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C  ********************************************************************
C                                PEDROP
C  THIS PROGRAM COMPUTES THE PRESSURE DROP AGAINST THE MASS FLOW RATE
C  OF AN UNIFORMLY HEATED NOMINAL BWR SUBCHANNEL MADE UP OF FOUR RODS
C  ARRANGED IN A SQUARE ARRAY. THE COOLANT AT THE INLET IS SINGLE
C  PHASE PRESSURISED WATER. THE PROGRAM IS GOOD FOR THE PRESSURE
C  RANGE OF 5.514 TO 11.029 MPA (800 TO 1600 PSIA).
C  C YEE-NING CHAN 1982 MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
C
C  ********************************************************************
C
C  NOMENCLATURE AND UNITS OF INPUTS.
C  P      PRESSURE(MPA)
C  DROD   ROD DIAMETER(M)
C  PITCH  ROD CENTER-TO-CENTER DISTANCE(M)
C  TL     CHANNEL AXIAL LENGTH(M)
C  TIN    COOLANT INLET TEMPERATURE(K)
C  TSAT   SATURATION TEMPERATURE(K)
C  HIN    INLET ENTHALPY (KJ/KG)
C  NQ     NUMBER OF HEAT FLUXES
C  Q      HEAT FLUX(MW/M**2)
C  MASS   HIGHEST MASS FLOW RATE(KG/SEC)
C  DEC    MASS FLOW RATE DECREMENTS(KG/SEC)
C  MINM  LOWEST MASS FLOW RATE(KG/SEC)
C  LBOT BOTTOM UNHEATED LENGTH (M)
C  LTOP  TOP UNHEATED LENGTH (M)
C  LEBOT BOTTOM, EQUILEVENT LENGTH TO ACCOUNT FOR FORM LOSS(M)
C  LETOP  TOP      ''          '          '     '   '     '
C  IFLAG  IFLAG>0 => NO CALCULATION OF ACCELERATION PR. DROP
C  JFLAG  JFLAG>0 => USE DEVIDED FACTOR IN PRESSURE RANGE
C                    14.7 PSI <  P  <  100 PSI
C  KFLAG   KFLAG>0 => TWO PHASE MULTIPLIER IN SUBCOOLED BOILING REGION =1
C
C  ZSC    AXIAL POINT OF INCEPTION OF SUBCOOLED BOILING(M)
C  ZB     AXIAL POINT OF INCEPTION OF BULK BOILING(M)
C  ZV     AXIAL POINT OF INCEPTION OF SINGLE PHASE VAPOR(M)
      COMMON Q(30)
      CHARACTER*64 FINPUT,FOUTPUT
      REAL MASS,MDOT,MINM,LBOT,LTOP,LEBOT,LETOP
      DATA C4,C5,C6,C7,C8/958.75,-0.8566,2619410.618,-4.995E10,3.403E5/
      DATA C9,C10,C11,C12/1.0665545,1.02E-8,-2.548E-15,2589600./
      DATA C13,C14,C15,C16/6.350E-3,-1.0582E-9,1.0764,3.625E-10/
      DATA C17,C20,C23,C24,C26/-9.063E-17,461.7,647.3,1.3,0.3/
      DATA PI/3.1415926/
C     CALL LINK('UNIT5=IPEDROP,UNIT6=(OPEDROP,CREATE,TEXT),UNIT59=TTY//'
C    1)
      WRITE(*,888)
      READ(*,887)FINPUT
       WRITE(*,886)
       READ(*,887)FOUTPUT
       OPEN(5,  FILE=FINPUT)
       OPEN(6,  FILE=FOUTPUT,STATUS='NEW')
888    FORMAT(' INPUT DATA FILE NAME'\)
887    FORMAT(A)
886    FORMAT(' OUTPUT DATA FILE NAME'\)
C     CALL ERRSET(208,256,-1,0,0,0)
      READ(5,1001) NSET
      DO 700 K=1,NSET
        LBOT=0.0
        LTOP=0.0
        IFLAG=0
        JFLAG=0
        KFLAG=0
        LEBOT=0.
