Kikeh Deepwater Block- Reenergizing Malaysia’s Petroleum Industry

According to Oil & Gas Journal (OGJ), Malaysia held proven oil reserves of 3.0 billion barrels as of January 2007, down from a peak of 4.6 billion barrels in 1996. The majority of the country’s oil reserves are located off the coast of peninsular Malaysia, and tend to be of high quality. Malaysia’s benchmark crude, Tapis Blend, is very light and sweet with an API gravity of 44° and sulfur content of 0.08 percent by weight. Several new oil production projects have come online during the last few years, although Malaysia’s oil output declined somewhat in 2006. Average production for 2006 stood at 798,000 barrels per day (bbl/d), down 7 percent from 2005 levels. During 2006, Malaysia consumed an estimated 515,000 bbl/d of oil, with net exports of about 283,000 bbl/d. Oil production has been falling in Malaysia in recent times as fields mature, but a new deepwater oil field, Kikeh, operated by Murphy Oil, came on-stream in August 2007.

Malaysia’s new oil production projects include the Kikeh block, whose operator Murphy Oil expects initial production of 40,000 bbl/d in January 2008, ramping up to 120,000 bbl/d later in the year, and the Shell-operated Gumusut/Kakap deepwater fields which are scheduled to begin production in 2010, possibly reaching 150,000 bbl/d by 2011. Shell also expects to begin oil production at the deepwater Malikai field by 2012, although no production timetable is set.

Our article will be concentrating on the Murphy Oil-operated Kikeh Block, as Malaysia’s maiden offshore deepwater development, which has established a number of “firsts” on its way from discovery in August 2003 to production in August of 2007. So significant were the innovations at the field, that Kikeh qualified for the Offshore list of Top 5 field development projects for 2007. The Kikeh field development has also opened up new avenues for development offshore Malaysia which promise the revitalization of Malaysia’s declining exploration & production activity.

What Murphy Oil did

The Kikeh Field is located 110 kilometers offshore Sabah in 4,400 feet of water and is the first deepwater oil production in Malaysia. Kikeh was developed as a stand-alone facility with oil being produced from both subsea and dry tree wells on board a spar facility. The oil is processed, stored and exported from a Floating Production Storage and Offloading (FPSO) vessel. Murphy, as Operator, has an 80% working interest in the Kikeh Field with

Oil has been produced from offshore locations since the 1950s. Originally, all oil platforms sat on the seabed, but as exploration moved to deeper waters and more distant locations in the 1970s, floating production systems came to be used. Oil produced from offshore production platforms can be transported to the mainland either by pipeline or by tanker. When a tanker solution is chosen, it is necessary to accumulate oil in some form of tank such that an oil tanker is not continuously occupied while sufficient oil is produced to fill the tanker. Often the solution is a decommissioned oil tanker which has been stripped down and...
PETRONAS Carigali Sdn Bhd holding the remaining interest. First oil production commenced in August of 2007, 5 years after commercial discovery in the block.

Murphy Oil used a spar² dry-tree unit (DTU) for the Kikeh development concept, one of its advantages being the ability to bring on a large number of wells through the spar, which can accommodate a more accessible well pattern. According to Murphy Sabah Oil Co VP, Operations Roger Jenkins “a DTU lowers drilling expenses, lowers life-of-field operating expenditure, enhances recovery, and enhances well intervention”. “With the limitation of few vessels in the region capable of intervention services, the DTU is an obvious plus over an all-subsea concept. We see now that drilling costs would have been much higher with an all-subsea development using a MODU (mobile offshore drilling unit) for drilling.”

Technip was awarded a full engineering, procurement, construction, installation, and commissioning (EPIC) contract to design the Kikeh spar. The contract included the delivery of the spar hull and topsides as well as the drilling and production riser systems and the marine installation, hookup, and commissioning of the facilities offshore.

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² A spar is a cylindrical, partially submerged offshore drilling and production platform that is particularly well adapted to deepwater. Its four major systems are hull, moorings, topsides (Topsides are surface installations allowing the drilling and/or production and/or processing of offshore hydrocarbons), and risers (A riser is a pipe or assembly of flexible or rigid pipes used to transfer produced fluids from the seabed to surface facilities, and transfer injection or control fluids from the surface facilities to the seabed). The spar relies on a traditional mooring system (that is, anchor-spread mooring) to maintain its position. About 90 percent of the structure is underwater. The distinguishing feature of a spar is its deep-draft hull, which produces very favorable motion characteristics compared to other floating concepts. Low motions and a protected centerwell also provide an excellent configuration for deepwater operations. Water depth capability has been stated by industry as ranging up to 10,000 ft.
“Although Kikeh isn’t a huge spar, it is definitely not on the small end when compared with the spars operating in the Gulf of Mexico,” Jenkins says. “In fact, this is probably one of the largest spars from a standpoint of well count,” Jenkins says, “because there are 24 well slots on the Kikeh spar.”

