INDIAN OIL CORPORATION LMTD
SUMMER INTERNSHIP PRESENTATION
(2023-24)

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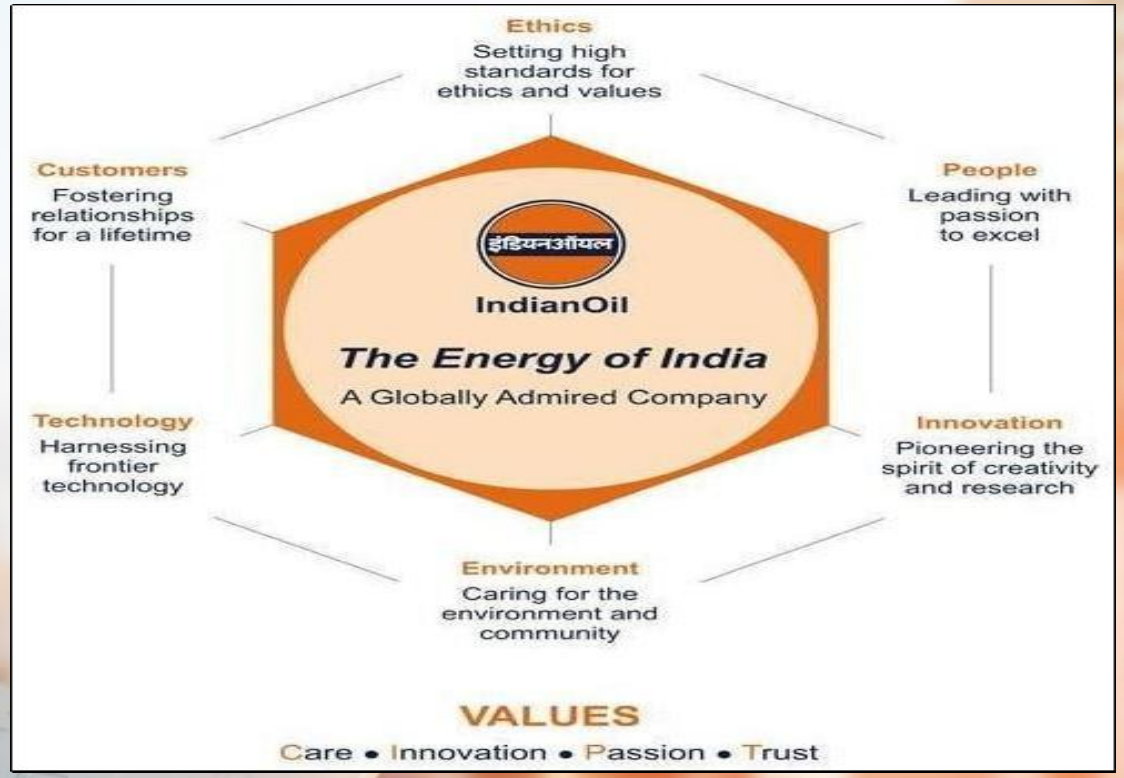
ABOUT IOCL

- Indian Oil Corporation (Indian Oil) is India's largest commercial enterprise, with a salesturnover of Rs. 9,34,953 crore (USD 65,391 million) and profits of Rs. 19,106 crores (USD2,848 million) for the year 2022-23.
- With a corporate vision to be 'The Energy of India' and to become “A globally admired company”.



ABOUT MATHURA REFINERY

- **Mathura Refinery, was commissioned in 1982 with a capacity of 6.0 MMTPA to meet thedemand of petroleum products in north western region of the country, which includes National Capital Region. Refinery is located along the Delhi-Agra National Highway about 154 KM away from Delhi.**

- **Its close proximity to the magnificent wonder Taj Mahal adds to extra responsibility towards acleaner environment. For upgrading environmental standards, old Sulphur Recovery Units (SRU) werereplaced with new Sulphur Recovery Units with 99.9 % recovery in the year 1999. Additional SulphurRecovery Unit (4th SRU) was implemented as a hot standby and was commissioned by 2011.**

MOTOR SPIRIT QUALITY UNIT(MSQU)

