

“2016 and Two FPSOs in US GoM: the Twenty Year Saga”

Rice Global E&C Forum

Roundtable meeting

Peter Lovie

10 June 2016

Rice Global E&C Forum

First, the 20 year saga for Rice Global E&C Forum!

The Steering Council gathers at Duncan Hall just prior to the ninth annual Forum in 2005



Dean Sallie Keller of Engineering is at center in white, with Rice President Leebron next on right. You may recognize the others!

The 20 year saga of Rice Global E&C Forum . . .

Before the era of lunchtime Roundtable meetings like today!

Introducing the 2005 Annual Forum: Professor Ahmad Durrani (Forum founder and University Co-Chair) plus Peter Lovie (Industry Co-Chair):



Peter Lovie moderating at the 2005 Annual Forum

“2016 and Two FPSOs in US GoM: the Twenty Year Saga”

Published 10 April at www.fpsosingom.com by Peter Lovie, freely downloadable: 10,525 words, 16 pictures, 1 graph, 4 tables. Basis for today's Roundtable: industry pioneers, events and what we might learn from the saga:-

- Unrecognized initiatives of operating oil companies on the regulatory process;
- The real reason for FPSOs being disconnectable in US GoM;
- Shuttle tanker business in US GoM: \$\$\$, DP. safety, Jones Act;
- Why it's about time we amend the Jones Act;
- Fourfold growth in the world's FPSO fleet over these 20 years, yet of 218 FPSOs, only 2 are in the US GoM;
- Outlook as FPSO business faces its worst ever downturn;
- Closing thoughts.

Back when it all started, 20 years ago . . .

Back in 1996 there were ~50 FPSOs in the world, working in environments from the harsh North Sea to the more benign in West Africa. FPSOs had been around since 1977;

Texaco's *Fuji* prospect in US GoM – a remote location in VERY deep water for 1996 (1,700 ft.!), looked ideal for an FPSO;

Desire by operators in US GoM to have FPSOs in their “toolbox”;

Unlike anywhere else in the world, MMS as key regulator wanted an Environmental Impact Statement (EIS) before they'd consider a field development plan using an FPSO;

And MMS would not pay for the EIS;

The operating oil companies huddle, decide they need the FPSO option, will pay MMS to get that EIS done.

Making such a change in the regulatory process was not easy



There is nothing more difficult to take in hand,
More perilous to conduct,
Or more uncertain in its success,
Than to take the lead in the introduction of a new order of things.

Machiavelli, "The Prince", Chapter 6, 1513

Thus started a journey that turned out to
cost the oil companies \$3+million and five years;

Fuji that prompted it all turned out to be non commercial;

[Jeffrey Harrison and Ron Skarbek of Texaco deserve recognition
for their astute observation of the reality of Machiavelli's words,
cited in a January 2000 SPE presentation!]

Industry Pioneer – Allen Verret



Allen Verret,
the father of the EIS

Texaco/Chevron

Offshore Operators' Committee

Retired end 2014

The EIS did not just automatically happen by decree!

Allen Verret succeeded in balancing the technical, commercial and political interests of more than 20 operating oil companies

with

the interests of regulators, FPSO contractors and designers;

It meant bringing together 50-60 stakeholders, over the five year period it eventually took for completion of the EIS.

Cat herder extraordinaire!

The EIS Document + Government Approval of FPSOs

(for a copy, Google BSEE EIS FPSO)

OCS EIS/EA
MMS 2000-090

Proposed Use of Floating Production, Storage, and Offloading Systems On the Gulf of Mexico Outer Continental Shelf

Western and Central Planning Areas

Final Environmental Impact Statement

Author

Minerals Management Service
Gulf of Mexico OCS Region

Prepared under MMS Contract
1435-01-99-CT-30962

Cover

Turret-moored FPSO in a tandem offloading configuration with shuttle tanker
(Illustration courtesy of Advanced Production and Loading AS, 1999).

Published by



U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

New Orleans
January 2001

Signature page in Record of Decision allowing consideration of FPSOs for GoM

____ **Alternative B-4** (Approve the general concept of using FPSO's with a requirement for an attendant vessel.)

____ **Alternative C** (No action at this time (insufficient information to make a decision)).

____ **Other** _____

This decision, authorized by the signature below, and this Recommendation and Decision Document together establish the Agency's Record of Decision on the Environmental Impact Statement prepared on the Proposed Use of Floating Production, Storage, and Offloading Systems on the Gulf of Mexico Outer Continental Shelf, Western and Central Planning Areas. This programmatic decision is effective immediately. This decision does not constitute approval of any specific FPSO project. Submission, review, and approval of all required OCS plans, permit applications, and other submittals must be completed for every proposed FPSO system.