        LETOP=0.
        DETOP=0.
        DFTOP=0.
        DEBOT=0.
        DFBOT=0.
      WRITE(6,1) K
    1 FORMAT(///3X,'RESULTS OF DATA SET NUMBER = ',I5//)
      READ(5,1000) P,DROD,PITCH,TL,TIN,TSAT,HIN
      READ(5,1000) MASS,DEC,MINM,LBOT,LTOP,LEBOT,LETOP
      READ(5,1001) NQ,IFLAG,JFLAG,KFLAG
      READ(5,1000) (Q(I),I=1,NQ)
      A11 = 2.*C26/(C24+C20)
      A13 = A11*(1.+C26)
      A12 = 1./A13
      A15 = 1./C23
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C
C  CALCULATION OF HYDRAULIC DIAMETER.
C
      A = PITCH**2-PI*DROD**2/4.
      PW = PI*DROD
      D = 4.*A/PW
      WRITE(6,3)
    3 FORMAT(3X,'GEOMETRICAL PARAMETERS AND INLET CONDITIONS')
      WRITE(6,4)
    4 FORMAT(3X,'*****************************************'/)
      WRITE(6,5) A,PW,D,TL
    5 FORMAT(3X,'CHANNEL FLOW AREA = ',E13.6,1X,'M**2'/3X,'WETTED PERIME
     1TER = ',E13.6,1X,'M'/3X,'HYDRAULIC DIAMETER = ',E13.6,1X,'M'/3X,'C
     2HANNEL AXIAL LENGTH = ',E13.6,1X,'M')
      WRITE(6,6) P,TIN
    6 FORMAT(3X,'INLET PRESSURE = ',F10.4,1X,'MPA'/3X,'INLET TEMPERATURE
     1 = ',F10.4,1X,'K')
      DO 700 I=1,NQ
      WRITE(6,7)
    7 FORMAT(//3X,'*****************************')
      WRITE(6,10) Q(I)
   10 FORMAT(3X,'HEAT FLUX = ',E13.6,1X,'MW/M**2')
      WRITE(6,20)
   20 FORMAT(3X,'*****************************'/)
      MDOT = MASS
C     IF(Q(I).EQ.0.0) MMP = 31
C     IF(Q(I).GT.0.0) MMP = 30
C     DO 700 J=1,MMP
   23 DFNONB = 0.0
      DENONB = 0.0
      DANONB = 0.0
      HFO = 0.0
      DTNONB = 0.0
      DTSUB = 0.0
      DEBB = 0.0
      DFBB = 0.0
      DABB = 0.0
      DESUB = 0.0
      DASUB = 0.0
      DFSUB = 0.0
      DTSUB=0.0
      DTBB = 0.0
      DEVAP = 0.0
      DAVAP = 0.0
      DFVAP = 0.0
      DTVAP = 0.0
      DROP = 0.0
C
C  FLUID PROPERTIES AT INLET.
C
      TBA = TIN
      CPF = CP(TBA)
      TKW = TKCOOL(TBA,P)
      UBF = UF(TBA)
C     RHOFI = RHOF(TBA)
       PP=P*1.E6
       CALL STATE(PP,TBA,TBA,ROV,RHOFI,EV,EL,TTSAT,HVS,HLS,DTSTP,
     1 DELDP,DEVDP,DELDT,DEVDT,DRLDP,DRVDP,DRLDT,DRVDT,IOP,IERR)
      IF(MDOT.LT. MINM) GO TO 700
      IF(MDOT .LE. 0.) GO TO 700
      VELI = MDOT/(RHOFI*A)
      G = VELI*RHOFI
      WRITE(6,40) MDOT,G
   40 FORMAT(/3X,'MASS FLOW RATE = ',E13.6,1X,'KG/SEC'/3X,'MASS FLUX = '
     1,E13.6,1X,'KG/SEC-M**2')
C
C  CALCULATION OF THE POINT OF BUBBLE DETACHMENT (ASSUMED = ZSC) USING
C  THE SAHA AND ZUBER METHOD.
