



Session 6: The Race For Capacity (Part 1)

# Impact of Logistics of FPSO Production on Markets

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Houston

**Pipeline networks and the Jones Act do affect the FPSO equation in US GoM.**

**Historically not much place for FPSOs in GoM until occasionally now for business and reservoir reasons.**

**US crude oil production delivery by shuttle tankers driven by use of FPSOs, modest in relation to imports.**

**Will explore the drivers, economics and an outlook on this market segment.**

# The Vision of Flexibility with Shuttle Tankers

A totally different delivery model from pipelines!

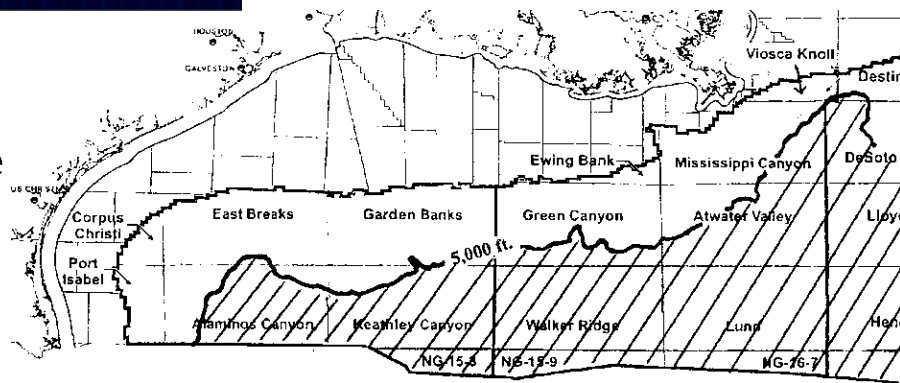


Shuttle tankers can work between any combination of production locations offshore with destinations onshore;

BUT, right now only one red dot (*Cascade/Chinook*) and two (2) shuttle tankers.

Maybe a few more in next five years;

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



# Tankers V. Pipelines

## Difficult to Make "Apples & apples" Comparisons

- a. Comparisons tend to be site specific;
- b. Tankers can be redeployed, higher operating component;
- c. Pipelines also have large front end CAPEX commitment, lower operating component, but cannot be rolled up and redeployed elsewhere!
- d. Many regions in the world employing tanker "export" are truly exporting, whereas GoM always imports all production;
- e. Shuttle tankers business pioneered in North Sea, since spread to Brazil;
- f. US shuttle tankers have to be small (330,000 – 600,000 bbl) to get into ports (max draft 40 ft.) versus up to 1,000,000 bbl in North Sea and Brazil.

