THE BUCKSKIN DEVELOPMENT

Balancing cost and performance in the deepwater Gulf of Mexico
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"Energy companies like ours are rare in the Gulf of Mexico. LLOG is a privately-owned exploration and production company, yet it has become the region’s fifth largest oil and gas producer. Since our founding in 1977, growth has been traditional and organic, through lease sales, exploration, drilling and production. Now LLOG’s reputation for safety, efficiency and profitability is opening new doors. The Buckskin development is a prime example."

— **PHILIP LEJEUNE**, LLOG CHIEF EXECUTIVE OFFICER
HOW
BUCKSKIN
EVOLVED

Counting on LLOG’s Reputation for Success

LLOG’s business partners got straight to the point: The Buckskin discovery seemed to have commercial quantities of oil in place. There was a wealth of data to back that up. The margins were tight, however, and three of the four original companies owning Buckskin left the project. One of the remaining partners, the Spanish energy giant Repsol, had taken over leadership with a new perspective for the design and value of the project. Now time was short. Soon, the lease would expire and revert to the Bureau of Ocean Energy Management (BOEM). Would LLOG be interested in developing and operating the field?

“Acquisitions have never been a big part of LLOG’s business strategy”, says Randy Pick, Vice President of Acquisitions, Divestitures and Reserves. “The company has focused on creating value via the drill bit, and has done so quite successfully. In most cases, trying to beat several of your competitors in what amounts to a sealed-bid auction does not allow for superior economics. Buckskin is different. LLOG recognized early on that combining our ability to move quickly, technical expertise and operating efficiency with Buckskin’s huge resource base had unusual potential. And we were right. The economics for Buckskin are far better than any acquisition I have seen in my 25 years of doing this.”

A lot to consider
Buckskin consists of 5-1/2 deepwater blocks organized as a single unit. The total field covers 43 square miles of the Keathley Canyon in 6,800 feet of water, some 300 miles due south of Lafayette, Louisiana. LLOG is no stranger...
to deepwater. At the 2017 Offshore Technology Conference, LLOG earned the Distinguished Achievement Award for its Delta House deepwater development.

With Buckskin, the wild card was geology. The reservoir is in the Wilcox trend, a rock familiar to onshore producers from Southeast Texas to Southwestern Louisiana, but relatively new to operators in the deepwater Gulf of Mexico. LLOG had yet to drill its first well in the Wilcox.

“After an extensive evaluation of the data, our team was excited about the opportunity and confident in its potential,” says John Doughtie, LLOG’s Vice President of Exploration. “Over the years we have appraised multiple Wilcox developments. At Buckskin, our geologic interpretation and in-place reserve potential proved its unparalleled viability and promise.” Based on seismic data, five exploratory wells and extensive core samples, the original Buckskin partners figured it would cost some $2.2 billion to develop the field using four subsea production wells tied to a nearby spar production platform operated by Anadarko. The joint venture would pay the spar’s owners for handling its production; as much as 30,000 barrels per day. Would that be enough to justify the cost of developing the field? There were considerable hydrocarbons in place—perhaps the oil-equivalent of five billion barrels—but the consensus was that only about six percent was recoverable. Even that amount would be costly to reach. Could LLOG make it work?

“Before our first meeting with them, the Buckskin partners had secured a Suspension of Production (SOP) agreement from the BOEM,” says Rick Fowler, LLOG’s Chief Operations Officer. “That bought more time to develop the field, but certain spending milestones were about to be missed. There was a real danger of losing the opportunity altogether.”

If Buckskin could be saved, the LLOG team knew that it needed to cut costs. Interest in the project was high, in part because there was an abundance of data. It was far more information than they had expected, and it turned out to be more promising.

“We began reviewing the data in May of 2016,” Fowler says. “Besides the logs from five wells, we had access to 2,352 feet of core, 58 fluid samples, 278 formation dynamics tests and four seismic data sets. The previous Buckskin operator gave us all the information we asked for. With that, we set out to build our own model of the reservoir, to see if our analysis matched what others had come up with.”

As LLOG’s geoscientists pored over the data, the geology began looking better every day. LLOG’s confidence in the reservoir grew and the company now expects oil recovery percentages in the low to mid-teens of original oil in place. Meanwhile, the development team began to see how the whole project could be made more efficient.

LLOG signs on

“In November of 2016 LLOG agreed to become operator of the Buckskin field with a 34 percent working interest,” Fowler says. “We proposed developing the field with two Phase I wells instead of four. Based on our estimates of the reservoir, that could be enough to deliver the target production rate of 30,000 barrels a day. We also thought we could significantly reduce the drilling and completion costs, from $327 million to $120 million per well.”

Buckskin’s partners, Repsol, Beacon Offshore Energy, Ridgewood, and the Israeli group, Navitas, were somewhat skeptical, but had faith in LLOG’s reputation for delivering what it said it could do. Beyond that, LLOG’s optimism was supported by news from other wells in the Wilcox.

“The Jack and St. Malo fields had just come on in 2016, so we were starting to see monthly production data,” says reservoir engineer Jon Wood. “We could see what the Jack and St. Malo wells were capable of flowing.”

Even though the Jack/St. Malo wells were 30 miles away, there was some correlation to Buckskin. The LLOG geoscience team consulted publicly available logs and compared the net-to-gross porosity using their own estimates of what the permeability might be.

“ We got fairly comfortable with our evaluation,” Wood says. “We had the data from the four original Buckskin wells drilled into four different compartments. They were probably the bookends in terms of the outboard Wilcox reservoir quality. There were different delineated fault blocks that we could exploit. It would help if they were all connected, but we knew that wasn’t the case. Still, for each structure, we estimated that there was roughly the equivalent of two billion barrels of oil in place.”

LLOG Exploration Buckskin
The Nature of the Beast

The Wilcox trend has a bad reputation. “The rock’s no good. The reservoir is no good. The oil’s no good.” LLOG had heard that too, so its geoscience team took a long, hard look at the data. Why is the Wilcox so different from the more familiar basins that Gulf of Mexico producers have been tapping for more than 70 years? One reason is that the Wilcox rock is much older, and it formed under different conditions.

During the Miocene and Pliocene ages, some 5 to 20 million years ago, the geography of the southern United States looked very similar to what it is today. You’d recognize the continents on a world map. But during the Paleogene, which extends back more than 50 million years, the earth looked quite different. That’s when the Wilcox formed. The sediment that created the more familiar hydrocarbon-bearing basins in the central Gulf of Mexico were carried by the Mississippi River, but the Wilcox sands were more likely deposited by ancient rivers farther to the west.

Origin of the Wilcox

The Cretaceous geologic period dates from about 144 million to 65 million years ago. The earth was warmer then. There was more carbon dioxide in the air. Sea levels were higher than they are today, and the largest of the dinosaurs still roamed the earth. Central North America was unrecognizable; its center an open sea. But toward the end of the Cretaceous period, in an event geologists call the “Laramide orogeny,” smaller tectonic plates started sliding beneath the great North American plate, and the middle of North America began to rise. Over the next few million years—quickly in geologic terms—the sea drained away, eventually giving way to today’s high plains and the Rocky Mountain range. As the
land rose, rivers carried vast amounts of sand and soil to the southeast, toward the Gulf of Mexico. Erosion on a continental scale pushed sediment far out to sea, into water depths as great as 3,000 feet.

“That powerful process formed a wedge of sediment that became the Wilcox,” says geologist Katy Pasch. “There was enough energy to push detrital material all the way to the center of the Gulf of Mexico, where it formed one of the largest Cratonic basins in the world.”

Evidence of the Wilcox trend’s violent origin can be seen in what are known as “turbidite” sands. They entered the gulf in a high-speed slurry that dug channels and flowed into submarine canyons, seeking low places to deposit. Some of the rushing sand filled mini basins, then stopped. Elsewhere, the sediment simply spread in wide lobes across the ocean floor.

“The lobate sands are evidence of broad-scale deposition that can be hundreds of feet thick,” Pasch explains. “But the Wilcox also contains fine-scale deposition where brief pulses of sand came to settle in layers no more than a few inches thick. To imagine all that going on in a deep marine setting some 50 million years ago is pretty amazing.”

Seismic Complexity
Mapping Buckskin on seismic data proves challenging due to the complex, local geology. Sound waves must travel through a complex and varied geology before reaching the structure: expanded Pliocene section, Miocene unconformities sitting atop a rotated Oligocene/Cretaceous raft, a thin body of salt, and Pliocene sediment. This intricacy makes for interesting velocity obstacles.

“Seismic is often taken at face value; I believe that is where mistakes are made,” says Joe Letko, a Senior Geophysicist at LLOG. “We mapped several datasets, and our team considered every interpretation before drilling the first well. We believe our thoroughness has paid off.”

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Earl Cumming, Geomodeler

“Buckskin’s complexity forced us to revisit geologic fundamentals,” says John Dougherty. “The apparent faulting varied on each dataset. I quickly realized the limitations of solely relying on seismic to define faulting. We deemed it necessary to revisit the well logs and generate fault plane maps at every level, from Miocene to Lower Wilcox. Although arduous, the maps were key to our accurate interpretations and complete understanding of the structure.”

How we see the opportunity
“When three companies walk away from a project, you have to think twice about taking it on yourself,” says LLOG Geomodeler Earl Cumming. “But if you recall the timeline, you can see the other factors in their decision. In 2016, oil prices were way down. The Buckskin margins looked thin, and three of the previous owners felt they had bigger and better prospects in its portfolio.”

A key technical challenge for operators in the Wilcox is evaluating the quality of the reservoir rock and the ability of liquids to flow through it. Part of the problem is that the Wilcox trend ranges from massively thick to highly laminated, depending on the formation, composition and fossil content of the rock. While the primary porosity (a rock’s ability to hold liquid) ranges from 15 to 25 percent, the permeability (the potential for liquid to flow through the rock) is typically low. Beyond that, other factors weight in, including the physical and chemical changes that occurred during the millions of years it took for the ancient alluvial sediment to morph into sedimentary rock. Like the land above it, the chemistry of the sediment below the surface changed over time. The result is that older rocks, like the ones that compose the Wilcox trend, are geologically more complex. In younger rock, geoscientists are concerned mainly with the primary porosity, but in the Wilcox, they also have to consider the rock’s secondary and even its micro porosity. It’s a mystery that is still unfolding.
DEFINING THE RESERVOIR

A Running Start

MONTHS BEFORE LLOG agreed to become the operator of Buckskin, its geoscience team began building a model of the reservoir. Was Buckskin worth the time and money it would take to develop it? The geoscience recommendation would mean the difference between taking on the project or leaving it behind. But the Wilcox is tough to nail down. Well logs can look promising, but then the well’s production doesn’t reflect that promise. That’s one reason that the original part-
ners took so many core samples; to be able to hold the basin rock in their hands and test it in the lab. From the beginning, the challenge for LLOG’s reservoir team was to get their consensus model to match the empirical data from the cores. There were also different opinions among the partners about the location of the major faults.

“There was a process of synthesizing what we wanted to represent in the model,” says Eric Zimmermann, LLOG’s vice president of Geology. “There’s an eastern area of the field that some of the partners believed was deպositionally related, but the cores showed better quality rock on the crest, so that’s where we focused our attention.”

The decision to go dual-porosity model, to account for some of the unique features of Wilcox-aged rock. The nearest analog fields were Jack/St. Malo, and the Petrobras-operated Cascade and Chinook development.

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XINGLAI GONG, RESERVOIR ENGINEER

Eric Zimmermann, VP of GEOLOGY

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STAN HEWITT, PETROPHYSICIST

Eric Zimmermann, VP of GEology

Based on our comparison, we are closer to Jack and St. Malo than Cascade,” Gong says. “The original Buckskin partners had estimated that each well would produce around 6,000 barrels per day. Jon Wood and I spent two months reviewing the data and matching it to the core samples. By August, we were beginning to think that the original estimate was too conservative. Our base case was 12,500 barrels per day per well. That was enough to make the Buckskin development worthwhile.”

New data Reservoir models typically evolve over time, as the geoscience team receives more information about a new field. After LLOG drilled and logged its first two production wells, for example, its geoscientists better understood the faulting patterns and were able to define another promising area to the northeast.

“We used the model, not only to drive the initial phase of development, but also to shape our long-term development plan,” says reservoir engineer Jon Wood. “We called that first area the ‘Northern High.’ Now we have a ‘Southern High.’ The field is somewhat compartmentalized, so we began looking at what was the smallest tank size that would justify the cost of a well. The model also helped us plan ahead for secondary recovery.”

While core samples are extremely valuable, they won’t tell you everything about the reservoir. For the two wells that LLOG drilled for the initial phase of Buckskin, one downhole tool in particular helped the geoscience team get a clearer picture of the resource.

“We gained a lot of information from Schlumberger’s new Quanta Geo imaging service,” says petrophysicist Stan Hewitt. “For the first time, we could get high resolution photorealistic images in Oil-Based Mud (OBM) environments. The tool gave us full wellbore coverage and greatly enhanced confidence in our model.”
As Buckskin’s potential became more apparent, LLOG’s field development team began seeing opportunities to cut the project’s original $1.4 billion budget. Two wells instead of four, for example, and each would cost less than half of the original estimate. The savings were not apparent from the start, and not all of the partners agreed that the development could be built so efficiently, but LLOG has a reputation for delivering what it promises.

