Offshore

Deepwater rig designs give up mobility for stability, storage

Larger drilling units pursue production option

- *Gusto 10,000 [14,912 bytes]*
- *Exmar 2500 [17,931 bytes]*
- *Noble Super EVA [13,059 bytes]*
- *Hoop Huisman JBF 6000 [17,957 bytes]*
- *Bass T-Semi [14,084 bytes]*

Naval architects and mobile rig designers are increasingly challenged to try to beat the dichotomy of building a sophisticated rig for deepwater challenges while at the same time being cost-efficient. The new designs being marketed are focused on giving the operator more drilling efficiency, reducing weather and re-supply downtime, and providing for easier well testing and early production.

Because so many functions depend on vessel stability, many of the drillship designs are trying to achieve the motion characteristics of a semisubmersible, and some of the semisubmersible designs and conversions are measures to boost already substantial stability.

A representative of drilling contractor, Navis, said that "most operators look for drillships instead of semisubmersibles. Drillships have a lot of features that they don't have on a semisubmersible. With respect to deckload, you can have a much higher deckload on a drillship than a semi. But at the same time, a hull is a hull, a shipshape is a shipshape. The designer must improve motion characteristics in order to make the hulls better for operation."

Mobility versus stability

For example, Navis has developed a drillship with three moonpools and a cross-sectional hull that reduces the water line area thereby cutting motion response. On the semisubmersible side, Exmar has developed a ring pontoon semisubmersible that offers more stability than any other semi design. Also, Bennett & Associates and Noble Drilling have also each developed designs based on a three-sided hull, which provides excellent seakeeping for the cost.

There are also designs such as the "Deep Draft Floater" and "Deepwater Drilling Spar" that seek to provide more stability than any other design as well as providing a protected riser.

Often enough, increased hull stability comes with a price. The Exmar ring pontoon and the drilling spar compromise mobility, a key factor in the deepwater market. However, many are claiming that mobility is no longer the signficiant factor it once was. Many drilling contractors are developing rigs for a "single theater." This means the rig will spend its useful life in one sector of the world - such as the deepwater Gulf of Mexico - and will not be moved to other theaters.

Designers of these less mobile rigs feel that if the rig needs to be moved, there are plenty of vessels available to take these rigs on ocean tows. Of course, a spar or deep draft floater would not have that mobility.

Harris Knecht, President of Exmar, commented on the mobility issue and Exmar's ring pontooon design: "Mobility was an issue back in the 1970s when the fleet was beginning to grow. Rigs had to move from theater to theater. Mobility is no longer an issue, today. Now that we have a deepwater theater in the Gulf of Mexico, Brazil, and Africa, a good deepwater rig in any one of those theaters will probably never have to leave."

But others are skeptical. Paul Dixon, Chief Naval Architect with Friede & Goldman, said that "contractors want a rig that's as fast as possible. They want total efficiency, they all want more; no one settles for less. If a rig is not as quick, it can't be as efficient. If more efficient in drilling and less in transit, it's not a good design."

These designs will however be key for development drilling, but mobility is still a major role in exploration. Hence the increase in the rush of drillships.

Production options

A number of the new designs are being developed to accommodate early well testing and minor production. A majority of the new drillship designs feature crude oil storage and extended well testing. This is being designed into the vessel to provide for possible conversion into an FPSO in the future, if necessary.

However, the addition of production capabilities comes with increased costs. A drillship that can handle production must be much larger. Therefore, the operators must pay for extra hull size they do not plan on using in the near future, and the topsides must be arranged in such a way that changes are convenient later. In a sense, they are building that capability speculatively.

Semisubmersibles, however, are being designed with more production equipment. The stability and motion characteristics of a semisubmersible make it more attractive for production than any other vessel. The major problem, not a small one, is that compromises with the drilling equipment are necessary. This has led to much larger vessels such as the Exmar 2500, which covers two acres. Harris Knecht said that the Exmar has been studied for adding production, due to its size, and drilling equipment has been moved to the front of the vessel and production added to the back end.

Paul Dixon explains that "people are paying for extra life. What you want put on board is directly related to the price of the vessel. The more non-essential drilling equipment, the higher the price, because you need a bigger vessel."

"All the equipment for producing is not as expensive as all the equipment for drilling. A full production unit is going to be less expensive than full drilling. What percentage do you want. That is the question for the operator," Dixon added.

