First drilling FPSO goes to work offshore Africa

Judy Murray
May 1, 2009

In 2Q, 2009, Murphy West Africa Ltd, Societe Nationale Des Petroles du Congo, and PA Resources AB will put the world's first FDPSO into operation on the Republic of Congo's Azurite field.

The deepwater Azurite field lies offshore the Republic of Congo in 4,600 ft (1,400 m) of water in the Mer Profonde Sud block approximately 80 nautical miles offshore.

WFM designed and built another deck to support the drilling structure on the FDPSO. (Image courtesy of William Jacob Management Inc.)

The field development program for Azurite consists of a spread-moored floating, drilling, production, storage, and offloading (FDPSO) vessel tied to a subsea manifold. The manifold has 10 slots — six for oil and gas production and four for water injection — and is connected to the FDPSO by three flexible high-pressure risers that were designed, fabricated, and installed by Technip. Two of the risers are production risers, and one is for water injection. Ten enhanced vertical deepwater trees, provided by FMC Technologies, are tied in to the subsea manifold by flexible well jumpers. A multiphase pump will provide artificial lift for the field.

The making of an FDPSO

In October, 2006, Murphy Oil Corp. subsidiary Murphy West Africa Ltd. issued Prosafe a letter of intent for the conversion and operation of the world's first FDPSO. The US $400 million contract that was signed in November 2007 gave Prosafe responsibility for converting the very large crude carrier M/T Europe into the Azurite FDPSO.

The vessel underwent conversion between July 2007 and February 2009 at the Keppel Shipyard in Singapore.

After awarding the conversion project to Prosafe, Murphy selected drilling contractor Nabors Industries Ltd. for the drilling component of the system. Nabors, which supervised the rig fabrication, was to provide and erect the drilling rig on the FDPSO such that the completed vessel would be equipped with a modular drilling package that could be removed and reused elsewhere when the drilling work on the Azurite field was completed.

Murphy's decision to go with a new type of floating production system was based in part on the fact that Azurite would be a fast-track project. With high rig rates and limited availability of suitable mobile offshore drilling units, the company was in a position to consider less traditional options that would allow it to achieve first oil in 2009.

After evaluating a number of production concepts, including a spar/FPSO arrangement like the one

used on the Kikeh field offshore Malaysia and a production semisubmersible option like the one being used on Thunder Hawk in the Gulf of Mexico, Murphy decided that the most suitable solution was the FDPSO.

Murphy remained schedule-driven throughout the project and worked closely with the other companies involved to make sure the schedule was kept. One of the keys to success on the project was the focus on interfaces — interaction between operator and contractors and among the contractors working together on the project.

Communication and cooperation were critical.

This project marked the first time an FPSO would be developed with a mobile drilling rig. Because no such project had been undertaken before, the construction of the FDPSO brought with it a number of significant challenges.

Dealing with those challenges became the purview of William Jacob Management (WJM) Inc. of Houston.

The company's initial involvement was straightforward — to determine loading limits for the deck and hull for Prosafe. When the time came to place the drilling rig on the deck, however, WJM's role changed.

According to Trevor F. Smith, technical director at WJM, the unique nature of the project brought together two specialized groups (an FPSO operator and a drilling contractor) that had no experience working together. That lack of experience led to construction and installation challenges when it came time to place the rig on the deck.

"The first concept was to put the rig and all of its equipment directly onto the deck of the vessel," Smith explained, "which wouldn't work because the deck is cambered and can't support the drilling structure that way. The rig also needs to have clearance underneath the drilling decks because the tanker is storing petroleum at the surface, and a buffer is required to allow for foam firefighting capability. We proposed some concepts, layouts, and ideas that we eventually ended up building."

The most critical component of the solution was the concept of a support structure for the rig. "We took the deck, moved it up three meters (10 ft), and built another deck to support the drilling structure," Smith explained. "That was our first work scope, but as the project progressed, the scope of work continued to change."

Michael Duffy, president of WJM, said the work his company did addressed what he called the "gap scope" — "the work that fell clearly under neither the drilling scope nor the vessel scope."

Running piping throughout the drilling area and into the rig substructure was the next challenge.

"We took the vessel specification and the rig specifications and had to build almost a cross-breed between the two to make it work," Smith said. "It was a bit of trial and error, and there were challenges because there were schedule concerns, and the inspection authorities had to class the vessel."

In the end, WJM designed the rig decks and piping and oversaw their construction in the PT Citra yard in Indonesia. The rig installation and commissioning were done in Keppel's Benoi facility under the supervision of Murphy and Nabors.

In a class by itself

DNV's Singapore Offshore Class Centre carried out the classing exercise. The life extension program involved assessing global and local strength, fatigue life analysis for critical connections, and replacement of structural steel as well as preparations for periodical in-water surveys.

Problems that required solutions during the conversion and classification processes included the physical arrangement of adjacent process and utilities modules with their associated structures, such as piping and cabling. Mitigating the effect of motions was also necessary.

DNV also assisted Prosafe in creating a coherent safety philosophy when combining two ongoing activities that are subject to different regulations. The society examined topics such as defining accidental loads, shutdown logic, area classification, and fire fighting. These issues were addressed within the framework of existing DNV offshore specifications and standards with a certain amount of interpretation and prioritizing.

DNV verified the process plant design guided by the company's Offshore Standards and Rules as templates that had been modified according to Prosafe's specification. The majority of the topsides equipment also required DNV certification.

In mid-December 2008, the vessel underwent commissioning in the Keppel Shipyard before beginning its journey to Republic of Congo.

The completed vessel is a spread-moored FDPSO with a storage capacity of 1.4 MMbbl of oil and a processing capacity of 60,000 b/d of total liquids and 40,000 b/d of oil.

Another in the works

In early September 2008, Brazil's Petroserv SA awarded Sembcorp Marine subsidiary Sembawang Shipyard Pte Ltd. a contract to convert a 111,567-dwt tanker into a dynamically positioned FDPSO with extended well testing drilling capability.

When the new FDPSO is completed, it will have a drilling and storage capacity of 300,000 bbl. The vessel, to be named Dynamic Producer, is to be delivered to the owners in 4Q 2009.

Dynamic Producer Inc. will operate the new DP FDPSO on a long-term charter to Petrobras. The vessel will work in the Espírito Santo, Campos, and Santos basins off Brazil.