Project Report
on

Production Unit, Barauni Expansion Project and TPM

Under taken at
Indian Oil Corporation Limited
Barauni Refinery
(24/07/07—21/12/07)

Submitted by:

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ACKNOWLEDGEMENT

This report bears imprints of many people.

Firstly, I am deeply indebted to Mr. J.N.Bhilware ,(Training Officer. Indian Oil Corporation Ltd, Barauni Refinery) who provided me a great opportunity to undergo training in Indian Oil Corporation Ltd. Barauni (Bihar). I acknowledge my gratitude to him for his kind and a valuable support throughout my training period without which this work would have been tedious.

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Now I extend my thanks to all Indian Oil Employees, technical staff workers and coworkers for their kind cooperation and support.

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Indian Oil Corporation Limited
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Phone : 06243 - 240183-86 (4 Lines)
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रिफाइनरी प्रभाग
Refineries Division

ISO 9001-2000, 14001 & OHSAS 18001 Certified Refinery

TRG.NO.07/2007 **DATE: 21/12/2007**

VOCATIONAL TRAINING CERTIFICATE

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Name Of Institute	:	**U.P.E.S. Dehradun**
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Area of the Training	:	**PRODN. & MECH. DEPARTMENT**
STIPEND	:	**NO**
Punctuality	:	**REGULAR**
Overall Performance	:	Very Good
Remark	:	**Job done with sincerity and shown** keen interest in learning

Jagannath 21.12.2007
(J.N.Bhilware)
Training Officer

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PREFACE

I feel great pleasure in presenting to the readers,the project report about the Barauni Refinery.It includes information about the various units in the Production Department, the Barauni Expansion Project and TPM.

I have included necessary pictures about the various units and the reactions involved in the Production Department and the Barauni Expansion Project.The meaning and essence of Total Productive Maintenance ,the need for TPM and its benefits.
I would like the Mr.J.N.Bhilware(Training Officer. Indian Oil Corporation Ltd, Barauni Refinery) who provided me a great opportunity to undergo training in Indian Oil Corporation Ltd. Barauni (Bihar).

I am also very grateful to Mr. B.P.Pandey (Dean COE) and Mrs. Bhawna Yadav Lamba(Course Coordinator) for allowing me to undergo and supporting me in this project of mine. Their much needed guidance and support provided me with a solid platform for undergoing the process of learning during my training period.

Now I extend my thanks to all Indian Oil Employees, technical staff workers and coworkers for their kind cooperation and support.

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A Project Report

On

Production Unit, Barauni Expansion Project and Total Productive Maintenance

Indian Oil Corporation Limited

Barauni Refinery

Reviewed By

Mrs.Bhawna Yadav Lamba

(Course Co-ordinator)

Contents

INDIAN OIL CORPORATION LIMITED

Indian Oil Corporation Ltd. is the only Indian company in FORTUNE's "Global 500" listing of the world's largest industrial & service companies with a ranking of 232 for fiscal year 1999 and 170 for the year 2005 based on fiscal year 2004.Among the petroleum refining companies it is ranked 16th & 19th place in sales and profit respectively. Incorporated in 1959 as Indian Oil Comp. Ltd. it became a Corporation in 1964 when Indian Refineries Ltd. (Estd. 1958) was merged with the company. Indian oil owns & operates seven of the countries' 14 refineries with a refining share of over 46.4%. The eighth refinery in the east coast at Paradeep is under construction and will be commissioned shortly.

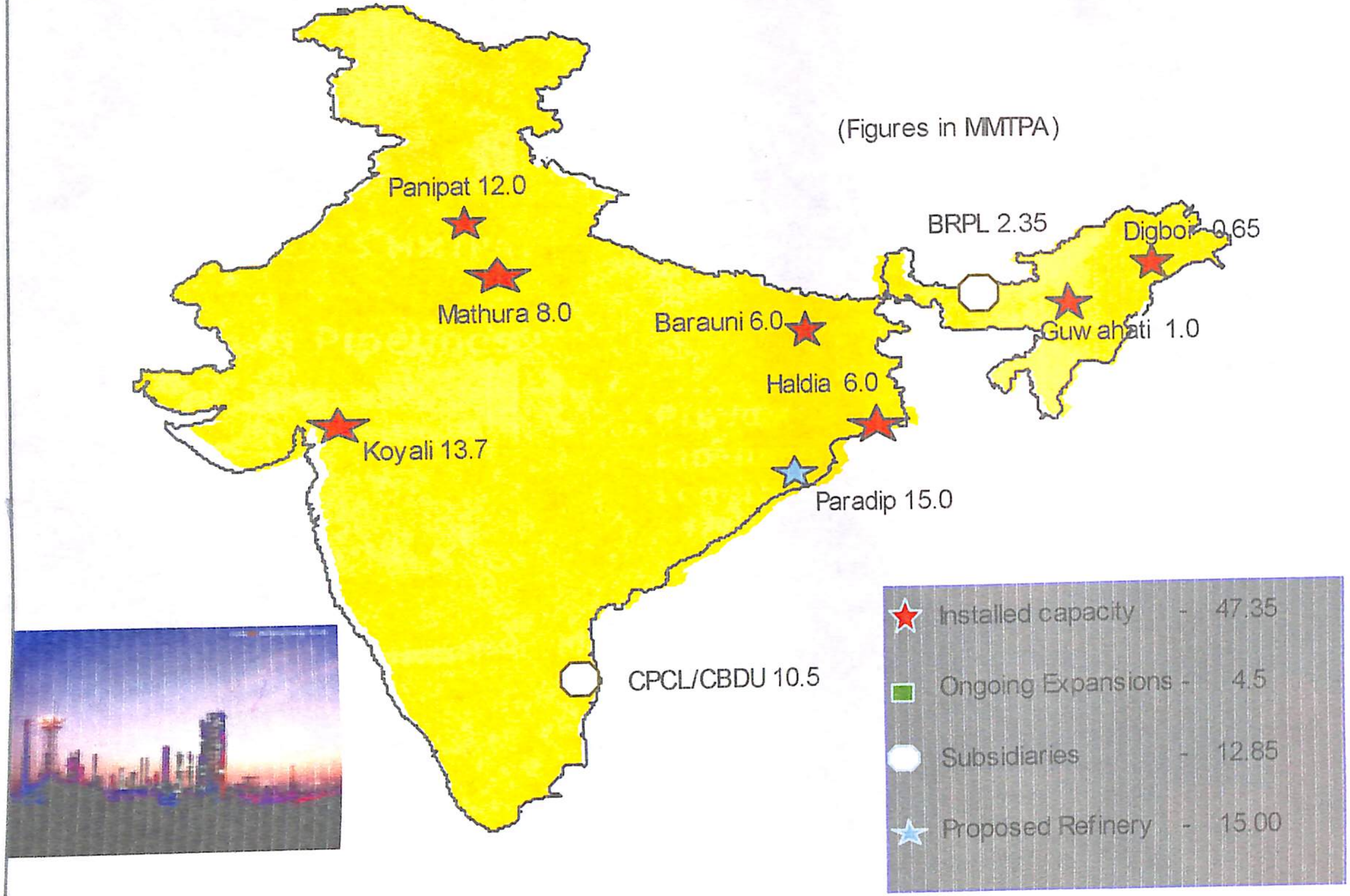
Indian Oil has a 5762 km network of pipelines comparable with of any standard oil company in any other part of the world for economical, reliable and eco friendly transportation of crude oil & petroleum products. Indian Oil is only Indian company chosen as one of the 15 most admired companies in the world in petroleum refining category as per the survey conducted by Hay Group Consultancy for FORTUNE Magazine. Indian Oil meets 55% of the petroleum products consumption of India. It is also the canalizing agency for import of crude oil major petroleum products. It's extensive network of over 18000 sales points covered the entire country and is backed for supply by 184 terminals and depots, 43 LPG bottling plants and 92 Aviation fuel stations. Indian Oil has been ranked 2nd among 14 national companies in India. Indian Oil is only oil company in the country with ISO 9001/9002 accreditation for over 50 units which includes Refineries, Pipelines, Aviation, Fuel station, Grease plants, Quality control laboratories, LPG bottling plants and Indian Oil Institute of Petroleum Management. By the end of 1997 all the eight refineries of Indian oil were accredited ISO 14001 certification for environmental management system. Indian Oil natures the vision of becoming an integrated & diversified global energy corporation. It is augmenting infrastructure and expanding into explanation & production of crude oil, petrochemicals, power generating LNG & fuel management. It is globalizing it's R&D, training & consultancy services and marketing lubricants. Indian Oil is Public Sector undertaken (PSU) company registered under the companies act 1956 and is managed by the Board of Directors who are appointed by the President of India. Indian Oil owns and operates seven of the countries' fourteen refineries which are as follows :

UNIT	**CAPACITY**
1. Barauni Refinery	06 .00 MMTPA.
2. Panipat Refinery	12.00 MMTPA.
3. Mathura Refinery	08.00 MMTPA.
4. Koyali Refinery	13.70 MMTPA
5. Guwahati Refinery	01.00 MMTPA.
6. Haldia Refinery	9.60 MMTPA.
7. Digboi Refinery	00.65 MMTPA

*MMTPA = Million Metric Tones Per Annum

All the seven refineries attained a record crude throughput 33.1 million tones, surpa sing the previous best of 32.4 million tones achieved in 1999-2000. All the tree awards in the refining sector instituted by Minister of Power under National Energy Conservation Award 2000 were bagged by IOCL Refineries which was the third time in succession.

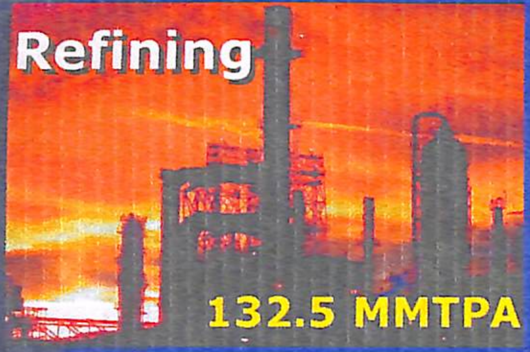
Indian Oil Refineries



★	Installed capacity	-	47.35
🟩	Ongoing Expansions	-	4.5
⬡	Subsidiaries	-	12.85
☆	Proposed Refinery	-	15.00

Downstream Industry Snapshot

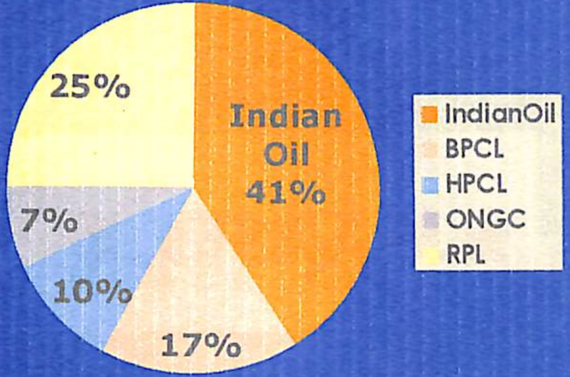
- IndianOil's Dominance

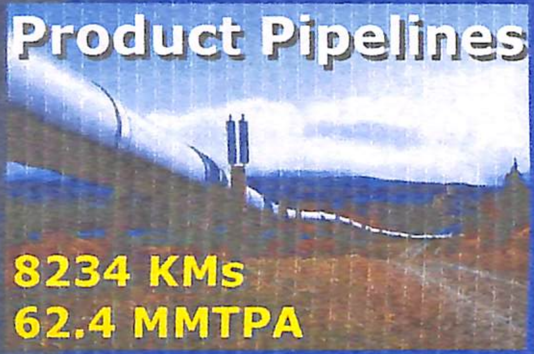


Refining

132.5 MMTPA

Refining Capacity
1.4.06

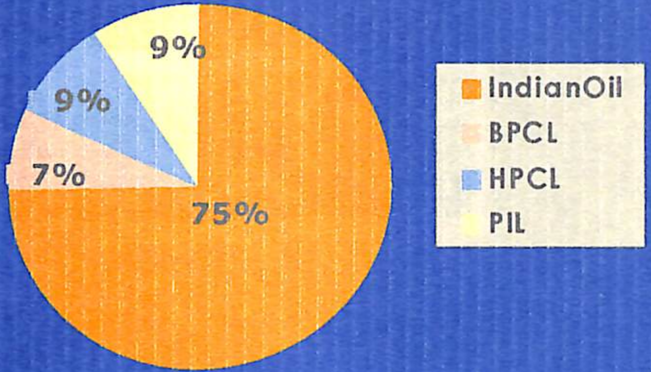




Product Pipelines

8234 KMs
62.4 MMTPA

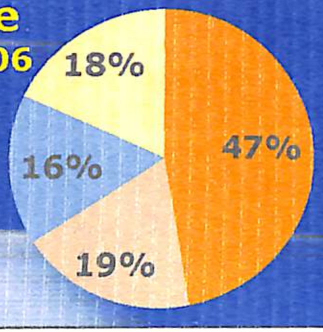
Product Pipelines Length
1.4.06



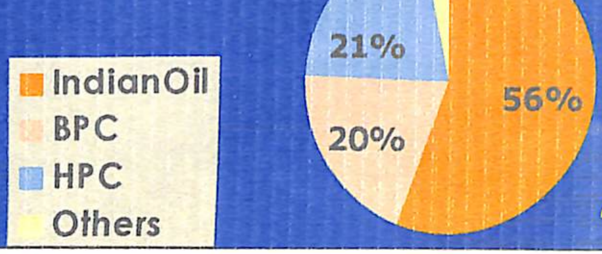
Marketing

Mkt size: 112 MMT
55,500 touch points

Market Share
2005-06



Marketing Infrastructure
1.4.06



OUR BRANDS

IndianOil Brands

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IndianOil XTRAMILE
SUPER DIESEL

Available from 6248 Retail Outlets

IndianOil Indane
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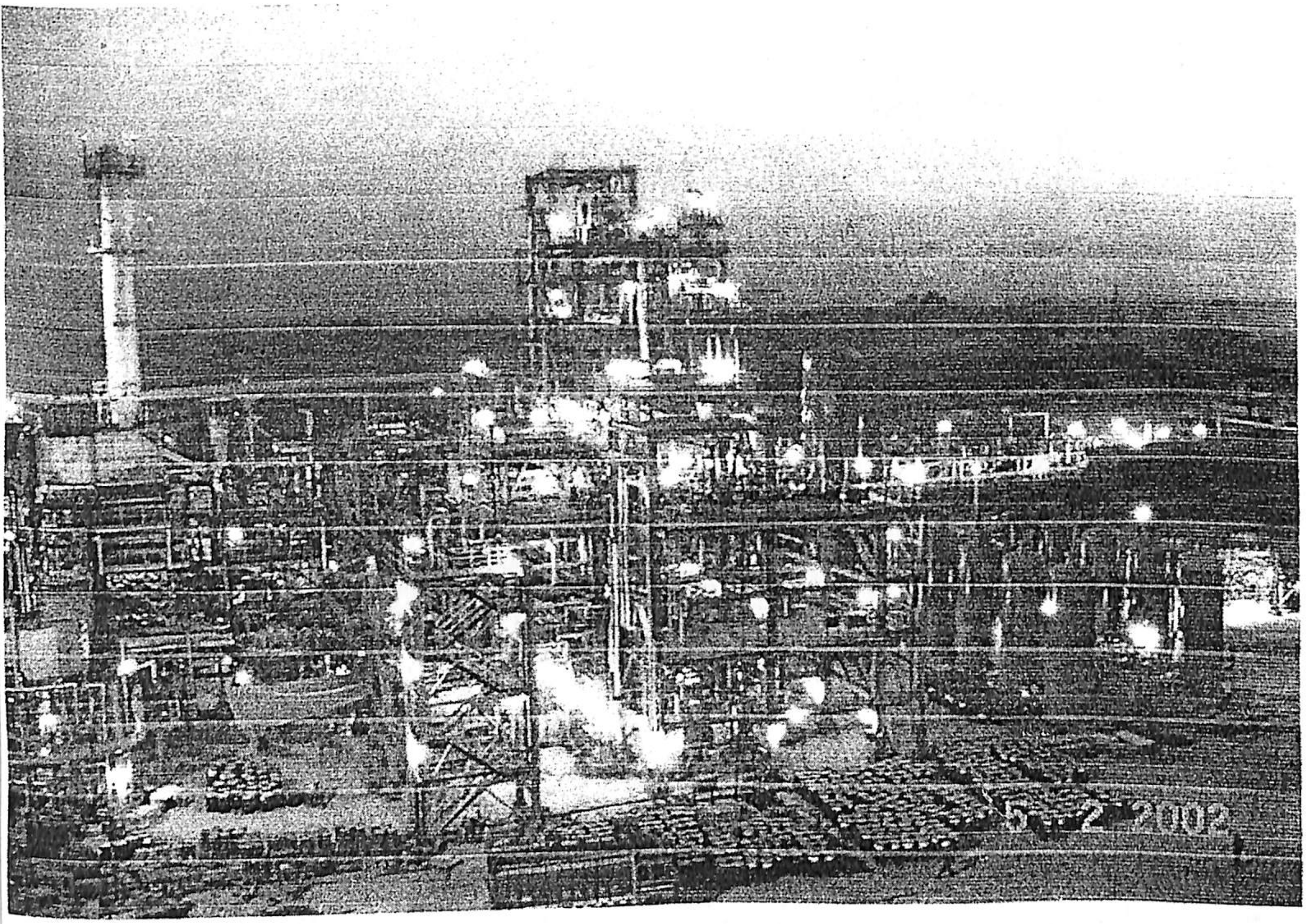
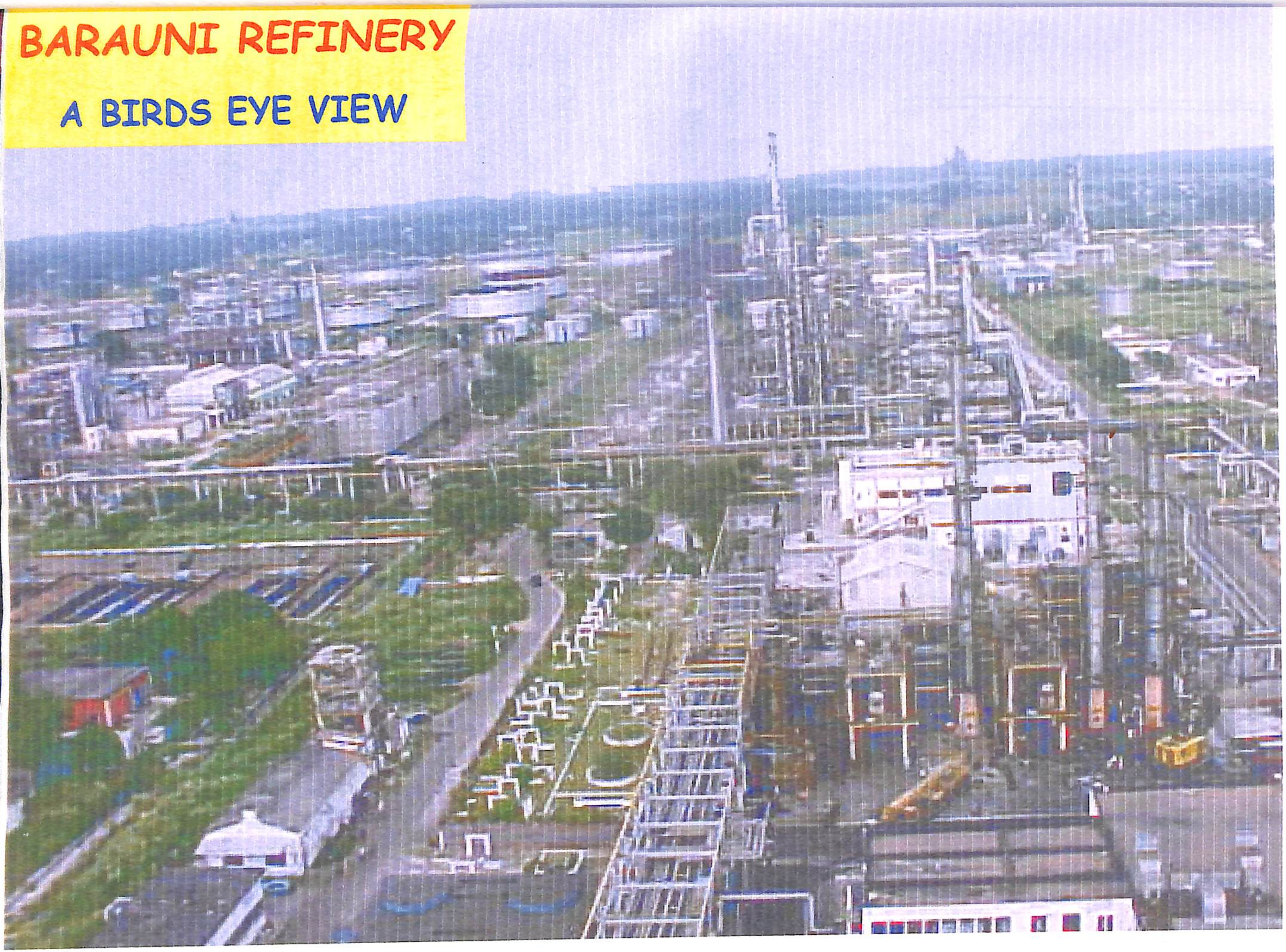
India's First Lubricant "Superbrand"