# Basic Drivers: Two Linked & Ongoing Debates in US UDW GoM: 1 Facility and 2 Transportation

## 1 Facility

Two main options

(a) Semisubmersible or Spar without storage

May allow well access (DVA), even drilling

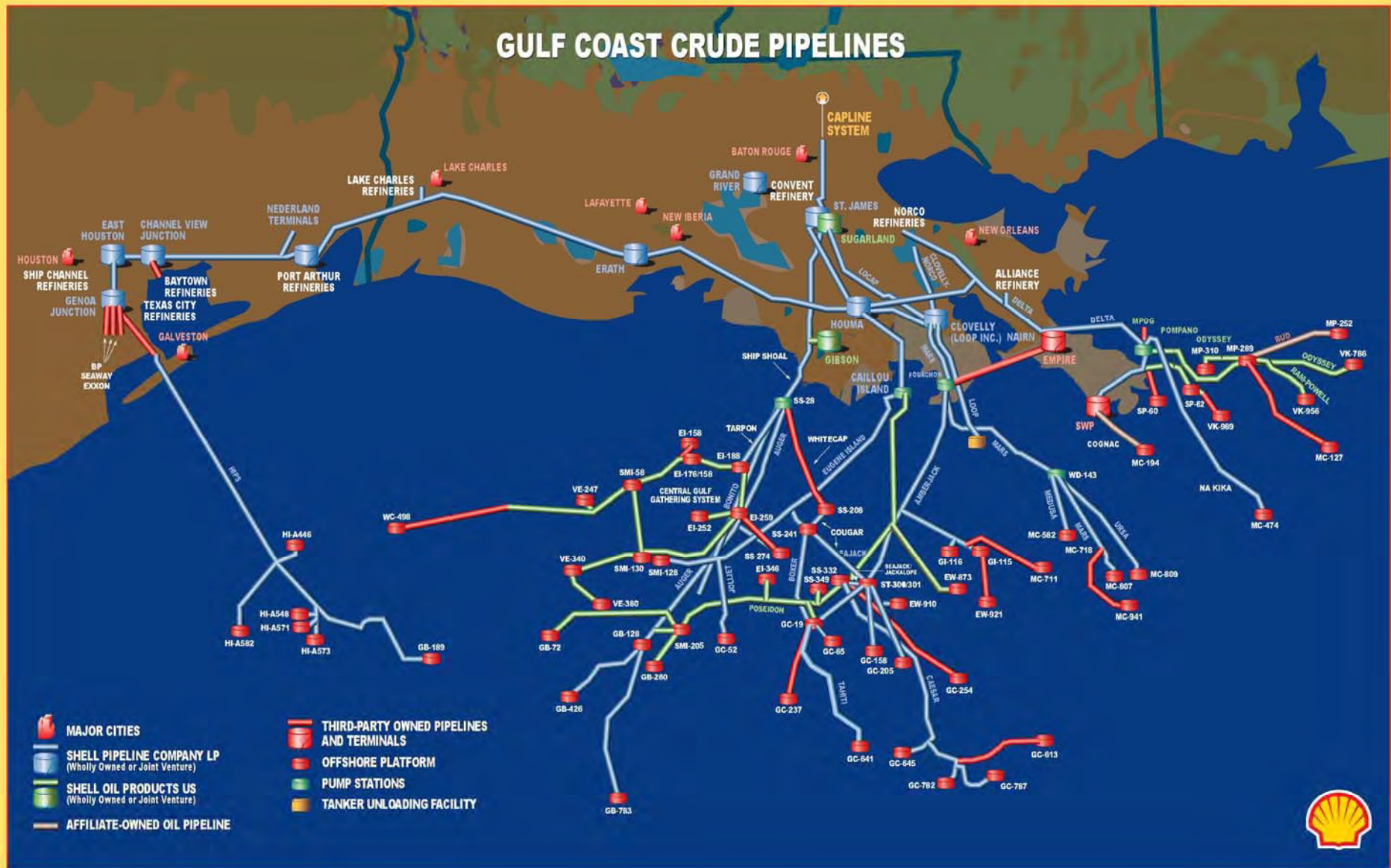
(b) FPSO with storage + Disconnectable

DVA not usually possible



# 2 Transportation:

Already have a well developed pipeline network



# 2. Transportation from UDW

Pipelines now reach out to Lower Tertiary discoveries in WR & KC





## The Pipeliners' Friend in Washington

Senator Wesley Livsey Jones (1863-1932), Republican from the state of Washington, author of the Jones Act passed in 1920, intended to protect his state's trade with Alaska, a measure acceptable in the protectionist times of the 1920s.

In recent years strong union and industry lobbies (seafarers, shipyards, railroads), has resisted efforts to repeal.

The Jones Act applies to ships engaged in coastwise trade in US waters: requires US built vessels, 75+% US owned, US crew. CAPEX about 3X international trade, OPEX about 2X.

A production platform is considered a US port, so delivery of production from a production facility to shore is "coastwise trade".



# The Wonderful Commercial Logic of the Jones Act

Created well before ethanol subsidies and Solyndra!!!

Airbus aircraft made in Europe can fly people from one point in the US to another in the US;

Volvo trucks made in Europe or Isuzu trucks from Japan can deliver freight from one point in the US to another in the US;

But 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;

Senator John McCain claimed in 2003 the Jones Act cost our country \$10billion per year. His efforts to repeal the Jones Act failed;

Such is our free market and politics!

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 waters a mile or more deep!!!

# The Debate so Far

## Shallow to deep water now: Pipelines win

- a. Extensive pipeline network over fairly flat sea floor in deep and shallow waters in US GoM means competition for both oil and gas export tariffs;
- b. Pipeline extensions and new lines over the years mean pipeline export usually economically feasible and fairly quick to arrange;
- c. Hubs have been reasonably doable in deep waters in recent years: lining up “anchor tenants” to enable investing in transportation pipelines;

## It changes in the Ultra Deep Water (UDW): tankers have a chance

- d. Costs of pipeline extensions is greater in \$MM/mile, distances longer, more demanding over mountainous sea floors;
- e. Uncertain producibility of reservoirs in UDW can make economics and risks for pipeline hubs difficult, opening opportunity for FPSOs and tanker export;
- f. Complicating the facility choice is the potential need to have direct vertical access (DVA) to the wells during production life.

