(I+1)                    00029000
      DENS(I-1)=AUX                                                     00029100
      AUX=AUX1                                                          00029200
1     CONTINUE                                                          00029300
      DENS(M+1)=0.5*DENS(M)+0.5*DENS(M+1)                               00029400
      DENS(M)=AUX                                                       00029500
      RETURN                                                            00029600
      END                                                               00029700
                                                                          S
*=================================================================================

                                                                          S

      NO ERRORS DETECTED.  NUMBER OF CARDS = 305
      COMPILATION TIME = 20 SECONDS ELAPSED,  5.58 SECONDS PROCESSING.
      D2 STACK SIZE = 46 WORDS.  FILESIZE = 842 WORDS.  ESTIMATED CORE STORAGE RE
      TOTAL PROGRAM CODE = 1196 WORDS.  ARRAY STORAGE = 120474 WORDS.
      NUMBER OF PROGRAM SEGMENTS = 17.  NUMBER OF DISK SEGMENTS = 90.
      PROGRAM CODE FILE = (117PNV)SIMROLL/OBJ ON PACK.
      COMPILER COMPILED ON 09/07/79 (FORTRAN ON PACK).
```

APÊNDICE K

PROGRAMA SIM3D

```
            B6700  F O R T R A N  C O M P I L A T I O N  M A R K  2.9.004 WE
                                                  S I M 3 D / O B J
                                                  = = = = = = = = =
 FILE  35=TRES/PLOT,UNIT=DISKPACK,RECORD=7                                    00000100
 FILE  90=TRES/HIDRO,UNIT=DISKPACK,RECORD=270,AREA=1*1                        00000200
 FILE  40=TRES/YAWL,UNIT=DISKPACK,RECORD=3                                    00000300
 FILE  45=TRES/YAWE,UNIT=DISKPACK,RECORD=3                                    00000400
 FILE  50=TRES/SWAL,UNIT=DISKPACK,RECORD=3                                    00000500
 FILE  55=TRES/SWAL,UNIT=DISKPACK,RECORD=3                                    00000600
 FILE  95=TRES/ROLL,UNIT=DISKPACK,RECORD=3,AREA=300                           00000700
 FILE  98=TRES/ROLE,UNIT=DISKPACK,RECORD=3,AREA=300                           00000800