Dated: 13 December 2001

Carolita U. Kallaur
Associate Director for
Offshore Minerals Management

Industry Pioneer – George Rodenbusch



George Rodenbusch of Shell:
an early FPSO pioneer
Career in Shell. Retired 2006

An investigation on use of an FPSO for US GoM was completed two years before completion of the EIS;

Pioneered by Shell under masterful leadership of George Rodenbusch;

Investigated the use of lazy wave SCRs, later used in the BC-10 FPSO in Brazil and now at the *Turritella* FPSO at *Stones* in US GoM in 2016;

Ultimately the *Na Kika* development in US GoM employed a semi-submersible, as a result of careful analyses of technical and economic factors.

2002 arrives and FPSOs are approved for US GoM

So who will go first?

After all that sweat by so many, in 2002 no one was ready to order an FPSO for GoM!

A complication for FPSOs in US GoM is that tankers normally used for export in the world market cannot be called on. In US GoM “export” tankers have to be Jones Act and there’s very few of them around;

And they have to be small enough to get into the shallow US GoM ports (maximum 40 ft. draft);

Crude oil produced in US GoM had to be delivered to US ports, could not be exported outside the US (relaxed December 2015);

Despite all these constraints, two companies chose to offer this specialized shuttle tanker service.

The original vision - flexibility of shuttle tankers

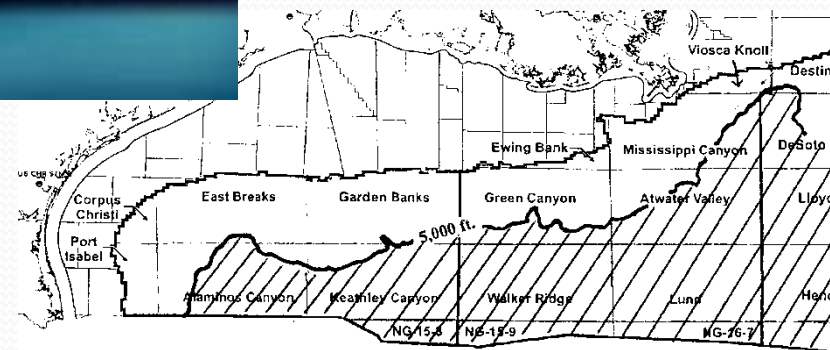
A totally different delivery model from pipelines!



Shuttle tankers can work between any combination of production locations offshore with a range of delivery points onshore.

Oil companies could play the crude oil market like elsewhere in world;

Realistically, shuttle tankers may be serving GoM production locations in 5,000 ft. and deeper waters, i.e. the shaded areas here:



A “pioneer” from a century ago: Wesley Jones

Posthumously became the pipeliners’ friend in Washington!



Senator Wesley
Livsey Jones
(R-WA)
1863-1932

Author of the Merchant Marine Act of 1920,
aka The Jones Act;

Intended to protect his state’s trade with
Alaska, a measure acceptable in the
protectionist times of the 1920s;

