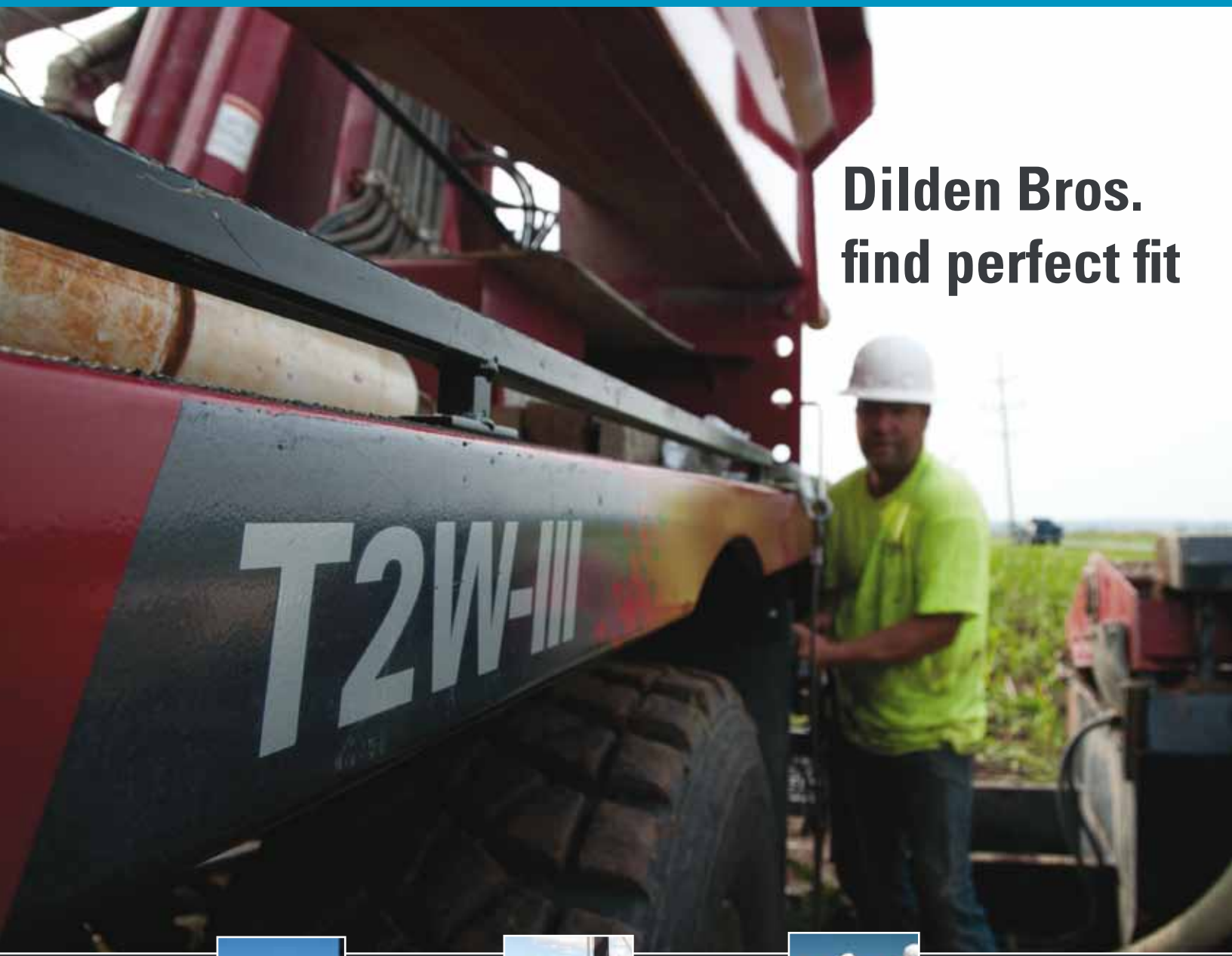
DEEP HOLE DRILLER

AN ATLAS COPCO PUBLICATION FOR THE DRILLING PROFESSIONAL — NO. 2 / 2012



Dilden Bros. find perfect fit

Atlas Copco

EDITORIAL

Oil and gas drilling is a very important market to Atlas Copco. We are always trying to be there for our customers through training, new product development and increasing our manufacturing capacity.

Early this year Atlas Copco held a deep hole drilling training session in Little Rock, Ark. We had 22 participants from six countries. Six instructors from five different divisions shared their knowledge of products and application experiences. Training is used not only to showcase our product offering but also to teach participants what is happening at the bottom of the hole with DTH hammers.

New product development is always first in mind at Atlas Copco. Some of these products include increasing ROP in directional drilling using hammers, and also drill string components to assist with protection of down-the-hole measurement equipment by reducing vibration while maintaining hole cleaning. We have the EDGE drill monitoring system that allows drillers to monitor the performance of the hammer down the hole. Bit development is an ongoing project that never stops. This includes new face designs, gage protection insert placement and ensuring we have the best diamond insert in the market. We have proven that our DTH hammers consistently have superior performance over competitors, and this has gained us market share not only in the USA but also in the Middle East, Poland, India and Korea.

Atlas Copco is also committed to having a state-of-the-art manufacturing process. We have made investments to increase our bit capacity by 25 percent and are always looking at ways to decrease manufacturing lead times.

I see great growth opportunity for oil and gas customers and believe that Atlas Copco has the best products to meet those demands.

Mike Millsaps
Area Manager,
North & South American DTH Equipment

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Atlas Copco

Perfect fit

Dilden Brothers Drilling Company sticks with Atlas Copco T2W »

The dense gray dust clouds that rose up from the super single tires drifted little before settling back down on what should have been an Indiana cornfield.

The farmer who owned the section reported a 3 bushel per acre yield this year, far from enough to justify the cost of planting it. However, an orchard across the road had proven that irrigation could make the land profitable.

Dilden Brothers Drilling Company of Lafayette, Ind., used its Atlas Copco T2W Series III drill rig—the first of its kind—to create the first of two 168-foot-deep (51 m) wells bringing relief both to the thirsty ground and to the farmer, who won't have to watch the rain gauge as closely next year.

Dilden Bros. drilled the well to within 20 feet (6 m) of final depth the first day with a 17 ½ inch (445 mm) tricone, returning the next to complete it to total depth and set a 20-foot section of 100 slot stainless steel screen at the bottom beneath 12-inch (305 mm) steel casing. They backfilled the annulus around the screen with gravel and developed the well with air until it was clean and producing the maximum yield possible.

Wayne Findlay co-owns Dilden Brothers with brother Don Findlay. Wayne said about 2 feet of topsoil lay above the sand and gravel that ran to 170 feet with a static water level of 81 feet. For the most part any rain falling on the field drained too rapidly to fully benefit the crops at the surface. Fortunately there was a plentiful supply of water available. He expected the well to produce over 1,000 gallons (3,785 liters) per minute.

(above) The rig is quiet enough even while drilling, owner-driller Wayne Findlay and helper Mike McCall can easily communicate over rigs single 500 hp engine.

(left) While Wayne Findlay is most often found in the field, brother Don oversees the office side of operations. Established in 1932, the company exchanged hands when Jude Dilden retired in 1985. Coming from a large drilling family themselves, the Findlays continue to build upon the 80-year-old legacy of service to residential, commercial and agricultural customers throughout the region.

Improving along the way

The large-bore well represents just one end of the spectrum of jobs Dilden's T2W performs on any given day, and Wayne said the T2W was the perfect fit for all of the company's specialties.

The rig had just been used Friday for a residential water well. Now in the cornfield on a Monday morning, Wayne said, "Switching over to this job just means hauling a pipe trailer and taking some bigger tools." Dilden has favored the T2W for this very reason ever since it first purchased one in 1996.

