FPSOs in the US GoM - a 21 Year Saga

Peter Lovie
Peter M Lovie PE, LLC

FPSOs – Why so Long in US GoM?
Fundamental differences v. rest of the world

- No reason to store and export oil, as in say West Africa where FPSOs serve storage function as well as providing real estate for production facilities;
- US a net importer for many years. Export illegal until December 2015;
- Geography: Flat alluvial plain going out 100+ miles favors fixed platforms and pipelines;
- Only in last decade, in two remote ultra deep water developments, have FPSOs prevailed over other production and delivery systems.

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It All Started 21 Years Ago

- 1996: ~50 FPSOs worldwide, already widely accepted outside US GoM, in mild (WA) to harsh (NS) environments;
- Before approving an FPSO for a specific field development, MMS required a delay to do an Environmental Impact Statement (EIS) on the use of FPSOs in US GoM;
- Operators in US GoM wanted FPSOs in their "toolbox" and no delay on sanctioning;
- Driver was Texaco's *Fuji* prospect – 1,700 ft. w.d.;
- Operators mobilized industry support for EIS on FPSOs, operators would pay $1 million to MMS and incur $2+ million in costs over 5 years in EIS effort.

1996 Fear of US GoM Oil Spills

After *Valdez* in 1989, can we risk new tanker based operations?

But:

Experience of many years of many safe tanker operations every day:

Offloading to CALM Buoy offshore

+

Lightering: side by side offloading VLCC to shuttle tanker size, offshore

=

Imported oil, crucial to US, 3-4 mmbopd, exemplary safety record

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EIS Tasks

- Rigorously weigh spill risks - proper management of marine operations when oil stored offshore and delivered by tanker;
- US Coast Guard responsible for oversight and regulation of marine operations;
- Regulatory jurisdictions of USCG and MMS had to be defined - MoU negotiated to do that;
- Governmental studies, debates, lots of consultants;
- Public hearings around GoM explain effects of FPSOs;
- Industry viewed FPSOs in US GoM as typically million bbl, permanently moored.

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Industry Pioneer – Allen Verret
The Father of the EIS

Texaco / Chevron, later OOC, Cat herder extraordinaire!

- EIS did not just automatically happen by governmental decree!
- Took much longer than “two years”!
- Balanced technical, commercial and political interests of more than 20 operators, with interests of regulators, FPSO contractors and designers;
- 50-60 stakeholders, organized via a DeepStar initiative;
- Kept focus on approval of FPSOs for US GoM.

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Here's What the Famous EIS Looks Like

[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

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

New Orleans
January 2001

[Final approval from Washington]

____ **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

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Industry Pioneer – George Rodenbusch
Pre EIS (1999) consideration of an FPSO for US GoM

Career in Shell, retired 2010

- Thorough investigation on design, construction, installation, operations, reservoir exploitation with an FPSO for *Na Kika* prospect in US GoM;
- Undertaken by Shell two years before completion of the EIS;
- Masterful leadership of study;
- Ahead of its time: Investigated the use of lazy wave SCRs with an FPSO, later used in *BC-10* in Brazil and now at *Stones.*

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2002 arrives: FPSOs approved for US GoM
So who goes first? A missing key ingredient

- Despite all the talk of prior years, no operator was close to ordering an FPSO for US GoM!
- Industry attention shifted to what to do about delivery of production - shuttle tanker service;
- Shuttle tankers had to be small enough to get into the shallow US GoM ports (maximum 40 ft. draft), be Jones Act and OPA 90 compliant;
- Very few suitable Jones Act tankers available;
- Despite all these constraints, two companies offered this specialized shuttle tanker service.

Industry "Pioneer" - Wesley Livsey Jones -
US Senator from a century ago

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;
- An anchored production facility (e.g. FPSO) is considered a US port, so delivery of crude oil to shore by shuttle tanker is "coastwise trade";

