RAJAHMUNDRY ASSET

About Rajahmundry Asset

ONGC Rajahmundry is a facility of the Oil and Natural Gas Corporation (ONGC), which is a public sector enterprise in India and a major player in oil and gas exploration and production. Rajahmundry Asset deals with oil and gas exploration and production, so there exist wells and production platforms in the Krishna Godavari and Pranahita Godavari basin. Rajahmundry Asset focuses on offshore and onshore exploration based on its location in the Krishna Godavari basin (offshore) and Pranahita Godavari basin (onshore). The Asset Supplies natural gas to GAIL (Gas Authority of India Limited) via a network of gas collecting stations and pipelines.

Facilities at Rajahmundry Asset

- **Base Complex (Godavari Bhavan):** This is the main office complex that likely houses the administration, technical departments, and possibly support facilities for employees.
- **Regional Geoscience Lab:** This suggests the presence of a laboratory for analysing geological samples to understand the potential for oil and gas reserves
- **Mandapeta GCS**: A gas collecting station managed by the Rajahmundry Asset.
- **Kesanapalli:** An Oil Field managed by the Rajahmundry Asset.
- **Tatipaka:** An oil refinery managed by the Rajahmundry Asset.

Type of Formation

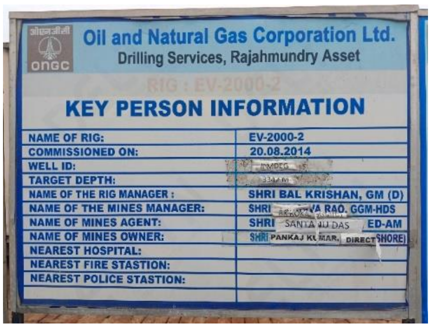
The Krishna Godavari and Pranahita Godavari basins where Rajahmundry Asset operates likely involve sedimentary rock formations. These formations are typically targeted for oil and gas exploration. The Formation here is tight and produces waxy crude.

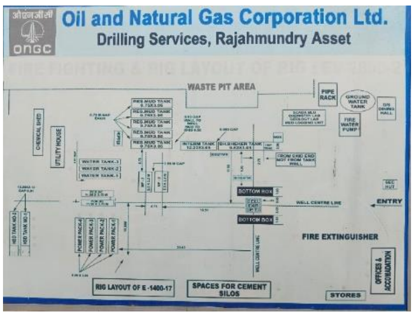
Asset Capacity

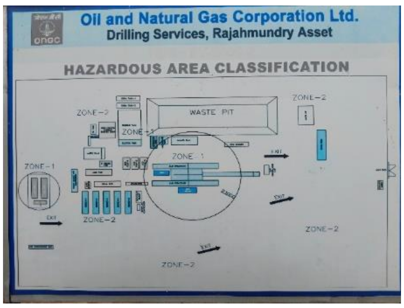
A 2020 report mentions gas supply from Rajahmundry at 2.9 mmscmd (million metric standard cubic meters per day).

Technology

ONGC utilizes advanced technologies for reservoir characterization, drilling, and production optimization. This includes seismic imaging, reservoir simulation, horizontal drilling, hydraulic fracturing, and artificial lift techniques to maximize recovery and minimize operational costs. They employs various techniques such as drilling, well stimulation, and enhanced oil recovery methods to extract oil and gas from the reservoirs.







Reservoir Testing Facility

The basic work of RTF is to take onsite readings data from the well examine and process the data to provide output result to the drilling department.

The tools used for this purpose are

- Mechanical Manometer
- Electronic pressure sensor

Mechanical Manometer

- **Clock Spring:** A clock spring is used as a pressure-sensitive element. As pressure increases downhole, it compresses the spring, causing it to unwind or rotate.
- **Recording Chart:** A pressure-sensitive recording medium, like a coated paper chart, is wrapped around a drum. The drum is rotated by a mechanical linkage connected to the unwinding clock spring.
- **Pressure Gradient:** The rotational movement of the drum, proportional to the spring compression (and therefore pressure), is recorded on the pressure-sensitive chart as the tool descends down the wellbore. In theory, the slope of the recorded line on the chart is related to the pressure gradient.

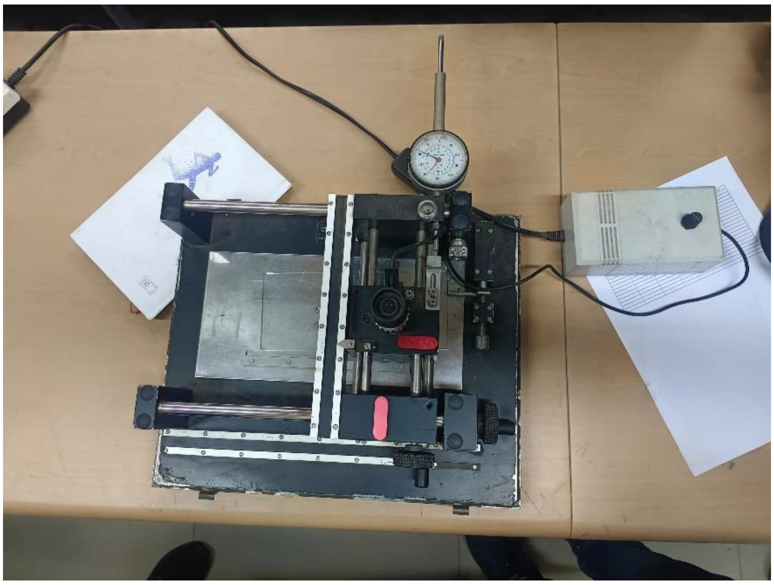
Data Retrieval: Retrieving the recording chart after deployment downhole could be challenging and might require additional mechanisms.

Electronic Pressure Sensor

Pressure Gauges: These are the dominant tools used for downhole pressure measurements, including pressure gradients. They consist of sensors that convert pressure into an electrical signal. Multiple gauges can be placed at different depths within a wireline tool string to measure pressure at various points. The pressure difference between these points, divided by the distance between them, gives the pressure gradient.
Data Analysis: In some cases, pressure gradient might be indirectly determined by analyzing data from other downhole logging tools. For instance, formation properties measured by resistivity or neutron porosity logs can be used to estimate pore pressure, which can then be used along with wellbore pressure data to calculate the pressure gradient

Measurement Of Downhole Pressure Gradient

1. Ball Plug is removed
2. Lubricator is attached
3. Top plug (Pack net) is placed to prevent pressure escape
4. Small BOP is attached
5. Then the tool is lowered and readings are taken



Some Miscellaneous Information

- For releasing pressure needle valve is used
- BOP attached is smaller in size
- Ballor (Bottom hole bucket) is used for collection of samples

Mandapeta Gas Collection Station

Introduction

The Mandapeta Gas Collection Station (GCS), managed by ONGC (Oil and Natural Gas Corporation), is an essential facility for the processing and handling of natural gas. This report provides an overview of the equipment used, their functions, and observations from a site visit, complemented by additional information about the station's operations.

Components of a Gas Collection Station:

Well header:

In a gathering system, a pipe arrangement that connects flowlines from several wellheads into a single gathering line. A header has production and testing valves to control the flow of each well, thus directing the produced fluids to production or testing vessels. Individual gas/oil ratios and well production rates of oil, gas and water can be assigned by opening and closing selected valves in a header and using individual metering equipment or separators.

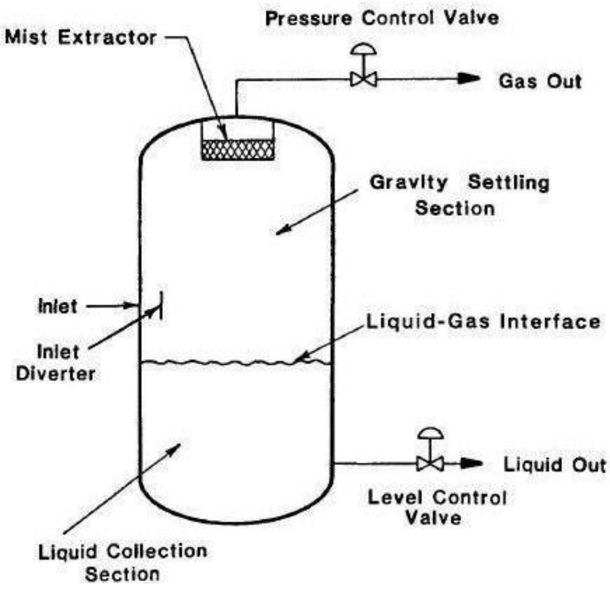
Separator:

The purpose of the separator is to flash the well fluids to separate into liquids and gas at a controlled pressure. Fluid enters tangentially and due to the sudden pressure drop to the set level, the fluid gets separated into liquid and gases. Baffles are fitted inside the separator to help in better separation of fluid. The fluid is given residence time to allow better separation. There are three types of separators on the basis of their design:

- Vertical Separator
- Horizontal Separator
- Spherical Separator

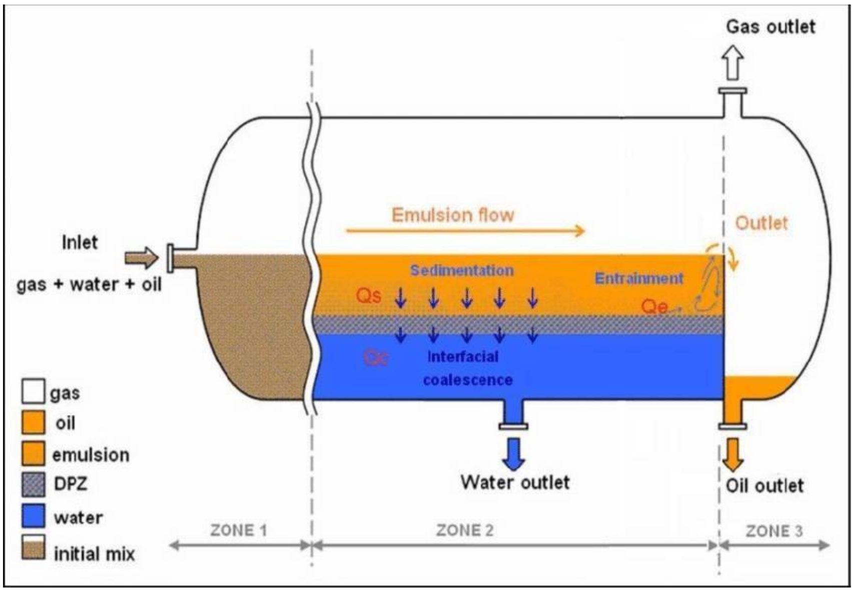
Vertical Separator:

A vertical separator is a crucial piece of equipment in the oil and gas industry used to separate a mixed fluid stream of gas, oil, and water into their individual components based on density differences. The mixed fluid enters the separator from the top and is directed downward, allowing gravity to facilitate the separation process. As the fluid descends, the denser water settles at the bottom, oil forms a middle layer, and gas rises to the top. Internal components like inlet diverters and baffles enhance the separation efficiency by distributing the flow and increasing retention time. Gas exits from the top through a mist extractor that removes liquid droplets, while the separated oil and water are drained through outlets at different levels. Vertical separators are efficient for handling lower volumes of fluid and are commonly used in well testing and production operations.



Horizontal Separator:

A horizontal separator is a key device in the oil and gas industry designed to separate a mixed stream of gas, oil, and water into their individual components based on density differences. The mixed fluid enters the separator through an inlet diverter, which slows the fluid and distributes it evenly. In the gravity settling section, the fluids naturally stratify with water at the bottom, oil in the middle, and gas at the top. Internal baffles and weirs direct the flow and increase retention time, enhancing separation efficiency. A mist extractor removes any liquid droplets from the gas before it exits. The separated oil and water are collected in designated sections and removed through outlet valves. Horizontal separators are highly efficient, versatile for handling various fluid mixtures, and easier to maintain than vertical separators, making them essential in gas processing plants, oil production facilities, and chemical plants.



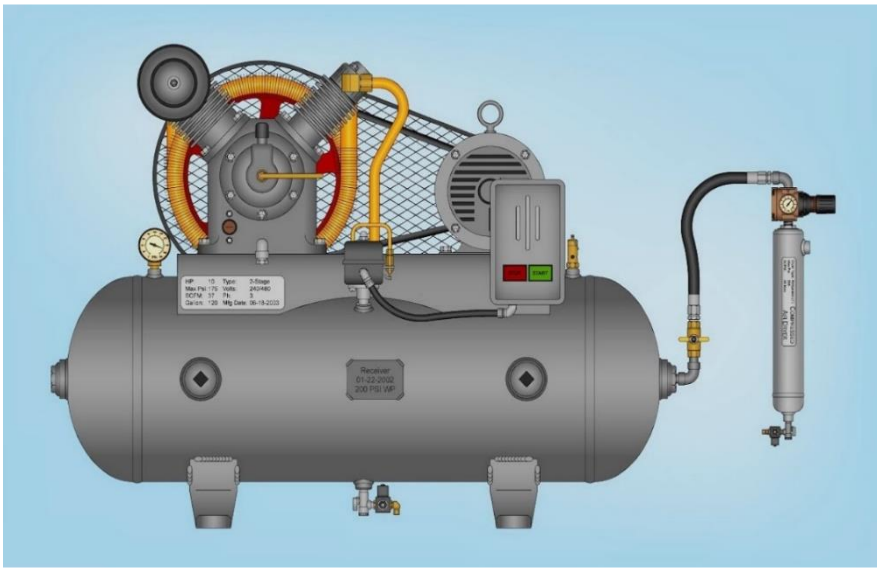
Compressor:

The main function of a compressor is to Increase gas pressure for pipeline transportation or further processing.

Two main types:

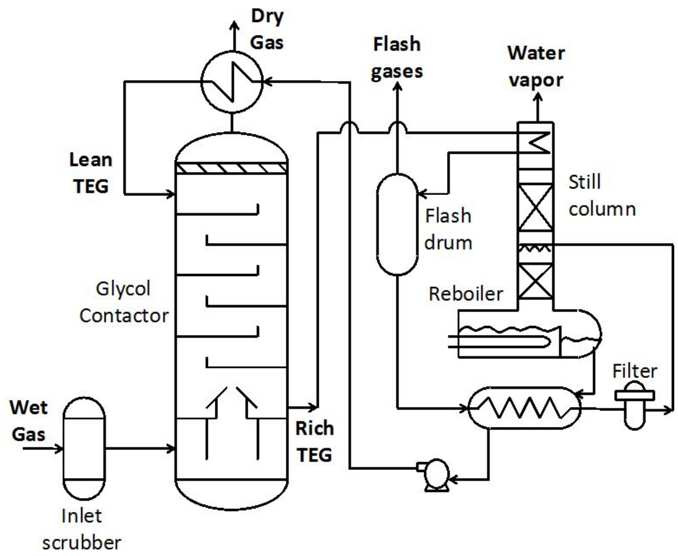
- **Single Stage Compressor**
  A single-stage compressor is a type of compressor in which the gas or air is compressed in a single stage. This compressor uses a single cylinder and a piston for the compression of air. And also, the air is compressed only one time. The body of this compressor sets according to the arrangement of the piston and cylinder.

- **Multi-Stage Compressor**
  Multi-stage compressors use multiple stages of compression to delivery higher airflow or achieve higher pressures than are possible with a single-stage compressor. These workhorses in the air compressor industry may be two-stage compressors or even three-stage compressors, and they may be either piston-style or rotary screw.



Gas Dehydration unit:

The Gas Dehydration Unit (GDU) plays a critical role in ensuring the quality and safety of the natural gas produced. After high-pressure (HP) and low-pressure (LP) gases are separated and compressed, they are directed to the GDU to remove water vapor. This process typically involves passing the gas through a contactor tower where it comes into contact with glycol, usually triethylene glycol (TEG), which absorbs the water vapor from the gas. The water-rich glycol is then regenerated by heating it in a reboiler to evaporate the absorbed water, allowing the dry glycol to be reused. By removing water vapor, the GDU prevents hydrate formation and corrosion in pipelines, ensuring that the gas meets the required specifications for transportation and further processing



Gas dehydration unit

Knockout Drum:

A Knockout drum is a specific type of pressure vessel in the flare header system used to remove & accumulate any condensed & entrained liquids or liquid droplets from the relief/flare gases. This process equipment is also known as the flash drum, knockout pot, KO drum, knock-out vessel, or flare KO drum.

Knockout drums are classified as “two-phase” when they separate gas from the total liquid stream. Also, they are known as “three-phase” when they separate gas, water, and oil phase means separating crude oil and water from the liquid stream.

Knockout Drum

Flare System:

A Flare system is defined as the controlled burning of natural gas that cannot be processed for sale or use because of technical or economic reasons. Flares are primarily used for burning off flammable gas released by pressure relief valves during any over-pressure scenario of plant process unit/equipment, due to process upset or during startups & shutdowns, and for the planned combustion of gases over relatively short periods.

Site Visit:

On the first day, we visited the Mandapeta gas collection station and learned about the electrical equipment used there. They use pressure switches that handle gas at a suction pressure of 4.5 kg and hydro pressure of 10 kg. We observed both horizontal and vertical separators. The station utilizes double-stage compressors that compress gas at 13 kg and 137°C in the first stage, and at 54 kg and 148°C in the second stage. Gas from the wellhead is divided at the well header into high-pressure (HP) and low-pressure (LP) gas, with inlet pressures exceeding 55 kg/cc for HP and over 45 kg/cc for LP. This separation occurs in Zone 1. The HP gas moves through separator units with a pressure limit of 6 atm, and is eventually released at an outlet pressure of 54/56 kg/cc before being sent to the Gas Dehydration Unit (GDU) to remove water vapor. In the LP unit, gas passes through a horizontal three-phase separator, then goes to a two-stage compressor powered by a Caterpillar engine. After being cooled in the aftercooler, the gas is sent to the GDU at 56 kg/cc. Any excess gas in the aftercooler is sent to a knockout drum to separate liquids and flared to remove the excess gas.

New Generation RIG VISIT

The drilling rig in Rajahmundry is an EV 2000 model. Around the rig, there are two designated safety zones: Zone 1 and Zone 2. Zone 1 is a high-danger zone requiring stringent safety measures during drilling activities, while Zone 2 encompasses all other areas not classified as Zone 1. Maintaining the rig costs 17 lakh per year.

