

DEEP HOLE DRILLER

AN ATLAS COPCO PUBLICATION FOR THE DRILLING PROFESSIONAL — NO. 1 / 2015

Predator Drilling System takes performance to a new level



Diamondback modular rig design redefines versatility

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RD20 strategy leads in the Bakken

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TH60 lowers the 'drama factor'

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Atlas Copco

EDITORIAL



Welcome to this first edition of Deep Hole Driller for 2015. At the time of writing we are faced with a mixed reaction to the deep hole markets we participate in. For water well we are seeing a steady growth this year, which is a positive sign the market is returning. Unfortunately, the same cannot be said for the oil and gas industry.

Having attended a couple of oil and gas conferences this year, the majors are still positive regarding the near future and see this downturn as an opportunity to review their costs and efficiencies; this will put them in a stronger position when the market returns. Two of the stories we cover in this edition focus on the efficiencies and cost reductions our oil and gas customers have been able to realize for their customers through the mixed fleet approach.

2015 is an exciting year for us at Atlas Copco as we announce the launch of our new product range—Diamondback. The 40,000 lb pullback rig will make its first appearance at the South Atlantic Jubilee, Myrtle Beach, South Carolina, in July with larger and smaller size rigs launching through 2016. Diamondback is very different from anything we have previously designed, with a one-size-fits-all style. We have taken a modular approach to the rig, which makes it extremely versatile to different drilling markets, configuration changes (even after the customer has taken delivery), and easy adaptability for changes. We believe our customer will enjoy how easy we've made it to reconfigure a rig—if you liked Meccano or Erector sets as a child, you will love this concept.

For those of you attending Jubilee, I look forward to meeting you and taking you around our new rig.

Alex Grant
Product Line Manager Atlas Copco
Deep Hole Drilling Rigs

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Atlas Copco

Through **INDIA'S** *sands*

Predator Drilling System drills for oil and gas while taking performance, energy efficiency and safety to a new level »

The Shivganga Drillers Pvt Ltd. crew with the Predator Drilling System in the background. Shivganga brought the first Predator to India in 2013.





The Predator completed the targeted depth in what the company believes is a record time in India.

» **F**or a country looking to reduce its dependence on imports of oil and petroleum products by exploiting its domestic natural gas, the latest technology and advanced equipment is critical. India still predominantly uses conventional methods of exploration and production drilling, which is time consuming and expensive. That's why when Indore-based contractor Shivganga Drillers Pvt Ltd. was approached by various oil and gas exploration companies, it realized that a significant advantage could be had by adopting the latest technology.

"We were aware that Atlas Copco had done extensive field trials with both mud drilling and air drilling and that its Predator Drilling System incorporated advanced, new generation technology," said Anuj Rathi, Shivganga's Chief Operating Officer. "We decided it was extremely suitable for this task."

As a result, Shivganga brought the world's first Predator system to India in 2013, and soon after its arrival, the company was awarded a major drilling contract from ONGC (Oil & Natural Gas Corporation Ltd.), India's largest oil and gas exploration and production company, to drill a well more than 6,500 feet (2,000 m) in depth.

Challenging conditions

However, this project was not as easy as Shivganga initially thought. Located in the interiors of central India, the site posed a major challenge. In most zones, the company encountered sandstone with an abrasiveness of 80 to 85 percent mixed with much softer formations, making it difficult for the driller to anticipate the hardness of the rock and act accordingly.

"The compressive strength of the formation was fickle, ever-changing and never a constant. When you encounter a forma-

tion that changes so fast, you need to be very careful and have very precise control over all the parameters," explained Rathi. "Thankfully, the Predator gave us that kind of precision, and we were able to keep changing the parameters depending on the requirements. The machine responds very quickly, and you can change these parameters instantly."

During the project Shivganga achieved a performance of more than 1,300 feet (400 m) in 18 hours—a speed it believes may be a record in such formations. "We managed to keep our promise and delivered a time savings of 35 to 40 percent," Rathi commented. "Using conventional drilling technology, it would have probably taken around six to eight months to drill this well, whereas we did it in just two and a half months, including field trials, testing, setup and drilling. That's probably never been equaled."



Using the Predator Drilling System, Shivganga Drillers Pvt Ltd. was able to drill more than 1,300 feet (400 m) in 18 hours, which they believe to be a record under these conditions.

Shivganga insisted on outstanding rock drilling tools and full support from Atlas Copco. Therefore, they chose Secoroc DTH hammers and bits for this deep, high-pressure, percussive-drilling application.

Secoroc QL 120 hammers were chosen for larger diameter holes of 17 3/8 inches (442 mm) and 12 3/4 inches (323 mm).

QL 80 hammers finished the well to total depth with an 8 1/2-inch (216 mm) bit.

The QL hammers also came with additional attachments such as a Hydrocyclone and a bit retrieval system, which made them even more efficient. The retrieval system could hold the bit in case of breakage from the shank, and under no circumstances could a bit be lost inside the well, eliminating the need for “fishing” and the risk of having to abandon a hole. The bits also had buttons specially made with polycrystalline diamonds on the face and gauge to make them more aggressive in the hardest rock.

“ONGC was very excited with the progress we made with this rig,” Rathi said. “They were a little skeptical initially about the outcome if we found hydrocarbons, but we managed to finish the work successfully.”

Safety and environmental impact

The oil and gas industry is both hazardous and environmentally sensitive, calling for the highest levels of safety and health precautions. Any contractor aiming to get into oil and gas exploration and mining has to follow strict guidelines set by the Director General of Mine Safety. Shivganga was no exception and had to ensure stringent safety and environment norms when carrying out the drilling work. The energy-efficient and environmentally friendly design of the Predator gave Shivganga an added advantage in negotiating the contract.

“The Predator consumes less diesel and requires fewer oil changes in comparison to >>



ANUJ RATHI,
Chief Operating Officer, Shivganga Drillers Pvt Ltd.



B L RATHI,
Director, Shivganga Drillers Pvt Ltd.

The Predator Drilling System ready to go to work. The mobility of the Predator enabled crews to have it set up in a matter of hours.



» other drilling systems,” Rathi said. “The level of emission and sound pollution is also extremely low for the rig. In fact, it’s way below the permissible limits in India.”

Another big plus was the Predator’s mobility that reduces the rig’s setup time. “With conventional rigs, it takes roughly two months to mobilize and set them up, whereas the Predator, being a mobile machine, can be set up in a matter of hours. Also, it’s an automated drill so you need less manpower, which means there are fewer safety hassles and hazards,” Rathi added. Shivganga managed to complete the ONGC contracts in the preset time frame, which enabled the company to win two more drilling contracts in quick succession.

High quality service and support

One of the company’s main concerns as a

newcomer to the oil and gas drilling business was being able to source spare parts quickly in the event of a breakdown.

“In the oil and gas business,” explained Shivganga’s director, B L Rathi, “once explorers identify a well, they set up a timeline for drilling. This is defined in the actual contract, and the job has to be completed within the stipulated time period. If the work goes beyond that, a penalty has to be paid by the contractor,”

Rathi said: “We took this challenge and the risk because we felt confident that Atlas Copco could support us, as they have been in India for so many years. All of the promises made to us during the purchasing process, from providing adequate backup to bringing engineers from abroad to support us and train our people, were fulfilled satisfactorily. Their response was fast. They

listened to our problems and attended to them very quickly.”