THE DEVELOPMENT PLAN

A Conservative Approach Pays Off
A strategic timeline
“LLOG moves quickly compared to the majors,” says reservoir engineer Jon Wood. “Bigger companies typically do things in stages or “gates”. That means a project has to pass one gate before it moves to the next. Our process is less linear. We were still modeling the reservoir while we were meeting with representatives from the host platform and with government regulators.”

When LLOG sanctioned the project in the fall of 2016, the cost estimate had already been reduced from $2.2 billion to $697 million. In mid-2018, as developers grew more comfortable with the drilling results, completions and the facilities, they realized they were still being too conservative. By early 2019, the project team had shaved another $150 million from what had been sanctioned, without sacrificing safety or performance. The capital cost savings, along with a multi-billion barrel oil in place resource size should make Buckskin profitable for decades to come.

The regulatory pace
The field that LLOG calls “Buckskin” is known to the U.S. Department of the Interior as “Keathley Canyon 872.” Approved in October, 2014, the unit consists of 5-1/2 blocks, covering a total of 31,680 acres or nearly 50 square miles.

“The regulatory idea behind forming units is to be able to control and maximize the government’s royalties for the entire geologic feature,” says Mike Altobelli, LLOG’s vice president of Land. “If you think of a geologic feature as a circle on a map, you generally get a unit that covers all areas of the circle. Buckskin is unique because it includes two circles. We are producing the northern structure first, and we have a southern structure that is quite interesting for future development.”

As the new operator, LLOG inherited the production handling agreement that would send 30,000 barrels per day to Anadarko’s Lucius spar. An existing Suspension of Production (SOP) permit from July, 2016, came with the deal, but LLOG and Repsol needed a revised development plan and new SOP to keep the project on track.

“We kept the same timeline, but completely changed the milestones,” says Chief Operations Officer Rick Fowler. “The SOP gave us through May to show progress. To demonstrate our commitment, we normally have an approved development plan, but at that time, we were not quite there. We filed a revised development plan soon after getting the extension.”

The new SOP was approved in February of 2017, along with LLOG’s revised schedule. The permit was later extended through March, 2018. “That’s typical,” Altobelli notes. “Regulatory approvals are granted in stages as a way to keep projects moving along. If we have seven things to do, we’re granted enough
time for the first two. When those are done, we can apply for another SOP for the time it will take to achieve the next two milestones.”

Each revision required a new permit, which meant quite a few road trips from LLOG’s headquarters in Covington, LA, to the regulatory agency’s New Orleans office.

“With any project this size, there are many permits involved,” says LLOG’s regulatory coordinator Carol Eaton. “Before we drill a well, for example, we need an underwater survey, an archaeological survey and a biological survey. We need to know what’s on the seabed and around the well site before we drill. On other projects, the surveys have turned up old shipwrecks and even unexploded military ordnance left over from World War II.”

For every pipeline, there’s a survey. If any of the equipment needs to cross someone else’s lease, there are more approvals. Operators must file an Exploration Plan and an Application for Permit to Drill. When it’s time to complete the well, there is a separate Application for Permit to Modify.

“And that’s just on the well side, Eaton adds. “On the development side, you first need a Deepwater Operational Plan and a Development Operations Coordination Document. Part of that is a Conservation Information Document, which shows the government that you’re not leaving any recoverable reserves behind, and that you plan to develop the field with the right number of wells. Each of these documents can be several binders thick.”

**Artificial lift**
The original $2.2 billion budget included the price of a subsea pump to compensate for Buckskin’s relatively low reservoir pressure. Some believed that the project would not work without one.

“We went back to our model and looked at the possibility of riser-based gas lift,” Wood recalls. “It turned out that in this application, gas lift would be almost as efficient as a subsea pump, but much less expensive. Repsol, the only remaining partner who had been with the project since the discovery well, was very supportive. Their geoscientists had participated in other Wilcox fields, and they were very good about sharing their experience.”

Production levels will determine when it’s time to begin using gas lift, but the system is in place and ready to go. The gas will initially be purchased from Anadarko; after that, most of it will be recycled. As it stands now, gas lift at Buckskin could begin as early as early as 2020, or as late as mid-2021.
After LLOG took over as operator, the previous Buckskin operator and Repsol were very good about sharing what they had learned since discovering the field. They had spent a lot of time deciding where to drill the production wells, and LLOG’s drilling team saw no reason to look elsewhere. It turned out to be the right decision. The only real debate was over the cost.

Well safety by design
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“We told our partners that we could deliver the wells for half what they had estimated,” says VP of Deepwater Exploration Jay Cole. “They were skeptical, and rightly so, but we knew we could do it. Part of our efficiency comes from the size of our organization and the ease of communication among all the players. That doesn’t mean that safety is ever compromised, and we don’t cut corners.”

Take the well design, for example. Even though LLOG’s drilling team figured that they could reach the target zone with a certain number of casing changes, they built in an additional margin of safety by starting with a larger, more expensive hole. That allowed room for another protective liner in case one was needed later on.

“We were also building on the previous operator’s experience,” Cole adds. “They paved the way by sharing with us the challenges they’d encountered with...
the exploration wells. Not everything had to do with the reservoir. They had to move off during the Macondo event, and they had other delays due to mechanical problems with the rig, but having access to their drilling information was most helpful.”

LLOG’s drilling team spent a year analyzing data and planning the production wells. The Buckskin discovery well and two appraisal wells had been understandably time consuming and expensive, because they were some of the first wells in the Wilcox trend. The original owners’ goal had been to understand the field. LLOG’s job was to deliver the oil.

“Oil companies only compete for the lease and the grease,” says Rick Fowler, LLOG’s COO. “That’s it. With the mechanics of actually drilling the well, drilling engineers from all operators will share stories. When it comes to safety, we’re all on the same team.”

The kickoff meeting for drilling operations took place in LLOG’s Covington office. Everyone involved was there. “Our largest meeting room was full,” Fowler recalls. “Our partners were there. Key suppliers and vendors were there. The geologists talked, the safety experts talked, and our engineers presented the well plan. We walked through every aspect of the job.”

The production wells Seadrill’s West Neptune spudded in Buckskin’s first producer in January, 2018. The dual-BOP rig is one of the newest and most advanced drill ships in the Gulf of Mexico. LLOG has had the West Neptune on contract since it was launched in 2014. Drillers first installed the 38-inch “structural” casing to a depth of 300 feet below the mudline. That was followed with 28-inch “conductor” casing to a depth of 1,000 feet. From there, 22-inch “surface” casing was run to a depth of 5,800 feet. Because of drill ship’s dual activity capabilities, this initial phase of drilling could begin on the second well as soon as the first well’s casing was cemented in place.

“John White, DRILLING ENGINEER

“While we were cementing the last string of casing in the hole, we could run the blowout preventer and riser to the mudline on the main side. We latched the BOPs within hours of completing the riserless section.”

With the initial work on both wells done and the blowout preventers in place, LLOG’s engineers and the crew of the West Neptune focused on taking the first Buckskin well the rest of the way to total depth. Starting at 5,800 feet, they had another 25,000 feet to go.

Reading the rocks
Incorporating the experiences from the initial Paleogene wells as a base, more data became available later as similar fields in the area came on production. For the first time, they used onsite real-time paleo data, too. While drilling aboard the West Neptune, LLOG kept six paleontologists working eight-hour shifts. As the cuttings came up, they filtered the drilling mud, examining the rocks for evidence of their age and the original depositional environment.

“The paleontologists were watching for assemblages and different fossils,” says VP of Exploration Malloy French. “They were looking for abundances and the first occurrence of certain things in the drilling mud. Paleo data can also indicate a change in downhole pressure, either higher or lower. We were drilling in one of the most unusual environments in the Gulf of Mexico, so we needed all the information we could get.”

Sometimes the Wilcox shows its age in other unique ways. Due to the combination thick layers of salt, numerous faults and movement over geologic time, the drill bit passed through relatively shallow “rafts” of cretaceous rock that had broken off from reservoirs far below and pushed their way up. There could be a raft of reservoir rock at 18,000 feet, while the actual target zone was another 10,000 feet farther down.
A mid-course correction
The first wellbore was almost to the pay zone when drillers got a rude surprise. “The subsurface team knew there was a fault down there,” Fowler says. “We wanted to be relatively close to it, but we wanted to stay on the oil side of the fault. It turns out that we were off by about 200 feet.”

LLOG’s geoscience and drilling teams in Houston and Covington watched their computers in real time as the hole inched closer to the critical zone. They figured it should miss the fault by a safe margin, but suddenly, the bit broke through. Within minutes, the wellbore was no longer where it needed to be.

They were drilling into the Lower Wilcox. The Upper Wilcox pay zone they were looking for was gone.

“Mellows,” Fowler says, “but at the same time, some of our geologists were extremely excited. They were right. We missed our objective on our first well, but we planned and drilled a sidetrack within 48 hours. From then on, we drilled almost continuously to the final target.”

That unexpected change had consequences that will likely affect the way new production wells are drilled in the Buckskin field. The sidetrack angle was steep, as much as 60 degrees. The bit was back in the Upper Wilcox, but outside the immediate LLOG team, some worried that the well’s new high angle would make it difficult to complete. Instead, drilling at such a high angle kept the wellbore in the pay zone much longer than anyone had expected.

“The most amazing thing,” French recalls, “is that for the next week, we were drilling 30 to 50 feet per hour through hydrocarbons the whole time. I’ve never seen anything like it. The true vertical depth was only 500 feet, but because of the high angle, we ended up with 2,200 feet of measured pay.”

The second well
“With the success of the first well, we felt pretty good about drilling the second one,” French says. “We did have some of the shallower section of the field come in slightly different than anticipated and we interpreted the main zone somewhat differently, but the targets were pretty spot on.”

The first well proved that the reservoir was indeed as large as the LLOG team had predicted. By then, logs from the two new wells also confirmed the shape of the container. For drillers, the geology of these two wells was the most difficult part. The same wellbores passed through Cretaceous rock that was 90 million years old, and soon after, a zone of Pliocene sands and rock that was much newer. The older rock is typically dense and slow to drill, and the pressure inside them is high. Newer rock is easier to drill, and the pressure can be relatively low. Some of the softest rock was at total depth, where the hole kept collapsing on itself. Drillers had anticipated that, and compensated by shortening the casing string by 500 feet.

The biggest challenge for the second well occurred when a 3-mile long casing string refused to seat. “We were running 16-inch casing and were just 40 feet from where we needed to be when downhole instability caused the pipe to stop moving,” says drilling engineer Jason Brink.

Even with more than two million pounds of steel pushing down, the casing refused to drop another inch. That meant the upper end of the string would not seat, and drilling couldn’t continue until it did. For six hours the drilling crew slacked-off and pulled on the casing string with no success.

“It would not have been a disaster,” Brink says, “but it would have been an expensive pain in the neck. Rig operations proceeded to cement the casing in place.

“We were all watching the real-time block height from the office,” Brink says. “An hour into the cement job, we saw the block height decrease. The casing had landed right where it needed to be.”
Flexibility was the key to completing Buckskin’s first two wells. After having to sidetrack around a fault, LLOG’s drilling team adjusted the bit for a much steeper angle. That meant the hole encountered more of the reservoir, but it also increased the number of completion zones. The original plan called for three, but the longer wellbore required five. That, in turn, changed the economics of the well and the dynamics downhole. Far from being a problem, however, Buckskin’s first production well set new completion records for the Gulf of Mexico.

One for the record books

“We expect these wells would be producing for the next 20 or 30 years,” says LLOG reservoir engineer Jon Wood, so we wanted to build in as much flexibility as possible to help us manage production over time.”

The industry calls them “smart wells.” They include all the necessary downhole valves and sensors to allow production operators to monitor and adjust the flow from each zone individually. For Buckskin’s planners, a smart well design made sense, even though other operators in the area were employing less expensive single-trip multi-zone completions.

“After the sidetrack we ended up with a gross interval of 2,400 feet, and 1,400 feet of net pay sand,” Wood says. “We knew it would take five fracs instead of three to complete the first well. Because of the additional fracs, the smart well capability was no longer the best completion strategy. We decided very quickly that the intelligent well control equipment would have added extra complexity.”
The length of the pay interval was unique, and so was the size of the frac. Baker Hughes reported pumping more than a million pounds of proppant in a single frac, and a combined total of 4 million pounds for all five fracs. Both the single-zone and total wellbore volumes were new records for the Gulf of Mexico.

The fracking operation was unique in other ways as well. Thanks to the abundance of core samples, LLOG’s geoscientists were able to test sections of reservoir rock under laboratory conditions to optimize the type of proppant and frac fluids they would need. While qualifying the proppant and fluids beforehand is not unusual for deepwater wells, the rigor and intensity of the testing on Buckskin was exceptional.

“We benefitted from all the pre-planning,” says completions engineer Kenny Champagne. “We were hoping for a frac zone that extended at least 250 feet, and we achieved that. Our design criteria ranged from 250 to 300 feet, so theoretically, we were consistently fracking rock 500 feet around the wellbore. Between the two Buckskin wells, we pumped eight frac jobs. That, for us, was a step change in volume.”

