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AN OVERVIEW OF OFFSHORE PLATFORMS AND TRANSPORTATION OF OIL AND NATURAL GAS

Regulapati Venkata Soma Sekhar
Student
M.V.V.S Anuprakash
Assistant professor
Petroleum engineering
Aditya engineering college
Surampalem

Abstract:

There are basically two divisions under engineering services –Offshore Design Section (ODS) and Offshore Works Division(OWD). During the tenure of the training our focus was mainlyon ODS, under which there are seven disciplines-

- Process
- Piping
- Pipelines
- Instrumentation
- Mechanical
- Electrical
- Structure

Apart from getting the overview of all these disciplines, we have also worked on a small project on PGC, along with a single day visit to the process platform at URAN, and an overview of the basics of drilling processes.

Introduction:

There are mainly four steps involved in the production of crude oil and gas. They are:
1. Exploration
2. Gas and Crude Oil Production
3. Processing
4. Transportation.

EXPLORATION:

Exploration means a scientific search set by the geologists and geophysicists for locating the probable regions of oil and gas. In general terms this refer to the entire gamut of search for hydrocarbons with the help of geological and geophysical surveys integrated with laboratory data backup, selection of suitable locations of exploratory test-drilling and testing of such wells.
Geophysical technology greatly reduces the risk of drilling. Wells are drilled to test a geological theory or model that is generated in the Wide Area Geological Review and validated by seismic data. The relative position of rock layers can be imaged from the patterns of acoustic sound waves that are reflected from subsurface formations. For twodimensional (2D) seismic operations, field crews run parallel lines of sound recorders at wide intervals to cover large areas in a relatively inexpensive manner. Once a field is discovered, 3D seismic can be run in a grid pattern with close sound recorders to delineate the most attractive places to drill additional wells and determine the areal extent of a formation.

GAS AND CRUDE OIL PRODUCTION:

According to generally accepted theory, Crude Oil is derived from ancient biomass. It is a fossil fuel derived from ancient fossilized organic materials. More specifically, crude oil and natural gas are products of heating of ancient organic materials (i.e. kerogen) over geological time. Three conditions must be present for oil reservoirs to form: a source rock rich in hydrocarbon material buried deep enough for subterranean heat to cook it into oil; a porous and permeable reservoir rock for it to accumulate in; and a cap rock (seal) or other mechanism that prevents it from escaping to the surface.
Within these reservoirs, fluids will typically organize themselves like a three-layer cake with a layer of water below the oil layer and a layer of gas above it according to their densities, although the different layers vary in size between reservoirs. Because most hydrocarbons are lighter than rock or water, they often migrate upward through adjacent rock layers until either reaching the surface or becoming trapped within porous rocks (known as reservoirs) by impermeable rocks above. However, the process is influenced by underground water flows, causing oil to migrate hundreds of kilometers horizontally or even short distances downward before becoming trapped in a reservoir. When hydrocarbons are concentrated in a trap, an oil field forms, from which the liquid can be extracted by drilling and pumping.