C
      IF(Q(I).EQ.0.0) GO TO 53
      PEC = G*D*CPF/TKW
      IF(PEC.LE.70000.) DELSUB = .0022*Q(I)*1.E6*D/TKW
      IF(PEC.GT.70000.) DELSUB = 153.8*Q(I)*1.E6/(G*CPF)
      TFZSC = TSAT-DELSUB
      ZSC = D*G*CPF*(TFZSC-TIN)/(4.*Q(I)*1.E6)
      WRITE(6,50) PEC,DELSUB,TFZSC,ZSC
   50 FORMAT(3X,'PECLET NUMBER = ',E13.6/3X,'DELTA-T SUB = ',E13.6,1X,'K
     1'/3X,'FLUID TEMP. AT ZSC = ',E13.6,1X,'K'/3X,'ZSC = ',E13.6,1X,'M'
     2)
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   53 IF(ZSC.GT.TL.OR.Q(I).EQ.0.0) ZSC = TL
      IF(ZSC.LT.0.0) ZSC=0.0
C
C  NON-BOILING PRESSURE DROPS.
C       WRITE(6,121) VELI
C
      IF(VELI.GT.0.0) RE = G*D/UBF
      IF(VELI.GT.0.0) FRIC = .316/RE**.25
      IF(VELI.LE.0.0) GO TO 55
      HFO = .023*TKW/D*(G*D/UBF)**.8*(UBF*CPF/TKW)**.4
      TBA = TIN+0.5*(TFZSC-TIN)
C     RHOBF = RHOF(TBA)
       PP=P*1.E6
       CALL STATE(PP,TBA,TBA,ROV,RHOBF,EV,EL,TTSAT,HVS,HLS,DTSDP,
     1 DELDP,DEVDP,DELDT,DEVDT,DRLDP,DRVDP,DRLDT,DRVDT,IOP,IERR)
   55 IF(Q(I).EQ.0.0) RHOBF=RHOFI
      IF(VELI.GT.0.0) DFNONB = ZSC*FRIC*G**2/(2.*D*RHOBF)
      DENONB = RHOBF*9.81*ZSC
        DFBOT=(LBOT+LEBOT)*FRIC*G**2/(2.*D*RHOFI)
        DEBOT=RHOFI*9.81*LBOT
         DTBOT=DEBOT+DFBOT
      TBA = TFZSC
C     RHOZSC = RHOF(TBA)
      PP=P*1.E6
      CALL STATE (PP,TBA,TBA,ROV,RHOZSC,EV,EL,TTSAT,HVS,HLS,DTSDP,
     1 DELDP,DEVDP,DELDT,DEVDT,DRLDP,DRVDP,DRLDT,DRVDT,IQP,IERR)
      IF(Q(I).EQ.0.0) RHOZSC=RHOFI
      IF(VELI.LE.0.0) GO TO 59
      IF(ZSC.GT.0.0) DANONB=G**2*(1./RHOZSC-1./RHOFI)
        IF(IFLAG .GT.  0) DANONB=0.0
        IF(ZSC .LT. TL) GO TO 59
        DFTOP=(LTOP+LETOP)*FRIC*G**2/(2.*D*RHOBF)
        DETOP=RHOBF*9.81*LTOP
        DTTOP=DETOP+DFTOP
   59 DTNONB = DFNONB+DENONB+DANONB
C     WRITE(6,60) RE,FRIC,RHOBF,RHOZSC,HFO
   60 FORMAT(3X,'REYNOLDS NUMBER = ',E13.6/3X,'FRICTION FACTOR = ',E13.6
     1/3X,'AV. NON-BOILING BULK FLUID DENSITY = ',F10.3,1X,'KG/M**3'/3X,
     2'FLUID DENSITY AT ZSC = ',F10.3,1X,'KG/M**3'/3X,'COEFFICIENT OF HE
     3AT TRANSFER = ',F10.3,1X,'W/M**2-K')
      IF(ZSC.GE.TL.OR.Q(I).EQ.0.0) GO TO 625
C
C  DETERMINATION OF ZB.