Working to improve

Mukul Bahety, Chief Executive Officer at Shivganga, explained that the company is now working to make the Predator even better. “We are in a learning phase, understanding the opportunities that an advanced system like the Predator can offer, and are working together with the Atlas Copco team to further improve the machine’s performance.”

Bahety concluded: “Overall, our customer, ONGC, is extremely satisfied with the Predator, as are we. I see this rig as having a huge future in India, and I anticipate that the Predator population in this country will go to at least eight or more within the next five years.”

Venture Drilling *expands capacity*

Venture Drilling Supply's move to a new Midland-Odessa facility offers its customers expanded service capabilities. Located at 1535 Windcrest Road, the Odessa, Texas, facility has room to work on multiple drill rigs simultaneously, comfortably housing rigs even as large as Atlas Copco RD20 III drilling rigs. Increased storage and display space means customers have access to readily available parts and consumables and will spend less time waiting on shipping.

"We'd simply outgrown our other location," said Tyler Williams, a Venture Drilling Supply account manager whose route extends across the company's customer base served from three locations in Oklahoma and Texas.

Multiple work bays protect customer rigs undergoing repairs and renovations from the elements. The building has ample room for its offices with on-site living quarters for itinerant mechanics during surges in work orders. A large, paved yard allows Venture Drilling Supply to showcase a wide array of new and used rigs and equipment.

Venture Drilling Supply had been at the previous site for just three years. The new location is about seven miles from the previous address, just north of exit 115 on Interstate 20. 📍

The new Venture Drilling location in Odessa, Texas, gives the company more service bays as well as storage for parts and consumables and on-site living quarters for itinerant mechanics.



The new location features multiple work bays. Pictured here are a Venture Drilling service truck and an Atlas Copco TH60. The new bays are large enough to accommodate RD20 III rigs.



Atlas Copco STRIKES AGAIN

*New Atlas Copco
Diamondback drill
rig gives potent bite*

Named for an iconic symbol of the American Revolution, the new Atlas Copco Diamondback drill rig has been created as a multipurpose rig to help drillers world-wide respond quickly to rapid changes in customer demand. Bolt-on modular components—a new concept in rig design—substantially reduce time from order to delivery and enable drillers to adapt to their local markets without having to buy additional, specialized rigs.

The new rig design features trusted innovations of other Atlas Copco water well rigs and, like the T2W and TH60, drilling operations of the Diamondback are PTO driven, powered by the truck's 600 hp carrier engine. An optional deck engine module is available for markets that prefer a separate engine for drilling operations.

The first series of Diamondback rigs is being introduced in the 40,000-pounds pullback class. Pulldown is rated at 30,000 pounds. Other versions on the drawing table based on this first model range from 15,000-pound to 100,000-pound rigs. »

“ We’ve all seen in recent years how a contractor can find himself suddenly needing to expand his drilling repertoire or even switching from one specialty to another. The Diamondback is the only rig on the market that allows owners to do that without intensive after-purchase modifications.”

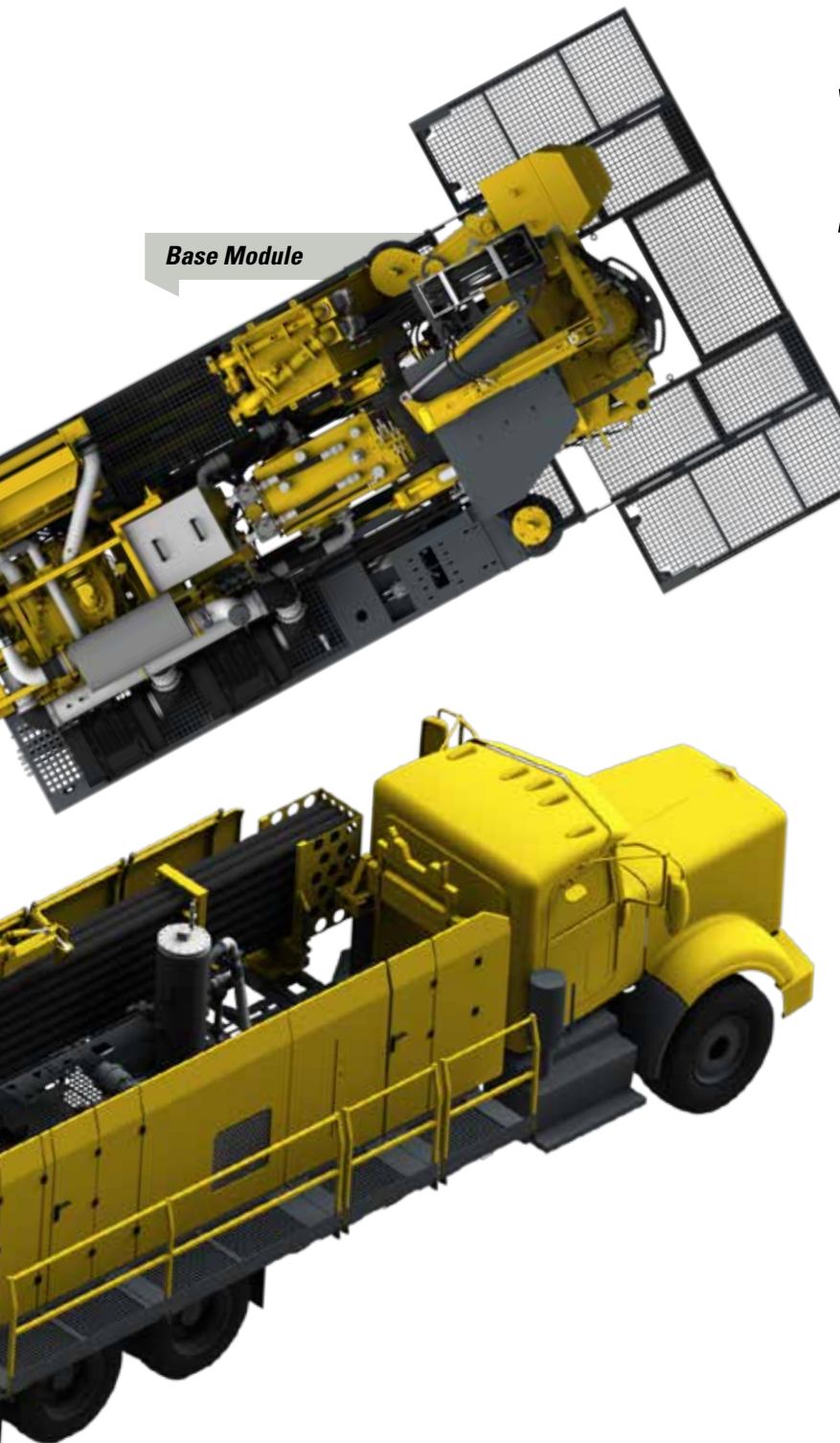
Alex Grant

Product Line Manager Atlas Copco Deep Hole Drilling Rigs

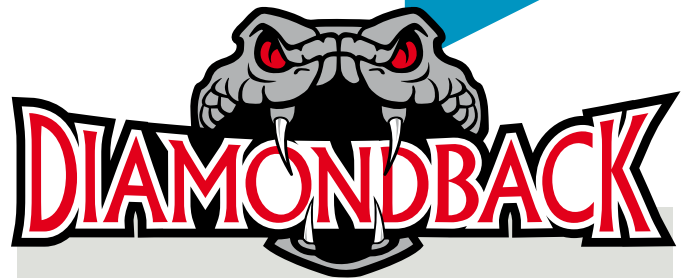


NEW CONCEPT IN RIG DESIGN

Bolt-on modular components offer flexibility with one rig for multiple demands



Base Module



MENU OF DIAMONDBACK OPTIONS

Owners will generally build their new unique Diamondback rig at purchase. However, many of the initial choices can be swapped out later should the market or an owner's opportunities evolve.