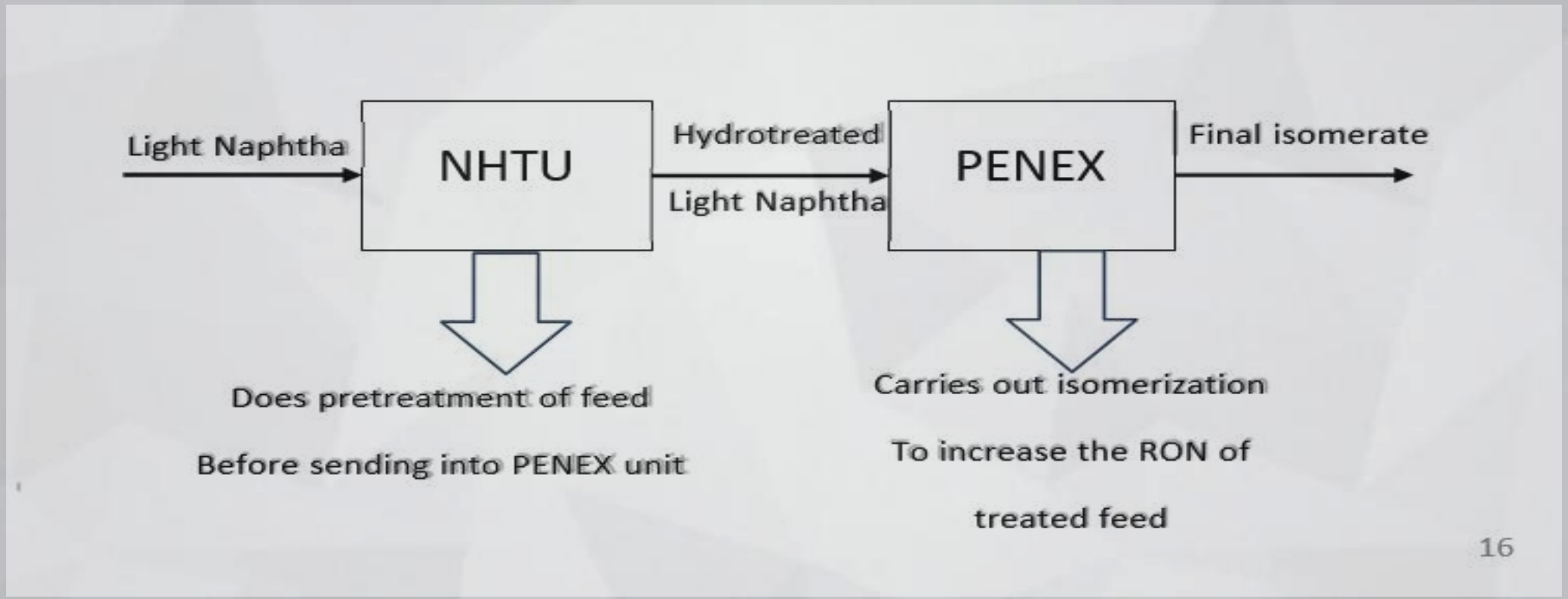
- **OBJECTIVE:** To Upgrade the Naphtha by increasing its Octane Number to Higher Octane , Low Benzene

- **FEED:** The feed to the MSQU unit is Light Straight Run (LSR) naphtha with feed cut of C5-85which majorly contains carbon chains of 5C and 6C (of which 4-5% is benzene) and sulfurcontent of about 400 ppm which is much more than BS-VI norms. Also the Research OctaneNumber (RON) of the feed LSR Naphtha is around (64-70) which has to be increased to around(84-86) with the help of isomerisation to meet RON conditions of BS-VI afterwards.

- **CATALYST**: Co-Mo for Hydrotreator Reactor
  Pt for Penex Reactor
  Ni based in Methanation
- **PROCESSES:** Naphtha Hydrotreating Unit
  Penex/Isomerization Unit

- The feedstock that is Light Naphtha first enters into the NHTU and is pretreated beforebeing sent into the PENEX unit for quality upgradation by increasing RON and removing benzene.
- The current capacity of the MSQU unit is 440 TMTPA
- **OPERATING CONDITION:** Temperature range :126-145°C