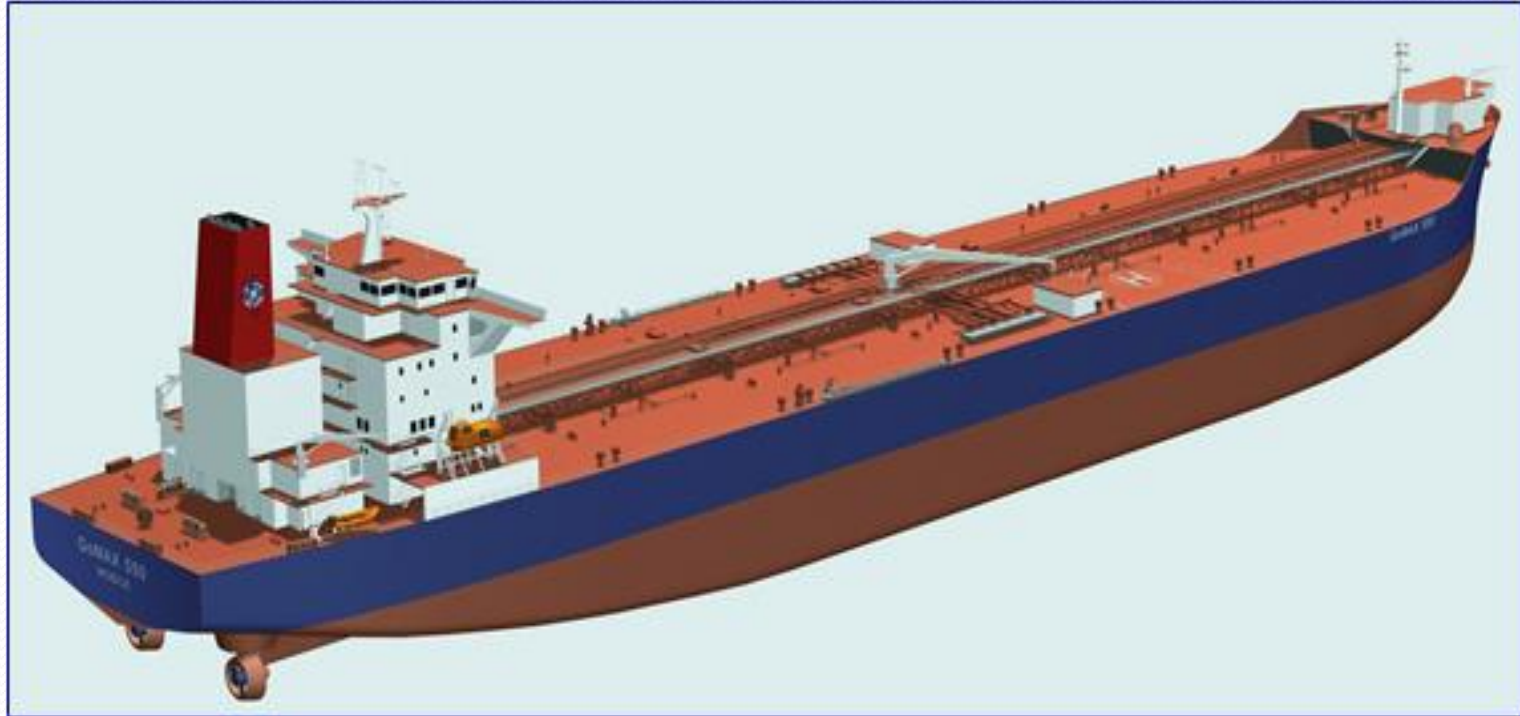
The Jones Act applies to ships engaged in
coastwise trade in US waters: requires US
flag, US built vessels, 75+% US owned, US
crew. In contrast to 1920, by 2002 US
shipbuilding costs had grown to about 3X
international trade, OPEX about 2X;

A production platform is considered a US port,
so delivery of production from a production
facility such as an FPSO to shore is “coastwise
trade”.

Seahorse Shuttling (2001-2003)

Operator parent, new GOMAX shuttle tanker design

Seahorse Shuttling was a unit of Conoco that drew on their shuttle tanker experience for their production in the North Sea.



550,000 bbl capacity, special design for US GoM using BLS and DP2. Newbuilds planned at Alabama Drydock, drew on Korean ship building expertise.

American Shuttle Tankers LLC (2001-2004)

Owned 50:50 by two tanker operating parents

Navion A.S.

Wholly owned company of
Teekay (NYSE - TK)

Leader in shuttle tankers in the
North Sea, Brasil, Canada -
operating since 1979, over
12,000 offloadings. Operated a
fleet of 25 shuttle tankers, 23
platforms, 50+ CoA agreements



Skaugen PetroTrans Inc.

Jointly owned by Teekay and
I.M. Skaugen (Oslo - IMSK)

Leader in lightering in US GoM:
operating since 1982, over 9,800
lighterings. Operate a fleet of 10
lightering tankers.



Handymax Size of Shuttle Tanker

American Shuttle Tankers LLC planned to use existing Jones Act product tankers of 330,000 bbl capacity, converted to use BLS and DP2 with North Sea training & management practices.



In 2007 at *Cascade/Chinook*, the same size of tanker was employed but with Petrobras' own design created in Brazil 2002-2006, with BLS, but no DP. Time charters signed August 2007 by Petrobras with OSG for two shuttle tankers for US GoM.

The debate on shuttle tankers and DP

Pro

- Ultimate in proven safety from years in North Sea since 1979;
- No support vessels at FPSO (hold off tug, hose handling vessel);
- No tugs needed for docking at destination;
- Can hook up and cast off in more severe sea conditions offshore (less weather downtime).

Con

- Require well trained operating crew - slightly higher OPEX;
- Somewhat higher CAPEX;
- In US shipyards, getting DP2 tankers would be costly and slow. Even the non DP tankers for firsts FPSO in US GoM turned out to be on critical path for reaching first oil.

