A

Thesis titled "SIMULATION OF HYDROCRACKING REACTION NETWORK"

Submitted in partial fulfillment of the requirements for the award of Degree of Master of Technology

In

Refining & Petrochemical Engineering

Submitted By

Uttara sakuntala simhadri R080207013 M.Tech (Refining and Petrochemical Engineering)

Under the guidance of

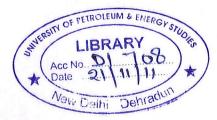
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(A Company promoted by Bharat Petroleum Corporation Limited and Oman Oil Company Limited)

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TO WHOMSOEVER IT MAY CONCERN

This serves to certify that Ms. Sakuntala is a member of our management cadre. Presently she is undergoing in-plant training at BPCL- Refinery, Mumbai.

She has completed a project on the "Modeling and Simulation on Hydro cracking Unit" as a part of the training.

Yours faithfully, For BHARAT OMAN REFINERIES LIMITED

RAJESH SHUKLA

21/4/09

MANAGER- HR



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TABLE OF CONTENTS

1.	INTRO	DOCTION				
	1.1 SITE	LOCATION	1			
	1.2 PROJ	TECT INFORMATION	1			
2.	LITERA	ATURE REVIEW				
	2.1 HYDI	RO CRACKING BASICS	4			
	2.1.1	REACTION MECHANISM & DEACTIVATION	4			
	2.1.2	FEEDSTOCK TYPES	6			
2.2 HYDROCRACKING UNITS 7						
	2.2.1	INTRODUCTION	7			
	2.2.2	SINGLE STAGE HYDROCRACKING	7			
	2.2	2.2.1 SINGLE STAGE ONCE THROUGH	7			
	2.2	2.2.2 SINGLE STAGE WITH RECYCLE	8			
2.2.3 SERIES FLOW HYDROCRACKING						
	2.2.4 TWO STAGE HYDROCRACKING					
2.3 SURVEY OF UNITS						
	2.3.1	HYDRO CRACKING IN GLOBSL PERSPECTIVE	9			
	2.3.2	SHELL GLOBAL SOLUTIONS IN HYDRO CRACKING(SIOP-ORGH)GROUP	10			
3.	DESCRI	PTION OF HYDROCRACKING UNIT	11			
1.	6. GENERATION OF REACTION NETWORK					
	4.1 RULE	S FOR GENERATING THE REACTION NETWORK	14			
	4.2 REAC	TION NETWORK FOR N – HEXADECANE	15			
	4.2.1	ISOMERIZATION STEPS	15			

	SIMULATION OF HYDROCRACKII	NG REACTION NETWORK	2009		
4.2.2 CRACKING STEPS		15			
4.2.3 PROTONATION/DEPR	OTONATION STEPS	16			
4.3 MASS TRANSFER CONSIDER	RATIONS	19			
5. SIMULATION OF THE REACTION NETWORK					
5.1 EXPERIMENTAL / COMPU	UTATIONAL	20			
5.1.1 SIMULATION		20			
5.1.2 FLOW SHEET DEVELO	DPMENT	20			
5.2 ASSUMPATIONS AND EXP	LNATIONS	20			
5.3 VALIDATION WITH COM	MERCIAL UNITS	20			
6. RESULTS & DISCUSSIONS					
6.1 OBSERVATIONS AND MOI	DEL VALIDATIONS	22			
6.2 RESULTS		22			
7. CONCLUSION		23			
8. BIBLIOGRAPHY 24					
APPENDIX I 25					
APPENDIX II 26					

LIST OF FIGURES

Figure 1 Brief Overview of BORL Refinery

Figure 2 Process Flow sheet for HCU

NOMENCLATURE

LPG Liquified Petroleum Gas

SKO Superior Kerosene Oil

ATF Aviation Turpentine Oil

FCC Fluidized Catalytic Cracking

TC Thermal Cracking

RHP Residue Hydro Processing

HC Hydro Cracking

GRM Gross Refinery Margin

RON Road Octane Number

H₂S Hydrogen Sulphide

NH₃ Ammonia

H₂O Water

HDS Hydrogen Desulphurization

PNA Paraffins, Naphthenes, Aromatics

HCU Hydro Cracking Unit

CHPS Cold High Pressure Separator

CLPS Cold Low Pressure Separator

HHPS Hot High Pressure Separator

HLPS Hot Low Pressure Separator

НР	High Pressure
TLP	Total Liquid Product
TBP	True Boiling Product
$\mathbf{a_v}$	Gas Liquid interfacial area per unit reactor volume, m_i^2/m_r^2
C_i^{G}	Molar concentration of i in gas bulk, Kmol/ m _G ³
$C_i^{\ L}$	Molar concentration of i in liquid bulk, Kmol/ m _L ³
C_{sat}	Saturation surface concentration of physisorbed hydrocarbons, Kmol/Kg of catalyst
C _H +	Surface concentrationof vacant acid sites Kmol/Kg of catalyst
C_{r}	Total surface concentration of acid sites, Kmol/ Kg of catalyst
F_i^G	Molar flow rate of i in gas phase, Kmol/hr
F_i^L	Molar flow rate of i in liquid phase, Kmol/hr
h	Planck's constant KJ hr/ molcule
H_{i}	Henry's law coefficient of i
$\Delta H^{\Delta Z}$	Standard entropy of activation, KJ/ Kmol
k	Rate coefficient of an eelementary step, 1/hr
$ ilde{k}$	Single event rate coefficient, 1/hr
\tilde{k}_{isom} (m;n)	Single event rate coefficient for the isomerization of m type of carbenium ion to n type of carbenium ion, 1/hr
\tilde{k}_{cr} (m;n,no)	Single event rate coefficient for the cracking of m typeof carbenium ion to n type of carbenium ion, 1/hr
K _B	Boltzmann constant, KJ/ Kmolecule

$K_{o,i}$	Overall mass transfer coefficient of i in terms of liquid concentration gradient, $m_L^{\ 3}/m_i^{\ 2}$ hr
K_G	Mass transfer coefficient from gas bulk to gas – liquid interface, based on concentration driving force, m_G^3 / m_i^2 hr
K_L	Mass transfer coefficient from gas – liquid interface to liquid bulk, based on concentration driving force, m_L^3 / m_i^2 hr
$K_{L,Pi}$	Langmuir physisorption equilibrium constant of paraffin P _i m _i ³ / Kmol
n_{c}	Number of single events
N_c	Number of components in the model
N_i	Mass transfer flux of i from gas bulk to the liquid bulk, Kmol/ m _i ² hr
$\mathbf{r_i}$	Net rate of formation of i, Kmol/m _i ³ /hr
R	Gas constant, KJ/Kmol ⁰ K
$\Delta S^{\Delta Z}$	Standard entropy of activation, KJ/Kmol ⁰ K
T	Temperature, ⁰ K
x	Cracking Conversion %

SYNOPSIS

Objective:

To generate a reaction network for the hydro cracking unit. After that simulating the total hydro cracking unit using this reaction network to prepare the simulation base for further calculations during revamping.

Abstract:

The current project deals mainly as such that the current refinery is under commissioning. The heart of the refinery is the hydro cracking unit which has demonstrated a broad diversity in upgrading a wide range of feed stocks ranging from atmospheric gas oil through heavy vacuum gas oil; conversion products from cat crackers and cokers; and product streams from lube plants and deasphalters.

The over 100 units now operating around the world provide a broad spectrum of products from light gasoline to heavy diesel fuels, as well as feedstock for olefin plants and cat crackers. Modeling of the process and then finding out the optimum operable parameters. Checking these values with ASPEN HYSYS.

Purpose Of The Project:

The present project is validating the results of the BORL Refinery as such it is in the stage of commissioning so it should require the design data along with the mathematical modeling of the design data of the reactor and also the simulation base for further expansion and to know the inflow and out flow of the reactor.

The main aim lays generation of reaction network of the hydrocracking reactons for n-hexadecane for future expansion purposes as now the hydro cracking unit is of full conversion where it does not release bottoms for maximization of middle distillates. After full operating of the refinery then the plant can be expanded for producing the lighters also by converting it into once through hydrocracker by connecting an FCC unit for producing gasoline.

Conclusion:

This project is presently going in the refinery as such that they are validating the results from BPCL Mumbai Refinery.

1. INTRODUCTION

1.1 SITE LOCATION:

Bharat Oman Refineries Limited is located at "Bina", Dist. Sagar in Madhya Pradesh and it is 135 km from "Bhopal". Nearest important railway junction to the refinery is "Bina", which is 9 km from the site. The nearest airport is "Bhopal", which is 135 km away from the Bina Refinery site. Bhopal is well connected by rail & road to Bina.

1.2 PROJECT INFORMATION:

Bharat Oman Refineries Limited (BORL), a company promoted by Bharat Petroleum Corporation Limited (BPCL) and Oman Oil Company Limited (OOCL), is setting up a 6 MMTPA grass root refinery at Bina, District – Sagar, Madhya Pradesh along with crude supply system consisting of Single Point Mooring System (SPM). Crude Oil Storage Terminal (COT) is at "Vadinar", District – Jamnagar, Gujarat and 935km long cross country crude pipeline from "Vadinar to Bina". 3 X 33 MW CPP – Coke based CFBC technology is also available and other infrastructure facilities are available at the Refinery as well as at COT, Townships, Water and Power supply system, etc.).

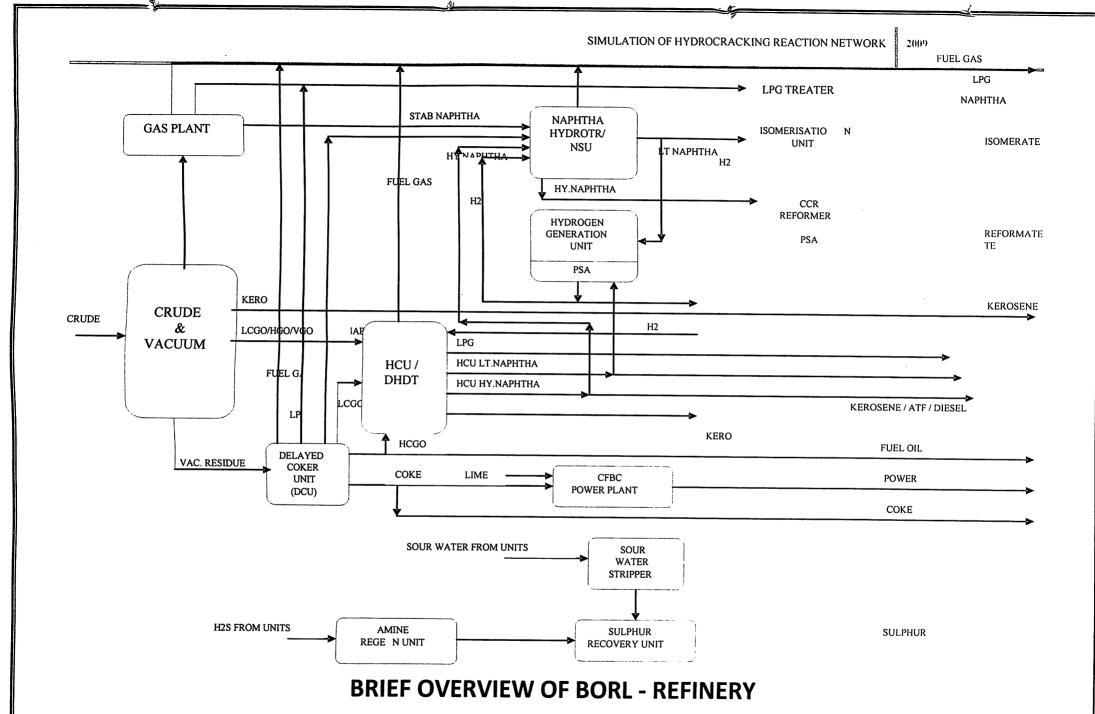
The process of separating Crude Oil into the useful products with desired set of properties and purities is called Refining. In general, Refinery performs three different functions:

- ✓ Separate Crude Oil into different streams such as LPG, Naphtha, Kerosene, Diesel components etc by Fractional Distillation.
- ✓ Chemically convert some of the lower valued fractions into more desirable products in Secondary units; and
- ✓ Treat intermediate products by removing unwanted elements and compounds for blending into final end products.
- ✓ Various hydrocarbon fractions which are separated by distillation and upgraded in secondary units, are blended to make desired products like Petrol, Diesel.
- ✓ Unlike Chemical manufacturing, petroleum products almost never have a specific chemical composition, but rather are complex mixture of thousands of

compounds, which are neither separated nor identified individually. Instead, these mixtures are characterized by their physical properties such as Boiling ranges, Freezing points, Sulphur content etc

✓ Each step in the Refining process is designed to add value to its inputs.

Bina refinery is designed to process 6 MMTPA of "Arab Mix" crude (65 % crude Arab Light and 35% crude Arab Heavy), but it also has the flexibility to process other types of Middle East crudes, adopting the State of Art Technologies with configuration of following units see appendix I.



2. LITERATURE SURVEY

Hydro cracking has demonstrated a broad diversity in upgrading a wide range of feedstock ranging from Atmospheric gas oil through heavy vacuum gas oil; conversion products from cat crackers and cokers; and product streams from Lube plants and Deasphalters. Over 100 units now operating around the world provide a broad spectrum of products from light Gasoline to Heavy diesel fuels, as well as feedstock for olefin plants and cat crackers.

The 90's bring many challenges to the Refining Industry with more stringent environmental specifications on fuels and a general trend for conversion units such as hydrocrackers to process more difficult/low value feedstock at higher throughputs. These changes are making hydrogen availability and catalyst stability a limiting factor in many Refineries. There is an ever increasing incentive to develop catalyst technology to meet the challenges of the 1990's.

2.1 HYDROCRACKING BASICS

The main objective in hydro cracking is to reduce the boiling point of the feedstock by increasing the hydrogen content and hence reducing the average carbon number per molecule. This is achieved using a catalyst at high pressure and temperature in a hydrogen-rich atmosphere. Under these conditions, hydrogenation reactions remove heteroatom as well as saturating aromatic and olefinic molecules. The large majority of heteroatom is sulphur, nitrogen and oxygen and hydrogenation of these elements produces H₂S, NH₃ and H₂O. The removal of the heteroatom has, in general, a positive effect on product quality.

2.1.1 Reaction Mechanisms & Deactivation

Given the range of reactions which are possible in a hydro cracking unit, a complete chemical description of all reactions is not possible; however there are several general principles. Catalysis in hydro cracking is classified as bifunctional i.e. two different types of catalytic chemistry are required to bring about the desired reactions. On the one hand, hydrogenation/dehydrogenation reactions are required, which are catalyzed by the hydrogenation function (metal or metal-sulphides). On the other hand cracking of hydrocarbon chains is catalyzed by acid sites. Both catalytic sites (metals and acid) must be present.

Heteroatom removal and hydrogenation reactions are catalyzed by the metal (or metal sulphides) function. Cracking will occur over the acid function but requires the hydrogenation function for the first step in the reaction mechanism. The cracking is characterized by

carbenium ion chemistry, which gives rise to highly branched hydrocarbon molecules. This results in product properties such as high i/n ratio and low cloud/freezing characteristics relative to straight-run material. Also the low C1 - C2 yields are also the result of the carbenium ion chemistry.

In the hydrogen-rich environment, hydrogenation of the cracked products is also promoted, resulting in minimum coke (carbon) formation on the catalyst sites. Over time, as the coke levels on the catalyst sites increase, higher operating temperatures are required to sustain the hydrogenation and cracking reactions. If temperature is not increased, the reactions diminish and this is generally referred to as coke deactivation of catalyst. After a certain period of operation, or run length, when the operating temperature nears the design temperature limit of the reactor, the hydrocracker has to be shut down for replacement of the spent catalyst with fresh or regenerated catalyst. This allows a new run or cycle to commence.

The study of reaction rates is known as kinetics, and the fastest reactions are the hydrogenation of heteroatom such as sulphur, oxygen and nitrogen (in order of decreasing rate of reaction). The hydrogenation of aromatics and cracking reactions are much slower. The rate of cracking depends on the chemical form and carbon number of the molecule involved. For example, aromatic compounds are converted more easily than paraffinic ones. Generally, the higher the boiling point (longer molecules), the higher the reaction rate at a given temperature.

Apart from kinetics, thermodynamic considerations also come into play for hydrogenation reactions. Thermodynamics determine the maximum hydrogen saturation level that is, in principle, possible at a given temperature and hydrogen partial pressure. Higher hydrogen partial pressures and lower temperatures promote higher hydrogenation levels of especially nitrogen and aromatics, which in turn allows more conversion of the feed to lighter products at a given temperature. It is generally accepted that the presence of aromatics in the feed, to a large extent, determines the catalyst deactivation rate by coke deposition. Higher hydrogen partial pressures reduce the rate of catalyst coke deactivation.

The hydrogenation and cracking reactions promoted by hydro cracking catalysts are highly exothermic and require special measures to control the rate of reaction and the energy of heat generated. Usually the total catalyst volume is staged or divided into a number of catalyst beds with inter bed quenching facilities. If the heat generated cannot be controlled or dissipated,

then the temperature of successive catalyst beds will escalate resulting in even higher rates of reaction and heat generation. In the extreme case where the heat balance can no longer be brought under control, the temperature excursion will lead to a temperature "runaway", requiring an emergency shutdown of the unit and depressurizing of reactants from the reactor in order not to exceed the design temperature and pressure limits of the unit.

2.1.2Feedstock Types

Hydrocracker feedstocks vary considerably in boiling range. Traditionally, in the U.S., where large-scale hydro cracking was first applied, relatively light gas oils were hydro cracked to produce naphtha/gasoline. Heavier feedstocks cause faster deactivation of the catalyst, but improved catalyst technology has allowed an increase in feed heaviness in the U.S. over the years. Elsewhere, heavier feeds are commonly used, such as flashed distillate (VGO) in the 370 - 540 °C range. Another difference between N. America & the Rest of the World is that many North American refineries have both a Hydrocracker and Fluid Catalytic Cracker or Coker and Hydro cracking is often used as a complementary process to FCC and coking to dispose of the cycle oils and coker gas oils. Elsewhere, refineries tend to have either an FCC or a HC, and the Hydrocrackers process straight-run material.

Straight-run flashed distillates of different origins can vary greatly in composition as shown in Figure 1.4 in (appendix II). The typical composition of two feeds, Bombay High and Arabian Light, are indicated. The hydrocarbons in the feed are divided into (PNA). As mentioned before, the presence of more aromatics promote more coke lay down on the catalyst sites. In extreme feedstocks with very high levels of aromatics, the rate of deactivation can be so high that the cycle length becomes considerably shortened such that it does not become economically attractive to process the feedstock.

Novel feedstocks now include thermally cracked flashed distillate and deasphalted oils, both of which provide challenges as a result of their aromaticity and heaviness. These feedstocks are which provide challenges as a result of their aromaticity and heaviness. These feedstocks are usually co-processed in limited ratios with straight-run flashed distillates for acceptable cycle lengths.

2.2 HYDROCRACKING SCHEMES

2.2.1 Introduction

Three schemes in hydro cracking are commonly applied. Over the years, the relative importance of the schemes has changed. The oldest configuration is the two stages HCU. With advances in high pressure/high temperature vessel manufacture, catalyst development, and changes in the product slate desired by the refiner, single stage and series flow hydro cracking have become more prominent nowadays.

2.2.2 Single Stage Hydrocracking

2.2.2.1 Single Stage Once-through

The simplest configuration is the Single Stage "Once-through" unit with only one reactor. If only one catalyst type is used in the reactor, it is called a Single Stage Single Catalyst unit, while with two or more different catalyst types it is called a Single Stage Stacked Bed unit. The feed is heated up and passed over the reactor and converted. After heat exchange and depressurizing in Cold High Pressure and Cold Low Pressure Separators (CHPS, CLPS), the total product is fractionated. The unconverted feed or fractionator bottoms (hydro wax) are not routed back to the reactor. Hydro wax can be used as feedstock to other processes (ethylene steam crackers or cat crackers), routed to lube oil facilities or used for fuel oil blending. Most of the vapors from the CHPS is compressed (recycle gas compressor), hydrogen-enriched with fresh gas, heated (recycle gas furnace) and recycled back to the reactor. Some of the cold recycle gas is routed to the reactor as quench gas to control the heat release and temperatures of successive catalyst beds in the reactor.

A stacked-bed configuration is often preferable to a single catalyst system. The first amorphous catalyst desulphurises, deoxygenates and denitrifies the feed, i.e. promotes hydrogenation of the heteroatom in the feed, with some cracking of hydrocarbons. This catalyst is also referred to as the pretreated catalyst. The majority of the cracking is then typically achieved over the second, cracking catalyst. The cracking catalyst typically contains zeolite. Zeolite-containing catalysts are more active and very stable i.e. they require lower temperatures for a given duty and usually deactivate more slowly compared to amorphous catalysts. Therefore, if a zeolite containing catalyst is included, the cycle length between catalyst change outs can be much longer. In terms of yield slate, zeolite-containing catalysts are typically more naphtha selective than amorphous catalysts.

2.2.2.2 Single Stage with Recycle

A more complex unit is the Single Stage with Recycle where most of the hydro wax from the fractionator bottoms is recycled back to the reactor. Recycling has some advantages; in that the recycled unconverted hydrowax gets another chance to be cracked, thereby increasing the overall conversion of the feedstock to lighter products. The fraction of the hydro wax that is not recycled is referred to as the Bleed. In a full-conversion unit, all of the hydro wax is recycled and the bleed is zero.

2.2.3 Series Flow Hydro cracking

In Series Flow hydro cracking the treated first stage effluent is further cracked in a successive, dedicated reactor. Thus, the first stage effluent is directly routed to the conversion catalyst, without any separation. The reactor temperature level of the first and second stages can be relatively independent. The hydro wax can also be recycled directly back to the reactor with the cracking catalyst, unlike the Single Stage with Recycle scheme, where the hydro wax has to be recycled back to the pretreated catalyst.

2.2.4 Two Stage Hydro cracking

The old generation of hydrocrackers is based on the Two Stage configuration. Traditionally in this line-up, the feed is deeply denitrogenated in the first reactor or stage. In view of the high required severity, some hydro cracking will take place as well. Subsequently the effluent is routed to the fractionator, where products, including NH₃ and H₂S are removed. Unconverted feed (normally the majority) is then converted in the second reactor or stage. Since, in a large number of units the recycle gas facilities are common for both stages, H_2S generated in the first stage and remaining in the recycle gas will be routed to the second stage. Most of the NH₃, however, will be removed from the recycle gas using a water wash upstream the effluent air cooler and cold HP separator.

Thus, the main difference between the two-stage configuration and the others are:

In Single Stage and Series Flow units, the unconverted nitrogen from the \triangleright pretreated catalyst (N slip) is typically high - from 50 to perhaps as high as 300 ppmw. In Two Stage

hydrocrackers, the feed is typically deeply denitrified to below 20 ppmw.

Single Stage and Series Flow cracking catalysts operate in the presence of ammonia

produced by denitrification of the feed. In Two Stage units ammonia is almost absent from

the second stage.

2.3 SURVEY OF UNITS

2.3.1 Hydro cracking in a Global Perspective

From data in Oil and Gas Journal, the 1999 world hydro cracking capacity was about 4 million barrels per day. This represents a significant increase of 450,000 barrels per day compared to 1998, with the largest increases in North America and Asia Pacific. Of this total capacity, about 80% is distillate hydro cracking. It is projected that in 2001 there will be a further hydro cracking capacity increase of more than 200,000 barrels per day.

The world hydro cracking capacity has increased on average by about 7% p.a. over the six years from 1993. It is of note that only Western Europe and Africa did not show a significant increase over this period. The hydro cracking capacity relative to crude capacity for Middle East and North America both show a ratio of nearly 10% which is significantly higher than other regions.

Current projections for the period 1999 to 2003 indicate that the rate of capacity increase will decline with only an additional 600,000 kb/d total new capacity over this period. In line with current ratios, approximately 75% of this increase will be in distillate hydro cracking. The highest growth rate in this period is expected to be in the Asia-Pacific zone, Latin America and Eastern Europe.

The main driving forces for the expansion of the hydro cracking process continue to be: sustained growth in middle distillates consumption

Introduction of more stringent automotive fuel specifications (sulphur, aromatics, T95)

Processing synergy in combining catalytic cracking with hydro cracking, exploited in large scale refineries.

Increasing development of mild hydro cracking technology.

Unocal/UOP, who merged in 1990, is by far the dominant hydrocracker licensor with

over 50% of the market. As a process licensor, SIOP, who had previously designed hydrocrackers only for Shell companies, affiliates and SIOP-advised refineries, occupies a modest third position in the market after UOP and Chevron.

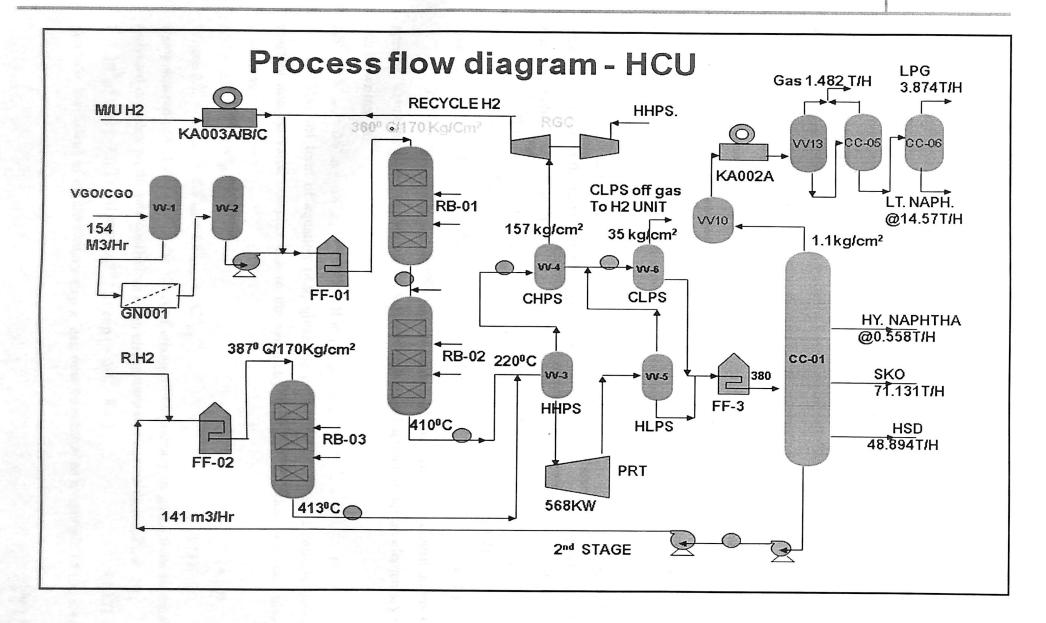
2.3.2 Shell Global Solutions in Hydro cracking (SIOP-OGRH Group)

SIOP's world-wide position as a technical service provider in hydro cracking is strong. With the start-up of Rayong (Thailand, March 1996) and Pernis (Netherlands, May 1997), SIOP provides technical service and advice to 11 distillate hydro cracking units with a total nameplate capacity of more than 18 Million tons per annum. This represents a little less than 10% of the world hydro cracking capacity with an annual upgrading margin of some US\$ 250-700 millions. Technical service is also provided to some 11 base oil hydro processing units in support of the core activity of the Shell Global Solutions Base Oil group.

3. DESCRIPTION OF HYDROCRACKING UNIT

The process of hydro cracking mainly consists of series of reactors in two stage for better conversion. From the list of different types of hydrocrackers we choose "TWO STAGE HYDRO CRACKING" for complete conversion of feed. Since the refinery doesn't need bottoms for disposal it has been suggested this type in which it consists of two stage hydro cracking process. In the first stage there is a series of three reactors in which the feed is first heat exchanged with the effluent coming from the third reactor and also again heated up to required temperature for the inlet of the feed to the reactor. The bottom of the fractionators is sent back to the second stage for complete conversion of the unconverted oil obtained from the fractionators. This is the reason it is called as "Full Conversion Hydro Cracking Unit" which is integrated to "Diesel Hydro treater Unit". This unit is integrated to get the diesel free from sulphur.

In the first stage, the feed is first heat exchanged with the effluent coming out of the third reactor from the first stage. Then again, the feed is heated to the required temperature and hydrogen is added before entering in to the reactor and it is sent to the reactor from top. The bottoms of the reactor are again sent to the second and then to third and finally the obtained products are sent to separators. Meanwhile the effluent obtained from the second stage also is collected along with the first stage effluent and sent to a series of separators. Then the collected effluent is sent to first HHPS (Hot High Pressure Separator) to remove the vapors present in the liquid and the vapors obtained are hot so it is sent to CHPS (Cold High Pressure Separator). In this separator the at most vapors are recovered and the bottom liquid is passed to HLPS (Hot Low Pressure Separator) and then to CLPS (Cold Low Pressure Separator). In this process of separators the total vapors from the liquid is separated and is sent to off gases condenser to use as off gases for furnace fuel. The obtained liquid is sent to the fractionators and the desired products like Light Naphtha, Heavy Naphtha, Kerosene, High Speed Diesel. In this the bottoms Unconverted Oil is sent back to the second stage reactor system and the obtained diesel is sent to "Diesel Hydrotreating Unit" to make the diesel free from sulphur. The obtained naphtha is sent to Penex and CCR(Continous Catalytic Reformer) to produce MS(Motor Spirit).



4. GENERATION OF REACTION NETWORK

The rate coefficient of an elementary step is given by transition state theory as,

$$K = [(K_B T)/h] \exp[\Delta S^0/R] \exp[-\Delta H^0/RT]$$
(4.1)

According to statistical thermodynamics, the entropy of a species can be determined by adding the contribution from different types of motion viz. transnational, rotational, vibrational and electronic, i.e.,

$$S^{0} = S^{0}_{trans} + S^{0}_{vib} + S^{0}_{rot} + S^{0}_{elec}$$
(4.2)

Where
$$S_{\text{rot}}^0 = S_{\text{extrot}}^0 + S_{\text{introt}}^0$$
 (4.3)

The rotational part of the entropy is composed of an intrinsic term, $\hat{S}^{\ 0}$ and a contribution from the symmetry of the molecule, R ln σ , i.e.,

$$S^{0}_{\text{extrot}} = \hat{S}^{0}_{\text{extrot}} - R \ln (\sigma_{\text{ext}})$$
 (4.4)

$$S_{introt}^{0} = \hat{S}_{introt}^{0} - R \ln (\sigma_{int})$$
 (4.5)

For racemic mixtures of optically active species, an additional entropy contribution of R ln (2^n) due to the mixing of different enantiomers has to be considered, where n is the number of chiral centers in the molecule.

$$S_{\text{rot}}^{0} = \hat{S}_{\text{rot}}^{0} - R \ln \left[\left(\sigma_{\text{ext}} \sigma_{\text{int}} \right) / 2^{n} \right]$$
 (4.6)

Where
$$\hat{S}^0_{\text{rot}} = \hat{S}^0_{\text{extrot}} + \hat{S}^0_{\text{introt}}$$
 (4.7)

And
$$[(\sigma_{\text{ext}}\sigma_{\text{int}})/2^n] = \sigma_{\text{gl}}[\text{Global Symmetry Number}]$$
 (4.8)

The global symmetry number $\sigma_{\mbox{\scriptsize gl}}$ quantifies all the symmetry contributions of a species. Using the above equations, the standard entropy of activation for an elementary step can be written as:

$$\Delta S^{0} = \Delta S^{0}_{trans} + \Delta S^{0}_{vib} + \Delta S^{0}_{elec} + \Delta S^{0}_{rot} + R \ln \left[\sigma^{R}_{gl} / \sigma_{gl} \right]$$
(4.9)

The last term of equation (4.9) gives the difference in standard entropy between reactant and activated complex due to the symmetry changes. Equation (4.9) can also be written as

$$\Delta S^0 = \Delta \hat{S}^0 + R \ln \sigma^R_{gl} / \sigma_{gl}$$
 (4.10)

Where
$$\Delta \hat{S}^0 = \Delta S^0_{\text{trans}} + \Delta S^0_{\text{vib}} + \Delta S^0_{\text{elec}} + \Delta S^0_{\text{rot}}$$
 (4.11)

Using equation (4.1) and (4.10), the effect of changes in symmetry in going from reactant to activated complex on the rate coefficient of an elementary step can be factored out. i.e.,

$$K = [\sigma^{R}_{gl} / \sigma_{gl}] [(K_B T) / h] \exp [\Delta \hat{S}^{0} / R] \exp [-\Delta H^{0} / RT]$$
(4.12)

The rate coefficient of an elementary step k, can now be written as a multiple of the single-

event rate coefficient \tilde{k} as

$$K = n_e \,\tilde{k} \tag{4.13}$$

where the number of single events n_e and single event rate coefficient \tilde{k} can be defined as

$$n_{e} = \left[\sigma^{R}_{gl} / \sigma_{gl}\right] \tag{4.14}$$

$$\tilde{k} = [(K_B T) / h] \exp [\Delta \hat{S}^0 / R] \exp [-\Delta H^0 / RT]$$
 (4.15)

Since the difference in symmetry, i.e. the difference in structure between the reactant and the activated complex has been factored out by introducing the number of single events n_e , the single-event rate coefficient \tilde{k} is independent of the structure of the reactant.

