Intervening on Pompano

Unique fields deserve equally unique intervention solutions when production begins to wane, this was the challenge Stone Energy had to meet when it contracted Cross Group to develop new methodology and technology for its Pompano subsea production template. Audrey Leon reports.

Pompano field with intervention package installed. Photo from Cross Group.

When Lafayette, Louisiana-based Stone Energy purchased the Pompano field from BP in late 2011, the field's subsea intervention kit was in need of serious refurbishment while several subsea wells on Pompano Phase II, a 10-well subsea template remained shut-in.

In 2012, Stone Energy had 16 platform wells producing, and only three of 10 template wells producing. An intervention would be necessary, but the subsea system, the only one of its kind in the US Gulf of Mexico, had issues such as stuck tooling that made through-flowline (TFL) intervention unworkable, said Craig Castille, director of Deepwater Drilling and Completion at Stone Energy.

Before BP sold the field to Stone Energy, it mulled a total refurbishment of the original intervention kit, which is now-20 years old. Now that it was Stone's challenge, Castille says the company estimated a total refurbishment of the original intervention kit could cost as much as $40-50 million and the operation and maintenance of the complex system would increase safety risks and cost. Castille says that the company knew there had to be a better way.

"Not having a system in place wasn't an option," Castille says. "We had no way to do plugging and abandonment work on these wells. It wasn't an 'if,' it was how soon can we get it done?"

The field

Pompano was one of the first deepwater projects in the Gulf of Mexico and it remains a production hub for neighboring fields, including the ExxonMobil-operated Mica field (Stone Energy 50%), which is tied back to the Pompano platform through two, 8in flowlines.

The Pompano field was discovered in 1985 by BP and Kerr-McGee (acquired by Anadarko in 2006), with first oil in 1994.

The 8mi-long Pompano field sits inside six lease blocks including Viosca Knoll Block 989 and Mississippi Canyon Block 28, about 120mi southeast of New Orleans, in 1100-2200ft water depths.

BP installed a 40-slot fixed platform in 1994, in the southeast corner of the Viosca Knoll block, in 1290ft water depth. Pompano's 10-well diverless subsea oil production template system was installed in 1995 in Mississippi Canyon, about 4.5mi southeast of the platform, at 1865ft water depth (Clarke and Cordner)[1], with first oil in 1996.

The field's Pliocene reserves and some of the offset Miocene reserves could be drilled from the platform with the use of extended reach drilling. The rest of Pompano's Miocene reserves were developed using the subsea well template[2] (Cordner and Klienhans).

Through-flowline systems

In a 1999 SPE paper by then-BP Exploration engineers James P. Cordner and John W. Kleinhans, a TFL system, deployed from a moored mobile offshore drilling unit (MODU), was selected for the field's subsea template after numerous concepts were evaluated[2].

"Based on the results, the best match-up of reservoir needs, including uncertainty about both well count and reservoir management needs, indicated that subsea facilities comprised of a 10-well, subsea template structure and designed for production wells outfitted for TFL servicing would best meet objectives," they wrote.

TFL was cutting edge technology when developed almost 30-40 years ago as an alternate solution to high cost, high mobilization drilling vessel intervention back into a subsea well. TFL was seen as the economic solution to Pompano's unique and troublesome reservoir properties that

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might be plagued by several planned (and unplanned) interventions, says Brian Skeels, emerging technology director at FMC Technologies and an adjunct professor of subsea engineering at the University of Houston.

While Pompano is currently the only field using a TFL system in the Gulf of Mexico, it's not the only one in the world.

"What started with Exxon's SPS project at Garden Banks 70/71 back in the 1970's later moved to Shell/Esso's Central Cormorant project in the UK's North Sea sector in the 1980s, and Statoil's (Saga Petroleum) Snorre project offshore Norway in 1992. TFL was also experimented with on other North Sea pilot projects for Mobil and Conoco in the same era," Skeels says.

Skeels, who serves on an API Subcommittee 17 executive committee, says that TFL continues to have its merits. "But, its cachet may have come and gone," he says, when compared to some of today's lower cost intervention solutions like monohull riserless intervention.