When Atlas Copco was looking to update the T2W they met with drillers to seek out what improvements should be made to the T2W. As Dilden Bros. has a long history with T2W rigs, it's no surprise the company stepped forward to offer input and their desire to purchase the first T2W Series III. Wayne and Don, who worked closely with the development team, were excited by the redesigned carousel and other changes. Dilden's other rig is also a T2W, as was the one they traded for the Series III.

Atlas Copco worked with Dilden to tailor the new rig's options specifically for their operation. Though the bulk of Dilden's business had been water well drilling and installation, since about 2008 they now find they are being called upon more and more for their geothermal services. So Atlas Copco bumped up the capacity of the 3 ½-inch carousel from nine rods to 12 rods. The rig now also allows the driller the ability to backload the carousel from the rod box, allowing uninterrupted pipe handling.

"We wanted it for geothermal, for less time spent handling rod. The more you can

Technical data T2W-III

Pullback	30,000 lbf (133 kN)	
Pulldown	30,000 lbf (133 kN)	

Rotary Head

Option 1	**Option 2**
2 motor spur gear tophead, 3-speed	8300 ft-lb (11,250 Nm) @ 0 to 85 rpm
12,000 ft-lb (16,270 Nm) @ 0 to 80 rpm	6213 ft-lb (8425 Nm) @ 0 to 119 rpm
8000 ft-lb (10,850 Nm) @ 0 to 110 rpm	2850 ft-lb (3860 Nm) @ 0 to 255 rpm
3500 ft-lb (4750 Nm) @ 0 to 275 rpm	2 5/8 inch Spindle ID
2 1/2 inch Spindle ID	
Both options have hydraulic off-hole slide to the right	

Hoisting System

Main Hoist	Standard	12,000 lb (5443 kg) 150 ft/min (45.7 m/min)
	Option	15,000 lb (6803 kg) 146 ft/min (44.5 m/min)
	2 part winch line for main hoist	
Aux Hoist	8000 lb (3629 kg) with integral brake, 85 ft/min (35.9 m/min)	
	4000 lb (1814 kg) with integral brake, 120 ft/min (36.6 m/min)	
Sandreel	2000 lb without clutch	

Compressor
500 cfm/200 psi (236 L/s / 14 Bar)
750 cfm/300 psi (354 L/s / 20 Bar)
900 cfm/350 psi (425 L/s / 24 Bar)
No air compressor or air piping

Options
Water injection
On-board mud
Hydraulically operated off-board mud piping
350 gal. (1325 L) Swing up mud pit with Moyno grout pump
Floating sub spindle
DHD lubricator
Single rod loader (cannot be used with carousel)
Pipe spinner
6x6 hydraulic front drive
9-rod 4 ½" carousel or 12-rod 3 ½" carousel
Automatic Allison transmission

> “The T2W is a lot less restrictive for working with large diameter tools and casings.”
>
> **Wayne Findlay**
> Co-owner, Dilden Brothers

The swing-in carousel stows over the tower at the centerline of the truck, reassuring the driver of a balanced load. Wayne Findlay said they find the extra-wide super single tires they requested to be “more aggressive in mud and better on the highway” than duals.

do it with the rig, the better,” Wayne said. “But now we also use it in our water well applications.”

The upgraded rig’s swing-in carousel design brings the pipe over the hole, instead of moving the head to a fixed carousel. The head still moves aside to the right, for instance during case-setting, but when it’s called for, the head always returns exactly to center over the hole with perfect accuracy every time.

Then, too, Wayne said he liked how the swing-in carousel stows for transportation. It centers itself over the truck rather than to the side of it. “I have always felt that a swing-in carousel was better for the road,” he said.

Distinctly T2W

The new rig continues the T2W solid boom tower design, which provides ample clearance to perform such work as welding casing. Wayne said, “I can work around it. It’s a lot less restrictive for working with large diameter tools and casings.”

The irrigation well at this site demonstrated the T2W rig’s ability to switch quickly and easily from rotary mud to air drilling. It was a simple matter of changing a hose from the mud pump piping to the compressor and switching from the 6 $^{5}/_{8}$-inch drill pipe to working with the 3 ½-inch drill pipe that was in the carousel.

Whatever job the T2W is on, Wayne appreciated its speed: “It’s a very fast rig. Easily keeps up with bigger models.” He attributed its speed to three things: a well-designed, three-speed head; the feed system; and its rod handling. “You get the same quick feed rate from it going up as you do going down [190 feet per minute]. Not many other rigs that can say that. And this last rig, in 10 years I never had to touch its feed system.”

The rig is available with a variety of air packages. The largest is a 900 cfm, 350 psi (425 L/s, 24 bar) model. It also comes as 750/300 (355 L/s, 14 bar), 500/200 (236 L/s, 14 bar) and no air configurations.

The attraction of an automatic transmission

This is Dilden’s third T2W with automatic transmission. Co-owner Wayne Findlay said they had noticed how well their pipe and water trucks worked with automatic transmissions and made a request for it in their 2001 T2W. He said Dilden hasn’t had one bit of trouble, not in three drills rigs since then. As for those who “had drive line and rear end fears,” Wayne said reality proved them all to be “myths.” Maintenance has amounted only to changing the oil on schedule. With a manual transmission, Wayne said he’d eventually have to service or replace the clutch.

Wayne said the transmissions have made a huge difference: “On the road it out-accelerates a manual transmission. Shifts are fast and smooth. In high-drag situations, such as a soft field, it will upshift and downshift very fast, unlike a manual transmission that can be nearly impossible to shift without coming to a stop. And you can back in slowly, not have to ride the clutch.” Plus, he added, anyone can drive it—it doesn’t require a driver experienced with shifting a manual transmission.

Lyndell Pannell is fleet account representative for Southwest International Trucks Inc. and is a proponent of the Allison automatic transmission. He believes they are safer to drive because the driver is concentrating on the road rather than operation of the vehicle.

He said, “They also increase productivity. The reliability is unsurpassed by anything in the industry. The transmission is smart with respect to maintenance. It has prognostics which actually tell you when it needs service so you can avoid over- and

(right) On this irrigation well job Dilden Bros. crews switched deftly from 6 5/8-inch pipe on the trailer to 3 ½-inch pipe on their 12-rod carousel in moments. The extra-capacity carousel, which can be back-loaded for uninterrupted pipe-handling, was intended originally for drilling geothermal installations. However, Dilden Bros. has found it useful in other applications as well, providing quicker tripping as it did to develop this 12-inch irrigation well.

Truck options

Dilden got exactly the rig they wanted by knowing exactly what they wanted. John Baker, who has worked at Dilden's for 22 years now, said that's because Wayne, his boss, actually drills on the rigs. He admires him for working alongside his men, but said also, "What's nice about working for an owner who drills himself is that it means we always get the good stuff."

As for the carrier, Dilden was pleased with Atlas Copco's accommodations. "Once again," Wayne said, "they made a special truck for us, just the way we wanted it."

An Allison automatic transmission is now an option for T2Ws in the no-air and 500/200 versions. It is currently required for 750/300 and 900/350 air models, though Atlas Copco plans to offer a manual transmission for the 750/300 air model in the first quarter of 2013.

Dilden's rig also has the optional hydraulic front axle assist, which gives the driver near all-wheel-drive capability without raising the truck height. Wayne said they decided to go with super single instead of dually tires on the rear. There are many other options on the T2W including mud pumps, pipe spinner, sand reel, water injection, service hoist and more.

