Chevron offers rare look at controversial practice of fracking

John Cox, Bakersfield Californian, 7-26-15

Patrick Niebuhr was chatting with a visitor outside a mobile command center in the Lost Hills Oil Field when suddenly a loud rumbling arose and exhaust began to stream from a series of red semi-trucks parked nearby.

The commotion told Niebuhr, a Bakersfield-based technology manager with Halliburton Co.that the "frack job" he and engineers at Chevron had spent months planning was now at a critical stage.

The trucks were pumping a thick slurry of water, sand and chemicals nearly 2,000 feet underground at close to 2,500 pounds per square inch. At that moment, highly porous rock composed of algae that lived there more than 10 million years ago was being cracked open to release its abundant oil.

As intense as the hydraulic fracturing operation was, it was also carefully controlled, monitored and regulated to make sure the fluid being injected did not accidentally escape its target zone. For if it did, the toxic fluid might reach a relatively shallow aquifer containing groundwater that, though undrinkable now, must be protected as a possible source of future drinking water.

This very expensive well stimulation process, which Chevron USA Inc. expects to perform on about three dozen additional oil wells in Lost Hills this year alone, has generated controversy across the country, even as it has turned the United States into the world's largest producer of petroleum.

While not typical of most U.S. frack jobs, the operation that took place earlier this month is more or less representative of how hydraulic fracturing is done in California. That is, the well fracked that morning is expected to produce oil, not natural gas; also, it is vertical, not horizontal; and the stimulation technique used only water found on site, none of it fresh water.

GOING PUBLIC

As commonplace as the procedure has become, oil producers rarely allow members of the news media or the general public to view the process. This stems partly from safety concerns, but it is also rooted in the industry's penchant for secrecy, a value instilled over decades of competition between individual companies vying to tap the same limited resource.

This reticence has diminished in recent years, however. Prodded by environmental groups, lawmakers and regulators, oil companies have been forced to disclose an unprecedented amount of detail about hydraulic fracturing, including what chemicals are used in the process and from where the water involved comes.

Chevron invited a Californian reporter and photographer to witness this particular operation because, spokeswoman Carla Musser said, "I think we have a responsibility in today's times to educate as much as we can."

The company has an incentive to clear up misconceptions about hydraulic fracturing.

Anti-fracking activists, some of whom see the technique as enabling climate change, have issued statements that do not spell out significant differences between how the procedure is done in California as distinct from approaches used in other states with different geologies.

Some have also confused hydraulic fracturing with the related but separate process of wastewater disposal injections, which has been linked to increased seismicity in Oklahoma and, in California, to permitting errors environmental groups say threaten federally protected aquifers.

Two government-sponsored scientific studies released recently raised concerns about fracking but, as industry defenders emphasize, did not point to any looming dangers. A federal report cited instances of groundwater contamination and other pollution outside California, even as it found no evidence of systematic problems with the technique.

A separate survey commissioned by the state Legislature raised questions about fracking's safety, saying more study must be done before the process can be declared safe.

Fracking has been conducted in California for at least six decades, industry representatives say, with no reported instances of groundwater contamination. They deem it an indispensable tool for extending the life of oil fields that have produced crude for more than 100 years, in some cases. The great majority of fracking in the state occurs in Kern County.

The well Chevron and Halliburton fracked in Lost Hills, with The Californian looking on, is expected to produce about 15 barrels of oil per day for approximately 10 years. That amounts to almost 55,000 barrels, or about 2.3 million gallons, of relatively light crude during the well's lifespan.

Chevron, which has 800 active, fracked wells in Lost Hills alone, said it has no plans to frack the well a second time.

The company withheld the cost of the frack job, but said the process makes up about 60 percent of the well's total cost. That means the procedure is more expensive than the preceding drilling, which can easily top $1 million.

PREPARING TO FRACK

The well itself was drilled last year to a depth of 2,442 feet. Normally, fracking happens within two months after drilling, but in this case it was delayed because of complications related to new state rules on the need for groundwater monitoring wells.

After the well bore was drilled, three layers of steel casing were put in, each to a different depth. The outermost casing runs from the surface to 92 feet below. Inside that is one that extends to 790 feet below the surface, while the innermost casing, measuring 7 inches in diameter, reaches all the way to the bottom of the well.

Each of those layers was cemented in place with the goal of preserving the well's integrity and shielding groundwater that exists from about 600 to 1,600 feet below the surface. That aquifer, known as the Tulare formation, contains water of varying quality. The best of it measures about 4,000 parts per million of total dissolved solids — too salty to drink but well within the range considered a potential source of future drinking water.

The well's "pay zone," where the oil will be tapped, exists in the Belridge formation at about 2,200 feet underground. It is located in a kind of rock called diatomite, formed long ago by tiny organisms called diatoms when the area was covered by ocean.

