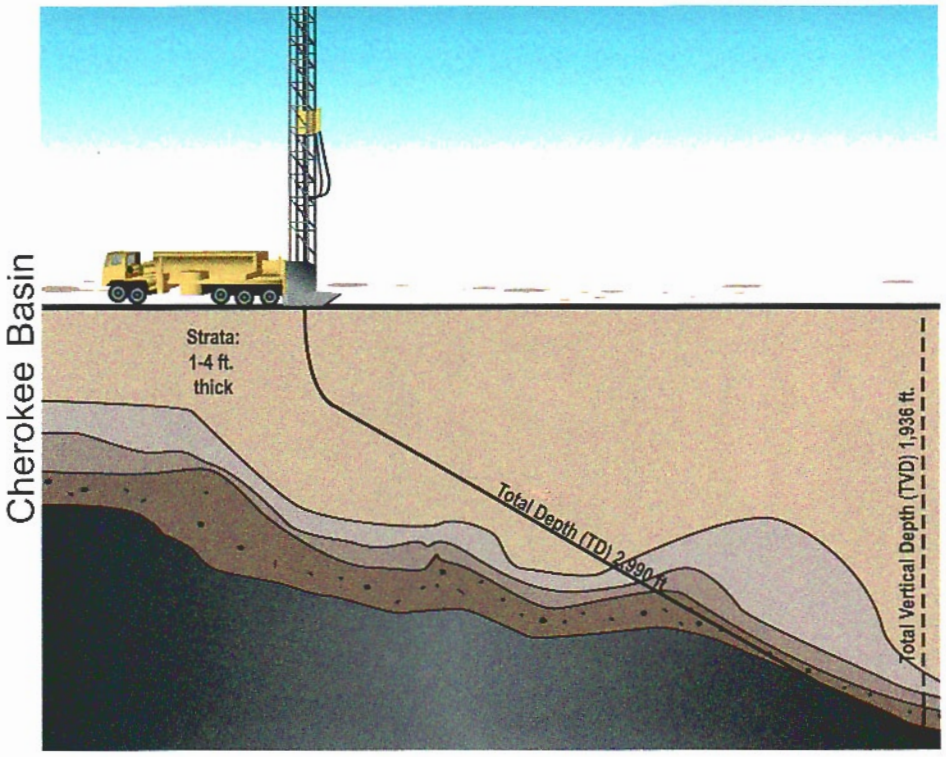
Turning CORNERS

Using the RD20 for directional drilling in gas formations

Discovering ways to increase well output is an evolving science. Getting the most production from a well once revolved only around the size of hole or how the well was developed using various fracking or casing methods. Today optimal production is also determined by how a well is drilled. Pense Brothers Drilling, based in Fredericktown, Mo., is working with Scientific Drilling to develop a directional well in coal bed methane for Constellation Energy Partners (CEP). The Cherokee Basin reservoir in Osage County, Okla., has the potential to produce more when drilling directionally.

As background, Pense Bros. operates 23 rigs, 13 of which are Atlas Copco RD20 drills in the five south central states of Utah, Colorado, Arkansas, Alabama and Oklahoma. CEP is an energy company marketing gas from three reservoirs, including the Black Warrior Basin, Woodford Shale, and Cherokee Basin. Scientific Drilling specializes in directional drilling, hiring out its advanced directional drilling skills to energy companies like CEP. The coal bed methane (CBM)

The drill site includes a large shaker box and two large mud pumps to deliver clean mud that will drive the directional mud motor.



gas potential of the Cherokee Basin lies in thin strata ranging from 1 to 4 ft (30 to 122 cm) thick, which allow greater recovery when boreholes are directionally drilled.

Larry Pense, manager of Pense Bros.' Glenpool, Okla., office, said that the formation and customer dictate the method of drilling. "Our job is to keep equipment operating on the surface. CEP tells us where to drill and the method to be used. Scientific Drilling drills the hole. I don't want to make it sound too simple, but our job is to go up and down and round and round and Scientific tells us what move to make."

Rodney Tate, drilling engineer with CEP, said, "The Cherokee lends itself to directional drilling. The formation is hardly ever flat and following it allows more contact area."