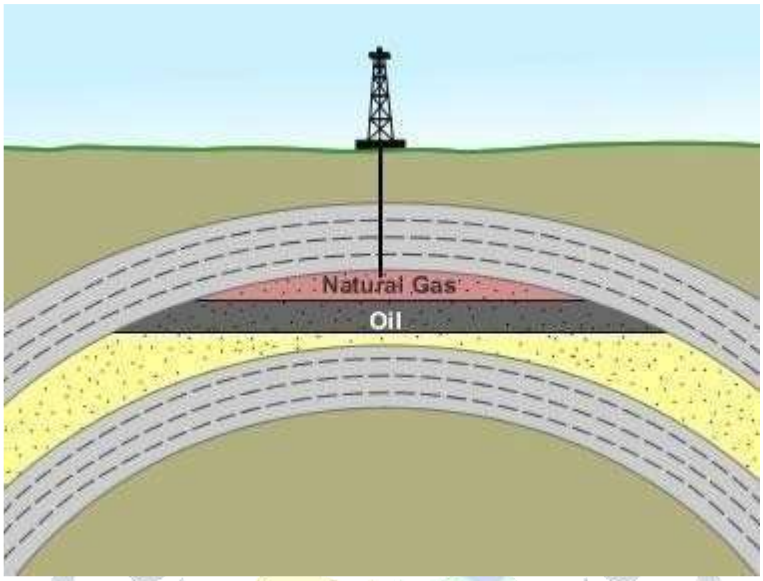

Fig:Hydrocarbon trapping in an anticline structure

Prospects must be well defined in order to obtain oil and gas leases from landowners prior to the drilling of a wildcat well after the necessary land work has been completed, the drilling rig is moved on site and crews work 24 hours a day to drill a hole for the calculated depth.

PROCESSING:

Offshore productions consists of a number of operations that allow the safe and efficient production of hydrocarbons from the flowing wells. The key operations that will be conducted at the offshore platform include:

- Produced Hydrocarbon Separation
- Gas Processing
- Oil and Gas Export
- Well Testing
- Produced Water Treatment and Injection
- Utillities to support these processes

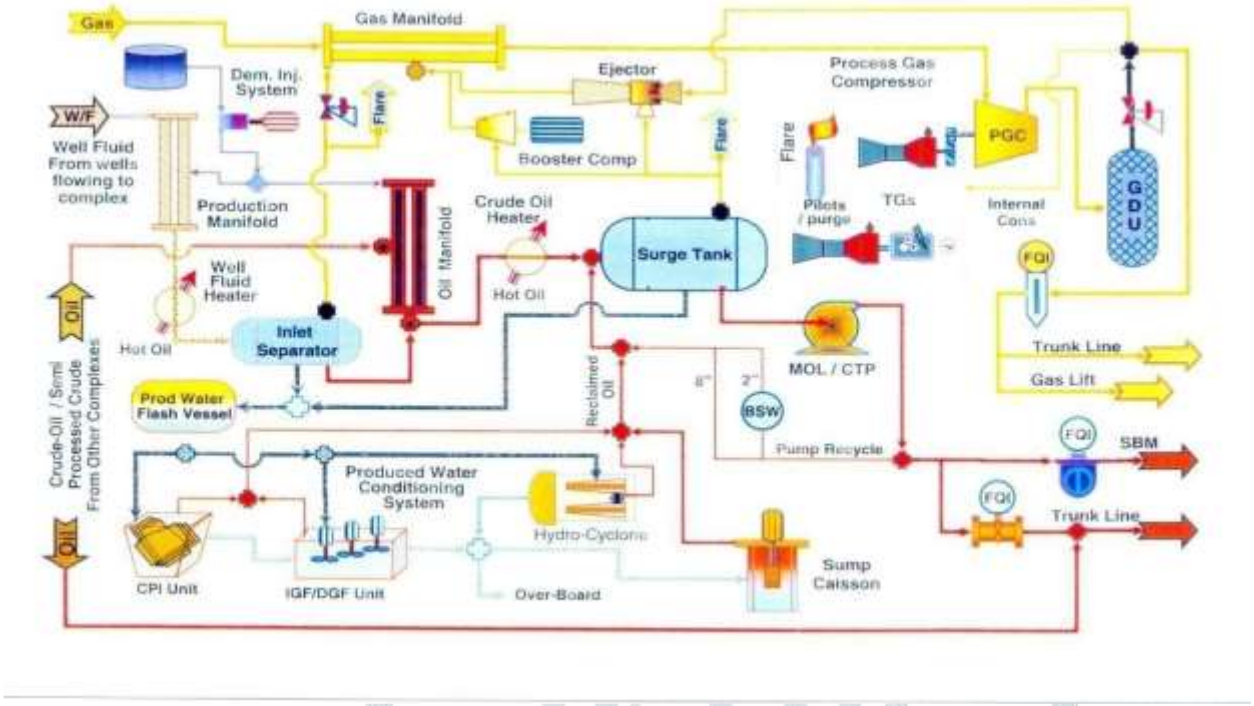

Fig: Schematic Diagram of an Offshore Process Complex

The Pipelines and Risers facility uses Subsea production wells. The typical High Pressure (HP) wellhead at the bottom right, with its Christmas tree and choke, is located on the sea bottom. A production riser (offshore) or gathering line (onshore) brings the well flow into the manifolds. As the reservoir is produced, wells may fall in pressure and become Low Pressure (LP) wells. This line may include several check valves. The choke, master and
wing valves are relatively slow, therefore in case of production shutdown, pressure before the first closed sectioning valve will rise to the maximum wellhead pressure before these valves can close.
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TRANPORTATION:

The gas pipeline is fed from the High Pressure compressors. Oil pipelines are driven by separate booster pumps. For longer pipelines, intermediate compressor stations or pump stations will be required due to distance or crossing of mountain ranges.

OFFSHORE DESIGN SELECTIONS:

PROCESS:

This discipline lays out the initial specifications required for the process platform in the offshore. Any process platform is the gathering and distribution point for all the pipelines i.e. well fluid lines, lift gas lines and oil export line for tanker loading. All the processing facilities i.e. separation, produced water treatment, gas compression and dehydration, gas sweetening is installed on this platform. In addition there are testing facilities for testing of
production coming from individual platforms.
Therefore, using many softwares like ASPEN HYSYS, SMARTPLANT etc. The process discipline under ODS drafts out the basic plans for any offshore process platform. The various diagrams like PFDs (Process Flow Diagram) and P&IDs (Piping and instrumentation diagram) are being designed by the people of this discipline. After the process design is completed the feasibility study for the designed process is carried out for future bidding and finalisation for the design.

PIPING:

The piping discipline under ODS looks after the pipes on the process platform. Plant layout and design of piping systems constitutes a major part of the design and engineering effort. Basically the following are the main tasks carried out by this discipline:
• Piping and instrumentation diagrams (P&IDs)
• Piping design and engineering principles
• Terminology, symbols and abbreviations used in piping design
• Piping materials
• Piping specifications and piping codes
• Components of piping systems - fittings, flanges and valves

INSTRUMENTATION:

Instrumentation discipline comes into play after the process platform has been designed by the process design section with the help of a P&ID. This discipline helps in controlling and automating all the process parameters involved in the offshore as well as in the onshore process platforms.
The various controlling instruments looked after by this discipline may be either pneumatic or electronic. It deals with the measurement of pressure, temperature, flow-rates with the help pressure transducers, temperature sensors (RTD, Thermocouples etc.) and flow meters respectively. Instrumentation discipline also takes care of the ―Shut Down Panel‖ which shuts down all the processes in case of an emergency.

ELECTRICAL:

Every power plant needs one or the other way electrical power for its proper functioning. For an offshore platform it requires huge electrical power to run all the mechanical devices employed, living quarters electrical consumption and also some power to run various instruments.
For any general platform of ONGC, it requires about 20-25 MW or more power to run the system. To produce such large amount of power is challenging. For this ONGC has its own power production unit where power is generated by a portion of the natural gas produced. There are huge Gas Turbine Units (GTU) for power production. Also the circuit breaker station is installed on the platform itself. For some other purposes which may require small power say few KWs, power is generated by the renewable sources of energy like solar energy, wind energy etc.

MECHANICAL:

The Mechanical devices such as Turbines, Compressors, Pumps, Heat Exchangers etc.
are the basics for a plant to operate and such devices are included under the Mechanical discipline for both running and maintenance of the same..

DRILLING PROCESSES:

A major difference between onshore and offshore drilling is the nature of the drilling platform. In addition, in offshore drilling the drill pipe must pass through the water column before entering the lake or seafloor. Offshore wells have been drilled in waters as deep as 10,000 ft (305 m). The following text provides an overview of drilling in offshore environments:

DRILLING TEMPLATES:

Offshore drilling requires the construction of an artificial drilling platform, the form of which depends on the characteristics of the well to be drilled. Offshore drilling also involves the use of a drilling template that helps to connect the underwater drilling site to the drilling platform located at the water's surface. This template typically consists of an open steel box with multiple holes, depending on the number of wells to be drilled. The template is
installed in the floor of the water body by first excavating a shallow hole and then cementing the template into the hole. The template provides a stable guide for accurate drilling while allowing for movement in the overhead platform due to wave and wind action.