Even with the sidetrack and subsequent adjustments, the first well took just 75 days from spud to total depth. At $60 million, drilling cost about a third of the original budget. Exceptional help from several key suppliers made the subsequent completions go equally well.

“One reason we were able to make it all work on the first well was that Superior Energy, the supplier of our gravel pack equipment, expedited the deliveries,” says completion engineer Alex Lawler. “They were also able to take some equipment from the second well and move it to the first. Superior did an excellent job, adjusting to all the changes in short order.”

By abandoning the smart well plan on the first well, LLOG gave up the ability to remotely isolate individual zones and control them based on production rates. That can still be done at a later date, but a mechanical intervention to isolate one or two zones would likely be too expensive to justify. Since the reservoir is not homogeneous, some of layers will deplete quicker than others, but even without the smart well capability, Buckskin’s operators will have some options to manage the flow.

**Number two**

Buckskin’s second well, unlike the first, stuck to the original smart well design. With experience, the job also went smoother. Like the first well, spud to total depth on the second took about 75 days. Drilling and completions for Buckskin’s first two wells averaged $120 million each; less than half the original estimate. Superior Energy, Schlumberger and Baker Hughes were key suppliers. Schlumberger logged and perforated the wells and provided the safety valves. Superior provided and installed the lower completion hardware, including the packers and screens. Baker Hughes was responsible for the production packer on the first well, and the packer and smart well completion on the second well.

The two wellheads and the subsea manifold were supplied by FMC. All of the work was supervised by LLOG personnel on site.

“We attribute much of our success to our people in the field,” says completion engineer Erik Hoffpauir. “They’ve been with LLOG for a long time, and many have in excess of 30 years’ experience. They’ve grown with the company. That’s one of the principles that makes LLOG so successful; we keep our talent close to the rotary, right where it needs to be.”
BUCKSKIN’S FIRST two wells and their production manifold are on the seabed about six miles south of Anadarko’s Lucius spar. Dual 8-inch flowlines can deliver daily up to 30,000 barrels of production to the host platform. Besides the flowlines, an umbilical large enough to handle eight wells links the manifold to the Lucius control room. With work progressing on two fronts, coordination was the order of the day.

Making room for a guest
There wasn’t enough space aboard Lucius for the equipment needed to tie in Buckskin’s production, so with LLOG’s input, Anadarko designed and built three wing decks. The operation took teamwork on both sides.

“The Anadarko people were great to work with,” says Mark Farrow, offshore construction manager for the Buckskin Project. “They are the operator...
of the facility and we were coming onboard, so the trick was to maintain a good interface, while making sure that we stayed on schedule and on budget.”

One of the bigger challenges was pulling Buckskin’s two risers onto the host facility. The conventional winches available did not have capacity to pull in the risers, or were too large due to space constraints on the platform.

“During installation, the upper end of the riser was supported by Technip’s Deep Blue installation vessel,” Farrow says. “But there was a point where that load had to transfer from the ship and be pulled up through the middle of the spar. We custom-built the winch equipment specific for the platform to make that happen.”

The risers were installed successfully in January of 2019. Soon after, the production and gas lift umbilicals were installed. Final installation and certification of the entire tieback was completed in the second quarter, and oil began flowing from Buckskin to the Lucius spar shortly thereafter.
“Unless there’s an overriding reason not to, we always use the same four-slot manifold,” says Mike Vercher, VP Deepwater Projects. “If we eventually need more than four wells, we just add a second manifold to the first. Not only does that simplify the design, it also saves money. It turns out that two 4-slot manifolds are less expensive than one custom-built 6-slot manifold.”

Subsea trees are another case in point. LLOG’s standard is a horizontal subsea tree made by FMC. Nearly identical trees (10,000 psi instead of Buckskin’s 15,000 psi rating) are in the Delta House and Who Dat fields, and in many more LLOG-operated wells in the deepwater Gulf of Mexico. Buckskin varies only in the use of FMC’s vertical trees instead of the horizontal design. That was done to make it easier to re-enter the wells at a later date.

“We also work hard to keep our Safety and Environmental Management System (SEMS) manual relevant, readable, useful and direct. After all, the binder is worthless if it’s just gathering dust on someone’s shelf.”

LLOG’s approach is to keep its SEMS manuals relevant, readable, useful and direct. After all, the binder is worthless if it’s just gathering dust on someone’s shelf.
FINANCING

An Attractive Package for Investors

As described, on the Buckskin project, LLOG had to overcome many preconceived notions the market had on what can or can’t be done. Not the least of which, was the ability to secure debt financing at reasonable costs. But lo and behold, this was accomplished as well.

By the time LLOG began developing the Buckskin prospect in early 2017, only Repsol remained as one of the original partners. New investors stepped in to share the financial load, including Beacon, Ridgewood, and Navitas Petroleum. One of the main funding sources was new for LLOG and the Gulf of Mexico, and it came with a steep learning curve.

A strong track record
LLOG brought five fields on line in 2018. Buckskin is one of the company’s three new developments in 2019. There are more than 30 promising exploration projects waiting in LLOG’s portfolio, but historically, funding has been a bigger constraint on growth than lack of opportunity. As a private company, LLOG doesn’t have the same access to financial markets that the majors do. It can’t raise money by selling stock.

“Still, our guys are brilliant at figuring out how to do more with the capital we do have,” says Chief Operations Officer Rick Fowler. “Throughout the recent economic downturn, as other operators were walking away from their drilling contracts, we kept two state-of-the-art deepwater rigs working non-stop in the Gulf of Mexico. Over the last five years, we’ve drilled quite a few new wells.”

The Israeli connection
Late in 2016, about the time that Buckskin was becoming a real possibility, LLOG received a cold call from Navitas Petroleum, an energy company based in Israel. Navitas executives had guessed that LLOG might soon become Buckskin’s new operator, and they offered to help finance the deal.

“At first they showed us several bank loan term sheets with solutions common outside of the US, all at cost of capital that we thought was reasonable,” says LLOG President and CEO, Philip LeJeune. “But in February, 2017, those plans quickly fell apart. They suggested instead something revolutionary; the idea of financing the development of Buckskin through issuing S&P rated non-recourse project finance bonds sold on the Tel Aviv Stock Exchange, in Israel. Honestly, we thought it was a long shot. Our biggest risk was in not understanding the deal,” LeJeune says. “After all, the prospectus was in Hebrew.”

Everyone scratched their heads and spent lots of time with attorneys, but things worked out. In July, 2017, LLOG and Navitas issued the first of two bonds, raising a total of more than $200 million.

“As hard as it was for us, I’d say it was equally difficult for Navitas,” says LLOG’s Chief Financial Officer Phil Cossich. “But each time we do one of these projects, our investors see that we can accomplish what we say. Every year we visit with our underwriters. We show them that we met our goals for the previous year and tell them what we are going to accomplish in the coming year. Over and over, the message is clear. We end up doing what we say we’re going to do.”

From Zero to Hero
At one time, Buckskin was considered a marginal project and three of the four original owners dropped out. LLOG was able reduce project cost to less than one fourth of the previous cost and reduce cycle time by six months compared to the previous plan. These changes, along with the unique financing, completely changed the economics of the project. “Buckskin is one of highest return on investment projects we have executed in LLOG’s history. In addition, with up to 5 Billion barrels of oil in place, the field has a tremendous amount of upside potential.” said Philip LeJeune, CEO of LLOG.
PROFILES

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Ridgewood Energy.
TECHNOLOGY. EXPERTISE. DISCIPLINE.

As an energy-focused private equity firm and active investor in Gulf of Mexico exploration and production projects for over three decades, Ridgewood Energy has partnered with many of the most successful and pioneering energy companies in the Gulf.

Since 2009, Ridgewood Energy’s activities have been focused in the deepwater Gulf of Mexico, where it has participated in a series of major oil discoveries and built a significant leasehold inventory of oil prospects. Ridgewood Energy is also a proud partner in the development of the Buckskin Project.

Today, Ridgewood Energy is participating in deepwater projects that have discovered estimated gross reserves in excess of 1.5 billion gross barrels of oil equivalent (proven plus probable) and holds interests in Gulf of Mexico leases with additional resource estimated to exceed 1.3 billion gross barrels of potential resource. Ridgewood Energy’s projects are currently producing approximately 40,000 BOE per day (net to Ridgewood Energy’s managed interests); its discoveries are on track to produce approximately 45,000 BOE per day by the end of 2019.

Ridgewood Energy is committed to being a value-added, non-operating partner to leading exploration and production companies. Its 30+ member Houston-based team is comprised of seasoned industry professionals with dedicated geoscience, production and reservoir engineering, land, marketing, commercial and joint venture management expertise. The Ridgewood Energy team is highly skilled and accomplished in all areas related to successful oil and gas exploration, development, and production, and brings deep, basin-specific knowledge to the evaluation, execution, and management of projects.

With a strategic focus on projects located in the Deepwater Central Gulf of Mexico, Ridgewood Energy has until recently concentrated the majority of its deepwater investment activity in the Mississippi Canyon, Green Canyon, Ewing Bank, and Atwater Valley areas. However, Ridgewood has now further expanded its portfolio footprint west into Keathley Canyon with a 17.5% interest in the Buckskin Field. With first production scheduled for 2H 2019, coupled with a significant material resource base and the potential for high rate wells, the Buckskin project firmly aligns with Ridgewood’s key strategic priority of investing in high-quality, low cost opportunities. We look forward to continuing to participate and work alongside our key joint venture partners over the coming months and years on this exciting new project.

Ridgewood Energy currently manages a deepwater Gulf of Mexico investment program with capital and commitments totaling more than $5 billion. Since the beginning of 2017, Ridgewood Energy participated in drilling more than 20 wells, adding 2P reserves of more than 100 million (net) BOE, with a combined estimated finding and development cost of around $12 per BOE. Ridgewood Energy is able to deliver such low-cost barrels—among the lowest cost in North America according to Wood Mackenzie—through a combination of being excellent explorers, working with our operators to value-engineer the development plans for projects, and taking advantage of the low-cost environment for offshore rigs and services.

In addition to development work related to existing discoveries, Ridgewood Energy’s current inventory of 20+ exploration prospects lays a strong foundation for continued growth and value-creation, and provides visibility to its participation in the drilling of a significant number of exploration wells during 2019 and beyond. In the meantime, Ridgewood Energy’s technical in-house team will continue its active origination work, reviewing opportunities from industry partners, and generating new high-potential prospects.

In the months and years ahead, the team at Ridgewood Energy looks forward to building on its existing relationships—and to forging new partnerships—to develop America’s vital deepwater Gulf of Mexico oil and gas resources. In this pursuit, Ridgewood Energy will remain dedicated to preserving its reputation as a reliable, professional, and value-adding partner to leading energy companies in the Gulf of Mexico.
Beacon Offshore Energy is committed to the deepwater Gulf of Mexico

Beacon Offshore Energy LLC is focused on exploring, developing, acquiring and operating upstream oil and gas properties in the deepwater Gulf of Mexico (“GOM”). Formed in 2016, Beacon is wholly owned by funds managed by Blackstone Energy Partners. The company holds significant ownership position in 14 high-return oil discoveries including a 18.7% working interest in the Buckskin project. The company currently holds interests in 40 deepwater leases with net resource potential in excess of 250 mmbboe.

Blackstone is one of the world’s leading investment firms with $457 billion in assets under management. Blackstone Energy Partners is Blackstone’s energy-focused private equity business, which has committed more than $16 billion of equity in the global energy industry.

Experienced GOM leadership team

Beacon’s executive team has extensive GOM experience being led by Scott Guterman (Chairman and CEO), Marc Hensel (President and CFO), and Joe Leimkuhler (COO). Beacon’s veteran independent directors Paul Dailly, Jim Farnsworth, and John Hollowell provide hands on GOM experience and operating experience.

Exploiting discoveries near infrastructure

Beacon’s strategy has been to exploit potentially stranded deepwater assets that can be tied back to existing infrastructure. In building its asset portfolio, Beacon has acquired discoveries and leases in the Minscene trend in Mississippi Canyon and Viosca Knoll and the Wilcox trend in Keathley Canyon and Walker Ridge, located in proximity to production facilities with export pipelines to shore.

Beacon believes that, because of their relatively high-volume, long-term production potential and the limited CAPEX required for tiebacks, deepwater assets can compete favorably with multi-well onshore shale developments, which typically face rapid production declines.

Innovative financing

The company also has been innovative in the way it finances its developments. In early 2018, Beacon partnered with several European banks to secure pre-production financing for Beacon’s development program. This multi-field secured term loan facility represents the first instance that such a structure was employed in the deepwater GOM.

Five fields on production

Beacon has interest in 14 discoveries, including seven that are in development and seven that are in the appraisal phase. In addition to Buckskin, Beacon is partner in five assets that are in production, including Blue Wing Olive, Red Zinger and La Femme, tied back to the Delta House production facility; Clouser, tied back to the Coelacanth platform; and Crown & Anchor, producing to the Marlin platform. The Stonely field in Viosca Knoll is expected to produce to the Ram Powell platform by the end of 2019.

