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# DRILLING OF GAS AND OIL PIPELINES AND ITS MODERN METHODS

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## ABSTRACT

*This article provides a brief overview of gas and oil pipeline drilling, types of drilling, and drilling operations.directional drilling is intentional deviation of a well bore from the vertical. It is often necessary to drill at an angle from the vertical to reach different parts of the formation. Controlled directional drilling makes it possible to reach subsurface areas laterally remote from the point.*

**KEYWORDS:** *Derrick, Drawworks, Mud Handing, Percussion Or Cable Drilling,Rotary Drilling, Rotary Percussion Drilling, Directional Drilling, Electro And Turbo Drilling.*

## INTRODUCTION

The global oil and gas industry encompasses exploration, extraction, refining, transportation (by tankers and pipelines) and distribution. The industry is usually divided into three major components:

- The upstream sector, dealing with exploration and production (E&P).
- The midstream sector, involving transportation of products to refineries, natural gas purification plants etc. using pipelines, rail, vessels etc.
- The downstream sector, including refining of petroleum crude oil, processing and purifying of raw natural gas till distribution of products to end users.

The main components of the drilling rig are the derrick, floor, draw works, drive and mud handling. Control and power can be hydraulic or electric. Earlier pictures of drillers and roughnecks working with rotary tables (bottom drives) are now replaced with top drive and semi automated pipe handling on larger installations. The hydraulic or electric top drive hangs from

the derrick crown and gives pressure and rotational torque to the drill string. The whole assembly is controlled by the draw works.

The drill string is assembled from pipe segments about 30 meters (100 feet) long, normally with conical inside threads at one end and outside at the other. As each 30 meter segment is drilled, the drive is disconnected and a new pipe segment inserted in the string. A cone bit is used to dig into the rock. Different cones are used for different types of rock and at different stages of the well. The picture above shows roller cones with inserts (on the left). Other bits are PDC (polycrystalline diamond compact, on the right) and diamond impregnated.

Directional drilling is intentional deviation of a well bore from the vertical. It is often necessary to drill at an angle from the vertical to reach different parts of the formation. Controlled directional drilling makes it possible to reach subsurface areas laterally remote from the point where the bit enters the earth. It often involves the use of a drill motor driven by mud pressure mounted directly on the cone (mud motor, turbo drill, and dyna-drill), whip stocks – a steel casing that bends between the drill pipe and cone, or other deflecting rods, also used for horizontal wells and multiple completions, where one well may split into several bores. A well that has sections of more than 80 degrees from the vertical is called a horizontal well. Modern wells are drilled with large horizontal offsets to reach different parts of the structure and achieve higher production. The world record is more than 15 km. multiple completions allow production from several locations. Wells can be of any depth from near the surface to a depth of more than 6,000 meters. Oil and gas are typically formed at 3,000-4,000 meters depth, but part of the overlying rock may have since eroded away. The pressure and temperature generally increase with increasing depth, so that deep wells can have more than 200 ºC temperature and 90 MPa pressure (900 times atmospheric pressure), equivalent to the hydrostatic pressure set by the distance to the surface. The weight of the oil in the production string reduces wellhead pressure. Crude oil has a specific weight of 790 to 970 kg per cubic meter. For a 3,000 meter deep well with 30 MPa down hole pressure and normal crude oil at 850 kg/m3 , the wellhead static pressure will only be around 4.5 MPa. During production, the pressure will drop further due to resistance to flow in the reservoir and well.

The mud enters though the drill pipe, passes through the cone and rises in the uncompleted well. Mud serves several purposes:

• It brings rock shales (fragments of rock) up to the surface

• It cleans and cools the cone

• It lubricates the drill pipe string and cone

• Fibrous particles attach to the well surface to bind solids • Mud weight should balance the down hole pressure to avoid leakage of gas and oil. Often, the well will drill though smaller pockets of hydrocarbons, which may cause a “blow-out" if the mud weight cannot balance the pressure. The same might happen when drilling into the main reservoir

Basic drilling rigs contain a derrick (tower), a drilling pipe, a large winch to lower and lift out the drilling pipe, a drilling table which rotates the drilling pipe and bit, a mud mixer and pump and an engine to drive the table and winch. Small drilling rigs used to drill exploratory or seismic

wells may be mounted on trucks for movement from site to site. Larger drilling rigs are either erected onsite or have portable, hinged (jack knife) derricks for easy handling and erection.