Drilling efficiency

Drilling efficiency is another trend for designs. Rig designers are finding different and more efficient ways to lay out a rig, so as to make drilling as efficient as possible. One such way is

vertical racking of risers, rather than conventionally laying them down.

The Hoop-Huisman JBF 6000 design incorporates an interesting twist to riser storage. The riser sections are stacked vertically in the columns of the vessel. This allows for maximum use of available space and allows for more available deck area.

Another influencing factor is the use of dual pipe-handling systems and increased automation. The Sedco Express features three separate stations where pipe is made up and broken out. The rig also has built in systems for wireline, MWD/LWD, and coiled tubing operations, and an integrated mud and cement pumping system. These design innovations improve drilling performance by minimizing nonproductive time.

Many of these designs try to achieve the optimal characteristics of different types of vessels, such as drillships attempting to duplicate the stability of a semisubmersible. This "cross-pollination" of designs is a great benefit to the industry. Such design innovation appears to be leading to a "mega-rig," a vessel that will be able to handle all the tasks - from drilling the well to refining the oil - and be cost-effective in the process.

The following are descriptions of some of the more innovative deepwater semisubmersible designs.

Exmar 2500

Exmar has developed the Exmar 2500 semisubmersible, referred to as an "Island" design. This is touted as the first truly new design for ultra deepwater offshore exploration in the 21st century. Harris Knecht, President of Exmar, justifies this claim: "The uniqueness of the design comes from the fact that we started from a clean sheet of paper, not just modifying designs from the 1980s."

The design focuses on deepwater, high currents, and drilling efficiency. The 2500 design has about 3,900 sq meters of usable deck area. The semisubmersible can drill in 10,000 plus ft water depth, can handle 10,000 tons of variable deck load, 14,000 tons total payload, and has a crude oil storage capacity of 10,000 bbl. The semi can be dynamically positioned (DP), moored, or both.

A unique feature of the design is the ring pontoon hull shape, which offers greater stability than other semis. This is the first time the ring pontoon has been used for a mobile rig. Reduced mobility is offset by the much-increased stability. The ring pontoons allows for lower current forces than equivalent displacement twin pontoons, and achieves deep draft motions with shallower draft hull configuration.

No contracts have been signed for the 2500 as of yet, but it is being actively bid by a few deepwater drilling contractors.

Exmar is also marketing the Exmar II Series design - a smaller version of the 2500, also featuring the ring pontoon. The Exmar II has 2,900 sq meters of usable deck area, can operate in 6,000 ft water depths, and has 9,500 tons total payload.

Sedco Express

Sedco Express, developed by Sedco Forex, is a compact design semisubmersible that is capable of reducing total well construction time by 25%, and total well construction cost by as much as 30%.

The Express is a fifth-generation modular design built to operate in 7,500 ft water depth in mild environments. The 328 ft by 226 ft semi is capable of DP drilling and mooring applications, and has a 6,000-ton variable load in transit and on location.

The savings generated from some of the rigs features including dual pipe-handling stations, built in wireline/MWD/LWD/coiled tubing systems, and an integrated mud and cement pumping system. These features improve drilling performance by minimizing nonproductive time.

The Express also incorporates advanced ergonomics and a low center of gravity. Much of the mass of the rig is located below the water line, which lowers the center of gravity and improves stability. The engine room and machinery spaces are located in the pontoons. The low center of gravity allows for a lighter deck structure and increased mobility.

Two Sedco Express rigs are currently under construction with delivery scheduled for the fourth quarter of 1999 and the first quarter of 2000.

JBF 6000

The JBF 6000 was developed by shipyard De Hoop-Lobith and Huisman-Itrec as a cost-effective made-to-fit semisubmersible for ultra deepwater drilling. The JBF 6000 is based on the M.S.V. Amethyst, but with a variable deck load of 6,000 tons and a drilling capacity to 8,200 ft water depth.

The fully DP semisubmersible measures 281 ft by 215 ft in area, and has eight forward and eight aft omnidirectional thrusters. The JBF 6000 has several unique features incorporated into the design.

One interesting aspect is that risers also are stored vertically in the columns. This allows for maximization of space. Also, a portion of the active mud system is stored in the pontoons. A box girder mast structure is used instead of the conventional lattice derrick. These innovations allow for a more compact design, and offer significant cost, size and space savings.

