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Laboratorium voor Chemische Technologie

PROCESS-bijlage bij het
Verslag behorende
bij het fabrieksvoorontwerp
van

.....M. J. Baerken.....en.....M. C. Franken.....

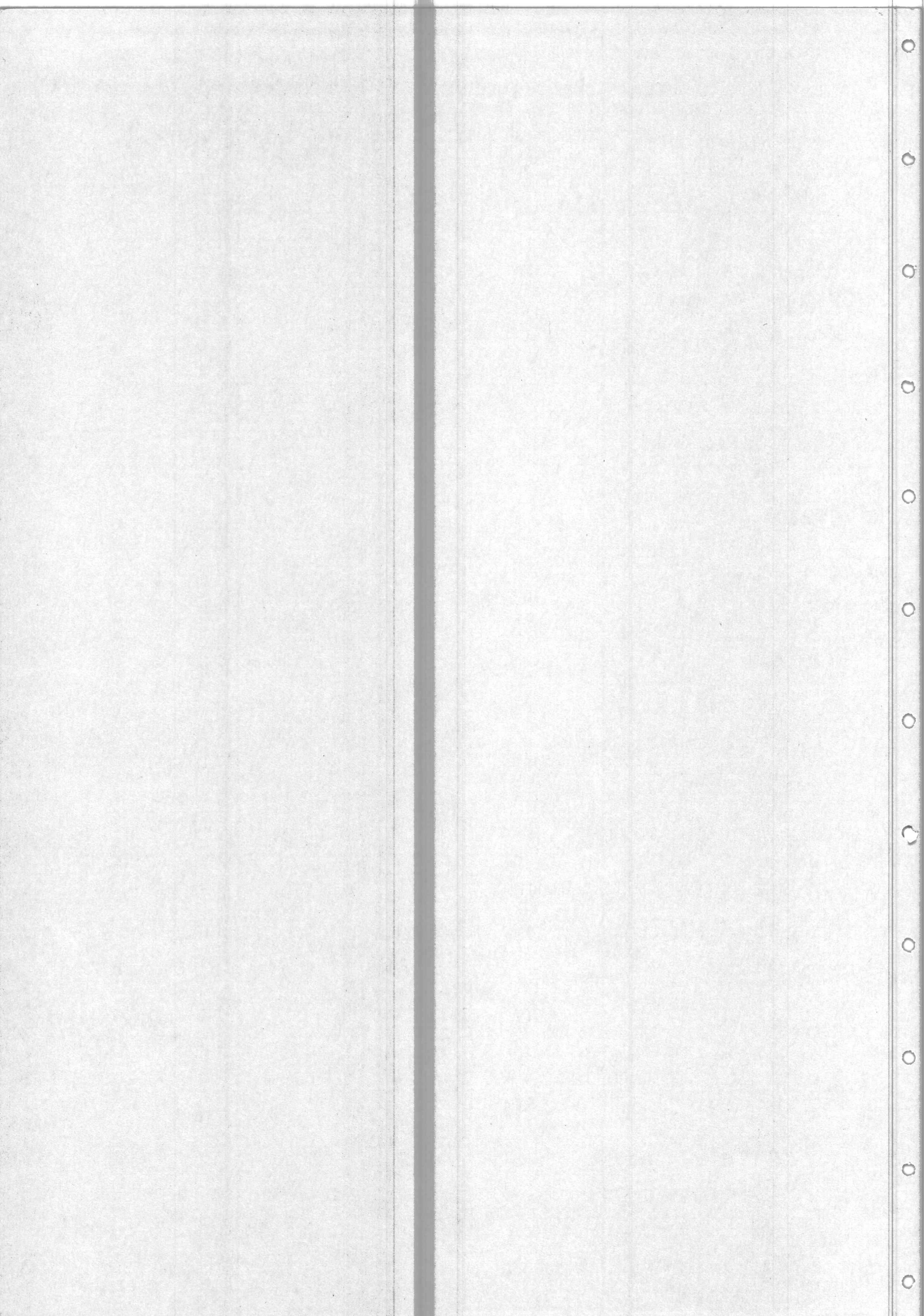
onderwerp:

.....C₅/C₆ isomerisatie.....

.....Total Isomerisation Process (TIP).....

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PROCESS BIJLAGE

INHOUDSOPGAVE VAN DE BIJLAGE

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1. Adviezen en opmerkingen

Voor het werken met PROCESS is een uitgebreide handleiding aanwezig bij dhr C. van Leeuwen. Met het doornemen van deze handleiding, die op vele punten erg onduidelijk is, is veel tijd gemoeid. Om het werken met PROCESS iets eenvoudiger te maken volgen hier eerst wat algemene adviezen en opmerkingen. Vervolgens komt in hoofdstuk 2 van deze bijlage het schrijven van een eigen subroutine aan de orde.

- Voordat men het eigenlijke proces gaat simuleren is het aan te bevelen eerst het tweede jaars computerpracticum en de daarbij behorende Fortrancursus te volgen. De handleidingen zijn te verkrijgen bij dhr C. van Leeuwen.

In dit practicum worden enkele eenvoudige unit-operations met PROCESS doorgerekend.

- Let bij het gebruik van PROCESS op de eenheden. Met de energie-eenheid kJ en de tijd in hr wordt er voor vermogen kW en kJ/hr door elkaar gebruikt.

Bovendien wordt er voor het aanduiden van de waarden 10^3 , 10^6 etc M resp. MM vóór de eenheden geplaatst.

- Bij het doorrekenen van een proces is het aan te raden -indien mogelijk- eerst met PROCESS de massabalans op te lossen. Alle warmte-wisselaars, fornuizen en koelers worden weggelaten en de temperaturen van de stromen gespecificeerd in de STREAM DATA :

bv. PROP STREAM=2 , TEMP=200 , REFS=1

zorgt ervoor dat stroom 2 identiek aan stroom 1 maar met een temperatuur van 200 eenheden wordt gedefinieerd.

De warmtebalans kan vervolgens met de exacte massastromen worden opgelost. Op deze manier wordt de rekentijd aanzienlijk verkort en kunnen fouten gemakkelijker teruggevonden worden.

- Let er bij het geven van beginschattingen op dat het systeem kan convergeren en zichzelf niet opblaast.

- Een CONTROLLER (= feedback controller) is een "unit-operation" die in het systeem een bepaalde grootte meet en aan de hand van de gemeten waarde elders in het systeem een andere grootte aanpast.

Na de CONTROLLER springt het programma terug naar de unit waarin deze grootte moet worden aangepast. Daarna worden weer alle units tussen deze unit en de CONTROLLER volgens de normale, opgegeven rekenvolgorde doorgerekend.

Voor het in de hand houden van de rekentijd is het essentieel dat de CONTROLLER zo dicht mogelijk achter de unit die hij bestuurt geplaatst wordt.

- In bijlage 3 van het FVO van D. J. Sinke en H. R. Tijsseling staan enkele onvolkomenheden:

ad 2: Het Input Manual zou voor dit proces een Material Balancer aanraden. Er wordt in het Input Manual echter het advies gegeven alléén een Material Balancer te gebruiken in zeer bijzondere gevallen. Met name wordt de Ammoniaksynthese genoemd waar grote recyclestromen met sporen inerten voorkomen.

ad 3: Ingaande voedingsstromen en gespecificeerde recyclestromen zouden tijdens de berekeningen ongewijzigd blijven. Recyclestromen zijn echter t.g.v. het iteratieproces aan verandering onderhevig.

ad 4: Vergeten van een apparaatcode op de Sequence Card zou betekenen dat de Sequence Card in zijn geheel genegeerd wordt.

De Sequence Card is juist bedoeld om elke units apart te kunnen doorrekenen zonder de invoerfile te hoeven veranderen. Uit de gehele invoer worden dan alleen de op de Sequence Card opgegeven units doorgerekend.

- Een unit-operation kan slechts worden doorgerekend als alle benodigde gegevens voor die unit bekend zijn. Dit geldt niet alleen voor de ingaande stromen maar ook voor allerlei specificaties die gebruik maken van gegevens van andere units. Let vooral op de CONTROLLERS (feedback controller) en de SETS (feed forward controllers) omdat deze springen in het programma.

De benodigde gegevens moeten of in de invoerfile worden opgegeven of al eerder door het programma zijn uitgerekend.

- DENK EERST LOGISCH NA EN DRAAI NIET TE GAUW EEN PROGRAMMA

2. Schrijven van een USER ADDED SUBROUTINE (UAS)

PROCESS biedt de mogelijkheid om een eigen subroutine toe te voegen en deze in combinatie met het standaard PROCESS-programma te gebruiken. Hiertoe wordt een in PROCESS aanwezige Dummy-subroutine vervangen door de UAS. Deze beide subroutines moeten derhalve dezelfde naam hebben : USER_n met n = 41-60

De UAS werd geschreven in Fortran-66 en vertaald met de Fortran-H-extended compiler.

De informatiestroom tussen het hoofdprogramma en de UAS wordt mogelijk gemaakt door :

Interfacing subroutines: Deze subroutines kunnen in de UAS worden aangeroepen om informatie van en naar het hoofdprogramma over te schrijven of het hoofdprogramma iets te laten berekenen.

Common Storage Area: Hieruit kunnen gegevens van componenten, thermodynamische gegevens en dimensionele conversiefactoren opgehaald worden.

Voor het schrijven van een UAS gelden de volgende richtlijnen:

- Initialiseer alle opslagvariabelen
- De door de Interfacing Subroutines overgebrachte error flags moeten na aanroepen van een van deze subroutines onmiddellijk getest worden.
- In de subroutine moeten tests aanwezig zijn, zoals controle op het delen door nul.
- De gegevens in de Common Blocks mogen niet door de subroutine veranderd worden.
- De eenheden waarin gegevens teruggeschreven worden naar het hoofdprogramma moeten de OUTPUT-eenheden zijn.
- Loops in de subroutine moeten een van tevoren bepaalde limiet hebben.
- De subroutine moet efficiënt van rekentijd gebruik maken, zeker wanneer deze meerdere malen wordt aangeroepen.

Bij een UAS bijv. USER41 hoort een speciale OUTPUT-Subroutine die automatisch met het aanroepen van USER41 wordt aangeroepen (U41OUT). Deze OUTPUT-Subroutine zorgt na de berekeningen "at printout time" voor speciale door de gebruiker bepaalde uitvoer.

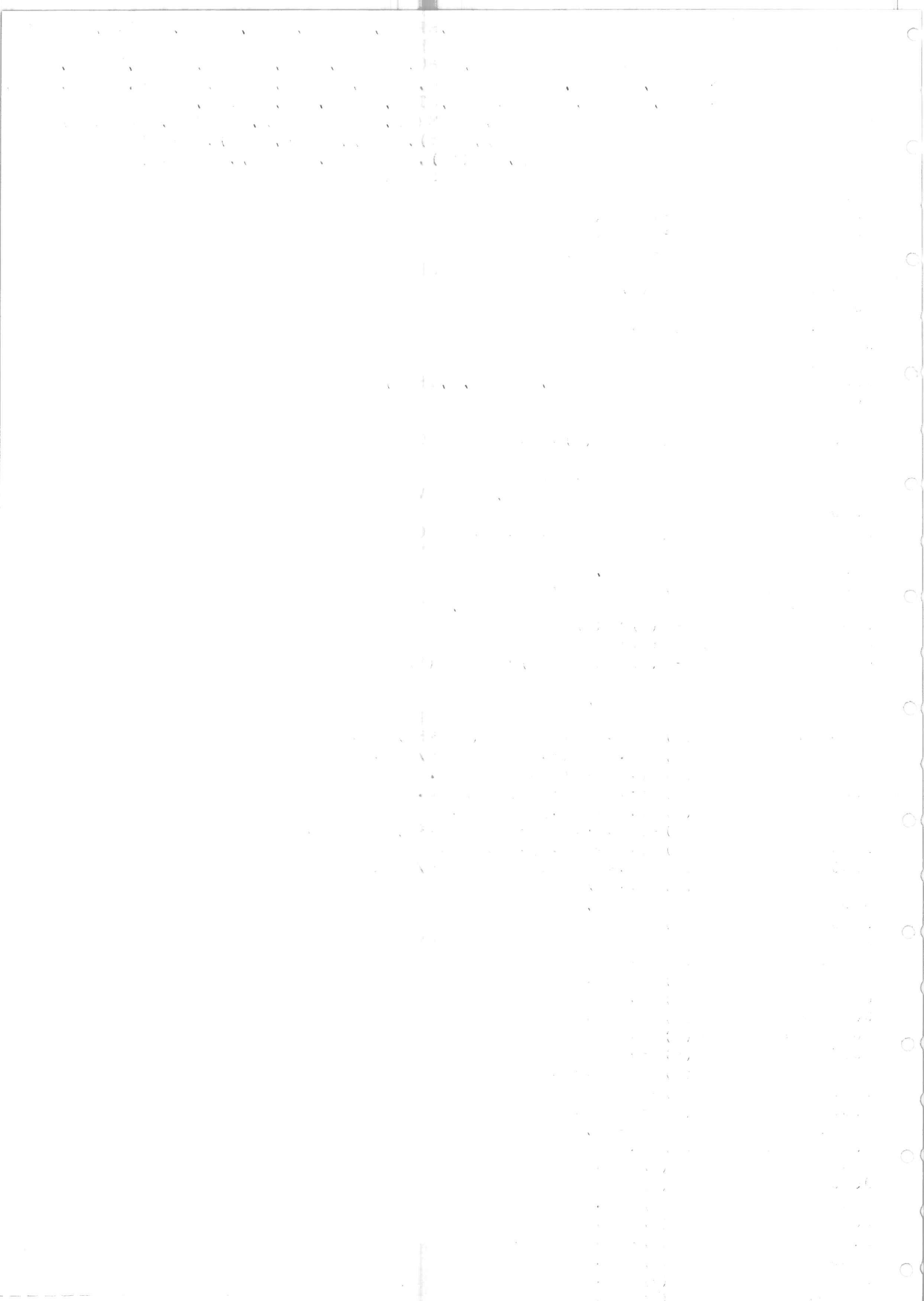
Het schrijven van een UAS zal verduidelijkt worden aan de hand van de zelfgeschreven isomerisatiereactor-UAS.

USER ADDED SUBROUTINE USER43


```

00000010 SUBROUTINE USER43 (IPARM,RPARM,SUPPLE,HEAT,IDATA,ISOLVE,I STOP)
00000020 C THIS UNIT OPERATION IS A REACTOR
00000030 COMMON /FACTOR/TCONVT,TFAC,PCONVT,PFAC,TIMFAC,WTFAC,VVFAC,
00000040 *ARFAC,XLVFAC,SPGFAC,HSFAC,WKFAC,VISFAC,TCFAC,VVFACA,STFAC,FACA,
00000050 *FACB,EXPFAC,XM3FAC,FTOR,CTOK,XKTOR,ATM,VVTOML,RCONST
00000060 DIMENSION IPARM(12),RPARM(8),SUPPLE(260),HEAT(4),IDATA(30)
00000070 DIMENSION STREAM(60),F(15),P(15),H(15),C(15),HC(15)
00000080 DIMENSION RON(15),FFR(15),RONF(15),PFR(15),RONP(15)
00000090 C NO FATAL ERRORS FORM THIS UNIT
00000100 ISOLVE=10
00000110 NOF=IDATA(1)
00000120 NOP=IDATA(2)
00000130 NOCX=IDATA(4)
00000140 C SET UP OUTPUTSWITCH FOR ERROR CODES
00000150 IPARM(2)=0
00000160 C TRAP FOR NO STREAMS
00000170 IF(NOF.EQ.0) GOTO 1
00000180 C FETCH STREAM FROM STORAGE
00000190 IX=IDATA(11)
00000200 CALL URSTRM (IX,STREAM,1,IERR)
00000210 IF (IERR.NE.0) GOTO 2
00000220 C TEST MOLAL FEEDSTREAM
00000230 IF (STREAM(1).EQ. 0.) GOTO 3
00000240 C TEST FOR PRODUCT
00000250 IF (NOP .EQ. 0) GOTO 4
00000260 C TEST PHASE OF FEED, ONLY VAPOUR PHASE ALLOWED
00000270 IFAZE=1
00000290 IF (STREAM(5) .GE. 0.01) GOTO 5
00000310 C COPY STREAM COMPOSITION IN F(15)
00000320 DO 20 I=1,NOCX
00000330 20 F(I)=STREAM(I+10)
00000340 C CALCULATE TOTAL BUTANE,PENTANE AND HEXANE FEED
00000350 FB=F(1)+F(2)
00000360 FP=F(3)+F(4)
00000370 FH=F(5)+F(6)+F(7)+F(8)+F(9)
00000380 C FETCH REACTOR TEMPERATURE
00000390 T=STREAM(2)
00000400 C CALCULATE COMPOSITION OF PRODUCT STREAM
00000410 P(1)=(-6.0+3.42*SQRT(T))*FB/100.
00000420 P(2)=89.*EXP(-.0022*T)*FB/100.
00000430 P(3)=(.075*T+11.)*FP/100.
00000440 P(4)=(-.075*T+89.)*FP/100.
00000450 P(5)=(.06*T+2.)*FH/100.
00000460 P(6)=(18.5+.09*T-15E-5*T**2)*FH/100.
00000470 P(7)=(.05*T+7.3)*FH/100.
00000480 P(8)=67.*EXP(-.0043*T)*FH/100.
00000490 P(9)=9.*FH/100.
00000500 DO 25 I=10,NOCX
00000510 25 P(I)=F(I)
00000520 C REACTION ENTHALPY IN KJ/KMOL
00000530 H(1)=0.
00000540 H(2)=-6930.
00000550 H(3)=0.
00000560 H(4)=-8060.
00000570 H(5)=0.
00000580 H(6)=-7200.
00000590 H(7)=-4700.+2.8*T
00000600 H(8)=-18300.
00000610 H(9)=-10600.
00000620 DO 27 I=10,NOCX
00000630 27 H(I)=0.
00000640 RON(1)=94.
00000650 RON(2)=100.
00000660 RON(3)=62.
00000670 RON(4)=90.
00000680 RON(5)=25.
00000690 RON(6)=73.5
00000700 RON(7)=74.5
00000710 RON(8)=92.

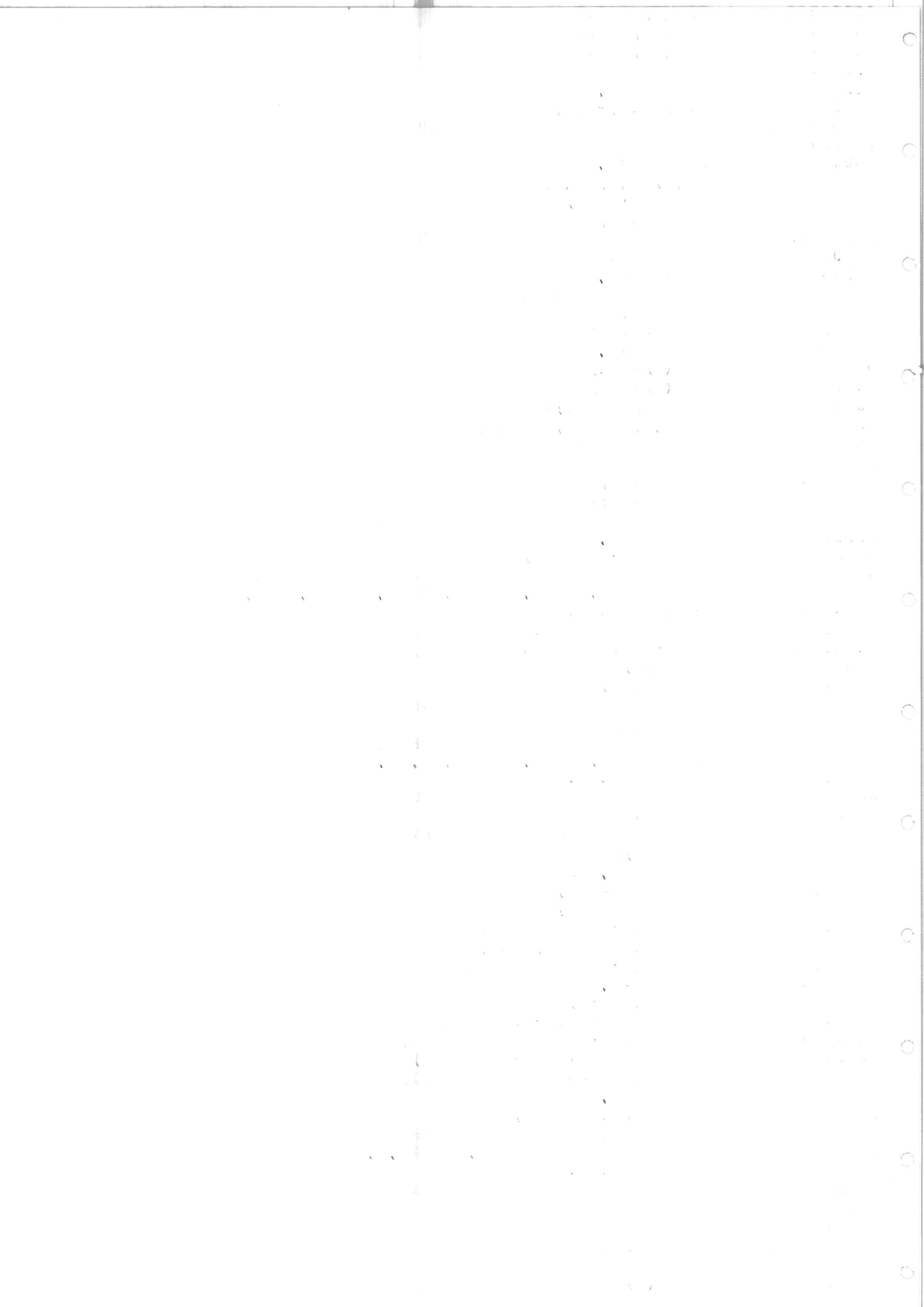
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00000720      RON (9) =103.5
00000730      RON (10) =102.5
00000740      RON (11) =91.5
00000750 C      CALCULATE CONVERSION
00000760      DO 30 I=1,NOCX
00000770 30     C (I) =P (I) -F (I)
00000780 C      CALCULATE REACTION ENTHALPY
00000790      THC=0
00000800      DO 40 I=1,NOCX
00000810      HC (I) =C (I) *H (I)
00000820 40     THC =THC +HC (I)
00000830      SUPPLE (98) =THC
00000840 C      CALCULATE MOLEFRACTION AND RCNNUMBER OF HYDROCARBON STREAMS
00000850      HCFEED=0.
00000860      DO 42 I=1,11
00000870 42     HCFEED =HCFEED + F (I)
00000880      TRONF=0.
00000890      TRONP=0.
00000900      DO 43 I=1,11
00000910      FFR (I) =F (I) /HCFEED
00000920      PFR (I) =P (I) /HCFEED
00000930      RONF (I) =RON (I) *FFR (I)
00000940      RONP (I) =RON (I) *PFR (I)
00000950      TRONF =TRONF +RONF (I)
00000960 43     TRONP =TRONP +RONP (I)
00000970      SUPPLE (96) =TRONF
00000980      SUPPLE (97) =TRONP
00000990 C      STORE PRODUCT COMPOSITION IN STREAMVECTOR
00001000      DO 50 I=1,NOCX
00001010 50     STREAM (I+10) =P (I)
00001020 C      CALCULATE MOLAL HEAT CAP. AND TOTAL ENTH. OF PRODUCT
00001030      CALL UHS (1, IFAZE, STREAM, STRMH, STRMCP, IERR)
00001040      IF (IERR .NE. 0) GOTO 6
00001050 C      CALCULATE ADIAB. TEMP. RISE
00001060      ATR =-THC / (STREAM (1) *STRMCP)
00001070      RPARM (8) =ATR
00001080      SUPPLE (99) =STRMCP
00001090 C      STORE ENTHALPY IN STREAM VECTOR
00001100      STREAM (4) =STRMH
00001110 C      CALCULATE COMPRESSIBILITY FACTOR
00001120      CALL UHS (3, IFAZE, STREAM, ZO, DZ, IERR)
00001130      IF (IERR .NE. 0) GOTO 7
00001140 C      STORE COMPRESSIBILITY FACTOR IN STREAM VECTOR
00001150      STREAM (7) =ZO
00001160 C      CALCULATIONS COMPLETED- SAVE THE RESULTS
00001170      IPARM (1) =IFAZE
00001180      DO 60 I=1,NOCX
00001190      SUPPLE (I) =F (I)
00001200      SUPPLE (I+NOCX) =P (I)
00001210      SUPPLE (I+2*NOCX) =H (I)
00001220      SUPPLE (I+3*NOCX) =C (I)
00001230 60     SUPPLE (I+4*NOCX) =HC (I)
00001240      DO 65 I=1,11
00001250      SUPPLE (100+I) =RON (I)
00001260      SUPPLE (100+NOCX+I) =FFR (I)
00001270      SUPPLE (100+2*NOCX+I) =RONF (I)
00001280      SUPPLE (100+3*NOCX+I) =PFR (I)
00001290 65     SUPPLE (100+4*NOCX+I) =RONP (I)
00001300      DO 70 I=1,7
00001310 70     RPARM (I) =STREAM (I)
00001320 C      STORE PRODUCT STREAM VECTOR
00001330      CALL URSTRM (IDATA (21), STREAM, 2, IERR)
00001340      IF (IERR .NE. 0) GOTO 8
00001350 C      PRODUCT STREAM GENERATED AND STORED
00001360      ISTOP=0
00001370      RETURN
00001380 1      IPARM (2) =1
00001390      GOTO 10
00001400 2      IPARM (2) =2
00001410      GOTO 10

```



```
00001420 3      IPARM(2)=3
00001430      GOTO 10
00001440 4      IPARM(2)=4
00001450      GOTO 10
00001460 5      IPARM(2)=5
00001461      WRITE(6,2000) STREAM(5)
00001462 2000   FORMAT('1', 'DE WAARDE VAN LIQ. MOLE FR. IS ')
00001470      GOTO 10
00001480 6      IPARM(2)=6
00001490      GOTO 10
00001500 7      IPARM(2)=7
00001510      GOTO 10
00001520 8      IPARM(2)=8
00001530 10     ISTOP=1
00001540      RETURN
00001550      END
```

Toelichting bij de isomerisatiereactor-UAS

regel

10 De naam van de subroutine (USER43) met argumenten. In de
PROCESS-invoerfile wordt de subroutine echter alleen aange-
roepen met : US3
IPARM, RPARM, SUPPLE en HEAT zijn arrays die vanuit de invoer-
file gevuld kunnen worden.
IDATA speelt een centrale rol in de structuur van PROCESS:
Iedere unit-operation heeft zijn eigen IDATA-array waarin:
IDATA(1) = aantal voedingen
IDATA(2) = aantal producten
IDATA(3) = aantal heaters
IDATA(4) = aantal componenten
IDATA(5) = waterswitch 1= water normaal/2= water speciaal
IDATA(6) = standaard output file
IDATA(7) = identifier voor unit bijv. P1 (4 kar.)
IDATA(8)-(10) = naam voor unit bijv. fornuis (12 kar.)
IDATA(11)-(20) = stroom identifiers voor voedingen in de-
zelfde volgorde als op de FEED-card
IDATA(21)-(30) = stroom identifiers voor producten in de-
zelfde volgorde als op de PRODUCT-card
ISOLVE en ISTOP moeten in de subroutine een waarde krijgen
en worden vervolgens door het hoofdprogramma getest:
ISOLVE is signaal voor bereiken van oplossing
0-9 : geen oplossing
10 : oplossing bereikt
ISTOP is fatal error switch
0 = doorgaan
1 = fatale fout, stop berekeningen

30 declaratie van het commonblock FACTOR. Hierin staan de
dimensionele conversiefactoren en fysische constanten.

60-80 declareren van alle in de subroutine gebruikte variabelen.

100 om te beginnen is ISOLVE 10

110-130 hernoemen van IDATA(1) = N(umber) O(f) F(eeds)
" IDATA(2) = N(umber) O(f) P(roducts)
" IDATA(4) = N(umber) O(f) C(omponents) X

150 al naar gelang de fouten die er optreden krijgt IPARM(2)
een andere waarde. IPARM wordt doorgegeven aan de output-
subroutine, zodat daar de bijbehorende tekst kan worden
geprint.

regel
160-170 test of er wel voedingen zijn voor de reactor
190 zet de identifier voor de eerste (en enige) voeding in IX
200 haal de gegevens die bij deze stroom horen binnen
Hiervoor wordt de interfacing subroutine URSTRM gebruikt:
IX = identifier voor de stroom die opgehaald/weggeschreven
moet worden
STREAM is ook een zeer belangrijke array in de structuur
van PROCESS:
STREAM(1) = totale molenstroom
STREAM(2) = temperatuur van de stroom
STREAM(3) = druk van de stroom
STREAM(4) = totale enthalpie van de stroom
STREAM(5) = molfractie van de stroom die vloeibaar is
STREAM(6) = molfractie water
STREAM(7) = compressibiliteitsfactor Z
STREAM(8)-(10) = gereserveerd door PROCESS
STREAM(11)-(60) = molenstromen van de afzonderlijke compo-
nenten in volgorde van invoer.
Het derde argument van URSTRM duidt aan of de subroutine
moet lezen of schrijven : 1 = ophalen/2 = wegschrijven
IERR is de error flag van de subroutine die in regel 210
getest wordt : 0 = geen fouten/ 1-3 = fouten (zie manual)
210 test error flag van URSTRM
220-230 test of molenstroom niet nul is
240-250 test of er wel een productstroom gegenereerd kan worden
260-270 test de fase van de voeding, de isomerisatiereactie moet
in de gasfase plaatsvinden.
310-330 schrijf de molenstromen van de afzonderlijke componenten
in de voeding in F(15), in dezelfde volgorde als bij invoer.
340-370 bereken de totale molenstromen aan C4, C5 en C6 niet cycli-
sche alkanen
380-390 T = reactortemperatuur. Deze temperatuur moet binnengehaald
worden met de voedingsstroom omdat voedingen alleen gelezen
en producten alleen weggeschreven kunnen worden (beveiliging
binnen PROCESS). Toch is in feite de reactortemperatuur de
temperatuur van de uitgaande stroom. Daarom berekent het pro-
gramma ook de adiabatistische temperatuurstijging in de reactor.
Is deze bijv. 20^oC dan laat men de voeding in een fornuis
tot 230^oC opwarmen (zeg stroom 1) en laat men met:
PROP STRM = 2, TEMP=250 , REFS = 1

regel

- toch een stroom van 250°C de reactor binnenkomen.
- 400-510 bereken de samenstelling van de productstroom (de molenstromen van de afzonderlijke componenten)
De molenstromen cyclopentaan, me-cyclopentaan en waterstof veranderen niet.
- 520-630 geef de reactieenthalpie voor de verschillende reacties op.
- 640-740 geef de RON-waarden van de afzonderlijke componenten
- 750-770 bereken de conversies : verschil tussen molenstroom uit en molenstroom in.
- 780-830 bereken de totale reactieenthalpie en sla deze waarde op in SUPPLE(98)
- 840 980 bereken molfractie in en RON-waarde van de voeding en product
- 990-1010 sla de molenstromen van de componenten in het product op in de STREAM-vector
- 1020-1040 bereken de molaire warmtecapaciteit en enthalpie van de productstroom (de temperatuur staat nog steeds goed in de STREAM-vector)
Hiervoor wordt de interfacing subroutine UHS gebruikt
De betekenis van de argumenten is als volgt:
Eerste argument : 1 = enthalpie en/of warmtecapaciteit
2 = entropie
3 = compressibiliteitsfactor
IFAZE = de fase van de stroom
STREAM de reeds bekende vector
STRMH, STRMCP de berekende waarden (d.w.z. de naam waaronder men ze na aanroepen van de subroutine binnen kan halen)
IERR = error flag
- 1050-1100 bereken de adiabatische temperatuursstijging in de reactor, sla deze op in RPARM(8). Sla de warmtecapaciteit van de stroom op in SUPPLE(99) en de totale molaire enthalpie van de stroom in STREAM(4).
- 1010-1150 bereken de compressibiliteitsfactor van de productstroom en schrijf ook deze weg in STREAM.
- 1160-1310 sla alle gegevens die nodig zijn in de output-subroutine op in IPARM, RPARM of SUPPLE
- 1320-1340 schrijf de product STREAM-vector weg onder de naam die in

regel

IDATA(21) staat. Dit is immers de identifier voor het eerste product voor deze unit operation.

1360 de oplossing is bereikt, de berekeningen behoeven niet afgebroken te worden.

1370 ga terug naar het hoofdprogramma

1380-1540 toekenning van de foutencodes ten behoeve van de output subroutine alvorens terug te keren naar het hoofdprogramma. ISTOP wordt bij het optreden van een fout 1 gemaakt. De berekeningen worden afgebroken.

Tevens is er een outputsubroutine geschreven om de berekende waarden uit te printen (U43OUT), alsmede een outputsubroutine om voor een willekeurige stroom het RON-getal te berekenen. Op de volgende bladzijden volgt een listing van deze subroutines.

USER ADDED SUBROUTINE U43OUT

```

00000010 SUBROUTINE U43OUT (IPARM,RPARAM,SUPPLE,HEAT,IDATA)
00000020 C OUTPUT SUBROUTINE FOR REACTOR UNIT OPERATION
00000030 COMMON/FACTOR/TCONVT,TFAC,PCONVT,PFAC,TIMFAC,WTFAC,VVFAC,
00000040 *ARFAC,XLVFAC,SPGFAC,HSFAC,WKFAC,VISFAC,TCFAC,VVFACA,STFAC,FACA,
00000050 *FACB,EXPFAC,XM3FAC,FTOR,CTOK,XKTOR,ATM,VVTOML,RCONST
00000060 C OUTPUT CONVERSION FACTORS COMMON
00000070 COMMON/OUTFAC/TXXX(20),IHOL(37),IXNAME(4,50)
00000080 DIMENSION IPARM(12),RPARAM(8),SUPPLE(260),HEAT(4),IDATA(30)
00000090 DIMENSION F(15),P(15),H(15),C(15),HC(15)
00000100 DIMENSION RON(15),FFR(15),RONF(15),PFR(15),RONP(15)
00000110 NOCX=IDATA(4)
00000120 C RETRIEVE DATA FROM SUPPLE
00000130 DO 10 I=1,NOCX
00000140 F(I)=SUPPLE(I)
00000150 P(I)=SUPPLE(I+NOCX)
00000160 H(I)=SUPPLE(I+2*NOCX)
00000170 C(I)=SUPPLE(I+3*NOCX)
00000180 10 HC(I)=SUPPLE(I+4*NOCX)
00000190 DO 15 I=1,11
00000200 RON(I)=SUPPLE(100+I)
00000210 FFR(I)=SUPPLE(100+NOCX+I)
00000220 RONF(I)=SUPPLE(100+2*NOCX+I)
00000230 PFR(I)=SUPPLE(100+3*NOCX+I)
00000240 15 RONP(I)=SUPPLE(100+4*NOCX+I)
00000250 CALL HEAD
00000260 WRITE(6,1000) (IDATA(I),I=7,10)
00000270 1000 FORMAT(' ',10X,'UNIT IDENTITY= ',A4,' NAME= ',3A4)
00000280 IF (IPARM(2) .NE. 0) GOTO 200
00000290 C WRITE REACTOR CONDITIONS
00000300 WRITE(6,1010) RPARAM(2),IHOL(6),RPARAM(3),IHOL(7)
00000310 1010 FORMAT('0',10X,'REACTORTEMPERATUUR= ',F6.2,3X,A3,10X,
00000320 *'REACTORDRUK= ',F6.2,3X,A4)
00000330 WRITE(6,1020)
00000340 1020 FORMAT('0',10X,'*****STROOMGEGEVENS*****'////)
00000350 WRITE(6,1030)
00000360 1030 FORMAT('0',10X,' COMP COMPONENT ',3X,'VOEDING',9X
00000370 *,'CONV',10X,'PRODUCT',6X,'REACT.ENTH.',6X,'CONV.ENTH.')
00000380 WRITE(6,1040) ((IHOL(2),IHOL(29),IHOL(1)),I=1,3),(IHOL(8),
00000390 *IHOL(4),IHOL(29)),(IHOL(8),IHOL(1))
00000400 1040 FORMAT(' ',12X,' NO NAME ',3A4,3X,3A4,3X,3A4,3X,
00000410 *3A4,5X,3A4)
00000420 DO 20 I=1,NOCX
00000430 WRITE(6,1050) I,(IXNAME(K,I),K=1,4),F(I),C(I),P(I),H(I),HC(I)
00000440 1050 FORMAT(' ',11X,I3,3X,3A4,A2,2X,E12.4,3X,E12.4,3X,E12.4,3X
00000450 *,E12.4,3X,E12.4)
00000460 20 CONTINUE
00000470 WRITE(6,1060) RPARAM(4),(IHOL(8),IHOL(1))
00000480 1060 FORMAT('0',11X,' ENTHALPY VAN PRODUCT STROOM',F12.4,3X,2A4)
00000490 WRITE(6,1070) SUPPLE(99),(IHOL(8),IHOL(4),IHOL(29))
00000500 1070 FORMAT('0',11X,' MOLAIRE WARMTE CAPACITEIT VAN PRODUCT STROOM',
00000510 *F12.4,3X,3A4,A3)
00000520 1075 FORMAT('0',11X,'TOTALE REACTIEENTHALPIE',F12.4,3X,2A4)
00000530
00000540 WRITE(6,1080) RPARAM(8),IHOL(5),IHOL(6)
00000550 1080 FORMAT('0',12X,'ADIABATISCHE TEMPERATUUR STIJGING',F12.4,3X,2A4)
00000560 WRITE(6,1090) RPARAM(1),(IHOL(2),IHOL(29),IHOL(1))
00000570 1090 FORMAT('0',11X,' TOTALE MOL PRODUCT STROOM',F12.4,3X,3A4)
00000580 CALL HEAD
00000590 WRITE(6,2005)
00000600 2005 FORMAT('0',10X,'*****OCTANE NUMBERS*****'////)
00000610 WRITE(6,2000)
00000620 2000 FORMAT('0',10X,'COMP COMPONENT RON MOLFR HC RON MO
00000630 *HC RON',12X,'NO NAME',15X,'FEED',14X,'PROD')
00000640 DO 50 I=1,11
00000650 WRITE(6,2010) I,(IXNAME(K,I),K=1,3),RON(I),FFR(I),RONF(I),PFR(I)
00000660 *,RONP(I)
00000670 2010 FORMAT(' ',11X,I2,4X,3A4,F5.1,3X,F5.3,5X,F5.2,2X,F5.3,5X,F5.2)
00000680 50 CONTINUE
00000690 WRITE(6,2020) SUPPLE(96),SUPPLE(97)

```

[The page contains several columns of extremely faint, illegible text, likely from a document or report. The text is too light to be transcribed accurately.]

USER ADDED SUBROUTINE U44OUT

```

00000010      SUBROUTINE U44OUT (IPARM,RPARM,SUPPLE,HEAT,IDATA)
00000020      COMMON /FACTOR/TCONVT,TFAC,PCONVT,PFAC,TIMFAC,WTFAC,VVFAC,
00000030      *ARFAC,XLVFAC,SPGFAC,HSFAC,WKFAC,VISFAC,TCFAC,VVFACA,STFAC,FACA,
00000040      *FACB,EXPFAC,XM3FAC,FTOR,CTOK,XKTOR,ATM,VVTOML,RCONST
00000050 C      OUTPUT CONVERSION FACTORS COMMON
00000060      COMMON/OUTFAC/TXXX (20),IHOL (37),IXNAME (4,50)
00000070      DIMENSION IPARM (12),RPARM (8),SUPPLE (260),HEAT (4),IDATA (30)
00000080      DIMENSION STREAM (60),F (15)
00000090      DIMENSION RON (15),FFR (15),RONF (15)
00000100      NOF=IDATA (1)
00000110      NOCX=IDATA (4)
00000120 C      TRAP FOR NO STREAMS
00000130      IF (NOF.EQ.0) GOTO 1
00000140 C      FETCH STREAM FROM STORAGE
00000150      IX=IDATA (11)
00000160      CALL URSTRM (IX,STREAM,1,IERR)
00000170      IF (IERR.NE.0) GOTO 2
00000180 C      TEST MOLAL FEEDSTREAM
00000190      IF (STREAM (1).EQ. 0.) GOTO 3
00000200 C      COPY STREAM COMPOSITION IN F (15)
00000210      DO 20 I=1,NOCX
00000220 20      F (I)=STREAM (I+10)
00000230      RON (1)=94.
00000240      RON (2)=100.
00000250      RON (3)=62.
00000260      RON (4)=90.
00000270      RON (5)=25.
00000280      RON (6)=73.5
00000290      RON (7)=74.5
00000300      RON (8)=92.
00000310      RON (9)=103.5
00000320      RON (10)=102.5
00000330      RON (11)=91.5
00000340 C      CALCULATE MOLEFRACTION AND RONNUMBER OF HYDROCARBON STREAMS
00000350      HCFEED=0.
00000360      DO 42 I=1,11
00000370 42      HCFEED=HCFEED+ F (I)
00000380      TRONF=0.
00000390      DO 43 I=1,11
00000400      FFR (I)=F (I)/HCFEED
00000410      RONF (I)=RON (I)*FFR (I)
00000420 43      TRONF=TRONF+RONF (I)
00000430      CALL HEAD
00000440      WRITE (6,2005)
00000450 2005      FORMAT ('0',10X,'*****OCTANE NUMBERS*****'////)
00000460      WRITE (6,2000)
00000470 2000      FORMAT ('0',10X,'COMP      COMPONENT      RON      MOLFR HC      RON '
00000480      */,12X,'NO      NAME',15X,'FEED')
00000490      DO 50 I=1,11
00000500      WRITE (6,2010) I,(IXNAME (K,I),K=1,3),RON (I),FFR (I),RONF (I)
00000510 2010      FORMAT (' ',11X,I2,4X,3A4,F5.1,3X,F5.3,5X,F5.2)
00000520 50      CONTINUE
00000530      WRITE (6,2020) TRONF
00000540 2020      FORMAT ('0',38X,'TOTAAL ',F6.2)
00000550      RETURN
00000560 C      ADD FOOTNOTES AND WARNINGS
00000570 1      WRITE (6,1100)
00000580 1100      FORMAT ('0',12X,'FEED IS MISSING, CALC. DELETED')
00000581      GOTO 77
00000590 2      WRITE (6,1120)
00000600 1120      FORMAT ('0',12X,'RETRIEVAL STREAMVECTOR FAILED')
00000601      GOTO 77
00000610 3      WRITE (6,1130)
00000620 1130      FORMAT ('0',12X,'MOL FEED STREAM = 0,CALC. DELETED')
00000621 77      CONTINUE
00000630      RETURN
00000640      END

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3. Linkage aan PROCESS

De geschreven subroutines werden met het hierna volgende programma PROLNK aan PROCESS gekoppeld. Eerst wordt een versie van PROCESS binnengehaald, waarna de betreffende dummy subroutines vervangen worden door de eigen versies. Na deze vervanging volgt nog een COMPRESS-stap om de ingenomen ruimte te verkleinen.


```
00000010 //STVPPROC JOB 2651,'MARC./MARG.',TIME=(,9),REGION=1024K,MSGLEVEL=(1,1)
00000020 /*JOBPARM Q=F
00000030 /*      STAQCLO.STR.CNTL (PROLNK)
00000040 /*
00000050 /*      VERVANGT USER41 IN PROCESS DOOR EEN EIGEN SUBROUTINE
00000060 /*      MET NAAM USER41 IN DATASET STVPCLA.PROCES.FORT(USER41)
00000070 /*      DE NIEUWE PROCES STAAT NU IN DE BIBLIOTHEEK STVP.PROCESS.LOAD
00000080 /*      ALS MEMBER MAIN.
00000090 /*
00000100 /*
00000110 /*      AUTOMATIC REPLACEMENT OF CONTROL SECTION MEMBER
00000120 /*      OS/V S LINKAGE EDITOR AND LOADER GC26-3813-5 PAGE 61
00000130 /*
00000140 // EXEC FORTXCL
00000150 /*
00000160 //FORT.SYSIN      DD  DISP=SHR,DSN=STVPCLA.PROCES.FORT(U43OUT)
00000161 //              DD  DISP=SHR,DSN=STVPCLA.PROCES.FORT(USER43)
00000170 /* ALLE ANDERE KEREN
00000180 //LKED.SYSLMOD DD  DISP=OLD,DSN=STVP.PROCESS.LOAD(MAIN)
00000190 /* EERSTE KEER:
00000200 /*KED.SYSLMOD DD  DISP=(NEW,CATLG),DSN=STVP.PROCESS.LOAD(MAIN),
00000210 /*              UNIT=DISK,VOL=SER=DISK11,SPACE=(TRK,(10,10,10))
00000220 /*
00000230 //OLDLOAD          DD  DISP=SHR,DSN=CCNU.PROCESS.PROCESS
00000240 //LKED.SYSIN      DD  *
00000250 INCLUDE OLDLOAD(MAIN,U43OUT,USER43)
00000270 ENTRY MAIN
00000280 /*
00000290 //COMPRS1 EXEC XCOMPR,DSN='STVP.PROCESS.LOAD',DISK=DISK,
00000300 //              VOL=DISK11,SPACE='(TRK,(200,30,30))',
00000310 //              DCB='(RECFM=U)'
00000320 //
```

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4. Het draaien van PROCESS

Omdat de eigen versie van PROCESS moest worden gemaakt onder een andere naam was het niet meer mogelijk de bestaande catalogued procedure EXEC PROCESS te gebruiken. Het volgende programma werd gebruikt om PROCESS te laten draaien en de invoerdataset, in dit geval :

STVPCLA.PROC.CNTL(PROBE2),

aan het programma te koppelen.