4.1 RULES FOR GENERATING THE REACTION NETWORK

The generation of the reaction network for paraffins is based on certain predefined rules. These rules are derived from the carbenium ion chemistry and from the experimental evidences obtained from the hydro cracking of paraffinic species. The summary of these rules and their explanation is given as follows:

- Generation of primary and methyl carbenium ions is not considered. This rule came from the stability study of the carbenium ions. Considering the high energy required to form the primary and methyl carbenium ions and their highly unstable nature as compared to secondary and tertiary carbenium ions, no elementary step generating primary and methyl carbenium ions has been considered in the reaction network.
- It has been found from analysis of oil fractions that the species with more than three side chains are present in very low concentrations. Therefore, species having more than three side chains are not considered in the network generation.
- ✓ Species with only methyl side chains are considered. Therefore, no species with ethyl or longer side chains are generated in the reaction network. This rule is also based on the experimental studies of hydro cracking.
- The contribution of protonated cycloalkanes to the formation of branched isomers rapidly decreases as the ring size increases above three carbon atoms and therefore, only protonated cyclo propane (PCP) elementary steps are considered for the isomerization steps introducing the degree of branching. This rule makes sure that no species having ethyl or bigger side chains are generated.

Bimolecular hydrogen transfer steps are not considered.

4.2 REACTION NETWORK FOR N-HEXADECANE

The reaction network has been generated for the hydro cracking of n-hexadecane and for a heavy paraffinic feed up to C₃₃. The number of different type of elementary steps, and the number of olefin species and carbenium ions involved for these two feed stocks.

The details of different type of elementary steps and the number of single event rate coefficient required for their modeling are discussed below:

4.2.1 Isomerization Steps

Based on the energy levels of the reactant and the product carbenium ions, only four single event rate coefficient isomerization \hat{k}_{isom} (s;s), \hat{k}_{isom} (s;t), \hat{k}_{isom} (t;s), \hat{k}_{isom} (t;t). It should be noted that the degree of branching of a carbenium ion in hydride shift and methyl shift isomerization remains the same in contrast to PCP isomerization in which the degree of branching changes. Because of lesser changes in the molecular structure in HS and MS isomerization as compared to PCP, the former isomerization steps are much faster than the latter, and thus for any particular carbon number, all the isomers with same degree of branching rapidly reach reaction equilibrium.

Because of this equilibrium between the isomers of same degree of branching, a partial lumping is introduced in this kinetic model based on the degree of branching per carbon number. This eliminates the need to estimate the rate parameters for HS and MS leaving out only four rate parameters for PCP isomerization, namely and $\vec{k}_{PCP}(s;s)$, $\vec{k}_{PCP}(s;t)$, $\vec{k}_{PCP}(t;t)$. The further reduction in the number of isomerization parameters has been discussed later using the thermodynamic relationships.

4.2.2 Cracking Steps

Until recently, the elementary steps for cracking were modeled similar to that for isomerization steps, i.e., four single event rate coefficients \mathbf{k}_{cr} (s;s), \mathbf{k}_{cr} (s;t), \mathbf{k}_{cr} (t;s), \mathbf{k}_{cr} (t;t) and, were used irrespective of the type of the olefin produced for any carbon number of the reactant carbenium ion. On the other hand it is introduced to the dependency of the produced olefin on the single event rate coefficient of cracking. The basis of introducing this dependency, however, is thus far empirical in nature.

4.2.3 Protonation / Deprotonation Steps:

Protonation/deprotonation steps are very fast as compared to PCP and cracking steps, and therefore, it is assumed that protonation/deprotonation steps are always at reaction equilibrium.

The equilibrium constant for the isomerization between these two olefins can be expressed as the product of the protonation/deprotonation equilibrium constants for the pathways connecting the olefins through the common carbenium ion. i.e.,

$$\bar{k}^{C_1 = C_2}_{isom} = \frac{\bar{k}^{C_1 = R^-} p_r}{\bar{d}_r} \frac{\bar{k}^{R^- = C_2} d_r}{\bar{d}_r}$$
(4.16)

Expressing the equilibrium constant by the ratio of the forward to the backward rate coefficient and identifying that R_I^+ is a secondary carbenium ion, the above equation becomes,

$$\tilde{k}^{O_1 = O_2}_{isom} = \frac{K_{pr}(O_1; S) K_{de} \cdot S : O_2}{K_{de}(S; O_1) K_{pr}(O_2; S)}$$
(4.17)

To simplify this equation, it is assumed that the activated complex in a protonation/deprotonation step has a structure resembling the olefin structure but with the double bond not yet broken/formed completely. This line of thought makes it possible to consider that the differences in the stability between the olefin isomers are maintained in the corresponding activated complexes.

Assuming that physical adsorption is in quasi-equilibrium, the concentration of the adsorbed paraffins can be given in terms of the measurable paraffin concentrations using the Langmuir isotherm as.

$$C_{p_{i}}^{ads} = \frac{C_{sat} K_{LP_{i}} C_{p_{i}}^{liq}}{1 + \sum_{i} K_{lp_{i}} C_{p_{i}}^{liq}}$$

$$(4.18)$$

These adsorbed paraffins are dehydrogenated at the metal sites of the catalyst. A particular paraffinic molecule P_i can produce several olefins O_{ij} on dehydrogenation at the metal site of the catalyst, i.e.,

$$P_i^{ads} = O_{ij}^{liq} + H_2^{liq} \tag{4.19}$$

Here it is assumed that olefins and hydrogen remains in the liquid phase and hydrogenation

dehydrogenation steps are at quasi-equilibrium. This assumption allows calculating the equilibrium concentration of olefins in terms of the concentration of the adsorbed paraffins.

$$C_{\mathcal{G}_{\mathcal{G}}}^{l:q} = \frac{K_{\mathcal{D}H}^{\mathcal{P}_{l}=\mathcal{G}_{\mathcal{G}}} C_{\mathfrak{p}_{l}}^{ads}}{C_{\mathcal{H}_{2}}^{l:q}}$$

$$(4.20)$$

Combining equations (4.18) and (4.20) gives,
$$\frac{K_{DH}^{P_i = G_g} C_{sat} K_{lp_i} C_{p_i}^{liq}}{C_{H_2}^{liq} \left(1 - \sum_{i} K_{lp_i} C_{p_i}^{liq}\right)} \tag{4.21}$$

The olefins produced at the metal site are protonated at the acid sites to give the carbenium

$$O_{ij}^{l;q} + H^+ \leftrightarrows R_{ik}^+ \tag{4.22}$$

It should be noted that one particular olefin can produce a maximum of two carbenium ions, depending upon the location of the double bond. If the double bond is in the terminal position, one of the produced carbenium ion will be primary and will not be considered in the reaction network. The index k in equation (4.22) is used to describe all the possible carbenium ions that can be produced by protonation of all the olefins obtained from Pi on dehydrogenation. As discussed above, protonation/deprotonation steps are in quasiequilibrium giving the concentrations of the carbenium ions in terms of the olefin concentrations as follows:

$$C_{R_{ik}^{+}} = \frac{K_{pr}^{O_g = R_g^{-}} C_{O_g}^{l_{iq}}}{de} C_{H^{+}}$$
(4.23)

If there are n olefins in equilibrium with a single carbenium ion R⁺_{ik}, n equations can be written similar to equation (4.18), each describing the equilibrium of R⁺_{ik} with a different olefin. The average concentration of R ik can therefore be given as

$$C_{R+} = \frac{1}{n} \sum_{j=1}^{n} K_{\frac{pr}{d\theta}}^{O_g = R_g^+} C_{O_g}^{liq} C_{H^+}$$
(4.24)

The number n will be 2 in case of a secondary carbenium ion and 3 in case of a tertiary carbenium ion. Substituting the concentration of olefins in equation (4.20) from equation (4.24) gives the concentration of the carbenium ions in terms of the liquid phase concentration of paraffins,

$$C_{R_{ij}} = \frac{1}{n} \sum_{j=1}^{n} \frac{K_{\underline{p}\underline{r}}^{\mathcal{O}_{g} = R_{g}^{+}} K_{\mathcal{D}H}^{P_{i} = \mathcal{O}_{g}} C_{sat} K_{lp_{i}} C_{p_{i}}^{liq} C_{H^{+}}}{C_{H_{2}}^{liq} \left(1 - \sum_{i} K_{lp_{i}} C_{p_{i}}^{liq}\right)}$$

$$(4.25)$$

The (de)protonation and (de)hydrogenation equilibrium constants can now be expressed in terms of the respective single event equilibrium constants, using the following two equations:

$$K_{\underline{pr}}^{G_{g=R_{g}^{+}}} = \frac{\sigma_{O_{i}}^{G^{:}}}{\sigma_{R^{+}}^{G^{:}}} K_{\underline{pr}}^{O_{g=R_{g}^{+}}}$$

$$(4.26)$$

$$K_{DH}^{P_i = O_g} = \frac{\sigma_{p_i}^{g_i}}{\sigma_{c_{ij}}^{g_i}} K_{DH}^{P_i = O_g}$$

$$(4.27)$$

Substituting equations (4.26) and (4.27) in equation (4.25) gives,

$$\frac{1}{C_{R_{1k}^{+}}} = \frac{1}{n} \left[\frac{\sigma_{p_{i}}^{gl}}{\sigma_{R^{+}}^{gl} \sigma_{H_{2}}^{gl}} \right] \sum_{j=1}^{n} \frac{K_{pr}^{O_{g} = R_{g}^{+}} K_{DH}^{P_{i} = O_{g}} C_{sat} K_{lp_{i}} C_{p_{i}}^{liq} C_{H^{-}}}{C_{H_{2}}^{liq} \left(1 + \sum_{i} K_{lp_{i}} C_{p_{i}}^{liq}\right)}$$
(4.28)

By using equation (4.28), the single event protonation/deprotonation equilibrium $\mathbf{k}_{pr}^{O_g = R_{ik}^{+}}$ can be expressed in terms of the single event protonation / deprotonation

equilibrium constant of R_{ik}^{\dagger} with reference olefin, $k_{pr}^{r=R_{ik}^{\dagger}}$ i.e., as

$$\frac{\ddot{k}_{pr}^{O_g = R_{ik}}}{de} = \frac{\ddot{k}_{pr}^{O_r = m_{ik}}}{de} \ddot{k}_{isom}^{O_g = O_r} \tag{4.29}$$

where m_{ik} can be secondary or tertiary depending on the type of carbenium ion R_{ik}^{*} . Substituting equation (4.27) in (4.28) gives the concentration of the carbenium ions as per equation (4.29). This concentration can be used in equation (4.30) to get the rate of consumption of the carbenium ion through an elementary step in which a product carbenium ion R_{il}^{*} of type w (s or t) is formed.

$$C_{R_{ik}^{+}} = \frac{1}{n} \left[\frac{\sigma_{p_{i}}^{gl}}{\sigma_{R^{+}}^{gl}} \frac{\tilde{k}_{pr}^{O_{r}=m_{ik}} C_{sat} K_{lp_{i}} C_{p_{i}}^{liq} C_{H^{+}}}{C_{H_{2}}^{liq}} \sum_{j=1}^{n} \tilde{k}_{isom}^{O_{g}=O_{r}} K_{DH}^{P_{i}=O_{g}} \right]$$

$$r_{R_{ik}^{+}} = n_{e} \tilde{k}_{g} \left(m_{i}(ik) + w_{i}il \right) C_{\downarrow}(R^{+})$$

$$(4.30)$$

Equations (4.30) and (4.31) can be combined to give the rate of consumption of carbenium

ions as,

$$\frac{1}{n} \left[\frac{\sigma_{p_i}^{gl}}{\sigma_{R^+}^{gl}} \frac{1}{\sigma_{R^+}^{gl}} \frac{\tilde{k}_{pr}^{gl} = m_{ik} C_{sat} K_{lp_i} C_{p_i}^{lq} C_{H^-}}{C_{H_2}^{liq} \left(1 - \sum_{i} K_{lp_i} C_{p_i}^{liq}\right)} \right] \sum_{j=1}^{n} \tilde{k}_{isom}^{gg=0}$$

$$K_{DH}^{P_i = G_g} (4.32)$$

4.3 MASS TRANSFER CONSIDERATIONS:

Accounting that the continuity equations for the gas phase will be only in the mass transfer between the gas and the liquid phase, the interphase mass transfer flux is described in terms of the two film model

$$N_i = \frac{K_{o,i} \left[\frac{C_i^G}{H_i} - C_i^2 \right]} \tag{4.33}$$

with
$$\frac{1}{K_{o.i.}} = \frac{1}{K_{GH_i}} + \frac{1}{K_L}$$
 (4.34)

The interphase mass transfer flux is calculated for each component/lump and the continuity equations for the gas phase components are formulated as follows,

$$\frac{1}{\Omega} \frac{dF_i^G}{dz} = -K_{o,:} a_v \left[\frac{C_i^G}{H_i} - C_i^I \right] \quad \text{where } i = 1, 2, 3 - \dots - N_c$$

$$(4.35)$$

The continuity equations for liquid phase components also take into account the net rate of formation of component/lump *i.e.*

$$\frac{1}{\Omega} \frac{dF_i^L}{dz} = \begin{pmatrix} K_{o,i} \alpha_r \left[\frac{C_i^G}{H_i} - C_i^l \right] + r_i \end{pmatrix} \text{ where } i = 1,2,3----N_c$$
(4.36)

The molar flow rates of component in the gas phase and in the liquid phase are obtained from the continuity equations and are added to get the total molar flow rates of the component. The total molar flow rate of component thus obtained ys converted into the percent molar flow rate based on the total hydro carbons at the reactor exit(on hydrogen free basis) and are finally used as responses in the parameter estimates as

$$y_i = \frac{F_i^G - F_i^L}{\sum_{j=1}^{N_C-1} \left(F_j^G - F_j^L\right)} * 100$$
(4.37)

With the initial boundary conditions given by the feed composition as,

$$F_i^G = F_i^{G,o} \text{ and } F_i^I = F_i^{I,o} \text{ at } z = 0, \text{ where } i = 1,2,3----N_c$$
 (4.38)

These set of differential equations can be solved using Peng-Robinson equation of state.

5. SIMULATION OF HYDROCRACKING REACTOR

5.1 EXPERIMENTAL / COMPUTATIONAL:

5.1.1 Simulation:

For the process of Hydro Cracking, simulation is to be done n order to estimate the product, and for reaction extents with given stoichimetries. But during these some assumptions are to be considered for the software compatibility. The software used is ASPEN – HYSYS.

5.1.2 Flow Sheet Development:

The mixed feed consisting of $C_{16}-C_{33}$ cut from Vacuum Distillation Unit after preheating through a series of heat exchangers and a furnace is entered into the reaction section. In this section there are series of 3 reactors for better conversions as each reactor is of 66% efficiency where products from one reactor enters into the other. Similarly there is another set of two reactors where the preheated feed through heat exchangers and a furnace into this reaction section. Then the products in vapor phase coming from both the reactor sections are distilled for separation of required products.

5.2 ASSUMPTIONS AND EXPLANATIONS:

In terms of chemistry the compounds being handled in this simulation are not pure components of molecules. So being a mixture with varying properties, and HYSYS is not having this facility of handling such components. But it can handle in terms of pure component compositions in each compound. We need to consider liquid hypothetical components for this. Where few molecular properties like, molecular weight, densities, boiling points are used to estimate the other molecular properties. Information or details about all the properties are not required, but few important properties are sufficient for estimating the rest of properties basing on these.

In actual processes the process includes catalysts. But ASPEN – HYSYS require rate of forward and backward reaction in case of catalytic reactions which is difficult to obtain. So during simulation conversion reactors are considered where we will be obtaining the reaction extents of each individual molecule. This data can be used for developing new catalyst for better conversions. We can understand what exactly the cracking chemistry being involved here. If the catalyst properties in terms of reactions extents or rate of reactions are known the can used directly.

5.3 VALIDATION WITH COMMERCIAL UNITS:

This entire simulation is done in steady state mode. But on comparing with the plant data the results obtained are almost very similar including the graphs. These results can now be used to vary the operating conditions for better conversions and efficiencies. And even for the

development of new catalysts for better selectivity and conversions. But a close observation on these are to be made even in pilot plant studies. As the current simulation is made in steady state mode where as the actual process will be in dynamic mode. But yet these results can be used for comparisons and to know what and how of the process.

The simulated values and reports are included and also graphs related to the values are in appendix III.

6. RESULTS AND DISCUSSIONS

6.1 OBSERVATIONS AND MODEL VALIDATIONS:

The feed entering in to the reactor industrially was a mixed feed for which all the parameters like a compound cannot be preformed / pre estimated. But yet for compatibility there are few properties that will be periodically checked. These will generally be the physical parameters. ASPEN - HYSYS is the simulator is used to handle these compounds by creating a hypothetical component. These hypothetical compounds in order to estimate the other required properties of the mixture the known physical parameters are given and a hypothetical component is created.

ASPEN HYSYS is not having the in built catalysts properties. But yet it can handle them by using the rate constants. These rate constants cannot be very specific for a process they will depend upon the feed type, catalyst nature, type and many process parameters. Else stoichiometry is needed. So for these the outlets of each reacts are considered and are giving. So now a balance between the inlet and outlet compositions was taken and then the reaction stoichiometry was developed. On analyzing this stoichiometry we can balance the gross consumption and formation of a production. According to the values of dynamic case a mismatch with the stoichiometry and the feed and the desired products are accordingly modified. Though the practical reaction was 66% conversion in first reactor. But yet 99% conversion is achieved by adding second stage of reactors. Now the simulator is used to back calculate each stream and given the results in terms of the reaction extents. Now according to this data it will be helpful in preparing a particular catalyst recipe and can even alter the existing catalyst depending upon the reaction extents. The out let streams obtained with these reactions are seen without any error. This is done to observe whether the feed entering to the next reactor is fixed constant and as the reaction extents are changed these will be automatically changed. And the same process was used for the other reactors also.

6.2 RESULTS:

The obtained results are compared with the existing plant data and were found that the obtained graphs are almost same to that of the existing process and the considered model is valid to compare the plant data and make necessary modification with respect to process parameters or catalysts.

7. CONCLUSION

Among all the units in primary and secondary processing "HYDROCRACKER" is the one of the efficient secondary process unit. The demand to the hydro cracking is increasing day by day because of the stringent conditions to follow in environment norms. Refineries prefer in hydrogen addition at lower temperatures rather than much more carbon reduction because this might lead to more coke formation. So an equilibrium based model has been performed to study the kinetics of the data along with simulating the input plant data to these kinetics that it is giving the same output with these kinetics considering a conversion reactor instead of catalytic reactor.

The project finally gives us the idea about the kinetics of the hydro cracking unit and also about the stoichiometry of the hydro cracking unit. This leads to rough estimate of the physical parameters of the reactor at steady state conditions.

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APPENDIX I

Table 1.1 CONFIGURATION OF BORL REFINERY UNITS.

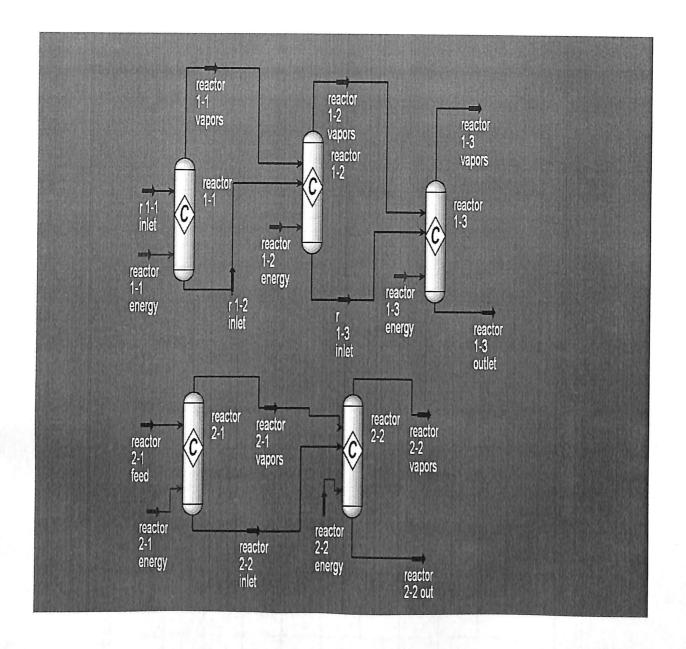
S.No	UNITS	CAPACITY (MMTPA)	
1	Crude / Vacuum Distillation Unit	6.0	
2	Full Conversion Hydrocracker (HCU)	1.95	
3	Diesel Hydrotreator	1.63	
. 4	Delayed Coker Unit	1.36	
5	Hydrogen Unit	0.07	
6	Naphtha Hydrotreater	1.0	
7	CCR Reformer Unit	0.5	
8	Isomerization Unit	0.3	
9	Sulphur Recovery Unit	2 * 180 MTPD	

APPENDIX II

TABLE 3.1: Results of Network Generation for C₁₆ and C₃₃ Feedstocks

Type of Elementary Steps	Number of Elementary Steps				
	C16 Feed	C33 Feed			
Protonation	12831	836693			
Deprotonation	12845	837015			
Hydride shift	10470	761712 89960			
Methyl shift	2670				
Protonated cyclo propane	8485	275176			
Total Elementary Steps	2335	851602			
Carbenium Ions Involved	49636	2886158 (~3 Million)			
β- scission	6167	396354			
Olefins Involved	7601	448395			

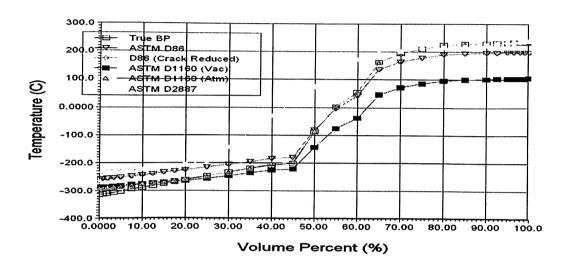
SIMULATION FLOWSHEET WITH CODE NAMES



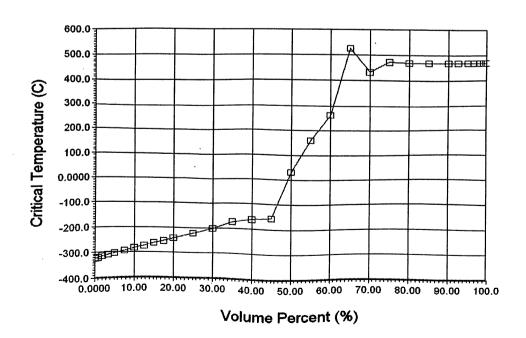
Graphs:

Reactor 1-1

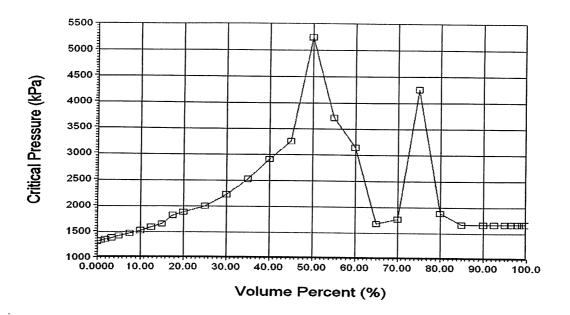
Boiling curves



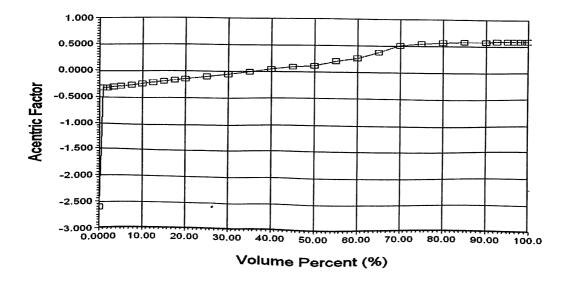
Critical temperature



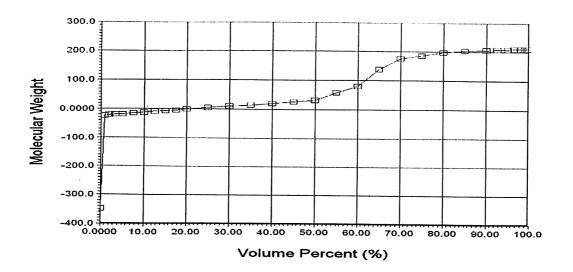
Critical pressure



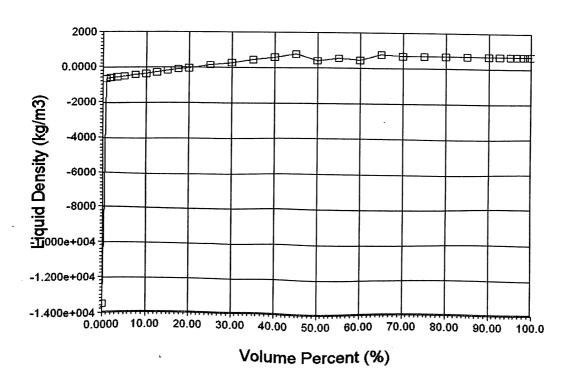
Accentric factor



Molecular weights

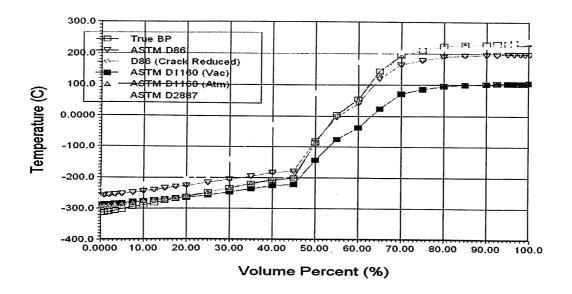


Liquid denstity

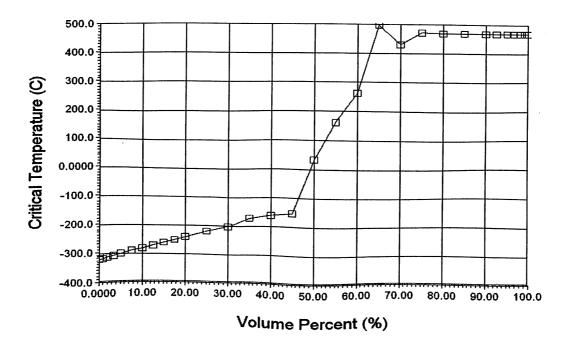


Reactor 1-2 vapors:

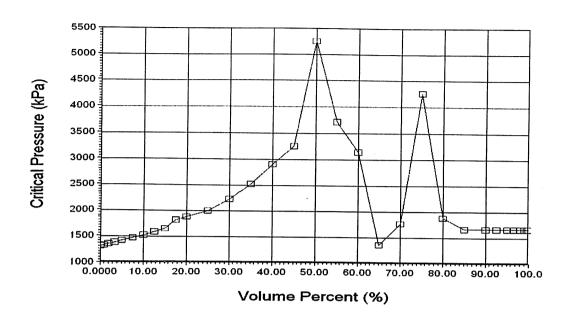
Boiling point



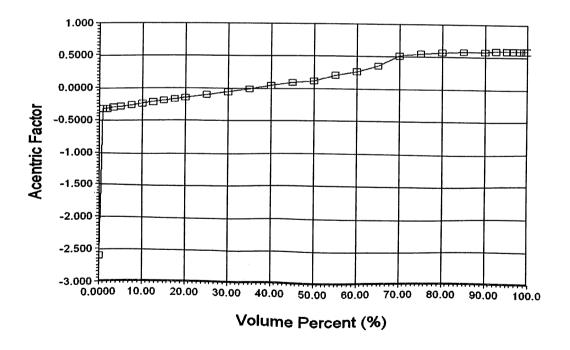
Critical temperature



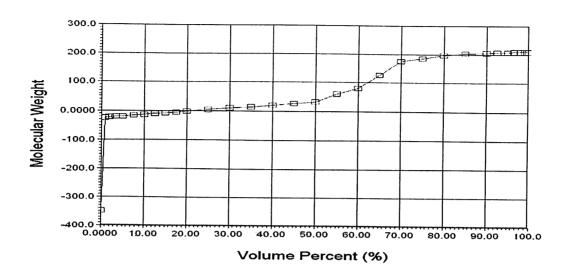
Critical pressure



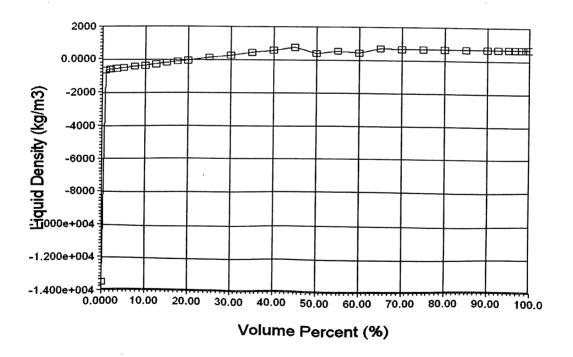
Acentric factor



Molecular weight

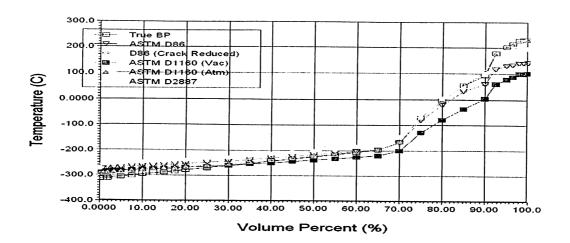


Liquid density

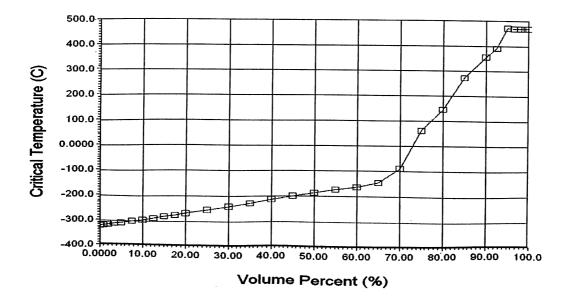


Reactor 1-3:

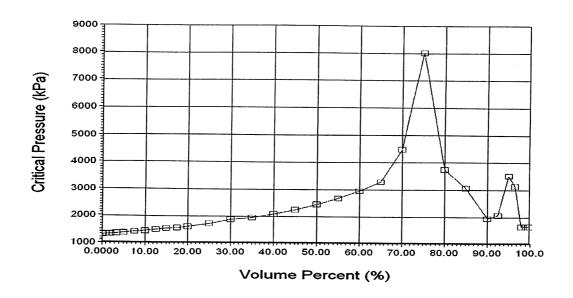
Boiling point



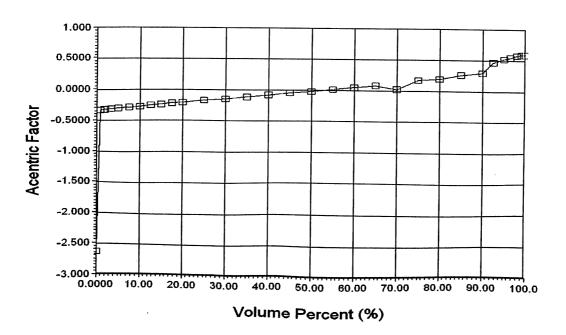
Critical tempearture



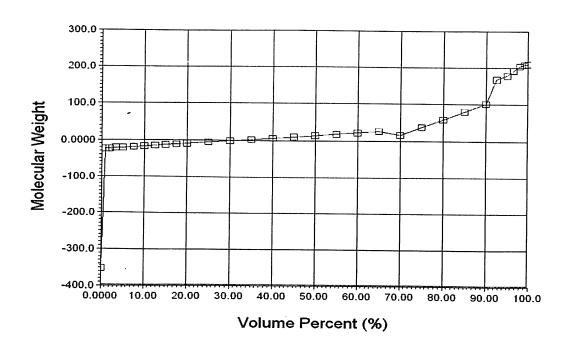
Critical pressure



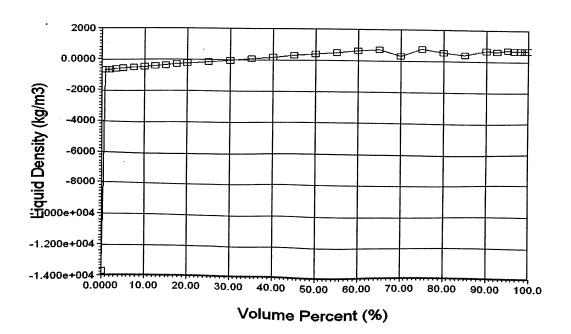
Acentric factor



Molecular weight

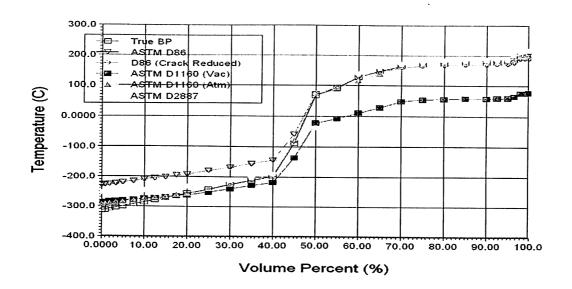


Liquid density

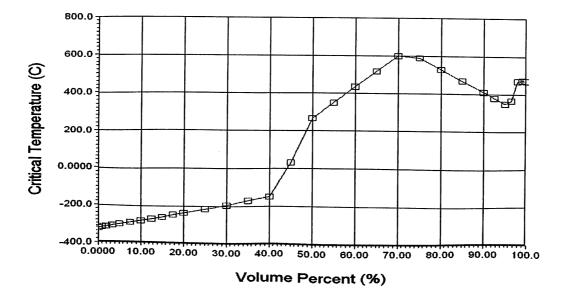


Reactor 2-1:

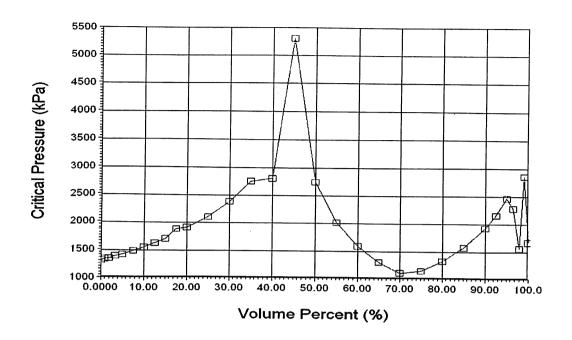
Boiling point



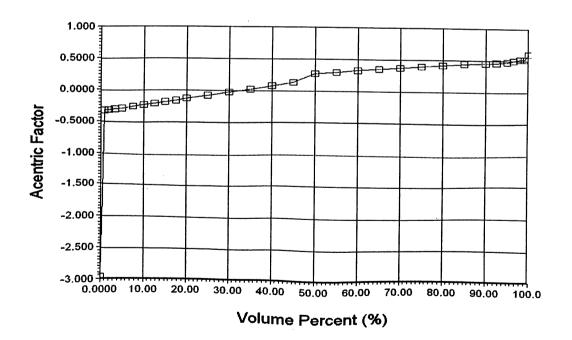
Critical temperature



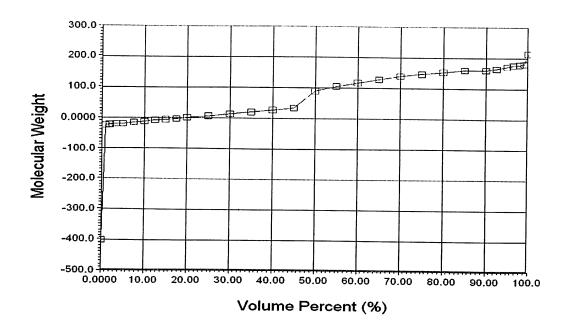
Critical pressure



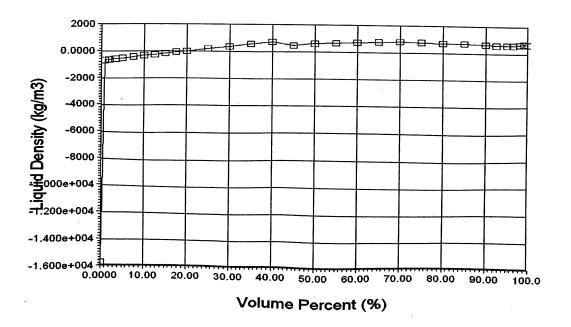
Acentric factor



Molecular weight

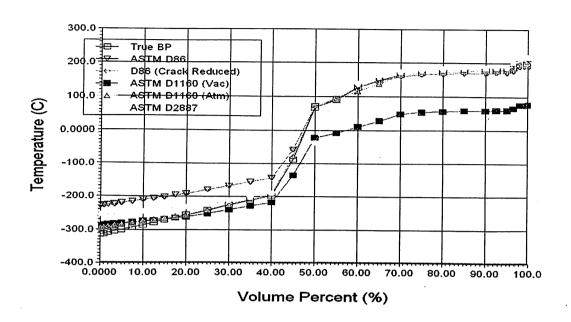


Liquid density

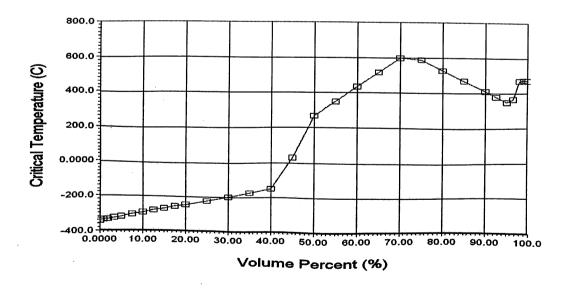


Reactor 2-2:

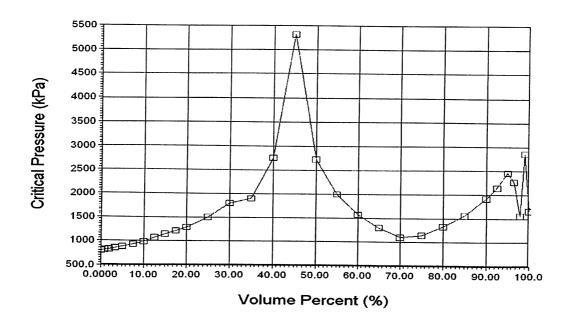
Boiling point



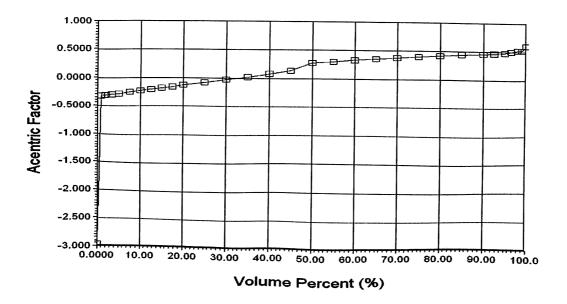
Critical temperature



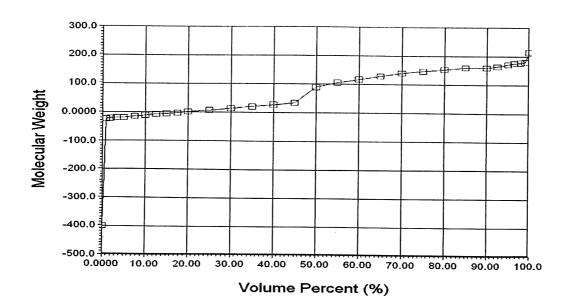
Critical pressure



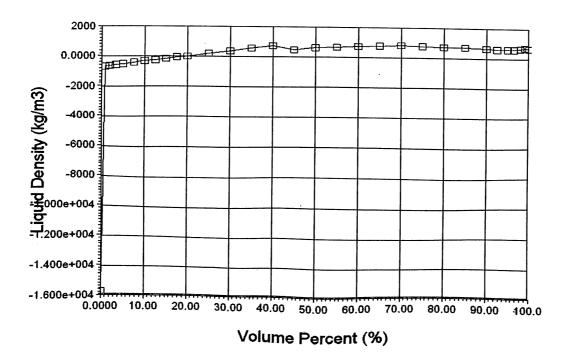
Acentric factor



Molecular weight



Liquid density





7

8

University Of Petroleum And Energy UPES, Bidholi, Dehradun, Uttarakhand

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name: Unit Set: Date/Time: Thu Apr 23 15:14:10 2009

Material Stream: r 1-1 inlet

MOLAR FLOW

(kgmole/h)

7960.1114

0.0487

0.0000

Fluid Package:

Basis-1

Property Package: SRK

CON	IDI	TI	ON	IS
-----	-----	----	----	----

10						
11			Overall	Vapour Phase	Liquid Phase	
12	Vapour / Phase Fraction	on	0.7837	0.7837	0.2163	
13	Temperature:	(C)	385.0 *	385.0	385.0	
14	Pressure:	(kPa)	1.673e+004 *	1.673e+004	1.673e+004	
15	Molar Flow	(kgmole/h)	1.101e+004 *	8632	2383	
16	Mass Flow	(kg/h)	2.748e+005 *	6.255e+004	2.122e+005	
17	Std Ideal Liq Vol Flow	(m3/h)	588.7	301.6	287.2	
18	Molar Enthalpy	(kJ/kgmole)	-2.300e+004	2263	-1.145e+005	
19	Molar Entropy	(kJ/kgmole-C)	158.2	120.6	294.4	
20	Heat Flow	(kJ/h)	-2.534e+008	1.953e+007	-2.729e+008	
21	Liq Vol Flow @Std Cor	nd (m3/h)	-		286.5	

COMPOSITION

Overall Phase

Vapour Fraction

0.7837

25							
COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION	
Hydrogen	8794.2037 •	0.7984 *	17729.1149 *	0.0645 *	253.7839 *	0.4311 *	
H2S	0.0587 *	0.0000 •	2.0000 *	0.0000 *	0.0025 *	0.0000 •	
Ammonia	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	
H2O	8.5484 *	0.0008 *	154.0010 *	0.0006 *	0.1543 *	0.0003 *	
Methane	323.5720 •	0.0294 *	5191.0337 *	0.0189 *	17.3385 *	0.0295 *	
Ethane	46.1262 *	0.0042 *	1387.0090 *	0.0050 *	3.8996 *	0.0066 •	
Propane	41.9986 *	0.0038 *	1852.0120 *	0.0067 *	3.6552 *	0.0062 *	
i-Butane	29.6437 *	0.0027 *	1723.0112 *	0.0063 *	3.0660 *	0.0052 *	
n-Butane	15.1229 *	0.0014 *	879.0057 *	0.0032 *	1.5072 *	0.0026 *	
CO	0.1785 *	0.0000 *	5.0000 *	0.0000 •	0.0063 *	0.0000	
CO2	0.0682 *	0.0000 •	3.0000 *	0.0000 *	0.0036 *	0.0000 •	
MIXED FEED*	1732.2912 *	0.1573 *	243997.5818 *	0.8880 *	302.0894 *	0.5131 •	
LIGHT NAPHT*	17.6725 *	0.0016 *	1431.0093 *	0.0052 *	2.2582 *	0.0038	
HEAVY NAPHT*	4.3595 *	0.0004 *	353.0023 *	0.0013 *	0.8948 *	0.0015	
LIGHT DIESE*	0.0763 *	0.0000 •	16.0001 *	0.0001 *	0.0233 *	0.0000 *	
DHT HY DIES*	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	
KEROSINE*	0.1733 *	0.0000 *	30.0002 *	0.0001 *	0.0479 *	0.0001 *	
	0.0392 *	0.0000 *	7.0000 •	0.0000 *	0.0099 *	0.0000 *	
·UC OIL*	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	
DHT FEED*	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	
HEAVY DIESE*	0.0000 •	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 •	
MDEthnlAmine	0.0000 *	0.0000 •	0.0000 *	0.0000 *	0.0000 *	0.0000 •	
Total	11014.1330	1.0000	274759.7812	1.0000	588.7406	1.0000	
	Hydrogen H2S Ammonia H2O Methane Ethane Propane i-Butane n-Butane CO CO2 MIXED FEED* LIGHT NAPHT* HEAVY NAPHT* LIGHT DIESE* DHT LT DIES* ·UC OIL* DHT FEED* HEAVY DIESE* MDEthnlAmine	Hydrogen 8794.2037 * H2S 0.0587 * Ammonia 0.0000 * H2O 8.5484 * Methane 323.5720 * Ethane 46.1262 * Propane 41.9986 * i-Butane 29.6437 * n-Butane 15.1229 * CO 0.1785 * CO2 0.0682 * MIXED FEED* 1732.2912 * LIGHT NAPHT* 17.6725 * HEAVY NAPHT* 4.3595 * LIGHT DIESE* 0.0763 * DHT HY DIES* 0.0000 * KEROSINE* 0.1733 * DHT LT DIES* 0.0392 * *UC OIL* 0.0000 * DHT FEED* 0.0000 * MDEthnlAmine 0.0000 *	(kgmole/h) Hydrogen 8794.2037 * 0.7984 * 0.0000 * H2S 0.0587 * 0.0000 * 0.0000 * Ammonia 0.0000 * 0.0000 * 0.0000 * H2O 8.5484 * 0.0088 * 0.00294 * Methane 323.5720 * 0.0294 * 0.0042 * 0.0042 * Ethane 46.1262 * 0.0042 * 0.0038 * 0.0038 * 0.0038 * 0.0027 * 0.0027 * 0.0027 * 0.0027 * 0.0027 * 0.0014 * 0.00000 * 0.00000 * 0.00000 * 0.00000 * 0.00000 * 0.00000 * 0.00000 * 0.00000 * 0.00000 *	Hydrogen 8794.2037 * 0.7984 * 17729.1149 * H2S 0.0587 * 0.0000 * 2.0000 * Ammonia 0.0000 * 0.0000 * 0.0000 * 0.0000 * H2O 8.5484 * 0.0008 * 154.0010 * Methane 323.5720 * 0.0294 * 5191.0337 * Ethane 46.1262 * 0.0042 * 1387.0090 * Propane 41.9986 * 0.0038 * 1852.0120 * 180.000 * 1723.0112 *	Hydrogen 8794.2037	Record R	

Vapour Phase

MASS FLOW

(kg/h)

16047.5849

1.6608

MASS FRACTION

0.2565

0.0000

MOLE FRACTION

0.9222

0.0000

Phase Fraction 0.7837

LIQUID VOLUME

FLOW (m3/h)

229.7136

0.0021

FRACTION 0.7618 0.0000 0.0000 0.0004

LIQUID VOLUME

0.0000 0.0000 0.0000 0.0000 58 H2O 7.3077 131.6497 0.0008 0.0021 0.1319 59 Methane 285.9688 4587.7681 0.0331 0.0733 15.3235 0.0508 60 Ethane 39.1294 0.0045 1176.6175 0.0188 3.3081 0.0110 61 Propane 34.2308 1509.4751 0.0040 0.0241 2.9792 0.0099 62 i-Butane 23.2668 1352.3609 0.0027 0.0216 2.4065 0.0080 63 n-Butane 11.7248 681.4932 0.0109 0.0014 1.1685 0.0039 CO 0.1622 4.5438 0.0001 0.0057 0.0000 0.0000 Hyprotech Ltd. (Build 4602 Page 1 of 24

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COMPONENTS

Hydrogen

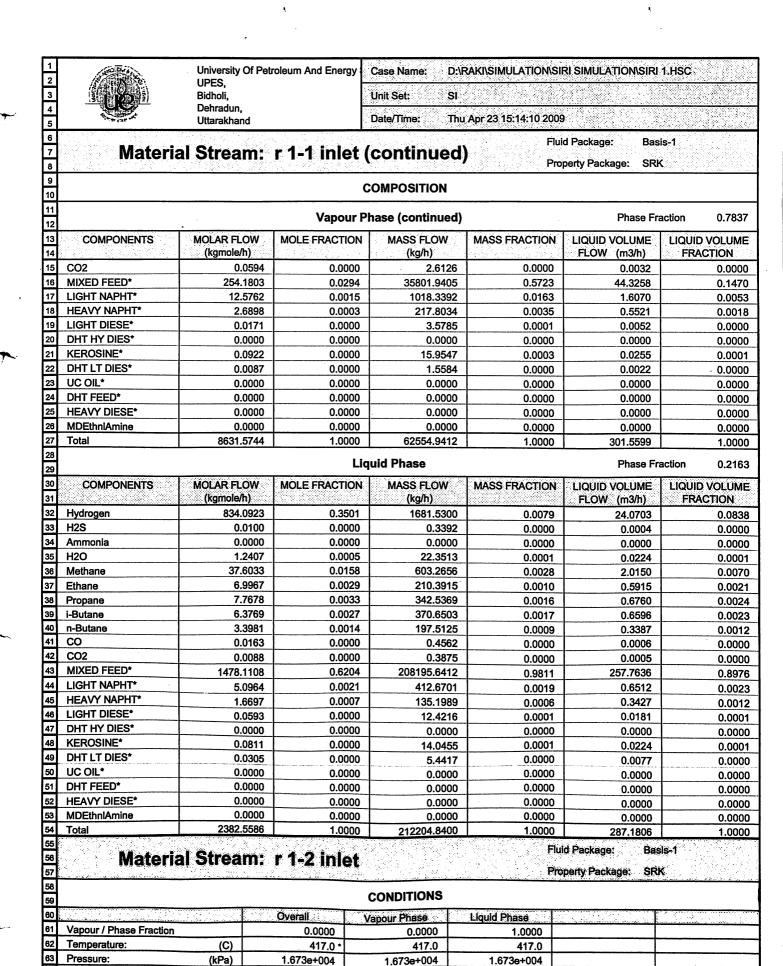
Ammonia

H2S

52

53

Specified by user.



(kgmole/h)

0.0000

0.0000

HYSYS v3 0.1 (Build 4602)

0.0000

Molar Flow

University Of Petroleum And Energy Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC 2 3 Unit Set: Bidholi, SI 4 Dehradun. Thu Apr 23 15:14:10 2009 Date/Time: . Uttarakhand 5 6 Fluid Package: Basis-1 7 Material Stream: r 1-2 inlet (continued) Property Package: SRK 9 **CONDITIONS** 10 11 Overall Vapour Phase Liquid Phase 12 Mass Flow 0.0000 0.0000 0.0000 (kg/h) Std Ideal Liq Vol Flow (m3/h) 13 0.0000 0.0000 0.0000 14 (kJ/kgmole) Molar Enthalpy -5874 -5848 -5874 15 (kJ/kgmole-C) 215.1 215.1 Molar Entropy 214.9 16 **Heat Flow** (kJ/h) 0.0000 0.0000 0.0000 Liq Vol Flow @Std Cond (m3/h)0.0000 0.0000 0.0000 COMPOSITION 19 20 **Overall Phase** Vapour Fraction 0.0000 21 22 **COMPONENTS** MOLAR FLOW MOLE FRACTION MASS FLOW MASS FRACTION LIQUID VOLUME LIQUID VOLUME FLOW (m3/h) FRACTION (kg/h) (kgmole/h) Hydrogen 0.8262 0.0000 0.0000 0.0000 0.0874 0.4557 H2S 0.0000 0.0144 0.0000 0.0258 0.0000 0.0119 Ammonia 0.0000 0.0017 0.0000 0.0016 0.0000 0.0009 27 H20 0.0000 0.0011 0.0000 0.0011 0.0000 0.0004 28 Methane 0.0000 0.0359 0.0000 0.0302 0.0000 0.0367 29 Ethane 0.0000 0.0074 0.0000 0.0116 0.0000 0.0119 30 Propane 0.0000 0.0077 0.0000 0.0178 0.0000 0.0128 31 i-Butane 0.0000 0.0065 0.0000 0.0197 0.0000 0.0128 32 n-Butane 0.0000 0.0038 0.0000 0.0117 0.0000 0.0073 33 CO 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 34 CO₂ 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 35 MIXED FEED* 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 36 LIGHT NAPHT* 0.0000 0.0142 0.0000 0.0602 0.0000 0.0346 37 **HEAVY NAPHT** 0.0000 0.0167 0.0000 0.0655 0.0710 0.0000 LIGHT DIESE* 0.0000 0.0162 0.0000 0.1788 0.0000 0.0949 39 **DHT HY DIES*** 0.0000 0.0300 0.0000 0.3225 0.0000 0.1704 49 KEROSINF* 0.0000 0.0075 0.0000 0.0681 0.0000 0.0396 41 **DHT LT DIES*** 0.0000 0.0010 0.0000 0.0093 0.0000 0.0048 42 UC OIL* 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 43 **DHT FEED*** 0.0000 0.0056 0.0000 0.0000 0.0524 0.0263 44 **HEAVY DIESE*** 0.0000 0.0041 0.0000 0.0000 0.0308 0.0136 **MDEthnlAmine** 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 46 Total 0.0000 1.0000 0.0000 0.0000 1.0000 1.0000 47 Vapour Phase **Phase Fraction** 0.0000 48 49 COMPONENTS MOLAR FLOW MOLE FRACTION MASS FLOW MASS FRACTION LIQUID VOLUME LIQUID VOLUME (kgmole/h) 50 (kg/h) FLOW (m3/h) FRACTION 51 0.0000 Hydrogen 0.0876 0.8264 0.0000 0.0000 0.4561 52 0.0000 H2S 0.0144 0.0258 0.0000 0.0000 0.0119 0.0000 53 Ammonia 0.0017 0.0000 0.0016 0.0000 0.0009 0.0000 H20 0.0011 0.0000 0.0011 0.0004 0.0000 Methane 0.0000 55 0.0359 0.0000 0.0302 0.0367 0.0000 58 Ethane 0.0000 0.0074 0.0000 0.0117 0.0000 0.0119 Propane 0.0000 57 0.0077 0.0000 0.0178 0.0000 0.0128 0.0000 58 i-Butane 0.0065 0.0000 0.0197 0.0000 0.0128

64 HEAVY NAPHT*

65 Hivprotech Ltd.

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MIXED FEED*

LIGHT NAPHT*

n-Butane

CO₂

59

60 CO

61

62

0.0000

0.0000

0.0000

0.0000

0.0000

0.0000

0.0038

0.0000

0.0000

0.0000

0.0142

0.0167

0.0000

0.0000

0.0000

0.0000

0.0000

0.0000

HYSYS v3.0.1 (Build 4602

0.0117

0.0000

0.0000

0.0000

0.0602

0.0710

Page 3 of 24
Specified by user.

0.0073

0.0000

0.0000

0.0000

0.0346

0.0655

0.0000

0.0000

0.0000

0.0000

0.0000

0.0000

University Of Petroleum And Energy Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC 2 UPES. Bidholi. **Unit Set:** 4 Dehradun. Date/Time: Thu Apr 23 15:14:10 2009 5 Uttarakhand 6 Fluid Package: Basis-1 Material Stream: r 1-2 inlet (continued) 7 Property Package: SRK 8 COMPOSITION 10 11 Vapour Phase (continued) Phase Fraction 0.0000 12 13 COMPONENTS **MOLAR FLOW MOLE FRACTION** MASS FLOW MASS FRACTION LIQUID VOLUME LIQUID VOLUME FLOW (m3/h) FRACTION (kgmole/h) (kg/h) 14 LIGHT DIESE* 15 0.0000 0.0162 0.0000 0.1787 0.0000 0.0948 16 **DHT HY DIES*** 0.0000 0.0300 0.0000 0.3223 0.0000 0.1701 17 **KEROSINE*** 0.0000 0.0000 0.0000 0.0075 0.0681 0.0396 18 **DHT LT DIES*** 0.0000 0.0010 0.0000 0.0093 0.0000 0.0048 UC OIL* 19 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 20 **DHT FEED*** 0.0000 0.0056 0.0000 0.0524 0.0000 0.0262 **HEAVY DIESE*** 21 0.0000 0.0041 0.0000 0.0308 0.0000 0.0135 **MDEthnlAmine** 22 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 23 Total 1.0000 0.0000 0.0000 1.0000 0.0000 1.0000 24 **Liquid Phase** Phase Fraction 1.000 25 LIQUID VOLUME 26 MOLAR FLOW **MOLE FRACTION** MASS FLOW COMPONENTS LIQUID VOLUME MASS FRACTION 27 (kgmole/h) (kg/h) FLOW (m3/h) **FRACTION** 28 0.8262 0.0000 Hydrogen 0.0000 0.0000 0.0874 0.4557 29 H2S 0.0000 0.0144 0.0000 0.0258 0.0000 0.0119 30 Ammonia 0.0000 0.0017 0.0000 0.0016 0.0000 0.0009 31 H20 0.0000 0.0011 0.0000 0.0011 0.0000 0.0004 32 Methane 0.0367 0.0000 0.0359 0.0000 0.0302 0.0000 33 Ethane 0.0000 0.0074 0.0000 0.0116 0.0000 0.0119 34 0.0077 Propane 0.0000 0.0000 0.0178 0.0000 0.0128 35 i-Butane 0.0000 0.0065 0.0000 0.0197 0.0000 0.0128 n-Butane 0.0000 0.0038 0.0000 0.0117 0.0073 0.0000 37 CO 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 CO₂ 0.0000 0.0000 0.0000 0.0000 39 MIXED FEED* 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 40 LIGHT NAPHT 0.0000 0.0142 0.0000 0.0602 0.0000 0.0346 41 **HEAVY NAPHT*** 0.0000 0.0167 0.0000 0.0710 0.0000 0.0655 LIGHT DIESE* 0.0000 0.0162 0.0000 0.0000 0.1788 0.0949 **DHT HY DIES*** 0.0300 0.0000 0.0000 0.0000 0.3225 0.1704 KEROSINE* 0.0000 0.0000 0.0075 0.0000 0.0681 0.0396 **DHT LT DIES*** 0.0010 0.0000 0.0000 0.0000 0.0093 0.0048 46 UC OIL* 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 47 **DHT FEED*** 0.0000 0.0056 0.0524 0.0000 0.0000 0.0263 HEAVY DIESE 48 0.0000 0.0041 0.0308 0.0000 0.0000 0.0136 49 **MDEthnlAmine** 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 50 Total 1.0000 0.0000 1.0000 0.0000 1.0000 51 Fluid Package: Basis-1 Material Stream: r 1-3 inlet 52 Property Package: SRK 53 CONDITIONS 55 56 Overall Liquid Phase Vapour Phase 57 Vapour / Phase Fraction 0.0000 0.0000 1.0000 (C) 58 Temperature: 408.6 408.6 408.6 1.592e+004 59 (kPa) Pressure: 1.592e+004 1.592e+004

65 Hyprotech Ltd: Licensed to: TEAM LND

Molar Enthalpy

Molar Entropy

Std Ideal Liq Vol Flow

Molar Flow

Mass Flow

(kgmole/h)

(kJ/kgmole)

(kJ/kgmole-C)

(kg/h)

(m3/h)

0.0000

0.0000

0.0000

599.3

-8.072e+004

0.0000

0.0000

0.0000

-6556

214.3

HYSYS v3.0.1 (Build 4602)

0.0000

0.0000

0.0000 -8.072e+004

60

61

62



University Of Petroleum And Energy

Bidholi, Dehradun, Uttarakhand

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name:

Unit Set:

Date/Time:

Thu Apr 23 15:14:10 2009

Material Stream: r 1-3 inlet (continued)

Fluid Package:

Basis-1

Property Package: SRK

CO	N	n	IT	'n	N	8
\sim	H.	υ		ı	IV.	3

11			Overall	Vapour Phase	Liquid Phase	
12	Heat Flow	(kJ/h)	0.0000	0.0000	0.0000	
13	Liq Vol Flow @Std Cond	(m3/h)	0.0000 *	0.0000	0.0000	

COMPOSITION

Overall Phase

Vapour Fraction

0.0000

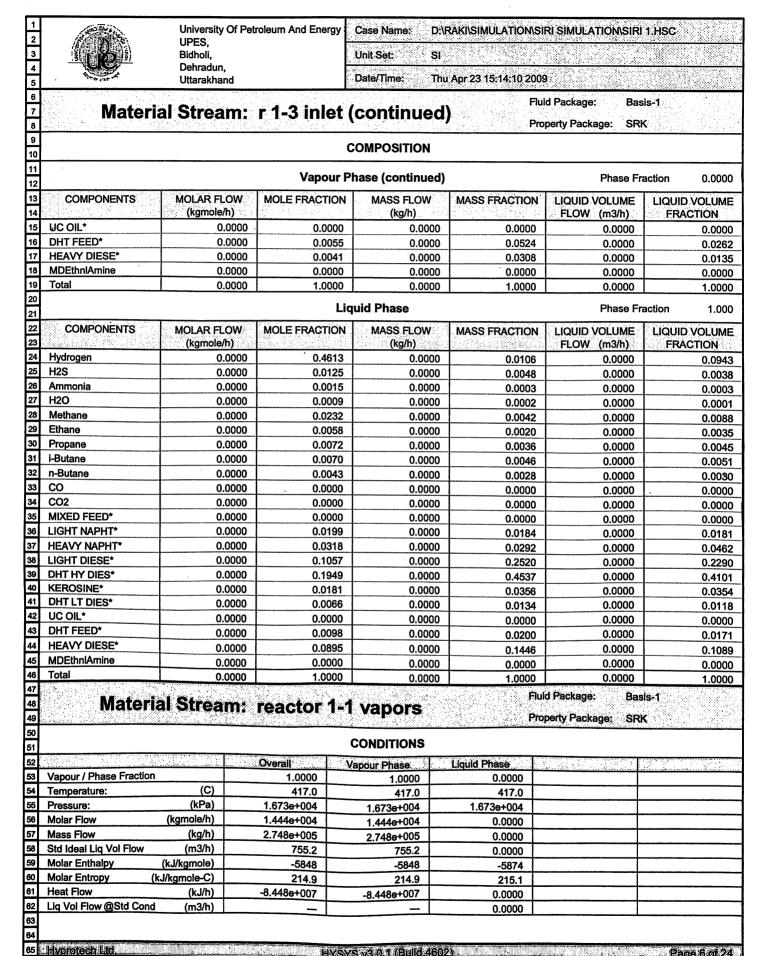
17							
18 19	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
20	Hydrogen	0.0000	0.4613	0.0000	0.0106	0.0000	0.0943
21	H2S	0.0000	0.0125	0.0000	0.0048	0.0000	0.0038
22	Ammonia	0.0000	0.0015	0.0000	0.0003	0.0000	0.0003
23	H2O	0.0000	0.0009	0.0000	0.0002	0.0000	0.0001
24	Methane	0.0000	0.0232	0.0000	0.0042	0.0000	0.0088
25	Ethane	0.0000	0.0058	0.0000	0.0020	0.0000	0.0035
26	Propane	0.0000	0.0072	0.0000	0.0036	0.0000	0.0045
27	i-Butane	0.0000	0.0070	0.0000	0.0046	0.0000	0.0051
28	n-Butane	0.0000	0.0043	0.0000	0.0028	0.0000	0.0030
29	со .	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32	LIGHT NAPHT*	0.0000	0.0199	0.0000	0.0184	0.0000	0.0181
33	HEAVY NAPHT*	0.0000	0.0318	0.0000	0.0292	0.0000	0.0462
34	LIGHT DIESE*	0.0000	0.1057	0.0000	0.2520	0.0000	0.2290
35	DHT HY DIES*	0.0000	0.1949	0.0000	0.4537	0.0000	0.4101
36	KEROSINE*	0.0000	0.0181	0.0000	0.0356	0.0000	0.0354
37	DHT LT DIES*	0.0000	0.0066	0.0000	0.0134	0.0000	0.0118
38	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
39	DHT FEED*	0.0000	0.0098	0.0000	0.0200	0.0000	0.0171
40	HEAVY DIESE*	0.0000	0.0895	0.0000	0.1446	0.0000	0.1089
41	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
42	Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000
43 44	•	Phase Fra	action 0.0000				

Vapour Phase

44				0.0000			
45 48	COMPONENTS	MOLAR FLOW (kgmale/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
47	Hydrogen	0.0000	0.8264	0.0000	0.0876	0.0000	0.4561
48	H2S	0.0000	0.0144	0.0000	0.0258	0.0000	0.0119
49	Ammonia	0.0000	0.0017	0.0000	0.0016	0.0000	0.0009
50	H2O	0.0000	0.0011	0.0000	0.0011	0.0000	0.0004
51	Methane	0.0000	0.0359	0.0000	0.0302	0.0000	0.0368
52	Ethane	0.0000	0.0073	0.0000	0.0116	0.0000	0.0119
53	Propane	0.0000	0.0077	0.0000	0.0178	0.0000	0.0128
54	i-Butane	0.0000	0.0065	0.0000	0.0197	0.0000	0.0128
55	n-Butane	0.0000	0.0038	0.0000	0.0117	0.0000	0.0073
56	CO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
57	CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
58	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
59	LIGHT NAPHT*	0.0000	0.0142	0.0000	0.0603	0.0000	0.0346
60	HEAVY NAPHT*	0.0000	0.0167	0.0000	0.0710	0.0000	0.0655
61	LIGHT DIESE*	0.0000	0.0162	0.0000	0.1787	0.0000	0.0948
62	DHT HY DIES*	0.0000	0.0300	0.0000	0.3223	0.0000	0.1701
63	KEROSINE*	0.0000	0.0075	0.0000	0.0681	0.0000	0.0396
64	DHT LT DIES*	0.0000	0.0010	0.0000	0.0093	0.0000	0.0048
65	Hyprotech Ltd.		HVEV	S v2 0 1 (Build 460)	<i>X</i>		Page 5 of 24

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* Specified by user.





University Of Petroleum And Energy UPES, Bidholi,

Dehradun, Uttarakhand

Case Name:

Date/Time:

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1:HSC

Unit Set:

Thu Apr 23 15:14:10 2009.