According to Technip, the spar is a good choice for Kikeh because it provides a stable floating platform that allows drilling and production via dry trees, significantly reducing cost and complexity of the drilling operations. The Kikeh spar designed to accommodate a tender assist drilling (TAD) rig, comprising a temporary drilling derrick equipment set mounted on the spar and a semisubmersible drilling tender barge, which is moored alongside. This allows the operator to avoid the capital cost of installing permanent drilling equipment on the spar itself.

For the most part, the design principles and configuration for the Kikeh spar hull are very similar to the Gulf of Mexico spars. One difference, however, is that the benign metocean criteria offshore Malaysia allowed the draft, freeboard, and weight of the spar hull to be decreased from a comparable Gulf of Mexico design.

Another plus was that the spar hull and topsides could be installed without using deepwater heavy lift vessels or DP construction barges, which are not readily available in the region. The topsides was designed to be installed by floatover, a first for spar installation.

Kikeh firsts

- First deepwater development offshore Malaysia
- First spar constructed in Malaysia
- First spar installed outside the Gulf of Mexico
- First topsides floatover onto a spar
- First turret-moored FPSO in conjunction with a spar
- First use of a tender assisted drilling rig on a spar

Earlier in 2007, Malaysia Marine Heavy and Heavy Engineering Sdn Bhd (MMHE), a subsidiary of MISC, also made history when it completed the construction of Malaysia’s first deepwater facility – the Kikeh Floating, Production, Storage and Offloading (FPSO Kikeh) facility – the biggest to be built in Malaysia. FPSO Kikeh also has the largest external turret ever built for any FPSO in the world. MMHE also completed the region’s first Truss Spar floating production unit for the Kikeh field. The successful delivery of FPSO Kikeh and Kikeh Truss Spar by a local shipyard signifies not only an important milestone in Malaysia’s foray into the upstream deepwater industry but bodes well for the country’s aspiration to position itself as an emerging regional centre for engineering and construction of deepwater facilities.

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3 The word “Metocean” was constructed from the contraction of meteorology and oceanology. Metocean activities act as a support for design and operation of the offshore structures of the Industry: platforms and other oil & gas production systems, ships, barges, and of coastal planning and management: dykes and breakwaters, sewage outlets, hydrodynamics of sediment and pollutant transport; Metocean studies rely mainly on statistics of oceanographic measurements, on hindcast using numerical models, and on the identification and estimation of characteristic quantities relevant to the phenomena of interest, i.e. essentially waves, wind and currents.

4 A floatover is an installation method of an integrated production deck (topsides) on a fixed or floating structure without any heavy lift operation. In the case of a catamaran floatover installation, the integrated topsides are positioned over the substructure using two lateral barges, achieving load transfer by ballasting and deballasting operations.
Offshore Thrust

In February 2007, PETRONAS started construction of the new Sabah Oil and Gas Terminal (SOGT), which will have a capacity to handle 300,000 bbl/d of oil and 1 Bcf/d of natural gas. The construction of the SOGT terminal has led many analysts to believe that new deepwater oil and natural gas production slated to come onstream over the next several years in Sabah will be destined for export markets.

A Big Turret!

FPSO Kikeh (Source: offshore-technology.com)
What next?

In conclusion, despite the declining reserves and production in Malaysia, the country is continuously searching for new opportunities to boost production and reserves, not only in Malaysia, but also abroad. The Kikeh deepwater block proves that there is still untapped oil & gas potential offshore Malaysia, and with oil prices soaring past the US$100 per barrel mark, even marginal fields once thought un-commercial, and alternative sources such as tar and oil sands can be utilised to produce the lifeblood of modern civilisation. Malaysia must continually strive to develop its local oil & gas capabilities, and also position itself not only as a producer and exporter of oil & gas, but also as a hub for the region’s oil & gas industry, strengthen its refining capacity, and to eventually develop itself into a hub for oil trading.