While the equipment used to drill and complete an oil well is usually quite simple, the engineering required to drill one properly can be highly complex. Whether the drilling rig is offshore or onshore, they all have the same basic structure and use the same equipment.

Anatomy of an Oil Rig

The purpose of a rotary oil rig is to drill a hole to a predetermined depth. Hopefully, in the drilling process, one or more oil and gas bearing reservoirs will be encountered. While drilling, cuttings created by the drill bit must be removed. This is done by pumping mud through the drill pipe to the bit and backing up the annulus or space between the drill pipe and the outer casing that is added as drilling proceeds. The mud is mixed with chemicals and pumped down the drill pipe. The returning mud and rock cuttings that reach the surface move by gravity down a return line to a shale shaker designed to separate the returning mud from the rock cuttings for re-use. The remaining cuttings travel down a shale slide to a reserve pit.

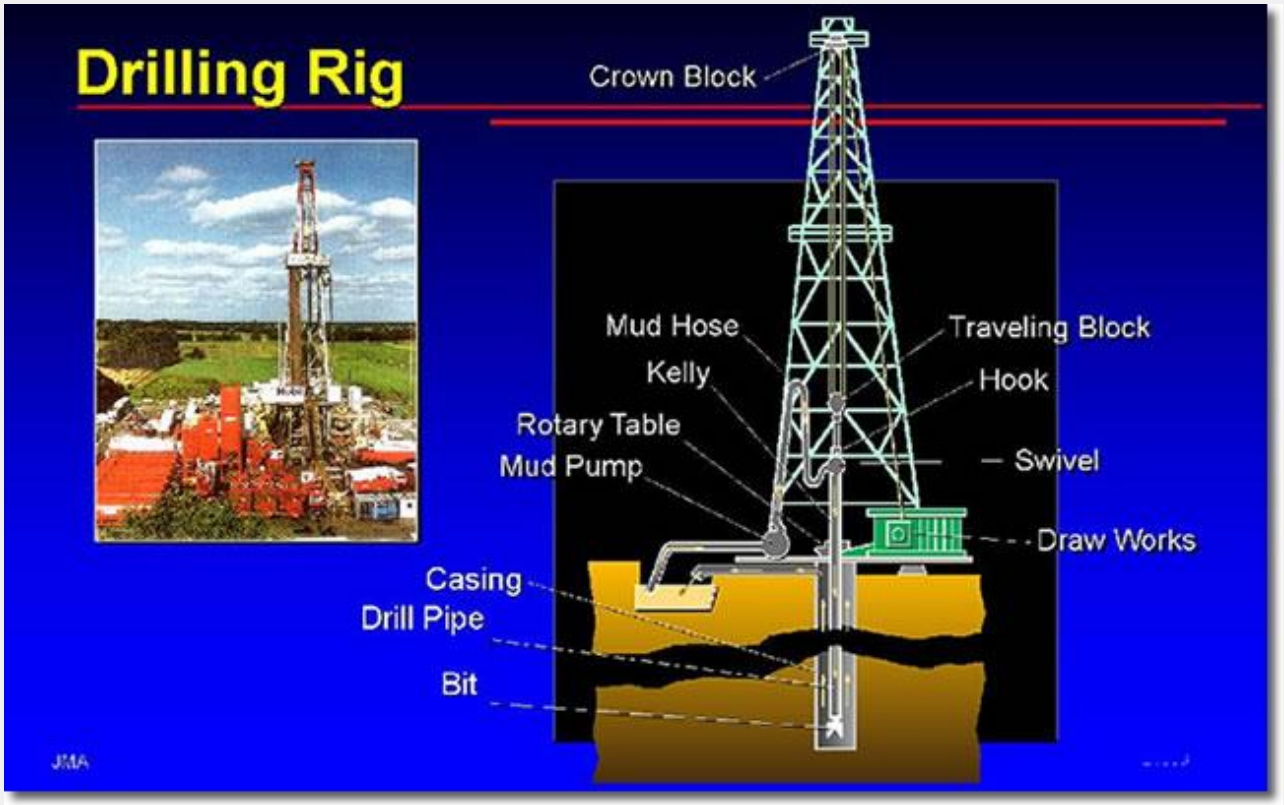


Chart courtesy of Earth Science World and Exxon-Mobil

(843)298-5039
(775)747-0393
fodie@hargray.com

FODOR GROUP OF COMPANIES

P.O. Box 8907
Reno, NV 89507

The kelly is a special section of pipe that has flattened sides that are either square or hexagonal in shape. The kelly fits inside an opening called a kelly bushing. The kelly bushing, in turn, fits into a part of the rotary table called the master bushing. As the master bushing rotates, the kelly bushing rotates. The turning kelly rotates the drill stem and thus the bit. Since the kelly slides through the opening in the kelly bushing, the kelly can move down as the drilling progresses.