Material Stream: reactor 1-1 vapors (continued

Fluid Package:

Basis-1

Property Package:

SRK

COMPOSITION

11 12		Vapour F	Vapour Fraction 1.0000				
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	Hydrogen	11936.5256	. 0.8264	24064.0361	0.0876	344.4653	0.4561
16	H2S	208.0087	0.0144	7088.1045	0.0258	8.9904	0.0119
17	Ammonia	25.1010	0.0017	427.4704	0.0016	0.6939	0.0009
18	H2O	16.2909	0.0011	293.4831	0.0011	0.2941	0.0004
19	Methane	517.9392	0.0359	8309.2474	0.0302	27.7536	0.0367
20	Ethane	106.5603	0.0074	3204.2578	0.0117	9.0087	0.0119
21	Propane	110.8558	0.0077	4888.4065	0.0178	9.6480	0.0128
22	i-Butane	93.3373	0.0065	5425.1352	0.0197	9.6538	0.0128
23	n-Butane	55.3525	0.0038	3217.3076	0.0117	5.5164	0.0073
24	CO	0.2708	0.0000	7.5856	0.0000	0.0095	0.0000
25	CO2	0.1266	0.0000	5.5709	0.0000	0.0067	0.0000
26	MIXED FEED*	0.0017	0.0000	0.2440	0.0000	0.0003	0.0000
27	LIGHT NAPHT*	204.4165	0.0142	16552.3389	0.0602	26.1201	0.0346
28	HEAVY NAPHT*	240.9190	0.0167	19508.0775	0.0710	49.4501	0.0655
29	LIGHT DIESE*	234.1666	0.0162	49089.0130	0.1787	71.5792	0.0948
30	DHT HY DIES*	432.6512	0.0300	88547.7594	0.3223	128.4790	0.1701
31	KEROSINE*	108.1067	0.0075	18711.5680	0.0681	29.8907	0.0396
32	DHT LT DIES*	14.3433	0.0010	2560.7857	0.0093	3.6128	0.0048
33	UC OIL*	0.0004	0.0000	0.1063	0.0000	.0.0001	0.0000
34	DHT FEED*	80.1706	0.0056	14399.8412	0.0524	19.8208	0.0262
35	HEAVY DIESE*	59.5787	0.0041	8459.4423	0.0308	10.2254	0.0135
36	MDEthnlAmine `	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
37	Total	14444.7235	1.0000	274759.7812	1.0000	755.2191	1.0000
38			\/	Db			

Vapour Phase

Phase Fraction

1.000

39	Vapour Filase						1.000
40 41	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
42	Hydrogen	11936.5256	0.8264	24064.0361	0.0876	344.4653	0.4561
43	H2S	208.0087	0.0144	7088.1045	0.0258	8.9904	0.0119
44	Ammonia	25.1010	0.0017	427.4704	0.0016	0.6939	0.0009
45	H2O	16.2909	0.0011	293.4831	0.0011	0.2941	0.0004
46	Methane	517.9392	0.0359	8309.2474	0.0302	27.7536	0.0367
47	Ethane	106.5603	0.0074	3204.2578	0.0117	9.0087	0.0119
48	Propane	110.8558	0.0077	4888.4065	0.0178	9.6480	0.0128
49	i-Butane	93.3373	0.0065	5425.1352	0.0197	9.6538	0.0128
50	n-Butane	55.3525	0.0038	3217.3076	0.0117	5.5164	0.0073
51	СО	0.2708	0.0000	7.5856	0.0000	0.0095	0.0000
52	CO2	0.1266	0.0000	5.5709	0.0000	0.0067	0.0000
53	MIXED FEED*	0.0017	0.0000	0.2440	0.0000	0.0003	0.0000
54	LIGHT NAPHT*	204.4165	0.0142	16552.3389	0.0602	26.1201	0.0346
55	HEAVY NAPHT*	240.9190	0.0167	19508.0775	0.0710	49.4501	0.0655
56	LIGHT DIESE*	234.1666	0.0162	49089.0130	0.1787	71.5792	0.0948
57	DHT HY DIES*	432.6512	0.0300	88547.7594	0.3223	128.4790	0.1701
58	KEROSINE*	108.1067	0.0075	18711.5680	0.0681	29.8907	0.0396
59	DHT LT DIES*	14.3433	0.0010	2560.7857	0.0093	3.6128	0.0048
60	UC OIL*	0.0004	0.0000	0.1063	0.0000	0.0001	0.0000
61	DHT FEED*	80.1706	0.0056	14399.8412	0.0524	19.8208	0.0262
62	HEAVY DIESE*	59.5787	0.0041	8459.4423	0.0308	10.2254	0.0135
63	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
64	Total	14444.7235	1.0000	274759.7812	1.0000	755.2191	1.0000
85	Hyprotech Ltd.	т.	HYSY	3 V3.0.1 (Build 4602	3)		Page 7 of 24



University Of Petroleum And Energy UPES,

Bidholi, Dehradun, Uttarakhand

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name:

Unit Set:

Date/Time:

Thu Apr 23 15:14:10 2009

Fluid Package:

Basis-1

Material Stream: reactor 1-1 vapors (continued Property Package:

SRK

COMPOSITION

12		Phase Fra	Phase Fraction 0.0000				
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	Hydrogen	0.0000	0.8262	0.0000	0.0874	0.0000	0.4557
16	H2S	0.0000	0.0144	0.0000	0.0258	0.0000	0.0119
17	Ammonia	0.0000	0.0017	0.0000	0.0016	0.0000	0.0009
18	H2O	0.0000	0.0011	0.0000	0.0011	0.0000	0.0004
19	Methane	0.0000	0.0359	0.0000	0.0302	0.0000	0.0367
20	Ethane	0.0000	0.0074	0.0000	0.0116	0.0000	0.0119
21	Propane	0.0000	0.0077	0.0000	0.0178	0.0000	0.0128
22	i-Butane	0.0000	0.0065	0.0000	0.0197	0.0000	0.0128
23	n-Butane	0.0000	0.0038	0.0000	0.0117	0.0000	0.0073
24	CO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	LIGHT NAPHT*	0.0000	0.0142	0.0000	0.0602	0.0000	0.0346
28	HEAVY NAPHT*	0.0000	0.0167	0.0000	0.0710	0.0000	0.0655
29	LIGHT DIESE*	0.0000	0.0162	0.0000	0.1788	0.0000	0.0949
30	DHT HY DIES*	0.0000	0.0300	0.0000	0.3225	0.0000	0.1704
31	KEROSINE*	0.0000	0.0075	0.0000	0.0681	0.0000	0.0396
32	DHT LT DIES*	0.0000	0.0010	0.0000	0.0093	0.0000	0.0048
33	UC OIL*	0.0000 .	0.0000	0.0000	0.0000	0.0000	0.0000
34	DHT FEED*	0.0000	0.0056	0.0000	0.0524	0.0000	0.0263
35	HEAVY DIESE*	0.0000	0.0041	0.0000	0.0308	0.0000	0.0136

Material Stream: reactor 1-2 vapors

0.0000

0.0000

Fluid Package:

0.0000

0.0000

1.0000

Property Package:

0.0000

CONDITIONS

0.0000

0.0000

1.0000

43	,		Overall	Vapour Phase	Liquid Phase	
44	Vapour / Phase Fraction	on	1.0000	1.0000	0.0000	
45	Temperature:	(C)	408.6	408.6	408.6	
46	Pressure:	(kPa)	1.592e+004	1.592e+004	1.592e+004	
47	Molar Flow	(kgmole/h)	1.444e+004	1.444e+004	0.0000	
48	Mass Flow	(kg/h)	2.748e+005	2.748e+005	0.0000	
49	Std Ideal Liq Vol Flow	(m3/h)	755.2	755.2	0.0000	
50	Molar Enthalpy	(kJ/kgmole)	-6556	-6556	-8.072e+004	
51	Molar Entropy	(kJ/kgmole-C)	214.3	214.3	599.3	
52	Heat Flow	(kJ/h)	-9.470e+007	-9.470e+007	0.0000	
53	Liq Vol Flow @Std Co	nd (m3/h)			0.0000	

COMPOSITION

57				vapour Fraction 1.0000			
58 59	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
60	Hydrogen	11936.5983	0.8264	24064.1826	0.0876	344.4674	0.4561
61	H2S	208.0110	0.0144	7088.1838	0.0258	8.9905	0.0119
62	Ammonia	25.1013	0.0017	427.4756	0.0016	0.6939	0.0009
63	H2O	16.2910	0.0011	293.4834	0.0011	0.2941	0.0004
64	Methane	517.9459	0.0359	8309.3550	0.0302	27.7539	0.0368
65	Hveretech Ltd		PACAG	1.0 0 1 (Built 4605	A Property of the Control of the Con		Page 8 of 24

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MDEthnlAmine

Total

* Specified by user.



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Bidholi, Dehradun, Uttarakhand

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name:

Unit Set:

Date/Time: Thu Apr 23 15:14:10 2009

Material Stream: reactor 1-2 vapors (continued

Property Package: SRK

COMPOSITION

11 12				Vapour Fraction 1.0000					
13 14	COMPONENTS	MOLAR FLOW (kgmale/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION		
15	Ethane	105.9634	0.0073	3186.3094	0.0116	8.9583	0.0119		
16	Propane	110.8439	0.0077	4887.8832	0.0178	9.6469	0.0128		
17	i-Butane	93.3365	0.0065	5425.0893	0.0197	9.6538	0.0128		
18	n-Butane	55.3517	0.0038	3217.2643	0.0117	5.5164	0.0073		
19	CO	0.2708	0.0000	7.5855	0.0000	0.0095	0.0000		
20	CO2	0.1266	0.0000	5.5711	· 0.0000	0.0068	0.0000		
21	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
22	LIGHT NAPHT*	204.5376	0.0142	16562.1395	0.0603	26.1356	0.0346		
23	HEAVY NAPHT*	240.9154	0.0167	19507.7861	0.0710	49.4494	0.0655		
24	LIGHT DIESE*	234.1681	0.0162	49089.3226	0.1787	71.5796	0.0948		
25	DHT HY DIES*	432.6469	0.0300	88546.8806	0.3223	128.4778	0.1701		
26	KEROSINE*	108.1692	0.0075	18722.3910	0.0681	29.9080	0.0396		
27	DHT LT DIES*	14.3421	0.0010	2560.5777	0.0093	3.6126	0.0048		
28	UC OIL*	0.0000	0.0000	0.0025	0.0000	0.0000	0.0000		
29	DHT FEED*	80.1641	0.0055	14398.6690	0.0524	19.8192	0.0262		
30	HEAVY DIESE*	59.5800	0.0041	8459.6290	0.0308	10.2256	0.0135		
31	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
32	Total	14444.3639	1.0000	274759.7812	1.0000	755.1991	1.0000		
33 34		Vapour Phase					Phase Fraction 1.000		
35	COMPONENTS	MOLAR FLOW	MOLE ERACTION	MASS FLOW	MASS EDACTION	LIQUID VOLUME	LIOUID VOLUME		

34								
35 36	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION	
37	Hydrogen	11936.5983	0.8264	24064.1826	0.0876	344.4674	0.4561	
38	H2S	208.0110	0.0144	7088.1838	0.0258	8.9905	0.0119	
39	Ammonia	25.1013	0.0017	427.4756	0.0016	0.6939	0.0009	
40	H2O	16.2910	0.0011	293.4834	0.0011	0.2941	0.0004	
41	Methane	517.9459	0.0359	8309.3550	0.0302	27.7539	0.0368	
42	Ethane	105.9634	0.0073	3186.3094	0.0116	8.9583	0.0119	
43	Propane	110.8439	0.0077	4887.8832	0.0178	9.6469	0.0128	
44	i-Butane	93.3365	0.0065	5425.0893	0.0197	9.6538	0.0128	
45	n-Butane	55.3517	0.0038	3217.2643	0.0117	5.5164	0.0073	
46	СО	0.2708	0.0000	7.5855	0.0000	0.0095	0.0000	
47	CO2	0.1266	0.0000	5.5711	0.0000	0.0068	0.0000	
48	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
49	LIGHT NAPHT*	204.5376	0.0142	16562.1395	0.0603	26.1356	0.0346	
50	HEAVY NAPHT*	240.9154	0.0167	19507.7861	0.0710	49.4494	0.0655	
51	LIGHT DIESE*	234.1681	0.0162	49089.3226	0.1787	71.5796	0.0948	
52	DHT HY DIES*	432.6469	0.0300	88546.8806	0.3223	128,4778	0.1701	
53	KEROSINE*	108.1692	0.0075	18722.3910	0.0681	29.9080	0.0396	
54	DHT LT DIES*	14.3421	0.0010	2560.5777	0.0093	3.6126	0.0048	
55	UĆ OIL*	0.0000	0.0000	0.0025	0.0000	0.0000	0.0000	
56	DHT FEED*	80.1641	0.0055	14398.6690	- 0.0524	19.8192	0.0262	
57	HEAVY DIESE*	59.5800	0.0041	8459.6290	0.0308	10.2256	0.0135	
58	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
59	Total	14444.3639	1.0000	274759.7812	1.0000	755.1991	1.0000	
60			Phase Fra	ction 0.0000				

61		Phase Fr	action 0.0000				
62	COMPONENTS	MOLAR FLOW	MOLE FRACTION	MASS FLOW	MASS FRACTION	LIQUID VOLUME	LIQUID VOLUME
63		(kgmole/h)		(kg/h)		FLOW (m3/h)	FRACTION
64	Hydrogen	0.0000	0.4613	0.0000	0.0106	0.0000	0.0943
65	Hyprotech Ltd.		HYSYS	W340MK/BWI614602	1) . +6		Page 9 of 24

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Case Name: Unit Set:

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC

Date/Time:

Thu Apr 23 15:14:10 2009

Material Stream: reactor 1-2 vapors (continued

Fluid Package:

Basis-1

Property Package: SRK

COMPOSITION

12	Liquid Phase (continued)					Phase Fraction 0.0000		
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION	
15	H2S	0.0000	0.0125	0.0000	0.0048	0.0000	0.0038	
16	Ammonia	0.0000	0.0015	0.0000	0.0003	0.0000	0.0003	
17	H2O	0.0000	0.0009	0.0000	0.0002	0.0000	0.0001	
18	Methane	0.0000	0.0232	0.0000	0.0042	0.0000	0.0088	
19	Ethane	0.0000	0.0058	0.0000	0.0020	0.0000	0.0035	
20	Propane	0.0000	0.0072	0.0000	0.0036	0.0000	0.0045	
21	i-Butane	0.0000	0.0070	0.0000	0.0046	0.0000	0.0051	
22	n-Butane	0.0000	0.0043	0.0000	0.0028	0.0000	0.0030	
23	CO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
24	CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
25	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
26	LIGHT NAPHT*	0.0000	0.0199	0.0000	0.0184	0.0000	0.0181	
27	HEAVY NAPHT*	0.0000	0.0318	0.0000	0.0292	0.0000	0.0462	
28	LIGHT DIESE*	0.0000	0.1057	0.0000	0.2520	0.0000	0.2290	
29	DHT HY DIES*	0.0000	0.1949	0.0000	0.4537	0.0000	0.4101	
30	KEROSINE*	0.0000	0.0181	0.0000	0.0356	0.0000	0.0354	
31	DHT LT DIES*	0.0000	0.0066	0.0000	0.0134	0.0000	0.0118	
32	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
33	DHT FEED*	0.0000	0.0098	0.0000	0.0200	0.0000	0.0171	
34	HEAVY DIESE*	0.0000	0.0895	0.0000	0.1446	0.0000	0.1089	
35	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
36	Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000	

Material Stream: reactor 1-3 outlet

Fluid Package:

Basis-1

Property Package: SRK

CONDITIONS

42			Overall	Vapour Phase	Liquid Phase	X	
43	Vapour / Phase Fraction	n	0.0000	0.0000	1.0000		
44	Temperature:	(C)	250.0 *	250.0	250.0		
45	Pressure:	(kPa)	1.569e+004 *	1.569e+004	1.569e+004		
46	Molar Flow	(kgmole/h)	1232	0.0000	1232		
47	Mass Flow	(kg/h)	1.661e+005	0.0000	1.661e+005		
48	Std Ideal Liq Vol Flow	(m3/h)	256.2	0.0000	256.2		
49	Molar Enthalpy	(kJ/kgmole)	-2.035e+005	-4381	-2.035e+005		
50	Molar Entropy	(kJ/kgmole-C)	799.5	132.7	799.5		
51	Heat Flow	(kJ/h)	-2.508e+008	0.0000	-2.508e+008		
52	Liq Vol Flow @Std Con	d (m3/h)	252.5 *	0.0000	252.5		

COMPOSITION

Overall	Phase
Overail	Filase

Vapour Fraction

0.0000

- 30						· ·	
57	COMPONENTS	MOLAR FLOW	MOLE FRACTION	MASS FLOW	MASS FRACTION	LIQUID VOLUME	LIQUID VOLUME
58		(kgmole/h)		(kg/h)		FLOW (m3/h)	FRACTION
59	Hydrogen	257.3771	0.2088	518.8722	0.0031	7.4274	0.0290
60	H2S	15.6321	0.0127	532.6800	0.0032	0.6756	0.0026
61	Ammonia	2.0218	0.0016	34.4308	0.0002	0.0559	0.0002
62	H2O	0.9182	0.0007	16.5407	0.0001	0.0166	0.0001
63	Methane	19.2695	0.0156	309.1386	0.0019	1.0325	0.0040
64	Ethane	6.5774	0.0053	197.7820	0.0012	0.5561	0.0022
65	Hvorotech Ltd.		HMEN	C.va.0 1 (Build 4602	N .		Page 10 of 24

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* Specified by user.



University Of Petroleum And Energy

Bidholi, Dehradun, Uttarakhand

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name:

Unit Set:

Thu Apr 23 15:14:10 2009 Date/Time:

Material Stream: reactor 1-3 outlet (continued) Property Package:

SRK

COMPOSITION

12				Vapour Fraction 0.0000				
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION	
15	Propane	10.1825	0.0083	449.0159	0.0027	0.8862	0.0035	
16	i-Butane	11.4423	0.0093	665.0703	0.0040	1.1835	0.0046	
17	n-Butane	7.4245	0.0060	431.5445	0.0026	0.7399	. 0.0029	
18	CO	0.0068	0.0000	0.1911	0.0000	0.0002	0.0000	
19	CO2	0.0061	0.0000	0.2673	0.0000	0.0003	0.0000	
20	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
21	LIGHT NAPHT*	44.3910	0.0360	3594.4963	0.0216	5.6722	0.0221	
22	HEAVY NAPHT*	85.2174	0.0691	6900.3584	0.0415	17.4914	0.0683	
23	LIGHT DIESE*	215.1609	0.1746	45104.7968	0.2715	65.7696	0.2567	
24	DHT HY DIES*	396.8738	0.3220	81225.4556	0.4890	117.8547	0.4599	
25	KEROSINE*	58.3392	0.0473	10097.6076	0.0608	16.1304	0.0630	
26	DHT LT DIES*	13.0760	0.0106	2334.5344	0.0141	3.2936	0.0129	
27	UC OIL*	0.0000	0.0000	0.0023	0.0000	0.0000	0.0000	
28	DHT FEED*	29.8137	0.0242	5354.9881	0.0322	7.3709	0.0288	
29	HEAVY DIESE*	58.7167	0.0476	8337.0574	0.0502	10.0774	0.0393	
30	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
31	Total	1232.4471	1.0000	166104.8302	1.0000	256.2346	1.0000	
32	Vanour Phase							

Vapour Phase

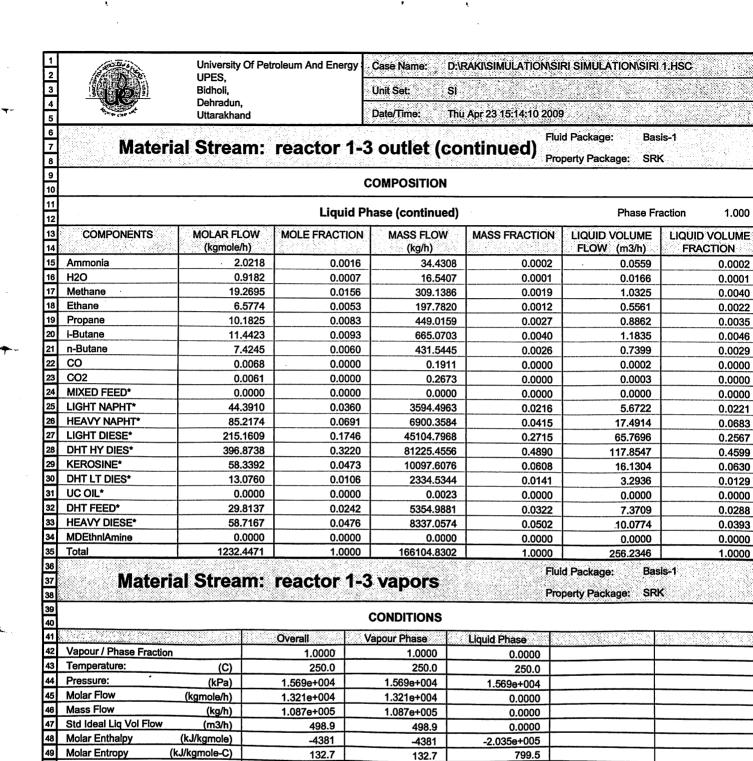
Phase Fraction

0.0000

33	33					7 11400 1 1400011 0.0000		
34 35	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW: (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION	
36	Hydrogen	0.0000	0.8840	0.0000	0.2167	0.0000	0.6755	
37	H2S	0.0000	0.0146	0.0000	0.0603	. 0.0000	0.0167	
38	Ammonia	0.0000	0.0017	0.0000	0.0036	0.0000	0.0013	
39	H2O	0.0000	0.0012	0.0000	0.0025	0.0000	0.0006	
40	Methane	0.0000	0.0377	0.0000	0.0736	0.0000	0.0536	
41	Ethane	0.0000	0.0075	0.0000	0.0273	0.0000	0.0167	
42	Propane	0.0000	0.0076	0.0000	0.0408	0.0000	0.0176	
43	i-Butane	0.0000	0.0062	0.0000	0.0438	0.0000	0.0170	
44	n-Butane	0.0000	0.0036	0.0000	0.0256	0.0000	0.0096	
45	CO	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	
46	CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
47	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
48	LIGHT NAPHT*	0.0000	0.0121	0.0000	0.1194	0.0000	0.0410	
49	HEAVY NAPHT*	0.0000	0.0118	0.0000	0.1160	0.0000	0.0640	
50	LIGHT DIESE*	0.0000	0.0014	0.0000	0.0367	0.0000	0.0116	
51	DHT HY DIES*	0.0000	0.0027	0.0000	0.0674	0.0000	0.0213	
52	KEROSINE*	0.0000	0.0038	0.0000	0.0795	0.0000	0.0276	
53	DHT LT DIES*	0.0000	0.0001	0.0000	0.0021	0.0000	0.0006	
54	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
55	DHT FEED*	0.0000	0.0038	0.0000	0.0832	0.0000	0.0249	
56	HEAVY DIESE*	0.0000	0.0001	0.0000	0.0011	0.0000	0.0003	
57	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
58	Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000	
59 60		Liquid Phase						

60		Liquiu Filase						
61	COMPONENTS	MOLAR FLOW	MOLE FRACTION	MASS FLOW	MASS FRACTION	LIQUID VOLUME	LIQUID VOLUME	
62		(kgmole/h)		(kg/h)		FLOW (m3/h)	FRACTION	
63	Hydrogen	257.3771	0.2088	518.8722	0.0031	7.4274	0.0290	
64	H2S	15.6321	, 0.0127	532.6800	0.0032	0.6756	0.0026	
65	Hyprotech Ltd		HWeW	Sealou (Build 4602	K		Dage 11 of 24	

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-5.788e+007	
COMPOSITION	

0.0000

0.0000

55	Overall Phase					Vapour F	raction 1.0000
56 57	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
58	Hydrogen	11679.2905	0.8840	23545.4500	0.2167	337.0420	0.6755
59	H2S	192.3810	0.0146	6555.5755	0.0603	8.3150	0.0167
60	Ammonia	23.0798	0.0017	393.0497	0.0036	0.6380	0.0013
61	H2O	15.3728	0.0012	276.9429	0.0025	0.2775	0.0006
62	Methane	498.6829	0.0377	8000.3203	0.0736	26.7217	0.0536
63	Ethane	98.7924	0.0075	2970.6777	0.0273	8.3520	0.0167
64	Propane	100.6496	0.0076	4438.3438	0.0408	8.7597	0.0176
65	Hyprotech Ltd.		HYSY	SIV\$ (0.11 (Build: 4602			Page 12 of 24

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Heat Flow

Liq Vol Flow @Std Cond

(kJ/h)

(m3/h)

-5.788e+007

1.000

0.0002

0.0001

0.0040

0.0022

0.0035

0.0046

0.0029

0.0000

0.0000

0.0000

0.0221

0.0683

0.2567

0.4599

0.0630

0.0129

0.0000

0.0288

0.0393

0.0000

1.0000



University Of Petroleum And Energy UPES,

Bidholi, Dehradun, Uttarakhand

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name:

Unit Set:

Date/Time:

Thu Apr 23 15:14:10 2009

Material Stream: reactor 1-3 vapors (continued

Fluid Package:

Basis-1

Property Package:

SRK

COMPOSITION

12			Vapour Fraction 1.0000				
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	i-Butane	81.8934	0.0062	4759.9692	0.0438	8.4702	0.0170
16	n-Butane	47.9264	0.0036	2785.6742	0.0256	4.7763	0.0096
17	CO	0.2640	0.0000	7.3943	0.0001	0.0093	0.0000
18	CO2	0.1205	0.0000	5.3039	0.0000	0.0064	0.0000
19	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	LIGHT NAPHT*	160.2667	0.0121	12977.3700	0.1194	20.4787	0.0410
21	HEAVY NAPHT*	155.6942	0.0118	12607.1162	0.1160	31.9572	0.0640
22	LIGHT DIESE*	19.0084	0.0014	3984.7749	0.0367	5.8104	0.0116
23	DHT HY DIES*	35.7681	0.0027	7320.4147	0.0674	10.6216	0.0213
24	KEROSINE*	49.8920	0.0038	8635.5150	0.0795	13.7948	0.0276
25	DHT LT DIES*	1.2649	0.0001	225.8314	0.0021	0.3186	0.0006
26	UC OIL*	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
27	DHT FEED*	50.3437	0.0038	9042.4867	0.0832	12.4466	0.0249
28	HEAVY DIESE*	0.8644	0.0001	122.7404	0.0011	0.1484	0.0003
29	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	Total	13211.5557	1.0000	108654.9510	1.0000	498.9444	1.0000
31 32		Phase Fr	action 1.000				

Vapour Phase

-							
33 34	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
35	Hydrogen	11679.2905	0.8840	23545.4500	0.2167	337,0420	0.6755
36	H2S	192.3810	0.0146	6555.5755	0.0603	8.3150	0.0167
37	Ammonia	23.0798	0.0017	393.0497	0.0036	0.6380	0.0013
38	H2O	15.3728	0.0012	276.9429	0.0025	0.2775	0.0006
39	Methane	498.6829	0.0377	8000.3203	0.0736	26.7217	0.0536
40	Ethane	98.7924	0.0075	2970.6777	0.0273	8.3520	0.0167
41	Propane	100.6496	0.0076	4438.3438	0.0408	8.7597	0.0176
42	i-Butane	81.8934	0.0062	4759.9692	0.0438	8.4702	0.0170
43	n-Butane	47.9264	0.0036	2785.6742	0.0256	4.7763	0.0096
44	CO	0.2640	0.0000	7.3943	0.0001	0.0093	0.0000
45	CO2	· 0.1205	0.0000	5.3039	0.0000	0.0064	0.0000
46	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
47	LIGHT NAPHT*	160.2667	0.0121	12977.3700	0.1194	20.4787	0.0410
48	HEAVY NAPHT*	155.6942	0.0118	12607.1162	0.1160	31.9572	0.0640
49	LIGHT DIESE*	19.0084	0.0014	3984.7749	0.0367	5.8104	0.0116
50	DHT HY DIES*	35.7681	0.0027	7320.4147	0.0674	10.6216	0.0213
51	KEROSINE*	49.8920	0.0038	8635.5150	0.0795	13.7948	0.0276
52	DHT LT DIES*	1.2649	0.0001	225.8314	0.0021	0.3186	0.0006
53	UC OIL*	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
54	DHT FEED*	50.3437	0.0038	9042.4867	0.0832	12.4466	0.0249
55	HEAVY DIESE*	0.8644	0.0001	122.7404	0.0011	0.1484	0.0003
56	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
57	Total	13211.5557	1.0000	108654.9510	1.0000	498.9444	1.0000
58 59		Phase Fra	action 0.0000				

Liquid Phase

-							
60	COMPONENTS	MOLAR FLOW	MOLE FRACTION	MASS FLOW	MASS FRACTION	LIQUID VOLUME	LIQUID VOLUME
61		(kgmole/h)		(kg/h)		FLOW (m3/h)	FRACTION
62	Hydrogen	0.0000	0.2088	0.0000	0.0031	0.0000	0.0290
63	H2S	0.0000	0.0127	0.0000	0.0032	0.0000	0.0026
64	Ammonia	0.0000	0.0016	0.0000	0.0002	0.0000	0.0002
65	Hyprotech Ltd.		HMSV	s v3 0 1 (Build 4602	3		Page 13 of 24



University Of Petroleum And Energy UPES,

Bidholi, Dehradun, Uttarakhand Case Name: D:\RÁKI\SIMÜLATION\SIRI SIMULATION\SIRI 1.HSC

Unit Set: SI

Date/Time: Thu Apr 23 15:14:10 2009

Fluid Package:
Property Package:

Basis-1

SRK

Material Stream: reactor 1-3 vapors (continued

COMPOSITION

12				Phase Fraction 0.0000			
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	H2O .	0.0000	0.0007	0.0000	0.0001	0.0000	0.0001
16	Methane	0.0000	0.0156	0.0000	0.0019	0.0000	0.0040
17	Ethane	0.0000	0.0053	0.0000	0.0012	0.0000	0.0022
18	Propane	0.0000	0.0083	0.0000	0.0027	0.0000	0.0035
19	i-Butane	0.0000	0.0093	0.0000	0.0040	0.0000	0.0046
20	n-Butane	0.0000	0.0060	0.0000	0.0026	0.0000	0.0029
21	CO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	CO2	0.0000	0.0000	0.0000	0.0000	. 0.0000	0.0000
23	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	LIGHT NAPHT*	0.0000	0.0360	0.0000	0.0216	0.0000	0.0221
25	HEAVY NAPHT*	0.0000	0.0691	0.0000	0.0415	0.0000	0.0683
26	LIGHT DIESE*	0.0000	0.1746	0.0000	0.2715	0.0000	0.2567
27	DHT HY DIES*	0.0000	0.3220	0.0000	0.4890	0.0000	0.4599
28	KEROSINE*	0.0000	0.0473	0.0000	0.0608	0.0000	0.0630
29	DHT LT DIES*	0.0000	0.0106	0.0000	0.0141	0.0000	0.0129
30	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31	DHT FEED*	0.0000	0.0242	0.0000	0.0322	0.0000	0.0288
32	HEAVY DIESE*	0.0000	0.0476	0.0000	0.0502	0.0000	0.0393

Material Stream: reactor 2-1 feed

0.0000

0.0000

Fluid Package: Ba

0.0000

1.0000

Basis-1

0.0000

1.0000

0.0000

0.0000

Property Package: SRK

CONDITIONS

0.0000

0.0000

0.0000

1.0000

39						
40	a a sa		Overall	Vapour Phase	Liquid Phase	
41	Vapour / Phase Fraction	on	0.7372	0.7372	0.2628	
42	Temperature:	(C)	316.0 *	316.0	316.0	
43	Pressure:	(kPa)	1.806e+004 *	1.806e+004	1.806e+004	
44	Molar Flow	(kgmole/h)	7790	5743	2047	
45	Mass Flow	(kg/h)	2.056e+005 *	1.977e+004	1.859e+005	
46	Std Ideal Liq Vol Flow	(m3/h)	426.6	178.0	248.6	
47	Molar Enthalpy	(kJ/kgmole)	-3.345e+004	4556	-1.401e+005	
48	Molar Entropy	(kJ/kgmole-C)	144.3	107.0	248.8	
49	Heat Flow	(kJ/h)	-2.606e+008	2.617e+007	-2.868e+008	
50	Liq Vol Flow @Std Cor	nd (m3/h)			245.2	
51						

COMPOSITION

54			Ove	rali Phase	Vapour Fraction 0.7372		
55 56		MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
57	Hydrogen	6170.6348 *	0.7921 *	12440.0000 *	0.0605 *	178.0727 *	0.4174 *
58	H2S	0.0293 •	0.0000 •	1.0000 *	0.0000 *	0.0013 *	0.0000 *
59	Ammonia	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *
60	H2O	5.9950 *	0.0008 •	108.0000 *	0.0005 *	0.1082 *	0.0003 *
61	Methane	227.0786 *	0.0291 *	3643.0000 *	0.0177 *	12.1679 *	0.0285 *
62	Ethane	32.3579 *	0.0042 *	973.0000 *	0.0047 *	2.7356 *	0.0064 *
63	Propane	29.4805 *	0.0038 •	1300.0000 *	0.0063 *	2.5657 *	0.0060 *
64	i-Butane	20.8004 *	0.0027 *	1209.0000 *	0.0059 *	2.1514 *	0.0050 •
85	Hyprotech Ltd		PIVOV	S-220 d (Pulle 4602	N.		Dage 14 of 24

Licensed to: TEAM LND

MDEthnlAmine

Total

Specified by user.



