

# upstream

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## Floaters firing up

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## OVERVIEW

# Industry looks ahead after v

**Floater orders** back to 2013 and 2014 levels, with **lower breakeven costs** a major factor for sector

**RUSSELL MCCULLEY**  
London

**T**HE floating production market is on an upswing after four punishing years, with floater orders back on the books, yard activity picking up and some delayed deep-water projects moving back into the development queue.

Floating production, storage and offloading projects are leading the trend, with 10 new orders logged so far in 2018 — six for new-build vessels and four redeployments of existing FPSOs.

Brazil is the main driver but other regions are giving the industry cause for hope.

Given the severity of the recent downturn, industry observers may be reluctant to appear too enthusiastic. But the numbers offer good reason for some cheer.

“The overall trend is that the number of awards is up and we’re getting back to where we were in 2013 and 2014, which was 11-12 (FPSO) awards per year,” says Energy Maritime Associates (EMA) managing director David Boggs.

Other floating production solutions are also picking up. EMA has identified 31 projects likely to be sanctioned over the next year, including floating liquefied natural gas, storage and regasification units and semi-submersible production units.

Boggs says 17 FPSO developments could be sanctioned in the next 12 months. “Some of those might slip, but we’re still looking at 11 to 15 awards in the next year,” he says.

## Poised for increase

Lars Roberg Folgesvold, oilfield services analyst at Rystad Energy, notes that the number of final investment decisions for floating production projects in 2018 was equal to the previous year’s total by the start of the fourth quarter and is poised for a sharp increase next year.

Eleven final investment decisions are likely by the end of the year, Folgesvold says, with a possible 21 to come in 2019. “The general trend looks good for the floater market and particularly for the FPSO market,” he says.

Rystad forecasts that more than 30 FPSO projects could be sanctioned between 2019 and 2021, largely led by demand in Brazil.

The upturn has also been good for the subsea sector, which is seeing an increase in orders and some relief from the exceedingly tight margins of the past few years.

In the floater market, he says: “There is a better mood. Companies are hiring and positioning themselves for what’s coming in 2019.” The sustained oil price



Arrival: the Boka Vanguard vessel transporting the P-67 FPSO arrives in Brazilian waters earlier this year

recovery has restored confidence to the industry at large but offshore in particular is benefiting from efficiencies imposed during the downturn.

“The oil price is a big factor but the cost side of the equation is where things have really swung for deep-water,” says Boggs. Break-even costs have plummeted, making deep-water projects in many cases more attractive than onshore shale developments, where costs have escalated in recent months.

The resurgence in activity has been good news for Asian shipyards, where the downturn spurred a major shake-up. Sembcorp Marine, for example, had invested heavily in a mega-yard in Singapore designed chiefly for building drillships and semisub drilling rigs, Boggs says. “When that market dried up, they turned their attention to production units,” he says, and have subsequently picked up awards for FPSO hulls for Equinor’s Johan Castberg and Energean’s Karish and Tanin project off Israel, as well as the

production semi-submersible for Shell’s Vito project in the US Gulf of Mexico.

Chinese yards have also come into their own, tackling technologically sophisticated projects that would have gone elsewhere just a few years before, Boggs says.

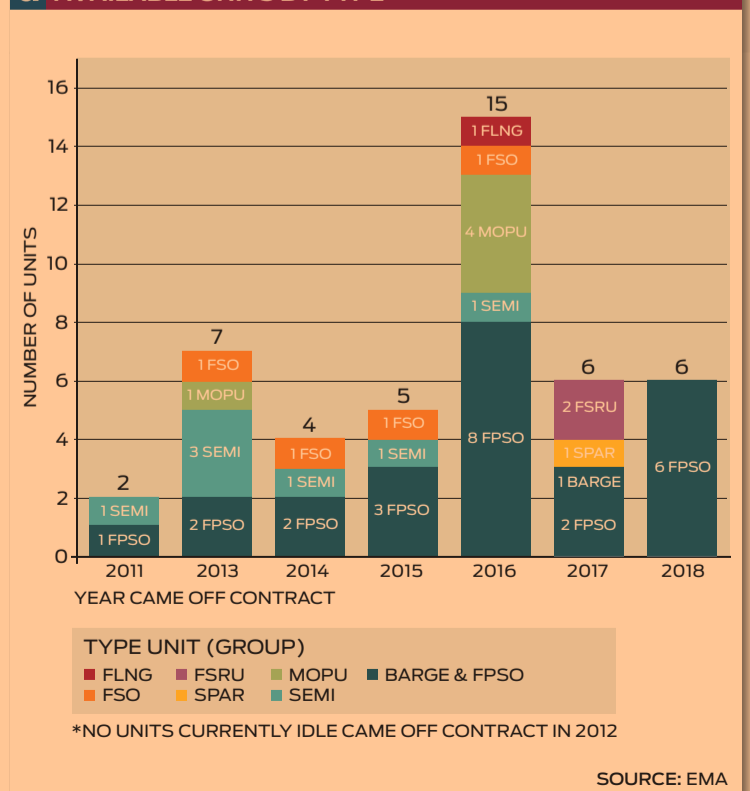
South Korean yards, where such projects once flourished, have devoted more effort to FLNG and FSRUs, he says.

EMA carried out an annual survey of offshore officials that, while largely anecdotal, nevertheless provides a revealing snapshot. Early in 2017, Boggs says, about 43% of respondents said they were “somewhat confident” in the market. This year the number had jumped to 58%, and those who were “somewhat pessimistic” has dropped to 15% from 25% a year earlier.

The next survey could reinforce the trend.

“The general mood has definitely picked up,” he says. “It’s been a bumpy road over the last few years but things have shifted quite a bit recently.”

## AVAILABLE UNITS BY TYPE





# weathering storm



Photo: ANDRE MOTTA DE SOUZA/PETROBRAS

## FLOATER AWARDS

Approval	Country	Operator	Field	Facility
2017	US	BP	Mad Dog 2	Semi
2017*	Vietnam	Repsol	Red Emperor	FPSO
2017	Guyana	ExxonMobil	Liza 1	FPSO
2017	Norway	Equinor	Njord Future	Semi
2017	Gabon	BW Energy	Dussafu	FPSO
2017	UK	Hurricane Energy	Lancaster	FPSO
2017	Brazil	Petrobras	Mero Pilot	FPSO
2017	Brazil	Petrobras	Sepia Leste	FPSO
2018	UK	Shell	Penguins	FPSO
2018	Israel	Energiean Oil & Gas	Karish	FPSO
2018	India	ONGC	U-1	FPSO
2018	US	Shell	Vito	Semi
2018	Norway	Equinor	Johan Castberg	FPSO
2018	China	CNOOC	Lihua 20-2	FPSO
2018	China	CNOOC	Lingshui 17-2	Semi

\* The Vietnamese government pulled back its earlier agreement with Repsol, due to diplomatic pressures from China.