C
      TBA = TSAT
C     RHOFZB = RHOF(TBA)
C     PP=P*1.E6
       PB=P-0.004*P
  100  PPB=PB*1.E6
      CALL STATE(PPB,TBA,TBA,ROV,RHOFZB,EV,EL,TTSAT,HVS,HLS,DTSDP,
     1 DELDP,DEVDP,DELDT,DEVDT,DRLDP,DRVDP,DRLDT,DRVDT,IQP,IERR)
       CALL STATE(PPB,TTSAT,TTSAT,RHOGZB,RHOFZB,EV,EL,TTTSAT,HVS,HLS,DTSD
     1P,DELDP,DEVDP,DELDT,DEVDT,DRLDP,DRVDP,DRLDT,DRVDT,IQP,IERR)
       HF=HLS/1.E3
        UBF=UF(TSAT)
        UBG=UG(TSAT)
C     WRITE(6,121) RHOGZB,RHOFZB,HLS
C     RHOGZB = RHOG(TBA,PB)
       TBA=.5*(TSAT+TFZSC)
       RHOSUB=.5*(RHOFZB+RHOZSC)
      CPF = CP(TBA)
      ZB = MDOT*(HF-HIN)/(PI*Q(I)*1.E3*DROD)
      IF(ZB.GT.TL) ZB=TL
      IF(ZB.LT.0.0) ZB=0.0
      IF(ZB .LT. ZSC) ZSC=ZB
C
C  SUBCOOLED BOILING PRESSURE DROPS.
C
      DESUB = RHOSUB*9.81*(ZB-ZSC)
      IF(ZB.GT.0.0) DASUB=(G**2*(1./RHOFZB-1./RHOZSC))
      RE=G*D/UF(TBA)
      IF(VELI.GT.0.0) FRIC=.316/RE**.25
C
C  BRITISH UNITS USED FOR SUBCOOLED FRICTION PR. DROP CALCULATIONS.
C
      FPD = (G*737.73)**2*FRIC/(2.*32.2*3600.**2*D*3.281*RHOSUB*0.06243)
      TLBSTR= (((TSAT-273.15)*1.8+32.+60.*((Q(I)*.3169E6/.1E7)**.25/EXP(
     1PB*.145E3/900.))-.766*Q(I)*.3169E6/(HFO*.1761))-32.)*5./9.+273.15
      PHLOMN = (1.2*((RHOFZB/RHOGZB)-1.)*.042**.824)
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C     WRITE(6,120)
  120 FORMAT(1X,'FPD,TLBSTR,PHLOMN,FACTOR,CORFAC')
C     WRITE(6,121) FPD,TLBSTR,PHLOMN,FACTOR,CORFAC
  121 FORMAT(1X,8E13.6)
  150 IF(G*737.73.LT.7.E5) CORFAC = 1.36+.0005*PB*.145E3+.1*(G*737.73/1.
     1E6)-.000714*PB*.145E3*(G*737.73/1.E6)
      IF(G*737.73.GT.7.E5) CORFAC = 1.26-.0004*PB*.145E3+.119*(1.E6/(G*7
     137.73))+.00028*PB*.145E3*(1.E6/(G*737.73))
      FSAT = PHLOMN*CORFAC+1.
      DEVID=(7.04-3.8*.042)*(1.172-1.7*PB)+3.4*PB-0.344
      IF(JFLAG .GT. 0) FSAT=FSAT/DEVID
      FOFISO = 1.+(TBA-TLBSTR)*(FSAT-1.)/(TSAT-TLBSTR)
      IF (TBA .LT. TLBSTR) FOFISO = 1.-0.001*Q(I)/HFO
      IF (KFLAG .GT. 0) FOFISO=1
      DFSUB = 47.867*FPD*(ZB-ZSC)*3.281*FOFISO
        IF(ZB .LT. TL) GO TO 160
        TEXIT=TIN+TL*PI*Q(I)*1.E6*DROD/(MDOT*CPF)
        PPB=PB*1.E6
        CALL STATE(PPB,TEXIT,TEXIT,ROV,RHOFTL,EV,EL,TTSAT,HVS,HLS,DTSDP,
     1  DELDP,DEVDP,DELDT,DEVDT,DRLDP,DRVDP,DRLDT,DRVDT,IQP,IERR)
C       WRITE(6,121) RHOFTL
C       WRITE(6,121) TEXIT,RHOFTL
        DASUB=G**2*(1./RHOFTL-1./RHOZSC)
         DESUB=.5*(RHOFTL+RHOZSC)*9.81*(TL-ZSC)
        CPEXIT=CP(TEXIT)
        TKEXIT=TKCOOL(TEXIT,PB)
        UBFEX=UF(TEXIT)
        RE=G*D/UBFEX
        FRIC=.316/RE**.25
        DFTOP=(LTOP+LETOP)*FRIC*G**2/(D*RHOFTL*2.)