University Of Petroleum And Energy UPES,

Bidholi, Dehradun, Uttarakhand

Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC

Unit Set:

Date/Time:

Thu Apr 23 15:14:10 2009

Fluid Package:

Basis-1

Material Stream: reactor 2-1 feed (continued)

Property Package:

SRK

COMPOSITION

11 12		Vapour F	raction 0.7372				
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	n-Butane	10.6152 *	0.0014 *	617.0000 *	0.0030 *	1.0579 *	0.0025 *
16	CO	0.1071 *	0.0000 *	3.0000 •	0.0000 *	0.0038 *	0.0000 •
17	CO2	0.0454 *	0.0000 *	2.0000 *	0.0000 *	0.0024 *	0.0000 •
18	MIXED FEED*	0.0000 •	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *
19	LIGHT NAPHT*	0.0000 •	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 •
20	HEAVY NAPHT*	12.3991 *	0.0016 *	1004.0000 *	0.0049 *	2.5450 *	0.0060 *
21	LIGHT DIESE*	1.1830 *	0.0002 *	248.0000 *	0.0012 *	0.3616 *	0.0008 *
22	DHT HY DIES*	0.1026 *	0.0000 *	21.0000 *	0.0001 *	0.0305 *	0.0001 *
23	KEROSINE*	0.0693 *	0.0000 *	12.0000 •	0.0001 *	0.0192 *	0.0000 •
24	DHT LT DIES*	64.8833 *	0.0083 *	11584.0000 *	0.0563 *	16.3431 *	0.0383 *
25	UC OIL*	0.0211 *	0.0000 *	5.0000 *	0.0000 *	0.0059 *	0.0000 •
26	DHT FEED*	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 •
27	HEAVY DIESE*	1214.6261 *	0.1559 *	172462.0000 *	0.8387 *	208.4637 *	0.4886 *
28	MDEthnlAmine	0.0000 •	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 •
29	Total	7790.4289	1.0000	205632.0000	1.0000	426.6358	1.0000

Vapour Phase

Phase Fraction

0.7372

31			•					
32 33	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION	
34	Hydrogen	5458.3069	0.9504	11003.9469	0.5565	157.5163	0.8849	
35	H2S	0.0222	0.0000	0.7552	0.0000	0.0010	0.0000	
36	Ammonia	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
37	H2O .	4.7873	0.0008	86.2436	0.0044	0.0864	0.0005	
38	Methane	191.9158	0.0334	3078.8867	0.1557	10.2837	0.0578	
39	Ethane	25.4541	0.0044	765.4026	0.0387	2.1519	0.0121	
40	Propane	21.5123	0.0037	948.6286	0.0480	1.8723	0.0105	
41	i-Butane	14.0891	0.0025	818.9120	0.0414	1.4572	0.0082	
42	n-Butane	7.0262	0.0012	408.3897	0.0207	0.7002	0.0039	
43	CO	0.0942	0.0000	2.6395	0.0001	0.0033	0.0000	
44	CO2	0.0372	0.0000	1.6352	0.0001	0.0020	0.0000	
45	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
46	LIGHT NAPHT*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
47	HEAVY NAPHT*	5.2423	0.0009	424.4851	0.0215	1.0760	0.0060	
48	LIGHT DIESE*	0.0731	0.0000	15,3264	0.0008	0.0223	0.0001	
49	DHT HY DIES*	0.0064	0.0000	1,3097	0.0001	0.0019	0.0000	
50	KEROSINE*	0.0209	0.0000	3.6169	0.0002	0.0058	0.0000	
51	DHT LT DIES*	4.0050	0.0007	715.0327	0.0362	1.0088	0.0057	
52	UC OIL*	0.0012	0.0000	0.2874	0.0000	0.0003	0.0000	
53	DHT FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
54	HEAVY DIESE*	10.5553	0.0018	1498.7199	0.0758	1.8116	0.0102	
55	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
56	Total	5743.1494	1.0000	19774.2181	1.0000	178.0011	1.0000	
57 50		Phase Fra	action 0.2628					

I iquid Phase

58	Liquio Phase					Fliase Fla	3CUUII 0.2026
59 60		MOLAR FLOW (kgmale/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
61	Hydrogen	712.3279	0.3479	1436.0531	0.0077	20.5564	0.0827
62	H2S	0.0072	0.0000	0.2448	0.0000	0.0003	0.0000
63	Ammonia	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
64	H2O	1.2077	0.0006	21.7564	0.0001	0.0218	0.0001
65	Hyprotech Ltd.		HYSY	S.v3.0.1 (Build 4602)		Page 15 of 24



University Of Petroleum And Energy

Bidholi, Dehradun, . Uttarakhand

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name:

Unit Set:

Date/Time:

Thu Apr 23 15:14:10 2009

Material Stream: reactor 2-1 feed (continued)

Fluid Package:

Basis-1

Property Package: SRK

COMPOSITION

Liquid Phase (continued)

Phase Fraction

0.2628

12							
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	Methane	35.1628	0.0172	564.1133	0.0030	1.8842	0.0076
16	Ethane	6.9038	0.0034	207.5974	0.0011	0.5837	0.0023
17	Propane	7.9681	0.0039	351.3714	0.0019	0.6935	0.0028
18	i-Butane	6.7113	0.0033	390.0880	0.0021	0.6941	0.0028
19	n-Butane	3.5891	0.0018	208.6103	0.0011	0.3577	0.0014
20	CO	0.0129	0.0000	0.3605	0.0000	0.0005	0.0000
21	CO2	0.0083	0.0000	0.3648	0.0000	0.0004	0.0000
22	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	LIGHT NAPHT*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	HEAVY NAPHT*	7.1568	0.0035	579.5149	0.0031	1.4690	0.0059
25	LIGHT DIESE*	1.1099	0.0005	232.6736	0.0013	0.3393	0.0014
26	DHT HY DIES*	0.0962	0.0000	19.6903	0.0001	0.0286	0.0001
27	KEROSINE*	0.0484	0.0000	8.3831	0.0000	0.0134	0.0001
28	DHT LT DIES*	60.8783	0.0297	10868.9673	0.0585	15.3343	0.0617
29	UC OIL*	0.0199	0.0000	4.7126	0.0000	0.0055	0.0000
30	DHT FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31	HEAVY DIESE*	1204.0708	0.5881	170963.2801	0.9199	206.6521	0.8311
32	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
33	Total _	2047.2795	1.0000	185857.7819	1.0000	248.6348	1.0000

Material Stream: reactor 2-1 vapors

Fluid Package:

Basis-1

Property Package: SRK

CONDITIONS

		Overall	Vapour Phase	Liquid Phase	
Vapour / Phase Fraction	1	1.0000	1.0000	0.0000	
Temperature:	(C)	357.0	357.0	357.0	
Pressure:	(kPa)	171.6	171.6	171.6	
Molar Flow	(kgmole/h)	7790	7790		
Mass Flow	(kg/h)	2.056e+005	2.056e+005	0.0000	
Std Ideal Liq Vol Flow	(m3/h)	426.6	426.6	0.0000	
Molar Enthalpy	(kJ/kgmole)	-2.244e+004	-2.244e+004	-2.181e+005	
Molar Entropy	(kJ/kgmole-C)	199.4	199.4	327.7	
Heat Flow	(kJ/h)	-1.748e+008	-1.748e+008	0.0000	
Liq Vol Flow @Std Cond	(m3/h)	_		0.0000	
	Temperature: Pressure: Molar Flow Mass Flow Std Ideal Liq Vol Flow Molar Enthalpy Molar Entropy Heat Flow	Vapour / Phase Fraction Temperature: (C) Pressure: (kPa) Molar Flow (kgmole/h) Mass Flow (kg/h) Std Ideal Liq Vol Flow (m3/h) Molar Enthalpy (kJ/kgmole) Molar Entropy (kJ/kgmole-C) Heat Flow (kJ/h)	Vapour / Phase Fraction 1.0000 Temperature: (C) 357.0 Pressure: (kPa) 171.6 Molar Flow (kgmole/h) 7790 Mass Flow (kg/h) 2.056e+005 Std Ideal Liq Vol Flow (m3/h) 426.6 Molar Enthalpy (kJ/kgmole) -2.244e+004 Molar Entropy (kJ/kgmole-C) 199.4 Heat Flow (kJ/h) -1.748e+008	Vapour / Phase Fraction 1.0000 1.0000 Temperature: (C) 357.0 357.0 Pressure: (kPa) 171.6 171.6 Molar Flow (kgmole/h) 7790 7790 Mass Flow (kg/h) 2.056e+005 2.056e+005 Std Ideal Liq Vol Flow (m3/h) 426.6 426.6 Molar Enthalpy (kJ/kgmole) -2.244e+004 -2.244e+004 Molar Entropy (kJ/kgmole-C) 199.4 199.4 Heat Flow (kJ/h) -1.748e+008 -1.748e+008	Vapour / Phase Fraction 1.0000 1.0000 0.0000 Temperature: (C) 357.0 357.0 357.0 Pressure: (kPa) 171.6 171.6 171.6 Molar Flow (kgmole/h) 7790 7790 0.0000 Mass Flow (kg/h) 2.056e+005 2.056e+005 0.0000 Std Ideal Liq Vol Flow (m3/h) 426.6 426.6 0.0000 Molar Enthalpy (kJ/kgmole) -2.244e+004 -2.244e+004 -2.181e+005 Molar Entropy (kJ/kgmole-C) 199.4 199.4 327.7 Heat Flow (kJ/h) -1.748e+008 -1.748e+008 0.0000

COMPOSITION

A			
Over	ан н	'na	se

Vapour Fraction

1.0000

53								
54 55	COMPONENTS	MOLAR FLÓW (kgmale/h)	MOLE PRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION	
56	Hydrogen	6170.6500	0.7921	12440.0306	0.0605	178.0732	0.4174	
57	H2S	0.0300	0.0000	1.0219	0.0000	0.0013	0.0000	
58	Ammonia	0.0001	0.0000	0.0015	0.0000	0.0000	0.0000	
59	H2O	5.9950	0.0008	108.0001	0.0005	0.1082	0.0003	
60	Methane	227.0806	0.0291	3643.0321	0.0177	12.1680	0.0285	
61	Ethane	32.1767	0.0041	967.5499	0.0047	2.7203	0.0064	
62	Propane	29.4770	0.0038	1299.8484	0.0063	2.5654	0.0060	
63	i-Butane	20.8005	0.0027	1209.0101	0.0059	2.1514	0.0050	
64	n-Butane	10.6152	0.0014	616.9976	0.0030	1.0579	0.0025	
65	Hyprotech Ltd		LINGV	6 v2 6 4 (Build 4602			Page 16 of 24	

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30

University Of Petroleum And Energy UPES, Bidholi,

Bidholi, Dehradun, Uttarakhand Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1 HSC

Unit Set: SI

Date/Time: Thu Apr 23 15:14:10 2009

Fluid Package:

Basis-1

Material Stream: reactor 2-1 vapors (continued

Property Package: SRK

COMPOSITION

12				Vapour Fraction 1.0000			
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	CO .	0.1071	0.0000	3.0000	0.0000	0.0038	0.0000
16	CO2	0.0454	0.0000	2.0000	0.0000	0.0024	0.0000
17	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	LIGHT NAPHT*	0.0390	0.0000	3.1561	0.0000	0.0050	0.0000
19	HEAVY NAPHT*	12.3996	0.0016	1004.0360	0.0049	2.5451	0.0060
20	LIGHT DIESE*	1.1857	0.0002	248.5580	0.0012	0.3624	0.0008
21	DHT HY DIES*	0.1126	0.0000	23.0377	0.0001	0.0334	0.0001
22	KEROSINE*	0.0917	0.0000	15.8724	0.0001	. 0.0254	0.0001
23	DHT LT DIES*	64.8836	0.0083	11584.0581	0.0563	16.3432	0.0383
24	UC OIL*	0.0000	0.0000	0.0008	0.0000	0.0000	0.0000
25	DHT FEED*	0.0018	0.0000	0.3295	0.0000	0.0005	0.0000
26	HEAVY DIESE*	1214.6293	0.1559	172462.4593	0.8387	208.4642	0.4886
27	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	Total	7790.3209	1.0000	205632.0000	1.0000	426.6310	1.0000
29							

Vapour Phase

Phase Fraction

1.000

31 32	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
33	Hydrogen	. 6170.6500	0.7921	12440.0306	0.0605	178.0732	0.4174
34	H2S	0.0300	0.0000	1.0219	0.0000	0.0013	0.0000
35	Ammonia	0.0001	0.0000	0.0015	0.0000	0.0000	0.0000
36	H2O	5.9950	0.0008	108.0001	0.0005	0.1082	0.0003
37	Methane	227.0806	0.0291	3643.0321	0.0177	12.1680	0.0285
38	Ethane	32.1767	0.0041	967.5499	0.0047	2.7203	0.0064
39	Propane	29.4770	0.0038	1299.8484	0.0063	2.5654	0.0060
40	i-Butane	20.8005	0.0027	1209.0101	0.0059	2.1514	0.0050
41	n-Butane	10.6152	0.0014	616.9976	0.0030	1.0579	0.0025
42	CO	0.1071	0.0000	3.0000	0.0000	0.0038	0.0000
43	CO2	0.0454	0.0000	2.0000	0.0000	0.0024	0.0000
44	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
45	LIGHT NAPHT*	0.0390	0.0000	3.1561	0.0000	0.0050	0.0000
46	HEAVY NAPHT*	12.3996	0.0016	1004.0360	0.0049	2.5451	0.0060
47	LIGHT DIESE*	1.1857	0.0002	248.5580	0.0012	0.3624	0.0008
48	DHT HY DIES*	0.1126	0.0000	23.0377	0.0001	0.0334	0.0001
49	KEROSINE*	0.0917	0.0000	15.8724	0.0001	0.0254	0.0001
50	DHT LT DIES*	64.8836	0.0083	11584.0581	0.0563	16.3432	0.0383
51	UC OIL*	0.0000	0.0000	0.0008	0.0000	0.0000	0.0000
52	DHT FEED*	0.0018	0.0000	0.3295	0.0000	0.0005	0.0000
53	HEAVY DIESE*	1214.6293	0.1559	172462.4593	0.8387	208.4642	0.4886
54	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
55	Total	7790.3209	1.0000	205632.0000	1.0000	426.6310	1.0000
56							

Liquid Phase

Phase Fraction

0.0000

57		111030116	101011 0.0000				
58 59	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLÖW (m3/h)	LIQUID VOLUME FRACTION
60	Hydrogen	0.0000	0.0075	0.0000	0.0001	0.0000	0.0013
61	H2S	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
62	Ammonia	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
63	H2O	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
64	Methane	0.0000	0.0004	0.0000	0.0000	0.0000	0.0001
65	Hyprofechildo.	72 (1)	HYSY	S v3 0 1 (Build 4602)		Page 17 of 24



University Of Petroleum And Energy UPES, Bidholi.

Bidholi, Dehradun, Uttarakhand Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1:HSC

Unit Set: S

Date/Time:

Thu Apr 23 15:14:10 2009

Material Stream: reactor 2-1 vapors (continued Package: Property Package:

Basis-1

COMPOSITION

Liquid Phase (continued)

Phase Fraction

SRK

0.0000

12				ass (seminasa)	1 11455 1 1454511 0.0000		
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	Ethane	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
16	Propane	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
17	i-Butane	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
18	n-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	СО	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	LIGHT NAPHT*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	HEAVY NAPHT*	0.0000	0.0001	0.0000	0.0001	0.0000	0.0002
24	LIGHT DIESE*	0.0000	0.0001	0.0000	0.0002	0.0000	0.0002
25	DHT HY DIES*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	KEROSINE*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	DHT LT DIES*	0.0000	0.0067	0.0000	0.0085	0.0000	0.0099
28	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	DHT FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	HEAVY DIESE*	0.0000	0.9848	0.0000	0.9909	0.0000	0.9881
31	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32	Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Material Stream: reactor 2-2 inlet

Fluid Package:

Basis-1

Property Package: SRK

CONDITIONS

38			Overall	Vapour Phase	Liquid Phase	
39	Vapour / Phase Fraction		0.0000	0.0000	1.0000	
40	Temperature:	(C)	357.0 *	357.0	357.0	
41	Pressure:	(kPa)	171.6 *	171.6	171.6	
42	Molar Flow (k	gmole/h)	0.0000	0.0000	0.0000	
43	Mass Flow	(kg/h)	0.0000	0.0000	0.0000	
44	Std Ideal Liq Vol Flow	(m3/h)	0.0000	0.0000	0.0000	
45	Molar Enthalpy (kJ	J/kgmole)	-2.181e+005	-2.244e+004	-2.181e+005	
46	Molar Entropy (kJ/kg	gmole-C)	327.7	199.4	327.7	
47	Heat Flow	(kJ/h)	0.0000	0.0000	0.0000	
48	Liq Vol Flow @Std Cond	(m3/h)	0.0000 *	0.0000	0.0000	
140						

COMPOSITION

Overa	II P	hase
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Vapour Fraction

0.0000

[52]			_	ian i nace		7 apoe: 7 aoaoii 0.000	
53 54	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
55	Hydrogen	0.0000	0.0075	0.0000	0.0001	0.0000	0.0013
56	H2S	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
57	Ammonia	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
58	H2O	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
59	Methane	0.0000	0.0004	0.0000	0.0000	0.0000	0.0001
60	Ethane	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
61	Propane	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
62	i-Butane	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
63	n-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
64	CO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
65	Hyprotech Ltd.		HXCX	3 /2 0 1 (Build 4602	b		Page 18 of 24

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Bidholi, Dehradun, Uttarakhand

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name:

Unit Set:

Date/Time: Thu Apr 23 15:14:10 2009

Material Stream: reactor 2-2 inlet (continued)

Fluid Package:

Basis-1

Property Package: SRK

COMPOSITION

11 12		Overall Phase (continued)					
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	CO2 ·	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	LIGHT NAPHT*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	HEAVY NAPHT*	0.0000	0.0001	0.0000	0.0001	0.0000	0.0002
19	LIGHT DIESE*	0.0000	0.0001	0.0000	0.0002	0.0000	0.0002
20	DHT HY DIES*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	KEROSINE*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	DHT LT DIES*	0.0000	0.0067	0.0000	0.0085	. 0.0000	0.0099
23	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	DHT FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	HEAVY DIESE*	0.0000	0.9848	0.0000	0.9909	0.0000	0.9881
26	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Vapour Phase

Phase Fraction

0.0000

30	COMPONENTS	MOLAR FLOW	MOLE FRACTION	MASS FLOW	MASS FRACTION	LIQUID VOLUME	LIQUID VOLUME
31		(kgmole/h)		(kg/h)		FLOW (m3/h)_	FRACTION
32	Hydrogen	0.0000	0.7921	0.0000	0.0605	0.0000	0.4174
33	H2S	_ 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
34	Ammonia	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
35	H2O	0.0000	0.0008	0.0000	0.0005	0.0000	0.0003
36	Methane	0.0000	0.0291	0.0000	0.0177	0.0000	0.0285
37	Ethane	0.0000	0.0041	0.0000	0.0047	0.0000	0.0064
38	Propane	0.0000	0.0038	0.0000	0.0063	0.0000	0.0060
39	i-Butane	0.0000	0.0027	0.0000	0.0059	0.0000	0.0050
40	n-Butane	0.0000	0.0014	0.0000	0.0030	0.0000	0.0025
41	CO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
42	CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
43	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
44	LIGHT NAPHT*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
45	HEAVY NAPHT*	0.0000	0.0016	0.0000	0.0049	0.0000	0.0060
46	LIGHT DIESE*	0.0000	0.0002	0.0000	0.0012	0.0000	0.0008
47	DHT HY DIES*	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001
48	KEROSINE*	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001
49	DHT LT DIES*	0.0000	0.0083	0.0000	0.0563	0.0000	0.0383
50	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
51	DHT FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
52	HEAVY DIESE*	0.0000	0.1559	0.0000	0.8387	0.0000	0.4886
53	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
54	Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000
55							

Liquid Phase

56		Phase Fra	action 1.000				
57 58	COMPONENTS	MOLAR FLOW (kgmale/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
59	Hydrogen	0.0000	0.0075	0.0000	0.0001	0.0000	0.0013
60	H2S	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
61	Ammonia	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
62	H2O	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
63	Methane	0.0000	0.0004	0.0000	0.0000	0.0000	0.0001
64	Ethane	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
65	Hyprotech Ltd.		IH X Š V	S v3 0 1 (Build 4602	N		Page 19 of 24



University Of Petroleum And Energy

Bidholi, Dehradun, Uttarakhand Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC

Unit Set:

Date/Time: Thu Apr 23 15:14:10 2009

Material Stream: reactor 2-2 inlet (continued)

Fluid Package:

Basis-1

Property Package: SRK

COMPOSITION

Liquid Phase (continued)

Phase Fraction

1.000

13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW	MASS FRACTION	LIQUID VOLUME	LIQUID VOLUME
15	Propane	0.0000	0.0004	(kg/h)	0.0000	FLOW (m3/h)	FRACTION
_			0.0001	0.0000	0.0000	0.0000	0.0000
16	i-Butane	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
17	n-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	CO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	LIGHT NAPHT*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	HEAVY NAPHT*	0.0000	0.0001	0.0000	0.0001	0.0000	0.0002
23	LIGHT DIESE*	0.0000	0.0001	0.0000	0.0002	0.0000	0.0002
24	DHT HY DIES*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	KEROSINE*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	DHT LT DIES*	0.0000	0.0067	0.0000	0.0085	0.0000	0.0099
27	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	DHT FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	HEAVY DIESE*	0.0000	0.9848	0.0000	0.9909	0.0000	0.9881
30	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31	Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Material Stream: reactor 2-2 out

Fluid Package:

Basis-1

Property Package: SRK

CONDITIONS

37	•		Overall	Liquid Phase	Vapour Phase	
38	Vapour / Phase Fraction		0.0000 *	1.0000	0.0000	
39	Temperature:	(C)	370.0 *	370.0	370.0	
40	Pressure:	(kPa)	1.273e+005	1.273e+005	1.273e+005	
41	Molar Flow	(kgmole/h)	0.0000	0.0000	0.0000	
42	Mass Flow	(kg/h)	0.0000	0.0000	0.0000	
43	Std Ideal Liq Vol Flow	(m3/h)	0.0000	0.0000	0.0000	
44	Molar Enthalpy	(kJ/kgmole)	-7479	-7479	5140	
45	Molar Entropy (k	J/kgmole-C)	150.9	150.9	112.0	
46	Heat Flow	(kJ/h)	0.0000	0.0000	0.0000	
47	Liq Vol Flow @Std Cond	(m3/h)	0.0000 *	0.0000	0.0000	
40						

COMPOSITION

Overall Phase

Vapour Fraction

0.0000

51		Vapodi i laction 0.0000					
52 53	COMPONENTS	MOLAR FLOW (kgmale/h)	MOLE FRACTION:	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
54	Hydrogen	0.0000 •	0.8367 •	0.0000 *	0.0914 *	0.0000 *	0.4888 *
55	H2S	0.0000 •	0.0000 •	0.0000 *	0.0000 *	0.0000 *	0.0000 *
56	Ammonia	0.0000 •	0.0000 •	0.0000 *	0.0000 *	0.0000 *	0.0000 *
57	H2O	0.0000 *	0.0008 •	0.0000 *	0.0008 *	0.0000 *	0.0003 *
58	Methane	0.0000 *	0.0335 *	0.0000 •	0.0291 *	0.0000 *	0.0363 *
59	Ethane	0.0000 *	0.0048 *	0.0000 *	0.0077 *	0.0000 *	0.0081 *
60	Propane	0.0000 •	0.0061 *	0.0000 •	0.0146 *	0.0000 *	0.0108 •
61	i-Butane	0.0000 *	0.0075 *	0.0000 *	0.0238 *	0.0000 *	0.0158 *
62	n-Butane	0.0000 *	0.0035 •	0.0000 •	0.0111 *	0.0000 *	0.0071 *
63	СО	0.0000 *	0.0000 •	0.0000 *	0.0000 *	0.0000 *	0.0000 •
64	CO2	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 •
65	Hyprotech Ltd.		HYSYS	Waxon Maulia 44602)		Page 20 of 24

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28

University Of Petroleum And Energy UPES, Bidholi,

Dehradun, Uttarakhand

Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1:HSC

Unit Set:

Date/Time: Thu Apr 23 15:14:10 2009

Material Stream: reactor 2-2 out (continued)

Fluid Package:

Basis-1

Property Package: SRK

COMPOSITION

12		Overall Phase (continued)						
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION	
15	MIXED FEED*	• 0.0000	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	
16	LIGHT NAPHT*	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	
17	HEAVY NAPHT*	0.0000 *	0.0169 *	0.0000 *	0.0743 *	0.0000 *	0.0704 *	
18	LIGHT DIESE*	0.0000 *	0.0074 *	0.0000 *	0.0838 *	0.0000 *	0.0457 *	
19	DHT HY DIES*	0.0000 *	0.0026 *	0.0000 *	0.0284 *	0.0000 *	0.0154 *	
20	KEROSINE*	0.0000 *	0.0100 *	0.0000 •	0.0940 *	0.0000 *	0.0561 *	
21	DHT LT DIES*	0.0000 *	0.0010 *	0.0000 *	0.0101 *	0.0000 *	0.0053 *	
22	UC OIL*	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 •	
23	DHT FEED*	0.0000 *	0.0000 •	0.0000 *	0.0000 *	0.0000 *	0.0000 *	
24	HEAVY DIESE*	0.0000 *	0.0690 *	0.0000 •	0.5308 *	0.0000 *	0.2398 *	
25	MDEthnlAmine	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	0.0000 *	
26	Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000	
27								

Liquid Phase

Phase Fraction

1.000

29	COMPONENTS	MOLAR FLOW	MOLE FRACTION	MASS FLOW	MASS FRACTION	LIQUID VOLUME	LIQUID VOLUME			
30		(kgmole/h)		(kg/h)		FLOW (m3/h)	FRACTION			
31	Hydrogen	0.0000	0.8367	0.0000	0.0914	0.0000	0.4888			
32	H2S	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
33	Ammonia	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
34	H2O	0.0000	0.0008	0.0000	0.0008	0.0000	0.0003			
35	Methane	0.0000	0.0335	0.0000	0.0291	0.0000	0.0363			
36	Ethane	0.0000	0.0048	0.0000	0.0077	0.0000	0.0081			
37	Propane	0.0000	0.0061	0.0000	0.0146	0.0000	0.0108			
38	i-Butane	0.0000	0.0075	0.0000	0.0238	0.0000	0.0158			
39	n-Butane	0.0000	0.0035	0.0000	0.0111	0.0000	0.0071			
40	CO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
41	CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
42	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
43	LIGHT NAPHT*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
44	HEAVY NAPHT*	0.0000	0.0169	0.0000	0.0743	0.0000	0.0704			
45	LIGHT DIESE*	0.0000	0.0074	0.0000	0.0838	0.0000	0.0457			
46	DHT HY DIES*	0.0000	0.0026	0.0000	0.0284	0.0000	0.0154			
47	KEROSINE*	0.0000	0.0100	0.0000	0.0940	0.0000	0.0561			
48	DHT LT DIES*	0.0000	0.0010	0.0000	0.0101	0.0000	0.0053			
49	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
50	DHT FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
51	HEAVY DIESE*	0.0000	0.0690	0.0000	0.5308	0.0000	0.2398			
52	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
53	Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000			
54 55	Manager Phase Pro									

Vapour Phase

22							
58 57	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
58	Hydrogen	0.0000	0.9226	0.0000	0.2804	0.0000	0.7483
59	H2S	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
60	Ammonia	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
61	H2O	0.0000	0.0008	0.0000	0.0022	0.0000	0.0004
62	Methane	0.0000	0.0337	0.0000	0.0815	0.0000	0.0508
63	Ethane	0.0000	0.0042	0.0000	0.0191	0.0000	0.0100
64	Propane	0.0000	0.0049	0.0000	0.0327	0.0000	0.0120
65	Hyprotech Ltd.		HYSY	SING YOU WIS WILL WE SO ?	Ŋ.		Page 21 of 24



University Of Petroleum And Energy Bidholi, Dehradun,

Uttarakhand

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name: Unit Set:

Thu Apr 23 15:14:10 2009 Date/Time:

Material Stream: reactor 2-2 out (continued)

Fluid Package:

Basis-1

Property Package: SRK

COMPOSITION

Vapour Phase (continued)

Phase Fraction

0.0000

12			<u>*</u>				
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	i-Butane	0.0000	0.0056	0.0000	0.0491	0.0000	0.0163
16	n-Butane	0.0000	0.0026	0.0000	0.0225	0.0000	0.0072
17	CO	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
18	CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	LIGHT NAPHT*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	HEAVY NAPHT*	0.0000	0.0089	0.0000	0.1089	0.0000	0.0515
22	LIGHT DIESE*	0.0000	0.0019	0.0000	0.0589	0.0000	0.0160
23	DHT HY DIES*	0.0000	0.0006	0.0000	0.0200	0.0000	0.0054
24	KEROSINE*	0.0000	0.0045	0.0000	0.1185	0.0000	0.0353
25	DHT LT DIES*	. 0.0000	0.0003	0.0000	0.0071	0.0000	0.0019
26	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	DHT FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	HEAVY DIESE*	0.0000	0.0093	0.0000	0.1987	0.0000	0.0448
29	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000
	MASAWASI NASA PILISSOPERSOPERSOPASIASIASIAN SANTAKA	t an und bund tubban nebankubi bahasi babasa un			******************************		

Material Stream: reactor 2-2 vapors

Basis-1

SRK Property Package:

Fluid Package:

CONDITIONS

36			Overall	Vapour Phase	Liquid Phase	
37	Vapour / Phase Fraction		1.0000	1.0000	0.0000	
38	Temperature:	(C)	370.0	370.0	370.0	
39	Pressure:	(kPa)	1.273e+005	1.273e+005	1.273e+005	
40	Molar Flow	(kgmole/h)	7790	7790	0.0000	
41	Mass Flow	(kg/h)	2.056e+005	2.056e+005	0.0000	
42	Std Ideal Liq Vol Flow	(m3/h)	426.6	426.6	0.0000	
43	Molar Enthalpy	(kJ/kgmole)	-1.655e+004	-1.655e+004	7810	
44	Molar Entropy (k.	J/kgmole-C)	138.5	138.5	94.65	
45	Heat Flow	(kJ/h)	-1.289e+008	-1.289e+008	0.0000	
46	Liq Vol Flow @Std Cond	(m3/h)	_		0.0000	
4-						

COMPOSITION

50	l	Vapour Fraction 1.0000					
51 52	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW: (m3/h)	LIQUID VOLUME FRACTION
53	Hydrogen	6170.6501	0.7921	12440.0308	0.0605	178.0732	0.4174
54	H2S	0.0300	0.0000	1.0220	0.0000	0.0013	0.0000
55	Ammonia	0.0001	0.0000	0.0015	0.0000	0.0000	0.0000
56	H2O	5.9950	0.0008	108.0001	0.0005	0.1082	0.0003
57	Methane	227.0807	0.0291	3643.0323	0.0177	12.1680	0.0285
58	Ethane	32.1758	0.0041	967.5223	0.0047	2.7202	0.0064
59	Propane	29.4770	0.0038	1299.8476	0.0063	2.5654	0.0060
60	i-Butane	20.8005	0.0027	1209.0100	0.0059	2.1514	0.0050
61	n-Butane	10.6152	0.0014	616.9976	0.0030	1.0579	0.0025
62	CO	0.1071	0.0000	3.0000	0.0000	0.0038	0.0000
63	CO2	0.0454	0.0000	2.0000	0.0000	0.0024	0.0000
64	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
65	Hyprotech Ltd.		HYSY	3.V3.0.11(Build 4602	N ZOHAZI BERANDA (LOS Z		Page 22 of 24

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University Of Petroleum And Energy UPES, Bidholi,

Dehradun, Uttarakhand

Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1:HSC Unit Set:

Thu Apr 23 15:14:10 2009 Date/Time:

Fluid Package: Material Stream: reactor 2-2 vapors (continued

Basis-1

Property Package: SRK

COMPOSITION

11 12			Overall Pl	nase (continued)		Vapour Fr	raction 1.0000
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	LIGHT NAPHT*	0.0392	0.0000	3.1712	0.0000	0.0050	0.0000
16	HEAVY NAPHT*	12.3995	0.0016	1004.0355	0.0049	2.5451	0.0060
17	LIGHT DIESE*	1.1857	0.0002	248.5584	0.0012	0.3624	0.0008
18	DHT HY DIES*	0.1126	0.0000	23.0365	0.0001	0.0334	0.0001
19	KEROSINE*	0.0918	0.0000	15.8891	0.0001	0.0254	0.0001
20	DHT LT DIES*	64.8836	0.0083	11584.0578	0.0563	16.3432	0.0383
21	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	DHT FEED*	0.0018	0.0000	0.3278	0.0000	0.0005	0.0000
23	HEAVY DIESE*	1214.6293	0.1559	172462.4596	0.8387	208.4642	0.4886
24	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	Total	7790.3204	1.0000	205632.0000	1.0000	426.6310	1.0000
26 27			Vap	our Phase		Phase Fra	action 1.000
28	COMPONENTS	MOLARELOW	MOLE ERACTION	MASSELOW	MASS EDACTION	LIQUID VOLUME	LIQUID VOLUME

1							
3	COMPONENTS	MOLAR FLOW	MOLE FRACTION	MASS FLOW	MASS FRACTION	LIQUID VOLUME	LIQUID VOLUME
7		(kgmole/h)		(kg/h)		FLOW (m3/h)	FRACTION
1	Lindrages	6170.6501	0.7921	12440.0308	0.0605	178.0732	
4	Hydrogen	0170.0501	0.7921	12440.0308	0.0605	178.0732	0.4174

29	COMPONENTS	(kgmole/h)	WOLE FRACTION	(kg/h)	WASS FRACTION	FLOW (m3/h)	FRACTION
30	Hydrogen	6170.6501	0.7921	12440.0308	0.0605	178.0732	0.4174
31	H2S	0.0300	0.0000	1.0220	0.0000	0.0013	0.0000
32	Ammonia	0.0001	0.0000	0.0015	0.0000	0.0000	0.0000
33	H2O	₋ 5.9950	0.0008	108.0001	0.0005	_ 0.1082	0.0003
34	Methane	227.0807	0.0291	3643.0323	0.0177	12.1680	0.0285
35	Ethane	32.1758	0.0041	967.5223	0.0047	2.7202	0.0064
36	Propane	29.4770	0.0038	1299.8476	0.0063	2.5654	0.0060
37	i-Butane	20.8005	0.0027	1209.0100	0.0059	2.1514	0.0050
38	n-Butane	10.6152	0.0014	616.9976	0.0030	1.0579	0.0025
39	CO	0.1071	0.0000	3.0000	0.0000	0.0038	0.0000
40	CO2	0.0454	0.0000	2.0000	0.0000	0.0024	0.0000
41	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
42	LIGHT NAPHT*	0.0392	0.0000	3.1712	0.0000	0.0050	0.0000
43	HEAVY NAPHT*	12.3995	0.0016	1004.0355	0.0049	2.5451	0.0060
44	LIGHT DIESE*	1.1857	0.0002	248.5584	0.0012	0.3624	0.0008
45	DHT HY DIES*	0.1126	0.0000	23.0365	0.0001	0.0334	0.0001
46	KEROSINE*	0.0918	0.0000	15.8891	0.0001	0.0254	0.0001
47	DHT LT DIES*	64.8836	0.0083	11584.0578	0.0563	16.3432	0.0383
48	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
49	DHT FEED*	0.0018	0.0000	0.3278	0.0000	0.0005	0.0000
50	HEAVY DIESE*	1214.6293	0.1559	172462.4596	0.8387	208.4642	0.4886
51	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
52	Total	7790.3204	1.0000	205632.0000	1.0000	426.6310	1.0000

- 4			
- 1	53		
- 1	∽ı		
			0.0000
- 1	54	Liquid Filase	0.0000

54							
55 56	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
57	Hydrogen	0.0000	0.9503	0.0000	0.4628	0.0000	0.8676
58	H2S	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
59	Ammonia	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60	H2O	0.0000	0.0008	0.0000	0.0034	0.0000	0.0004
61	Methane	0.0000	0.0305	0.0000	0.1181	0.0000	0.0517
62	Ethane	0.0000	0.0036	0.0000	0.0259	0.0000	0.0095
63	Propane	0.0000	0.0028	0.0000	0.0300	0.0000	0.0078
64	i-Butane	0.0000	0.0018	0.0000	0.0248	0.0000	0.0058
65	Hyprotech Ltd.		HVQV	CIVAIO 1 (Build 4602	A U		Page 23 of 24

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University Of Petroleum And Energy UPES. Bidholi, Dehradun.

