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opinion

Brazil in the spotlight, despite the crisis

by **Álvaro Teixeira**, executive secretary of the IBP (Brazilian Petroleum, Gas and Biofuels Institute)

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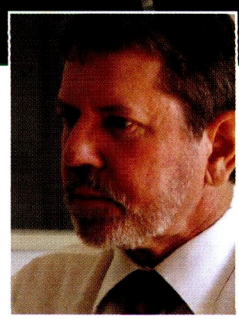

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Ship shaped offshore hull design

The Brazilian shipbuilder point of view

The current scenario for Petrobras new developments indicates a very strong demand for new ship-shaped offshore units to be constructed in Brazil. Eight FPSO hulls are programmed for the new Petrobras shipyard in the south of Brazil and a total of twenty eight new drilling rigs, including around fourteen drillships, are expected for the near future.

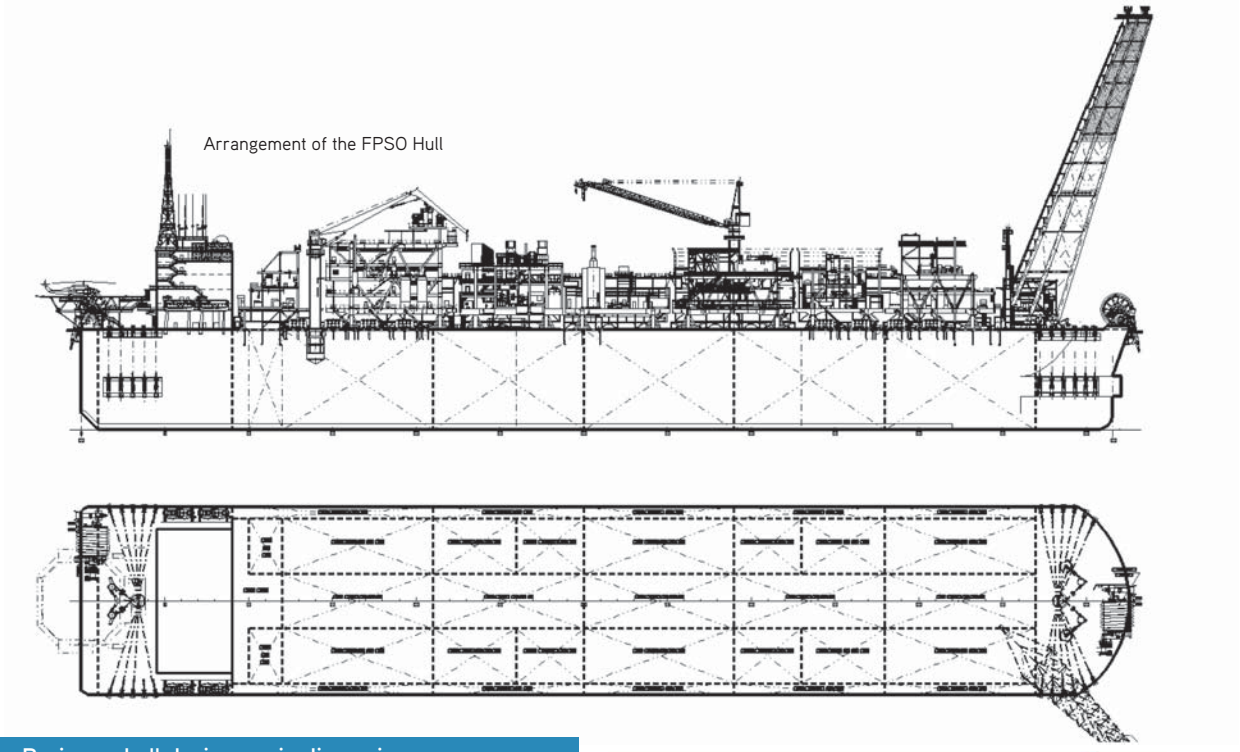
In this very promising scenario, Projemar is celebrating its 40 years of services for the Brazilian offshore and shipbuilding industries with two innovative conceptual designs developed to be genuine Brazilian shipbuilding industry answer to Petrobras' upcoming demand, with the history of Projemar as the background that supports this initiative.