IOCL BARAUNI REFINERY – THE JEWEL OF BIHAR

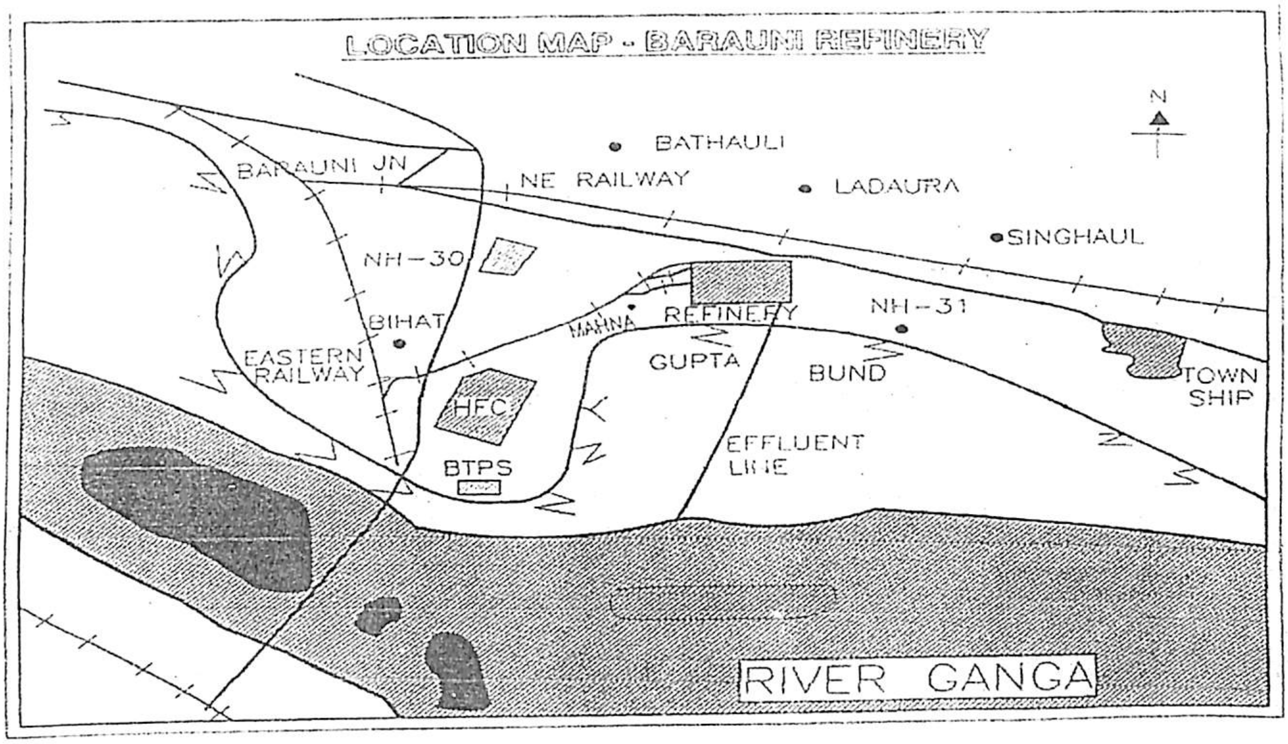


Barauni Refinery is the second public sector refinery of Indian Oil Corporation Ltd. which was setup under the collaboration of erstwhile USSR and limited participation of Romania. It is located near the northern bank of the river Ganga at Begusarai District town of Bihar state. The refinery is strategically located on the crossroads of two important national highways, NH-30 & NH-31 and two important railways, Eastern railways & North Eastern railways. The river Ganga flows around 8 km away from the refinery.



BARAUNI REFINERY

A BIRDS EYE VIEW



The barauni refinery takes its crude oil from foreign countries through Barauni-Haldia crude pipeline (BHCPL). Barauni refinery is one of the biggest size oil refinery owned and managed by IOCL. The refinery is located about 8 km from the town Begusarai and is surrounded by villages.

The construction activity of the refinery commenced in 1962 and it went on stream in the year 1964 facing insurmountable hurdles, heavy equipment, men and machinery was moved into a predominantly agrarian district of Begusarai.

Barauni refinery was formally inaugurated by Prof. *Humayun Kabir*, the then union minister of petroleum & chemicals, govt. of India on January 15, 1965. It started with a refining capacity of processing 2 Million Metric Tones Per Annum of Assam crude through the Nahar-Katiya-Barauni pipeline. The capacity was subsequently enhanced to 3 Million Metric Tones Per Annum.

The refinery consists of three crude oil distillation units, two coker units, CRU, LRU and BXP. The oil movement and storage section of refinery does the storage and dispatch of all the products. An LPG bottling plant has also been provided which is able to fill 3500 to 4000 cylinders per day. A captive Power plant has been provided to meet the steam and power requirements of the refinery. Under the expansion program following process units & facilities are put up :

- The Resid Fluidised Bed Catalytic Cracking Unit (RFCCU) yielding LPG, Diesel and Petrol.
- Diesel Hydro Treater (DHDT) for improving Cetone no. and to meet the Euro emission norms.

Primarily, the refining technology was sourced from the eastern countries like Russia. Later as the refinery grew over the years, it drew upon technologies from rest of the world. In February 16 1999the 498 km long Haldia-Barauni crude oil pipeline commenced its crude supply position of the refinery, which was dependent on Assam crude alone. At the beginning of the new millennium, Barauni refinery is poised to touch stellar heights in modernizing its refining technology. Barauni refinery is among the few refineries in the world to have scored the coveted ISO 9002 certification.

The refinery processes imports the low sulphur and high sulphur crude oil to produce the following :

- Motor spirit (MS) Petrol
- Liquified Petroleum Gas (LPG)
- Naphtha
- Superior Kerosene Oil
- High Speed Diesel
- Light Oil Diesel
- Low Sulphur Heavy Stock
- Raw Petroleum Coke
- Sulphur

FIRE AND SAFETY

Introduction -

Oil industry is on inherently hazardous industries where various hazards chemical are used under varying process conditions. To meet the operational requirements a high inventory of hazardous chemical is also maintained in the refinery.

Safety is the key to keep various hazards and risks under control by setting up standards, systems, procedure control measures and implementation of some to run the refinery safety.

Personal protective equipment (PPE):-

1. safety shoes
2. rubber gumboots
3. PVC gum boots
4. Body protection
5. Rubber and plastic aprons.
6. leather aprons
7. proximity suit "Fire rescue suit ``
8. asbestos unit
9. asbestos blanket
10. Aluminized suit

Work permit system:-

1. Hot work permit
2. Cold work permit

a. clearance certificate
b. Excavation / dyke cutting permit
c. Road cutting and blockage permit
d. Vessel entry / vessel box – up
e. Permit for working at height
f. Radiation work permit.

General safety regulation:-

- Smoking is strictly prohibited in any part of the Refinery area except at authorized smoking booths.
- Hand rails should be used while climbing up and down the stairs
- Check / inspect ladder before use.
- All employees in Refinery must know the location and use of fire fighting equipment use dry chemical ore co_2 extinguishers in fire around electrical equipment and not water.
- Wears shoes in the Refinery wearing chapels and sandals is against safety norms.
- Only flame proof safety torches or hand lamps are allowed to be used in refinery area.

- Goggles or shield must be used while doing grinding, chipping and sand blasting etc. where there are possible eye hazards.
- Personal protective equipment are for safety. This should be used wherever necessary to prevent injuries.
- Before starting any job, necessary permits and clearances must be obtained.
- Safety belt must be worn by persons working at elevated place where adequate protection against falling is not available.
- Safety helmets must be worn by all employees working inside refinery units. It is advisable to be used all the time inside refinery premises.
- Transporting or storing of petrol or any other light product or corrosive chemicals in open containers is strictly prohibited.
- Cotton clothing should always be used on duty.
- Loose clothing are not permitted inside refinery.

Principle causes of accidents:-

Most of the accidents are caused because of unsafe practices and unsafe conditions,

1. Failure to warn or secure.
2. Non compliance of safety rules and norms.
3. Operating at improper speed.
4. Using defecting equipment
5. Improper loading or placement of materials.
6. Taking improper position.
7. Servicing equipment in motion.
8. Inadequate guards or protection.
9. Defective tools , equipment , substance
10. Congested walk way.
11. In adequate warning system
12. Fire and explosion hazards
13. Substandard house keeping.
14. hazardous atmospheric conditions
15. Gases, dust, fumes, vapors.
16. Excessive noise.
17. Radiation exposure
18. In adequate illumination for ventilation
19. Horse play
20. Poor judgement

ATMOSPHERIC & VACCUM DISTILLATION UNITS

- UNIT – 1
- UNIT – 2
- UNIT – 3
- COKER – A & B

REFINING PROCESS AVU- I II & III

Introduction :-

Crude oil, which comes from abroad via Haldia through pipelines is received in tanks. After settling and water draining, it is taken to CRUDE DISTRILLATION UNIT, where it is first heated in a heat exchanger train and then taken to desalter, for removal of salt and residual water after further heating in another exchanger train it goes to pretopping column to produce gas and unstabilizer gasoline. The gasoline goes to stabilizer column is heated in a furnace and sent to atmospheric column for fractionation. The top product is gasoline. Gas is used as refinery fuel and gasoline as feed stock of CRU. The side streams are heavy Naphtha, straight run kerosene and gas oil. Gas oil goes out as diesel component. The bottom product of atmospheric column is reduced crude, which is further heated in the furnace and fractionated in vacuum column to produce vacuum gas oil (Diesel component) and wide cut goes to phenol extract and raffinate processing. The bottom product is vacuum residue (Short Residue), which is used as coking unit feed for production of middle distillates and Raw petroleum coke. Vacuum wide cut obtained from crude distillation unit is subjected to aromatic removal by extraction with phenol in phenol extract and raffinate is fed to solvent dewaxing unit for production of slack wax by solvent extraction with toluene and methyl ethyl ketone followed by chilling crystallization and filtering dewaxed oil is used as light Diesel oil component of feed stock component for coking unit vacuum residue and a portion of reduced crude and dewaxed oil, are fed to coking units A & B to yield various cracked products by thermal cracking. The products obtained after fractional of cracked stream are gas unstabilized gasoline kerosene, gas oil and fuel oil. Gas and gasoline are sent to LPG recovery unit for production of LPG and stabilized gasoline by compression of gas followed by absorption / stripping. This gasoline by compression of gas followed by absorption stripping. This gasoline sold as mixed run naphtha Coker kerosene is blended in high speed diesel and Coker gas oil is blended in light diesel oil. Raw petroleum coke obtained from coking unit reactors is partly sold to other industries and the rest is calcined in coke calcinations unit to produce calcined petroleum coke which is sold to electrode manufacturing industries.

The gasoline from AVU is sent to CRU for enhancing the octane number. This is achieved by converting the paraffins and Napthene to Aromatics in the Reformer reactors reactors and octane number is increase from 72 to 95 unleaded gasoline from cru is used as motor spirit.

ATMOSPHERIC & VACCUM DISTILLATION UNIT I & II

Introduction :-

AVU is a mother unit of any refinery crude is first of all processed in this unit and products formed are either stored or send to various other units as a feed.

Distillation is a method of separating the components of a soln which depends on distribution of the substance between gas & liquid phases. Distillation exploits and vapour pressure of different component i.e, relative volatility in creation of a second phase by addition of heat. By appropriate manipulation of the process or by repeated vaporization and condensation, it is possible to make a complete separation.

Phase differs in addition the new heat content, but heat s readily added or removed, in distillation the feed is introduced, In distillation the feed is introduced more or less centrally in vertical cascade of stages. Vapour rising in the section called the enriching or rectification section is washed with liquid to remove or absorb the more volatile component.

Since no extraneous material is added, condensing the vapour issuing from the top, which is rich in more volatile component, provides washing liquid. The liquid return to the top of the tower is called reflux and the material permanently removed is called the distillate, which is a liquid rich in more volatile component.

In the section below the feed called the stripping or exhausting section the liquid stripped of volatile component by vapour produced at the bottom by partial vaporization of the removed rich in less volatile component is the residue.

In side the tower the liquids and vapours are always at their abubble peirs or dew points respectively, so that the highest tempr is at the bottom and the lowest tempr at the top. The entire device is called a fractionators.

AVU AT BARAUNI REFINERY

There are three numbers of AVU in Barauni Refinery numbered as AVU-1, AVU-II and AVU-III initially each was designed for 1.0 MMTPA crude processing by the Russians. The revamping of furnaces in AVU-I and AVU-II was done in December 1086, by EIL. Where in Russian cabin type furnaces of 72% efficiency where replaced by box type and cylindrical type bottom fired heaters of 91% efficiency.

Crude processing capacity of both units AVU-I & AVU-II where increased to 1.6 MMTPA by HETO project (Heat exchanger Train Optimization) in 1990. The above modification HETO project job was designed by EIL. The units were again revamped in 1998 (M & I) when capacity was expanded to 1.75 MMTPA in each of the two units.

AVU –III was revamped to AVU-III in 2001 and crude processing capacity enhanced to 3MMTPA AVU-III can process low and high sulphur crude in blocked out operation.

Through there units were designed on the basis of evaluation data of Naharkatiya crude, the units have switched on to imported crude due to Non-availability of Assam crude.

GENERAL DESCRIPTION :-

1. **Capacity :-**

AVU – I & II : 2.1 MMTPA each
AVU – III : 3.0 MMTPA.

2. **Date of Commissioning :-**

AVU – I : 1964
AVU – II : 1966
AVU – III : 1969

CRUDE CHARACTERISTICS :-

TABLE -1. LIGHT ENDS.

Light Ends	Methane	Ethane	Propane	i-Butane	n-Butane	i pentane	N pentane
Mirilite	Traces	0.01	0.15	0.15	0.40	0.44	0.60
Bonny Light	0.005	0.02	0.25	0.30	0.63	0.75	0.69

TABLE -2 PHYSICAL PROPERTIES :-

PHYSICAL PROPERTIES	MIRILITE	LUBUAN	BONNY LIGHT
Density @ 15^0c	0.8697	0.8605	0.8480
Sulfur % ^{0}c	(-1)12	(-1)6	(-1)9
Pour Point, ^{0}c	3.60	4.022	3.43
Viscosity @ 40^0c, c^{st}	2.94	2.88	2.84
Vis @ 500c, c^{st}	2.94	2.88	2.84

RVP, PSI	2.6	4.5	5.2

TYPICAL YEILD PATTERN :-

PRODUCT	YIELD%
LPG	0.8
GASOLINE	14.5
KEROSENE	11.5
GAS OIL	37.0
First Cut +	35.0
Wide cut+	
Short + Residue	
Gases	0.3
Loss	0.9

UTILITIES AND CHEMICAL :-

CHEMICAL & UTILITIES	ESTIMATED TARGET
10 ATA STEEM	36KG / MT OF CRUDE
CIRCULATING WATER	14M3 / MT OF CRUDE
SRF	1.34%
POWER	6 KWH/MT OF CRUDE
CAUSTIC (FOR GASOLINE)	305 gms / MT OF GASOLINE
CAUSTIC (FOR LPG)	6.25 kg/MT OF LPG
AMMONIA	3 gms / MT OF CRUDE
AHURALAN	3 gms / MT OF CRUDE
DEMULSIFIER	5 gm/ MT OF CRUDE
MFA (LUBRIZOL)	85.8 gm / MT OF MS(NORMAL)
MFA (LUBRIZOL)	129 gm / MT OF MS (Premium)

PROCESS DESCRIPTION :-

Crude oil Received from Haldia by pipelines and is pumped from storage tanks through heat exchangers after exchanging of approx. 120^0c – 130^0c after attaining temperature of about 130^0c the two crude combine together and enters in Desalter for separation and removal of water and salt. Inside the unit crude is pumped to desalter through two parallel passes of predesalter heat exchanger train and heating is done using various products streams from different columns. Both the passes combine in a single header and inter the desalter from bottom through 2 separator nozzles after splitting.

DESALTER CIRCUIT :-

Desalter is placed just after first heat exchanger train in order to have maximum absorption of salts, present in the water. Which is favorable at the existing tempr and pressure of the crude water and demulsifier are mixed with the crude prior to entry to the desalter. Salts in crude oils cause corrosion because they lead to evolution of Hcl in distillation columns. The severe corrosion due to combination of sulfur compound (H2S) with Hcl evolved from sats is caused by an oxidation reduction reaction the Hcl reacts with iron to form iron chloride, which in turn reacts with H2S producing iron sulfide and more Hcl. Salts in crude reduce charge rates, shorten runs, cause excessive down time and increase labor cost and severely stain equipment necessity frequent repairs and replacement. Efficient desalting ensure higher through put, more effective refinery operations and lower operating cost and improved product quality desalter eliminates the most ardlous tank of refinery maintenance cleaning of exchangers and furnace coil. The minimize corrosion in the top section of the fractionators there by reducing costly downtime and replacement.

CONTAMINANTS IN CRUDE :-

Chlorides, sodium, magnesium and calcium salts are present. Chloride is a source of Hcl envolved during operation.

Carbonates and sulfates present in significant quantities, solubility of calsium sulfate dimensions with tempr above 37^0c and it undergoes change in hydration at 100^0c.

Sediments :- Sediments contain fine particles of sand, clay, volcanic ash, iron sulfide etc.

Organo-metal compounds :- They consist of hydrocarbon combinations with vanadium, ni, cu and fe. These are poision to pt. catalyst.

BI-ELECTRIC DESALTER :-

A static mix valve and a control valve are provided for mixing water and demulsifier with crude prior to entry into the desalter. The desalter pressure is controlled through pressure control valves located on crude lines.

In electric desalting the electric field is powerful enough for over coming the resistance of stabilizer films. The collision and coalescence of drops is accomplished by an induced dipole attraction b/w them.

Bi-electric desalter has 3 electrodes between which dual streams of oi water system is fed. The stream flowing out ward encounters optimal conditions for coalescence. The bi-electric design increase water residence time by allowing a higher level and environment which vertical flow desalter are unable to attain because of turbulence, desalted crude and brine water containing salts from two different layers because of being attracted to two different poles.

The outgoing desalter brine heats the desalter injection water to a tempr of around 1300c. The desalter brine is further cooled to around 450c in the brine cooler and is let off to the ows (Oily Water Sewer). After desalter the crude to a tempr of around 2300c in order to limit the vaporization of the crude at his tempr the back pressure controller which control pressure is provided. The desalted crude is pumped to pretopping column k-l.

PRE – TOPPING COLUMN :-

As the name indicates the column is used before main fractionality column. This is done for the increasing productivity of the process and making it more efficient. The desalted crude at a tempr of 2300c enters the column and flashes into liquid and vapour.

Inside the tower the liquids and vapours are always at their bubble points or dew points respectively so highest tempr is at the bottom and lowest tempr is at the top of the column.

Stripping steam is given in the bottom of the column which decreases the partial pressure and thus the boiling point of the hydrocarbon inside the column and there by strips out the lighter portion of the feed. It is also an alternative source of heat.

The over head vapour from the main fractionators is condensed and cooled in the air condenser to 650c and further cooled in the trim cooler. The condensed gasoline at a tempr of 450c collected in the 3-ways reflux vessel.

A part of the gasoline is sent as reflux to the column under flow control for maintaining the tempr of the column top. The over part is pumped t naphtha caustic wash. Sour water collected in the boot is drained under level control of the vessel. Gases from the top of the reflux vessel are sent to the flare under control of the hydrocarbon carbon level.

The next side stream from the column of the kerosene a part of this kerosene goes to the kero stripper where the lighter ends are stripped by steam. The vapour from the stripper goes back to the main fractionating column.