System Pressure: 33.5 kg/cm^2

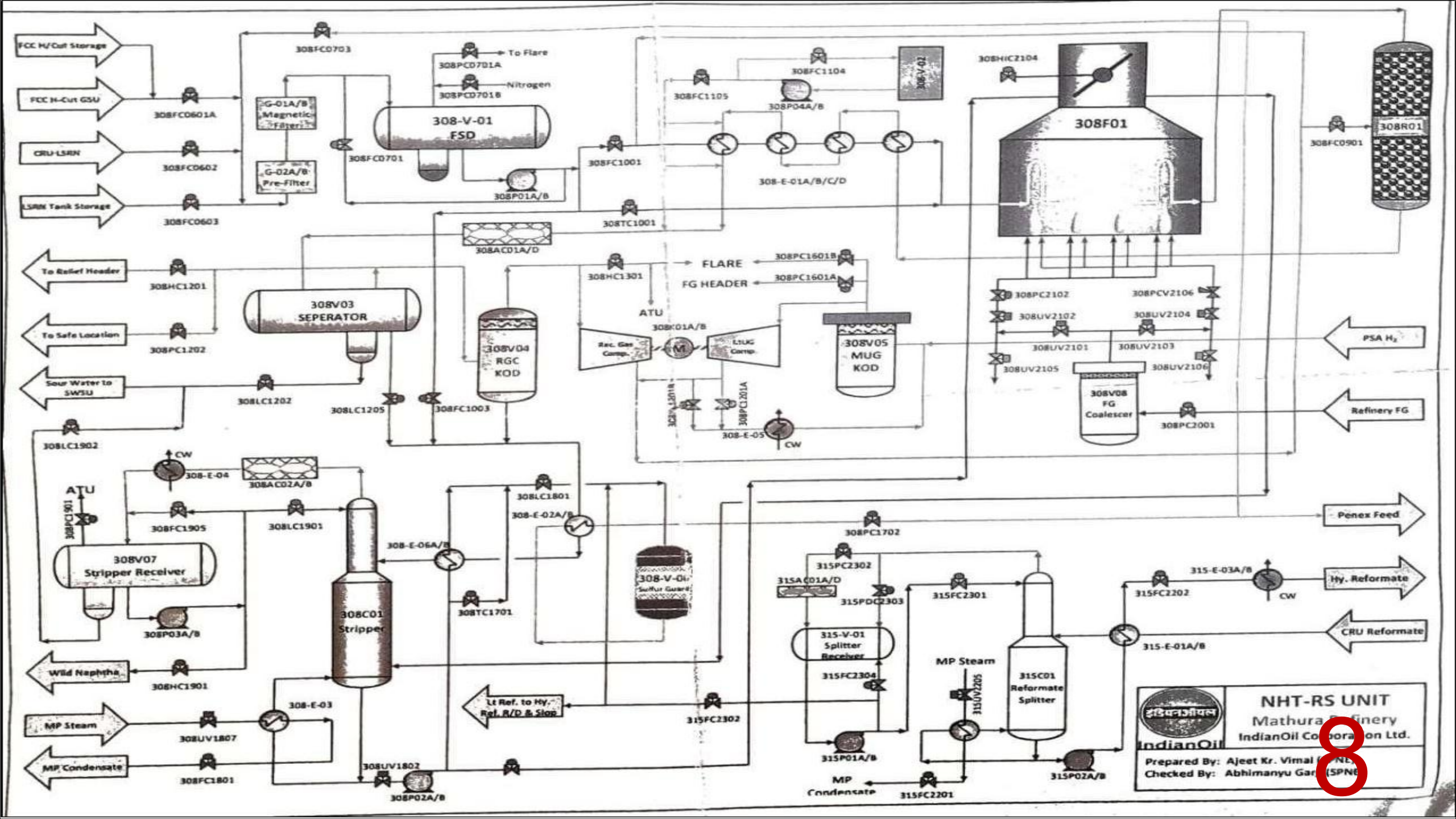


NAPHTHA HYDROTREATING UNIT (NHTU)