DIRECTIONAL DRILLING AND THE RD20

It's no secret that the RD20 is the drill of choice in the south central states. The deepest Pense has drilled is about 5,600 ft (1,707 m), clearly within the pullback range for the RD20. According to Pense, the deepest well drilled to date in Oklahoma is 4,500 ft (1,372 m), with wells as shallow as 500 to 600 ft (152 to 183 m). Tate added, "Some wells are as much lateral as they are vertical."

Total Vertical Depth (TVD) measures the actual "straight down" depth from the ground surface to the bottom of a well. Total Depth (TD) includes all measured depth, from the surface to the end of the drill string. The gas formation is shallower on the eastern side of the basin than on the west, with a 700 to 2,300 ft (213 to 701 m) TVD variance. "We could have a lateral well from 0 to 2,000 ft (0 to 610 m)," said Tate.

Speed is the primary thing that makes the RD20 fit CEP's drilling program. "Anything that reduces time to TD is beneficial," according to Tate. "The RD20 is mobile and the auxiliary equipment has a smaller footprint." Tate said it could take a conventional rig 20 days to complete what an RD20 can do in two days – from rig-up to rig-down. "Daily rig costs are much greater for a double or triple conventional rig, and the leased footprint costs are much greater. Economically, this just makes sense," said Tate.

The RD20 works well for directional drilling. "Top drive is useful because it allows you to turn on top verses just rotating the mud motor. Also, the hydraulic pull back and pull down allow the driller to accommodate the formation," said Tate.

Scientific Drilling's directional driller, Walter Hancock, is the man on site working with Pense. His role is to direct the operation and give guidance to Pense's driller, Jose Pedraza. He reads the data feedback on his computer and keeps an eye on the cuttings, then conveys to Pedraza to turn the rotary head or increase or decrease mud flow which ultimately translates into directing the bit. The directional mud motor turns by the flow of mud moving through it. For example, 150 gpm of mud equals 70 rpm. "Directional drilling is much the same if you're at 2,000 or 12,000 ft (610 or 3,658 m)," Hancock pointed out. "It comes down to knowing the weight on the bit. That's how the hole talks to you," he said.

To drill at an angle, a mud motor is needed. Pumping mud down the string through the motor turns the bit. The position of the drill string determines the angle the hole will take. Pedraza has a gauge that shows him the direction he is going. Compare the round drill pipe to a 360 degree face of a compass: the gauge points to the location on the drill pipe that indicates the direction in which the bit is moving. (As seen in the photo, the bit is turned 240 degrees southwest.)

For Hancock, directional drilling with the RD20 is somewhat different from conventional rigs. The RD20 has 30,000 pounds of hydraulic pulldown, whereas, with conventional drilling, the weight of the string puts weight on the bit. Because the gas zones are much shallower in Oklahoma, the pulldown on the RD20 puts more control in the hands of the driller.

A gamma sensor within the drill string tells the operator the location of the bit and the formation's composition or contents. The sensor feeds data back to the driller's laptop in the doghouse.

Tate said, "As technology improves,

Walter Hancock directs the drilling from the feedback the gamma sensor sends to his laptop computer.

Pense Bros. helper Michael Casselman, Venture Drilling salesman Delaney Erickson, Pense helper Chase Waldrop, Pense driller Jose Pedraza, Scientific Drilling's directional driller Walter Hancock, and Pense helper Miguel Flores is in the front

sensors have moved closer to the bit and the motors have become smaller, and deciding which to use comes down to economics."

The gamma sensor used by Scientific is 28 ft (8.5 m) behind the bit, but Tate said it's possible to get within a few feet. In addition to the inclination and azimuth as the drill string advances away from the surface, the gamma sensor indicates the radiation in the formation, allowing the driller to follow the gas in the formation. Scientific's proprietary sensor technology is in a section added to the drill string that Hancock will only describe as a "hybrid sub that looks like two sections of pipe with a plastic piece in the middle." The non-metal section is needed to separate the sensor's antenna from the mud motor, keeping it from shorting out.