        DETOP=RHOFTL*9.81*LTOP
  160   IF(IFLAG .GT.  0) DASUB=0.0

      DTTOP=DFTOP+DETOP
      DTSUB = DESUB+DASUB+DFSUB
C     WRITE(6,170)
C 170 FORMAT(1X,'CORFAC,FSAT,FOFISO,TBA,TLBSTR')
C     WRITE(6,121)CORFAC,FSAT,FOFISO,TBA,TLBSTR
C
C  ITERATIONS OF PRESSURE AT ZB.
C
      PBB = (P*1.E6-(DTNONB+DTSUB+DTBOT))
C     WRITE(6,121) PB,PBB
      PBITE = ABS((PBB/1.E6-PB)/PB)
      IF(PBITE.GT.0.00005) PB=PBB/1.E6
      IF(PBITE.GT.0.00005) GO TO 100
        IF (KFLAG .LE. 0) GO TO 162
        DANONB=DANONB+DASUB
        TBA=(TIN+TSAT)/2.

        IF(ZB .GE. TL) TBA=(TEXIT+TIN)/2.
        PPB=PB*1.E6
        CALL STATE(PPB,TBA,TBA,ROV,RHOFBA,EV,EL,TTSAT,HVS,HLS,DTSDP,
     1  DELDP,DEVDP,DELDT,DEVDT,DRLDP,DRVDP,DRLDT,DRVDT,IQP,IERR)
        DENONB=RHOFBA*9.81*ZB
         DFNONB=DFNONB*(RHOBF/RHOFBA)*(ZB/ZSC)
        DTNONB=DANONB+DENONB+DFNONB
        DESUB=0.0
        DASUB=0.0
         DFSUB=0.0
        DTSUB=0.0
  162 WRITE(6,200) ZB
  200 FORMAT(3X,'ZB = ',F10.4,1X,'M')

      IF(ZB.GE.TL) GO TO 625
C
C  DETERMINATION OF ZV.
C
      PV = (P-0.006*P)
C 300 HG = ENTHAG(PV)
  300   PPV=PV*1.0E6
        CALL STATE(PPV,TSAT,TSAT,ROV,ROL,EV,EL,TTSAT,HVS,HLS,DTSTP,
     1DELDP,DEVDP,DELDT,DEVDT,DRLDP,DRVDP,DRLDT,DRVDT,IOP,IERR)
        HG=HVS/1.E3
      ZV = MDOT*(HG-HIN)/(PI*Q(I)*1.E3*DROD)
      IF(ZV.GT.TL) ZV=TL
      IF(ZV.LT.0.0) ZV=0.0
C
C  CALCULATION OF MARTINELLI-NELSON VOID FRACTION.
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C
      XZSC = -CPF*DELSUB/((HG-HF)*1.E3)
      XZB = -XZSC/2.71828
      XTTZB = (UBF/UBG)**.1*(((1.-XZB)/XZB)**.9)*(RHOGZB/RHOFZB)**.5
      RGZB = 1.-XTTZB/((XTTZB**2+20.*XTTZB+1.)**.5)
C
C   DETERMINATION OF X(Z=TL)=XOUT
C
C     HGPB=ENTHAG(PB)
        PPB=PB*1.E6
        CALL STATE (PPB,TSAT,TSAT,ROV,ROL,EV,EL,TTSAT,HVS,HLS,DTSDP,
     1  DELDP,DEVDP,DELDT,DEVDT,DRLDP,DRVDP,DRLDT,DRVDT,IQP,IERR)
        HGPB=HVS/1.E3
C       WRITE(6,121) HVS
      HOUT=TL*(PI*Q(I)*1.E3*DROD)/MDOT+HIN
      XEOUT=(HOUT-HF)/(HGPB-HF)
      XOUT=XEOUT-XZSC*EXP(XEOUT/XZSC-1.)
