

Point by point: The business of FPSOs

In advance of OE's 2014 Global FPSO Forum, Managing Editor Audrey Leon spoke with Peter Lovie, Senior Advisor, Floating Systems for Peter M Lovie PE, LLC, and program chair for Global FPSO Forum; Arjan Voogt, MARIN USA; and Bruce Crager, Endeavor Management, to discuss topics affecting the FPSO sector.

OE: How have you seen FPSOs – both the technology, the attitudes regarding them, and regulatory requirements – change from when you started your career to now?



CRAGER

Bruce Crager, Executive Vice President, Endeavor Management: My first FPSO, *Ocean Producer*, was converted in 1991 when I was SVP at Oceanengineering Production Systems. The unit was converted in about 12 months after the engineering was complete. The first client was Amoco in Gabon for a project in 50ft of water, which was the shallowest FPSO installation in the world for many years. The FPSO conversion was

about \$27 million, including installation. The unit was then moved to Angola where it worked in shallow water for Sonangol P&P for about 18 years. This small FPSO could store about 500,000bbl and process about 20,000bbl. Most of the FPSOs in recent history are much larger, work in deeper water and cost much more. For these reasons, most of the FPSOs leased today, both conversions and newbuild vessels, are contracted initially with much longer term contracts. In addition, the regulatory

requirements have become more stringent in the last 20 years, particularly in areas such as the US and North Sea.

Peter Lovie: I got into the FPSO business in Houston in 1995 when I started work for Bluewater of Holland, as their Business Development Manager for North America. After a fascinating seven years at Bluewater with their fleet of turret moored FPSOs for the North Sea and elsewhere, I left to join American Shuttle Tankers as its VP-BD.



LOVIE

They were attempting to introduce shuttle tankers in Gulf of Mexico, employing the proven practices of the North Sea's leader in the field. The case for these DP2 tankers was strong: (1) the ultimate in proven safety, (2) ability to work with more uptime in rougher conditions than hawser-moored shuttle tankers, and (3) the cost effectiveness of not having to use support tugs while loading offshore or maneuvering and docking in port.

However we—like our Seahorse Shuttling competitor backed by Conoco—did not succeed in this five-year campaign and the company was absorbed into Teekay.

I had been pretty active in the environmental impact statement (EIS) team effort (1998-2001) for using FPSOs in Gulf of Mexico. Consequently, when the Cascade moved forward, I was working for Devon Energy, which was non-operating partner (50:50 with Petrobras) on this development that contemplated an FPSO with shuttle tanker export.

We felt that there was room to improve terms for the leased FPSO and the partners were persuaded to open up a bidding process, which took a few more months, but saved a nine figure amount. The requirement here was quite different from that in the general industry expectation: storage capacity was less—around 600,000bbl instead of 1MMbbl and now the FPSO had to be disconnectable instead of permanently moored as had been called for in the EIS. At 8200ft the water depth was several times greater than when the EIS was approved in 2001.

DP2 did not win as the shuttle tanker design choice for Cascade. Petrobras opted instead for enhanced maneuverability tankers

with bow loading, controllable pitch propeller and bow thrusters, still requiring two tugs for loading offshore, plus tugs in port.

You asked about the regulatory side. I have to say that I found the USCG and Minerals Management Service (MMS) very willing to listen to new directions in these early formative stages, whether from a contractor or an operator, and where we really went after fundamental sound and safe methods and took a lead in it. Maybe this is an American thing—we did not “go cap in hand as supplicants for papal blessing”—but rather it was an attempt to take the lead and get it right.

Arjan Voogt, Manager of MARIN’s

Houston office: The FPSO community has always been proactive in solving challenges in design and operation together as an industry. The reality that if one of these systems fails all will suffer, is seen by all competitors who work together towards safe and efficient operations. Since the FPSO Research Forum began 17 years ago, many joint industry projects tackled important issues like green water and bow slamming, life cycle management, mooring integrity and safe offloading operations.



VOOGT

OE : Currently, only one company (Petrobras) operates an FPSO in the Gulf of Mexico in the Cascade/Chinook field, and Shell is soon to follow with the FPSO *Turritella* at its Stones development. What’s your view of this market? Will more companies follow suit as production heads into deeper Gulf waters or will US regulations interfere?