# Transportation – Five Main Options

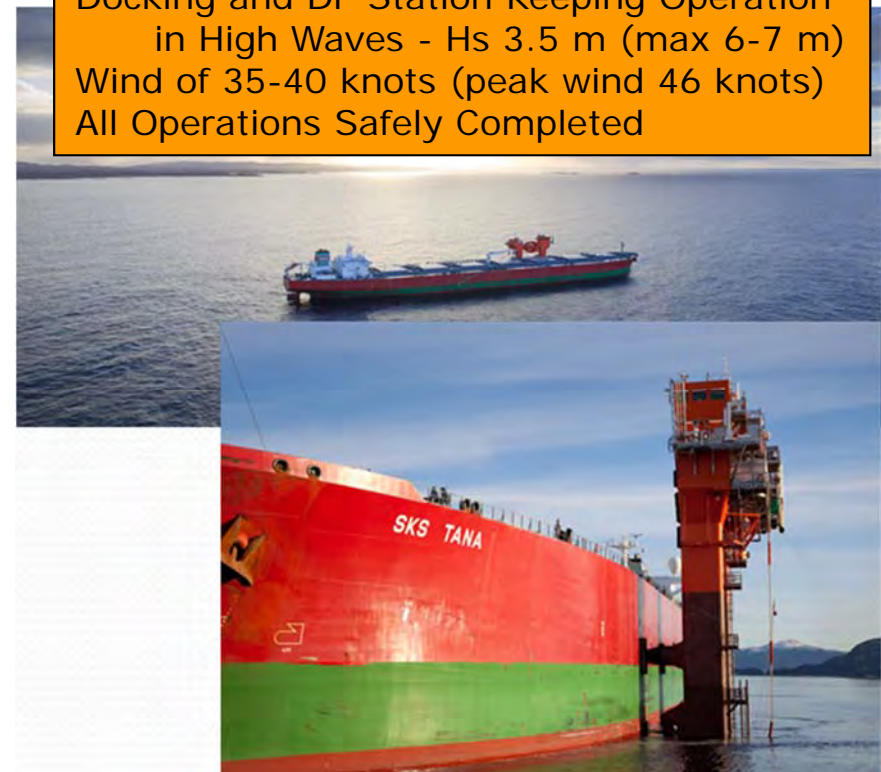
## Traditional choices:

1. Pipeline: Long history of success in GoM;
2. Shuttle tankers: First use at *Cascade/Chinook* in 2012, started in North Sea, widely used there;
3. Shuttle tankers + FSO: Common elsewhere in world, studied for GoM;

## New options:

4. Conventional tankers + HiLoad for FPSO: only new part is HiLoad prototype;
5. Conventional tankers + 2 HiLoads for Semi/Spar.

Docking and DP Station Keeping Operation  
in High Waves - Hs 3.5 m (max 6-7 m)  
Wind of 35-40 knots (peak wind 46 knots)  
All Operations Safely Completed



# Key Issues in Economics

Comparisons from a paper at DOT 2009 that follow are hypotheticals, based on realistic GoM fields and economics.

Believed to be first public exposure of this kind of comparison.

- |       |   |   |
|-------|---|---|
| FIRM  | a | New construction tariffs. Tanker figures include time charter as applicable, fuel & port costs; |
|       | b | Tariff on existing deepwater pipelines, booster platforms, pipelines to beach (total system);   |
|       | c | Equivalent of export system CAPEX in facility;  |
| FUZZY | d | Quality bank in existing pipelines (controversial);   |
|       | e | Optionality, no. of destinations;   |
|       | f | Upside on marketing to wider range of destinations;   |
|       | g | Guaranteed future access throughout field life;   |
|       | h | Premium for prompt payment on delivery.   |

Factors a-h are illustrated in the table that follows

# Illustrative Economics

Table 6: Comparison of \$/bbl Economics for Different Export Options for "Large Reservoir"

