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c       FORTRAN PROGRAM FOR PROBLEMS SIMILAR TO EXAMPLE VId.6.1
c       In this example, 1000 Btu/s is added to the atmosphere
c
      implicit real*8 (a-h,o-z)
c
c   Vol; Volume,   Vdot; d(Volume),   v; Sp. Vol.,   vo; Void Fraction
c   ks; kstat  ,  (ks = 1 subcooled,  ks = 2 sat.,   k3 = 3 superheated)
c   Ts; Sat. Temp.,  dQ; Qdot,        phi = relative humidity
c   dmi; Includes all internal flow rates to or from a region
c   dmx; Includes all external flow rates injected to a region
c   hx; Includes all external flow enthalpies injected to a region
c   dmh; Includes all flow rates times their enthalpies
c
      dimension ks(3)
      dimension Vol(3)
      Dimension cof(6,7)
      dimension P(3),Pdot(3)
      dimension aM(3),Alf(3),Bet(2)
      dimension x(3),vo(3),sf(3),sg(3)
      dimension h(3),hf(3),hg(3),hdot(3)
      dimension T(3),Ts(3),dTdh(3),dTdp(3)
      dimension v(3),vf(3),vg(3),dvdp(3),dvdh(3)
      dimension dmi(3),dmx(3),hx(3),dmh(3),dQ(2)
c
      data Apool,Dhyd/100,10.00/
      data P/100.0,0.0,0.0/
      data vol/10,1000,1000/
      data T/100.,100.,100./
      data phi/0.0/
      data dmx/0.,0.,0./
      data hx/00.,0.,00./
      data dQ/00.,000.00/
      data dt,time,ttt/0.1,0.0,500.00/
      data ip,c,Rgas/0,0.18509,53.34/
c
      Open(7,file='f1.out')
      Open(8,file='f2.out')
      open(9,file='f3.out')
c
      print *,'Enter: dmx(i),hx(i), dq(i), phi'
      read(*,*) dmx(1),hx(1),dmx(2),hx(2),dmx(3),hx(3),dq(1),dq(2),phi
c
c...  Find Steady State Values.
c
      if(phi.le.0.0) phi=1.e-6
      call Start(p,T,phi,h,Vol,aM,vf,vg,voi,hg,hf)
      write(7,102) phi
      write(7,102) p
      write(7,102) T
      write(7,102) h
      write(7,102) am
      write(7,102) vol
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102   format(3f12.2)
      write(7,40)
      write(8,41)
c
c... >>>>>>>>>>>>>>>   Start OF Transient    <<<<<<<<<<<<<<<<<<<<<<<<
c
100   continue
      ip=ip+1
c
c...   Below the forcing functions are updated
c
c      Call EvaCon(Apool,Dhyd,p,T,Ts,am,hg(1),hf(2),dm,de,fudge)
c
      jg=1
c
c
      do 1 i=1,3
      if(i.lt.3)
     1 call prp(p(i),h(i),hf(i),hg(i),ks(i),T(i),v(i),x(i),
     1      vo(i),vf(i),vg(i),dvdh(i),dvdp(i),ts(i),sf(i),sg(i))
      if(i.eq.3)
     1call prpg(jg,p(i),h(i),v(i),T(i),dvdh(i),dvdp(i),dTdh(i),dTdp(i))
1     continue
      if(ks(2).ne.3) go to 11
      call Sup(p(2),h(2),cp2,v(2),T(2),dvdh(2),dvdp(2),dTdh(2),dTdp(2))
11    continue
456   format(4f8.2,4f8.3)
       alf(1)=dmx(1)
       alf(2)=dmx(2)
       alf(3)=dmx(3)
       bet(1)=dmx(1)*hx(1)+dq(1)
       bet(2)=dmx(2)*hx(2)+dmx(3)*hx(3)+dq(2)
c
c...  Initialize the coefficient matrix to zero
c
      do 500 i=1,6
      do 500 j=1,7
      cof(i,j)=0.0
500   continue
c
c...  Fill coefficients of the augmented matrix
c
      cof(1,1)=am(1)
      cof(1,4)=-c*vol(1)
      cof(1,7)=bet(1)-alf(1)*h(1)
      cof(2,2)=am(2)
      cof(2,3)=am(3)
      cof(2,4)=-c*vol(2)
      cof(2,7)=bet(2)-alf(2)*h(2)-alf(3)*h(3)
      cof(3,1)=am(1)*dvdh(1)
      cof(3,2)=am(2)*dvdh(2)
      cof(3,4)=am(1)*dvdp(1)
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      cof(3,5)=am(2)*dvdp(2)
      cof(3,7)=-(alf(1)*v(1)+alf(2)*v(2))
      cof(4,1)=am(1)*dvdh(1)
      cof(4,3)=am(3)*dvdh(3)
      cof(4,4)=am(1)*dvdp(1)
      cof(4,6)=am(3)*dvdp(3)
      cof(4,7)=-(alf(1)*v(1)+alf(3)*v(3))
      cof(5,2)=dtdh(2)
      cof(5,3)=-dtdh(3)
      cof(5,5)=dtdp(2)
      cof(5,6)=-dtdp(3)
      cof(5,6)=0
      cof(6,4)=1.0
      cof(6,5)=-1.0
      cof(6,6)=-1.0
c
c...  Solve The set of 6 x 6 equations to find hdots and Pdots
c
      irow=6
      icol=6
      call yenbob(cof,irow,icol)
      do 501 i=1,3
      hdot(i)=cof(i,7)
      pdot(i)=cof(i+3,7)
501   continue
c
c...  Having derivatives, integrate to find M, h, & P
c
      do 3 i=1,3
      am(i)=am(i)+alf(i)*dt