It comes preplumbed and prewired. Unassigned hydraulic and electrical connections are available for aftermarket components.

Table

Tables for inclinable Diamondback versions have a T3W/TH60-style table with a 17-inch or 24-inch opening that bolts to the tower's bottom or fixed to the back of the rig. Bushings and bushing holders are available in 24-inch and 10 3/4-inch sizes. Table options include

- Hands-free
- 24-inch table opening or
- 17-inch table opening

Rotary heads

- 3-inch ID spindle—Most common water well drilling option
- 5-inch ID spindle—For RC and flooded reverse circulation
- High speed coring head

Air and mud modules

- Atlas Copco 1100 cfm, 350 psi compressor
- No mud pump
- 3" x 4" standard centrifugal mud pump package
- 7.5" x 10" Centerline pump package
- 5" x 6" Gardner Denver piston mud pump package

Catwalks, enclosures

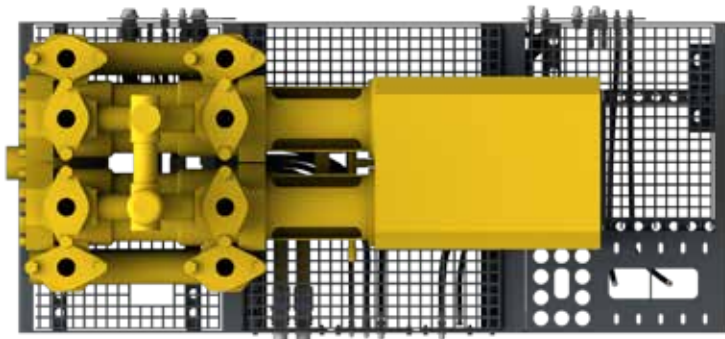
- Optional catwalks and enclosures give professional look to the rig, while offering safety standard approved access down the side of the rig.

Water options

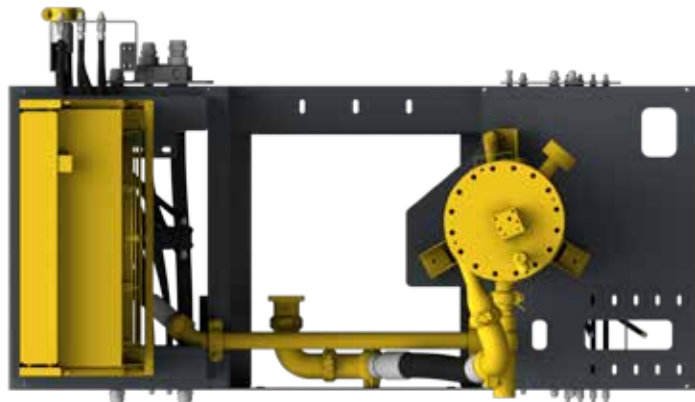
- Standard 12, 18 or 25 gpm injection system
- New 39 gpm, 1,200 psi Dynaset system

Rod handling

- Exploration rod handling system
- Basic water well rod box for up to 28, 3 1/2-inch rods
- Semi-automated rod handling for up to 28, 3 1/2-inch rods
- Carousel with rodbox



Mud Module



Air Module

» By December 2014 the Diamondback prototype had drilled over 30 wells totaling more than 18,000 feet without trouble before it was called back to the factory for top-to-bottom inspection. The first production rig hit the field by the end of June 2015, with three more scheduled to be assembled at the Atlas Copco facility in Garland, Texas, by September.

Modular design advantages

Tom Moffitt, business development manager of the U.S.-based Atlas Copco deep hole rig lines, said that the greatest advantage to customers who order new rigs is that the Diamondback's modular design shortens lead time. Bolt-on components share universal mounting locations and connection points allowing customization, he explained. Factory slots will not be limited to just a few rigs of select models with little commonality among their rig-specific parts.

"Once the base module is mounted on the truck, it is a matter of selecting options," Moffitt said. "Drillers just have to choose their options such as air and mud package, carousel or rod box, automated rod handling systems or none, which rotary head, spindle size, carrier-mounted table or tower-mounted—this is all as available to them as easily as any other configuration. And one doesn't necessarily take longer than another to build for them."

In short, modular assembly means customers get exactly the rig they want, quicker.

Truck and tower

In the U.S., the Diamondback is based on a 600 hp Peterbilt carrier, with PTO-powered drilling operations similar to a TH60 setup. However, a tubular tower will be more famil-

“ [Customers] just have to choose their options... all available to them as easily as any other configuration.”

Tom Moffitt

U.S. Business Development Manager
Atlas Copco Deep Hole Drilling Rigs

iar to T2W operators. Globally the rig will be mounted to an appropriately sized carrier of the customer's operational location.

The weight-to-strength ratio of tubular towers is superior to lattice designs. And its cage-free tower base leaves plenty of room at the deck to weld casing or work around pipe. The sliding head, which will slide well to the right of centerline, offers room for running casing, which the deck design permits in sizes up to 24 inches.

New to everyone is the inclined drilling capability of the Diamondback rig's choice of 34 and 38-foot towers. The Diamondback tower can be set to drill at any angle from 90 degrees vertical to 45 degrees inclined, or raised and lowered in the vertical position to adjust the table height. It may be ordered with a fixed deck-mounted tower, if the customer prefers, but only the table-mounted configuration can be inclined.

Featured upgrades

Owners have a choice of locations for mounting a DHD lubricator. The rig can be ordered with side enclosures and catwalks. These two options are not only functional and increase working environment safety but show the driller's customers that the rig in this configuration was made precisely for work in the mining, and oil and gas industry. A ready-to-bolt-on breakout wrench is also available, which is adaptable for either Petol or hands-free use.

Hose management for the tower and deck was a prime focus as well on this project, grounded in over a thousand hours of engineering design and testing. Diamondback hosing runs along the side of its deck, not through the center.

On-demand hydraulics have been improved over other market offerings with a simpler, more robust design. The driller's console pivots for good visibility of any operation taking place, even with the head slid right while casing or while drilling at an angle.

Alex Grant, product line manager for Atlas Copco deep hole rigs who works from Atlas Copco Drilling Solutions headquarters in Garland, Texas, said the modular design of the Diamondback concept arose in response to the changing global market. "We've all seen in recent years how a contractor can find himself suddenly needing to expand his drilling repertoire or even switching from one specialty to another.

The Diamondback is the only rig on the market that allows owners to do that without intensive after-purchase modifications."