Uttarakhand

Unit Set:

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC

Date/Time:

Case Name:

Thu Apr 23 15:14:10 2009

Material Stream: reactor 2-2 vapors (continued

Fluid Package:

Basis-1

Property Package: SRK

COMPOSITION

12	Liquid Phase (continued)				Phase Fra	action 0.0000	
13 14	COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION	LIQUID VOLUME FLOW (m3/h)	LIQUID VOLUME FRACTION
15	n-Butane	0.0000	0.0009	0.0000	0.0122	0.0000	0.0027
16	CO	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
17	CO2	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
18	MIXED FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	LIGHT NAPHT*	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
20	HEAVY NAPHT*	0.0000	0.0006	0.0000	0.0122	0.0000	0.0041
21	LIGHT DIESE*	0.0000	0.0000	0.0000	0.0010	0.0000	0.0002
22	DHT HY DIES*	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
23	KEROSINE*	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000
24	DHT LT DIES*	0.0000	0.0011	0.0000	0.0462	0.0000	0.0085
25	UC OIL*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	DHT FEED*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	HEAVY DIESE*	0.0000	0.0077	0.0000	0.2629	0.0000	0.0416
28	MDEthnlAmine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000
30			29 - 100000 No. 100 To No. 100 No. 100 No.	K. K. G. Pagas, Laf. (1515) 1982 - 1913 (1917) 199	Too had in a decree of the confidence of	en i socia i turvida e de ser vida de la polici.	Carloud to the good or or greater to have an ex-

Energy Stream: reactor 1-1 energy

Fluid Package: Basis-1

Property Package:

CONDITIONS

_						
35	Duty Type:	Direct Q	Duty Calculation Operation:	reactor 1-1		
36	Duty SP:	1.689e+008 kJ/h	Minimum Available Duty:		Maximum Available Duty:	-
37					Fluid Package* Basis-1	0.00 () () 0.00 () ()

Energy Stream: reactor 1-2 energy

Property Package:

CONDITIONS

2	Duty Type:	Direct Q	Duty Calculation Operation:	reactor 1-2	
13	Duty SP:	-1.023e+007 kJ/h	Minimum Available Duty:		Maximum Available Duty:
				the state of the second	

Energy Stream: reactor 1-3 energy

Fluid Package:

Basis-1

Property Package: SRK

CONDITIONS

49	Duty Type:	Direct Q	Duty Calculation Operation:	reactor 1-3		
50	Duty SP:	-2.140e+008 kJ/h	Minimum Available Duty:		Maximum Available Duty:	

Energy Stream: reactor 2-1 energy

Fluid Package:

Basis-1

Property Package: SRK

CONDITIONS

56	Duty Type:	Direct Q	Duty Calculation Operation:	reactor 2-1		
57	Duty SP:	8.583e+007 kJ/h	Minimum Available Duty:	***	Maximum Available Duty:	
50				PRODUCTION OF THE PRODUCT		

Energy Stream: reactor 2-2 energy

Fluid Package:

Property Package:

CONDITIONS

∽	Duty Type.	Direct Q	Duty Calculation Operation:	reactor 2-2	
64	Duty SP:	4.586e+007 kJ/h	Minimum Available Duty:		Maximum Available Duty:
65	Hyprotech Ltd.		HYSYS v3.0.1/(Bu	lid 4602)	and an analysis for the E.S. (2) was easily P. (2)

41

62

	IRI,1.HSC				
Delet This Apr 23 16:14-15 2009 This Apr 23 16:14-15	4.				
Conversion Reactor: reactor 1-1 CONNECTIONS	Date/Time: Thu:Apr 23 15:14:15 2009				
CONNECTIONS Inlet Stream Connections					
Injust Injus I					
Inlet Stream Name					
Stream Name					
Stream Name					
Stream Name					
Energy Stream Connections From Unit Operation	reactor 1-2				
Stream Name	reactor 1-2				
Stream Name					
PARAMETERS Physical Parameters Optional Heat Transfer:					
Physical Parameters					
Delta P					
28	Heating				
Section Sect	ergy Stream stor 1-1 energy				
REACTION DETAILS					
Reaction: reactor 1-1					
Component Mole Weight Stoichiomet					
38 H2S 34.08 37 Ammonia 17.03 38 H2O 18.02 39 Methane 16.04 40 Ethane 30.07 41 Propane 44.10 42 I-Butane 58.12 43 n-Butane 58.12 44 CO 28.01 45 CO2 44.01 46 MIXED FEED* 44.01 47 LIGHT NAPHT* 80.97 48 HEAVY NAPHT* 80.97 49 LIGHT DIESE* 209.6 50 HEAVY DIESE* 173.1 51 KEROSINE* 173.1 52 DHT LT DIES* 179.6 53 UC OIL* 236.7 54 DHT FEED* 179.6 55 DHT HY DIES* 204.7 56 MDEthniAmine 119.2 56 Reaction: reactor 1-2 59 Component Mole Weight Stoichiomet	ric Coeff.				
37 Ammonia	2529				
38 H2O 18.02 39 Methane 16.04 40 Ethane 30.07 41 Propane 44.10 42 i-Butane 58.12 43 n-Butane 58.12 44 CO 28.01 45 CO2 44.01 46 MIXED FEED* 140.9 47 LIGHT NAPHT* 80.97 48 HEAVY NAPHT* 80.97 49 LIGHT DIESE* 209.6 50 HEAVY DIESE* 142.0 51 KEROSINE* 173.1 52 DHT LT DIES* 178.5 53 UC OIL* 236.7 54 DHT FEED* 179.6 55 DHT HY DIES* 204.7 56 MDEthnIAmine 119.2 56 Reaction: reactor 1-2 59 Component Mole Weight Stoichiomet	161 ¹				
## Bithane ## ## ## ## ## ## ## ## ## ## ## ## ##	6 '				
Propane	150				
### 18-butane ### 58.12 ### CO	47 °				
43 n-Butane 58.12	42 1				
45 CO2 44.01 46 MIXED FEED* 140.9 47 LIGHT NAPHT* 80.97 48 HEAVY NAPHT* 80.97 49 LIGHT DIESE* 209.6 50 HEAVY DIESE* 142.0 51 KEROSINE* 173.1 52 DHT LT DIES* 178.5 53 UC OIL* 236.7 54 DHT FEED* 179.6 55 DHT HY DIES* 204.7 56 MDEthnlAmine 119.2 57 58 Reaction: reactor 1-2 59 Component Mole Weight Stoichiomete	28 '				
## MIXED FEED* ## LIGHT NAPHT* ## HEAVY NAPHT* ## LIGHT DIESE* ## DIESE*	0.				
47 LIGHT NAPHT* 80.97 48 HEAVY NAPHT* 80.97 49 LIGHT DIESE* 209.6 50 HEAVY DIESE* 142.0 51 KEROSINE* 173.1 52 DHT LT DIES* 178.5 53 UC OIL* 236.7 54 DHT FEED* 179.6 55 DHT HY DIES* 204.7 56 MDEthnlAmine 119.2 57 Reaction: reactor 1-2 59 Component Mole Weight Stoichiomet	0 <u>0 </u>				
49 LIGHT DIESE* 209.6 50 HEAVY DIESE* 142.0 51 KEROSINE* 173.1 52 DHT LT DIES* 178.5 53 UC OIL* 236.7 54 DHT FEED* 179.6 55 DHT HY DIES* 204.7 56 MDEthnlAmine 119.2 57 Reaction: reactor 1-2 59 Component Mole Weight Stoichiomet	108 '				
Solution Stoichiomen Sto	157				
51 KEROSINE* 173.1 52 DHT LT DIES* 178.5 53 UC OIL* 236.7 54 DHT FEED* 179.6 55 DHT HY DIES* 204.7 56 MDEthnlAmine 119.2 57 Reaction: reactor 1-2 59 Component Mole Weight Stoichiomet	144 '				
53 UC OIL* 236.7 54 DHT FEED* 179.6 55 DHT HY DIES* 204.7 56 MDEthnlAmine 119.2 57 Reaction: reactor 1-2 59 Component Mole Weight Stoichiomet	28 '				
54 DHT FEED* 179.6 55 DHT HY DIES* 204.7 56 MDEthnlAmine 119.2 57 Reaction: reactor 1-2 59 Component Mole Weight Stoichiomet	0 .				
55 DHT HY DIES* 204.7 56 MDEthnlAmine 119.2 57 *** 58 Reaction: reactor 1-2 59 Component Mole Weight Stoichiomet	339				
56 MDEthnlAmine 119.2 57 8 58 Reaction: reactor 1-2 59 Component Mole Weight Stoichiomet	0 ¹				
Reaction: reactor 1-2 Component Mole Weight Stoichiomet	0 .				
59 Component Mole Weight Stoichiomet					
	ric Coeff.				
	1349 '				
61 H2S 34.08 62 Ammonia 17.03	80 10 1				
63 H2O 18.02	10 ¹				
64 Methane 16.04	120				
BYSYS v3.0.1 (Build 4602)	Page 1 of 19. * Specified by user.				



12

University Of Petroleum And Energy UPES, Bidholi

Bidholi, Dehradun, Uttarakhand

Component

Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC
Unit Set: SI

Stoichiometric Coeff.

Date/Time: Thu Apr 23 15:14:15 2009

Conversion Reactor: reactor 1-1 (continued)

REACTION DETAILS Reaction: reactor 1-2

Mole Weight

13	Ethane	30.07	26 •
14	Propane	44.10	28 *
15	i-Butane	58.12	23 •
16	n-Butane	58.12	15 •
17	CO	28.01	0 *
18	CO2	44.01	<u>0.</u>
19	MIXED FEED*	140.9	-641 *
20	LIGHT NAPHT*	80.97	54 •
21	HEAVY NAPHT*	80.97	78 ·
22	LIGHT DIESE*	209.6	. 67 *
23	HEAVY DIESE*	142.0	0.
24	KEROSINE*	173.1	14 •
25	DHT LT DIES*	178.5	0.
26	UC OIL*	236.7	170 •
27	DHT FEED*	179.6	0 •
28	DHT HY DIES*	204.7	54 *
29	MDEthnlAmine	119.2	0 •
30			
31		Reaction: reactor 2-1	
32	Component	Mole Weight	Stoichiometric Coeff.
33	Hydrogen .	2.016	-521 *
34	H2S	34.08	-0 *
35	Ammonia	17.03	0 •
36	H2O	18.02	0 *
37	Methane	16.04	·2*
38	Ethane	30.07	2 *
39	Propane	• 44.10	16 *
40	i-Butane	58.12	38 *
41	n-Butane	58.12	17 •
42	CO	28.01	0 *
43	CO2	44.01	-0 *
44	MIXED FEED*	140.9	0.
45	LIGHT NAPHT*	80.97	200 •
46	HEAVY NAPHT*	80.97	141 •
47	LIGHT DIESE*	209.6	200 •
48	HEAVY DIESE*	142.0	250 •
49	KEROSINE*	173.1	300 •
50	DHT LT DIES*	178.5	60 •
51	UC OIL*	236.7	-1840 *
52	DHT FEED*	179.6	336 *
53	DHT HY DIES*	204.7	1000 •
54	MDEthnlAmine	119.2	· 0·
55			
56		Reaction: reactor 2-2	
57	Component	Mole Weight	Stoichiometric Coeff.
i eo l	Library was a	2.046	407.1

2.016

34.08

17.03

18.02

16.04

30.07

44.10

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Hydrogen H2S

Ammonia

Methane

Propane

Ethane

H2O

* Specified by user.

Page 2 of 19

-197 •

0.

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-1 •

-11 •

-3 *



University Of Petroleum And Energy UPES, Bidholi,

Bidholi, Dehradun, Uttarakhand Case Name:

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC

Unit Set: S

Date/Time;

Thu Apr 23 15:14:15 2009

Conversion Reactor: reactor 1-1 (continued)

REACTION DETAILS

11		Reaction: reactor 2-2	
12	Component	Mole Weight	Stoichiometric Coeff.
13	i-Butane	58.12	-10 *
14	n-Butane	58.12	-5 *
15	CO .	28.01	0 •
16	CO2	44.01	0 •
17	MIXED FEED*	140.9	0 •
18	LIGHT NAPHT*	80.97	40 •
19	HEAVY NAPHT*	80.97	30 •
20	LIGHT DIESE*	209.6	100 •
21	HEAVY DIESE*	142.0	100 •
22	KEROSINE*	173.1	7.
23	DHT LT DIES*	178.5	0.
24	UC OIL*	236.7	-356 *
25	DHT FEED*	179.6	245 *
26	DHT HY DIES*	204.7	0.
27	MDEthnlAmine	119.2	0.
28	A 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		

Reaction: reactor 1-3

30	Component	Mole Weight	Stoichiometric Coeff.
31	Hydrogen	2.016	0 *
32	H2S	34.08	0.
33	Ammonia .	17.03	- 0 *
34	H2O	18.02	0 •
35	Methane	16.04	0 •
36	Ethane	30.07	-1 •
37	Propane	44.10	-0 •
38	i-Butane	58.12	-0 •
39	n-Butane	58.12	-0 •
40		28.01	-0 •
41	CO2	44.01	0.
42	MIXED FEED*	140.9	0 •
43	LIGHT NAPHT*	80.97	0 *
44	HEAVY NAPHT*	80.97	-0 *
45	LIGHT DIESE*	209.6	0.
46	HEAVY DIESE*	142.0	0.
47	KEROSINE*	173.1	0 *
48	DHT LT DIES*	178.5	-0 *
49	UC OIL*	236.7	0 *
50	DHT FEED*	179.6	-0 *I
51	DHT HY DIES*	204.7	-0 *
52	MDEthnlAmine	119.2	0 •
52 53			

REACTION RESULTS FOR: reactor 1

Extents

58	Name	Rank	Specified	Use Default	Actual	Base	Reaction Extent
59			% Conversion		% Conversion	Component	(kgmole/h)
60	reactor 1-1	0.	99.90	Yes	99.90	MIXED FEED*	1.290
61	reactor 1-2	1.	99.90	Yes	9.990e-002	MIXED FEED*	2.698e-003
62	reactor 2-1	2.	99.90	Yes		UC OIL*	0.2378
63	reactor 2-2	3.	99.90	Yes		UC OIL*	1.230e-003
64	reactor 1-3	4 *	99.90	Yes		DHT FEED*	1.201
65	Hyprotech Ltd.		Valation of the N	eve on a /Build A	ing\		Page 2 of 10

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University Of Petroleum And Energy UPES, Bidholi, Dehradun, Uttarakhand

Case Name: Unit Set: Date/Time:

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1:HSC

Thu Apr 23 15:14:15 2009

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REACTION RESULTS FOR: reactor 1

Balance

13	Components	Total Inflow (kgmole/h)	Total Reaction (kgmole/h)	Total Outflow
14	I bulan and			(kgmole/h)
15	Hydrogen	8794	3142	1.194e+004
16	H2S	5.869e-002	208.0	208.0
17	Ammonia	0.0000	25.10	25.10
18	H2O	8.548	7.743	16.29
19	Methane	323.6	194.4	517.9
20	Ethane	46.13	60.43	106.6
21	Propane	42.00	68.86	110.9
22	i-Butane	29.64	63.69	93.34
23	n-Butane	15.12	40.23	55.35
24	CO	0.1785	9.230e-002	0.2708
25	CO2	6.817e-002	5.842e-002	0.1266
26	MIXED FEED*	1732	-1732	1.732e-003
27	LIGHT NAPHT*	17.67	186.7	204.4
28	HEAVY NAPHT*	4.359	236.6	240.9
29	LIGHT DIESE*	7.632e-002	234.1	234.2
30	DHT HY DIES*	0.0000	432.7	° 432.7
31	KEROSINE*	0.1733	107.9	108.1
32	DHT LT DIES*	3.921e-002	14.30	14.34
33	UC OIL*	0.0000	4.489e-004	4.489e-004
34	DHT FEED*	0.0000	80.17	80.17
35	HEAVY DIESE*	0.0000	59.58	59.58
36	MDEthnlAmine	0.0000	0.0000	0.0000

Conversion Reactor: reactor 1-2

CONNECTIONS

Inlet Stream Connections

_		
44	Stream Name	From Unit Operation
45	r 1-2 inlet	Conversion Reactor reactor 1-1
46	reactor 1-1 vapors	Conversion Reactor reactor 1-1
47		

Outlet Stream Connections

ı	49	Stream Name	To Unit Operation	
ı	50	reactor 1-2 vapors	Conversion Reactor:	reactor 1-3
ı	51	r 1-3 inlet	Conversion Reactor:	reactor 1-3
- [=0			

Energy Stream Connections

_	_		
٤	54	Stream Name	From Unit Operation
5	55	reactor 1-2 energy	

PARAMETERS

58	Physical I	Parameters	Optional He	eat Transfer:	Heating
59	Delta P	Vessel Volume	Duty	Energy Stream	
60	814.0 kPa		-1.023e+007 kJ/h	reactor 1-2 energy	,
61					

User Variables

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University Of Petroleum And Energy UPES,

UPES, Bidholi, Dehradun, Uttarakhand Case Name: D:\RAKI\SIMULATION\SIRI:SIMULATION\SIRI:1:HSC

Unit Set: SI

Date/Time: Thu Apr 23 15:14:15 2009

Conversion Reactor: reactor 1-2 (continued)

REACTION DETAILS

	Reaction: reactor 1-1	
Component	Mole Weight	Stoichiometric Coeff.
Hydrogen	2.016	2529 *
H2S	. 34.08	161 •
Ammonia	17.03	19 *
H2O	18.02	6.
Methane	16.04	150 *
Ethane	30.07	47 *
Propane	44.10	50 *
i-Butane	58.12	42 *
n-Butane	58.12	28 *
CO .	28.01	0.
CO2	44.01	0 *
MIXED FEED*	140.9	-1341 •
LIGHT NAPHT*	80.97	108 *
HEAVY NAPHT*	80.97	157 *
LIGHT DIESE*	209.6	144 •
HEAVY DIESE*	142.0	0 •
KEROSINE*	173.1	28 *
DHT LT DIES*	178.5	0.
UC OIL*	236.7	339 •
DHT FEED*	179.6	0 •
DHT.HY DIES*	₋ 204.7	151 •
MDEthnlAmine	119.2	0 *
	Reaction: reactor 1-2	
Component	Mole Weight	Stoichiometric Coeff.
Hydrogen	2.016	1349 •
	Hydrogen H2S Ammonia H2O Methane Ethane Propane i-Butane n-Butane CO CO2 MIXED FEED* LIGHT NAPHT* HEAVY NAPHT* LIGHT DIESE* KEROSINE* DHT LT DIESE* UC OIL* DHT FEED* DHT.HY DIES* MDEthnlAmine Component	Hydrogen 2.016 H2S 34.08 Ammonia 17.03 H2O 18.02 Methane 16.04 Ethane 30.07 Propane 44.10 i-Butane 58.12 CO 28.01 CO2 44.01 MIXED FEED* 140.9 LIGHT NAPHT* 80.97 HEAVY NAPHT* 80.97 HEAVY NIPHT* 80.97 LIGHT DIESE* 142.0 KEROSINE* 173.1 DHT LT DIES* 178.5 UC OIL* 236.7 DHT FEED* 179.6 DHT.HY DIESE* 204.7 MDEthnlAmine 119.2 Reaction: reactor 1-2 Mole Weight

36		Reaction: reactor 1-2	
37	Component	Mole Weight	Stoichiometric C
38	Hydrogen	2.016	
39	H2S	34.08	
40	Ammonia	17.03	
41	H2O	10.00	

42	Methane	16.04	120
43	Ethane	30.07	26
44	Propane ·	44.10	28
45	i-Butane	58.12	23
46	n-Butane	58.12	15
47	CO	28.01	0
48	CO2	44.01	0
49	MIXED FEED*	140.9	-641
50	LIGHT NAPHT*	80.97	54
51	HEAVY NAPHT*	80.97	78
52	LIGHT DIESE*	209.6	67
-	LICANAL DICCER	440.0	

81	· · · · · · · · · · · · · · · · · · ·	4 0 4	
60			
59	MDEthnlAmine	119.2	0 '
58	DHT HY DIES*	204.7	54 '
57	DHT FEED*	179.6	0.
58	UC OIL*	236.7	170 '
55	DHT LT DIES*	178.5	0 '
54	KEROSINE*	173.1	14 '
53	HEAVY DIESE*	142.0	0 '
52	LIGHT DIESE*	209.6	67 '
21	TEAVT IVAPUL	80.97	78 '

61	·	Reaction: reactor 2-1	
62	Component	Mole Weight	Stoichiometric Coeff.
63	Hydrogen	2.016	-521 •
64	H2S	34.08	-0 •
85	Hyperotech (Sd)		

80 °



University Of Petroleum And Energy: UPES, Bidholi, Dehradun, Uttarakhand Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC

Unit Sets: SI

Date/Time: Thu Apr 23 15:14:15 2009:

	REACTION DETAILS				
10 11		Reaction: reactor 2-1			
12	Component	Mole Weight	Stoichiometric Coeff.		
13	Ammonia	17.03	0 1		
14	H2O	18.02	0		
15	Methane	. 16.04	2.		
16	Ethane	30.07	2 .		
17	Propane	44.10	16 '		
18	i-Butane	58.12	38 '		
19	n-Butane	58.12	17		
20	CO	28.01	0.		
21	CO2	44.01	-0		
22	MIXED FEED*	. 140.9	0		
23	LIGHT NAPHT*	80.97	200		
24 25	HEAVY NAPHT* LIGHT DIESE*	80.97 209.6	200		
26	HEAVY DIESE*	142.0	250		
27	KEROSINE*	173.1	300		
28	DHT LT DIES*	178.5	60		
29	UC OIL*	236.7	-1840		
30	DHT FEED*	179.6	336		
31	DHT HY DIES*	204.7	1000		
32	MDEthnlAmine	119.2	0		
33		-			
34		Reaction: reactor 2-2			
35	Component	Mole Weight	Stoichiometric Coeff.		
36	Hydrogen	2.016	-197		
37	H2S	34.08	. 0		
38	Ammonia	17.03	. 0		
39	H2O	18.02			
40 41	Methane Ethane	16.04			
42	Propane	30.07			
43	i-Butane	44.10	<u>-6</u>		
44	n-Butane	58.12	-10		
=	CO	58.12 28.01			
15		28.01			
_	CO2	1 44.01			
46	CO2 MIXED FEED*	44.01			
46 47	MIXED FEED*	140.9	0		
46 47 48	MIXED FEED* LIGHT NAPHT*	140.9 80.97	0 40		
46 47 48 49	MIXED FEED* LIGHT NAPHT* HEAVY NAPHT*	140.9 80.97 80.97	0 40 30		
46 47 48 49	MIXED FEED* LIGHT NAPHT*	140.9 80.97 80.97 209.6	0 40 30 100		
46 47 48 49 50	MIXED FEED* LIGHT NAPHT* HEAVY NAPHT* LIGHT DIESE*	140.9 80.97 80.97	0 40 30 100 100		
46 47 48 49 50 51	MIXED FEED* LIGHT NAPHT* HEAVY NAPHT* LIGHT DIESE*	140.9 80.97 80.97 209.6 142.0	0 40 30 100 100 7		
46 17 48 49 50 51 52	MIXED FEED* LIGHT NAPHT* HEAVY NAPHT* LIGHT DIESE* HEAVY DIESE* KEROSINE*	140.9 80.97 80.97 209.6 142.0	0 40 30 100 100 7		
46 47 48 49 50 51 52 53	MIXED FEED* LIGHT NAPHT* HEAVY NAPHT* LIGHT DIESE* HEAVY DIESE* KEROSINE* DHT LT DIES* UC OIL* DHT FEED*	140.9 80.97 80.97 209.6 142.0 173.1 178.5 236.7	0 40 30 100 100 7 0 -356		
16 17 18 19 50 51 52 53 54 55 58	MIXED FEED* LIGHT NAPHT* HEAVY NAPHT* LIGHT DIESE* HEAVY DIESE* KEROSINE* DHT LT DIES* UC OIL* DHT FEED* DHT HY DIES*	140.9 80.97 80.97 209.6 142.0 173.1 178.5 236.7 179.6 204.7	0 40 30 100 100 7 0 -356 245		
46 47 48 49 50 51 52 53 54 55 56 57	MIXED FEED* LIGHT NAPHT* HEAVY NAPHT* LIGHT DIESE* HEAVY DIESE* KEROSINE* DHT LT DIES* UC OIL* DHT FEED*	140.9 80.97 80.97 209.6 142.0 173.1 178.5 236.7	0 40 30 100 100 7 0 -356 245		
46 47 48 49 50 51 52 53 54 55 56 57	MIXED FEED* LIGHT NAPHT* HEAVY NAPHT* LIGHT DIESE* HEAVY DIESE* KEROSINE* DHT LT DIES* UC OIL* DHT FEED* DHT HY DIES*	140.9 80.97 80.97 209.6 142.0 173.1 178.5 236.7 179.6 204.7 119.2	0 0 40 30 30 30 30 30 30 30 30 30 30 30 30 30		
45 46 47 48 49 50 51 52 53 54 55 56 57 68 60	MIXED FEED* LIGHT NAPHT* HEAVY NAPHT* LIGHT DIESE* HEAVY DIESE* KEROSINE* DHT LT DIES* UC OIL* DHT FEED* DHT HY DIES*	140.9 80.97 80.97 209.6 142.0 173.1 178.5 236.7 179.6 204.7	7 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 ·		

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붜	The state of the s	University Of Petroleum And Energy	Case Name:	D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC
3		UPES, Bidholi,	Unit Set:	Si
5	and the state of t	Dehradun, Uttarakhand	Date/Time:	Thu Apr 23 15:14:15 2009
6 7	Convers	sion Reactor: reac	tor 1-2 (continued)
8				
9		RE	EACTION DET	TAILS
10	· · · · · · · · · · · · · · · · · · ·			
111		Rea	ction: react	tor 1-3

11	Reaction: reactor 1-3		
12	Component	Mole Weight	Stoichiometric Coeff.
13	Methane	16.04	0.
14	Ethane	30.07	
15	Propane	. 44.10	-O *
16	i-Butane	58.12	-0 *
17	n-Butane	58.12	-0*
18	CO	28.01	-0*
19	CO2	44.01	0*
20	MIXED FEED*	140.9	0.
21	LIGHT NAPHT*	80.97	0.
22	HEAVY NAPHT*	80.97	-0 *
23	LIGHT DIESE*	209.6	0 *
24	HEAVY DIESE*	142.0	0*
25	KEROSINE*	173.1	0 *
26	DHT LT DIES*	178.5	-0 *
27	UC OIL*	236.7	0 •
28	DHT FEED*	179.6	-0 *
29	DHT HY DIES*	204.7	-0 *
30	MDEthnlAmine	119.2	0 *
31			

REACTION RESULTS FOR: reactor 1

Extents

35							
36 37	Name	Rank	Specified % Conversion	Use Default	Actual % Conversion	Base Component	Reaction Extent (kgmole/h)
38	reactor 1-1	0.	99.90	Yes	99.90	MIXED FEED*	1.290e-006
39	reactor 1-2	1.	99.90	Yes	9.990e-002	MIXED FEED*	2.698e-009
40	reactor 2-1	2 *	99.90	Yes	100.0	UC OIL*	4.815e-007
41	reactor 2-2	3*	99.90	Yes	0.1974	UC OIL*	2.490e-009
42	reactor 1-3	4*	99.90	Yes	8.343e-003	DHT FEED*	1.194
T.,							

Balance

44	Datance			
45 46	Components	Total Inflow (kgmole/h)	Total Reaction (kgmole/h)	Total Outflow (kgmole/h)
47	Hydrogen	1.194e+004	7.267e-002	1.194e+004
48	H2S	208.0	2.325e-003	208.0
49	Ammonia	25.10	3.092e-004	25.10
50	H2O	16.29	1.729e-005	16.29
51	Methane	517.9	6.708e-003	517.9
52	Ethane	106.6	-0.5969	106.0
53	Propane	110.9	-1.187e-002	110.8
54	i-Butane	93.34	-7.890e-004	93.34
55	n-Butane	55.35	-7.447e-004	55.35
56	CO	0.2708	-2.295e-006	0.2708
57	CO2	0.1266	3.640e-006	0.1266
58	MIXED FEED*	1.732e-003	-1.732e-003	1.732 e- 009
59	LIGHT NAPHT*	204.4	0.1210	204.5
60	HEAVY NAPHT*	240.9	-3.598e-003	240.9
61	LIGHT DIESE*	234.2	1.477e-003	234.2
62	DHT HY DIES*	432.7	-4.294e-003	432.6
63	KEROSINE*	108.1	6.253e-002	108.2
64	DHT LT DIES*	14.34	-1.165e-003	14.34
65	Mayorotech Utol	ENSYSTON (IBD	II614602)	Page 7 of 19

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1 2	University Of Petroleum A	nd Energy C	Case Name: D:\RAKI\SIM	ULATIONSIRI SII	MÜLATION(SIRI 1.HSC
3	UPES, Bidholi,	Ů	Jnit Set: SI		
4 5	Dehradun, Uttarakhand	D	Date/Time; Thu Apr 23 1	5:14:15 2009	
6					
7 8	Conversion Reactor:	reacto	or 1-2 (continue	∍d)	
9	REACTION R	ESULTS FO	R : reactor 1		
10 11			Balance		
12 13	Components Tota	I Inflow	Total Rea	ction	Total Outflow
14		nole/h)	(kgmole	/h)	(kgmole/h)
15 16	UC OIL* DHT FEED*	4.489e-	-004 0.17	-4.382e-004 -6.526e-003	1.075e-005 80.16
17	HEAVY DIESE*		9.58	1.315e-003	59.58
18	MDEthnlAmine	0.0	0000	0.0000	0.0000
19 20 21	Conversion Reactor: reactor 1-3				
22 23		co	NNECTIONS		·
24 25		Inlet Str	ream Connections		
26	Stream Name		Fron	unit Operation	1
27	r 1-3 inlet reactor 1-2 vapors	Conversion R Conversion R			reactor 1-2
28 29	reactor 1-2 vapors		tream Connections		Teactor 1-2
30	N. W.	Outlet St		Ilmit On anation	
31 32	Stream Name reactor 1-3 vapors			Unit Operation	
33	reactor 1-3 outlet				
34 35		Energy S	tream Connections		
36	Stream Name		Fron	unit Operation	1
37 38	reactor 1-3 energy	L			
39		P#	ARAMETERS		
40 41	Physical Parameters Delta P Vessel	Volume	Duty	Optional Hea	at Transfer: Heating Energy Stream
42	225.2 kPa		-2.140e+00		reactor 1-3 energy
43 44 45		Us	ser Variables		
46			CTION DETAILS		
47 48	Component		on: reactor 1-1 Mole Weight		Stoichiometric Coeff.
49	Hydrogen		2.0		2529 *
50	H2S		34.0 17.0		161 •
51 52	Ammonia H2O		17.0 18.0		19 *
53	Methane		16.0)4	150 •
54 55	Ethane		30.0 44.*	······	47 * 50 *
55 56	Propane i-Butane		58.		42 *
57	n-Butane		58.		28 *
58 59	CO CO2		28.0 44.0		0.
60	MIXED FEED*		140	.9	-1341 •
61	LIGHT NAPHT*		2.08		108 *
62 63	HEAVY NAPHT* LIGHT DIESE*		80.9 209		157 • 144 •
64	HEAVY DIESE*		142	.0	0.*
65	Hyprotech Ltd.	HYSYS	(v3.0.1 (Bulld 4602)		Page 8 of 19



University Of Petroleum And Energy UPES, Bidholi.