Power to rotate the drill stem comes from the rotary table. This is equipped with its master bushing and kelly bushing. When the kelly and kelly bushing are removed, the hole left in the master bushing accommodates slips that have teeth-like gripping elements called dies. These are placed around the drill pipe and keep it suspended in the hole when the kelly is disconnected and an additional section of drill pipe and/or casing is attached.

Both the mud transfer pumps and drilling pipe require power to operate. Usually both are handled by large diesel engines with as much as 3,000 horsepower. Additional power and engines are required to supply electricity to the rig since the rig typically drills 24 hours a day.

Drilling

The engineering becomes more complex as the well is being drilled to its total depth. The deeper one drills, the more pressure that is exerted on the lower strata. Drilling engineers maintain a density (weight) of mud in the hole in order to counter the natural pressures of fluids and gases that might otherwise release into the well hole. But at certain depths and conditions, it becomes impossible to either keep the mud from penetrating a formation or for fluids to release into the well hole. At some point, it becomes necessary to pull the drill stem and bit from the hole, insert casing in the hole, and fill the annulus (space) between the

(843)298-5039
(775)747-0393
fodie@hargray.com

FODOR GROUP OF COMPANIES

P.O. Box 8907
Reno, NV 89507

casing and the wall of the hole with concrete.

Anytime the drill stem and bit are removed, whether to case the well or retrieve a broken tool, the process is call "tripping out." Cement is used to cement casing or steal pipe in a wellbore. The cement is pumped into a special valve called a cementing head. As the cement arrives at the head, a plug called a bottom plug, is released from the cementing head and precedes the concrete slurry down the inside of the casing. This plug keeps the cement and the mud ahead of it from mixing. The plug travels downward until it reaches the float collar. At the collar, the plug stops, but continuing pump pressure breaks the seal in the top of the plug and allows the slurry to pass on. The slurry flows through the plug and starts up the annulus. When the estimated amount of cement required has been pumped into the casing, a top plug is inserted and fluid is pumped in behind the top plug. The top plug keeps the cement from being contaminated by the following displacement fluid. When the top plug reaches the bottom, the pumps are stopped, and the cement is allowed to harden. Once the cement hardens, to resume drilling, the drill stem and a new, smaller bit that fits inside the casing must be tripped back into the hole. This process is called "tripping in."

Completion

Once a well has been drilled and tested (logged, cored and pressure data), a decision must be made whether to complete the well or plug it. Examination of the target reservoir rock porosity and permeability may indicate that the potential flow of oil and gas from the well will not justify the cost to complete the well. In these cases, the well is plugged with concrete in several places, and the well is abandoned.

IIf, however, the well's test information indicates that the well will be commercially productive, the well is completed. If the well is to be completed, production casing is run down the hole and cemented. Once the casing is in place, a tool called a "perforating gun" is lowered into the well-bore to blast holes through the casing, cement and into the reservoir. These holes are made in order for there to be communication between the reservoir and the production casing. Tubing may then be lowered into the casing. A plug may then be set above the perforations as a barrier between the production casing and the tubing. This allows the earth's natural pressure to push hydrocarbons to the well-bore and to the surface through the tubing unless a pumpjack is necessary to raise the fluids to the surface.