**PERCUSSION OR CABLE DRILLING**

The oldest drilling technique is percussion or cable drilling. This slow, limited depth method, which is seldom used, involves crushing rock by raising and dropping a heavy chisel bit and stem on the end of a cable. At intervals, the bit is removed and the cuttings are suspended in water and removed by flushing or pumping to the surface. As the hole deepens, it is lined with steel casing to prevent cave-in and protect against contamination of groundwater. Considerable work is required to drill even a shallow well, and upon striking oil or gas, there is no way to control the immediate flow of product to the surface.

**ROTARY DRILLING**

Rotary drilling is the most common method and is used to drill both exploratory and production wells at depths over 5 miles (7,000 m). Lightweight drills, mounted on trucks, are used to drill low-depth seismic wells on land. Medium and heavy rotary mobile and floating drills are used for drilling exploration and production wells. Rotary drilling equipment is mounted on a drilling platform with a 30- to 40-m-high derrick, and includes a rotary table, engine, mud mixer and injector pump, a wire-line drum hoist or winch, and many sections of pipe, each approximately 27 m long. The rotary table turns a square kelly connected to the drilling pipe. The square kelly has a mud swivel on the top which is connected to blowout preventors. The drill pipe rotates at a speed of from 40 to 250 rpm, turning either a drill which has drag bits with fixed chisel-like cutting edges or a drill whose bit has rolling cutters with hardened teeth.

**ROTARY PERCUSSION DRILLING**

Rotary percussion drilling is a combination method whereby a rotary drill uses a circulating hydraulic fluid to operate a hammer-like mechanism, thereby creating a series of rapid percussion blows which allow the drill to simultaneously bore and pound into the earth.

**ELECTRO AND TURBO DRILLING**

Most rotary tables, winches and pumps of heavy drills are usually driven by electric motors or turbines, which allows for increased flexibility in operations and remote-controlled drilling. Electro drill and turbo drill are newer methods which provide more direct power to the drill bit by connecting the drilling motor just above the bit at the bottom of the hole.

**DIRECTIONAL DRILLING**

Directional drilling is a rotary drilling technique which directs the drill string along a curved path as the hole deepens. Directional drilling is used to reach deposits which are inaccessible by vertical drilling. It also reduces costs, as a number of wells can be drilled in different directions from a single platform. Extended-reach drilling allows tapping into undersea reservoirs from the shore. Many of these techniques are possible by using computers to direct automatic drilling machines and flexible pipe (coiled tubing), which is raised and lowered without connecting and disconnecting sections.

## OTHER DRILLING METHODS

Abrasive drilling uses an abrasive material under pressure (instead of using a drill stem and bit) to cut through the substrata. Other drilling methods include explosive drilling and flame piercing.

## ABANDONMENT

When oil and gas reservoirs are no longer productive, the wells are typically plugged with cement to prevent flow or leakage to the surface and to protect the underground strata and water. Equipment is removed and the sites of abandoned wells are cleaned up and returned to normal conditions.

## DRILLING OPERATIONS

## DRILLING TECHNIQUES

The drilling platform provides a base for workers to couple and uncouple the sections of drilling pipe which are used to increase the depth of drilling. As the hole deepens, additional lengths of pipe are added and the drilling string is suspended from the derrick. When a drilling bit needs to be changed, the entire drilling string of pipe is pulled out of the hole, and each section is detached and stacked vertically inside the derrick. After the new bit is fitted in place, the process is reversed, and the pipe is returned to the hole to continue drilling.

Care is needed to assure that the drilling string pipe does not split apart and drop into the hole, as it may be difficult and costly to fish out and may even result in the loss of the well. Another potential problem is if drilling tools stick in the hole when drilling stops. For this reason, once drilling begins, it usually continues until the well is completed.

## DRILLING MUD

Drilling mud is a fluid composed of water or oil and clay with chemical additives (e.g., formaldehyde, lime, sodium hydra zide, barite). Caustic soda is often added to control the pH (acidity) of drilling mud and to neutralize potentially hazardous mud additives and completion fluids. Drilling mud is pumped into the well under pressure from the mixing tank on the drilling platform, down the inside of the drilling pipe to the drill bit. It then rises between the outside of the drill pipe and the sides of the hole, returning to the surface, where it is filtered and recirculated.

Drilling mud is used to cool and lubricate the drilling bit, lubricate the pipe and flush the rock cuttings from the drill hole. Drilling mud is also used to control flow from the well by lining the sides of the hole and resisting the pressure of any gas, oil or water which is met by the drill bit. Jets of mud may be applied under pressure at the bottom of the hole to aid in drilling.

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