      IF(XEOUT .GT. 1.0) XEOUT = 1.0
      IF(XOUT  .GT. 1.0) XOUT  =1.0
C
C  BULK BOILING PRESSURE DROPS.
C
      XZV = 1.-XZSC*EXP(1./XZSC-1.)
      IF(ZV .GE. TL) XZV=XOUT
      IF(XZV.GT.1.0) XZV=1.0
      XTTZV = (UBF/UBG)**.1*(((1.-XZV)/XZV)**.9)*(RHOGZB/RHOFZB)**.5
      RGZV = 1.-XTTZV/((XTTZV**2+20.*XTTZV+1.)**.5)
      RHOB = RHOFZB-0.5*(RGZB+RGZV)*(RHOFZB-RHOGZB)
      DEBB = RHOB*9.81*(ZV-ZB)
        RHOZV=RHOFZB-RGZV*(RHOFZB-RHOGZB)
      DZV = XZV**2/(RHOGZB*RGZV)
      IF(XZV.NE.1..OR.RGZV.NE.1.) DZV = (1.-XZV)**2/(RHOFZB*(1.-RGZV)
     1)+DZV
      DZB = (1.-XZB)**2/(RHOFZB*(1.-RGZB))+XZB**2/(RHOGZB*RGZB)
      IF(ZV.GT.0.0) DABB = (G**2)*(DZV-DZB)
        XEZV=1.0
         IF(ZV .GE. TL) XEZV=XEOUT
      PHLOMN=1.2*((RHOFZB/RHOGZB)-1.)*(XEZV)**.824
      DFBB=(G*737.73)**2*FRIC*(PHLOMN*CORFAC/1.824+1.)*(ZV-ZB)/(RHOFZB*
     10.06243*2*32.2*3600.**2*D)*47.867
       DEVID=((7.04-3.8*XEZV)*(1.172-1.7*PB)+3.4*
     1 PB-.344)
        IF(IFLAG .GT.  0) DABB=0.
        IF(ZV .LT. TL ) GO TO 350
        DFTOP=G**2*FRIC*(PHLOMN*CORFAC+1.0)*(LTOP+LETOP)/
     1  (RHOFZB*D*2.)
        IF(JFLAG .GT. 0) DFTOP=DFTOP/DEVID
        DETOP=RHOZV*9.81*LTOP
        DTTOP=DFTOP+DETOP
  350   IF(JFLAG .GT.  0) DFBB=DFBB/DEVID
C     WRITE (6,320)
  320 FORMAT(1X,'DFBB,FRIC,PHLOMN,CORFAC,ZB,RHOFZB,RHOGZB')
C     WRITE(6,121) DFBB,FRIC,PHLOMN,CORFAC,ZB,RHOFZB,RHOGZB
      DTBB = DEBB+DABB+DFBB
C
C  ITERATIONS OF PRESSURE AT ZV.
C
      PVV = (P*1.E6-(DTNONB+DTSUB+DTBB+DTBOT))
      PVITE = ABS((PVV/1.E6-PV)/PV)
      IF(PVITE.GT.0.00005) PV=PVV/1.E6
      IF(PVITE.GT.0.00005) GO TO 300
      WRITE(6,400) ZV,XZSC,XZB,RGZB,XZV,RGZV,XEOUT,XOUT
  400 FORMAT(3X,'ZV= ',F10.4,1X,'M'/
     1 3X,'EQUILIBRIUM QUALITY AT ZSC = ',E13.6/
     2 3X,'NON EQUILIBRIUM QUALITY AT ZB =',E13.6/
     3 3X,'MARTINELLI-NELSON VOID FRACTION AT ZB =',F10.4/
     4 3X,'NON EQUILIBRIUM QUALITY AT ZV = ',E13.6/
     5 3X,'MARTINELLI-NELSON VOID FRACTION AT ZV =', E13.6/
     6 3X,'QUALITY AT CHANNEL OUTLET , EQ = ',F10.4,' NON EQ = ',F10.4)
      IF(ZV.GE.TL) GO TO 625
C
C  DETERMINATION OF VAPOR DENSITY AT EXIT.