F&G Millenium

The Millennium is a fifth generation semisubmersible designed by Friede & Goldman. The configuration consists of twin-hull pontoons with four corner columns, which support the upper deck and provide operating stability. The design is rated for 7,500 ft water depth in severe environments such as the North Sea and offshore Newfoundland.

"We are claiming 7,500 ft capabilities. We don't think anyone knows what it takes to drill in 10,000 ft of water, so we are claiming 7,500 ft. We are staying rational," explains Paul Dixon, F&G Chief Naval Architect.

Stationkeeping is accomplished with a DP DPS-2 system or DPS-3, depending upon what the operator wants, and can be upgraded to an 8 point pre-set mooring system. Compartments for eight thrusters are also included in the design. The overall length of the vessel is 325.4 ft, with a beam of 258.1 ft.

The Millenium is a fifth generation single activity rig with what F&G calls "enhanced pipe

handling." This allows the rig to do a lot of the dual activity topside - not dual strings, not dual risers being run, but above the rig floor, there is dual activity, according to the designers.

This allows for economical savings by doing the pipe handling topside. "On a semi, which is weight conscious, if you try to do too much topside, then you cut into the economics," Dixon says. "Or too much below the rig floor, you can also cut into the economics. The savings is there with the efficient pipe handling topside."

A letter of intent has been signed on the Millenium for Canadian waters. This will include DP and mooring, but no contract has been signed yet. F&G is also in intense negotiations with an oil company and two or three contractors bidding this rig to that oil company.

Noble Super EVA

The Super EVA is a new design semisubmersible capable of drilling in 10,000 ft water depths. It is based on the EVA 4000 conversion. The EVA has a 79 ft draft, a 6,600 ton vertical deckload, and a payload of 14,000 tons while operating. The unit features a dual mud system, vertical riser storage in 100-ft lengths, casing make up and setback while drilling, and multiple subsea tree handling capability.

The unique feature of the EVA is its three sides. It has the distinct advantage of being fully equipped with a nine-point mooring system and full DP with thrusters. The unit can operate in a moored configuration in up to 6,000 ft water depths, and 10,000 ft in full DP. This allows for better motions and thruster curves. The dual mode stationkeeping mooring system has 9 anchor points (three off each side), this gives a distinct advantage over a four-sided design with 8 anchors (two off each side). If an anchor is lost on this design, it still retains the support of two other anchors, not one anchor as on a four-sided unit. The Super EVA is also the first rig to be designed to include the Gulf of Mexico loop current event as operating criteria.

The design is still in the early stages with some engineering underway. The construction time is 24 months. No contract has been signed yet.

T-Semi

Bennett & Associates has developed the T-Semi, a three-column design capable of 7,000 ft water depth operation. The vessel can be DP or moored, has a variable deckload of 7,000 tons, and 43,350 tons displacement. The vessel was designed for milder operations such as the Gulf of Mexico and West Africa, and is not suited for harsh environment like the North Sea. The unit measures 259 ft by 299 ft in area.

The triangular design provides for a very hydro-dynamically efficient drilling unit. The triangular hull form adds a great deal more stability than square or rectangle hulls. The T-Semi has also been fitted with the company's patented center caisson to improve the vessel's motion characteristics.

The caisson also provides substantial support for the upper hull and the drilling loads and will not increase the hydrodynamic loading of the unit. The center caisson also provides protection for the drilling riser from the highest energy portion of the waves and the wind-driven currents.

Another feature of the design is the lower hull is made up of three pontoons that form a triangular ring at the base of the columns. These are attached with three radial sections that extend through

the center unit and define the center caisson.

Bennett & Associates has also developed the B-Semi which is a conventional box type of semisubmersible capable of operating in 5,000 ft water depths. The unit features 34,600 tons displacement and 6,000 tons variable deckload capacity. It can also be DP or moored.