       REAL MIO,LAM,LPP,KAPA,MI                                               00000900
       COMMON/AAA/HEAD(20),H13(10),FN(5),LAM(30),T13(10),XLAM(30)             00001000
       COMMON/BBB/PI,GRAV,MIO,LPP,NFN,NOH,NLAM,NH13                           00001100
       COMMON/FFF/H(20,5,30,8),FASE(20,5,30,8)                                00001200
       COMMON/SPEC/KSPEC,AN,NSPEC                                             00001300
       COMMON/COEF/A(100,19),W(100),DEL(100,19),KAPA(19)                      00001400
       DIMENSION SS(27),DS(27),HBM(27),SOAR(27),AM(27),SAS(27),HB3(27)        00001500
       DIMENSION SIG0(10),SIG1(10),SIG2(10)                                   00001600
       DIMENSION MI(19),HA(100,19,8),FAS(100,19,6),OMEN(100,19)               00001700
       REWIND 35                                                              00001800
       REWIND 90                                                              00001900
       REWIND 95                                                              00002000
       REWIND 98                                                              00002100
       READ(90)NST,LPP,BOCA,NLAM,NFN,NOH,NWSTP,(HEAD(I),I=1,NOH),(FN(I),I     00002200
      1=1,NFN),(LAM(I),I=1,NLAM),DPART,E144,(SS(K),DS(K),HBM(K),SOAR(K),A     00002300
      2M(K),SAS(K),HB3(K),K=1,NST-2),TVOL,TPST,TPCM,CHV,CMC,ZG,XC,VNY,GRA     00002400
      3V,NFR                                                                  00002500
       PI=3.141592654                                                         00002600
       FC=PI/180.                                                             00002700
 9080  FORMAT(1X,I4,15I5)                                                     00002800
       DO 100 MM=1,NOH                                                        00002900
       DO 100 JJ=1,NFN                                                        00003000
       DO 100 LL=1,NLAM                                                       00003100
       READ(40)LAM(LL),H(MM,JJ,LL,3),FASE(MM,JJ,LL,3)                         00003200
       READ(50)LAM(LL),H(MM,JJ,LL,2),FASE(MM,JJ,LL,2)                         00003300
       READ(95)LAM(LL),H(MM,JJ,LL,4),FASE(MM,JJ,LL,4)                         00003400
       FASE(MM,JJ,LL,2)=FASE(MM,JJ,LL,2)*FC                                   00003500
       FASE(MM,JJ,LL,3)=FASE(MM,JJ,LL,3)*FC                                   00003600
       FASE(MM,JJ,LL,4)=FASE(MM,JJ,LL,4)*FC                                   00003700
       H(MM,JJ,LL,3)=H(MM,JJ,LL,3)/FC*360./(LAM(LL)*LPP)                      00003800
  100  H(MM,JJ,LL,4)=H(MM,JJ,LL,4)/FC*360./(LAM(LL)*LPP)                     00003900
       DO 150 MM=1,NOH                                                        00004000
       DO 150 JJ=1,NFN                                                        00004100
       DO 150 LL=1,NLAM                                                       00004200
       READ(45)LAM(LL),H(MM,JJ,LL,7),FASE(MM,JJ,LL,7)                         00004300
       READ(55)LAM(LL),H(MM,JJ,LL,6),FASE(MM,JJ,LL,6)                         00004400
       READ(98)LAM(LL),H(MM,JJ,LL,5),FASE(MM,JJ,LL,5)                         00004500
       FASE(MM,JJ,LL,6)=FASE(MM,JJ,LL,6)*FC                                   00004600
```

```
      FASE(MM,JJ,LL,7)=FASE(MM,JJ,LL,7)*FC                                  00004700
      FASE(MM,JJ,LL,8)=FASE(MM,JJ,LL,8)*FC                                  00004800
      H(MM,JJ,LL,7)=H(MM,JJ,LL,7)/FC*360./(LAM(LL)*LPP)                     00004900
  150 H(MM,JJ,LL,8)=H(MM,JJ,LL,8)/FC*360./(LAM(LL)*LPP)                     00005000
      DO 200 MM=1,NOH                                                       00005100
      MAUX=NOH+1-MM                                                         00005200
  200 HEAD(MAUX+1)=HEAD(MAUX)                                               00005300
      HEAD(1)=0.                                                            00005400
      HEAD(NOH+2)=180.                                                      00005500
      DO 220 JJ=1,NFN                                                       00005600
      DO 220 LL=1,NLAM                                                      00005700
      DO 210 MM=1,NOH                                                       00005800
      MAUX=NOH+1-MM                                                         00005900
      H(MAUX+1,JJ,LL,6)=H(MAUX,JJ,LL,6)                                     00006000
      H(MAUX+1,JJ,LL,7)=H(MAUX,JJ,LL,7)                                     00006100
      H(MAUX+1,JJ,LL,8)=H(MAUX,JJ,LL,8)                                     00006200
      FASE(MAUX+1,JJ,LL,6)=FASE(MAUX,JJ,LL,6)                               00006300
      FASE(MAUX+1,JJ,LL,7)=FASE(MAUX,JJ,LL,7)                               00006400
      FASE(MAUX+1,JJ,LL,8)=FASE(MAUX,JJ,LL,8)                               00006500
      FASE(MAUX+1,JJ,LL,2)=FASE(MAUX,JJ,LL,2)                               00006600
      FASE(MAUX+1,JJ,LL,3)=FASE(MAUX,JJ,LL,3)                               00006700
      FASE(MAUX+1,JJ,LL,4)=FASE(MAUX,JJ,LL,4)                               00006800
      H(MAUX+1,JJ,LL,2)=H(MAUX,JJ,LL,2)                                     00006900
      H(MAUX+1,JJ,LL,3)=H(MAUX,JJ,LL,3)                                     00007000
  210 H(MAUX+1,JJ,LL,4)=H(MAUX,JJ,LL,4)                                     00007100
      NOH1=NOH+1                                                            00007200
      NOH2=NOH+2                                                            00007300
      DO 215 KK=2,4                                                         00007400
      DO 215 K=1,2                                                          00007500
      DO 215 IK=1,NOH2,NOH1                                                 00007600
      H(IK,JJ,LL,KK+3*(K-1))=0.                                             00007700
  215 FASE(IK,JJ,LL,KK+3*(K-1))=0.                                          00007800
  220 CONTINUE                                                              00007900
  250 CONTINUE                                                              00008000
      NOH=NOH+2                                                             00008100
      READ(5,9070)NCOND                                                     00008200