The stripper bottom is sent to rundown via heat exchangers. The balance kerosene is pumped as circulating reflux-exchanging heat exchangers for maintaining the tempr of the column.

The next side stream is of LGO & LGO CR, LGO product is condensed while the LGO CR is sent back to the column as circulating reflux.

HGO & HGO CR forms the next side steam. HGO product is condensed while the HGO CR is sent back to the column as circulating reflux. The bottom product of the column is RCO (Reduced Crude Oil) which is pumped to the furnace for heating it to a tempr of around 460c and is other flashed into the vacuum column.

Various Problems in Absence of Pre topping column are :-
More load on the main fractionating column.
Increase in the height of the main fractionating column which cause design complications.
More cooperating cost.
Working will be more difficult with increase precautions.
Yield will be less.

Parameters.

AVU – III

Introduction :- The unit is designed for 3.0 MMTPA of crude processing. The unit can process sweet crude as well as sour crude. The design of the unit has considered Bonny light crude as sweet crude and arab mix as sour crude. The design of the unit has considered Bonny light crude as sweet crude and Arab mix as sour crude.

Original Technology	-	Russian
Date of commissioning	-	1969
Plant capacity	-	3 MMTPA
On stream factor	-	8000 hr/ year
Turn down	-	50%

The unit is designed for the following two cases :

CASE1 : High sulfur crude processing(50:50% wt) of arab heavy and arab light crude.

CASE II : Sweet crude processing (100% wt) Bonny light.

PRODUCT CUT RANGES :-

STREAM	TBP RANGE (^{0}c)
Off Gas	C1 – C2
LPG	C3 – C4
Naphtha	1 - 160^{0}c
Kerosene	108 - 305^{0}c
Diesel	150 - 400^{0}c
Heavy vacuum gas oil	340 - 600^{0}c
Short residue	535 - 680^{0}c

PRODUCT ROUTING :-

STREAM	DESTINATION
Off Gas	LRU / RGH / Flare
LPG	Monded bullet / Horton Sphere
Gasoline	CRU, OMS
Kerosene	Kerosene storage tanke
MGO	DHDT tank
HVGO	Coker tank, FCC tank, FCCuni
SR	Coker, FCC unit.

FEED :- Incoming crude to AVU – III is received at pressure and tempr **Conditions as bellow :-**

Stream	**Normal pressure kg/cm^2.g**	**Condition Tempr ^{0}c**	**Mech pressure ^{0}c**	**Design Tempr ^{0}c**	**Source**
Crude	7.0	30	10	65	Crude booster pump
Crude	2.5	30	5.0	65	Crude tanks

Outgoing streams from AVU – III are delivered from unit at pressure and tempr condition as follows :-

Stream	**Normal pressure kg/cm^2.g**	**Condition Tempr ^{0}c**	**Mech pressure ^{0}c**	**Design Tempr ^{0}c**	**Destination**
Off Gas	1.0	45	2.5	65	Unit fuel gas system/LRU
LPG	8.0	35.0	18.0	65	Mounded bullet / Horton sphere
Nephtha	6.0	40	6.0	200	Cruadoms
Kerosene	6.0	40	11.7	90	OMS
Diesel	6.0	40	21	140	OMS
HVGO	6.0	90	18.2	140	OMS
Short + Residue	16	90	33.6	140	OMS orFCC

CRUDE CHARACTERSSTICS :-

TABLE -1 LIGHT ENDS

LIGHT ENDS	**ARAB LIGHT**	**ARAB HEAVY**	**BONNY LIGHT**
Methane	0.0005	0.0005	0.0005
Ethane	0.01	0.04	0.03
Propane	0.27	0.43	0.31

i-Butane	0.17	0.20	0.35
n-Butane	0.85	0.93	0.71
x-Pentave	0.69	0.61	0.82
n-Pentave	1.28	0.93	0.73

OPERATING CONDITION FOR AVU – III

FEED

Crude oil, = 1.5 MT/hr

PRE TOPPING COLUMN :

Pressure - 1.5 kg/cm2g.
Top tempr - 122^{0}c
Feed tempr - 233^{0}c
Bottom tempr - 250^{0}c
Reflux ratio - 0.56
Heavy Naphtha drasaff - 164^{0}c
Heavy Naphtha vapour return tempr - 155^{0}c

Main Fractionator :

Pressure Top - 1.0 kg/cm2g.
Top tempr - 133^{0}c
Kerosene draw off tempr - 204^{0}c
Kerosene CR return tempr- 124^{0}c
LGO draw off tempr - 302^{0}c
LGO CR return tempr - 152^{0}c
HGO draw off tempr - 335^{0}c
HGO CR return tempr - 155^{0}c
Bottom tempr - 354^{0}c

STABILISER COLUMN :

Pressure - 8.2 kg/cm^{2}g
Top tempr - 61^{0}c
Reflux Ratio - 4.8

VACUUM COLUMN:

Feed - 131.3 MT/hr
Pree, mm of Hg. Top - 684
Top tempr - 75^{0}c
LVGO with drawal tempr- 148^{0}c

HVGO with drawal tempr- 56^0c
HVGO CR return tempr - 184^0c
Bottom tempr - 336^0c

USES OF PRODUCTS:

(A.) **LPG** – Used as a deomestic cooking fuel, its 95% evaporation tempr is kept at 2^0c (max).

(B.) E-I GASOLINE :-

The product is termed E-I gasoline because it is derived it is derived from the reflux drum of k-I with name plate E-I. It is used to be one of the major components of MS, commonly known as petrol.

However, as % specification (BIS) the AKI of MS must be 81.5, which has now made mandatory that the RON of gasoline is raised in CRU. Therefore E-I gasoline is now used as feed stream to CRU.

Quality Wise

(1) 10% distillation tempr should be below - 70^0c
(2) FBP should be below 165^0c in addition RVP is kept as low as possible to ensure maximum recovery of LPG.

PROCESS DESCRIPTION

Crude Preheat :

Crude from crude booster pump station is pumped to desalter unit through two parallel passes in pre-desalter heat exchanger. The exchanger has two shells stacked on above another in such a fashion that both are kept in line, in case of Bonny light crude and one exchanger is by passed in case of Arab Mix crude.

Both the passes combine in a single header and enter the desalter from bottom.

Desalter Circuit :

A static mix valve and a control valve is provide for mixing water and demulsifier with crude prior to entry into the desalter. The desalter pressure is maintained at around 9 kg/cm2 (g). The desalted crude is pumped to the pre-topping column. The outgoing desalter brine heats the desalter injection water to a temperature of around 130^0c. The desalter brine is further cooled to around 45^0c in the brine cooler and le off to the OWS. Demulsifier chemical and caustic is injected at the suction of pump.

Pretopping Column :

The desalted crude at a temperature of 230^{0}c enters the pre-topping column. The overhead vapours from the column is concerned in the air Condensers to 65^{0}c and further cooled to 45^{0}c in trim cooler.
The condensed gasoline at 45^{0}c is collected in the reflux nessel. Part of te overhead gasoline is pumped back to the column as reflux and the balance is pumped to the stabilizer.

Heavy naphtha steam is withdrawn as a side draw, from below the packing and led to the stripper column. The stripped product is pumped by heavy naphtha R/D pumps to air coolers where it is cooled from around 142^{0}c to 65^{0}c. Part of the Heavy naphtha from the column is usec. As a circulating reflux. The cooled CR at a temperature of around 90^{0}c is sent back to the pretopping column.

Main Fractionator :
The main column is provided with:

Valve trays
KERO/LGO section
Structured packing in LGO/HGO Section
Bottom stripping section
Over flash section

The overhead vapours are cooled/ condensed to 45^{0}c. The condensed gasoline at a temperature of 45^{0}c is collected in the reflux aessel. A part of the gasoline is pumped as reflux to the column and rest sent to Naphtha caustic wash. The next side stream kerosene is withdrawn from 10th tray and sent KERO stripper. The balance kerosene is used as a circulating reflux. LGO and LGO CR is drawn from 19th tray and LGO CR returns to 17th tray.

HGO and HGO CR is drawn from the chimney tray below a structured packing bed and returns to column above the HGO packing bed.
The column bottom (RCO) is sent to the vacuum distillation unit via the furnace.

Stabilizer Section :
Part of the condensed overhead gasoline is sent to the stabilizer column. The overhead vapours are condensed and collected in the reflux vessel. A part of the LPG goes back to the column for controlling the temperature and rest

goes to the LPG caustic wash. Stabilised naphtha from the bottom is cooled to 40^{0}c through heat exchangers.

LPG Caustic Wash Section :
LPG is washed with caustic solution and sent to caustic settler for settling of the entrained caustic from LPG.

Vacuum Section:
The Vacuum column is provided with structured packing in
LVGO pump around section
LVGO/HVGO fractionation section
HVGO pump around section
Wash section
Valve trays in the bottom stripping section

The column is operated a top pressure of 70 mm Hg.

The overhead vapours are taken to pre-condenser. The non condensable are sucked up by the Primary Ejectors and sent to the condensers. The condensed liquid goes to the Hot-Well.

Fire first side stream drawn from the column is LVGO and CR. The product LVGO joins the HSD stream. The second side stream drawn from the column is HVGO and CR. The short residue from the bottom of the column is pumped to run down via heat exchangers.

(C) E-2 GASOLINE :- It is a component of SR naphtha or Gas Turbine feed in TPS. Used for manufacture of fertilizers and petrochemicals. E-2 Gasoline is also used as feed stream to CRU. Quality wise its end point should be below 155^{0}c.

(D) SR KEROSENE :- It is used as a domestic fuel.
(i) FBP in the range of 240-250^{0}c
(ii) Flash point of 38^{0}c (min) for sk operation.

(E) SR GASOIL :- It is the major component of HSD manufactured by Barauni Refinery and its quality Requirements are :-

(i) Recovery at 350^{0}c	-	85% (v)
(ii) Recovery at 370^{0}c	-	95%(v)
(iii) Colour	-	Around 1.5 ASTM

(iv) Pour point - 0^0c (winter)
+ 18^0c (Summer)

SR gas oil is routed to DHDT feed tanks along with other diesel is improved to 48 as required by CPCB.

(F) First CR/LVGO :- Ist CR is a side stream of vaccum column. It is termed so because this is the Ist circulating reflux of vacuum column, A part of this also called light vacuum gas oil is son to DHDT feed tanks or OM & S for LDO (Light Diesel Oil) operation it is also a component for LSHS (Low Sulphur Heavy Stock) used as fuel in many industries.

(G) First Cut :- Ist cut is the 2nd side stream of vacuum column. This is sent to OM & S for LDO operation. It is also a component for FO and LSHS.

(H) WIDE CUT / HVGO :- Wide cut was feed stock for phenol extraction unit initially quality wise it should have

(i) Colour Around 6.0 ASTM
(ii) Flash point above 150^0c
(iii) Viscosity 48 to 50 red wood second.

The same cut is used as the feed stock second.

(I) **SHORT RESIDUE :-** This either goes to coking unit or to the LSH pool. Quality wise it should have flash point of above 150^0c and as high density as possible (Since this confirms maximum recovery of distillates)

There is provision to route the short residue to FCC with the name vacuum residue (VR).

COKER – A

troduction :-

The Coker –A unit of Barauni Refinery is designed for processing 600000 MT per year f reduced crude from AVU's. The unit can process vacuum residue from a wide variety of ude oil including Bonny light & Arab mix crudes. It can also process a number of low value reams such as extracts and dew axed oils from lube plants and decant oil from the bottom of CC units in addition to the vacuum residues. The unit is designed to produce unsterilized aphtha, LPG rich off gas, Raw petroleum coke (RPC) and components for HSD, LDO and el oil pools. The unit upgrades heavy residual oil converting it is above products.

A delayed coker unit mainly consists of feed pre-heat section, and furnace, coke hambers (Reactors) and fractionators. The associated facilities include coke cutting, handling nd water re-use system.

APACITY:-

Coker – A unit is designed to process 0.6 MMTPA of feed in 7200 on streams hours / ear.

COKER –B

NTRODUCTION:-

The Coker-B unit of Barauni Refinery is designed for processing 00,000MT per year of reduced crude oil (RCO) from crude distillation units processing aharkatiya – Lakwa- Rudrasagar crude mix in the weight ratio of 68:19:13 respectively, esides coke, the unit is designed to produce component for HSD, LDO, Fuel Oil and feed for PG recovery units namely fuel gas and cracked unsterilized naphtha. The unit upgrades the eavy residual oil converting into above products.

Coker – B unit consists mainly of a four-pass natural draft furnace, pair of coke hambers, fractionators column and light ends recovery system. The associated facilities include oke cutting/ handling, hydrocarbon recovery and water re-use system.

APACITY:-

ormal feed capacity – 391,000MT/year
esigned feed capacity – 500,000 tonnes/year
ream days / year = 320
urn down ratio = 80%

EED :-

Blended feed stock from the pool of AVU's Residue/ Vacuum Residue / Decant oil from FCCU for coker –B will have CCR 8.5% wt. max, with the following specification.

ROCESS DESCRIPTION:-

Reduced crude is received in the Additional coking unit from offsite storage nks by a 18" dia pipeline. The feed stock RCO from storage is preheated to 200^0c by heat changer against coker products like kerosene heavy gas oil (HGO), coker fuel oil (CFO) and esidue fuel oil (RFO).

The preheated RCO is further heated to 240^0c in the pre heat section of the oker furnace and fed to fractionators column this feed goes to the fractionators is at two levels, e below and the other above the vapour inlet nozzle. This facility is provided to control actionators bottom temperature.

The fed material along with the cycle stock is pumped to the reaction coils of the ker furnace at a temperature of $370\text{-}380^0$c. BFW is injected at 1.1wt% of pass flow in each ss up stream of furnace to reduce the residence time of the furnace. The material is heated to e coking temperature of the stock $495\text{-}500^0$c, which produce partial vaporization and mild acking. The vapour liquid mixture then enters the coke chamber which is in coking service, here the vapour experiences further cracking as it passes through the coke chamber and the luid experiences successive cracking and polymerization unit it is converted to vapour and ke. The unit has two-coke chambers; one in coking service while the other is being decoked ith high-pressure water jets.

The coke chamber overhead vapors enter the fractionators via a quench lumn at a temperature of about 425^0c. In the fractionators column, gas and naphtha are btained as overhead products and kerosene; HGO and CFO as side draw off products. erosene and HGO are steam stripped in the stripper columns, cooled prior to they are being outed to their destinations. A heavy gas oil (HGO) circulating reflux stream is drawn and is tilized for MP steam generation; part of this circulating reflux stream is utilized for providing op reflux in the quench column and gas oil quench in the vapour line of the coke chambers.

he residue from the bottom of quench column is sent to storage after further cooling in an conomizer exchanger and tempered water cooler.

The vapour from the fractionators overhead are cooled in air cooler and water condensers nd then led to reflux drum where gas and liquid separate out. The gases from the fractionators eflux drum where gas and liquid separate out. The gases from the fractionators reflux drum ent to LPG recovery unit of the refinery. Condensed naphtha from reflux drum is also routed to e LPG recovering unit for stabilization. A part of condensed naphtha sent back to fractionators olumns as top reflux.

Coke from the cooled drained chamber is cut and cleared by ydraulic jets operating at a pressure of about 200 kg/cm2. Coke along with water falls to the round. The coke from the drop-out area is placed in intermediate storage area for de-watering nd storage.

The de-coking water after clarification etc. is pumped back to the de-coking water storage nk for refuse.

In this unit the main reaction mechanism involves the polymerization and condensation f aromatics, grouping a large number of those compounds to such a degree the eventually coke formed.

rocess Description are completed in following section.
eed preheat section
oker furnace
oke chamber and quench section. Coker fractionators section
ydraulic decoking and blow down system.
tilities system.
oke handling section.

eed and product specification (coker –B) Feed :-

Blended feed stock from the pool of Atmospheric Residue/vacuum residue / phenol ffinate for ACU will have CCR 8.5% wt max, will the following specification.

haracteristics	**Atmospheric Residue**	**Short Residue**
BP cut point, ^{0}c	370 +	490-
ensity at 15^{0}c	0.9596	0.9974
inematic Viscosity, cst at 85^{0}c	47.75	330.66
t 100^{0}c	213.98	148.95
our point, ^{0}c	52	60
CR, % wt	6.6	12.3
lash point	220	230
race metal, PPM		
anadium	<1	<1
ickel	2.4	3.5

roduct :-

HARACTERISTI S	**FUEL GAS**	**UNSTABLISED NAPHTHA**	**KERO**	**LGO**	**HGO**	**CFO**	**RFO**	**GREEN COKE**
BP, ^{0}c		C5 – 140		230-320	320-400	400-480		
ensity @ 5^{0}c		0.710				0.923		
lash point, ^{0}c						104		
otal swt %						0.38		
iscosity @ 50^{0}c, cst						16.53	7.0	
our point, ^{0}c						39	51	
CR wt%						0.091	4.5	
ehane wt%	26.28							
thane wt%	15.28							
thane wt%	4.17							
opylene wt%	9.29							
Butane wt%	2.29							
Butane wt%	7.68							
transButane	8.56							
5	11.12							

LPG RECOVERY UNIT (LRU)

Introduction:-

LPG Recovery unit is designed to process the gas and unstabilised Naphtha available from Coker-A&B.
The function of the unit to recover the LPG from the hydrocarbon streams obtained from Coker-A&B besides producing LPG, the unit also produces stabilized naptha feed from Coker-A&B.
The designed through put of the LPG Recovery unit is 99000 T/Year of gases and unstabilised naptha from Coker-B and 93696 T/ year of gases from Coker-A

CAPACITY :-

(a) Gas & unstabilised naphtha from Coker-B = 99000T/yr
(b) Gas from Coker-A = 93696 t/yr
(c) Unit turn down = 25%

FEED CHARACTERISTICS :-

FEED STOCK-

(a) Gas from Coker-B

	wt%
COMPONENT	26.28
Methane	15.28
Ethane	4.17
Propylene	24
i-Butane	7.68
n-Butane	8.56
cis-trans Butane	11.12
C5	

(b) Unstabilised naphtha from Coker-B	0.71
sp. gravity@15°C	22.0kg/cm2g
vapour pressure	

(c) Gases from Coker-A

COMPONENT	wt%
Methane	25.7
Ethane/Ethylene	18.9
Propane	17.7
Propylene	8.6
i-Butane	1
n- Butane	9.7
i-Butane	2.3
n-Butane	4.0
cis butane	0.6
trans Butane	
i-pentane	
n-pentane	
1-pentane&2- Methyl 1-Butene	2.8

CHEMICALS:-

Caustic soda	12.0tones/year
Corrosion inhibiter	0.75tones/ year

PROCESS DESCRIPTION :-

Gases from Coker-A&B, AVU-1,2,3 are compressed in a two stage steam turbine driven compressor. Compressed gases at a pressure of 14.0kg/cm_2.g along with unstabilised naphtha from Coker-A&B are cooled at 40°C in air and water cooler successively and fed to a discharge knock out pot where gas and condensate (mainly LPG) are separated.

Gases from the knock out pot are passed through an absorber column and flow counter to the naphtha & kerosene streamns in two separate sections respectively. Naphtha absorbs any C3,C4 fractions present in the gas. Kerosene further minimized the loss of naphtha entrained by the gases. Kero can be taken either from Coker-A&B and Rich kerosene from this absorber is fed back to either the fractionating column of Coker-Aor B. Rich naphtha from the lower zone of the absorber along with the condensate obtained from the compressor discharge knock out drum is preheated by Debutaniser bottom stream & pumped to stripper column where light ends (C1&C2) are stripped off by reboiler vapour, fed back to the inlet of compressor discharge KO drum (to Recover C3-C4, if any)

Fuel gas from the absorber top goes to a knock out drum & fed to the refinery gas network. Stripper bottom containing mainly LPG & naphtha are fed to the Debutanizer column for separation of LPG & naphtha. LPG is withdrawn from the top reflux drum & stabilized naphtha from the bottom of the debutanizer column. A required part of this stabilized naphtha is recycled back to the absorber as absorbing medium & rest of stabilized naphtha goes as product.

Both LPG & stabilized naphtha products are further in caustic soda wash section separately for removal of any H_2S . Products are further passed through sand filters then sent to the product storage tank.