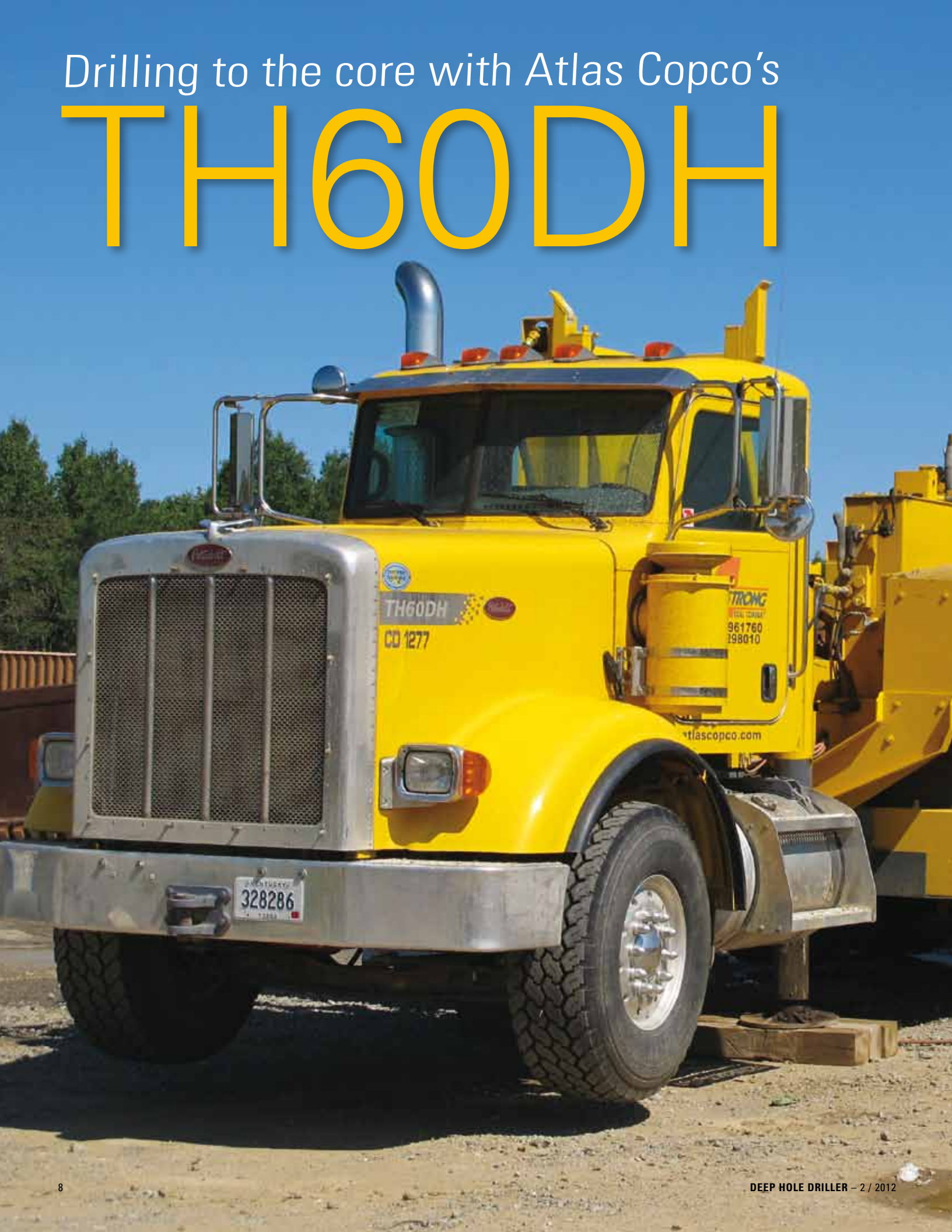
It took a while to customize the rig exactly to Dilden's specifications and get it tuned just right. But Wayne was pleased with the results. He said, "Since we got it all dialed in correct, there hasn't been a problem at all." It has been running smoothly, and cool: "The cooling is fabulous, thanks to that large radiator."

Tom Moffitt, U.S. sales manager for Atlas Copco water well drilling rigs, said, "We were very willing to do all of these things for Dilden Bros. on the T2W," noting that Wayne and his crew's feedback has been instrumental in making a rig that has always been popular in the Midwest even better. Many of the features Dilden Bros. requested for their rig, Moffitt said, are standard options now that make the T2W appealing to a wider customer base.

under-servicing the transmission."

The automatic transmission allows the engine to operate at a lower rpm, which results in better fuel economy. Pannell also pointed out that safety features can be programmed into the transmission based on the application. He said, "The initial cost of the Allison is offset over time by the decrease in driveline and clutch and transmission related failures. Once you get past the initial upcharge it is just a better and smoother product."

Drilling to the core with Atlas Copco's TH60DH



Western Kentucky is known for its ample supply of coal. Although it might seem unusual to see an Atlas Copco TH60 water well rig at work in a coal mine, Armstrong Coal Company has found it valuable in starting up its two new mines.

Classified as a water well drill, Atlas Copco's TH60DH (deep hole) can do much more. In fact, Atlas Copco's entire range of water well products can be used in various applications, including geothermal, dewatering, degassing, uranium, leaching, coring, reverse circulation, potash drilling and exploration.

Armstrong Coal controls more than 300 million tons of proven and probable coal reserves in western Kentucky where they operate five mines, surface and underground.

The company became interested in the exploration and core drilling capabilities of the TH60DH drill rig when it started the expansion in 2011. Armstrong uses both rotation motors with a speed of 145 rpm to get their core samples and has found that is fast enough to get the quality they're looking for.

Armstrong Director of Engineering Keith Brown said, "We're doing exploration drilling to look for strata, normal mining strata, and we target some areas where we're looking for strip faults—anomalies where there wouldn't be good drilling."

Core drilling and the exploration process are imperative to understanding different types of rock conditions, faults and abnormalities that will affect the design of the mine. Armstrong uses Atlas Copco core bits and drill steel.

Executive Vice President of Operations for Armstrong Coal Kenneth (Kenny) E. Allen described what they're looking for in underground mines: "We look for the strata to determine the integrity and competency of the roof, and the quality of the coal seam.

"We analyze the coal for ash, sulfur, moisture and BTU content as well as perform a trace element analysis. It is important to know the constituents of the coal for marketing purposes," Allen said. "We evaluate the floor material to help us size the pillars that support the mine—the softer the floor, the bigger the pillars. It's all part of underground mining."

Mining in the Bluegrass state

Sandstone, shale, and limestone are the most common rock formations in western Kentucky.

Driller Pat Reeter uses a sifter to sample the material of the hole in order to determine the rock type in each location. The most commonly encountered at greater depths were shale, limestone and coal.

Approximately one month after the TH60DH arrived on site, Armstrong Coal drilled a continuous core for the new mine shaft with the TH60DH in Union County, Kentucky. Once completed, drillers will use the TH60DH to drill seven to eight water monitoring wells. This process involves drilling both shallow and deep wells and monitoring both surface water and deep water for at least six months prior to filing an application for a permit to mine.

Armstrong Coal also initiated exploratory drilling to target depths that could be used for the roof, floor, and seams at different localities around the location of their future mine. So far, drillers have been drilling to depths ranging between 270 feet to 1,500 feet, depending on the coal seam or slopes being analyzed.

As of August 2012, the TH60DH drilled more than 20,000 feet in Union County and logged more than 1,800 hours of drill time. According to Project Manager/Coordinator Steve Kane, the TH60DH is running at 95 to 96 percent availability and has had no major issues since it arrived.

Gaining flexibility

Armstrong Coal was pleased with the versatility of the TH60DH. "The biggest benefit of having this rig is flexibility of doing things that we used to have to contract, which cost us a lot of money," said Kane. "That drill has saved this company a bunch of money just from that standpoint. I'm very comfortable we can do anything »

Ricky Hawes (left) and Pat Reeter

The TH60DH is a mid-weight, truck-powered, hydraulic tophead drive drill rig. It is designed for water well and other applications requiring air or mud rotary and down-hole hammer drilling methods. The drill is designed for drilling 5 to 12 inch (127 to 305 mm) holes but can drill up to 20 inches (508 mm) and handle up to 19 inch (483 mm) diameter casing.