Source: RYSTAD

## ANTICIPATED FLOATER AWARDS

Approval	Country	Operator	Field	Facility
2018	Brazil	Petrobras	Buzios	FPSO
2018	Mexico	Eni	Mizton	FPSO
2018	UK	Alpha Petroleum	Cheviot	FPSO
2018	Nigeria	First E&P	Anyala	FPSO
2019	India	Reliance	D-55	FPSO
2019	Mauritania	BP	Tortue-Ahmeyim	FPSO
2019	Brazil	Petrobras	Mero 2	FPSO
2019	Guyana	ExxonMobil	Liza 2	FPSO
2019	Brazil	Petrobras	Itapu	FPSO
2019	Brazil	Petrobras	Neon Sul	FPSO
2019	Brazil	Petrobras	Marlim 1	FPSO
2019	Brazil	Petrobras	Marlim 2	FPSO
2019	US	LLOG	Khaleesi	Semi
2019	Australia	Carnarvon	Buffalo	FPSO
2019	Senegal	Woodside	SNE 1	FPSO
2019	Falklands	Premier Oil	Sea Lion	FPSO
2019	UK	Siccar Point Energy	Cambo	FPSO
2019	Indonesia	Santos	Ande-Ande Lumut	FPSO
2019	UK	Equinor	Rosebank	FPSO
2019	China	CNOOC	Lufeng 15-1	FPSO
2019	Brazil	QGEF	Atlanta	FPSO
2019	Brazil	Petrobras	Jubarte	FPSO
2019	Ghana	Aker Energy	Pecan	FPSO
2019	Guyana	ExxonMobil	Payara	FPSO
2019	UK	Bridge Petroleum	Galapagos	FPSO

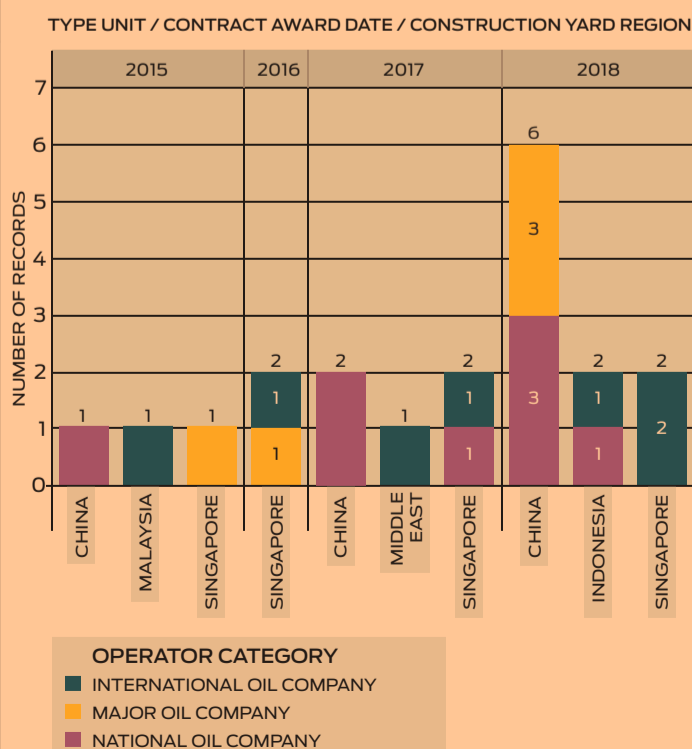
Source: RYSTAD

*The general mood has definitely picked up... It's been a bumpy road over the last few years but things have shifted quite a bit recently.*

EMA managing director  
**David Boggs**



## AWARD BY OPERATOR CATEGORY (FPSOs)



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## SOUTH AMERICA



# Wind in sails for floater market in Brazil

**Future looking brighter** for specialist players as **significant number of potential developments** are coming up, mostly led by **Petrobras**

**FABIO PALMIGIANI**

Rio de Janeiro

**D**EMAND for floating production, storage and offloading vessels in Brazil is on the rise again and contractors are bullish this wave of activity will endure, as state-controlled company Petrobras leads the way with a series of new requirements on the horizon.

After a few years of idleness due to the oil price meltdown and the Car Wash corruption probe, the market outlook for FPSOs in Brazil is looking brighter, with many floater specialists paying close attention to potential future developments in the country.

While Petrobras will continue to be the main driving force when it comes to FPSO demand in the short term, international oil companies that acquired acreage in Brazil in the latest bid rounds, including ExxonMobil, Chevron, BP, Shell and Equinor, are also expected to generate additional floater orders over the next decade.

With a solid track record of 15

years of operation in the country, Japanese player Modec is looking beyond Petrobras to continue amassing contracts.

“The international oil companies are coming in a wave never seen before and I believe this will be part of the future of Brazil,” says Modec Brazil commercial and contracts manager Felipe Baldissera.

#### Opportunities

In terms of global demand, Brazil usually represents a third of future FPSO opportunities, but contractors point out that the number only takes Petrobras into account.

“Now with all these international oil companies coming, the future demand will be even higher. It will be a real challenge for all floater companies to cope with this demand,” Baldissera adds.

Netherlands-based SBM Offshore, which also has a large FPSO fleet in Brazil, shares some of

the same concerns. Eduardo Chamusca, SBM Brazil country director, says the floater industry was starved for projects during the lean years, leading companies to enter survival mode.

“This was good in a way to cut out the fat and get more efficient, but eventually it starts eating on your muscles. And by the time this happens, it will take a while to recover,” Chamusca explains.

“We spent such a long time with no projects and then the market picked up very fast. I am not sure we, as an industry, will have all the capabilities to execute these upcoming projects with the proper reliability.”

In late 2017, after a three-year gap with no FPSO contracts signed, Petrobras awarded Modec a pair of floaters for the Mero and Sepia pre-salt fields.

The company is currently in negotiations with Belgium’s Exmar for the charter of a large unit for the Buzios pre-salt field and is set to receive commercial

bids in December for an additional four floaters — one each for Mero and Parque das Baleias and two for the revitalisation of the ageing Marlim field.

The Petrobras contracting bonanza is set to speed up next year with at least four planned FPSO tenders, including one for the Itapu pre-salt field, another for a cluster of deep-water discoveries in the Sergipe-Alagoas basin and a couple more for Mero.

A potential sixth unit for Buzios may also be likely for 2020.

On top of that, Upstream understands that Equinor will tender for up to two FPSOs to develop the Carcara discovery, while Shell is expected to issue bid documents for a unit to produce in Gato do Mato. Both requirements are earmarked for early next decade.

However, the projected FPSO demand does not include potential discoveries that may take place at blocks acquired in recent rounds.

Baldissera believes the market

*I am more optimistic than pessimistic at this point. There are risks, but I believe Brazil has a bright future ahead.*

Jose Elias,  
managing director,  
Brazil, Teekay  
Offshore





Recent addition: the Petrobras P-74 FPSO on its way to Buzios field in Santos basin off Brazil  
 Photo: PETROBRAS

## Malaysian trio see potential

BUMI, MISC AND YINSON IN MIX

*Floater contractors trying to gain stronger foothold*

THREE Malaysian contractors are eyeing potential new opportunities in the Brazilian market for floating production, storage and offloading vessels, writes Fabio Palmigiani.

Bumi Armada, MISC and Yinson Holdings are all newcomers to Brazil, but they are slowly trying to solidify their presence in a market that is expected to generate billions of dollars in contracts in the next few years.

Bumi made the decision to come to Brazil earlier, and in the past the company teamed up with local player UTC Engenharia to bid for a pair of Petrobras-operated FPSO projects.

The partnership has since been dismantled after UTC Engenharia was caught up in the Car Wash investigation for paying bribes to win contracts with Petrobras.

However, Bumi did not quit Brazil and the company now appears to be in the driver's seat to win its first Brazilian FPSO contract with Australia-based Karoon Gas for the development of the Neon and Goia shallow-water fields in the Santos basin.

It is understood that Bumi is working with Schlumberger and Subsea 7 as a consortium, with Bumi focusing on provision of a small-sized FPSO with capacity to produce 40,000 barrels per day of oil.

There is market speculation that Bumi, if awarded the contract, intends to retrofit the Armada Claire floater to meet the Brazilian standard.

MISC is also displaying strong interest in Brazil. Earlier this year, the company bid for the Buzios-5 FPSO contract, but was disqualified on technical grounds.

"As a new player, one of our main concerns is that our track record in Brazil is non-existent, although we do have projects in other parts of the world," says MISC Brazil managing director Faisal Lee.

"Our main challenge is to convince the client that we can do these big projects in Brazil with the required local content."

Lee adds that MISC is adopting a strategy to look at the Brazilian supply chain not only as sub-contractors, but as potential partners to build a track record and be more competitive in future tenders.

Yinson, on the other hand, has yet to present a commercial proposal in a tender in Brazil, but the company is said to have spent the last year assessing opportunities and the best strategy to participate in tenders.

can absorb this new demand, especially since upstream projects usually take a long time to materialise from exploration to field development, giving contractors time to recover.

"The market outlook in Brazil is great right now, with production potentially more than doubling by the end of next decade, but for me it is sort of a *deja vu*," says BW Offshore Brazil country manager Jon Harald Kilde.