- **OBJECTIVE** – To remove the sulfur and other impurities and to saturate the olefins in FCC portion offeed for PENEX unit
- **FEEDSTOCK** – Feed consists of Light SR Naphtha produced from high “S” imported crude or low “S”crude, FCC Gasoline Heart Cut.
- **PRODUCT:** The product is Hydro-Treated Naphtha, which is the feed for the PENEX-DIH Process unit.
- **REACTION MECHANISMS**:The Main purpose of the Naphtha Hydrotreating Process Unit is to "Clean-up" the light naphthaso that it is suitable as charge to the Penex Unit. Reactions that occur in the Naphtha Hydro TreatingUnit are as follows.
- **Olefin Saturation**: Olefin saturation is almost as rapid as desulfurization and is highly exothermic Moststraight run naphthas contain only trace amounts of olefins, but cracked naphthas usually have higholefin concentrations. Processing high concentrations of olefins in NHTU must be approached with carebecause of the high exothermic heat of reaction associated with the saturation reaction.
- **Sulfur Removal:** Sulfur removal in the NHTU is relatively easy and for the best operation of a PENEXUnit, the Hydrotreated light naphtha sulfur content should be maintained below 0.1 ppm

sulfur or less in the light hydrotreated naphtha is common.

- Operating NHTU at too high a temperature for maximum sulfur removal is possible but recombination of hydrogen sulfide with smallamounts of olefins or olefin intermediates can then result which produces mercaptans in the product.(mercaptans are the organic components of hydrocarbons with sulfur,they have bad smell and corrosive properties.
- **Nitrogen Removal:** Nitrogen removal is considerably more difficult than sulfur removal in NHTU. Therate of de-nitrification is only about one-fifth the rate of desulfurization.
- PENEX catalyst a maximum of 0.1 ppm nitrogen allowed. Cracked naphtha's are expected to contain higher nitrogen levels. Any organic nitrogen that does enter the Penexwill cause permanent catalyst poisoning and will decompose to NH, and react with the chloride to form ammonium chloride leads to permanent catalyst poisoning.
- These problems can be avoided or minimized by maximizing nitrogen removal in theNHTU.
- **Metal Removal:** Most metallic impurities are permanently deposited onthe catalyst when removed from the naphtha.
- The catalyst loses activity for sulfur removal as highermetal loadings are reached. Some commonly detected components found on used hydrotreating iron, calcium, magnesium, phosphorous, lead, silicon, copper, and sodium. Removal ofmetals is essentially complete above temperatures of 315 °C


FCC H/Cut Storage
FCC H-Cut GSU
CRU-LSRN
LSRN Tank Storage
308FC0703
308FC0601A
308FC0602
308FC0603
G-01A/B Magnetic Filter
G-02A/B Pre-Filter
308PCD701A
To Flare
308PCD701B
Nitrogen
308-V-01 FSD
308FC0701
308P01A/B
308FC1001
308TC1001
308ACD1A/D
308FC1104
308FC1105
308P04A/B
308-E-01A/B/C/D
308HIC2104
308F01
308R01
308FC0901
To Relief Header
To Safe Location
Sour Water to SWSU
308HC1201
308PC1202
308LC1202
308LC1205
308V03 SEPERATOR
308V04 RGC KOD
308HC1301
FLARE
FG HEADER
308PC1601B
308PC1601A
ATU
308K01A/B
Rec. Gas Comp.
LTUG Comp.
308V05 MUG KOD
308PC2102
308PCV2106
308UV2102
308UV2104
308UV2101
308UV2103
308UV2105
308UV2106
308V08 FG Coalescer
308PC2001
PSA H2
Refinery FG
308LC1902
308-E-04
CW
308ACO2A/B
308FC1905
308LC1901
308LC1801
308-E-02A/B
308-E-06A/B
308TC1701
308V07 Stripper Receiver
308P03A/B
308C01 Stripper
308-V-04 Sulfur Guard
308PC1702
Penex Feed
315PC2302
315ACO1A/D
315PDC2303
315FC2301
315-V-01 Splitter Receiver
315FC2304
315P01A/B
MP Steam
315SV2205
315C01 Reformate Splitter
315P02A/B
315-E-03A/B
315FC2202
Hy. Reformate
315-E-01A/B
CRU Reformate
Wild Naphtha
308HC1901
MP Steam
MP Condensate
308UV1807
308FC1801
308-E-03
308UV1802
308P02A/B
Lt Ref. to Hy. Ref. B/D & Stor
315FC2302
MP Condensate
315FC2201
NHT-RS UNIT
Mathura Refinery
IndianOil Corporation Ltd.
Prepared By: Ajeet Kr. Vimal
Checked By: Abhimanyu Gar
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NHTU PFD EXPLANATION