Features and benefits

- Single engine design provides lighter weight and quieter operation
- Electronic air regulation system continuously monitors compressor volume and pressure output for optimum efficiency
- 70,000 lb pullback (311 kN) with 37 ft, 6 in (11.4 m) tower support deeper applications

	TH60	TH60DH
Pullback	40,000 lbf (178 kN)	70,000 (311 kN)
Feed System	Single cylinder, cable feed	Twin Cylinder, cable feed
Derrick	Capacity: 45,000 lb (20,412 kg)	Capacity: 75,000 lb (34,019 kg)
Rotary Head	Standard: 5,500 ft-lb (7,458 Nm) at 145 rpm single-speed rotary head Optional: 5,500 ft-lb (7,458 Nm) at 145 rpm two-speed rotary head (second speed) 4,000 ft-lb (5,424 Nm) at 195 rpm Optional: 6,200 ft-lb (8,406 Nm) at 134 rpm single-speed rotary head Optional: 6,200 ft-lb (8,406 Nm) at 134 rpm two-speed rotary head (second speed) 4,650 ft-lb (6,305 Nm) at 180 rpm Optional: 8,000 ft-lb (10,847 Nm) at 105 rpm single-rotary head Optional: 8,000 ft-lb (10,847 Nm) at 105 rpm two-speed rotary head (second speed) 5,500 ft-lb (7,457 Nm) at 145 rpm	

» we're asked to do with it—monitor wells, holes for safe rooms, core drilling for underground, travel way and belt slopes. We can do it all."

Using Atlas Copco PDC or tricone bits, the size of the holes varies from 9 to 12 ¼ inches, with consistent use of 3 ½-inch (89 mm) drill pipe. Armstrong Coal also used bits ranging from 5 ⅞ to 6 ⅛ inches for grouting once the casing was set. They drill through the casing, concrete, and then use a 4 ⅝-inch (117 mm) bit to finish drilling the hole. They case with PVC mostly, but use steel when deeper than 1,000 feet.

Allen said the decision-making process to purchase an Atlas Copco TH60DH for use in a coal mine was simple: "We might be a little biased because we've had good results with our blasthole drills. We get good service. Atlas Copco has worked with us on issues that have come along on the drills."

In fact, Armstrong Coal owns three Pit Viper 275 rotary blasthole drill rigs, three DML blasthole rigs and two ROC F9 top hammer drills. The company also uses Atlas Copco bits for a number of projects. "Everything we've got in our drilling stable, so to speak, is an Atlas Copco drill. Since we evaluated the deep hole drills, Atlas Copco seemed to have everything in the TH60 that we were looking for," said Allen. "So it made sense to stay with the same group of people and the same company."

The capabilities of the TH60DH had Armstrong Coal interested in more than brand loyalty. Allen said, "Many claimed they had the capabilities of doing what we wanted them to do and the TH60 seemed to stand out to us. We're really pretty deep, taking core at 1,500 feet (460 m), and it's pretty important to be able to get those cores where we need them."

Armstrong Coal doesn't need auxiliary air, even at those depths.

Kane and Atlas Copco salesman Paul Haynes worked closely together during the sales process. When Haynes visited Armstrong Coal in early 2011 to present the deep hole product range, Kane was adamant about having at least 50,000 lbf (220 kN) of pullback capacity. "We wanted something that had a lot of pullback power and with the TH60DH, of course we've got 70,000 lbf (310 kN) of pullback in case we get in trouble, and a lot of these other drills we looked at don't have this capability," said Kane. "We just felt that with the versatility, we could make the TH60 do what we needed to do with everything we were involved in."

Armstrong Coal Project Manager Steve Kane and Atlas Copco Salesman Paul Haynes check out work on the drill site.

Haynes and fellow Atlas Copco Product Manager Frank Chickey were the two that led the training of the TH60DH. Kane said, "We got it in July, but these drillers had to go through a training process. Paul [Haynes] and Frank Chickey had a class for the drillers, and then we took the drill back in the parking lot and spent two, maybe three days of hands-on training." According to Kane, the drill was unlike anything his two drillers had ever used, but they quickly caught on.

> "Since we evaluated the deep hole drills, Atlas Copco seemed to have everything in the TH60 that we were looking for."
>
> **Kenneth Allen**
> Executive Vice President of Operations, Armstrong Coal

Future plans

As of September 2012, the Armstrong West project has no definitive timeline. Drilling of exploratory holes continues to determine the best locale and structure for the new underground mine. Once all exploratory holes are completed for this project, the TH60DH will begin drilling safe-room holes, which are required for underground mines in case of disaster.

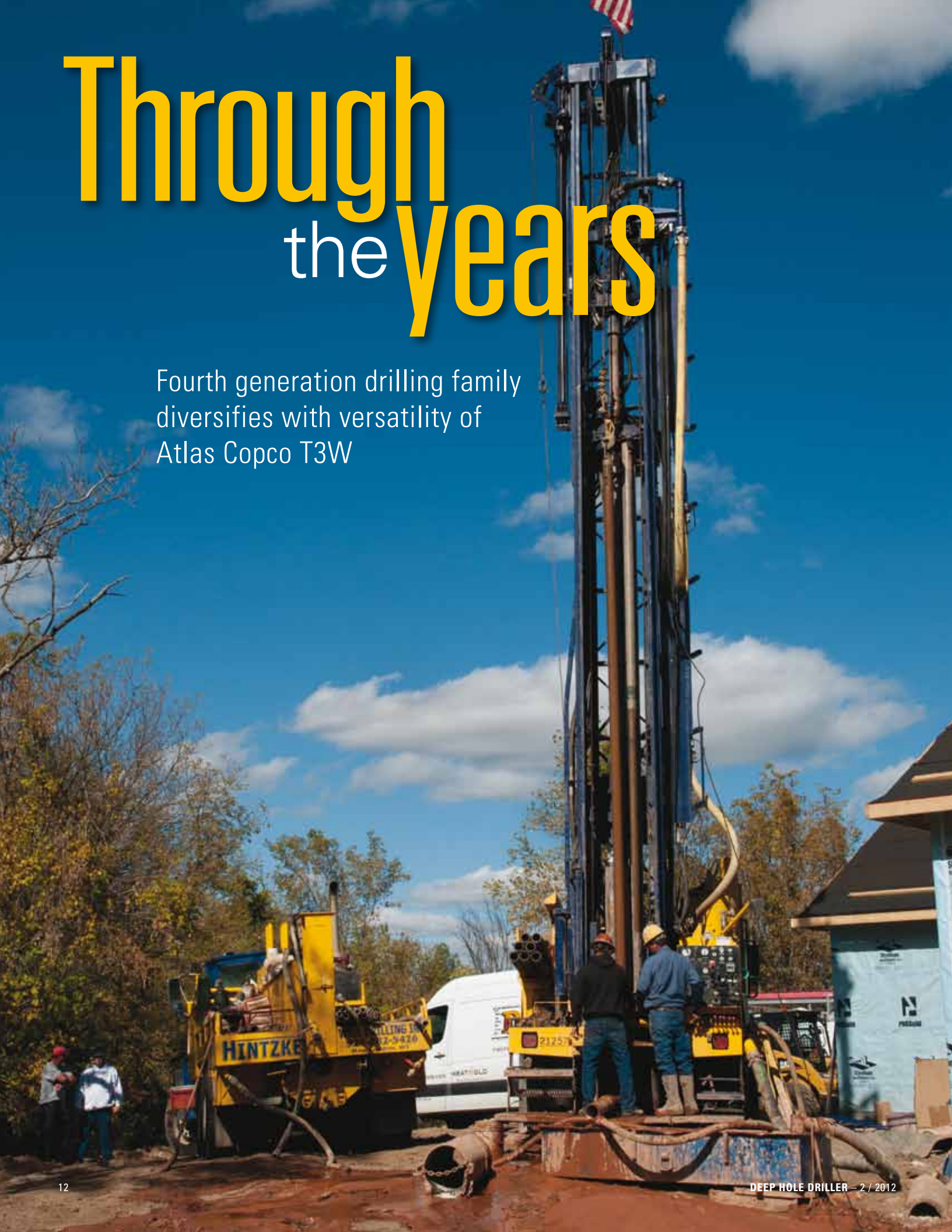
"We have to provide so many days of water, so many days of food, oxygen tanks, but also you have to have a surface hole coming all the way down and into that room so you can use it to drop communications, more food, more water," said Kane. "As soon as the undergrounds get progressed enough to need those, then we'll be putting those in, too." Kane said it's likely the TH60DH will be drilling a 10 ⅝-inch (270 mm) hole and setting 8-inch (203 mm) casing.