      DO 999 N=1,NCOND                                                      00008300
      READ(5,9070)KSPEC,NSPEC,AN,H13D,T13D,MIO                              00008400
 9070 FORMAT(2I5,7F10.0)                                                    00008500
      READ(5,9800)V,DT,TLIM,XK1,XK2,BETA1                                   00008600
 9800 FORMAT(8F10.0)                                                        00008700
  300 CALL REGIST(NPONT,DT,H13D,T13D)                                       00008800
      WRITE(6,9000)                                                         00008900

 9000 FORMAT('1'//16X,'SIMULACAO  DE  BALANCO'///4X,'T',8X,'ZETA',6X,'ZE  00009000
     1TAP',5X,'OZETA',4X,'BALLIV',4X,'BALEST',4X,'BETA',5X,'SWAYLIV',3X,  00009100
     2'SWAYEST',4X,'YAWLIV',4X,'YAWEST'//)                                  00009200
      V=V*.514444444444                                                     00009300
      FRN=V/SQRT(GRAV*LPP)                                                  00009400
      DO 420 I=1,NFN                                                        00009500
      IF(ABS(FN(I)-FRN).LT..001)JJ=I                                        00009600
  420 CONTINUE                                                              00009700
      DO 500 IK=1,19                                                        00009800
      MI(IK)=MIO+KAPA(IK)                                                   00009900
      IF(MI(IK).LT.0.) MI(IK)=MI(IK)+360.                                   00010000
      DO 430 I=1,NOH                                                        00010100
      IF(HEAD(I).LT.MI(IK)) GO TO 430                                       00010200
      MM2=I                                                                 00010300
      MM1=I-1                                                               00010400
```

