ROLE OF VARIOUS EQUIPMENT IN OIL AND GAS PRODUCTION PROCESS FROM DOWNSTREAM TO MIDSTREAM

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ABSTRACT:

An oil and gas field have a long-life cycle, from the discovery of hydrocarbons to the complete exploitation of reserves. The stages in the life of hydrocarbon field are discovery, evaluation, development, production and abandonment. Globally, the demand for oil is persistently on the rise. This demand has led to companies developing fuel sources all around the world, and even then, it never seems like there is enough. One of the most important factors to consider with regards to oil and gas production is the equipment that is used. When you consider the current oil and gas industries, you have to also take into consideration that the sheer variety of equipment is almost incomprehensible, and the quality of one piece of equipment could be incomparable to the next.
Pieces of both static and rotating equipment are commonly used across every corner of the entire hydrocarbons industry, regardless of whether you are considering upstream, midstream, or downstream. Static equipment covers a larger percentage of the current global market, consisting of everything from valves and heat exchangers to furnaces and boilers. Rotating equipment covers a smaller percentage of the current global market, consisting of everything from compressors and turbines to pumps.
During both oil and gas production, the use of static and rotating equipment has to be utilized at every single step. Here we are considering the most important equipment that you need to consider with.

Here I have taken some case studies of the downstream and midstream plant. Also, in this paper I have drafted some key important explorations of Cairn India along with their process in their respective fields with their safety concerns.

INTRODUCTION:

CAIRN IN RAJASTHAN
The Mangala, Bhagyam and Aishwarya (MBA) are the three largest finds in Rajasthan. The oil and gas fields in the Rajasthan Block constitutes Cairn India's key assets in Rajasthan. The Mangala field- considered to be the largest onshore hydrocarbon find in India in the last two decades - was discovered in January 2004. This was followed by the discovery of Aishwarya and Bhagyam, Saraswati, gudafields. To date, 37 discoveries have been made in the Rajasthan block. The Production Sharing Contract (PSC) for the project was signed on 15 May, 1995. In 1997, Cairn acquired an interest in the block. In 2002, Cairn acquired 100% of the exploration interest and assumed the role of operator.
RAJASTHAN BLOCK BASIC FACTS
The Rajasthan block, RJ-ON-90/1, is spread over 3,111 km2 in the Barmer district.
Cairn India is the operator with 70% participating interest. Its joint venture (JV) partner, ONGC, has the remaining 30% participating interest.

EXPLORATION - FIELD DISCOVERY:

THE BLOCK CONSISTS OF THREE CONTIGUOUS DEVELOPMENT AREAS:
Development Area (DA) 1, which comprises the Mangala, Aishwarya, Raageshwari and Saraswati (MARS) fields;
DA 2, consisting of the Bhagyam, NI, NE and Shakti fields; and DA 3, having the Kaameshwari West fields.
At present, oil is being produced mainly from Mangala, Bhagyam, Aishwarya, Raageshwari and Saraswati fields, Guda satellite fields.

VISITED FIELDS:
GUDA, SARASWATI, RAAG OIL
WELLS:
GUDA – 4 wells (presently in closed condition) (average production – 400 bopd)
Guda s1 & s3 (srp wells)
Guda 2(srp wells)
SARASWATI -5 wells (one in closed) (average production 500 bopd)
Sara -1,5,6,7,8 (srp where s-8 is closed)
RAAG OIL – 6 wells (average production – 1050 bopd)
Raag 3,8,9,10,11,12 (raag 10 is srp well and remaining are natural wells)

MARGINAL FIELDS:

The various cycles which affect our oil industry have emphasized the need for detailed control of expenditure for development and production of small discoveries.
Marginal fields refer to discoveries which have not been exploited for long, due to one or more of the following factors:
Very small sizes of reserves/pool to the extent of not being economically viable
Lack of infrastructure in the vicinity and profitable consumers
Prohibitive development costs, fiscal levies and technological constraints
However, should technical or economic conditions change, such fields may become commercial fields.
MARGINAL FIELDS HAVE SEVERAL PARAMETERS THAT AFFECT THEM. THIS INCLUDES:
environmental concerns
political stability
access, remoteness
price and price stability of the produced gas/liquids.
IN THE FIELD:
well head and srp well
manifold
IWBH (indirect water bath heater)
Separator or heater treater
Export oil Storage tanks
Flare package
Loading bay
Diesel storage tank and supply
Safety

In some field's **heater treater** is used in place of IWBH and separator

WELL :(SRP WELL):