```
00000010 //STVPPROC JOB 2651,'MARGOT ',TIME=(,18),REGION=2048K,MSGLEVEL=(1,1)
00000020 /*JOBPARM Q=F,FORMS=6A15,LINES=4
00000030 /*JOBPARM DELAY
00000040 /*
00000050 /*      STAQCLO.STR.CNTL (PRO2GO)
00000060 /*
00000070 /* JCL OM EEN EIGENGEMAAKTE PROCESS VERSIE TE DRAAIEN.
00000080 /*
00000090 /*
00000100 /*
00000110 /*
00000120 //MARGOT PROC P2='&&P2',P3='&&P3',P4='&&P4',DSP1=NEW,DSP2=PASS,
00000130 //      VOL=DISK10
00000140 /*$CCNUFPS DOEL: PROCESS PROCEDURE VERSION 2
00000150 /*
00000160 /*      PROBLEMS PHONE: F SOPERS TEL 015-784650 RC THD
00000170 /*      15 - OCT - 82
00000180 /*
00000190 //SSI      EXEC PGM=MAIN
00000200 //STEPLIB DD DSN=CCNU.PROCESS.PREPRO,DISP=SHR
00000210 //FT06F001 DD SYSOUT=A
00000220 //FT22F001 DD DSN=&&PREP,SPACE=(CYL,(1,1)),DISP=(,PASS),UNIT=SYSDA
00000230 //FT08F001 DD DSN=&&SSI,DISP=(,PASS),SPACE=(TRK,(5,5)),UNIT=SYSDA,
00000240 //      DCB=(BLKSIZE=2000,LRECL=80)
00000250 /*
00000260 /* NU DE EIGEN NORMALE PROCESS INVOER IN DATASET DSN=.....
00000270 /*
00000280 /*
00000290 //FT05F001 DD DDNAME=SYSIN
00000300 /*
00000310 /*
00000320 //PRO EXEC PGM=MAIN,COND=(66,EQ,SSI)
00000330 /*
00000340 //STEPLIB DD DSN=STVP.PROCESS.LOAD,DISP=SHR
00000350 /*
00000360 //FT02F001 DD DSN=&P2,DISP=(&DSP1,&DSP2),SPACE=(2600,(45)),
00000370 // VOL=SER=&VOL,UNIT=3350
00000380 //FT03F001 DD DSN=&P3,DISP=(&DSP1,&DSP2),SPACE=(12000,(91)),
00000390 // VOL=SER=&VOL,UNIT=3350
00000400 //FT04F001 DD DSN=&P4,DISP=(&DSP1,&DSP2),SPACE=(12000,(80)),
00000410 // VOL=SER=&VOL,UNIT=3350
00000420 //FT05F001 DD DSN=&&SSI,DISP=(OLD,DELETE)
00000430 //FT06F001 DD SYSOUT=A
00000440 //FT11F001 DD DSN=&&PRO11,UNIT=SYSDA,DISP=(,PASS),SPACE=(CYL,(1,1))
00000450 //FT12F001 DD SYSOUT=A
00000460 //FT13F001 DD SYSOUT=A
00000470 //FT15F001 DD DSN=CCNU.PROCESS.DATBANK2,UNIT=3350,VOL=SER=DISK19,
00000480 // DISP=SHR
00000490 //FT16F001 DD DSN=&&PRO16,UNIT=SYSDA,DISP=(,PASS),SPACE=(CYL,(1,1)),
00000500 // DCB=(RECFM=VS,BUFNO=1)
00000510 //FT18F001 DD DUMMY
00000520 // PEND
00000530 // EXEC MARGOT
00000540 //SYSIN DD DISP=SHR,DSN=STVPCLA.PROC.CNTL (PROBE2)
00000550 //
```

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Fifth section of faint, illegible text.

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5. Het simuleren van de isomerisatieplant

5.1. De invoerdatafile

De invoerdatafile bestaat uit een aantal categorieën die opgebouwd zijn uit één of meerdere kaarten (cards).

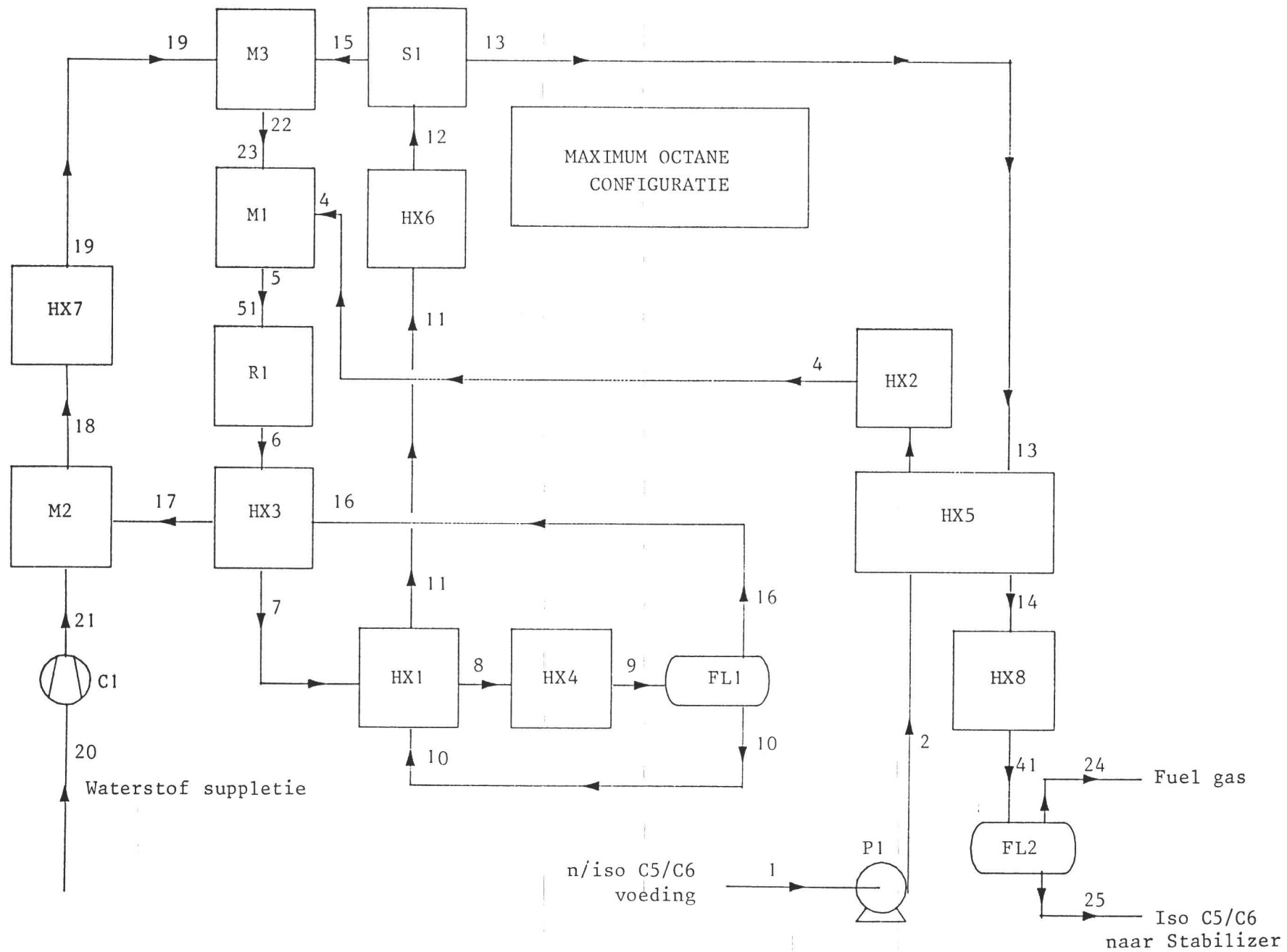
Deze categorieën zijn:

1. general data
2. component data
3. thermodynamic data
4. stream data
5. unit operation data
6. recycle data

- ad 1: Onder de general data vallen zaken zoals de naam van het programma, de gebruiker, de gebruikte eenheden en het toegestane aantal iteraties.
- ad 2: Hierbij geeft men de componenten die in het systeem voorkomen op en nummert deze. De componenten moeten opgegeven worden onder de naam waaronder ze in de PROCESS-bibliotheek vermeld staan.
- ad 3: Op deze kaarten geeft men aan welke methode PROCESS moet gebruiken voor de berekening van H, K en S waarden. De mogelijkheden die PROCESS hiervoor heeft zijn : Soave Redlich Kwong (SRK), Peng Robinson (PR), Chao Seader (CS), Curl Pitzer (CP), Lee Kesler (LK) en RICE.
- ad 4: Hieronder valt de specificatie van de stromen. Onder dit hoofdstuk vallen alleen stromen waarvan alles wordt opgegeven: samenstelling, temperatuur, druk en fase. Wil men van een bepaalde stroom bijv. alleen een temperatuur specificeren dan moet dit onder de betreffende unit operation gebeuren.
- ad 5: Voor elke unit operation bestaat een aparte code card, bijv. HX voor warmtewisselaar en PUMP voor pomp. Iedere unit operation heeft zijn eigen specifieke mogelijkheden en kaarten.
- ad 6: Wanneer er recyclestromen in het proces aanwezig zijn kan men hier een acceleratie-methode invoeren.

5.2. Max-octane-configuratie

In het volgende gedeelte vindt men het flowsheet aan de hand waarvan de PROCESS-invoerfile bepaald is alsmede de uitvoer van PROCESS voor de max-octane-configuratie.



VERSION 0881

SM
PROCESS INPUT LISTING - PAGE 1

TITLE PROB=TIPPLANT,USER MCF&MJB
DIMENSION SI,TEMPERATURE=C,PRESSURE=BAR
CALCULATIONS NOTRIALS=50
COMPONENT DATA

LIBID 1,BUTANE/2,IBUTANE/3,PENTANE/4,IPENTANE/5,HEXANE/*
6,2MPENTAN/7,3MPENTAN/8,22DMB/9,23DMB/10,CYPNTANE/*
11,MCYCPNT/12,HYDROGEN

THERMO DATA

TYPE SYSTEM=SRK

STREAM DATA

PROP STRM=1,TEMP=20,PRES=1,COMP(W)=1,.5/2,.2/3,44.6/4,29.3/5,6.7/*
6,9.3/7,4.6/8,.6/9,1.8/10,2.2/11,.2,RATE(W)=10000
PROP STRM=5,TEMP=235.6,PRES=25,COMP=1,2.21/2,.63/3,108.38/*
4,48.17/5,13.40/6,11.05/7,5.49/8,.97/9,2.17/10,3.27/*
11,.24/12,219.45
PROP STRM=9,TEMP=35,PRES=25,REFS=6
PROP STRM=12,TEMP=250,PRES=25,REFS=10
PROP STRM=20,TEMP=20,PRES=1,COMP=12,4.972
PROP STRM=51,TEMP=250,PRES=25,REFS=5
PROP STRM=23,TEMP=250,PRES=25,REFS=22

UNIT OPERATIONS

PUMP UID=P1,NAME=FEEDPUMP

FEED 1

PROD L=2

OPERATION PRES=25,EFF=70

US3 UID=R1,NAME=REACTOR

FEED 51

PROD 6

FLASH UID=FL1,NAME=PHASESEP

FEED 9

PROD V=16,L=10

ISO TEMP=35,PRES=25

HX UID=HX3

COLD FEED=16,V=17

HOT FEED=6,V=7

SPEC COLD,TEMP=230

CONFIGURATION U=500,SPASS=2

HX UID=HX1

COLD FEED=10,V=11

HOT FEED=7,M=8

SPEC COLD,TEMP=180

CONFIGURATION U=3000,SPASS=4

HX UID=HX4,NAME=CONDENS.

HOT FEED=8,M=9

SPEC HOT,TEMP=35

CONFIGURATION U=3000,SPASS=2

UTILITY WATER,TIN=20,TOUT=40

SEPARATOR UID=S1,NAME=MOLSIEVE

FEED 12

OVHD STRM=13,PHASE=V,PRES=25,TEMP=250

BTMS STRM=15,PHASE=V,PRES=25,TEMP=250

FACTOR 1,1,0./2,2,1./3,3,0./4,4,1./5,5,0./6,12,1.

HX UID=HX5

SM
PROCESS INPUT LISTING - PAGE 2

$\frac{1}{2} \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = \frac{1}{2} m v \frac{dv}{dt}$
 $= \frac{1}{2} m v \frac{dv}{dt}$
 $= \frac{1}{2} m v \frac{dv}{dt}$

The work done by the force F is
 $W = \int_{x_1}^{x_2} F dx$
 $= \int_{x_1}^{x_2} m a dx$
 $= m \int_{x_1}^{x_2} a dx$

$$\begin{aligned}
 &= m \int_{x_1}^{x_2} \frac{dv}{dt} dx \\
 &= m \int_{x_1}^{x_2} v \frac{dv}{dx} dx \\
 &= \frac{1}{2} m v^2 \Big|_{x_1}^{x_2}
 \end{aligned}$$

The work done by the force F is
 $W = \int_{x_1}^{x_2} F dx$
 $= \int_{x_1}^{x_2} m a dx$
 $= m \int_{x_1}^{x_2} a dx$

The work done by the force F is
 $W = \int_{x_1}^{x_2} F dx$
 $= \int_{x_1}^{x_2} m a dx$
 $= m \int_{x_1}^{x_2} a dx$

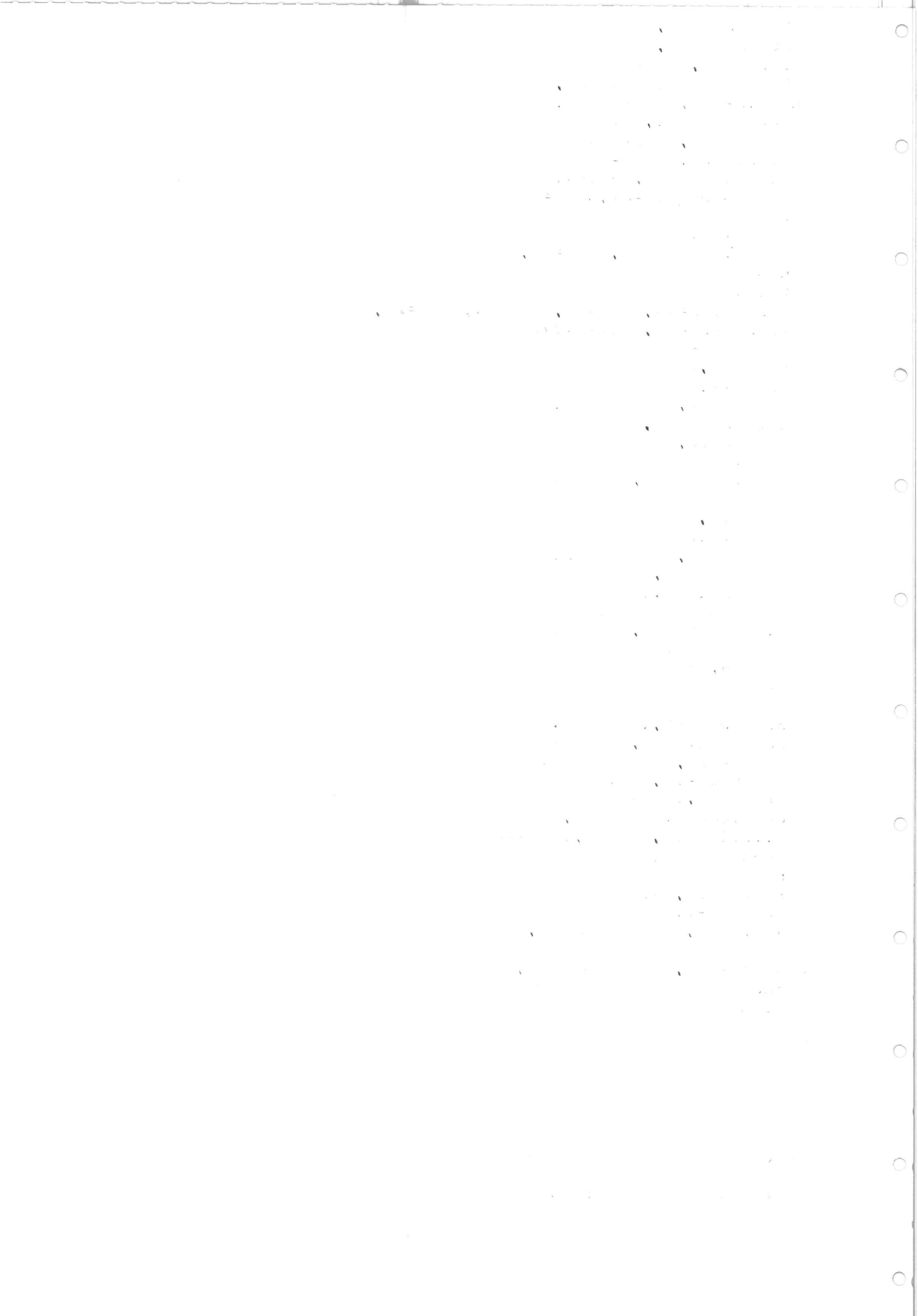
The work done by the force F is
 $W = \int_{x_1}^{x_2} F dx$
 $= \int_{x_1}^{x_2} m a dx$
 $= m \int_{x_1}^{x_2} a dx$

COLD FEED=2,V=3
HOT FEED=13,L=14
SPEC HOT,TEMP=70
CONFIGURATION U=3000,SPASS=5
HX UID=HX6,NAME=FORNUIS2
COLD FEED=11,V=12
SPEC COLD,TEMP=250
CONFIGURATION U=2650
UTILITY STEAM,TSAT=410
COMPRESSOR UID=C1,NAME=H2COMPR
FEED 20
PROD V=21
OPERATION PIN=1,POUT=25,EFF=40
COOLER TOUT=50
CONTROLLER
SPEC STRM=14,COMP=12,RATE=1.,REFS=20,REFC=12
PARA STRM=20,EST2=4.972
MIXER UID=M2
FEED 21,17
PROD V=18
HX UID=HX7,NAME=FORNUIS
COLD FEED=18,V=19
SPEC COLD,TEMP=250
CONFIGURATION U=2050
UTILITY STEAM,TSAT=410
MIXER UID=M3
FEED 15,19
PROD V=22
HX UID=HX2,NAME=FORNUIS
COLD FEED=3,V=4
SPEC DUTY=0.5
CONFIGURATION U=2650
UTILITY STEAM,TSAT=410
MIXER UID=M1
FEED 4,23
PROD V=5
CONTROLLER
SPEC STRM=5,TEMP=236.1
PARA UNIT=HX2,HEATER=1
HX UID=HX8,NAME=LUCHTK.
HOT FEED=14,M=41
SPEC HOT,TEMP=50
CONFIGURATION U=410,SPASS=1
UTILITY AIR,TIN=25,TOUT=40
FLASH UID=FL2
FEED 41
PROD V=24,L=25
ADIA DP=21
US4 UID=01,NAME=RONTABEL,BYPASS
FEED 1
US4 UID=014,NAME=RONTABEL,BYPASS
FEED 25
RECYCLE DATA

SM

PROCESS INPUT LISTING - PAGE 3

ACCEL TYPE=DEM DEMF=1.
END



VERSION 0881

Simulation Sciences logo graphic composed of 'M' and 'MM' characters forming a border and central text.

PROCESS

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I PROBLEM AND PROCESS DESCRIPTION

1 PROBLEM DESCRIPTION

2 DIMENSIONAL UNITS - SI

TIME	-	HR	WEIGHT	-	KG	TEMP	-	C	PRESSURE	-	BAR
ENERGY	-	KJ	WORK	-	KW	LIQ VOL	-	M3	VAP VOL	-	M3
VISCOSITY	-	PAS	T.CONDUCT.	-	WMK	S. TENSION	-	NM			

COMP LIQ DENSITIES ARE INPUTTED IN DENS FORM

3 TOLERANCES FOR

PRODUCT CONVERGENCE ON COMPS WITH X GT 0.0100	0.01000
TEMPERATURE	-0.556

TOWER ENTHALPY BALANCES	0.00278
BUBBLE POINT RELATIONS	0.00100
COMPONENT BALANCES	0.00100

SPECIFICATIONS ON TEMPERATURE	-0.05556
PRESSURE	0.00500
STREAM RATE/PROPERTY	0.01000
PURITY/RECOVERY	0.01000
HEATER/COOLER DUTY	0.00100
OTHERS	0.00100

5 CALCULATIONAL OPTIONS

NUMBER OF TRIALS	50
------------------	----

II DEFINED COMPONENTS

NUMBER OF DEFINED COMPS = 12

COMP NO	1	2	3	4
	BUTANE	IBUTANE	PENTANE	IPENTANE
COMP TYP	LIBRARY	LIBRARY	LIBRARY	LIBRARY
LIB NO	9010010	9010070	9010120	9010080
NAME	BUTANE	IBUTANE	PENTANE	IPENTANE
MOL WT	58.124	58.124	72.151	72.151
NBP, DEG C	-0.500	-11.730	36.074	27.850
STD COND.LIQ				
SP GR	0.5844	0.5631	0.6307	0.6227
DEG API	110.629	119.788	92.844	95.727
KGS/M3	583.199	561.943	629.432	621.446
UOP K	13.4973	13.8129	13.0418	13.0913
TC, DEG C	152.000	134.980	196.500	187.240
PC, BAR	37.997	36.477	33.691	33.812
VC,CC/G-MOLE	255.000	263.000	304.000	306.000
ZC	0.2741	0.2827	0.2623	0.2703
ACENTRIC FAC	0.201	0.177	0.251	0.229
H FORMATION	-126.232	-134.606	-146.538	-154.577
G FORMATION	0.0	0.0	0.0	0.0
COMP NO	5	6	7	8
	HEXANE	2MPENTAN	3MPENTAN	22DME
COMP TYP	LIBRARY	LIBRARY	LIBRARY	LIBRARY
LIB NO	9010060	9010100	9010110	9010020
NAME	HEXANE	2MPENTAN	3MPENTAN	22DME
MOL WT	86.178	86.178	86.178	86.178
NBP, DEG C	68.740	60.270	63.280	49.741
STD COND.LIQ				
SP GR	0.6633	0.6580	0.6691	0.6540
DEG API	81.843	83.558	79.993	84.858
KGS/M3	661.887	656.609	667.678	652.664
UOP K	12.8245	12.8200	12.6452	12.7602
TC, DEG C	234.200	224.300	231.200	215.580
PC, BAR	29.688	30.104	31.238	30.803
VC,CC/G-MOLE	370.000	367.000	367.000	359.000
ZC	0.2604	0.2671	0.2734	0.2721
ACENTRIC FAC	0.294	0.279	0.274	0.233
H FORMATION	-167.305	-174.422	-171.743	-185.685
G FORMATION	0.0	0.0	0.0	0.0

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COMP NO	9	10	11	12
	23DMB	CYPNTANE	MCYCPNT	HYDROGEN
COMP TYP	LIBRARY	LIBRARY	LIBRARY	LIBRARY
LIB NO	9010030	10020020	10020100	16020090
NAME	23DMB	CYPNTANE	MCYCPNT	HYDROGEN
MOL WT	86.178	70.135	84.163	2.016
NBP, DEG C	57.988	49.260	71.810	-252.800
STD COND.LIQ				
SP GR	0.6664	0.7506	0.7535	0.0700
DEG API	80.838	57.025	56.281	1889.929
KGS/M3	665.021	749.021	751.990	69.856
UOP K	12.6289	11.1132	11.3216	47.4439
TC, DEG C	226.780	238.500	259.580	-239.900
PC, BAR	31.269	45.079	37.845	12.970
VC,CC/C-MOLE	358.000	260.000	319.000	65.000
ZC	0.2693	0.2755	0.2726	0.3050
ACENTRIC FAC	0.248	0.196	0.231	0.0
H FORMATION	-177.897	-77.288	-106.763	0.0
G FORMATION	0.0	0.0	0.0	0.0

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PROCESS
INPUT

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III THERMODYNAMIC DATA

1 SUMMARY

SET	K VALUES	LIQUID H	VAPOR H	LIQUID S	VAPOR S
1	SOAVE	SOAVE	SOAVE	SOAVE	SOAVE

STREAM HOT LIQ DENSITIES ARE COMPUTED BY K/H CORRELATION

STREAM HOT VAP DENSITIES ARE COMPUTED BY K/H CORRELATION

IV STREAM DATA

1 STREAM 1 , , IS OF MIXED PHASE

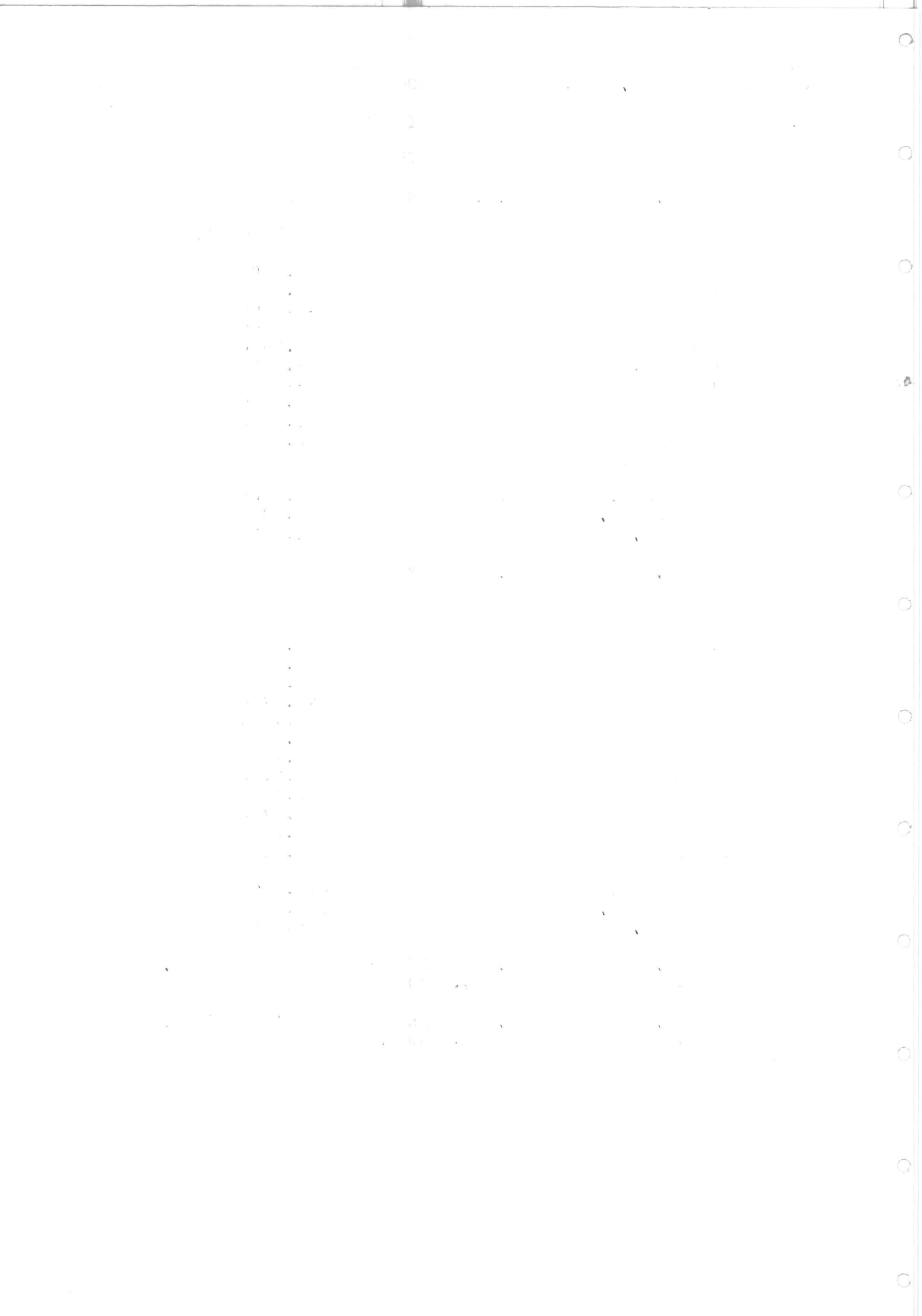
COMPONENT	WEIGHT COMPOSITION
1 BUTANE	0.5000
2 IBUTANE	0.2000
3 PENTANE	44.6000
4 IPENTANE	29.3000
5 HEXANE	6.7000
6 2MPENTAN	9.3000
7 3MPENTAN	4.6000
8 22DMB	0.6000
9 23DMB	1.8000
10 CYPNTANE	2.2000
11 MCYCPNT	0.2000
TOTAL RATE, KGS/HR	10000.0000
TEMPERATURE, DEG C	20.0000
PRESSURE, BAR	1.0000

2 STREAM 5 , , IS OF MIXED PHASE

COMPONENT	MOLAR COMPOSITION
1 BUTANE	2.2100
2 IBUTANE	0.6300
3 PENTANE	108.3800
4 IPENTANE	48.1700
5 HEXANE	13.4000
6 2MPENTAN	11.0500
7 3MPENTAN	5.4900
8 22DMB	0.9700
9 23DMB	2.1700
10 CYPNTANE	3.2700
11 MCYCPNT	0.2400
12 HYDROGEN	219.4500
TOTAL RATE, KG MOL/HR	415.4297
TEMPERATURE, DEG C	235.6000
PRESSURE, BAR	25.0000

3 STREAM 9 , , IS REFERENCED TO STREAM 6 ,
AT 35.000 DEG C AND 25.0000 BAR

4 STREAM 12 , , IS REFERENCED TO STREAM 10 ,
AT 250.000 DEG C AND 25.0000 BAR



5 STREAM 20 , , IS CF MIXED PHASE

COMPONENT MOLAR COMPOSITION

12 HYDROGEN 4.9720

TOTAL RATE, KG MOLS/HR 4.9720

TEMPERATURE, DEG C 20.0000

PRESSURE, BAR 1.0000

6 STREAM 51 , , IS REFERENCED TO STREAM 5 ,
AT 250.000 DEG C AND 25.0000 BAR

7 STREAM 23 , , IS REFERENCED TO STREAM 22 ,
AT 250.000 DEG C AND 25.0000 BAR

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UNIT 1 - P1
INPUT

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1 UNIT P1 , FEEDPUMP , IS A PUMP

1 FEED STREAMS

1 STREAM 1

2 PRODUCT STREAMS

1 STREAM 2 IS OF LIQUID PHASE

3 THERMO DATA SETS USED

K VALUES		- SET 1		
ENTHALPY	LIQUID	- SET 1	VAPOR	- SET 1

4 OPERATING CONDITIONS

OUTLET PRESSURE, BAR	25.0000
PUMP EFFICIENCY, PERCENT	70.0000

2 UNIT R1 , REACTOR , IS A USER-DEFINED OPERATION

1 FEED STREAMS

1 STREAM 51

2 PRODUCT STREAMS

1 STREAM 6 IS CF MIXED PHASE

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

5 INTEGER PARAMETERS

PARAMETER	1	2	3	4
VALUE	0	0	0	0
PARAMETER	5	6	7	8
VALUE	0	0	0	0
PARAMETER	9	10	11	12
VALUE	0	0	0	0

6 REAL PARAMETERS

PARAMETER	1	2	3	4
VALUE	0.0	0.0	0.0	0.0
PARAMETER	5	6	7	8
VALUE	0.0	0.0	0.0	0.0

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UNIT 3 - FL1
INPUT

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3 UNIT FL1 , PHASESEP , IS A FLASH DRUM

1 FEED STREAMS

1 STREAM 9

2 PRODUCT STREAMS

1 STREAM 16 IS OF VAPOR PHASE
2 STREAM 10 IS OF LIQUID PHASE

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

4 UNIT SPECIFICATIONS

1 HOLD UNIT TEMPERATURE AT 35.00 DEG C
2 HOLD UNIT PRESSURE AT 25.0000 BAR

4 UNIT HX3 , , IS A HEAT EXCHANGER

1 HOT SIDE

FEED STREAMS
1 STREAM 6

PRODUCT STREAMS
1 STREAM 7 IS CF VAPOR PHASE

PRESSURE DRCP, BAR 0.0

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

FEED STREAMS
1 STREAM 16

PRODUCT STREAMS
1 STREAM 17 IS CF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 500.0000
NUMBER OF SHELL SIDE PASSES 2
NUMBER OF TUBE SIDE PASSES 4

4 UNIT SPECIFICATION

HOLD COLD SIDE OUTLET TEMP AT 230.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

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PROBLEM TIPPLANT

SM
PROCESS
UNIT 5 - HX1
INPUT

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5 UNIT HX1 , , IS A HEAT EXCHANGER

1 HOT SIDE

FEED STREAMS
1 STREAM 7

PRODUCT STREAMS
1 STREAM 8 IS CF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

FEED STREAMS
1 STREAM 10

PRODUCT STREAMS
1 STREAM 11 IS OF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 3000.0000
NUMBER OF SHELL SIDE PASSES 4
NUMBER OF TUBE SIDE PASSES 8

4 UNIT SPECIFICATION

HOLD COLD SIDE OUTLET TEMP AT 180.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

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PROBLEM TIPPLANT

SM
PROCESS
UNIT 6 - HX4
INPUT

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6 UNIT HX4 , CONDENS. , IS A HEAT EXCHANGER

1 HOT SIDE

FEED STREAMS
1 STREAM 8

PRODUCT STREAMS
1 STREAM 9

IS OF VAPOR PHASE

PRESSURE DROP, BAR

0.0

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1

VAPOR - SET 1

2 COLD SIDE

UTILITY USED AND CONDITIONS

COOLING WATER

TEMPERATURE IN , DEG C
TEMPERATURE OUT, DEG C

20.0000
40.0000

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1

VAPOR - SET 1

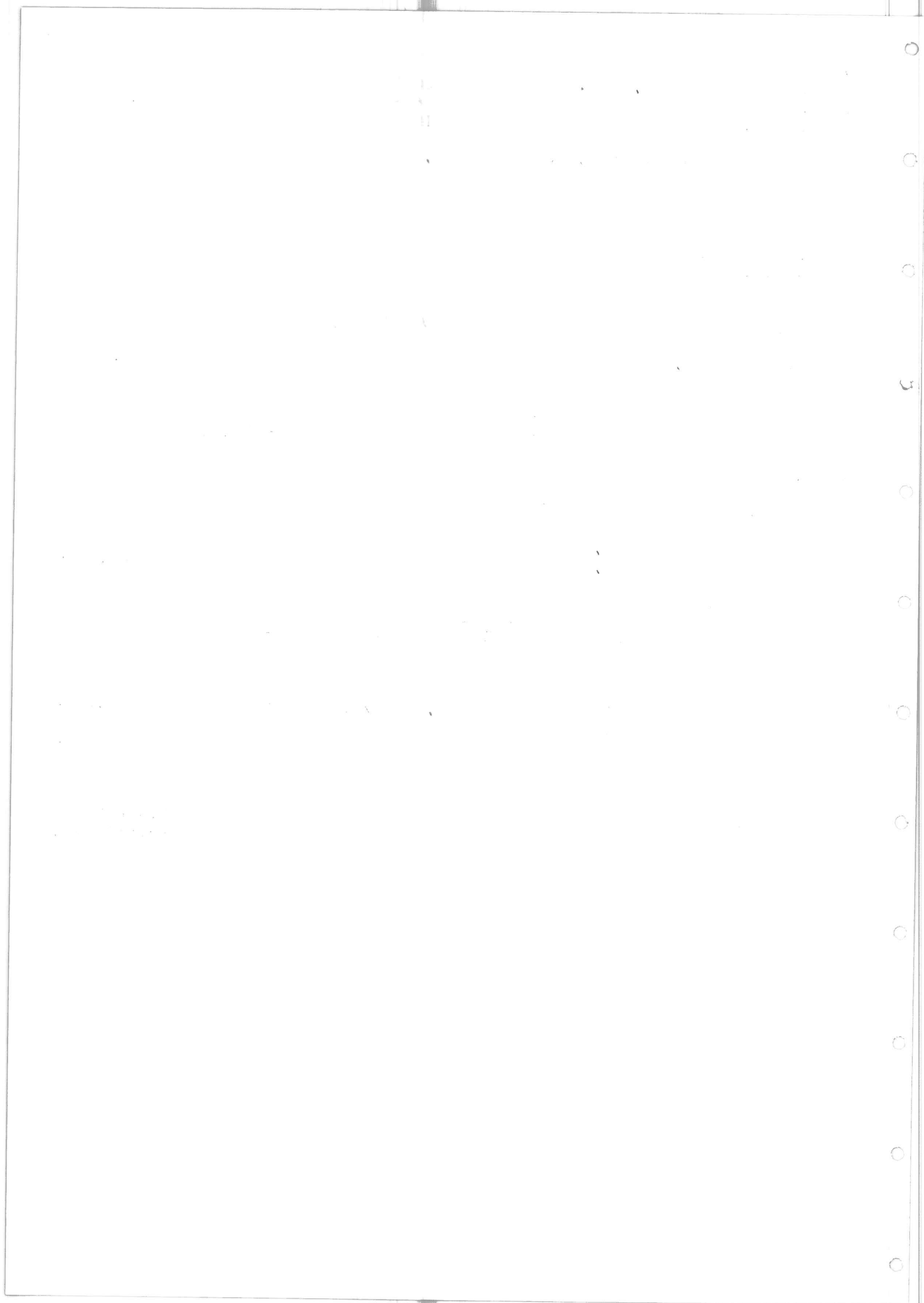
3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 3000.0000
NUMBER OF SHELL SIDE PASSES 2
NUMBER OF TUBE SIDE PASSES 4

4 UNIT SPECIFICATION

HOLD HOT SIDE OUTLET TEMP AT
TOLERANCE ON SPECIFICATION

35.000 DEG C
-0.5556E-01



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PROJECT
PROBLEM TIPPLANT

SM
PROCESS
UNIT 7 - S1
INPUT

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7 UNIT S1 , MOLSIEVE , IS A SEPARATOR

1 FEED STREAMS

1 STREAM 12

2 PRODUCT STREAMS

1 OVERHEAD IS STREAM 13 , OF VAPOR PHASE
2 BOTTOMS IS STREAM 15 , OF VAPOR PHASE

3 THERMO DATA SETS USED

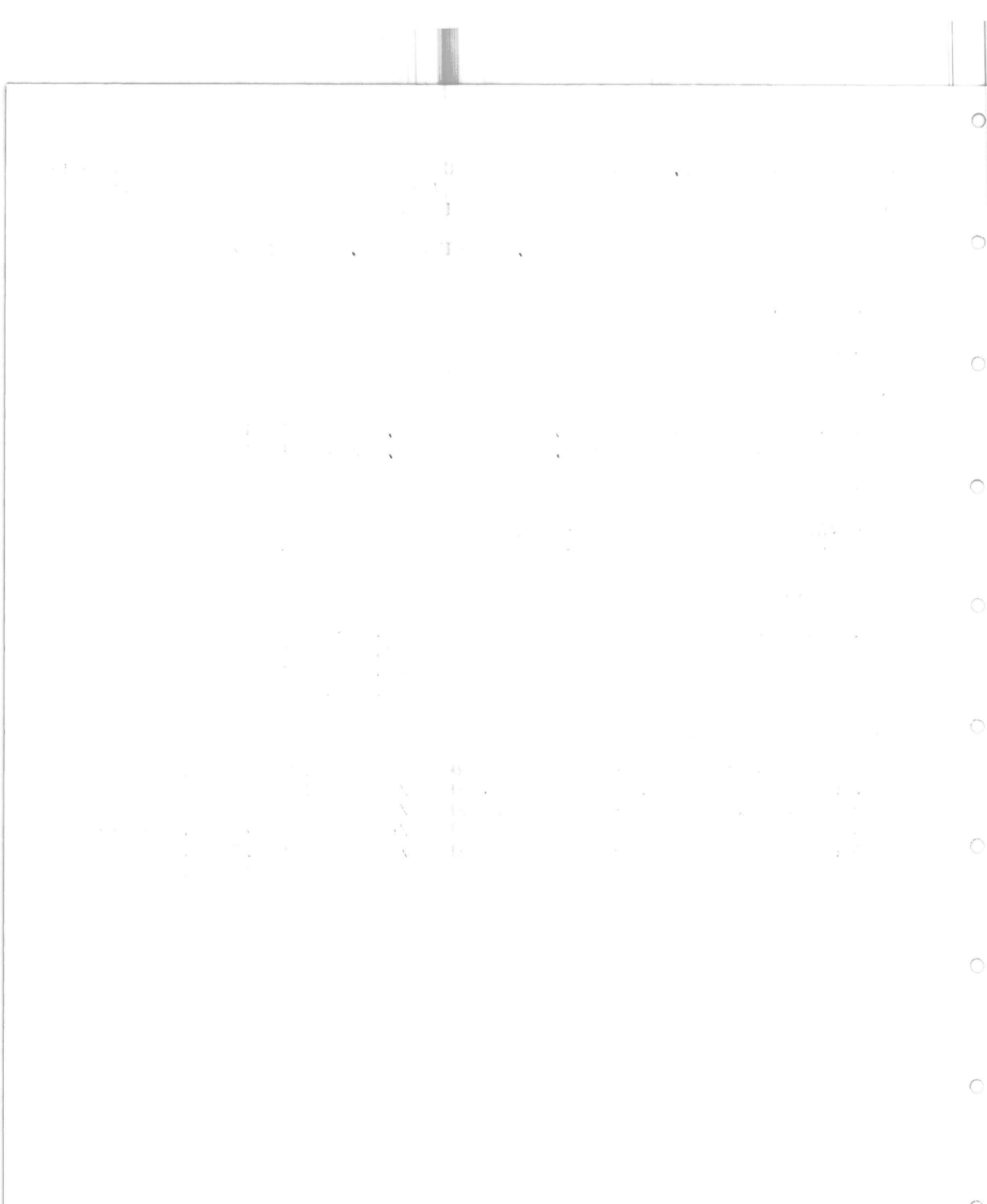
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

4 UNIT SPECIFICATIONS

1 HOLD OVERHEAD PRESSURE AT 25.0000 BAR
TEMPERATURE AT 250.0000 DEG C
2 HOLD BOTTOMS PRESSURE AT 25.0000 BAR
TEMPERATURE AT 250.0000 DEG C

5 SEPARATION SPECIFICATIONS

1 FOR COMPONENTS 1 - 1 HOLD OVERHEAD/FEED RATIO AT 0.0
2 FOR COMPONENTS 2 - 2 HCLD OVERHEAD/FEED RATIO AT 0.10000E+01
3 FOR COMPONENTS 3 - 3 HOLD OVERHEAD/FEED RATIO AT 0.0
4 FOR COMPONENTS 4 - 4 HOLD OVERHEAD/FEED RATIO AT 0.10000E+01
5 FOR COMPONENTS 5 - 5 HOLD OVERHEAD/FEED RATIO AT 0.0
6 FOR COMPONENTS 6 - 12 HCLD OVERHEAD/FEED RATIO AT 0.10000E+01



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8 UNIT HX5 ,

, IS A HEAT EXCHANGER

1 HOT SIDE

FEED STREAMS
1 STREAM 13

PRODUCT STREAMS
1 STREAM 14

IS OF LIQUID PHASE

PRESSURE DROP, BAR

0.0

THERMO DATA SETS USED

K VALUES

- SET 1

ENTHALPY

LIQUID

- SET 1

VAPOR

- SET 1

2 COLD SIDE

FEED STREAMS
1 STREAM 2

PRODUCT STREAMS
1 STREAM 3

IS OF VAPOR PHASE

PRESSURE DROP, BAR

0.0

THERMO DATA SETS USED

K VALUES

- SET 1

ENTHALPY

LIQUID

- SET 1

VAPOR

- SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 3000.0000
NUMBER OF SHELL SIDE PASSES 5
NUMBER OF TUBE SIDE PASSES 10

4 UNIT SPECIFICATION

HOLD HOT SIDE OUTLET TEMP AT 70.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

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SM
PROCESS
UNIT 9 - HX6
INPUT

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9 UNIT HX6 , FORNUIS2 , IS A HEAT EXCHANGER

1 HOT SIDE

UTILITY USED AND CONDITIONS
STEAM

SATURATION TEMPERATURE, DEG C 410.0000

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

FEED STREAMS
1 STREAM 11

PRODUCT STREAMS
1 STREAM 12 IS OF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 2650.0000
NUMBER OF SHELL SIDE PASSES 1
NUMBER OF TUBE SIDE PASSES 1

4 UNIT SPECIFICATION

HOLD COLD SIDE OUTLET TEMP AT 250.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

10 UNIT C1 , H2COMPR , IS AN EXPANDER/COMPRESSOR

1 FEED STREAMS

1 STREAM 20

2 PRODUCT STREAMS

1 STREAM 21 IS OF VAPOR PHASE

3 THERMO DATA SETS USED

K VALUES		- SET 1		
ENTHALPY	LIQUID	- SET 1	VAPOR	- SET 1
ENTROPY	LIQUID	- SET 1	VAPOR	- SET 1

4 OPERATING CONDITIONS

INLET PRESSURE, BAR	1.0000
OUTLET PRESSURE, BAR	25.0000
ADIABATIC EFFICIENCY, PERCENT	40.0000

5 AFTERCOOLER

PRESSURE DROP, BAR	0.0
OUTLET TEMPERATURE, DEG C	50.0000

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SM
PROCESS
UNIT 11 -
INPUT

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11 UNIT , , IS A CONTROLLER

1 CONTROL PARAMETER IS RATE OF
MAXIMUM NUMBER OF ITERATIONS
SECOND ESTIMATE FOR PARAMETER

STREAM 20
10
4.972000

2 CONTROL SPECIFICATIONS

1 HOLD RATIO OF MOLAR RATE FOR COMPS 12- 12 IN STREAM 14 AT
1.00000 WITH REF TO COMPS 12- 12 IN STREAM 20
RELATIVE TOLERANCE IS, .100000E-01

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PROBLEM TIPPLANT

SM
PROCESS
UNIT 12 - M2
INPUT

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12 UNIT M2 , , IS A MIXER/SPLITTER

1 FEED STREAMS

1 STREAM 21
2 STREAM 17

2 PRODUCT STREAMS

1 STREAM 18 IS OF MIXED PHASE

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

4 PRESSURE SPECIFICATION

PRESSURE DROP, BAR 0.0

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SM
PROCESS
UNIT 13 - HX7
INPUT

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13 UNIT HX7 , FORNUIS , IS A HEAT EXCHANGER

1 HOT SIDE

UTILITY USED AND CONDITIONS
STEAM

SATURATION TEMPERATURE, DEG C 410.0000

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

FEED STREAMS
1 STREAM 18

PRODUCT STREAMS
1 STREAM 19 IS OF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 2050.0000
NUMBER OF SHELL SIDE PASSES 1
NUMBER OF TUBE SIDE PASSES 1

4 UNIT SPECIFICATION

HOLD COLD SIDE OUTLET TEMP AT 250.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

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SM
PROCESS
UNIT 14 - M3
INPUT

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14 UNIT M3 ,

, IS A MIXER/SPLITTER

1 FEED STREAMS

1 STREAM 15
2 STREAM 19

2 PRODUCT STREAMS

1 STREAM 22

IS OF MIXED PHASE

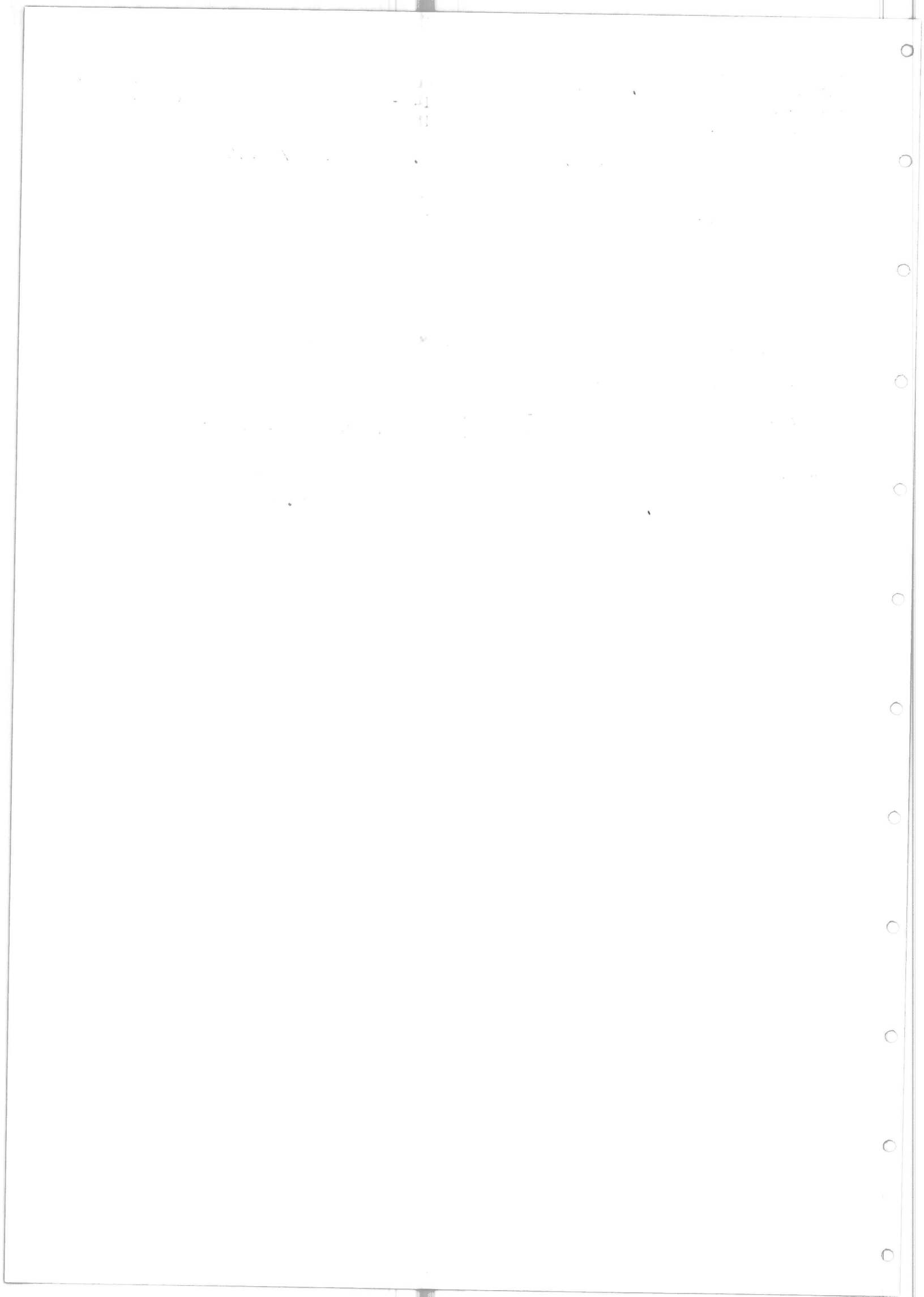
3 THERMO DATA SETS USED

K VALUES		- SET 1		
ENTHALPY	LIQUID	- SET 1	VAPOR	- SET 1

4 PRESSURE SPECIFICATION

PRESSURE DROP, BAR

0.0



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SM
PROCESS
UNIT 15 - HX2
INPUT

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15 UNIT HX2 , FORNUIS , IS A HEAT EXCHANGER

1 HOT SIDE

UTILITY USED AND CONDITIONS
STEAM

SATURATION TEMPERATURE, DEG C 410.0000

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

FEED STREAMS
1 STREAM 3

PRODUCT STREAMS
1 STREAM 4 IS OF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 2650.0000
NUMBER OF SHELL SIDE PASSES 1
NUMBER OF TUBE SIDE PASSES 1

4 UNIT SPECIFICATION

HOLD DUTY AT 0.500000 MM KJ /HR
TOLERANCE ON SPECIFICATION 0.1000E-02

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SM
PROCESS
UNIT 16 - M1
INPUT

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16 UNIT M1 , , IS A MIXER/SPLITTER

1 FEED STREAMS

1 STREAM 4
2 STREAM 23

2 PRODUCT STREAMS

1 STREAM 5 IS OF MIXED PHASE

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

4 PRESSURE SPECIFICATION

PRESSURE DROP, BAR 0.0

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SM
PROCESS
UNIT 17 -
INPUT

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17 UNIT , , IS A CONTROLLER

1 CONTROL PARAMETER IS HEATER DUTY NO 1 OF
MAXIMUM NUMBER OF ITERATIONS
SECOND ESTIMATE FOR PARAMETER

UNIT HX2
10
0.0

2 CONTROL SPECIFICATIONS

1 HOLD VALUE OF STRM 5 TEMP AT 236.100 DEG C
ABSOLUTE TOLERANCE IS, .555556E-01

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PROBLEM TIPPLANT

SM
PROCESS
UNIT 18 - HX8
INPUT

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18 UNIT HX8 , LUCHTK. , IS A HEAT EXCHANGER

1 HOT SIDE

FEED STREAMS
1 STREAM 14

PRODUCT STREAMS
1 STREAM 41 IS CF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

UTILITY USED AND CONDITIONS
COOLING AIR
TEMPERATURE IN , DEG C 25.0000
TEMPERATURE OUT, DEG C 40.0000

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 410.0000
NUMBER OF SHELL SIDE PASSES 1
NUMBER OF TUBE SIDE PASSES 2

4 UNIT SPECIFICATION

HOLD HOT SIDE OUTLET TEMP AT 50.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

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PROBLEM TIPPLANT

SM
PROCESS
UNIT 19 - FL2
INPUT

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19 UNIT FL2 , , IS A FLASH DRUM

1 FEED STREAMS

1 STREAM 41

2 PRODUCT STREAMS

1 STREAM 24 IS OF VAPOR PHASE
2 STREAM 25 IS OF LIQUID PHASE

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

4 UNIT SPECIFICATIONS

1 HOLD PRESSURE DROP AT 21.000 BAR

2 HOLD VALUE OF UNIT DUTY NO 1 AT .0 MM KJ /HR
RELATIVE TOLERANCE IS, .0

20 UNIT C1 , RONTABEL , IS A USER-DEFINED OPERATION

1 FEED STREAMS

1 STREAM 1

2 PRODUCT STREAMS

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

5 INTEGER PARAMETERS

PARAMETER	1	2	3	4
VALUE	0	0	0	0
PARAMETER	5	6	7	8
VALUE	0	0	0	0
PARAMETER	9	10	11	12
VALUE	0	0	0	0

6 REAL PARAMETERS

PARAMETER	1	2	3	4
VALUE	0.0	0.0	0.0	0.0
PARAMETER	5	6	7	8
VALUE	0.0	0.0	0.0	0.0

21 UNIT C14 , RONTABEL , IS A USER-DEFINED OPERATION

1 FEED STREAMS

1 STREAM 25

2 PRODUCT STREAMS

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

5 INTEGER PARAMETERS

PARAMETER	1	2	3	4
VALUE	0	0	0	0
PARAMETER	5	6	7	8
VALUE	0	0	0	0
PARAMETER	9	10	11	12
VALUE	0	0	0	0

6 REAL PARAMETERS

PARAMETER	1	2	3	4
VALUE	0.0	0.0	0.0	0.0
PARAMETER	5	6	7	8
VALUE	0.0	0.0	0.0	0.0

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VI RECYCLE SPECIFICATIONS

2 RECYCLE ACCELERATION

DEM ACCELERATION IS USED WITH DUMPING FACTOR OF

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VIIIA UNIT STREAM CORRELATION MATRIX

UNIT NO	21
ID	C14
STREAM ID	
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VIIIB CALCULATIONAL SEQUENCE DETERMINED BY PROGRAM

1. UNIT	1, P1	2. UNIT	10, C1	3. UNIT	2, R1
4. UNIT	3, FL1	5. UNIT	4, HX3	6. UNIT	5, HX1
7. UNIT	6, HX4	8. UNIT	7, S1	9. UNIT	8, HX5
10. UNIT	9, HX6	11. UNIT	11,	12. UNIT	12, M2
13. UNIT	13, HX7	14. UNIT	14, M3	15. UNIT	15, HX2
16. UNIT	16, M1	17. UNIT	17,	18. UNIT	18, HX8
19. UNIT	19, FL2	20. UNIT	20, O1	21. UNIT	21, O14

VIIIC RECYCLE LOOPS DETERMINED BY PROGRAM

LOOP 1 STARTS AT UNIT 2, R1 AND ENDS AT UNIT 17,

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VIIID RECYCLE STREAMS

STREAM	FROM UNIT	TO UNIT	LOOP
9	6,HX4	3,FL1	1
12	9,HX6	7,S1	1

*** ALL INPUT DATA IN ORDER ***

UNIT 1, P1 , SOLVED
 UNIT 10, C1 , SOLVED
 UNIT 2, R1 , SOLVED
 UNIT 3, FL1 , SOLVED
 UNIT 4, HX3 , SOLVED
 UNIT 5, HX1 , SOLVED
 UNIT 6, HX4 , SOLVED
 UNIT 7, S1 , SOLVED
 UNIT 8, HX5 , SOLVED
 UNIT 9, HX6 , SOLVED
 UNIT 11, , SOLVED
 UNIT 12, M2 , SOLVED
 UNIT 13, HX7 , SOLVED
 UNIT 14, M3 , SOLVED
 UNIT 15, HX2 , SOLVED
 UNIT 16, M1 , SOLVED
 UNIT 17, , NOT SOLVED
 UNIT 15, HX2 , SOLVED
 UNIT 16, M1 , SOLVED
 UNIT 17, , NOT SOLVED
 UNIT 15, HX2 , SOLVED
 UNIT 16, M1 , SOLVED
 UNIT 17, , SOLVED
 LOOP 1 SOLVED AFTER 1 TRIALS
 UNIT 18, HX8 , SOLVED
 UNIT 19, FL2 , SOLVED

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**** PROBLEM SOLUTION REACHED ****

SUMMARY OF FLASH DRUMS, MIXER/SPLITTERS AND VALVES

UNIT ID SEQ NO NAME TYPE	FL1 3 PHASESEP FLASH	M2 12 MIXER	M3 14 MIXER	M1 16 MIXER
FEEDS	9	21 17	15 19	4 23
PRODUCTS	16 (V) 10 (L)	18 (V)	22 (V)	5 (V)
TEMP, DEG C	35.000	226.938	243.150	236.115
PRESSURE, BAR	25.0000	25.0000	25.0000	25.0000

UNIT ID SEQ NO NAME TYPE	FL2 19 FLASH
FEEDS	41
PRODUCTS	24 (V) 25 (L)
TEMP, DEG C	47.841
PRESSURE, BAR	4.0000

SUMMARY OF HEAT EXCHANGE UNITS

4 UNIT HX3 , , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

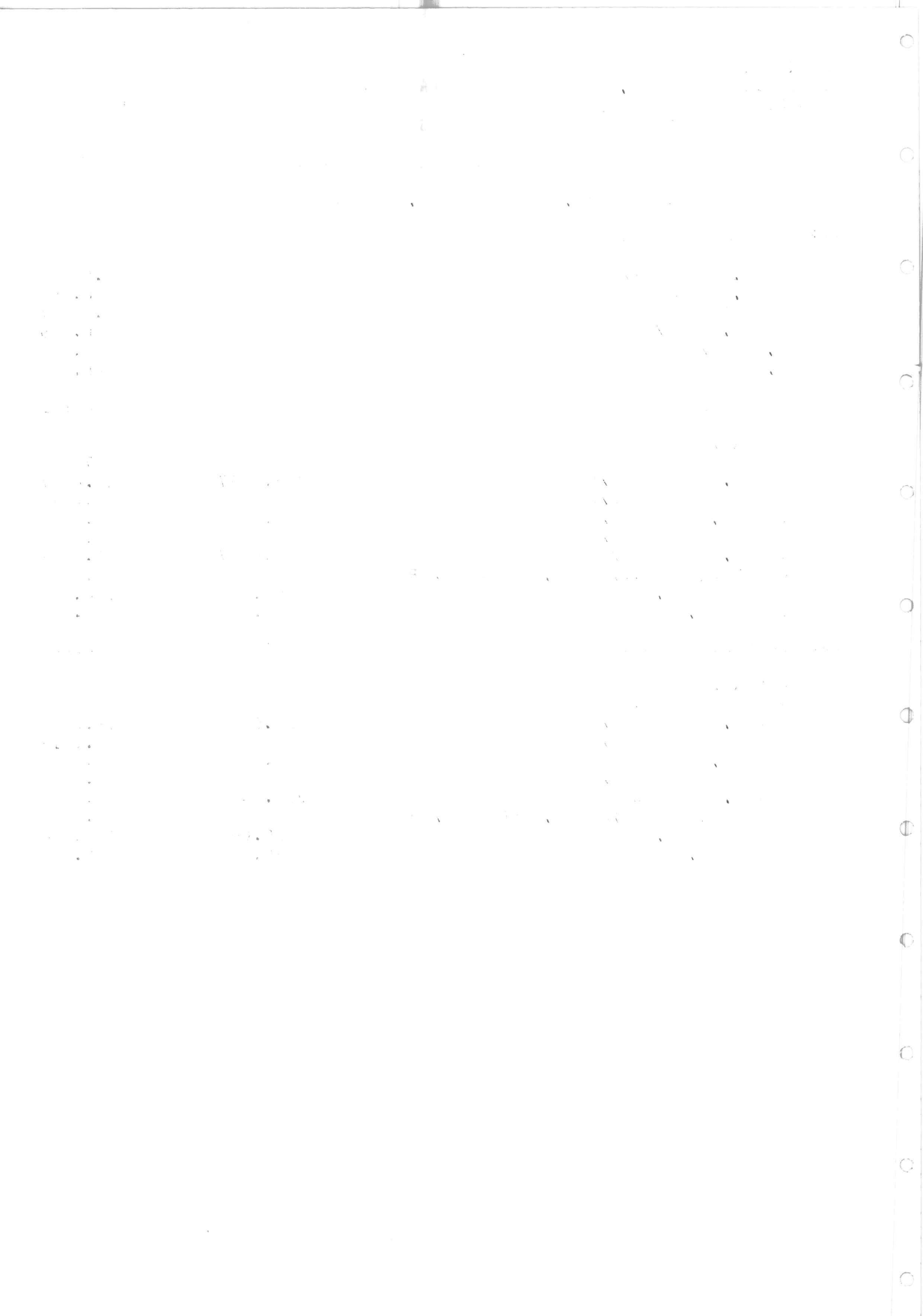
DUTY, MM KJ /HR	1.58416
LMTD, DEG C	68.294
F FACTOR	0.93917
U * A, KJ /HR DEG C	23196.059
U, KJ /HR DEG C SQ M	500.000
A, SQ M	46.392

*** HOT SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	6	
VAPOR PRODUCT		7
VAPOR, KG MOL/HR	415.4297	415.4297
M KGS/HR		15.0075
LIQUID, KG MOL/HR	0.0	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	415.4297	415.4297