703.7 mmbbl recovery in first 16 years

Maximum rate of 166,948 bopd

Cost Component	Facility <u>without</u> storage			Facility <u>with</u> Storage		Notes
	1 Pipeline	2 FSO+ST	3 HiLoad+DLCT	4 ST	5 HiLoad+CT	
a New construction tariffs. Tanker figures include time charter as applicable, fuel & port costs:	2.58	3.70	3.55	2.47	2.37	(i)
b Tariff on existing deepwater pipelines, booster platforms, pipelines to beach:	1.00	0.00	0.00	0.00	0.00	(ii)
c Equivalent of export system CAPEX in facility:	0.40	0.13	0.13	0.13	0.13	(iii)
d Quality bank in existing pipelines:	0.80	0.00	0.00	0.00	0.00	(iv)
e Optionality, no. of destinations:	2 ?	10	10	10	10	(v)
f Upside on marketing to wider range of destinations	0.00	-0.50	-0.50	-0.50	-0.50	(vi)
g Guaranteed future access throughout field life	TBD	yes	yes	yes	yes	(vii)
h Premium for prompt payment on delivery	0.00	-0.30	-0.30	-0.30	-0.30	(viii)
TOTALS, \$/bbl:	4.78	3.03	2.88	1.80	1.70	
RATIOS:	1.00	0.63	0.60	0.38	0.36	
SIZE OF THE PRIZE, \$BILLION:	0.00	1.23	1.34	2.10	2.17	(ix)
<i>Discounted at 10%, 16 years, \$BILLION:</i>	<i>0.00</i>	<i>0.60</i>	<i>0.65</i>	<i>1.01</i>	<i>1.05</i>	

Please excuse the small print!

Source:  
Lovie, P.M.: "The Lower Tertiary Trend and the Oil Export Economic Prize", Deep Oil Technology (DOT), conference, paper 138, New Orleans, 3 February 2009, 28 pages.

# History: FPSOs Considered for US Waters for a Long Time

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
1996	Fuji	GoM	Texaco	None	Study 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, MODUs adrift, caused rethink of design codes				
2007 August	<i>Cascade /Chinook</i>	GoM	Petrobras America	BW Offshore	Charters signed for FPSO + 2 shuttle tankers
2010 April	<i>BW Pioneer</i> arrives in GoM, 2 weeks before <i>Macondo</i> , delays, FPSO & shuttle tanker assist in spill				
2012 TODAY	<i>Cascade /Chinook</i>	GoM	Petrobras America	BW Offshore	Satisfy latest regulatory requirements, installation difficulties overcome

# History: Exxon in 1981- First FPSO in US waters

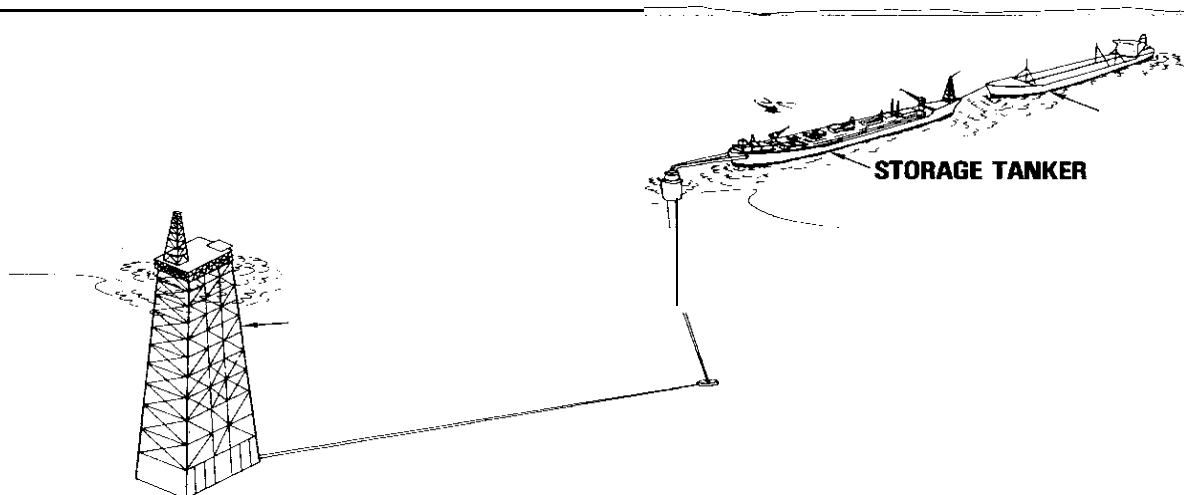
"OS&T" tanker at the *Hondo* development offshore California