Well head: Manually controlled by the choke in the Christmas tree
The surface pressure control is provided by a Christmas tree, which is installed on top of the wellhead, with isolation valves and choke equipment to control the flow of well fluids during production.
A sucker rod is a steel rod, typically between 25 and 30 feet (7 to 9 meters) in length, and threaded at both ends, used in the oil industry to join together the surface and downhole components of a reciprocating piston pump installed in an oil well. The pumpjack is the visible above-ground drive for the well pump, and is connected to the downhole pump at the bottom of the well by a series of interconnected sucker rods. Sucker rods are also commonly available made of fiberglass in 37 1/2-foot lengths and diameters of 3/4, 7/8, 1, and 1 1/4 inch. These are terminated in metallic threaded ends, female at one end and male at the other.
Working: The surface unit transfers energy for pumping the well from prime-mover to sucker rod string. In doing this, it must change the rotary motion of prime-mover to reciprocating motion of sucker rod. And it must reduce the speed of prime-mover to suitable pumping speed. Speed reduction is accomplished at gear reducer. And rotary motion of crank shaft is converted to oscillatory motion by means of walking beam. The crank arm is connected to the walking beam by means of pitman arm. Walking beam is supported by Samson post and saddle bearing. The horse head and bridle are used to ensure that pull on the sucker rod string is vertical all times so that no bearing movement is applied to that part of sucker rod string above stuffing box. The polished rod and stuffing box combination is used to maintain a good liquid seal at the surface.

INDIRECT WATER BATH HEATER:

Indirect bath heaters are mainly used in the oil and gas industry to heat process fluids. The mechanism takes place indirectly through a bath (utilitybath) as opposed to heating directly by flame or furnace (direct fire-tube heaters).
The use of a bath promotes uniform heating and reduces the chance of hotspots. Hotspots often occur in direct fire-tube heaters as a result of carbon build up on the fire side of the tubes. If left unchecked this build up can be a source of process fluid degradation and may lead to ruptures, explosions and leaks.
Due to the indirect nature of bath heaters the safety risks are much lower (combustible streams isolated) compared to direct fire-tube heaters, they can therefore be used in hazardous areas where safety is a concern.
The "indirect" name comes from the fact that a fire-tube is submerged in a bath that provides heating through the bath medium to a submerged coil containing theprocess stream.
Usually the bath fluid is water but depending on the climate and heating requirements it can also be oil (capable of heating process fluids to higher temperatures) or a mixture of water and glycol (used in colder climates to lower the freezing point).Typically, indirect bath heaters should achieve around 50-55% heating efficiency. This relatively low efficiency compared to direct fire-tube heaters is a result of the number of heat transfer steps involved.
In catalytic infrared fire-tube heaters for example, there are only two steps: 1 – infrared from flame to HX, 2 – HX to process fluid. While indirect (fire-tube) bath heaters have four: 1 – heat from flame to fire-tube, 2 – fire-tube to bath fluid, 3 – bath fluid to process stream coil, 4 – process stream coil to process fluid. It's also worth mentioning that a bath heater is slow to react to changes in the inlet stream temperature, mostly due to the large thermal capacity of the bath medium.
Typically, indirect bath heaters are used where the flow rate of the process stream is low and operations may be unattended, they could also be used to prevent coke formation on the tubes when low heat fluxes are required.
IWBH consists of a Diesel Fired burner to heat the medium around the Fire tubes which in turn heats the crude. **The heating bath medium consists of about 30% Water mixed with 70% Tri Ethylene Glycol**. Crude oil is heated while flowing through the hot bath medium.
Temperature of the water in the IWBH is automatically controlled by TS as part of the burner management system (BMS).
Temperature of the process fluid is monitored by TT on the outlet of the process coil.

SEPARATOR:

A separator for petroleum production is a large vessel designed to separate production fluids into their constituent components of oil, gas and water
An oil and gas separator generally include the following essential components and features:
A vessel that includes (a) primary separation device and/or section, (b) secondary "gravity" settling (separating) section, (c) mist extractor to remove small liquid particles from the gas, (d) gas outlet, (e) liquid settling (separating) section to remove gas or vapor from oil (on a three- phase unit, this section also separates water from oil), (f) oil outlet, and (g) water outlet (three- phase unit).
Adequate volumetric liquid capacity to handle liquid surges (slugs) from the wells and/or flowlines.
Adequate vessel diameter and height or length to allow most of the liquid to separate from the gas so that the mist extractor will not be flooded.
A means of controlling an oil level in the separator, which usually includes a liquid-level controller and a diaphragm motor valve on the oil outlet.
A back-pressure valve on the gas outlet to maintain a steady pressure in the vessel.

CLASSIFICATION OF SEPARATOR:
CLASSIFICATION BY OPERATING CONFIGURATION-
HORIZONTAL SEPARATOR: may vary in size from 10 or 12 in. in diameter and 4 to 5 ft seam to seam (S to S) up to 15 to 16 ft in diameter and 60 to 70 ft S to S. Manufactured with monotube and dual-tube shell
VERTICAL SEPARATOR: Vary in size from 10 or 12 in. in diameter and 4 to 5 ft S to S up to 10 or 12 ft in diameter and 15 to 25 ft S to S.
SPHERICAL SEPARATOR:
Usually available in 24 or 30 in. up to 66 to 72 in. in diameter
CLASSIFICATION BY FUNCTION:
TWO PHASE SEPARATORS: Gas is separated from the liquid with the gas and liquid being discharged separately.
THREE PHASE SEPARATORS: In three-phase separators, well fluid is separated into gas, oil, and water with the three fluids being discharged separately.

