```
C*****************************************************************
C
C Program SCRUB
C
C      This program determines the outlet temperature and
C water content of the gas stream.
C
C*****************************************************************
C
C Common
C
C      CPG    = Heat capacity of the gas stream, cal/g-K
C      DENG   = Density of the gas, g/cu.cm.
C      TG     = Inlet gas temperature, K
C      CPW    = Heat capacity of water, cal/g-K
C      DENW   = Density of water, g/cc
C      TW     = Temperature of water, K
C      TB     = Boiling temperature of liquid, K
C      P      = Scrubber pressure, atm
C      FS     = Water content to saturate inlet gas stream
C      DHV    = Heat of vaporization of water, cal/g
C      QG     = Volumetric flow rate of the gas, cc/s
C      QW     = Volumetric flow rate of water, cc/s
C
C*****************************************************************
       COMMON CPG,DENG,TG,CPW,DENW,TW,TB,P,FS,DHV,QG,QW
C
C Obtain the needed information from input data file
C (See: Subroutine PARAM)
C
       CALL PARAM
C
C Calculate the equilibrium temperature, (See: Subroutine
C TCALC )
C
       CALL TCALC(TE)
C
C Calculate the water vapor content of the outlet
C stream (See: Subroutine VCALC)
C
       CALL VCALC(TE,QGO)
C
C Write the final values
C
       CALL REPORT(TE,QGO)
C
```

```
      STOP
      END
C***************************************************
C
C Subroutine PARAM
C
C      This subroutine reads the data from an input data
C file.
C
C***************************************************
      SUBROUTINE PARAM
C
      COMMON CPG,DENG,TG,CPW,DENW,TW,TB,P,FS,DHV,QG,QW
C
      OPEN(5,FILE='SLUR.DAT',STATUS='OLD',ACCESS='DIRECT'
     +      ,FORM='FORMATTED',RECL=80)
C
      READ(5,*)  CPG,DENG,TG,QG
      READ(5,*)  CPW,DENW,TW,QW
      READ(5,*)  TB,P,FS,DHV
C
      RETURN
      END
C***************************************************
C
C Subroutine TCALC
C
C      This subroutine calculates the temperature of the
C the outlet gas stream.
C
C***************************************************
C
C           TE = Equilibrium temperature, K
C
C***************************************************
      SUBROUTINE TCALC(TE)
C
      COMMON CPG,DENG,TG,CPW,DENW,TW,TB,P,FS,DHV,QG,QW
C
      HEATG=QG*CPG*DENG*TG
      HEATW=QW*CPW*DENW*TW
      COMB=QG*CPG*DENG+QW*CPW*DENW
      TE=(HEATG+HEATW)/COMB
C
      RETURN
      END
```

```
C*********************************************************
C
C Subroutine VCALC
C
C       This subroutine calculates the water content of
C the outlet stream assuming that the stream is
C saturated and using the technique outlined in Perry's
C Chemical Engineering Handbook to calculate saturated
C water content.
C
C*********************************************************
C
C       TE = Outlet temperature, K
C       QGO= Outlet gas volumetric flow rate, cc/s
C
C*********************************************************
      SUBROUTINE VCALC(TE,QGO)
C
      COMMON CPG,DENG,TG,CPW,DENW,TW,TB,P,FS,DHV,QG,QW
C
      R=8.312
      RATIO=FS*22.0/18.0
      IF(TE.GT.TB) GOTO 10
      HUM=WATER(TE,P)
      QG=QG*TE/TG
      QDRY=QG/(1+RATIO)
      FDRY=QDRY*P/(R*TE)*22.0
      FST=HUN*FDRY
      QST=(FST/18.0)*R*TE/P
      QGO=QST+QDRY
      GOTO 20
   10 QG=TB/TG*QG
      QDRY=QG/(1+RATIO)
      FST=(QG*DENG*CPG+QW*DENW*CPW)*(TE-TB)/DHV
      QST=(FST/18.0)*R*TE/P
      QGO=QST+QDRY
      TE=TB
   30 CONTINUE
      RETURN
      END
C*********************************************************
C
C Function WATER
C
C       This subroutine calculates saturated humidity.
C
```

```
C*****************************************************************
C
C         TE = temperature, K
C         P  = Pressure, atm
C
C*****************************************************************
       FUNCTION WATER(TE,P)
C
       T=TE*9.0/5.0+32.0
       PSR=EXP(6.53247-7173.79/(T+389.4747))
       PS=PSR*217.6
       WATER=PS/(P-PS)*18/28.9
       RETURN
       END
C*****************************************************************
C
C Subroutine REPORT
C
C      This subroutine write out the calculated data
C
C*****************************************************************
C
C          TE = Outlet temperature, K
C          QGO= Outlet flow rate, cc/s
C
C*****************************************************************
      SUBROUTINE REPORT(TE,QGO)
C
      WRITE(6,100) TE
  100 FORMAT(' EXIT GAS TEMPERATURE ',E12.4)
      WRITE(6,200) QGO
  200 EXIT GAS FLOW RATE ',E12.4)
      RETURN
      END
```