Pattern of high cost Jones Act tankers

Crippled plans for “export” by tanker v. pipeline

2000: A supermajor debated use of FSOs plus tanker export for deepwater developments versus a new pipeline trunk system. Eventually pipeline won out over high priced Jones Act tankers;

2004: Shell’s *Great White* development looked to use an FPSO plus shuttle tanker export. But shuttle tankers at Jones Act full payout rates represented an unduly high cost component (even yours truly could not convince otherwise!) and *Great White* became the *Perdido* development with a spar;

2005-2009: Devon’s deepwater portfolio prompted development of their FSOG concept of a host FSO fed by spars and non FPSO solutions, with shuttle tanker export. Studies in 2007-2009 showed a good economic advantage but only with lifetime commitments for Jones Act shuttle tankers. But Devon then exited offshore altogether in 2H2009.

Industry Pioneer: Dave Bozeman



Dave Bozeman, Vice
President on Project Support
Office at Devon Energy
Retired 2010

The manager behind Devon's FSO, FPSO and shuttle tanker investigations for Devon's huge Lower Tertiary portfolio – second after Chevron's. Devon (NYSE: DVN) was 50:50 with Petrobras (NYSE: PBR) on *Cascade* which went to contract in 2007 for first FPSO in US GoM.

Pioneered the investigations on use of export tankers for multiple deepwater fields, showing how shuttle tankers could make business sense for ultra-deep where so much of Devon's portfolio was located, independent of the pipeline dominated market in GoM.

The Twenty Year Saga for Shuttle Tankers

Region	Shuttle tanker fleet	
	1996	2016
North Sea	31	40
Eastern Canada	0	5
Brazil	0	40
GoM	0	3
	31	88

Source: Alex Tischendorf, Managing Director for Teekay do Brasil Servicos Maritimos Ltda. , March 2016

Somewhat like FPSOs, the pattern of growth moved from North Sea to Brazil where shuttle tanker operations started in 2002, with remarkable growth since!

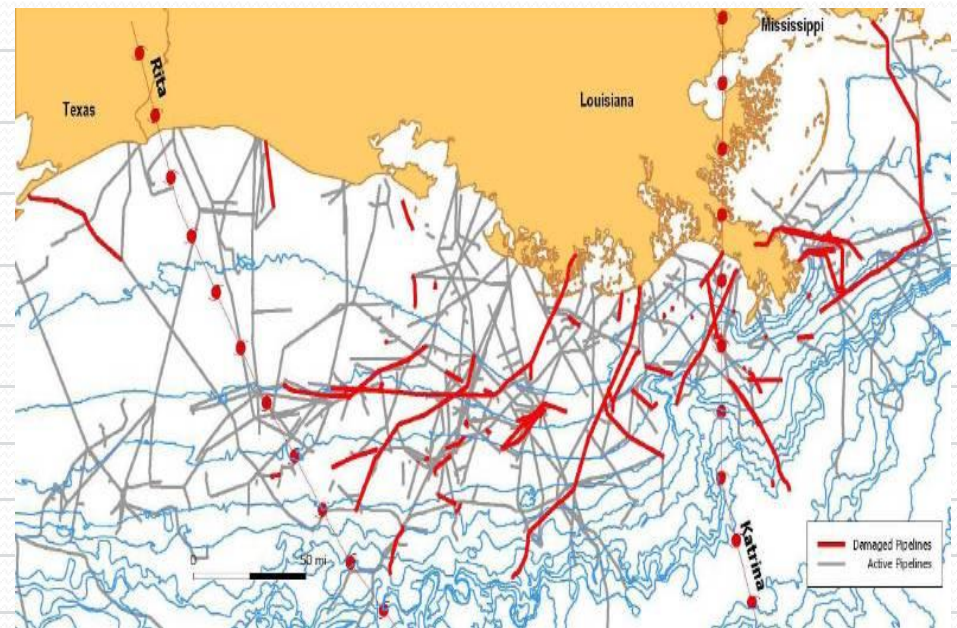
US GoM far behind: first shuttle tankers arrived in 2010.

The hurricanes of 2005

Mother Nature's "game changer"



Source: Shell



Source: MMS

Typical pipeline and platform damage from Katrina and Rita hurricanes in 2005.

MMS counted 113 production platforms destroyed and 52 heavily damaged in these two hurricanes. A number of jackup MODUs were destroyed and something like 19 jackup and semisubmersible MODUs dragged anchors or went fully adrift.