Kane is confident the TH60DH can handle the job no matter what project comes up for Armstrong Coal.

He said, "You can do so many things with it. You're not handicapped. I've talked to different people around the country and we've been talking about equipment, primarily core drills and blasthole drills. And when I would tell them that we had a TH60DH water well drill, they said, 'Well what are you going to do with it?' And I said, 'You don't understand. This is what we have set this thing up to do—what we need it to do. We don't call it a water well drill. It's our multipurpose machine.'" ⊙

Through the years

Fourth generation drilling family diversifies with versatility of Atlas Copco T3W



Things are looking up for the drilling market in the Green Bay region of Wisconsin, but Hintzke Well Drilling Inc. of New London soberly recalls how a series of threats these past few years seemed to conspire against them. There was the recession of 2008. Then came the incessant rains and widespread flooding in the spring of 2011 that delayed some projects well into June. Bidding for other projects that Hintzke specializes in, such as geothermal drilling, was overwhelmed by other drillers looking to put their water well rigs to use.

John Hintzke, eldest brother of the drilling trio, said, "You try to hang on. That's all any of us can do. But some companies just couldn't."

His tone was filled with respect and sympathy for those in the industry who have called it quits. Some he had ties to, as it is not unusual for drilling companies to help each other out on projects in this region. In fact, one of Hintzke's Well Drilling's trucks does not brandish the company name, so that they do not steal another company's thunder when lending a hand on a project.

Hintzke's survival is part of the legacy of Theodore Hintzke who founded the company in 1896. As fourth generation drillers, they make the best of the boom times and hunker down to outlast the lean times. Expertise in several drilling markets gives Hintzke the diversity it needs to stay in business as demand for specialty drilling fluctuates. Water wells, geothermal drilling and exploration for a steady sandstone mining client keep Hintzke healthy.

They also avoid overreacting to market fluctuations. John and Jason agreed they shake their heads at those who jump into new markets, enlarging their equipment outlays to chase industry swings. That's one of the benefits, Jason said, of their Atlas Copco T3W water well drilling rig, which the company uses for nearly every job.

Like many startup companies, Great Grandfather Theodore Hintzke started with simple equipment, building his own wooden cable rig powered by a one-cylinder engine. Generation after generation, the Hintzkes have continued making careful equipment upgrade choices, working up to rotary rigs that included a used Ingersoll–Rand TH60 and later, a pre-owned 1993 T3W.

In 2008 the company traded in the 1993 for its first new rig ever, a 2008 Atlas Copco T3W with improvements such as large-diameter top and bottom sheaves for extended cable life, redesigned feed cylinders to improve pullback and pulldown, and increase feed speed to 150 feet per minute (45.5 m/min).

The brothers agreed the T3W rig's speed was important in getting them off one job and on to the next, especially now, when work orders are plentiful again. For comparison, Jason said, on one job where they were drilling a residential well in quartzite with an Atlas Copco QL60 water well hammer, he was able to go as deep in 15 minutes as the other driller had gone in 45 minutes.

Jason said, "So the guy wanted to know what hammer I was using. I told him, 'You've got to have Atlas Copco.' So he got »

Hintzke brothers John, Jay and Jason do the majority of their drilling projects with the versatile Atlas Copco T3W rig. Jason (right) is a third-year board member of the Wisconsin Water Well Association.

"Snap" Hintzke learned the business from his father, John Hintzke Sr. (now 92 years old), who is the son of company founder Theodore Hintzke. Snap said when he returned from a difficult tour in Vietnam in 1967 that drilling blessed him with the freedom and flexibility he needed. "I couldn't have worked in a factory, you know, in one place. I needed to move around."

an Atlas Copco hammer but he still couldn't keep up. Heck, I can get 120 feet an hour in granite. The other guy can't keep up." The Hintzke's T3W compressor can provide up to 900 cfm and 350 psi (425 L/s, 24 bar).

Even for rotary drilling, Jason couldn't think of a rig that could compete with his T3W. "For rotary, that other guy's rig is maybe spinning at 80 rpm. I have a two-speed head. On low I'm turning 134, and 180 at top speed."

Concluding his assessment of the T3W, he exclaimed, "This sonofabitch really hogs down!"

One afternoon found the Hintzke's returning to complete a 130-foot (40 m) water well at a rural residence under construction near their headquarters in New London. They had waited a day for the grout to set up. To prevent contamination from mineralized arsenic, stringent Wisconsin regulations aim to stop it at its source. The source is not allowed to be in contact with air, which can trigger self-sustaining arsenic production in that zone. Therefore, the only drilling technique allowed by law is rotary drilling with mud. In this location water well bores must also be cased to a minimum of 90 feet (27 m), which is sufficient to get through the arsenic zone of the St. Petersburg sandstone formation and down to the unaffected water in Cambrian sandstone.

For this project the Hintzkes used an 8 ¾-inch (222 mm) tricone bit on their rig's usual 4 ½-inch pipe (114 mm) with a bentonite mix for drilling fluid. They drilled the bore to 90 feet, set 6-inch (152 mm) steel casing and then grouted the hole all within a period of just three hours.

Jason had hit the Cambrian sandstone early and said he could have safely set the well at 70 feet (21 m), but he was required to go the full 90 feet. Now drilling through 90 feet to finish the well, Jason entered a shale layer, which he described as "sticky" for tricone drilling. It slowed progress a bit, but he continued until he picked up sandstone again. He finished the well at 130 feet, sufficiently into the sandstone. They were back home well before suppertime, preparing for the next day.

Diversity with the T3W

At dawn the brothers traveled one-and-a-half hours to an exploration job. A sandstone mining client needed the Hintzkes to prove out a new site as a source of high quality sand to mine for use in hydraulic fracturing. Just moments after arriving they were positioned and raising the tower to begin. Sometimes, Jason said, a drilling plan would be marked out in a field with flags. This time a representative from their client's company led them to the field, pointing to general locations for them to sample.

Jason explained that the client wanted samples to be as dry as possible so for this job, he would use rotary air, tipping the same 4 ½-inch pipe with a 6 ⅛-inch (155 mm) Atlas Copco Grizzly Paw bit. He was adding roughly 3 gpm (47 L/s) of water as he drilled. He started with the rig's air at about half volume, around 600 cfm (283 L/s). For pressure, he said, it was simply "on." He did not need to turn pressure up at all.

The benefit of the claw, Jason said, was its aggressiveness without having to add much WOB. Less WOB meant he could save on fuel. The claw was ideal as he did not want to use a hammer in this sediment, saying, "Drilling this stuff with a hammer, I'd bury myself."