Buckskin’s potential

Buckskin is an attractive prospect for Beacon Offshore Energy. Members of the Beacon team were involved in the adjacent Lucius discovery and have a detailed familiarity with the area. The Buckskin discovery in 2009 and subsequent Buckskin appraisal wells identified the field’s potential that could ultimately support production from numerous wells. Buckskin, via a production handling agreement with the Lucius owners, has secured 30,000 bopd of firm production capacity. The current project, as re-defined by the current Buckskin owners, takes a phased approach starting with two wells focused on the northern portion of the Buckskin field.

From success in Deepwater Israel to success in Deepwater GoM

Tel Aviv Stock Exchange traded, Navitas Petroleum LP (NYP.L) is a deepwater North America focused upstream company.

Navitas founder and Chairman, Gideon Tadmor, headed the Delek Group, Israel’s largest energy conglomerate) upstream companies for 18 years. At this position, together with JV partner, Noble Energy, Gideon led the discovery of over 42 TCF of natural gas offshore Israel & Cyprus, including the world-class Leviathan (22 TCF) and Tamar (11 TCF) fields. These discoveries and subsequent developments, have created over 8 billion dollars in value for investors.

The Navitas geoscientists and engineers first encountered Buckskin in early 2016 and liked it from the start. Navitas initially passed on the opportunity, since–at the time–it considered itself too small for deepwater development in the GoM. However, this decision was eventually overturned—Buckskin looked way too good and Navitas’ management inherently liked the deepwater, due to its great success offshore Israel. However, by the time the decision was overturned, Navitas was seemingly too little too late. The entire interest had gone to an unnamed operator who surprisingly wanted to take the 55% stake. Navitas would not take no for an answer, and cold-called LLOG with an “out of the box” proposal. Navitas would facilitate debt financing for the development of Buckskin at very favorable terms—unheard-of in the GoM—in return for a slice of Buckskin. Surprisingly, LLOG agreed to give this a shot. Navitas would not take no for an answer, and cold-called LLOG with an “out of the box” proposal. Navitas would facilitate debt financing for the development of Buckskin at very favorable terms—unheard-of in the GoM—in return for a slice of Buckskin. Surprisingly, LLOG agreed to give this a shot. Navitas would not take no for an answer, and cold-called LLOG with an “out of the box” proposal. Navitas would facilitate debt financing for the development of Buckskin at very favorable terms—unheard-of in the GoM—in return for a slice of Buckskin. Surprisingly, LLOG agreed to give this a shot. Navitas would not take no for an answer, and cold-called LLOG with an “out of the box” proposal. Navitas would facilitate debt financing for the development of Buckskin at very favorable terms—unheard-of in the GoM—in return for a slice of Buckskin. Surprisingly, LLOG agreed to give this a shot. Navitas would not take no for an answer, and cold-called LLOG with an “out of the box” proposal. Navitas would facilitate debt financing for the development of Buckskin at very favorable terms—unheard-of in the GoM—in return for a slice of Buckskin. Surprisingly, LLOG agreed to give this a shot. Navitas would not take no for an answer, and cold-called LLOG with an “out of the box” proposal. Navitas would facilitate debt financing for the development of Buckskin at very favorable terms—unheard-of in the GoM—in return for a slice of Buckskin. Surprisingly, LLOG agreed to give this a shot. Navitas would not take no for an answer, and cold-called LLOG with an “out of the box” proposal. Navitas would facilitate debt financing for the development of Buckskin at very favorable terms—unheard-of in the GoM—in return for a slice of Buckskin. Surprisingly, LLOG agreed to give this a shot. Navitas would not take no for an answer, and cold-called LLOG with an “out of the box” proposal. Navitas would facilitate debt financing for the development of Buckskin at very favorable terms—unheard-of in the GoM—in return for a slice of Buckskin. Surprisingly, LLOG agreed to give this a shot. Navitas would not take no for an answer, and cold-called LLOG with an “out of the box” proposal. Navitas would facilitate debt financing for the development of Buckskin at very favorable terms—unheard-of in the GoM—in return for a slice of Buckskin. Surprisingly, LLOG agreed to give this a shot.

Followling the success of their Buckskin collaboration, LLOG and Navitas Petroleum have teamed up to develop the Shenandoah and North Yucatan fields.

Navitas Petroleum earned a stake in LLOG’s Buckskin project by raising the debt financing for the project through a publicly traded bond fund in Israel.

Navitas Petroleum offered a stake in LLOG’s Buckskin project by raising the debt financing for the project through a publicly traded bond fund in Israel.
Repsol optimizes Buckskin discovery for development

Repsol, the global oil and gas company with upstream activity in 31 countries, has been a driving force behind the Buckskin development from the project’s very beginning. In 2009, Repsol drilled the KC-872-1 discovery well in Keathley Canyon to 8,653 m (28,750 ft) in just 75 days, penetrating 91 m (300 ft) of oil-bearing Paleogene sandstone in the Lower Wilcox formation. A subsequent 300 m (1,000 ft) sidetrack obtained cores and log-data, confirming a top-tier discovery. These results and data gathered from two appraisal wells and a sidetrack indicated that the discovery held approximately 5 billion barrels of stock tank oil in place (STOIP).

Original development plan
Repsol remained a partner in the field and continued to evaluate the prospect. Pre-FEED work was completed in mid-2015 with a development plan that included producing four wells through a six-slot subsea manifold tied back to the Lucius spar, approximately six miles away. The original plan called for custom-designed subsea trees, umbilicals and control lines, and provisions for future water flooding and multiphase subsea pumps. By the end of 2015, the project team had begun the FEED process, procurement of long lead-time items was under way, all tenders had been completed, and commercial arrangements had been made with the operator of the Lucius host facility. The project team was awaiting management and partner approval for Buckskin development CAPEX AFEs totaling $2.25 billion. However, the steep decline in oil prices that began in 2014 had continued through the end of 2015 when prices plunged to $30 per barrel. On January 6, 2016, the previous operator notified the Buckskin co-owners that it would withdraw from the project, and by the end of the month, Repsol became the Buckskin Unit Operator with a 27.78% working interest.

Repsol as Buckskin operator
While Buckskin holds significant reserves, it could no longer be developed economically following the original plan. Repsol’s new project team was tasked with re-evaluating the prospect and devising a plan that could make the field profitable at the anticipated “lower-for-longer” oil prices. As interim operator, Repsol’s two main objectives were to: 1) reduce project CAPEX by phasing the development, designing a streamlined, fit-for-purpose solution while meeting all regulatory requirements, and renegotiating major contracts in light of lower commodity prices, and 2) farm out its working interest and possibly the operational accrual to another qualified company that could execute the project in a lean, safe and timely manner.

The Repsol team quickly reviewed more than 800 project-related documents, 102 fluid samples and 2,000 ft of core and began the process of developing a cost-effective solution. The Repsol Project Team employed two strategies to re-define the Buckskin development plan: phased development and simplified subsea architecture using standard equipment.

Phased development, simpler subsea architecture
Phased development deploys the reservoir less aggressively and in stages so the operator can gain a better understanding of the reservoir while generating a return on the initial investment. The team decided to begin developing the field with two wells instead of the four wells called for in the original plan.

To simplify the subsea architecture, the project team downsized the original six-well manifold to a four-well design. This step reduced cost, streamlined the offshore installation campaign and shortened the project schedule while providing space for additional wells in the future. The redundancy of the electro-hydraulic power/control umbilical also was reduced, lowering cost without significantly affecting functionality.

By simplifying the subsea tree requirements, the team could specify off-the-shelf trees instead of custom-designed equipment, which saved money and reduced lead time for these components.

Additional cost saving could be obtained because—with the elimination of the original water flood project phase and any risk of H2S formation—flow lines did not need to be manufactured from premium sour-service materials.

By implementing these and other changes, the project team brought total CAPEX for the project’s first development phase to $912 million compared to $2.25 billion in the original plan. Federico Giannangeli (GoM Asset Manager) says, “In the case of Buckskin, simplification was the name of the game. We were a small team, with multiple tasks to perform all of which were pressing due to SOP regulatory commitments. Our only avenue was to go back to the basics, capture the tipping point in the GoM market conditions and focus on delivering value.”

LLOG becomes operator
While the Project Team was re-defining the project, Repsol also worked with the Buckskin co-owners to find an experienced operator who could join the partners and implement the streamlined development plan. Following a short but intensive data room phase with a limited group of players known as best performers in the GoM, LLOG was selected to take on the operatorship in January 2017 and to date has successfully implemented the optimized plan while improving every aspect of the project through standardization and top-tier drilling performance. In reference to LLOG, Federico Giannangeli says “There are numerous advantages to working with LLOG, but among those Repsol recognizes as unique are their inclusive, humble and technically proficient way of doing things. From day one, we were part of their team.”

Repsol, an active non-operating partner
As a non-operating partner, Repsol continued to support the Buckskin project by providing geosciences recommendations before and during the drilling of the development wells in Buckskin. In this complex geological environment, Repsol used in-house technology as well as existing commercial tools for generating detailed geological and geomechanics models. Those models contributed to the success of LLOG in delivering above expectation drilling and completion results, through GoM record performance that includes but is not limited to the injection of more than 7 million pounds of proppant in the development wells, yielding a combined production rate that is expected to be in the order of 30,000 BOE/day for the two Buckskin wells. Taoufik Ait-Ettajer, (Repsol’s geoscience team lead for GoM) noted, “Since LLOG became operator, we had regular technical exchanges, and we provided feedback and recommendations in the geosciences area. LLOG was always open to hear Repsol’s feedback and recommendations and to integrate the recommendation in the field development plan for the best interest of the project.”
Experience, expertise and advanced technologies bring ambitious GOM project online

LLOG Exploration Company’s ambitious deepwater Buckskin project in the Gulf of Mexico (GOM) illustrates the importance of collaborating with a service provider that has a track record for expert multidisciplinary planning and integrating advanced technical solutions with flawless implementation to address formation challenges and minimize risk.

The project launched in January 2018 with two multizoned development wells to 29,000-ft total depth (TD) in 6,800 ft of water. Key challenges included the lower completion frac job and a highly deviated hole with a sidetrack.

Schlumberger, a long-time service provider of LLOG, brought together expertise and technologies from drilling fluids, wireline, testing services, and completions to help meet the operator’s objective to begin first production in mid-2019.

**Optimized operations with flat rheology fluid**

The narrow hydraulic window between pore and fracture pressure required a synthetic-based mud (SBM) system to optimize high-angle (60°) maximum drilling efficiency. Excellent sag prevention would be essential to avoid time-consuming conditioning trips during the subsequent extensive logging program.

M-I SWACO, a Schlumberger company, selected the new RheGuard® flat rheology drilling fluid system that delivers the low rheological profile and sag potential required for intricate intervals drilled in deepwater and other complex wells offshore.

Flat rheology is a concept defined by the uniformity of rheological properties and gel structure over a range of temperatures, pressures or shear rates. The goal from the drilling perspective is to minimize the contribution of the drilling fluid on (annular) frictional pressure losses and help mitigate loss circulation events while conditioning before running casing or liner or they compromised drilling rates in order to isolate the overburden formations and provide a strong shoe for the sections to be drilled ahead. The RheGuard fluid system was engineered to be independent of the conditions prevalent in most deepwater drilling scenarios.

Field-trialed in LLOG wells before deployment at Buckskin, the RheGuard system advances flat rheology with the capability to run a thinner cold-temperature profile and gel structure than the high-temperature profile, providing a reversed rheology effect and significantly reducing riser pressures.

Some first-generation flat rheology systems could deliver clean wellbores, but they required excessive rig time for conditioning. The RheGuard flat rheology system was engineered to be independent of the conditions prevalent in most deepwater drilling scenarios. The RheGuard system conditioner quickly prepared the RheGuard system for running and cementing when logging was completed.

The fluid system optimized ECD management, decreased mud losses, enhanced penetration rates and improved wellbore stability. Outstanding fluid stability enabled effective logging over eight days at static well conditions with maximum temperature to 240°F and no barite sag incidents. Drilling fluid cost per foot in SBM intervals was reduced by 40% compared with offset wells.

**Mapping the ideal trajectory to unlock the reservoir**

Schlumberger Wireline deployed state-of-the-art technologies to identify the ideal trajectory for accessing the massive pay in the second sidetrack. The Quanta Geo® photorealistic reservoir geology service redefines high-definition imaging in nonaqueous-based mud to accurately represent formation geology. The Rt Scanner® triaxial induction service is ideal for wells at any deviation because it determines vertical and horizontal resistivity while simultaneously solving for formation dip.

The Wireline team successfully logged the 60° deviated hole through a milled window and aggressive 4°/100-ft dogleg severity to reach 29,300-ft TD at 22,000-psi borehole pressure. The high deviation was easily managed by a wireline conveyance system integrating tool tugs, angled hole finders and cable standoffs.

XL-Rock® large-volume sidewall coring service was deployed to obtain critical formation samples with 100% core recovery. Average drilling was less than 9 minutes per core, achieving at least an 80% reduction from typical drill times exceeding 45 minutes in the formation.

Seven open-hole and two cased-hole descents were conveyed on 30,000-lb torque-balanced composite wireline cable to complete logging in 190.5 hours with zero non-productive time (NPT). A cast iron bridge plug for the whipstock was set with the ReSOLVE® instrumented wireline intervention service, saving valuable rig time.