The rig employs two types of drive systems: the Independent Rotary Drive (IRD) and the Top Drive System (TDS). It is defined by its drawworks capacity, mud pumps, and Caterpillar engines, which produce both AC and DC power, with all major equipment operating on DC.

A Variable Frequency Drive (VFD) is used to control motor speed by varying the frequency of input power. All equipment for the rig is supplied by National Oil Varco (NOV).

Hoisting operations are controlled by the driller, who uses drawworks to command the VFD, drawing variable power from the engines to pull in drill strings in groups of three.

The Geotechnical Order (GTO) is a comprehensive blueprint for well execution, detailing all geological and technical data necessary for drilling an exploratory well. It includes guidance on:

- Geological Data
- Pore Pressure Prediction
- Casing Design
- Mud Program
- Depth vs. Days projections
- Specifications for the wellhead, BOP, drawworks, and mud pumps

A multi-disciplinary committee prepares the GTO, involving Geology, Drilling, Mud Services, Logging, and Well Services teams. This document ensures a structured and informed approach to drilling operations.

In Rajahmundry, the rig manages a cluster of four wells: two S-profile wells and two L-profile wells.

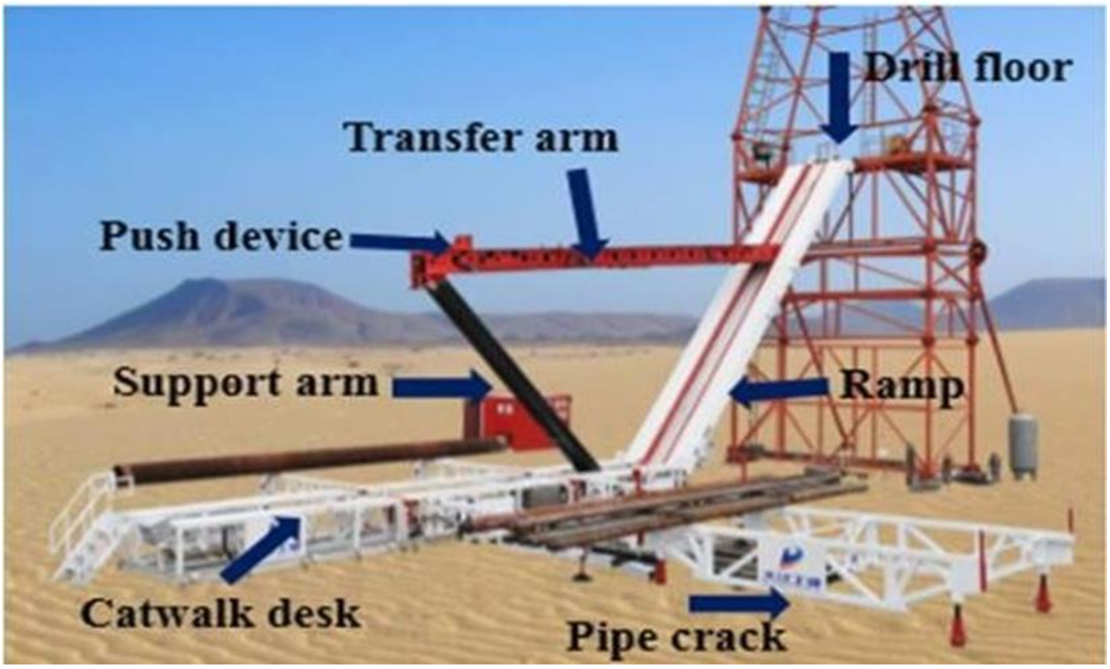
There are two types of losses: dynamic and static. The primary indicators of a kick are an increase in strokes per minute (spm) and a decrease in pump rate. However, in VFD rigs, spm doesn't increase. Additionally, an increase in mud viscosity and flow-out temperature are primary indicators of a kick.

RIG SETUP

The seller pit is drilled and mast is placed at the required location and then riser legs are connected, the whole rig structure four hydraulic pins were there which means that our derrick was made in five parts which are then connected through four hydraulic pins. The rig was firstly assembled in horizontal direction and the support at the other end of the mast is provided to maintain the level and then hydraulic pins were there which were connected to the hydraulic cylinders which lifts the rig slowly in about 30 minutes. The hydraulic pressure was supplied at about 150 bar pressure.

Various components at the Rig

1. **Cat-walk** – It is a platform which is used to supply the drill pipe to the top at the drill floor from where it either gets handover to the stringer or the elevator links. A long, rectangular platform about 3 ft [0.9 m] high, usually made of steel and located perpendicular to the vee-door at the bottom of the slide. This platform is used as a staging area for rig and drill string tools, components that are about to be picked up and run, or components that have been run and are being laid down. A catwalk is also the functionally similar staging area, especially on offshore drilling rigs, that may not be a separate or raised structure.



2. **Power control room** – This room generates the required power for the working of different instrument on the rig-

There were two power control room, supported with on A.C on the top (as a lot of heat is generated in this region).

- They use both diesel and gas as the fuel and for that underground pipe lines are being laid down.
- There was one diesel tank, which was supplying diesel to the unit.

3. **Power Pack-** The power generated in PCR moves towards the PP, where they gets step up or down as required for different instruments , there are four main power pack producing at 600 V and 1 reserve producing at 450 V.

   There is a sense system connected that sense the power requirement and switch on and off the power packs as required (automatically). The power requirement increases as we move downwards during our drilling.

4. **Top Drive system**- It includes crown block, hock travelling block etc. This system is highly automated in this rig. From this top drive a proper conduct is provided for the passage of drilling mud at the time of drilling and proper holder for drill pipe with external gripping mechanism is provided in the top drive, just below this elevator links are connected which are mainly for the supported of casing pipe.

Advanced Vertical pipe Handler/ Stringer / Robotic arm-

It is situated at some height on the rig. It is a highly automatic instruments and is being used first time in India, Because of this rig is the most automatic in India.

Main work of stringer is to take the drill pipe from the catwalk at rest in on the rest in on the rotary table, where at the top the drill pipe gets attached to the top drive and the bottom part is made to attach from the previous drill pipe using Iron Roughneck which was situated near the rotary table on the drill floor. This arm is provided with a long extension, and cameras and laser technology are implemented which auto senses the pipes and automatically makes the grip without any manpower requirements.

Draw Works –

Draw works are used to get hold to the drill string. Red colored draw work was there 2 motors were connected at the draw work. It contains the grooves for the alignment of drill string and a 6- strand drill pipe was present there.

Mud Tanks- Mud tanks are used to store the drilling mud; these tanks are connected to the mud pump through which they get circulated. There were 2 mud tanks. There were black colored lines passing from mud pump towards the top drive, so that mud can be passes through top drive into the Drill Pipe.

Now we move to the Drill floor -

The drill floor contains :

a) Dog House – For Staff
b) Tool House- For keeping of tools
c) Drillers Cabin
d) All other necessary equipments for drilling.

The return flow lines connected towards the shale shaker, which is further Connected to the dumping zone for the dumping of cuttings and a pass way.

For further processing. there were desanders, degassers and desalters

Mud Pumps – 2 mud pumps are there attached to the mud tanks working as reciprocating pumps. These are Triplex reciprocating pumps, suppling maximum output at 120 degrees phase angle. As the output at different phases is not constant so, a discharge damper & a suction damper is used. Discharge damper has storage of mud, and it supplies to the main line when the output through the pump is less.

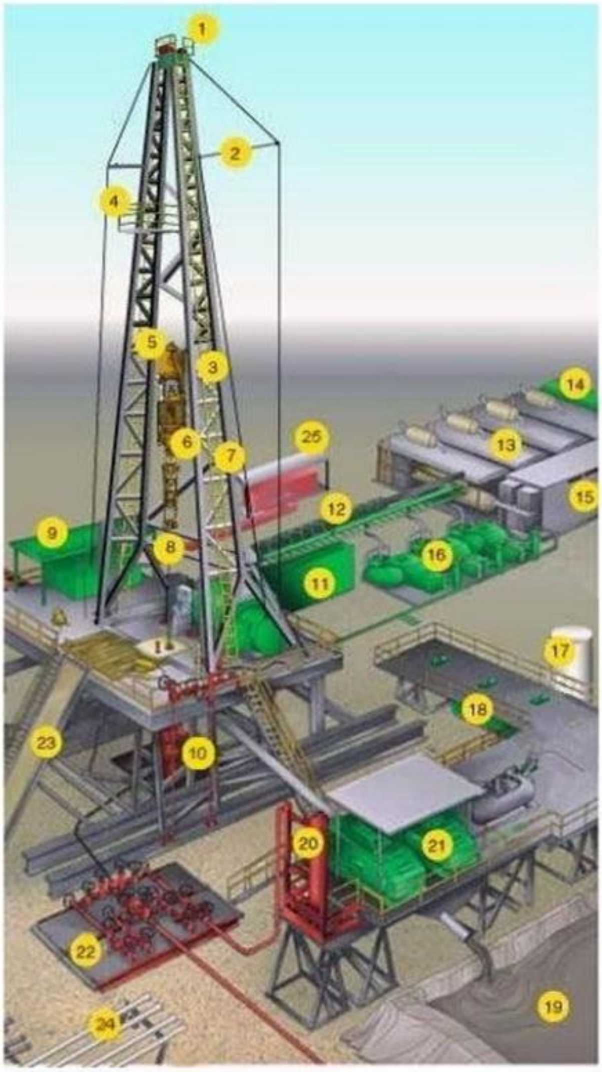
Pressure safety value- It is also installed near the pump in the flow line, to ensure that the flow rate is less than the maximum allowable flow rate, which is in accordance with the weakest joint.