CONDENS(VAPORIZ)ATION, KG MOL/HR		0.0
TEMPERATURE, DEG C	250.000	214.626
PRESSURE, BAR	25.000	25.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	16	
VAPOR PRODUCT		17
VAPOR, KG MOL/HR	226.0491	226.0491
M KGS/HR		1.2718
LIQUID, KG MOL/HR	0.0	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	226.0491	226.0491
CONDENS(VAPORIZ)ATION, KG MOL/HR		0.0
TEMPERATURE, DEG C	35.000	230.000
PRESSURE, BAR	25.000	25.000



5 UNIT HX1 , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	7.93312
LMTD, DEG C	37.621
F FACTOR	0.88266
U * A, KJ /HR DEG C	210869.375
U, KJ /HR DEG C SQ M	3000.000
A, SQ M	70.290

*** HOT SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	7	
MIXED PRODUCT		8
VAPOR, KG MOL/HR	415.4299	274.9578
M KGS/HR		4.8198
LIQUID, KG MOL/HR	0.0	140.4722
M KGS/HR		10.1878
TOTAL, KG MOL/HR	415.4299	415.4299
CONDENS(VAPORIZ)ATION, KG MOL/HR		140.4722
TEMPERATURE, DEG C	214.626	86.763
PRESSURE, BAR	25.000	25.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	10	
VAPOR PRODUCT		11
VAPOR, KG MOL/HR	0.0	189.3805
M KGS/HR		13.7356
LIQUID, KG MOL/HR	189.3805	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	189.3805	189.3805
CONDENS(VAPORIZ)ATION, KG MOL/HR		189.3805
TEMPERATURE, DEG C	35.000	180.000
PRESSURE, BAR	25.000	25.000

 6 UNIT HX4 , CONDENS. , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	3.22632
LMTD, DEG C	26.287
F FACTOR	0.94101
U * A, KJ /HR DEG C	122734.437
U, KJ /HR DEG C SQ M	3000.000
A, SQ M	40.911

*** HOT SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	8	
MIXED PRODUCT		9
VAPOR, KG MOL/HR	274.9575	226.0477
M KGS/HR		1.2718
LIQUID, KG MOL/HR	140.4721	189.3820
M KGS/HR		13.7357
TOTAL, KG MOL/HR	415.4297	415.4297
CONDENS(VAPORIZ)ATION, KG MOL/HR		48.9099
TEMPERATURE, DEG C	86.763	35.000
PRESSURE, BAR	25.000	25.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
COOLING WATER, KG /HR	38529.488	38529.488
TEMPERATURE, DEG C	20.000	40.000

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This ensures transparency and accountability in the financial process.

2. The second part of the document outlines the procedures for handling discrepancies. It states that any variance between the recorded amounts and the actual amounts should be investigated immediately. The responsible personnel should identify the cause of the error and take corrective action to prevent future occurrences.

3. The third part of the document details the requirements for the monthly financial review. It specifies that all department heads must submit their reports by the 15th of each month. These reports should include a summary of the department's performance, a breakdown of expenses, and any outstanding issues.

4. The fourth part of the document describes the process for budgeting. It notes that the budgeting process should be a collaborative effort involving all relevant departments. Each department should provide input on their needs and priorities, which will be used to formulate a comprehensive budget for the upcoming period.

5. The fifth part of the document discusses the importance of staying within the budget. It advises that all expenditures should be carefully monitored and approved in advance. Any requests for additional funds should be justified and approved by the appropriate authority.

6. The sixth part of the document outlines the procedures for auditing. It states that the internal audit department will conduct regular audits of all major accounts and transactions. The purpose of these audits is to ensure compliance with financial policies and to identify any areas of weakness or risk.

7. The seventh part of the document discusses the importance of maintaining up-to-date financial information. It emphasizes that all financial data should be entered into the accounting system promptly and accurately. This allows for real-time monitoring of the organization's financial health.

8. The eighth part of the document outlines the procedures for reporting. It states that the financial statements should be prepared and reviewed by the management team. These statements provide a clear picture of the organization's financial performance and are essential for decision-making.

9. The ninth part of the document discusses the importance of financial control. It advises that all financial activities should be subject to strict control and oversight. This helps to minimize the risk of fraud and ensures that the organization's resources are used effectively.

10. The tenth part of the document outlines the procedures for financial planning. It states that the organization should engage in regular financial planning to anticipate future needs and opportunities. This involves setting financial goals and developing strategies to achieve them.

8 UNIT HX5 , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	6.88688
LMTD, DEG C	40.025
F FACTOR	0.88073
U * A, KJ /HR DEG C	172066.125
U, KJ /HR DEG C SQ M	3000.000
A, SQ M	57.355

*** HOT SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	13	
MIXED PRODUCT		14
VAPOR, KG MOL/HR	138.6553	0.9844
M KGS/HR		0.0125
LIQUID, KG MOL/HR	0.0	137.6709
M KGS/HR		10.0021
TOTAL, KG MOL/HR	138.6553	138.6553
CONDENS(VAPORIZ)ATION, KG MOL/HR		137.6709
TEMPERATURE, DEG C	250.000	70.000
PRESSURE, BAR	25.000	25.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	2	
VAPOR PRODUCT		3
VAPOR, KG MOL/HR	0.0	133.6914
M KGS/HR		9.9999
LIQUID, KG MOL/HR	133.6914	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	133.6914	133.6914
CONDENS(VAPORIZ)ATION, KG MOL/HR		133.6914
TEMPERATURE, DEG C	21.614	207.375
PRESSURE, BAR	25.000	25.000



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Faint, illegible text scattered across the page, possibly representing a list or data entries. The text is too light to transcribe accurately.

 9 UNIT HX6 , FORNUIS2 , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	2.74835
LMTD, DEG C	192.888
U * A, KJ /HR DEG C	14248.449
U, KJ /HR DEG C SQ M	2650.000
A, SQ M	5.377

*** HOT SIDE CONDITIONS

	INLET	OUTLET
STEAM, KG /HR	3142.619	3142.619
SATURATION PRESSURE, BAR		227.145
SATURATION TEMPERATURE, DEG C		410.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	11	
VAPOR PRODUCT		12
VAPOR, KG MOLS/HR	189.3805	189.3805
M KGS/HR		13.7356
LIQUID, KG MOLS/HR	0.0	0.0
M KGS/HR		0.0
TOTAL, KG MOLS/HR	189.3805	189.3805
CONDENS (VAPORIZ)ATION, KG MOLS/HR		0.0
TEMPERATURE, DEG C	180.000	250.000
PRESSURE, BAR	25.000	25.000

The following information was obtained from the records of the
 Department of Health, State of New York, for the period
 ending 12/31/54:

Year	Number of Cases	Number of Deaths
1950	12	1
1951	15	2
1952	18	3
1953	22	4
1954	25	5

The total number of cases reported for the period
 1950-1954 is 72. The total number of deaths
 reported for the period 1950-1954 is 15.

It is noted that the number of cases and deaths
 reported for the period 1950-1954 is in
 substantial agreement with the information
 furnished by the Bureau of Health Statistics,
 State of New York, for the period 1950-1954.



 13 UNIT HX7 , FORNUIS , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	0.19903
LMTD, DEG C	171.272
U * A, KJ /HR DEG C	1162.092
U, KJ /HR DEG C SQ M	2050.000
A, SQ M	0.567

*** HOT SIDE CONDITIONS

	INLET	OUTLET
STEAM, KG /HR	227.587	227.587
SATURATION PRESSURE, BAR		227.145
SATURATION TEMPERATURE, DEG C		410.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	18	
VAPOR PRODUCT		19
VAPOR, KG MOL/HR	231.0211	231.0211
M KGS/HR		1.2818
LIQUID, KG MOL/HR	0.0	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	231.0211	231.0211
CONDENS(VAPORIZ)ATION, KG MOL/HR		0.0
TEMPERATURE, DEG C	226.938	250.000
PRESSURE, BAR	25.000	25.000

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 15 UNIT HX2 , FORNUIS , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR		0.80863
LMTD, DEG C		188.178
U * A, KJ /HR DEG C		4297.148
U, KJ /HR DEG C SQ M		2650.000
A, SQ M		1.622

*** HOT SIDE CONDITIONS

	INLET	OUTLET
STEAM, KG /HR	924.630	924.630
SATURATION PRESSURE, BAR		227.145
SATURATION TEMPERATURE, DEG C		410.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	3	
VAPOR PRODUCT		4
VAPOR, KG MOLS/HR	133.6913	133.6913
M KGS/HR		9.9999
LIQUID, KG MOLS/HR	0.0	0.0
M KGS/HR		0.0
TOTAL, KG MOLS/HR	133.6913	133.6913
CONDENS(VAPORIZ)ATION, KG MOLS/HR		0.0
TEMPERATURE, DEG C	207.375	235.567
PRESSURE, BAR	25.000	25.000

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This ensures transparency and allows for easy verification of the data.

In the second section, the author outlines the various methods used to collect and analyze the data. This includes both manual data entry and the use of specialized software tools. The goal is to ensure that the data is both accurate and easy to interpret.

The third part of the document provides a detailed breakdown of the results. It shows that there has been a significant increase in sales over the period covered by the report. This is attributed to several factors, including improved marketing strategies and better customer service.

Finally, the document concludes with a series of recommendations for future actions. These include continuing to invest in marketing, maintaining high standards of customer service, and regularly reviewing financial performance to identify areas for improvement.

 18 UNIT HX6 , LUCHTK. , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	0.49939
LMTD, DEG C	25.489
F FACTOR	0.92943
U * A, KJ /HR DEG C	19592.488
U, KJ /HR DEG C SQ M	410.000
A, SQ M	47.787

*** HOT SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	14	
MIXED PRODUCT		41
VAPOR, KG MOLS/HR	0.9844	1.1961
M KGS/HR		0.0097
LIQUID, KG MOLS/HR	137.6709	137.4592
M KGS/HR		10.0049
TOTAL, KG MOLS/HR	138.6553	138.6553
CONDENS(VAPORIZ)ATION, KG MOLS/HR		0.2117
TEMPERATURE, DEG C	70.000	50.000
PRESSURE, BAR	25.000	25.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
COOLING AIR, KG /HR	32772.180	32772.180
TEMPERATURE, DEG C	25.000	40.000

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SUMMARY OF COMPRESSOR/EXPANDER/PUMP UNITS

1 UNIT P1 , FEEDPUMP , IS A PUMP

*** FEED STREAMS ARE 1
 *** LIQUID PRODUCT IS STREAM 2
 *** OPERATING CONDITIONS

WORK, KW 16.40
 EFFICIENCY, PERCENT 70.00

	INLET	OUTLET
MOLE FRACTION LIQUID	1.0000	1.0000
TEMPERATURE, DEG C	20.000	21.614
PRESSURE, BAR	1.0000	25.0000
HOT VOLUME, M3/HR	17.216	17.134

10 UNIT C1 , H2COMPR , IS A COMPRESSOR

*** FEED STREAMS ARE 20
 *** VAPOR PRODUCT IS STREAM 21
 *** OPERATING CONDITIONS

	INLET	ISENTROPIC	OUTLET
TEMPERATURE, DEG C	20.00	458.81	1093.38
PRESSURE, BAR	1.0000	25.0000	25.0000
ENTHALPY, MM KJ /HR	0.0020	0.0661	0.1623
ENTROPY, KJ /MOLE DEG C	135.0057	135.0057	153.9599
MOLE PERCENT LIQUID	0.0	0.0	0.0
ADIABATIC EFFICIENCY, PERCENT			40.00
POLYTROPIC EFFICIENCY, PERCENT			59.43
ISENTROPIC COEFFICIENT, K			1.3983
POLYTROPIC COEFFICIENT, N			1.9205

**** ISENTROPIC EXPONENT CALCULATED FROM TEMPS INSTEAD OF FROM WORK ****

WORK, KW
 THEORETICAL 17.81
 POLYTROPIC 26.47
 ACTUAL 44.54

AFTERCOOLER
 DUTY, MM KJ /HR 0.1559
 TEMPERATURE, DEG C 50.00
 PRESSURE, BAR 25.0000

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 UNIT IDENTITY= R1

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NAME= REACTOR

REACTORTEMPERATUUR= 250.00 C REACTORDRUK= 25.00 BAR

*****STROOMGEGEVENS*****

COMP NO	COMPONENT NAME	VOEDING KG MOLS/HR	CONV KG MOLS/HR	PRODUCT KG MOLS/HR	REACT.ENTH KJ /KG MOLS
1	BUTANE	0.2210E+01	-0.8447E+00	0.1365E+01	0.0
2	IBUTANE	0.6300E+00	0.8283E+00	0.1458E+01	-0.6930E+04
3	PENTANE	0.1084E+03	-0.6181E+02	0.4657E+02	0.0
4	IPENTANE	0.4817E+02	0.6181E+02	0.1100E+03	-0.8060E+04
5	HEXANE	0.1340E+02	-0.7776E+01	0.5624E+01	0.0
6	2MPENTAN	0.1105E+02	-0.5885E+00	0.1046E+02	-0.7200E+04
7	3MPENTAN	0.5490E+01	0.1060E+01	0.6550E+01	-0.4000E+04
8	22DMB	0.9700E+00	0.6594E+01	0.7564E+01	-0.1830E+05
9	23DMB	0.2170E+01	0.8072E+00	0.2977E+01	-0.1060E+05
10	CYPNTANE	0.3270E+01	0.0	0.3270E+01	0.0
11	MCYCPNT	0.2400E+00	0.0	0.2400E+00	0.0
12	HYDROGEN	0.2194E+03	0.0	0.2194E+03	0.0

ENTHALPY VAN PRODUCT STROOM 14258.2383 KJ /HR

MOLAIRE WARMTE CAPACITEIT VAN PRODUCT STROOM 109.7844 KJ /KG MOLS

ADIABATISCHE TEMPERATUUR STIJGING 13.8822 DEG C

TOTALE MOL PRODUCT STROOM 415.4297 KG MOLS/HR

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry must be supported by a valid receipt or invoice. This ensures transparency and accountability in the financial process.

Furthermore, it is noted that regular audits are essential to identify any discrepancies or errors. By conducting these audits frequently, potential issues can be resolved promptly, preventing them from escalating into larger problems.

In addition, the document highlights the need for clear communication between all parties involved. Regular meetings and reports should be held to keep everyone informed of the current status and any changes that may occur.

Finally, it is stressed that adherence to all applicable laws and regulations is non-negotiable. This includes proper tax reporting and compliance with industry standards.

The second part of the document provides a detailed breakdown of the financial data for the current period. This includes a summary of income, expenses, and the resulting net profit. Each item is categorized and quantified to provide a clear overview of the financial performance.

The following table shows the key financial metrics:

Category	Amount
Total Revenue	\$120,000
Operating Expenses	\$85,000
Net Profit	\$35,000

A detailed analysis of these figures reveals that while revenue has increased, operating expenses have also risen significantly. This suggests that the company is investing in growth, but it is crucial to monitor these costs closely to ensure they remain within budget.

The document concludes by reiterating the commitment to financial integrity and the goal of achieving long-term success through sound financial management.

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SIMULATION SCIENCES, INC.
PROJECT
PROBLEM TIPPLANT

SM
PROCESS
UNIT 2 - R1
SOLUTION

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*****OCTANE NUMBERS*****

COMP NO	COMPONENT NAME	RON	MOLFR HC FEED	RON	MOLFHC PROD	RON
1	BUTANE	94.0	0.011	1.06	0.007	0.65
2	IBUTANE	100.0	0.003	0.32	0.007	0.74
3	PENTANE	62.0	0.553	34.29	0.238	14.73
4	IPENTANE	90.0	0.246	22.12	0.561	50.50
5	HEXANE	25.0	0.068	1.71	0.029	0.72
6	2MPENTAN	73.5	0.056	4.14	0.053	3.92
7	3MPENTAN	74.5	0.028	2.09	0.033	2.49
8	22DMB	92.0	0.005	0.46	0.039	3.55
9	23DMB	103.5	0.011	1.15	0.015	1.57
10	CYPNTANE	102.5	0.017	1.71	0.017	1.71
11	MCYCPNT	91.5	0.001	0.11	0.001	0.11
			TOTAAL	69.15	TOTAAL	80.71

VERSION 0881
SIMULATION SCIENCES, INC.
PROJECT
PROBLEM TIPPLANT

SM
PROCESS
UNIT 20 - 01
SOLUTION

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MCF&MJB

*****OCTANE NUMBERS*****

COMP NO	COMPONENT NAME	RON	MOLFR HC FEED	RON
1	BUTANE	94.0	0.006	0.60
2	IBUTANE	100.0	0.003	0.26
3	PENTANE	62.0	0.462	28.67
4	IPENTANE	90.0	0.304	27.34
5	HEXANE	25.0	0.058	1.45
6	2MPENTAN	73.5	0.081	5.93
7	3MPENTAN	74.5	0.040	2.97
8	22DMB	92.0	0.005	0.48
9	23DMB	103.5	0.016	1.62
10	CYPNTANE	102.5	0.023	2.40
11	MCYCPNT	91.5	0.002	0.16
			TOTAAL	71.89

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PROJECT
PROBLEM TIPPLANT

SM
PROCESS
UNIT 21 - 014
SOLUTION

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*****OCTANE NUMBERS*****

COMP NO	COMPONENT NAME	RON	MOLFR HC FEED	RON
1	BUTANE	94.0	0.0	0.0
2	IBUTANE	100.0	0.008	0.82
3	PENTANE	62.0	0.0	0.0
4	IPENTANE	90.0	0.763	68.68
5	HEXANE	25.0	0.0	0.0
6	2MPENTAN	73.5	0.077	5.69
7	3MPENTAN	74.5	0.049	3.63
8	22DMB	92.0	0.055	5.07
9	23DMB	103.5	0.022	2.27
10	CYPNTANE	102.5	0.024	2.43
11	MCYCPNT	91.5	0.002	0.16
			TOTAAL	88.76

STREAM COMPONENT FLOW RATES - KG MOL/HR

STREAM ID NAME	1	2	3	4
PHASE	LIQUID	LIQUID	VAPOR	VAPOR
1 BUTANE	0.8602	0.8602	0.8602	0.8602
2 IBUTANE	0.3441	0.3441	0.3441	0.3441
3 PENTANE	61.8148	61.8147	61.8146	61.8146
4 IPENTANE	40.6093	40.6092	40.6091	40.6091
5 HEXANE	7.7746	7.7746	7.7746	7.7746
6 2MPENTAN	10.7916	10.7916	10.7916	10.7916
7 3MPENTAN	5.3378	5.3378	5.3378	5.3378
8 22DMB	0.6962	0.6962	0.6962	0.6962
9 23DMB	2.0887	2.0887	2.0887	2.0887
10 CYPNTANE	3.1368	3.1368	3.1368	3.1368
11 MCYCPNT	0.2376	0.2376	0.2376	0.2376
12 HYDROGEN	0.0	0.0	0.0	0.0
TOTALS	133.6918	133.6914	133.6914	133.6913
TEMPERATURE, DEG C	20.0000	21.6142	207.3745	235.5668
PRESSURE, BAR	1.0000	25.0000	25.0000	25.0000
H, MM KJ /HR	0.3416	0.4006	7.2875	8.0961
MOLE FRACT LIQUID	1.0000	1.0000	0.0	0.0
RECYCLE CONVERGENCE	0.0	0.0	0.0	0.0
STREAM ID NAME	5	6	7	8
PHASE	VAPOR	VAPOR	VAPOR	MIXED
1 BUTANE	2.2253	1.3653	1.3651	1.3651
2 IBUTANE	0.6327	1.4583	1.4580	1.4580
3 PENTANE	108.3790	46.5736	46.5646	46.5649
4 IPENTANE	48.1635	109.9764	109.9551	109.9558
5 HEXANE	13.3971	5.6236	5.6225	5.6226
6 2MPENTAN	11.0534	10.4615	10.4595	10.4596
7 3MPENTAN	5.4859	6.5498	6.5486	6.5486
8 22DMB	0.9659	7.5644	7.5629	7.5630
9 23DMB	2.1696	2.9772	2.9766	2.9766
10 CYPNTANE	3.2669	3.2700	3.2694	3.2694
11 MCYCPNT	0.2420	0.2400	0.2400	0.2400
12 HYDROGEN	219.4570	219.4500	219.4077	219.4066
TOTALS	415.4380	415.5100	415.4297	415.4299
TEMPERATURE, DEG C	236.1149	250.0000	214.6262	86.7636
PRESSURE, BAR	25.0000	25.0000	25.0000	25.0000
H, MM KJ /HR	13.7461	14.2582	12.6740	4.7409
MOLE FRACT LIQUID	0.0	0.0	0.0	0.3381
RECYCLE CONVERGENCE	0.0	0.0	0.0	0.0

Year	Month	Day	Event	Location	Notes
1950	Jan	1
1950	Jan	2
1950	Jan	3
1950	Jan	4
1950	Jan	5
1950	Jan	6
1950	Jan	7
1950	Jan	8
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1950	Jan	31
1950	Feb	1
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1950	Feb	30
1950	Mar	1
1950	Mar	2
1950	Mar	3
1950	Mar	4
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1950	Mar	6
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1950	Mar	27
1950	Mar	28
1950	Mar	29
1950	Mar	30
1950	Mar	31
1950	Apr	1
1950	Apr	2
1950	Apr	3
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1950	Apr	5
1950	Apr	6
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1950	Apr	21
1950	Apr	22
1950	Apr	23
1950	Apr	24
1950	Apr	25
1950	Apr	26
1950	Apr	27
1950	Apr	28
1950	Apr	29
1950	Apr	30
1950	Apr	30

STREAM COMPONENT FLOW RATES - KG MOL/HR

STREAM ID NAME	9	10	11	12
PHASE	MIXED	LIQUID	VAPOR	VAPOR
1 BUTANE	1.3651	1.1609	1.1609	1.1609
2 IBUTANE	1.4580	1.1694	1.1694	1.1694
3 PENTANE	46.5646	44.0478	44.0477	44.0477
4 IPENTANE	109.9551	102.4002	102.4000	102.3999
5 HEXANE	5.6225	5.5170	5.5170	5.5170
6 2MPENTAN	10.4595	10.1977	10.1977	10.1977
7 3MPENTAN	6.5486	6.4004	6.4004	6.4004
8 22DMB	7.5629	7.2932	7.2931	7.2931
9 23DMB	2.9766	2.8957	2.8957	2.8957
10 CYPNTANE	3.2694	3.1392	3.1392	3.1392
11 MCYCPNT	0.2400	0.2356	0.2356	0.2356
12 HYDROGEN	219.4076	4.9240	4.9240	4.9240
TOTALS	415.4297	189.3810	189.3805	189.3805
TEMPERATURE, DEG C	35.0000	35.0000	180.0000	250.0000
PRESSURE, BAR	25.0000	25.0000	25.0000	25.0000
H, MM KJ /HR	1.5146	0.9903	8.9234	11.6718
MOLE FRACT LIQUID	0.4559	1.0000	0.0	0.0
RECYCLE CONVERGENCE	-0.0002	0.0	0.0	-0.0000

STREAM ID NAME	13	14	15	16
PHASE	VAPOR	MIXED	VAPOR	VAPOR
1 BUTANE	0.0	0.0	1.1609	0.2041
2 IBUTANE	1.1694	1.1694	0.0	0.2886
3 PENTANE	0.0	0.0	44.0478	2.5165
4 IPENTANE	102.4002	102.4002	0.0	7.5543
5 HEXANE	0.0	0.0	5.5170	0.1055
6 2MPENTAN	10.1977	10.1977	0.0	0.2618
7 3MPENTAN	6.4004	6.4004	0.0	0.1481
8 22DMB	7.2932	7.2932	0.0	0.2697
9 23DMB	2.8957	2.8957	0.0	0.0809
10 CYPNTANE	3.1392	3.1392	0.0	0.1301
11 MCYCPNT	0.2356	0.2356	0.0	0.0044
12 HYDROGEN	4.9240	4.9240	0.0	214.4851
TOTALS	138.6553	138.6553	50.7257	226.0492
TEMPERATURE, DEG C	250.0000	70.0000	250.0000	35.0000
PRESSURE, BAR	25.0000	25.0000	25.0000	25.0000
H, MM KJ /HR	8.4616	1.5747	3.2093	0.5243
MOLE FRACT LIQUID	0.0	0.9929	0.0	0.0
RECYCLE CONVERGENCE	0.0	0.0	0.0	0.0

The first part of the document discusses the importance of maintaining accurate records. It emphasizes that proper record-keeping is essential for the efficient operation of any organization. This section covers the various methods used to collect and analyze data, highlighting the need for consistency and reliability in the information gathered.

The second part of the document focuses on the implementation of these practices. It provides a detailed overview of the procedures and protocols that should be followed to ensure that all data is properly documented and stored. This includes instructions on how to handle sensitive information and how to maintain the confidentiality of the records.

The final part of the document discusses the benefits of a well-maintained record-keeping system. It explains how such a system can improve decision-making, enhance communication, and provide a clear history of the organization's activities. The document concludes by encouraging all staff members to take responsibility for their own records and to work together to maintain the highest standards of accuracy and integrity.

The following table provides a summary of the key points discussed in the document. It is intended to serve as a quick reference for all staff members involved in the record-keeping process.

Section	Key Points
Introduction	Importance of accurate records for organizational efficiency.
Data Collection	Consistency and reliability in data gathering.
Implementation	Procedures and protocols for documentation and storage.
Confidentiality	Handling sensitive information and maintaining privacy.
Benefits	Improved decision-making, enhanced communication, and clear history.
Conclusion	Encouragement for staff to take responsibility for their records.

The document concludes with a final note on the importance of ongoing training and support for all staff members. It is essential that everyone remains up-to-date on the latest record-keeping practices and procedures to ensure the continued success of the organization.

STREAM COMPONENT FLOW RATES - KG MOL/HR

STREAM ID NAME	17	18	19	20
PHASE	VAPOR	VAPOR	VAPOR	VAPOR
1 BUTANE	0.2041	0.2041	0.2041	0.0
2 IBUTANE	0.2886	0.2886	0.2886	0.0
3 PENTANE	2.5165	2.5165	2.5165	0.0
4 IPENTANE	7.5543	7.5543	7.5543	0.0
5 HEXANE	0.1055	0.1055	0.1055	0.0
6 2MPENTAN	0.2618	0.2618	0.2618	0.0
7 3MPENTAN	0.1481	0.1481	0.1481	0.0
8 22DMB	0.2697	0.2697	0.2697	0.0
9 23DMB	0.0809	0.0809	0.0809	0.0
10 CYPNTANE	0.1301	0.1301	0.1301	0.0
11 MCYCPNT	0.0044	0.0044	0.0044	0.0
12 HYDROGEN	214.4850	219.4570	219.4570	4.9720
TOTALS	226.0491	231.0211	231.0211	4.9720
TEMPERATURE, DEG C	230.0000	226.9384	250.0000	20.0000
PRESSURE, BAR	25.0000	25.0000	25.0000	1.0000
H, MM KJ /HR	2.1085	2.1149	2.3139	0.0020
MOLE FRACT LIQUID	0.0	0.0	0.0	0.0
RECYCLE CONVERGENCE	0.0	0.0	0.0	0.0
STREAM ID NAME	21	22	23	24
PHASE	VAPOR	VAPOR	VAPOR	VAPOR
1 BUTANE	0.0	1.3651	1.3651	0.0
2 IBUTANE	0.0	0.2886	0.2886	0.1032
3 PENTANE	0.0	46.5643	46.5643	0.0
4 IPENTANE	0.0	7.5543	7.5543	3.0798
5 HEXANE	0.0	5.6225	5.6225	0.0
6 2MPENTAN	0.0	0.2618	0.2618	0.1151
7 3MPENTAN	0.0	0.1481	0.1481	0.0657
8 22DMB	0.0	0.2697	0.2697	0.1147
9 23DMB	0.0	0.0809	0.0809	0.0352
10 CYPNTANE	0.0	0.1301	0.1301	0.0562
11 MCYCPNT	0.0	0.0044	0.0044	0.0020
12 HYDROGEN	4.9720	219.4570	219.4570	4.5577
TOTALS	4.9720	281.7466	281.7466	8.1296
TEMPERATURE, DEG C	50.0000	243.1503	250.0000	47.8409
PRESSURE, BAR	25.0000	25.0000	25.0000	4.0000
H, MM KJ /HR	0.0064	5.5232	5.6500	0.1181
MOLE FRACT LIQUID	0.0	0.0	0.0	0.0
RECYCLE CONVERGENCE	0.0	0.0	0.0	0.0

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This ensures transparency and allows for easy verification of the data.

In the second section, the author details the various methods used to collect and analyze the data. This includes both manual and automated processes. The manual process involves reviewing each entry individually, while the automated process uses software to identify patterns and anomalies.

The third section describes the results of the analysis. It shows that there are several areas where the data is inconsistent or incomplete. These areas need to be investigated further to determine the cause of the discrepancies.

Finally, the document concludes with a list of recommendations for improving the data collection and analysis process. These include implementing more rigorous controls, using more advanced software tools, and providing additional training for the staff involved.

STREAM COMPONENT FLOW RATES - KG MOL/HR

STREAM ID NAME	25	41	51
PHASE	LIQUID	MIXED	VAPOR
1 BUTANE	0.0	0.0	2.2253
2 IBUTANE	1.0662	1.1694	0.6327
3 PENTANE	0.0	0.0	108.3790
4 IPENTANE	99.3205	102.4002	48.1635
5 HEXANE	0.0	0.0	13.3971
6 2MPENTAN	10.0826	10.1977	11.0534
7 3MPENTAN	6.3347	6.4004	5.4859
8 22DMB	7.1785	7.2932	0.9659
9 23DMB	2.8605	2.8957	2.1696
10 CYPNTANE	3.0830	3.1392	3.2669
11 MCYCPT	0.2336	0.2356	0.2420
12 HYDROGEN	0.3662	4.9240	219.4570
TOTALS	130.5256	138.6553	415.4380
TEMPERATURE, DEG C	47.8409	50.0000	250.0000
PRESSURE, BAR	4.0000	25.0000	25.0000
H, MM KJ /HR	0.9571	1.0753	14.3739
MOLE FRACT LIQUID	1.0000	0.9914	0.0
RECYCLE CONVERGENCE	0.0	0.0	0.0

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STREAM SUMMARY

STREAM ID.	1	2	3	4
NAME				
PHASE	LIQUID	LIQUID	VAPOR	VAPOR
FROM UNIT/TRAY	0/ 0	1/ 0	8/ 0	15/ 0
TO UNIT/TRAY	20/ 0	8/ 0	15/ 0	16/ 0
FROM STREAM				
KG MOL/HR	133.691	133.691	133.691	133.691
TEMPERATURE, DEG C	20.000	21.614	207.375	235.567
PRESSURE, BAR	1.000	25.000	25.000	25.000
H, MM KJ /HR	0.342	0.401	7.288	8.096
M KJ /KG MOLE	2.555	2.997	54.510	60.558
KJ /KG	34.162	40.064	728.756	809.617
MOLE FRACT LIQUID	1.00000	1.00000	0.0	0.0
M KGS/HR	10.000	10.000	10.000	10.000
MOLECULAR WEIGHT	74.799	74.799	74.799	74.799
STD LIQ M3/HR	15.722	15.722	15.722	15.722
DEG API	90.515	90.515	90.515	90.515
SP GR	0.6373	0.6373	0.6373	0.6373
KGS/M3	636.0347	636.0344	636.0347	636.0344
UOP K	12.952	12.952	12.952	12.952
REDUCED TEMP	0.619	0.622	1.014	1.074
REDUCED PRESS	0.030	0.749	0.749	0.749
ACENTRIC FACTOR	0.248	0.248	0.248	0.248
VAPOR				