He pointed to the diagnostics meter on

Jason Hintzke said using the Grizzly Paw bit allowed him to drill aggressively without having to add much weight-on-bit. Less WOB meant he could save up to 25 percent on fuel.

the control panel. "This helps me a lot. I can see everything here. I'm running about 15 gallons an hour (56.8 Lph) of fuel." He said that with a tricone he might be using as much as 20 gallons per hour (75.7 Lph), representing a 25 percent fuel savings with the claw. As he got deeper, he said he was using a little bit more fuel to contend with a bit of ground water in the hole.

Jason hit limestone at 18 feet (2.4 m), getting about 10 minutes a rod, achieving a rate of 120 feet (37 m) an hour. At 50 feet (15 m) he found the sandstone, rapidly completing the test bore to 120 feet while averaging just 3 minutes from the start of a rod to the start of the next rod, which translated to 600 feet (183 m) an hour.

Jason laughed: "Of course you'd never be able to put rods on it fast enough to actually see 600 feet an hour." His brother Jay bagged samples every 5 feet (1.5 m) once Jason was into the sandstone, marking them and entering them into a log.

Satisfied with the samples they had taken and certain the client was going to be happy with this first hole, Jay and Jason backfilled it with a bentonite hole filler. In only moments Jason had the tower down and moved on to the next location. Only an hour had passed since they started the first hole.

Since early summer 2012 the Hintzkes have been working long days and six-day weeks to keep up, booked solidly through the fall. However, no one complains about working hard after the lack of demand these past few years. Once more, the Hintzke legacy has survived lean times with their family formula for success and their good eye for sensible drilling equipment.

Jay Hintzke (left) logs sand samples every five feet while brother Jason uses a refurbished 6 ⅛-inch claw bit to make quick work of a 120 foot exploration hole for an energy company. The hole took about an hour total, from positioning the rig to dropping the tower to move to the next location.

American experience enlightens Polish exploration company during unique tour

An oil and gas company's challenges are rarely so unique that they have not been experienced by another. Businesses who partner with a global manufacturer like Atlas Copco often discover they have not only found a supportive partner in that manufacturer but have also joined a global resource network.

Poland's Oil and Gas Exploration Company Krakow, or Nafta Krakow for short has been exploring the country's vast shale gas resources for about five years now. Recoverable reserves there were estimated by Poland's Geological Institute in a March 2012 report to be as high as 1.9 trillion cubic meters, which is about the same as reserves in the United States.

Built upon the former State Enterprise Oil Exploration company established in Krakow in 1946, Nafta is a governmental organization. Though it has been operating throughout Europe, Asia and Africa, Nafta has not drilled previously for gas in Poland.

To date Poland has been entirely dependent upon Russia for natural gas, the world's largest natural gas exporter. Tapping its own reserves would move Poland toward energy self-sufficiency and, by providing other European countries with a reliable supply of the relatively clean fossil fuel at competitive prices, it would create considerable revenue for itself.

In spite of the excitement and national pride generated by such a promising forecast, Nafta Krakow is moving cautiously to make sure it is creating the safest, most efficient production program. So Atlas Copco Poland's customer center in Raszyn looked for a way to put Nafta in touch with another company that could serve as a sort of model for modern shale gas drilling. Since Atlas Copco is a global manufacturer with a presence in more than 200 countries, it was simply a matter of selecting which company.

They called on Josh Marcus, who works out of the marketing office of Atlas Copco USA's Roanoke, Virginia, research and development facility for DTH tools. Marcus hoped Southwestern Energy Company, who specializes in exploration and production of unconventional oil and natural gas, would be interested in hosting a visit for a Polish delegation. Southwestern Energy has had remarkable success in Arkansas's Fayettville Shale gas play.

In April, Nafta drilling engineers Marek Siola and Andrzej Gaska, accompanied by four Atlas Copco Poland representatives, traveled to Southwestern Energy's offices in Conway, Arkansas. Southwestern gave the envoy a generous briefing of its operations, fielded their questions, and treated them to genuine southern cuisine for lunch with a welcome side of Arkansas hospitality.

Southwestern Energy and the Fayettvile play

Jim Tully, the division drilling manager at Southwestern, related how the company was established as a gas utility company initially and started drilling wells of its own in the early 1940s to supplement its supply for its customers. Under what Tully called "the right leadership" in the late 1990s, its exploration and production divisions, SEECO and SEPCO, began making a name in the industry. It was in the early 2000s, while trying to identify the source of inexplicably larger volumes of gas than should volumetrically be recoverable from another formation, that the company first recognized the potential economic viability of a shale that stretches across a large part of north central Arkansas.

Siola asked Tully one of the main questions on his mind. Was drilling for gas with air safe?

Tully answered, "Conditions are good here for air drilling in that the gas in the Arkoma Basin is a dry gas without the heavier hydrocarbon components."

When Siola inquired further about down hole fires, which can occur when air drilling, Tully said he wasn't familiar with the geology or makeup of the hydrocarbons in Poland, but air drilling may be feasible in Poland. He said he had some experience with down-hole fires in the western part of the Arkoma Basin and in west Texas.

"It is not so much a safety issue as it is a cost issue if it occurs on a frequent basis due to replacement costs of your drilling bottom-hole assembly and potentially sidetracking of the well. In some areas, you can use a nitrogen membrane or even drill with nitrogen and potentially prevent down hole fires or you could possibly plan your casing program to allow you to drill certain intervals on air," Tully suggested

Marcus, who had firsthand knowledge of the drilling there, helped with details for »

The Oilfield Division of Luby's Equipment Services in Heber Springs, Arkansas, keeps Southwestern Energy's bits, hammers and tools in top condition. This Atlas Copco TD 85 with 8.875-inch bit lies ready to complete the vertical portion of the well through hard rock to a kick off point just above the shale. Before returning to Little Rock, the team from Poland visited Luby's, where they saw technicians inspecting hammer components and getting them back to specifications for a quick return to Southwestern Energy.

Deck Travis, Southwestern Energy's area driling superintendent, shows Nafta Krakow engineers one of the Atlas Copco QL 120 hammers with 12.45-inch bit used to drill the first 1,000 feet of the vertical section of the gas wells. The wells are filled with mud and then sealed to await conventional rigs that will trun the lateral and complete the well to 6,000-foot (1,828 m) total measured depth with 5 ½-inch (140 mm) surface casing.

Nafta Krakow engineers and Atlas Copco service managers from Poland get a briefing on how the performance of each Southwestern Energy rig is remotely monitored in real time for the company's engineers to access 24/7. This is just one bank of the control room's displays.

a comparison, "They've drilled a couple 22-inch holes on air there through fractured limestone using a hydrocyclone with polymer as we do in Texas. The two holes were very successful."

Andrezj Majczyna, the business line manager for Atlas Copco rock drilling tools in Poland, asked again to make certain, "You are not afraid to drill for gas with air?" Air drilling is a completely new approach to oil and gas drilling in Poland, and Nafta is the first company to use it. Mikal Goral, also of Atlas Copco Poland customer center, told Tully, "This is why this visit is important for us, to learn."

Tully offered that even in some parts of the Barnett Shale of Texas, they drill a portion of the hole with air.

Techniques to cut costs

Eventually the discussion turned to the cost of drilling a hole. Siola estimated that drilling one of their 12,000-foot (3,660 m) wells ran them about $10 million USD. Eyebrows went up and cheeks puffed out in unison from the Americans at the table. Tully addressed this with techniques U.S. companies like Southwestern Energy use to lower costs.

Tully said the highest costs in constructing a Fayetteville Shale well is in hydraulic fracturing, not in drilling. A well with a 5,000 foot lateral length might have as many as 13 to 15 fracturing stages or 13 to 15 individual jobs.