UPES, Bidholi, Dehradun, Uttarakhand Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC

Unit Set: SI

Date/Time: Thu Apr 23.15:14:15 2009

Conversion Reactor: reactor 1-3 (continued)

9 10	REACTION DETAILS				
10					
11		Reaction: reactor 1-1			
12	Component	Mole Weight	Stoichiometric Coeff.		
13	KEROSINE*	173.1	28 *		
14	DHT LT DIES*	178.5	0 *		
15	UC OIL*	236.7	339 *		
16	DHT FEED*	179.6	0 *		
17	DHT HY DIES*	204.7	151 *		
18	MDEthnlAmine	119.2	0 •		
19					
20		Reaction: reactor 1-2			

20	·		
21	Component	Mole Weight	Stoichiometric Coeff.
22	Hydrogen	2.016	1349 *
23	H2S	34.08	80 *
24	Ammonia	17.03	10 *
25	H2O	18.02	3*
26	Methane	16.04	120 •
27	Ethane	30.07	26 ⁺
28	Propane	44.10	28 *
29	i-Butane	58.12	23*
30	n-Butane	58.12	15*
31	CO	28.01	0.
32	CO2	44.01	0*
33	MIXED FEED*	140.9	
34	LIGHT NAPHT*	80.97	54 *
35	HEAVY NAPHT*	80.97	78*
36	LIGHT DIESE*	209.6	67 *
37	HEAVY DIESE*	142.0	0.
38	KEROSINE*	173.1	14*
39	DHT LT DIES*	178.5	0.
40	UC OIL*	236.7	170 *
41	DHT FEED*	179.6	0.
42	DHT HY DIES*	204.7	54 *
43	MDEthnlAmine	119.2	0.
44			

Reaction: reactor 2-1	
Mole Weight	Stoichiometric Coeff.
2.016	-521 *
34.08	-0 •
17.03	0.
18.02	0*
16.04	2*
30.07	2*
44.10	16 •
58.12	38 •
58.12	17 *
28.01	0 •
44.01	-0 •
140.9	0.
80.97	200 •
80.97	141 •
209.6	200 *
142.0	250 *
173.1	300 *
178.5	60 •
EXSYSIV3 01 (Build 4602)	Page 9 of 19
	Mole Weight 2.016 34.08 17.03 18.02 16.04 30.07 44.10 58.12 58.12 28.01 44.01 140.9 80.97 209.6 142.0 173.1

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1 2	University Of Petrole UPES.	eum And Energy	Case Name: D:\RAKI\SIMULA	TION/SIRI SIMULATION/SIRI 1.HSC					
	Bidholi,		Unit Set: Si						
	Dehradun, Uttarakhand		Date/Time: Thu Apr 23 15:14	<u>k:15 2009</u>					
<u>,</u>	Conversion React	or: reac	tor 1-3 (continued)					
2		RE	EACTION DETAILS						
1		Read	ction: reactor 2-1						
2	Component		Mole Weight	Stoichiometric Coeff.					
3	UC OIL*		236.7						
4	DHT FEED*		179.6						
5	DHT HY DIES*		204.7	·					
3	MDEthnlAmine		119.2						
7									
3		Rea	ction: reactor 2-2						
9	Component		Mole Weight	Stoichiometric Coeff.					
1	Hydrogen		2.016						
╝	H2S		34.08						
2	Ammonia		17.03						
빜	H2O		18.02						
빜	Methane		16.04						
5	Ethane		30.07						
깈	Propane		44.10						
4	i-Butane		58.12						
빜	n-Butane		58.12						
4	CO	ļ	28.01						
4	CO2		44.01						
4	MIXED FEED*		140.9						
2	LIGHT NAPHT*		80.97						
3	HEAVY NAPHT*		80.97						
4	LIGHT DIESE*		209.6						
1	HEAVY DIESE*		142.0 173.1						
1	KEROSINE*	ļ	173.1						

42			
43		Reaction: reactor 1-3	
44	Component	Mole Weight	Stoichiometric Coeff.
45	Hydrogen	2.016	0.
46	H2S	34.08	0*
47	Ammonia	17.03	0 *
48	H2O	18.02	0 *
49	Methane	16.04	0.
50	Ethane	30.07	
51	Propane	44.10	-0 *
52	i-Butane	58.12	-0•
53	n-Butane	58.12	-0 *
54	CO	28.01	-0 *
55	CO2	44.01	0 *
56	MIXED FEED*	140.9	0 *
57	LIGHT NAPHT*	80.97	0 •
58	HEAVY NAPHT*	80.97	-0 *
59	LIGHT DIESE*	209.6	0.
60	HEAVY DIESE*	142.0	0 •
61	KEROSINE*	173.1	0.
62	DHT LT DIES*	178.5	-0 *
63	UC OIL*	236.7	0 *
64	DHT FEED*	179.6	-0 *
85	Hyprofect fd.	HXSVS v3 (0.1 (Bullet 4602)	Page 10 of 19

178.5

236.7

179.6

204.7

119.2

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DHT LT DIES*

UC OIL*

40

DHT FEED* DHT HY DIES*

41 MDEthnlAmine

* Specified by user.

-1840 * 336 * 1000 *

> -197 * 0. 0 • -1 * -11 * -3 * -6 * -10 * -5 ***** 0 * 0 * 0 • 40 • 30 • 100 * 100 * 7 •

> > 0 •

-356 *

245 •

0 •

0.

Carried Carried	University Of Petro UPES,	eum And Energy Cas	Name: D:\RAKI\SIN	/ULATION\SIRI SIMI	ULATION\SIRI 1.HSC		
3 UE	Bidholi, Dehradun,	Unit	Set: SI				
the car of	Uttarakhand	Date	/Time: Thu Apr 23	15:14:15 2009			
С	onversion Reac	tor: reactor	1-3 (continu	ed)			
		REACTI	ON DETAILS				
			reactor 1-3				
HT HY DIES*	Component	Mo	e Weight 204		Stoichiometric Coeff.	-0 •	
DEthnlAmine	A. C.		119			0 *	
	REACTI	ON RESULTS FOR	reactor 1				
			xtents		Page	tion Extent	
Jame	1			Actual	6366	kauoleju)	
Name reactor 1-1	Rank	% Conversion		& Conversion	Menograss	1200aU	
(cesolpulis)	7		es (es	99.90 9.990e-002	MIXED FEED*	2.698e-015	
1/25/1/00/00/00/1/25/ 1/25/1/00/00/00/1/25/	1	99:80	Yes	99:90	NC OIL*	5.833e-009 3,017e-0141	
(29) 188010		09:99	Yes Yes	9:990e-002 8:296e-008	OHN FEEDS	N.48si	
155	Marin and Marin		Ballance				
158				Total Readilit		walltu@\istaT	
100	<u>Components</u>		wolfmla	Wamale!		(Kgmolelh)	
	an		gmolelh) 1.194e+004	(liginos	6.926e-002	11.11	34640041
	31 Hydrogen 32 H2S		208.0		2.105e-003		208.0
	33 Ammonia		25.10		2.826e-004		25.10 16.29
	34 H2O		16.29		9.498e-006		518.0
	35 Methane		517.9 106.0		6.476e-003 -0.5936		105.4
	36 Ethane		110.8		-1.187e-002		110.8
	37 Propane		93.34		-8.569e-004		93.34
	38 i-Butane	***************************************	55.35		-7.846e-004		55.35
	39 n-Butane	-	0.2708		-2.374e-006		0.2708 0.1266
	40 CO		0.1266		3.562e-006		1.732e-015
		To the same			-1.732e-009		204.7
K	41 CO2		1.732e-009				
	42 MIXED FEED*		1.732e-009 204.5		0.1201		
	41 CO2 42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT*		204.5 240.9	9	0.1201 -3.847e-003		240.9 234.2
	42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE*		204.5 240.9 234.2	5) 2	0.1201 -3.847e-003 1.188e-003		240.9
	42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE* 46 DHT HY DIES*		204.5 240.9 234.2 432.6	5 9 2 3	0.1201 -3.847e-003 1.188e-003 -4.937e-003		240.9 234.2
	42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE* 46 DHT HY DIES* 47 KEROSINE*		204.5 240.9 234.2 432.6 108.2	5	0.1201 -3.847e-003 1.188e-003 -4.937e-003 6.200e-002		240.9 234.2 432.6
	42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE* 46 DHT HY DIES* 47 KEROSINE* 48 DHT LT DIES*		204.5 240.9 234.2 432.6 108.2 14.34	5 9 9 2 8 8	0.1201 -3.847e-003 1.188e-003 -4.937e-003		240.9 234.2 432.6 108.2 14.34 1.068e-005
	42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE* 46 DHT HY DIES* 47 KEROSINE*		204.5 240.9 234.2 432.6 108.2 14.34 1.075e-005	5 9 2 3 3 2 4 5	0.1201 -3.847e-003 1.188e-003 -4.937e-003 6.200e-002 -1.187e-003		240.9 234.2 432.6 108.2 14.34 1.068e-005 80.16
	42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE* 46 DHT HY DIES* 47 KEROSINE* 48 DHT LT DIES* 49 UC OIL*		204.5 240.9 234.2 432.6 108.2 14.34 1.075e-005 80.16	5	0.1201 -3.847e-003 1.188e-003 -4.937e-003 6.200e-002 -1.187e-003 -6.107e-008 -6.649e-003 1.189e-003		240.9 234.2 432.6 108.2 14.34 1.068e-005 80.16 59.58
	42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE* 46 DHT HY DIES* 47 KEROSINE* 48 DHT LT DIES* 49 UC OIL* 50 DHT FEED*		204.5 240.9 234.2 432.6 108.2 14.34 1.075e-005	5	0.1201 -3.847e-003 1.188e-003 -4.937e-003 6.200e-002 -1.187e-003 -6.107e-008 -6.649e-003		240.9 234.2 432.6 108.2 14.34 1.068e-005 80.16
	42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE* 46 DHT HY DIES* 47 KEROSINE* 48 DHT LT DIES* 49 UC OIL* 50 DHT FEED* 51 HEAVY DIESE* 52 MDEthnlAmine 53 54 CONV	ersion React	204.5 240.9 234.2 432.6 108.2 14.34 1.075e-005 80.16 59.58 0.0000	5	0.1201 -3.847e-003 1.188e-003 -4.937e-003 6.200e-002 -1.187e-003 -6.107e-008 -6.649e-003 1.189e-003		240.9 234.2 432.6 108.2 14.34 1.068e-005 80.16 59.58
o S	42 MIXED FEED* 45 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE* 46 DHT HY DIES* 47 KEROSINE* 48 DHT LT DIES* 49 UC OIL* 50 DHT FEED* 51 HEAVY DIESE* 52 MDEthnlAmine 53 54 CONV	ersion React	204.5 240.9 234.2 432.6 108.2 14.34 1.075e-005 80.16 59.58 0.00000 Or: reactor 2	5	0.1201 -3.847e-003 1.188e-003 -4.937e-003 6.200e-002 -1.187e-003 -6.107e-008 -6.649e-003 1.189e-003		240.9 234.2 432.6 108.2 14.34 1.068e-005 80.16 59.58
	42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE* 46 DHT HY DIES* 47 KEROSINE* 48 DHT LT DIES* 49 UC OIL* 50 DHT FEED* 51 HEAVY DIESE* 52 MDEthnlAmine 53 54 CONV	ersion React	204.5 240.9 234.2 432.6 108.2 14.34 1.075e-005 80.16 59.58 0.0000 Or: reactor 2	2-1 MECTIONS m Connections	0.1201 -3.847e-003 1.188e-003 -4.937e-003 6.200e-002 -1.187e-003 -6.107e-008 -6.649e-003 1.189e-003 0.0000		240.9 234.2 432.6 108.2 14.34 1.068e-005 80.16 59.58
6 S S T T T T T T T T T T T T T T T T T	42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE* 46 DHT HY DIES* 47 KEROSINE* 48 DHT LT DIES* 49 UC OIL* 50 DHT FEED* 51 HEAVY DIESE* 52 MDEthnlAmine 53 54 CONV 56 57 58 59	ersion React	204.5 240.9 234.2 432.6 108.2 14.34 1.075e-005 80.16 59.58 0.0000 Or: reactor 2	2-1 MECTIONS m Connections	0.1201 -3.847e-003 1.188e-003 -4.937e-003 6.200e-002 -1.187e-003 -6.107e-008 -6.649e-003 1.189e-003		240.9 234.2 432.6 108.2 14.34 1.068e-005 80.16 59.58
yd 22S mr 22C eth ha 00 3U BL 00 022	42 MIXED FEED* 43 LIGHT NAPHT* 44 HEAVY NAPHT* 45 LIGHT DIESE* 46 DHT HY DIES* 47 KEROSINE* 48 DHT LT DIES* 49 UC OIL* 50 DHT FEED* 51 HEAVY DIESE* 52 MDEthnlAmine 53 54 CONV 55 56 57 58 59 60 Strea 61 reactor 2-1 feed 62 63		204.5 240.9 234.2 432.6 108.2 14.34 1.075e-005 80.16 59.58 0.0000 Or: reactor 2 CONN Inlet Stream	2 -1 SECTIONS THE CONNECTIONS Fam Connections	0.1201 -3.847e-003 1.188e-003 -4.937e-003 6.200e-002 -1.187e-003 -6.107e-008 -6.649e-003 1.189e-003 0.0000		240.9 234.2 432.6 108.2 14.34 1.068e-005 80.16 59.58

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University Of Petroleum And Energy UPES,

UPES, Bidholi, Dehradun, Uttarakhand

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Un	it S	et:		s	ı,											٠٠. د د		ě,											
 Da	le/T	ime		Ţ	hù	Αp	r 2:	3 1	5:1	4:	15	20	909))							ě.			×		

9 10			R	REACTION DET	AILS					
11			Re	action; react	or 1-3					
12	Со	mponent		Mole Weight	Stoichiometric Coeff.					
13	DHT HY DIES*				204.7			-0 '		
4	MDEthnlAmine				119.2			0 .		
15 16		·					· · · · · · · · · · · · · · · · · · ·	 		
7	· · · · · ·	REA	ACTION RESULTS	FOR: react	or 1					
9				Extents						
20	Name	Rank	Specified % Conversion	Use Default	Actual % Conversion		Base Component	Reaction Extent (kgmole/h)		
2	reactor 1-1	0.	99.90	Yes	99.9	<u>, </u>	MIXED FEED*	1.290e-012		
3	reactor 1-2	1 •	99.90	Yes	9.990e-00		MIXED FEED*	2.698e-015		
4	reactor 2-1	2*	99.90	Yes	99.9		UC OIL*	5.833e-009		
5	reactor 2-2	3.	99.90	Yes	9.990e-00		UC OIL*	3.017e-011		
6	reactor 1-3	4 •	99.90	Yes	8.296e-00	3	DHT FEED*	1.187		
7 8				Balance						
9	Componer	nts	Total Inflow		Total Reaction		1	il Outflow		
				94e+004	(kgmole/h)	Se-002	(KÇ	mole/h)		
╛	H2S			208.0		5e-002	1.194e+004 208.0			
3	Ammonia		_	25.10		Se-003				
4	H2O			16.29		3e-006	<u> </u>	25.10 16.29		
5	Methane			517.9		Se-003		518.0		
3	Ethane			106.0		0.5936		105.4		
7	Propane			110.8		re-002		110.8		
3	i-Butane			93.34	-8.569	9e-004		93.34		
1	n-Butane			55.35	-7.846	Se-004		55.35		
4	CO			0.2708	-2.374	le-006				
1	CO2			0.1266	3.562	2e-006				
릭	MIXED FEED*		1.7	732e-009	-1.732	2e-009	1.732e-015			
4	LIGHT NAPHT*			204.5	(0.1201	1 204.7			
4	HEAVY NAPHT*			240.9	-3.847	'e-003	3 240.9			
틱	LIGHT DIESE*			234.2		3e-003		234.2		
4	DHT HY DIES* KEROSINE*			432.6		'e-003		432.6		
4	DHT LT DIES*			108.2		e-002	<u> </u>	108.2		
	UC OIL*		4 /	14.34		'e-003		14.34		
1	DHT FEED*		1.5)75e-005		'e-008 le-003		1.068e-005		
1	HEAVY DIESE*			80.16 59.58		e-003		80.16		
,	MDEthnlAmine			0.0000		0.0000		59.58 0.0000		
the state of the s		version Re	actor: reac	The second se				0.000		
7			İnlət	Stream Conne	·····		···			
9	Str	eam Name	1		From Unit O	porotic				

Stream Name

64

To Unit Operation

2	University Of Petroleum Ar	d Energy	Case Name: D:\F	KAKI\SIMULATION\	SIRI SIMULATION\SIRI 1.HSC		
3	UPES, Bidholi,		Unit Set: SI				
4 5	Dehradun, Uttarakhand		Date/Time: Thu	Apr 23 15:14:15 20	109		
6							
7	Conversion Reactor:	reac	tor 2-1 (con	tinued)			
9			CONNECTIONS				
10							
12	reactor 2-1 vapors reactor 2-2 inlet		on Reactor:		reactor 2-2 reactor 2-2		
13			y Stream Connection	ne	10000122		
14 15	Stream Name			From Unit Op	oration		
16	reactor 2-1 energy			Tront onit op	eration		
17			PARAMETERS				
18 19	Physical Parameters			Optio	nal Heat Transfer: Heating		
20	Delta P Vessel	Volume		Duty	Energy Stream		
21	1.789e+004 kPa -	=	8.	583e+007 kJ/h	reactor 2-1 energy		
22 23			User Variables				
24		RE	EACTION DETAILS				
25 26			ction: reactor 1-1				
27	Component		Mole Weight		Stoichiometric Coeff.		
28	Hydrogen			2.016	2529		
29	H2S			34.08	161		
30 31	Ammonia H2O			17.03 18.02			
32	Methane		***************************************	16.04	150		
33	Ethane _			30.07	- 47		
34	Propane			44.10	. 50		
35	i-Butane			58.12 58.12	42 28		
36 37	n-Butane CO			28.01			
38	CO2			44.01			
39	MIXED FEED*			140.9	-134		
40 41	LIGHT NAPHT* HEAVY NAPHT*			80.97 80.97	108 157		
42	LIGHT DIESE*			209.6	144		
43	HEAVY DIESE*			142.0	0		
44	KEROSINE*			173.1	28		
45 46	DHT LT DIES* UC OIL*			178.5 236.7	0		
47	DHT FEED*			179.6	339		
48	DHT HY DIES*			204.7	151		
49 50	MDEthnlAmine			119.2	0		
51		Rea	ction: reactor 1-2				
52	Component		Mole Weight		Stoichiometric Coeff.		
53 54	Hydrogen			2.016	1349		
54 55	H2S Ammonia			34.08 17.03	80 10		
56	H2O			18.02	3		
57	Methane			16.04	120		
58 59	Ethane Propane			30.07 44.10	26		
59 60	i-Butane			58.12			
61	n-Butane		15				
62	CO	28.01					
63 64	CO2 MIXED FEED*			44.01 140.9	-641		
65		HYS	YS v3.0.1 (Build 4602	170.3	-041 Page 1/2 of 1/9		
-	Licensed to: TEAM LND				* Specified by user.		



LIGHT NAPHT*

HEAVY NAPHT*

LIGHT DIESE*

HEAVY DIESE*

DHT LT DIES*

KEROSINE*

Component

University Of Petroleum And Energy UPES, Bidholi, Dehradun, Uttarakhand

Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1:HSC

Unit Set: SI .

Date/Time: Thu:Apr 23 15:14:15 2009

80.97

80.97

209.6

142.0

173.1

178.5

Stoichiometric Coeff.

54 '

78 **•**

67 *

0.

14 •

0.

Conversion Reactor: reactor 2-1 (continued)

REACTIO	N DETAILS
Reaction:	reactor 1-2

Mole Weight

19	UC OIL*	236.7	170 •
20	DHT FEED*	179.6	0.
21	DHT HY DIES*	204.7	54 °
22	MDEthnlAmine	. 119.2	. 0*
23			
24		Reaction: reactor 2-1	
25	Component	Mole Weight	Stoichiometric Coeff.
26	Hydrogen	2.016	-521 °
27	H2S	34.08	-0 •1
28	Ammonia	17.03	0.
29	H2O	18.02	0.
30	Methane	16.04	2.
31	Ethane	30.07	2.
32	Propane	44.10	16 •
33	i-Butane	- 58.12	. 38 •
34	n-Butane	58.12	17 •
35	CO	28.01	0.
36	CO2	44.01	٠
37	MIXED FEED*	140.9	0.
38	LIGHT NAPHT*	80.97	200 °
39	HEAVY NAPHT*	80.97	141 •
40	LIGHT DIESE*	209.6	200 •
41	HEAVY DIESE*	142.0	250 •
42	KEROSINE*	173.1	300 •
43	DHT LT DIES*	178.5	60 •
44	UC OIL*	236.7	-1840 *
45	DHT FEED*	179.6	336 °
46	DHT HY DIES*	204.7	1000 •
47	MDEthnlAmine	119.2	0.
48			
49		Reaction: reactor 2-2	

50	Component	Mole Weight	Stoichiometric Coeff.
51	Hydrogen	2.016	-197 °
52	H2S	34.08	0.
53	Ammonia	17.03	0.
54	H2O	18.02	-1 •
55	Methane	16.04	-11 •
56	Ethane	30.07	-3•
57	Propane	44.10	-6 •
58	i-Butane	58.12	-10 *
59	n-Butane	58.12	-5 •
60	CO	28.01	0.
61	CO2	44.01	0.
62	MIXED FEED*	140.9	0.
63	LIGHT NAPHT*	80.97	40 •
64	HEAVY NAPHT*	80.97	30 •
85	Hyomitech Ifd	HVCVC (A.0.1 (Build 4602)	Page 13 of 19

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University Of Petroleum And Energy UPES, Bidholi, Dehradun,

Uttarakhand

Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC

Unit Set: Si

Date/Time: Thu Apr 23 15:14:15 2009

Conversion Reactor: reactor 2-1 (continued)

REACTION DETAILS

11		Reaction: reactor 2-2	
12	Component	Mole Weight	Stoichiometric Coeff.
13	LIGHT DIESE*	209.6	100 *
14	HEAVY DIESE*	. 142.0	, 100 °
15	KEROSINE*	173.1	. 7*
16	DHT LT DIES*	178.5	0 *
17	UC OIL*	236.7	-356 *
18	DHT FEED*	179.6	245 *
19	DHT HY DIES*	204.7	0 •
20	MDEthnlAmine	119.2	0 *
21			

22		Reaction: reactor 1-3	
23	Component	Mole Weight	Stoichiometric Coeff.
24	Hydrogen	2.016	0.
25	H2S	34.08	0.*
26	Ammonia	17.03	0.
27	H2O	18.02	0 *
28	Methane	16.04	0 *
29	Ethane	30.07	-1 *
30	Propane	44.10	-0 *
31	i-Butane	58.12	-0 *
32	n-Butane	58.12	-0 *
33	CO	28.01	- -0 *
34	CO2	44.01	0 *
35	MIXED FEED*	140.9	0.
36	LIGHT NAPHT*	80.97	0+
37	HEAVY NAPHT*	80.97	-0 •
38	LIGHT DIESE*	209.6	0.
39	HEAVY DIESE*	142.0	0.
40	KEROSINE*	173.1	0.
41	DHT LT DIES*	178.5	-0 *
42	UC OIL*	236.7	0.
43	DHT FEED*	179.6	-0 *
44	DHT HY DIES*	204.7	-0 *
45	MDEthnlAmine	119.2	0.
46			

REACTION RESULTS FOR: reactor 1

Extents

-							
51 52	Name	Rank	Specified % Conversion	Ușe Default	Actual % Conversion	Base Component	Reaction Extent (kgmole/h)
53	reactor 1-1	0*	99.90	Yes		MIXED FEED*	0.0000
54	reactor 1-2	1 •	99.90	Yes		MIXED FEED*	0.0000
55	reactor 2-1	2 *	99.90	Yes	99.90	UC OIL*	1.147e-005
56	reactor 2-2	3 *	99.90	Yes	9.990e-002	UC OIL*	5.930e-008
57	reactor 1-3	4 *	99.90	Yes		DHT FEED*	0.3625

Balance

60 61	Components	Components Total Inflow (kgmole/h)		Total Outflow (kgmole/h)
62	Hydrogen	6171	1.517e-002	6171
63	H2S	2.935e-002	6.426 e -004	2.999e-002
64		0.0000	8.628 e -005	8.628e-005
65	A Hyprotect Role	HYSYSVOIO	f ((Bulld:4602);	Page 14 of 19



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Bidholi, Dehradun, Uttarakhand

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI.1.HSC Case Name: SI Unit Set: Date/Time: Thu Apr 23 15:14:15 2009

Conversion Reactor: reactor 2-1 (continued)

REACTION RESULTS FOR: reactor 1

Balance

12				
13	Components	Total Inflow	Total Reaction	Total Outflow
14		(kgmole/h)	(kgmole/h)	(kgmole/h)
15	H2O .	5.995	2.867e-006	5.995
16	Methane	227.1	2.003e-003	227.1
17	Ethane	32.36	-0.1812	32.18
18	Propane	29.48	-3.439e-003	29.48
19	i-Butane	20.80	1.736e-004	20.80
20	n-Butane	10.62	-4.089e-005	10.62
21	CO	0.1071	-7.251e-007	0.1071
22	CO2	4.544e-002	1.077e-006	4.545e-002
23	MIXED FEED*	0.0000	0.0000	0.0000
24	LIGHT NAPHT*	0.0000	3.898e-002	3.898e-002
25	HEAVY NAPHT*	12.40	4.441e-004	. 12.40
26	LIGHT DIESE*	1.183	2.662e-003	1.186
27	DHT HY DIES*	0.1026	9.956e-003	0.1126
28	KEROSINE*	6.933e-002	2.237e-002	9.170e-002
29	DHT LT DIES*	64.88	3.25 4e- 004	64.88
30	UC OIL*	2.112e-002	-2.112e-002	3.284e-006
31	DHT FEED*	0.0000	1.835e-003	1.835e-003
32	HEAVY DIESE*	1215	3.235e-003	1215
33	MDEthnlAmine	0.0000	0.0000	0.0000
24				

Conversion Reactor: reactor 2-2

CONNECTIONS

Inlet Stream Connections

4	Stream Name	From Unit Operation	
42	reactor 2-2 inlet	Conversion Reactor reac	ctor 2-1
43	reactor 2-1 vapors	Conversion Reactor reac	ctor 2-1
44		Outlet Stream Connections	

Outlet Stream Connections

45	Guard Grani Connections		
46	Stream Name	To Unit Operation	
47	reactor 2-2 vapors		
48	reactor 2-2 out		
40			

Energy Stream Connections

51	Stream Name	From Unit Operation
52	reactor 2-2 energy	

PARAMETERS

Ī	55	Physical Parameters		Optional Heat Transfer:		
ľ	56	Delta P	Vessel Volume	Duty	Energy Stream	
Ī	57	-1.271e+005 kPa		4.586e+007 kJ/h	reactor 2-2 energy	
r						

User Variables

60 61	REACTION DETAILS						
62							
63	Component	Mole Weight	Stoichiometric Coeff.				
64	Hydrogen	2.016	2529 •				
65	Hyarofech Ud	HYSYS (40.1 (Build 4602))	Page 15 of 19				

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D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name: Unit Set: Date/Time; Thu Apr 23:15:14:15 2009

		REACTION DETAILS	
		Reaction: reactor 1-1	
2	Component	Mole Weight	Stoichiometric Coeff.
H2		34.08	16 ⁻
	mmonia	17.03	19
H2		18.02	
	ethane	16.04	150
	hane	30.07	4'
	opane	44.10	5
_	Butane	58.12	4
n-E	Butane	58.12	2
CC		28.01	
	IXED FEED*	44.01	
	GHT NAPHT*	140.9	-134
	EAVY NAPHT*	80.97 80.97	10
	GHT DIESE*		15
	EAVY DIESE*	209.6 142.0	14
	EROSINE*	173.1	2
	HT LT DIES*	173.1	
_	C OIL*	236.7	33
	HT FEED*	179.6	33
	IT HY DIES*	204.7	15
	DEthnlAmine .	119.2	
1		113.2	
		Reaction: reactor 1-2	
	Component	Mole Weight	Stoichlometric Coeff.
Ну	drogen	2.016	134
H2	28	34.08	8
An	nmonia	17.03	1
H2		18.02	
	ethane	16.04	12
	hane	30.07	2
	opane	44.10	2
	Butane	58.12	2
	Butane	58.12	1
CC		28.01	
CC		44.01	
	XED FEED*	140.9	-64
***************************************	GHT NAPHT*	80.97	5
	EAVY NAPHT* GHT DIESE*	80.97	
		209.6	6
	EAVY DIESE* EROSINE*	142.0	
_	TROSINE*	173.1	<u> </u>
	COIL*	178.5 236.7	4.7
	TFEED*	179.6	17
	IT HY DIES*	204.7	F
	DEthnlAmine	119.2	5
IVIL		113.2	
		Reaction: reactor 2-1	
	Component	Mole Weight	Stoichiometric Coeff.
	/drogen	2.016	-52
Ну	a. 0g0:1		
Hy H2		34.08	



University Of Petroleum And Energy UPES,

Bidholi, Dehradun, Uttarakhand Case Name: D:\RAKI\SIMULATION\SIRI\SIMULATION\SIRI\1.HSC:
Unit Set: SI

Date/Time: Thu Apr 23 15:14:15:2009

Conversion Reactor: reactor 2-2 (continued)

RF4	CT	ION	DET	ΓΔΙΙ	S

11					
12	Component	Mole Weight	Stoichiometric Coeff.		
13	H2O	18.02	0.		
14	Methane	16.04	2 •		
15	Ethane	30.07	2*		
16	Propane	44.10	16 *		
17	i-Butane	58.12	38 *		
18	n-Butane	58.12	17 •		
19	CO	28.01	0 •		
20	CO2	44.01	-0 *		
21	MIXED FEED*	140.9	0.		
22	LIGHT NAPHT*	80.97	200 •		
23	HEAVY NAPHT*	80.97	141 •		
24	LIGHT DIESE*	209.6	200 *		
25	HEAVY DIESE*	142.0	250 *		
26	KEROSINE*	173.1	300 •		
27	DHT LT DIES*	178.5	60 •		
28	UC OIL*	236.7	-1840 *		
29 30	DHT FEED* DHT HY DIES*	179.6	336 •		
-		204.7	1000 •		
31	MDEthnlAmine	119.2	0.		
32		Positions reactor 2.2			
33 34	Component	Reaction: reactor 2-2 Mole Weight	Stoichiometric Coeff.		
35	Hydrogen	2.016	-197 °		
36	H2S	34.08	0.		
37	Ammonia	17.03	0.		
38	H2O	18.02	-1 *		
39	Methane	16.04	-11 *		
40	Ethane	30.07	-3*		
41	Propane	44.10	-6 •		
42	i-Butane	58.12	-10 *		
43	n-Butane	58.12	-5 *		
44	CO	28.01	0.		
45	CO2	44.01	0.		
46	MIXED FEED*	140.9	0.		
47	LIGHT NAPHT*	80.97	40 •		
48	HEAVY NAPHT*	80.97	30 •		
49	LIGHT DIESE*	209.6	100 *		
50	HEAVY DIESE*	142.0	100 •		
51	KEROSINE*	173.1	7.		
52	DHT LT DIES*	178.5	0.		
53	UC OIL*	236.7	-356 *		
54	DHT FEED*	179.6	245 *		
55	DHT HY DIES*	204.7	0.		
56	MDEthnlAmine	119.2	0 •		
57					
58		Reaction: reactor 1-3			
59	Component	Mole Weight	Stoichiometric Coeff.		
60	Hydrogen	2.016	0.		
61	H2S	34.08	0.		
62	Ammonia	17.03	0.		
63	H2O	18.02	0.		
64	Methane	16.04	0 •		
165	· Hyprotech Ltd.	HYSYS v3.0.1 (Build 4602)	Page 17 of 19		



University Of Petroleum And Energy UPES, Bidholi,

Bidholi, Dehradun, Uttarakhand Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1:HSC

Unit Set:

Date/Time:

Thu Apr 23 15:14:15 2009

Conversion Reactor: reactor 2-2 (continued)

REACTION DETAILS

11	Reaction: reactor 1-3				
12	Component	Mole Weight	Stoichiometric Coeff.		
13	Ethane	30.07	-1 •		
14	Propane	44.10	-0 •		
15	i-Butane	58.12	-0*		
16	n-Butane	58.12	-0 •		
17	CO	. 28.01	0 *		
18	CO2	44.01	0.		
19	MIXED FEED*	140.9	0.		
20	LIGHT NAPHT*	80.97	0.		
21	HEAVY NAPHT*	80.97	-0 •		
22	LIGHT DIESE*	209.6	. 0.		
23	HEAVY DIESE*	142.0	0.		
24	KEROSINE*	173.1	0.		
25	DHT LT DIES*	178.5	-0 •		
26	UC OIL*	236.7	0.		
27	DHT FEED*	179.6	-0 •		
28	DHT HY DIES*	204.7	-0 *		
29	MDEthnlAmine	119.2	0.		
30					

REACTION RESULTS FOR: reactor 1

Extents

먇	4						
3	_	Rank	Specified % Conversion	Use Default	Actual % Conversion	Base Component	Reaction Extent (kgmole/h)
3	7 reactor 1-1	0.	99.90	Yes		MIXED FEED*	_
3	8 reactor 1-2	1.	99.90	Yes		MIXED FEED*	
3	9 reactor 2-1	2.	99.90	Yes		UC OIL*	
4	o reactor 2-2	3*	99.90	Yes		UC OIL*	
4	reactor 1-3	4 *	99.90	Yes		DHT FEED*	

Balance

43				
44 45	Components	Total Inflow (kgmole/h)	Total Reaction (kgmole/h)	Total Outflow (kgmole/h)
46	Hydrogen		(against an	
47	H2S			
48	Ammonia	_		
49	H2O			_
50	Methane		—	
51	Ethane			
52	Propane			_
53	i-Butane			
54	n-Butane			
55	CO			
56	CO2			
57	MIXED FEED*			
58	LIGHT NAPHT*			
59	HEAVY NAPHT*			
60	LIGHT DIESE*			
61	DHT HY DIES*			
62	KEROSINE*			
63	DHT LT DIES*			
64	UC OIL*	and the state of t		
65	Hyprotech Ltd.	INSYSV301	1 ((Build: 4602)).	Page:18-of 19



University Of Petroleum And Energy

UPES, Bidholi, Dehradun, Uttarakhand

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t	Case Name:	D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HS	Co
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S			

