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By David Wethe

March 26 (Bloomberg) -- The oilfield of the future is taking shape two miles underwater.

As explorers search for energy in ever-greater depths offshore, the technical challenges of ferrying oil and natural gas more than 10,000 feet through the ocean is spurring a drive to relocate production operations to the sea floor. Spending on subsea valves, pipelines and cables that will help build these underwater oilfields will grow to a record $13.9 billion this year, a 66 percent jump over the $8.4 billion spent last year, according to Quest Offshore Resources, an industry research consultant.

Equipment makers specializing in gear designed to handle the intense cold and high pressures of the submarine depths, including FMC Technologies Inc. and Cameron International Corp., are best positioned to gain from the surge in investment. As oil companies improve their ability to operate undersea with new technology, they'll be able to open up new areas to exploration at lower costs, said Astrid Sorensen, vice president of U.S.
offshore field development at Statoil ASA.

"The point now is to stretch the limits so you can put together a toolbox the way you need it," Sorensen said.

Operating more efficiently in ultra-deep water, with less maintenance and down-time from weather disruptions, can be worth billions to a company, said Martin Craighead, chief executive officer at Baker Hughes Inc. A 1 percent improvement in the oil recovery factor translates into $3.2 billion in the value of some projects, he said. It also carries high risk, as BP Plc's oil spill at the deep-water Macondo well in the Gulf of Mexico demonstrated to the world in 2010.

Underwater Evolution

Since oil companies first placed the opening to the well, or wellhead, on the seabed two decades ago, other equipment has gradually been following. The aim is to transplant underwater everything currently done at the surface, including well flow controls, basic processing, and transportation of the oil and gas to onshore markets. The University of Houston, which plans to offer the first U.S. graduate program in subsea engineering this fall, calls its vision of an underwater industrial oil city, overseen by free-swimming robots, "Project Atlantis."

To reach that goal, companies must figure out how to design equipment that can be operated by remote control, withstand the extreme conditions and corrosive fluids prevalent in the deep- water environment, while making it the safest and most cost- effective option, said David Eyton, head of technology at BP Plc, in an interview at the IHS CERAWeek energy conference in Houston earlier this month.

Balancing Act

"There is a balance to be struck here between the capital savings that you can achieve, in theory, from putting more and more of it on the seabed, and operating costs and reliability and safety of what you've created," Eyton said.

The best proxy for the surge in subsea investment is a “tree” of pressure valves that sits at the wellhead on the sea floor to control the flow of oil and gas, said Mehdi Menouar, an analyst at Bloomberg Industries in Princeton, New Jersey.

Spending on subsea trees is expected to hit a record $4.7 billion this year, more than double the amount spent in 2005, and climb another 29 percent by the end of 2017, according to Quest Offshore.

“A powerful wave of orders has begun to affect subsea equipment providers that in our opinion will last for at least the next five years and probably more,” James Crandell, an analyst at Cowen Securities in New York, wrote Feb. 21 in a note to investors. “We believe no one will benefit more from this wave than FMC Technologies.”

Subsea Services

FMC had orders for 159 subsea trees last year, while General Electric Co.’s oil and gas unit had orders for 126, and Cameron 83, according to Quest Offshore. FMC’s revenue for subsea services may reach $2.5 billion in 2016, and double within the next five years, Chief Executive Officer John Gremp said at a March 20 presentation at the Howard Weil energy conference in New Orleans. Cameron said March 12 it landed a
$600 million order from Petroleo Brasileiro SA for 47 of the trees.

After falling 18 percent in 2012, FMC has gained 23 percent so far this year, and Cameron is up 13 percent.

When the first subsea well was installed in shallow waters in the 1960s, the opening to the well, or wellhead, was placed on top of a production platform with stilt-like legs reaching to the sea floor. All the related production equipment was on the platform for easy access and maintenance.

Companies have been pushing out into deeper waters and harsher environments as old oil discoveries play out and new supplies become more difficult to find. Transocean Ltd. said last month it set a new record drilling in 10,385 feet of water.