Teekay's *Nordic Trym*: the only DP shuttle tanker to ever operate in GoM



Not shown here:

The scramble for a Jones Act waiver signed by the president.

Plus finding and getting hoses and fittings to site for this emergency.

In the post hurricane emergency of lost production, BP Shipping saw a way to get back into production more quickly for one of their platforms: chartered the Teekay owned, Bahamas flagged, *Nordic Trym* DP shuttle tanker to receive crude from BP America platform at Main Pass 225 in the eastern part of Central GoM.

The 2006 “aha moment” for FPSO disconnection in US GoM

Up east, some might call it “an epiphany”. Here in Texas known as an “aw-shit moment”;

Reality: Knowledgeable hands in the GoM operator community all had the same brainstorm at the same time: “holy crap, we could have one of these drifting MODUs crashing into an FPSO full of oil the next time we have a 2005 style hurricane and we could have an oil spill far worse than *Exxon Valdez*”;

Low probability, extremely high consequence. Cannot take this risk;

Initiative came from the operators. The big bad oil companies were instinctively doing the right thing! Requiring FPSO disconnection had never occurred to the regulators or to Washington.

Data published 3 years later confirmed wisdom of operators' initiative on FPSO disconnection

MODUs adrift in 2005 hurricanes - total mooring failure		
2005 Hurricane	Total MODUs	Distances drifted in GoM
<i>Katrina</i>	5	between 4 and 80 miles
<i>Rita</i>	7	between 75 and 145 miles
<u>Source: MMS/OTRC</u>		
The total MODUs adrift with partial mooring failure was much larger, but the distances they moved was much less		

Data available in 2005 led to operators concluding that a horrendous oil spill potential existed, e.g. a 50,000 ton MODU colliding with an FPSO storing 500,000+ bbl of oil. No one even imagined a *Macondo* event that was ten times worse.

Less Mayhem – for a while

2005 forced the industry to stop & rethink

2006 Petrobras America takes over operatorship of *Cascade/Chinook* from BHP;

Petrobras with non-op partners Devon and Total announce plans for first FPSO in US GoM at *Cascade /Chinook*;

Changes in design criteria debated at OTC and Deepstar;

2007 March Bids solicited for the third FPSO in GoM - and first on US side – for a lease of five years with three one year options;

2007 August Stiff competition on contract for FPSO, signed with BW Offshore. First shuttle tankers in US GoM contracted – signed 2 from OSG.

Petrobras contracts for first FPSO in US GoM with contractor/owner: BW Offshore



- At that time deepest water FPSO in world at 8,200 ft. WR 249
- First FPSO in US GoM;
- Disconnectable, turret moored, with hybrid riser system;
- 80,000 bopd production capacity on an Aframax hull.

***BW Pioneer* arrived US GoM April 2010**

After voyage under its own power from Singapore



Source: Petrobras

Then it all hits the fan

Two weeks after arrival of *BW Pioneer* in US GoM, the *Macondo* disaster strikes;

Delays everything;

Regulatory process in turmoil, reorganizations – Obama and the Bromwich Junta;

Shuttle tanker arrives but no oil to shuttle, diverted to Brazil;

Cascade/Chinook plagued with a chain failure on hybrid risers, more delay.

And Petrobras America Inc. manages its way through it all!



Success at last – first oil at *Cascade/Chinook* Achieved on 25 February 2012

Since then more than 90 offloadings with uptimes in the high 90s



Source: Petrobras

Industry Pioneer - Cesar Palagi



Cesar Palagi: Walker Ridge
Production Asset Manager
with Petrobras America Inc.

Responsible for his company's design and implementation of development projects of ultra-deep waters in Lower Tertiary fields in GoM, at a time of great change.

A career professional from Brazil, led a team of experts from Brazil joining the expanding Houston office.

Managed his company's interests through difficulties beyond their control as well as pioneering production plans from reservoirs with few analogues.

Why have FPSOs taken so long in GoM?

Fundamental differences in US GoM v. rest of the world

- a. Geography: Flat alluvial plain in US GoM going out 100+ miles, making it simple and cost efficient to lay pipelines out to wherever production platforms are located, unlike the Norwegian Trench that helped prompt development of shuttle tankers in the Norwegian North Sea;
- b. US oil and gas domestic production always been in great demand for domestic consumption: US long a net importer. Export outside US was illegal until 6 months ago;
- c. No reason to think of storing and sending the oil outside the country, unlike in West Africa where oil revenue is crucial and storing production in an FPSO for export is an advantage;
- d. Only recently in a very few particularly remote and deep waters in US GoM has necessity over ridden other production and delivery solutions to make FPSOs the ultimate choice.