Projemar was founded in 1969 as a subsidiary of the former Emaq shipyard and at that time the main purposes of the company were the development of shipyard's ship designs and to become the shipyard technological base and so it was that in 1976 Projemar produced the first mathematical fairing ever in Brazil using a in-house developed software and after that, due to its high development in the CAD/CAM field, Emaq shipyard and Projemar were awarded in 1980 with the prize "Liceu de Tecnologia", the most important technological award in Brazil at that time.

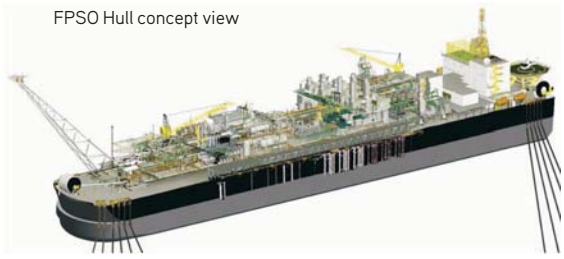
The company took its current form with a management buyout in 1995 and started a migration into the offshore design area as the Brazilian shipbuilding industry was being shut down, but the innovative spirit of the first days remained the same. Today Projemar is the most active design company in the offshore oil and gas industry in Brazil with fourteen FPSO designs and where the company took part in several important achievements like:

- The first internal turret moored unit – Petrobras P-34 installed at Barracuda Field in 1997
- The first taut-leg mooring system using polyester ropes for a floating production unit- Petrobras P-19 – installed at Marlin Field in 1997;
- The largest to that time floating production unit – Petrobras P-40 – installed at Marlin Sul Field in 2001;

Ricardo Barreto Portella is a Naval Architect graduated at the Federal University of Rio de Janeiro (UFRJ) has a Master Degree in Ocean Engineering at COPPE – UFRJ (2000) with specialisation in Mooring Systems Design and Analysis. He is the Head of the Naval Architecture and Hydrodynamics Department in PROJEMAR since 1995 where is responsible for the development of conceptual and basic design of floating offshore structures and ships. Member of the Brazilian ABNT CB-50 committee and Brazilian delegate at the ISO TC-67/SC-7 for the development of Offshore Structures for Petroleum and Natural Gas Industries standards.



The Projemar hull design: main dimensions	
Length overall	330.0 m
Length between perpendiculars	310.0m
Breadth (molded)	56.0 m
Depth (molded)	30.0 m
Operational draft	20.0 m
Total oil storage capacity	301,400 m³
Available oil for offloading	1,680,000 bbl



- The biggest dry tow operation in the world, the transportation of FPU Petrobras P-40 from Singapore to Rio de Janeiro;
- The first permanent FPSOs moored by a DICAS mooring system – Petrobras P-43 and Petrobras P-48 – installed at Barracuda and Caratinga fields in 2004;
- The largest internal turret installed in a FPSO (first very large turret), with 75 flexible risers – Petrobras P-53 – installed at Marlim Leste field in 2008.

Today the Brazilian shipbuilding industry is booming again, with a considerable number of new ships under construction of Brazilian shipyards. In this new scenario Projemar is responsible for the basic and construction design of the majority of these ships, including:

- Four product tankers for PDVSA/PDV Marina
- Eight Panamax size tankers for PDVSA
- Five full containerships for LOG-IN
- Four product carriers for Transpetro

So, this is the company's background: a lot of experience in the Brazilian shipbuilding industry, a lot of experience in the offshore units market especially related to FPSOs design and a strong vocation to accept challenges, and the design of a modern ship shaped offshore unit to be totally built in Brazil is exactly the type of challenge that Projemar would like to have.