The new Atlas Copco Diamondback at work in a field trial. Since the trials, several additional modifications have been made to the rig, so the final version available to customers will differ slightly in appearance from this test model.

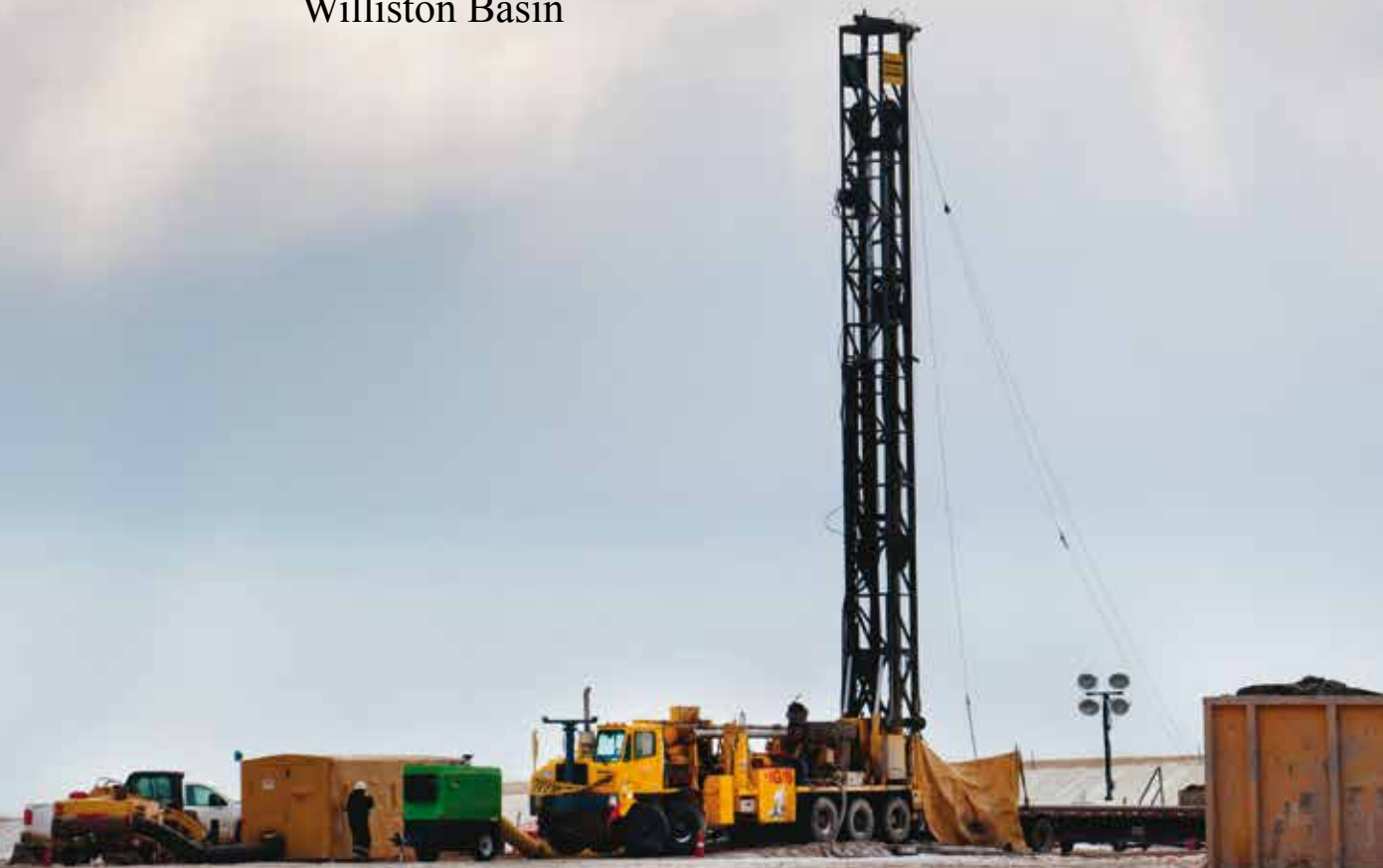
**See the Diamondback in person at the
SOUTH ATLANTIC JUBILEE**

July 25–27, 2015, Myrtle Beach, South Carolina



Staying on top

Efficiency of mixed
fleet approach increases
profitability in the
Williston Basin



Letting Craig Energy's RD20 rigs drill and case the top portion of well profiles eliminates fluid swap out for the customer's conventional deep hole rigs, which will complete the wells. It's an additional benefit of the mixed fleet approach in North Dakota's sub-zero temperatures.



Oil prices had been on the decline since June 2014, so no one anticipated the market's panicked response in late November when prices at the pumps began their freefall. In times like these, top hole contractors find their clients looking for ways to bring down costs and drive efficiencies. Concerned by tightened profit margins, they commit to drilling and potentially postpone the completion of their wells.

However, Danny Jimenez, president of Craig Energy, said that while the price of oil may be uncertain for the short term, rising demand worldwide is a fact the industry can bank on. Producers can step up production even through market fluctuations.

Teaming up with mobile drilling rig contractors in a mixed fleet approach to well development maintains profitability two ways. Not only does a mixed fleet offer greater economy while making the wells, but it adds increased revenue through increased production capability.

"Using preset contractors, producers increase their efficiencies by streamlining their operations," Jimenez said.

Preset contractors create the surface profile of a production well, isolating it from fresh water aquifers and the surface layers of the gas or oil play. Conventional rigs can then follow behind to complete the wells to total depth.

An experienced top hole contractor, Craig Energy has provided well development services to oil and gas custom-

ers throughout the Rockies from its Vernal, Utah, headquarters for more than 30 years.

The past few years Craig Energy has also been operating a successful base outside of Williston, North Dakota, complete with a full-service mechanics' shop, product storage and a camp for drilling crews.

One key to Craig Energy's success, Jimenez said, is their ability to provide integrated services, including cementing, focusing on surface drilling efficiency. Safety performance is ensured by Craig Energy's skilled personnel and its fleet of Atlas Copco RD20 drilling rigs.

Williston fleet

Five Atlas Copco RD20 drill rigs currently keep Craig Energy from experiencing any downtime for routine maintenance.

Bret Williams, Craig Energy operations superintendent in Williston, said they started with three, adding two more just last year, and will acquire more depending on market outlook and customer demand.

The fleet now consists of three RD20 III rigs and two RD20 XC models, currently configured for external flush pipe drilling operations. One RD20 III has an optional top head brake kit for directional drilling. The rigs are all currently running 30-foot joints of 4.5-inch outside diameter (OD) 2 7/8-inch IF box and drill pipe, although they can handle longer joints.

Craig Energy has complemented its RD20 fleet with a Predator Drilling System, the deepest drilling mobile rig in the

Atlas Copco product line. The system consists of a truck-mounted rig, substructure and pipe skate. The Predator gives Craig Energy nearly double the pullback capability and torque of its RD20 rigs for drilling and setting casing.

RD20

RD20 rigs have been drilling for oil and gas since 1986. It was designed as a self-contained, highly mobile rig that could be run by a small crew to reduce drilling costs. Its ease of transportation and quick setup times from the ground or over a range of substructure options helped independent contractors reduce operational costs and increase productivity, with the ability to complete more jobs in the same time frame.