Allowing export of US crude

- a. Question used to be asked: "Can we export the production from an FPSO in US GoM to (say) St Croix or somewhere outside the US? The answer hitherto had to be NO.
- b. It changed in December 2015: Legislation was signed into law to allow export of crude oil from the US.
- c. Possible now for an FPSO in US GoM to offload to a foreign flag tanker to send the oil outside the US, conceivably with financial advantage on both oil sales prices and transport costs. Cycle times then somewhat longer;
- d. If operator still wants flexibility to sell production in US – has to use Jones Act tonnage;
- e. Theoretically a new option to Petrobras or Shell for their US GoM FPSOs - but shuttle tankers already on time charters. A capability worth considering for a new FPSO in US GoM?

Economics of Jones Act tankers penalize the US

- a. In 1920 when the Jones Act became law, no one ever dreamed we'd be going 200 miles offshore in 2012 to pick up a cargo of oil from 6 miles down in waters a mile or more deep ! ! !
- b. Senator John McCain claimed in 2003 the Jones Act cost our country \$10billion per year. His efforts to repeal the Jones Act failed;
- c. It costs \$5 to \$6 per barrel to ship crude from the Gulf Coast to the US East Coast via Jones Act and yet only \$2 to ship it from US GoM to Eastern Canada with a foreign flag tanker. Same for products (e.g. diesel, gasoline). Source: Houston Chronicle 29Nov15;
- d. Bright spot is US built vessels 300 ft. loa and smaller – still competitive in world market, exporting (source: Joe Keefe, Maritime Professional), no need for their protection.

Time to amend the Jones Act

Jones Act created by the wisdom of US government well before it thought of ethanol and wind subsidies, Solyndra and RPSEA !

Air transport

Fly on United out of IAH to US destinations on Airbus aircraft made in Europe, or Embraer aircraft made in Brazil, as well as Boeings made in USA. Free market choice;

Ground transport

Deliver freight in US with Volvo trucks made in Europe or Isuzu trucks from Japan – as well as Mack and GMC made in USA. “Ram Tough” or Mercedes is OK. Free market choice;

Marine transport

Crude oil or refined products must be transported from one point in the US to another in the US only in US made tankers at three times international market CAPEX. National security “build in America” argument from WW II is way out of date. NO free market choice.

Proposed amendment to the Jones Act

Amendment would offer economic benefits to USA plus increased employment for Americans:

- a. Do away with the “US built” part of the Jones Act;
- b. Allow foreign built tankers to operate under Jones Act;
- c. Continue the US crewed requirement. Valuable for experience in inland waters plus offshore. Trip times generally short hence amenable for domestic crewing;
- d. Can expect a larger number of tankers in US waters for petroleum transportation, increasing US crews employed;
- e. More competitive transport from offshore developments.

The second FPSO in US GoM: Six years after the first, *Turritella* arrives

Sailed from Singapore to US GoM for Shell's *Stones* development:



Designed and built by SBM under a ten year lease commitment with Shell for its operation, the management, design and construction embraced many advances pioneered by Shell.

Remarkable engineering achievement

- Disconnectable turret in combination with lazy wave SCRs and all for a world record water depth of 9,500 ft. in WR 551;
- Requirements set by operator and this pioneering development executed by the contractor team in true collaboration;
- Full descriptions coming in next year via conferences, OTC technical sessions, etc.

Quick summary

Oil export by shuttle; gas by pipeline: 60kbopd, 30kbwd, 15 mmscfd

Fields in 7,500-9,500' wd, 200 miles south of New Orleans

100% Shell (Operator) double hull – Suezmax hull size

6 wells + artificial lift

1 x Artificial Lift manifold, mudline pumps

2 x medium voltage electro-hydraulic umbilicals

2 x 8" Steel lazy wave risers

8 x 15k subsea wells

Remarkable safety & management achievements

- Safest comparable project in Shell and maybe the safest FPSO ever built anywhere: 13.2 million man-hours and not a single incident;
- FPSOs are tough to bring in on budget and schedule at best of times. This project meant bringing talents of FPSO contractor plus service provider team together on a novel project despite uncertainties and risks;
- Proved management of the soft sciences can lead to hard business benefits.

Quick Summary

Safety as a key project driver;

Excellent working relationships;

Genuine care for people;

Commitment from project and senior management;

Careful thought on mitigating risk for both sides of table + building trust;

Consistent approach to safety.

