



Active Communications International

The 2nd FPSO Vessel Conference

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DEVELOPMENTS IN THE ULTRA-DEEP WATERS OF THE U.S. GULF OF MEXICO

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Themes in Worldwide FPSO Business

Volatility;

Project risks;

Low profitability;

Spec builds not good for financial health !

**2012: 'Too much "sexy", not enough
beans on the table' (BWO);**

Changes ahead ?

***Macondo* some day, somewhere.**

Themes in US GoM FPSO Business

Geography, pipeline networks and the Jones Act - effects on the FPSO equation in US GoM.

Fundamentals affecting production delivery to refineries and absence of FPSOs;

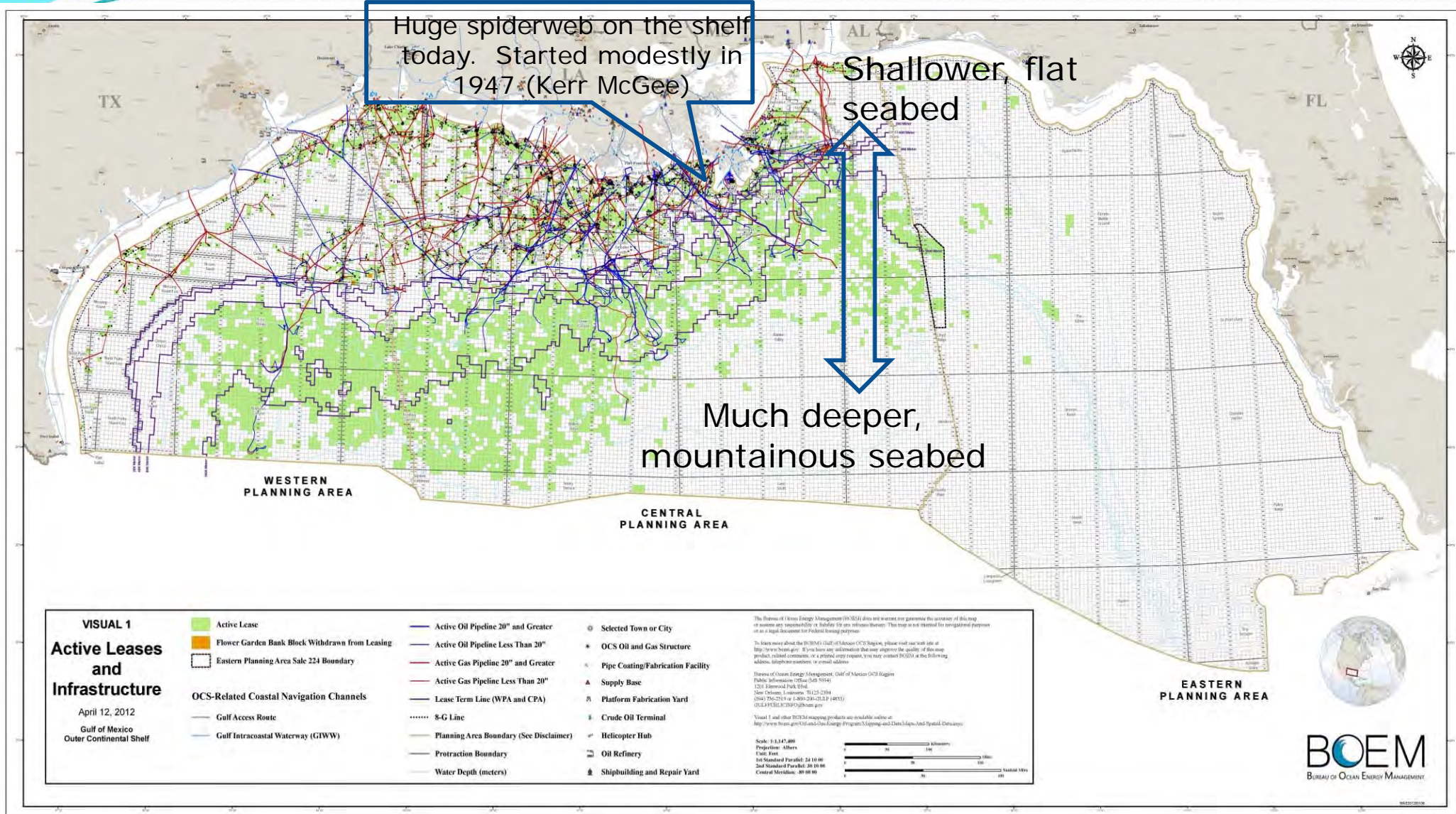
Historically not much place for FPSOs in GoM until occasionally now: business drivers.