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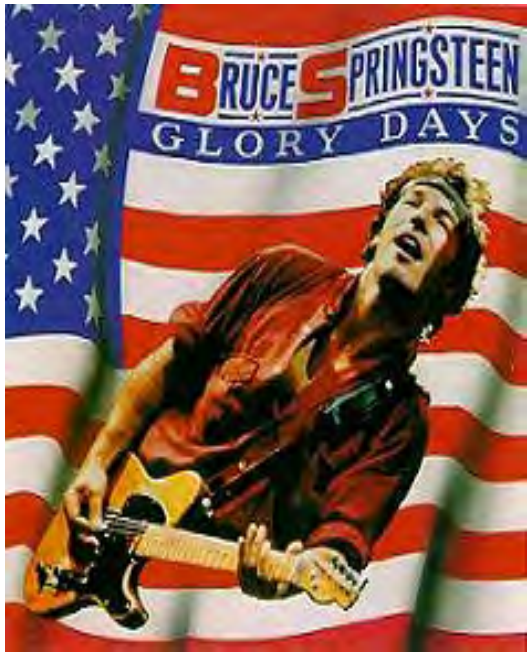
“Born in the USA”
Effects of Jones Act on FPSOs and shuttle tankers

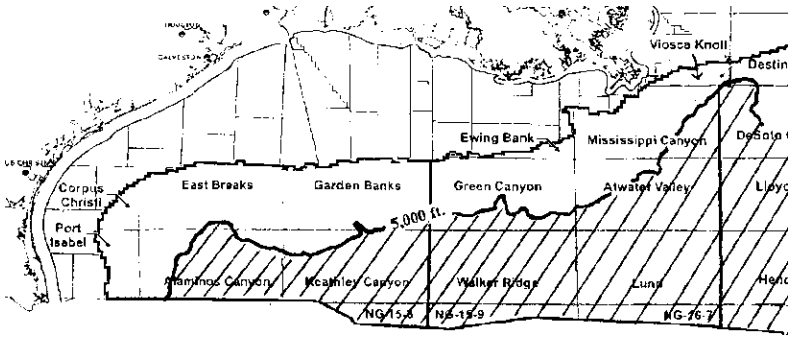


- The Jones Act applies to ships engaged in coastwise trade in US waters: must be US flag, US built, 75+% US owned, US citizens for crew;
- In contrast to Wesley Jones’ day in 1920, by 2002 US shipbuilding costs had grown to about 3X international trade, OPEX about 2X;
- Jones Act now a serious economic constraint on shuttle tankers;
- FPSOs are not subject to Jones Act, can be built anywhere at market rates.

2002 Vision: Flexibility of Shuttle Tankers
A totally different business model from pipelines!

New ability to deliver from any offshore location to a choice of ports along GoM;

Operators can seek port for best price for their oil.



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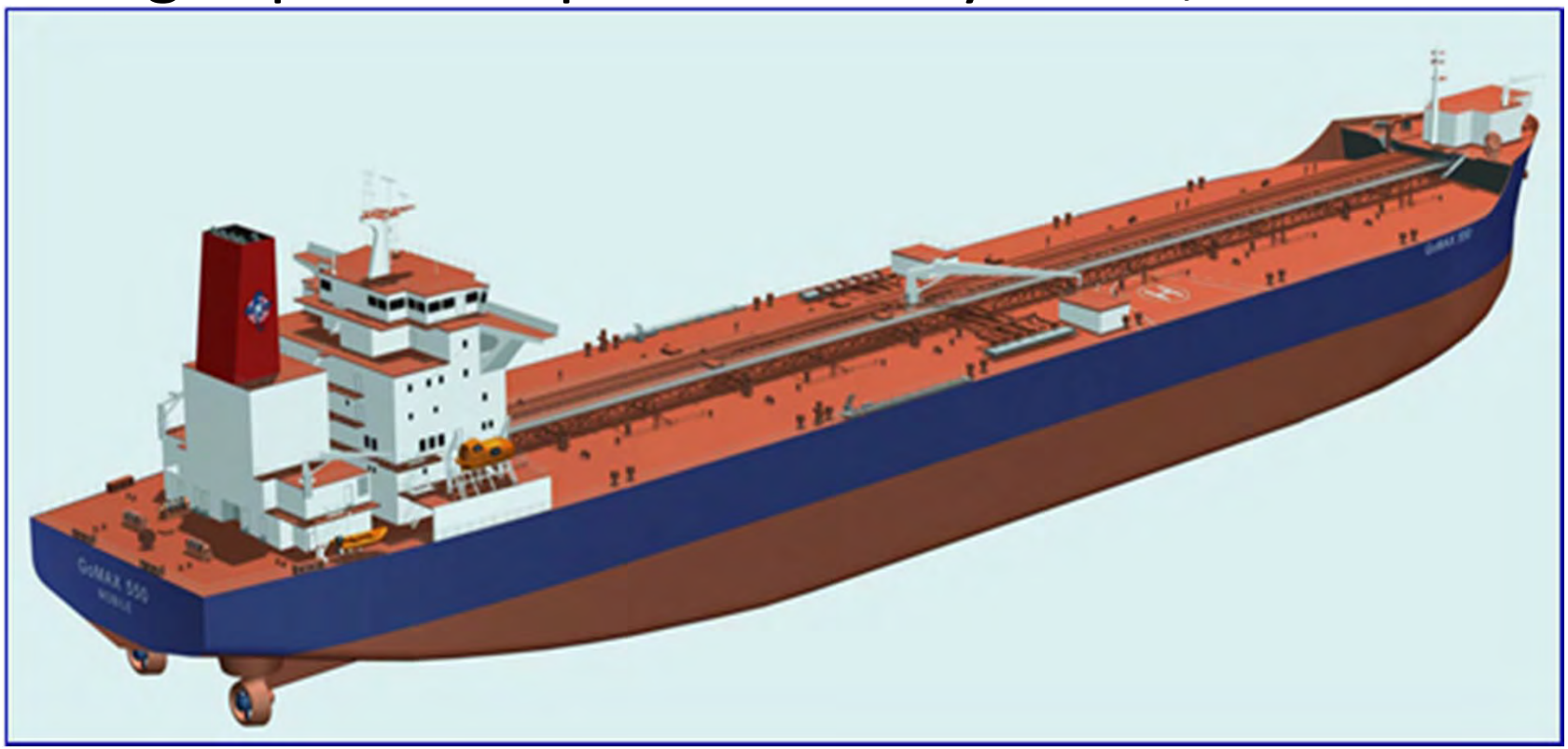
Seahorse Shuttling (2001-2003)