Exploring Mars

“If a typical deep-water well is like going to the moon, then the Gulf of Mexico ultra-deepwater frontier is like going to Mars,” Baker Hughes’ CEO Craighead told investors March 19 at the Howard Weil conference.

Wellheads in the deep water now sit on the seabed, along with equipment including blow-out preventers and pressure-valve stacks. Firehose-like umbilical cords with layers of metal and other materials protect the electrical lines and cables that connect the platform to the equipment at the sea floor.

Long strings of pipe carry the oil or gas up to floating production vessels that span the length of three American football fields, where workers and machinery separate, clean and process the oil, gas and water produced from the well. Oil is loaded on tankers to be carried away. Gas is piped back down to the sea floor and pushed through pipelines back to shore, while water is dispersed overboard.

FMC’s Vision

Instead of all that up and down travel through the ocean, FMC Technologies wants to move those operations to the sea floor, said Tore Halvorsen, senior vice president of subsea technologies at FMC.

There would be less need for the massive, floating production platforms that can cost as much as $1 billion and contain tons of equipment. Operating costs would drop with no need to ferry workers by helicopter to offshore sites, or house and feed them there, Halvorsen said. And the less equipment sitting at the top of the sea, the less vulnerable operations would be to hurricanes sweeping through warm seawaters during the summer.

With more equipment located at the seafloor and not tied into platforms, wells could be more widely spaced, draining the reservoir more efficiently, he said. And if processing is done at the sea floor, water would be separated and left behind, minimizing energy consumption and eliminating the problem of ice crystals plugging up pipelines in the cold waters below.

Submarine Grid

To build the integrated system the industry envisions, a network of remote monitoring sensors will be needed to transmit data and instructions between surface and sea floor; swimming robots, untethered by the usual long cables to the production platform, will monitor and execute the work, and a new offshore electrical grid will power the submarine communities.

Cameron and Schlumberger Ltd., the world's largest oilfield services provider, announced a joint venture deal last year to take a more holistic approach to designing a subsea system, blending the service company's reservoir expertise with Cameron's mechanical knowledge of valves, pumps and other machinery.

Siemens AG is working on the power piece. The submarine grid, which will include onshore generation plants running as much as 100 megawatts of electricity through power lines along the sea floor to the oilfields, should be ready to roll out by the end of next year, Adil Toubia, head of Siemens' oil and gas business, said in an interview in Houston at the IHS CERAWeek energy conference.

"We'll be the engine to drive this," he said.

Robot Watchmen

Woods Hole Oceanographic Institution is one of the many companies and research groups working on untethering and improving underwater robots. At two miles undersea, where temperatures drop to 40 degrees and pressures are 300 times greater than at the surface, companies will have to rely on robots as their eyes, ears, and hands.

"Subsea engineering is like a new frontier," said Matthew Franchek, a mechanical engineering professor who's heading up the new subsea master's program at the University of Houston. Imagine building a world you could never visit, he said. "We can at least walk on the moon. You're not walking in subsea."

The world saw submarine robots at work during BP's oil spill, when the remote-control vehicles were dispatched to troubleshoot the broken machinery of the Macondo well 5,000 feet underwater. The new robots will need to be far more advanced, with better sensors, gauges and programming to evaluate and respond to their surroundings, said Larry Madin, director of research at Woods Hole.

Underwater Docks

Franchek envisions the robots remaining docked to charging stations near the underwater cities until they're needed.

"There's no reason to have to come up for air," he said.

Royal Dutch Shell Plc is working on undersea vehicles it calls "flying nodes," which it says are cheaper and more lightweight than today's machines. The nodes are being designed to swim down and collect seismic data on the sea floor that will be used to form better images of the underground oil reservoir.

Subsea development is still in the "middle innings," said Stephen Trauber, vice chairman and global head of energy at Citigroup Inc.

“It’s huge and expected to stay strong,” he said. In the oilfield service sector, “That’s the biggest growth area there is.”

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