Exxon's OS&T moored at Hondo development offshore Santa Barbara;

50,000 dwt tanker for production plus shuttle tanker;

OS&T (aka FPSO) is SALM Moored in 490 ft. of water, 1-1/2 miles from the *Hondo* platform in 850 ft. of water;



Pioneers on this project included:

N.A. Deacon, J.E. Hofferber,

T.E. Law, D.E. Masnada,

D.R. Olsen, R.E. Olson,

J.D. Rullmann, F.G. Vasser,

W.R. Wolfram,

(All from Exxon)

# Environmental Impact Statement on FPSOs

## 2001: Key US regulatory policy documents on FPSOs for GoM

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

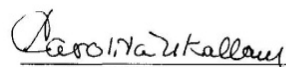
\_\_\_\_\_ **Alternative B-4** (Approve the general concept of using FPSO's with a requirement for an attendant vessel.)

\_\_\_\_\_ **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

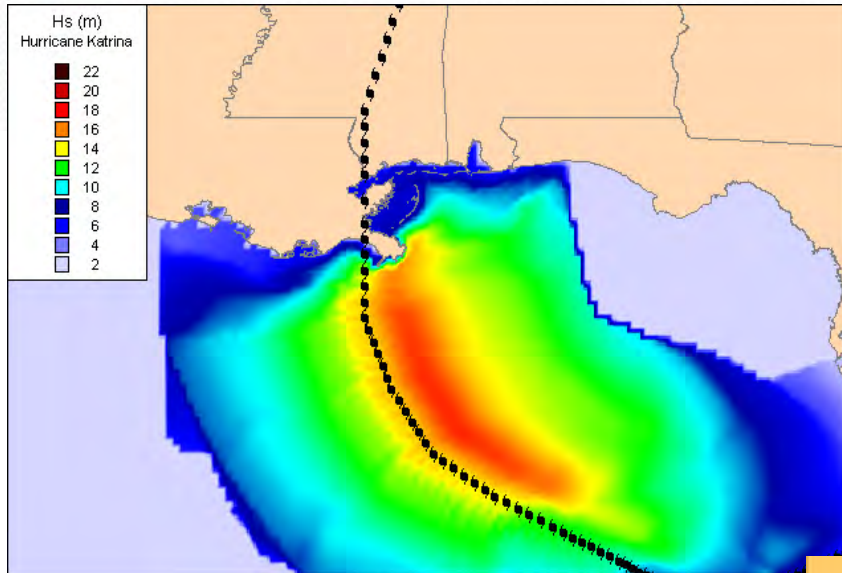
The signed Record of Decision: US Government says FPSOs OK in principle in GoM

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# When Finalizing FPSO & Shuttle Tanker Designs

