HYDRAULIC FRACTURING

What is hydraulic fracturing?
Hydraulic fracturing is the process of transmitting pressure, using fluid or gas, to create cracks or open existing cracks in hydrocarbon-bearing rocks underground. Hydraulic fracturing is a type of stimulation. Almost all of the North American reservoirs remaining today likely require some sort of stimulation treatment in order to raise production rates to economic levels.

The type of stimulation used is dependent on a number of variables:
• Type of well that has been drilled (vertical or horizontal)
• Rock properties of the reservoir
• Depth, thickness and temperature of the reservoir
• Type of wellbore cement and casing (completion technique)
• Number of fractures to be completed in the wellbore
• Choice of fracturing fluids and materials (for additional information on Fracturing Fluids please see our Fracturing Fluids fact sheet)
• Cost of fracturing and materials

Why is hydraulic fracturing necessary?
Most sedimentary rocks have the ability to store natural gas or oil in the small pores or spaces within the rock. However, the ability for these hydrocarbons to flow out of these reservoir rocks is controlled by the connectivity, or pathways, that link the pore spaces. In reservoirs with low permeability, the connectivity of the existing pore spaces within the rock is not sufficient enough for the gas or oil to flow through the rock to the wellbore. As a result, some type of reservoir stimulation is required. The purpose of hydraulic fracturing is to connect existing pathways within the reservoir to enable the oil or gas to flow more easily from the formation to the wellbore.

Process of Hydraulic Fracturing
Once the well is drilled and cased to the target depth, perforations (holes) are made in the production casing, within the target zone only, to provide entry points by which the fracturing fluid and proppant can enter into the targeted hydrocarbon zones(s). The number and orientation of the perforations is pre-determined and designed to intersect the natural fracture system that may be present in the reservoir. These perforations provide the entry point for the hydrocarbons to flow from the reservoir into the production casing of the wellbore.

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Permeability: The ability of the rock to pass fluids or oil through it. The higher the permeability number, the greater the amount of fluid or oil that can flow through the rock. Permeability is measured in a unit called Darcies. Conventional reservoirs may have permeabilities in the 10's to 100's of milliDarcies or occasionally Darcy range. Unconventional or tight reservoirs usually have permeabilities in the micro to nanoDarcy (one millionth of a milliDarcy) range.

Proppant: Non-compressible material, usually sand or ceramic beads, that is added to the fracture fluid and pumped into the open fractures to prop them open once the fracturing pressures are removed.
Hydraulic fracturing equipment is then brought to the surface location and connected to the wellbore for the fracture treatment. Hydraulic fracturing is essentially a four step process:

- **Step 1**: Pressure the reservoir rock using a fluid to create a fracture
- **Step 2**: Grow the fracture by continuing to pump fluids into the fracture(s)
- **Step 3**: Pump proppant materials into the fracture (contained in the fracture fluid)
- **Step 4**: Flow back the well to recover the fracture fluids while keeping the proppant in place

**What direction do fractures grow?**

Fractures in oil and gas bearing rocks will extend along “the path of least resistance”. At any point in the zone of interest, the rock will have three stresses acting upon it: a vertical stress primarily due to the weight of the rock that lies from the surface to the depth of the target zone, and two horizontal stresses that may be thought of as front to back and side to side. The fracture is created by using fluid pressure to “push back” against the least of these three stresses thus opening a fracture.

The most growth will be seen in a horizontal direction. Some vertical growth will occur, however, the pressure from the overlying rock will not typically allow a vertical fracture to grow beyond 100 meters (328 feet).

**How does the oil and gas industry ensure that hydraulic fracturing activities do not negatively impact groundwater sources?**

A key element of a successful hydraulic fracture operation is proper well construction. During the drilling and completion processes, proper drilling techniques must be undertaken to ensure that the wellbore minimizes the damage to the surrounding rock so that the well can be drilled safely with the ability to prevent unconstrained flow of hydrocarbons to the surface and also the protection of groundwater. The critical aspects of proper well construction are the selection and application of casing and cement.

**Is Hydraulic Fracturing a new process?**

No. The oil and gas industry has used this type of technology for more than 60 years. What has changed is the type of wells being hydraulically fractured, the number of hydraulic fractures required and the volume of fracturing fluid needed to create the pressure necessary to crack the rock and provide pathways for the hydrocarbons to travel to the wellbore.

For more information about the oil and gas industry’s use, production and disposal of fracturing fluids, please see Understanding Water and Unconventional Resources.