```
      IF(HEAD(I).EQ.MI(IK))MM1=I                                        00010500
      GO TO 435                                                         00010600
  430 CONTINUE                                                          00010700
  435 PROH=0.                                                           00010800
      MI(IK)=MI(IK)*FC                                                  00010900
      IF(MM2.NE.MM1)PROH=(MI0-HEAD(MM1))/(HEAD(MM2)-HEAD(MM1))          00011000
      DO 490 IW=1,NPONT                                                 00011100
      OMEN(IW,IK)=W(IW)-W(IW)*W(IW)*V*COS(MI(IK))/GRAV                  00011200
      XLAMB=2.*PI*GRAV/(W(IW)*W(IW)*LPP)                                00011300
      LL1=NLAM+1                                                        00011400
      LL2=NLAM+1                                                        00011500
      DO 440 I=1,NLAM                                                   00011600
      IF(LAM(I).LT.XLAMB) GO TO 440                                     00011700
      LL2=I                                                             00011800
      LL1=I-1                                                           00011900
      IF(LAM(I).EQ.XLAMB)LL1=I                                          00012000
      IF(I.EQ.1.AND.LAM(I).LT.XLAMB)LL1=1                               00012100
      GO TO 450                                                         00012200
  440 CONTINUE                                                          00012300
  450 PROL=0.                                                           00012400
      IF(LL2.NE.LL1)PROL=(XLAMB-LAM(LL1))/(LAM(LL2)-LAM(LL1))           00012500
      IF(LL2.EQ.NLAM+1)PROL=0.                                          00012600
      DO 490 KK=2,4                                                     00012700
      DO 490 K=1,2                                                      00012800
      H11=H(MM1,JJ,LL1,KK+3*(K-1))                                      00012900
      H12=H(MM1,JJ,LL2,KK+3*(K-1))                                      00013000
      H21=H(MM2,JJ,LL1,KK+3*(K-1))                                      00013100
      H22=H(MM2,JJ,LL1,KK+3*(K-1))                                      00013200
      F11=FASE(MM1,JJ,LL1,KK+3*(K-1))                                   00013300
      F12=FASE(MM1,JJ,LL2,KK+3*(K-1))                                   00013400
      F21=FASE(MM2,JJ,LL1,KK+3*(K-1))                                   00013500
      F22=FASE(MM2,JJ,LL2,KK+3*(K-1))                                   00013600
      HINT1=H11+PROL*(H12-H11)                                          00013700
      HINT2=H21+PROL*(H22-H21)                                          00013800
      FINT1=F11+PROL*(F12-F11)                                          00013900
      FINT2=F21+PROL*(F22-F21)                                          00014000
      HA(IW,IK,KK+3*(K-1))=HINT1+PROH*(HINT2-HINT1)                     00014100
      FAS(IW,IK,KK+3*(K-1))=FINT1+PROH*(FINT2-FINT1)                    00014200
  490 CONTINUE                                                          00014300
      IF(KSPEC.LT.3)IK=20                                               00014400
  500 CONTINUE                                                          00014500
      ITLIM=TLIM/DT                                                     00014600
      WRITE(35)ITLIM,TLIM,DT                                            00014700
      DO 900 IT=1,ITLIM                                                 00014800
      XIT=IT                                                            00014900
      T=DT*XIT                                                          00015000
      ZETA=0.                                                           00015100
      ZETAP=0.                                                          00015200
      DZETA=0.                                                          00015300
      BALLIV=0.                                                         00015400
      BALEST=0.                                                         00015500
      DO 850 IK=1,19                                                    00015600
      DO 800 IW=1,NPONT                                                 00015700
      FH=OMEN(IW,IK)*T+DEL(IW,IK)                                       00015800
      ZETA=ZETA+A(IW,IK)*COS(FH)                                        00015900
      ZETAP=ZETAP-A(IW,IK)*OMEN(IW,IK)*SIN(FH)                          00016000
      DZETA=DZETA+A(IW,IK)*W(IW)*W(IW)/GRAV*SIN(MI(IK))*SIN(FH)         00016100
      BALLIV=BALLIV+HA(IW,IK,4)*A(IW,IK)*COS(FH+FAS(IW,IK,4))           00016200
      SWALIV=SWALIV+HA(IW,IK,2)*A(IW,IK)*COS(FH+FAS(IW,IK,2))           00016300
      YAWLIV=YAWLIV+HA(IW,IK,3)*A(IW,IK)*COS(FH+FAS(IW,IK,3))           00016400
```