Oil companies carefully considered FPSOs as an option for US GoM over many years – events, reservoir conditions, thought processes that got us to where we are today;

What may be next.

Growth in Platform & Pipeline Infrastructure

Unlike many offshore regions with FPSOs, ALL production **IMPORTED**

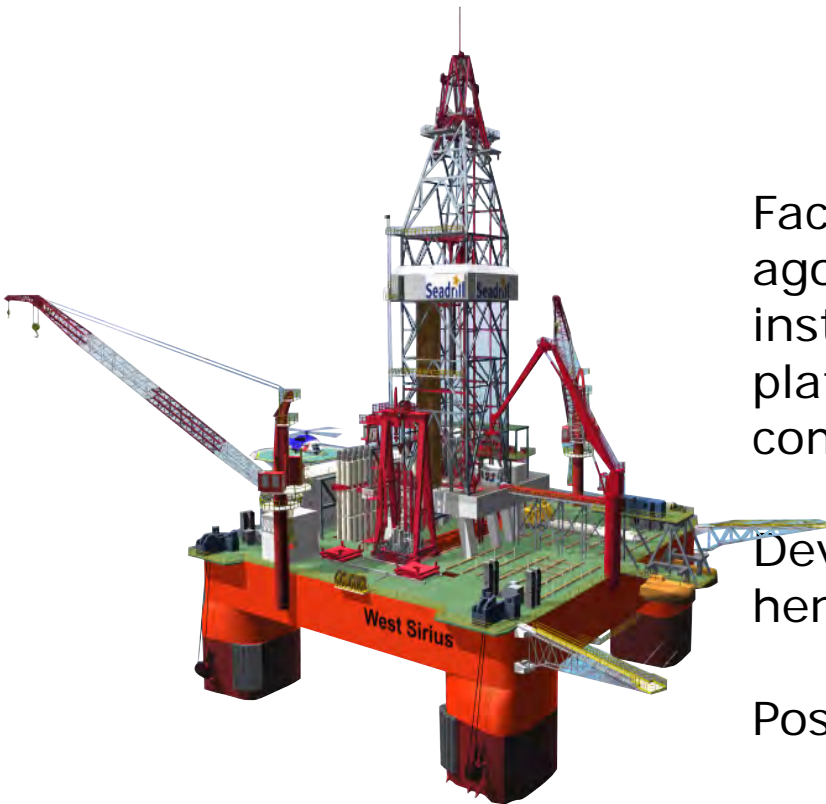
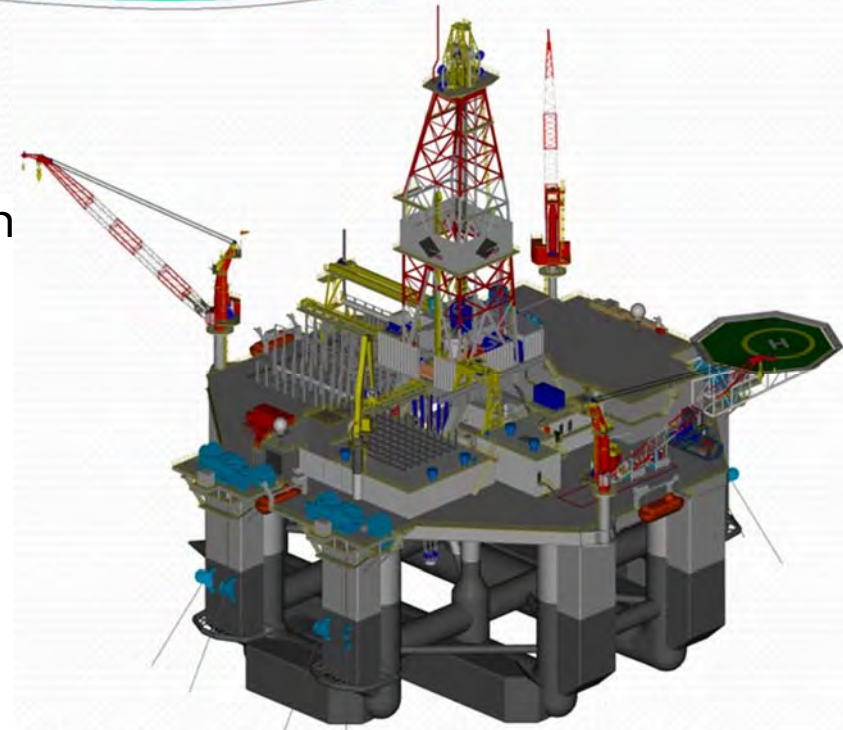