Conoco owned, brought North Sea shuttle tanker operating experience plus US safety ethos;



GOMAX design: Newbuild, 550,000 bbl storage, DP2, BLS; Alabama Drydock + Samsung building expertise.

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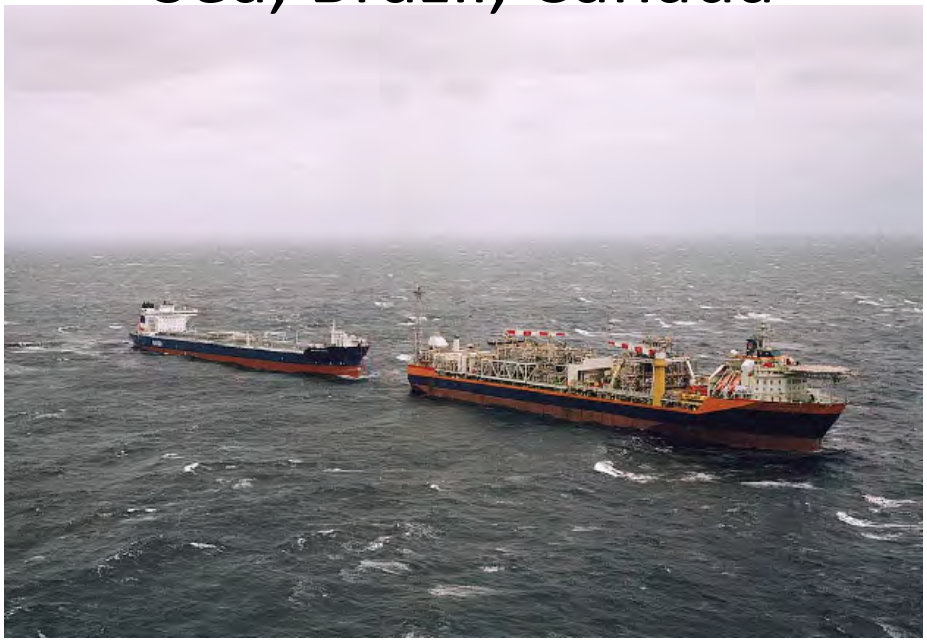
American Shuttle Tankers LLC (2001-2004)
Owned 50:50 by two tanker operating parents

Navion A.S.: Leader in shuttle tankers in North Sea, Brazil, Canada



Skaugen PetroTrans Inc. Leader in lightering in US GoM

Neither owner was US controlled, thus took ingenuity on tanker ownership for Jones Act compliance!

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Handymax Size of Shuttle Tanker
AST proposals in 2002-2004, ultimately used 2010 to date

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

Same size later used for *Cascade/Chinook* but without DP: two contracted 2007 for delivery 2010, entered service 2012. A third for *Stones* entered service in 2016.