APPENDIX C

DESIGN CONSIDERATIONS

POTENTIAL PROBLEMS

In the design of the test reactor several items will present problems that must be overcome. This is a list of some of the likely design considerations that will have to be made.

1. Account of thermal expansion and contraction. The pyrolyzer will be hotter and will accordingly expand more than the combustor.

2. Assembly/disassembly considerations will be important. The simulator is constructed so that it can only be disassembled from the top down. This is a distinct disadvantage.

3. The feed must be injected through a tube that passes through the combustor. This tube must be insulated and flushed with some carrier fluid.

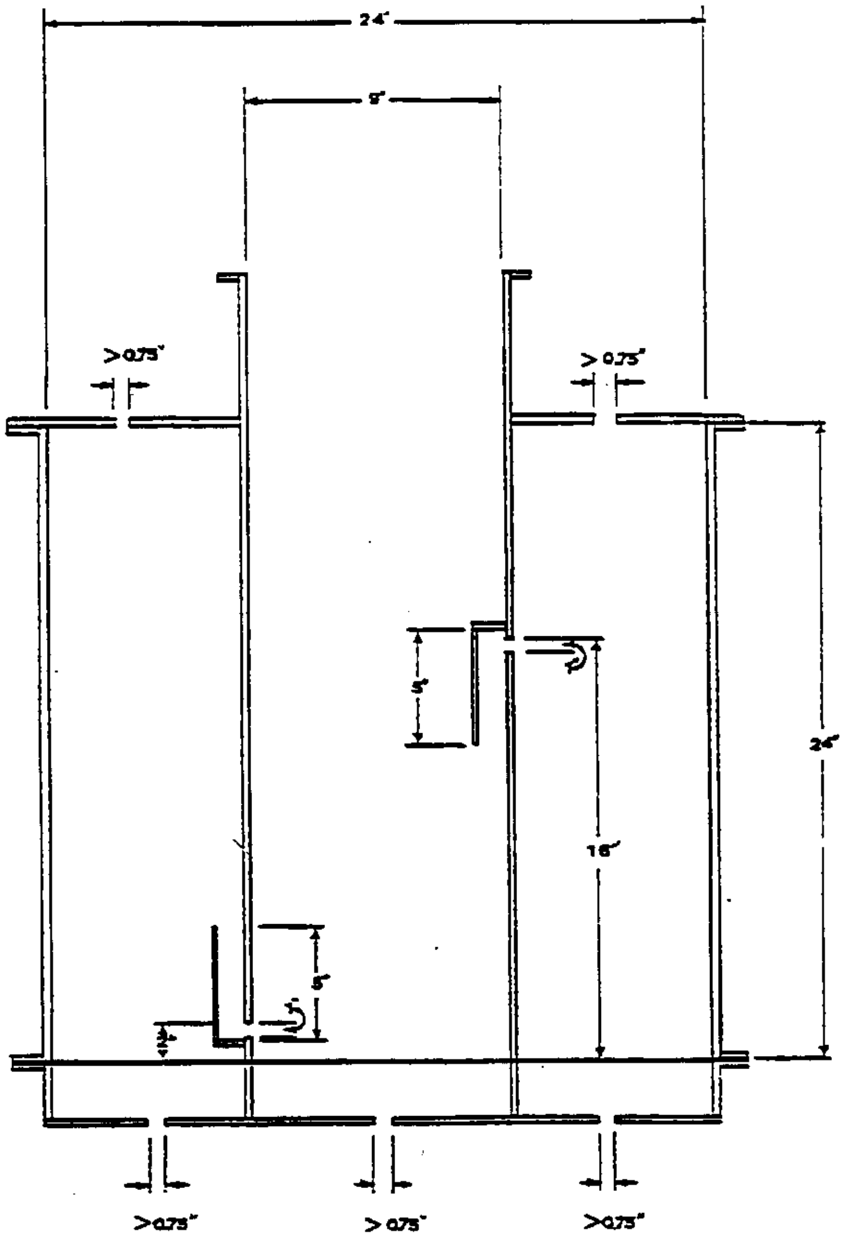
4. Flow considerations will be important. The combustor will require a fairly large volumetric flow of gas. Care must be taken so that the combustor outlet lines are large enough to handle the flow.