Drill Bits- TCR Bits were there of different diameters as while drilling at different depths, different diameter bits are required. Drill collars are there with stabilizers to make diameter same as annulus so that it does not move eccentrically.

DRILLING OPERATIONS

Drilling is basically creating a conduit between the surface and the subsurface location where it is suspected to find the oil and gas. To drill a well, a set of equipment is needed that when assembled is used as a tool to create the path for the formation fluid to travel to the surface. This operation is carried out with the help of Drilling rig.

DRILLING RIG COMPONENTS



1. Crown Block and Water Table
2. Catline Boom and Hoist Line
3. Drilling Line
4. Monkeyboard
5. Traveling Block
6. Top Drive
7. Mast
8. Drill Pipe
9. Doghouse
10. Blowout Preventer
11. Water Tank
12. Electric Cable Tray
13. Engine Generator Sets
14. Fuel Tank
15. Electrical Control House
16. Mud Pumps
17. Bulk Mud Component Tanks
18. Mud Tanks (Pits)
19. Reserve Pit
20. Mud-Gas Separator
21. Shale Shakers
22. Choke Manifold
23. Pipe Ramp
24. Pipe Racks
25. Accumulator

DRILLING RIG COMPONENTS

The major components of drilling rigs that work together to drill the well in a safe manner .

1. Rotating Component
2. Hoisting Component
3. Circulating Component
4. Well Control Component
5. Tubular and Tubular Handling Equipment
6. Power and Prime Movers

ROTATING COMPONENTS

These are the set of equipment used to rotate the drill string. Following are the components in use:

1. Swivel
2. Kelly spinner
3. Kelly
4. Kelly Bushing
5. Master Bushing
6. Rotary Table

SWIVEL

➢ **The rotary tool that is hung from the hook of the traveling block to suspend the drill string and permit it to rotate freely.**

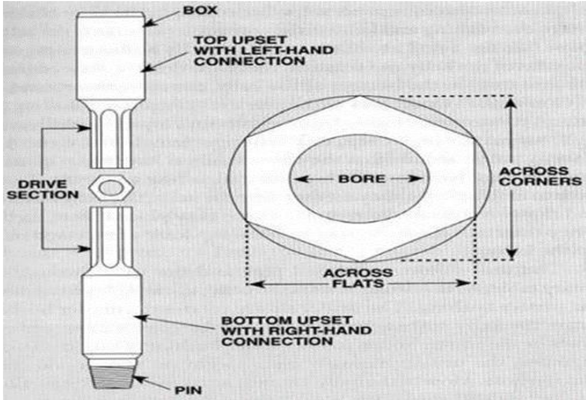
➢ **It also provides connection for the rotary hose and provides a passageway for the flow of drilling fluid into the drill stem.**

KELLY SPINNER

A pneumatically controlled device mounted below the Swivel that when actuated causes the Kelly to spin.

KELLY

The heavy steel member, usually four or six-sided, is suspended from the Swivel through the Rotary Table and connected to the topmost joint of drill pipe to turn the drill stem as the rotary table turns.



KELLY BUSHING

A device that when fitted to master bushing transmits torque to the kelly and simultaneously permits vertical movement of the Kelly to make hole.

TATIPAKA

Tatipaka is the first re-located skid mounted refinery with erection time 6 months to 18 months. It was commissioned on 3rd September 2001 and is ONGC's first ever oil refinery to produce oil products.

ABOUT TATIPAKA COMPLEX

Following units are present in the Complex

1. Gas Collecting Station (GCS)
2. Gas Compression Plant (GCP)
3. Effluent Treatment Plant (ETP)
4. Quality Control Lab
5. Mini Refinery

Gas Collecting Station (GCS)

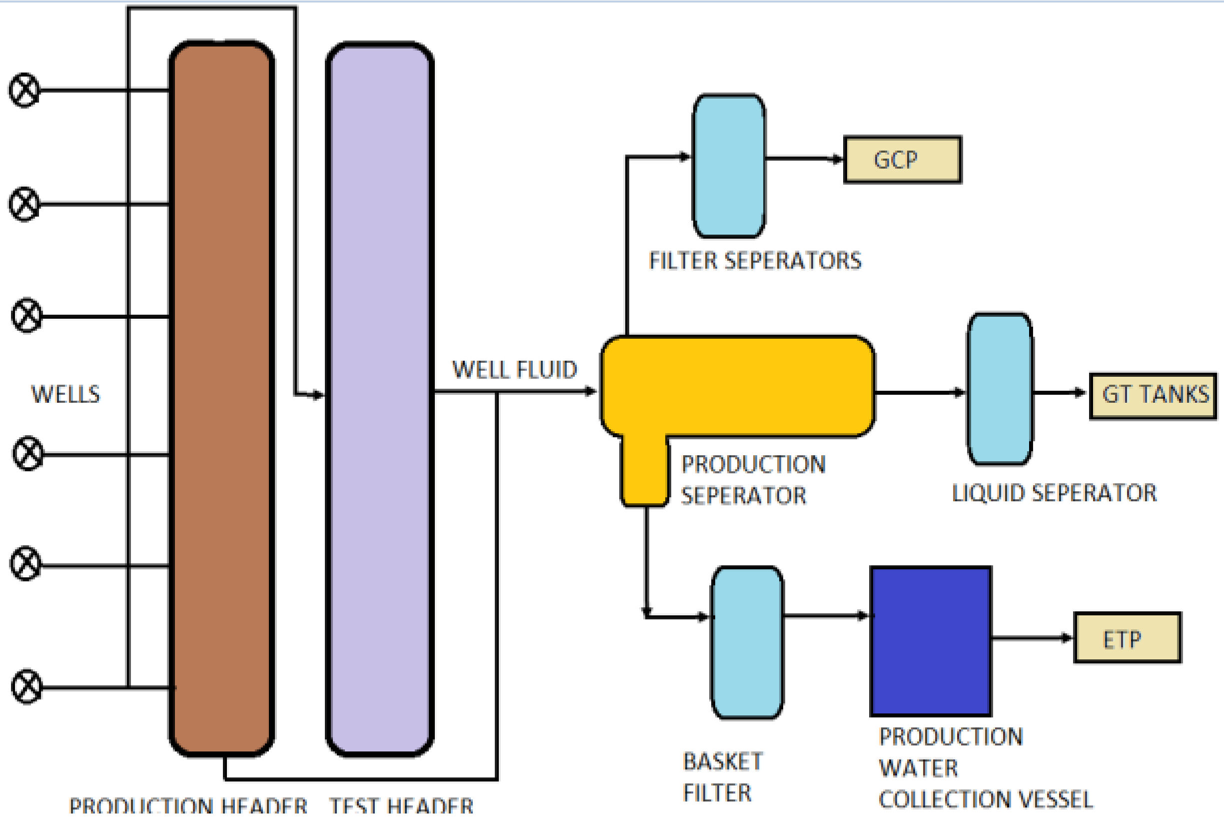
Tatipaka GCS is a major installation in KG project with good infrastructural facilities. The GCS collects and processes the gas that is produced from different wells under tatipaka complex. This is the largest onshore installation of KG project where all associated also exist.

Process description:

Gas from about (at present 19) wells are directed to the production header. This gas not only comprises of produced gas but also crude/condensate and water. So, for the separation the gas is sent to a production separator with a liquid boot.

Production Separator:

The well fluid is received in a 3-phase low pressure production separator, operates at a pressure of 6.0 kg/cm2. Three phase separation is achieved inside the separator due to change in momentum of the well fluid and providing the required time for the liquid phase. The gas stream from the top of separator is routed to the filter separators for the filtration and knocks out of entrained liquid particles. The produced gas from the LP production separator is routed to the LP gas compressor at tatipaka site. The hydrocarbon liquid is separated in the production separator and routed to the existing condensate storage via two phase liquid separators. The separated water after passing through the basket filter is collected in the produced water collection tank. Test separator has been provided at the site for testing the performance of the individual wells at low pressures i.e. 6.0 kg/cm2. The gas separated from the test separator is metered and is connected to the separated gas from the production separator prior to filter separators. The hydrocarbon liquid stream from test separator is routed to two phase liquid separator and produced water stream to produced water collection vessel.