The ultrahigh-strength cable also prevented a stuck tool fishing job, giving LLOG confidence to proceed with logging.
TCP services
The electronic firing head also provides fast cycling independently or sequentially for greater flexibility. The dual valve enhances safety with lower-pressure operation and no need for the nitrogen pre-charges typical with mechanical downhole test valves. Automatic sequencing and multiple movements from a single command accelerate valve cycling to save three to four hours per average run over mechanical valves.

The electronic firing head avoids the rigid conditions necessary with conventional spring-type designs.

TCP services
The deepwater experience of Schlumberger Testing Services was instrumental in delivering eight successful tubular-conveyed perforating (TCP) runs with more than 29,000 charges and no misfires. Services included the IRDV* intelligent remote dual valve and eFire-TCP* TCP electronic firing head controlled with low-intensity annular pulses from the IRIS* intelligent remote implementation system. The IRDV dual valve system pairs tester and circulating valves, allowing operators to install single valves, or a series of valves, independently or sequentially for greater safety margins.

The TRC-II tubing-retrievable charged safety valve is a surface-controlled subsurface valve that uses a gas-spring mechanism to initiate production and move to the next phase. This valve is used in various applications, including the Buckskin project. To date, New Industries has built over 35 jumpers and 14 subsea structures. The sleepers were constructed to 80-ft lengths using 42-in. pipe with four 10-ft × 10-ft mudmats.

Aker Solutions provides the products and systems needed for oil, natural gas and offshore wind energy production across the world. Aker Solutions has broad expertise, allowing it to tackle projects from subsurface to surface and concept to decommissioning in environments ranging from shallow to ultra-deep and tropical to the Arctic. This experience means Aker Solutions can deliver products and services throughout the lifetime of the oil field. The subsea product portfolio includes Control Systems, Pumps, Ties-in Systems & Structures, Trees, Wellheads & Workover Systems and Umbilicals.

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Aker Solutions, located on the quayside of the Gulf of Mexico, is home to a service and subsea equipment manufacturing base, and the world’s largest umbilicals facility. Since opening in 2003, the facility has produced over 1,500 miles of umbilicals for deepwater projects around the world. In the U.S. Gulf of Mexico, Aker Solutions provides subsea equipment, including dynamic and static umbilicals, to LLOG’s Buckskin project. From their manufacturing and staging facility in Mobile, these umbilicals were designed, engineered and constructed to meet specific Buckskin production specifications. Aker Solutions utilizes technologies such as carbon fiber rods, company-supplied design and allowed LLOG to install insulation to existing facilities. The sleepers were constructed to 80-ft lengths using 42-in. pipe with four 10-ft × 10-ft mudmats.

New Industries, LLC has a long-standing relationship with both LLOG and Pinnacle Engineering and has participated in numerous projects for LLOG besides the Buckskin project. To date, New Industries has built over 35 jumpers and 14 subsea structures. The insulation clamps were manufactured to meet the company-supplied design and allowed LLOG to install insulation to existing facilities. The sleepers were constructed to 80-ft lengths using 42-in. pipe with four 10-ft × 10-ft mudmats.

New Industries, LLC involvement in the LLOG Buckskin project has included the fabrication of four jumpers, insulation clamps, and marine sleepers. The jumpers were 8-in. diameter × 1.450-in. wall thickness X70 pipe. The completed jumpers were manufactured to meet the company-supplied design and allowed LLOG to install insulation to existing facilities. The insulation clamps were manufactured to meet the company-supplied design and allowed LLOG to install insulation to existing facilities. The sleepers were constructed to 80-ft lengths using 42-in. pipe with four 10-ft × 10-ft mudmats.

Closing line of the umbilical suspension of power cores underneath fatigue-exposed sections, and polymers to meet extreme thermal requirements. The company’s special system for packaging tubes and cables minimizes longitudinal forces while offering greater internal and external strength and high fatigue capacity, with no restrictions on geometry.
Baker Hughes, a GE company (BHGE), applied its technology, expertise and resources for drilling, evaluating, completing and fracturing the two 29,000 ft MD Buckskin development wells.

Drilling
BHGE provided directional drilling and logging while drilling for the two wells. Of particular concern were problem formations in the intermediate hole sections. BHGE engineers recommended a Talon™ Force drill bit; the AutoTrak™ rotary steerable system, and the CoPilot™ drilling dynamics system. This combination successfully combated drilling dysfunction, provided precise directional control and reduced drilling time in the challenging intermediate hole sections.

Logging while drilling
BHGE provided enhanced well placement and data for real-time petrophysical analysis with a full suite of logging while drilling technology. This bottomhole assembly included the OnTrak™ system for formation evaluation; the LithoTrak™ system to identify formation dips; the SoundTrak™ system to apply downhole acoustic measurements with surface seismic data; and the TesTrak™ system to perform downhole pressure tests. LLOG calibrated its pore pressure model by combining data that could yield 3-5 joints per hour (or more), given the thickness requirements.

BHGE technology enhances Buckskin project drilling, evaluation, completions and fracturing

The system was successfully set, cemented, released, and tested. Then BHGE’s exclusive BOSS™ slide joint eliminated the need for a space out run during the tie back to the upper completion, saving LLOG rig time.

Intelligent well systems
BHGE also installed an advanced intelligent well systems on one of the Buckskin wells. Rated at 15,800 psi, the intelligent completion included a Premier™ feedthrough production packer; an InForce™ Dual HCM-S sliding sleeve system with seven adjustable choke settings; a SureSens™ QPT Elite permanent downhole gauge; and a SureTREAT™ chemical injection system to control asphaltene and scale deposition.

Hydraulic fracturing
BHGE provided hydraulic fracturing utilizing the Blue Tarpon™ well stimulation vessel. A high capacity vessel and high pressure equipment were required for the required volumes of fluid and proppant and extended pumping times at high rates and pressures needed to frac the low-permeability, Lower Tertiary reservoirs.

On the Blue Tarpon, dual blenders provided a high-speed production process. Both vessels exhibited high PI and low skin, which exceeded the customer’s expectations.

In Buckskin #1, five intervals were treated with a volume of proppant that set the single-well proppant record for the Gulf of Mexico, with 4,416,229 lbs pumped from the vessel, and 4,028,999 lbs in formation. Three intervals were treated in Buckskin #2. This completion set the Gulf of Mexico record for most proppant pumped in a single zone, with 1,099,807 lbs in the zone out of a total of 2.9 million lbs pumped into the well.

Bayou Wasco’s HT-100 Insulation provides flow assurance for LLOG’s Buckskin flowlines

Bayou Wasco Insulations (BWI) HT-100 insulation was critical in providing flow assurance for Buckskin’s 8 flowlines and SCRs. In water depths of 7,500 ft. and a maximum operating temperature upwards of 230°F, typical anti-corrosion coating is not sufficient. BWI’s HT-100 is a wet insulation system consisting of high-temp Fusion Bond Epoxy (FBE) for anti-corrosion protection and overlaid with Glass Syntactic Polyurethane (GSPU), which is utilized to ensure the product remains above critical temperature, even in the event of a full shutdown of the line.

Wasscope
Pipe was delivered by barges to BWI’s 6000 ft. receiving and loading quayside in the Port of Iberia, LA. Next, trial pipe was sent to BWI’s lab/test facility for comprehensive pre-production testing. Upon successful results, the bare pipe was then acid washed to remove any impurities prior to coating. The first (FBE) layer was coated in Bayou’s Anticorrosion Coating plant, then sent to BWI’s state-of-the-art multi-layer facility to apply high-quality GSPU. BWI’s facility is a fully automated plant designed for the greatest level of safety and quality output through minimal touch points between man and machine, precise control of pipe and mold temperatures, hyper-accurate centering of pipe within the insulation; better end centering for improved field jointing; 100% abrasion of the FBE coating for vastly improved GSPU to FBE adhesion, and a high-speed production process that can yield 3.5 joints per hour (or more), delivered.

Delivering Results.
BWI successfully received, acid-washed, coated, insulated and loaded over 86,000 ft. of 8-inch pipe. The plant delivered record productivity of 120 joints per day at peak production and exceptional safety performance (zero recordable incidents), on-time delivery of the coated pipe to the designated spoolbase, and superior product integrity of the parent coating during storage and spooling operations.

Corporate HQ | Sales Office
16225 Park Ten Place
Suite 280
Houston, TX 77084
337-296-4612
www.bayoucompanies.com

Operations Office | Coating Campus
in the Port of Iberia
5200 Curtis Ln
New Iberia, LA 70560
337-296-4612
www.bayoucompanies.com

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Connecting customers to solutions: How Benoit assured seamless Buckskin completions

The mantra of 'Connecting Customers to Solutions' has captured the essence of this Cajun-rooted company and has become the drumbeat of its manufacturing facility south of New Orleans. Benoit prides itself on connecting customers to solutions; being whatever ‘it’ requires.

With LLOG, the result has been a reward - of loyal offshore customers.

Benoit’s new Offshore Research & Development Center in Houma, LA has opened doors for the company, but it’s knowledge and expertise of deepwater completions that has allowed Benoit from the doors to a new Offshore Research & Development Center in Houma, Louisiana. While many suppliers and service companies are refocusing their business in the Gulf Coast region to better service its portfolio of loyal offshore customers. Since 2014 Benoit has been providing LLOG with torque and test services, utilizing mark-less jaws to make-up and test completion assemblies before running offshore. Benoit’s facilities can make-up assemblies up to 110 ft in length and can internal pressure test up to 20,000 psi. Specific to the Buckskin development, Benoit supplied and threaded alloy-tubing materials for the gravel pack isolation zones for the #1 and #2 completions. LLOG’s string design required a robust connection that offered clearance. Benoit modified and validated its semi-flush connection, the Benoit Near-Flush Joint (BNFJ) for this application. The connection utilizes Benoit’s industry-leading two-step design on a slim-hole upset, providing excellent sealing performance with internal and external metal-to-metal seals. With over 150 years of combined experience and well over 300 deepwater and ultra-deepwater completions under their belt, Benoit is ready to be that solution that’s required. Whatever “it” may be Benoit has its headquarters in Houma, LA and operates threading facilities in Houma and Ennis, TX.

Bevel Tech Group, Inc. provides the critical ID machining of the LLOG Buckskin production risers

Bevel Tech Group, Inc. (BTG) provides critical, precision machining on the ID and OD of deepwater piping and components with the widest range of any system developed. From pipe sizes of 3” ID to 28” OD and bore depths up to 20” for specialized transition joints BTG can deliver CNC precision machined pipe ends. BTG’s CNC systems have logged over 100,000 ends of multiple sizes and bore configurations. From risers, SSFLs, transition joints, fatigue strings, weld procedure pups, PLETs, PLEMs and J-Collars the system can adapt to your needs. As well with the development of BTG’s Laser Pipe End Measurement System (PEMS), we have added the precision service of pre-dimensioning critical deep-water pipe joints and components. Confirming the "as built" condition of your project pipe, target ID analysis and predictions, grouping, rotational data and arrays can be performed quickly and safely at your given location. BTG also can supply the portable rack system from 40 ft to 90 ft suitable to allow dimensioning outside of the plant’s production facility so that there is no need to tie up or slow down the production cycle, whether at the pipe manufacturer or the facility coating the pipe.

Proprietary CNC machining

From the development of the system late in 2016, BTG’s CNC machining system was designed to provide CNC quality machined products in virtually any location, no matter how rugged or remote. The system operates well under generator power, is adjustable to compensate for uneven landscapes and is containerized for shipping domestically as well as internationally. However, BTG’s main goal in developing the concept was to provide and maintain a trained staff to ensure all quality and safety goals are met each and every time regardless of the set-up location. Now with over 12 years of operation free of any safety or quality incident, the system has proven its longevity for producing the best possible product delivered to the deepwater industry.

For the LLOG Buckskin project BTG’s automated system was deployed to a local coating yard where the SCR pipe joints would be machined after the external thermal coating was applied. Counter boring after this process eliminates the chances of damage to ends counter bored prior to the coating cycle. The engineered target ID and wall WT specifications of each joint were machined to the exact ID and WT specifications.

About Bevel Tech Group, Inc.

Bevel Tech Group, Inc. was established in 1998 as a specialty field and shop machining company with heavy emphasis on deepwater pipe and products. Since then, BTG has become the leader in counter boring SCR pipe and components needed for the deepwater demands. BTG partners with major oil companies or their EPC contractors to develop and provide unique solutions for the industry.

- Counter boring (ID and OD) of SCR’s and flow line pipe and components.
- Specialized coating machining applications for removal or modifications.
- Pipe End Measurement System (PEMS laser metrology)
- Faro laser metrology
- Field machining of all types
- NC/CCER certified millwright services
- Line isolation/testing
- Hot tapping

BTG achieving the highest standards in safety, quality and project management.
CETCO ENERGY SERVICES (CETCO), a Minerals Technologies Company, worked with Seadrill to design a custom dedicated well test package and filtration system dedicated to the Seadrill West Neptune for deepwater operations.