The way the TFL system works is that tools have to be pumped through a 4.5mi flowline from the Pompano platform and into a well in order to perform work that is typically done with slickline on conventional dry tree wells. This requires the TFL tools to be extremely flexible, almost like snakes, says Jason Leath, Director of Projects at Cross Group.

Deployment of the lower completion package. Photo from Cross Group.

"You have to pump them in and they go through a service loop in the tree and they go downhole. You have two production bores. You have to pump down one and reverse out, basically pumping your tool all the way back to the platform when it is done," he says.

The key to TFL technology, Skeels says, is understanding how it works and then building and installing the equipment correctly with that "pump down and pump back" understanding in mind. "If the pipeline is improperly constructed (welding slag or misalignment of joints) or the trees do not feature the right chamfers and entry/exit angles, or later on you developed a production problem, the pipe was clogged with paraffins, or you had debris issues like sand or corrosion, you could really get yourself in a bind by sticking a TFL tool somewhere in the maze of piping," Skeels says.

Stuart Morrison, a senior subsea engineer at Stone Energy who oversaw the completion workover riser (CWOR) design and refurbishment for the operator, says another problem is few people in the industry with this in-depth knowledge of TFL systems remain. Additionally, there's only one company that provides the pump-down equipment for TFL systems, Otis (now Halliburton).

Left: Tree ROV panel. Right: The insert safety valve ROV bucket. Photo from Stone Energy.

This meant Stone Energy had to find a way to intervene on its subsea template with an open mind, Morrison says, bringing in several intervention companies to offer solutions before eventually settling on Cross Group.

"We knew we had work to do, relative to the template," Castille says. "The system was in ill-repair and needed to be refurbished. Because of the cost of rigs today, putting a rig on location for a very minor intervention was not cost effective."

Stone Energy needed a more flexible system in order to carry out interventions on at least two wells that were shut-in, one of which had been out of production for 10 years. Stone laid out its needs, including the freedom to use DP semisubmersible or DP monohull vessel rather than a moored MODU.

Finding a solution

The Pompano field and its TFL system wasn't a total mystery to Cross Group. Several team members overseeing the project had previously worked on the original equipment for BP while at Saipem, says Larry Klentz, vice president, Operations, Cross Group.

Cross Group's proposal provided a new system, which would grant access to each wellbore and annulus through a new triple bore selector and valve assembly, allowing the work to be done with or without a riser. Working with Houston engineering firm OilPatch Technologies (OPT), the two companies created and manufactured this new system that would interface with both Cross Group's upper intervention package and the existing triple bore vertical tree/TFL system.

OPT lead the design, analysis, drawings, manufacturing, and assisted with testing of the new system. The work took approximately 18 months, says Gary Galle, associate principal and director of new markets and new technology, OPT.

The biggest challenge, says Galle, was figuring out the requirements. Cameron made the original equipment and work on the new system meant working with Cameron, Cross Group, Stone Energy, and others to define and close interfaces.

Galle says by keeping the adaptor's design as modular as possible, it allowed OPT to evolve with changing needs and requirements. "We broke it up into enough sub-components so that if we changed one, it wouldn't change the overall design," he says.

The technology

Cross Group considered several concepts

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An aerial shot of the *BOA Deep C*.
Photo from Cross Group.

Production rates comparison of the first two wells to be brought back into service following intervention work

Oil production rates	Well name: TB-02	Well name: TB-03
Prior to offline	825 bo/d (offline, Q2 2004)	325 bo/d (offline, Q4 2013)
After intervention	1350 bo/d IP (Flush Production)	1175 bo/d IP (Flush Production)
Current (as of March 2015)	900 bo/d IP	670 bo/d IP

Current gross production on platform from the Pompano wells, Pompano template wells, and Cardona wells is approximately 14,500 bo/d and 20 MMcf/d of gas.

before landing on the one selected, but this design in particular was, in-part, inspired by Klentz and his team's previous experience on Pompano.