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Debate on Shuttle Tankers and DP

PRO

- Ultimate in proven safety demanded for US waters, drew on years in North Sea since 1979;
- No support vessels at FPSO (hold off tug, hose handling vessel);
- No tugs needed for docking at destination;
- Less weather downtime.

CON

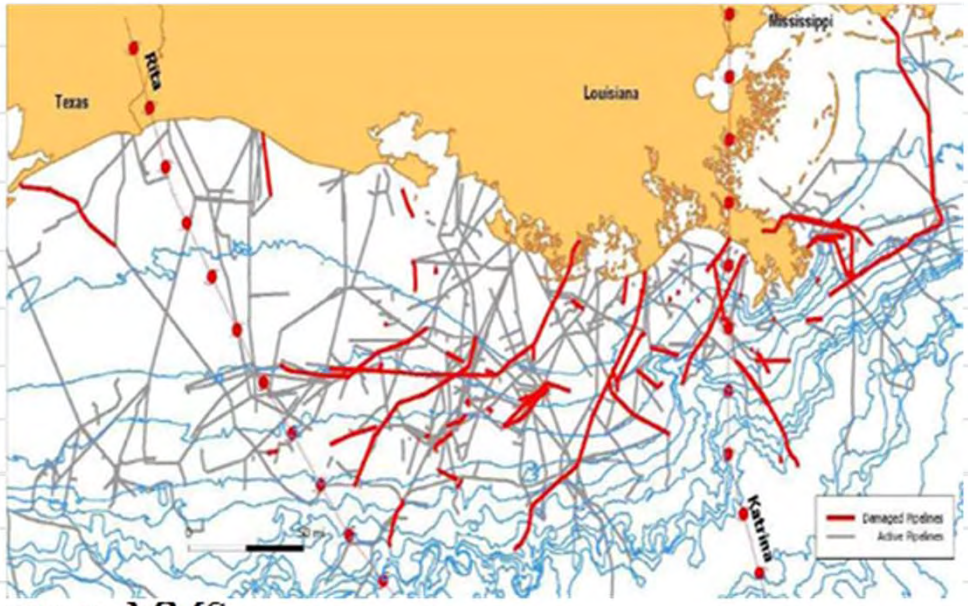
- Require well trained operating crew - slightly higher OPEX;
- Somewhat higher CAPEX;
- Procuring DP2 tankers costly and slow in US shipyards;
- The non DP tankers with first FPSO in US GoM turned out to be on critical path for first oil.

2005: Both US Shuttle Tanker Cos. Disappear

- Despite the EIS, industry talk and curiosity seekers, very few real FPSO prospects for US GoM;
- Seahorse Shuttling had served a profitable purpose in reducing pipeline tariffs on a Conoco development;
- Shell's *Great White* had looked to use an FPSO plus shuttle tanker export. American Shuttle Tankers, by then owned by Teekay, would not take any project risk with DP2 Jones Act tankers, required full payout on a rather short term;
- High export tariff with an FPSO became obvious;
- *Great White* morphed into the *Perdido* development with a spar and pipeline export.

Then Along Came *Katrina* and *Rita* in 2005
Mother Nature's "game changers"

Source: Shell



Source: MMS

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

Total of 19 jackup and semisubmersible MODUs dragged anchors or went fully adrift.

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FPSO Disconnection – the Epiphany of 2006
a.k.a. an "aw shit moment"

- US GoM operator community all had the same brainstorm at the same time!
- "Holy crap, we could have one of these drifting 50,000 ton MODUs crashing into an FPSO full of 500,000 bbl of oil, the next time we have a 2005 style hurricane;
- "We could have an oil spill worse than *Exxon Valdez.* Low probability, extremely high consequence. Cannot responsibly take that risk";
- EIS had specified permanently moored FPSOs, no longer thought a wise choice;
- FPSO Disconnection was an <u>operator</u> initiative, not regulatory or Washington decree.