The Buckskin Well required a zinc bromide completion fluid. CETCO's filtration system was utilized to recover and recycle the zinc bromide fluid by removing hydrocarbons and then pumping the recovered fluid back to the rig pit for reuse. By recycling the completion fluid instead of transferring the recovered completion fluid to the storage tanks on the Offshore Service Vessel (OSV), CETCO allowed the total available storage tanks on the OSV to include two 3-inch, 15k psi hydraulic choke manifold and a complete package of surface piping. CETCO worked with Seadrill to design a custom dedicated completion fluid system that included the lubrication system that included the lubrication manifold, a complete package of surface piping, and rotating cementing heads. At its expansive facility in Houma, La., the company’s staff of skilled technicians maintains an inventory of more than 50,000 pieces of frac iron, inspected and ready for deployment. Gulfstream follows a meticulous process to track its assets and assure that every piece of equipment meets specifications. In addition to being ISO certified, Gulfstream obtained its API Q2 certification in 2018 entering a very elite group of suppliers with the ability to supply equipment for the oil and gas industry meeting these requirements.

CETCO well testing and water treatment & filtration services team up with LLOG to assess the Buckskin reservoir

To support TCP services, Gulfstream provided the 100bbl tanks, control head, manifold and a complete package of surface piping inspected and tested for the operation. Gulfstream Services’ premium equipment, quality control, innovative designs, and reliable service contributed to the successful completion of the first two development wells in LLOG’s Buckskin project. The two wells were drilled from the West Neptune drill ship in 6,300 ft of water in Keathley Canyon to a measured depth of approximately 27,000 ft below the mud line. The first well was designed to produce from five separate zones, and the second well targeted three distinct zones. All eight zones would be perforated and fractured. Prior to the Buckskin project, Gulfstream had provided equipment and services to successfully complete 15 Gulf of Mexico wells for LLOG. Based on this track record, LLOG selected Gulfstream Services to support the completions on the two Buckskin wells with well test control equipment for logging the high pressure system and surface package for tubing conveyed perforating (TCP) services; and frac iron and dual hydraulic choke manifold for the frac treatments. Gulfstream provided all-inclusive packages for these services to enhance LLOG’s operational and financial management of the project.

CETCO ENERGY SERVICES
www.cetcoenergieservices.com

Gulfstream Services supports Buckskin with innovative frac iron solution

Due to the high pressures involved, the Buckskin Well test design met five separate well test requirements. CETCO's well test decision making. Through these differentiated factors, CETCO has successfully contributed towards decreased rig time for well test operations.

Safety and quality CETCO ENERGY SERVICES’ highest priorities are incident prevention, employee safety, and environmental protection. CETCO is committed to being a global leader in all of its offerings by focusing on high quality service delivery and innovative solutions, underpinned by operational excellence for total customer satisfaction.

Gulfstream Services facility in Houma, Louisiana

To support TCP services, Gulfstream provided the 100bbl tanks, control head, manifold and a complete package of surface piping inspected and tested for the operation. Gulfstream Services’ premium equipment, quality control, innovative designs, and reliable service contributed to the successful completion of the first two development wells in LLOG’s Buckskin project. The two wells were drilled from the West Neptune drill ship in 6,300 ft of water in Keathley Canyon to a measured depth of approximately 27,000 ft below the mud line. The first well was designed to produce from five separate zones, and the second well targeted three distinct zones. All eight zones would be perforated and fractured. Prior to the Buckskin project, Gulfstream had provided equipment and services to successfully complete 15 Gulf of Mexico wells for LLOG. Based on this track record, LLOG selected Gulfstream Services to support the completions on the two Buckskin wells with well test control equipment for logging the high pressure system and surface package for tubing conveyed perforating (TCP) services; and frac iron and dual hydraulic choke manifold for the frac treatments. Gulfstream provided all-inclusive packages for these services to enhance LLOG’s operational and financial management of the project.

Gulfstream delivered an innovative solution for high pressure piping used during pumping treatment of the target zones. Typical chisak packages for offshore fracturing include two choke manifolds, each with a 4 ft by 6 ft footprint. Gulfstream redesigned the hydraulic frac manifold to include two 3-inch, 15k psi hydraulic chokes in a single manifold with a 4 inch flow line and maintained a 4 ft by 6 ft footprint, saving deck space. The package also included the frac head, jumpers and all the flow iron needed for the pumping operation.

Zero Safety Incidents Gulfstream maintained a three-person crew on the West Neptune throughout the completion operations. The three-zone well was completed in 28 days and the five-zone well took 44 days to perforate and stimulate. Gulfstream provided its services without any safety incidents during the two completions. Unique capabilities for high quality service Founded in 1978 to support Gulf of Mexico operators, Gulfstream Services Inc. has unique capabilities, focused on providing quality support solutions for frac iron, frac heads, well test control equipment, and rotating cementing heads. At its expansive facility in Houma, La., the company’s staff of skilled technicians maintains an inventory of more than 50,000 pieces of frac iron, inspected and ready for deployment. Gulfstream follows a meticulous process to track its assets and assure that every piece of equipment meets specifications. In addition to being ISO certified, Gulfstream obtained its API Q2 certification in 2018 entering a very elite group of suppliers with the ability to supply equipment for the oil and gas industry meeting these requirements.

Gulfstream Services, Inc
www.gulfstreamservices.com

Gulfstream Services, Inc
www.gulfstreamservices.com
Advanced technologies achieve exceptional results for Buckskin wells

Founded in 1919, Halliburton celebrates 100 years of service as one of the world’s largest providers of products and services to the energy industry. With 60,000 employees, representing 140 nationalities in more than 80 countries, the company helps its customers maximize value throughout the lifecycle of the reservoir— from locating hydrocarbons and managing geological data, to drilling and formation evaluation, well construction and completion, and optimizing production throughout the life of the asset.

For the deepwater Buckskin field, Halliburton provided LLOG with a comprehensive set of drilling and completion solutions. Featured here are a few of the products and services that achieved exceptional results for Buckskin wells.

Cementing operations

Based on our previous track record with Halliburton’s Neptune and West Neptune drillship, Halliburton Cementing was assigned 19 cement jobs for the Buckskin #2 and Buckskin #3 wells. No remedial cement jobs were required during either of these completions.

Well construction services

Halliburton is one of LLOG’s preferred vendors for Retrievable and Drillable Service Tools. Halliburton Wellbore Cleanout Service Tools provided RTTS® Storm Packers for potential temporary abandonment scenarios and cement retainers for any potential remedial cementing applications in the 16-in., 14-in., and 10 1/4-in. casing. Halliburton Completion Tools provided the 14-in. x 16-in. VersaFlex® liner hanger technology for both Buckskin wells. Halliburton Testing and Subsea PSI provided high-pressure gauges for downhole completion activities and the Veto® Subsea Safety System to provide temporary well isolation during the upper completion installation and well backflow operations, along with the required interfaces to the Tubing Hanger Running Tool, BOP Stack, and the DHPT gauges. The Veto® Subsea Safety System also included a circulation valve that provided LLOG the ability to circulate fluid within the BOP stack without disconnecting from the well. We also performed the slickline work for the Buckskin completions. Services included gauging the tubing, test tools to set the production packer, and shifting tools for sleeves downhole.

Wellbore cleanup

Halliburton’s CleanWell® Technologies (CWT) provided mechanical wellbore cleanup tools during the side track and completion operations for Buckskin. CWT equipment was utilized to mechanically clean the wellbore, manage downhole debris, and restore drift to support successful completion installations.

Successful track record

Halliburton is pleased to contribute its advanced technologies and professional teams to the Buckskin project. This is yet another major milestone for LLOG and Halliburton in the series of successful deepwater projects that are extending the technology envelope in the Gulf of Mexico’s deepwater frontier.

Hunting’s Back Pressure Valve improves topside chemical injection for Buckskin

Located in Stafford, Texas, just a few miles southwest of Houston, Hunting PLC’s Subsea Technology Division is known as Hunting’s Back Pressure Valve. LLOG chose Hunting’s Back Pressure Valve for numerous projects, including Claiborne, Crown and Anchor, Red Zinger, Stonefly, and Buckskin.

The Back Pressure Valve (BPV) is installed subsea on dedicated chemical injection lines supplied by topside metering pumps. For wells with sub-ambient pressure, the chemical being injected has a tendency to drain faster than the topside flow rate, effectively emptying the supply line. Side effects include improper dosage, fluid properties, and even line collapse from hydrostatic pressure in the case of thermoplastic umbilicals. Hunting’s BPV solves each of those issues by maintaining pressure in the supply line at a fixed value relative to hydrostatic sea pressure.

It is this unique relationship that originally attracted LLOG to Hunting’s technology. Most backpressure valves are essentially a high cracking pressure check valve, which means those valves function based on the relationship between inlet and outlet pressure. By contrast, the BPV functions based on supply and external hydrostatic pressure. The result is reduced demand for topside pump pressure, which can be a challenge early in the life of a well.

Hundreds of wells currently feature Hunting’s BPV technology, which has been deployed for over 12 years with no reported issues. Greenfield projects that are anticipated to become sub-ambient in the future, incorporate the valve into a tree or logic cap, while brownfield projects typically install the valve into a cobra head. In one case study, installation of Hunting’s BPV prevented an Operator from replacing a multi-million-dollar thermoplastic umbilical, which was subject to collapse in service of a sub-ambient well. No field adjustments to the valve are necessary, as it is automatically depth compensated. It is qualified for pressures to 15,000 psi, water depths to 15,000 ft, and flow rates up to 3 gallons per minute.

For larger projects with multiple wells, Hunting also offers Chemical Injection Metering Valves (CIMV) with active orifice control, full-time positive displacement measurement, real-time injection feedback, and the ability to simultaneously deliver two fluids. Hunting’s CIMV leads the industry in working and differential pressures, rated installation depth, and most importantly, accuracy.
Oceaneering International provided a wide range of services on the Buckskin project including remotely operated vehicle (ROV) support, installation workover and control system (IWOCs) engineering and services; a multipurpose service vessel; engineering and services related to steel catenary riser (SCR) installation; and setting of sleepers along the North and South Buckskin pipelines.

IWOCs services
Oceaneering has provided IWOCs services for LLOG over a decade, and its ROV and launch and recovery system (LARS) have been resident on Seadrill’s West Neptune drill ship since it was commissioned in 2014. On the Buckskin project, LLOG requested Oceaneering to provide IWOCs services deployed using the LARS to control subsea trees during completion activities on the field’s two development wells.

Over the past 25 years, Oceaneering has performed more than 800 IWOCs operations with 99% uptime performance. This outstanding record has been achieved through the company’s comprehensive pre- and post-job inspection and maintenance program for IWOCs umbilical reefs, hydraulic power units (HPU), and winches, as well as for ROVs and related tooling. Oceaneering’s IWOCs systems have redundant features designed to avoid downtime, and its offshore personnel are cross-trained to provide backup if issues arise during deployment.

The most significant challenge in preparing for the Buckskin project was to qualify the 11,000 ft IWOCs thermoplastic umbilical for use in a 15,000 psi application. Oceaneering faced the challenge in preparing for the Buckskin deployment, the Oceaneering team tested the umbilical to certify it for service at 15,000 psi, then tested the complete system to identify and resolve any potential issues before offshore deployment. The team also performed pre-job engineering to assure safe and efficient operation from the available deck space on West Neptune drill ship.

Once qualified, the IWOCs reel, HPU and winches were mobilized to the drill ship. Before each completion, the umbilical was lowered to test the subsea tree, and the equipment was kept on standby until needed for the completion. The IWOCs system performed flawlessly during each completion, with connections made to provide hydraulic and electrical control of the subsea trees during the running of completion assemblies and gravel pack operations. The IWOCs services were performed without HSE incidents. In addition to the six-person offshore crew, approximately 50 other Oceaneering employees performed engineering and support tasks to prepare for the Buckskin IWOCs deployment.

The most significant challenge Oceaneering faced in preparing for Buckskin was qualifying the 11,000 ft IWOCs thermoplastic umbilical for 15,000 psi application.

Oceaneering subsea services support LLOG on Buckskin project

Oceaneering provided a number of services for LLOG’s Buckskin project, including IWOCs services.

SCR and sleeper installation
Oceaneering also provided services needed to install the Buckskin SCRs at the Lucius SPAR and to lay the pipeline tying back the Buckskin well center to the production facility. On October 10, 2018, Oceaneering mobilized the MSV Ross Candies service vessel, equipped with two Millennium Plus work-class ROVs and a 110 MT crane with a 3400 m (11,155 ft) depth capacity. At the Lucius SPAR in Keathley Canyon 875, the vessel removed and recovered two umbilical tube bottom covers with messenger wire and centralizers attached. Then the crew installed two bend stiffener latch mechanisms (BSLM) at the umbilical tubes. Next, using the ROVs, Oceaneering technicians drifted two umbilical segmented tubes and two SCR continuous tubes, each with messenger wires that would remain in place. The Oceaneering team also provided for future marine growth cleaning with jetting and pigging of the SCRs, and set up positions to accommodate video cameras to monitor SCR and umbilical tube integrity.