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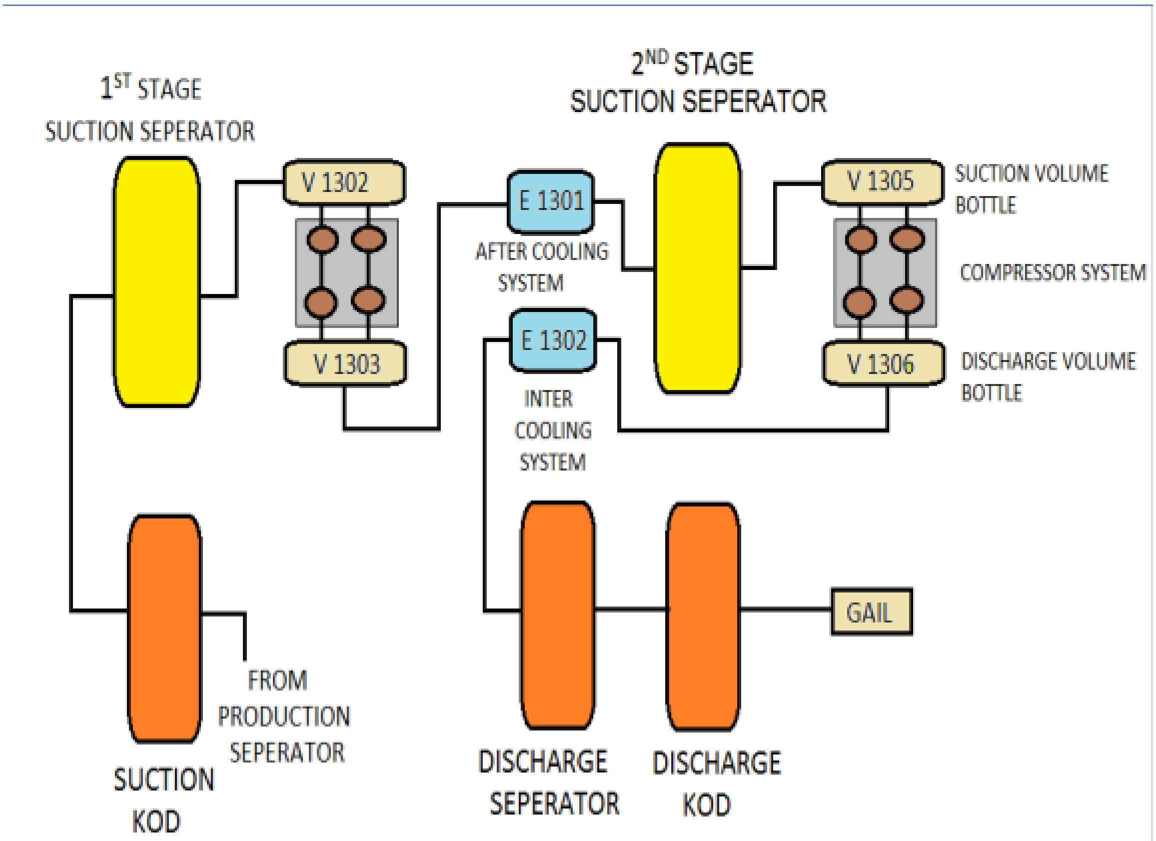
Gas Compression Plant (GCP)

The gas from the wells used to be obtained at high pressure. Slowly the pressure from the wells started to drop. Now, almost all wells under Tatipaka complex are producing low pressure gas. Hence, the GCP was established in 2010 to process and compress LP gas.



Process description:

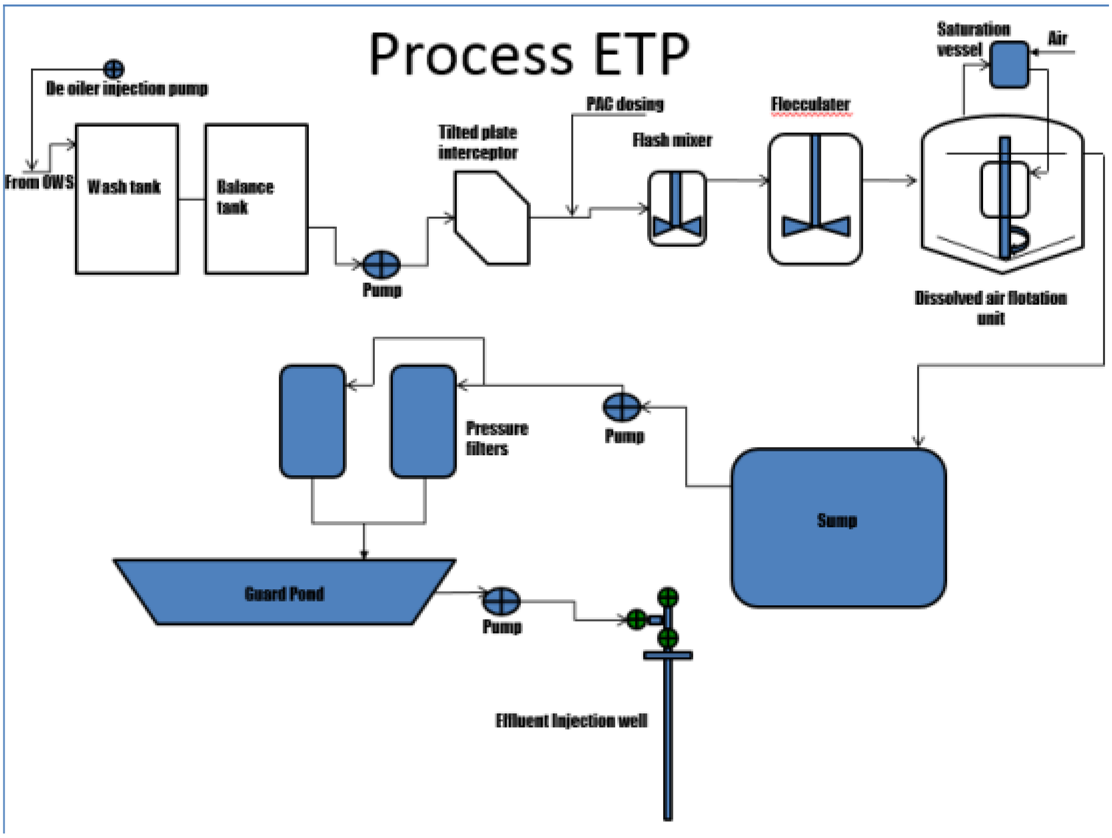
Liquid free low-pressure gas after the filter separator is routed to the gas compressor suction KOD operating at a pressure 5 kg/cm2. Gas flow from the overhead of the suction KOD is metered before entering the compressor skid. Liquid collected in the suction KOD flows to the intermediate blow down (IBD) vessel. Intermediate blow down vessel is designed to receive various hydrocarbon liquid streams from the suction KOD, discharge KOD, compressor package, trunk line KOD and the fuel gas conditioning system. The gas stream from the blow down vessel is routed to the flare. There are three compressor units, each of 4 LSCMD capacities. Gas form suction KOD is routed to the 1st stage suction separator where any small amount of liquid left over in the gas stream is knocked off. Gas from the suction separator flows into the 1st stage at 5 kg/cm2 and discharge pressure is 22-26 kg/cm2. As the discharge temperature of 1 st stage gas is 144 °C, it is cooled in air cooled heat exchanger up to 58 0C before entering the 2nd stage suction separator. Gas from overhead of the 2nd stage suction separator is routed to the second stage of the compressor where it is compressed to 60-62 kg/cm2 and with a discharge temperature of 138 °C. An air cooled after cooler, cools the gas at the outlet of the second stage to a temperature of 58 °C. Compressed gas leaves the compressor skid and is routed to the discharge KOD. Liquid from discharge KOD flows to the intermediate blow down vessel. The gas from the discharge KOD goes to the GAIL terminal.

Effluent Treatment Plant (ETP)

Effluent is primarily water with hydrocarbon. Hydrocarbon mixed with water is characterized with two types of oil:

1. Free oil
2. Emulsified oil

The treatment philosophy is largely based on oil water separation through specific gravity differences of two phases. This separation is carried out in stages by either coalesce of small oil droplets into larger droplets or through reducing the specific gravity by nucleating the micro bubbles to emulsified oil thereby allowing the oil droplets to rise to the surface, facilitating separation. The entire treatment scheme for Tatipaka GCS is designed to treat 500 m3 per day with an average load of 21m3 per day.



