Hydraulic Fracturing

[MUSIC PLAYING]

PRESENTER: Geologists have known for years that substantial deposits of oil and natural gas are trapped in deep shale formations. These shale reservoirs were created tens of millions of years ago. Around the world today, with modern horizontal drilling techniques and hydraulic fracturing, the trapped oil and natural gas in these shale reservoirs is being safely and efficiently produced, gathered, and distributed to customers.

Let's look at the drilling and completion process of a typical oil and natural gas well. Shale reservoirs are usually 1 mile or more below the surface-- well below any underground source of drinking water, which is typically no more than 300 to 1,000 feet below the surface. Additionally, steel pipes-- called casing-- cemented in place provide a multilayered barrier to protect freshwater aquifers.

During the past 60 years, the oil and gas industry has conducted fracture stimulations in over 1 million wells worldwide. The initial steps are the same as for any conventional well. A hole is drilled straight down using fresh water-based fluids, which cools the drill bit, carries the rock cuttings back to the surface, and stabilizes the wall of the wellbore.

Once the hole extends below the deepest freshwater aquifer, the drill pipe is removed and replaced with steel pipe, called surface casing. Next, cement is pumped down the casing. When it reaches the bottom, it is pumped down and then back up between the casing and the borehole wall, creating an impermeable, additional protective barrier between the wellbore and any fresh water sources.

In some cases, depending on the geology of the area and the depth of the well, additional casing sections may be run, and like surface casing, are then cemented in place to ensure no movement of fluids or gas between those layers and the groundwater sources. What makes drilling for hydrocarbons in a shale formation unique is the necessity to drill horizontally.

Vertical drilling continues to a depth called the kick-off point. This is where the wellbore begins curving to become horizontal. One of the advantages of horizontal drilling is that it's possible to drill several wells from only one drilling pad, minimizing the impact to the surface environment.

When the targeted distance is reached, the drill pipe is removed, and additional steel casing is inserted through the full length of the wellbore. Once again, the casing is cemented in place. For some horizontal developments, new technology in the form of sliding sleeves and mechanical isolation devices replace cement in the creation of isolations along the wellbore.

Once the drilling is finished and the final casing has been installed, the drilling rig is removed, and preparations are made for the next steps-- well completion. The first step in completing a well is the creation of a connection between the final casing and the reservoir rock. This consists of lowering a specialized tool called a perforating gun, which is equipped with shaped explosive charges, down to the rock layer containing oil or natural gas.

This perforating gun is then fired, which creates holes through the casing, cement, and into the target rock. These perforating holes connect the reservoir and the wellbore. Since these perforations are only a few inches long and are performed more than a mile underground, the entire process is imperceptible on the surface.

The perforation gun is then removed in preparation for the next step-- hydraulic fracturing. The process consists of pumping a mixture of mostly water and sand-- plus a few chemicals-- under controlled conditions, into deep underground reservoir formations. The chemicals are generally for lubrication, to keep bacteria from forming, and to help carry the sand. These chemicals typically range in concentrations from 0.1% to 0.5% by volume, and help to improve the performance of the stimulation.

This stimulation fluid is sent to trucks that pump the fluid into the wellbore and out through the perforations that were noted earlier. This process creates fractures in the oil and gas reservoir rock. The sand and the frack fluid remains in these fractures in the rock and keeps them open when the pump pressure is relieved. This allows the previously-trapped oil or natural gas to flow to the wellbore more easily.

This initial stimulation segment is then isolated with a specially-designed plug, and the perforating guns are used to perforate the next stage. This stage is then hydraulically fractured in the same manner. This process is repeated along the entire horizontal section of the well, which can extend several miles.

Once the stimulation is complete, the isolation plugs are drilled out, and production begins. Initially water, and then natural gas or oil, flows into the horizontal casing and up the wellbore. In the course of initial production of the well, approximately 15% to 50% of the fracturing fluid is recovered. This fluid is either recycled to be used on other fracturing operations, or safely disposed of according to government regulations.

The whole process of developing a well typically takes from three to five months-- a few weeks to prepare the site, four to six weeks to drill the well, and then one to three months of completion activities, which includes one to seven days of stimulation. But this three to five month investment can result in a well that will produce oil or natural gas for 20 to 40 years or more.

When all of the oil or natural gas that can be recovered economically from a reservoir has been produced, work begins to return the land to the way it was before the drilling operations commenced. Wells will be filled with cement, and pipes cut off 3 to 6 feet below ground level. All surface equipment will be removed, and all pads will be filled in with dirt or replanted. The land can then be used again by the landowner for other activities, and there will be virtually no visual signs that a well was once there.

Today, hydraulic fracturing has become an increasingly important technique for producing oil and natural gas in places where the hydrocarbons were previously inaccessible. Technology will continue to be developed to improve the safe and economic development of oil and gas resources.

[MUSIC PLAYING]