Bruce Crager: This is correct for the US Gulf of Mexico, but there is another FPSO working for Petróleos Mexicanos (Pemex) in the Mexican Gulf and several more planned, including two at Ayatsil-Tekel. FPSOs are not the only floating production option in the Gulf due the well-developed offshore pipeline infrastructure. Spars, TLPs and semi FPU are practical options in most locations. However, as we move into deeper water and new areas without pipeline infrastructure, such as the Cascade/Chinook and Stones developments. FPSOs are a very viable option. One significant advantage of FPSOs is the ability to disconnect in the event of a hurricane, which is not common practice for other floating production systems. For these reasons, I expect the use of FPSOs in the Gulf to increase.

Arjan Voogt: As is shown by their track records around the world FPSO can be safe and reliable means to produce and store oil, so I don’t see the US regulations block this option for field development. However, the choice for FPSO’s is driven by many more factors and with the existing infrastructure and experience in the Gulf of Mexico, it will not be the one solution that fits all.

Peter Lovie: The evidence is not good for there being many more FPSOs in the US Gulf of Mexico. First, taking the broad operating oil company viewpoint, there are multiple factors at play influencing the choice of an FPSO as the development

The Cidade de Ilhabela FPSO berthed at the Brasa shipyard in Niteroi, Rio de Janeiro, Brazil.

Photo from SBM Offshore.





The FPSO Cidade de Ilhabela is in the final stages of construction at the SBM Offshore/Synergy joint venture Brasa shipyard in Niteroi.

Photo from SBM Offshore.

oil and it went away.

An industry study in 2013 involved an informal “focus group” opining on the need for more FPSOs in US Gulf of Mexico. Not one of the ten operators in the project meetings saw a need in a time frame of the next ten years for another FPSO after Stones. The context was the need for offloading in Gulf, which of course, largely hinged on the presence of FPSOs. This is documented in RPSEA project 10121-4407-01.

Ten or fifteen years ago, I was much more optimistic for growth of the FPSO fleet in US Gulf of Mexico, but now have to go with what I see. If you listen to the shuttle tanker people and the FPSO contractors they can be somewhat more optimistic.

OE : In May, OE ran an article about a recent RPSEA study that sought to investigate whether cylindrical-hull FPSOs could be a potential production solution for remote ultra-deepwater Gulf of Mexico operations. Response to the article indicated that not enough was done in the study to both include a disconnectable option as well as account for wave slam loads. Will cylindrical FPSOs ever have a place in the Gulf of Mexico? Or is it just as simple as providing the option to disconnect when storms approach?

Bruce Crager: Cylindrical FPSOs operate offshore Brazil as well as the North Sea. While these are not disconnectable, those in the North Sea work in a severe environment. The industry has proven it can develop technical solutions as needed, and developing a disconnectable concept for round hulls should be possible. The FPSO *Ocean Producer*, converted in 1991, was located in only 50ft of water offshore Gabon and required a simple disconnect capability in the case of extreme storms. While this feature, which was based on remote release of chain stoppers on deck was never

solution: reservoir conditions, bringing the oil inward instead of sending outward to other countries, convenience and cost-effectiveness of the extensive pipeline network, economics and risks versus other development options (semi, spar, TLP or subsea tie-in). All of this gets risked and looked at again and again as reservoir options get investigated. One really has to have worked for an operator to fully grasp it. Gulf of Mexico operators do genuinely consider the FPSO option, but the logic for choosing that solution has not prevailed very often.

The DeepStar-led effort during 1998-2000 to secure an EIS from MMS was driven by avoiding the need for a two-year regulatory delay in securing an EIS for an FPSO-based developments, to try to keep the FPSO option available and on the table. The practical example cited back then was Texaco’s Fuji prospect, the leading FPSO prospect in sight at that point. Appraisal later showed that prospect did not contain enough

required at this location, the disconnect system was activated at each anchor as the vessel left the field. The biggest issue is likely to be how to maneuver a cylindrical hull which lacks propulsion after disconnect.

Arjan Voogt: There is a reason why vessels aren’t cylindrical shaped. Disconnecting and moving away for a storm might not be the most practical solution for a cylindrical floater. Offloading the oil and evacuating the platform will be considered as well. Both options have technical and regulatory challenges ahead, but it’s definitely possible.

Peter Lovie: I was in the middle of the first FPSO in Gulf of Mexico needing to be disconnectable, and again when it was contracted back in August 2007. Then, another disconnectable FPSO for Stones was contracted by Shell last year (using SCR’s).

Why should a new round FPSO for ultra-deepwater Gulf of Mexico be any different, and not disconnectable? Regulators at the 2012 and 2013 Emerging FPSO Forums in Galveston spelled out their needs on this. Knowledgeable Gulf of Mexico industry people know about it. The disconnectability issue is a serious fundamental to resolve—no excuse for ducking it if an operator is to take this work seriously.