M KGS/HR	0.0	0.0	10.000	10.000
STD LIQ M3/HR	0.0	0.0	15.722	15.722
STD M M3/HR	0.0	0.0	2.997	2.997
ACTUAL M M3/HR	0.0	0.0	0.148	0.174
KGS/M M3	0.0	0.0	67431.875	57434.867
Z	0.0	0.0	0.69413	0.76979
LIQUID				
M KGS/HR	10.000	10.000	0.0	0.0
STD LIQ M3/HR	15.722	15.722	0.0	0.0
ACTUAL GPM	75.7980	75.4391	0.0	0.0
M3/HR	17.216	17.134	0.0	0.0
KGS/M3	580.866	583.626	0.0	0.0
Z	0.00528	0.13074	0.0	0.0

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STREAM SUMMARY

STREAM ID.	5	6	7	8
NAME				
PHASE	VAPOR	VAPOR	VAPOR	MIXED
FROM UNIT/TRAY	16/ 0	2/ 0	4/ 0	5/ 0
TO UNIT/TRAY	0/ 0	4/ 0	5/ 0	6/ 0
FROM STREAM				
KG MOL/HR	415.437	415.430	415.430	415.429
TEMPERATURE, DEG C	236.115	250.000	214.626	86.763
PRESSURE, BAR	25.000	25.000	25.000	25.000
H, MM KJ /HR	13.746	14.258	12.674	4.741
M KJ /KG MOLE	33.088	34.322	30.508	11.412
KJ /KG	916.239	950.076	844.516	315.904
MOLE FRACT LIQUID	0.0	0.0	0.0	0.33814
M KGS/HR	15.003	15.010	15.007	15.008
MOLECULAR WEIGHT	36.113	36.125	36.125	36.125
STD LIQ M3/HR	29.280	29.395	29.390	29.390
DEG API	144.094	145.036	145.036	145.035
SP GR	0.5134	0.5117	0.5117	0.5117
KGS/M3	512.3806	510.6362	510.6360	510.6375
UOP K	13.992	14.002	14.002	14.002
REDUCED TEMP	2.116	2.189	2.041	1.506
REDUCED PRESS	1.106	1.104	1.104	1.104
ACENTRIC FACTOR	0.117	0.113	0.113	0.113
VAPOR				
M KGS/HR	15.003	15.010	15.007	4.820
STD LIQ M3/HR	29.280	29.395	29.390	13.190
STD M M3/HR	9.312	9.313	9.311	6.163
ACTUAL M M3/HR	0.682	0.704	0.649	0.324
KGS/M M3	22001.805	21333.859	23123.582	14897.809
Z	0.96915	0.97329	0.96308	0.98304
LIQUID				
M KGS/HR	0.0	0.0	0.0	10.188
STD LIQ M3/HR	0.0	0.0	0.0	16.200
ACTUAL GPM	0.0	0.0	0.0	88.8481
M3/HR	0.0	0.0	0.0	20.180
KGS/M3	0.0	0.0	0.0	504.858
Z	0.0	0.0	0.0	0.12002

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559	560	561	562	563	564
565	566	567	568	569	570
571	572	573	574	575	576
577	578	579	580	581	582
583	584	585	586	587	588
589	590	591	592	593	594
595	596	597	598	599	600

STREAM SUMMARY

STREAM ID. NAME PHASE	9	10	11	12
FROM UNIT/TRAY	6/ 0	3/ 0	5/ 0	9/ 0
TO UNIT/TRAY	3/ 0	5/ 0	9/ 0	7/ 0
FROM STREAM				
KG MOL/HR	415.429	189.381	189.381	189.381
TEMPERATURE, DEG C	35.000	35.000	180.000	250.000
PRESSURE, BAR	25.000	25.000	25.000	25.000
H, MM KJ /HR	1.515	0.990	8.923	11.672
M KJ /KG MOLE	3.646	5.229	47.119	61.631
KJ /KG	100.925	72.096	649.657	849.747
MOLE FRACT LIQUID	0.45587	1.00000	0.0	0.0
M KGS/HR	15.007	13.736	13.736	13.736
MOLECULAR WEIGHT	36.125	72.529	72.529	72.529
STD LIQ M3/HR	29.390	21.858	21.858	21.858
DEG API	145.036	93.212	93.212	93.212
SP GR	0.5117	0.6297	0.6297	0.6297
KGS/M3	510.6362	628.4011	628.4006	628.4011
UOP K	14.002	13.008	13.008	13.008
REDUCED TEMP	1.289	0.672	0.989	1.141
REDUCED PRESS	1.104	0.760	0.760	0.760
ACENTRIC FACTOR	0.113	0.234	0.234	0.234
VAPOR				
M KGS/HR	1.272	0.0	13.736	13.736
STD LIQ M3/HR	7.532	0.0	21.858	21.858
STD M M3/HR	5.067	0.0	4.245	4.245
ACTUAL M M3/HR	0.234	0.0	0.180	0.270
KGS/M M3	5443.539	0.0	76259.937	50869.414
Z	1.00855	0.0	0.63111	0.81952
LIQUID				
M KGS/HR	13.736	13.736	0.0	0.0
STD LIQ M3/HR	21.858	21.858	0.0	0.0
ACTUAL GPM	107.0544	107.0544	0.0	0.0
M3/HR	24.315	24.315	0.0	0.0
KGS/M3	564.908	564.908	0.0	0.0
Z	0.12529	0.12529	0.0	0.0

1. Introduction

The purpose of this study is to investigate the effects of various factors on the performance of a system. The study is divided into several sections, each focusing on a different aspect of the problem. The first section discusses the background and motivation for the research. The second section describes the methodology used in the study. The third section presents the results of the experiments. The fourth section discusses the implications of the findings and suggests directions for future research.

The methodology employed in this study is a combination of theoretical analysis and experimental evaluation. Theoretical analysis is used to derive predictions about the system's behavior under different conditions. Experimental evaluation is used to verify these predictions and to measure the actual performance of the system. The results of the experiments are presented in a series of tables and graphs, which show that the system performs well under a wide range of conditions.

The implications of these findings are significant, as they provide a better understanding of the system's behavior and help to identify areas for improvement. Future research should focus on extending the current study to include more complex scenarios and to investigate the effects of additional factors on system performance.

STREAM SUMMARY

STREAM ID. NAME PHASE	13	14	15	16
FROM UNIT/TRAY	7/ 0	8/ 0	7/ 0	3/ 0
TO UNIT/TRAY	8/ 0	18/ 0	14/ 0	4/ 0
FROM STREAM				
KG MOL/HR	138.655	138.655	50.725	226.049
TEMPERATURE, DEG C	250.000	70.000	250.000	35.000
PRESSURE, BAR	25.000	25.000	25.000	25.000
H, MM KJ /HR	8.462	1.575	3.209	0.524
M KJ /KG MOLE	61.026	11.357	63.268	2.320
KJ /KG	844.923	157.238	862.485	412.285
MOLE FRACT LIQUID	0.0	0.99290	0.0	0.0
M KGS/HR	10.015	10.015	3.721	1.272
MOLECULAR WEIGHT	72.227	72.227	73.356	5.626
STD LIQ M3/HR	15.975	15.975	5.883	7.532
DEG API	93.753	93.753	91.761	704.750
SP GR	0.6282	0.6282	0.6338	0.1692
KGS/M3	626.8931	626.8931	632.4854	168.8602
UOP K	13.003	13.003	13.022	24.743
REDUCED TEMP	1.155	0.757	1.107	5.575
REDUCED PRESS	0.763	0.763	0.750	1.781
ACENTRIC FACTOR	0.226	0.226	0.254	0.012
VAPOR				
M KGS/HR	10.015	0.013	3.721	1.272
STD LIQ M3/HR	15.975	0.041	5.883	7.532
STD M M3/HR	3.108	0.022	1.137	5.067
ACTUAL M M3/HR	0.199	0.001	0.071	0.234
KGS/M M3	50258.500	11209.629	52659.125	5443.547
Z	0.82602	0.99531	0.80069	1.00855
LIQUID				
M KGS/HR	0.0	10.002	0.0	0.0
STD LIQ M3/HR	0.0	15.934	0.0	0.0
ACTUAL GPM	0.0	83.3564	0.0	0.0
M3/HR	0.0	18.932	0.0	0.0
KGS/M3	0.0	528.305	0.0	0.0
Z	0.0	0.12051	0.0	0.0

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[Faint, illegible text, possibly bleed-through from the reverse side of the page. The text is arranged in several columns and appears to be a list or a set of notes.]



STREAM SUMMARY

STREAM ID.	17	18	19	20
NAME				
PHASE	VAPOR	VAPOR	VAPOR	VAPOR
FROM UNIT/TRAY	4/ 0	12/ 0	13/ 0	0/ 0
TO UNIT/TRAY	12/ 0	13/ 0	14/ 0	10/ 0
FROM STREAM				
KG MOL/HR	226.049	231.021	231.021	4.972
TEMPERATURE, DEG C	230.000	226.938	250.000	20.000
PRESSURE, BAR	25.000	25.000	25.000	1.000
H, MM KJ /HR	2.108	2.115	2.314	0.002
M KJ /KG MOLE	9.328	9.154	10.016	0.399
KJ /KG	1657.902	1649.904	1805.179	197.764
MOLE FRACT LIQUID	0.0	0.0	0.0	0.0
M KGS/HR	1.272	1.282	1.282	0.010
MOLECULAR WEIGHT	5.626	5.548	5.548	2.016
STD LIQ M3/HR	7.532	7.675	7.675	0.143
DEG API	704.749	714.017	714.017	1889.929
SP GR	0.1692	0.1674	0.1674	0.0700
KGS/M3	168.8602	167.0093	167.0093	69.8562
UOP K	24.743	24.920	24.920	47.444
REDUCED TEMP	9.102	9.125	9.546	8.817
REDUCED PRESS	1.781	1.784	1.784	0.077
ACENTRIC FACTOR	0.012	0.012	0.012	0.0
VAPOR				
M KGS/HR	1.272	1.282	1.282	0.010
STD LIQ M3/HR	7.532	7.675	7.675	0.143
STD M M3/HR	5.067	5.178	5.178	0.111
ACTUAL M M3/HR	0.382	0.388	0.406	0.121
KGS/M M3	3329.732	3303.761	3158.613	82.673
Z	1.00980	1.00983	1.00967	1.00052
LIQUID				
M KGS/HR	0.0	0.0	0.0	0.0
STD LIQ M3/HR	0.0	0.0	0.0	0.0
ACTUAL GPM	0.0	0.0	0.0	0.0
M3/HR	0.0	0.0	0.0	0.0
KGS/M3	0.0	0.0	0.0	0.0
Z	0.0	0.0	0.0	0.0

STREAM SUMMARY

STREAM ID.	21	22	23	24
NAME				
PHASE	VAPOR	VAPOR	VAPOR	VAPOR
FROM UNIT/TRAY	10/ 0	14/ 0	0/ 0	19/ 0
TO UNIT/TRAY	12/ 0	0/ 0	16/ 0	0/ 0
FROM STREAM				
KG MOL/HR	4.972	281.746	281.746	8.130
TEMPERATURE, DEG C	50.000	243.150	250.000	47.841
PRESSURE, BAR	25.000	25.000	25.000	4.000
H, MM KJ /HR	0.006	5.523	5.650	0.118
M KJ /KG MOLE	1.281	19.603	20.053	14.529
KJ /KG	635.173	1104.017	1129.360	437.450
MOLE FRACT LIQUID	0.0	0.0	0.0	0.0
M KGS/HR	0.010	5.003	5.003	0.270
MOLECULAR WEIGHT	2.016	17.756	17.756	33.213
STD LIQ M3/HR	0.143	13.558	13.558	0.549
DEG API	1889.929	251.194	251.194	155.385
SP GR	0.0700	0.3697	0.3697	0.4932
KGS/M3	69.8562	368.9868	368.9868	492.2156
UOP K	47.444	16.071	16.071	14.210
REDUCED TEMP	9.719	3.970	4.023	1.445
REDUCED PRESS	1.928	1.429	1.429	0.181
ACENTRIC FACTOR	0.0	0.055	0.055	0.101
VAPOR				
M KGS/HR	0.010	5.003	5.003	0.270
STD LIQ M3/HR	0.143	13.558	13.558	0.549
STD M M3/HR	0.111	6.315	6.315	0.182
ACTUAL M M3/HR	0.005	0.485	0.492	0.053
KGS/M M3	1852.429	10308.648	10169.566	5100.273
Z	1.01269	1.00319	1.00359	0.97606
LIQUID				
M KGS/HR	0.0	0.0	0.0	0.0
STD LIQ M3/HR	0.0	0.0	0.0	0.0
ACTUAL GPM	0.0	0.0	0.0	0.0
M3/HR	0.0	0.0	0.0	0.0
KGS/M3	0.0	0.0	0.0	0.0
Z	0.0	0.0	0.0	0.0

Date	Particulars	Debit	Credit	Balance	Total
1911	Jan 1				
	By Balance		100.00	100.00	100.00
	To Cash	50.00		50.00	50.00
	To Cash	50.00		100.00	100.00
	To Cash	100.00		200.00	200.00
	To Cash	100.00		300.00	300.00
	To Cash	100.00		400.00	400.00
	To Cash	100.00		500.00	500.00
	To Cash	100.00		600.00	600.00
	To Cash	100.00		700.00	700.00
	To Cash	100.00		800.00	800.00
	To Cash	100.00		900.00	900.00
	To Cash	100.00		1000.00	1000.00
	To Cash	100.00		1100.00	1100.00
	To Cash	100.00		1200.00	1200.00
	To Cash	100.00		1300.00	1300.00
	To Cash	100.00		1400.00	1400.00
	To Cash	100.00		1500.00	1500.00
	To Cash	100.00		1600.00	1600.00
	To Cash	100.00		1700.00	1700.00
	To Cash	100.00		1800.00	1800.00
	To Cash	100.00		1900.00	1900.00
	To Cash	100.00		2000.00	2000.00
	To Cash	100.00		2100.00	2100.00
	To Cash	100.00		2200.00	2200.00
	To Cash	100.00		2300.00	2300.00
	To Cash	100.00		2400.00	2400.00
	To Cash	100.00		2500.00	2500.00
	To Cash	100.00		2600.00	2600.00
	To Cash	100.00		2700.00	2700.00
	To Cash	100.00		2800.00	2800.00
	To Cash	100.00		2900.00	2900.00
	To Cash	100.00		3000.00	3000.00
	To Cash	100.00		3100.00	3100.00
	To Cash	100.00		3200.00	3200.00
	To Cash	100.00		3300.00	3300.00
	To Cash	100.00		3400.00	3400.00
	To Cash	100.00		3500.00	3500.00
	To Cash	100.00		3600.00	3600.00
	To Cash	100.00		3700.00	3700.00
	To Cash	100.00		3800.00	3800.00
	To Cash	100.00		3900.00	3900.00
	To Cash	100.00		4000.00	4000.00
	To Cash	100.00		4100.00	4100.00
	To Cash	100.00		4200.00	4200.00
	To Cash	100.00		4300.00	4300.00
	To Cash	100.00		4400.00	4400.00
	To Cash	100.00		4500.00	4500.00
	To Cash	100.00		4600.00	4600.00
	To Cash	100.00		4700.00	4700.00
	To Cash	100.00		4800.00	4800.00
	To Cash	100.00		4900.00	4900.00
	To Cash	100.00		5000.00	5000.00
	To Cash	100.00		5100.00	5100.00
	To Cash	100.00		5200.00	5200.00
	To Cash	100.00		5300.00	5300.00
	To Cash	100.00		5400.00	5400.00
	To Cash	100.00		5500.00	5500.00
	To Cash	100.00		5600.00	5600.00
	To Cash	100.00		5700.00	5700.00
	To Cash	100.00		5800.00	5800.00
	To Cash	100.00		5900.00	5900.00
	To Cash	100.00		6000.00	6000.00
	To Cash	100.00		6100.00	6100.00
	To Cash	100.00		6200.00	6200.00
	To Cash	100.00		6300.00	6300.00
	To Cash	100.00		6400.00	6400.00
	To Cash	100.00		6500.00	6500.00
	To Cash	100.00		6600.00	6600.00
	To Cash	100.00		6700.00	6700.00
	To Cash	100.00		6800.00	6800.00
	To Cash	100.00		6900.00	6900.00
	To Cash	100.00		7000.00	7000.00
	To Cash	100.00		7100.00	7100.00
	To Cash	100.00		7200.00	7200.00
	To Cash	100.00		7300.00	7300.00
	To Cash	100.00		7400.00	7400.00
	To Cash	100.00		7500.00	7500.00
	To Cash	100.00		7600.00	7600.00
	To Cash	100.00		7700.00	7700.00
	To Cash	100.00		7800.00	7800.00
	To Cash	100.00		7900.00	7900.00
	To Cash	100.00		8000.00	8000.00
	To Cash	100.00		8100.00	8100.00
	To Cash	100.00		8200.00	8200.00
	To Cash	100.00		8300.00	8300.00
	To Cash	100.00		8400.00	8400.00
	To Cash	100.00		8500.00	8500.00
	To Cash	100.00		8600.00	8600.00
	To Cash	100.00		8700.00	8700.00
	To Cash	100.00		8800.00	8800.00
	To Cash	100.00		8900.00	8900.00
	To Cash	100.00		9000.00	9000.00
	To Cash	100.00		9100.00	9100.00
	To Cash	100.00		9200.00	9200.00
	To Cash	100.00		9300.00	9300.00
	To Cash	100.00		9400.00	9400.00
	To Cash	100.00		9500.00	9500.00
	To Cash	100.00		9600.00	9600.00
	To Cash	100.00		9700.00	9700.00
	To Cash	100.00		9800.00	9800.00
	To Cash	100.00		9900.00	9900.00
	To Cash	100.00		10000.00	10000.00

STREAM SUMMARY

STREAM ID.	25	41	51
NAME			
PHASE	LIQUID	MIXED	VAPOR
FROM UNIT/TRAY	19/ 0	18/ 0	0/ 0
TO UNIT/TRAY	21/ 0	19/ 0	2/ 0
FROM STREAM			
KG MOL/HR	130.526	138.655	415.437
TEMPERATURE, DEG C	47.841	50.000	250.000
PRESSURE, BAR	4.000	25.000	25.000
H, MM KJ /HR	0.957	1.075	14.374
M KJ /KG MOLE	7.333	7.755	34.599
KJ /KG	98.223	107.372	958.084
MOLE FRACT LIQUID	1.00000	0.99137	0.0
M KGS/HR	9.745	10.015	15.003
MOLECULAR WEIGHT	74.657	72.227	36.113
STD LIQ M3/HR	15.426	15.975	29.280
DEG API	92.045	93.752	144.094
SP GR	0.6330	0.6282	0.5134
KGS/M3	631.6826	626.8933	512.3806
UOP K	12.969	13.003	13.992
REDUCED TEMP	0.687	0.713	2.173
REDUCED PRESS	0.120	0.763	1.106
ACENTRIC FACTOR	0.234	0.226	0.117
VAPOR			
M KGS/HR	0.0	0.010	15.003
STD LIQ M3/HR	0.0	0.044	29.280
STD M M3/HR	0.0	0.027	9.312
ACTUAL M M3/HR	0.0	0.001	0.703
KGS/M M3	0.0	7503.379	21326.672
Z	0.0	1.00462	0.97330
LIQUID			
M KGS/HR	9.745	10.005	0.0
STD LIQ M3/HR	15.426	15.931	0.0
ACTUAL GPM	77.0322	79.7850	0.0
M3/HR	17.496	18.121	0.0
KGS/M3	556.962	552.110	0.0
Z	0.02009	0.12267	0.0

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for the company's financial health and for providing reliable information to stakeholders.

2. The second part of the document outlines the specific procedures for recording transactions. It details the steps from identifying a transaction to entering it into the accounting system, ensuring that all necessary information is captured and verified.

3. The third part of the document discusses the role of the accounting department in monitoring and controlling the company's financial performance. It highlights the importance of regular reviews and the use of financial ratios to assess the company's position.

4. The fourth part of the document addresses the challenges of managing financial data in a complex and rapidly changing environment. It suggests strategies for staying organized and up-to-date, such as using technology and maintaining clear communication channels.

5. The fifth part of the document discusses the importance of transparency and accountability in financial reporting. It stresses that providing clear and honest information is essential for building trust and ensuring the long-term success of the organization.

6. The sixth part of the document outlines the responsibilities of the accounting department in supporting the company's strategic goals. It emphasizes the need for proactive financial management and the ability to provide valuable insights to management.

7. The seventh part of the document discusses the importance of staying current with changes in accounting standards and regulations. It suggests that the accounting department should regularly update its knowledge and skills to ensure compliance and accuracy.

8. The eighth part of the document addresses the role of the accounting department in risk management. It highlights the need to identify and mitigate financial risks, such as currency fluctuations and credit defaults, to protect the company's assets.

9. The ninth part of the document discusses the importance of collaboration and teamwork in the accounting department. It emphasizes that effective communication and cooperation are essential for ensuring the accuracy and reliability of financial data.

10. The tenth part of the document concludes by summarizing the key points discussed and reiterating the importance of a strong accounting function for the company's overall success. It encourages the accounting department to continue to strive for excellence and to adapt to the ever-changing business environment.

VERSION 0881
SIMULATION SCIENCES, INC.
PROJECT
PROBLEM TIPPLANT

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SOLUTION

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UNIT 1, P1 , - P. 7
UNIT 2, R1 , - P. 8
UNIT 3, FL1 , - P. 9
UNIT 4, HX3 , - P. 10
UNIT 5, HX1 , - P. 11
UNIT 6, HX4 , - P. 12
UNIT 7, S1 , - P. 13
UNIT 8, HX5 , - P. 14
UNIT 9, HX6 , - P. 15
UNIT 10, C1 , - P. 16
UNIT 11, , - P. 17
UNIT 12, M2 , - P. 18
UNIT 13, HX7 , - P. 19
UNIT 14, M3 , - P. 20
UNIT 15, HX2 , - P. 21
UNIT 16, M1 , - P. 22
UNIT 17, , - P. 23
UNIT 18, HX8 , - P. 24
UNIT 19, FL2 , - P. 25
UNIT 20, O1 , - P. 26
UNIT 21, O14 , - P. 27
RECYCLE - P. 28
UNIT STREAM RELATIONS - P. 29
INPUT IN ORDER

UNIT 1, P1 , SOLVED
UNIT 10, C1 , SOLVED
UNIT 2, R1 , SOLVED
UNIT 3, FL1 , SOLVED
UNIT 4, HX3 , SOLVED
UNIT 5, HX1 , SOLVED
UNIT 6, HX4 , SOLVED
UNIT 7, S1 , SOLVED
UNIT 8, HX5 , SOLVED
UNIT 9, HX6 , SOLVED
UNIT 11, , SOLVED
UNIT 12, M2 , SOLVED
UNIT 13, HX7 , SOLVED
UNIT 14, M3 , SOLVED
UNIT 15, HX2 , SOLVED
UNIT 16, M1 , SOLVED
UNIT 17, , NOT SOLVED
UNIT 15, HX2 , SOLVED
UNIT 16, M1 , SOLVED
UNIT 17, , NOT SOLVED
UNIT 15, HX2 , SOLVED
UNIT 16, M1 , SOLVED
UNIT 17, , SOLVED
LOOP 1 SOLVED AFTER 1 TRIALS
UNIT 18, HX8 , SOLVED
UNIT 19, FL2 , SOLVED
*** PROBLEM SOLUTION REACHED ***

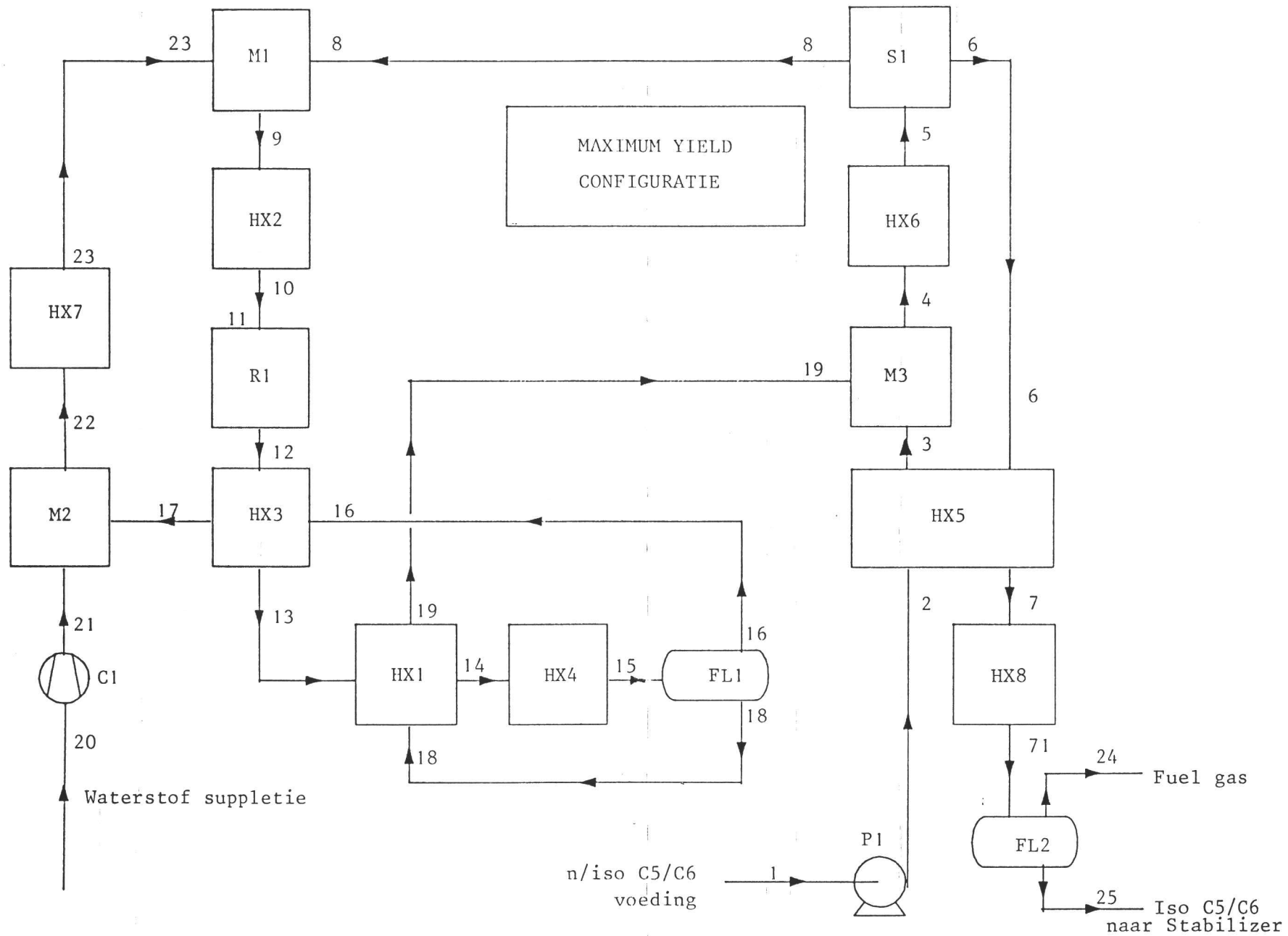
DATE	DESCRIPTION	AMOUNT	BALANCE
10-11-64
10-12-64
10-13-64
10-14-64
10-15-64
10-16-64
10-17-64
10-18-64
10-19-64
10-20-64
10-21-64
10-22-64
10-23-64
10-24-64
10-25-64
10-26-64
10-27-64
10-28-64
10-29-64
10-30-64
10-31-64

HEAT EXCHANGER UNIT	4,HX3	- P.	35
HEAT EXCHANGER UNIT	5,HX1	- P.	36
HEAT EXCHANGER UNIT	6,HX4	- P.	37
HEAT EXCHANGER UNIT	8,HX5	- P.	38
HEAT EXCHANGER UNIT	9,HX6	- P.	39
HEAT EXCHANGER UNIT	13,HX7	- P.	40
HEAT EXCHANGER UNIT	15,HX2	- P.	41
HEAT EXCHANGER UNIT	18,HX8	- P.	42
PUMP UNIT	1,P1	- P.	43
COMPRESSOR UNIT	10,C1	- P.	43
STREAM COMPONENT MOLAL RATES		- P.	48
STREAM SUMMARY		- P.	52

**SIMSCI ROYALTY IS 90.80 PROCESS CHARGE UNITS

5.3. Max-yield-configuratie

Hierna volgt het flowsheet en de PROCESS uitvoer voor de max-yield-configuratie.



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SM
PROCESS INPUT LISTING - PAGE 1

TITLE PROB=TIPPLANT,USER MCF&MJB
DIMENSION SI,TEMPERATURE=C,PRESSURE=BAR
CALCULATIONS NOTRIALS=50
COMPONENT DATA

LIBID 1,BUTANE/2,IBUTANE/3,PENTANE/4,IPENTANE/5,HEXANE/*
6,2MPENTAN/7,3MPENTAN/8,22DMB/9,23DMB/10,CYPNTANE/*
11,MCYCPNT/12,HYDROGEN

THERMO DATA
TYPE SYSTEM=SRK

STREAM DATA

PROP STRM=1,TEMP=20,PRES=1,COMP(W)=1,.5/2,.2/3,44.6/4,29.3/5,6.7/*

6,9.3/7,4.6/8,.6/9,1.8/10,2.2/11,.2,RATE(W)=10000

PROP STRM=10,TEMP=226.2,PRES=25,COMP=1,1.82/2,.20/3,89.91/*

4,4.55/5,9.41/6,.08/7,.04/8,.08/9,.02/10,0.00/*

11,0.0/12,116.94

PROP STRM=5,TEMP=250,PRES=25,COMP=1,1.69/2,1.18/3,88.40/*

4,102.41/5,9.38/6,13.76/7,7.20/8,2.82/9,2.93/10,3.14/11,.24/12,2.68

PROP STRM=20,TEMP=20,PRES=1,COMP=12,2.70

PROP STRM=11,TEMP=250,PRES=25,REFS=10

PROP STRM=15,TEMP=35,PRES=25,REFS=12

PROP STRM=7,TEMP=137,PRES=25,COMP=12,2.68

PROP STRM=9,TEMP=250,PRES=25,REFS=91

UNIT OPERATIONS

PUMP UID=P1,NAME=FEEDPUMP

FEED 1

PROD L=2

OPERATION PRES=25,EFF=70

US3 UID=R1,NAME=REACTOR

FEED 11

PROD 12

FLASH UID=FL1,NAME=PHASESEP

FEED 15

PROD V=16,L=18

ISO TEMP=35,PRES=25

HX UID=HX3

COLD FEED=16,V=17

HOT FEED=12,V=13

SPEC COLD,TEMP=230

CONFIGURATION U=500,SPASS=2

HX UID=HX1

COLD FEED=18,L=19

HOT FEED=13,V=14

SPEC COLD,TEMP=180

CONFIGURATION U=3000,SPASS=4

HX UID=HX4,NAME=CONDENS.

HOT FEED=14,M=15

SPEC HOT,TEMP=35

CONFIGURATION U=3000,SPASS=2

UTILITY WATER,TIN=20,TOUT=40

SEPARATOR UID=S1,NAME=MOLSIEVE

FEED 5

OVHD STRM=6,PHASE=V,PRES=25,TEMP=250

BTMS STRM=8,PHASE=V,PRES=25,TEMP=250

SM
PROCESS INPUT LISTING - PAGE 2

10-

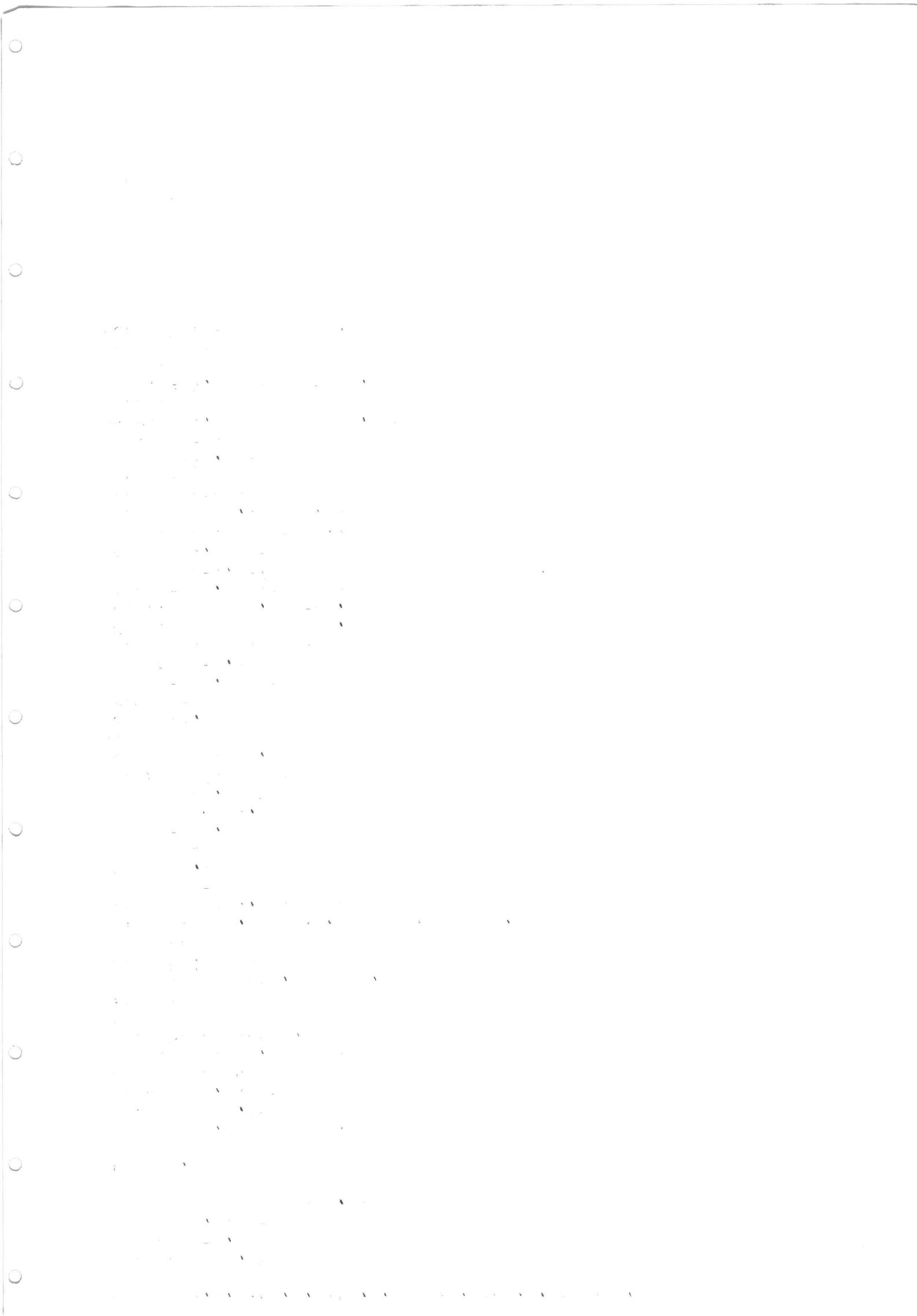
... ..

... ..

... ..

11-

... ..



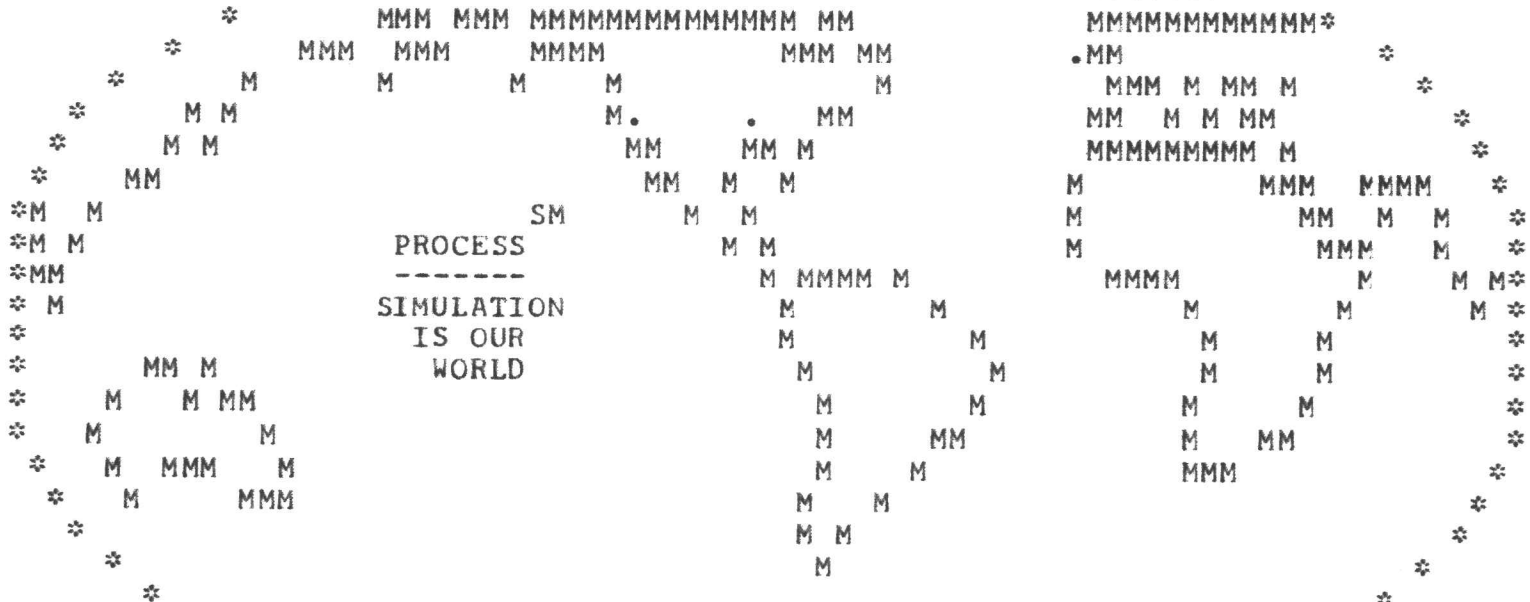
FACTOR 1,1,0./2,2,1./3,3,0./4,4,1./5,5,0./6,12,1.
HX UID=HX5
COLD FEED=2,L=3
HOT FEED=6,V=7
SPEC HOT,TEMP=70
CONFIGURATION U=3000,SPASS=5
MIXER UID=M3
FEED 3,19
PROD L=4
HX UID=HX6,NAME=FCRNUIS2
COLD FEED=4,V=5
SPEC COLD,TEMP=250
CONFIGURATION U=2650
UTILITY STEAM,TSAT=410
COMPRESSOR UID=C1,NAME=H2COMPR
FEED 20
PROD V=21
OPERATION PIN=1,POUT=25,EFF=40
COOLER TOUT=50
CONTROLLER
SPEC STRM=7,COMP=12,RATE=1.,REFS=20,REFC=12
PARA STRM=20,EST2=2.68
MIXER UID=M2
FEED 21,17
PROD V=22
HX UID=HX7,NAME=FORNUIS
COLD FEED=22,V=23
SPEC COLD,TEMP=250
CONFIGURATION U=2050
UTILITY STEAM,TSAT=410
MIXER UID=M1
FEED 23,8
PROD V=91
HX UID=HX2,NAME=COOLER
HOT FEED=9,V=10
SPEC HOT TEMP=226.2
CONFIGURATION U=3000,SPASS=1
UTILITY WATER,TIN=20,TOUT=40
HX UID=HX8,NAME=LUCHTKOELER
HOT FEED=7,M=71
SPEC HOT,TEMP=50
CONFIGURATION U=410,SPASS=1
UTILITY AIR,TIN=25,TOUT=40
FLASH UID=FL2
FEED 71
PROD V=24,L=25
ADIA DP=21
US4 UID=01,NAME=RONTABEL,BYPASS
FEED 1
US4 UID=07,NAME=RONTABEL,BYPASS
FEED 25
RECYCLE DATA
ACCEL TYPE=DEM DEMF=1.

SM

PROCESS INPUT LISTING - PAGE 3

END

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MMM MMM MMMMMMMMMMMMMMM MM      MMMMMMMMMMMMM*
MMM  MMM  MMMM           MMM MM   .MM                *
 M      M      M          M           M                *
 M.          .   MM                 MM  M MM M      *
MM          MM M           MM M MM M  M M MM      *
MM          M M M           M          M M M MM      *
SM                    M  M            M          MM  MMMM *
PROCESS               M M              M          MM  M  M *
-----             M M              M          MM  M  M *
SIMULATION          M MMMM M           MMMM             M M *
IS OUR              M          M           M           M   M *
WORLD               M          M           M           M   M *
                   M          M           M           M   M *
                   M          MM          M           M   M *
                   M          M           M           MM  MM *
                   M          M           M           MMM   *
                   M M              M           M           *
                   M
    
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* SM - PROCESS IS A SERVICE MARK OF SIMULATION SCIENCES *

IF THERE IS ANYWAY WE MAY BE OF SERVICE, PLEASE CONTACT

SIMULATION SCIENCES, INC	
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TELEX 68-5547
CABLE SSI, FULLERTON, CALIF

REGENT HOUSE, HEATON LANE
STOCKPORT SK4 1BS
ENGLAND
PHONE 061-429-6744
TELEX 851-666127

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I PROBLEM AND PROCESS DESCRIPTION

1 PROBLEM DESCRIPTION

2 DIMENSIONAL UNITS - SI

TIME	-	HR	WEIGHT	-	KG	TEMP	-	C	PRESSURE	-	BAR
ENERGY	-	KJ	WORK	-	KW	LIQ VOL	-	M3	VAP VOL	-	M3
VISCOSITY	-	PAS	T.CONDUCT.	-	WMK	S. TENSION	-	NM			

COMP LIQ DENSITIES ARE INPUTTED IN DENS FORM

3 TOLERANCES FOR

PRODUCT CONVERGENCE ON COMPS WITH X GT	0.0100
TEMPERATURE	-0.556

TOWER ENTHALPY BALANCES	0.00278
BUBBLE POINT RELATIONS	0.00100
COMPONENT BALANCES	0.00100

SPECIFICATIONS ON TEMPERATURE	-0.05556
PRESSURE	0.00500
STREAM RATE/PROPERTY	0.01000
PURITY/RECOVERY	0.01000
HEATER/COOLER DUTY	0.00100
OTHERS	0.00100

5 CALCULATIONAL OPTIONS

NUMBER OF TRIALS	50
------------------	----

II DEFINED COMPONENTS

NUMBER OF DEFINED COMPS = 12

COMP NO	1	2	3	4
	BUTANE	IBUTANE	PENTANE	IPENTANE
COMP TYP	LIBRARY	LIBRARY	LIBRARY	LIBRARY
LIB NO	9010010	9010070	9010120	9010080
NAME	BUTANE	IBUTANE	PENTANE	IPENTANE
MOL WT	58.124	58.124	72.151	72.151
NBP, DEG C	-0.500	-11.730	36.074	27.850
STD COND.LIQ				
SP GR	0.5844	0.5631	0.6307	0.6227
DEG API	110.629	119.788	92.844	95.727
KGS/M3	583.199	561.943	629.432	621.446
UOP K	13.4973	13.8129	13.0418	13.0913
TC, DEG C	152.000	134.980	196.500	187.240
PC, BAR	37.997	36.477	33.691	33.812
VC,CC/G-MOLE	255.000	263.000	304.000	306.000
ZC	0.2741	0.2827	0.2623	0.2703
ACENTRIC FAC	0.201	0.177	0.251	0.229
H FORMATION	-126.232	-134.606	-146.538	-154.577
G FORMATION	0.0	0.0	0.0	0.0
COMP NO	5	6	7	8
	HEXANE	2MPENTAN	3MPENTAN	22DME
COMP TYP	LIBRARY	LIBRARY	LIBRARY	LIBRARY
LIB NO	9010060	9010100	9010110	9010020
NAME	HEXANE	2MPENTAN	3MPENTAN	22DMB
MOL WT	86.178	86.178	86.178	86.178
NBP, DEG C	68.740	60.270	63.280	49.741
STD COND.LIQ				
SP GR	0.6633	0.6580	0.6691	0.6540
DEG API	81.843	83.558	79.993	84.858
KGS/M3	661.887	656.609	667.678	652.664
UOP K	12.8245	12.8200	12.6452	12.7602
TC, DEG C	234.200	224.300	231.200	215.580
PC, BAR	29.688	30.104	31.238	30.803
VC,CC/G-MOLE	370.000	367.000	367.000	359.000
ZC	0.2604	0.2671	0.2734	0.2721
ACENTRIC FAC	0.294	0.279	0.274	0.233
H FORMATION	-167.305	-174.422	-171.743	-185.685
G FORMATION	0.0	0.0	0.0	0.0

Case No.	Date	Particulars	Debit	Credit	Balance
1	1/1	Balance		100.00	100.00
2	1/5	John Doe	50.00		50.00
3	1/10	John Doe	50.00		0.00
4	1/15	John Doe	50.00		50.00
5	1/20	John Doe	50.00		0.00
6	1/25	John Doe	50.00		50.00
7	1/30	John Doe	50.00		0.00
8	2/1	John Doe	50.00		50.00
9	2/5	John Doe	50.00		0.00
10	2/10	John Doe	50.00		50.00
11	2/15	John Doe	50.00		0.00
12	2/20	John Doe	50.00		50.00
13	2/25	John Doe	50.00		0.00
14	2/28	John Doe	50.00		50.00
15	3/1	John Doe	50.00		0.00
16	3/5	John Doe	50.00		50.00
17	3/10	John Doe	50.00		0.00
18	3/15	John Doe	50.00		50.00
19	3/20	John Doe	50.00		0.00
20	3/25	John Doe	50.00		50.00
21	3/30	John Doe	50.00		0.00
22	4/1	John Doe	50.00		50.00
23	4/5	John Doe	50.00		0.00
24	4/10	John Doe	50.00		50.00
25	4/15	John Doe	50.00		0.00
26	4/20	John Doe	50.00		50.00
27	4/25	John Doe	50.00		0.00
28	4/28	John Doe	50.00		50.00
29	5/1	John Doe	50.00		0.00
30	5/5	John Doe	50.00		50.00
31	5/10	John Doe	50.00		0.00
32	5/15	John Doe	50.00		50.00
33	5/20	John Doe	50.00		0.00
34	5/25	John Doe	50.00		50.00
35	5/30	John Doe	50.00		0.00
36	6/1	John Doe	50.00		50.00
37	6/5	John Doe	50.00		0.00
38	6/10	John Doe	50.00		50.00
39	6/15	John Doe	50.00		0.00
40	6/20	John Doe	50.00		50.00
41	6/25	John Doe	50.00		0.00
42	6/28	John Doe	50.00		50.00
43	7/1	John Doe	50.00		0.00
44	7/5	John Doe	50.00		50.00
45	7/10	John Doe	50.00		0.00
46	7/15	John Doe	50.00		50.00
47	7/20	John Doe	50.00		0.00
48	7/25	John Doe	50.00		50.00
49	7/28	John Doe	50.00		0.00
50	8/1	John Doe	50.00		50.00

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COMP NO	9	10	11	12
	23DMB	CYPNTANE	MCYCPNT	HYDROGEN
COMP TYP	LIBRARY	LIBRARY	LIBRARY	LIBRARY
LIB NO	9010030	10020020	10020100	16020090
NAME	23DMB	CYPNTANE	MCYCPNT	HYDROGEN
MOL WT	86.178	70.135	84.163	2.016