"We have seen it before — six years ago, before the Petrobras crisis, and it did not materialise. Will it happen now? I strongly believe it (will). We have a more diversified client base with new companies entering the market, especially in the pre-salt."

Jose Elias, managing director at Teekay Offshore in Brazil, praises market regulator ANP for implementing a positive regulatory agenda to try to unlock the country's resources potential, while also making the industry more attractive for investors. Over the

past two years, the agency has taken a more pragmatic approach on thorny issues such as local content requirements and sanctioned an aggressive long-term licensing calendar, giving operators predictability on areas to be auctioned off.

"These changes put Brazil on a modern path and attracted new DNA. It happened as oil prices started to recover, so I see Brazil slightly ahead of the curve and

stealing attention from other parts of the world. But I am also concerned about the market delivering all these forthcoming projects on schedule," Elias says.

Building these new FPSOs will require significant investments, and contractors hope banks and financial institutions will be up to the task.

"The FPSO market is improving, but it is also important to know the capabilities of the financial

market to fund all these big projects nearly simultaneously," says Ocyan superintendent director of offshore integrated services Jorge Luiz Mitidieri.

Elias adds: "I hope there is enough appetite from financial institutions to fund all these projects."

"I am more optimistic than pessimistic at this point. There are risks, but I believe Brazil has a bright future ahead."

### NEW UNITS ON THE HORIZON

Project	Operator	Oil Production	Gas Production	Bid Date
Marlim 1	Petrobras	80,000 bpd	7 Mmcmd	3 December
Marlim 2	Petrobras	70,000 bpd	4 MMcmd	3 December
Mero 2	Petrobras	180,000 bpd	12 MMcmd	10 December
Parque das Baleias	Petrobras	100,000 bpd	5 MMcmd	10 December
Itapu	Petrobras	TBD	TBD	2019
Sergipe-Alagoas Deepwater	Petrobras	TBD	TBD	2019
Mero 3	Petrobras	180,000 bpd	12 MMcmd	2019
Mero 4	Petrobras	180,000 bpd	12 MMcmd	2019
Buzios 6	Petrobras	TBD	TBD	2020
Cacara	Equinor	TBD	TBD	2020+
Gato do Mato	Shell	TBD	TBD	2020+



## SOUTH AMERICA



Looking ahead: Guyana Natural Resources Minister Raphael Trotman (left) and ExxonMobil Guyana project executive CT Khoo discuss the Liza Destiny FPSO

Photo: EXXONMOBIL

# Liza puts Guyana on the map

ExxonMobil **draws on Angolan experience** in providing units for **oil development**

GARETH CHETWYND

Rio de Janeiro

**E**XXONMOBIL'S Liza development has put Guyana on the map as an exciting offshore oil province, helped by the supermajor's willingness to draw on its own West African experience.

Angola's Kizomba project has provided a useful model for Liza, both conceptually and in offering a proven path with selected suppliers.

This was the case when ExxonMobil ordered a first floating production, storage and offloading unit for Liza from SBM Offshore, a regular supplier on Kizomba.

The Liza-1 FPSO, converted from a very large crude carrier, was designed to produce up to 120,000 barrels per day of oil, with water injection capacity of 200,000 bpd, and will be spread-moored in

water depth of 1525 metres. Production is due to begin in 2020.

ExxonMobil is set to reinforce this strategy by offering a home for the first in a promised line of highly standardised SBM floaters known as Fast4Ward FPSOs.

The first of these is under construction with Shanghai Waigaoqiao Shipbuilding (SWS), with processing capacity of around 220,000 bpd of oil and water injection capacity of 250,000 bpd. The step-up in scale appeared to fit perfectly with ExxonMobil's plans.

A steel-cutting ceremony took place at the SWS yard in Shanghai, China in March 2018, about eight months after SBM ordered the hull on speculation.

The FPSO, which will be spread-moored in waters about 1600

metres deep and able to store about 2 million barrels of oil, is effectively earmarked for the Liza-2 module.

ExxonMobil has awarded SBM a front-end engineering contract for another FPSO fitting closely with the specifications of the unit under construction at SWS.

#### Final investment decision

With some government approvals pending, ExxonMobil and its Stabroek block partners Hess and CNOOC Nexen are expected to reach a final investment decision in the first quarter of 2019.

ExxonMobil's preference for repeat solutions is evident in other aspects of the project.

Saipem was awarded an engineering, procurement, construction and installation contract to

supply the subsea umbilicals, risers and flowlines package for Liza-1, then followed this up in August with a similar award for the bigger Liza-2 project.

The Italian contractor is working out of a shore base facility run by John Fernandes Ltd, a local shipping firm.

The contract covers the import, storage, handling and load-out of project equipment, vessels and personnel, with the first batch of line pipes due to arrive before the end of this year.

Saipem expected to be in peak activity for installation of flowlines and risers by mid-2019.

Similarly, TechnipFMC won contracts for the engineering and supply of subsea trees, manifolds and associated controls and tie-in equipment for the Liza-1 floater,

now known as Destiny FPSO, and recently won an engineering contract for Liza-2, subject to the final project sanction.

With ExxonMobil's growing ambitions for Guyana — sources say the supermajor wants to roll out a new floater project at a rate of one per year — engineering for a third FPSO, for the Payara field, is already moving along briskly.

"Suppliers are being told that there will be a broad re-tendering of contracts for many goods and services, with a host of new opportunities," says one source.

"ExxonMobil is not going to sit back and watch while a handful of suppliers run into bottlenecks. There will be more competition, and new suppliers will get the chance to become part of Guyana's offshore development," the source adds.



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## AFRICA

## West Africa emerging from

**Oil price crash** stymied project sanctions — but the market is **beginning to revive**

**IAIN ESAU**

London

**T**HE floater market in the Africa-Mediterranean region remains dominated by West Africa, although in recent years the theatre of operations has edged west into the Mauritania-Senegal-Guinea-Bissau-Conakry basin and north east into the Levant basin.

Due to the negative impact of the oil price crash, Japan-based Modec said in an August presentation that just five FPSO contracts had been awarded in the Africa-Mediterranean region between 2015 and 2018.

These included Eni's OCTP off Ghana, BP's Greater Tortue-Ah-meyim off Mauritania and Senegal, BW's Dussafu Marine off Gabon, Perenco's Yombo in Congo-Brazzaville and Energean's Israeli project at Karish-Tanin.

TechnipFMC landed the Energean and BP contracts, while Yinson emerged as Eni's preferred contractor.

BW Offshore used one of its own fleet on its upstream associate's project, while a Perenco affiliate, Dixstone Holdings, landed the Yombo job.

Historically, Nigeria and Angola have been the core floater plays in Africa, with Ghana a smaller FPSO hotspot.

#### Political challenges

However, as has happened globally, the oil price crash has stymied final investment decisions on projects in Nigeria and Angola, a situation exacerbated by political, fiscal and legislative challenges on the domestic front.

The market is starting to revive from its long torpor, particularly in deep water, where unit development costs have fallen and can be lower than US shale plays.

Shorter project schedules have also helped operators look at floater projects more favourably.

In Nigeria, France's Total is commissioning its large Egina FPSO — designed to produce 200,000 barrels of oil equivalent per day — and targeting first oil by the end of the year.

Beyond Egina, Nigeria's market is stagnant when it comes to awards, although activity will increase next year once elections have come and gone.

Shell's Bonga South West development and Eni's ZabaZaba project remain in a logjam of FPSO projects awaiting launch, albeit for different reasons.

Bonga SW is forecast to produce about 150,000 boepd and, while the operator is advising contractors to expect invitations to tender to be released any day now,

Landmark: the Egina FPSO enters the Lagos channel

Photo: TOTAL



most sources suggest they are unlikely to emerge until next year.

A final investment decision could be taken in 2020, with first oil flowing four years later from a discovery that holds resources of about 600 million barrels of oil equivalent.

Previously, there had been talk of a new FPSO for the Bonga North discovery, but little has been heard on that proposal for some years.