GVA 4500, 5800E, 9500 DEPS

GVA has developed three new mobile rig designs:

- The GVA 4500 is a "modernized" and enhanced version of the proven GVA 4500 with two units in operation - Transocean Richardson and Transocean Rather. The GVA 4500 was developed to meet stringent motion characteristic requirements for worldwide operation in any environment. The design is capable of working in water depths up to 6,560 ft and can be DP or moored. The moored version has a deck and column payload of 4,500 tons, and the DP version has a deck and column payload of 5,000 tons while operating. The GVA 4500M has also been developed and is basically the same design as the 4500 but is equipped for only moderate conditions.
- The GVA 5800 E is based on the 4000 and 4500. It is suitable for operation in harsh environments. It can be either DP or moored as well and can operate in 4,920 ft of water depth in the DP version, but upgradable to 8,200 ft. It features a total payload of 13,500 tons in operation. A moderate environment version of the 5800 has been developed also called the 5800 M.
- The third design is the GVA 9500 DEPS. The rig is designed for deepwater exploration and production drilling at 6,560 ft water depth. It can perform extended well testing with 60,000 - 100,000 bbl of crude oil storage. The deck payload in operation is set at 9,000 tons. It is available with full DP or 8-point mooring. Other notable semisubmersible mobile rig designs include the following:
- The Bingo 8000 from Trosvik has a 7,500 ft water depth capability, and has six columns and is self-propelled. The unit currently is under construction for Marine Drilling, and will be known as the Marine 700.
- The RBS-6 from Reading & Bates/ Ishikawajima-Harima is capability of 5,000 ft water depth, and has four columns and is propulsion assisted. One is under construction for R&B Falcon.
- Ensco 7500 has a drilling capability of 7,500 ft water depth, and can be moored or stationed with DP.

The following are descriptions of some of the more innovative drillship designs that have been recently unveiled for the deepwater MODU market:

Gusto 10,000, P-10,000 DP

The Gusto 10,000 and P-10,000 designs are essentially the same design - a 10,000 ft water depth capability drillship. The only difference is that the P-10,000 features an extended well testing unit.

The dimensions of the 10,000 (689 ft overall length, 105 ft width, 32.8 ft draft) are designed to provide a high payload capacity and have superior motion characteristics. The unit is designed for dual to triple redundant DP operations, and has two underwater mountable azimuthing thrusters aft, three retrievable azimuthing thrusters in the midship, and two bow tunnel thrusters. It also has an

open riser hold designed to store 10,000 ft of 75 ft long risers, and can accommodate a single derrick suitable for dual handling operations. Vessel costs presently are less than $140 million, exclusive of drilling equipment, and can be delivered in less than 20 months.

The P-10,000 includes the same features as the 10,000 but with the additional capability to perform well testing and processing of the well fluids. It also has a 200,000 bbl crude oil capacity in the hull. Due to crude oil storage in the hull, all drilling and production equipment is modularized, with mud and process modules located aft of the derrick. To increase stability, the P-10,000 measures 12.5 ft wider than the 10,000 (117.5 ft), and 66.6 ft longer (755.6 ft).

The Gusto 10,000 design is being used for the Pride Europe and Pride Africa drillships, currently under construction.

R&B Falcon Drillship

Reading & Bates and Samsung Heavy Industries have designed and are currently constructing three new identical double-hulled, fully-automated, ultra-deepwater drillships. Two of these have received contracts from Conoco.

The design is rated for operations in 10,000 ft water depths with initial outfitting for operations in 7,500 ft. The unit incorporates a triple-redundancy DP system designed to DP-3 standards and six azimuthing FPP thrusters. The overall length of the vessel is 726.5 ft with a breadth of 137.8 ft and a 42.6 ft draft (59 ft operating with thruster). Displacement for the vessel is rated at 103,000 mt. The vessel is also designed for 22,580 mt of variable deckload.

The drillship was designed for exploratory drilling, but is also suited for development drilling with a 97,400 bbl crude oil capacity outfitting it for extended well testing operations. This also serves to give it the eventual option of conversion into an FPSO. One of the most interesting features of this design is the double-hull feature, which is technology transferred from Conoco's tanker experience. This will further ensure maximum environmental safety for the production aspect of the design.

The first vessel, Deepwater Pathfinder, will be delivered in September, followed by the Deepwater Frontier in January. The third unnamed drillship will be delivered in May 1999.

NAVIS Class

The NAVIS Class drillship has been designed and promoted through a joint venture between NAVIS and Pride International. The drillship is equipped for 10,000 ft water depth operation. The design possesses the load capacity (15,000 tons), deck space, and crude oil storage capabilities (100,000 bbl) of a drillship, and the motion characteristics close to a semisubmersible, with more than three times the deckload.