Industry Pioneer - Curtis Lohr,



Curtis Lohr,
Project Director for
Shell's *Stones*
development



Humor and *Stones* – symbolic of a high morale project.

Where we've been - FPSO history

Year	Field Development	Location	Operator	Contractor	Comments
1977	Castellon	Spain	Shell	SBM	World's First true FPSO
1981	Hondo	California	Exxon	Various	First FPSO in US waters
The Twenty Year Saga in US GoM:-					
1996	Fuji	GoM	Texaco	None	Field that prompted DeepStar led industry wide support of EIS
1999	Na Kika	GoM	Shell	None	Exhaustive study of deepwater development options included FPSO
2001 December	Regulatory approval of FPSOs: US Department of Interior signs Record of Decision, approving FPSOs in GoM on basis of EIS				
2005	Mayhem: Hurricanes <i>Katrina</i> and <i>Rita</i> damaged platforms, pipelines, set MODUs adrift, caused rethink of design criteria				
2007 August	<i>Cascade /Chinook</i>	GoM	Petrobras America	BW Offshore	Charters signed for first FPSO + 2 shuttle tankers
2010 April	<i>BW Pioneer</i> FPSO arrives in GoM, 2 weeks before <i>Macondo</i> oil spill, other delays beyond Petrobras' control, FPSO & shuttle tanker assist in spill				
2012 25Feb12	<i>Cascade /Chinook</i>	GoM	Petrobras America	BW Offshore	Success at last: First Oil!
2016 February	<i>Stones</i>	GoM	Shell	SBM	<i>Turritella</i> FPSO arrives in GoM for installation at <i>Stones</i>
TODAY					

What's next? Fleet growth been good for FPSOs but FPSO orders now at a halt

Comparison of Ten Years of Fleet Growth of FPSOs versus Other Types of Floating Production Systems

The World's Floating Production Systems	Existing & Ordered		- - Fleet Growth - -	
	Year end 2005	Year end 2015	Change in 10 years	Av. Growth, % p.a.
F P S O s	138	218	80	5.8%
Semisubmersibles + TLPs + Spars	84	105	21	2.5%
<u>Source</u>	Fearnley Offshore - May 2016			

About half of world's FPSO fleet is operator owned, half contractor owned and leased to operators.

FPSOs seen better growth than other FPS types.

What's next – when do we see new FPSO contract awards worldwide?