```
      BALEST=BALEST+HA(IN,IK,8)*A(IN,IK)*COS(FH*FAS(IN,IK,8))                   00016500
      SWAEST=SWAEST+HA(IN,IK,6)*A(IN,IK)*COS(FH*FAS(IN,IK,6))                   00016600
      YAWEST=YAWEST+HA(IN,IK,7)*A(IN,IK)*COS(FH*FAS(IN,IK,7))                   00016700
  800 CONTINUE                                                                  00016800
      IF(KSPEC.LT.3) IK=20                                                      00016900
  850 CONTINUE                                                                  00017000
      BETA=(ZETA*XK1+ZETAP*XK2)/FC                                              00017100
      IF(ABS(BETA).GT.BETA1)BETA=BETA1*SIGN(1.,BETA)                            00017200
      WRITE(6,9100)T,ZETA,ZETAP,DZETA,BALLIV,BALEST,BETA,SWALIV,SWAEST,Y 00017300
     1AWLIV,YAWEST                                                              00017400
      WRITE(35)T,ZETA,ZETAP,DZETA,BALLIV,BALEST,BETA,SWALIV,SWAEST,YAWLI 00017500
     1V,YAWEST                                                                  00017600
 9100 FORMAT(1X,F6.2,F11.3,9F10.3)                                              00017700
  900 CONTINUE                                                                  00017800
  999 CONTINUE                                                                  00017900
      LOCK 35                                                                   00018000
      LOCK 40                                                                   00018100
      LOCK 45                                                                   00018200
      LOCK 50                                                                   00018300
      LOCK 55                                                                   00018400
      LOCK 90                                                                   00018500
      LOCK 95                                                                   00018600
      LOCK 98                                                                   00018700
      END                                                                       00018800
      002:0381:2  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      002:0382:4  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      002:0384:0  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      002:0385:2  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      002:0386:4  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      002:0388:0  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      002:0389:2  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      002:038A:4  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
      002:038C:0  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT
                                                                              S
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      SUBROUTINE REGIST(NPOINT,DT,H13,T1)                                       00018900
      COMMON /SPEC/ KSPEC,NSPEC,AN                                              00019000
      COMMON /REG/ ZETA(1500),DZETA(1500)                                       00019100
      COMMON/COEF/A(100,19),B(100),DEL(100,19),KAPA(19)                         00019200
      COMMON /CAUX/ KONTA,ZETAL(1500,8),NT,IDIV                                 00019300
      DIMENSION C(13)                                                           00019400
      DIMENSION DELAUX(100,100)                                                 00019500
      REAL NSPEC                                                                00019600
      DATA ALFA /0.0081/,G/9.8/                                                 00019700
      PI=4.*ATAN(1.)                                                            00019800
      ASPEC=ALFA*G*G                                                            00019900
      BSPEC=3.11/(H13*H13)                                                      00020000
      WP=1.2559/SQRT(H13)                                                       00020100
      IF (KSPEC-3) 11,10,11                                                     00020200
 10   BSPEC=ASPEC/(H13*H13)                                                     00020300
      GO TO 13                                                                  00020400
 11   IF(KSPEC-2) 13,12,13                                                      00020500
 12   ASPEC=172.79*H13*H13/T1**4.                                               00020600
      BSPEC=691.17/T1**4.                                                       00020700
      WP=4.85/T1                                                                00020800
 13   CONTINUE                                                                  00020900
      SERA=1.E10                                                                00021000
```