In 2005 offshore industry forced to stop & rethink design codes

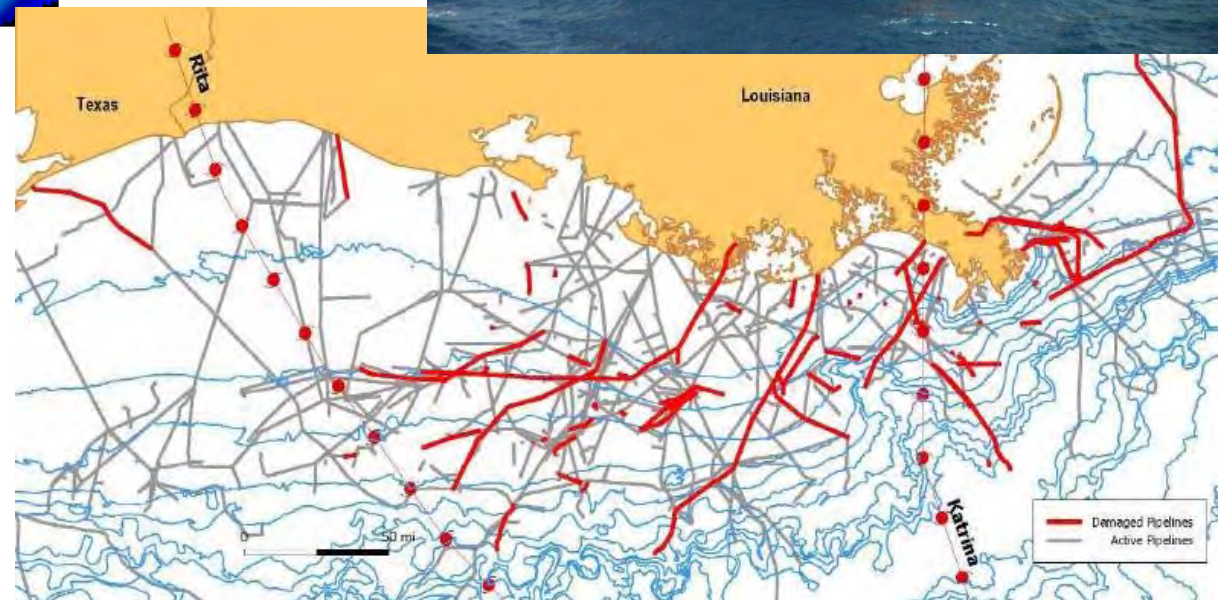


Map of Hs for Hurricane Katrina, with Water Depth Effects Included

Example of  
Topsides  
Damage Due  
to Wind



Engineers get busy on diagnoses and design code revisions, to be presented at OTC 2007



Hurricane Damage to GoM Pipeline Network  
(Source: MMS)

# Less Mayhem – for a While

2006-2010: Serious progress for the first FPSO in US GoM

2006 Petrobras takes over operatorship of *Cascade/Chinook*;

Major find: BP's *Kaskida* in Keathley Canyon;

Petrobras and partners announce plans for first FPSO at *Cascade /Chinook*;

2007 March Bids were solicited for the third FPSO in GoM - and first on US side – for a minimum lease of five years.

May OTC: GoM design practices extensively revised, tightened;

August Stiff competition on contract for FPSO, signed with BW Offshore;

First shuttle tankers in GoM contracted – signed 2 from OSG;

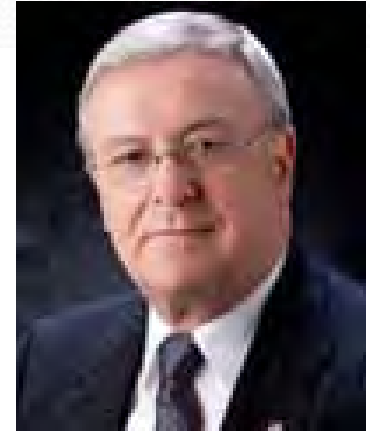
# Devon the Independent

2003-2009: A truly independent force in US GoM



**W.D. (Dave) Bozeman** was Vice President at Devon Energy Corporation in Houston, responsible for the Project Support Office, set up to plan and manage major projects, before Devon's sell down of deepwater assets and ultimately exiting offshore altogether.

- a. No ownership in pipelines or refineries: the export of oil and gas to shore driven by open consideration of all options: FPSOs plus shuttle tankers openly competed in field development studies with Spars and Semisubmersibles;
- b. Searching for nimble solutions to reach first oil early, e.g. try EWT or EPS if overall it gets us there faster;
- c. Large acreage position in remote ultra deep waters of Lower Tertiary: second after Chevron, big potential impact on company;
- d. 50:50 with Petrobras at *Cascade*;
- e. Then Devon chose to completely exit offshore in 2H 2009!



**Peter Lovie**, Senior Advisor Floating Systems. Seriously in the loop on contracting for FPSO and shuttle tankers at *Cascade / Chinook*, then later in deliberations on other GoM field developments for Devon

# Petrobras Pioneers (Again!)

2006 to date: operator on first FPSO in US GoM!



**Cesar Palagi** is the Walker Ridge Production Asset Manager with Petrobras America Inc., responsible for the design and implementation of development projects of ultra-deep waters in Lower Tertiary fields in GoM. Provided technical and managerial E&P services to Petrobras for 30 years.



Contracted in 3Q07: Aframax size FPSO for 8,200 ft. w.d., 5+1+1+1 years (with BW Offshore), plus two Handymax size shuttle tankers (from OSG);

First disconnectable turret for GoM, first Jones Act shuttle tankers.