Quality Control Lab

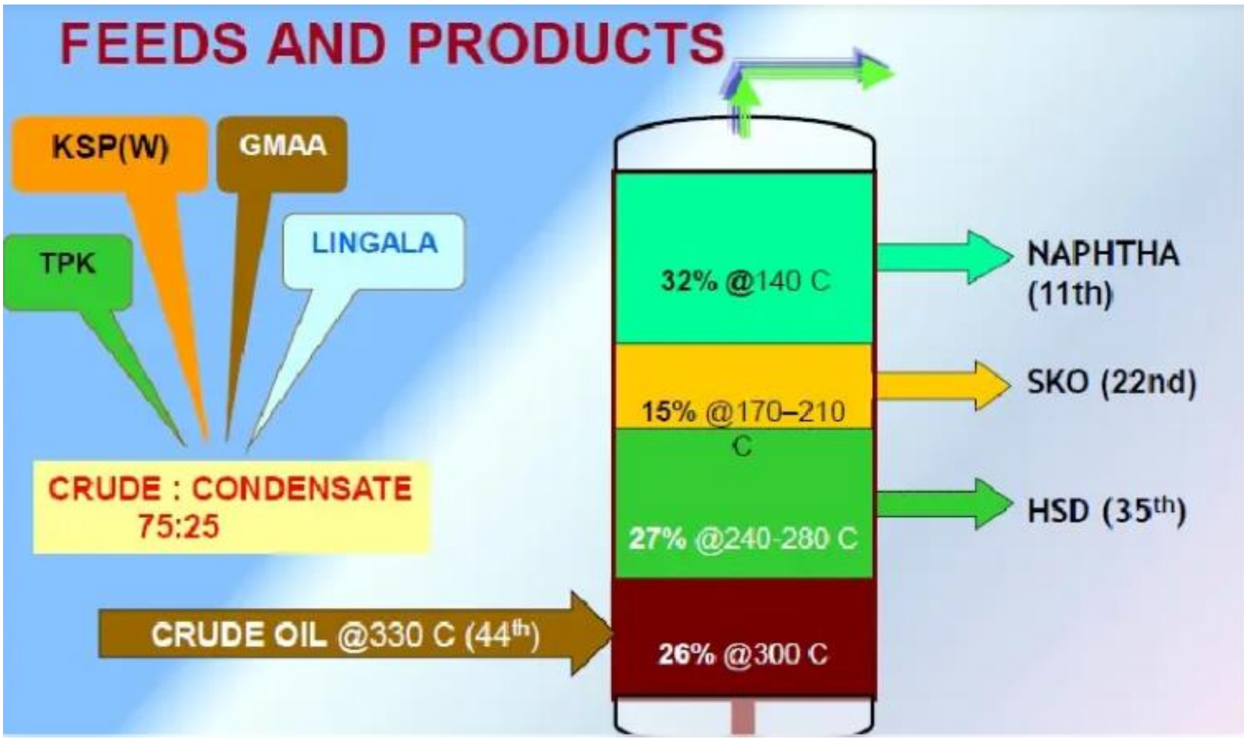
In this laboratory the quality and characteristics of crude and distillates are tested. Online sample (test sample collected before entering the storage tanks) is tested for its purity based on its composition and properties for any change. The various equipment in the laboratory and their functioning are:

- Reid vapor pressure apparatus- to determine vapor pressure.
- Hydrometer- for measuring density
- ASTM distillation unit - the quality of the product is tested
- Copper corrosion apparatus
- Abel flash point apparatus- to determine flash point

- Pensky marten apparatus- to determine flash point
- Smoke point apparatus- to determine smoke point of diesel and naphtha
- Blumont lamp - to determine smoke point of kerosene
- Auto kinematic viscometer- to determine viscosity
- Otal sulphur UV - to determine sulphur content
- Dean and stark apparatus - to determine associated water content
- Pour point apparatus - to determine pour point.

Mini Refinery

It has a normal refining capacity of 1500BPD (186TPD) and Max capacity of 2000 BPD (250TPD). The plant produces naptha,MTO,HSD, HFHSD and LSHS. Crude oil's characteristics vary from light (which is straw coloured liquid) to heavy (tar black solid). Crude oil is also called sweet (<0.1ppm sulphur) and sour (>0.1ppm sulphur) crude oil depending upon the amount of sulphur it contains. At tatipaka crude oil is received in tankers from the wells at Kesanapalli, Lingala, Nagayalanka, Raghavapuram, Nandigama, Vadaparru, Kanukollu, Matsyapuri and many other wells in KG basin.



Refinery process:

1. **Storage of crude oil:** Two tanks each of 500 m3 capacity are used for storage of crude which is received every day from nearby fields constituting feed for refinery. One of these tanks receives crude oil from tanker intermittently and condensate from GCS on continuous basis. The other tank supplies feed to the refinery through centrifugal pumps.

2. **Crude charging & pre-heating:**
A mixture of crude and condensate with a composition range of 30% to 70% is fed in a distillation column by adding de-emulsifier, at a temperature of 3300°C, after passing through two stages of preheating exchangers, a de-salter vessel and furnace. In the first stage of preheating the crude feed is made to exchange heat with Kerosene, Diesel & LSHS (cold LSHS) product streams in respective heat exchangers. After the first stage of preheating the crude enters the de-salter vessel which is positioned between the two sets of exchangers. The salt content of the feed is separated in the de-salter vessel with the help of mixing water with the feed and then breaking the emulsion with temperature, high voltage and demulsifier. In the second stage of preheating the crude feed is allowed to exchange heat with kerosene circulating reflux, LSHS (hot LSHS) and diesel circulating reflux streams and then enters furnace.

3. **Crude furnace:** At a temperature of 170-190 °C, feed enters the gas-fired furnace where crude gets partially vaporized gaining a temperature of 330 °C.

4. **Atmospheric distillation column:**
The crude column operates at atmospheric pressure and fractionates crude feed into Naphtha, Kerosene, Diesel & LSHS products. The column contains 49 trays (48 valve trays and 01 sieve tray). Different fractions get liquefied in different trays at temperatures just below their boiling point. Heavy naphtha is drawn from tray-11, kerosene is drawn from tray-22, diesel is drawn from tray-35 and LSHS from bottom of the distillation column.

5. **Process at other various Individual sections:**
   a) Overhead section
   b) Heavy naphtha section
   c) Kerosene section
   d) Diesel section
   e) Low sulphur heavy stock section
   f) Strippers
   g) Circulating refluxes
   h) Naphtha stabilizers
   i) De-salter
   j) Valve trays and sieve trays
   k) Heat exchanger

a) Overhead section:
The overhead vapor from the crude column at 114 ° C is withdrawn under pressure control and is condensed and cooled in overhead condenser to 55 ° C. The condenser utilizes cooling water as the cooling medium and this condensed overhead product separates out as hydrocarbons and water in the overhead accumulator. Water is withdrawn from the boot under level control and sent to the effluent treatment plant for treatment. Crude column overhead pumps to the naphtha stabilizer pump part of the un-stabilized naphtha from the accumulator under level cascade flow control and the rest is

sent back to the crude column as reflux. Crude column top temperature & reflux controller sets reflux demand. A split range pressure control maintains the column overhead pressure by controlling fuel gas make-up and vapor to flare.

b) **Heavy naphtha section:** Heavy naphtha is withdrawn as side product from tray-11 of the crude column at a temperature of 144 ° C under level control sent to side-stripper bottom. Light ends in the heavy naphtha steam are stripped in heavy naphtha side-stripper using superheated steam. Stripped vapors sent back to tray-9 of the crude column and the bottom product, heavy naphtha is pumped by gear pumps and cooled in the heavy naphtha cooler using cooling water. Part of this stream is blended with final diesel product (to maintain Cetane number of diesel oil) and the rest is mixed stabilized naphtha in the naphtha storage tanks.

c) **Kerosene section:** Kerosene as Superior Kerosene Oil (SKO) is withdrawn as a side product form chimney tray, which receives liquid from tray-22 of the crude column at a temperature of 186 ° C under level control sent to side-stripper bottom. Light ends in the kerosene stream are sent back to tray-19 of the crude column and the hot bottom product of kerosene stripper is pumped by gear pumps, under flow control to the crude pre-heating section to exchange heat with crude in crude/kerosene exchanger. The kerosene product gets cooled to 60 ° C in the preheat train and further cooled in kerosene product cooler to 40 °C using cooling water. The cooled product is stored is stored in kerosene storage tanks.

d) **Diesel section:** Diesel as High-Speed Diesel (HSD) is withdrawn as a side product from tray-35 of the crude column at a temperature of 290 °C under level control of side-stripper bottom. Light ends in the diesel stream are stripped in the diesel side-stripper using superheated steam. Stripped vapors are sent back to the tray-32 of the crude column and the hot bottom of the diesel stripper is pumped by diesel product gear pumps under flow control to the crude preheating train to exchange heat with the crude in the crude/diesel exchanger. The diesel product gets cooled to 53 ° C in the preheating section and further cooled in diesel product cooler to 40 ° C using cooling water and the cooled product is stored in diesel storage tanks.

e) **Low Sulphur Heavy Stock section (LSHS):** Stripped LSHS at a temperature of 330 ° C is withdrawn from the bottom of the crude column under level control cascaded with flow control. It is pumped by LSHS centrifugal pumps to pre-heat crude. This hot LSHS exchanges heat with crude in crude/LSHS (hot) exchanger in first stage of heating and crude/LSHS (cold) exchanger and in turn gets cooled to a temperature of 110 ° C in this pre-heating section in second stage of heating. Thereafter LSHS is sent to the storage tanks provided with steam heating coils to avoid LSHS congealing.