- The purpose of Naphtha hydrotreater is to eliminate the impurities (such as sulphur, nitrogen,olefins oxygen,water,and metals) from the feed that would otherwise affect th performance and lifetime of reformer/PENEX unit catalyst .
- This is achieved by the use of selected catalyst (nickel) and optimum operating condition except for water , which is eliminated in strippper.
- In this unit, the naphtha coming from the NSU is mixed with H_2 which comes from the reforming unit.
- This mixture is heated to 340°C in the furnace and then passed to the hydrotreater reactor at a pressure of 22 kg/cm ^{2} .
- In the reactor , there are two beds of catalyst . In one bed, the unsaturated hydrocarbon are converted to saturated hydrocarbons and in the second bed impurities like N, S, and O are converted to NH_3 H_2O and H_2S respectively.
- The effluent of the reactor is sent to stripper section to eliminate the light end, mainly the H_2S and moisture from the reformate feed .
- There is a reboiler attached to the bottom of the stripper , which maintains the heat requirement .
- The product of the stripper is either sent to PENEX Unit.

- After the Hydro-treatment of Naphtha in NHT Unit, the amount of contaminants such as Sulfur, Nitrogen, Fluorides, Metals and most importantly moisture are reduced up to large extent to avoid degradation of catalyst present in PENEX Unit i.e. Platinum
- Thus this hydrotreated light naphtha feed can now be sent to PENEX unit for isomerization to increase the RON of the feed to our desired value of MSQU unit that is 86-88 and to reduce the amount of benzene content by ringopening as a side reaction.Therefore, NEXT UP PENEX/ISOMERIZATION UNIT.