NBP, DEG C	57.988	49.260	71.810	-252.800
STD COND.LIQ				
SP GR	0.6664	0.7506	0.7535	0.0700
DEG API	80.838	57.025	56.281	1889.929
KGS/M3	665.021	749.021	751.990	69.856
UOP K	12.6289	11.1132	11.3216	47.4439
TC, DEG C	226.780	238.500	259.580	-239.900
PC, BAR	31.269	45.079	37.845	12.970
VC,CC/G-MOLE	358.000	260.000	319.000	65.000
ZC	0.2693	0.2755	0.2726	0.3050
ACENTRIC FAC	0.248	0.196	0.231	0.0
H FORMATION	-177.897	-77.288	-106.763	0.0
G FORMATION	0.0	0.0	0.0	0.0

1. 100	1. 100	1. 100	1. 100
2. 200	2. 200	2. 200	2. 200
3. 300	3. 300	3. 300	3. 300
4. 400	4. 400	4. 400	4. 400
5. 500	5. 500	5. 500	5. 500
6. 600	6. 600	6. 600	6. 600
7. 700	7. 700	7. 700	7. 700
8. 800	8. 800	8. 800	8. 800
9. 900	9. 900	9. 900	9. 900
10. 1000	10. 1000	10. 1000	10. 1000

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III THERMODYNAMIC DATA

1 SUMMARY

SET	K VALUES	LIQUID H	VAPOR H	LIQUID S	VAPOR S
1	SOAVE	SOAVE	SOAVE	SOAVE	SOAVE

STREAM HOT LIQ DENSITIES ARE COMPUTED BY K/H CORRELATION

STREAM HOT VAP DENSITIES ARE COMPUTED BY K/H CORRELATION

IV STREAM DATA

1 STREAM 1 , , IS OF MIXED PHASE

COMPONENT	WEIGHT COMPOSITION
1 BUTANE	0.5000
2 IBUTANE	0.2000
3 PENTANE	44.6000
4 IPENTANE	29.3000
5 HEXANE	6.7000
6 2MPENTAN	9.3000
7 3MPENTAN	4.6000
8 22DMB	0.6000
9 23DMB	1.8000
10 CYPNTANE	2.2000
11 MCYCPNT	0.2000
TOTAL RATE, KGS/HR	10000.0000
TEMPERATURE, DEG C	20.0000
PRESSURE, BAR	1.0000

2 STREAM 10 , , IS OF MIXED PHASE

COMPONENT	MOLAR COMPOSITION
1 BUTANE	1.8200
2 IBUTANE	0.2000
3 PENTANE	89.9100
4 IPENTANE	4.5500
5 HEXANE	9.4100
6 2MPENTAN	0.0800
7 3MPENTAN	0.0400
8 22DMB	0.0800
9 23DMB	0.0200
12 HYDROGEN	116.9400
TOTAL RATE, KG MOL/HR	223.0499
TEMPERATURE, DEG C	226.2000
PRESSURE, BAR	25.0000

3 STREAM 5 , , IS OF MIXED PHASE

COMPONENT	MOLAR COMPOSITION
1 BUTANE	1.6900
2 IBUTANE	1.1800
3 PENTANE	88.4000
4 IPENTANE	102.4100
5 HEXANE	9.3800
6 2MPENTAN	13.7600
7 3MPENTAN	7.2000
8 22DMB	2.8200
9 23DMB	2.9300
10 CYPNTANE	3.1400
11 MCYCPNT	0.2400
12 HYDROGEN	2.6800
TOTAL RATE, KG MOL/HR	235.8299
TEMPERATURE, DEG C	250.0000
PRESSURE, BAR	25.0000

4 STREAM 20 , , IS OF MIXED PHASE

COMPONENT	MOLAR COMPOSITION
12 HYDROGEN	2.7000
TOTAL RATE, KG MOL/HR	2.7000
TEMPERATURE, DEG C	20.0000
PRESSURE, BAR	1.0000

5 STREAM 11 , , IS REFERENCED TO STREAM 10 ,
 AT 250.000 DEG C AND 25.0000 BAR

6 STREAM 15 , , IS REFERENCED TO STREAM 12 ,
 AT 35.000 DEG C AND 25.0000 BAR

7 STREAM 7 , , IS OF MIXED PHASE

COMPONENT	MOLAR COMPOSITION
12 HYDROGEN	2.6800
TOTAL RATE, KG MOL/HR	2.6800
TEMPERATURE, DEG C	137.0000
PRESSURE, BAR	25.0000

8 STREAM 9 , , IS REFERENCED TO STREAM 91 ,
 AT 250.000 DEG C AND 25.0000 BAR

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes the need for transparency and accountability in financial reporting.

2. The second part of the document outlines the various methods and techniques used to collect and analyze data. It includes a detailed description of the experimental procedures and the tools used for data collection.

3. The third part of the document presents the results of the study, including a comparison of the different methods and techniques used. It highlights the strengths and weaknesses of each approach.

4. The fourth part of the document discusses the implications of the findings and provides recommendations for future research. It suggests areas where further investigation is needed to improve the accuracy and reliability of the data.

5. The fifth part of the document concludes the study and summarizes the key findings. It reiterates the importance of maintaining accurate records and the need for transparency and accountability in financial reporting.

6. The sixth part of the document provides a detailed description of the experimental procedures and the tools used for data collection. It includes a list of the equipment and materials used in the study.

7. The seventh part of the document presents the results of the study, including a comparison of the different methods and techniques used. It highlights the strengths and weaknesses of each approach.

8. The eighth part of the document discusses the implications of the findings and provides recommendations for future research. It suggests areas where further investigation is needed to improve the accuracy and reliability of the data.

9. The ninth part of the document concludes the study and summarizes the key findings. It reiterates the importance of maintaining accurate records and the need for transparency and accountability in financial reporting.

10. The tenth part of the document provides a detailed description of the experimental procedures and the tools used for data collection. It includes a list of the equipment and materials used in the study.

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PROCESS
UNIT 1 - P1
INPUT

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1 UNIT P1 , FEEDPUMP , IS A PUMP

1 FEED STREAMS

1 STREAM 1

2 PRODUCT STREAMS

1 STREAM 2 IS OF LIQUID PHASE

3 THERMO DATA SETS USED

K VALUES		- SET 1		
ENTHALPY	LIQUID	- SET 1	VAPOR	- SET 1

4 OPERATING CONDITIONS

OUTLET PRESSURE, BAR	25.0000
PUMP EFFICIENCY, PERCENT	70.0000

2 UNIT R1 , REACTOR , IS A USER-DEFINED OPERATION

1 FEED STREAMS

1 STREAM 11

2 PRODUCT STREAMS

1 STREAM 12 IS OF MIXED PHASE

3 THERMO DATA SETS USED

K VALUES - SET 1
 ENTHALPY LIQUID - SET 1 VAPOR - SET 1

5 INTEGER PARAMETERS

PARAMETER VALUE	1	2	3	4
	0	0	0	0
PARAMETER VALUE	5	6	7	8
	0	0	0	0
PARAMETER VALUE	9	10	11	12
	0	0	0	0

6 REAL PARAMETERS

PARAMETER VALUE	0.0	1	0.0	2	0.0	3	0.0	4
PARAMETER VALUE	0.0	5	0.0	6	0.0	7	0.0	8

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PROCESS
UNIT 3 - FL1
INPUT

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3 UNIT FL1 , PHASESEP , IS A FLASH DRUM

1 FEED STREAMS

1 STREAM 15

2 PRODUCT STREAMS

1 STREAM 16

IS OF VAPOR PHASE

2 STREAM 18

IS OF LIQUID PHASE

3 THERMO DATA SETS USED

K VALUES

- SET 1

ENTHALPY

LIQUID

- SET 1

VAPOR

- SET 1

4 UNIT SPECIFICATIONS

1 HOLD UNIT TEMPERATURE AT

35.00 DEG C

2 HOLD UNIT PRESSURE AT

25.0000 BAR

4 UNIT HX3 , , IS A HEAT EXCHANGER

1 HOT SIDE

FEED STREAMS
1 STREAM 12

PRODUCT STREAMS
1 STREAM 13 IS CF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

FEED STREAMS
1 STREAM 16

PRODUCT STREAMS
1 STREAM 17 IS CF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 500.0000
NUMBER OF SHELL SIDE PASSES 2
NUMBER OF TUBE SIDE PASSES 4

4 UNIT SPECIFICATION

HOLD COLD SIDE OUTLET TEMP AT 230.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

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5 UNIT HX1 , , IS A HEAT EXCHANGER

1 HOT SIDE

FEED STREAMS
1 STREAM 13

PRODUCT STREAMS
1 STREAM 14 IS OF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

FEED STREAMS
1 STREAM 18

PRODUCT STREAMS
1 STREAM 19 IS OF LIQUID PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 3000.0000
NUMBER OF SHELL SIDE PASSES 4
NUMBER OF TUBE SIDE PASSES 8

4 UNIT SPECIFICATION

HOLD COLD SIDE OUTLET TEMP AT 180.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

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PROJECT
PROBLEM TIPPLANT

SM
PROCESS
UNIT 6 - HX4
INPUT

PAGE 12
MCF&MJB

6 UNIT HX4 , CONDENS. , IS A HEAT EXCHANGER

1 HOT SIDE

FEED STREAMS
1 STREAM 14

PRODUCT STREAMS
1 STREAM 15 IS OF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

UTILITY USED AND CONDITIONS
COOLING WATER
TEMPERATURE IN , DEG C 20.0000
TEMPERATURE OUT, DEG C 40.0000

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 3000.0000
NUMBER OF SHELL SIDE PASSES 2
NUMBER OF TUBE SIDE PASSES 4

4 UNIT SPECIFICATION

HOLD HOT SIDE OUTLET TEMP AT 35.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

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7 UNIT S1 , MCLSIEVE , IS A SEPARATOR

1 FEED STREAMS

1 STREAM 5

2 PRODUCT STREAMS

1 OVERHEAD IS STREAM 6 , OF VAPOR PHASE
2 BOTTOMS IS STREAM 8 , OF VAPOR PHASE

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

4 UNIT SPECIFICATIONS

1 HOLD OVERHEAD PRESSURE AT 25.0000 BAR
TEMPERATURE AT 250.0000 DEG C
2 HOLD BOTTOMS PRESSURE AT 25.0000 BAR
TEMPERATURE AT 250.0000 DEG C

5 SEPARATION SPECIFICATIONS

1 FOR COMPONENTS 1 - 1 HOLD OVERHEAD/FEED RATIO AT 0.0
2 FOR COMPONENTS 2 - 2 HOLD OVERHEAD/FEED RATIO AT 0.10000E+01
3 FOR COMPONENTS 3 - 3 HOLD OVERHEAD/FEED RATIO AT 0.0
4 FOR COMPONENTS 4 - 4 HOLD OVERHEAD/FEED RATIO AT 0.10000E+01
5 FOR COMPONENTS 5 - 5 HOLD OVERHEAD/FEED RATIO AT 0.0
6 FOR COMPONENTS 6 - 12 HOLD OVERHEAD/FEED RATIO AT 0.10000E+01

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PROJECT
PROBLEM TIPPLANT

SM
PROCESS
UNIT 8 - HX5
INPUT

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MCF&MJB

8 UNIT HX5 , , IS A HEAT EXCHANGER

1 HOT SIDE

FEED STREAMS
1 STREAM 6

PRODUCT STREAMS
1 STREAM 7 IS OF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

FEED STREAMS
1 STREAM 2

PRODUCT STREAMS
1 STREAM 3 IS OF LIQUID PHASE

PRESSURE DRCP, BAR 0.0

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 3000.0000
NUMBER OF SHELL SIDE PASSES 5
NUMBER OF TUBE SIDE PASSES 10

4 UNIT SPECIFICATION

HOLD HOT SIDE OUTLET TEMP AT 70.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. This is essential for ensuring the integrity of the financial data and for providing a clear audit trail.

2. The second part of the document outlines the various methods used to collect and analyze data. These methods include direct observation, interviews, and the use of specialized software tools.

3. The third part of the document describes the results of the data collection and analysis. It shows that there is a significant correlation between the variables being studied, which supports the hypothesis.

4. The fourth part of the document discusses the implications of the findings. It suggests that the results could be used to inform policy decisions and to guide future research in this area.

5. The fifth part of the document provides a conclusion and summarizes the key points of the study. It emphasizes the need for further research to explore the underlying mechanisms of the observed relationships.

6. The sixth part of the document includes a list of references to the sources used in the study. These references provide additional context and support for the findings presented in the document.

7. The seventh part of the document contains a list of appendices, which include additional data and supporting information. These appendices are provided for reference and to allow for a more detailed examination of the study's results.

8. The eighth part of the document is a list of figures and tables. These visual aids are used to present complex data in a more accessible and understandable format, allowing for easier interpretation of the results.

9. The ninth part of the document is a list of footnotes, which provide additional information and clarification on specific points mentioned in the main text. These footnotes are essential for ensuring the accuracy and completeness of the document.

10. The tenth part of the document is a list of page numbers, which are used to identify the location of specific sections and subsections within the document. This list is helpful for navigating through the document and finding the information you need.

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PROBLEM TIPPLANT

SM
PROCESS
UNIT 9 - M3
INPUT

PAGE 15
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9 UNIT M3 , , IS A MIXER/SPLITTER

1 FEED STREAMS

1 STREAM 3
2 STREAM 19

2 PRODUCT STREAMS

1 STREAM 4 IS OF MIXED PHASE

3 THERMO DATA SETS USED

K VALUES		- SET 1		
ENTHALPY	LIQUID	- SET 1	VAPOR	- SET 1

4 PRESSURE SPECIFICATION

PRESSURE DROP, BAR 0.0

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SM
PROCESS
UNIT 10 - HX6
INPUT

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10 UNIT HX6 , FORNUIS2 , IS A HEAT EXCHANGER

1 HOT SIDE

UTILITY USED AND CONDITIONS
STEAM

SATURATION TEMPERATURE, DEG C 410.0000

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

FEED STREAMS
1 STREAM 4

PRODUCT STREAMS
1 STREAM 5

IS OF VAPOR PHASE

PRESSURE DROP, BAR

0.0

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 2650.0000
NUMBER OF SHELL SIDE PASSES 1
NUMBER OF TUBE SIDE PASSES 1

4 UNIT SPECIFICATION

HOLD COLD SIDE OUTLET TEMP AT 250.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. This is essential for ensuring the integrity of the financial data and for providing a clear audit trail.

2. The second part of the document outlines the various methods used to collect and analyze data. These methods include direct observation, interviews, and the use of specialized software tools.

3. The third part of the document describes the results of the data collection and analysis. The findings indicate that there are significant areas for improvement in the current processes, particularly in the areas of data accuracy and reporting.

4. The fourth part of the document provides recommendations for addressing the identified issues. These recommendations include implementing more rigorous data verification procedures and investing in more advanced data analysis software.

5. The fifth part of the document discusses the implementation of the recommended changes. This involves a detailed plan of action, including the assignment of responsibilities and the establishment of a timeline for completion.

6. The sixth part of the document provides a summary of the overall findings and conclusions. It emphasizes the need for ongoing monitoring and evaluation to ensure that the implemented changes are effective and that the organization continues to improve its data management practices.

7. The seventh part of the document includes a list of references and a bibliography. These references provide additional information on the topics discussed in the document and are essential for further research and study.

8. The eighth part of the document contains a list of appendices and a glossary. The appendices provide additional data and information that support the findings and conclusions of the document. The glossary defines the key terms and concepts used throughout the document.

9. The ninth part of the document includes a list of figures and tables. These figures and tables present the data in a clear and concise manner, making it easier to understand the results of the analysis.

10. The tenth part of the document is a concluding statement that summarizes the main points of the document and expresses the author's hope that the findings and recommendations will be helpful to the organization.

11 UNIT C1 , H2COMPR , IS AN EXPANDER/COMPRESSOR

1 FEED STREAMS

1 STREAM 20

2 PRODUCT STREAMS

1 STREAM 21 IS OF VAPOR PHASE

3 THERMO DATA SETS USED

K VALUES		- SET 1		
ENTHALPY	LIQUID	- SET 1	VAPOR	- SET 1
ENTROPY	LIQUID	- SET 1	VAPOR	- SET 1

4 OPERATING CONDITIONS

INLET PRESSURE, BAR	1.0000
OUTLET PRESSURE, BAR	25.0000
ADIABATIC EFFICIENCY, PERCENT	40.0000

5 AFTERCOOLER

PRESSURE DROP, BAR	0.0
OUTLET TEMPERATURE, DEG C	50.0000

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SM
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UNIT 12 -
INPUT

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12 UNIT , , IS A CONTROLLER

1 CONTROL PARAMETER IS RATE OF
MAXIMUM NUMBER OF ITERATIONS
SECOND ESTIMATE FOR PARAMETER

STREAM 20
10
2.680000

2 CONTROL SPECIFICATIONS

1 HOLD RATIO OF MOLAR RATE FOR COMPS 12- 12 IN STREAM 7 AT
1.00000 WITH REF TO COMPS 12- 12 IN STREAM 20
RELATIVE TOLERANCE IS, .100000E-01

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UNIT 13 - M2
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13 UNIT M2 ,

, IS A MIXER/SPLITTER

1 FEED STREAMS

1 STREAM 21
2 STREAM 17

2 PRODUCT STREAMS

1 STREAM 22 IS OF MIXED PHASE

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

4 PRESSURE SPECIFICATION

PRESSURE DROP, BAR 0.0

Mr. J. P. ...
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PROBLEM TIPPLANT

SM
PROCESS
UNIT 14 - HX7
INPUT

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14 UNIT HX7 , FORNUIS , IS A HEAT EXCHANGER

1 HOT SIDE

UTILITY USED AND CONDITIONS
STEAM

SATURATION TEMPERATURE, DEG C 410.0000

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

FEED STREAMS
1 STREAM 22

PRODUCT STREAMS
1 STREAM 23 IS OF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 2050.0000
NUMBER OF SHELL SIDE PASSES 1
NUMBER OF TUBE SIDE PASSES 1

4 UNIT SPECIFICATION

HOLD COLD SIDE OUTLET TEMP AT 250.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

The first part of the report deals with the general situation in the country. It is noted that the economy is showing signs of recovery, but that there are still many problems to be solved. The government is working hard to improve the situation and to bring about a more stable and prosperous future for the people.

In the second part of the report, the author discusses the various aspects of the country's development. He points out that there has been a significant increase in the number of schools and hospitals, and that the standard of living is slowly improving. However, he also notes that there are still many areas where the government needs to intervene and provide assistance.

The third part of the report is devoted to a discussion of the country's political situation. The author expresses his confidence in the government's leadership and its ability to overcome the challenges it faces. He believes that the country is on the right path and that the people have a bright future ahead of them.

Finally, the author concludes the report by expressing his hope that the government will continue to work hard and that the people will continue to support the government's efforts. He believes that together they can build a better and more prosperous country for all.

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SM
PROCESS
UNIT 16 - HX2
INPUT

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16 UNIT HX2 , COOLER , IS A HEAT EXCHANGER

1 HOT SIDE

FEED STREAMS
1 STREAM 9

PRODUCT STREAMS
1 STREAM 10 IS OF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

UTILITY USED AND CONDITIONS

COOLING WATER

TEMPERATURE IN , DEG C 20.0000
TEMPERATURE OUT, DEG C 40.0000

THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 3000.0000
NUMBER OF SHELL SIDE PASSES 1
NUMBER OF TUBE SIDE PASSES 2

4 UNIT SPECIFICATION

HOLD HOT SIDE OUTLET TEMP AT 226.200 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

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17 UNIT HX8 , LUCHTKOELER , IS A HEAT EXCHANGER

1 HOT SIDE

FEED STREAMS
1 STREAM 7

PRODUCT STREAMS
1 STREAM 71 IS OF VAPOR PHASE

PRESSURE DROP, BAR 0.0

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

2 COLD SIDE

UTILITY USED AND CONDITIONS
COOLING AIR
TEMPERATURE IN , DEG C 25.0000
TEMPERATURE OUT, DEG C 40.0000

THERMO DATA SETS USED
K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

3 UNIT CONFIGURATION

OVERALL HEAT TRANSFER COEFFICIENT, KJ /HR DEG C SQ M 410.0000
NUMBER OF SHELL SIDE PASSES 1
NUMBER OF TUBE SIDE PASSES 2

4 UNIT SPECIFICATION

HOLD HOT SIDE OUTLET TEMP AT 50.000 DEG C
TOLERANCE ON SPECIFICATION -0.5556E-01

1.1.1

1.1.1.1

1.1.1.1.1

1.1.1.1.1.1

1.1.1.1.1.1.1

1.1.1.1.1.1.1.1

1.1.1.1.1.1.1.1.1

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SM
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UNIT 18 - FL2
INPUT

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18 UNIT FL2 , , IS A FLASH DRUM

1 FEED STREAMS

1 STREAM 71

2 PRODUCT STREAMS

1 STREAM 24 IS OF VAPOR PHASE
2 STREAM 25 IS OF LIQUID PHASE

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

4 UNIT SPECIFICATIONS

1 HOLD PRESSURE DROP AT 21.000 BAR

2 HOLD VALUE OF UNIT DUTY NO 1 AT .0 MM KJ /HR
RELATIVE TOLERANCE IS, .0

19 UNIT 01 , RONTABEL , IS A USER-DEFINED OPERATION

1 FEED STREAMS

1 STREAM 1

2 PRODUCT STREAMS

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

5 INTEGER PARAMETERS

PARAMETER	1	2	3	4
VALUE	0	0	0	0
PARAMETER	5	6	7	8
VALUE	0	0	0	0
PARAMETER	9	10	11	12
VALUE	0	0	0	0

6 REAL PARAMETERS

PARAMETER	1	2	3	4
VALUE	0.0	0.0	0.0	0.0
PARAMETER	5	6	7	8
VALUE	0.0	0.0	0.0	0.0

20 UNIT 07 , RONTABEL , IS A USER-DEFINED OPERATION

1 FEED STREAMS

1 STREAM 25

2 PRODUCT STREAMS

3 THERMO DATA SETS USED

K VALUES - SET 1
ENTHALPY LIQUID - SET 1 VAPOR - SET 1

5 INTEGER PARAMETERS

PARAMETER	1	2	3	4
VALUE	0	0	0	0
PARAMETER	5	6	7	8
VALUE	0	0	0	0
PARAMETER	9	10	11	12
VALUE	0	0	0	0

6 REAL PARAMETERS

PARAMETER	1	2	3	4
VALUE	0.0	0.0	0.0	0.0
PARAMETER	5	6	7	8
VALUE	0.0	0.0	0.0	0.0

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VI RECYCLE SPECIFICATIONS

2 RECYCLE ACCELERATION

DEM ACCELERATION IS USED WITH DUMPING FACTOR OF

1.00

UNIT - 1

Sl. No.	Name	Roll No.	Grade	Section	Score	Remarks
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
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48						
49						
50						

VIIIA UNIT STREAM CORRELATION MATRIX

UNIT NO ID STREAM ID	11 C1	12	13 M2	14 HX7	15 M1	16 HX2	17 HX8	18 FL2	19 O1	20 O7
1	-	-	-	-	-	-	-	-	F	-
2	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	F	-	-	-
8	-	-	-	-	F	-	-	-	-	-
9	-	-	-	-	-	F	-	-	-	-
10	-	-	-	-	-	P	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-
17	-	-	F	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-
20	F	-	-	-	-	-	-	-	-	-
21	P	-	F	-	-	-	-	-	-	-
22	-	-	P	F	-	-	-	-	-	-
23	-	-	-	P	F	-	-	-	-	-
24	-	-	-	-	-	-	-	P	-	-
25	-	-	-	-	-	-	-	P	-	F
71	-	-	-	-	-	-	P	F	-	-
91	-	-	-	-	P	-	-	-	-	-

VIIIB CALCULATIONAL SEQUENCE DETERMINED BY PROGRAM

1. UNIT	1, P1	2. UNIT	11, C1	3. UNIT	2, R1
4. UNIT	3, FL1	5. UNIT	4, HX3	6. UNIT	5, HX1
7. UNIT	6, HX4	8. UNIT	7, S1	9. UNIT	8, HX5
10. UNIT	9, M3	11. UNIT	10, HX6	12. UNIT	12,
13. UNIT	13, M2	14. UNIT	14, HX7	15. UNIT	15, M1
16. UNIT	16, HX2	17. UNIT	17, HX8	18. UNIT	18, FL2
19. UNIT	19, O1	20. UNIT	20, O7		

VIIIC RECYCLE LOOPS DETERMINED BY PROGRAM

LOOP 1 STARTS AT UNIT 2, R1 AND ENDS AT UNIT 16, HX2

1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												

1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1950												
1951												
1952												
1953												
1954												
1955												
1956												
1957												
1958												
1959												
1960												

1950
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1959
1960

VIIID RECYCLE STREAMS

STREAM	FROM UNIT	TO UNIT	LOOP
5	10,HX6	7,S1	1
15	6,HX4	3,FL1	1

*** ALL INPUT DATA IN ORDER ***

UNIT 1, P1 , SOLVED
 UNIT 11, C1 , SOLVED
 UNIT 2, R1 , SOLVED
 UNIT 3, FL1 , SOLVED
 UNIT 4, HX3 , SOLVED
 UNIT 5, HX1 , SOLVED
 UNIT 6, HX4 , SOLVED
 UNIT 7, S1 , SOLVED
 UNIT 8, HX5 , SOLVED
 UNIT 9, M3 , SOLVED
 UNIT 10, HX6 , SOLVED
 UNIT 12, , SOLVED
 UNIT 13, M2 , SOLVED
 UNIT 14, HX7 , SOLVED
 UNIT 15, M1 , SOLVED
 UNIT 16, HX2 , SOLVED
 LOOP 1 SOLVED AFTER 1 TRIALS
 UNIT 17, HX8 , SOLVED
 UNIT 18, FL2 , SOLVED

1941

1942

1943

1944

1945

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PROBLEM TIPPLANT

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PROCESS
SOLUTION

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**** PROBLEM SOLUTION REACHED ****

SUMMARY OF FLASH DRUMS, MIXER/SPLITTERS AND VALVES

UNIT ID SEQ NO NAME TYPE	FL1 3 PHASESEP FLASH	M3 9 MIXER	M2 13 MIXER	M1 15 MIXER
FEEDS	15	3 19	21 17	23 8
PRODUCTS	16 (V) 18 (L)	4 (V)	22 (V)	91 (V)
TEMP, DEG C	35.000	195.724	226.935	242.511
PRESSURE, BAR	25.0000	25.0000	25.0000	25.0000

UNIT ID SEQ NO NAME TYPE	FL2 18 FLASH
FEEDS	71
PRODUCTS	24 (V) 25 (L)
TEMP, DEG C	49.143
PRESSURE, BAR	4.0000

SUMMARY OF HEAT EXCHANGE UNITS

4 UNIT HX3 , , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	0.85808
LMTD, DEG C	68.064
F FACTOR	0.93792
U * A, KJ /HR DEG C	12606.996
U, KJ /HR DEG C SQ M	500.000
A, SQ M	25.214

*** HOT SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	12	
VAPOR PRODUCT		13
VAPOR, KG MOL/HR	223.0499	223.0499
M KGS/HR		7.9996
LIQUID, KG MOL/HR	0.0	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	223.0499	223.0499
CONDENS (VAPORIZ)ATION, KG MOL/HR		0.0
TEMPERATURE, DEG C	250.000	214.078
PRESSURE, BAR	25.000	25.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	16	
VAPOR PRODUCT		17
VAPOR, KG MOL/HR	120.9147	120.9147
M KGS/HR		0.7097
LIQUID, KG MOL/HR	0.0	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	120.9147	120.9147
CONDENS (VAPORIZ)ATION, KG MOL/HR		0.0
TEMPERATURE, DEG C	35.000	230.000
PRESSURE, BAR	25.000	25.000

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5 UNIT HX1 , , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	4.24030
LMTD, DEG C	36.347
F FACTOR	0.87458
U * A, KJ /HR DEG C	116662.687
U, KJ /HR DEG C SQ M	3000.000
A, SQ M	38.888

*** HOT SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	13	
MIXED PRODUCT		14
VAPOR, KG MOL/HR	223.0498	147.8183
M KGS/HR		2.6368
LIQUID, KG MOL/HR	0.0	75.2315
M KGS/HR		5.3628
TOTAL, KG MOL/HR	223.0498	223.0498
CONDENS(VAPORIZ)ATION, KG MOL/HR		75.2315
TEMPERATURE, DEG C	214.078	85.062
PRESSURE, BAR	25.000	25.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	18	
VAPOR PRODUCT		19
VAPOR, KG MOL/HR	0.0	102.1351
M KGS/HR		7.2898
LIQUID, KG MOL/HR	102.1351	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	102.1351	102.1351
CONDENS(VAPORIZ)ATION, KG MOL/HR		102.1351
TEMPERATURE, DEG C	35.000	180.000
PRESSURE, BAR	25.000	25.000

一、 序言

本報告之目的，在於探討我國經濟發展之現狀與未來趨勢。報告內容包括：一、經濟成長之回顧；二、主要產業之分析；三、國際貿易之現況；四、未來發展之展望。

二、 經濟成長之回顧

近年來，我國經濟成長率維持穩定，顯示我國經濟具有強韌之生命力。

一、 國內生產毛額 (GDP) 之增長

根據統計局之數據，我國 GDP 在過去五年中，平均每年增長百分之七點五。其中，製造業之增長最為顯著，佔 GDP 增長之百分之六十。

二、 消費者物價指數 (CPI) 之波動

CPI 在過去五年中，呈現波動之態勢。主要由於能源價格之大幅波動所致。然而，核心 CPI 則維持穩定，顯示我國通脹壓力尚可控。

三、 失業率之變化

失業率在過去五年中，維持在百分之六點五左右。政府已採取多項措施，以促進就業，包括鼓勵創業、加強職業培訓等。

三、 主要產業之分析

一、 製造業

製造業是我國經濟之支柱，佔 GDP 之百分之三十。近年來，我國製造業競爭力不斷提升，主要得益於技術進步與規模效應。