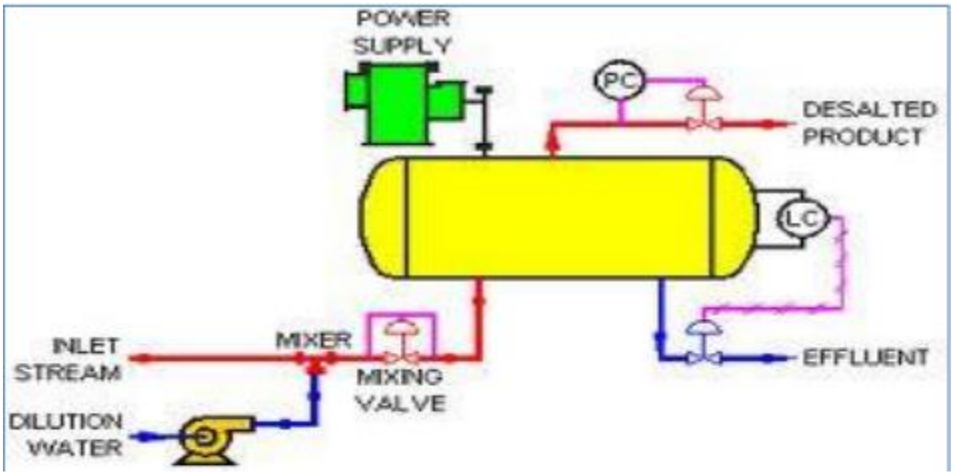
f) **Strippers:** Stripper is also a process vessel (packed column) where heat transfer operations and mass transfer (stripping) operations occur. Respective liquid streams drawn out from the nozzle are made to fall through liquid inlet in the region above the stripper column and from the bottom, steam is sent. In the stripping column the liquid and steam contact occur and then heat transfer occurs between them. The steam being at lower temperature than that of the drawn liquid, by direct contact in counter-current flow, decrease of liquid temperature occurs. Mass transfer (stripping) occurs between the steam and drawn liquid (from column), heavy liquid is drawn out through the stripper bottom and the lighter vapor is sent back to the column as reflux. The importance of refluxing of vapors is to maintain column temperature, pressure balancing and to enhance product quality and quantity. There are three strippers, namely:

1. Heavy naphtha stripper, liquid drawn from tray -11 and its vapor refluxing sent back to tray 9.
2. Kerosene stripper, liquid drawn from tray-22 and its vapor refluxing sent back to tray-19.
3. Diesel stripper, liquid drawn from tray-35 and its vapor refluxing sent back to tray-32.

g) **Circulating refluxes:** In order to maximize the heat recovery and balance the tower loading, heat is removed by way of circulating refluxes from kerosene and diesel sections. Kerosene CR is withdrawn from kerosene product withdraw tray - 22 of the crude column at a temperature of 175-185 °C. It is pumped by kerosene CR pumps, 20-P-102 A/B to the crude preheat section where it exchanges heat with the crude in the crude/ kerosene CR exchanger 20-E-104 A/B. Diesel CR is withdrawn from diesel product withdraw tray - 35 of the crude column at temperature of 280- 290 °C. Then it is pumped by diesel CR pumps, 20-P-103 A/B to the crude preheating section where it exchanges heat with the crude in the crude/diesel CR exchanger 20-E-105 A/B. The diesel CR is routed back to tray - 32 of the crude column after exchanging heat in naphtha stabilizer re-boiler 20-E-112. The diesel and kerosene CR draw rate is controlled by a flow controller.

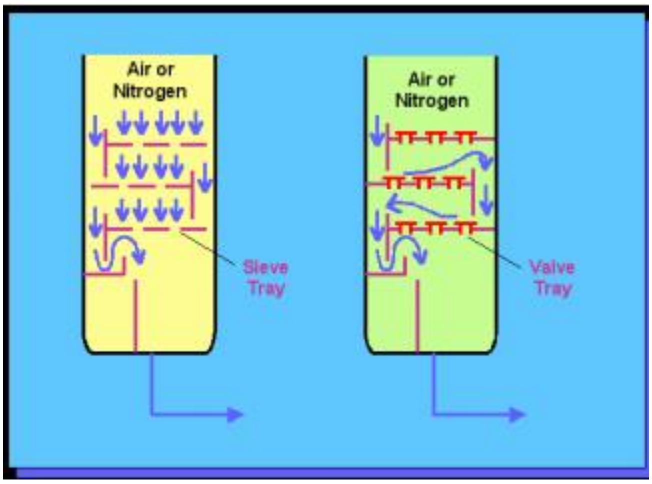
h) **Naphtha stabilizers:** The un-stabilized naphtha from the overhead naphtha accumulator of the crude column is stabilized by removal of light ends in the naphtha stabilizer column 20-C-105. The light ends are recovered as fuel gas and stabilized naphtha at 140 °C is obtained from the bottom of the column under level control. The necessary heat required for light naphtha in re-boiler is provided by diesel circulating reflux under temperature control of the naphtha stabilizer bottom, through thermo-syphon reboiler 20-E-112. Naphtha is further cooled in 20-E-113 using cooling water and sent to storage tanks 20-T104 A/B. The stabilizer is provided with a stub in exchanger 20-E-111 to condense the overhead vapor. Water is used as the cooling medium and water flow is controlled by stabilizer top temperature control. The fuel gas from the top of the stabilizer is sent to the fuel gas system. Stabilizer pressure is controlled by a pressure control provided in the fuel gas line.

i) **De-salter:** The crude feed enters the De-salter vessel after the first stage of heating. In this process the salts are removed from the crude feed. The chemicals are added to the injection water and then added to crude feed. The undesired salts are dissolved in the water and form an emulsion. The electric field is used to break the oil-water emulsion. By means of voltage (10KV-25KV) and temperature the fluid is separated into two phases. Then the desalted crude is further sent to the second stage of heating.



j) Valve trays and Sieve trays:

1. **Valve trays:** They have perforations which are covered by caps. These caps make the vapor move laterally through them.



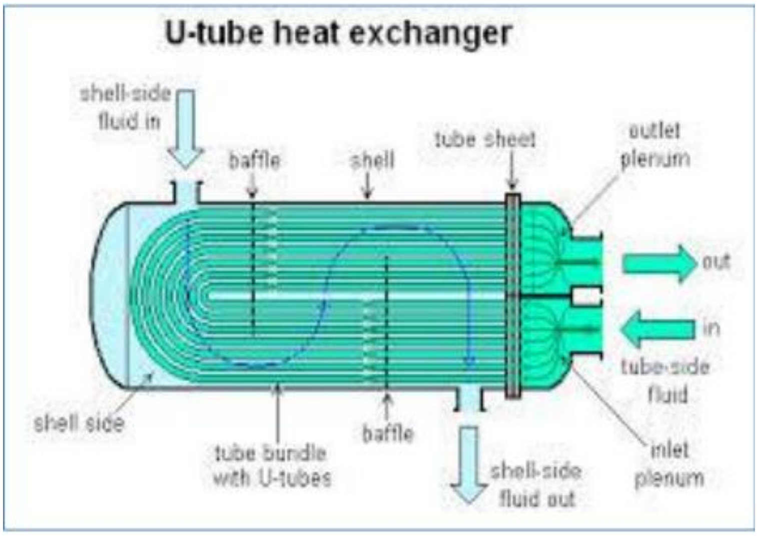
Features of valve trays:

1. Provides best turndown and efficiency.
2. Valves positioned parallel to the liquid flow allow the liquid to flow unopposed across the tray.
3. Lateral vapor release ensures uniform contact in all active areas.

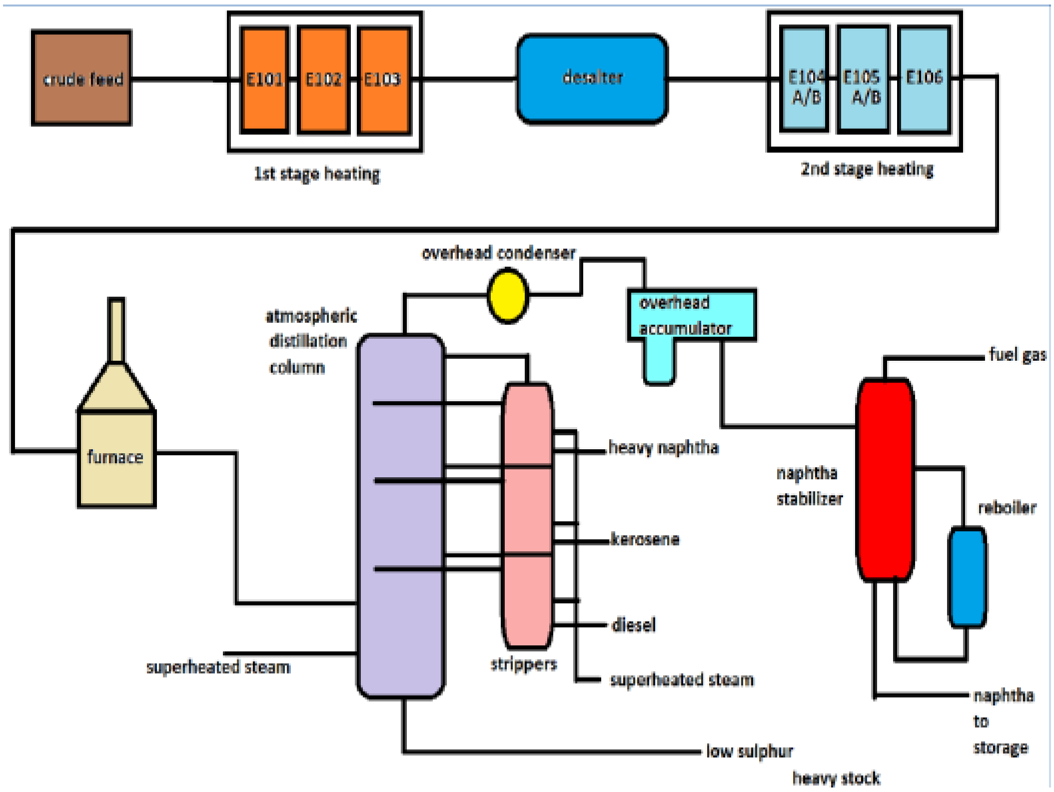
2. Sieve trays: They are simple metal plates with holes in them. There is no lateral movement of vapor. Features of sieve trays:

1. Most economical for low turndown
2. Low pressure drops
3. Each tray has two extensions namely the downcomer (lower extension) and the weir (upper extension).
4. Continuous condensation and vaporization occur at the trays which help in separating the required fractions more effectively.

k) **Heat exchanger**: Heat exchanger is a device built for efficient heat transfer from one medium to the other. In Tatipaka refinery, shell and tube heat exchangers are used. A shell and tube heat exchanger has shell with a bundle of tubes inside it. The crude feed flows in the tubes and the other fluid flows in the shell. The shell is provided with baffles which maximize their heat efficiency.