STORAGE TANKS:

The production of petroleum in all of its different states requires different types and sizes of tanks at different stages. Crude oil is the naturally occurring liquid form of petroleum.
This is the oil that is then refined into other fuels and oil products that we use on a daily basis all over the world, such as petrol, paraffin and diesel oil.
There are some companies that speculatively buy crude oil, and then store it for a time when oil prices go up. Most of the time, the storage of crude oil is temporary.
This is because the oil gets moved to other places for further refinement. The tanks are predominantly found above ground. The crude oil storage tanks design must be up to code to ensure that there are no leaks that could potentially cause environmental damage.
TYPES OF CRUDE OIL STORAGE TANKS:
There are a few different types of crude oil storage tanks. To see which type of tank is better suited for a product, you must take the properties of the type of substance that you want to store into consideration.
Generally, storage tanks can be classified as pressurized storage tanks and atmospheric storage tanks.
Pressurized storage tanks are usually used for storing liquids that evaporate.

FLARE PACKAGE:

Flare is a system, used to dispose of natural gas produced along with crude oil.

SAFETY:

PERSONNEL PROTECTION EQUIPMENT:
Personal protective equipment (PPE) refers to protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection.

The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. Protective equipment may be worn for job-related occupational safety and health purposes, as well as for sports and other recreational activities.
"Protective clothing" is applied to traditional categories of clothing, and "protective gear" applies to items such as pads, guards, shields, or masks, and others.
The purpose of personal protective equipment is to reduce employee exposure to hazards when engineering and administrative controls are not feasible or effective to reduce these risks to acceptable levels.
PPE is needed when there are hazards present. PPE has the serious limitation that it does not eliminate the hazard at source and may result in employees being exposed to the hazard if the equipment fails

FIRE WATER SYSTEM:

Fire water is used in fields for safety purpose. If any fire accident happened ,used to stop fire.
FIRE WATER SYSTEM CONSISTS:
Fire water tank- contains water
Fire water transfer pump- used to transfer water with high force and run by diesel.
Hose connection- used to connect from pump to all points in field.
FIRE EXTINGUISHER:
A fire extinguisher, or extinguisher, is an active fire protection device used to extinguish or control small fires, often in emergency situations.
It is not intended for use on an out-of-control fire, such as one which has reached the ceiling, endangers the user (i.e., no escape route, smoke, explosion hazard, etc.), or otherwise requires the expertise of a fire department.
Typically, a fire extinguisher consists of a hand-held cylindrical pressure vessel containing an agent which can be discharged to extinguish a fire.
There are two main types of fire extinguishers**:**
stored-pressure and cartridge-operated.
In stored pressure units, the expellant is stored in the same chamber as the firefighting agent itself. Depending on the agent used, different propellants are used. With dry chemical extinguishers, nitrogen is typically used; water and foam extinguishers typically use air. Stored pressure fire extinguishers are the most common type.

Cartridge-operated extinguishers contain the expellant gas in a separate cartridge that is punctured prior to discharge, exposing the propellant to the extinguishing agent. This type is not as common, used primarily in areas such as industrial facilities, where they receive higher-than-average use.

They have the advantage of simple and prompt recharge, allowing an operator to discharge the extinguisher, recharge it, and return to the fire in a reasonable amount of time. Unlike stored pressure types, these extinguishers use compressed carbon dioxide instead of nitrogen, although nitrogen cartridges are used on low temperature

EYE WASH AND EMERGENCY SHOWER:

There are two types of emergency showers:

Plumbed Shower: An emergency shower permanently connected to a continual source of potable water

Self-Contained Shower: A stand-alone shower that contains its own flushing fluid

WATER CUT:

More water cut observed in guda 2 field as that field on an average produced 30% water cut daily. To maintain a record how much water is coming, regularly check the water level in storage tanks **using water finding paste**

This water finding paste is also used during tanker loading to confirm how much water is dispatching.

A method for detecting water present an ingredient, which in an admixture of an aqueous solution and a separate hydrocarbon liquid phase comprising:

Providing a water finding probe coated on at least one end thereof with a visual indicating paste composition comprising a **water soluble indicator dye** capable of changing color in the **pH range between about 7 and 11,an inorganic base** in the form of a caustic powder dispersed in a liquid carrier capable of absorbing water but which is not rapidly leached by water or hydrocarbon, a **gelling agent**, and **a boron-containing compound** which is miscible with or soluble in said carrier and capable of being hydrolyzed upon contact with water to yield boric acid or a salt thereof, present in a moisture inhibiting amount.

CONCLUSION:

As discussed, the detailed information on marginal field production facilities and its operations, various problems faced in field have been shown with an observed example.

After reading this report every individual can understand clearly about production operations in a marginal field and boosts confidence in freshers to work in field.

Because information given about every instrumental operation in field in both theory and field observation. As it is good to know these operations as crude coming from well to separator and loading is carried in a same place. We can see everything in same place and feel it. That feel is given in this report.

I hope this report will be helpful for people interested to work in marginal production fields.

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