The top head drive, hydraulic RD20 drilling rig has evolved to become an integral part of energy production on every continent, in every climate, and over any terrain. The rig has a hook load of 120,000 lbf (533 kN).

Drilling operations are powered by customer's choice of either a 755 hp Cummins or 800 hp Cat deck engine. The spur gear top head drive gives 8,000 lbf-ft. (10.8 kNm) of torque, which is maintained regardless of changes in speed. Its air end delivers 1,250 cfm at 350 psi.

Its 3-inch (76 mm) mud piping is rated for circulation pressure of 1,500 psi (103 bar). The RD20 XC rig's oilfield configuration includes a 3,000 psi (207 bar) mud piping system that readily adapts to »



Windchills of minus 20 F (-29 C) and less on this North Dakota November day make it difficult for Denver-based Atlas Copco sales rep Kevin House (left) to see through tearing eyes. Still, he makes a site visit to meet with Craig Energy's Bret Williams, superintendent of its Williston operations (center), and Lee Keller, maintenance lead.



“It’s all about how much can we reduce cost at this point. Using top hole contractors increases the drilling efficiency of wells the customer gets into production.”

Danny Jimenez
Craig Energy CEO

Eliminates fluid swap out

Top hole service adds value for the Williston Basin, where a considerable portion of the calendar year can be spent drilling in temperatures of minus 40 degrees F (-40 C) or less. Since surface casing is set to isolate fresh water aquifers from the hydrocarbon resources far below them, a conventional derrick rig must start a hole with water-based drilling fluid for the vertical portion of the well. After that point, drilling converts to oil-based drilling fluids, appropriate for the targeted resource.

That means making a fluid swap-out in the harsh temperatures and relentless winds of the North Dakota prairie. Top hole contractors eliminate that ordeal for their customers. A top hole contractor does the water-based drilling, leaving the hole ready for the conventional rig to drill it to completion.

Factoring in the typical day rate for a conventional derrick rig, the top hole contractor drills at a significantly lower cost, adding value to a mixed fleet approach.

“Top hole contractors benefit the industry as a whole,” Jimenez said. “Williston has matured now into a production-driven play like those of Texas. It’s all about how much can we reduce cost at this point. Using top hole contractors increases the drilling efficiency of wells the customer gets into production. Another benefit for many operators dealing with market uncertainties is the ability to hold leases by spudding their wells using a surface rig.”

Tricone regimen

Williams said most of their 13.5-inch-diameter holes are typically drilled to around 2,000 feet, with a few as deep as 2,400 to 2,500 feet (730 to 760 m). Craig Energy has experimented with PDC bits but prefers to drill with tricones for two reasons, he said. First, in this formation tricones give them penetration rates of between 100 and 120 feet per hour (30.5 to 36.5 m/h).

» oil field compressors, boosters and mud systems. Rig-mounted water injection and DHD lubricator systems are piped into the air system.

Both derrick and table on the RD20 rig are designed to handle Range II or Range III casing with ease. A clearance between the spindle and the table on the RD20 II of over 51 feet (15.5 m) provides plenty of room for 30-foot (9 m) drill pipe.

The standard RD20 II, and RD20 III are configured for external flush-joint drill pipe. The RD20 XC—named for its “extra capabilities”—is designed for use with 2 7/8 to 4 1/2-inch (73–114 mm) Range II external upset “bottleneck” pipe common throughout the conventional oil patch, and 4 1/2 to 8-inch collars. The RD20 XC has pipe and casing elevators and integral breakout wrenches.

Pipe, collars and casing are handled on the RD20 XC model by its tip-out hydraulic link and elevator system on the top drive.

Value of full service contractor

Jimenez said the best-value top hole contractors offer integrated services. “For each well, a pad has to be constructed, a well-head built. Then there’s drilling, casing and cementing. It’s hard to convince a customer to use a mixed fleet approach if they have to hire a half dozen separate contractors just to drill the first 2,000 feet of a 20,000-foot (6,100 m) hole. With a multi-service contractor, all that hassle is taken care of with a single point of contact. You can let your conventional derrick rigs do what they do best—deep drilling—and complete wells more efficiently.”

Second, tricones are part of a highly efficient formula that Craig Energy has developed for this formation. It lets them complete the vertical portion of a well and get off the hole in 2.8 days or fewer, without problems. Often they are moving in less than 30 hours.

“Our tricone formula is perfect for what we’re in,” Williams said. “There’s that old saying, ‘If it ain’t broke, don’t fix it.’”

That formula varies slightly over a surface formation that isn’t as uniform as it might appear, Williams explained. “Most people think of the Williston Basin as one big, wide mix of coal seams, clay and sand. But where you’ll find gravel or clay varies from location to location. You definitely know when you hit bentonite because the downhole pressure skyrockets. So you always have to watch your viscosity.”

Drillers manage viscosity by keeping their eyes on their downhole pressure gauge. In most places the formation has clay already, so they won’t add much mix to the water, as drilling fluid viscosity will be sufficient to float cuttings, maintain pressure differential and hold the wall.

A geological chart for the region combined with their own experience in the basin means they can anticipate what drilling conditions will be.

Gravel is a given near the Canadian border but occurs only sporadically in the rest of the basin. Williams said, “Where we know we’ll find gravel, we’ll mix a pill in

our mixing tank and build up our mud before we attack the hole.”

In these gravel zones Craig Energy likes to run thicker mud at viscosities between 34 and 38.

“In the rest of the play, we can stay between 30 and 34 ‘visc,’ although some places we can run with fluid as low as 28, which is just about plain water.”

Most places they drill will not present circulation problems. Where they do experience lost circulation, Williams said they won’t drill blind. “We always get our returns back.”

While continuing rotation and steadily pumping fluid, they stop advancing the bit. They send down a pill of cedar fiber or another viscofier to patch the fracture or void until circulation is restored.

Likewise, if pressure spikes as they hit bentonite, they’ll hold off penetration but keep pumping until viscosity comes back down to avoid building a mud ring. “You have to be careful not to out-drill your mud here. Penetration is based on what you’re pumping in the hole.”

Today’s hole

Craig Energy’s Williston-based, drillers and hands are working as five-man drill crews in 12-hour shifts, 28 days on, 14 days off. On this morning, temperatures were in the single digits with a north wind sandblasting equipment surrounding one of their five RD20s. The crew was finishing the second hole of a two-well pad.

Drillers Jeremy Brewton and Josh Thompson said they had had no loss of circulation from the 2,115-foot-deep holes. They spudded the hole in the day before, with rotation at 60 to 70 rpm. Rotation varies from location to location, but after collaring to 500 feet on this hole they sped rotation up to 90 rpm and kept it there.

They had been steadily pumping mud at a viscosity of 30 flowing at “140 strokes,” or 390 gpm. They reamed most joints with the 13 ½-inch bit while drilling.

Holes in this area were being drilled in about 16 hours. Running a wiper trip and casing it adds 9 hours to completion time, followed by cementing operations. They were ready to leave the pad and move to the next hole after first setting up here in just a little over two days.

Williams isn’t too worried about keeping this drilling formula a secret. He said that’s because one of the key ingredients can’t be duplicated outside of Craig Energy: “You have to have the right drillers and the right crew—our crew.”

