УДК 622.276.34

PETROLEUM INDUSTRY: WELL CONTROL AND SAFETY

Ledkov A.O.
Scientific supervisor - Associate professor Tsigankova E.V.
Siberian Federal University

Petroleum is the Source of life on Earth. Today, man is both master and slave of petroleum, which formed under the surface of the earth millions years ago. Man has long been aware of the existence of oil and he has fully realized its value and usefulness. No doubt the world's economy is based not on gold or political philosophies, but rather on the price of a barrel of crude oil. Today we depend on petroleum products not only for transportation, heating, and to generate electricity, but also for fertilizers and fabrics, plastics, medicines, paints and pesticides, and thousands of other items we take for granted every day. The search for petroleum has been conducted in practically every corner of the world, and oil and gas have been discovered in almost every country. In 2009, the Russia was the world leader in oil production. However very few people knows that an oil recovery not only profitable business but also very dangerous. Drilling process is accompanied by many dangers among which most serious complication is oil, gas and water show. Probably the most important concern during drilling is that the pressure which exists in any formation penetrated by the bit must be controlled at all times. Detailed well planning is the first step in preventing trouble while drilling. After drilling begins, constantly monitoring drilling variables, using appropriate equipment, and employing well-trained drilling crews can drastically reduce the chance of losing control of the well. A kick is an unscheduled entry of formation fluids in the wellbore, of sufficient quantity to require shutting in the well. A blowout is the uncontrolled release of formation fluid from a well, typically for petroleum production, after pressure control systems have failed. A blowout is a loss of control of kick. Blowouts can be surface blowouts, or underground blowouts. A surface blowout is an uncontrolled flow of formation fluids to the surface, while an underground blowout is an uncontrolled flow of formation fluids from one formation (the kicking formation) to another. If a kick is not recognized and brought under control quickly and properly, a blowout is a definite possibility. Loss of control of a kick, blowout, can be brought about for two reasons – equipment failure or human error. Almost all blowouts can be attributed to an error or series of errors on someone's part. Even if our well control equipment fails, it is likely that we trace the cause of the malfunction to improper use, maintenance, testing, installation, or manufacture of the equipment – all errors committed by some person or persons. If a kick is not controlled, a blowout may occur so it is necessary to notice the signs of a kick. They are:

1. Drilling break
2. Mud pit gain
3. Flowing well
4. Show of gas, oil, or salt water
5. Decrease in circulating pressure (flow rate increase)
6. Pump stoke increase
7. Improper hole fill-up
8. String weight change (buoyancy effect decreases, and string becomes heavier)

A drilling break usually indicates entry into a higher formation pressure. When higher formation pressure is hit, the mud weight becomes underbalanced and the drilling rate increases, sometime dramatically, sometimes slightly. The mud logger will be calculating the rate of penetration and should notice the difference and report it.

Always keep the mud loggers and the drilling shack rigged up with an intercom to report any changes in the rate of penetration (ROP). Quick response with everyone notified can give more time to check for a kick. Normally, you will notice a showing of the ROP while you are drilling on the top of high pressure, which in some areas is called the cap rock. After you drill thought the cap rock, a faster ROP will be noticed, because the mud becomes underbalanced due to the higher formation pressure, allowing gas or oil to enter the wellbore.

An each type of preventer is a separate component of a BOP stack. Onshore, the BOP stack sits under the rig floor, bolted to the top of the surface casing. Offshore, the BOP stack is either at the bottom of the ocean at the mud line or above the water on the drilling rig platform. If the drilling rig is a floater, there are disconnecting devices at the seafloor that close off the hole when the riser between the drillship and the BOP stack is disconnected and the rig is shifted off location, as when a violent storm is forecasted.

Blowout is caused when a combination of well control systems fail – primarily drilling mud hydrostatics and blow-out preventers (BOPs) – and formation pore pressure is greater than the wellbore pressure at depth.

When such an incident occurs, formation fluids begin to flow into the wellbore and up the annulus and/or inside the drill pipe, and is commonly called a **kick**. If the well is not shut in, a kick can quickly escalate into a blowout when the formation fluids reach the surface, especially when the fluid is a gas which rapidly expands as it flows up the wellbore and accelerates to near the speed of sound. Blowouts can cause significant damage to drilling rigs, injuries or fatalities to rig personnel, and significant damage to the environment if hydrocarbons are spilled.

When all the controls described above fail, a blowout occurs. Blowouts are dangerous since they can eject the drill string out of the well, and the force of the escaping fluid can be strong enough to damage the drilling rig. Blowouts often ignite due to the presence of an ignition source, from sparks from rocks being ejected along with flammable fluids, or simply from heat generated by friction. (Rarely the flowing gas will contain poisonous hydrogen sulfide and the oil operator might decide to ignite the stream to convert this to less hazardous substances.) A well control company will then need to extinguish the well fire and/or cap the well, and replace the casing head and hangars.

Sometimes, blowouts can be so forceful that they cannot be directly brought under control from the surface, particularly if there is so much energy in the flowing zone that it does not deplete significantly over the course of a blowout. In such cases, other wells (called relief wells) may be drilled to intersect the well or pocket, in order to allow kill-weight fluids to be introduced at depth. (Contrary to what might be inferred from the term, such wells generally are not used to help relieve pressure using multiple outlets from the blowout zone.)

Failure to control well pressures can result at the very least in problems that impede drilling progress. At its most serious, failure to control formation pressures while drilling can cause loss of lie, destruction of equipment, and abandonment of the well. A well blowout can also damage the surrounding environment.

All of these consequences have caused great emphasis to be placed on the design and use of blowout control equipment, personnel training in well control, and regulations aimed at minimizing the chance of well blowouts. Because offshore blowouts are especially troublesome and a few incidents have been particularly dramatic, they have had considerable influence on industry and government efforts to prevent both offshore and onshore blowouts.

Making mistakes in a well control situation can be dangerous and can result in significant cost additions to any well project. Should things go terribly wrong, an uncontrolled blowout situation may be the consequence.