ZabaZaba could be sanctioned in 2019, but the schedule is uncertain because the project is mired in controversy over how Eni and Shell, its partner, acquired their

stakes in OPL 245. Upstream was told earlier this year that Bumi Armada is Eni's preferred contractor to provide the 150,000 barrels per day FPSO.

ExxonMobil's 1 billion barrel Owowo discovery could be another floater-based scheme but at this stage it is uncertain if a phased subsea tieback to nearby infrastructure is on the agenda.

This project could be sanctioned in 2020, with production starting to flow in 2024 at rates of up to 160,000 boepd.

Other long-stalled projects, all once touted as having floater potential, include Bosi, Uge and Nsiko. One source has suggested

that Shell is quietly assessing the commerciality of a floater being installed at the Bolia-Chota complex that straddles OMLs 131 and 135 and holds about 240 million barrels of oil and 1 trillion cubic feet of gas.

#### FPSO opportunities

Small FPSO opportunities abound in Nigeria in both shallow and mid-water depths.

These include First E&Ps's Anyala-Madu project and state-owned Nigeria Petroleum Development Company's replacement Okpoho/Okono floater.

There are also hints that Sinopec-owned Addax Petroleum has

plans to revive development work in OML 137.

Angola is quieter than Nigeria with no fresh FPSO projects on the horizon.

France's Total brought on line the first of its two, delayed Saipem-built Kaombo FPSOs this year with the second to enter production in Block 32 next year.

There have been murmurs that BP may need a new FPSO at its PAJ project in Block 31, but a subsea tieback now appears to have found favour.

Last year, BP is also said to have commissioned a feasibility study on deploying an FPSO that could hop from discovery to discovery,



# n doldrums

## Strong spotlight on new plays off Mauritania and Senegal

THE emerging markets of Mauritania and Senegal in the MSGBC basin — where BP and Woodside Energy are in the vanguard — are currently grabbing the limelight in West Africa, writes Iain Esau.

Mauritania is not strictly a newcomer to the floater market, having already established some pedigree with Petronas Carigali's Chinguetti FPSO, although that vessel was recently decommissioned.

BP's Greater Tortue-Ahmeyim (GTA) project will see TechnipFMC carry out front-end engineering and design work on a mid-sized FPSO to be installed in shallow water.

Once these FEED studies have been completed then the contract will be transformed into an engineering, procurement, construction and installation contract.

TechnipFMC has chosen China's Cosco Shipping Heavy Industry to build the FPSO.

This sub-contract is a breakthrough because it is believed to be the first time that a Chinese yard has won an FPSO-related contract on an African floater project.

It also signals that a western supermajor now has increased confidence — and trust — in placing work in China.

Cosco is expected to fabricate the hull and living quarters and would also be responsible for integration.

Sources said integration of the FPSO could either be carried out at Cosco's Shanghai facilities or Nantong facilities, depending on the drydock requirements.

It is expected that fabrication of the remaining topsides will be sub-contracted elsewhere by TechnipFMC.

The FPSO will handle production from an initial four subsea

### MSGBC BASIN ACTIVITY

wells, separating out liquids before the gas is piped to a floating liquid natural gas hub terminal, sheltered behind a breakwater.

The spread-moored vessel will be installed in 100 to 200 metres of water and is expected to be a VLCC-sized vessel with a 13,000-tonne deck.

The topsides will be designed to handle more than 500 million cubic feet per day of gas and about 20,000 barrels per day of liquids.

It is thought that the vessel will be designed to handle additional production from future GTA phases.

FEED studies are set to run for another two months, coinciding with a final investment decision by the end of this year and first production by late 2021 or early 2022.

At SNE, Woodside was reviewing fresh commercial bids submitted two weeks ago by floater players, although the effective operator's base case remains using the existing OSX-2 FPSO.

Elsewhere off Africa, Cameroon and Congo-Brazzaville could each host a new floating LNG vessel if NewAge manages to sanction projects adversely affected by a number of issues.

In Equatorial Guinea, Ophir Energy is still pursuing a Golar LNG-backed deepwater FLNG project centred on its Fortuna asset, but state-owned Gepetrol's plan to develop the shallow water Venus field have not progressed.

Gabon is quiet after BW Offshore began producing the Tortue field from its BW Adolo FPSO while a Yinson-owned FPSO is set

to be removed from Canadian Natural Resources' Olowi field.

In Congo-Brazzaville, Total is still mulling over a potential floater scheme for a constellation of ultra-deepwater discoveries including Andromede and Cassiopeia.

Africa's east and south coasts are almost dormant, largely because few viable oil discoveries have been made there.

After PetroSA's long-serving Oribi-Oryx floating production system was removed from South Africa's Bredasdorp basin waters a few years ago, the only ongoing project is Eni's Coral South floating LNG scheme in Mozambique.

For years, there has been talk of a floater of some kind being deployed on the marginal Ibhubsesi project off South Africa, but most sources predict that is unlikely to come to fruition for some years yet.

In Namibia, BW Offshore is working on plans to supply a floating production unit for its Kudu gas and condensate project, which remains in limbo.

Tanzania is the only other regional player with floater potential, with rumours continuing that Shell could look to use an FLNG vessel, perhaps in Block 4.

North Africa and the Mediterranean (the world's first FPSO was deployed by Shell off Spain in 1976) remain quiet with the only project underway being Energean's FPSO which will tap the Karish and Tanin gas fields off Israel.

Opportunities may exist in Libya if stability is brought to that restive country while Tunisia, Egypt and Italy could also offer possibilities.

For example, there has been market talk about a floater being used on Shell's Aphrodite gas field off Cyprus.



mopping up oil held in small structures in blocks 31 and 18. This concept is similar to BP's Single Well Oil Production System that the supermajor developed in the 1980s and was then known as the Seillean FPSO.

Total is talking about developing the Chissonga find in Block 16, but a subsea solution is said to be in a stronger position than a floater.

Undeveloped discoveries in Chevron's Block 14 — Lucapa and Negage — were long considered FPSO candidates, but subsea satellites could be the order of the day here also.

Ghana is the focus for new vessels with the possibility that two

new FPSOS could be operating within the next four years.

One vessel is needed by Aker Energy to exploit its Greater Pecan project in the Deepwater Tano-Cape Three Points block, with a contract award due next year.

This FPSO is expected to handle about 125,000 bpd of oil as well as gas and will tap Greater Pecan's contingent resources of about 550 million barrels of oil equivalent.

Accra-based Springfield E&P may also have a need for an FPSO for early production operations in its West Cape Three Points Block 2, on either of the Odum or Banda finds.

**East Mediterranean:**  
Page 32

**China breakthrough: TechnipFMC has chosen China's Cosco Shipping Heavy Industry to build the Tortue-Ahmeyim FPSO**

Photo: Cosco



## EUROPE

## West of Shetland in focus

Around **18 oil and gas projects** are centred on **floating production systems** and more are on the way

**ROB WATTS**  
London

**A**BOUT 18 UK oil and gas developments are centred on floating production systems and more are on the way, chiefly to exploit reserves located in the harsh waters west of Shetland and in the northern North Sea.

Arguably the highest profile scheme that could take a leap forward in the months ahead is Rosebank, where Norway's Equinor recently agreed to acquire Chevron's 40% operated interest in the deep-water field, located about 130 kilometres north-west of Shetland.

#### Development options

Rosebank, holding more than 300 million barrels of recoverable oil, has been an on-off affair for Chevron since it was discovered in 2004, with the US supermajor weighing development options for years without ever reaching a final investment decision.

The scheme was put on hold in



**Progress: Siccar Point Energy and Shell are gearing up to start FEED work on a phased floater-based development of their Cambo oil and gas field**

Photo: SICCAR POINT ENERGY

2013 due to what Chevron said were poor industry economics, prompting the cancellation of a \$1.5 billion contract with Hyundai Heavy Industries for a newbuild floating production, storage and offloading vessel.