(843)298-5039
(775)747-0393
fodie@hargray.com

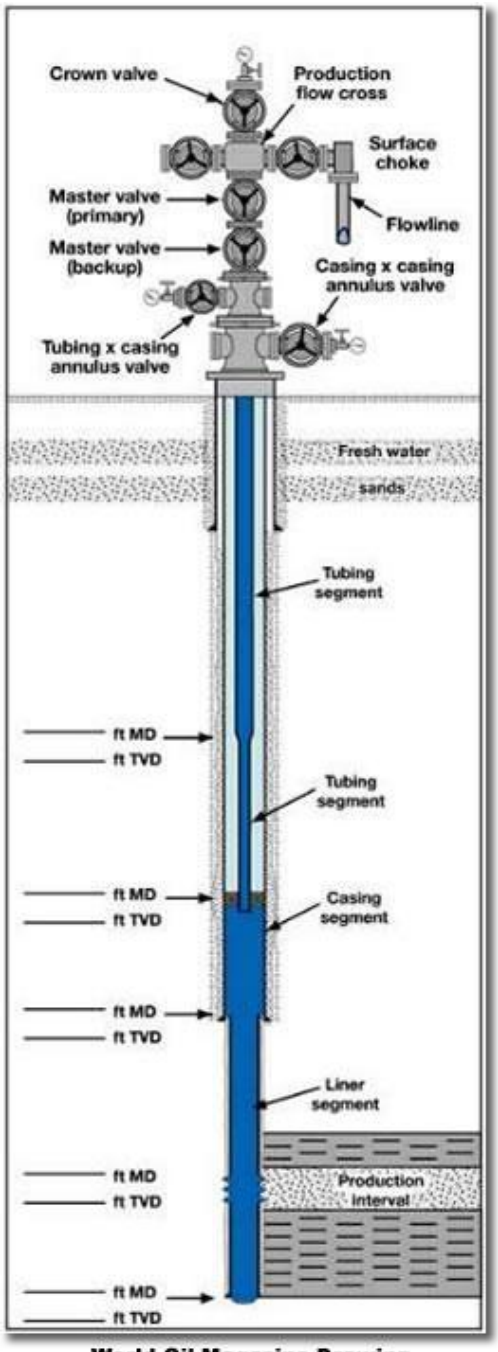
FODOR GROUP OF COMPANIES

P.O. Box 8907
Reno, NV 89507

Several steps are taken at this time to cut out excessive costs from the production process. A large drilling rig will be replaced by a smaller, moveable completion rig. Also, a completion team will use a swabbing method to force the reservoir to give up fluids naturally. This natural flow rate will be measured and compared to other wells in the area. If it is not up to par, then further measures will be taken to increase the volume of production. These measures include chemically or physically treating the reservoir to stimulate the flow. Acid treatment can be used in a reservoir containing limestone. A physical method would be to pump fluid containing small beads into a reservoir under great pressure to fracture the reservoir. The beads are then used to keep the fractures open to allow the flow to increase.

When a satisfactory rate of production has been established, the well will be tested to calculate the maximum production for the well over a period of 24 hours. This is termed as a well's potential. This and other completion information may be required by the state and will aid other geologists and analysts scouting for oil and/or natural gas in the same area.

If a well contains more than one zone of interest, the operator will usually begin by producing the lowest zone in the well-bore first and then work their way up the well-bore as each zone becomes depleted. When a zone is completed, a multi-valve device will be connected to the surface called a "Christmas tree." This device is placed at the top of the production casing and will allow connections to flow the oil and gas. Equipment to process the recovered oil and gas is placed near the well to make sure the oil or gas is ready for transportation.



World Oil Magazine Drawing

Production

Production is the process of extracting petroleum from the underground reservoir and bringing it to the surface to be separated into gases and fluids that can be sold to refineries. Production begins with a high level of production and decreases through time until the well is ultimately plugged and abandoned. This decrease in production is a natural result of the inevitable decline in original pressure within the reservoir. The time period for commercial production and the rate of production depends on the reservoir.

Either gas expansion and/or water encroachment

provides the principal natural energy for most petroleum reservoirs to produce. Both can operate as reserves are taken from the reservoir. The reduction in pressure around the well-bore as hydrocarbons are extracted causes other hydrocarbons to move into their space. This process continues until the energy is depleted and/or the well makes too much water to be commercially productive.

Engineers take the past performance of a well and use it to project the future reserves of a well. One way of predicting future production is to measure the percentage of decline in production over a given period of time and use this rate of decline to estimate future reserves.

(843)298-5039
(775)747-0393
fodie@hargray.com

FODOR GROUP OF COMPANIES

P.O. Box 8907
Reno, NV 89507