二、 服務業

服務業是我國經濟之新興動力，佔 GDP 之百分之六十。隨著消費升級與技術進步，服務業將繼續保持高速增長。

四、 國際貿易之現況

我國國際貿易總額在過去五年中，增長了百分之二十。其中，進出口貿易均保持穩定增長，顯示我國國際貿易競爭力不斷提升。

五、 未來發展之展望

未來我國經濟將繼續保持穩定增長，主要得益於改革開放之深入與技術進步之推動。政府將繼續加大對基礎設施建設與科技研發之投入，以推動經濟高質量發展。

 6 UNIT HX4 , CONDENS. , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	1.69707
LMTD, DEG C	25.701
F FACTOR	0.94042
U * A, KJ /HR DEG C	66031.125
U, KJ /HR DEG C SQ M	3000.000
A, SQ M	22.010

*** HOT SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	14	
MIXED PRODUCT		15
VAPOR, KG MOL/HR	147.8183	120.9146
M KGS/HR		0.7097
LIQUID, KG MOL/HR	75.2315	102.1351
M KGS/HR		7.2899
TOTAL, KG MOL/HR	223.0498	223.0498
CONDENS (VAPORIZATION), KG MOL/HR		26.9036
TEMPERATURE, DEG C	85.062	35.000
PRESSURE, BAR	25.000	25.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
COOLING WATER, KG /HR	20266.805	20266.805
TEMPERATURE, DEG C	20.000	40.000

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. This is essential for ensuring the integrity of the financial system and for providing a clear audit trail. The records should be kept up-to-date and should be accessible to all authorized personnel.

2. The second part of the document outlines the procedures for handling incoming and outgoing payments. It is important to ensure that all payments are processed in a timely and accurate manner. This involves verifying the details of the payment, such as the amount and the recipient, before it is processed.

3. The third part of the document discusses the importance of maintaining accurate records of all assets and liabilities. This is essential for ensuring the accuracy of the financial statements and for providing a clear picture of the organization's financial position. The records should be kept up-to-date and should be accessible to all authorized personnel.

4. The fourth part of the document outlines the procedures for handling incoming and outgoing payments. It is important to ensure that all payments are processed in a timely and accurate manner. This involves verifying the details of the payment, such as the amount and the recipient, before it is processed.

5. The fifth part of the document discusses the importance of maintaining accurate records of all assets and liabilities. This is essential for ensuring the accuracy of the financial statements and for providing a clear picture of the organization's financial position. The records should be kept up-to-date and should be accessible to all authorized personnel.

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8 UNIT HX5 , , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	6.88208
LMTD, DEG C	40.129
F FACTOR	0.88135
U * A, KJ /HR DEG C	171500.062
U, KJ /HR DEG C SQ M	3000.000
A, SQ M	57.167

*** HOT SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	6	7
LIQUID PRODUCT		
VAPOR, KG MOL/HR	136.3599	0.0
M KGS/HR		0.0
LIQUID, KG MOL/HR	0.0	136.3599
M KGS/HR		10.0052
TOTAL, KG MOL/HR	136.3599	136.3599
CONDENS (VAPORIZ)ATION, KG MOL/HR		136.3599
TEMPERATURE, DEG C	250.000	70.000
PRESSURE, BAR	25.000	25.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	2	3
VAPOR PRODUCT		
VAPOR, KG MOL/HR	0.0	133.6914
M KGS/HR		9.9999
LIQUID, KG MOL/HR	133.6914	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	133.6914	133.6914
CONDENS (VAPORIZ)ATION, KG MOL/HR		133.6914
TEMPERATURE, DEG C	21.614	207.209
PRESSURE, BAR	25.000	25.000

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 10 UNIT HX6 , FORNUIS2 , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	2.67441
LMTD, DEG C	185.819
U * A, KJ /HR DEG C	14392.598
U, KJ /HR DEG C SQ M	2650.000
A, SQ M	5.431

*** HOT SIDE CONDITIONS

	INLET	OUTLET
STEAM, KG /HR	3058.075	3058.075
SATURATION PRESSURE, BAR		227.145
SATURATION TEMPERATURE, DEG C		410.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	4	
VAPOR PRODUCT		5
VAPOR, KG MOL/HR	235.8264	235.8264
M KGS/HR		17.2898
LIQUID, KG MOL/HR	0.0	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	235.8264	235.8264
CONDENS (VAPORIZ)ATION, KG MOL/HR		0.0
TEMPERATURE, DEG C	195.724	250.000
PRESSURE, BAR	25.000	25.000

 14 UNIT HX7 , FORNUIS , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR		0.10805
LMTD, DEG C		171.273
U * A, KJ /HR DEG C		630.872
U, KJ /HR DEG C SQ M		2050.000
A, SQ M		0.308

*** HOT SIDE CONDITIONS

	INLET	OUTLET
STEAM, KG /HR	123.552	123.552
SATURATION PRESSURE, BAR		227.145
SATURATION TEMPERATURE, DEG C		410.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	22	
VAPOR PRODUCT		23
VAPOR, KG MOL/HR	123.6147	123.6147
M KGS/HR		0.7151
LIQUID, KG MOL/HR	0.0	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	123.6147	123.6147
CONDENS(VAPORIZ)ATION, KG MOL/HR		0.0
TEMPERATURE, DEG C	226.935	250.000
PRESSURE, BAR	25.000	25.000

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 16 UNIT HX2 , COOLER , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	0.57198
LMTD, DEG C	207.713
F FACTOR	0.99813
U * A, KJ /HR DEG C	2753.691
U, KJ /HR DEG C SQ M	3000.000
A, SQ M	0.918

*** HOT SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	9	
VAPOR PRODUCT		10
VAPOR, KG MOL/HR	223.0846	223.0846
M KGS/HR		7.9998
LIQUID, KG MOL/HR	0.0	0.0
M KGS/HR		0.0
TOTAL, KG MOL/HR	223.0846	223.0846
CONDENS (VAPORIZ)ATION, KG MOL/HR		0.0
TEMPERATURE, DEG C	250.000	226.200
PRESSURE, BAR	25.000	25.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
COOLING WATER, KG /HR	6830.684	6830.684
TEMPERATURE, DEG C	20.000	40.000

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 17 UNIT HX8 , LUCHTKOELER , IS A HEAT EXCHANGER

*** OPERATING CONDITIONS

DUTY, MM KJ /HR	0.49455
LMTD, DEG C	25.489
F FACTOR	0.92943
U * A, KJ /HR DEG C	19402.895
U, KJ /HR DEG C SQ M	410.000
A, SQ M	47.324

*** HOT SIDE CONDITIONS

	INLET	OUTLET
FEED(S)	7	
LIQUID PRODUCT		71
VAPOR, KG MOL/HR	0.0	0.0
M KGS/HR		0.0
LIQUID, KG MOL/HR	136.3599	136.3599
M KGS/HR		10.0052
TOTAL, KG MOL/HR	136.3599	136.3599
CONDENS (VAPORIZ)ATION, KG MOL/HR		0.0
TEMPERATURE, DEG C	70.000	50.000
PRESSURE, BAR	25.000	25.000

*** COLD SIDE CONDITIONS

	INLET	OUTLET
COOLING AIR, KG /HR	32455.039	32455.039
TEMPERATURE, DEG C	25.000	40.000

The following information was obtained from the records of the
 Department of the Interior, Bureau of Land Management, regarding
 the land owned by the State of California and the United States
 Government in the County of Santa Clara, California, as of
 the date of the filing of this report.

Section	Township	Range	Acres	Owner
1	10N	12E	360	State of California
2	10N	12E	360	State of California
3	10N	12E	360	State of California
4	10N	12E	360	State of California
5	10N	12E	360	State of California
6	10N	12E	360	State of California
7	10N	12E	360	State of California
8	10N	12E	360	State of California
9	10N	12E	360	State of California
10	10N	12E	360	State of California
11	10N	12E	360	State of California
12	10N	12E	360	State of California
13	10N	12E	360	State of California
14	10N	12E	360	State of California
15	10N	12E	360	State of California
16	10N	12E	360	State of California
17	10N	12E	360	State of California
18	10N	12E	360	State of California
19	10N	12E	360	State of California
20	10N	12E	360	State of California
21	10N	12E	360	State of California
22	10N	12E	360	State of California
23	10N	12E	360	State of California
24	10N	12E	360	State of California
25	10N	12E	360	State of California
26	10N	12E	360	State of California
27	10N	12E	360	State of California
28	10N	12E	360	State of California
29	10N	12E	360	State of California
30	10N	12E	360	State of California
31	10N	12E	360	State of California
32	10N	12E	360	State of California
33	10N	12E	360	State of California
34	10N	12E	360	State of California
35	10N	12E	360	State of California
36	10N	12E	360	State of California
37	10N	12E	360	State of California
38	10N	12E	360	State of California
39	10N	12E	360	State of California
40	10N	12E	360	State of California
41	10N	12E	360	State of California
42	10N	12E	360	State of California
43	10N	12E	360	State of California
44	10N	12E	360	State of California
45	10N	12E	360	State of California
46	10N	12E	360	State of California
47	10N	12E	360	State of California
48	10N	12E	360	State of California
49	10N	12E	360	State of California
50	10N	12E	360	State of California
51	10N	12E	360	State of California
52	10N	12E	360	State of California
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80	10N	12E	360	State of California
81	10N	12E	360	State of California
82	10N	12E	360	State of California
83	10N	12E	360	State of California
84	10N	12E	360	State of California
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94	10N	12E	360	State of California
95	10N	12E	360	State of California
96	10N	12E	360	State of California
97	10N	12E	360	State of California
98	10N	12E	360	State of California
99	10N	12E	360	State of California
100	10N	12E	360	State of California

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SUMMARY OF COMPRESSOR/EXPANDER/PUMP UNITS

1 UNIT P1 , FEEDPUMP , IS A PUMP

*** FEED STREAMS ARE 1
 *** LIQUID PRODUCT IS STREAM 2

*** OPERATING CONDITIONS

WORK, KW 16.40
 EFFICIENCY, PERCENT 70.00

	INLET	OUTLET
MOLE FRACTION LIQUID	1.0000	1.0000
TEMPERATURE, DEG C	20.000	21.614
PRESSURE, BAR	1.0000	25.0000
HOT VOLUME, M3/HR	17.216	17.134

11 UNIT C1 , H2COMPR , IS A COMPRESSOR

*** FEED STREAMS ARE 20
 *** VAPOR PRODUCT IS STREAM 21

*** OPERATING CONDITIONS

	INLET	ISENTROPIC	OUTLET
TEMPERATURE, DEG C	20.00	458.81	1093.38
PRESSURE, BAR	1.0000	25.0000	25.0000
ENTHALPY, MM KJ /HR	0.0011	0.0359	0.0881
ENTROPY, KJ /MOLE DEG C	135.0057	135.0057	153.9598
MOLE PERCENT LIQUID	0.0	0.0	0.0
ADIABATIC EFFICIENCY, PERCENT			40.00
POLYTROPIC EFFICIENCY, PERCENT			59.43
ISENTROPIC COEFFICIENT, K			1.3983
POLYTROPIC COEFFICIENT, N			1.9205

**** ISENTROPIC EXPONENT CALCULATED FROM TEMPS INSTEAD OF FROM WORK ****
 WORK, KW
 THEORETICAL 9.67
 POLYTROPIC 14.37
 ACTUAL 24.19

AFTERCOOLER

DUTY, MM KJ /HR 0.0847
 TEMPERATURE, DEG C 50.00
 PRESSURE, BAR 25.0000

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VERSION 0881
 SIMULATION SCIENCES, INC.
 PROJECT
 PROBLEM TIPPLANT
 UNIT IDENTITY= R1

SM
 PROCESS
 UNIT 2 - R1
 SOLUTION
 NAME= REACTOR

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 MCF&MJB

REACTORTEMPERATUUR= 250.00 C REACTORDRUK= 25.00 BAR

*****STROOMGEGEVENS*****

COMP NO	COMPONENT NAME	VOEDING KG MOLS/HR	CONV KG MOLS/HR	PRODUCT KG MOLS/HR	REACT.ENTH KJ /KG MOLS
1	BUTANE	0.1820E+01	-0.8489E+00	0.9711E+00	0.0
2	IBUTANE	0.2000E+00	0.8372E+00	0.1037E+01	-0.6930E+04
3	PENTANE	0.8991E+02	-0.6181E+02	0.2810E+02	0.0
4	IPENTANE	0.4550E+01	0.6181E+02	0.6636E+02	-0.8060E+04
5	HEXANE	0.9410E+01	-0.7773E+01	0.1637E+01	0.0
6	2MPENTAN	0.8000E-01	0.2965E+01	0.3045E+01	-0.7200E+04
7	3MPENTAN	0.4000E-01	0.1867E+01	0.1907E+01	-0.4000E+04
8	22DMB	0.8000E-01	0.2122E+01	0.2202E+01	-0.1830E+05
9	23DMB	0.2000E-01	0.8467E+00	0.8667E+00	-0.1060E+05
10	CYPNTANE	0.0	0.0	0.0	0.0
11	MCYCPNT	0.0	0.0	0.0	0.0
12	HYDROGEN	0.1169E+03	0.0	0.1169E+03	0.0

ENTHALPY VAN PRODUCT STROOM 7615.0430 KJ /HR

MOLAIRE WARMTE CAPACITEIT VAN PRODUCT STROOM 109.1911 KJ /KG MOLS

ADIABATISCHE TEMPERATUUR STIJGING 23.8391 DEG C

TOTALE MOL PRODUCT STROOM 223.0499 KG MOLS/HR

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VERSION 0881
SIMULATION SCIENCES, INC.
PROJECT
PROBLEM TIPPLANT

SM
PROCESS
UNIT 2 - R1
SOLUTION

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*****OCTANE NUMBERS*****

COMP NO	COMPONENT NAME	RON	MOLFR HC FEED	RON	MOLFHC PROD	RON
1	BUTANE	94.0	0.017	1.61	0.009	0.86
2	IBUTANE	100.0	0.002	0.19	0.010	0.98
3	PENTANE	62.0	0.847	52.53	0.265	16.42
4	IPENTANE	90.0	0.043	3.86	0.625	56.28
5	HEXANE	25.0	0.089	2.22	0.015	0.39
6	2MPENTAN	73.5	0.001	0.06	0.029	2.11
7	3MPENTAN	74.5	0.000	0.03	0.018	1.34
8	22DMB	92.0	0.001	0.07	0.021	1.91
9	23DMB	103.5	0.000	0.02	0.008	0.85
10	CYPNTANE	102.5	0.0	0.0	0.0	0.0
11	MCYCPNT	91.5	0.0	0.0	0.0	0.0
			TOTAAL	60.58	TOTAAL	81.13

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PROCESS
UNIT 19 - 01
SOLUTION

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*****OCTANE NUMBERS*****

COMP NO	COMPONENT NAME	RON	MOLFR FEED	HC	RON
1	BUTANE	94.0	0.006		0.60
2	IBUTANE	100.0	0.003		0.26
3	PENTANE	62.0	0.462		28.67
4	IPENTANE	90.0	0.304		27.34
5	HEXANE	25.0	0.058		1.45
6	2MPENTAN	73.5	0.081		5.93
7	3MPENTAN	74.5	0.040		2.97
8	22DMB	92.0	0.005		0.48
9	23DMB	103.5	0.016		1.62
10	CYPNTANE	102.5	0.023		2.40
11	MCYCPNT	91.5	0.002		0.16
			TOTAAL		71.89

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PROCESS
UNIT 20 - 07
SOLUTION

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MCF&MJB

*****OCTANE NUMBERS*****

COMP NO	COMPONENT NAME	RON	MOLFR HC FEED	RON
1	BUTANE	94.0	0.0	0.0
2	IBUTANE	100.0	0.009	0.85
3	PENTANE	62.0	0.0	0.0
4	IPENTANE	90.0	0.765	68.81
5	HEXANE	25.0	0.0	0.0
6	2MPENTAN	73.5	0.104	7.63
7	3MPENTAN	74.5	0.054	4.05
8	22DMB	92.0	0.021	1.95
9	23DMB	103.5	0.022	2.29
10	CYPNTANE	102.5	0.024	2.42
11	MCYCPNT	91.5	0.002	0.17
			TOTAAL	88.17

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STREAM COMPONENT FLOW RATES - KG MOL/HR

STREAM ID NAME	1	2	3	4
PHASE	LIQUID	LIQUID	VAPOR	VAPOR
1 BUTANE	0.8602	0.8602	0.8602	1.6866
2 IBUTANE	0.3441	0.3441	0.3441	1.1769
3 PENTANE	61.8148	61.8147	61.8146	88.3986
4 IPENTANE	40.6093	40.6092	40.6091	102.4159
5 HEXANE	7.7746	7.7746	7.7746	9.3809
6 2MPENTAN	10.7916	10.7916	10.7916	13.7607
7 3MPENTAN	5.3378	5.3378	5.3378	7.2013
8 22DMB	0.6962	0.6962	0.6962	2.8198
9 23DMB	2.0887	2.0887	2.0887	2.9318
10 CYPNTANE	3.1368	3.1368	3.1368	3.1368
11 MCYCPNT	0.2376	0.2376	0.2376	0.2376
12 HYDROGEN	0.0	0.0	0.0	2.6797
TOTALS	133.6918	133.6914	133.6914	235.8264
TEMPERATURE, DEG C	20.0000	21.6142	207.2095	195.7240
PRESSURE, BAR	1.0000	25.0000	25.0000	25.0000
H, MM KJ /HR	0.3416	0.4006	7.2827	12.0502
MOLE FRACT LIQUID	1.0000	1.0000	0.0	0.0
RECYCLE CONVERGENCE	0.0	0.0	0.0	0.0

STREAM ID NAME	5	6	7	8
PHASE	VAPOR	VAPOR	LIQUID	VAPOR
1 BUTANE	1.6866	0.0	0.0	1.6900
2 IBUTANE	1.1769	1.1800	1.1800	0.0
3 PENTANE	88.3985	0.0	0.0	88.4000
4 IPENTANE	102.4158	102.4100	102.4100	0.0
5 HEXANE	9.3809	0.0	0.0	9.3800
6 2MPENTAN	13.7607	13.7600	13.7600	0.0
7 3MPENTAN	7.2013	7.2000	7.2000	0.0
8 22DMB	2.8198	2.8200	2.8200	0.0
9 23DMB	2.9318	2.9300	2.9300	0.0
10 CYPNTANE	3.1368	3.1400	3.1400	0.0
11 MCYCPNT	0.2376	0.2400	0.2400	0.0
12 HYDROGEN	2.6797	2.6800	2.6800	0.0
TOTALS	235.8264	136.3599	136.3599	99.4700
TEMPERATURE, DEG C	250.0000	250.0000	70.0000	250.0000
PRESSURE, BAR	25.0000	25.0000	25.0000	25.0000
H, MM KJ /HR	14.7246	8.4401	1.5581	6.2839
MOLE FRACT LIQUID	0.0	0.0	1.0000	0.0
RECYCLE CONVERGENCE	-0.0010	0.0	0.0	0.0

Year	Month	Day	Event	Location
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STREAM COMPONENT FLOW RATES - KG MOL/HR

STREAM ID NAME	9	10	11	12
PHASE	VAPOR	VAPOR	VAPOR	VAPOR
1 BUTANE	1.8347	1.8347	1.8347	0.9711
2 IBUTANE	0.2043	0.2043	0.2043	1.0372
3 PENTANE	89.9157	89.9157	89.9157	28.1018
4 IPENTANE	4.5463	4.5463	4.5463	66.3581
5 HEXANE	9.4107	9.4107	9.4107	1.6371
6 2MPENTAN	0.0761	0.0761	0.0761	3.0455
7 3MPENTAN	0.0431	0.0431	0.0431	1.9067
8 22DMB	0.0784	0.0784	0.0784	2.2021
9 23DMB	0.0235	0.0235	0.0235	0.8667
10 CYPNTANE	0.0	0.0	0.0	0.0
11 MCYCPNT	0.0	0.0	0.0	0.0
12 HYDROGEN	116.9518	116.9518	116.9518	116.9400
TOTALS	223.0846	223.0846	223.0846	223.0664
TEMPERATURE, DEG C	250.0000	226.2000	250.0000	250.0000
PRESSURE, BAR	25.0000	25.0000	25.0000	25.0000
H, MM KJ /HR	7.7275	7.1555	7.7275	7.6150
MOLE FRACT LIQUID	0.0	0.0	0.0	0.0
RECYCLE CONVERGENCE	0.0	0.0	0.0	0.0

STREAM ID NAME	13	14	15	16
PHASE	VAPOR	MIXED	MIXED	VAPOR
1 BUTANE	0.9710	0.9710	0.9710	0.1447
2 IBUTANE	1.0372	1.0372	1.0372	0.2043
3 PENTANE	28.0997	28.0997	28.0996	1.5157
4 IPENTANE	66.3532	66.3532	66.3530	4.5463
5 HEXANE	1.6370	1.6370	1.6370	0.0307
6 2MPENTAN	3.0453	3.0453	3.0452	0.0761
7 3MPENTAN	1.9066	1.9066	1.9066	0.0431
8 22DMB	2.2019	2.2019	2.2019	0.0784
9 23DMB	0.8666	0.8666	0.8666	0.0235
10 CYPNTANE	0.0	0.0	0.0	0.0
11 MCYCPNT	0.0	0.0	0.0	0.0
12 HYDROGEN	116.9314	116.9314	116.9316	114.2519
TOTALS	223.0499	223.0498	223.0498	120.9147
TEMPERATURE, DEG C	214.0781	85.0615	35.0000	35.0000
PRESSURE, BAR	25.0000	25.0000	25.0000	25.0000
H, MM KJ /HR	6.7570	2.5167	0.8196	0.2925
MOLE FRACT LIQUID	0.0	0.3373	0.4579	0.0
RECYCLE CONVERGENCE	0.0	0.0	-0.0001	0.0

Main body of text, appearing to be a list or series of entries, possibly a table with multiple columns. The text is extremely faint and largely illegible, but the structure suggests a data table.

STREAM COMPONENT FLOW RATES - KG MOL/HR

STREAM ID NAME	17	18	19	20
PHASE	VAPOR	LIQUID	VAPOR	VAPOR
1 BUTANE	0.1447	0.8263	0.8263	0.0
2 IBUTANE	0.2043	0.8329	0.8329	0.0
3 PENTANE	1.5157	26.5839	26.5839	0.0
4 IPENTANE	4.5463	61.8067	61.8067	0.0
5 HEXANE	0.0307	1.6063	1.6063	0.0
6 2MPENTAN	0.0761	2.9691	2.9691	0.0
7 3MPENTAN	0.0431	1.8635	1.8635	0.0
8 22DMB	0.0784	2.1236	2.1236	0.0
9 23DMB	0.0235	0.8431	0.8431	0.0
10 CYPNTANE	0.0	0.0	0.0	0.0
11 MCYCPNT	0.0	0.0	0.0	0.0
12 HYDROGEN	114.2519	2.6797	2.6797	2.7000
TOTALS	120.9147	102.1351	102.1351	2.7000
TEMPERATURE, DEG C	230.0000	35.0000	180.0000	20.0000
PRESSURE, BAR	25.0000	25.0000	25.0000	1.0000
H, MM KJ /HR	1.1506	0.5272	4.7675	0.0011
MOLE FRACT LIQUID	0.0	1.0000	0.0	0.0
RECYCLE CONVERGENCE	0.0	0.0	0.0	0.0

STREAM ID NAME	21	22	23	24
PHASE	VAPOR	VAPOR	VAPOR	VAPOR
1 BUTANE	0.0	0.1447	0.1447	0.0
2 IBUTANE	0.0	0.2043	0.2043	0.0578
3 PENTANE	0.0	1.5157	1.5157	0.0
4 IPENTANE	0.0	4.5463	4.5463	1.6767
5 HEXANE	0.0	0.0307	0.0307	0.0
6 2MPENTAN	0.0	0.0761	0.0761	0.0844
7 3MPENTAN	0.0	0.0431	0.0431	0.0402
8 22DMB	0.0	0.0784	0.0784	0.0241
9 23DMB	0.0	0.0235	0.0235	0.0194
10 CYPNTANE	0.0	0.0	0.0	0.0305
11 MCYCPNT	0.0	0.0	0.0	0.0011
12 HYDROGEN	2.7000	116.9519	116.9518	2.3170
TOTALS	2.7000	123.6147	123.6147	4.2513
TEMPERATURE, DEG C	50.0000	226.9353	250.0000	49.1432
PRESSURE, BAR	25.0000	25.0000	25.0000	4.0000
H, MM KJ /HR	0.0035	1.1540	1.2621	0.0642
MOLE FRACT LIQUID	0.0	0.0	0.0	0.0
RECYCLE CONVERGENCE	0.0	0.0	0.0	0.0

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for the company's financial health and for providing reliable information to stakeholders.

2. The second part of the document outlines the specific procedures for recording transactions. It details the steps from initial entry to final review, ensuring that all necessary information is captured and verified.

3. The third part of the document addresses the challenges associated with record-keeping, such as data entry errors and incomplete information. It provides strategies to minimize these risks and ensure the integrity of the data.

4. The fourth part of the document discusses the role of technology in modern record-keeping. It highlights how digital tools can streamline the process and reduce the risk of human error.

5. The fifth part of the document concludes by reiterating the importance of consistent and accurate record-keeping. It encourages all employees to take responsibility for their part in maintaining the company's financial records.

STREAM COMPONENT FLOW RATES - KG MOLS/HR

STREAM ID NAME	25	71	91
PHASE	LIQUID	LIQUID	VAPOR
1 BUTANE	0.0	0.0	1.8347
2 IBUTANE	1.1222	1.1800	0.2043
3 PENTANE	0.0	0.0	89.9157
4 IPENTANE	100.7333	102.4100	4.5463
5 HEXANE	0.0	0.0	9.4107
6 2MPENTAN	13.6756	13.7600	0.0761
7 3MPENTAN	7.1598	7.2000	0.0431
8 22DMB	2.7959	2.8200	0.0784
9 23DMB	2.9106	2.9300	0.0235
10 CYPNTANE	3.1095	3.1400	0.0
11 MCYCPNT	0.2389	0.2400	0.0
12 HYDROGEN	0.3629	2.6800	116.9518
TOTALS	132.1086	136.3599	223.0846
TEMPERATURE, DEG C	49.1432	50.0000	242.5109
PRESSURE, BAR	4.0000	25.0000	25.0000
H, MM KJ /HR	0.9994	1.0635	7.5460
MOLE FRACT LIQUID	1.0000	1.0000	0.0
RECYCLE CONVERGENCE	0.0	0.0	0.0

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STREAM SUMMARY

STREAM ID.	1	2	3	4
NAME				
PHASE	LIQUID	LIQUID	VAPOR	VAPOR
FROM UNIT/TRAY	0/ 0	1/ 0	8/ 0	9/ 0
TO UNIT/TRAY	19/ 0	8/ 0	9/ 0	10/ 0
FROM STREAM				
KG MOL/HR	133.691	133.691	133.691	235.827
TEMPERATURE, DEG C	20.000	21.614	207.209	195.724
PRESSURE, BAR	1.000	25.000	25.000	25.000
H, MM KJ /HR	0.342	0.401	7.283	12.050
M KJ /KG MOLE	2.555	2.997	54.474	51.098
KJ /KG	34.162	40.064	728.275	696.953
MOLE FRACT LIQUID	1.00000	1.00000	0.0	0.0
M KGS/HR	10.000	10.000	10.000	17.290
MOLECULAR WEIGHT	74.799	74.799	74.799	73.316
STD LIQ M3/HR	15.722	15.722	15.722	27.420
DEG API	90.515	90.515	90.515	92.446
SP GR	0.6373	0.6373	0.6373	0.6318
KGS/M3	636.0347	636.0344	636.0347	630.5491
UOP K	12.952	12.952	12.952	13.003
REDUCED TEMP	0.619	0.622	1.014	1.007
REDUCED PRESS	0.030	0.749	0.749	0.753
ACENTRIC FACTOR	0.248	0.248	0.248	0.241
VAPOR				
M KGS/HR	0.0	0.0	10.000	17.290
STD LIQ M3/HR	0.0	0.0	15.722	27.420
STD M M3/HR	0.0	0.0	2.997	5.286
ACTUAL M M3/HR	0.0	0.0	0.148	0.249
KGS/M M3	0.0	0.0	67509.875	69335.750
Z	0.0	0.0	0.69357	0.67813
LIQUID				
M KGS/HR	10.000	10.000	0.0	0.0
STD LIQ M3/HR	15.722	15.722	0.0	0.0
ACTUAL GPM	75.7980	75.4391	0.0	0.0
M3/HR	17.216	17.134	0.0	0.0
KGS/M3	580.866	583.626	0.0	0.0
Z	0.00528	0.13074	0.0	0.0

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice.

2. The second section details the various methods used to collect and analyze data. It includes a table summarizing the different techniques and their respective strengths and weaknesses.

Method	Advantages	Disadvantages
Surveys	Wide reach, easy to administer	Low response rate, potential bias
Interviews	Deep insights, flexibility	Time-consuming, expensive
Focus Groups	Interactive, rich data	Small sample size, group dynamics
Observation	Real-time data, natural behavior	Subjective, limited scope
Experiments	Controlled environment, causal inference	Artificial setting, limited generalizability

3. The final section concludes with a series of recommendations for future research. It suggests that further exploration into the integration of qualitative and quantitative methods would be beneficial.

STREAM SUMMARY

STREAM ID.	5	6	7	8
NAME				
PHASE	VAPOR	VAPOR	LIQUID	VAPOR
FROM UNIT/TRAY	10/ 0	7/ 0	8/ 0	7/ 0
TO UNIT/TRAY	7/ 0	8/ 0	17/ 0	15/ 0
FROM STREAM				
KG MOL/HR	235.827	136.360	136.360	99.470
TEMPERATURE, DEG C	250.000	250.000	70.000	250.000
PRESSURE, BAR	25.000	25.000	25.000	25.000
H, MM KJ /HR	14.725	8.440	1.558	6.284
M KJ /KG MOLE	62.438	61.896	11.426	63.174
KJ /KG	851.635	843.576	155.725	862.618
MOLE FRACT LIQUID	0.0	0.0	1.00000	0.0
M KGS/HR	17.290	10.005	10.005	7.285
MOLECULAR WEIGHT	73.316	73.373	73.373	73.235
STD LIQ M3/HR	27.420	15.898	15.898	11.523
DEG API	92.446	92.872	92.872	91.863
SP GR	0.6318	0.6307	0.6307	0.6335
KGS/M3	630.5491	629.3542	629.3542	632.1956
UOP K	13.003	12.988	12.988	13.024
REDUCED TEMP	1.124	1.136	0.745	1.107
REDUCED PRESS	0.753	0.756	0.756	0.749
ACENTRIC FACTOR	0.241	0.231	0.231	0.254
VAPOR				
M KGS/HR	17.290	10.005	0.0	7.285
STD LIQ M3/HR	27.420	15.898	0.0	11.523
STD M M3/HR	5.286	3.056	0.0	2.230
ACTUAL M M3/HR	0.333	0.194	0.0	0.139
KGS/M M3	51962.477	51583.035	0.0	52513.281
Z	0.81098	0.81759	0.0	0.80160
LIQUID				
M KGS/HR	0.0	0.0	10.005	0.0
STD LIQ M3/HR	0.0	0.0	15.898	0.0
ACTUAL GPM	0.0	0.0	82.8596	0.0
M3/HR	0.0	0.0	18.820	0.0
KGS/M3	0.0	0.0	531.639	0.0
Z	0.0	0.0	0.12094	0.0

The first part of the document discusses the importance of maintaining accurate records. It emphasizes that every detail matters, from the date of entry to the specific observations made. This section also touches upon the need for consistency in reporting and the role of these records in long-term research or monitoring.

In the second section, the focus shifts to the methodology used for data collection. It describes the tools and techniques employed, ensuring that the data gathered is reliable and valid. This part also addresses potential sources of error and how they were minimized through careful planning and execution.

The third section provides a detailed account of the results obtained. It includes a summary of the key findings, supported by specific data points and observations. This section is crucial for understanding the outcomes of the study and for identifying any trends or patterns that have emerged.

Finally, the document concludes with a discussion on the implications of the findings. It reflects on the broader significance of the results and offers suggestions for future research or actions based on the current study. The conclusion also expresses gratitude to those who supported the project throughout its duration.

VERSION 0881
 SIMULATION SCIENCES, INC.
 PROJECT
 PROBLEM TIPPLANT

SM
 PROCESS
 SOLUTION

PAGE 52
 MCF&MJB

STREAM SUMMARY

STREAM ID.	9	10	11	12
NAME				
PHASE	VAPOR	VAPOR	VAPOR	VAPOR
FROM UNIT/TRAY	0/ 0	16/ 0	0/ 0	2/ 0
TO UNIT/TRAY	16/ 0	0/ 0	2/ 0	4/ 0
FROM STREAM				
KG MOL/HR	223.085	223.085	223.085	223.050
TEMPERATURE, DEG C	250.000	226.200	250.000	250.000
PRESSURE, BAR	25.000	25.000	25.000	25.000
H, MM KJ /HR	7.728	7.156	7.728	7.615
M KJ /KG MOLE	34.639	32.075	34.639	34.141
KJ /KG	965.956	894.458	965.957	951.932
MOLE FRACT LIQUID	0.0	0.0	0.0	0.0
M KGS/HR	8.000	8.000	8.000	8.000
MOLECULAR WEIGHT	35.860	35.860	35.860	35.864
STD LIQ M3/HR	15.668	15.668	15.668	15.766
DEG API	145.065	145.065	145.065	146.791
SP GR	0.5116	0.5116	0.5116	0.5085
KGS/M3	510.5818	510.5818	510.5818	507.4158
UOP K	14.042	14.042	14.042	14.064
REDUCED TEMP	2.163	2.065	2.163	2.190
REDUCED PRESS	1.102	1.102	1.102	1.098
ACENTRIC FACTOR	0.120	0.120	0.120	0.113
VAPOR				
M KGS/HR	8.000	8.000	8.000	8.000
STD LIQ M3/HR	15.668	15.668	15.668	15.766
STD M M3/HR	5.000	5.000	5.000	5.000
ACTUAL M M3/HR	0.378	0.358	0.378	0.378
KGS/M M3	21182.547	22364.012	21182.535	21185.035
Z	0.97306	0.96558	0.97306	0.97306
LIQUID				
M KGS/HR	0.0	0.0	0.0	0.0
STD LIQ M3/HR	0.0	0.0	0.0	0.0
ACTUAL GPM	0.0	0.0	0.0	0.0
M3/HR	0.0	0.0	0.0	0.0
KGS/M3	0.0	0.0	0.0	0.0
Z	0.0	0.0	0.0	0.0

100

to

The first part of the document discusses the importance of maintaining accurate records. It emphasizes that proper record-keeping is essential for the efficient operation of any organization. This includes tracking financial transactions, inventory levels, and personnel records.