In my experience the RPSEA business model was well intended, but mulling it over, a year after serving as principal investigator on one of their projects, I believe allowing the free market to sift out the worthwhile new technologies is better than a government assistance plan. The centuries old process of survival of the fit in the marketplace of real needs is sensible, but it can get forgotten with passing years. What I have seen happen is that some operator's technology guy says this new system is going to be great, without ever having to face the real business world. And people tend to think operator guys are always right!

OE: It was mentioned at last year's forum that FPSOs are being designed to operate for 20-30 years, but with most FPSOs being conversions instead of newbuilds, the hull's life span is likely 50-60 years. How is that extra life taken into account before work begins on the conversion?

Bruce Crager: Hull life—assuming proper hull coatings and cathodic protection with regular inspections – can last for a very long time. However, most process systems are designed for a shorter life such as 20 to 30 years. There are extreme examples such as Petrobras FPSO P-34, previously known as the *PP Moreas*, which was built in 1959 and first converted to an FPSO in 1979. However, while the hull is now very old, this unit has been upgraded three more times with significant modifications to the topsides and is still operating offshore Brazil.

Arjan Voogt: Not every trading tanker is a good candidate for conversion. The consumed fatigue life can be calculated and taken into account in the design of the conversion. Older vessels that traveled in more harsh environments, will need more

time in the yard and more steel replaced before they're ready for a life as FPSO. Many conversion are done on relatively new vessels, just to reduce the time to first oil.

Peter Lovie: This is now a normal part of the design process. It's not unlike the circumstances in the last two decades where semisubmersible MODUs have been modified for deeper water and deeper drilling and their hull lives extended much longer than the original 25 year target. The offshore industry has become much more skilled in dealing with hull fatigue life. There are much better analytical tools and amazing practical gauging methods are now available that were unthinkable a decade or two ago, plus contractors' ingenuity in devising practical remedial measures.

OE: Last year, several speakers brought up factors negatively affecting the FPSO industry. These included increased local content requirements, rising costs, clogged supply chains, and competition. What can be done to overcome these challenges?

Bruce Crager: These challenges are common to other large projects in the offshore industry. The solution will require coordinated efforts between FPSO providers, operators and suppliers to focus on well-defined up front engineering, minimal change orders, and ongoing communication during project execution. One key to successful FPSO start-up is to have the operations team involved early so they can support commissioning as well as long term operation of the vessel. Another issue is the experience level of the companies working in the FPSO industry. Some have little experience and competition is a real concern because there are about 30 owners of leased FPSO units. Many of these only own one unit, but all are actively focused on leasing their FPSO fleet on an ongoing basis and many are trying to win work for more units.

Arjan Voogt: Many FPSO's are designed to changing specification, resulting in multiple iterations. There are often good reasons for this (changing field expectation, financial markets,

'Emerging' no more

The 4th Annual Global FPSO Forum, formerly Emerging FPSO, serves as a rare opportunity to meet and deliberate over topics affecting the global industry. While most conferences are held in Europe and Asia, Global FPSO Forum is held annually in Galveston, Texas. Although the event is held near the center of the oil and gas industry – Houston – the conference tackles issues spanning the globe, hence the new name.

The Global FPSO Forum draws operators, contractors and service providers alike to present new findings

and to debate old ones in a convenient setting. The 2014 lineup includes speakers from ABS, BW Offshore, FMC Technologies, MODEC, Moss Maritime, National Ocean Industries Association, NextDecade LLC, NOV, Petrobras, Saipem, SBM Offshore, Sevan Marine, Shell Exploration and Production, Society of Naval Architects and Marine Engineers (SNAME), Trittech International, and Wood Group Mustang.

The Global FPSO Forum will hold a special workshop on moorings on Tuesday, September 23, which

will host speakers from Chevron, Shell, ExxonMobil, MARIN, Trittech International, InterMoor, SBM Offshore, SOFEC, and NOV. Topics to be discussed include: changes in design philosophy, mooring integrity, mooring line monitoring, prevention techniques, turrets and station keeping, shallow water mooring systems, challenges in disconnectable turret designs, and case studies.

OE's Global FPSO Forum will be held this September 23-25, 2014, at the Galveston Island Convention Center at San Luis Resort. For more information, please visit: www.globalfpso.com. ■



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FPSO

other new data), but it increases costs and limits the availability of good qualified engineers.

Peter Lovie: Every time the offshore business gets busy this kind of discussion starts again. It is part of life, how things get difficult and when the going gets tough, the tough get going, to paraphrase Vince Lombardi.