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Data 3 Years Later: Confirmed Wisdom of Operators' Caution on FPSO Disconnection

MODUs adrift in 2005 hurricanes - total mooring failure

2005 Hurricane	Total MODUs	Distances drifted in GoM
Katrina	5	between 4 and 80 miles
Rita	7	between 75 and 145 miles

Source: MMS/OTRC

The total MODUs adrift with partial mooring failure was much larger, but the distances they moved was much less

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2006 - Less Mayhem – More Progress

- Changes in design criteria debated by industry at OTC and Deepstar;
- Petrobras America takes over operatorship of *Cascade/Chinook* from BHP;
- Petrobras with non-op partner Devon (50:50) on *Cascade* and Total (PBR:TOT 67:33) on *Chinook*) announce plans for first FPSO in US GoM for C*ascade/Chinook*;
- Planning and engineering starts on a field development to use the first ever FPSO in US GoM.

2007 - Project Starts for First FPSO in US GoM

March — Bids solicited for the third FPSO in GoM - and first on US side – for a lease of five (5) years with three one (1) year options;

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

Was deepest water FPSO in the world: 8,200 ft. at WR 249;

Disconnectable, turret moored, with hybrid riser system;

80,000 bopd production capacity on an Aframax hull.

BW Pioneer: First FPSO Contracted for US GoM

Design, construction, operation by BW Offshore

Record water depth, uncertain reservoirs, new design of disconnection system, DNV class, seriously tested BSEE and USCG regulatory practices, worldwide industry attention.

Source: Petrobras

Two Shuttle Tankers Built and Converted

Overseas Cascade and *Overseas Chinook* operated by OSG, under time charter with Petrobras America;

<u>Standard tankers built</u>: Aker Philadelphia PA

Two standard Handymax product tankers built in Philadelphia, then sailed down East Coast to Charleston SC for conversion and delivery.

<u>Converted</u> at Detyens Shipyard, Charleston SC

<u>Install</u>:
Controllable Pitch Propeller (CPP)
Bow Loading System (BLS)
Bow thrusters.
(half way to DP!)

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April 2010: *BW Pioneer* Arrived US GoM
After voyage from Singapore under its own power

Source: Petrobras

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Then Talk about Bad Luck!
Everything 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 only spilled oil to shuttle!

[To compound the misery: a chain failure at hybrid riser at *Cascade / Chinook* ! !]

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

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Industry Pioneer - Cesar Palagi
Sailing the first FPSO in US GoM through difficult seas

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

- Responsible for field development for *Cascade/Chinook*, at a time of great change;
- 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, pioneered production from reservoirs with few analogues.

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Success at Last – First Oil at *Cascade/Chinook*
Achieved on 25 February 2012

More than 90 offloadings, uptimes in the high 90s.
Options exercised 2016 to continue
3 more years with *BW Pioneer*

Source: Petrobras

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2016: The Second FPSO in US GoM
First oil 4-1/2 years after the first

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

Turritella arrives on location New Year's Day 2016

First oil early September 2016, first offload 2 mos. later

Designed & built by SBM under a 10 year lease with Shell for its operation, embraced many advances pioneered by Shell.

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An Inspiring Achievement

- Disconnectable turret in combination with lazy wave SCRs, all for a record water depth of 9,500 ft. in WR 551;
- Requirements set by operator, pioneering development executed by contractor team in true collaboration;
- Remarkable management of project demonstrated real business benefits from doing the safety ideal;
- Full story on *Stones* in 4 presentations at this conference:

Regulatory	*Session 1*
Engineering FPSO	*Session 4*
Disconnectable Buoy	*Session 4*
Pioneering Management	*Session 6*

Industry Pioneer - Curtis Lohr

Project Director for Shell's Stones development

Humor and *Stones* symbolic of a high morale project

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Where We've Been – 40 Years of FPSOs

Year	Field	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 One 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 *Katrina* and *Rita* damaged platforms, pipelines, set MODUs adrift, caused rethink of design criteria				
2007 August	*Cascade /Chinook*	GoM	Petrobras America	BW Offshore	Charters signed for first FPSO + 2 shuttle tankers
2010 April	*BW Pioneer* FPSO arrives in GoM, 2 weeks before *Macondo* oil spill, other delays beyond Petrobras' control, FPSO & shuttle tanker assist in spill				
2012 25Feb12	***Cascade /Chinook***	GoM	Petrobras America	BW Offshore	Success at last: First Oil!
2016	*Stones*	GoM	Shell	SBM	*Turritella* FPSO arrives in US GoM, installed, commissioned, first oil
2017	TODAY	Two FPSOs in US GoM: the 21 Year Saga			

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World Fleet Growth - FPSOs
More FPSOs, faster growth than other FPUs

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%
Source	Fearnley Offshore - May 2016			

Fromm ~50 in 1996 to today: fleet quadrupled

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World Fleet Growth - 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: Teekay do Brasil

Fleet ~trebled in 20 years

Akin to FPSOs, fleet growth moved from North Sea to Brazil where shuttle tanker operations started in 2002, serious growth since!