# Mother Nature can still be a Mean Mother!

- 2008 Hurricane *Ike* reminds industry – and the residents of Houston – that hurricanes are hazardous to health and property;
- 2009 Another big find announced: BP's *Tiber* in Keathley Canyon. FPSOs are considered seriously in GoM but only for a few prospects;
- 2010 April First FPSO for GoM: *BW Pioneer* arrives in GoM from Singapore;
- April *Macondo* disrupts everything
- 2011 Installation difficulties for FPSO at *Cascade/Chinook* adds to delays from *Macondo*, first oil expected 1Q 2012.



# Pioneering for US GoM

FPSO conversion in Singapore, shuttle tankers built in Philadelphia

The *BW Pioneer* in GoM waters



US construction of shuttle tankers



Conversion at KeppelFels



Source: Petrobras



Shuttle tankers owned by US company, crewed by US citizens

# BW Offshore's *BW Pioneer* in GoM

Now ready for first oil in 1Q 2012



Source: Petrobras

# The Next FPSO? Talk on the Street . . .

Barry Parker in Maritime Executive March/April, 2011, p 45:

“For U.S. waters, the talk of more FPSOs in addition to BW Offshore's *BW Pioneer* to serve areas beyond the Petrobras operated *Chinook* and *Cascade* fields seems to have waned.”

“Peter Lovie, a Houston-based FPSO and shuttle tanker expert, commented that **“BP's *Tiber* and Shell's *Stones* prospects in the deep remote GOM could be candidates**, but neither operator has confirmed that.”

“Lovie worked with Devon Energy, which sold its 50 percent stake in the *Cascade* field to Petrobras. He added, “Today there are no FPSO projects on the horizon in the GOM, and shuttle tanker prospects have likewise withered.” He contrasted this situation with mid-2007 when “There were multiple well-qualified contractors available and interested in providing FPSOs for the unique GOM requirements of deepwater and disconnectability.”





# Information on *Tiber*

2 June 2011:

## Bloomberg

Discovery announced September 2009;

More than billion barrels recoverable according to partner Petrobras. IHS says 450 million, at least 3 billion barrels in place according to BP);

Compares to 700 mmbbl said for ExxonMobil's *Hadrian* announced month earlier;

"Largest discovery in more than a decade";

Ownership, %:	62	BP (operator)
	20	Petrobras
	18	ConocoPhillips

27 October 2011:

BP personal comment: "Tiber is still in exploration and hence is not a project"