PRODUCT CHARACTERISTICS:-

(a) LPG	
Dryness	No free entrained water
Boiling point	-40°C
Vapour density	1.5
H_2S	Absent
Total volatile solution	0.02max.
Volatility(95% vaporize @760mmHg)	+2°C(max)
Vapour pressure at 65oC, kg/cm^{2}g	15
(b) STABILISED NAPHTHA	
TBP	C5+140°C
15°C	0.7109
HYDROCARBON	wt%
Saturates	64.5
Oleffins	23.5
Aromatics	12.0
Mercaptons	0.016
Cu strip corrosion	
Butane(3hrs@50°C)	2 a
RVP, psig(max)	10
(c) FUEL GAS	wt%
Methane	45.23
Ethylene	7.2
Ethane	25.5
Propane	11.70
C_5	2.77
Propylene	7.60

BARAUNI REFINERY EXPANSION PROJECT (BXP)

Introduction :-

The Barauni Refinery Expansion project was envisaged for augmenting crude processing capacity from 4.2 MMTPA to 6.0 MMTPA along with matching secondary processing facilities. The main objective of Barauni Refinery expansion project is to produce market oriented pattern of environment friendly high value products like LPG, Diesel and motor spirit. BXP launched at Barauni Refinery in 2002.

The project mainly consists of :-

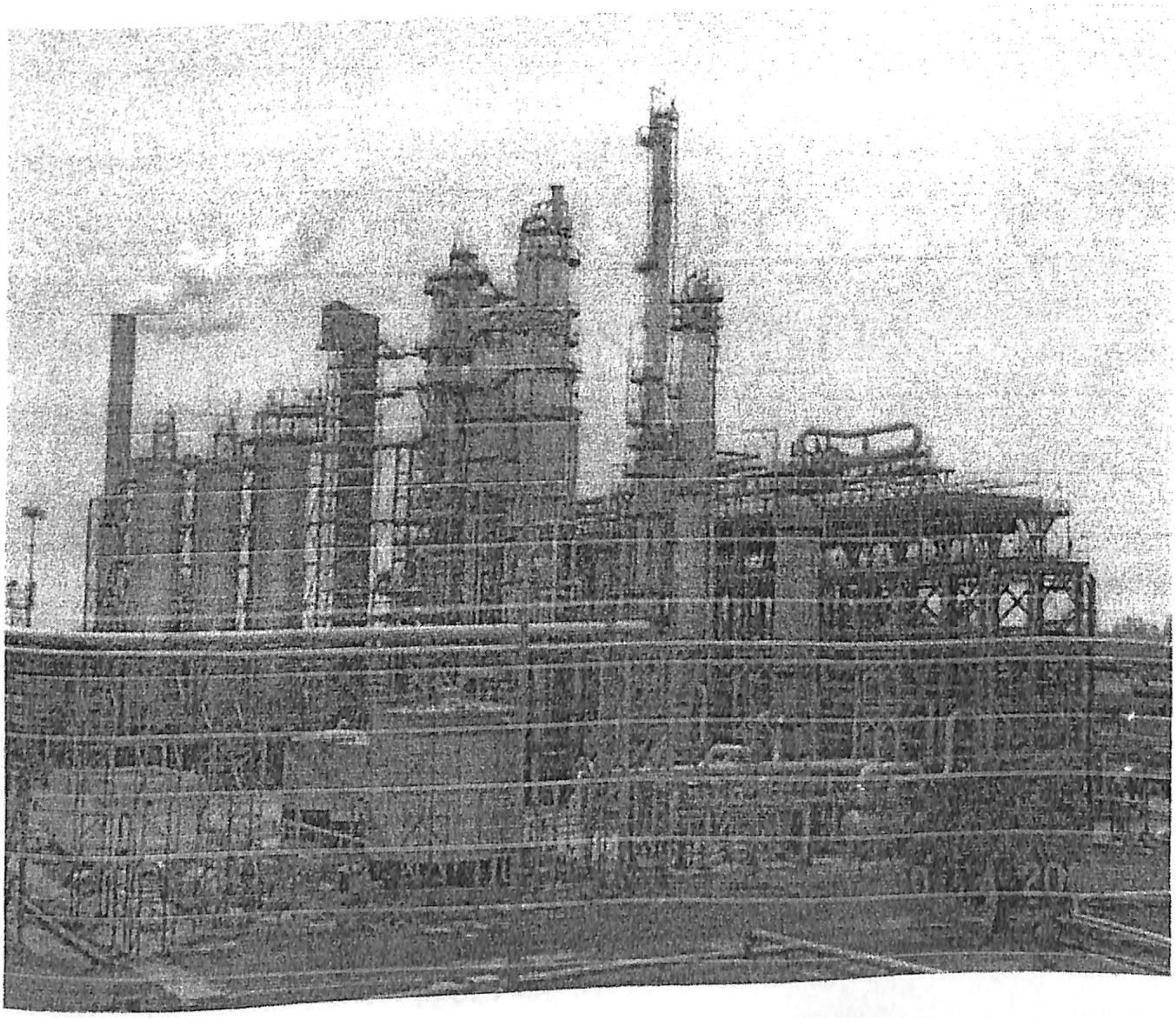
- **Residue Fluidized catalytic cracking unit (RFCCU)**
- **Diesel Hydro treating unit (DHDT)**
- **Hydrogen Generation unit (HGU)**
- **Sulfur Recovery unit (SRU)**
- **Amine Regeneration unit (ARU)**
- **Sour water stripping unit (SWSU)**
- **Catalytic Reforming unit (CRU)**

UNIT	**FEED**	**PRODUCT**
RFCCU	Blend of short Residue & HVGO (heavy vacuum gas oil)	Fuel gas oil, LPG, gasoline, diesel, DCO
DHDTU	High sulfur low cetane Diesel	Low sulfur High cetane Diesel
HGU	Naphta	Hydrogen (99.99% pure)
SWSU	Rich Amine containing high amount of dissolved H2S from DHDT / RFFCCU	Lean Amine (containing less amount of dissolved H2S) to DHDT, RFCCU Acid gas of SRU.
SWSU	Sour water (Containing high amount of dissolved H2S from DHDT, RFCCU AVU's, COKERS	
RFCCU	1.3 MMTPA	Stone & Webster engg corp. Ltd. USA

***. LPG Recovery UNIT** ***. GASOLINE TURBINE UNIT**	245000 T	MERICHEM USA
DHDT	2.2 MMTPA	UOP, USA
SRU	2 X 40 TPD	STORK, Netherlands
ARU	201 TPH	UOP, USA
SWSU	93 TPH	UOP USA
HGU	34000 TPA	HTAS Denmark

RESIDUE FLUIDISED CATALYTIC CRACKING UNIT

(RFCCU)



RISIDUE FLUDISED CATALYTIC CRACKING UNIT (RFCCU)

RFCCU has been licensed by the stone & Webster Engg. Corporation (SWEC) and the unit was constructed by Samsung Engg. Co. Ltd. (SECL). This unit was commissioned in 2002. This unit is designed for the cracking of the heavier Residues from the AVU into the lower carbon in the presence of a catalyst catalytic cracking reactions are selective resulting in a significantly lower production of C_2 gases. High octane no. of the gasoline and low cetane quality of the gas oil fractions are typical of the catalytic cracking process.

Capacity :-

Normal feed capacity	:-	1.3 MMTPA
Designed feed capacity	:-	1.309 MMTPA 1.432 MMTPA
ON steam factor	:-	800 hrs / annum
Turn down ratio	:-	50%

FEED SPECIFICATION :-

Case I :- Maximum distillate / LPG mode operation processing a mixture of the following stream at a rate of 1369 MTPA

CCR - 4.28 wt%
S content - 1.56 wt%

Feed Fluid	Flow rate	% Yield
Low s vacuum distillate	736 MTPA	53.8
High s vacuum distillate	277 MTPA	20.2
High s vacuum Residue	234 MTPA	17.1
Fuel oil	122 MTPA	8.9

Case II :- Maximum distillate / LPG mode operation processing a mixture of the following streams at a rate of 1436 MTP.

Conradson carbon Residue (CCR) :- 3.79 wt%

Sulfur content :- 2.54 wt %

Feed Fluid	Flow rate	% Yield
High s vacuumed istillate	889 MTPA	61.9
High	182 MTPA	12.7
Foots oil	126 MTPA	8.8
Coker Heavy Gas Oil	239 MTPA	16.6

Product Specification :-

1. LPG :- Vapour pressure @ 56^{0}C :- Max 16.87 kg / cm^{2}
Volatility :- Evaporation tempr for
95% vol @ 760 mm of Hg – 2^{0}C
C_2 content in LPG - 0.5 – 1.0 vol %
C_5 content in LPG - 0.2 – 0.9 vol %

2. Motor Gasoline :-

Research octane No. (RON)	91 MM
Reid vapour pressure (RVP) 38^{0}C stability	0.4 kg / cm^{2}
Recovery Evaporation Volume	2798 – 1971
For 120^{0}C Target @ 760 MMHg	Min 35 vol%

Total cycle oil (Tco : DIESEL)

Distillation @ 350^{0}C	Min 85 Vol%
Distillation @ 360^{0}C	Min 90 vol%
Distillation @ 370^{0}C	Min 95 vol%
Flash pt (Abel) P.M closed cup	Min 36^{0}C

4. DECANTED OIL (DCO)

Flash point (Pensky Closed) – in 66^{0}C

CATALYST :-

The catalyst used is silica-alumina based in amorphous from and its trade name is ZSM.

RFCCU PROCESS PRINCIPLE :-

Feed stock contact with the circulating high $temp^{r}$ solid catalysts with an average particle size of 60 Micron at the bottom of the reactor called a Rise and after quick vaporization Tle catalytic reaction is achieved with several seconds during on upward flow in the riser. The reaction tempr is in the range of 490 – 540^0C.

Coke produced in the cracking reaction is burned off in the Regenerator and then the catalyst is Regenerated. When coke is burnt, the catalyst bed tempr is increased due to the great heat generated. This Regenerated hot catalyst can supply the heat needed for feed oil vaporization and the catalyst cracking reaction (endothermic). The regeneration tempr is in the range or 650 – 780^0C. The overall equation for coke burning reaction is :-

$C + O_2 \longrightarrow CO_2$
$C + ½ O_2 \longrightarrow CO$
$C + ½ O_2 \longrightarrow CO_2$
$21 + ½ O_2 \longrightarrow HO_2$
$S + O2 \longrightarrow SO_2$
$SO_2 + ½ O_2 \longrightarrow SO_3$

In the Regenerator, partial combustion or complete combustion burns coke. In the partial combustion mode flue gas containing co is with drown from the Regenerator overhead and the co in down stream co incinerator.

As an option, a specific catalyst which has the function of sox removal (MCO :- DeSox Catalyst) will be injected in to the Regenerator. In this case the reaction for sox Removal is as follows.

$MeO + SO3 \longrightarrow MeSO4$ (Regenerator)
$MeSO2 + 4H2 \longrightarrow MeO + H2S + 3H2O$ (Reactor)

Me stands for a basic metal.

The converted H2S is Recovered as elemental s is the down stream. Refinery process unit. The catalyst is fluidized in both the reactor and the Regenerator and is circulated continuously between these vessels through standpipes like a liquid handled with pressure balance.

CATALYTIC CRACKING REACTION :-

The catalytic reaction is a reaction with intermediates of carbenium sites which are produced on the acid sites of a catalyst surface. The main reaction schemes of catalytic cracking progress with the following Mechanism :-

(a) Initiation :-

$R_1 - CH = CH - R_2 + H_2 \rightarrow R_1 - CH_2 - C^+ H - R_2 + Z$
Branched Site Carbenium ion

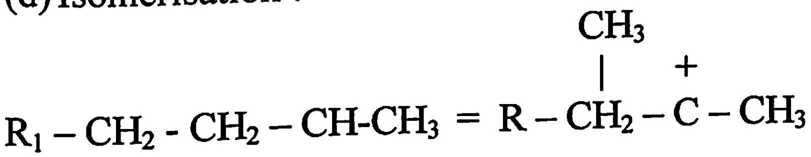
$R_1 - CH_2 - CH_2 - R_2 + L^+ \rightarrow R_1 - CH_2 - CH - R_2 + HZ$

Lewis Site Carbenium ion.

(b) Production of carbenium ion :-
$R_1 - CH_2 \text{-+} CH_3 - R_2 = R_1 - CH_2 - CH - R_2 + H_2$

(c) Cracking –
$R_1 - CH_2 - {}^{+}CH3 - R2 = R^{+} + CH_3 - CH_2 - R_2$

(d) Isomerisation :-



$$R_1 - CH_2 - CH_2 - CH\text{-}CH_3 = R - CH_2 - \overset{\overset{CH_3}{|}\;\;+}{C} - CH_3$$

(e) Cyclisation :-

The following hydrogen transfer reactions is also important to explain the results of high yields of aromatic products.

(f) Hydrogen Transfer :-

$3\ \ C_nH_2n\ + CmH_2m = 3\ cn\ H_2n + 2 + cmH_2m - 6$

Olefins Naphtenes Paraffins Aromatics

The reaction (c) to (e) affect the properties of cracked products. Such as the octane no. of gasoline or the cetane no. of creacked gas oil.

FUNCTION OF THE PLANT :-

The FCCU catalytically cracks the vacuum gas oil from AVU, Hydrocraker bottom and vacuum Residue to various high priced hydrocarbons. The hydrocarbon vapour are separated in following product in the fractionation & gas concentration section.

(1) Fuel gas
(2) LPG
(3) Gasoline of high octane Number
(4) HSD component
(5) Fuel oil component.

PROCESS DESCRIPTION :-

A modern designed fludised catalytic cracking unit consists of the following section which operates in an integrated Manner.

(a) Catalyst Section
(b) Fractionation Section

CATALYTIC REFORMING UNIT
(CRU)

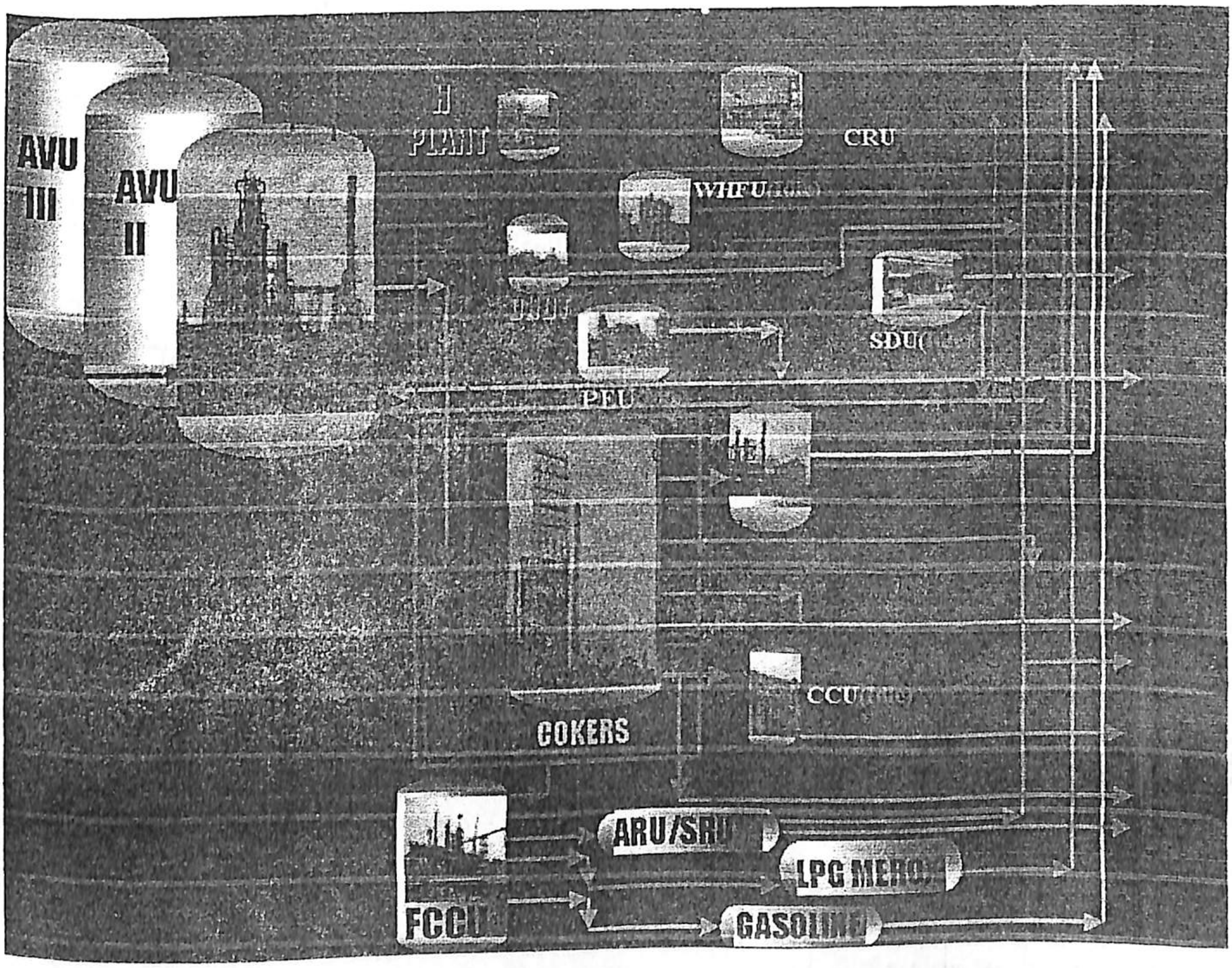
CATALYTIC CRACKING UNIT

(CRU)

PROCESS DESCRIPTION

Introduction

To get motor spirit of low lead and high octane number, the Catalytic Reformer Unit is setup at Barauni Refinery in 1990. The plant is having following facilities:



1. Naphtha Splitter Unit
2. Naphtha Hydro -- Treater Unit
3. Catalytic Reformer Unit
4. Feed and Hydro-Treated Naphtha Storage Facility
5. Circulating Water Facility.
6. Compressed Air & PSA system
7. Hydrogen Storage & Un-loading Facility.
8. Flare System

The purpose of Reformer is to enhance the octane number by changing the hydrocarbon structure in the presence of catalyst and hydrogen. It is not advantageous to operate reformer with lighter hydrocarbons. So splitter was required to get suitable catalyst, but impurities / water act as catalyst – poison, so we need hydro-Treater to remove impurities and water.

General Process Description

Catalytic Reforming Unit (CRU) improves the quality of MS (Petrol) by increasing it octane number or antiknock property.

The raw material / feed is (Gasoline) received from AVU's column K-101 & K-102 to Tank no 250, 251 & 252 in CRU. *From tanks through pump* 41-PA-001A/B it is fed to Naphtha splitter column 01-CC-001. In column it is splited into two parts. Top portion i.e. light naphtha *in routed to* HGU as feed of the Unit and O M & S after caustic wash in AVU I & II through pump 01-PA-001A/B.

The bottom product i.e. heavy Naphtha is sent to Hydro Theater Unit (HTU) where its organic impurities like Sulphur, N2, O2 are removed and stripped off from top of stripper column 02-CC-001. The bottom product of stripper column i.e. DSN (De sulphurised Naphtha) is feed to CRU.

In CRU, this DSN is aromatized / de-hydrogenated by catalyst in reactors 03-RB-001 / 002 / 003 along with hydrogen. This hydrogen is recycled with compressor 03-KA-001. The excess hydrogen produced is compressed by hydrogen Rich gas compressor 03-KA-002A/B.

The hydrocarbon from Reactor goes to L.P. separator 03-VV-001. The bottom of the separator is naphtha and it is pumped to H.P. separator 03-VV-003 through pump 03-PA-002A/B and the top of the L.P. Separator goes to compressor 03-KA-001 & 03-KA-002 A/B.

The Bottom of the H.P. Separator is sent to LPG separator. After removing or separating the LPG, the Naphtha is pumped to stabilizer column 03-CC-001 for residual LPG removal. The LPG from top of the column are removed and the bottom stabilized product is called reformate and sent to O.M & S as M.S. constituent.

PROCESS & PLANT DESCRIPTION

Naphtha Splitter Unit (NSU):

IBP-140 ^{0}C cut naphtha from storage (TK 250, 251, 252) is fed to splitter column 01-CC-001 under flow control by off site pump 41-PA-1A/B at tray No. 14. The feed is heated up to 95 ^{0}C in splitter feed/bottom exchanger 01-EE-001 A/B against splitter bottom stream before it enters the column.