He added that drillers need good equipment. “Craig Energy knew from the beginning that if we were going to work in Williston, we wanted to do it correctly. That’s why we have Atlas Copco rigs. We love them. And we have a relationship with Atlas Copco for oilfield support that you just can’t beat.”

Maintenance lead Lee Keller routinely makes the trip to Craig Energy’s Williston location from its Utah office. Keller says, “Craig Energy is known for its ability to work in remote areas independently. A lot of the reason we can do that is because we’re backed by Atlas Copco support anywhere we go—even out here in North Dakota.”



(From left) Larry Siddall, Ed Greer, Salvador Servin, Larry Molina and Miguel Chavez



When a turtle needs **MORE THAN ITS SHELL** for protection

Contractor displays environmentally responsible drilling practices with Atlas Copco TH60 in habitat protection area

It was California's regulations and the new federal emissions requirements that influenced AZCA Drilling & Pump owner Larry Siddall to upgrade to an Atlas Copco TH60 DH.

AZCA provides customers throughout Arizona and the southeastern part of California with water well drilling, pump repair and testing services from two offices,

in Ehrenberg and Marana, Arizona. In this region AZCA performs its services while complying with not only some of the nation's most restrictive regulations but also those borne by its domestic, agricultural, forestry and government customers.

Siddall accepted delivery of the new TH60 DH while drilling two 12-inch water production bores and three 4-inch monitor-

ing wells for a ground-mounted solar panel photovoltaic electricity farm.

The worksite in the Mohave Desert was not only in the California Desert Conservation Area administered by the federal Bureau of Land Management (BLM), but also in desert tortoise habitat. The desert tortoise is listed as a threatened species.

Siddall said, "California's environmen-



Larry Siddall, owner of AZCA Drilling & Pump, talks to two biologists tasked with patrolling the tortoise exclusion fences. The third-party contractors monitor tortoise activity, looking for any signs of distress that could jeopardize the tortoise's chances of survival in the Mojave Desert.

Larry Siddall (left), owner of AZCA Drilling & Pump, believes having the best people and state-of-the-art equipment inspires customer confidence. At right is Ed Greer, regional and store manager of Atlas Copco—Tucson.

tal regulations, the EPA's guidelines, protecting a threatened species—these are just reality, like any other job requirements. So far it really hasn't been a problem for us. We know we can meet the requirements.”

Rig for the future

Though AZCA had long been an Atlas Copco T3W customer, the single-engine simplicity of PTO-powered drilling from the TH60's EPA 2013-compliant 600 hp carrier engine made it more attractive to Siddall in this service area. Drilling operations of the T3W had been powered by a separate deck engine.

The TH60 gives AZCA the same capabilities as the T3W they traded in, with 70,000 lbf of pullback and 30,000 lbf of pull-down. The single-engine rig also has a quieter drilling environment, since the engine is farther away from the driller's station. The deck has more open space. And with only one engine, the rig's overall weight is lighter, which produces less compaction as it travels over sensitive landscapes.

Another TH60 difference is its unique cylinder feed design. An inverted cylinder allows the larger side of the piston to be

used for pullback force. The TH60 provides more pullback force at the same hydraulic pressure of non-inverted cylinder rigs. Increased hydraulic pump flow to the cylinders give it the ability to trip out at up to 150 feet per minute.

Drilling operations

Job specifications limited Siddall to mud drilling, though he said he would have liked to use a hammer in this formation. The drillers encountered fractured granitic rock at about 350 feet, which continued to total depth at 500 feet.

The drill site surface was sealed off with plastic lining. Drilling fluid brought onto the site included only approved additives. All fluid was contained in AZCA's shale shaker box and hauled away for treatment and disposal, as was initial development water. External pits were not allowed. Solids from the shaker box were also contained and hauled away for treatment and disposal.

One well site allowed AZCA a drilling area of about 2,500 square feet. Pad dimensions were crowded, but the crew could fit the TH60 in among a pipe trailer, water storage tanks, a shale shaker, treaded loader and AZCA's off-board mud pump. Siddall said

off-board pumps are common in the Western U.S. The TH60 easily accommodates the preference with quick connects at its hydraulic manifold.

Another site, however, was just too small. So instead of setting up its water storage tanks, AZCA cycled in water trucks as needed.

Water production wells were drilled in two passes, first with a 12 3/8-inch hard rock tricone bit, followed by a hole opener with a 12-inch PDC pilot and 17 1/2-inch tricone bit third reamer. The 4-inch monitoring wells were drilled single pass with 4-inch hard rock tricone bits.

Drilling rate of penetration on production wells was about 10 feet per minute in the alluvium. ROP dropped to as little as 1 foot a minute when the bit hit the fractured rock at 350 feet. ROP for the last 150 feet averaged 1 to 3 feet per minute.

Under the microscope

The modernized gauges and overall reliability of the new TH60 produced another benefit at this site: reducing what Siddall referred to as the “high scrutiny” factor.

“On sites like this, you have the environmental monitors observing operations 24/7. »

TORTOISE DISTRESS MITIGATION

Tortoises commonly symbolize endurance and long life. Some eastern Native American tribes portray the world as borne upon a tortoise's shell. In the mythology of tribes living in the deserts of the Southwest, the desert tortoise also represents life-giving water.

The Mojave Desert Tortoise is listed as a "threatened" species under the United States Threatened Species Act. Its habitat includes California, Utah, Nevada, Arizona and northwest Mexico, with the densest populations occurring in western sections of the Mojave Desert.

Biologists refer to the desert tortoise as a threatened "keystone species." Other

animals rely on the tortoise's ability to burrow as far as 6 feet beneath the desert floor. The tortoise shares its tunnels with them, protecting them from the harsh daytime environment above with access to humidity and cooler temperatures underground.

Before drilling crew members could enter the California Desert Conservation Area, they underwent Workers Environmental Awareness Program training. WEAP training makes workers aware not just of the tortoises but of all sensitive biological, cultural and paleontological resources they may encounter at the site.




Miguel Chavez, AZCA owner Larry Siddall and Frank Chickey, Atlas Copco deep hole product support.

After the Bureau of Land Management reviewed impact studies, it permitted a right of way in one of the least tortoise-populated areas.

Pathways for vehicle access were lined by a net-like tortoise exclusion fence. Biologists known as Environmental Compliance Monitors (ECM) patrolled the fences looking for signs of tortoise distress, logging their observations of tortoise activity.

Though the drilling site itself was only about 2 miles from the main road, it could take the drilling crew, tractor-trailer rigs and water trucks up to 40 minutes to make their way to it. An ECM accompanied each piece of equipment as it entered or departed the drill site. Speed was limited to 10 mph or less.


Gates in the fences had to be manually moved and replaced at intervals along the fence-lined route. Once a gate had been slid back into place, the drilling crew and accompanying ECM piled soil and rock against its bottom to seal off gaps that might permit a tortoise to crawl under it. The drilling crew also assisted in relocating any tortoises that happened to enter the tortoise-free areas.

AZCA's extra measures not only helped the desert tortoise but also helped the customer maintain regulatory compliance to finish construction of its project. In doing so AZCA shared a role in meeting a larger environmental objective, since power produced by this customer will help California reach the 2016 targets of its Renewable Energy Program initiative. 