Unit Set: SI

Date/Time; Thu Apr 23 15:14:15 2009

Conversion Reactor: reactor 2-2 (continued)

REACTION RESULTS FOR: reactor 1

Balance

12				
13	Components	Total Inflow	Total Reaction	Total Outflow
14		(kgmole/h)	(kgmole/h)	(kgmole/h)
15	DHT FEED*	. –		. —
16	HEAVY DIESE*	_		
17	MDEthnlAmine			

University Of Petroleum And Energy Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC UPES, Bidholi. Unit Set: Dehradun, Date/Time: Thu Apr 23 15:14:17 2009 Uttarakhand Stream: reactor 1-1 vapors **Boiling Point Curves: reactor 1-1 vapors BOILING POINT CURVES** 10 Basis Stream 12 Liquid Volume reactor 1-1 vapors 13 **RESULTS** 14 15 **BP Curves Results** 16 17 **Cut Point** TBP ASTM D86 D86 Crack Reduced ASTM D1160(Vac) ASTM D1160(Atm) **ASTM D2887** 18 (%) (C) (C) (C) (C) (C) (C) 19 0.00 -313.74 -259.20 -259.20 -287.04 -293.54 -267.98 20 1.00 -311.06 -257.52 -257.52 -291.74 -285.82 -233.68 21 2.00 -255.83 -255.83 -308.38 -289.94 -284.59 -232.33 22 3.50 -304.36 -253.30 -253.30 -287.25 -230.30 -282.76 23 5.00 -300.34 -250.77 -250.77 -228.28 -280.93 -284.55 24 7.50 -293.64 -246.55 -246.55 -277.87 -280.07 -224.92 25 10.00 -286.94 -242.33 -242.33 -274.82 -275.59 -221.48 26 12.50 -280.24 -238.11 -238.11 -271.76 -271.12 -217.38 27 15.00 -273.54 -233.89 -233.89 -268.71 -266.66 -213.18 17.50 -266.84 -229.67 -229.67 -265.65 -262.20 -208.99 20.00 -260.14 -225.45 -225.45 -262.60 -257.75 -204.79 30 -215.94 25.00 -246.74 -215.94 -254.83 -246.46 -192.53 31 30.00 -233.34 -205.04 -205.04 -244.92 -142.98 -232.12 32 -194.13 35.00 -219.94 -194.13 -235.02 -217.86 -84.70 33 40.00 -206.54 -183.23-183.23 -225.11 -28.42 -203.66 34 45.00 -200.44 -178.46 -178.46 -220.38 -196.90 23.47 35 -81.79 50.00 -87.33 -81.79 -142.15 -87.28 74.36 36 3.98 -2.42 -2.42 55.00 -75.56 2.93 126.98 37 60.00 55.00 43.36 43.36 -36.18 55.00 172.26 38 137.78 65.00 162.95 137.78 47.78 162.98 193.52 39 195.31 165.55 165.55 70.00 73.54 195.32 203.97 40 211.50 179.31 179.31 75.00 211.50 86.55 213.95 41 80.00 224.32 190.12 190.12 224.33 216.43 96.91 42 85.00 229.97 194.85 194.85 229.97 218.77 101.49 43 90.00 231.94 196.49 196.49 231.94 103.08 224.58 44 92.50 233.64 197.92 197.92 104.46 233.63 228.58 45 95.00 198.18 198.18 233.95 233.95 104.72 232.48 46 96.50 234.49 198.62 198.62 105.15 234.49 234.81 47 98.00 235.08 199.11 199.11 105.63 235.08 237.22 48 99.00 235.26 105.78 199.26 199.26 235.26 238.89 49 100.00 235.86 199.76 106.27 199.76 235.86 240.63 50 **CRITICAL PROPERTIES**

51 52 53	Cut Point (%)	Critical Temperature (C)	Critical Pressure (kPa)	Acentricity Factor	Molecular Weight	Liquid Density (kg/m3)
54	0.00	-339.22	810.04	-2.5991	-346,916	-13491.48
55	1.00	-334.85	823.92	-0.3238	-22.839	-627.67
56	2.00	-330.49	838.28	-0.3145	-21.699	-595.70
57	3.50	-323.95	860.78	-0.3005	-19.990	-547.74
58	5.00	-317.41	884.53	-0.2865	-18.281	-499.77
59	7.50	-306.50	927.15	-0.2631	-15.433	-419.83
60	10.00	-295.60	974.09	-0.2398	-12.584	-339.89
61	12.50	-284.70	1026.04	-0.2164	-9.736	-259.95
62	15.00	-273.79	1083.85	-0.1931	-6.888	-180.02
63	17.50	-262.89	1148.55	-0.1697	-4.039	-100.08
64	20.00	-251.99	1221.47	-0.1464	-1.191	-20.14
65	Hyprotech Ltd.		HYSYS v3.01	(Bulld 4602)		Page 1 of 9

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1	University Of Petroleum And Energy				Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1:HSC					
2	UPES, Bidholi,		7 0000001177810 2.1019)	13 12 23 30 38 56 60 13 13 13 13 13 13 13 13 13 13 13 13 13 1				Oli u rilico		
3	.s.ue	Bidnoli, Dehradun,		Unit Set: SI						
5	A CONTRACT OF	Uttarakhand		Date/Time	e: Th	u Apr 23 15:14:17	2009			
6	Ctroometor.	1 1	aan d inud	Pailin	- Dair					
8	Streamctor'	r-ı vapors (conunue	Donnig	g Poir	it Curves.	reactor 1-1	vapors (conti		
9	Cut Point	Critical Tempera	ture Critical Pre	essure	Acentri	city Factor	Molecular Weight	Liquid Density		
10	(%)	(C)	(kPa	`				(kg/m3)		
11 12	25.00 30.00		230.18 208.37	1399.13 1637.27		-0.0997 -0.0530	4.506 10.203	139.74 299.62		
13	35.00		74.84	1670.74		-0.0063	15.900	459.50		
14	40.00		64.76	2121.47		0.0404	21.597	619.37		
15	45.00		54.99	3238.33		0.0871	27.293	779.25		
16	50.00		32.06	5247.60		0.1181	32.046	431.71		
17	55.00	1	62.71	3716.98		0.2057	59.970	567.97		
18	60.00	2	62.53	3136.24		0.2577	80.974	473.53		
19	65.00	5	26.91	1670.96		0.3823	139.869	802.98		
20	70.00	4	32.24	1763.28		0.5180	177.935	685.11		
21	75.00		72.85	4263.77		0.5475	186.789	715.82		
22	. 80.00		70.54	1874.55		0.5729	198.516	694.42		
23	85.00		70.00	1657.32		0.5841	205.785	688:43		
24 25	90.00		70.00	1657.32		0.5881	207.660	687.15		
26	92.50		70.00	1657.32		0.5900	208.598	686.51		
27	95.00		70.00	1657.32 1657.32		0.5920	209.536	685.87		
28	96.50 98.00		70.00	1657.32		0.5932	210.098 210.661	685.48 685.10		
29	99.00		70.00	1657.32		0.5951	211.036	684.84		
30	100.00		70.00	1657.32		0.5959	211.411	684.58		
31 32				COLD PRO	PERTIES					
33	True VP-at 37.8 C		(kPa)		Cetane Ind					
34	Reid VP at 37.8 C		(kPa)		Research (Octane Number				
35	ASTM D93 Flash Point		(C)		Viscosity a	t 37.8 C	(cP)			
36	ASTM D97 Pour Point		(C)		Viscosity a	t 97.8 C	(cP)			
37	Refractive Index					•				
38 39				P:N:	A					
40	Paraffins [mol%]	33	.3333 Naphthas [mo	 %1		33.3333 Aı	romatics [mol%]	33.3333		
41		1								
42	Stream: re	actor 1-2 va	pors	Boiling	g Poir	nt Curves:	reactor 1-2	vapors		
43	444									
44	7 BUILING PUINT CURVES									
45										
46 47		Basis Liquid Volume					Stream			
48										
49	RESULTS									
50 51	BP Curves Results									
52	Cut Point (%)	TBP (C)	ASTM D86 (C)	D86 Crack F	Reduced	ASTM D1160(Vac (C)				
53 54	0.00	-313.74	-259.20	(C)	-259.20	-287.0	(C) 4 -293.	(C)		
55 55	1.00	-311.06	-257.51		-257.51	-285.8				
56	2.00	-308.38	-255.82		-255.82	-284.5		~		
57	3.50	-304.36	-253.29		-253.29	-282.7		~~~~		
58	5.00	-300.34	-250.76		-250.76	-280.9				
_										

-246.54

-242.32

-238.10

-233.88

-229.66

-225.45

-246.54

-242.32

-238.10

-233.88

-229.66

-225.45

Ve (OF Wishing 14602))

-277.87

-274.82

-271.76

-268.71

-265.65

-262.60

60 61

62 63 64 7.50

10.00

12.50

15.00

17.50

20.00

-293.64

-286.94

-280.24

-273.54

-266.84

-260.14

-224.84

-221.39

-217.25

-213.03

-208.82

-204.61

-280.07

-275.59

-271.12

-266.66

-262.20

-257.75



University Of Petroleum And Energy

UPES, Bidholi, Dehradun, Uttarakhand Case Name:

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1:HSC

Unit Set:

Date/Time:

Thu Apr 23 15:14:17 2009

Streamctor 1-2 vapors (continue

Boiling Point Curves: reactor 1-2 vapors (contin

BP Curves Result	S
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11	Cut Point	TBP	ASTM D86	D86 Crack Reduced	ASTM D1160(Vac)	ASTM D1160(Atm)	ASTM D2887
12	(%)	(C)	(C)	(C)	(C)	(C)	(C)
13	25.00	-246.74	-215.93	-215.93	-254.83	-246.46	-191.44
14	30.00	-233.34		-205.03	-244.93	-232.13	-141.68
15	35.00	-219.94	-194.13	-194.13	-235.02	-217.86	-83.35
16	40.00	-206.54	-183.22	-183.22	-225.11	-203.66	-27.32
17	45.00	-200.46	-178.47	-178.47	-220.39	-196.92	24.44
18	50.00	-87.30	-81.75	-81.75	-142.12	-87.24	75.29
19	55.00	4.06	-2.35	-2.35	-75.51	2.99	127.75
20	60.00	55.00	43.37	43.37	-36.18	55.00	172.81
21	65.00	144.65	121.74	121.74	25.24	134.40	193.66
22	70.00	195.31	165.56	165.56	73.55	195.32	204.09
23	75.00	211.50	179.32	179.32	86.55	211.51	213.98
24	80.00	224.33	190.12	190.12	96.91	224.33	216.45
25	85.00	229.97	194.86	194.86	101.49	229.97	218.79
26	90.00	231.94	196.50	196.50	103.08	231.94	224.61
27	92.50	233.64	197.93	197.93	104.46	233.63	228.60
28	95.00	233.95	198.18	198.18	104.72	233.95	232.50
29	96.50	234.49	198.63	198.63	105.15	234.49	234.82
30	98.00	235.08	199.12	199.12	105.63	235.08	237.23
31	99.00	235.26	199.27	199.27	105.78	235.26	238.90
32	100.00	235.86	199.77	199.77	106.27	235.86	240.64
33 34	<u> </u>		CR	RITICAL PROPERTIE	ES .		-

CRITICAL PROPERTIES

34						
35	1	Critical Temperature	Critical Pressure	Acentricity Factor	Molecular Weight	Liquid Density
36	(%)	(C)	(kPa)			(kg/m3)
37	0.00	-321.83	1315.39	-2.5991	-346.914	-13491.39
38	1.00	-317.85	1333.63	-0.3238	-22.839	· -627.68
39	2.00	-313.87	1352.38	-0.3145	-21.700	-595.70
40	3.50	-307.90	1381.52	-0.3005	-19.991	-547.74
41	5.00	-301.93	1411.94	-0.2865	-18.282	-499.78
42	7.50	-291.97	1465.73	-0.2631	-15.433	-419.84
43	10.00	-282.02	1523.78	-0.2398	-12.585	-339.90
44	12.50	-272.07	1586.62	-0.2164	-9.737	-259.97
45	15.00	-262.12	1654.86	-0.1931	-6.888	-180.03
46	17.50	-252.17	1819.00	-0.1697	-4.040	-100.09
47	20.00	-242.22	1876.61	-0.1464	-1.192	-20,16
48	25.00	-222.32	1998.75	-0.0997	4.505	139.71
49	30.00	-202.42	2230.50	-0.0530	10.202	299.59
50	35.00	-172.61	2523.05	-0.0063	15.898	459.46
51	40.00	-162.61	2903.92	0.0404	21.595	619.33
52	45.00	-154.99	3256.13	0.0871	27.292	779.21
53	50.00	32.06	5256.38	0.1186	32.094	433.49
54	55.00	162.89	3715.64	0.2058	60.002	567.71
55	60.00	262.46	3136.64	0.2577	80.974	473.75
56	65.00	499.62	1353.65	0.3495	126.198	761.04
57	70.00	432.29	1763.01	0.5180	177.936	685,14
58	75.00	472.85	4263.30	0.5475	186.790	715.81
59	80.00	470.54	1874.49	0.5729	198.518	694.42
60	85.00	470.00	1657.32	0.5841	205.785	688.43
61	90.00	470.00	1657.32	0.5881	207.660	687.15
62	92.50	470.00	1657.32	0.5900	208.598	686.51
63	95.00	470.00	1657.32	0.5920	209.536	685.87
64	96.50	470.00	1657.32	0.5932	210.098	685.48
65	Hyprotech Ltd.		EYSYS VION	(Build 4602)		

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University Of Petroleum And Energy D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name: UPES. 3 Bidholi, **Unit Set:** 4 Dehradun, Date/Time: Thu Apr 23 15:14:17 2009 Uttarakhand 5 Streamctor 1-2 vapors (continue **Boiling Point Curves: reactor 1-2 vapors (contin** 9 **Cut Point** Critical Temperature Critical Pressure Acentricity Factor Molecular Weight Liquid Density 10 (C) (kPa) (%) (kg/m3) 11 98.00 470.00 1657.32 0.5943 210.661 685.10 12 99.00 470.00 1657.32 0.5951 211.036 684.84 13 100.00 470.00 1657.32 0.5959 211.411 684.58 14 **COLD PROPERTIES** 15 16 True VP at 37.8 C (kPa) Cetane Index 17 Reid VP at 37.8 C (kPa) Research Octane Number 18 **ASTM D93 Flash Point** (C) (cP) Viscosity at 37.8 C 19 **ASTM D97 Pour Point** (C) Viscosity at 97.8 C (cP) 20 Refractive Index P:N:A Paraffins [mol%] Naphthas [mol%] 33.3333 Aromatics [mol%] **Boiling Point Curves: reactor 1-3 vapors** Stream: reactor 1-3 vapors **BOILING POINT CURVES** 28 29 Stream Liquid Volume reactor 1-3 vapors **l** 31 **RESULTS** 32 33 **BP Curves Results** 35 **Cut Point** ASTM D86 TBP D86 Crack Reduced ASTM D1160(Vac) ASTM D1160(Atm) **ASTM D2887** (%) (C) (C) (C) (C) (C) -273.68 37 0.00 -313.74 -273.68 -286.02 -292.04 -273.68 38 -311.93 -272.65 -272.65 -285.11 -290.70 -257.86 1.00 -271.61 39 -310.12 -256.93 2.00 -271.61 -284.20 -289.36 40 -307.41 -270.06 -270.06 3.50 -282.83 -287.35 -255.54 41 5.00 -304.69 -268.51 -268.51 -285.34 -281.46 -254.15 42 7.50 -300.17 -265.92 -265.92 -282.00 -251.85 -279.19 43 10.00 -295.65 -263.33 -263.33 -278.66 -249.54 -276.91 44 12.50 -291.12 -260.74-260.74 -275.32 -247.20 -274.63 45 15.00 -286.60 -258.16 -244.83 -258.16 -271.99 -272.35 46 17.50 -255.57 -282.08 -268.66 -255.57 -270.08 -242.40 47 20.00 -277.55 -252.98 -267.80 -265.33 -252.98 -239.89 48 25.00 -268.51 -247.80 -263.24 -258.69 -247.80 -234.51 -259.46 49 30.00 -242.63 -258.69 -252.06 -242.63 -228.34-250.41 50 35.00 -236.99 -236.99 -253.85 -245.04 -220.88 -241.37 40.00 -229.91 51 -229.91 -248.13 -236.76 -213.25 45.00 -232.32 -222.82 52 -222.82 -242.41 -228.50 -206.68 50.00 -223.27 -215.73 -215.73 -236.69 53 -220.26 -201.23 -214.23 55.00 -208.64 -208.64 -230.97 54 -212.04 -194.49 -201.55 -205.18 55 60.00 -201.55 -225.25 -203.85 -183.03 -196.14 -194.47 56 65.00 -194.47 -219.52 -195.67 -169.44 70.00 -165.46 -166.57 -166.57 57 -198.25 -165.48 -144.18 -70.45 -81.39 75.00 -81.39 -129.87 58 -70.44 -68.05 -3.5059 80.00 -20.60 -20.60 -79.29 -2.05 4.41 55.00 85.00 60 32.10 32.10 -36.18 55.00 44.28 90.00 94.17 61 60.24 60.24 4.57 107.93 100.49

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92.50

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131.00

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Page 4 of 9
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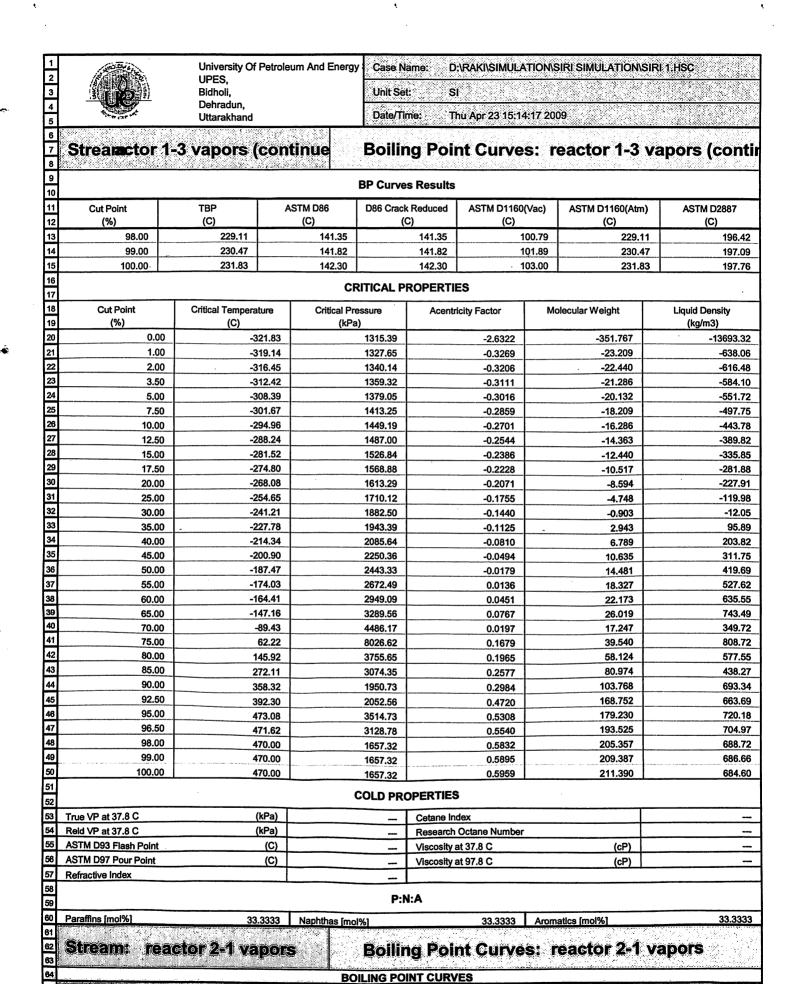
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Page 5 of 9

University Of Petroleum And Energy Case Name: D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC 3 Unit Set: SI Bidholi, 4 Dehradun, Thu Apr 23 15:14:17 2009 Date/Time: Uttarakhand 5 Streamctor 2-1 vapors (continue **Boiling Point Curves: reactor 2-1 vapors (contin BOILING POINT CURVES** 10 Basis Stream Liquid Volume reactor 2-1 vapors 12 **RESULTS** 13 14 **BP Curves Results** 15 16 **Cut Point** TBP ASTM D86 D86 Crack Reduced ASTM D1160(Vac) ASTM D1160(Atm) **ASTM D2887** (C) 17 (%) (C) (C) 0.00 -286.35 18 -313.74 -228.73 -228.73 -292.53 -252.12 19 -290.63 -248.44 1.00 -310.81 -226.85 -226.85 -285.06 2.00 -288.72 -247.99 20 -224.98 -283.77 -307.88 -224.98 3.50 -285.87 21 -222.17 -222.17 -247.31 -303.49 -281.82 5.00 -283.02 -246.65 22 -219.36 -219.36 -299.09 -279.88 7.50 -291.77 -214.68 -214.68 -276.65 -278.27 -245.70 24 10.00 -284.45 -210.00 -210.00 -273.41 -273.53 -244.43 25 -205.32 -205.32 -268.80 -241.80 12.50 -277.13 -270.17 26 15.00 -269.80 -200.63 -200.63 -264.07 -238.42 -266.94 27 17.50 -262.48 -195.95 -195.95 -263.70 -259.36 -234.68 28 20.00 -255.16 -191.27 -191.27 -260.47 -254.65 -230.95 29 -222.11 25.00 -240.51 -179.62 -179.62 -250.05 -239.53 30 -211.85 30.00 -225.87 -167.49 -167.49 -238.80 -223.29 31 -211.22 -155.35 -155.35 -201.24 35.00 -227.54 -207.13 32 40.00 -196.58 -143.22 -143.22 **-191:06** -188.80 -216.29 33 45.00 -86.07 -57.26 -57.26 -76.70 -174.04 -134.44 34 50.00 68.21 72.95 72.95 -21.46 74.23 -37.61 35 55.00 91.74 94.45 94.45 -7.31 92.59 112.50 36 60.00 128.23 128.06 128.06 116.08 139.73 10.92 37 65.00 149.07 147.05 147.05 139.38 161.91 29.16 38 70.00 165.56 161.97 161.97 49.90 165.66 173.98 39 178.89 75.00 171.52 167.06 167.06 54.55 171.52 40 173.77 183.00 80.00 173.77 168.70 168.70 56.34 41 85.00 176.02 176.02 185.43 170.33 170.33 58.13 42 90.00 178.27 171.96 171.96 178.27 187.54 59.92 43 92.50 179.39 188.70 179.39 172.78 172.78 60.82 44 95.00 173.60 180.52 189.88 180.52 173.60 61.71 45 96.50 179.13 186.73 204.91 186.72 179.13 66.67 46 98.00 200.01 200.01 191.25 77.30 215.58 191.25 47 99.00 200.78 192.09 200.78 217.29 77.93 192.09 48 100.00 201.56 192.92 192.92 78.55 201.56 218.66 49 **CRITICAL PROPERTIES** 50 Cut Point 51 Critical Temperature Critical Pressure Acentricity Factor Molecular Weight Liquid Density 52 (%) (kPa) (kg/m3) 0.00 -321.83 -2.9642 53 -400.417 1315.39 -15719.02 -317.48 54 1.00 -0.3230 -22.733 -624.71 1335.35 -58<u>9.76</u> 55 2.00 -313.13 -0.3128 -21.488 1355.92 56 -306.60 3.50 -0.2974 1388.00 -19.620 -537.34 57 -300.08 5.00 -0.2821 1421.63 -17.752 -484.92 58 -289.20 7.50 -0.2566 1481.46 -14.639 -397.55

1546.55

1617.62

1695.53

1881.99

1910.16

2100.16

-0.2311

-0.2056

-0.1801

-0.1545

-0.1290

-0.0780

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10.00

12.50

15.00

17.50

20.00

25.00

-278.32

-267.45

-256.57

-245.70

-234.82

-213.07

59

60

61

62

63

65

-310.19

-222.82

-135.45

-48.09

39.28

214.02

-11.526

-8.413

-5.300

-2.187

0.926

7,153



1	Bidholi,		rgy Case N	y Case Name: D:\RAK(\SIMULATION\SIRI SIMULATION\SIRI 1:HSC Unit Set: Si					
3			Unit Se						
4	-34	Dehradun, Uttarakhand		Date/Time: Thu Apr 23 15:14:17 2009					
5 6 7 8	Streamstor 2		ontinue	Boilir	ng Poil	nt Curves:	reactor 2-1	vapors (contir	
9	Cut Point (%)	Critical Temperate		Pressure (Pa)	Acentri	icity Factor	Molecular Weight	Liquid Density (kg/m3)	
11	30.00		1.32	2384.71		-0.0269	13.379	388.75	
12	35.00		9.57	2758.45		0.0241	19.605	563.48	
13	40.00		7.82	2800.24		0.0751	25.831	738.22	
14	45.00	3	1.96	5319.08		0.1326	33.128	469.60	
15	50.00	. 26	5.97	2740.83		0.2738	89.501	655.93	
16	55.00		9.65	2004.97		0.3016	103.716	695.54	
17	60.00		3.33	1580.61	ļ	0.3283	116.678	735.15	
18	65.00		7.01	1304.51		0.3539	128.388	813.80	
19 20	70.00 75.00		8.03	1110.52 1153.81	 	0.3784	138.846 146.273	826.68 799.56	
21	80.00		8.71	1330.38	 	0.4002 0.4211	152.635	758.38	
22	85.00		9.38	1570.75	 	0.4420	158.997	717.20	
23	90.00		0.05	1917.13		0.4420	160.204	676.01	
24	92.50	····	0.39	2154.71		0.4733	164.784	655.42	
25	95.00		0.72	2459.50		0.4837	170.353	634.83	
26	96.50	36	7.42	2274.14		0.4986	174.628	650.09	
27	98.00	47	0.02	1565.47	·	0.5250	178.541	708.88	
28	99.00	47	2.11	2863.75		0.5291	179.104	718.12	
29	100.00	47	0.00	1657.32		0.6017	214.183	682.69	
30				COLD PR	OPERTIES				
31								was a second of the second of	
32	True VP at 37.8 C		(Pa)		Cetane In				
33 34	Reid VP at 37.8 C	()	(Pa)			Octane Number			
35	ASTM D93 Flash Point ASTM D97 Pour Point		(C)		Viscosity a		(cP)		
36	Refractive Index		(6)		Viscosity a	at 97.8 C	(cP)		
37	TONGOUTO MIGOX				<u> </u>				
38				P:I	N:A				
39	Paraffins [mol%]	33.	3333 Naphthas [mol%]		33.3333 A	romatics [mol%]	33.3333	
40 41 42	Stream: re	actor 2-2 va	oors	Boilir	ng Poi	nt Curves:	reactor 2-2	vapors	
43 44			ı	BOILING PO	INT CURV	'ES			
45		Basis			1		Stream		
46		Liquid Volume					reactor 2-2 vapors		
47 48				RES	ULTS				
49					s Results				
50 51		700							
52	Cut Point (%)	TBP (C)	ASTM D86 (C)	1	k Reduced C)	ASTM D1160(Vac (C)	c) ASTM D1160(Atı (C)	n) ASTM D2887 (C)	
53	0.00	-313.74	-228.73		-228.73	-286.:			
54	1.00	-310.81	-226.8		-226.85	-285.0			
55	2.00	-307.88	-224.98		-224.98	-283.			
56	3.50	-303.49	-222.17		-222.17	-281.			
57	5.00	-299.09	-219.36	6	-219.36	-279.			
58	7.50	-291.77	-214.68	8	-214.68	-276.			
59	10.00	-284.45	-210.00		-210.00	-273.			
60	12.50	-277.13	-205.32		-205.32	-270.			
61	15.00	-269.80	-200.63		-200.63	-266.			
62	17.50	-262.48	-195.9		-195.95	-263.			
63 64	20.00	-255.16	-191.27	······	-191.27	-260.		······································	
	25.00	-240.51	-179.62		-179.62	-250.	05 -239	.53 -222.11	

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Page 7.of 9 * Specified by user.



University Of Petroleum And Energy UPES, Bidholi,

Dehradun, Uttarakhand

D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name: Unit Set: SI Thu Apr 23 15:14:17 2009 Date/Time:

Streamctor 2-2 vapors (continue

Boiling Point Curves: reactor 2-2 vapors (contin

9 10	BP Curves Results									
11 12	Cut Point (%)	TBP (C)	ASTM D86 (C)	D86 Crack Reduced (C)	ASTM D1160(Vac) (C)	ASTM D1160(Atm) (C)	ASTM D2887 (C)			
13	30.00	-225.87	-167.49	-167.49	-238.80	-223.29	-211.85			
14	35.00	-211.22	-155.35	-155.35	-227.54	-207.13	-201.24			
15	40.00	-196.58	-143.22	-143.22·	-216.29	-191.06	-188.80			
16	45.00	-86.07	-57.26	-57.26	-134.44	-76.70	-174.04			
17	50.00	68.21	72.95	72.95	-21.46	74.23	-37.61			
18	55.00	91.74	94.45	94.45	-7.31	92.59	112.50			
19	60.00	128.23	128.06	128.06	10.92	116.08	139.73			
20	65.00	149.07	147.05	147.05	29.16	139.38	161.91			
21	70.00	165.56	161.97	161.97	49.90	165.66	173.98			
22	75.00	171.52	167.06	167.06	54.55	171.52	178.89			
23	80.00	173.77	168.70	168.70	56.34	173.77	183.00			
24	85.00	176.02	170.33	170.33	58.13	176.02	185.43			
25	90.00	178.27	171.96	171.96	59.92	178.27	187.54			
26	92.50	179.39	172.78	172.78	60.82	179.39	188.70			
27	95.00	180.52	173.60	173.60	61.71	180.52	189.88			
28	96.50	186.72	179.13	179.13	66.67	186.73	204.91			
29	98.00	200.01	. 191.25	191.25	77.30	200.01	215.58			
30	99.00	200.78	192.09	192.09	77.93	200.78	217.29			
31	100.00	201.56	192.92	192.92	78.55	201.56	218.66			
32			_			· -				

CRITICAL PROPERTIES

34 35	Cut Point (%)	Critical Temperature (C)	Critical Pressure (kPa)	Acentricity Factor	Molecular Weight	Liquid Density (kg/m3)
36	0.00	-321.83	1315.39	-2.9642	-400,417	-15719.02
37	1.00	-317.48	1335.35	-0.3230	-22.733	-624.71
38	2.00	-313.13	1355.92	-0.3128	-21.488	-589.76
39	3.50	-306.60	1388.00	-0.2974	-19.620	-537.34
40	5.00	-300.08	1421.63	-0.2821	-17.752	-484.92
41	7.50	-289.20	1481.46	-0.2566	-14.639	-397.55
42	10.00	-278.32	1546.55	-0.2311	-11.526	-310.19
43	12.50	-267.45	1617.62	-0.2056	-8.413	-222.82
44	15.00	-256.57	1695.53	-0.1801	-5.300	-135.45
45	17.50	-245.70	1881.99	-0.1545	-2.187	-48.09
46	20.00	-234.82	1910.16	-0.1290	0.926	39.28
47	25.00	-213.07	2100.16	-0.0780	7.153	214.01
48	30.00	-191.32	2384.71	-0.0269	13.379	388.75
49	35.00	-169.57	2758.45	0.0241	19.605	563.48
50	40.00	-147.82	2800.24	0.0751	25.831	738.22
51	45.00	31.96	5319.12	0.1326	33.128	469.61
52	50.00	265.97	2740.83	0.2738	89.501	655.93
53	55.00	349.65	2004.97	0.3016	103.716	695.54
54	60.00	433.33	1580.61	0.3283	116.678	735.15
55	65.00	517.01	1304.51	0.3539	128.388	813.80
56	70.00	600.69	1110.52	0.3784	138.846	826.68
57	75.00	588.03	1153.81	0.4002	146.273	799.56
58	80.00	528.71	1330.38	0.4211	152.635	758.38
59	85.00	469.38	1570.75	0.4420	158.997	717.20
60	90.00	410.05	1917.13	0.4628	160.204	676.01
61	92.50	380.39	2154.71	0.4733	164.784	655.42
62	95.00	350.72	2459.50	0.4837	170.353	634.83
63	96.50	367.42	2274.13	0.4986	174.628	650.09
64	98.00	470.02	1565.47	0.5250	178.541	708.88
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University Of Petroleum And Energy D:\RAKI\SIMULATION\SIRI SIMULATION\SIRI 1.HSC Case Name: UPES, 3 4 5 6 7 Bidholi, Unit Set: Dehradun, Date/Time: Thu Apr 23 15:14:17 2009 Uttarakhand Streamctor 2-2 vapors (continue **Boiling Point Curves: reactor 2-2 vapors (contin** 8 9 10 11 **Cut Point** Critical Temperature Critical Pressure Acentricity Factor Molecular Weight Liquid Density (kPa) (kg/m3) (%) (C) 2863.75 99.00 472.11 0.5291 179.104 718.12 12 1657.32 0.6017 100.00 470.00 214.183 682.69 13 **COLD PROPERTIES** 14 15 (kPa) Cetane Index True VP at 37.8 C 16 (kPa) Research Octane Number Reid VP at 37.8 C 17 Viscosity at 37.8 C (cP) (C) **ASTM D93 Flash Point** Viscosity at 97.8 C (cP) (C) ASTM D97 Pour Point 19 Refractive Index 20 P:N:A 21 33.3333 Naphthas [mol%] 33.3333 Aromatics [mol%] 33.3333 Paraffins [mol%] 23 24 25 26 27 28 30 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 54 55 57 58 59 60 61 62 63 64

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Page 9 of 9