In order to be one step ahead in the new very promising scenario, Projemar has worked on the conceptual design of a new building FPSO hull and on the basic design of a deep water drillship, both designed not only to fulfill all Petrobras requirements but also designed with the purpose to built by Brazilian shipyards.

Conceptual design of the FPSO hull

For the design of the FPSO Hull, some main aspects were strongly taken into account:

- First of all, the hull's hydrodynamics should be improved in order to fulfill the very strong limits required by Petrobras in terms of motion response characteristics;
- Secondly, the arrangement and subdivision of the hull shall be able to carry the amount of

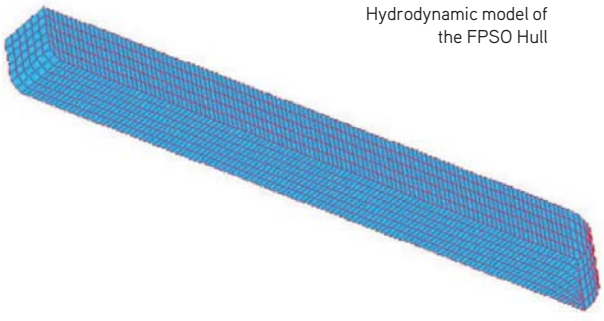
cargo required by Petrobras, but special attention was taken in order to reduce the hull girder loads acting on the ship;
- And finally, the ship structure shall be designed based on traditional shipbuilding concepts in order to minimize the steel weight and to reduce the shipyard construction work, having ever in mind that the hull is intended to be built in Brazil.

In terms of the hull hydrodynamic design, two very important aspects were considered:
- The FPSO shall have a limited motion response behavior in order to allow the safe operation of the SLWR (Steel Lazy Wave Riser)
- In addition to this, the hull shall have its total resistance minimized to improve the mooring system design.

In order to achieve the expected motion response it shall be considered that limited motion means to reduce the first order motion response, i.e, to reduce the heave, roll and pitch motions. Due to the nature of a FPSO hull, the heave motion cannot be modified and in order to minimize the ship motions the hull shall be properly designed to reduce the roll and pitch motions.

The FPSO hull motion response was investigated using the DnV SESAM / WADAM program, and when compared with a typical "box type" FPSO hull, the Projemar FPSO Hull presents a better motion behavior that allows for the use of Steel Lazy Wave Risers.

Hydrodynamic model of the FPSO Hull



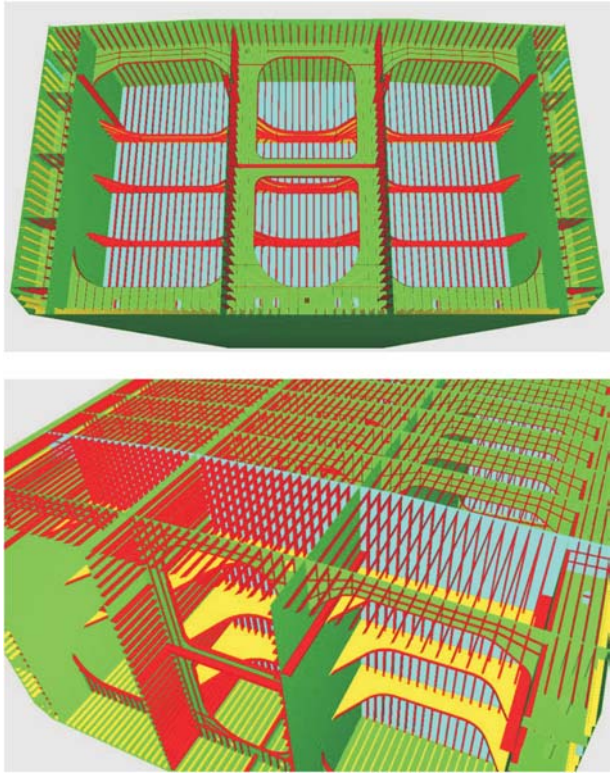
In terms of arrangement and subdivision, the FPSO Hull first of all follows the Petrobras specifications, with a Deck Area that allows more than 240 m x 50 m of exclusive area for the topsides modules and a total cargo tanks volume that allows for more than 1,600,000 bbl available for offloading, considering a maximum filling of 95%, a minimum filling of 3% and not considering the volume of the slop tanks.