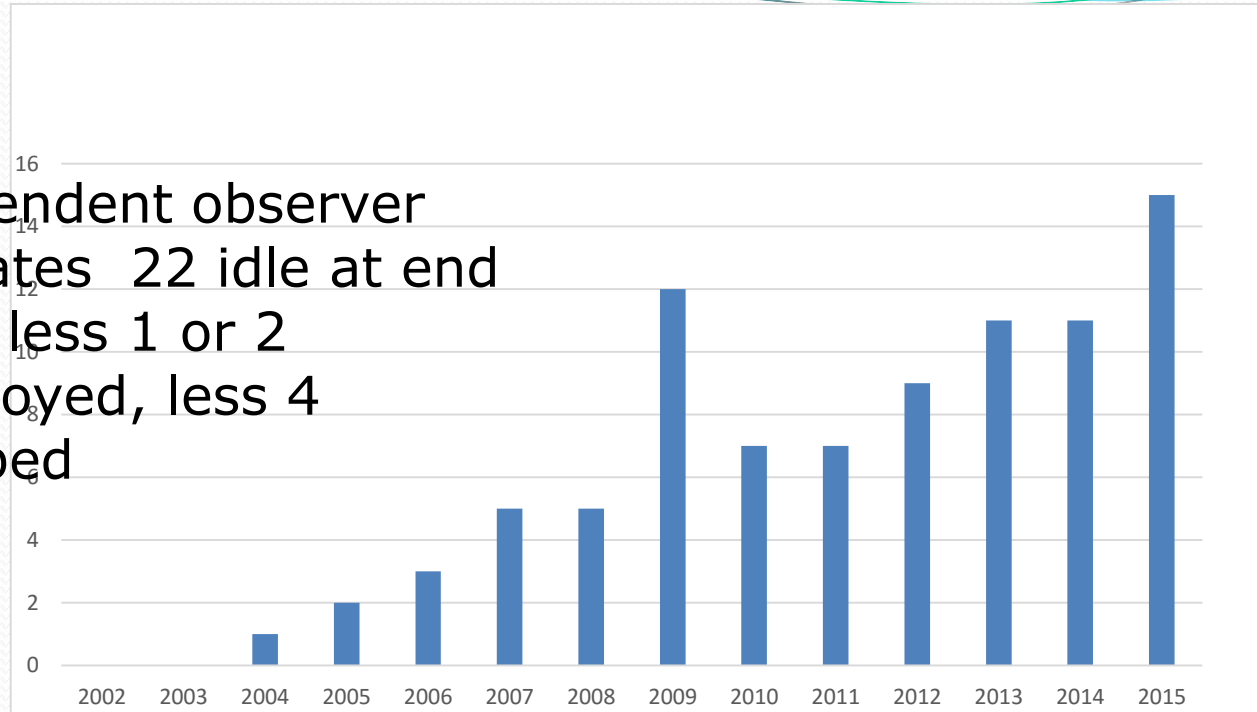


Data indicates unusual downtrend since 2010. As operators drastically cut back on CAPEX in 2015-2016, FPSO orders stop.

June 2016 sees the FPSO industry in its worst ever downturn. No one knows how long this goes on.

Worsening trend with idled FPSOs since 2010

Independent observer estimates 22 idle at end 2016, less 1 or 2 redeployed, less 4 scrapped



Source:
Fearnley
Offshore,
May 2016

At a time of few live projects the concern builds on what to do with idled FPSOs. Specter looms of layups and scrapping, plus pressure on balance sheets from write downs.

Redeployment more expensive and risky than commonly thought, affected by low oil prices, just like new FPSO projects. Far different from redeploying a drill ship!

Like so much in this world, FPSOs still a gamble

Don't we now have modern resources for good decisions? Reserves estimates, probabilities, decision trees, NPV v. cumulative probability plots. Construction bids and FIDs?



Source: "The Gambler"
by Kenny Rogers

Someone still makes the final gamble;

You got to know when to hold 'em,

Know when to fold 'em,

Know when to walk away,

 *Know when to run*

**Profound words written in 1978,
the year after the FPSO industry
started.**

Looking forward: real practitioners make guesses on FPSO market

US GoM: During 2012-2013 in a US DOE funded project with ten GoM operators knowledgeable in the FPSO business, the unanimous view was that it was unlikely that after *Stones* there would be another FPSO contracted in the next ten years;

US GoM: Over the 20 years saga multiple developments seen that initially looked like FPSOs in the early days but turned out to use something else when final development solutions were selected. Today in 2016 with the current downturn, why any different?

Worldwide: At an FPSO conference in Houston in November 2015: despite two market consultants forecasting 40-50 FPSO contracts worldwide during 2016-2020, these present that made a living with FPSOs would have none of it, variously seeing zero or 1-4 orders worldwide in 2016 and a few in 2017.

Longer term might be better, but what year does that start?

Closing thoughts (1 of 2)

- a. Everyone on the first FPSO project in US GoM - Petrobras + FPSO contractor BW Offshore + all the related service providers - deserve great credit in managing their way through all that has gone on, with events often beyond anyone's control;
- b. The shuttle tanker business in US GoM remains a difficult niche – limited projects, small vessels, economics crippled by Jones Act, but necessary for an FPSO in US GoM;
- c. Would help the petroleum industry and US economy to amend the Jones Act to do away with the “build in USA” requirement;
- d. Unlikely for US export of crude to make near term difference for FPSO business in US GoM;
- e. “Lower for longer” particularly relevant for the FPSO market worldwide as it waits for confidence to return to operators for long term investments in field developments;

Closing thoughts (2 of 2)

- f. In this worst ever downturn for FPSOs, owners face pressures to lay up or scrap idled FPSOs, with attendant write downs on balance sheets. Redeployments not as easy as often thought!
- g. Appears little chance of another *BW Pioneer* or *Turritella* sailing into the US GoM in the next decade;
- h. After two earlier runs at using an FPSO in GoM, Shell excelled in pushing back limits of industry experience at *Stones*, in engineering, safety and in managing such a complex project effectively with good results for all in the loop.
- i. *Stones* in 2016 makes one proud to be an engineer, whether starting out at 25, in an established career at 50 or getting ready to retire at 75, this project being a glistening positive in today's sea of cutbacks and layoffs.

. . . Thank you . . .

Questions?

Peter Lovie

PE PMP FRINA

Senior Advisor, Floating Systems

Peter M Lovie PE, LLC

PO Box 119733 Houston TX 77224 USA

Ph +1 713 419 9164 Fax +1 713 827 1771

peter@lovie.org www.lovie.org