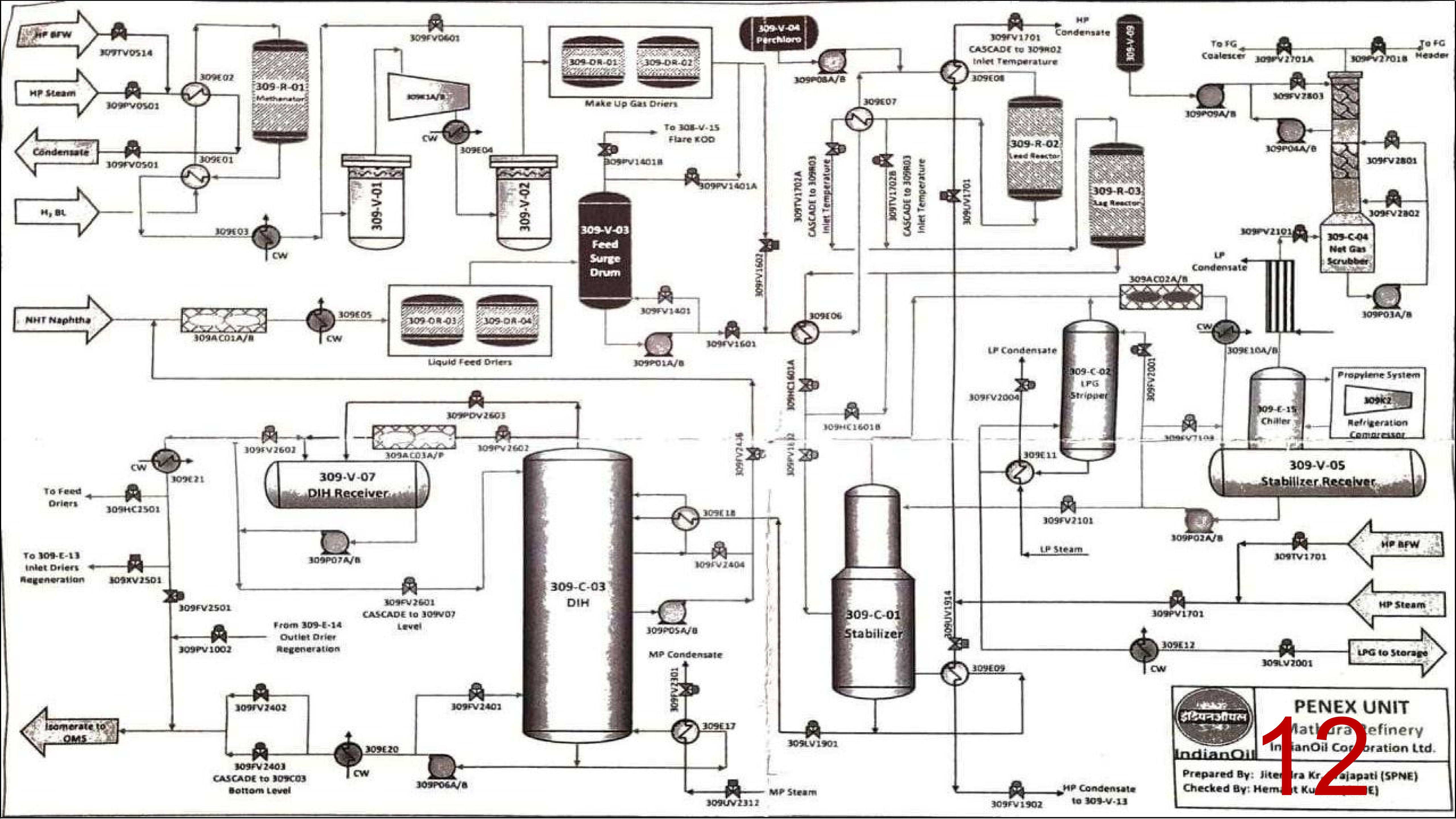
PENEX / ISOMERIZATION UNIT

- PENEX unit is used for converting low octane straight run naphtha (64-70) to high octane naphtha(84-86). Octane number is boosted by isomerization of n-paraffin to iso-paraffin in the presence ofHCL and Pt-AlCl3 catalyst.
- Other side reaction also takes place such as benzene saturation to cyclo-hexane, cyclo-paraffinsring opening and isomerization and cracking on some amount send to LPG storage.

- **CATALYST:** Pt catalyst with constant perchloro dozing to provide acidic medium. PERCHOLOROFORMULA – C2CL4 (PERCHLORO ETHYLENE).

PROCESS FLOW DESCRIPTION PENEX/ISOMERIZATION UNIT

- There are two fixed bed reactor , which convert normal C_5 and C_6 paraffin to isomers for increasing the octane number.
- Low octane methyl pentanes and unconverted n-hexane are recycled back.
- A stabilizer is used for removing light ends from the reactor effluent, before sending it to the deisohexaniser.
- Deisohexaniser Tower: For recovering and recycling the low octane numbers methyl pentanes and the unconverted n-hexane from the reactor effluent.
- The stabilizer reflux drum vent gas contains H_2 and chloride which are removed by neutralization with caustic soda in caustic scrubber.
- Dryers are used to dry the H_2O so that water is not present there as it the deactivator of catalyst.
- C_2Cl_4 is a activator of isomerisation catalyst.


HP BFW
309TV0514
HP Steam
309PV0501
Condensate
309FV0501
H2 BL
309E02
309E01
309E03
CW
309-R-01
Methanator
309FV0601
309K1A/B
309E04
309-V-01
309-V-02
309-DR-01
309-DR-02
Make Up Gas Driers
To 308-V-15
Flare KOD
309PV1401B
309PV1401A
309-V-03
Feed
Surge
Drum
309FV1401
309P01A/B
309FV1601
NHT Naphtha
309AC01A/B
309E05
309-DR-03
309-DR-04
Liquid Feed Driers
309-V-04
Perchloro
309P08A/B
309FV1602
309E07
309E06
309TV1702A
CASCADE to 309R03
Inlet Temperature
309TV1702B
CASCADE to 309R03
Inlet Temperature
309FV1701
CASCADE to 309R02
Inlet Temperature
HP
Condensate
309E08
309UV1701
309-R-02
Lead Reactor
309-R-03
Lag Reactor
309HC1601A
309HC1601B
309FV1612
309-V-09
To FG
Coalescer
309PV2701A
309PV2701B
To FG
Header
309P09A/B
309FV2803
309P04A/B
309FV2801
309FV2802
309PV2101
309-C-04
Net Gas
Scrubber
309P03A/B
LP
Condensate
309AC02A/B
309E10A/B
LP Condensate
309FV2004
309-C-02
LPG
Stripper
309FV2001
309FV2108
Propylene System
309K2
Refrigeration
Compressor
309-E-15
Chiller
309-V-05
Stabilizer Receiver
309E11
309FV2101
LP Steam
309P02A/B
HP BFW
309TV1701
HP Steam
309PV1701
309E12
CW
309LV2001
LPG to Storage
309-C-01
Stabilizer
309UV1914
309E09
309LV1901
309FV1902
HP Condensate
to 309-V-13
309PDV2603
309FV2602
309AC03A/P
309PV2602
309-V-07
DIH Receiver
309E21
To Feed
Driers
309HC2501
309P07A/B
To 309-E-13
Inlet Driers
Regeneration
309XV2501
309FV2501
309FV2601
CASCADE to 309V07
Level
From 309-E-14
Outlet Drier
Regeneration
309PV1002
309FV2416
309-C-03
DIH
309E18
309FV2404
309P05A/B
MP Condensate
309FV2301
309E17
MP Steam
309UV2312
309FV2401
309FV2402
309FV2403
CASCADE to 309C03
Bottom Level
309E20
309P06A/B
Isomerate to
OMS
PENEX UNIT
Mathura Refinery
IndianOil Corporation Ltd.
IndianOil
Prepared By: Jitendra Kr Prajapati (SPNE)
Checked By: Hemant Ku... (...E)