In recent years development & production risks and economics been tougher than expected for very remote areas in Ultra Deep Water (UDW): not just effects of location and UDW, formations also not as well understood

UDW Drilling & Fundamental Risks, Economics

Drilling and completion for one well may easily take six (6) months in the Lower Tertiary in GoM and an investment in the region of \$250+ million per producing well;

Well costs dramatically high for the Lower Tertiary: some of it day rates, lot to do with subsalt well characteristics;



Facility choices more driven by drilling than ten years ago: well CAPEX about 2/3 now of field development, instead of 1/3 before. Major choice is to drill from platform, OR from MODU(s) with subsea completions;

Developments may take several years to drill up, hence production ramp up may be slower;

Post spill, drilling costs even higher.

Contrasts

Shallow and out to what's now deep

Developed in 1940s to 1990s

Wells often 5,000-20,000 ft. RKB;

Pipelines economical, competitive infrastructure;

Little need or opportunity for FPSOs: no need for storage for export;

Well developed understanding of geology;

Remote UDW: high stakes, high risks

2000s & 2010s

Wells much more difficult: sub salt, often 25,000-35,000 ft. RKB;

Pipelines across mountainous sea bottom in 5-10,000 ft. water depth difficult, expensive;

Few analogues on reservoirs, high risks on reserves and producibility;

\$Megabillion projects common!

The EWT Dream in GoM

- a. Reservoir compartmentation, producibility questions lead to interest in an Extended Well Test (EWT) for say 6-12 months on remote ultra deepwater Lower Tertiary prospects;
- b. "No flaring" gives operators serious gas pains. What to do about small amounts of associated gas? Not just producing but practical solutions for transporting gas to shore?
- c. No easy answer, e.g. GTL, LNG, CNG, etc. etc.
- d. Leadership: the hazards of committee design v. engineers' desires v. commerciality;
- e. Historic success of *Seillean* in deepwater Brazil thus not workable in future for GoM;
- f. Commercial difficulties: A few operators talk, no one yet willing to pay the freight:
 - Stringing together enough 6-12 month jobs,
Arranging the sequence of prospects,
 - Securing partner agreements for multiple prospects;
- g. No one willing to offer a charter for 4-7 years for economic operation.



Two Linked Debates in UDW of the US GoM

1 Facility and 2 Transportation

1 Facility: Two main options

- a. Semisubmersible or Spar
without storage

May allow well access (DVA)

May even allow drilling

Surface completions or subsea

- b. FPSO with storage
+ Disconnectable

DVA not usually possible

Subsea completions



2. Transportation – Five Main Options

Traditional choices:

- a. Pipeline: Long history of success in GoM. Starting to reach out to UDW;
- b. Shuttle tankers + FPSO: First use at *Cascade/Chinook* in 2012, pioneered, common in North Sea;
- c. Shuttle tankers + FSO: Common elsewhere in world, studied for GoM;

New options:

- d. Conventional tankers + 1 HiLoad for FPSO: only new part is HiLoad prototype;
- e. Direct loading from Semi/Spar: Conventional tankers + 2 HiLoads.