» What might seem like a minor malfunction to us drillers can be alarming to them. Good equipment causes less drama when you're operating in front of non-drillers like that."

Normally a tortoise can live off its internal water supply for a year or more without a source of water. Under distress, a tortoise will void some of this water as a defense mechanism, depleting itself of critical moisture, causing death if it cannot replenish it. Therefore, any type of construction work permitted near tortoise habitat requires monitoring of the tortoises for signs of distress.

Prior to initial development at this particular site, a third-party environmental consulting company surveyed the land, identifying tortoises, their burrows and activities. All access points were plotted out and monitored throughout the project.



Flynn Drilling Company of Troy, Missouri, has found the rugged Atlas Copco T4W to be best matched to the wide range of jobs they do, both in their residential and their commercial divisions. Company owner Danny Flynn says, “The T4 is unmatched in the industry for what we’re looking for in a rig. Comparisons always lead back to the T4.”

30 YEARS AND RUNNING

Missouri water well driller sticks with proven rig solution—the T4W

Most of the state of Missouri lies above one of the largest complexes of freshwater aquifer systems in the United States, making groundwater one of the state’s most abundant natural resources. While potable water can be accessed with rotary drilling or even bucket rigs in some locations, most sites are best reached with down-the-hole rigs. The targets are Missouri’s Ozark Plateaus and Cambrian-Ordovician aquifers, whose permeable Roubidoux Sandstone and Gasconade Dolomite strata yield up to 2,000 gallons per minute depending on specific well development.

Flynn Drilling Company of Troy, Missouri, is one of the largest and most experienced water well drilling companies in the region. For more than 30 years Flynn Drilling has based its services on an Atlas Copco T4W.

Tough rigs save money

Flynn Drilling’s deep-hole version of the T4W, with a 755 hp (597 kW) Cummins QSK 19 deck engine running the 1,250 cfm/350 psi compressor and all drilling functions, has pullback capability of 70,000 pounds (311 kN). This enables them to drill and case the larger diameter municipal and

commercial wells that often reach depths of 2,500 feet in their service area, whether the job requires rotary, air or a mixed strategy of both.

Owner Danny Flynn said: “The T4 rig’s longevity and reliability keep our costs down. Over the years, of course, we’ve looked at other makes of rigs, but the T4 is unmatched in the industry for what we’re looking for. Comparisons always lead back to the T4.”

So when Flynn Drilling upgraded their 2000 model T4W, it chose a brand new 2015 T4W. The new rig’s Crane Carrier Company tandem-steer 8x4 base is 4 feet »

Dean Shocklee is as at home at the operator's panel of a 2015 T4W as he was with Flynn Drilling Company's 2000 model, the 1991 model before that, and the 1978 model before that.



Driller Dean Shocklee adds a 15 ½-inch stabilizer to minimize play between the 12-inch hammer he will use and the 17 ½-inch-diameter bore wall created by the hole opening bit.

longer than the previous rig's CCC 6x4 platform to accommodate the 425 hp (317 kW) Cummins ISX 11.9 engine with its EPA 2013-compliant, on-road emissions package. Twin steering axles up front smooth out the ride on the highway yet maintain the rig's maneuverability for positioning it over the hole.

In spite of the new base accommodations, the rig's functions and features are immediately familiar to T4W aficionados. While they had originally scheduled a full day to familiarize themselves with the new rig, Flynn Drilling's crew only needed a few hours before they were up and running.

Hometown job

Flynn Drilling put its new T4W to work completing a municipal water well for the city of Troy, Missouri. The previous T4W had drilled a 12-inch (305 mm) test hole to 1,500 feet (460 m) prior to being traded. When test results came back, the city gave Flynn Drilling—and its new T4W—approval to complete the well for production.

Shocklee had drilled an extraordinary well in this same reservoir, further south. That one was currently producing 1,600 gallons (6,060 L) per minute. He believed the Troy well, located nearer the confining unit between the Ozark Plateaus and Cambrian-Ordovician, would get about half that.

To align the T4W over the previous bore, Shocklee first backed the rig over it, then, alternately lifting the rig left and right by its rear jacks, he "walked" it sideways until it was centered over the hole. "I'd like them all perfect, of course, but within a quarter inch, that's pretty good."

Shocklee said he was now reaming the 12-inch hole with a 17 ½-inch (445 mm) DTH hole opening bit to 880 feet (270 m).

Then Flynn Drilling would cement a 12-inch steel casing to seal off the production zone from the strata lying above a shale layer cap to prevent possible contaminants.

Every precaution is taken to protect the resource. Shocklee said: "This area has had concerns with radionuclides. And that brine aquifer out west of us, the salinity is moving this way a little more each year."

Shocklee put a 12-inch hammer above the 17 ½-inch hole opening bit. He set a 15 ½-inch (394 mm) stabilizer above the hammer followed by two 12-inch collars, each weighing 1,500 pounds (630 kg).

Beginning on two compressors, Shocklee tied in a third to get to 2,150 cfm (1,015 L/s) at 490 psi (33.8 bar) before the hole was done.

The first 55 feet (16.8 m) were drilled through unconsolidated soil before hitting competent bedrock. Just 500 feet away from the rig, the rock outcropped at the surface. "The rock slants like this," he said, holding his palm out in front of him, angled sharply toward the sky. Yet, since he had not encountered voids or fractures in the Burlington limestone and dolomite layers, the

Sons Nick and Kaleb Shocklee get on-the-job training with the Atlas Copco T4W from their father, Dean Shocklee, Flynn Drilling Company's head driller.



test hole had hammered through straight as an arrow, maintaining circulation to total depth.

He recalled the penetration rate for his earlier 12-inch hole had been about 1 ½ feet (46 cm) per minute. With the 17 ½-inch hole opener, he was getting 1 foot (30 cm) a minute.

Shocklee used two barrels of foam from start to finish on about 30 gpm (114 L/min.) of water. “I’m one of those who believe in really keeping those cuttings moving,” he said.

Right rig in many ways

Established by Mike Flynn in 1954, Flynn Drilling Company’s services today include not only well drilling but pump installation and repair, testing, treatment and maintenance, with both residential and commercial divisions.

Flynn said the company will use the massive T4 rig occasionally on residential jobs: “Our T4 gets the job done at any depth.” But the rig truly excels on these

large-diameter commercial and municipal wells.

Testing and observation bores are routine drilling work in this region, since the same permeable limestone and dolomite strata that permit surface water to readily recharge it also make it vulnerable to contamination.

“Smaller rigs could drill most of the wells we drill,” Flynn said, “but not for long. We run our drill 12 hours a day, every day. The T4 we just traded in we got new in 2000. We don’t believe any other drill would hold up like that, not for what we do with it.”

Built to be the most solid mobile water well drilling platform on the market, the T4W is also a favorite of Lou Dale Walker, a lead technician for Venture Drilling Supply. Venture is the authorized Atlas Copco dealer serving Flynn Drilling. Referring to the rig as “a beast,” Walker added, “If they needed to take a drill to the moon to drill a hole, it’d be a T4.”