Once work supporting SCR installation was complete, the MSV Ross Candies installed 15 sleepers in 7,100 ft (2165 m) of water along the North and South Buckskin pipeline routes before the flow lines were laid on top of them. The sleepers are designed to prevent buckling caused by fluid flow and subsea currents and enable surveyors to quantify lateral movement of the pipeline over time. The SCR and sleeper-related activities were performed successfully with no HSE incidents, and the MSV Ross Candies was demobilized on October 26, 2018.
Premier insulation solutions for challenging offshore pipelines and subsea equipment

A winning team

Perma-Pipe and BASF are industry leaders supplying various types of thermal insulation products to enhance the flow assurance of products transmitted in offshore and onshore pipelines and equipment. Auto-Therm® GSPU (Glass Syntactic Polyurethane), Perma-Pipe’s most popular thermal insulation product for offshore pipelines and equipment, was used extensively for LLOG’s Buckskin, Delta House, and numerous previous projects for LLOG and other operators. Continuing with LLOG’s confidence in Perma-Pipe, two upcoming contracted projects will be insulated with GSPU in 2019.

Rick Fowler, LLOG COO stated, “Perma Pipe is a long-term and valued supplier to LLOG, providing quality thermal insulation products on flowlines, risers and subsea equipment for numerous projects over many years. We consider Perma-Pipe to be an important partner-supplier that will go the extra mile to ensure on-time delivery. Their performance has, and will be, key to help meet our aggressive construction schedules.”

Auto-Therm® GSPU was developed in collaboration with BASF, a world leader in polyurethane chemistry and the development and manufacture of polyurethanes and other specialty materials. Perma-Pipe and BASF have a long history working together, providing thermal insulation technology solutions for many different industries and applications; BASF on material development and Perma-Pipe on material application processes. Together, their expertise and capabilities provide GSPU insulation for subsea pipelines and subsea equipment—PLETs, manifolds, jumpers and other structures, to meet critical project requirements, safely and economically. Furthermore, the two companies combined their expertise resulting in the highly thermally efficient and cost-effective Auto-Therm® GSPU thermal insulation. Since 2005, GSPU has been used on a multitude of deepwater subsea pipeline projects for LLOG, including Buckskin, Delta House, and Who Dat as well as other major and independent operators.

Auto-Therm® GSPU is recognized as the premier insulation material for subsea pipelines and equipment, backed by years of testing from independent third-party organizations, including Heriot-Watt University, Edinburgh, Scotland; Stress Engineering, Houston, TX; and the Joint Industry Project (SWIS JIP) to name a few. The SWIS JIP members include major oil and gas operators, pipeline lay contractors, subsea equipment manufacturers, and thermal insulation applicators. In addition to the independent testing, Perma-Pipe and BASF have conducted extensive in-house R&D, testing and application trials over the years.

Perma-Pipe is the leading supplier of GSPU insulation to independent and major oil and gas operators in the Gulf of Mexico. Since Auto-Therm’s inception in 2004, Perma-Pipe’s has supplied GSPU to 40 projects, totaling some 2,080,000 feet (~375 miles). Perma-Pipe holds the record for the world’s deepest insulated flowline, Shell Perdido at 9,627 ft. (2,934m) and has successfully undergone low-temperature bending trials at 10°F (-12°C).

The product was developed to provide a combination of excellent material flexibility, low thermal conductivity and optimum temperature performance required for offshore pipelines and subsea equipment. Auto-Therm® GSPU is:

• Extremely flexible to meet the stringent requirements for insulated pipeline installation using the reeling method. Auto-Therm® has been reeled to a radius as low as 13 ft. (4 m) and has successfully undergone low-temperature bending trials at 10°F (-12°C).
• The lower thermal conductivity GSPU insulation results in a reduced insulation thickness required compared to other products to meet the project thermal performance specifications.
• Proven successful under simulated service conditions for one year at 226°F (108°C) by the SWIS JIP.

“Perma-Pipe is a long-term and valued supplier to LLOG, providing quality thermal insulation products on flowlines, risers and subsea equipment for numerous projects over many years. We consider Perma-Pipe to be an important partner-supplier that will go the extra mile to ensure on-time delivery. Their performance has, and will be, key to help meet our aggressive construction schedules.”

Rick Fowler, LLOG Chief Operating Officer

BASF performance materials

Working closely together, Perma-Pipe and BASF were the first to develop and offer mercury-free GSPU insulation for the offshore industry in 2004. The two firms continue to improve the overall performance, thermal and mechanical properties, and processing methods for Auto-Therm® GSPU with ongoing R&D.

BASF is well positioned to supply the global subsea insulation market from 39 polyurethane manufacturing centers located around the world. With over 122,000 employees, it is one of the world’s leading chemical companies and leads in polyurethane technology. BASF is among the top companies in the Patent Asset Index.

Insulated manifold lowered into the Gulf of Mexico

Buckskin insulated jumper
These facilities deliver the polyurethane
COMPANY PROFILE
Dat, Who Dat extension, Goose, Mandy,
Zinger, Claiborne, Crown and Anchor, Who
Perma-Pipe’s patented production method
Perma-Pipe has been the primary insula-
cious injection molding process. The GSPU
also provides Auto-Therm® Si, silicone
also provides Auto-Therm® Si, silicone
and close proximity to the subsea equipment fabri-
custom designed Auto-Therm® GSPU connector shrouds for LLOG
Custom designed Auto-Therm® GSPU connector shrouds for LLOG
before exiting the mold. This method has
significant advantages over other GSPU
processes, including shorter set up time,
and heat lay installation methods, therefore reducing
the number of field joints in half, resulting
insulated pipe to contractor lay barges in
the Gulf of Mexico. This location has also
competitively served the West African and
Brazilian markets.
Subsea equipment insulation
In addition to the application of Auto-
Therm® GSPU to pipeline flowlines and
risers, Perma-Pipe provides GSPU for
subsea equipment. For these specialized
services, portable processing equip-
ment is mobilized to the equipment fabricator’s yards
along the Gulf Coast states. Perma-Pipe has
furnished almost all of LLOG’s insula-
tion requirements for subsea struc-
tures, including numerous jump-
ers, PLETs, ILS and connector shrouds.
For higher temperatures up to 320°F (160°C), Perma-Pipe
also provides Auto-Therm® Si, silicone insulation which was used for the Buck-
skin project.
With the operational base in New
Iberia, LA, portable equipment spreads
and experienced field crews, and close
proximity to the subsea equipment fabri-
cator’s yards, enables Perma-Pipe to mobil-
lize on relatively short notice and meet the
tight installation schedules noted for the
offshore industry.
About Perma-Pipe
Perma-Pipe, Inc. is a leading supplier of
preinsulated and prefabricated piping
system products and solutions for indus-
trial and commercial markets around the
world. Perma-Pipe is known worldwide for
its innovation and ability to provide solu-
tions for the most challenging applications.
In addition to the offshore products sup-
plied for Buckskin and other LLOG proj-
cetions, Perma-Pipe’s other products include:

- Low-density, highly efficient Xtru-
Therm® polyurethane for district
heating and cooling (DHC) piping
systems for efficient energy distribution
from central energy plants
- Industrial piping systems for efficient
and safe transport of hot and cold fluids
- Industrial secondary containment
piping systems for transporting
chemicals, hazardous liquids, and
petroleum products
- Piping systems for cryogenic
applications including LNG, ammonia,
propane, and butane
- Onshore insulated long lines for oil, gas,
and mineral transportation
- Heat trace systems for temperature
maintenance and to enable viscous
fluids such as heavy crude oil, sulfur,
and asphalt to flow efficiently
- Leak detection products for piping
systems and sensitive areas such as
data centers
Perma-Pipe’s global manufacturing foot-
print consists of six facilities:
- New Iberia, LA USA
- Lebanon, TN USA
- Camroose, Alberta, Canada
- Fujairah, United Arab Emirates (UAE)
- Dammam, Saudi Arabia
- Gujrat, India
Perma-Pipe also mobilizes portable insu-
lation equipment for projects anywhere
in the world where significant savings in
transportation and logistics costs can be
realized by locating the insulation facility
near the project. Perma-Pipe is a divi-
sion of Perma-Pipe International Holdings,
a public company listed on the NASDAQ
stock exchange under the symbol PPHE.
Perma-Pipe and BASF are proud to be
participants to the overall success of Buck-
skin and numerous past and future LLOG projects.
About BASF Performance Materials
BASF Performance Materials division
compromises the entire materials know-
how of BASF regarding innovative, cus-
tomized plastics under one roof. Globally
active in four major industry sectors –
transportation, construction, industrial
applications, and consumer goods – the
division has a strong portfolio of prod-
ucts and services combined with a deep
understanding of application-oriented
system solutions. Key drivers of profitabil-
ity and growth are our collaboration with
customers and a clear focus on solutions.
Strong capabilities in R&D provide the
basis to develop innovative products and
applications.
Advanced tubular installations for challenging offshore wells

Founded in 1976, Offshore Energy Services, Inc. (OES) is a leading provider of tubular installations, including hammer services, fabrication, casing and tubing running services, specialty mud tools, and bucking and assembly. OES facilities are strategically located to serve the oil and gas industry from the US Gulf of Mexico and Gulf Coast to the various US shale plays (Haynesville, Eagleford and Mid-Continent).

International reach
OES Corporate Headquarters is located in Broussard, Louisiana and along with its Tubing & Assembly Division in Houma, Louisiana services the Gulf Coast and Gulf of Mexico regions. From its Broussard facility, OES has also shipped personnel and equipment to international oilfield areas such as Suriname and Mexico to West Africa, Malaysia and Trinidad.

Buckskin services
OES has supported LLOG Exploration with tubular installations since 2003. For the Buckskin 2 well, OES tubular installations included several large OD casing strings, including the conductor pipe. Equipment utilized included 42-in. power tongs, OES Track Tong Positioning System, OES Internal Lifting Tool, OES Flush Mounted Spiders (FMS) and OES Elevators for successful casing installation. The OES Drill Pipe Circulating Flow-Back Tool (CFT) was utilized on a tapered casing tieback.

For the Buckskin 3 well, OES tubular installation included all casing strings. Equipment utilized once again included 42-in. power tongs, OES Track Tong Positioning System, Internal Lifting Tool, FMS and Elevators as well as the OES Compensating Stand Elevator. On various tapered casing strings, the FMS and Elevator, which have a 1-in. upsizing capability, were used, thus eliminating equipment change out. On several casing strings including the tie-back, Compensating Stand Elevators were used to rack back casing stands prior to installation. The OES 1250 Ton Drill Pipe Landing String Elevators and FMS were used on several of the casing installations to prevent slip crushing. The OES CFT was also once again utilized on the tapered casing tieback.

Safe, efficient services
OES Track Tong Positioning System – Patterson, LA Training Facility

remote operation of hydraulic tongs. The track tong system can run on its own track or be used on the rig’s Iron Roughneck track. The system allows for quick rig up (one lift) and can be shipped with the track folded up to a 7 ft footprint. Total footprint with the track extended is 14 ft 2 inches. The track tong system can also make up connections at a maximum height of 17 ft. Only one technician per tour is needed to operate the track system by remote control. Lessons learned on the Buckskin installations are being applied by OES teams to reduce risk and improve efficiency for tubular installations throughout OES operations.

Pinnacle—Buckskin subsea development built off the success of a standardized approach

Pinnacle Engineering Inc. and sister company, Pinnacle Project Services, supply comprehensive solutions, project management, procurement, inspection and commissioning services to the offshore oil and gas industry. The company specializes in cradle-to-grave solutions for projects ranging from single wells to complex multi-well fields in any water depth. Pinnacle understands the importance of managing costs, schedules and risks, as well as being committed to providing a valued partner and trusted resource for economical, safe offshore project development.

With experience installing more than 100 platforms, 250 pipelines and 100 subsea tiebacks, Pinnacle has unmatched understanding of how to complete offshore projects on time and on budget. Utilizing a standardized approach, Pinnacle prides itself on simplifying complex projects into common-sense solutions.

LLOG Exploration and Pinnacle began their successful relationship in 2000, and project history now includes tiebacks to major floating production platforms including Brutus, Who Dat, Delta House, Materhorn, Martin, Lucius and Ram Powell.

In late 2016 LLOG kicked off its latest large scale project with the Buckskin development in Keathley Canyon, a 15K tieback to the Lucius spar in KC 875. Challenged with developing a field that previously operators considered uneconomical, Pinnacle scaled up the standardization model and presented a field development that relied on existing proven technologies. In addition, unlike with EPIC contracts, Pinnacle’s contracting strategy gave LLOG control of schedule and execution.

Working together, Pinnacle, LLOG management and flow assurance engineers selected a development concept that included dual, insulated, piggable flowlines connected to steel catenary risers (SCRs) with a riser-base gas lift system and a four-slot manifold at the wellsite. Thermal expansion was handled via sleepers, distributed buoyancy and multiple piled anchor points. For the subsea controls and distribution, an Ethernet/fiber optic system was selected to better support the large amount of data expected from multi-phase flowmeters and well sensors. Umbilical, distribution and chemical injection, and gas lift system designs address early, mid- and late life needs, including easy expansion for future discoveries.

Pinnacle strategically awarded and coordinated with multiple vendors and service providers for the execution of Buckskin. Timely and clear communications to share interface details and schedules was critical, with Pinnacle providing the central hub of information. The end result is a world class deepwater subsea development on par with any of its kind.
ProTechnics diagnostics evaluate Buckskin completions, support confident decision-making

ProTechnics, a division of Core Laboratories, provided completion and reservoir diagnostics services for LLOG’s two multi-zone development wells in the Buckskin field. Previously, ProTechnics engineers had worked with LLOG to evaluate completion performance on wells in the consolidated Mississippian formations in the Gulf of Mexico’s Mississippi Canyon. The Buckskin field, in Keathley Canyon with reservoirs in the consolidated Lower Tertiary Wilson formation, presented a new challenge. The deep Wilson reservoir rock is tight, with relatively low permeability and harder formations. A successful completion must create a fracture network that connects all the sand bodies along the well. LLOG completions and reservoir engineers collaborated with ProTechnics to evaluate completion results and provide diagnostic insights to update models used to plan subsequent frac treatments. LLOG also needed to verify that oil was being produced from each fractured zone.