C
       HTL = Q(I)*1.E3*PI*DROD*TL/MDOT+HIN
      TG = TSAT+2.
      IF(PV*1.E6.GT.2.E6) GO TO 500
      ES = C6+C7*(1./(C8+PV*1.E6))
      GS = C9+(C11*PV*1.E6+C10)*PV*1.E6
      GO TO 510
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  500 ES = C12+(C14*PV*1.E6+C13)*PV*1.E6
      GS = C15+(C17*PV*1.E6+C16)*PV*1.E6
  510 CPS = C4*(1.0-A15*TSAT)**C5
      BETA = TSAT**2*(1.0-1.0/(A11*CPS-1.0)**2)
  520 EG = ES+A12*((TG-TSAT)+(TG**2-BETA)**.5-TSAT/(A11*CPS-1.0))
      DENG = PV*1.E6/((GS-1.0)*ES+C26*(EG-ES))
      HG = EG+PV*1.E6/DENG
      HABS = ABS((HG/1.E3-HTL)/HTL)
      IF(TG.GT.700.) GO TO 530
      IF(HABS.GT.0.005) TG = TG+1.
      IF(HABS.GT.0.005) GO TO 520
C
C  SINGLE PHASE VAPOR PRESSURE DROPS. THESE PRESSURE DROPS MAY NOT BE
C  COMPATIBLE WITH THOSE CALCULATED EARLIER AND ARE NOT TABULATED.
C
  530 TBA = TG-0.5*(TG-TSAT)
      IF(TBA.GT.640.) TBA = 640.
      IF(TBA.GT.640.) WRITE(6,570)
  570 FORMAT(3X,'THE AV. VAPOR TEMP. HAS EXCEEDED THE RANGE OF VALIDITY
     1OF THE VAPOR VISCOSITY CORRELATION. SO AS TO AVOID A SUBSEQUENT NE
     2GATIVE ARGUMENT,TBA IS TAKEN TO BE 640. K')
      UBG = UG(TBA)
      RE = G*D/UBG
C     FRIC = .316/RE**.25
      DEVAP = 0.5*(RHOGZB+DENG)*9.81*(TL-ZV)
      DAVAP = G**2*(1./DENG-1./RHOGZB)
C     DFVAP = FRIC*G**2*(TL-ZV)/(2.*D*0.5*(RHOGZB+DENG))
       PHOLMN=1.2*(RHOFZB/RHOGZB-1.)
       DFVAP=FRIC*G**2.*(TL-ZV)*(PHOLMN*CORFAC+1.)/(RHOFZB
     1 *D*2.)
       DFTOP=FRIC*G**2.*(LTOP+LETOP)*(PHOLMN*CORFAC+1.)/(RHOFZB*D*2.)
      IF(IFLAG .GT.  0) DAVAP=0.0
C     DFVAP = DFVAP+FRIC*G**2*(LTOP+LETOP)/(2.*D*DENG)
      DETOP=DENG*9.81*LTOP
       IF(JFLAG .LE. 0) GO TO 580
       DFVAP=DFVAP/DEVID
       DFTOP=DFTOP/DEVID
  580 DTTOP=DETOP+DFTOP
      DTVAP = DEVAP+DAVAP+DFVAP
      WRITE(6,600) TG,HTL,DENG,HG,RE,DEVAP,DAVAP,DFVAP,DTVAP
  600 FORMAT(3X,'VAPOR TEMPERATURE AT EXIT = ',F10.3,1X,'K'/3X,'ENTHALPY
     1 AT EXIT(HEAT BALANCE)= ',F10.1,1X,'KJ/KG'/3X,'VAPOR DENSITY AT EX
     2IT = ',F10.3,1X,'KG/M**3'/3X,'ENTHALPY AT EXIT(CORRELATED) = ',F10
     3.1,1X,'J/KG'/3X,'VAPOR REYNOLDS NUMBER = ',F10.1/3X,'ELEVATION VAP
     4OR PR. DROP = ',F10.3,1X,'PA'/3X,'ACCELERATION VAPOR PR. DROP = ',
     5F10.3,1X,'PA'/3X,'FRICTION VAPOR PR. DROP = ',F10.3,1X,'PA'/3X,'TO
     6TAL VAPOR PR. DROP = ',F10.2,1X,'PA')
C
C  TOTAL PRESSURE DROP.