In the second section, the author outlines the various methods used to collect and analyze data. These methods include surveys, interviews, and focus groups. Each method has its own strengths and weaknesses, and the choice of method depends on the specific needs of the study.

The third section describes the process of data analysis. This involves organizing the collected data into a structured format, identifying patterns and trends, and drawing conclusions based on the findings. Statistical analysis is often used to quantify the results of the study.

Finally, the document concludes by discussing the implications of the research. It highlights the ways in which the findings can be used to inform decision-making and improve organizational performance. The author also notes the limitations of the study and suggests areas for future research.

STREAM SUMMARY

STREAM ID.	13	14	15	16
NAME				
PHASE	VAPOR	MIXED	MIXED	VAPOR
FROM UNIT/TRAY	4/ 0	5/ 0	6/ 0	3/ 0
TO UNIT/TRAY	5/ 0	6/ 0	3/ 0	4/ 0
FROM STREAM				
KG MOL/HR	223.050	223.050	223.050	120.915
TEMPERATURE, DEG C	214.078	85.062	35.000	35.000
PRESSURE, BAR	25.000	25.000	25.000	25.000
H, MM KJ /HR	6.757	2.517	0.820	0.292
M KJ /KG MOLE	30.294	11.283	3.675	2.419
KJ /KG	844.666	314.606	102.461	412.105
MOLE FRACT LIQUID	0.0	0.33729	0.45790	0.0
M KGS/HR	8.000	8.000	8.000	0.710
MOLECULAR WEIGHT	35.864	35.864	35.864	5.869
STD LIQ M3/HR	15.765	15.765	15.765	4.067
DEG API	146.791	146.791	146.791	677.777
SP GR	0.5085	0.5085	0.5085	0.1748
KGS/M3	507.4155	507.4155	507.4153	174.4882
UOP K	14.064	14.064	14.064	24.239
REDUCED TEMP	2.039	1.499	1.290	5.420
REDUCED PRESS	1.098	1.098	1.098	1.771
ACENTRIC FACTOR	0.113	0.113	0.113	0.013
VAPOR				
M KGS/HR	8.000	2.637	0.710	0.710
STD LIQ M3/HR	15.765	7.161	4.067	4.067
STD M M3/HR	4.999	3.313	2.710	2.710
ACTUAL M M3/HR	0.348	0.173	0.125	0.125
KGS/M M3	22970.992	15257.656	5681.441	5681.449
Z	0.96357	0.98139	1.00810	1.00810
LIQUID				
M KGS/HR	0.0	5.363	7.290	0.0
STD LIQ M3/HR	0.0	8.604	11.698	0.0
ACTUAL GPM	0.0	47.1300	57.2670	0.0
M3/HR	0.0	10.704	13.007	0.0
KGS/M3	0.0	500.997	560.464	0.0
Z	0.0	0.11944	0.12427	0.0

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for the company's financial health and for providing reliable information to stakeholders.

2. The second part of the document outlines the specific procedures for recording transactions. It details the steps from identifying a transaction to entering it into the accounting system, ensuring that all necessary details are captured.

3. The third part of the document addresses the role of the accounting department in monitoring and controlling the company's resources. It discusses how accurate records allow for better budgeting and cost management.

4. The fourth part of the document discusses the impact of accurate records on the company's overall performance. It highlights how reliable financial data is essential for making informed strategic decisions and for maintaining the company's reputation.

5. The fifth part of the document concludes by summarizing the key points and reiterating the importance of consistent and accurate record-keeping for the long-term success of the organization.

STREAM SUMMARY

STREAM ID.	17	18	19	20
NAME				
PHASE	VAPOR	LIQUID	VAPOR	VAPOR
FROM UNIT/TRAY	4/ 0	3/ 0	5/ 0	0/ 0
TO UNIT/TRAY	13/ 0	5/ 0	9/ 0	11/ 0
FROM STREAM				
KG MOL/HR	120.915	102.135	102.135	2.700
TEMPERATURE, DEG C	230.000	35.000	180.000	20.000
PRESSURE, BAR	25.000	25.000	25.000	1.000
H, MM KJ /HR	1.151	0.527	4.767	0.001
M KJ /KG MOLE	9.515	5.162	46.678	0.399
KJ /KG	1621.186	72.316	653.988	197.764
MOLE FRACT LIQUID	0.0	1.00000	0.0	0.0
M KGS/HR	0.710	7.290	7.290	0.005
MOLECULAR WEIGHT	5.869	71.375	71.375	2.016
STD LIQ M3/HR	4.067	11.698	11.698	0.078
DEG API	677.777	95.098	95.098	1889.929
SP GR	0.1748	0.6245	0.6245	0.0700
KGS/M3	174.4882	623.1716	623.1716	69.8562
UOP K	24.239	13.074	13.074	47.444
REDUCED TEMP	8.851	0.678	0.997	8.817
REDUCED PRESS	1.771	0.758	0.758	0.077
ACENTRIC FACTOR	0.013	0.231	0.231	0.0
VAPOR				
M KGS/HR	0.710	0.0	7.290	0.005
STD LIQ M3/HR	4.067	0.0	11.698	0.078
STD M M3/HR	2.710	0.0	2.289	0.061
ACTUAL M M3/HR	0.204	0.0	0.100	0.066
KGS/M M3	3473.777	0.0	72599.312	82.673
Z	1.00977	0.0	0.65238	1.00052
LIQUID				
M KGS/HR	0.0	7.290	0.0	0.0
STD LIQ M3/HR	0.0	11.698	0.0	0.0
ACTUAL GPM	0.0	57.2671	0.0	0.0
M3/HR	0.0	13.007	0.0	0.0
KGS/M3	0.0	560.464	0.0	0.0
Z	0.0	0.12427	0.0	0.0

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31	32	33	34	35
36	37	38	39	40
41	42	43	44	45
46	47	48	49	50
51	52	53	54	55
56	57	58	59	60
61	62	63	64	65
66	67	68	69	70
71	72	73	74	75
76	77	78	79	80
81	82	83	84	85
86	87	88	89	90
91	92	93	94	95
96	97	98	99	100

STREAM SUMMARY

STREAM ID.	21	22	23	24
NAME				
PHASE	VAPOR	VAPOR	VAPOR	VAPOR
FROM UNIT/TRAY	11/ 0	13/ 0	14/ 0	18/ 0
TO UNIT/TRAY	13/ 0	14/ 0	15/ 0	0/ 0
FROM STREAM				
KG MOL/HR	2.700	123.615	123.615	4.251
TEMPERATURE, DEG C	50.000	226.935	250.000	49.143
PRESSURE, BAR	25.000	25.000	25.000	4.000
H, MM KJ /HR	0.003	1.154	1.262	0.064
M KJ /KG MOLE	1.281	9.336	10.210	15.096
KJ /KG	635.173	1613.680	1764.772	440.392
MOLE FRACT LIQUID	0.0	0.0	0.0	0.0
M KGS/HR	0.005	0.715	0.715	0.146
MOLECULAR WEIGHT	2.016	5.785	5.785	34.279
STD LIQ M3/HR	0.078	4.145	4.145	0.292
DEG API	1889.929	687.003	687.003	151.890
SP GR	0.0700	0.1729	0.1729	0.4993
KGS/M3	69.8562	172.5214	172.5213	498.2856
UOP K	47.444	24.416	24.416	14.145
REDUCED TEMP	9.719	8.877	9.287	1.409
REDUCED PRESS	1.928	1.774	1.774	0.178
ACENTRIC FACTOR	0.0	0.013	0.013	0.105
VAPOR				
M KGS/HR	0.005	0.715	0.715	0.146
STD LIQ M3/HR	0.078	4.145	4.145	0.292
STD M M3/HR	0.061	2.771	2.771	0.095
ACTUAL M M3/HR	0.003	0.208	0.217	0.028
KGS/M M3	1852.427	3444.856	3293.436	5250.582
Z	1.01269	1.00980	1.00966	0.97459
LIQUID				
M KGS/HR	0.0	0.0	0.0	0.0
STD LIQ M3/HR	0.0	0.0	0.0	0.0
ACTUAL GPM	0.0	0.0	0.0	0.0
M3/HR	0.0	0.0	0.0	0.0
KGS/M3	0.0	0.0	0.0	0.0
Z	0.0	0.0	0.0	0.0

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36	37	38	39	40
41	42	43	44	45
46	47	48	49	50
51	52	53	54	55
56	57	58	59	60
61	62	63	64	65
66	67	68	69	70
71	72	73	74	75
76	77	78	79	80
81	82	83	84	85
86	87	88	89	90
91	92	93	94	95
96	97	98	99	100

STREAM SUMMARY

STREAM ID.	25	71	91
NAME			
PHASE	LIQUID	LIQUID	VAPOR
FROM UNIT/TRAY	18/ 0	17/ 0	15/ 0
TO UNIT/TRAY	20/ 0	18/ 0	0/ 0
FROM STREAM			
KG MOL/HR	132.109	136.360	223.085
TEMPERATURE, DEG C	49.143	50.000	242.511
PRESSURE, BAR	4.000	25.000	25.000
H, MM KJ /HR	0.999	1.064	7.546
M KJ /KG MOLE	7.565	7.799	33.826
KJ /KG	101.360	106.295	943.265
MOLE FRACT LIQUID	1.00000	1.00000	0.0
M KGS/HR	9.859	10.005	8.000
MOLECULAR WEIGHT	74.632	73.373	35.860
STD LIQ M3/HR	15.605	15.898	15.668
DEG API	91.999	92.872	145.065
SP GR	0.6331	0.6307	0.5116
KGS/M3	631.8105	629.3542	510.5818
UOP K	12.971	12.988	14.042
REDUCED TEMP	0.689	0.702	2.132
REDUCED PRESS	0.120	0.756	1.102
ACENTRIC FACTOR	0.235	0.231	0.120
VAPOR			
M KGS/HR	0.0	0.0	8.000
STD LIQ M3/HR	0.0	0.0	15.668
STD M M3/HR	0.0	0.0	5.000
ACTUAL M M3/HR	0.0	0.0	0.371
KGS/M M3	0.0	0.0	21538.801
Z	0.0	0.0	0.97086
LIQUID			
M KGS/HR	9.859	10.005	0.0
STD LIQ M3/HR	15.605	15.898	0.0
ACTUAL GPM	78.1985	79.4570	0.0
M3/HR	17.761	18.047	0.0
KGS/M3	555.123	554.405	0.0
Z	0.02007	0.12315	0.0

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SM
PROCESS SIMULATION PROGRAM - VERSION 0881

SM
PROCESS OUTPUT DIRECTORY - TIPPLANT
MCF&MJB

INPUT PRINTOUT

GENERAL - P. 1
COMP - P. 2
THERMO - P. 4
STREAM - P. 5
UNIT 1, P1 , - P. 7
UNIT 2, R1 , - P. 8
UNIT 3, FL1 , - P. 9
UNIT 4, HX3 , - P. 10
UNIT 5, HX1 , - P. 11
UNIT 6, HX4 , - P. 12
UNIT 7, S1 , - P. 13
UNIT 8, HX5 , - P. 14
UNIT 9, M3 , - P. 15
UNIT 10, HX6 , - P. 16
UNIT 11, C1 , - P. 17
UNIT 12, , - P. 18
UNIT 13, M2 , - P. 19
UNIT 14, HX7 , - P. 20
UNIT 15, M1 , - P. 21
UNIT 16, HX2 , - P. 22
UNIT 17, HX8 , - P. 23
UNIT 18, FL2 , - P. 24
UNIT 19, O1 , - P. 25
UNIT 20, O7 , - P. 26
RECYCLE - P. 27
UNIT STREAM RELATIONS - P. 28
INPUT IN ORDER

UNIT 1, P1 , SOLVED
UNIT 11, C1 , SOLVED
UNIT 2, R1 , SOLVED
UNIT 3, FL1 , SOLVED
UNIT 4, HX3 , SOLVED
UNIT 5, HX1 , SOLVED
UNIT 6, HX4 , SOLVED
UNIT 7, S1 , SOLVED
UNIT 8, HX5 , SOLVED
UNIT 9, M3 , SOLVED
UNIT 10, HX6 , SOLVED
UNIT 12, , SOLVED
UNIT 13, M2 , SOLVED
UNIT 14, HX7 , SOLVED
UNIT 15, M1 , SOLVED
UNIT 16, HX2 , SOLVED
LOOP 1 SOLVED AFTER 1 TRIALS
UNIT 17, HX8 , SOLVED
UNIT 18, FL2 , SOLVED

*** PROBLEM SOLUTION REACHED ***

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HEAT EXCHANGER UNIT 10, HX6 - P. 37
HEAT EXCHANGER UNIT 14, HX7 - P. 38
HEAT EXCHANGER UNIT 16, HX2 - P. 39
HEAT EXCHANGER UNIT 17, HX8 - P. 40

1952

1953

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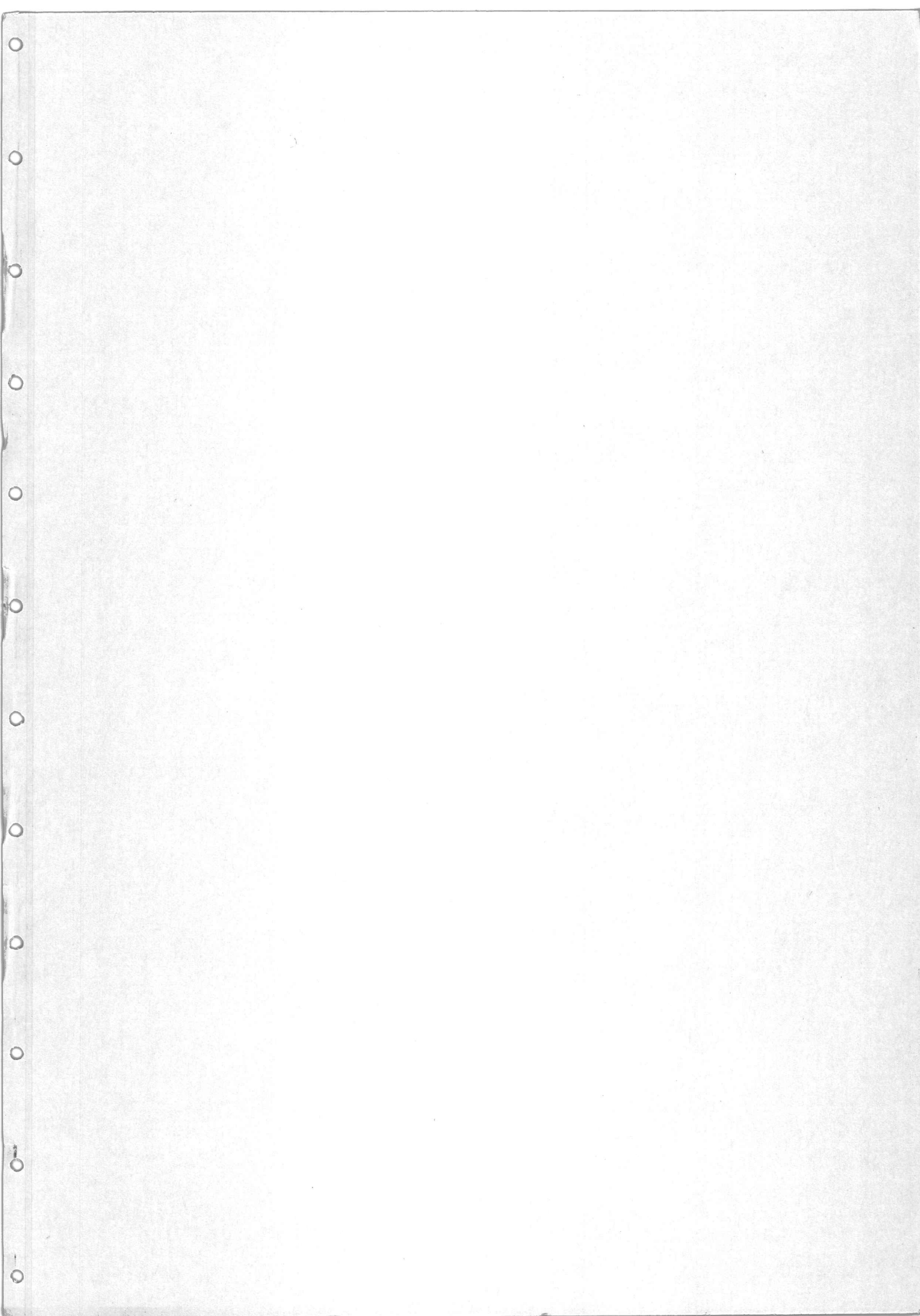
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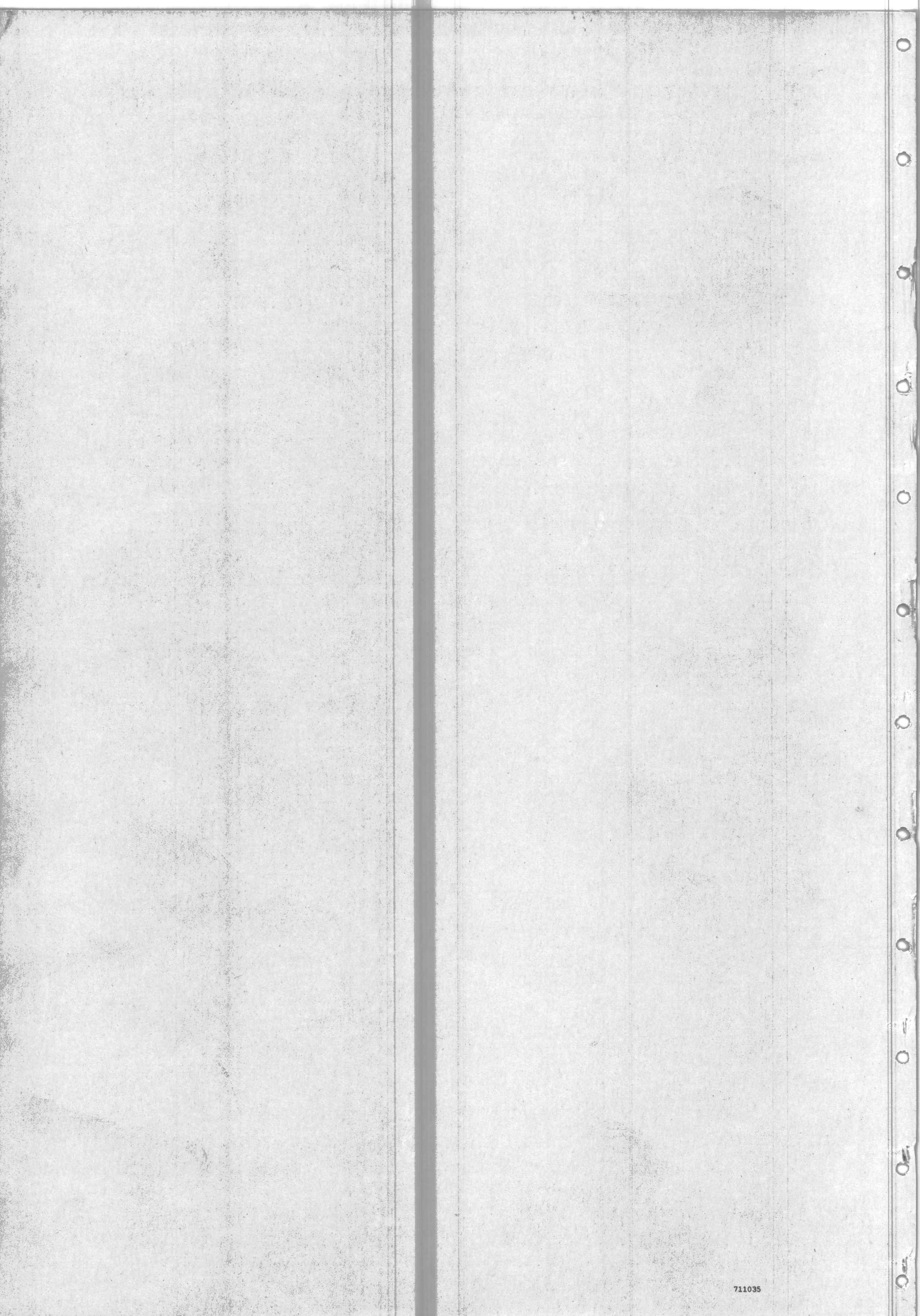
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STREAM COMPONENT MOLAL RATES	- P. 46
STREAM SUMMARY	- P. 50

**SIMSCI ROYALTY IS 88.80 PROCESS CHARGE UNITS





2313/84

Nr: 2577

Laboratorium voor Chemische Technologie

Verslag behorende
bij het fabrieksvoorontwerp
van

.....M. J. Baerken..... en..... M. C. Franken.....

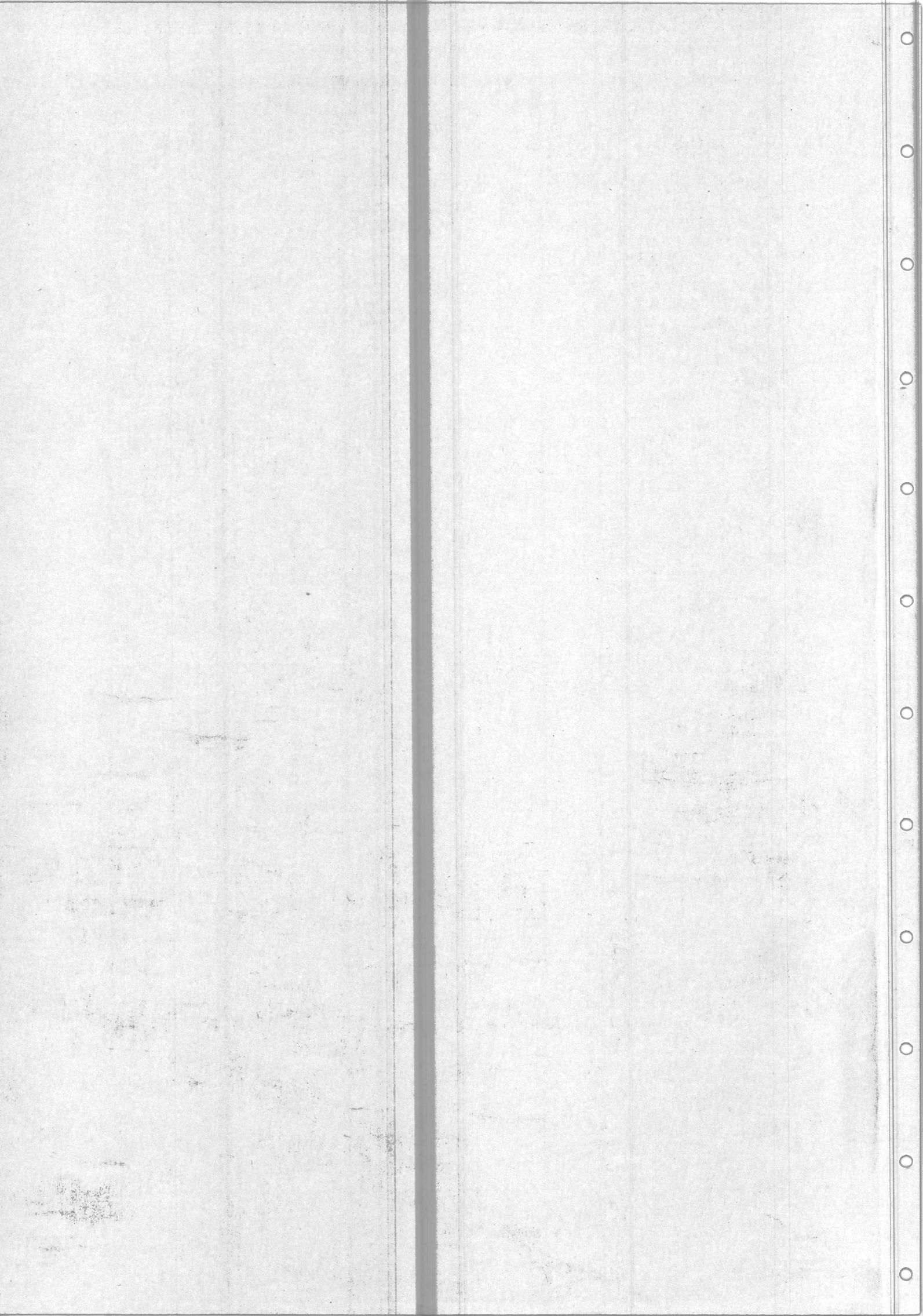
onderwerp:

.....C₅/C₆ isomerisatie.....

.....Total Isomerisation Process (TIP).....

adres: Jan Campertlaan 13, Delft
Nassaulaan 56, Hilversum

opdrachtdatum: oktober '83
verslagdatum: februari '84



C_5/C_6 isomerisatie

Total Isomerisation Process (TIP)

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Verslagdatum: februari 1984

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1. Samenvatting

In dit fabrieksvoorontwerp werden de twee bedrijfsvoeringen van het Total Isomerisation Process (TIP), te weten max-octane- en max-yield-configuratie, met het commerciële simulatieprogramma PROCESS door-gerekend. Hiertoe werd een zelfgeschreven reactormodule aan dit pro-gramma toegevoegd. De standaard PROCESS-reactor kan, uitgaande van het bereiken van evenwicht, slechts één reactie aan; voor het TIP-proces (C_5/C_6 isomerisatie) is dit te weinig.

Het gehele proces (d.w.z. isomerisatie, adsorptie en desorptie) vindt plaats in de gasfase bij een druk van 25 bar en een temperatuur van $250^{\circ}C$. De isomerisatiereactor wordt uitgevoerd als gepakt-bed-reactor, gevuld met "dual function" platina op zeoliet katalysator. De adsorp-tie van de normaalalkanen vindt plaats in een gepakt bed van molzeef 5A. Bij de desorptie wordt waterstof gebruikt als purgegas. De space velocity in de reactor bedraagt 3 (vol/(vol.hr)) en de waterstof/kool-waterstof molverhouding 1,1.

Uitgegaan werd van een voeding met RON-waarde van 71,9, een capaci-teit van 240 ton/~~jaar~~^{jaar} en een belasting van 8000 uur/jaar.

In een once through configuratie (zonder recycle) verhoogt de reactor in een operatiegebied van $150-300^{\circ}C$ de RON-waarde van de voeding met 11 (bij $150^{\circ}C$) tot 7,6 (bij $300^{\circ}C$) eenheden.

Bij het doorrekenen van de twee configuraties bleek voor de gebruik-te voeding de max-yield-configuratie de meest gunstige. Er wordt een octaangetalverhoging bereikt t.o.v. de voeding van 16,3 RON-een-heden. De kosten per RON-barrel bedragen 0,13 \$ ('82).

2. Conclusie

-Het doorrekenen van de TIP-plant met PROCESS leverde geen ernstige problemen op. De handleiding blijkt na enige bestudering redelijk duidelijk.

-Door het gebrek aan tijd is het ons niet gelukt een universele, breed toepasbare reactormodule te schrijven; de zelfgeschreven reactor bevat alleen de evenwichtsgegevens van de C_4 , C_5 en C_6 isomerisatieevenwichten als functie van de temperatuur.

-De problemen die ontstonden bij het toevoegen van de eigen reactor-module aan PROCESS werden voornamelijk veroorzaakt door de ingewikkeldheid van de Job Control Language (JCL) van het Amdahl-systeem.

Omdat deze problemen zijn opgelost is het in de toekomst voor iedereen mogelijk zijn eigen programma's in PROCESS in te bouwen.

-Omdat de mogelijkheden die PROCESS biedt bij het schrijven van een eigen subroutine enorm zijn, zal een aanzienlijk breder toepassingsgebied ontstaan.

3. Inleiding

3.1. Het simulatieprogramma PROCESS

Sinds enige tijd heeft onze afdeling de beschikking over het commerciële simulatieprogramma PROCESS. Om hiermee meer ervaring op te doen werd aan D.J. Sinke en H.R. Tijsseling in het kader van hun fabrieksvoorontwerp de opdracht gegeven een eenvoudig bestaand proces met dit programma door te rekenen. Als proces werd een C_5/C_6 -gasfase-isomerisatieproces gekozen. Zij slaagden er weliswaar in het gehele proces te simuleren, maar moesten wat betreft het reactorgedeelte grote vereenvoudigingen aanbrengen. De PROCESS-reactor-module kan namelijk, uitgaande van het bereiken van evenwicht, slechts één reactie aan.

In principe is het mogelijk PROCESS uit te breiden met eigen programma's (USER ADDED SUBROUTINES). Om deze mogelijkheid te onderzoeken werd aan ons de opdracht gegeven een eigen isomerisatiereactor aan PROCESS toe te voegen. In het vervolg zouden dan ook anderen eigen programma's kunnen toevoegen, wat PROCESS breder toepasbaar zou maken.

3.2. Isomerisatie

Bij het raffinageproces wordt uit ruwe olie een reeks halffabricaten gewonnen, waaronder lichte (C_5-C_7) en zware (C_6-C_{10}) naphta's. Van deze naphta's gaat men uit bij de productie van de benzines. Voor het goed functioneren van een verbrandingsmotor is het belangrijk dat er tijdens de compressieslag geen zelfontbranding van het gasmengsel optreedt (kloppen). Een maat voor de klopvastheid van de brandstof is het octaangetal. Hoe hoger het octaangetal des te lager is de neiging tot dit kloppen.

Om nu laag octaan naphta's om te zetten in producten met betere verbrandingskwaliteiten vindt in het raffinageproces "reforming" plaats. Een van deze reformingsprocessen is het isomerisatieproces. Hierbij worden (lineaire) koolwaterstoffen omgezet in hun meer vertakte isomeren, die een hoger octaangetal hebben.

Het octaangetal van de naphta's kan ook verhoogd worden door toevoeging van bepaalde stoffen (additives). Een van de meest gebruikte additives is het tetra-ethyl-lood (TEL). Met het oog op de schadelijke effecten van lood op het milieu wordt er echter door de verschillende overheden naar gestreefd de hoeveelheid TEL in de benzine te verminderen en op den duur deze additive geheel te verbieden.

3.3. C_5/C_6 gasfase isomerisatieprocessen

In de literatuur (lit. 18 en 19) worden de volgende C_5/C_6 gasfase isomerisatieprocessen beschreven:

- 1) Het Shell Hysomer proces (fig. 3.1) dat gekoppeld met een Isosiv scheidingsunit (fig. 3.2) het total isomerisation process (TIP) vormt (fig. 3.3)

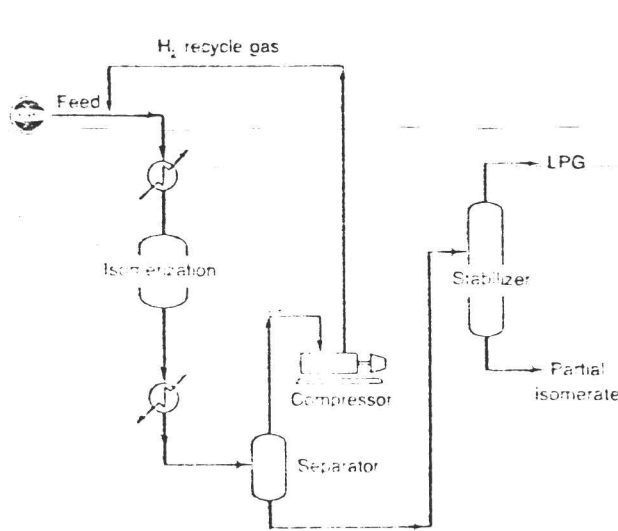


fig. 3.1 Shell Hysomer proces

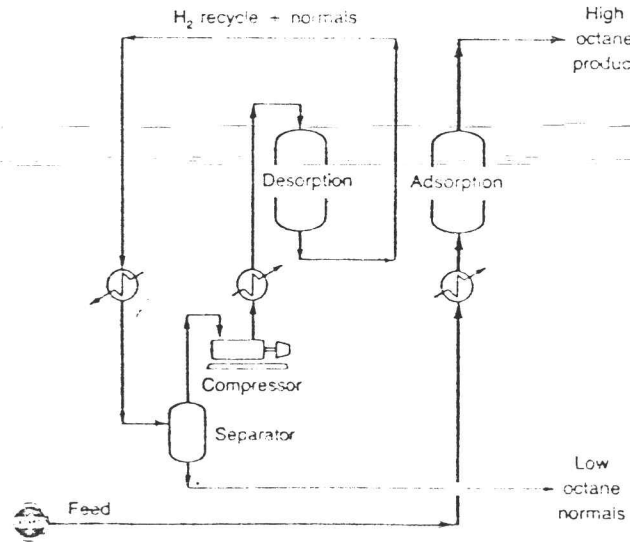


fig. 3.2 Isosiv proces

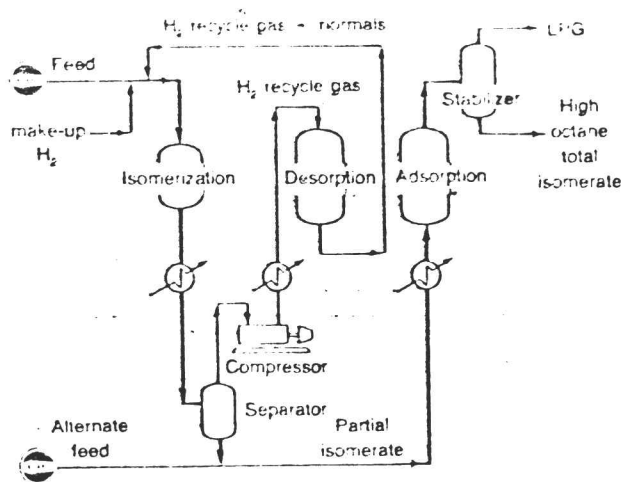


fig 3.3 TIP-proces

2) Het UOP Penex proces (fig. 3.4)

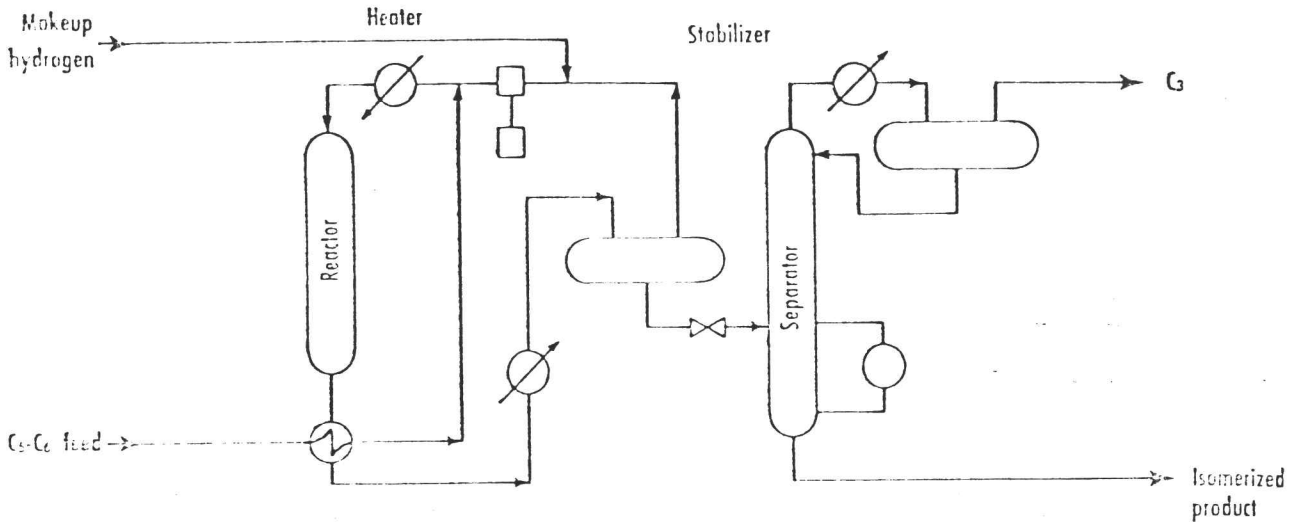


fig. 3.4 Penex proces

3) Het BP isomerisatieproces (fig. 3.5)

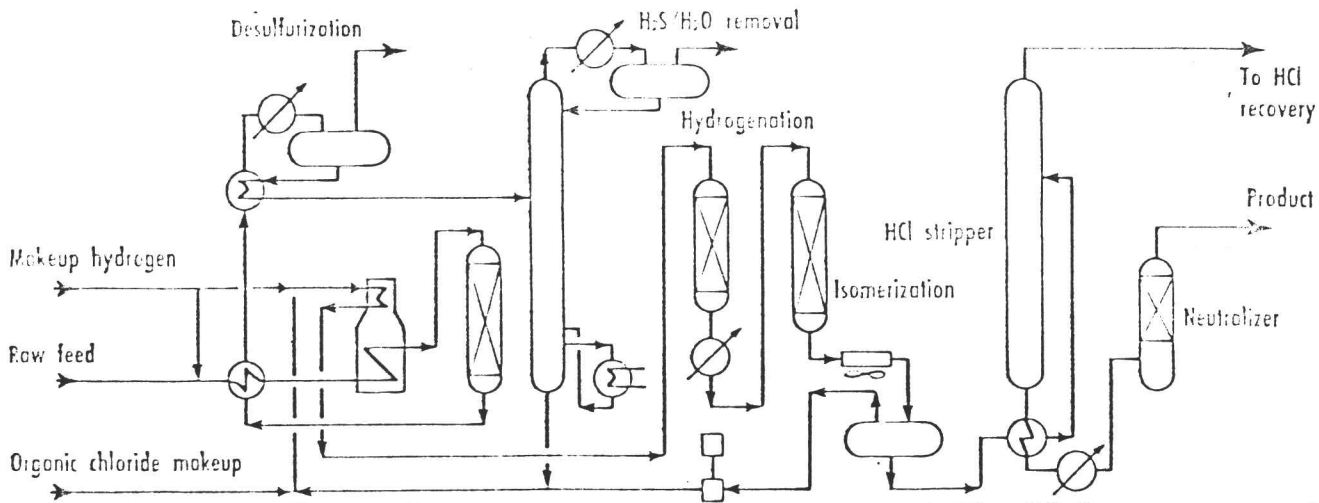


fig. 3.5 BP isomerisatieproces

3.4. Opdracht

Onze opdracht kan als volgt worden samengevat:

- 1) Het toevoegen van een eigen isomerisatiereactor aan PROCESS.
- 2) Het bepalen van de invloed van de reactortemperatuur op het isomerisatieproduct.
- 3) Het doorrekenen van een C_5/C_6 isomerisatieproces met de aangepaste versie van PROCESS.
- 4) Het bepalen van de meest gunstige configuratie voor dit isomerisatieproces.

4. Uitgangspunten voor het ontwerp

4.1. Proceskeuze

Van de in het vorige hoofdstuk beschreven processen hebben wij, om te kunnen vergelijken, evenals Sinke en Tijsseling (lit.17) het TIP-proces als uitgangspunt voor ons ontwerp genomen. Dit proces vergt, in tegenstelling tot de beide andere, geen constante toevoeging van katalysator of corrosieve (HCl) activator. Drogen en ontzwellen van de voeding is al evenmin nodig. Uit de literatuur (lit. 9,12,18,19 en 20) zijn de volgende gegevens over het proces verzameld:

Het TIP-proces is een integratie van de Shell Hysomer en Union Carbide Isosiv processen. In het Hysomer gedeelte vindt de isomerisatie, in het Isosiv gedeelte de scheiding tussen normaal- en isoalkanen plaats. De recycle waterstof uit het Hysomer proces wordt in het Isosiv gedeelte gebruikt als purgegas bij de desorptie van de normaalalkanen. Hierdoor wordt een TIP-unit 20% goedkoper dan twee aparte Hysomer en Isosiv-units samen.

Het gehele proces (d.w.z. isomerisatie, adsorptie en desorptie) vindt plaats in de gasfase bij constante druk.

De isomerisatiereactor wordt uitgevoerd als gepakt-bed-reactor, gevuld met "dual function" platina op zeoliet katalysator.

Typische procescondities voor deze isomerisatiereactor zijn:

Temperatuur	230 - 280 graden C
Druk	15 - 35 bar
H ₂ -koolwaterstof molverhouding	1 - 4
Space velocity (vol/vol/hr)	1 - 3

De adsorptie van de normaalalkanen vindt plaats in een gepakt bed van molzeef 5A. Om een zoveel mogelijk continue procesvoering te bewerkstelligen worden het adsorptie- en het desorptievat cyclisch verwisseld. De benodigde tijd voor één cyclus bedraagt tussen de 5 en 10 minuten. Regeneratie vindt "in situ" plaats door afbranden.

We vinden het TIP-proces in twee uitvoeringen: maximum yield en maximum octane configuratie. In het eerste geval wordt de verse voeding eerst door de n/iso-scheider gevoerd, waarna alleen de

n-alkanen naar de reactor gaan. In het tweede geval voert men de voeding eerst naar de reactor.

Om een verantwoorde keuze te kunnen maken zijn beide configuraties in dit ontwerp doorgerekend.

De verhoging van het octaangetal ten opzichte van de voeding bedraagt in het "once through" Hysomer proces ongeveer 10, in het TIP-proces ongeveer 20 eenheden (RON). Een en ander wordt nog eens verduidelijkt in figuur 4.1.

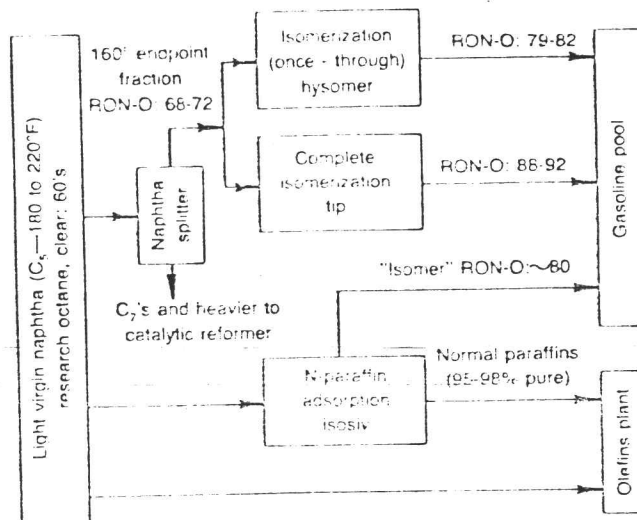


fig. 4.1 RON-verhoging bij verschillende processen (lit. 20)

4.2. Voeding en capaciteit

Ook wij zijn uitgegaan van een voeding van 10 ton per uur, een jaarlijks aantal bedrijfsuren van 8000 en een voedingssamenstelling zoals die door Kouwenhoven en van Zijll Langhout (lit. 12) wordt vermeld:

tabel 4.1 Samenstelling van de voeding voor het TIP-proces

component	samenstelling		octaangetal(lit. 1) (RON)
	(gew%)	(mol%)	
n-butaaan	0.5	0.6	94.0
i-butaaan	0.2	0.3	100.0
n-pentaaan	44.6	46.2	62.0
i-pentaaan	29.3	30.4	90.0
n-hexaaan	6.7	5.8	25.0
2-me-pentaaan	9.3	8.1	73.5
3-me-pentaaan	4.6	4.0	74.5
2,2-dime-butaaan	0.6	0.5	92.0
2,3-dime-butaaan	1.8	1.6	103.5
cyclopentaaan	2.2	2.3	102.5
me-cyclopentaaan	0.2	0.2	91.5

De voeding heeft een octaangetal van 71.9

RON = 71.9

4.3. Corrosie, giftigheid en explosiegrenzen

Uit de literatuur (lit. 10 en 15) blijkt dat de in het proces aanwezige stoffen geen of nauwelijks corrosie veroorzaken. Bij de constructie behoeven derhalve geen bijzondere maatregelen genomen te worden.

Ook de giftigheid van de gebruikte componenten is gering. In tabel 4.2 zijn de MAC-waarden, ontleend aan Ullmann (lit. 22) verzameld.

tabel 4.2 MAC(Maximaal Aanvaarde Concentratie)-waarden*

component	MAC-waarde (in parts per million)
n-butaaan	1000
i-butaaan	1000
n-pentaaan	1000
i-pentaaan	1000
n-hexaaan	500
2-me-pentaaan	100

* van de overige componenten werd geen MAC-waarde vermeld

In tabel 4.3 zijn voor de in het proces voorkomende componenten de vlampunten, de explosiegrenzen in lucht bij 20°C en de ontstekings temperatuur verzameld.

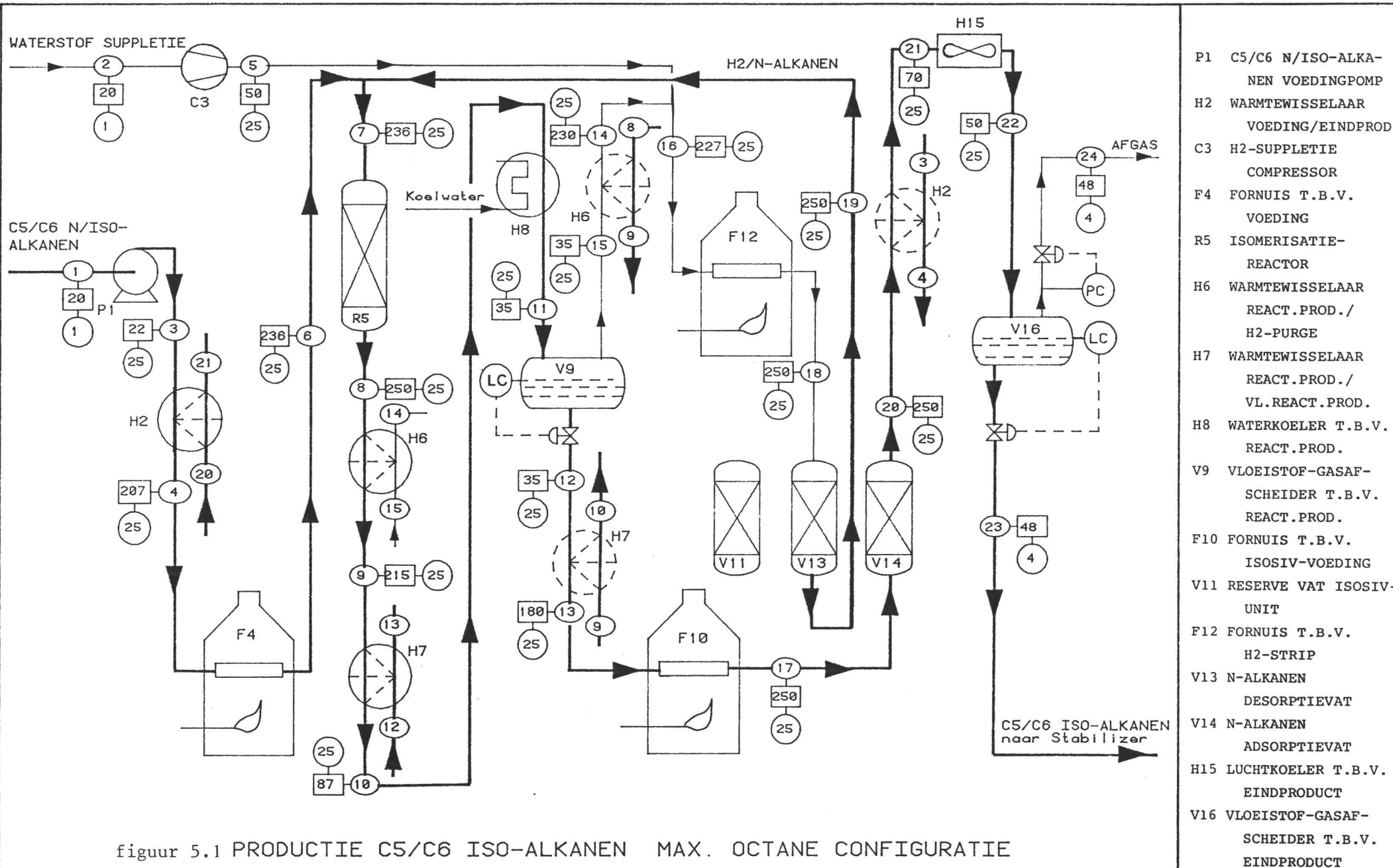
tabel 4.3 vlampunten, explosiegrenzen en ontstekings temperatuur

component	vlampunt (°C)	explosiegrenzen (vol%)		ontstekings temp. (°C)
		onder	boven	
n-butaan	-	1.9	8.4	365
i-butaan	<-20	1.8	8.5	460
n-pentaaan	<-20	1.4	7.8	285
i-pentaaan	<-20	1.3	7.6	420
n-hexaaan	<-20	1.2	7.4	240
2-me-pentaaan	<-20	1.0	7.4	260
3-me-pentaaan	<-20	1.2	7.0	300
2,2-dime-butaan	-	-	-	-
2,3-dime-butaan	<-20	1.2	7.0	415
cyclopentaaan	<-20	-	-	380
me-cyclopentaaan	<-10	-	-	315
waterstof	-77	3.8	22	472

5. Beschrijving van het proces

5.1. Max-octane-configuratie (zie ook figuur 5.1)

De voedingsstroom 1 wordt met pomp P1 op een druk van 25 bar gebracht en gaat naar warmtewisselaar H2, waar warmte wordt gewisseld met het gasvormige product uit het adsorptievat. Met een fornuis wordt de voeding verder verwarmd, zodanig dat na menging met de n-alkanen recyclestream uit het desorptievat (stroom 19) de temperatuur 236°C bedraagt. In de isomerisatiereactor wordt deze stroom door de vrijkomende warmte opgewarmd tot 250°C . Het reactorproduct gaat naar warmtewisselaar H6, waar warmte wordt gewisseld met de koude recycle waterstof (35°C stroom 15) en vervolgens naar warmtewisselaar H7. Hier wordt warmte gewisseld met het vloeibare product uit gas/vloeistof scheider V9. Met koelwater wordt verder gekoeld tot een temperatuur van 35°C , waarna scheiding tussen waterstof en alkanen optreedt in gas/vloeistofafscheider V9. De recycle waterstof wordt, na opgewarmd te zijn door het hete reactorproduct samen met de waterstofsuppletie in fornuis F12 verwarmd tot 250°C en gebruikt om de geadsorbeerde n-alkanen te desorberen en terug te voeren naar de reactor. De afgescheiden alkanen uit V9 worden, na ook door het hete reactorproduct te zijn opgewarmd in fornuis F10 verwarmd tot 250°C en naar de scheidingsunit (adsorptievat V14) gevoerd. De niet geadsorbeerde iso-alkanen (stroom 20) worden eerst gekoeld met de koude voeding tot 70°C en vervolgens met lucht tot 50°C . In flashvat V16 wordt ~~dan~~ de druk verlaagd van 25 tot 4 bar en de nog aanwezige waterstof verwijderd. Het vloeibare product gaat vervolgens naar de stabilizer-kolom, waar de C3-componenten afgescheiden worden.



- P1 C5/C6 N/ISO-ALKANEN VOEDINGPOMP
- H2 WARMTEWISSELAAR VOEDING/EINDPROD.
- C3 H2-SUPPLETIE COMPRESSOR
- F4 FORNUIS T.B.V. VOEDING
- R5 ISOMERISATIE-REACTOR
- H6 WARMTEWISSELAAR REACT.PROD./ H2-PURGE
- H7 WARMTEWISSELAAR REACT.PROD./ VL.REACT.PROD.
- H8 WATERKOELEER T.B.V. REACT.PROD.
- V9 VLOEISTOF-GASAFSCHEIDER T.B.V. REACT.PROD.
- F10 FORNUIS T.B.V. ISOSIV-VOEDING
- V11 RESERVE VAT ISOSIV-UNIT
- F12 FORNUIS T.B.V. H2-STRIP
- V13 N-ALKANEN DESORPTIEVAT
- V14 N-ALKANEN ADSORPTIEVAT
- H15 LUCHTKOELEER T.B.V. EINDPRODUCT
- V16 VLOEISTOF-GASAFSCHEIDER T.B.V. EINDPRODUCT

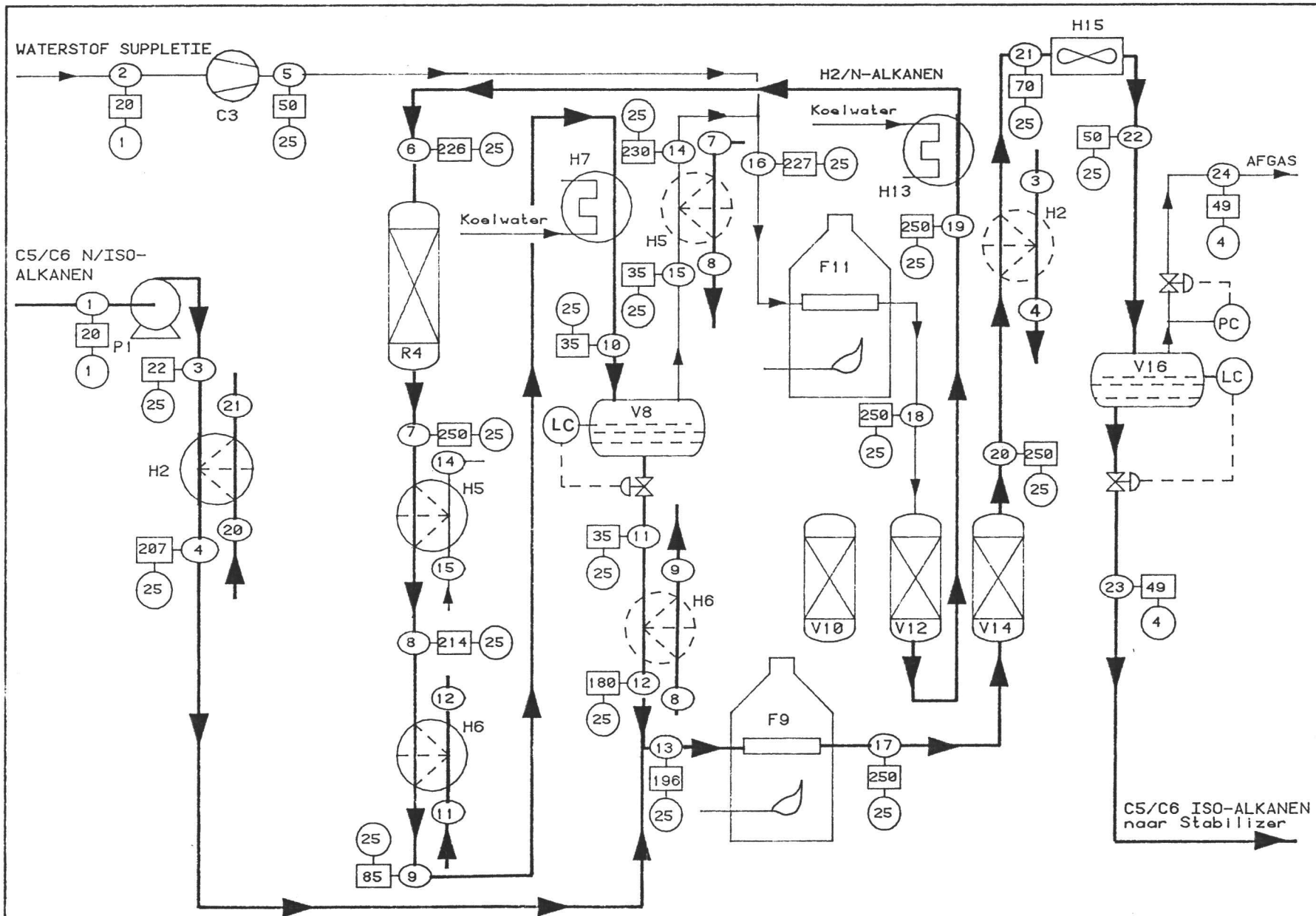
figuur 5.1 PRODUCTIE C5/C6 ISO-ALKANEN MAX. OCTANE CONFIGURATIE

○ Stroomnummer □ Temperatuur in °C ○ Absolute druk in Bar

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5.2. Max-yield-configuratie (zie ook figuur 5.2)

Voedingsstroom 1 wordt met pomp P1 op een druk van 25 bar gebracht en naar warmtewisselaar H2 geleid. Daar wordt warmte gewisseld met de gasvormige iso-alkanen die het adsorptievat verlaten. Deze stroom wordt vervolgens gemengd met het in V8 afgescheiden vloeibare gedeelte van het reactorproduct. In fornuis F9 worden deze stromen verwarmd tot 250°C en gaan naar het adsorptievat. De niet geadsorbeerde iso-alkanen vervolgen verder hun weg zoals in de max-octane-configuratie. De geadsorbeerd n-alkanen worden door de tot 250°C verwarmde recycle en suppletie waterstof gestript en naar de reactor gevoerd. De reacties verhogen ditmaal de temperatuur van 226°C tot 250°C. Het hete reactorproduct wordt gekoeld, eerst met de recycle waterstof, daarna met het vloeibaar gemaakte gedeelte van het reactor product. De temperatuur van de stroom (stroom 9) bedraagt dan nog 85°C, waarna verder gekoeld wordt met koelwater. De fasescheiding vindt plaats in gas/vloeistof afscheider V8.



- P1 C5/C6 N/ISO-ALKANEN VOEDINGPOMP
- H2 WARMTEWISSELAAR VOEDING/EINDPROD.
- C3 H2-SUPPLETIE COMPRESSOR
- R4 ISOMERISATIE-REACTOR
- H5 WARMTEWISSELAAR REACT.PROD./H2-PURGE
- H6 WARMTEWISSELAAR REACT.PROD./VL.REACT.PROD.
- H7 WATERKOELER T.B.V. REACT.PROD.
- V8 VLOEISTOF-GASAFSCHEIDER T.B.V. REACT.PROD.
- F9 FORNUIS T.B.V. ISOSIV-VOEDING
- V10 RESERVE VAT ISOSIV-UNIT
- F11 FORNUIS T.B.V. H2-STRIP
- V12 N-ALKANEN DESORPTIEVAT
- H13 WATERKOELER T.B.V. DESORPTIE STROOM
- V14 N-ALKANEN ADSORPTIEVAT
- H15 LUCHTKOELER T.B.V. EINDPRODUCT
- V16 VLOEISTOF-GASAFSCHEIDER T.B.V. EINDPRODUCT

figuur 5.2 PRODUCTIE C5/C6 ISO-ALKANEN MAX. YIELD CONFIGURATIE

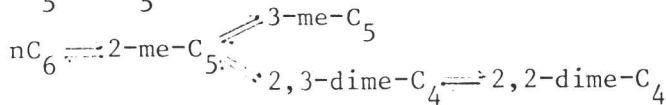
○ Stroomnummer □ Temperatuur in °C ○ Absolute druk in Bar

Margot Baerken Fabrieksvoorontwerp No.2577
 Marcel Franken Januari 1984

6. Procescondities

6.1. Het reactieevenwicht

In de isomerisatiereactor treden de volgende evenwichten op:



Over de kinetiek van deze reacties is weinig bekend. Omdat in de literatuur echter steeds gevonden wordt dat het reactieproduct in evenwicht is bij een temperatuur boven de 200°C, kunnen wij ook van de -wel goed bekende- evenwichtssamenstelling uitgaan. Deze evenwichtssamenstelling is in onderstaande figuur (fig. 6.1) weergegeven als functie van de temperatuur:

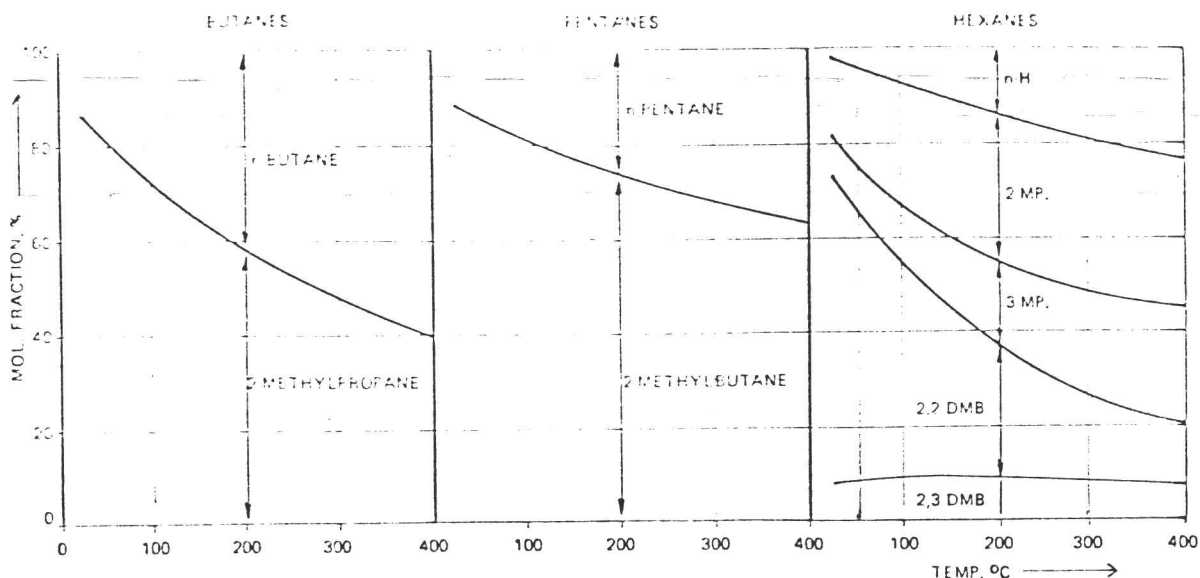


fig. 6.1 Evenwichtssamenstelling van C₄, C₅ en C₆ als functie van de temperatuur.

Met behulp van een parameteroptimaliseringsprogramma volgens Marquardt zijn uit fig. 6.1 de evenwichtsconcentraties van de verschillende componenten als functie van de temperatuur (150-300°C) bepaald. Hetzelfde is ook gebeurd met de reactieenthalpieën (lit.11). Deze waarden zijn verzameld in tabel 6.1

Handwritten notes:
 100%
 200°C
 300°C

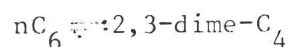
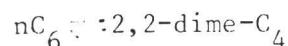
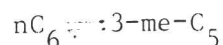
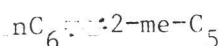
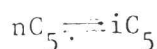
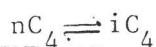
tabel 6.1 Evenwichtsconcentraties als functie van de temperatuur*

component	hoeveelheid in evenwichtsmengsel [†] (resp. C ₄ , C ₅ en C ₆ mol%)	ΔH (kJ/kmol)
n-butaan	-6,0 + 3,42 √T	-