Spectral PACKSCAN® service
ProTechnics’ Spectral PACKSCAN® service is designed to determine frac height, whether all zones are fractured, and competency of the annular pack. These diagnostic data can be used to calibrate frac models, adjust treatment design on subsequent nearby wells, and measure the quality and extent of the annular gravel packing.

The ProTechnics service utilizes a combined spectral gamma ray and gamma density tool deployed at the bottom of the washpipe. In addition, ProTechnics provides two uniquely identifiable ZeroWash® proppant tracers that employ different isotopes. With the Spectral PACKSCAN® tool in the hole, the well is frac packed in multiple stages approximately one week apart. One proppant tracer type is added to the proppant stream during the early portion of the proppant ramp for each stage, and the other tracer type is added during the latter portion of the proppant ramp. After each zone is completed, the Spectral PACKSCAN® tool acquires spectral gamma ray and density data for the completed zone and records the data to memory while the washpipe is retrieved from the well. The washpipe-conveyed service saves rig time and expense by eliminating a costly wireline run. Data is downloaded at the surface and transmitted to ProTechnics data analysts and engineering teams onboard, where the results and provide computed log data to decision-makers on the rig within a few hours.

Diagnostic insights
The PACKSCAN® measurements enable engineers to determine the extent of fracture height and proppant placement both in the formation and the annulus. The PACKSCAN® logs show the geometric placement of the proppant to identify which zones have been completed successfully, which areas have been missed, and intervals where treatment may have grown outside the target interval. The log identifies placement of the first and second proppant tracers, so completion engineers can understand how the reservoir responds to the treatment and pinpoint areas where early screening occurred. The PACKscan log also evaluates the competency of the annular pack achieved during the pumping operation.

ProTechnics also provides SPECTRACHEM® chemical tracers to help operators evaluate flowback efficiency and oil productivity from each completed zone. Two unique chemical tracers are added to the frac fluid used to stimulate each stage, one to evaluate frac fluid recovery and one to evaluate oil distribution. Water and oil samples collected during flowback are analyzed to determine cleanup and oil productivity from each completed zone. Two unique chemical tracers are added to the frac fluid used to stimulate each stage, one to evaluate frac fluid recovery and one to evaluate oil distribution. Water and oil samples collected during flowback are analyzed to determine cleanup and oil productivity from each completed zone.

The PACKSCAN® tool was retrieved from the washpipe, recording spectral gamma ray data across each zone. The ProTechnics engineer on the West Neptune drill ship downloaded the log data from the PACKSCAN® tool’s memory and emailed it to the ProTechnics team onboard for processing. Completion diagnostic results were relayed back to LLOG personnel on the rig within a few hours.

“The quick turnaround of the diagnostics helped us make a better petrophysical interpretation of the reservoir,” said Jon Wood, LLOG reservoir engineer. “The diagnostics also improve our understanding of how fracs grow near the wellbore, so we adjusted our frac model accordingly, and achieved even better results on the second well.”

The second Buckskin well was completed in three zones with a total of 2.7 million pounds of proppant and the Spectral PACKSCAN® service and SPECTRACHEM® chemical tracers were used to diagnose completion effectiveness.

“On both wells, the chemical tracers helped us understand how the reservoir was responding, so we were able to adjust our flowback procedure to achieve the drawdown that would optimize production without damaging the reservoir,” said Kenny Champagne, LLOG completion engineer.

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Kenny Champagne, LLOG completion engineer

ProTechnics brings more than 30 years of experience partnering with operators to address industry challenges. ProTechnics’ team of engineers align completions and reservoir diagnostics with our customers’ business initiatives to shorten the learning curve and maximize return on investment.

For further reading about ProTechnics technology and its application:

SPE 58779
Gravel-Pack Evaluation Using a Memory Gamma-Gamma Density Tool
By K. Fisher, ProTechnics; C. Kiesler, Haliburton Energy Services; F. Rambow and C. Tucker, Shell; and W. Madigan, Multiphysics Numerical Research Group.
Prepared for presentation at the 2000 SPE International Symposium on Formation Damage Control, Lafayette, Louisiana
SPE-181658-MS
Mississippi Canyon Gulf of Mexico Frac Pac Case Histories and the Importance of Proppant Tracing and Gravel Pack Logging
By S. Sanford, T. Hopper, and J. Fink, Noble Energy; R. Woodroof, M. Peacher, ProTechnics Division of Core Laboratories LP.
Prepared for presentation at the 2016 SPE Annual Technical Conference and Exhibition, Dubai UAE

ProTechnics
protechnics.technical@corelab.com
713-328-2320
www.corelab.com/protechnics
Superior Completion Services provides effective sand control systems for Buckskin wells

Superior Completion Services (SCS), a Superior Energy Services Company, provides technology, resources and experience to deliver effective sand control and production solutions and equipment in any downhole condition.

Extensive deepwater experience
SCS has installed sand control tool systems in over 400 zones in more than 200 deepwater wells in the Gulf of Mexico. These include both intelligent and non-intelligent systems in well depths greater than 30,000 ft and bottomhole pressures greater than 20,000 psi.

On the LLOG Buckskin project, SCS provided sand face completion tools including proprietary technologies, and services to efficiently complete eight zones in two challenging deepwater wells. The wells were drilled in 6650 ft of water to 28,800 ft MD, with 60° of inclination, and maximum bottomhole pressure of 19,000 psi. The Buckskin reservoir characteristics and expected flow rates required a high pressure, high rate, high volume sand control tool system that could convey over one million pounds of high strength proppant per completed interval at rates up to 40 BPM. SCS designed, manufactured, assembled and tested nine large-bore sand control systems to maximize recovery and meet the Buckskin reservoir’s requirements.

Custom-designed completion components
As part of the completion design, LLOG specified a 12,500-psi API 11D1 V0 rated bridge plug as a barrier to isolate the casing shoe. SCS developed, tested, certified and delivered the bridge plug within 12 weeks. SCS engineers also modified Superior’s existing 15,000-psi interventionless production initiation flow valve, increasing flow area to accommodate the high production rate expected from the Buckskin wells.

Eight zones successfully completed
LLOG performed five high-rate sand control stimulations in the Buckskin 1 well, and three stimulations in Buckskin 2 at depths up to 28,400 ft. The highest volume of proppant pumped in a zone was over 1,000,000 lbs., with an average of 853,000 lbs. of proppant pumped at an average rate of more than 35 BPM.

Buckskin 1 Completion Summary

<table>
<thead>
<tr>
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<td>Cog Desc</td>
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<td>Interval Length</td>
<td>250'</td>
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<td>Max Sand</td>
<td>10 ppa</td>
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<td>Max Rate</td>
<td>35 bpm</td>
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<td>Total Sand Pumped*</td>
<td>940,007 lbs</td>
<td>963,268 lbs</td>
<td>694,750 lbs</td>
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*Buckskin HD 25

**KryptoSphere HD 25

12,500 psi API 11D1 V0 rated Bridge Plug.

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<td>136'</td>
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<tr>
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<td>10 ppa</td>
<td>10 ppa</td>
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*X-over port from Buckskin completion delivered an average of 853,000 lbs of KryptoSphere HD 25 with minimal erosion.

Superior Completion Services completion tool testing facility in Houston enabled custom design of high pressure, high flow rate tools for the Buckskin project.

Superior’s Sand Control Services

Superior’s Sand Control Services offers a comprehensive range of sand control tools and services to help oil and gas producers achieve high recovery and meet the Buckskin reservoir’s requirements.

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Buckskin project continues TechnipFMC’s subsea equipment alliance with LLOG

In 2008, LLOG Exploration and Technip-FMC established an exclusive alliance for the supply of subsea equipment. Over the course of the last decade, the relationship, built on trust and open communication, has seen tremendous success on projects in the Gulf of Mexico, including the recent Buckskin development.

TechnipFMC was awarded the contract for the subsea production system (SPS) and subsea risers and flowlines for the Buckskin project in addition to installation and rental tooling.

Located in approximately 6,800 feet of water in the Gulf of Mexico and tied back to the Lucius platform, Buckskin was a promising, but challenging, development. LLOG selected the 1SK Enhanced Vertical Catenary Deepwater Tree (EVDT) system for the SPS scope, the first of its kind to be implemented in a LLOG field. Early engagement, open dialogue and a clear understanding of the requirements of this system were extremely critical to execution.

The project’s tight deadlines mandated a fast-track design, fabrication and installation schedule. Field architecture and structural design changes were implemented without any impact to the schedule, and the offshore scope was executed in the exact duration of time scheduled, all without incurring any safety incidents.

TechnipFMC will carry these lessons learned from the Buckskin project into the development of the Who Dat field, where TechnipFMC will provide the delivery and installation of the multiphase pumping system, including a manifold, umbilical termination assembly, power umbilical, jumper and topside control equipment. This project will demonstrate the value in the integrated Engineering, Procurement, Construction and Installation (iECPI™) offering, and through the use of the pumping system, will maximize production from the field.

TechnipFMC believes the trusting and transparent, honest relationship developed with LLOG over the years enabled the successful execution of the Buckskin project and looks forward to continuing this success through future projects.

Tenaris leverages global capabilities to provide Buckskin line pipe solution on tight schedule

Tenaris was awarded the SURF Line Pipe contract for the Buckskin offshore, deepwater development project. LLOG, Buckskin’s operator, selected Tenaris to provide deepwater SURF components, including steel catenary risers and flowlines, for the tie back completion.

Deepwater subsea umbilical riser and flowline (SURF) developments are complex, requiring extensive technical and commercial expertise due to the need for long-term, failure-free performance in hostile subsea environments. Tenaris’s challenge was to design, engineer, produce, and deliver a product solution that met LLOG’s project requirements in demanding deepwater conditions.

Tenaris produced and delivered more than six miles of heavy wall (HW) seamless Carbon Manganese (C-Mn) line pipe. During project implementation, the team had to overcome significant challenges including developing, testing, and manufacturing new alloys to meet project requirements.

Tenaris met these challenges in just nine months without a single safety incident.

Meeting the design challenge

Tenaris’s Pipeline Services team met the project’s unique technical requirements with proprietary steel design and production methods, individual pipe restrictions, dimensional tolerance enhancements, and ancillary pipe services, all to ensure the product solution was viable, not only in the laboratory, but also in the water.

The international team of 23 dedicated employees from four countries – the United States, Italy, Mexico and Romania – worked in concert to achieve their objectives in a timely manner. Engineering and design work was performed in Italy and Mexico, business coordination from Romania and the U.S.A., project management and supply chain support from Italy and the U.S.A., and management from the commercial team in the U.S.A. This resulted in a custom-designed solution, utilizing all facets of the Pipeline Services business unit.

Manufacturing and supply chain performance

Tenaris’s Pipeline Services team implemented best practices for steel design, steel making, pipe rolling, heat treatment and pipe finishing. The new steel alloys and production methods were developed at Tenaris’s Research & Development facilities, which include state of the art equipment, innovative technology and industry-leading research engineers. The pipe was produced within the internationally recognized API 5L Line Pipe standard for offshore applications with additional proprietary specifications. More than 300 Tenaris employees were involved in manufacturing the line pipe at multiple ISO-certified seamless production facilities.

Sustainable pipe manufacturing partner

Tenaris is a leading global supplier of steel tubes and related services for the world’s energy industry and certain other industrial applications. Tenaris has the commercial strength to produce superior product at a competitive price, while continuously improving and expanding its capabilities to develop new products and safely deliver them to customers. Tenaris strives to be a sustainable pipe manufacturing and service partner, with global reach, strategically growing in the United States and abroad.

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www.tenaris.com
West Neptune drillship contributes to LLOG’s success in deepwater Gulf of Mexico

Seadrill’s West Neptune is a sixth-generation ultra-deepwater drillship that has been on contract in the US Gulf of Mexico for LLOG since the unit was delivered from Samsung Heavy Industries in 2014. The West Neptune has only ever worked for LLOG. The West Neptune has conducted exploratory and development drilling at LLOG’s Delta House, Crown & Anchor, and Buckskin fields.

With the industry’s most advanced technology, the West Neptune is a dual-activity drillship, capable of drilling in 12,000 ft of water to a depth of 37,500 ft. The unit has 210 POB and features dual derricks rated at up to 2.5 million lbs, two, 7-ram BOPs and a Class 3 dynamic positioning system.

Even though the industry is still battling through an unprecedented downturn, Seadrill’s West Neptune continues to excel and perform for LLOG. The West Neptune’s history of strong and reliable performance is reinforced by the rig’s utilization in 2019, with Year to Date Uptime above 97%.

The consistency of personnel onboard the rig and the ongoing relationship between Seadrill and LLOG have been key factors in achieving the West Neptune’s outstanding five-year record of efficiency, safety and reliability.