In addition to the Petrobras basic specifications, the following aspects drove the definition of the FPSO tank arrangement:
- Compliance with damage stability regulations
- Compliance with MARPOL regulations
- Minimize Hull Girder Loads
- Minimize sloshing effects in cargo tanks

In terms of its general performance, the FPSO hull shall fit the first class standard required by Petrobras for a new building offshore unit, but it is on the hull structural concept where a truly constructability know-how has to be shown, in order to avoid a dream of a Brazilian construction becaming a nightmare.

First of all, the arrangement of the hull structure shall be based on traditional shipbuilding concepts in order to minimize the steel weight and to reduce the shipyard construction work. The FPSO structure design was performed in such a way that the structural arrangement considers standard plate sizes from Brazilian steel mills and the longitudinal tanks arrangement considers a standardization of the blocks size, reducing dramatically the number of different steel pieces. It shall also be noted that a three tanks arrangement reduces the reinforcements due to sloshing.

FPSO Hull structure concept



Drillship concept view

The vessel's main dimensions also allow for the simultaneous construction of two FPSO hulls in the new Petrobras dry-dock of Rio Grande Shipyard. The Projemar hull design has the following main dimensions:

Length overall ..... 330.0 m
Length between perpendiculars 310.0m
Breadth (molded) ..... 56.0 m
Depth (molded) ..... 30.0 m
Operational draft ..... 20.0 m
Total oil storage capacity ..... 301,400 m^3
Available oil for offloading ..... 1,680,000 bbl

Conceptual design of the drillship

Differently from the FPSO hull design that is a Projemar only initiative, the Drillship design is the result of the joint efforts of Projemar and the Dutch company Huisman. This ship is a novel project, designed to be built in Brazil, for a rig that is capable to conduct sub-sea BOP drilling operations in water depths up to 10,000 ft (3050m) and surface BOP drilling operations in water depths up to 15,000 ft (4570m) with a total drilling depth bellow the drill floor of 40,000ft (12190m). The conceptual design of this innovative drillship was presented in **T&B Petroleum Magazine** last year, causing a very good impression.

Even being a bit more compact than its competing designs, the vessel offers a large deck area due to the advanced drilling equipment concept developed by Huisman, specially the Dual Multi Purpose Tower (DMPT), which is based on the use of a vertical box structure instead of the lattice structure of more conventional derricks. The box structure provides both the main load-carrying element and an enclosed environment for the mounting of all major equipment, like draw works, compensators, electrical cabinets, drillers cabin etc. thus saving space on the vessel.

The drillship hull design was developed by and is completely integrated with the Huisman equipment. Constructability, focusing the construction and integration in existing Brazilian shipyards were a priority, where the key feature is the substructure and Multi Purpose Tower delivered as one unit by Huisman, allowing the assembly by single lift operations, which simplifies the vessel design, reduces the number of the interfaces and the testing of drilling equipment. Like the design of the FPSO hull, the drillship design considers that the arrangement of the hull structure shall be based on traditional shipbuilding concepts in order to minimize the steel weight and to reduce the shipyard construction work.

In terms of the vessel operational behaviour, Projemar conducted the stability analysis, motions response and dynamic positioning capacity in order to assure that the vessel complies with all Petrobras expectations for a rig intended to work on the deep waters of the pre-salt area. With excellent motion response characteristics and a very flexible DP system the vessel is able to achieve 99.9% of workability for drilling operations considering the offshore Brazil environmental conditions. ■