The overhead vapors are totally condensed in air condensers 01-EA-001. The liquid collected is pumped by splitter reflux pump 01-PA-001 A/B and one part sent as top reflux back to the column under flow control 02-FC-1102 to maintain the top temperature. The balance, which constitutes the IBP-70 ^{0}C cut naphtha is sent to HGU as their feed (bypassing 01EE002) and rest light naphtha is sent to storage under reflux drum level control 01-LC-1101 after cooling in a water cooler 01-EE-002. Reflux drum boot water is drained in OWS manually.

The pressure of splitter is controlled at reflux drum by passing a part of hot column overhead vapors around the condenser or releasing the reflux vapors to flare through a split range controller (01-PC-1101).

The splitter bottom product which constitutes 70-140 ^{0}C cut naphtha is pumped to splitter feed/bottom exchanger 01-EE-001 A/B by hydro Treater feed pumps 01-PA-003 A/B. The bottom product after exchanging heat with feed is split into two streams. One is fed to the hydro Treater unit at a temp. of 65 ^{0}C and the other is sent to storage under column level control 01-LC-1102 after being cooled in splitter bottom column 01-EE-003.

The heat necessary for splitter reboiling is supplied by splitter reboiler furnace 01-FF-001 and desired temperature maintained by controlling the fuel firing. Splitter reboiler pumps 01-PA-002 A/B. provide the circulation through reboiler 01-FF-001 is double pass vertical cylindrical furnace having four burners fired from the bottom. It has soot-blowing facility for convection section.

Hydrotreater Unit (HTU):

A) **Reaction and Separation Section:**

The naphtha from NSU is fed to HTU by a pump 01-PA-003 A/B. The feed flow is controlled by flow control valve 02-FC-1101. The feed then mixed with Rich Hydrogen Gas from HP separator of reformer. 02-FC-1202 controls the Rich Hydrogen gas flow. Both the liquid naphtha and rich hydrogen gas are pre-heated in a series of exchangers 02-EE-001 A/B/C/D/E/F, which are feed/reactor effluent heat exchangers. Then mixture is heated up to reaction temperature in a furnace 02-FF-001 and fed to the reactor 02-RB-001. The furnace 02-FF-001 is four pass having three burners fired from bottom. The furnace is having facility of soot blowing. The reactor inlet temperature is maintained by 02-TC-1101 cascaded with either fuel oil or fuel gas PC's. The furnace is provided with all safety shut down inter locks. It has also provision of decoking.

The desulphurisation and hydro treating reaction takes place in 02-RB-001 at almost constant temperature since heat of reaction is quite negligible. The reactor is provided with facility of steam and air for regeneration of catalyst. The catalyst for reactor is HR-306.

The reactor catalyst bed has been provided with five number of thermo couple points at various location to get the bed temperature during regeneration of the catalyst.

The reactor effluent after having heat exchanged in 02-EE-001 series with feed goes to air cooler 02-EA-001. The air cooler fans pitch is variable i.e. cooling load can be adjusted as per situation requirement. After air cooler the effluent is cooled in a trim cooler 02-EE-002. The product is collected in a separator vessel 02-VV-001. Sour water is drained from the separator drum boot manually. The separator drum pressure is maintained by routing the gas to HGU compressor K-05 fully through 2-PC-1201B and any excess gas can be routed to FG system through 02PC1201. In event of emergency the separator excess pressure can be released to flare through an on-off c/v HV-1201.

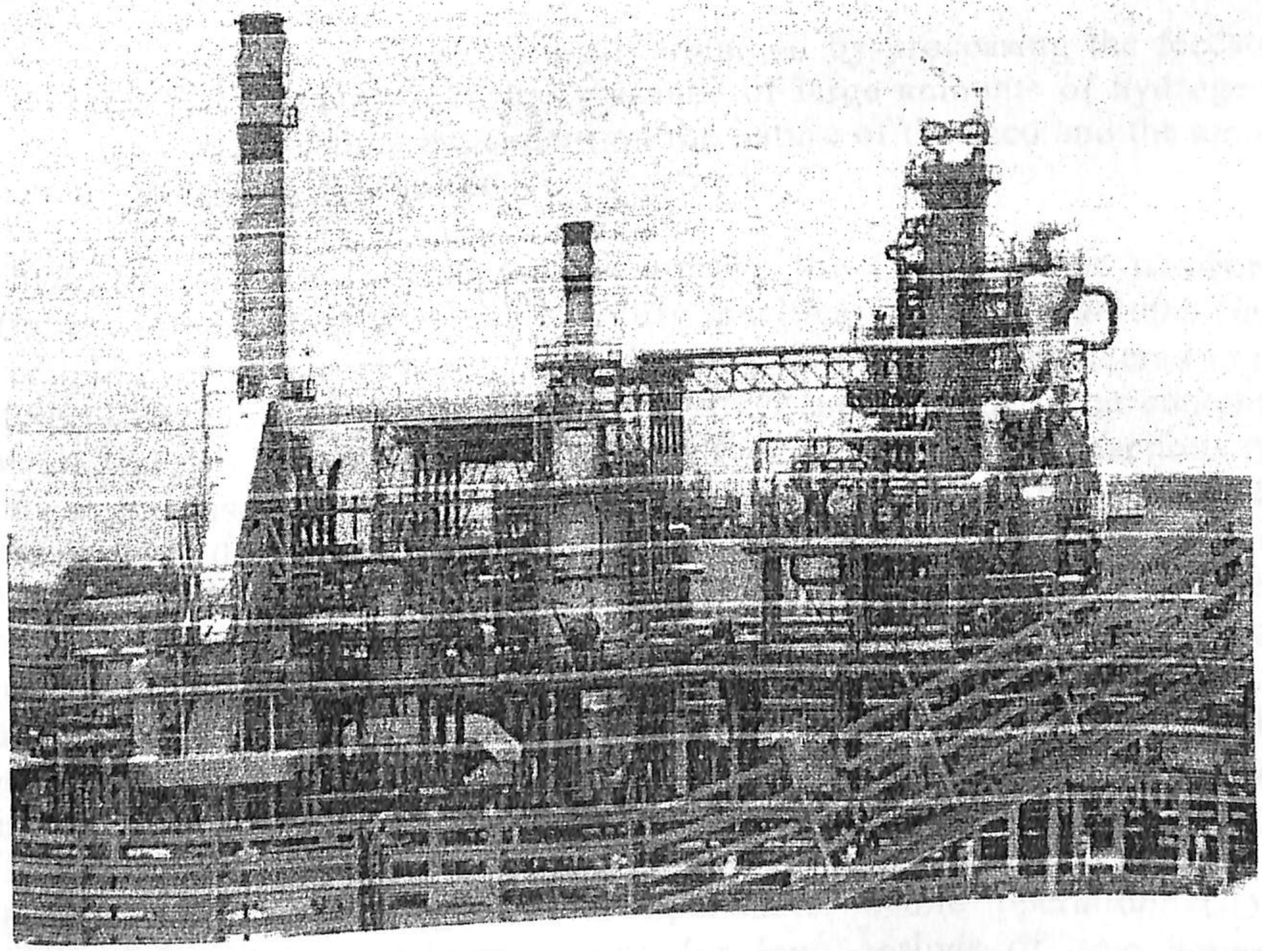
A line has been provided to feed the naphtha to stripper, during start up, bypassing the reaction/separation section.

B) STRIPPER SECTION:

The separator liquid is pumped by 02-PA-001A/B under flow control 02-FC-1201 cascaded with 02-LC-1201 to stripper feed/bottom exchanger 02-EE-003 A/B/C when it gets heat exchanged by hot stripper bottom stream.

The stripper column consists of 28 Nos. of valve trays one to eight number of trays are single pass and the rest double pass. Feed coming from 02-EE-003 A/B/C enters at 9th tray from two sides. The overhead vapors are cooled down in 02-EA-002-air condenser and collected in 02-VV-002-stripper reflux drum. The fan load can be adjusted. The condensed hydrocarbons are returned to column top by pump 02-PA-002A/B under flow control 02-FC-1301 cascaded with 02-LC-1302 as reflux to maintain the top temp. The water accumulated in the boot is sent for disposal as sour water. 02-PC-1301 releasing excess gas in the FG system maintains the reflux drum pressure. The facility is there to inject corrosion inhibitor by pump 02-PA-005A.

DIESEL
HYDRO TREATMENT UNIT
(DHDT)



DIESEL HYDROTREATMENT UNIT
(DHDT)

1.1 INTRODUCTION

Petroleum fraction contains various amount of naturally occurring contaminants including organic sulfur, nitrogen, and metals compounds. These contaminants may contribute to increase levels of air pollution, equipment corrosion, and cause difficulties in the further processing the material. The Unionfining process is a proprietary fixed-bed, catalytic process developed by UOP for hydro treating a wide range of feedstocks. The process uses a catalytic hydrogenation method to upgrade the quality of petroleum distillate fractions by decomposing the contaminant with negligible effect on the boiling range of the feed. Unionfining is designed primarily to remove sulfur and nitrogen. In addition, the process does an excellent job of saturating olefinic and aromatic compounds while reducing Conradson carbon and removing other contaminants such as oxygenates and organometallic compounds.

The desired degree of hydro treating is obtained by processing the feedstock over a fixed bed of catalyst in the presence of large amounts of hydrogen at temperatures and pressures dependent on the nature of the feed and the amount of contaminant removal required.

The hydrotreater unit is designed to improve the Diesel cetane number to 48.5(min) while *meeting the diesel stability specification* of 1.6 mg/100ml(max) and reducing sulfur content to 0.2wt%. Future provisions are considered in this unit to produce HSD of cetane no.51 and further reduction of sulfur content to 0.05wt%. The two features of Hydro treating Process and refining reactions. The refining reactions are desulphurisation and denitrification. The mercaptides, sulphides and disulphide react in an atmosphere of hydrogen to form corresponding saturated and aromatics compounds, H2S and NH3. The Hydrotreater feed consists of Straight Run Kerosene II (SRK II) and Coker Kerosene I (CK-I) and Diesel mode consisting of Straight Run Gas Oil from low sulphur imported crude (SRGO-LS), Straight Run Gas Oil from high sulphur imported crude (SRGO-HS), Total Cycle Oil from FCCU (TCO) and Light Coker Gas Oil (LCGO).

Unionfining units are designed for dependable, stable operation. UOP's selective, high-activity catalysts operate for long periods of time between regenerations. Specific process objectives determine which UOP catalyst is best suited for a particular installation. The activity and selectivity of the catalyst is influenced only to a slight extent by the type of feed processed. The same catalyst in varying quantities can be used to hydrotreat straight run naphtha, vacuum gas oil, and catalytically and thermally cracked distillates. The widespread use of catalytic reforming units has made available large quantities of excess hydrogen, making it feasible to hydrotreat many, or all, of the distillate produced by the refinery.

This "Operation Manual" has been prepared to aid the personnel responsible for the operation of the Diesel Hydro treating (DHDT) unit for the Barauni Refinery Expansion Project of the Indian Oil Corporation Limited (IOCL), India.

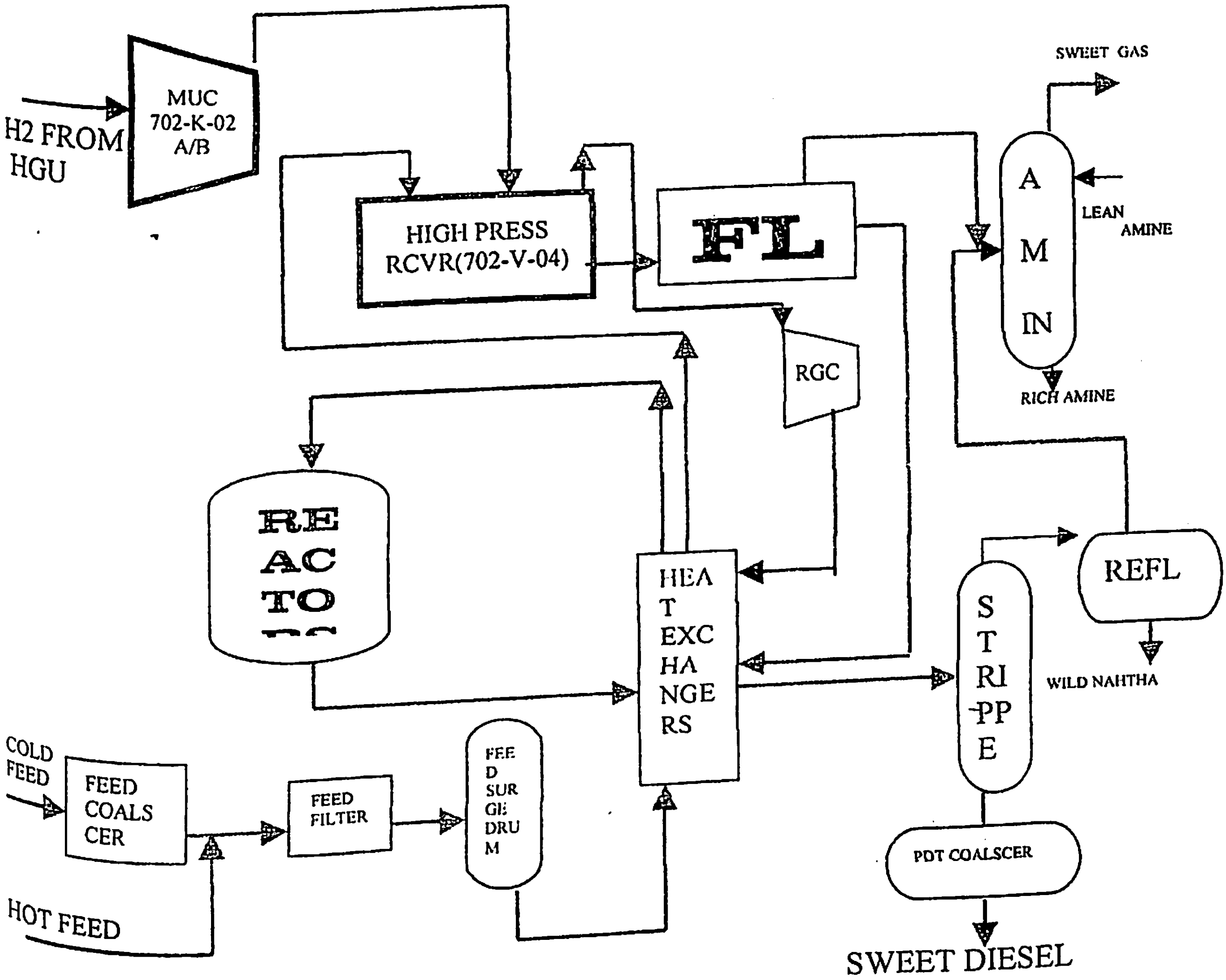
The supervisory operating guidelines were prepared by UOP, and the operation manual prepared by IOCL covers detailed operation procedure based on the supervisory operating guidelines.

General Process Description

The function of DHDTU is to improve the Diesel quality by removing the impurities like Sulphur, suspended particles and by the increasing the cetane number of Diesel. Increased cetane number help to improve the ignition property of fuel.

The Diesel is fed to the unit through pump 702-P-01 A/B/C, removes water particles suspended particles by feed coalscer (V-01) and feed filter (G-01) the pump 702-P-02 A/B send the feed to reactors from surge drum V-02 though feed Exchanger (E-03/06) and heater (F-01). In reactor the product react with H2 in presence of catalyst and increase the cetane number of Diesel. The products then enter to high-pressure receiver V-04 after releasing temperature through exchangers (E-06/04). The H2 from HGU through Compressors 702-K-02 A/B enters to the receiver (V-04). The liquid product from (V-04) bottoms enters to stripper column C3 via low-pressure flash drum (V-05) and Exchanger train E-04. The gaseous product (H2) from V-04 enters to suction of Recycle gas Compressor (702-K-01) & enters to Reactors after gaining temperature from Exchanger Train E-02, 05 & 07. The gaseous product from top of low-pressure flash drum (V-05) is taken to Amine absorber where H2S is absorbed in Amine. The Rich Amine is taken from the bottom of the absorber. Sweet gas from the top of the absorber is taken to Fuel gas header of Refinery.

DHDT BLOCK FLOW DIAGRAM



PROCESS & PLANT DESCRIPTION

The exact arrangement of lines, vessels, etc. may vary from unit to unit, but basically all units will consist of a reaction section and a fractionation section. These two sections are described below in general terms.

REACTION SECTION

Fresh Feed System

The feed to the unit can be either cold (40deg C) or hot (100deg C). Feed obtained from offsite storage tanks at 40deg C is pumped into a Feed coalescer (702-V-01) for the removal of potential free water. The feed is further heated to 100deg c in a preheater exchanger (702-E-01). Hot feed is sent from offsite and pumped by Hot feed pumps (702-P-08A/B). The combined feed is sent through a Feed Filter (702-G-01) for removal of suspended solids to the feed surge drum (702-V-02), which is blanked with nitrogen to prevent gum formation resulting in possible equipment fouling.

The feed pumps (702-P02A/B) take suction from the feed surge drum (702-V-02) and pump. the raw oil to reactor loops and the feed is preheated via process exchangers (702-E-06 and 702-E-03) with reactor effluent.
The feed pumps are high head machines capable *of pumping* large volumes of oil at pressures of over 120 kg/cm2. The manufacturer's instructions must be consulted before operating the charge pumps since special care must be taken to avoid damage due to low flow, high temperatures, *vibration, etc.* Proper lubrication and cooling must be assured at all times both for the pump and its driver if serious damage is to be avoided. This type of pump should never be operated against a blocked discharge, nor at flow rates below the *minimum* recommended by the manufacturer. A spillback to the surge drum may be added to maintain minimum flow at reduce throughput.

Feed Heat Exchange

In a more commonly used heat recovery scheme, the reactor charge is preheated by the reactor effluent in a series of feed-effluent exchangers before entering the reactor charge heater This attempts to recover as much heat as possible from the heat of reaction. Liquid feed is preheated separately with reactor-effluent exchanges (702-E-06 and 702-E03) before combining with the recycle gas, which is also preheated, with reactor-effluent exchanges (702-E-07, 702-E-05 and 702-E-02). The combined feed stream enters a mixed phase heater to reach the desired reactor inlet temperature (340-370□). A fresh feed bypass around one or more exchangers is used to provide better control of the charge heater outlet temperature.

Austenitic stainless steel materials are normally used in the hottest heat exchangers. The austenitic stainless steel in DHDT are

1) E08 A/B
2) E07
3) E06 A1/B 2
4) E05
5) E04 A/B
6) E03 A1/2/3 & B1/2/3
7) E02
8) F01

These materials provide the best resistance to the corrosive atmosphere and severe operating conditions. However, they are subject to stress corrosion when exposed to air and moisture. This type of corrosion can be avoided by neutralizing the sulfide scale on the tube walls and by avoiding the condensation of moisture in the tubes. Protection of austenitic steel equipment is described in detail in the Special Procedures section.

Makeup Hydrogen System

Make-up H2 is obtained from Hydrogen unit at a pressure of 19.5kg/cm2g. Since the reactor section pressure is 90-95 kg/cm2g, the make-up gas must be compressed before it can join the system. The compression system consists of two identical makeup compressors (702-K-02A/B). Reciprocating compressors are used to raise the pressure of the gas, with two stages of compression varying in accordance with the difference between the supply and reaction section pressures. From the discharge of the last stage of compression, the makeup gas joins the recycle gas just before Effluent condenser (702-AC-01). The point of entry into the reactor circuit depends on whether or not a stage of compression can be saved by entering the circuit at a lower pressure location.

On multi-stage compressors the gas from the first stage must be cooled to about 45deg C before it can enter the second stage. The spillback gases, used to control the interstage suction from and make up suction drum pressures also need to be cooled in First stage discharge cooler (702-AC-03) and First stage discharge trim cooler (702-E-10) before being returned to the first suction drum (702-V-07).

Reciprocating compressors are driven by electric motors. The manufacturer's instructions for the startup, shutdown and care of these units must be studied and well understood. In general, close attention must be paid to the compression ratio across each cylinder as well as the suction and discharge temperatures. Excessive compression ratios must be avoided since they will lead to high cylinder discharge temperatures, rapid wear, low compressor efficiency, and a possible overloading of the drive.

The cylinder discharge temperatures give a very good indication of the performance of the machine and should be recorded on a regular basis. Higher than normal temperatures show that cylinder or interstage cooling may be inadequate, or that the compressor valves are faulty. In such cases, quick remedial action must be taken in order to avoid overheating and damaging the cylinders. It must be remembered that higher than design compression ratio and high molecular weight gases (as indicated by a reduction in H2 purity) will increase the load on the driver..