Southwestern has lowered hydraulic fracturing costs by acquiring a plant to supply sand. Southwestern is also in the process of purchasing pumping equipment and training its own hydraulic fracturing crews, who will operate under the subsidiary, DeSoto Field Services. He said almost all of the fluid they use is recycled from the site and from other jobs, collected in man-made fluid ponds. They also gather rain water. "It takes a lot of water and a lot of sand."

Southwestern is still applying science to its Fayetteville Shale wells and sometimes incurs significant costs in running open hole electrical logging tools and cutting cores to evaluate the formations in a well.

"Science wells cost a lot, but we gain a lot of valuable knowledge from them," Tully said. He also offered up measures Southwestern takes to keep those costs down, such as for coring: "Wireline retrievable coring is a whole lot faster than conventional coring and is what we utilize. One of our guys came up with the idea to use casing and a casing running tool for coring, which has been a big savings and has sparked a lot of interest from other operators."

As for drilling itself, Tully said Southwestern could show them what they call their "spudder rig concept." This involves utilizing a smaller rig, very proficient at air drilling, to air drill the upper, vertical portion of the hole, typically to a depth near kick-off point where the directional portion of the well begins. The wellbore is then loaded with drilling fluid, or mud, and then a larger, conventional drilling rig is moved in. The conventional drilling rig drills the curve and lateral portion of the horizontal well.

Tully said the Fayetteville Shale play lies in a "good air drilling basin with hard, competent rock and not an excessive amount of water. The rate of penetration while drilling on air is much better than while drilling on mud."

Though he knew of companies that had been utilizing directional hammers to do some steering in the vertical portion of their wells, he said Southwestern was not, but might in the future.

After a tour of the engineering room where every rig's real-time data was portrayed on a two-wall array of monitors, the group suited up for site visits to four drilling pads. Two were Atlas Copco RD20 drilling rigs that were drilling the surface hole, setting surface casing and drilling vertical "spudder" holes down to near the wells' kick-off point. The other two were conventional drilling rigs that were drilling the curve (turning the wellbore to near 90 degrees), then drilling the lateral and running production casing in the well.

Deck Travis, the area drilling superintendent for Southwestern who helped lead the site visits, commented that his company is impressed with Pense Bros. Drilling Company's efficiency and quality of work drilling the top portions of the wells. Pense uses the Atlas Copco RD20 for the work, which is the rig of choice for its power and speed, as well as its unique feed system that puts the load on the cylinder, not the tower, which can be a lightweight lattice structure. Drilling operations are firmly planted on four points of contact. Rigs that rely on a cantilevered design do not provide as much support. Southwestern owns two of the RD20 units itself.

The RD20 is valued for its mobility, as well. Travis said Pense has been able to move an RD20 "from hole to hole in four hours and pad to pad in just six," though if pads were a long distance from each other, additional time would be spent on the road.

After seeing the RD20 drill rigs preparing the wells for the conventional rigs, the group visited pads where the second stage of drilling was underway by one of Southwestern's conventional single rigs, one of which was unique for having a triple's mast.

As group members took turns saying their goodbyes once back at Southwestern Energy's office at the end of the day, Majczyna politely waited for a break in conversation. Then speaking on behalf of his countrymen in his characteristically mild but deliberate voice, he said simply, "Thank you. This is exactly what we came for."

THEY WANT TO DRILL SMARTER

Drilling school attracts deep hole sales and service reps from around the world

"Today's oil and gas drillers care less about cost and more about value," said Kevin Mallin, an internationally respected consultant in deep hole drilling, during a seminar for Atlas Copco sales and service reps. Mallin selected the words carefully, clearly articulating the bottom line of deep hole drilling businesses: "They want to drill smarter."

The oil and gas course was directed by Mike Millsaps, who oversees sales, marketing and service of Atlas Copco deep hole drilling tools for all of North and South America, with worldwide responsibility for oil and gas equipment in particular. The course's field visits were coordinated with help from Luby's Equipment Services in Heber Springs, Arkansas, and Southwestern Energy Company from Houston, Texas.

Though the oil and gas market varies from country to country, the concerns facing drillers are universal. So Atlas Copco customer centers on four continents sent 23 enrollees to the course, who came from the United States, Poland, Ukraine, Chile, Tanzania and India. The instructors came from the U.S., England and Sweden.

Three full days of training and two site visits hosted by Southwestern Energy in the Fayettville Shale play underscored Mallin's message: smarter deep hole drilling means acquiring "additional skills, such as knowing when to drill with air and when to use rotary in the same hole." Relying on a single drilling technique is a thing of the past.

Mallin pointed out that although the class was really about fundamentals of deep hole drilling common to all deep hole applications, defining "deep" as greater than 300 meters, or 1,000 feet. This includes water wells, geothermal power production, coal seam gas, carbon sequestration and mineral exploration. Geological stratification typically requires different kinds of drilling at different levels, no matter what the application.

Mud, rotary or hammer, presets and more

Before the course's conclusion Millsaps showed how Atlas Copco's range of DTH equipment provides deep hole drillers what they need to stay competitive in today's market. The long list included drill rigs, mud pumps, compressors, drill pipes, col- »

Southwestern Energy's Area Drilling Superintendent Deck Travis walks course participants through the "doghouse" of Drill #16 which was setting conductor casing for the vertical portion of gas wells at this pad. The rig is just one of the Atlas Copco RD20 rigs owned and operated by Pense Bros., a drilling contractor that specializes in oil and gas exploration and production.

» lars, and stabilizers, hammers and bits, tricones and many more.

Mallin also taught the class that advancements in drilling fluids and additives make it increasingly beneficial to distinguish "drilling fluid" in their vocabularies from the term "mud." Understanding the characteristic differences between mud and various polymer-based drilling fluids gives deep hole drillers a wide range of hole wall and well pressure control, in addition to maintaining drilling performance as it varies with depth and formation changes.

Josh Marcus, an Atlas Copco DTH product specialist who works directly with Millsaps out of the deep hole tools research and development center in Roanoke, Virginia, updated participants on the function and capabilities of today's new hammer designs. Depending on the hardness of the formation, hammers are two to five times faster in rock than rotary, with the hammer's advantage greatest in the hardest rock formations. One example he gave was a company that had spent two weeks drilling a hole with rotary. A neighboring hole with a DTH hammer took only 10 hours.

Marcus challenged two of the long-held perceptions of hammers. First he assured the class that hammers can indeed drill with certain polymer-based drilling fluids (not bentonite mud), and companies have now been successfully demonstrating the ability to turn corners with hammers at the kicking point, as well as drilling laterals. The availability of jet subs and hydrocyclones further expand the versatility of hammers for deep hole drilling.

Before making two Southwestern Energy (SWN) drill-site visits, the group stopped at the Luby's Equipment Services–Oilfield Division shop in Heber Springs. Store Manager Gene Chandler gave them a tour during which they watched technician Josh Dill service a hammer and received hands-on instruction of the Atlas Copco R4 bit retrieval system by Millsaps himself.

SWN utilizes what they call a "spudder" rig concept in their Fayetteville Shale operations. They use a smaller, air drilling rig such as an Atlas Copco RD20 rig to drill the upper, vertical portion of a well. This works well in the Fayetteville Shale as this portion of the well goes through hard (sandstone) rock.

The spudder hole is drilled to a total depth near the base of the hard rock and the top of a large shale section where the hole is loaded with drilling fluid and a wellhead cap is installed. The spudder rig TD ranges from approximately 2,000 feet to approximately 5,000 feet depending on what part of the play it is located. The RD20 is then moved off the well and a larger "re-entry" rig is later moved on the well to perform directional drilling. The well is at or near kick-off point, the depth where the curve section of a horizontal well begins, when the re-entry rig moves in.