Equinor has vowed to take the

time it needs to scrutinise the development plans it will inherit from Chevron, with the parties aiming to complete the deal — still subject to approval by the UK authorities and field partners Suncor, with a 40% interest, and Siccar Point Energy, on 20% — “as soon as possible”, probably before the end of the year.

Analysts said Rosebank will be expensive to develop but Equinor could use it as an opportunity to re-scope Chevron's plans and reduce costs, as the company has done with its Johan Castberg project in Norway.

At Johan Castberg, the company is planning to use a standardised FPSO for production of about 100,000 barrels of oil equivalent per day.

Elsewhere in the west of Shetland area, Siccar Point Energy and heavyweight partner Shell are gearing up to start front-end engineering and design work on a phased floater-based development of their Cambo oil and gas field.

Boosted by successful early results from recent appraisal work, the private equity-backed operator has been screening a variety of contractors and FPSO solutions as it heads towards FEED.

Siccar Point chief executive Jonathan Roger recently told Upstream that the company hoped to have a shortlist drawn up soon with a view to then launching a competitive FEED process lasting about six months.

Roger said a variety of potential floater options across three main categories have been under consideration — redeployment candidates, conversion candidates and newbuild options. Market sources

said earlier Siccar Point is understood to have been in contact with Dutch contractor Bluewater over possible upgrades to the Munin FPSO, while the OSX-owned OSX-1 unit could also be an option, although that vessel has also been linked to Repsol's Ca Rong Do project off Vietnam and possibly Cairn Energy's SNE project off Senegal.

However, some floater market sources suggested a newbuild option remained open for Cambo, given the challenges of its remote, harsh-environment location in 1000 metres of water.

In the northern North Sea, Alpha Petroleum Resources recently entered into a formal agreement with Teekay Offshore Partners to use the Petrojarl Varg floating production, storage and offloading vessel to develop the Cheviot oilfield.

However, the private equity-backed oil company still needs to secure financing ahead of making a final investment decision, which it hopes to do this quarter.

Alpha said the agreement will allow project-specific process modifications to be made to the FPSO for it to operate for the planned 10-year term of the contract.

#### Work schedule

The modifications are set to take place at Sembcorp Marine Rigs & Floaters in Singapore, with work scheduled to start in the first quarter of 2019.

Alpha is targeting first oil in the second quarter of 2021, later than earlier guidance, at an expected rate of at least 30,000 barrels per day.

Hurricane Energy last month

said the Aoka Mizu FPSO, which is contracted from Bluewater, had left Drydocks World Dubai after upgrades and will be installed as an early production system on the company's Hurricane field to test the potential of the fractured basement reservoirs.

A string of discoveries by Hurricane containing large amounts of oil along a geological feature called the Rona Ridge have created excitement, but it remains unclear exactly how much of the oil can be recovered.

At the beginning of this year, Shell sanctioned the redevelopment of the Penguins cluster of fields in the northern North Sea.

Shell and its partner Exxon-Mobil will go ahead with the construction of a newbuild cylindrical FPSO, based on a design by Sevan Marine, to open up about 80 million recoverable barrels of oil equivalent.

Peak gross production is expected to be about 45,000 boe per day.

Global engineering company Fluor landed the coveted engineering, procurement and construction contract to provide the vessel, which is being built by China's Offshore Oil Engineering Company (COOEC).

COOEC started construction in July at its Qingdao facilities.

Shell has said the redevelopment will be an “attractive opportunity” that will make a profit at below \$40 per barrel.



**Shortlist: Siccar Point chief executive Jonathan Roger**

Photo: SICCAR POINT ENERGY



# for floaters



## UK FLOATER-BASED PROJECTS

Field Area	Operator	FPSO
<b>In Production</b>		
Alma/Galia	EnQuest	EnQuest Producer
Anasuria-Guillemot A, Teal and Teal South	Hibiscus	Anasuria FPSO
Balmoral	Premier	Balmoral
Banff	CNR	Banff
Catcher	Premier	BW Catcher
Chestnut	Spirit Energy	Hummingbird Spirit
Curlew	Shell	Curlew FPSO
Dumbarton	Total	GPIII
Foinaven	BP	Foinaven
Greater Stella Area	Ithaca	FPF1
Gryphon	Total	Gryphon FPSO
Huntington	Premier	Voyageur Spirit
Kraken	Enquest	Kraken FPSO
Pierce	Shell	Haewene Brym
Ross & Blake	Repsol Sinopec	Bleo Holm
Schiehallion & Loyal – Quad 204	BP	Glen Lyon FPSO
Triton & Greater Guillemot Area	Dana	Triton FPSO
Western Isles	Dana	Western Isles
<b>Under Development</b>		
Lancaster EPS	Hurricane	Aoka Mizu
Penguins Re-development	Shell	
<b>Near-Term Developments</b>		
Cheviot	Alpha	Petorjarl Varg
Rosebank	Equinor*	
<b>Longer-Term Developments</b>		
Cambo	Siccar Point	

\*Pending completion of acquisition



On station:  
the Glen  
Lyon FPSO  
Photo: BP

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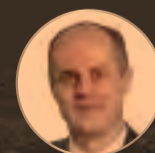
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## EAST MEDITERRANEAN



Under construction: an artist's illustration of the Karish-Tanin FPSO  
Image: ENERGEAN OIL & GAS



FPSO Cidade de Campos dos Goytacazes MV29

# Energean floater an East Med landmark

**FPSO at forefront** as for field development **off Israel**

**IAIN ESAU**

London

**T**ECHNIPFMC'S work on the Karish-Tanin floating production, storage and offloading vessel is part of a \$1.4 billion engineering, procurement, construction, installation and commissioning contract it was awarded by Energean Oil & Gas in March covering the fields' entire infrastructure.

In a groundbreaking deal, the London-based contractor is also responsible for the project's subsea production system, its subsea umbilical, flowline and riser equipment and a 90-kilometre gas export pipeline that will make landfall at Dor on Israel's coast.

#### Future discoveries

Due on stream in 2021, the deep-water FPSO will host gas and oil production from three initial subsea wells at Karish, with Tanin and future discoveries to be tied back at a later date.

In total, these fields hold about 2.1 trillion cubic feet of gas and 14.3 million barrels of oil.

After processing, up to 800 million cubic feet per day of dry gas will be piped to shore. Oil will be stored on the FPSO — which has a

storage capacity of 800,000 barrels — and offloaded onto tandem-moored shuttle tankers.

The vessel's topsides will be able to handle almost 22,000 barrels per day of liquids.

The FPSO, with a 227-metre long, 50-metre wide hull, will be spread-moored in 1700 metres of water and have a design life of 35 years.

It has been designed to accommodate 75 people on board, rising to 125 in maintenance periods.

Four gas turbines will provide up to 47.2 megawatts of power in total.

Energean said it will cut first steel on the FPSO's hull on 26 November at China's Cosco Shipping Heavy Industry.

Cosco is building the hull under a sub-contract to Sembcorp Marine in Singapore, while Siemens is building the topsides.

The hull and 8000-tonne deck will be integrated in Singapore.

A further 7000 tonnes of topsides could be installed on the hull later, if future discoveries warrant this, doubling the floater's processing capacity to 1.6 billion cubic feet per day.



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## NORTH AMERICA



Precursor: the new Llog unit will be based on Exmar's Opti-Ex design and therefore similar to the Delta House floating semisub in the US Gulf  
Photo: EXMAR

# Pace and costs key in US Gulf

**Floater sector** taking steps forward in region but focus is very much on **tighter financing and quicker turnarounds**

**KATHRINE SCHMIDT**

Houston

**T**HE Gulf of Mexico floater market has continued to see projects progress with the focus on economic designs that offer quicker schedules to first oil.

Companies are taking time to weigh options but at least two new floaters have already been ordered this year for the US part of the region.

In a long-awaited decision, Llog Exploration last month moved forward with a \$452.7 million award to South Korea's Hyundai Heavy Industries for a new floating production system for the US Gulf. The semi-submersible pro-

duction facility is expected to produce from the US independent's Khaleesi and Mormont discoveries in the deep-water Green Canyon area.