```
      DW=WP/IDIV                                                        00021100
      DT=PI/DW/FLOAT(NPONT)                                             00021200
      DO 1 I=1,NPONT                                                    00021300
      Y=RANDOM(GERA)                                                    00021400
      W(I)=I*DW                                                         00021500
      AUX1=W(I)**4.                                                     00021600
      AUX=ASPEC/AUX1/W(I)*EXP(-BSPEC/AUX1)                              00021700
      A(I,1)=SQRT(AUX*DW)                                               00021800
      A(I,1)=A(I,1)/5.                                                  00021900
      DEL(I,1)=PI*Y*2.                                                  00022000
      DO 8 JJ=1,5                                                       00022100
      DELAUX(I,JJ)=2.*PI*RANDOM(GERA)                                   00022200
8     CONTINUE                                                          00022300
      IF(KSPEC-2) 1,1,14                                                00022400
14    ANG=-PI/2.                                                        00022500
      DO 2 J=1,19                                                       00022600
      ANG=KAPA(J)*PI/180.                                               00022700
      IF (KSPEC.EQ.3) AN=2./ANG                                         00022800
      C(J)=AN*(COS(ANG))**NSPEC                                         00022900
      Y=RANDOM(GERA)                                                    00023000
      A(I,J)=C(J)*AUX*DW                                                00023100
      A(I,J)=SQRT(A(I,J))                                               00023200
      DEL(I,J)=PI*Y*2.                                                  00023300
2     CONTINUE                                                          00023400
1     CONTINUE                                                          00023500
      NT=15*NPONT                                                       00023600
      IF (NT.GT.1500) NT=1500                                           00023700
      DO 4 I=1,NT                                                       00023800
      ZETA(I)=0.                                                        00023900
      IT=19                                                             00024000
      IF(KSPEC.LE.2) IT=1                                               00024100
      DO 5 II=1,NPONT                                                   00024200
      DO 3 J=1,IT                                                       00024300
      DO 6 JJ=1,5                                                       00024400
      ZETA(I)=ZETA(I)+A(II,J)*COS(W(II)*I*DT+DELAUX(II,JJ))             00024500
6     CONTINUE                                                          00024600
3     CONTINUE                                                          00024700
5     CONTINUE                                                          00024800
      ZETAL(I,KONTA)=ZETA(I)                                            00024900
4     CONTINUE                                                          00025000
      RETURN                                                            00025100
      END                                                               00025200
                                                                        SU