DRILLING PLATFORMS:

There are two types of basic offshore drilling platforms, the movable drilling rig and the permanent drilling rig. The former is typically used for exploration purposes, while the latter is used for the extraction and production of oil and/or gas. A variety of movable rigs are used for offshore drilling. Drilling barges are used in shallow (<20 ft [<6 m] water depth), quiet waters such as lakes, wetlands, and large rivers. As implied by the name, drilling barges consist of a floating barge that must be towed from location to location, with the working platform floating on the water surface. In very shallow waters, these may be sunk to rest on the bottom. They are not suitable for locations with strong currents or winds and strong wave action. Like barges, jack-up rigs are also towed, but once on location three or four legs are extended to the lake bottom while the working platform is raised above the water surface; thus, they are much less affected by wind and water current than drilling barges.

DRILLING TECHNIQUES:

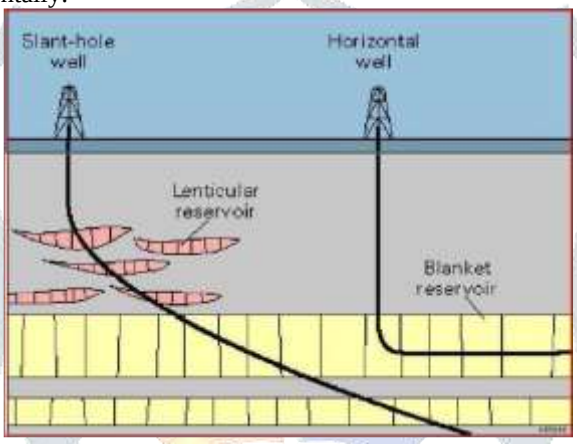
Several types of drilling techniques are currently employed in oil and gas drilling: straight hole drilling, directional drilling, horizontal drilling, air drilling, and foam drilling. Regardless of the drilling technique, a well is typically drilled in a series of progressively smaller-diameter intervals.

STRAIGHT HOLE DRILLING:

In straight hole drilling, the well bore is vertical and deviates by no more than 3 degrees anywhere along the well bore, and the bottom of the well deviates by no more than 5 degrees from the starting point of the well bore at the drilling platform. With straight hole drilling, the drill bit may be deflected if it contacts fault zones or dipping beds of hard rock layers.

DIRECTIONAL AND HORIZONTAL DRILLING:

Directional drilling (also termed slant drilling) involves the drilling of a curved well to reach a target formation. Directional drilling is employed when it is not possible, practicable, or environmentally sounds to place the drilling rig directly over the target area. Directional drilling is especially useful for offshore locations. With directional drilling, it may take several thousand feet for the well to bend from drilling vertically to horizontally.



WELL COMPLETION:

Once a well has been drilled and verified to be commercially viable, it must be completed to allow for the flow of oil or gas. The completion process involves the strengthening of the well walls with casing and installing the appropriate equipment to control the flow of oil or gas from the well. Casing consists of a stacked series of metal pipes installed into the new well in order to strengthen the walls of the well hole, to prevent fluids and gases from seeping out of the well as it is brought to the surface, and to prevent other fluids or gases from entering the rock formations through which the well was drilled.

Conclusions:

Engineering services plays a vital role in the off shore design. It imparts extensive support in the designing and processing of various off shore production taking place in the sea. It looks after a number of various departments and hence its importance can be compared to none when the question of implementing and executing the process comes.

Oil and gas industry thus has a huge role to play not only in the generation of power but as well as blossoming India's economy. They are the major contributors in Indian economy and hence continuous efforts are being made for their exploration in the near future.

Finally, summing it up we consider ourselves fortunate to be a part of India's tycoon company for Oil &Gas Production, though for a short tenure only. We had a great exposure to the oil and gas industry during our training as it continuously facilitated us developing our knowledge to the where-about of oil and gas industry.

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