Diatomaceous soil, as the rock is called, is porous and filled with oil; its extraordinary absorbency makes it

an ideal material for kitty litter. The rock is less permeable than a sidewalk, however, which is why fracking is used to create cracks in the diatomite so oil can flow to the well.

FLOODING THE ZONE

To enhance that flow, Chevron employs a procedure in Lost Hills called water flooding. Though not always used hand-in-hand with fracking, water flooding consists of injecting large amounts of water underground to saturate the diatomite, creating a pressure differential that pushes the oil toward the relatively low-pressure production wells.

The water injection pressure is between 500 and 1,000 pounds per square inch, which is lower than the "frack gradient" at which point the diatomite cracks. Because injections have been associated with seismic activity in other places, Chevron must monitor this process and report any earthquakes stronger than magnitude 2.7. It says the Lost Hills area has experienced nothing that large since 2000.

Water injections in Lost Hills also allow the company to replace underground fluid lost to oil production, so that the ground does not sink. The total water involved is about 8.4 million gallons per day.

About 25 percent of the water used in the flooding comes from the Tulare formation, with the other 75 percent being "produced water" that comes up from the ground along with oil. Produced water is separated from the oil in a water treatment system Chevron has built on the surface. The company says it uses no fresh water in oil production at Lost Hills; this is not the case in every oil field.

Before the fracking can begin, the cemented well casing must be perforated at, in this case, five different depths in the pay zone. In other oil fields, wells may be perforated by using explosives that literally blow holes in the well. But at Lost Hills, Halliburton uses a high-pressure jet that shoots water mixed with an abrasive to make holes in the steel casing. The perforation phase takes about 10 minutes at each of the five depths.

TURNING UP THE PRESSURE

Once the perforations are complete, Halliburton immediately begins the actual hydraulic fracturing. This is when the red pumping trucks, about four of them at a time, with one or two on standby, kick on to force fracking fluid underground, building up enough pressure to rupture the diatomite.

Inside the mobile command center, stationed a few hundred feet from the well, half a dozen Halliburton engineers and supervisors monitor the process on a series of video displays showing data such as fluid injection rates and pressure readings.

Niebuhr, Halliburton's district technology manager, said the workers know what the graphs are supposed to look like at each stage of the process. If something unexpected happens — if the injection pressure suddenly drops, for example — the job would be shut down immediately. That kind of event could suggest the slurry has made its way to a zone it wasn't intended for, like the aquifer.

At its peak, the slurry is forced into the well at a rate of more than 1,000 gallons per minute. The entire process takes about 20 minutes for each of the five perforation depths.

Throughout this process, an inspector with the California Division of Oil, Gas and Geothermal Resources sat in the command center with a laptop. He monitored the slurry injection rate and pressure to see whether anything out of the ordinary occurred. Since 2013's Senate Bill 4 went into effect, every frack job in the state is similarly monitored by a DOGGR official.

Niebuhr took a moment inside the command center to show The Californian's reporter and photographer what the slurry looks like. Initially, it was a viscous, translucent, gel-like substance. But when he returned a few minutes later, the mix was liquid, with sand settled at the bottom of a small container.

The transition from gel to liquid is a key characteristic of fracking fluid. It must start out thick in order to carry sand, water and chemicals to every nook in the fracture without allowing the sand to fall to the bottom of the well. While some frack fluids make the transition based on time elapsed, this one does it according to changes in pressure, Niebuhr said.

KEEPING THE CRACKS OPEN

But after the pressure has created fractures in the rock, the sand must separate from the liquid so it can remain deposited as a "proppant" to hold open the cracks, which start at about 1 inch in diameter near the well but become thinner as they extend outward to form a diameter measuring 100 to 150 feet.

Chevron well completions engineer Lori Soriano brought out a sampling of the proppant sand. Although it looked and felt like regular salt, she explained, this sample had been mined and screened to ensure consistent size. The goal is to lodge the granules into newly created underground fractures to keep them from closing up and rendering the whole process moot.

At Lost Hills, the production wells are spaced about 250 feet apart to keep fractures from one frack job separate from those of another frack job. Likewise, the water injection wells are built at specific distance intervals to make sure fractures do not mingle.

Chevron says fracking fluid stays in the well for seven to 10 days after the procedure is done, while tubing, a pump and rods are installed at the well. After that, production begins, and the fluid comes up along with oil and produced water.

It is later separated from the oil in a treatment facility on site, and ultimately disposed of by injection into the Belridge zone, which contains lower quality groundwater than the Tulare formation and is separated from it by a clay and shale "cap rock."

Having completed a full cycle of perforations and fracking, Niebuhr, Soriano and several other Chevron employees led a short tour of the fracking site. It was a busy scene, involving 22 semi-trucks and many oil field workers.

"All for gas in your cars," said Chevron's Lost Hills program manager, Eric May.