The flow of makeup gas through the compressor and into the unit is controlled by a complex system of pressure controllers on the high pressure separator and the first stage suction drum. The basic philosophy of the control scheme is to control the flow of gas as the demand for hydrogen dictates (as determined by the pressure in the high pressure separator). As hydrogen is consumed in the reactors, the pressure in the high pressure separator will start to decrease. This will in turn call for more makeup gas by closing the control valve in the spillback line from the final stage discharge to suction. This will cause the suction pressure of the final stage to decrease, which then closes the spillback around the second stage of compression. This works in the same way back through each stage, with the net result that less gas is spilled back through each stage and more gas flows forward into the Process.

In the event that the unit is calling for more makeup gas than is available (hydrogen consumption is too high), the pressure control system essentially works in reverse. The first stage suction drum pressure will start falling because there is not sufficient gas available from the hydrogen plant to replace what is being pumped out of the suction drum. When this happens, the pressure controller on the first stage suction drum senses the decrease in pressure and, in order to protect the first stage of the compressor from excessive compression ratio, overrides the second stage suction drum pressure controller and forces the first stage spillback valve to open. This spills back more gas back to the first stage suction drum to build the pressure back up. When this happens, the second stage suction drum pressure starts falling and its pressure controller opens the second stage spillback. The same thing happens to all stages of compression and the final result is that the high-pressure separator pressure will start decreasing. At this point the operator will recognize that hydrogen consumption is exceeding supply and must be reduced either by decreasing reactor temperatures or feed rate or both. Alternatively, the hydrogen supply may be increased.

It is very important for operating personnel to become familiar with the mode of control used so that pressure beyond the capability of the equipment may be avoided. The maximum allowable compressor temperatures and compression ratios should be obtained from the manufacturer and posted in the control room or near the compressors.

Recycle Hydrogen System

After separation of the gas and liquid phases in the high pressure separator (702-V-04), the gas leaves from the top of the high pressure separator and flows to the suction of the recycle gas compressor via Recycle gas K.O drum (702-C-01). The recycle gas will be sent to an amine scrubber to remove H2S in the future.

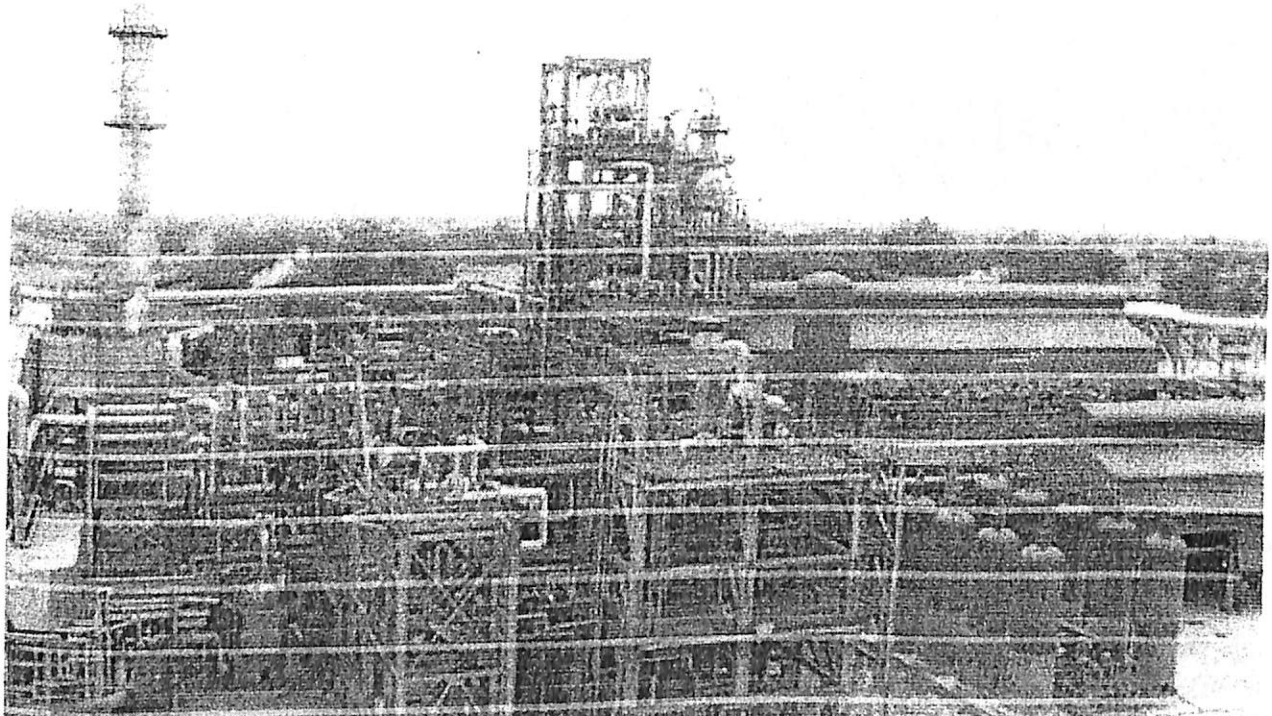
Non-condensable gases are removed from the condensate receiver by means of steam jet ejectors. The condensate is removed from the receiver and pumped to the refinery condensate header or H2 Plant in OSBL. Note that condensate should never be allowed to enter the turbine since it would seriously damage the rotor and other internals. Whenever the compressor is out of service the turbine casing drains should be kept open and sufficient steam flow should be maintained to keep the turbine warm.

Lube oil circulation should also be maintained when the compressor is down, and only shut off when required for maintenance.

After the recycle compressor discharge, some recycle gas will be split off the main stream for use as quench gas between catalyst beds in the reactor. Separate quench gas streams are used to reduce reactor interbed temperatures before each catalyst bed. Quench flow is regulated by a flow controller cascaded from a temperature controller at the top of the catalyst bed below the quench zone.

The makeup gas joins the recycle gas before the recycle gas compressor in order for a makeup stage of compression to be saved. The combined makeup and recycle gas is divided into passes which are normally allow controlled into the combined feed passes going to the combined feed exchanger. The object is to maintain equal gas flow to each reactor charge heater pass at a sufficiently high rate to avoid overheating the tubes. From this point until it returns to the high pressure separator, the gas flows along with the liquid through the reactor circuit in the same manner previously described.

HYDROGEN GENERATION UNIT
(HGU)



HYDROGEN GENERATION UNIT
(HGU)

Introduction

A Hydrogen Unit with a nominal capacity of 34,000 metric tones per annum of hydrogen is included in the processing scheme of Barauni Refinery.

The primary objective of the Hydrogen Unit is to produce hydrogen of 99.9-vol % purity to meet the hydrogen requirement of the Hydro treating Unit.

The process licensor :	Haldor Topsoe A/S, Denmark.
LSTK Contractor :	L&T Chiyoda
Process Consultant:	EIL

General Process Description

MAIN SECTIONS OF HGU ARE: -

- HDS SECTION
- REFORMER
- MT SHIFT SECTION
- PSA SECTION

Naphtha feed from surge drum V-04 is pumped to E-01 A/B feed vaporizer. FCC off gas is compressed & mixed to naphtha feed at its pump discharge. Recycle hydrogen is mixed to combined feed stream before the vaporizer. Naphtha, FCC off gas and Hydrogen mix after vaporization of naphtha feed in E-01, is superheated to 266 0C in E-02 with superheated HP steam.

Then it is sent to R-01 for hydrogenation of organic S and Cl compounds to H2S and HCl respectively. HCl is absorbed in R-02 and H2S is absorbed in R-03A/B. Desulphurized feed and unutilized H2 comes out of R-03 at around 385 0C. The de-sulphurised feed is mixed with the HP steam and heated to 490 0C in E-11. This stream goes to pre- reformer R-04, where controlled reforming reactions change the feed to methane. The outlet of R-04 is heated in E-12 to 625 0C and passed through reformer (F-01) tubes.

In reformer, the reforming reaction takes place and the feed and steam is converted to CO, CO2, H2. The steam reformed gas outlet from reformer contains CO, O2, H2, unconverted CH4 & unutilized steam. The process gas at outlet of reformer is at around 930 0C, which is cooled to 200 0C in WHB and BFW preheaters and passed through MT shift converter R-05 & LT shift converter R-06.

In shift converters, the carbon monoxide on reaction with steam gets converted to H2 and CO2. The unutilized steam is condensed in step cooling, down stream of R-06 and then the reformed gas is sent to PSA-1 to remove the CH4, CO, CO2 and production of 99.9% pure hydrogen.

Desulphurisation Section

General Information

Straight Run Naphtha alone or mixed with FCCU-off-gasses is used as feed to the desulphurisation section.

In the desulphurization section the sulphur and chlorine compounds are hydrogenated to form H_2S and HCl in the hydrogenator, 703-R-01, and are removed in the absorbers, 703-R-02 (HCl) and 703-R-03 A/B (H_2S).

Furthermore, the olefins present in the FCCU off-gas are saturated with hydrogen in the hydrogenate.

Feed

The hydrogen generation unit can be fed either by naphtha alone or naphtha mixed with FCCU off-gas. The pressure in the desulphurization section controls the feed flows. 703-PIC-1308 situated downstream 703-R-03 A/B, gives a set point to the naphtha feed flow controller, 703-FIC-1102.

Naphtha

The liquid naphtha feedstock is supplied at low pressure, about 4 kg/cm^2g, to the naphtha surge drum, 703-V-04. From the naphtha surge drum the naphtha is pumped by the naphtha feed pumps, 703-P-01 A/B to the desulphurization section, the second acting as spare. The pump discharge pressure is about 36 kg/cm^2g.

FCCU Off-Gas

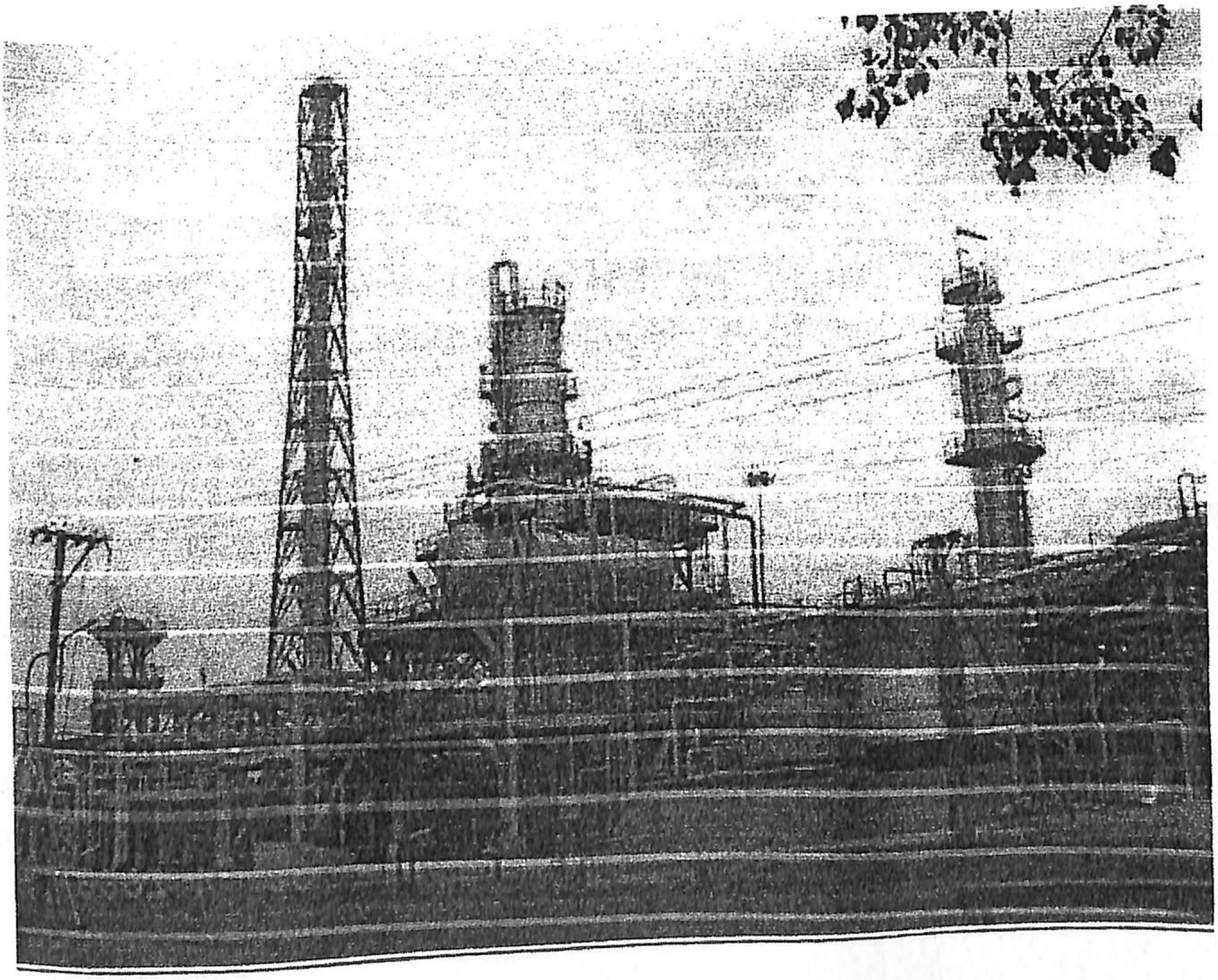
The FCCU off-gas is supplied at low pressure, about 12.5 kg/cm^2g, and is compressed in the feed compressor, 703-K-03 A/B, and mixed with the feed naphtha from 703-P-01 A/B.

If the suction pressure to 703-K-03 A/B becomes low, first a low passive alarm 703-PAL-1006) is given, and if the pressure continues to decrease an active interlock, I-112, will ramp down the FCCU off-gas flow on flow controller, 703-FIC-1103. When the pressure goes back to normal, the operator must manually reset I-112 and take FCCU off-gas back in operation. (Note 1)

Feed Control

Flow controllers, 703-FIC-1103 for the FCCU off-gas and 703-FIC-1102 for the naphtha, control the feed flows. 703-FIC-1102 acts in cascade with a pressure controller, 703-PIC-1308, keeping a constant pressure in the desulphurization section. FIC-1103 is controlled indirectly by FIC-1102 (flow of naphtha) and HIC-1102, which sets the ratio between FCCU off-gas and naphtha. This control system will ensure that all FCCU off-gas is used as feed up to a maximum of 30% by weight of the total feed. The cascade regulation principle as illustrated in Figure 1 is to ensure fast and stable regulation. (Note 2)

SULPHUR RECOVERY UNIT
(SRU)



SULPHUR RECOVERY UNIT
(SRU)

1.1 Introduction

Amine regeneration unit

The purpose of this unit is to receive rich amine (containing a high amount of dissolved H2S) from DHDT and FCCU, remove the h2s from it and return the lean amine (containing very low H2S) back to DHDT and FCCU for further absorption. The H2S thus released is sent to sulphur recovery unit.

Sour water stripper unit

The purpose of this unit is to receive sour water (containing a high amount of dissolved H2S) from DHDT, FCCU, AVUs and remove the H2S from it and return the stripped water back to the units. The H2S thus released is sent to sulphur recovery unit.

Sulphur recovery unit

The purpose of this unit is to receive H2S from ARU and SWS and convert it to elemental Sulphur using clause reaction, followed by super clause reaction. This liquid Sulphur is converted to solid form in the Sulphur yard.

The Sulphur Recovery Unit (Unit 706) in Barauni Refinery consists of two trains 706-1 (Train 1) & 706-2 (Train 2) of 40 MT/day capacities each with 10 % design margin.

The guaranteed turndown for SRU is 30 % (or 13.3 MT/day) based on the design base case feed gas rate (110 %) and12 composition as given below.

The feed gas to SRU is a mixture of the “Acid Gas ex ARU” and the “Sour Gas ex SWSU”. Each train in designed for 2738 kg/hr of feed.

PRODUCT YIELD AND SPECIFICATION

State: liquid sulphur

Colour : bright yellow (in solid state)

Purity : min 99.9% wt, on dry basis

H2S content : 10 ppm wt max

General Process Description

Amine Regeneration Unit:

Rich Amine i.e. more H2S in Amine received from DHDT/RFCCU are taken in Flesh Drum (704-V-01) & it pumps through 704-P-01A/B to column 704-C-01 via exchangers 704-E-01 to gain heat in Rich Amine to remove H2S from Rich Amine. H2S is extracted from top of the column and sent to SRU/ Sour flare and Lean Amine is collected at bottom and sent to DHDT / RFCCU to adsorb H2S in the Process to become Rich Amine.

Sour Water Stripping Unit:

H2S dissolved in water is known as sour water. Sour Water received from DHDT / RFCCU received in 705-V-01 goes to column 705-C-01 through pump 705-P-01A/B via exchanger 705-E-01A/B/C to gain Heat in Sour Water. Column tops contains H2S gas and sent to SRU/ Sour flare. And bottom product of column is stripped water sent to RFCCU/ ETP.

Sulphur Recovery unit:

Product from ARU/SWSU is taken in Main Combustion Chamber (MCC- 706-F-101) to burn H2S in controlled extent. Here sulphur vapour form at high temperature (1200°C) and the process gas sent through waste heat boiler (706-E-101) to reduce heat and then process gas goes to Sulphur condenser (706-E-102) to form gaseous Sulphur to liquid Sulphur. This liquid Sulphur goes to Sulphur pit via Sulphur lock. Sulphur is pumped to yard through Sulphur pit pump (706-P-101/102). The Sulphur lock arrests the process gas which contains a good amount of H2S. This process gas is sent to reactor 706-R-101 to convert H2S to Sulphur vapour and then Sulphur vapour sent to condenser 706-E-103 for condensing Sulphur for Sulphur pit and yard. Process gas from top of 706-E-103 goes to reactor to continue the process up to 706-R-103. After 706-R-103 the process /tail gas with minimum (1%) qty of H2S is burnt in incinerator (706-E-102) at a Temp 726-785°C.

General Information – SRU (Sulphur Recovery Unit)

The sulphur recovery process applied in the design, which is known as the Super Claus process, is based on the partial combustion of hydrogen sulphide (H2S) with a ratio controlled flow of air, which is maintained automatically in a correct quantity to accomplish the complete oxidation of all hydrocarbons and ammonia present in the acid gas feed and to obtain an H2S percentage of 0.5 – 0.7 vol % at the inlet of the Superclaus Reactor.

In the conventional Claus process, the 'Air to Acid Gas Ratio' is maintained to produce an H2S/SO2 ratio of exactly 2:1 in the burner effluent gases. This is known to be the optimum ratio of H2S/SO2 for the Claus reaction. The Superclaus process operates according to a different philosophy. In this process, the 'air to acid gas' ratio is adjusted to achieve an H2S/SO2 ratio of greater than 2:1 in the burner effluent.

The combustion air is controlled in such a manner that the concentration of H2S in the process gas entering the Superclaus stage is in the range of 0.5 – 0.7 vol % H2S.

(I) Claus Section

The main reaction in the main burner is :

$$H2S + 3/2\ O2 \longrightarrow SO2 + H2O + \text{heat}$$

The major part of the residual H2S combines with the SO2 to form sulphur, according to the equilibrium reaction

$$\mathrm{2\ H2S + SO2} \longleftrightarrow \mathrm{3/2\ S2 + 2\ H2O} - \text{heat}$$

By this reaction, known as the Claus reaction, sulphur is formed in vapour phase in the main burner and combustion chamber.

The primary function of the waste heat boiler is to remove the major portion of the heat generated in the main burner and utilize it to produce HP Steam.

The process gas from the waste heat boiler is passed into the 1st Sulphur condenser, where the formed sulphur is removed from the gas.