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



Source: Remora

The Pipeliners' Friend in Washington



No Jones Act for
Trucking:
Izuzu, Volvo OK,
**U.S. FREE
MARKET !**

No Jones Act for
Airlines:
Airbus, Bombardier,
Embraer all OK.
**U.S. FREE
MARKET !**

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 for tankers transporting oil, OPEX ~ 2X.

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

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.

Strong union and industry lobbies (seafarers, shipyards, railroads), have resisted efforts to repeal. Costs USA about \$10billion/year (Senator John McCain, R-AZ, 2002)

FPSOs Considered for US Waters for a Long Time

The history behind where we are today

Year	Field Development	Location	Operator	Contractor	Comments
1977	Castellon (First anywhere)	<i>Spain</i>	<i>Shell</i>	<i>SBM</i>	<i>World's First true FPSO</i>
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				
TODAY: October 2012	<i>Cascade /Chinook</i>	GoM	Petrobras America	BW Offshore	Satisfy latest regulatory requirements, installation difficulties overcome

First FPSO in US Waters: Exxon in 1981

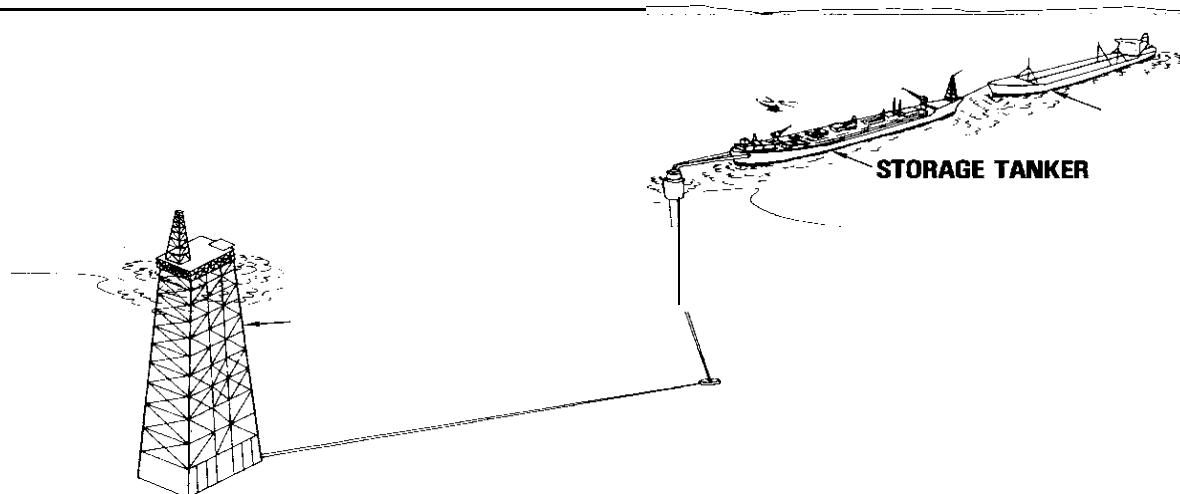
"OS&T" tanker at the *Hondo* development offshore California



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)

Industry Campaign Starts for FPSOs in US GoM

1997-2001: doing something about it - roots in DeepStar



Allen Verret is a 40-year veteran of Texaco's Offshore Gulf of Mexico Operations, presently the Executive Director of the Offshore Operators Committee and Technical Advisor to the Deepstar Regulatory Sub Committee.

Texaco had a prospect named *Fuji* in the then ultra deep of around 3,500 ft, remote from pipelines, looked like a field development candidate made for an FPSO;

Regulators would require an Environmental Impact Statement (EIS) before allowing such a revolutionary system into GoM! Would take 2+ years and \$millions of effort'

Absence of an EIS would delay *Fuji* and other developments and make it difficult for any other operator to use the FPSO "tool in the toolbox";

About this time DeepStar was tackling the joint development of technologies by competing operators, such as concepts for deep water in GoM and elsewhere;

Hence DeepStar took on the task of securing regulatory acceptance of FPSOs in GoM and preparing the EIS. The "cat herding' leader for this complex multi year initiative was Allen Verret, who deserves great credit for this accomplishment.