The first of the site visits was to a spudder rig pad where an RD20 rig, operated by Pense Bros. Drilling Company, was working. Pense Bros. is a drilling contractor that specializes in air drilling for natural gas and oil throughout North America.

The participants, who had studied well design in the classroom, now had a practical laboratory. The well plan called for a 12.45-inch diameter hole to be drilled to 1,000 feet and 9 5/8-inch surface casing to be cemented in place. The surface casing was then drilled out with a 8.875-inch bit with the hole size reduced to no smaller than 8.75 inches at "spudder" hole total depth.

The second site visit took participants to a pad in its second stage of drilling, demonstrating the operations of what SWN calls a "re-entry" rig. Here a conventional electric triple derrick rig operated by DeSoto Drilling Inc., a subsidiary of Southwestern Energy Production Company, was in the process of drilling the curve section of the well, gradually building the inclination to 90 degrees. Once the inclination was built to 90 degrees, the horizontal, or lateral, section of the hole was drilled. Most SWN well site pads in the Fayetteville Shale accommodate multiple horizontal wells.

Usually two or more wells are drilled by a rig each time it is moved to a pad. The re-entry rig visited had a walking system which allowed the rig to move itself hydraulically from well to well without having to lay down the derrick or drill pipe. This allows for a quicker and less expensive move of the rig from one well to another on the pad. It usually takes from six to 10 days for a re-entry rig to move on a well, drill the 8 ¾-inch curve and lateral hole sections, run 5 ½-inch production casing, cement the casing and release the rig. Total depth of Fayetteville Shale wells range from 5,000 to 13,000 foot measured depth and lateral lengths range from 2,500 feet to 8,500 feet.

Participants also learned about a stage of well construction, called hydraulic fracturing, which occurs after the well has been drilled

and cased and does not necessarily involve a drilling rig. Shale wells almost always require hydraulic fracturing to allow them to flow, due to their very low permeability.

Cullen McGinty of Atlas Copco's Rocky Mountain store in Commerce City, Colorado, said of the course, "It was perfect for me, connecting the dots and giving me a more complete picture of our roles with the distributors and their customers."

Simon Romli of Atlas Copco Tanzania's customer center, who specializes in rock drilling tools, said, "Now I know what is meant by 'deep hole' drilling. He said now that he knows what is needed, he will take back technical options to his customers, who work in a country that is just learning its potential for oil and gas production. He also appreciated the network of expert support the course introduced to him.

In addition to deep hole drilling fundamentals, well plans, casing types and fluid drilling, the course included an introduction to Atlas Copco Hurricane air and nitrogen booster compressors by engineers Maynard Jones and Pieter Taljaard.

Alex Grant, product manager for Atlas Copco well drilling equipment, outlined drilling rigs used for deep hole drilling. He explained why the Atlas Copco RD20 has been a rig of choice for the vertical part of gas and oil wells, highlighting its crane carrier with heavy duty I-beam construction, the 380 horsepower engine that get it to, on and off a pad quickly, and its unique feed system. The load is always on the cylinder, not the lattice tower, placing the 120,000 pounds of pullback on four solid points of contact. Other manufacturers competing with the RD20 in this class, he explained, have cantilevered designs, which project back from the rig. They do not provide such solid, centered support.

Ron Boyd, the project manager for Atlas Copco Secoroc oil and gas division, as well as the EDGE drill monitor, and Bjorn Samuelsson, training manager based out of Atlas Copco Secoroc distribution center in Fagersta, Sweden, led class discussion on market offerings and how the Atlas Copco brand stands out for customers as a greater value, returning the class to Mallin's point that deep hole drillers are looking for a smarter way of drilling.

Two smaller oil and gas seminars have been held in the past. This was the first time the course was held in Little Rock. Plans are to continue to offer the course as an annual event.

Atlas Copco DTH specialist and course presenter Josh Marcus demonstrates how to use the Air/Water Velocity Calculator to Simon Romli of Atlas Copco Tanzania's customer center.

RETRIEVAL SYSTEM SAVES BIT

When drillers are using quality DTH tools and bits, deep hole bit problems are almost always caused by improper weight on bit, not material defect. Yet even the best drillers carry at least a little anxiety every day throughout their shift over shanking a bit at depth. For such drillers and their companies the Atlas Copco Secoroc one-piece bit retrieval system is an insurance policy that eases some of that mental stress.

But drillers do indeed shank the occasional bit, and the unique design of the one-piece bit retrieval system has saved an untold number of hours in tripping and fishing for broken bits at depth, as well as associated costs of side-stepping holes whose bits otherwise would have proven irretrievable.

This simple but effective design consists only of a retrieval sleeve that comes packaged with the bit. Four locking grooves in the bit correspond with four lugs in the sleeve. Should the bit shank, it is literally caught by the sleeve and is retrieved as the string is tripped out of the hole. There is no fishing involved.

Retrieval system bits cannot be purchased separately from their sleeves but are sold only as an integrated package. They are available in several sizes for in both QL and TD hammers versions: 6 inches, 8 inches, 9 inches and 12 inches. Standard hammers can be modified to use the one-piece bit retrieval system with just a simple change of the chuck body.

Inside the retrieval sleeve at left can be seen two of the four locking lugs that will engage the grooves below the splines of this bit. The bit and its sleeve, which are sold together as a package, offer drillers and their companies a stress-relieving insurance policy against shanked bits. The sleeve, which attaches to the drill string, catches a broken bit so that it does not have to be fished out nor drilled around.

Atlas Copco acquires line of PDC bits

Atlas Copco Secoroc LLC has agreed to acquire U.S.-based NewTech Drilling Products, LLC. The acquisition adds a new type of high-quality product offering for oil and gas drilling.

Based in Salt Lake City, Utah, NewTech develops and manufactures drilling products with a focus on rotary PDC (polycrystalline diamond compact) drill bits. These durable tools are designed to be both impact and wear resistant and are particularly suited to shallow, land-based drilling applications. NewTech, which is privately owned, currently employs 20 people and had revenues in 2011 of MUSD 6.5 (MSEK 45).

"This acquisition extends our expertise in the oil and gas market and broadens our range of products for existing customers in the mining and construction industries," said Bob Fassl, Business Area President, Atlas Copco Mining and Rock Excavation Technique. "We look forward to combining NewTech's product development competence with the strength of the Atlas Copco brand and the global reach of our sales force."

NewTech will be part of Atlas Copco's division Rock Drilling Tools within the Mining and Rock Excavation Technique business area.

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PRE-OWNED DRILLS

Atlas Copco T3W/2002 sn:6753

» Location: Milwaukee, WI
Tower: 32 ft.
Drill Engine: CAT C15, 565 hp
Drill Hours: 6,562
Compressor: 900 cfm / 350 psi

Atlas Copco T2W/2001 sn:6620

» Location: Milwaukee, WI
Tower: 38 ft.
Drill Engine: CAT C10, 350 hp
Drill Hours: 14,231
Compressor: 400 cfm / 200 psi

Atlas Copco T3W/2000 sn:6592

» Location: Tucson, AZ
Tower: 32 ft.
Drill Engine: CAT 3406, 465 hp
Drill Hours: 11,000
Compressor: 900 cfm / 350 psi

Atlas Copco RD20 II/1998 sn:6389
Location: Denver, CO
Tower: 51 ft.
Drill Engine: Cummins QSK 19C, 755 hp
Drill Hours: 7,972
Compressor: 1,250 cfm / 350 psi

Atlas Copco RD20 III/2001 sn:6660
Location: Denver, CO
Tower: 61 ft.
Drill Engine: CAT 3412, 735 hp
Drill Hours: 13,950
Compressor: 1,250 cfm / 350 psi

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