The radical shift to much larger and more complex FPSOs was addressed at last year's forum and will be again this year. CAPEX obviously goes way up when the vessel is so much bigger and badder— but is it really a matter of “cost escalation”? Naturally supply and demand causes some escalation on unit rates as we saw in industry indexes during 2007-2009 when they rose and then came back down. There's a matter of what we define as “cost escalation.”

OE: Over the past two years, one topic that continues to pop up in

The FPSO Cidade de Paraty operating in the field.

Photo courtesy of Petrobras News Agency.

regards to FPSOs – no matter the location – are issues with mooring lines and the degradation of either the ropes or chains. What are some



FPSO market forecast

Energy analysts Douglas-Westwood estimates in its World Floating Production Market Forecast that US\$91 billion will be spent on FPSOs during the period of 2013-2017. This marks a 100% increase over the previous five-year period, with the global CAPEX set to double.

Douglas-Westwood attributes the remarkable jump to factors including an increased number of newbuilds and conversions when compared to redeployments; a greater degree of local

content requirements that can result in increased costs; and general inflation within the offshore oil and gas industry.

As exploration graduates into deeper waters, an industry-wide scramble to find cost-effective production methods generally follows. The deeper the water, the less options operators have; however, FPSOs are featured globally in some of the deepest projects in the world, including what will be the deepest project in the world: Shell's Stones in the Gulf

solutions that could curb these problems and help keep FPSOs and other floaters on station?

Bruce Crager: The industry has significant experience with mooring systems for both offshore rigs and floating production units, including FPSOs. There are only five dynamically-positioned FPSOs in the world so the large majority are moored. The mooring system normally remains in place during the life of the field. It is possible to inspect mooring systems in-situ using divers and ROVs and the industry has the capability to replace specific components such as chain, wire rope and synthetic rope sections. However, more work is needed to improve the longevity of these components in long life fields, particularly in harsh environments.

Arjan Voogt: As discussed in last year's forum, there are many different reasons why mooring lines break. In the end, an anchor chain is nothing stronger than its weakest link. Mooring systems are designed with this in mind and can maintain station with one line down. The broken line does need to be replaced, though, which often takes many months of planning and preparations. Anticipating line failures in advance and designing the mooring system for a potential line replacement, together with life monitoring of the lines will help keep FPSO's on station. This year's mooring special session (at Global FPSO Forum) will compare competing system to monitor the lines. In addition to this, FPSO operators will present ongoing research

in corrosion and failure mechanisms which will help to prevent some mooring line failures in the future.

Peter Lovie: Mooring line failures are not new, and not just with FPSOs. Hurricanes Katrina and Rita in 2005 caused multiple semisubmersible drilling units to break loose and drift in the Gulf. It was these mooring line failures that led to the nightmares in the minds of knowledgeable operators' that one of these MODUs would bang into an FPSO loaded with oil during the hurricane, causing a horrendous oil spill of Valdez proportions. Hence, the 2006 scramble to make FPSOs disconnectable for the US Gulf, and the OTC sessions and panels on this theme in 2007.

Around 2008, the ability to inspect mooring lines on location became much more doable. In 2014, these mooring line failures are widely recognized as a problem by operators, underwriters and regulators, and all working to do something about it. The underwriters see a loss rate of 10 times more with mooring systems than with other offshore underwritings.

Their Floating Unit Mooring Assessment (FUMA) initiative in its 21 July 2014 presentation says that in 2001-2011 there were 23 documented mooring failures, eight of which were systems failures (multiple line damage and drifting), all based on OTC Paper 24025. Their "Moored Floating Unit Portfolio" cites 112 incidents in six years with a total of \$2.86billion in claims.

"Houston we have a problem." **OE**

of Mexico. This could be why Douglas-Westwood found that FPSOs represent "the largest segment of the market both in numbers (94 installations) and forecast CAPEX (80%) over the 2013-2017 period. FPSSs account for the second largest segment of CAPEX (10%), followed by TLPs, then spars."

The firm, which analyzed around 1000 FPS projects for the report, found that Latin America accounted for 29% of the forecast installations and 37% of the projected CAPEX, partially due to the fact that Brazilian state-owned

Petrobras operates numerous fields in the country's presalt that account for the bulk of the region's FPSO installations. Despite the national's high-profile troubles, including significant financial cutbacks and a scandal related to contractors, Douglas-Westwood expects that it will continue its hold on the region. Beyond Latin America, it noted, "Asia is the next most important region in numerical terms (24 installations, but Africa is so in terms of forecast CAPEX (\$18.2 billion)." ■

—Sarah Parker Musarra



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