"We call it (the triple bore selector) a dynamic funnel," says Klentz, who spent 14 years at Saipem before Cross Group. "It's a hydraulic actuator that shifts from whichever of the three bores that is selected, and that allows you to select whatever bore in which you need to work. Under that adaptor is a valve block that gives you the ability isolate the other bores, as well as pump in ports, full circulation capabilities, giving you full access to your toolstrings."

Klentz says while he and Leath were at Saipem, a 4x2 dual bore type package with a slickline run kickover tool was used on other projects. This allowed access to the annulus bore through a mono bore riser. "Building off that concept, originally, we thought we could do a hydraulic kickover, but this (adaptor) worked out to be the best, most efficient, fewer moving parts, if it breaks you can fix it easily."

For the Pompano intervention, Cross Group paired the adaptor with its existing 3.0 riserless intervention system in conjunction with some select equipment from the original CWOR and the new dynamic funnel assembly to fulfill the scope.

Cross Group said that one of the hurdles for the project was the requirement to run e-line tractor tool strings – an ability the original CWOR did not possess. The minimum requirement was a system rated for 1865ft water depth and a bore pressure of 5000psi.

"Through our package, it allows work to be done from a monohull vessel, which is a much smaller vessel, with a much smaller day rate," Klentz says. "The equipment spread is a quarter of what it would normally be, meaning lots of cost savings. It's safer because they don't have to set anchors, and can do it from a DP vessel.

"The package actually gives them greater capabilities because you can run larger vertical toolstrings through it than the original intervention package designed for this work," Klentz says.

Leath, agrees, saying: "They went from the biggest, bulkiest, most expensive way to do it 20 years ago to one of the smallest, most mobile methods of doing it today. I don't believe that type of thing has ever been done before."

Crossing the finish line

Cross Group, was also requested by Stone to help prepare the RFP (request for proposal), which provided the technical requirements to find and contract an appropriate vessel. Based upon the vessel assessment for the intervention project, Cross Group chose the up to 2000m deep water offshore construction vessel *BOA Deep C* for the job. The *BOA Deep C* comes equipped with two ROVs, a 250-ton active heave compensated crane, and 1150sq m deck space. Cross Group staged its equipment on the vessel's back deck.

The vessel arrived at the Port of Galveston in mid-November, and the crew set sail for the Louisiana coast shortly after Thanksgiving. The job was completed by mid-January with all parties proclaiming it to be a huge success (see table for production figures), despite a few hiccups due to the currents, and weather limitations, says Kevin Smith, a completion engineer with Stone Energy who prepared the intervention work plans on the two wells to be serviced. Smith says the crew rigged up a work tower to minimize the wind limitation on the crane.

All parties involved in the intervention attribute its success to open lines of communication.

Jimmy Reed, senior deepwater drilling superintendent for Stone Energy, who was responsible for the overall execution of the work said that the biggest challenge for any project is getting everyone on the same page, and the companies (Stone Energy and Cross Group) were able to have daily conference calls and discuss not just the operations but HSE support with all parties involved.

"There was outstanding communication, HSE achievement, and to top all that off, we got the job done. All the new equipment functioned well," Reed says.

"There were no issues safety wise, even with cramped quarters on which the personnel had to work; load on back of the vessel and perform the operations without getting injured, and no near misses," he says.

The future

Castille says the intervention completed in January is just the beginning of the revitalization of the subsea template, saying Stone Energy has invested $30 million in new tree technology for two wells, which could be a future workover or sidetrack. In addition, the company continues to add to Pompano. It recently tied in two Cardona wells and will develop the Amethyst discovery as one well subsea tieback.

"Pompano is producing 14-15,000 b/d," Castille says. "When we got it from BP production was at 4000 b/d." OE

Works Cited:

[1] Clarke, D. G., & Cordner, J. P. (1996, January 1). BP Exploration's Pompano Subsea Development: Operational Strategy for a Subsea Project. Offshore Technology Conference. doi:10.4043/8209-MS

[2] Kleinhans, J. W., & Cordner, J. P. (1999, February 1). Pompano Through-Flowline System. Society of Petroleum Engineers. doi:10.2118/54130-PA

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