The gamma sensor is powered by three long lithium batteries. When the mud motor turns, the sensor sends information to the surface. When the rotary head on the drill turns the drill string, the sensor doesn't send information but it also does not use battery life. The batteries last about 150 hours. The advantage of turning from the surface and saving battery power is greater time in the hole and less time spent tripping.

Drilling in the Cherokee Basin is fast drilling. Using a 7⅞ inch (20 cm) Polycrystaline Diamond Compact (PDC) fixed cutter bit, the crew makes good time, as the formation is predominantly shale. The average well in this region is about 3,000 ft (914 m) to TD and takes about three days, according to Pedraza.

Like all drilling, the speed is dictated by the formation, and Hancock said that he is averaging 26.1 to 36.15 ft (8 to 11 m) an hour during the time the job was photographed, but that it has been as high as 216 ft (66 m) an hour on this well. Moving through coal seams, for example, is very fast because the coal is soft and the cuttings float so they come out of the hole fast.

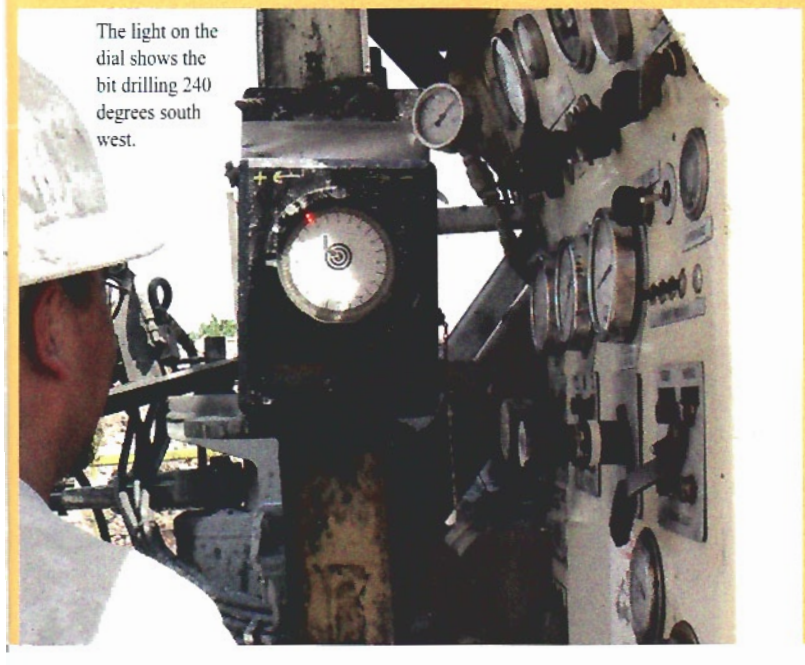
It is optimal to move through the gas zone as quickly as possible to avoid damaging the formation, which could impede gas recovery. Although the RD20 is capable of 30,000 pounds of pull down, Hancock said he works with Pedraza to pull back on the drill string, putting no more than 20,000 pounds on the bit.

Transitioning to a top drive rotary head rig took some getting used to for Hancock because the hydraulic gauge tells him the weight on the bit. On a kelly drive rig, the weight indicator on the string and pump gauge tells Hancock how fast to go. Complimenting Pedraza, Hancock said he's made the transition easier, "Jose is a good driller and he understands how all this [directional equipment] works."

Drilling this hole, the crew will set and cement 8⅝ inch (22 cm) surface casing to 120 ft (37 m). When drilling resumes, about 60 ft (18 m) past the steel casing, the sensor can be used. This is where Hancock will begin turning the corner. He will steer the bit at a 20 degree angle per 100 ft (30 m), increasing to 40 degrees, then 53 degrees to TD. The TD will be 2,990 ft (911 m). The TVD will be 1,936 ft (590 m) and is expected to pass through four gas zones.

DHD 308

The externally upset (also called EU or bottleneck) drill pipe requires a special hydraulic breakout wrench to hold and add pipe to the drill string. The bottleneck pipe is more flexible and the smooth joints take the turn better than standard internally upset (IU or flush joint) pipe.



The light on the dial shows the bit drilling 240 degrees south west.