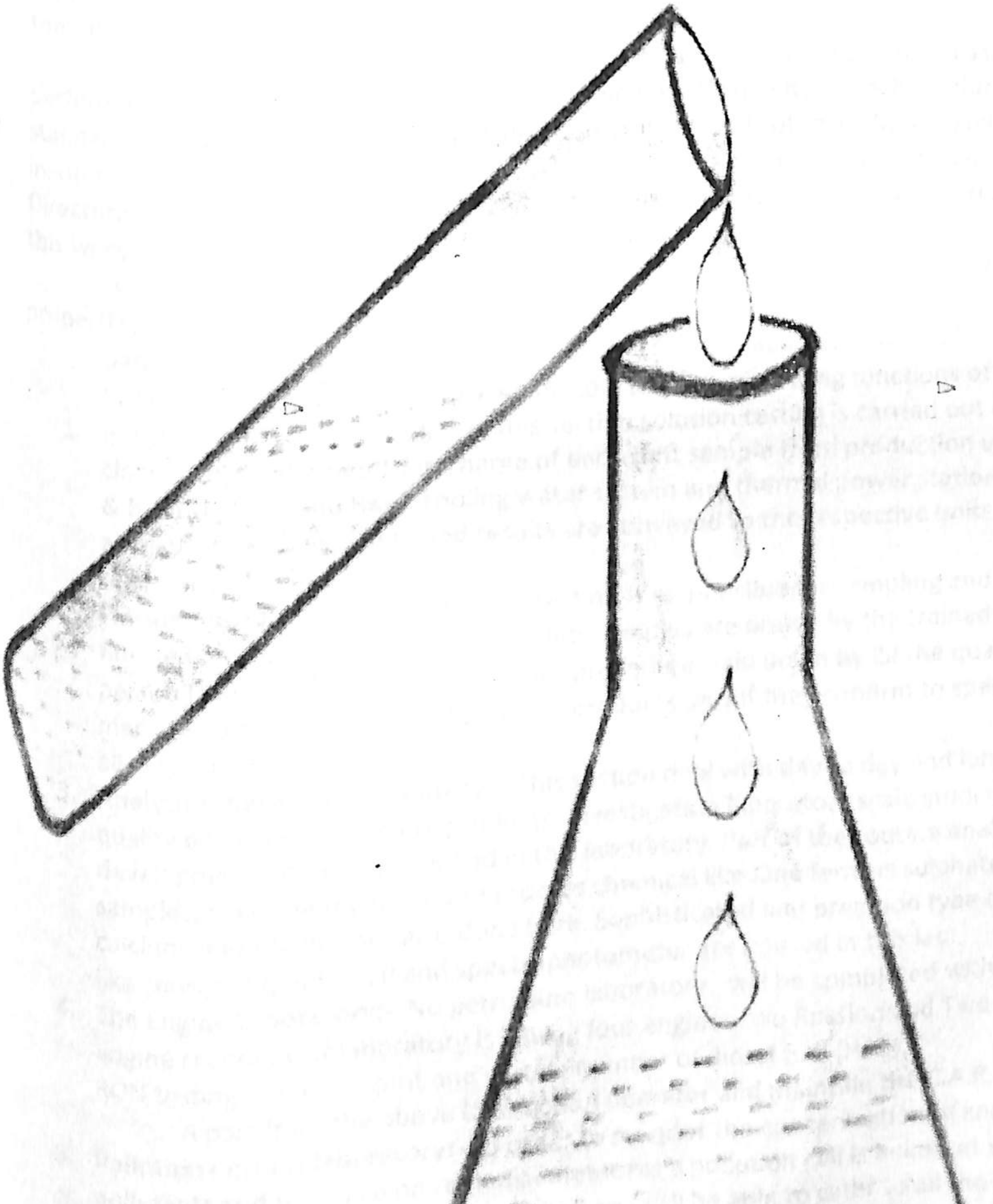
The process gas leaving the sulphur condenser still contains a considerable concentration of H2S and SO2, therefore the essential function of the following equipment is to convert these components to sulphur.

In the 1st, 2nd and 3rd reactor stages, the H2S and SO2 react again to form sulphur, but at a lower temperature and in presence of a catalyst.

In the Superclaus stage, the remaining H2S is selectively oxidized to sulphur. For this reason it is essential that the combustion in the main burner is such that at the downstream of the 3rd Reactor stage the amount of H2S is in the range of 0.5 – 0.7 vol % and the SO2 concentration is as low as possible.

Before entering the 1st Reactor, the process gas flow is heated by indirect steam reheat to obtain the optimum temperature for a high conversion of H2S and SO2 to elemental sulphur and simultaneously a high conversion of COS and CS2 to H2S and CO2.

QUALITY CONTROL



QUALITY CONTROL

Introduction

Quality control is the primary function of any industry. It is all the so more so in an oil industry like our Barauni Refinery. A Refinery laboratory is an important service section and it assists the production unit by supplying them quality control data on the product streams at regular intervals, routine tests apart laboratory also handles investigation problems, analysis of process chemicals and development of new products when required finally, it is responsible for the satisfaction of the finished products produces and dispatched

Quality control of petroleum products is to be insured so as to obtain a satisfactory performance of the product when used. Depending on the quality of each product, some standard organization has drafted specifications and methods of tests. Indian standards institution (ISI), Institute of petroleum (IP), American society for testing materials (ASTM), Directorate engine research and development (DERD) are some of the organization engaged in this work. There is an International standards organization(ISO) also for this purpose

A part from ISI specification, Central board of revenue have their own limits for certain properties of products for the purpose of axis levy.

Barauni Refinery has well established quality control laboratory with latest equipments.

Barauni Refinery quality control laboratory has five men wing functions of work.

1. **Routine control laboratory :-** In this section solution testing is carried out round the clock with a shift chemist in charge of each shift sample from production units(coker A & B, AVU-I/II/III and BXP), cooling water system and thermal power station are collected at regular intervals and tested results are conveyed to the respective units on telephone.
2. **Finished product laboratory:** - This section is responsible for sampling and testing of finished product tanks and L.P.G. bullets samples are drawn by the trained laboratory person from the tanks as per standard procedures laid down by ISI the quality control manager certifies the suitability to the products only if they confirm to specifications is all respects.
3. **Analytical Research Laboratory:** - This section deal with day to day and long range quality problems of refinery products. Investigation laboratory scale studies and development jobs being handled in this laboratory. Part of the routine analysis on water samples, checking the quality of process chemical like lime ferrous sulphate, rock salt, calcium chloride etc. are also done here. Sophisticated and precision type equipment like chromatograph. TBP and spectrophotometer are housed in this lab.
4. **The Engine Laboratory:-** No petroleum laboratory will be completed without an engine section. Our laboratory is having four engines two Russion and Two American for RON testing of motor spirit and certain number of diesel fuel (HSD).

   A part from the above this section operator and maintain the C.A.R.
5. **Pollution Control laboratory:** - In order to monitor the concentration of known pollutants and to advice on remedial measures a pollution cell is being set up in this laboratory. This section is fully equipped and will be able to cater to all the demands of environmental problems.

Following are the test and significance of petroleum products:-

(1) Density
(2) Distillation
(3) Flash point
(4) Fire point
(5) Smoke point
(6) Pour point
(7) Octane number
(8) cetane number
(9) copper corrosion
(10) RNS Test
(11) Gas chromatography of petroleum gases
(12) H_2S test
(13) Caustic Analysis
(14) Kinematic viscosity
(15) BS&W
(16) Acid gas analysis
(17) Water Test

TPM

Rahul Bhatnagar
Trainee in IOCL

TPM

What does it mean ?

TOTAL

DEVELOPMENT OF THE OVERALL EFFECTIVENESS

ENTIRE LIFE CYCLE OF THE PRODUCTIVE SYSTEM

TOTAL PARTICIPATION OF ALL EMPLOYEES

PRODUCTIVE

ZERO ACCIDENT / ZERO DEFECT

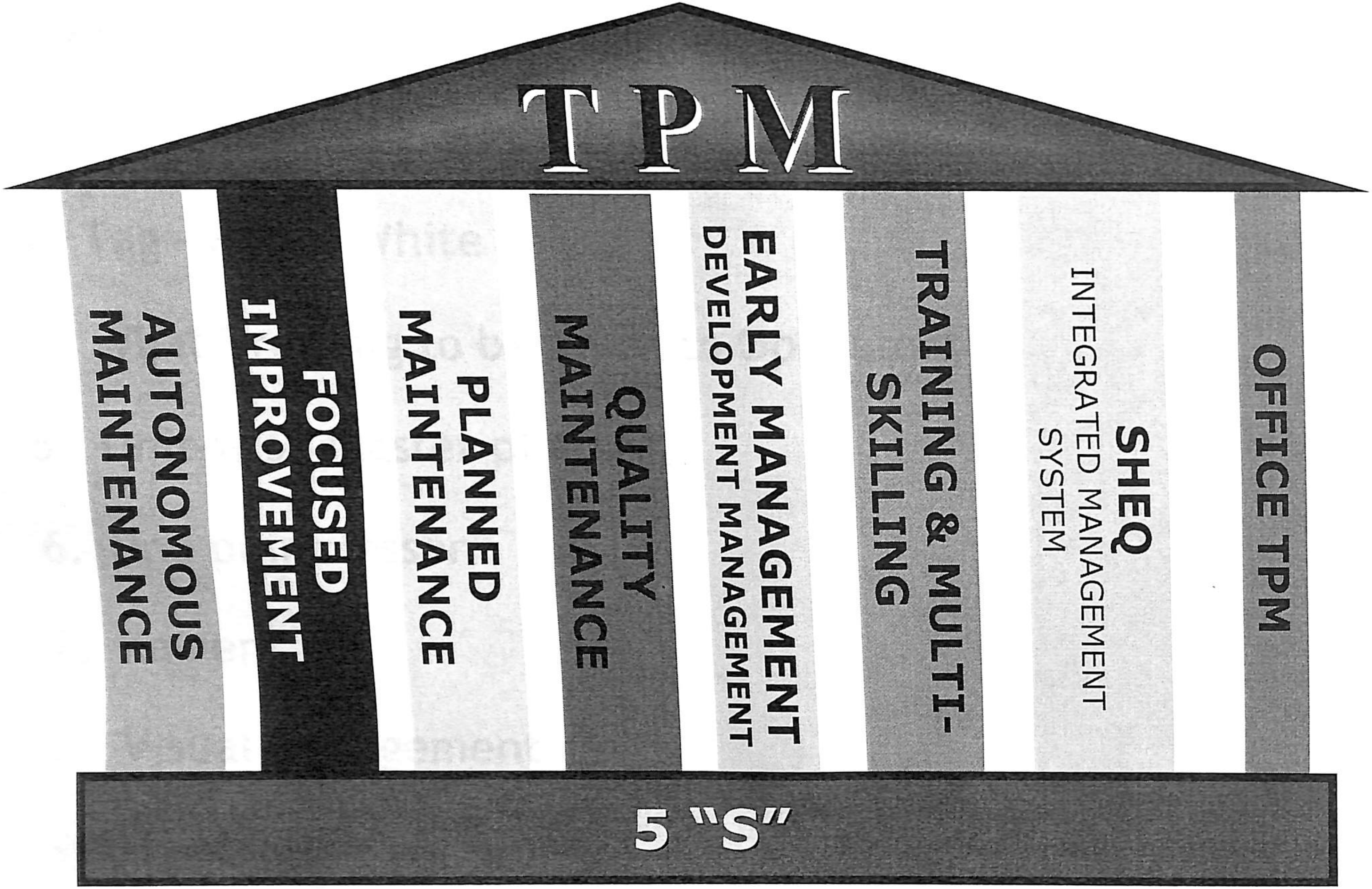
ZERO LOSS

ZERO DEFECTS / ZERO DEFAULT

MAINTENANCE

MAINTAINING THE IDEAL STATE OF PRODUCTION MANAGEMENT

8 - PILLARS



TPM

AUTONOMOUS MAINTENANCE

FOCUSED IMPROVEMENT

PLANNED MAINTENANCE

QUALITY MAINTENANCE

EARLY MANAGEMENT
DEVELOPMENT MANAGEMENT

TRAINING & MULTI-SKILLING

SHEQ
INTEGRATED MANAGEMENT SYSTEM

OFFICE TPM

5 "S"

OUTLINE OF PRESENTATION

1. Autonomous Maintenance - Step-1,2,3
2. Abnormalities - Seven types
3. Tag - Red & White
4. What Training to be given to Operators
5. Unit-wise master plan
6. One point lesson
7. Kaizens
8. Visual Management
9. Meetings

AUTONOMOUS MAINTENANCE

The most important pillar of TPM

GOALS

- Prevent equipment deterioration through correct operation & daily checks.

- Restore the basic condition of equipment & maintain it.

TOTAL PRODUCTIVE MAINTENANCE (TPM)

TOTAL

DEVELOPMENT OF THE OVERALL EFFECTIVENESS

ENTIRE LIFE CYCLE OF THE PRODUCTIVE SYSTEM

TOTAL PARTICIPATION OF ALL DIVISIONS

PRODUCTIVE

ZERO ACCIDENT

ZERO TROUBLE

ZERO DEFECTS

MAINTENANCE

MAINTAINING THE IDEAL STATE OF PRODUCTION MANAGEMENT

AUTONOMOUS MAINTENANCE
(JISHU HOZEN)

TOTAL PARTICIPATION OF ALL USERS

FROM

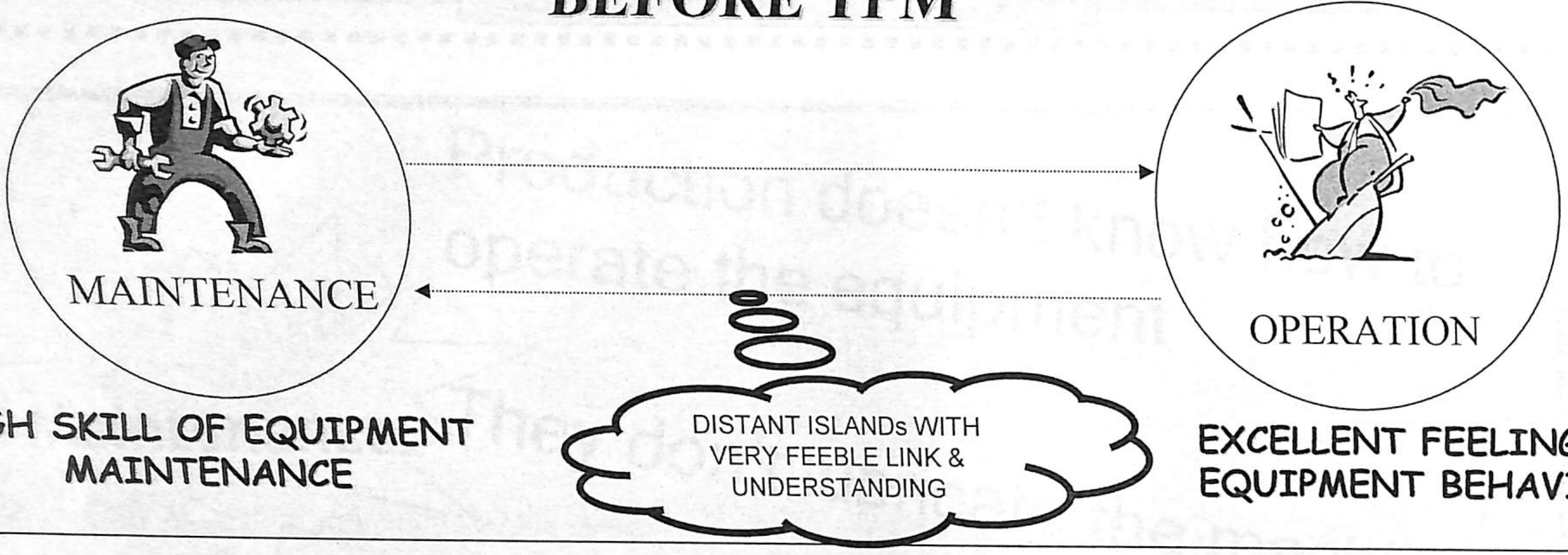
I OPERATE, SOMEONE FIXES IT

TO

I OPERATE, I FIX IT

PURPOSE FOR TPM IMPLEMENTATION AT BR

BEFORE TPM



MAINTENANCE

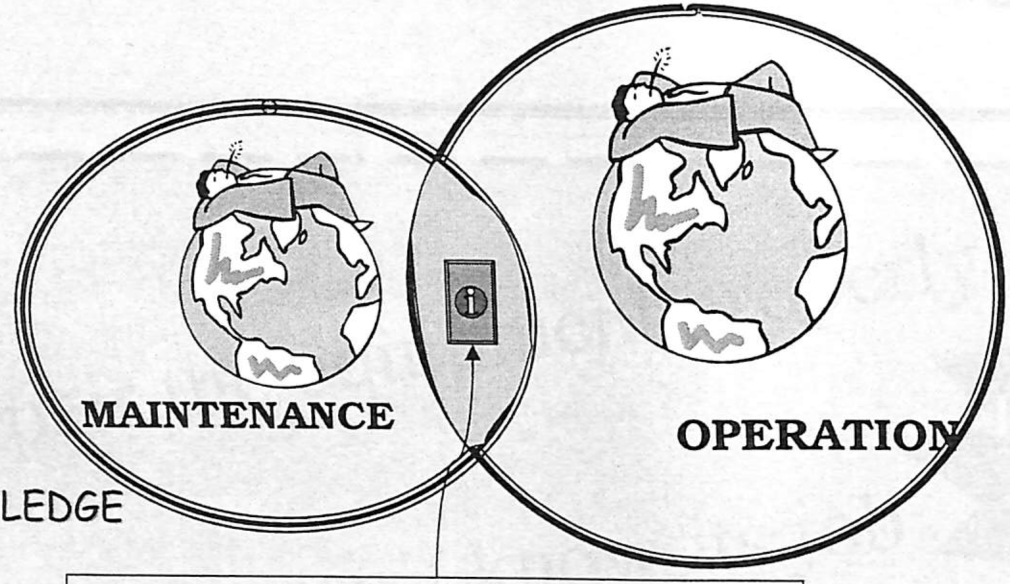
OPERATION

HIGH SKILL OF EQUIPMENT MAINTENANCE

DISTANT ISLANDs WITH VERY FEEBLE LINK & UNDERSTANDING

EXCELLENT FEELING OF EQUIPMENT BEHAVIOUR

AFTER TPM



MAINTENANCE

OPERATION

POSSESS MORE KNOWLEDGE ON PROCESSES

POSSESS MORE KNOWLEDGE ON EQUIPMENT INTRICACIES

COMMON AREA OF UNDERSTANDING EVOLVED

THE PROBLEM

Maintenance

Production doesn't know how to operate the equipment

They don't lubricate the machines

Production

They don't repair the equipment properly

Maintenance doesn't know its job

STEPS OF *AUTONOMOUS* MAINTENANCE

Know Your Equipment - STEP "0"

1. Perform Initial Cleaning
2. Address contamination sources & inaccessible places
3. Establish cleaning & inspection standards
4. Conduct general equipment inspection
5. Perform general process inspection
6. Systematic autonomous maintenance
7. Practice full self management

STEPS OF AUTONOMOUS MAINTENANCE

1. Perform Initial Cleaning

Make the list of

- Hard to clean
- Hard to lubricate
- Hard to tighten
- Hard to inspect
- Hard to adjust

Areas/ Parts

- Record cleaning time
- Carry out audit of 1st step
- Refer to the old history records

STEPS OF AUTONOMOUS MAINTENANCE

2. Countermeasures against abnormalities

- Eliminate sources generating dirt, dust & stains, prevent splashing & improve places.
- Eliminate hard to access areas, oil & check to shorten time required for cleaning, lubrication, inspection & tightening.
- Learn approach to equipment KAIZEN and achieve tangible results.

STEPS *OF AUTONOMOUS MAINTENANCE*

3. Formulation of clean up & lubrication standards

- Basic conditions of activities to prevent equipment deterioration.
- Maintenance & management of lubrication
- **Action standard** allowing accurate maintenance of basic conditions
- New ideas for visual control.