US GoM: smallest market using the smallest shuttle tankers!

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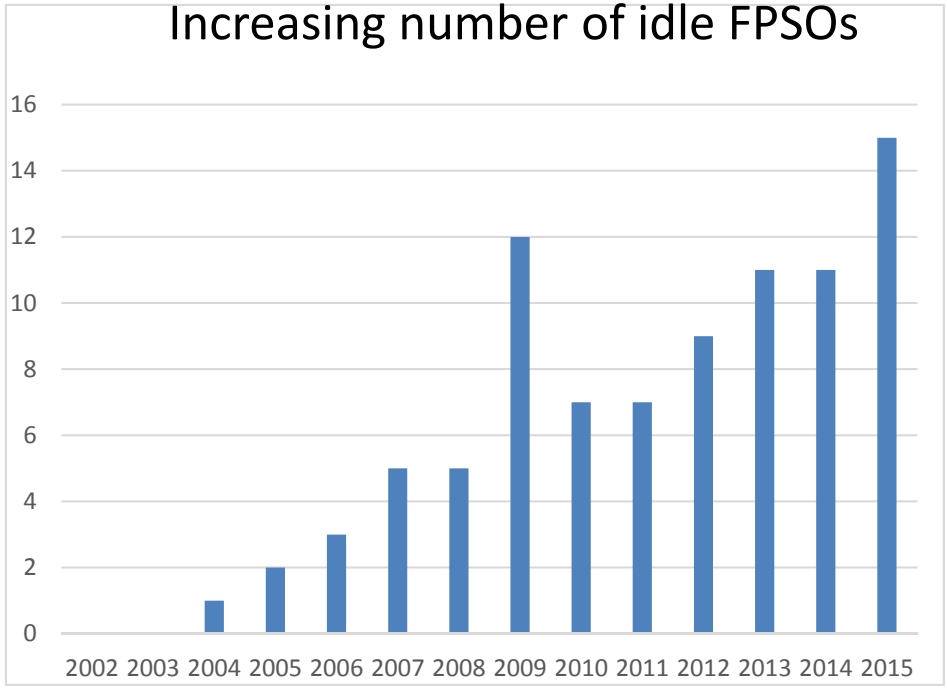
Arrival of Difficult Times

Early 2017: 20-24 idle FPSOs Contract Awards in 2017: ???



As operators cut back on CAPEX in 2015-2016,
FPSO industry entered worst ever downturn.

No one knows how long this goes on.

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Field Developments Still a Gamble

We pride ourselves in managing for sound decisions: reserves estimates, probabilities, decision trees, NPV v. cumulative probability plots, construction bids, FIDs.

But some “lucky” soul(s) still have to decide to do it!

[redacted]

You've got to know when to hold 'em
Know when to fold 'em
Know when to walk away
And know when to run
You never count your money
When you're sittin' at the table
There'll be time enough for countin'
When the dealin's done

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

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Closing Thoughts (1 of 2)

a. These two project teams deserve great credit in pioneering their way through all that has gone on:-

2012	*BW Pioneer*	Petrobras	BW Offshore
2016	*Turritella*	Shell	SBM Offshore

b. Unlikely another FPSO in the US GoM in the next decade;

c. Shuttle tanker business in US GoM remains a difficult niche – few projects, crippled by Jones Act. Would help to do away with the "build in USA" requirement but politics tough;

d. US export of crude unlikely to make any near term difference for FPSO business in US GoM;

Closing Thoughts (2 of 2)

e. Producing just the low cost oil can still mean business for FPSOs in some places worldwide;

f. Meantime owners with idle FPSOs face pressures to lay up or scrap, accept write downs;

g. In this worst ever FPSO downturn many of us face the uncertainties of "Lower for longer": perhaps this conference might help clarify your thinking a little!

h. Going forward, *Stones* in 2017 makes one proud to be an engineer, whether starting out at 25, in an established career at 50, or thinking of retiring at 75, this project is a glistening positive in today's sea of cutbacks and layoffs.

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. . . Thank you . . .

Questions?

Peter Lovie
Peter M Lovie PE, LLC
peter@lovie.org
+1 713 419 9164

www.lovie.org
www.fpsosingom.com

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