      h(i)=h(i)+hdot(i)*dt
      p(i)=p(i)+pdot(i)*dt
      vol(i)=v(i)*am(i)
3     continue
      phip=100.00*p(2)/psat(T(2))
      alcolaps=vol(1)/Apool
c
      if(ip.lt.10) go to 37
      if(ip.eq.10) ip=0
      write(7,39) time,am(1),am(2),am(3),Vol(1),Vol(2),phip
      write(8,38) time,P(1),P(2),P(3),h(1),h(2),h(3),T(1),T(2),T(3)
      write(*,38) time,P(1),P(2),P(3),h(1),h(2),h(3),T(1),T(2),T(3)
      write(9,391) time,p(1),phip,alcolaps,dm,de
37    continue
      time=time+dt
      if(time.lt.ttt) go to 100
38    format(f7.2,9f8.1)
39    format(f7.2,5f9.1,f9.3)
391   format(f7.2,5f9.3)
40    format(/,'   Time    M1       M2        M3     Vol1     Vol2')
41    format(' Time     P1        P2      P3      h1      h2     h3',
     1'      T1     T2     T3')
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      stop
      end
c.....................................................................
c.....................................................................
      Subroutine Start(P,T,phi,h,vol,am,vf,vg,vo,hg,hf)
c
c... This subroutine finds partial pressures, enthalpies, and masses
c... given total pressure, phase volumes, temperature and rel. humidity
c
      implicit real*8 (a-h,o-z)
      Dimension hf(2),hg(2),Ks(2),v(3),X(2),vo(2)
      Dimension vf(2),vg(2),Ts(2),sf(2),sg(2),dvdh(3),dvdp(3)
      Dimension P(1),T(1),h(1),vol(1),am(1)
c
c... Following For Steady-State Printout
c
      T1=T(1)
      T2=T(2)
c
c... Find pressures
c
      p(2)=phi*psat(T(2))
      p(3)=p(1)-p(2)
c
c...  Find Enthalpies From Temperatures
      j=0
      h(1)=hcl(p(1),T(1))
      call hgas(p(2),T(2),h(2))
      call prpg(j,p(3),h(3),v(3),T(3),dvdh(3),dvdp(3),dTdh,dTdp)
c
c    Having Pressures and Enthalpies, Find Other Properties
c
      do 1 i=1,2
      call PRP(P(i),H(I),HF(i),HG(i),KS(i),T(i),v(i),X(i),vo(i),
     1         VF(i),VG(i),DVDH(i),DVDP(i),TS(i),SF(i),SG(i))
      j=1
 1    continue
      call prpg(j,p(3),h(3),v(3),T(3),dvdh(3),dvdp(3),dTdh,dTdp)
      if(ks(2).eq.2) go to 3
      call tgas(p(2),h(2),T(2),cp2)
      call volvap(h(2),p(2),T(2),v(2))
3     continue
c
c...  Having specific volume and volumes Find Initial Masses
c
      do 2 i=1,3
      am(i)=vol(i)/v(i)
2     continue
4     format(/////////////////////////)
5     format(///)
      return
      write(*,4)
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      print *,'              CONTAINMENT ANALYSIS, INITIAL CONDITIONS'
      print *,'              ========================================'
      write(*,5)
      VVV=vol(1)+vol(2)+vol(3)
      omega=am(2)/am(3)
      phip=phi*100.00
      write(*,6) VVV,vol(1),p(1),p(2),p(3),T1,T2,T2,am(1),am(2),am(3),
     1           phip,omega
6     format('        Containment Volume (ft3): ........',f16.3,/,
     1       '        Water Volume (ft3): ..............',f16.3,/,
     1       '        Total Pressure (pisa): ...........',f16.3,/,
     1       '        Steam Partial Pressure (psia): ...',f16.3,/,
     1       '        Air Partial Pressure (psia): .....',f16.3,/,
     1       '        Water Temperature (F): ...........',f16.3,/,
     1       '        Steam Temperature (F): ...........',f16.3,/,
     1       '        Air Temperature (F): .............',f16.3,/,
     1       '        Water Mass (lbm): ................',f16.3,/,
     1       '        Steam Mass (lbm): ................',f16.3,/,
     1       '        Air Mass (lbm): ..................',f16.3,/,
     1       '        Relative Humidity (%): ...........',f16.3,/,
     1       '        Humidity Ratio: ..................',f16.3,///,
     1 ' Enter:  >  1: Transient Analysis',/,
     1 '         >  0: Main Menu',/)
      read(*,*) ic
      if(ic.eq.1) return
      stop
      return
      end
c.....................................................................
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