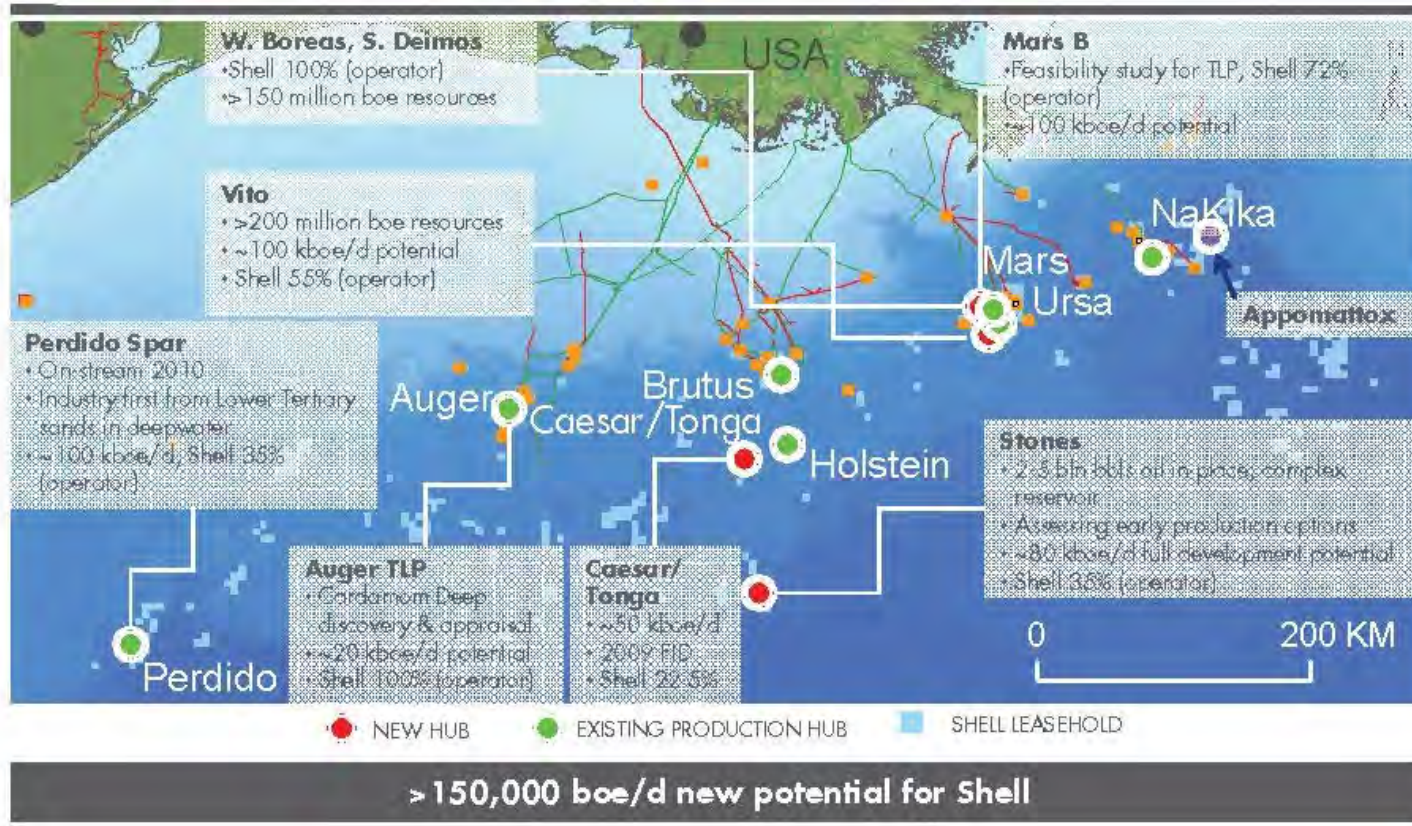
[I took it that the decision on a field development solution is just not yet ready to be made]

# More About Shell's *Stones* Development

FPSO has been chosen as the development solution

## DEEPWATER GULF OF MEXICO

Ownership, %: 35 Shell, operator  
 20 Marathon  
 20 Petrobras  
 15 ENI



Walker Ridge 508  
 2,919 meters  
 water depth

Rumored to  
 produce about  
 45,000 bopd via  
 EPS FPSO

 FEED underway

1 Copyright of Royal Dutch/Shell plc 16/03/2010

2-5 billion bbl oil in place,  
 no estimate published on recoverable reserves

# Effect of Adding FPSO Barrels in GoM

## Making a stab at a five (5) year projection

Year	Basis for assumed production from FPSOs in GoM (b)	Average production, bopd	Rough percentage of all waterborne imports in GoM (a)
2012	Initial wells at <i>Cascade/Chinook</i> come on line	40,000	0.7%
2013	Full nameplate capacity achieved at <i>Cascade/Chinook</i>	80,000	1.5%
2014	<i>Cascade/Chinook</i> continues on plateau	80,000	1.5%
2015	<i>Stones</i> additionally comes on line	125,000	2.3%
2016	Still to be identified FPSO comes on line in UDW, same rate as <i>Cascade/Chinook</i>	205,000	3.8%
<u>Notes:</u>	(a) Assumes 5.4 mmbbl waterborne imports daily to GoM ports and LOOP (EIA 6Jan12).		
	(b) Reservoirs rarely produce as projected, declines ignored here, best one can say is a SWAG!		

# Conclusions

- a. Moderating the demand for shuttle tankers are links in US GoM between well established extensive pipeline infrastructure and the choice of development solutions other than FPSOs, even in locations that are particularly remote, with uncertain reservoir conditions and expensive, difficult wells.
- b. Operator risk and field development philosophy IS a factor, e.g. compare Chevron and Petrobras: *Jack St. Malo* and *Cascade/Chinook*.
- c. The history in the North Sea of operators being able to play the market among a number of refiners using tanker deliveries to earn higher margins, has not been established in GoM, may take some time to make the adjustment with runs and margins.
- d. Compared to total production delivered to GoM refineries, FPSO barrels are still a small percentage, SWAG is less than 5% !

# Thank you

## Questions?

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