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      SUBROUTINE ALEAT (N,TR,DELT,M,IK,IN,IP,CX,DENS)                   00025300
      COMMON /REG/ R(1500),DP(1500)                                     00025400
      DIMENSION CORR(65),DENS(65)                                       00025500
      DIMENSION X(1002,65),XX(498,65),EX(65)                            00025600
      PI=ATAN(1.)*4.                                                    00025700
      DO 100 I=1,N                                                      00025800
      SOM=SOM+R(I)                                                      00025900
100   CONTINUE                                                          00026000
      SOM=SOM/FLOAT(N)                                                  00026100
      DO 101 I=1,N                                                      00026200
      R(I)=R(I)-SOM                                                     00026300
101   CONTINUE                                                          00026400
      DO 102 I=1,M+1                                                    00026500
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```
      II=I-1                                                            00026600
      DO 103 J=1,1002                                                   00026700
      X(J,I)=R(J)*R(J+II)                                               00026800
103   CONTINUE                                                          00026900
      DO 104 J=1003,N-II                                                00027000
      XX(J-1002,I)=R(J)*R(J+II)                                         00027100
104   CONTINUE                                                          00027200
102   CONTINUE                                                          00027300
      DO 105 I=1,M+1                                                    00027400
      EX(I)=PI*FLOAT(I-1)/DELT/FLOAT(M)                                 00027500
105   CONTINUE                                                          00027600
      IN=IN*IP-IP+1                                                     00027700
      WRITE (6,1) N,TR,DELT,M,IK                                        00027800
1     FORMAT (1X,"N=",I4,5X,"TR=",I2,5X,"DELT=",F3.1,5X,"M=",I2,5X,     00027900
     *"IK=",I1,//)                                                      00028000
      N=N*IP                                                            00028100
      DO 2 I=1,M+1                                                      00028200
      II=I-1                                                            00028300
      CORR(I)=0.                                                        00028400
      IF(N-1002) 10,10,11                                               00028500
10    DO 3 J=IN,N-IP*II,IP                                              00028600
      CORR(I)=CORR(I)+X(J,I)                                            00028700
3     CONTINUE                                                          00028800
      GO TO 20                                                          00028900
11    DO 8 J=IN,1002,IP                                                 00029000
      CORR(I)=CORR(I)+X(J,I)                                            00029100
8     CONTINUE                                                          00029200
      DO 9 J=1003,N-IP*II,IP                                            00029300
      CORR(I)=CORR(I)+XX(J-1002,I)                                      00029400
9     CONTINUE                                                          00029500
20    CONTINUE                                                          00029600
      CORR(I)=2.*CORR(I)/(N/IP-II)                                      00029700
2     CONTINUE                                                          00029800
      IF (IK.EQ.3) CALL TRI(M,CORR)                                     00029900
      DO 5 I=1,M+1                                                      00030000
      II=I-1                                                            00030100
      DENS(I)=CORR(1)                                                   00030200
      DO 6 J=2,M                                                        00030300
      JJ=J-1                                                            00030400
      AUX=PI*JJ*II/M                                                    00030500
      DENS(I)=DENS(I)+CORR(J)*COS(AUX)*2.                               00030600
6     CONTINUE                                                          00030700
      DENS(I)=DENS(I)+CORR(M+1)*COS(PI*II)                              00030800
5     CONTINUE                                                          00030900
      IF (IK.EQ.1) CALL HANN (M,DENS)                                   00031000
      RETURN                                                            00031100
      END                                                               00031200
                                                                          S
=======================================================================
      SUBROUTINE TRI (M,CORR)                                           00031300
      DIMENSION CORR(65)                                                00031400
      DO 1 I=1,M+1                                                      00031500
      CORR(I)=CORR(I)*(M-I+1)/M                                         00031600
1     CONTINUE                                                          00031700
      RETURN                                                            00031800
      END                                                               00031900
                                                                          S
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      SUBROUTINE HANN (N,DENS)                                          00032000
      DIMENSION DENS (65)                                               00032100
      AUX=0.5*DENS(1)+0.5*DENS(2)                                       00032200
      DO 1 I=2,N                                                        00032300
      AUX1=0.25*DENS(I-1)+0.5*DENS(I)+0.25*DENS(I+1)                    00032400
      DENS(I-1)=AUX                                                     00032500
      AUX=AUX1                                                          00032600
    1 CONTINUE                                                          00032700
      DENS(N+1)=0.5*DENS(N)+0.5*DENS(N+1)                               00032800
      DENS(N)=AUX                                                       00032900
      RETURN                                                            00033000
      END                                                               00033100
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NO ERRORS DETECTED.  NUMBER OF CARDS = 332.
COMPILATION TIME = 526 SECONDS ELAPSED,  7.91 SECONDS PROCESSING.
02 STACK SIZE = 79 WORDS.  FILESIZE = 1002 WORDS.  ESTIMATED CORE STORAGE RE
TOTAL PROGRAM CODE = 1497 WORDS.  ARRAY STORAGE = 143274 WORDS.
NUMBER OF PROGRAM SEGMENTS = 17.  NUMBER OF DISK SEGMENTS = 46.
PROGRAM CODE FILE = (117PNV)SIM3D/OBJ ON PACK.
COMPILER COMPILED ON 09/07/79 (FORTRAN ON PACK).
```

APÊNDICE L

PROGRAMA SIMPLOT