PROCESS DIAGRAM OF MINI REFINERY



CUSTOMERS:

- Naptha: HPCL and MBPC
- MTO: HPCL
- HSD: Rajahmundry Karaikal internal consumption
- HFHSD: HPCL
- LSHS: HPCL

SAFETY SYSTEMS:

- DCS and SCADA
- Fire station inside complex
- Fire Water network
- 18 CCTV cameras ROSOV ESD push buttons
- Integrated Fire Alarm System (Man call points: 51, Smoke detectors :55 Heat detectors:13 and Hydrogen detectors:5)
- Gas Detection System (Hydrocarbon detectors:41)
- Rim Seal Fire Protection System for Naptha Floating Roof Tank

About Kesanapalli

The Kesanapalli Oil Field is a significant hydrocarbon reservoir located in the Krishna-Godavari Basin, off the eastern coast of India. Discovered in the mid-2000s, this oil field has been a focal point of exploration and production activities by various oil and gas companies. Situated in the deep offshore waters of the Bay of Bengal, the Kesanapalli Oil Field has drawn attention due to its substantial reserves and potential for extraction.

Exploration and drilling efforts in the area have revealed promising results, with estimates suggesting sizable quantities of both oil and natural gas reserves. This has sparked considerable interest and investment from energy companies seeking to tap into the region's hydrocarbon potential.

The development of the Kesanapalli Oil Field holds strategic importance for India's energy security and economic growth. As the country continues to expand its energy infrastructure and reduce dependence on imported oil and gas, unlocking the resources of this field could play a crucial role in meeting domestic energy demands.
Furthermore, the successful exploitation of the Kesanapalli Oil Field could have broader implications for the region's energy landscape, potentially positioning India as a significant player in the global oil and gas market.

However, alongside the opportunities presented by the Kesanapalli Oil Field, there are also challenges and considerations related to environmental impact, technological feasibility, and regulatory frameworks. Balancing these factors will be essential for ensuring the sustainable and responsible development of this valuable energy asset.

Mechanics of ETP (Effluent Treatment Plant)

- Firstly, the water is received from all the sources (mostly wells) in the balancing tank.
- There are two tanks: Tank-A an Tank-B. Most of the oil remains in Tank A and water goes to Tank-B.
- The water is then transferred to CPI (The corrugated Plate Interceptor) for further processing.
- There DeOiler (chemical) is added to separate sludge (accumulates oil at top).
- Then it is transferred to IGF (Induced Gas Flotation). Here scaling Inhibitor is added so that solid particles do not choke. It has a rotating agitator so that it foams the oil particles.
- The water is then subjected to Nut Shell Filtration.
- The oil and sludge is then sent to Sludge Pit. Here sludge thicken and is then sent to Surge Feed Sump where dewatering chemical is added to remove water.
- The water from three filter outlet is then sent to Nutrient Dosing Sump.
- For maintain the pH four types of chemicals are added: Caustic Soda, HCL, Urea and DAP (diammonia phosphate).
- Then it is sent to SBR (sequential batch reactor). SBR proceeds with an aerobic plant process.
- SBR had four chambers (1,2,3 & 4). They worked in a cyclic process of 6hrs.The chambers were filled in pairs, 1&3, 2&4. During six hours three processes were run: Killing and Aeration (3 hours), Settling (1 hour), Emptying the chamber-decanting (2 hours).
- After that the water is sent to sump and through sump it then goes to filter.
- The water is filtered using coal, sand, gravel and anthracite.
- Water is then transferred to Treated Water Tank and then disposed in the sea.

Heater treater

heater treater in oil and gas is a 3-phase separator vessel that utilizes heat and mechanical separation devices to facilitate the separation of oil-water emulsions before transporting the dry oil through pipelines.
In this article, we will discuss how heater treaters work, types of heater treaters, and some common applications.
A heater treater consists of four sections that perform the following functions:

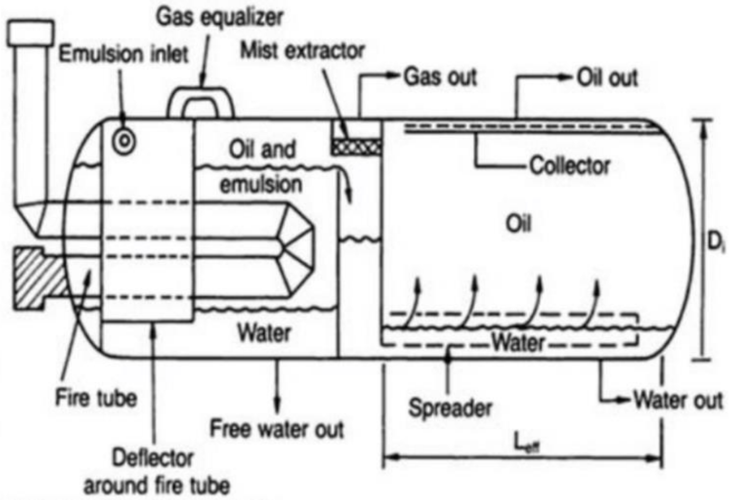
- Degassing
- Heating
- Differential oil control
- Coalescing

How a Heater Treater Works

Untreated crude enters the degassing section via an inlet located at the top of the vessel and dry, associated gases are vented into a gas collection line containing a mist extractor.
Produced water within the crude drops to the bottom of the vessel and is tapped off from a separate outlet. The emulsion passes into a heating section containing fire tubes that heat it indirectly with heated water. This 'washes' the crude mixture, separating the free water and solids.
The treating temperature typically used can be anywhere from 98.6 – 158 °F depending on the crude viscosity. The purpose of heating the oil is to reduce its viscosity and aid the breaking of the emulsion. The oil and emulsion rise over the fire tubes and flow into an oil surge chamber containing a differential float device that regulates the oil level. Some heater treaters have a section containing a filtering medium to screen solid particles out of the oil.
The oil and emulsion flow into the coalescing section through a spreader. This section comprises an electrostatic device that passes alternating current through the emulsion to induce droplet coalescence. As the water molecules separate from the emulsion, they collide and form larger droplets that settle to the bottom of the tank under the force of gravity. The dry oil is tapped via a separate outlet at the top of the tank.
Heater treaters are available in vertical or horizontal orientations. The main difference between a vertical heater treater and a horizontal heater treater for oil and gas is the duration for which the liquid stays in the vessel. The cycle time in horizontal heater treaters is usually longer than that in the vertical orientation.
The two configurations are as follows.

Horizontal Heater Treater

The orientation of a horizontal heater treater is a cylindrical vessel lying on its side. Horizontal heater treaters have the same basic operation as vertical treaters but have a larger section for treating the crude.
A key benefit of this orientation is that the vessel can handle higher volumes of fluid and heavier crudes that require longer retention periods for separation. Horizontal heater treaters can treat emulsions of any API gravity with high water content.



Horizontal heater treaters

Vertical Heater Treater

Vertical heater treaters are cylindrical vessels in an upright position. They have a smaller crude treating volume than the horizontal type, making them ideal for space-constrained applications. These vessels are better suited for separating lighter crudes that require shorter retention periods. Vertical heater treaters can treat emulsions having API gravity up to 27 and low water content.

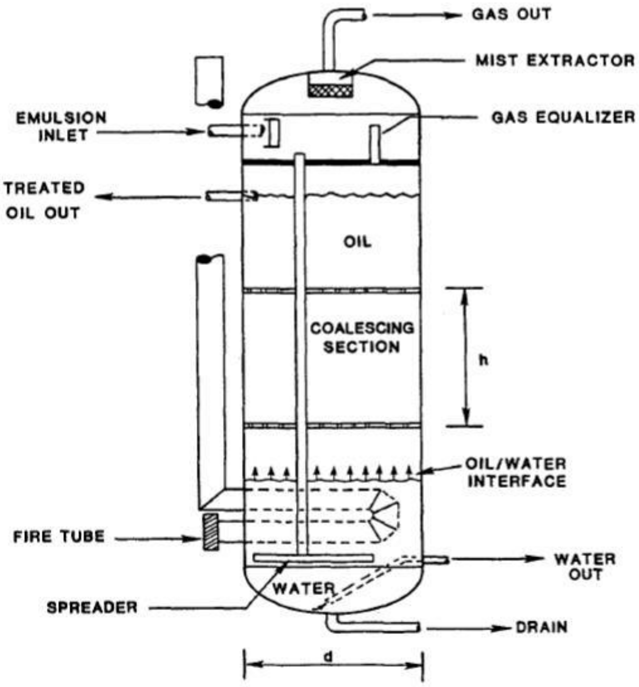


Figure 6-8. Vertical treater schematic.