The vessel is 655 ft by 130 ft, with a 41 ft draft. The unit is DP designed to DP-3 standards and has two azimuthing thrusters aft and three azimuthing thrusters forward. The vessel also includes a dual-activity derrick and storage capacities of 10,000 ft for riser, drillpipe, and casing.

The unique feature of the design are the three moonpools and a unique cross-sectional shape. The center moonpool is for drilling operations and the two others are dedicated for subsea operations. This three-moonpool design reduces the waterline area cutting the motion response. This brings the

motion characteristics very close to those of a semisubmersible. It also creates a calm working area protected from the wave zone, permitting drilling in heavy weather conditions.

A contract with Samsung for the construction of the vessel has been signed with delivery set for springtime 2000.

Maersk MC/OS DS 3000

The MC/OS DS 3000 drillship has been jointly designed by Maersk Contractors and Odense Steel shipyard. The ship is capable of performing exploration and development drilling in excess of 10,000 ft water depths in all areas except the North Sea.

The hull design was developed to optimize seakeeping and stationkeeping capabilities while maximizing hull and deck space and loading capacities. The length of the ship is 682 ft, with a width of 105 ft. It is equipped with a DP-3 DP system and two underwater dismountable azimuthing thrusters, four retractable azimuthing thrusters, and one tunnel thruster.

The ship incorporates an advanced drilling package including a double derrick for dual handling capabilities, a fully-mechanized pipe racking system in derrick, and a fully-mechanized pipe and riser handling systems on deck.

Other notable drillship designs being introduced include the following:

- Friede & Goldman's Drillship 7500
- PGS's drillship design, based on the V-shaped Ramform vessel
- The Glomar 456 ultra-deep drillship, capable of drilling in 12,000 ft of water
- Smedvig's West Navion I and II drillships, that were converted from multi-service shuttle tankers.

In addition to these conventional semisubmersible and drillship designs, there are new designs with alternative configurations to achieve special goals. These include the following:

Deep Draft Floater

Kværner has developed a Deep Draft Floater platform concept for water depths ranging from 425 ft down to 6,500 ft. The design will support minimum or full process facilities with dry well completions, and a full drilling system. The multi-leg steel hull provides full access throughout the flotation column, permitting easy maintenance and inspection. The concept can be moored with semi-taut, chain-wire strand lines allowing for operating capability in severe ocean storms.

The Deep Draft Floater offers several benefits over other similar designs - such as the spar - including low structural weight and less fabrication time. In addition, the concept has also been developed to use proven technologies such as external TLP-like risers, and existing well, process, and subsea systems.

Stability is the main advantage to using this design for drilling. The inertia of the platform is below the wave zone, providing more stability than drillships and semisubmersibles and allowing for more protection for the riser.

Kværner has already carried out detailed tests of the design at Escondido, California with very

favorable results.

Deepwater Drilling Spar

Spars International, a joint venture between Aker Maritime and J. Ray McDermott, has developed a spar specifically configured for drilling in deepwater. By using the unique characteristics of the spar concept such as a protected centerwell, deep draft, low motions, and active mooring system, the drilling spar offers the drilling contractor several capabilities not available in say other system.

The centerwell, protected from wave and current forces, allows the use of buoyancy modules instead of tensioners to support the drilling riser. This high capacity and economical method of riser support allows the use of a bare steel, high pressure, drilling riser out to depths of at least 8,000 ft of water.

Even though the spar hull already has very low motions, even in annual storms, the fact that the riser support is decoupled from the hull eliminates any excitation of the riser from hull motions. These low hull motions also allow the use of a stress joint instead of flex joint at the seafloor which increases the radius of the riser near the seafloor resulting in a grater percentage of time the drill string can be rotating.

With guides always aligning the riser with the axis of the spar hull, the riser always remains aligned with the drill floor, even in extreme offset and pitch conditions.

The deepwater drilling spar is viewed as particularly attractive for development drilling where the vessel will remain on location for a year or more. While the spar is fully stable for relocation by towing vertically, it will not normally be cost effective to relocate the spar's mooring system on a frequency consistent with exploratory drilling.

The company received oil company interest some time back, but no contract was received.

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