```
B6700  F O R T R A N  C O M P I L A T I O N  M A R K  2.9.004

                                        S I M P L O T / O B J
                                        = = = = = = = = = = =

FILE  33=FILE33,UNIT=PRINTER

FILE  25=SIMUL,UNIT=DISKPACK,RECORD=7


      DIMENSION T(3000),X(3000,6),Y(3000),A(12),B(12),C(6),D(6),E(6)
      DIMENSION TG(610)
      DATA C,D,E/25.,26.,43.,21.,28.,25.,1.,1.,1.,5.,5.,5.,6.,5.,3.,5.,5
     1.,5./
      WRITE(A,900)
  900 FORMAT('ESCALA DE TEMPO')
      ITLIM=1200
      TLIM=120.
      DT=.1
      REWIND 25
      DO 100 IT=1,ITLIM
      READ(25)T(IT),(X(IT,J),J=1,6)
  100 CONTINUE
      DO 500 K=1,2
      ESCX=6.5/TLIM
      CALL GSCAL(ESCX,1.,TLIM/A.5,1.)
      CALL GAXIS(-TLIM/170.,0.,A,15,TLIM+10.,0.,0.,5.)
      DO 110 IGRAF=1,3
      XIGRAF=IGRAF
      CALL GAXIS(-TLIM/170.,5.5-(XIGRAF-1.)*2.125,A,0,TLIM+10,0.,0.,5.)
      CALL GPLOT(TLIM+10.,5.5-(XIGRAF-1.)*2.125,3)
      CALL POINT(3)
      J=3*(K-1)+IGRAF
      XJ=J
      IF(J.EQ.1) READ(A,910)
      IF(J.EQ.2) READ(A,920)
      IF(J.EQ.3) READ(A,930)
      IF(J.EQ.4) READ(A,940)
      IF(J.EQ.5) READ(A,950)
      IF(J.EQ.6) READ(A,960)
      CALL GSYMB(TLIM/2.,4.5-(XIGRAF-1.)*2.125,-0.125,B,0,C(J))
  110 CONTINUE
  910 FORMAT('ELEVACAO DA ONDA - METROS')
  920 FORMAT('INCLINACAO DA ONDA - GRAUS')
  930 FORMAT('VARIACAO TEMPORAL DA ELEVACAO DA ONDA - M/S')
  940 FORMAT('BALANCO LIVRE - GRAUS')
  950 FORMAT('BALANCO ESTABILIZADO - GRAUS')
  960 FORMAT('DEFLEXAO DA ALETA - GRAUS')
      DO 400 IGRAF=1,3
      J=3*(K-1)+IGRAF
      XIGRAF=IGRAF
      IF(J.EQ.5) GO TO 210
      XMAX=0.
      DO 200 IT=1,ITLIM
  200 IF(ABS(X(IT,J)).GT.XMAX) XMAX=ABS(X(IT,J))
      YLIM=(IGT(XMAX/D(J))+1)*D(J)
  210 CALL GSCAL(1.,1.,1.,6.5-(XIGRAF-1.)*2.125)
      IF(J.EQ.1) READ(B,810)
      IF(J.EQ.2) READ(B,820)
      IF(J.EQ.3) READ(B,830)
```

```
      IF(J.EQ.4) READ(5,840)
      IF(J.EQ.5) READ(5,850)
      IF(J.EQ.6) READ(5,860)
      CALL GAXIS(0.,-.875,B,-E(J),1.75,90.,-YLIM,.175)
      I=0
      DO 220 IT=1,ILIM,5
      I=I+1
      TG(I)=T(IT)
  220 Y(I)=X(IT,J)
      ILIM=I
  810 FORMAT('METROS')
  820 FORMAT('GRAUS')
  830 FORMAT('M/S')
  840 FORMAT('GRAUS')
  850 FORMAT('GRAUS')
  860 FORMAT('GRAUS')
      FSCY=.875/YLIM
      CALL GSCAL(ESCX,FSCY,1./FSCX,(6.5-(XIGRAF-1.)*2.125)/ESCY)
      CALL GLINE(TG,Y,ILIM,+10.,9+J,.1,0.,0.)
  400 CONTINUE
      CALL ENDPLT
  500 CONTINUE
      STOP
      END
      002:00F2:5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT A
```

WARNING:THE SUBROUTINE "GSCAL" WAS NOT FOUND

WARNING:THE SUBROUTINE "GAXIS" WAS NOT FOUND

WARNING:THE SUBROUTINE "GPLOT" WAS NOT FOUND

WARNING:THE SUBROUTINE "POINT" WAS NOT FOUND

WARNING:THE SUBROUTINE "GSYMB" WAS NOT FOUND

WARNING:THE SUBROUTINE "GLINE" WAS NOT FOUND

WARNING:THE SUBROUTINE "ENDPLT" WAS NOT FOUND