The facility, which has a working name believed to be King's Quay, is scheduled to be delivered by the end of April 2021.

The unit is expected to be a four-columned semisub based on Exmar's Opti-Ex design with capacity for up to 100,000 barrels per day, similar to the floating production systems the company has used at its Gulf of Mexico Who Dat and Delta House developments. However, Llog has yet to

formally announce any final investment decision for the project and did not comment further when queried by Upstream.

The Llog order follows the move by Shell in April to take a final investment decision on its Vito project, a pared-down semisub design now planned to produce from Block 984 at the southern edge of the Mississippi Canyon area. The facility is expected to be built by Sembcorp Marine in Singapore.

Shell may also look to lessons learned from Vito as the company considers its next move for a promising new discovery at

Whale in the Alaminos Canyon area of the US Gulf.

Meanwhile, Chevron is continuing to progress towards a final investment decision for its Anchor project in the Green Canyon area, where plans call for a mid-sized production semisub.

Wood and KBR are conducting engineering work on the topsides and hull, respectively.

Market sources expect a final investment decision in 2019.

## Revision

However, Chevron revealed this autumn that it had elected not to further pursue its Tigris project in the Keathley Canyon area, though 50% partner BP told Upstream that it was still considering the opportunity.

Last month, French major Total was believed to have selected Jacobs and Intecsea to carry out a pre-front-end engineering and design study for its North Platte development in the Garden Banks area.

The mid-sized production semisub, which is to draw upon ultra high-temperature, high-

pressure technology, is expected to have capacity for about 75,000 barrels of oil equivalent per day.

The North Platte pre-FEED work is expected to last between five and six months and is aimed at defining the scope of the project, which Total is targeting for a final investment decision by 2020.

Total has also expressed enthusiasm for the potential of the Ballymore discovery, saying the find in the Norphlet play contains a resource of between 500 million and 1 billion barrels of oil equivalent, potentially supporting a standalone facility with capacity for up to 170,000 barrels per day.

Total, a partner in the field with operator Chevron, also floated the possible option of early production via a tie-back to the nearby Blind Faith host.

Two upcoming appraisal wells are planned as soon as later this year to firm up the potential of the discovery.

The company also included the project on a list of developments the company could sanction by 2020.

## New FPSO in the works for Mexico

MEXICO appears set for a new floating production, storage and offloading development with Eni, having signed a letter of intent with Modec to provide a unit to produce from the Amoca field.

The Italian major, which won the field in Mexico's Round 1.2, said it plans a final investment decision on the project in the fourth quarter.

The floater is planned to have production capacity of 90,000 barrels per day of oil and 75 million cubic feet per day of gas. It is due to be

brought online in early 2021 and will produce from the Amoca and Mizton fields.

An early production scheme at the Mizton field is due to start producing 8000 bpd by the first quarter of next year.

Modec said its Sofec business unit will design and supply the disconnectable tower yoke mooring system for the FPSO, which will be used to exploit the field under a \$7.5 billion development plan for Area 1 recently approved by the Mexican authorities.



## CHINA



# China targets gas challenge

**Chinese yards** have several hurdles to overcome as they turn attention to **floating gas production units**

XU YIHE

Singapore

**W**ITH new orders for offshore drilling rigs in the doldrums, Chinese yards are trying to find some relief in the construction of floating gas production units.

However, challenges such as investment risks, project management and offtake uncertainties will keep orders of these units from Chinese oil and gas operators at bay for the time being.

There are many hurdles ahead before Chinese energy authorities can rubberstamp development of

the country's first floating storage and re-gasification units or floating liquefied natural gas vessels for importing LNG or tapping the marginal offshore gas plays.

Project management skills, procurement for custom-made orders and co-ordinating a vast number of equipment suppliers and sub-contractors are among the challenges that need to be overcome before the first project flies.

Industry sources say that to overcome such challenges, Chinese yards should standardise work processes and technological

advances to improve efficiency and reduce costs.

One official from China National Offshore Oil Corporation (CNOOC) says that although FSRU technology is now a preferred solution to access global LNG supply and is considered instrumental for opening new markets, Chinese companies are very cautious about the new concept.

Last year, about 10% of global LNG was imported through FSRUs, the official says.

That figure is growing — Norwegian vessel owner Hoegh has

unveiled plans to double its FSRU fleet by 2020, and the market is poised to maintain the momentum, the official adds.

However, Chinese LNG project developers still seem to be getting their heads around issues such as long-term offtake and contracting risks and the development of competing fuels.

## Benefits

Although they recognise the benefits of using FSRU to import LNG, such as flexibility with onshore space constraints, the challenges

have led Chinese LNG project developers to favour onshore terminals over floating facilities for import.

CNOOC initially planned to develop FSRU projects at Tianjin city in northern China, Yantai in Shandong province and Yancheng in Jiangsu province.

However, the company later cancelled the plan and opted instead for onshore terminal solutions.

CNOOC now owns and operates 15 onshore LNG terminals, including six under construction.

However, CNOOC recently engaged Hoegh to charter its newly delivered Hoegh Esperanza FSRU for a three-year assignment in Tianjin as an LNG supply option to support the onshore terminal when demand rises.

The contract has a one-year extension option and covers use of the unit, which has storage capacity of 170,000 cubic metres, both as a regasification unit and as an LNG carrier.

The Hoegh Esperanza FSRU will process LNG and send regasified volumes to end users in Tianjin via an 18-kilometre pipeline grid that starts in Nanjiang and terminates at Tianjin's Lingang industrial zone.

## Floating LNG could help unlock remote resources

FLOATING liquefied natural gas could provide a development solution to unlock China's small and remote offshore gas deposits and those in environmentally sensitive areas, writes Xu Yihe.

Such projects in China come with great potential as well as specific risks that involve field and reservoir operations, long-term gas availability and project financing, according to an official with China National Offshore Oil Corporation (CNOOC).

China's offshore gas is being developed now through wellhead platforms or subsea production systems tied back via pipelines to onshore terminals.

However, the economics of pipeline

solutions do not work for getting gas to market from the East China Sea, where marginal reserves lie under shallow waters far away from the shore.

CNOOC is considering using two small FLNG units as a cost-effective option for development of marginal fields in the East China Sea.

The company has put forward two options to move the gas to market efficiently.

One solution would use a mobile jack-up production platform with a production capacity of 400,000 cubic metres per day. The unit would serve as an LNG producer with storage tanks and living quarters.

The second option proposes using

small polygon-shaped FLNG units with a production capacity of 800,000 cubic metres per day connected to subsea production systems.

The new design by CNOOC is understood to have a multiple-sided polygon shape that forms a rounded hull, avoiding duplication of the cylindrical FPSO unit initially designed by Norway's Magnora, formerly known as Sevan Marine.

The design by China's dominant offshore oil and gas operator was carried out with the support of China State Shipping Corporation.

No specific fields in the East China Sea area have been identified as FLNG developments to date.



## Chinese yards start to invest in technology for FSRU vessels

Leading the way: the Hoegh Esperanza is now in Tianjin where it will serve as China's sole FSRU under a contract with CNOOC  
Photo: HOEGH

A HANDFUL of Chinese yards have invested in technologies that can be applied to the fabrication of floating storage and regasification units and potentially to floating liquefied natural gas units, writes Xu Yihe.

The yards — including Hudong Zhonghua, Dalian Shipbuilding Industry Corporation, CIMC Rafles and Wison Offshore and Marine — have started with FSRUs, as the topsides technology is less complex than on FLNG units, and there is expected to be more demand for FSRUs than FLNG units in the future.

Chinese contractor Wison last year delivered the world's first barge-based FLNG vessel to Belgium's Exmar using Black & Veatch technology on a single-train on-board liquefaction unit with capacity to produce 500,000 tonnes per annum of LNG.

Exmar is now in talks with Argentina's YPF for possible charter of the unit to develop unconventional gas resources in the Neuquen basin, which accounts for more than half of Argentina's gas production.