5. The pyrolysis reactor will be operating at 1000 K and 5 atm. special consideration must be given to selecting an appropriate material fro construction.

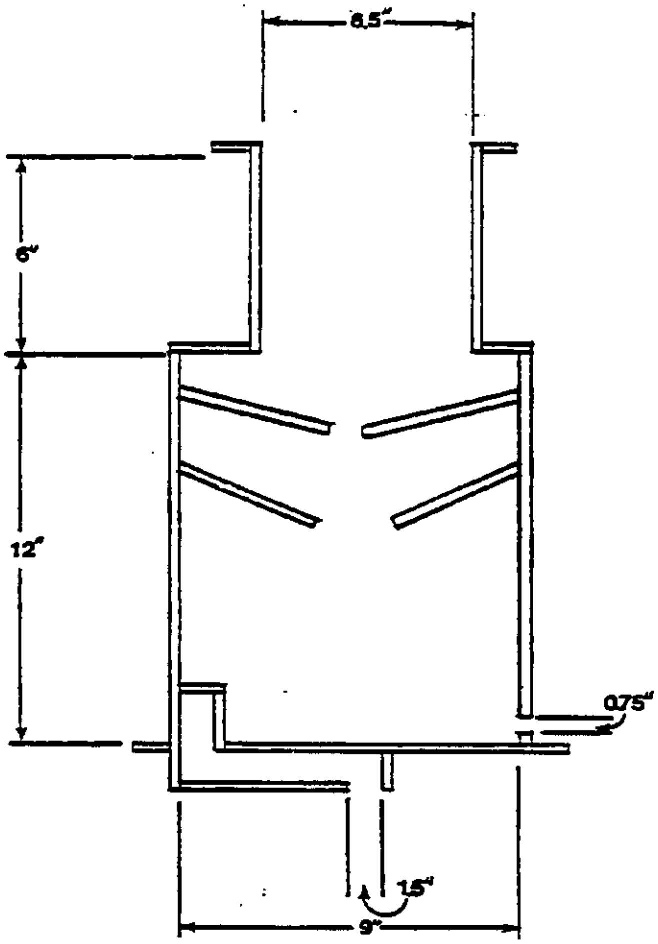
6. Provisions will have to be included for the addition of catalyst to the Fischer-Tropsch reactor and alumina to the combustor and pyrolyzer while the system is operating. Changes in the levels in these reactors occur due to attrition and blow over. These changes must be counteracted.

7. Provisions for emptying each of the reactors after a run will have to be included.

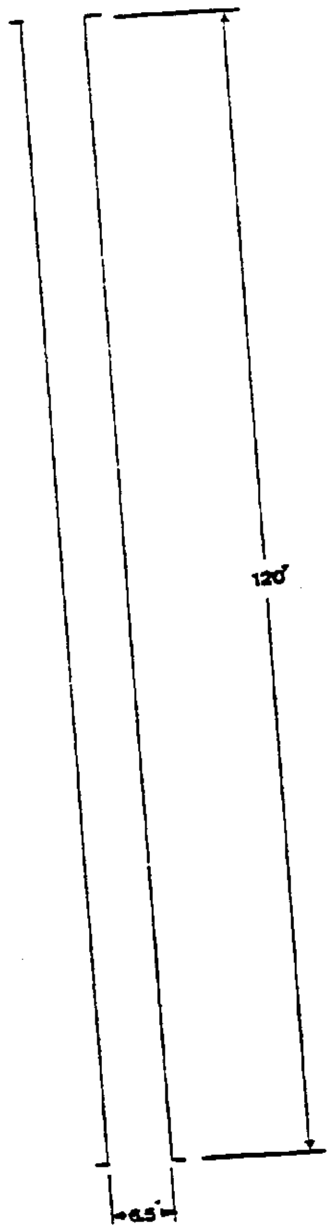
DIMENSIONED DRAWINGS



Pyrolyzer/combustor stage



Scrubber stage



Fischer-Tropsch stage