The company’s first T4 was a 1978

model, followed by upgrades in 1991 and 2000. When the 2000 model’s compressor went in for resealing at 1,300 hours, it was a convenient time to address the rotary head as well.

Shocklee usually performs his own maintenance but in this case, he had Venture technicians take it apart for a thorough inspection. They were astounded by what they saw. Venture account manager Tim Beaman, who coordinated the upgrade for Flynn Drilling, said: “They were taking pictures of that rotary head, a spur gear drive same as the new one has. You couldn’t tell it from brand new, it had been cared for that well.” This 2000 T4W had logged 18,000 hours by the time it was finally traded in for the 2015 rig.

Walker attributed the excellent condition of the 2000 model both to its design and to the preventive maintenance program Shocklee established years ago for Flynn Drilling’s equipment. “Dean proves the old driller saying, ‘Take care of your rig, and it will take care of you.’”

New reference book for deephole drilling market

Atlas Copco Drilling Solutions is pleased to announce the release of the 2015 deep-hole drilling reference book, titled “Deephole Drilling in the water-well, oil & gas, geothermal and exploration markets.”

This first edition of the book focuses primarily on deep-hole drilling and the techniques, tools, Atlas Copco products and various conditions that drilling rigs are exposed to around the world.

The new reference book will be available through local Atlas Copco customer centers and distributors: “Deephole Drilling,” Atlas Copco Part No. 5858 13 41.

To view the reference book or download a copy, visit www.atlascopco.com/wwdrills or www.atlascopco.com/oilandgas, where you will find the reference book along with the latest updates to Atlas Copco’s water well and oil and gas product lines.



See you there!

OFFSHORE TECHNOLOGY CONFERENCE, BOOTH #2981:
May 4–7, Houston, Texas <http://2015.otcnet.org/>

GLOBAL PETROLEUM SHOW, BOOTH #3332:
June 9–11, Calgary, Alberta, Canada
www.globalpetroleumshow.com

IADC DRILLING AND ONSHORE CONFERENCE AND EXHIBITION:
May 14, Houston, Texas www.iadc.org

IADC WORLD DRILLING CONFERENCE AND EXHIBITION:
June 17–18, Rome, Italy www.iadc.org

SOUTH ATLANTIC JUBILEE:
July 25–27, 2015, Myrtle Beach, South Carolina
www.jubileewatershow.com

IADC ADVANCED RIG TECHNOLOGY CONFERENCE AND EXHIBITION:
October 13–14, Amsterdam, The Netherlands
www.iadc.org

NATIONAL GROUND WATER ASSOCIATION EXPO:
December 15–17, Las Vegas, Nevada
www.groundwaterexpo.com

Atlas Copco & MegaDiamond Deep Leach Cutters

Partnership with MegaDiamond gives Atlas Copco customers PDC directional drilling bits specially engineered for unconventional oil & gas

Atlas Copco PDC bits will now feature MegaDiamond deep leach cutters. MegaDiamond, a Schlumberger company, has entered into a partnership with Atlas Copco to supply its patented and proprietary deep leaching technology.

The partnership permits Atlas Copco to bring its bit lines to customers for horizontal and directional drilling applications in the oil and gas industry. In the U.S. that market comprises about 80 percent of all energy drilling.

Curtis Larson, Atlas Copco Applications Engineer—Oil & Gas, said, “We’re already shipping them to customers and have seen good results after multiple runs in deep leach drilling applications.”

What is deep leaching technology?

Deep leach cutters stand up better to drilling the deeper holes at longer intervals due to high thermal resistance.

Standard PDC inserts, with their typical, highly abrasion-resistant cutting edge, tend to convert to graphite at a lower temperature than a simple diamond. This is due to the presence of cobalt, which acts as a catalyst to sinter the diamond-to-diamond bond, unitizing the diamond layer to the tungsten carbide substrate.

During heating, cobalt expands at a higher rate than diamond, causing the thermal stress in the diamond table to increase and the structure breaks down. The cobalt between the diamond crystals expands and breaks diamond-to-diamond bonds, resulting in reduced cutter life and cutter failure



For more information on deep leach cutters and to see Atlas Copco’s wide variety of oil and gas drilling tools, see www.atlascopco.com/oilgasdrilling

due to the heat created from the friction on the cutters during drilling.

The deep leaching process selectively removes cobalt from the diamond table of the PDC cutter. Leaching increases cutter thermal stability, which reduces damage and extends bit life in difficult and abrasive formations.

MegaDiamond employs a patent-protected technology to provide deep-leach performance. Internal lab testing has been confirmed by field tests in such demanding areas as the North Dakota oilfields. In a “Williston drill-out” between a bit with MegaDiamond cutters and another, the MegaDiamond cutter sharpness outlasted the non-MegaDiamond bit 2 to 1.

The MegaDiamond cutters have also shown similar results in West Texas, South Texas and Oklahoma through additional competitive runs, often outperforming standard deep leach cutters.



MegaDiamond builds a standard cutter, then removes the diamond table from the substrate. The substrate is discarded and cobalt is removed from the diamond table. The diamond table is then attached to a new substrate. The resulting PDC cutter is deep leached, removing infiltrated cobalt to several hundred microns.

AtlasCopcoMarketplace.com PRE-OWNED DRILLS



Ingersoll-Rand TH60/2000 sn:6530
Location: Milwaukee, WI
Tower: 32 ft. w/ 26,500 lb pullback
Compressor: 825 cfm / 350 psi
Truck: International Paystar
Truck Engine: 475 hp Cat C15
Mud Pump: Hydraulics in place



Ingersoll-Rand TH60/1993 sn:3797
Location: Milwaukee, WI
Tower: 38 ft. w/ 29,500 lb pullback
Compressor: 750 cfm / 250 psi
Truck: International Paystar
Truck Engine: 410 hp Cummins



Atlas Copco T3W/2005 sn:6879
Location: Clarks Summit, PA
Tower: 32 ft w/ 32,500 lb pullback
Compressor: 1070 cfm / 350 psi
Deck Engine: 580 hp Cat C15
Truck: International 7600
Truck Engine: 380 hp C13
Drill Hours: 2950



Atlas Copco T2W/2012 sn:21402
Location: Milwaukee, WI
Compressor: 750 cfm / 300 psi
Tower: 30,000 lb pulldown/pullback
Truck: International 7600
Truck Engine: 475 hp IH Maxxforce
Drill Hours: 607
Mud Pump: hydraulics in place



Atlas Copco T3W/2007 sn:21229
Location: Clarks Summit, PA
Tower: 36 ft w/40,000 lb pullback
Compressor: 900 cfm/ 350 psi
Deck Engine: 475 hp Cat C15
Truck: International 7600
Truck Engine: 380 hp C13
Drill Hours: 4239

INCOMING TRADE

Atlas Copco T2W/2006 sn:6982
Location: Milwaukee, WI
Tower: 30,000 lb pulldown/pullback
Compressor: 750 cfm/ 300 psi
Truck Engine: 525 hp Cat C13
Mud Pump: 3x4 Mission
Drill Hours: TBD



Schramm T450/2004
Tower: 30,000 lb pullback
Compressor: 900 cfm/ 350 psi
Deck Engine: Cat 3406C
Truck: International 7500
Truck Engine: HT530
Drill Hours: approx. 8,000

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