Building on its delivery of the Caribbean FLNG vessel, Wison is understood to have approached Dutch terminal and storage facility operator Vopak to build a floating storage and re-gasification power vessel to be deployed in Singapore.

The unit will have an annual



Delivered: the Caribbean FLNG vessel

Photo: EXMAR

power generation capacity of 500,000 kilowatts using re-gasified LNG for electricity production.

Last year, French certification agency Bureau Veritas classed Wison's FSRP concept, which when built will be the world's first barge-based power generation plant fuelled by LNG.

Wison is also working with China Classification Society Wuhan Rules & Research Institute on a range of FSRU developments in China.

The work is being carried out under a strategic co-operation agreement covering formulation of technical standards, design and review and joint research of new technologies to promote the commercial application of FLNG solutions in China.

In May, Switzerland-based commodity trader Gunvor chartered an FSRU barge, also built by Wison for Exmar, for deployment at the port of Chittagong in Bangladesh.

The 10-year deal is for a unit that is currently undergoing

site-specific modifications at Singapore's Keppel Shipyard.

The barge has LNG storage capacity of 25,000 cubic metres and re-gasification capacity of 600 million cubic feet equivalent per day.

Hudong Zhonghua Shipbuilding in Shanghai has developed its own FSRU based on technology developed for construction of the LNG carrier ordered by Australia's Queensland Curtis LNG.

The yard has already been awarded two LNG FSRU contracts by the Greek ship owner Dynagas. The units are designed with storage capacity of 174,000 cubic metres and can be used as floating regas terminals or as LNG carriers, according to a Hudong official.

The units will be powered by dual fuel diesel electric propulsion systems and able to travel at speeds up to 19.5 knots.

Work is currently in the detailed design stage, with first steel due to be cut this month, with delivery expected in early 2021.



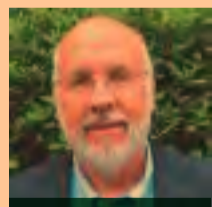
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## FLOATING LIQUEFIED NATURAL GAS

## FLNG comes of age in changing

**PFLNG Satu** and Prelude blazed trail for technology that is now **tried and tested**

**AMANDA BATTERSBY**

Singapore

**F**LOATING liquefied natural gas projects look set to come into their own in the 2020s.

The now tried and tested — albeit limitedly — technology can offer a realistic option to exploit gas reserves with little or no nearby infrastructure or where export markets are being targeted.

The initial industry excitement when Anglo-Dutch supermajor Shell in May 2011 took the final investment decision on its 3.6 million tonnes per annum Prelude FLNG off Australia might have waned.

And perhaps some will have forgotten that it was on 5 December 2016 that Malaysia's national oil company Petronas produced the world's first drop of LNG from PFLNG Satu, deployed on the Kanowit field off Sarawak.

However, it is no understatement to say that these two bold commitments have blazed a trail for FLNG, which could help unlock many trillions of cubic feet of global gas reserves for which pipeline infrastructure is not commercially viable.

Operator Petronas itself described the 1.2 million tpa PFLNG Satu as “a technological marvel that will change the landscape of liquefied natural gas production forever”.

The main drivers and challenges for FLNG projects are said to include location, countries' energy policies, environmental impact, business model flexibility, financing and overall LNG market trends, according to the International Gas Union (IGU).

#### Market trends

Market trends could be more important than the technological aspects given the liquefaction processes for FLNG are well known and applied throughout the LNG industry.

“As for any LNG development, the potential optimisation in terms of costs and implementation schedule are part of the key enablers for the FLNG developments,” says the IGU.

Japanese contractor Chiyoda notes that key to FLNG planning is to optimise the facility arrangement and specifications, considering the specific feed gas composition, LNG production rate target, metocean conditions and how close to shore the floater is situated, in order to improve the project economics.

Having condensate that can be produced alongside the gas is a big help towards improving project economics, as are phased develop-



#### GLOBAL FLNG PROJECTS

Project	Operator	Country	Capacity	Start-up/Status
PFLNG Satu	Petronas	Malaysia	1.2 million tpa	2017
Kribi	Perenco	Cameroon	2.4 million tpa	2018
Prelude	Shell	Australia	3.6 million tpa	Q4 2018
PFLNG Dua	Petronas	Malaysia	1.5 million tpa	2020
Coral South	Eni	Mozambique	3.4 million tpa	2022
Greater Tortue-Ahmeyin	BP	Mauritania/Senegal	2.5 million tpa (phase one)	Pre-FID
Scarborough	ExxonMobil	Australia	6.5 million tpa	Pre-FID
Bonaparte	Engie	Australia	2 million tpa	Pre-FID
Cash-Maple	PTTEP	Australia	2 million tpa	Pre-FID
Poseidon	ConocoPhillips	Australia	2 million tpa	Pre-FID
Sunrise	Woodside	Australia	4 million tpa	Pre-FID
Kitsault	Kitsault Energy	Canada	8 million tpa	Pre-FID
Congo-Brazzaville	NewAge	Congo-Brazzaville	1.2 million tpa	2020
Etinde	NewAge	Cameroon	1.2 million tpa	2023
Iran LNG	unknown	Iran	500,000 tpa	Pre-FID
Gorskaya	unknown	Russia	1.26 million tpa	By 2021
Djibouti	Poly-GCL	Djibouti	3 million tpa	2020
East Dara	Black Platinum Energy	Indonesia	830,000 tpa	N/A
Pandora	Cott Oil & Gas	Papua New Guinea	1 million tpa	N/A
CE	Cambridge Energy Holdings	US	7.5 million tpa	Pre-FID
Delfin	Fairwood LNG	US	12 million tpa	Pre-FID
Main Pass	Freeport-McMoRan Energy	US	24 million tpa	Pre-FID
Barca	Barca LNG	US	12 million tpa	Pre-FID
Eos	Eos LNG	US	12 million tpa	Pre-FID
Point Comfort	Lloyds Energy Group	US	9 million tpa	Pre-FID

Sources: Upstream and the IGU 2018 World Gas LNG Report

ments, which seem to be gaining in popularity, at least at the drawing board.

Project economics can also be helped by utilising converted FLNG units, rather than new-builds such as Prelude and PFLNG Satu, as these can be built faster and with lower capital expenditure.

Financing is also expected to become easier as lenders start to overcome a reluctance to fund

what was once deemed a novel technology.

Two FLNG projects are today operational — PFLNG Satu and Perenco's Kribi off Cameroon — while Prelude is now targeting start-up before the end of the year.

Meanwhile, construction has started at Samsung Heavy Industries' Geoje Island yard in South Korea on Petronas' second such vessel, PFLNG Dua, destined for the Murphy Oil-operated Rokan

field off Sabah. The 1.5 million tpa PFLNG Dua is expected to be completed by 2020.

France's Perenco is making progress off Cameroon, where it is the leading operator after acquiring compatriot Total's assets around seven years ago.

One of its key assets is the Sanaga gas field, which was initially exploited to provide feedstock gas to the Kribi power plant.

In September 2015, Perenco con-

tracted Golar LNG to help develop Sanaga's remaining reserves with an innovative FLNG vessel on a 10-year contract.

The Hilli Episeyo FLNG vessel was a conversion carried out at Singapore's Keppel Shipyard.

Golar LNG says the Hilli Episeyo's charterers, Perenco and state-owned partner SNH, are pleased with the performance of the unit and talks have started on utilising the vessel's spare capac-



# ing landscape

**Milestone: the PFLNG Satu FLNG vessel on location at the Kanowit gas field off Malaysia**  
Photo: PETRONAS



ity. The modular four-train liquefaction facility has capacity of 2.4 million tpa. All four of the trains have been successfully tested to their nameplate capacity although only two of the trains are currently being used.

At least 10 cargoes have been shipped since the Hilli Episeyo began commercial operations in March — the initial cargo was exported two months later.

The IGU earlier said that if Kribi FLNG started up smoothly, it would “lend credence to the converted FLNG approach, given the availability of laid-up carriers”.

Prelude has been a long time coming but Shell has never wavered from its oft-stated stance that safe operations are paramount and that offshore commissioning would take as long as was needed.