C
  625 DROP = DTNONB+DTSUB+DTBB+DTVAP+DTTOP+DEBOT+DFBOT
      WRITE(6,650) DROP
  650 FORMAT(/3X,'TOTAL PRESSURE DROP = ',F10.0,1X,'PA')
C
C  TABULATION OF PRESSURE DROP COMPONENTS
C
      DF = DFNONB+DFSUB+DFBB+DFTOP+DFBOT
      DE = DENONB+DESUB+DEBB+DETOP+DEBOT
      DA = DANONB+DASUB+DABB
      DFCENT = DF/DROP*100.
      DECENT = DE/DROP*100.
      DACENT = DA/DROP*100.
      DTNCEN = DTNONB/DROP*100.
      DTSCEN = DTSUB/DROP*100.
      DTBCEN = DTBB/DROP*100.
      WRITE(6,651)
  651 FORMAT(/3X,'******** TABULATION OF PRESSURE DROP COMPONENTS IN PAS
     1CALS *********')
      WRITE(6,652)
  652 FORMAT(3X,'**************************************************
     1*************')
      WRITE(6,653)
  653 FORMAT(13X,'BOILING REGIME                    SUBTOTAL (COMP./TOT
     1AL)%')
      WRITE(6,654)
  654 FORMAT(3X,'COMPONENT NON-BOILING  SUBCOOLED      BULK')
      WRITE(6,655)
  655 FORMAT(3X,'**************************************************
     1*************')
```

```
      WRITE(6,656) DFNONB,DFSUB,DFBB,DF,DFCENT
  656 FORMAT(3X,'FRICTION',4X,F10.0,1X,3F10.0,8X,F5.2)
      WRITE(6,657) DENONB,DESUB,DEBB,DE,DECENT
  657 FORMAT(3X,'ELEVATION',3X,F10.0,1X,3F10.0,8X,F5.2)
      WRITE(6,658) DANONB,DASUB,DABB,DA,DACENT
  658 FORMAT(3X,'ACCELERATION',F10.0,1X,3F10.0,8X,F5.2)
      WRITE(6,659)
  659 FORMAT(3X,'**************************************************
     1*************')
      WRITE(6,660)
  660 FORMAT(50X,'TOTAL')
      WRITE(6,661) DTNONB,DTSUB,DTBB,DROP
  661 FORMAT(3X,'SUBTOTAL',4X,F10.0,1X,3F10.0)
      WRITE(6,662)
  662 FORMAT(46X,'**********')
      WRITE(6,663) DTNCEN,DTSCEN,DTBCEN
  663 FORMAT(3X,'(REGIME/TOTAL)%',1X,F6.2,5X,F6.2,4X,F6.2)
      WRITE(6,675)
  675 FORMAT(/3X,'**************************************************
     1**************')
      WRITE(6,676) DETOP,DFTOP,DEBOT,DFBOT
  676  FORMAT(3X,'TOP    UNHEATED PR. DROP  ELEV  =',F8.2,' FRI=',F8.2/
     1 3X,'BOTTOM UNHEATED PR. DROP  ELEV  =',F8.2,' FRI=',F8.2)
      MDOT=MDOT-DEC
      GO TO 23
  700 CONTINUE
 1000 FORMAT(7f10.0)
 1001 FORMAT(6i5)
      STOP
      END
```