WHAT IS TO BE DONE DURING AM HOUR

1. Put on the HAND GLOVES
2. Take all necessary items like JUTE, BRUSH Etc. for cleaning.
3. Carry the ABNORMALITY TAGS


18/03/2004


13/04/2004

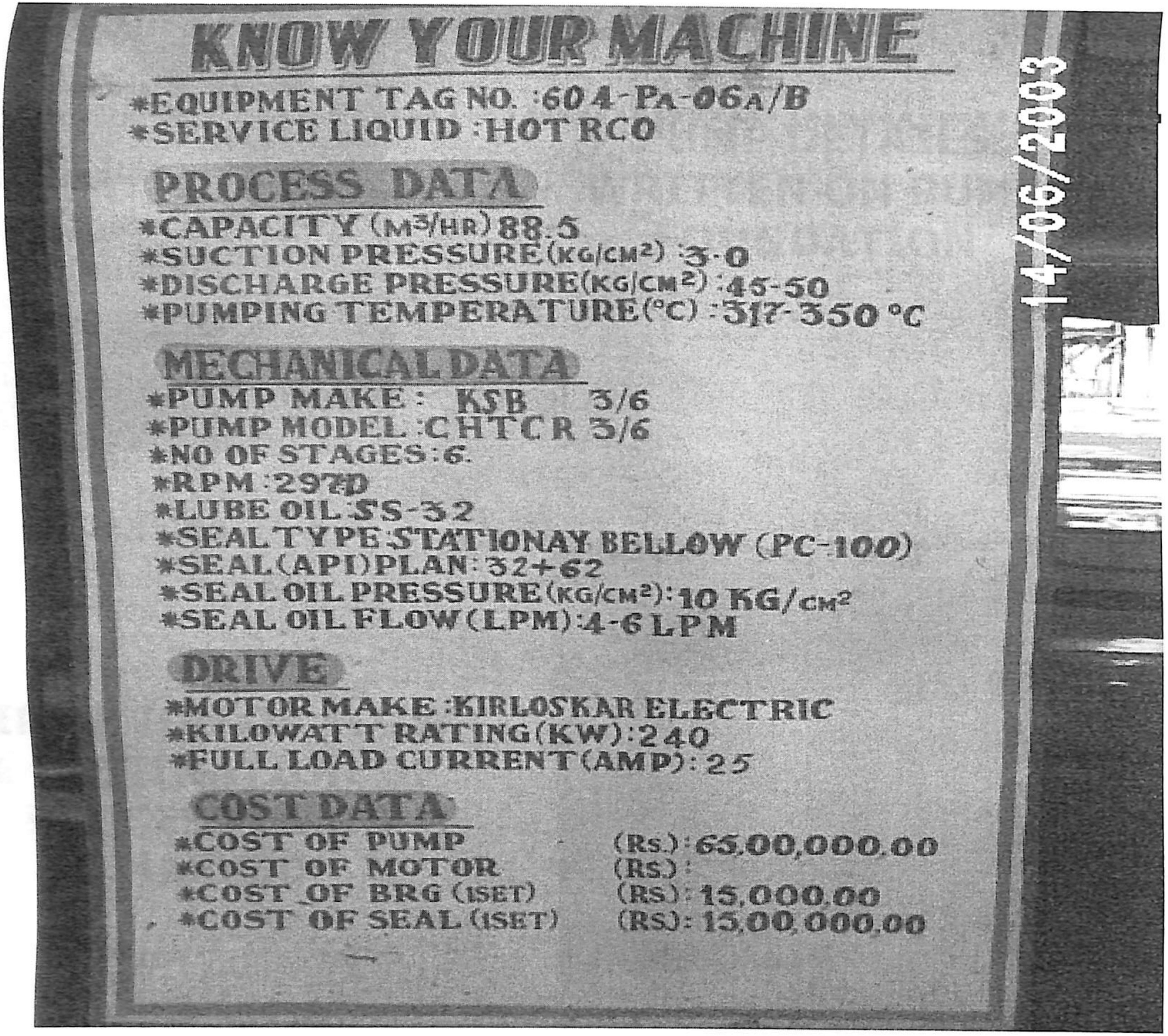
4. Do CLEANING & INSPECTION
5. Find out the ABNORMALITIES

6. Put the ABNORMALITY TAGS
7. Take a SHORT NOTE of them


18/03/2004


18/03/2004

8. Note the defects in the DEFECT REGISTERS.
9. Put SIGNATURE on the ATTENDENCE REGISTER.
10. Mention the CLIT TIME



14/06/2003

KNOW YOUR MACHINE

*EQUIPMENT TAG NO. :604-PA-06A/B
*SERVICE LIQUID :HOT RCO

PROCESS DATA

*CAPACITY (M^3/HR) 88.5
*SUCTION PRESSURE(KG/CM^2) :3·0
*DISCHARGE PRESSURE(KG/CM^2) :45-50
*PUMPING TEMPERATURE(°C) :317-350 °C

MECHANICAL DATA

*PUMP MAKE : KSB 3/6
*PUMP MODEL :CHTCR 3/6
*NO OF STAGES:6.
*RPM :2970
*LUBE OIL SS-32
*SEAL TYPE STATIONAY BELLOW (PC-100)
*SEAL(API)PLAN: 32+62
*SEAL OIL PRESSURE(KG/CM^2):10 KG/CM^2
*SEAL OIL FLOW(LPM):4-6 LPM

DRIVE

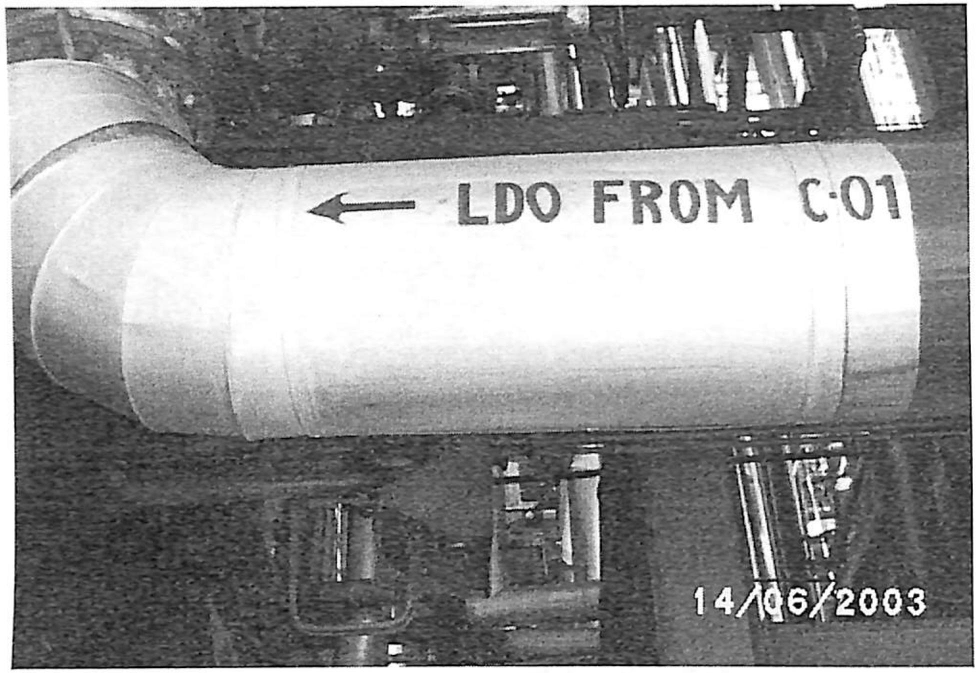
*MOTOR MAKE :KIRLOSKAR ELECTRIC
*KILOWATT RATING(KW):240
*FULL LOAD CURRENT(AMP): 25

COST DATA

*COST OF PUMP (Rs.):65,00,000.00
*COST OF MOTOR (Rs.):
*COST OF BRG (1SET) (RS.):15,000.00
*COST OF SEAL (1SET) (RS.):15,00,000.00

PUMP DETAILS WRITTEN ON PUMP FOUNDATION

DIRECTION OF FLOW & DESTINATION OF PROCESS FLUID MARKED



TPM BOARD IN FRONT OF COKER-A

TPM OBJECTIVE DISPLAYED IN COKER-A

COKER A RUNNING ON T P M

टी.पी.एम. उद्देश्य

मशीनों की उपलब्धता बढ़ाना
मशीनों की कार्यकारी आयु का विस्तार
मशीनों की न्यूनतम रखरखाव लागत
मशीनों का मनोनुकूल आचरण
कर्मचारियों, मशीनों तथा समीपवर्ती क्षेत्रों का सुरक्षा कवच मजबूत करना।

टी.पी.एम. दृष्टि

शून्य दुर्घटना
शून्य ब्रेक डाउन
शून्य क्षति

14/06/2003

ABNORMALITIES

ABNORMALITIES

MINOR FLAWS	
Contamination	Dust, dirt, powder, grease, rust, paint.
Damage	Creaking, crushing, deformation, chipping, bending.
Play	Shaking, falling out, tilting, eccentricity, wear, distortion, corrosion.
Slackness	Belts, chains
Abnormal phenomena	Unusual noise, overheating, vibration, strange smells, discoloration, incorrect pressure of current.
Adhesion	Blocking, hardening accumulation of

ABNORMALITIES

UNFULFILLED BASIC CONDITION	
Lubrication	Insufficient, dirty, unidentified, unsuitable, or leaking lubricant
Lubricant supply	Dirty, damaged, or deformed lubricant inlets, faulty lubricant pipes.
Oil level gauges	Dirty, damaged, leaking; no indication of correct level.
Tightening	Nuts and bolts: slackness, missing, cross threaded, too long, crushed, corroded, washer unsuitable, wing nuts on backward.

ABNORMALITIES

INACCESSIBLE PLACES	
Cleaning	Machine construction, covers, layout, footholds, space
Checking	Covers, construction, layout, instrument, position and orientation, operating range display.
Lubricating	Position of lubricant inlet, construction, height, footholds, lubricant outlet, space.
Tightening	Covers, construction, layout, size, footholds, space.
Operation	Machine layout, position of valves, switches and levers, footholds.
Adjustment	Position of pressure gages, thermometers, flow meters, moisture, vacuum gauges, etc.

ABNORMALITIES

CONTAMINATION SOURCES

Product	Leaks, spills, scatter, overflow
Raw materials	Leaks, spills, scatter, overflow
Lubricants	Leaking, splits, and seeping lubricating oils, hydraulic fluids, fuel oil, etc.
Gases	Leaking compressed air, gases, steam, vapours etc.
Liquids	Leaks, spills of cold water, hot water, intermediate products, hot oils, waste water, etc.
Scrap	Flashing, mixing of rejected oils & nonconforming product
Other	Contaminants brought in by people, forklift trucks, etc. and infiltrating through cracks.

ABNORMALITIES

QUALITY DEFECT SOURCES	
Foreign matter	Insulation, infiltration, and entrainment rust, oil scrapes, insects etc.
Shock	Dropping, jointing, collision, vibration.
Moisture	Too much, too little, infiltration, defective, elimination.
Concentration	Inadequate warming, heating, compounding, mixing, evaporation, stirring, etc.
Viscosity	Inadequate warming, heating, compounding, mixing, evaporation, stirring, etc.

ABNORMALITIES

UNNECESSARY AND NON-URGENT ITEMS	
Machinery	Pump, fans, compressors, columns, tanks, etc.
Piping equipment	Pipes, hoses, fittings, valves, dampers, etc.
Measuring instrument	Temperatures, pressure gauge, vacuum gauges, ammeters, etc.
Electrical equipment	Wiring, piping, power, leads, switches, plugs, etc.
Jigs and tools	General tools, cutting tools, jigs, moulds, dies, frames, etc.
Spares parts	Standby equipment, spares, permanent stocks, auxiliary materials, etc.
Makeshift repairs	Tape, string, wire, metal plates, etc.

ABNORMALITIES

UNSAFE PLACES	
Floors	Unevenness, ramps, projections, creaking, peeling, wear (steel deck plates)
Steps	Too steep, irregular, peeling, anti-slip covering, corrosion, missing handrails
Lights	Dim out position, dirty or broken covers, not properly explosion-proofed
Lifting gear	Wires, hooks, brakes, and other parts of cranes and hoists.
Other	Special substances, solvents, toxic gases, insulating materials, danger sings, protective clothing, etc.

TAGS

RED

WHITE

Visual

Management

MEETINGS

MEETING

Level of meeting	Frequency
Management Review	Fortnightly
Pillar Sub-committee	Fortnightly
Unit sub-Committee	**Weekly** (during TPM hour)
TPM **Circles**	**Weekly** (during TPM hour)

CURRENT ACTIONS

1. Selection of model area
2. Initial cleaning
3. Abnormality finding & recording
4. Autonomous Maintenance training to operators
5. Generation of KAIZENS
6. Generation of One Point Lessons
7. Ensure involvement of every body
8. Start Unit Sub-committee meeting & TPM Circle meeting

Most important

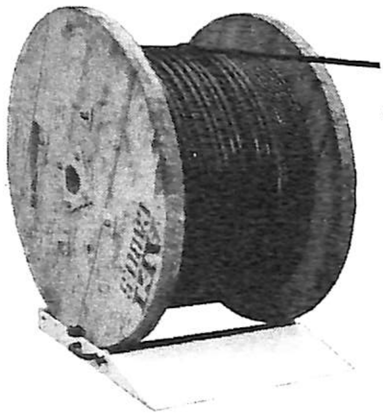
All the sub-committee members shall visit the unit during TPM hour & demonstrate TPM

TPM - One Point Lesson

Barauni Refinery

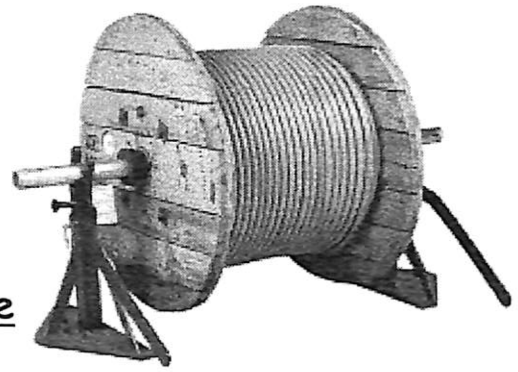
TPM

THEME	Cable Laying Practice			NO		
				DATE	14-04-07	
CLASSIFY	BASIC KNOWLEDGE	IMPROVEMENT CASE	TROUBLE CASE	PILLAR	GROUP LEADER	PREPARED BY
	✓			PM	D. DUTTA	D. DUTTA



Wrong Practice

☒



☑ **Correct Practice**

- Heavy cable Drum should be placed in a firm & even surface
- Lifting shaft should be capable to lift the load of the Cable Drum
- Cable drum should be lifted for unrolling with lifting Jack
- Lifting Jack should be firmly locked with the resting surface
- Drum should not be lifted too much. It should be lifted to the extant where the drum can rotate

ACTUAL RESULTS	Knowledge	Date executed	15/04/04					
		Teacher	D Dutta					
		Student	AMC personals					

TPM - One Point Lesson

Barauni Refinery

TPM

THEME	**Cable Gland assembly**			NO		
				DATE	14-04-07	
CLASSIFY	BASIC KNOWLEDGE	IMPROVEMENT CASE	TROUBLE CASE	PILLAR	GROUP LEADER	PREPARED BY
	✓				D. DUTTA	D. DUTTA

Cable Gland Assembled

Gland Assembly sequence

1. Use Cable Gland for any cable termination
2. Do not eliminate any component of the cable Gland during termination
3. Use the Gland component in proper order as given in the exploded view

ACTUAL RESULTS	Knowledge enhanced for safety	Date executed	15/04/04					
		Teacher	D Dutta					
		Student	AMC personals					

TPM - One Point Lesson

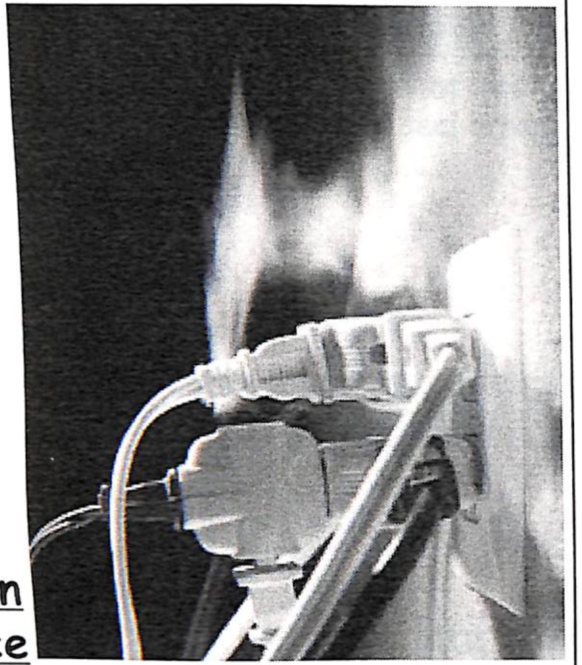
Barauni Refinery

TPM

THEME	**Multiple Power Connection from single point**			NO	
				DATE	20-04-07
CLASSIFY	BASIC KNOWLEDGE	IMPROVEMENT CASE	TROUBLE CASE	PILLAR	GROUP LEADER	PREPARED BY
	✓				D. DUTTA	D. DUTTA

Wrong Practice

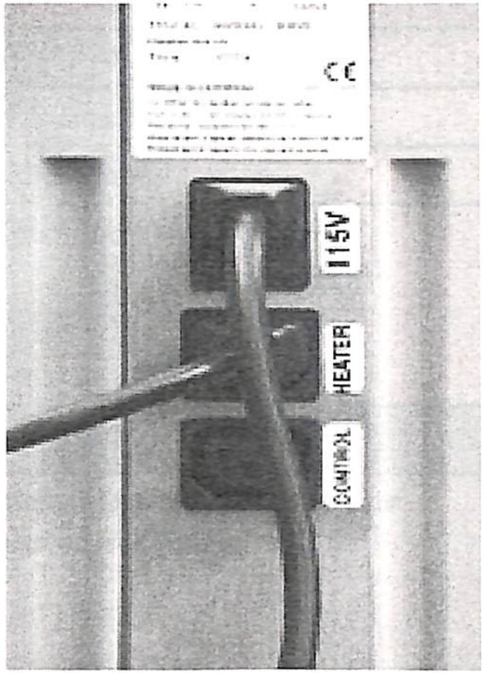
☒



Don't Take
Multiple Connection
From Single Source

Right Practice

☑



Use Single
Connection From
single Source

ACTUAL RESULTS	Safer working for enhanced electrical safety	Date executed	23/04/04					
		Teacher	D Dutta					
		Student	AMC personals					

Barauni Refinery

TPM

KAIZEN

Idea Sheet

Activity	KK	JH	PM	QM	DM	TRG	SHE	OTPM
Loss no./Step	☑							
Result Area	P	Q	C	D	S	M		
	☑							

Plant	Coker-A	Machine	H-11A/B	Component	Pumps

Kaizen Theme	Idea	Bench Mark
To avoid wastage of IFO through gland leakage	Replacement of the gland packing with mechanical seal	

Present Status	Countermeasures	Target	10/8/04
3 nos. of Russian screw pumps are installed in Fuel Oil Service. These are equipped with gland packing which results in fuel oil leakage.	Replacement of the gland packing system with mechanical seal arrangement.	KAIZEN Start	15/6/04
		KAIZEN Finish	
		Team Members	AK Roy S. Prakash J. Biruli

Analysis (WHY - WHY)	Results	Benefits (expected)
Wastage of Liquid ↓ Leakage from stuffing box ↓ Gland packing arrangement	Under Implementation	• Reduction of loss : Rs. 9.0 Lacs/year • Improved housekeeping

Eqpt.	Target	Resp.	Status

Keyword : Gland packing arrangement

TPM

KAIZEN
Idea Sheet

Barauni Refinery

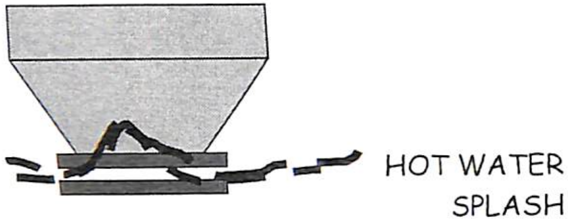
Activity	KK	JH	PM	QM	DM	TRG	SHE	OTPM
Loss no./Step							☑	
Result Area	P	Q	C	D	S	M		
					☑			

Plant	Coker-A	Machine	Reactor	Component	Bottom Cover

Kaizen Theme	Idea	Bench Mark
To avoid water splash on the operating person during opening of bottom flange.	To provide arrangement in bottom cover to avoid hot water splash during opening of bottom flange	

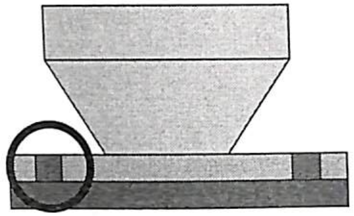
Present Status

During opening of the bottom flange of reactor leakage of water (temperature- 150 deg C) takes places which causes injury to the workers.



Countermeasures

- Bottom plate surface levelled.
- Stopper ring provided in bottom plate.
- Ring for provision of packing installed.



Target	15/6/2004
KAIZEN Start	20/4/04
KAIZEN Finish	14/6/04
Team Members	J. Biruli H. Singh Arjun Rai Mathura Rai

Analysis (WHY - WHY)

Risk of hot water burn & hit by Coke jets

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Splash of Hot water with coke

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No arrangement to stop leakage

Keyword : No arrangement to stop leakage

Results

- No splash of hot water through the reactor bottom cover
- Safe working atmosphere
- Good house keeping

Benefits

- Enhanced safety

Eqpt.	Target	Resp.	Status