The Prelude FLNG vessel is designed to also produce 1.3 million tpa of condensate and 400,000 tpa of liquid petroleum gas.

The operator is expected to soon invite bids for the front-end engineering and design work for its Crux wet gas field with the aim of achieving first gas in 2024 or 2025. Crux’s gas will be processed at Prelude FLNG.

## Future projects

Looking to the future, first steel for the hull for Eni’s Coral FLNG project in Area 4 off Mozambique was cut in September at Samsung’s yard.

Samsung is also tasked with building the liquefaction vessel’s

topsides and construction of these is scheduled to start before year-end.

Construction of the Coral FLNG vessel began in March with the start of work on the turret mooring system at Keppel.

However, another proposed such project, Ophir Energy’s 2.4 million tpa Fortuna FLNG development scheme suffered a major setback in late 2017 when talks collapsed with potential Chinese lenders.

Another blow came earlier this year when Schlumberger elected to pull out of OneLNG, its 49:51 joint venture with Golar LNG, because Fortuna had been unable to secure a debt financing package.

In 2016, Ophir formed a joint operating company with OneLNG, in which the UK-headquartered independent had held a 33.8% stake.

This joint outfit was to have had responsibility for the financing, construction, development and operation of Fortuna and would have held Ophir’s interest in offshore Block R and the Golar Gandria FLNG unit.

However, Ophir has not yet given up on Fortuna and there is a ray of sunshine given that Golar LNG is in talks with Chinese yards to construct its modular Mark 2 design FLNG unit.

Also, these negotiations could lead to a so-called “Chinese solution” that would offer fabrication, financing and potential LNG offtake.

## Eyes on costs as more yards target floating LNG vessel jobs

COSTS for floating liquefied natural gas vessels are expected to become increasingly competitive as more contractors enter the arena, writes *Amanda Battersby*.

South Korea’s Daewoo Shipbuilding & Marine Engineering and Samsung Heavy Industries have so far dominated the new-building scene, with Daewoo building the PFLNG Satu and Samsung the Prelude vessel.

Samsung is also in the process of fabricating the PFLNG Dua for Petronas and Eni’s Coral South deep-water FLNG unit.

Meanwhile, Keppel Shipyard in Singapore has converted the LNG carrier Hilli into the Hill Episeyo FLNG unit for Golar LNG — a contract that came with at least one more option, subject to projects’ final investment decision.

However, the dominance of these yards is now being challenged, not least by cost competitive yards in China, though the South Korean contractors are not resting on their laurels.

When Daewoo was building the PFLNG Satu while in partnership with then-Technip, the American Bureau of Shipping (ABS) was brought in to support safety and apply class guidance to a conceptual novel FLNG unit.

ABS has now granted approval in principle to South Korean compatriot Hyundai Heavy Industries for its deep-water FLNG hull design.

Hyundai claims its “newbuilding conversion” FLNG hull can be constructed at less than half the cost of a conventional LNG hull.

The hull is based on LNG carrier designs combined with the requirements for FLNG production, such as structural reinforcements to take topsides module loads.

The deep-water, harsh environment hull is designed to allow up to 25 years’ operation without



**Achievement: Samsung built the Prelude FLNG for Shell**  
Photo: SHELL

dry-docking. The same team from ABS and Hyundai had earlier successfully developed a low-cost near-shore FLNG hull that last year gained approval in principle.

Hyundai’s design features a barge-shaped hull and a GTT Mark III containment system with storage for about 192,000 cubic metres of LNG.

The 2.5 million tonnes per annum vessel can accommodate an internal turret and 45,000 tonnes of topsides modules.

Singapore’s Sembcorp Marine also has its sights firmly set on the FLNG market, where it is targeting opportunities for its proprietary GraviFloat concept, which has already attracted the attention of players such as Poly-GCL for its touted project off Djibouti.

GraviFloat, a Sembmarine subsidiary, designs and holds patents for a suite of re-deployable, modularised solutions based on unique near-shore floating yet gravity-based LNG terminal solutions and these units can be configured for FLNG projects.

Chinese yards could too soon be making inroads into the FLNG scene via BP and partner Kosmos Energy’s Tortue-Ahmedin project off Mauritania and Senegal.

The FLNG unit for phase one of this mega-project is to be supplied

by Golar LNG and the Norwegian contractor has made no bones about the potential for Chinese fabricators to carry out some of the work on FLNG vessels — at the potential expense of South Korean and Singaporean yards.

Samsung’s win of the deep-water 3.4 million tpa FLNG unit for Italian operator Eni’s Coral South project off Mozambique, the first sanctioned FLNG project in Africa, reinforced the contractor’s current market-leading position.

The award came after the latest oil price slump during which Shell pulled a contract worth some \$4.7 billion it had earlier awarded to Samsung for three FLNG units for the Woodside-operated Browse project off Australia.

Woodside and its co-venturers subsequently elected to exploit Browse utilising onshore liquefaction and last week signed a preliminary tolling agreement to exploit the giant offshore gas field via the existing North West Shelf facilities at Karratha.

Another touted FLNG project that has fallen by the wayside is Inpex’s Abadi off Indonesia, after the nation’s President Joko Widodo vetoed plans for a proposed 7.5 million tpa floater in favour of onshore liquefaction to develop the remote giant gas field.

## Financing still a challenge for projects

FLOATING liquefied natural gas projects require significant capital expenditure so access to financing is key to taking the final investment decision and for the success of such projects, writes *Amanda Battersby*.

Shell and Petronas entered into balance sheet funding to build their own facilities at Prelude and PFLNG Satu, respectively.

Both companies were able to build the pioneering FLNG facilities “because they could afford it” and because “they had direct oversight and therefore managed the commercial risks”, says consultancy Westwood Global Energy Group.

“By designing the facilities and entrusting the construction to well established contractors, technology and construction/completion risks were addressed.”

The consultancy adds that country and field reserve risks could be considered relatively low for both operators in relation to the fields being exploited.

“Finally, both operators have experience operating LNG assets and can be viewed as the offtakers on their respective projects.”

However, during the latest oil price downturn other players delayed or cancelled FLNG devel-

opments, which means that only one other such project — Perenco’s Kribi off Cameroon, sanctioned in 2015 — has since started operation.

In contrast to the Prelude and PFLNG Satu newbuilds, Kribi is being exploited via Golar LNG’s converted Hilli Episeyo FLNG vessel, reducing capital expenditure.

While the price tags have never been publicly divulged, the Prelude and PFLNG Satu units have estimated respective costs of around \$12 billion and \$2 billion.

Golar LNG managed to secure around 80% of the \$1.2 billion needed to convert the Hilli Episeyo at Singapore’s Keppel Shipyard from China State Shipbuilding Corporation (CSSC), which will ultimately transition into a sale and leaseback structure.

Financing for another of Golar’s FLNG planned conversions, the Golar Gandria, which was destined for Ophir Energy’s Fortuna project off Equatorial Guinea, had also been expected to come from Chinese lenders.

However, talks between potential financiers and Ophir broke down late last year amid questions about the technology and a reluctance by some Chinese insti-

tutions to fund projects not being built in China.

The LNG tanker Gandria had already arrived at Keppel for conversion for the Fortuna FLNG project.

Exmar’s reported \$300 million newbuild Caribbean FLNG unit availed itself of funding from banks and an ECA.

Argentine media reports have suggested that YPF is close to signing a charter with Belgium’s Exmar for the Caribbean, a 500,000 tpa-capacity barge-based FLNG vessel that could be operating off Argentina in mid-2019 if the deal goes ahead.

Meanwhile, Italian operator Eni’s Coral South FLNG project off Mozambique is believed to be the first to successfully secure project financing of \$4.7 billion from a consortium of international banks and export credit agencies.

Yet this still leaves Eni and its partners having to come up with a further \$2 billion-plus to fund the project.

“As technological risks are sufficiently mitigated, commercial risks become the focal point with external financing highly unlikely in speculative situations with no guaranteed offtake,” notes Westwood.