i-butaan	89.exp(-0,0022.T)	-6930
n-pentaaan	0,075.T + 11	-
2-me-butaan	- 0,075.T + 89	-8060
n-hexaan	0,06.T + 2	-
2-me-pentaaan	18,5 + 0,09.T - 1,5.10 ⁻⁵ .T ²	-7200
3-me-pentaaan	0,05.T + 7,3	-4700 + 2,8.T
2,2-dime-butaan	67.exp(-0,0043.T)	-18300
2,3-dime-butaan	9	-10600

[†] correlatiecoëfficiënten >0,99

*T in graden Celcius

Hierbij werd uitgegaan van het voorkomen van de volgende reacties:



De reactie 2,3-dime-C₄ ↔ 2,2-dime-C₄ wordt dus opgebouwd gedacht uit de reacties 2,3-dime-C₄ ↔ nC₆ en nC₆ ↔ 2,2-dime-C₄

Voor de reactieenthalpieën maakt dit geen verschil, want deze zijn onafhankelijk van de gevolgde weg.

6.2. Invloed van temperatuur en druk

Met behulp van de eigen reactormodule is de invloed van de temperatuur op de samenstelling en het RON-getal van het reactorproduct bekeken in een "once through" Hysomer configuratie.

De samenstellingen en RON-waarden voor een temperatuur van 150, 200, 250 en 300°C zijn verzameld in tabel 6.2

tabel 6.2 Samenstelling en RON-waarde van het reactorproduct bij 150, 200, 250 en 300°C

component	samenstelling (mol%)				voeding
	150	200	250	300	
n-butaan	0.3	0.4	0.4	0.5	0.6
i-butaan	0.6	0.5	0.5	0.4	0.3
n-pentaaan	17.0	19.9	22.8	25.7	46.2
i-pentaaan	59.6	56.7	53.8	50.9	30.4
n-hexaaan	2.2	2.8	3.4	4.0	5.8
2-me-pentaaan	5.7	6.1	6.3	6.4	8.1
3-me-pentaaan	3.0	3.5	4.0	4.5	4.0
2,2-dime-butaan	7.0	5.7	4.6	3.7	0.5
2,3-dime-butaan	1.8	1.8	1.8	1.8	1.6
cyclopentaaan	2.3	2.3	2.3	2.3	2.3
me-cyclopentaaan	0.2	0.2	0.2	0.2	0.2
RON :	82.9	81.6	80.5	79.5	71.9
ad.temp.stijging:	16.2°C	13.3°C	10.9°C	8.8°C	

Het octaangetal van het reactorproduct neemt af bij toenemende temperatuur. Hetzelfde verschijnsel vinden we in literatuur 20, zoals we kunnen zien in figuur 6.2

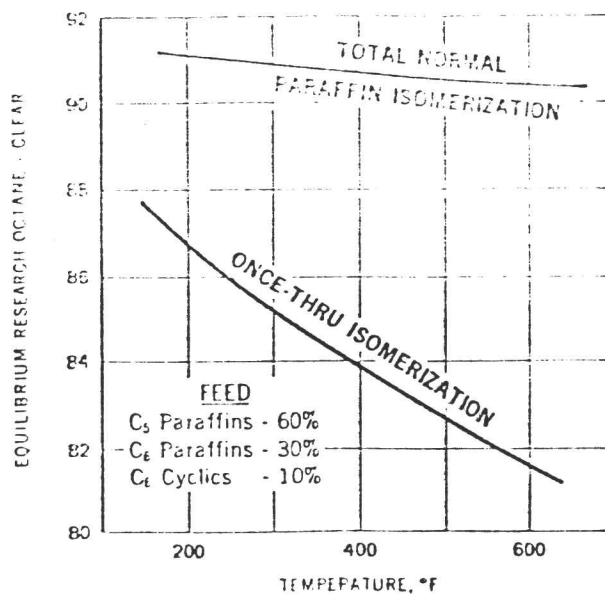


fig. 6.2 RON-waarde van het in evenwicht zijnde reactorproduct als functie van T

Uit figuur 6.2 blijkt tevens dat voor het TIP-proces de reactor-temperatuur slechts een geringe invloed op het octaangetal van het product heeft.

Met het oog op het bereiken van evenwicht en de koolafzetting op de katalysator wordt in de literatuur steeds een temperatuur tussen de 230 en de 280°C gekozen. Daarom leek ons 250°C een geschikte temperatuur voor ons proces.

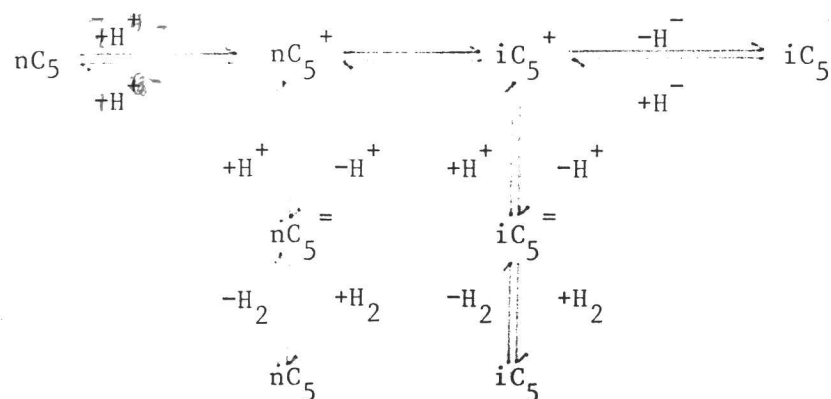
Omdat het aantal moleculen tijdens de reactie gelijk blijft heeft de druk geen invloed op de ligging van het evenwicht. Voor de druk in het proces wordt de gemiddelde literatuurwaarde van 25 bar gekozen (lit. 15-35 bar).

6.3. Katalysator

De katalysator voor de isomerisatiereactie is een zogenaamde "dual function catalyst", in dit geval fijn gedispergeerd platina op een zure zeoliet.

Het platina katalyseert de hydrogenerings/dehydrogenerings-stap en stabiliseert de conversie, reeds bij zeer lage beladingen ($2,5 \cdot 10^{-5}$ mol Pt/100 g zeoliet).

De zure plaatsen op de zeoliet zorgen voor de isomerisatiereacties. Voor pentaan is het isomerisatiemechanisme als volgt weer te geven:



Bij het isomerisatieproces kunnen tevens olefinen gevormd worden. Deze olefinen veroorzaken koolafzetting op de katalysator, wat deactivering tot gevolg heeft. Vanwege de overmaat aan waterstof, de vrij lage temperatuur en de hoge druk blijft de olefinenconcentratie echter laag.

6.4. De normaal/iso-scheiding

De scheiding tussen normaal- en isoalkanen vindt plaats in de gasfase d.m.v. molzeef 5A. De poriediameter van deze molzeef is juist groot genoeg om de n-alkanen te kunnen adsorberen en de iso-alkanen niet.

We nemen aan dat de vrijkomende adsorptiewarmte geheel ten goede komt aan de temperatuurstijging van het bed. Evenzo wordt de desorptiewarmte aan het bed onttrokken. De temperatuur van de stroom die het bed binnenkomt is dan ook de temperatuur van de stroom die het bed verlaat.

Als het adsorptiefront een bepaalde bedhoogte bereikt heeft wordt het adsorptievat verwisseld met het -inmiddels schone- desorptievat. De geadsorbeerde normaalalkanen worden met een waterstofstroom gestript.

De te adsorberen stroom, de waterstof en de te desorberen n-alkanen hebben bij het betreden en verlaten van het bed een temperatuur van 250⁰C.

Bij deze temperatuur treedt koolafzetting op, wat tot geringere activiteit leidt. Regenereren gebeurt "in situ" door afbranden.

7. Keuze en berekening van de apparatuur

7.1. Pompen en compressoren

Het door de pompen en compressoren te leveren vermogen werd berekend m.b.v. PROCESS. Voor de keuze van de typen en het schatten van de rendementen wordt verwezen naar literatuur 10.

De waterstofsuppletie wordt met een compressor op een druk van 25 bar gebracht. Om de temperatuur van de compressor niet te hoog te laten oplopen (corrosie) wordt er met koelwater gekoeld tot 50°C.

In de max-octane-configuratie moet er $0,156 \cdot 10^6$ kJ/hr aan warmte worden afgevoerd. Als het koelwater van 20 tot 40°C wordt opgewarmd is het benodigde debiet 1860 liter/hr.

In de max-yield-configuratie moet er $0,085 \cdot 10^6$ kJ/hr worden afgevoerd. Hier is 1000 liter koelwater per uur voor nodig.

Omdat het te verpompen debiet erg klein is werd er gekozen voor een compressor met heen en weer bewegende zuiger. Het rendement werd geschat op 40%.

De voedingspomp is voor beide configuraties een centrifugaalpomp met radiale waaier. Voor het rendement werd 70% aangenomen.

7.2. Reactor

De reactor wordt uitgevoerd als een adiabatisch gepakt bed van 1/8 inch (\pm 3 mm) katalysatordeeltjes.

Voor de "space velocity" (zie ook 4.1.) is de waarde 3 (vol/vol/hr) gekozen.

In de max-octane-configuratie komt er een stroom van $704 \text{ m}^3/\text{hr}$ de reactor in. In de max-yield-configuratie is dit $378 \text{ m}^3/\text{hr}$. Met een "space velocity" van 3 (vol/vol/hr) volgt hieruit in het eerste geval een bed van 235 m^3 , in het tweede geval een bed van 126 m^3 .

Daar de stortdichtheid van de katalysator 500 kg/m^3 bedraagt komt dit overeen met resp. 118 en 63 ton katalysator.

Voor het berekenen van de drukval over het bed gebruikten wij de Ergun-vergelijking:

$$\Delta P = \frac{\epsilon^3}{a \cdot (1-\epsilon) \cdot \rho \cdot u^2} = \frac{170}{36} \cdot \frac{(1-\epsilon) \cdot a}{u} \cdot \frac{\eta}{\rho} + \frac{1,75}{6}$$

We gingen uit van bolvormige deeltjes en een bedporositeit van 0,4. In de max-octane-configuratie werd voor een beddiameter van 4,5 m en een bedhoogte van 15 m gekozen. Dit leverde een drukval van 0,08 bar. In de max-yield-configuratie werd de beddiameter 3,5 m, de bedhoogte 13 m en de drukval 0,06 bar. In beide configuraties werd de drukval verwaarloosd.

Zowel onder als boven het bed werd een vrije ruimte van 0,5 m hoogte opengelaten.

Samenvattend:

Tabel 7.1 Reactordimensionering

	max-octane	max-yield
beddiameter D_b (m)	4,5	3,5
reactordiameter D_r (m)	4,5	3,5
bedlengte L_b (m)	15	13
rectorlengte L_r (m)	16	14
drukval (bar)	0,08	0,06
deeltjesdiameter d_p (mm)	3	3
Re-number m.b.t. deeltjes Re_p	$1,3 \cdot 10^2$	$1,3 \cdot 10^2$

Aan de in literatuur 1 vermelde eisen voor propstroom

$$L_b/d_p > 100$$

$$D_b/d_p > 10$$

$$Re_p > 10$$

wordt ruimschoots voldaan.

7.3. Adsorptie- en desorptievat

Voor de dimensionering van het adsorptie- en het desorptievat zijn de volgende gegevens van belang:

-De cycletijd van het proces. Deze bedraagt voor beide configuraties 10 minuten.

-De te adsorberen massastroom. Voor de max-octane-configuratie is deze stroom 50,7 kmol/hr groot. In de tijd dat er geadsorbeerd wordt (5 min) moet er dan 4,23 kmol (=310 kg) n-alkanen opgenomen worden. Voor de max-yield-configuratie zijn deze getallen 99,5 kmol/hr en 8,3 kmol (=610 kg)

-De capaciteit en de stortdichtheid van het adsorbens. Het verschil in belading bij een hoge partiaalspanning van de n-alkanen (8gew%) en een lage partiaalspanning (1gew%) bedraagt 7 gew%. De stortdichtheid van het adsorbens is 700 kg/m^3 .

In de max-octane-configuratie is er minimaal $4,4 \cdot 10^3 \text{ kg}$ adsorbens nodig. Dit is een volume van $6,3 \text{ m}^3$. Voor de max-yield-configuratie is dit $8,7 \cdot 10^3 \text{ kg}$ en $12,4 \text{ m}^3$.

Als een veiligheidsmarge van ongeveer 20% wordt aangehouden dan moet het adsorptievat een volume hebben van resp. 8 en 15 m^3 .

De drukval over het bed werd berekend met de Ergun-vergelijking, uitgaande van bolvormige deeltjes met een diameter van 3 mm en bedroeg resp. 0,04 en 0,05 bar. Ook deze drukval is in het verdere proces verwaarloosd.

De adsorptie/desorptiewarmte bedraagt $11,6 \text{ kcal/mol}$, de warmtecapaciteit van het bed $1,05 \text{ kJ/kg}^\circ\text{C}$. Wanneer we aannemen dat de adsorptie/desorptiewarmte geheel wordt afgestaan/onttrokken aan het bed levert dit ons een gemiddelde temperatuursstijging/daling van 36°C voor max-octane en 37°C voor max-yield-configuratie.

Samenvattend met een waarde van L_b/D_b van 3 à 4 levert dit:

Tabel 7.2 Adsorptie/desorptievat-dimensionering

	max-octane	max-yield
beddiameter D_b (m)	1,4	1,7
bedlengte L_b (m)	5,2	6,6
drukval (bar)	0,04	0,05
deeltjesdiameter d_p (mm)	3	3
temperatuur T_b ($^\circ\text{C}$)	250-286	250 -287
	286-250	287-250

7.4. Warmtewisselaars en fornuizen

De berekening van de in de warmtewisselaars en fornuizen over te dragen warmte werd geheel uitgevoerd door PROCESS. Met behulp van literatuur 10 werd een schatting van de overall warmteoverdrachtscoëfficiënt U en een configuratie (met f -factor $> 0,75$) voor deze apparaten ingevoerd.

Alle fornuizen werden gesimuleerd met warmtewisselaars door aan de warme kant hoge-druk-stoom toe te voeren ($T=410^{\circ}\text{C}$). In het werkelijke proces echter worden de fornuizen gestookt met stookolie. Het rendement bedraagt 85%.

8. Max-octane versus max-yield-configuratie

Als we de twee configuraties met elkaar vergelijken, kan het volgende geconcludeerd worden:

-In de max-octane-configuratie zijn er drie fornuizen nodig, die meer warmte moeten leveren dan de twee in de max-yield-configuratie. Dientengevolge moet er in de max-octane-configuratie ook meer gekoeld worden met koelwater en lucht.

Het totaal benodigde oppervlak van de warmtewisselaars bedraagt in de max-octane-configuratie bijna anderhalf maal zoveel als in de max-yield-configuratie (warmtewisselaars = warmtewisselaars + fornuizen + koelers).

-In 1980 (lit. 19) bedroegen de kosten voor de katalysator \$170/BPSD, die voor het adsorbens \$190/BPSD n-alkanen in de voeding. In de max-octane-configuratie bedragen deze kosten :

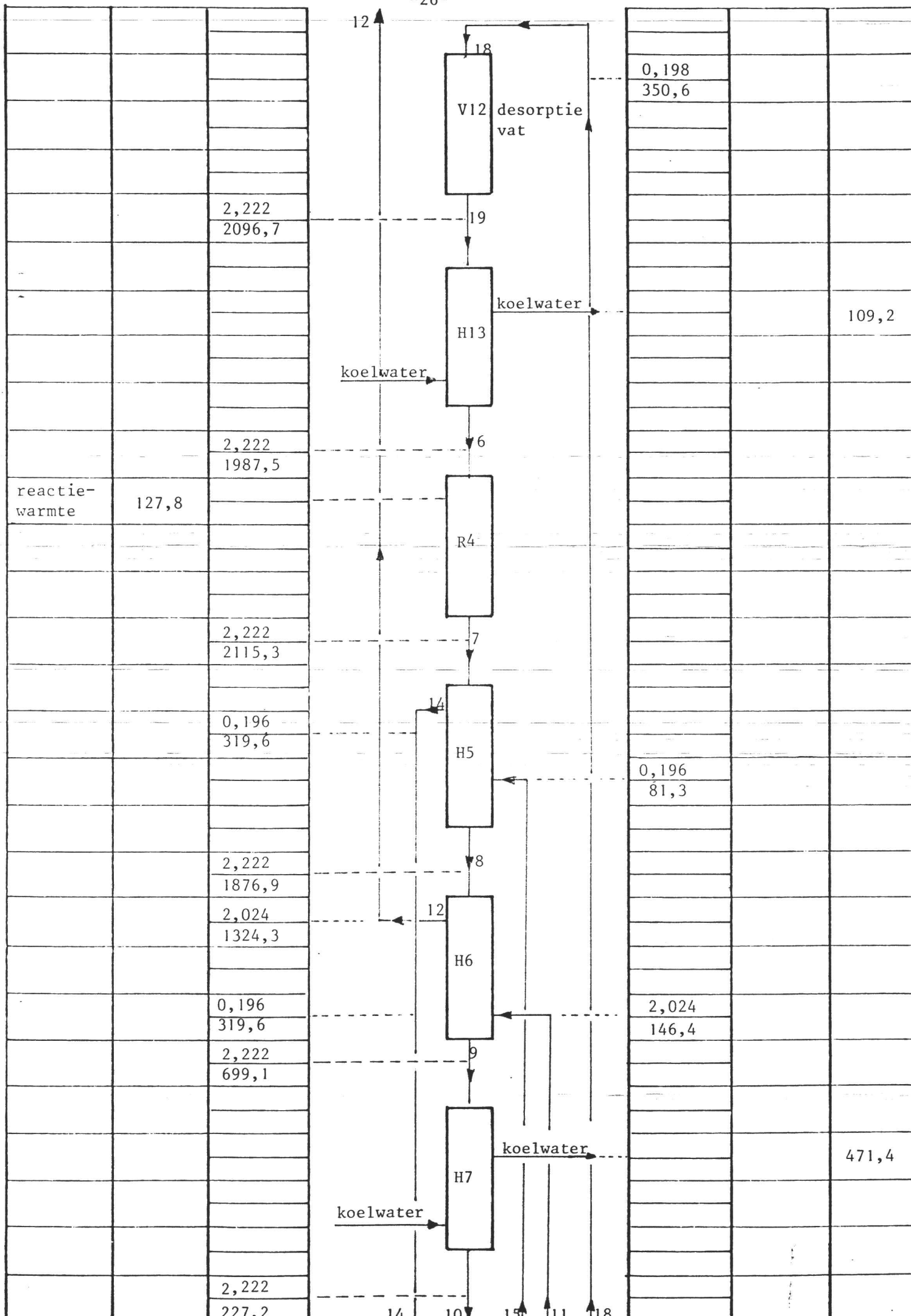
$21,9 \text{ m}^3/\text{hr} \cdot 6,3 \text{ B/m}^3 \cdot 24\text{hr}/\text{SD} \cdot \$170/\text{BPSD} = \$563.000$ voor de katalysator

$5,9 \text{ m}^3/\text{hr} \cdot 6,3 \text{ B/m}^3 \cdot 24\text{hr}/\text{SD} \cdot \$190/\text{BPSD} = \$170.000$ voor het adsorbens

In max-yield-configuratie bedragen de kosten voor de katalysator \$296.000 en die voor het adsorbens \$330.000.

We zien dat wat betreft katalysator- en adsorbenskosten ook de max-yield-configuratie als gunstigste naar voren komt.

-In de max-octane-configuratie wordt het octaangetal van de voeding verhoogd van 71,9 naar 88,8. Deze octaangetalverhoging (16,9) is een fractie hoger dan die in max-yield-configuratie bereikt wordt (16,3). Uit bovenstaande gegevens zal duidelijk zijn dat de kostprijs per RON-Barrel in de max-yield-configuratie het laagst zal zijn. Daarom zal in de volgende hoofdstukken alleen deze configuratie behandeld worden. Voor de stroom- en apparaatgegevens van de max-octane-configuratie wordt verwezen naar de uitvoer van PROCESS (Bijlage).



2,222
2096,7

2,222
1987,5

reactie-
warmte 127,8

2,222
2115,3

0,196
319,6

2,222
1876,9

2,024
1324,3

0,196
319,6

2,222
699,1

2,222
227,2

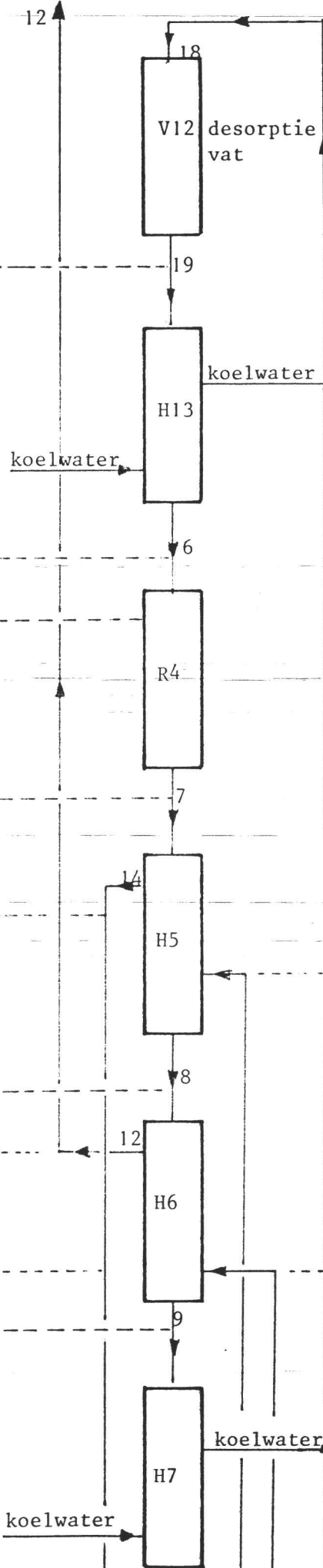
0,198
350,6

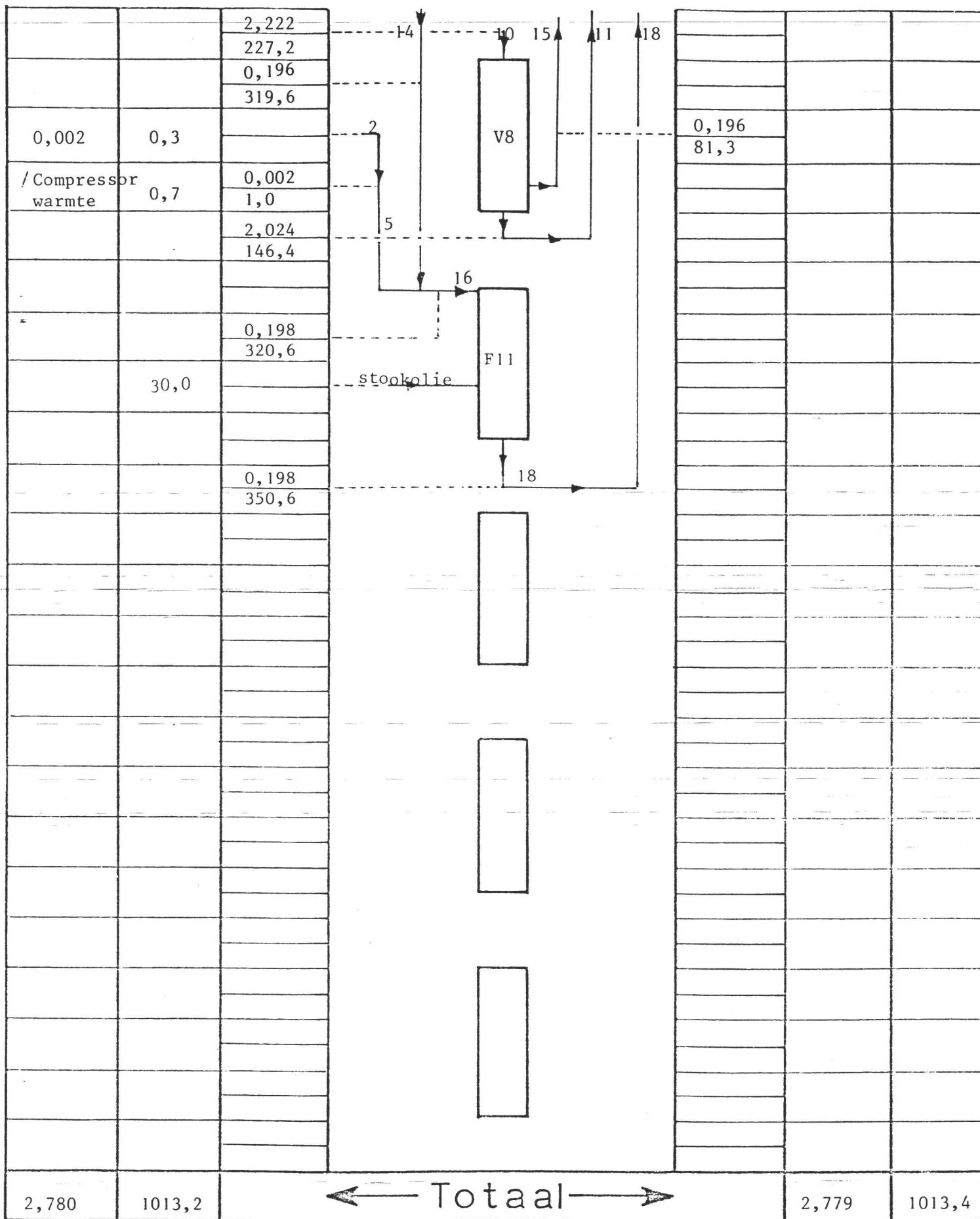
109,2

0,196
81,3

2,024
146,4

471,4





Massa in kg/s
Warmte in kW

Fabrieksvoorontwerp

No: 2577

Apparaatstroom	1		2		3		4		5	
↓ Componenten	M	Q	M	Q	M	Q	M	Q	M	Q
Waterstof			0.002						0.002	
Butaan	0.014				0.014		0.014			
iButaan	0.006				0.006		0.006			
Pentaaan	1.239				1.239		1.239			
iPentaaan	0.814				0.814		0.814			
Hexaan	0.186				0.186		0.186			
2Mpentaaan	0.258				0.258		0.258			
3Mpentaaan	0.128				0.128		0.128			
22DMButaan	0.017				0.017		0.017			
23DMButaan	0.050				0.050		0.050			
Rest	0.067				0.067		0.067			
Totaal:	2.778	95.0	0.002	0.3	2.778	111.4	2.778	2023.1	0.002	1.0

Apparaatstroom	6		7		8		9		10	
↓ Componenten	M	Q	M	Q	M	Q	M	Q	M	Q
Waterstof	0.065		0.065		0.065		0.065		0.065	
Butaan	0.030		0.016		0.016		0.016		0.016	
iButaan	0.003		0.017		0.017		0.017		0.017	
Pentaaan	1.802		0.563		0.563		0.563		0.563	
iPentaaan	0.091		1.330		1.330		1.330		1.330	
Hexaan	0.225		0.039		0.039		0.039		0.039	
2MPentaaan	0.002		0.073		0.073		0.073		0.073	
3MPentaaan	0.001		0.046		0.046		0.046		0.046	
22DMButaan	0.002		0.053		0.053		0.053		0.053	
23DMButaan	0.001		0.021		0.021		0.021		0.021	
Rest	0		0		0		0		0	
Totaal:	2.222	1987.5	2.222	2115.3	2.222	1876.9	2.222	699.1	2.222	227.7

M in kg/s

Q in kW

Stroom/Componenten staat

Apparaatstroom	11		12		13		14		15	
Componenten	M	Q	M	Q	M	Q	M	Q	M	Q
Waterstof	0.001		0.001		0.001		0.063		0.063	
Butaan	0.013		0.013		0.027		0.002		0.002	
iButaan	0.013		0.013		0.019		0.003		0.003	
Pentaaan	0.533		0.533		1.772		0.030		0.030	
iPentaaan	1.239		1.239		2.053		0.091		0.091	
Hexaaan	0.038		0.038		0.225		0.001		0.001	
2Mpentaaan	0.071		0.071		0.329		0.002		0.002	
3Mpentaaan	0.045		0.045		0.172		0.001		0.001	
22DMButaan	0.051		0.051		0.068		0.002		0.002	
23DMButaan	0.020		0.020		0.070		0.001		0.001	
Rest	0		0		0.067		0		0	
Totaal:	2.024	146.4	2.024	1324.3	4.803	3347.3	0.196	319.6	0.196	81.3

Apparaatstroom	16		17		18		19		20	
Componenten	M	Q	M	Q	M	Q	M	Q	M	Q
Waterstof	0.065		0.001		0.065		0.065		0.001	
Butaan	0.002		0.027		0.002		0.030		0	
iButaan	0.003		0.019		0.003		0.003		0.019	
Pentaaan	0.030		1.772		0.030		1.802		0	
iPentaaan	0.091		2.053		0.091		0.091		2.053	
Hexaaan	0.001		0.225		0.001		0.225		0	
2MPentaaan	0.002		0.329		0.002		0.002		0.329	
3MPentaaan	0.001		0.172		0.001		0.001		0.172	
22DMButaan	0.002		0.068		0.002		0.002		0.068	
23DMButaan	0.001		0.070		0.001		0.001		0.070	
Rest	0		0.067		0		0		0.067	
Totaal:	0.198	320.6	4.803	4090.3	0.198	350.6	2.222	2096.7	2.779	2344.4

in kg/s
in kW

Stroom/Componenten staat

Apparaatstroom	21		22		23		24			
↓ Componenten	M	Q	M	Q	M	Q	M	Q	M	Q
Waterstof	0.001		0.001		0		0.001			
Butaan	0		0		0		0			
iButaan	0.019		0.019		0.018		0.001			
Pentaaan	0		0		0		0			
iPentaaan	2.053		2.053		2.019		0.034			
Hexaan	0		0		0		0			
2MPentaaan	0.329		0.329		0.327		0.002			
3MPentaaan	0.172		0.172		0.171		0.001			
22DMButaan	0.068		0.068		0.067		0.001			
23DMButaan	0.070		0.070		0.070		0			
Rest	0.067		0.067		0.066		0.001			
Totaal:	2.779	432.8	2.779	295.4	2.738	277.6	0.041	17.8		

Apparaatstroom										
↓ Componenten	M	Q	M	Q	M	Q	M	Q	M	Q
Totaal:										

M in kg/s
Q in kW

Stroom/Componenten staat

10. Overzicht specificatie apparatuur

Apparatenlijst voor pompen, blowers, compressoren

Apparaat No:	P1	C3			
Benaming, type	Voedingpomp centrifugaal met radiale waaier	H ₂ -supple- tie zuiger- compressor			
te verpompen medium	C5/C6 n/iso alkanen	Waterstof			
Capaciteit in t/d of kg/s*	2.778	0.002			
Dichtheid in kg/m ³	581	0.001			
Zuig-/persdruk in bar (abs. of eff. *)	1/25	1/25			
temp. in °C in / uit	20/21.6	20/50			
Vermogen in kW theor./ prakt.	11.5/16.4	9.67/24.2			
Speciaal te ge- bruiken mat.					
aantal serie/parallel					

* aangeven wat bedoeld wordt

Technische Hogeschool Delft
Afd. Chemische Technologie

Fabrieksvoorontwerp No: 2577
Datum : Februari 1984
Ontworpen door : MJB & MCF

WARMTEWISSELAARSPECIFICATIEBLAD

Apparaatnummer : H.2.	Aantal : . . . serie/parallel*	
ALGEMENE EIGENSCHAPPEN :		
Functie	Warmtewisselaar voeding/ eindproduct	
Type	Warmtewisselaar* Koeler- Kondensor Verdamper	
Uitvoering	met vaste pijpplaten* floating head haarspeld dubbele pijp- platenwarmtewisselaar	
Positie	horizontaal/vertikaal*	
Kapaciteit1912	.kW (berekend)
Warmtewisselend oppervlak57.2	.m ² (berekend)
Overallwarmteoverdrachtscoëfficiënt833	.W/m ² K (globaal)
Logaritmisch temperatuurverschil (LMTD)	40.1	.°C
Aantal passages pijpzijde	5	
Aantal passages mantelzijde	10	
Korrektiefactor LMTD (min. 0,75).	0.88	
Gekorrigeerde LMTD.	35.3	.°C
BEDRIJFSKONDITIONS :		
	Mantelzijde	Pijpzijde
Soort fluidum	C5/ C6. n/ iso-	alkanen.
Massastroom	2.779	2.779
Massastroom te verdampen/kondenseren*	2.779	2.779
Gemiddelde soortelijke warmte	1.67	.74
Verdampingswarmte	379	375
Temperatuur IN	21.6	250.0
Temperatuur UIT	207.2	70.0
Druk	25	25
Materiaal	roestvrij-	staal

Lit.: -Fysische Transportverschijnselen I, Smith en Stammers (1973)
-College i20-A, Apparaten voor de Procesindustrie, Hfdst. IV,
Apparaten voor warmteoverdracht; E.J. de Jong (1978)

* Doorstrepen wat niet van toepassing is

Apparatenlijst voor warmtewisselaars, fornuizen

Apparaat No:	H 5	H 6	H 7	F 9	F 11
Benaming, type	Pijpenwarmte- wisselaar reactorproduct / H ₂ - purge	Pijpenwarmte- wisselaar reactorproduct / vloeistof -V8	Waterkoeler t.b.v. reactorproduct	Pijpenfornuis t.b.v. Isosiv-voeding	Pijpenfornuis t.b.v. H ₂ - purge
Medium pijpen-/ mantelzijde	reactorproduct / H ₂ - purge	reactorproduct / vloeistof V8	reactorproduct / koelwater	reactorvoeding /	H ₂ - purge /
Capaciteit, uitgewisselde warmte in kW.	238.3	1178.0	471.4	743.0	30.0
Warmtewisselend oppevl. in m ²	25.2	38.9	22.0	5.4	0.3
Aantal ^{serie/} parallel					
Abs. of eff.* druk in bar pijpen- / mantelzijde	25/ 25	25/ 25	25/	25/	25/
temp. in / uit in °C <u>pijpszijde</u> mantelzijde	250/ 214 35/ 230	214/ 85 35/ 180	85/ 35 20/ 40	196/ 250	227/ 250
Speciaal te ge- bruiken mat.					

* aangeven wat bedoeld wordt

Apparatenlijst voor warmtewisselaars, fornuizen

Apparaat No:	H 13	H 15			
Benaming, type	waterkoeler t.b.v. desorptie- stroom	luchtkoeler t.b.v. eindproduct			
Medium pijpen-/ mantelzijde	desorptie- stroom/ koelwater	eindproduct/ lucht			
Capaciteit, uitgewisselde warmte in kW.	102.2	137.4			
Warmtewisselend oppevl. in m ²	6.7	47.3			
Aantal ^{serie/} parallel					
Abs. of eff.* druk in bar pijpen- / mantelzijde	25/	25/			
temp. in / uit in °C <u>pijpzijde</u> mantelzijde	25 / 20 20 / 40	70 / 50 25 / 40			
Speciaal te ge- bruiken mat.					

* aangeven wat bedoeld wordt

Apparatenlijst voor reaktoren, kolommen, vaten

Apparaat No:	P 4	V 8	V 10	V 12	V 14
Benaming, type	Isomerisatie- reactor gepakt bed	Horizontale vloeistof gas- afscheider	Reserve vat Isosiv unit gepakt bed	Desorptie vat Isosiv unit	Adsorptie vat Isosiv unit
Abs. of eff.* druk in bar	25	25	25	25	25
temp. in °C	250	35	250	250	250
Inhoud in m ³	126		15	15	15
Diam. in m	3.5		1.7	1.7	1.7
l of h in m	14		6.6	6.6	6.6
Vulling:* schotels-aant. vaste pakking katalysator- type - ,, - vorm Adsorbens.....	Platina op zeoliet bolvorm				
Speciaal te ge- bruiken mat.			molzeef 5A ^o	molzeef 5A ^o	molzeef 5A ^o
aantal serie/parallel					

* aangeven wat bedoeld wordt

Apparatenlijst voor reaktoren, kolommen, vaten

Apparaat No:	V 16				
Benaming, type	Horizontale vloeistof gas- afscheider				
Abs. of eff.* druk in bar	4				
temp. in °C	50				
Inhoud in m ³ Diam. in m l of h in m					
Vulling:* schotels-aant. vaste pakking katalysator- type - ,, - vorm					
Speciaal te ge- bruiken mat.					
aantal serie/parallel					

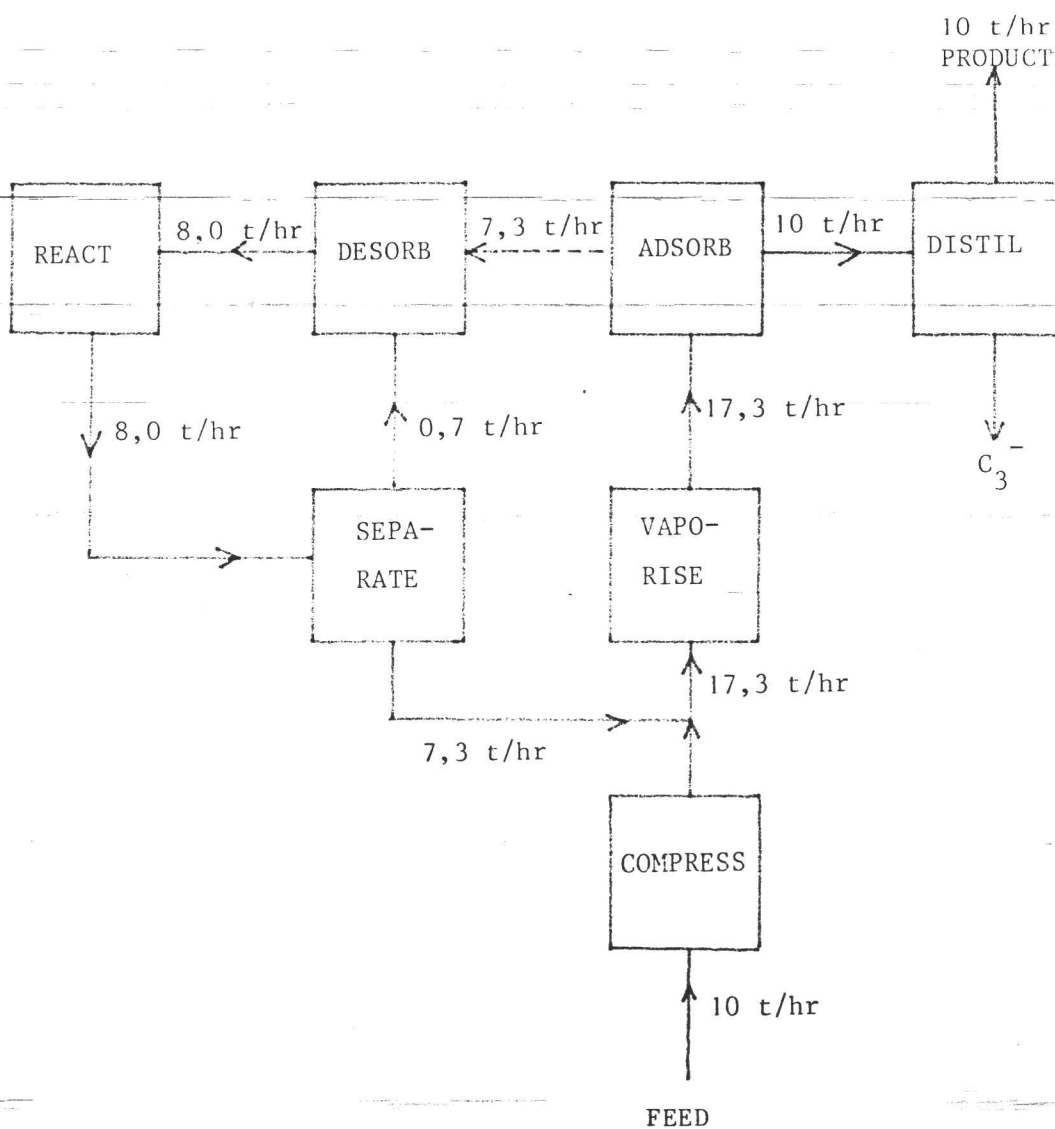
* aangeven wat bedoeld wordt

11. Kosten

11.1. Investeringsberekening

Investering in proceseenheden

Ter berekening van de investering in de proceseenheden (I_B) is gebruik gemaakt van Taylors "process step scoring" methode (lit. 21). Deze methode wordt in literatuur 13 als meest betrouwbare aangemerkt. Het schema van de "significant process steps" is afgebeeld in figuur 11.1



figuur 11.1 Significant process steps volgens Taylor

De bijbehorende scores voor deze processtappen zijn verzameld in tabel 11.1

tabel 11.1 Step scores volgens Taylor

	rel. throughput	reactiontime	mat. of constr.	temp.	pres.	multi streaming	other	score	costliness index	
compress	0	0	1	0	1,5	0	0	2,5	1,9	
vaporise	1	0	1	0,5	0	0	0	2,5	1,9	
adsorb	1	0	1	0,5	0	0	0	2,5	1,9	
distil	0	0	1	0	0	0	1	2	1,7	
desorb	-1	0	1	0,5	0	0	0	0,5	1,1	
react	-0,5	0	1	0,5	0	0	0	1	1,3	
separate	-0,5	0	1	0	0	0	0	0,5	1,1	
								+		
totale costliness index C_I :								Σ	10,9	

De investeringskosten kunnen nu met de volgende formule berekend worden:

$$I_B \text{ (in '77 kf)} = 42 \cdot (\text{yearly capacity in 1000 tons})^{0,39} \cdot C_I$$

In ons geval levert dit:

$$I_B \text{ (in '77 £)} = 42 \cdot (80)^{0,39} \cdot 10,9 = 2,5 \text{ miljoen £}$$

Inflatiegecorrigeerd m.b.v. de E.P. plant index wordt dit:

$$I_B \text{ (in '82 £)} = 2,5 \cdot 300 / 192 = 3,9 \text{ miljoen £}$$

andere investeringen

Omdat we er van uit gaan dat de TIP-plant geïntegreerd wordt in een reeds bestaand complex nemen we voor de overige investeringen (site en off-site development) een extra bedrag van slechts 15% aan. Het totaal te investeren bedrag wordt dan 4,5 miljoen £ ('82), wat overeenkomt met ongeveer 6,8 miljoen \$ ('82)

Ter vergelijking met tabel 11.2, een literatuur kostenoverzicht, wordt met de Taylormethode ook de investeringen voor een 8000 BPSD installatie berekend, er van uit gaande dat de costliness index niet verandert:

$$I_B \text{ (in '77 kf)} = 42 \cdot (240)^{0.39} \cdot 10,9 = 3,9 \cdot 10^3$$

Inflatiegecorrigeerd: 6,1 miljoen £ ('82)

Incl. overige investeringen 7,0 miljoen £ ('82)

= 10,5 miljoen \$ ('82)

De investeringsberekening met behulp van deze methode valt dus zo'n 20 procent te laag uit.

tabel 11.2 literatuur kostenoverzicht (lit. 6,7 en 9)

	1976	1978	1982
<u>Investments</u> (basis 8000 BPSD feed including stabilizer, \$ per BPSD capacity)	450	810	1650
<u>Catalyst</u> (including noble metal and adsorbent)			
First charge, \$ per BPSD capacity	170	180	470
replacement aprox. % of first cost	70	70	60
<u>Typical requirements</u> (incl. stabilizer per bbl feed)			
Electricity, kWh	4,6	3,1	4,0
Fuel, 10 ³ Btu	155	120	120
Steam, low pres., lb	65	45	35
Hydrogen, scf	95	100	120
Water cooling, gal	-	-	160

Katalysatorkosten

De katalysatorkosten worden overgenomen uit tabel 11.2 en bedragen voor onze plant 1,27 miljoen ('82) \$. Een tweede vulling kost 60 % van dit bedrag : 0,76 miljoen ('82) \$

Afschrijving

We schrijven de plant in 10 jaar af, voor de levensduur van de katalysator wordt 5 jaar genomen.

In 10 jaar moeten we dan afschrijven :

plant	6,8 miljoen \$
katalysator	1,27 miljoen \$
	0,76 miljoen \$
	<hr/>
	8,8 miljoen \$

Met een rentelast van 10 procent komt dit op een bedrag aan rente plus aflossing van 1,4 miljoen \$ per jaar.

11.2. Productiekosten

Personeelskosten

Er wordt uitgegaan van een personeelsbezetting van 5 man per dag.

De jaarlijkse kosten hiervoor bedragen ongeveer 0,15 miljoen \$.

Onderhoud

Het onderhoud aan de plant wordt geschat op 2,5 procent van de investeringskosten : 0,22 miljoen \$

Utilities

	prijs	jaarverbruik	kosten (miljoen \$)
stookolie	f 550/ton	638 ton	0,113
waterstof	f 0,20/m ³	488000 m ³	0,031
koelwater	f 0,08/m ³	226000 m ³	0,006
electriciteit	f 0,15/kWh	324800 kWh	0,016

11.3. De kostprijs per RON-barrel

De totale jaarlijkse kosten bedragen :

	miljoen \$ ('82)
rente en aflossing	1,4
personeelskosten	0,15
onderhoud	0,22
stookolie	0,113
waterstof	0,031
koelwater	0,006
electriciteit	0,016

1,94 miljoen \$ ('82)

De plant produceert ongeveer 2700 BPSD, dit is ongeveer 900.000
barrels per jaar. De verhoging van het octaangetal t.o.v. de voeding
bedraagt 16,3 RON eenheden.

De prijs per RON-barrel is dan:

$$\frac{1,94 \text{ miljoen } \$ ('82)}{16,3 \cdot 900.000} = 0,13 \$$$

De literatuur vermeldt een waarde variërend tussen 0,10 en 0,13 \$.

12. Symbolenlijst

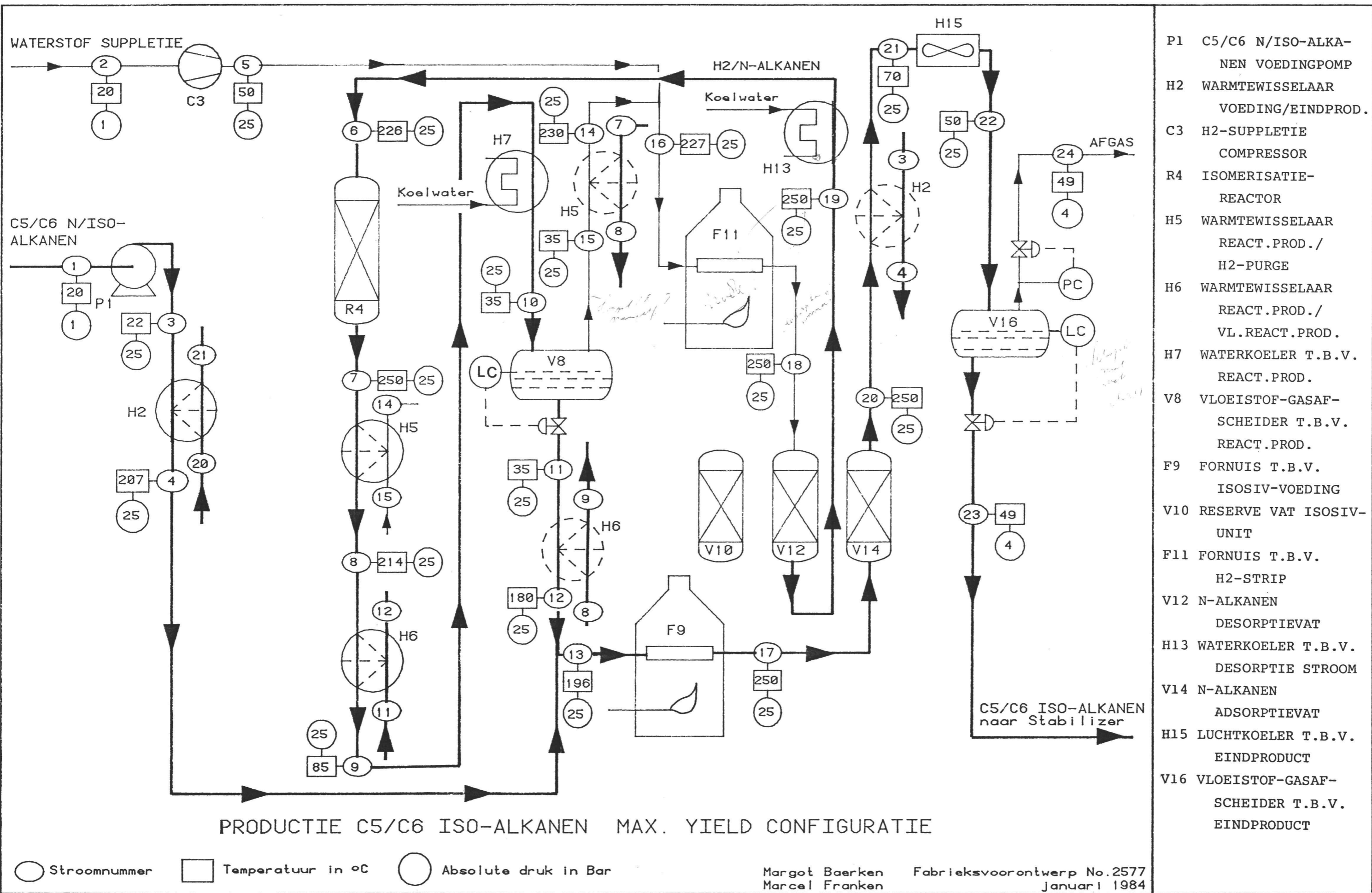
symbool	omschrijving	eenheid
a	specifiek oppervlak van een deeltje	(m^2/m^3)
C_I	costliness index	(-)
d_p	deeltjes diameter	(m, mm)
D	diameter	(m)
f	correctiefactor voor warmtewisselend oppervlak	(-)
H	enthalpie	(kJ/kmol)
ΔH	reactie-enthalpie	(kJ/kmol)
I_B	investering in de proceseenheden	(\$, £, k£)
K	evenwichtsconstante	(-)
L	lengte (hoogte)	(m)
M	massastroom	(kg/s)
Q	warmtestroom	(kW)
Re	Reynolds-number	(-)
S	entropie	(kJ/kmol ^o C)
T	temperatuur	(^o C)
u	superficiële snelheid	(m/s)
U	warmteoverdrachtscoëfficiënt	(kJ/(hr.m ² . ^o C))
ϵ	porositeit	(-)
η	dynamische viscositeit	(Ns/m ²)
ρ	dichtheid	(kg/m ³)

subscript

b	bed
r	reactor
p	particle

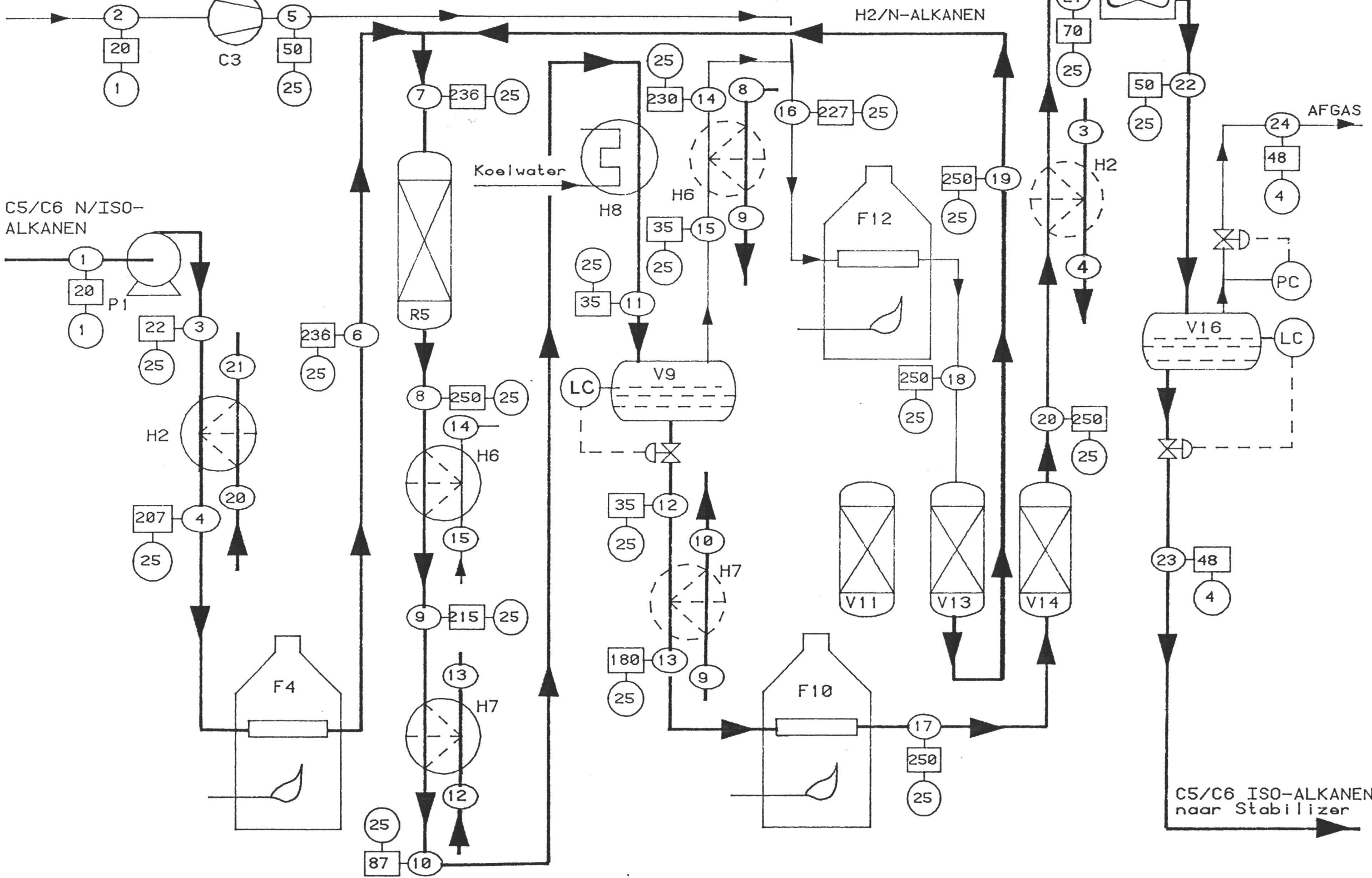
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- P1 C5/C6 N/ISO-ALKANEN VOEDINGPOMP
- H2 WARMTEWISSELAAR VOEDING/EINDPROD.
- C3 H2-SUPPLETIE COMPRESSOR
- R4 ISOMERISATIE-REACTOR
- H5 WARMTEWISSELAAR REACT.PROD./ H2-PURGE
- H6 WARMTEWISSELAAR REACT.PROD./ VL.REACT.PROD.
- H7 WATERKOELER T.B.V. REACT.PROD.
- V8 VLOEISTOF-GASAFSCHEIDER T.B.V. REACT.PROD.
- F9 FORNUIS T.B.V. ISOSIV-VOEDING
- V10 RESERVE VAT ISOSIV-UNIT
- F11 FORNUIS T.B.V. H2-STRIP
- V12 N-ALKANEN DESORPTIEVAT
- H13 WATERKOELER T.B.V. DESORPTIE STROOM
- V14 N-ALKANEN ADSORPTIEVAT
- H15 LUCHTKOELER T.B.V. EINDPRODUCT
- V16 VLOEISTOF-GASAFSCHEIDER T.B.V. EINDPRODUCT

WATERSTOF SUPPLETIE



- P1 C5/C6 N/ISO-ALKANEN VOEDINGPOMP
- H2 WARMTEWISSELAAR VOEDING/EINDPROD.
- C3 H2-SUPPLETIE COMPRESSOR
- F4 FORNUIS T.B.V. VOEDING
- R5 ISOMERISATIE-REACTOR
- H6 WARMTEWISSELAAR REACT.PROD./ H2-PURGE
- H7 WARMTEWISSELAAR REACT.PROD./ VL.REACT.PROD.
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- V9 VLOEISTOF-GASAFSCHEIDER T.B.V. REACT.PROD.
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- V14 N-ALKANEN ADSORPTIEVAT
- H15 LUCHTKOELER T.B.V. EINDPRODUCT
- V16 VLOEISTOF-GASAFSCHEIDER T.B.V. EINDPRODUCT

PRODUCTIE C5/C6 ISO-ALKANEN MAX. OCTANE CONFIGURATIE

○ Stroomnummer □ Temperatuur in °C ○ Absolute druk in Bar

Margot Baerken Fabrieksvoorontwerp No.2577
 Marcel Franken Januari 1984