- LPG,H_2,HCl are stripped and sent to scrubber mainly to reduce C_4 contents so C_5 concentration increases.
- Light isomerate is used as regenerate for dryers.
- The two isomerate products from the deisohexaniser the light isomerate and heavy isomerate . The heavy isomerate is required to be cooled before storage.

- **TRANSPORT OF LIGHT ISOMERATE TO MS POOL**
- The light isomerate that is obtained from the MSQU unit having RON of 86-88 is now sent tomotor-spirit pool for blending with other high RON products such as reformates from CCRU,desulfurized FCCU gasoline from Prime-G to get our desired min. RON of 91 and which canbe now be sent from the refinery for consumption in the market. And some amount of LPG produced is sent to LPG Storage section of refinery.

FIRE AND SAFETY TRAINING

- The products obtained from the refinery are highly inflammable and associated processing's are extremely dangerous and fire hazardous. So, fire and safety provides training teaches people to how to be safe while doing the refinery work and how to avoid serious accidents or mishaps.

- **Triangle of fire**- For a fire to catch, air heat and fumes are needed. If we cut the supply of anyone of these then the fire can be avoided.

- **Types of Hazards-**

- **Fire hazards**- In any case of fire explosion, fire alarms should be raised as soon as possible and people should meet the nearest assembly point. In case of oil based fire, cold water should be supplied to the burning system so that the temperature does not exceed a maximum permissible value. In Barauni Refinery, Auto foam system has been installed to extinguish fire.

- **Chemical and explosion hazards-** For example, toxic gas emission, acid spillage, corrosive chemical spillage etc. So, different kind of detectors are used like DSI (ionized smoke detector), DSO (Optical smoke detector), DGT (toxic gas detector), DGH (hydrogen gas detector) etc.

Safety measure that must be taken:

- A worker must use personal protecting equipments (PPE) inside the refinery. PPE includes safety helmet, safety shoes (to protect from electrical hazard), safety goggles, ear plugs, hand gloves hand gloves, nose mask, safety belt and Nomex (full body covering clothing for special cases).

- Mobile phones or any electronic devices should not be carried inside refinery. Without having proper knowledge, nothing should be touched to bring about any change.

- Self-controlled breathing apparatus (SCBA) should be used in any case of toxic gas (like SO_2, NH, CO_2 and H_2S) emission. Safety belt and rail guards, along with proper ladder (at 75°) and staircase, must be

- Self-controlled breathing apparatus (SCBA) should be used in any case of toxic gas (like SO_2, NH, CO_2 and H_2S) emission. Safety belt and rail guards, along with proper ladder (at 75°) and staircase, must be used when climbing above 2 meters.

- Full proof guarding of the motors and pumps and other electrical or mechanical devices musty be done to avoid injuries.

- Miniature circuit board, molded case circuit board, Earth leakage circuit board must be present so that it trips the electrical supply if there is some fault in the electrical circuit.

- Fire extinguishers must be present at suitable positions. For universal fire extinguisher, range is 2-3 m, duration 15-20 seconds and weight is 5-6 kg.

- In case of fire or emergency, one should use emergency phone to dial 333 or 7777, IOCL fire and safety department numbers and 301 for first aid.


THANK YOU :)