Shell Pioneers (again)

1998-1999: Early and thorough consideration of FPSO in US GoM



George Rodenbusch led a number of early studies at Shell on FPSOs for GoM in 1998-1999, involving a large multidiscipline team from Shell and partner BP in assessing the feasibility of FPSO and other field development solutions for the *Na Kika* deepwater development in US GoM.



The semisubmersible at *Na Kika* that we know today was decided on after consideration of all kinds of options, including multiple variations on the FPSO theme;

Back then some people speculated on an operator prejudice in GoM against FPSOs;

No evidence of this was in the deliberations for *Na Kika* - quite the opposite, it was a skillful rational decision, based on all reservoir, production and facilities choices and open internal debate;

More on this and other FPSO history in two part series "*The First FPSO in the US Gulf of Mexico – The 14 Year Journey*" in SPE's Journal of Petroleum Technology, April & May 2010.

Environmental Impact Statement on FPSOs

2001: Key US regulatory policy documents on FPSOs

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

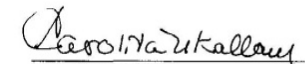
_____ **Alternative B-4** (Approve the general concept of using FPSO's with a requirement for an attendant vessel.)

_____ **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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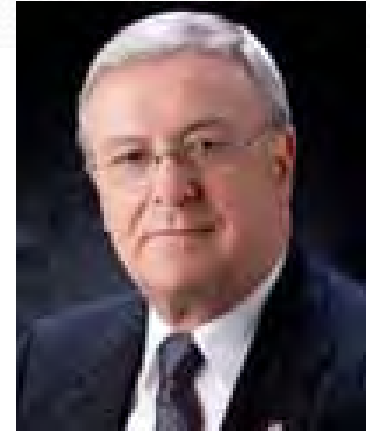
Devon the True Independent

2003-2009: An 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.

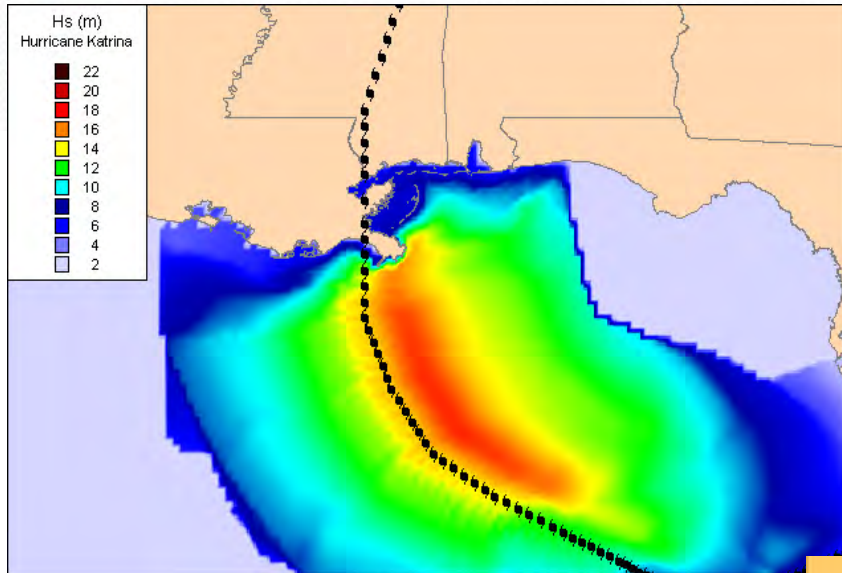
- a. No ownership in pipelines or refineries: the export of oil and gas to shore driven by open consideration of all options: FPSOs plus shuttle tankers openly competed in field development studies with Spars and Semisubmersibles;
- b. Searching for nimble solutions to reach first oil early, e.g. try 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, huge 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

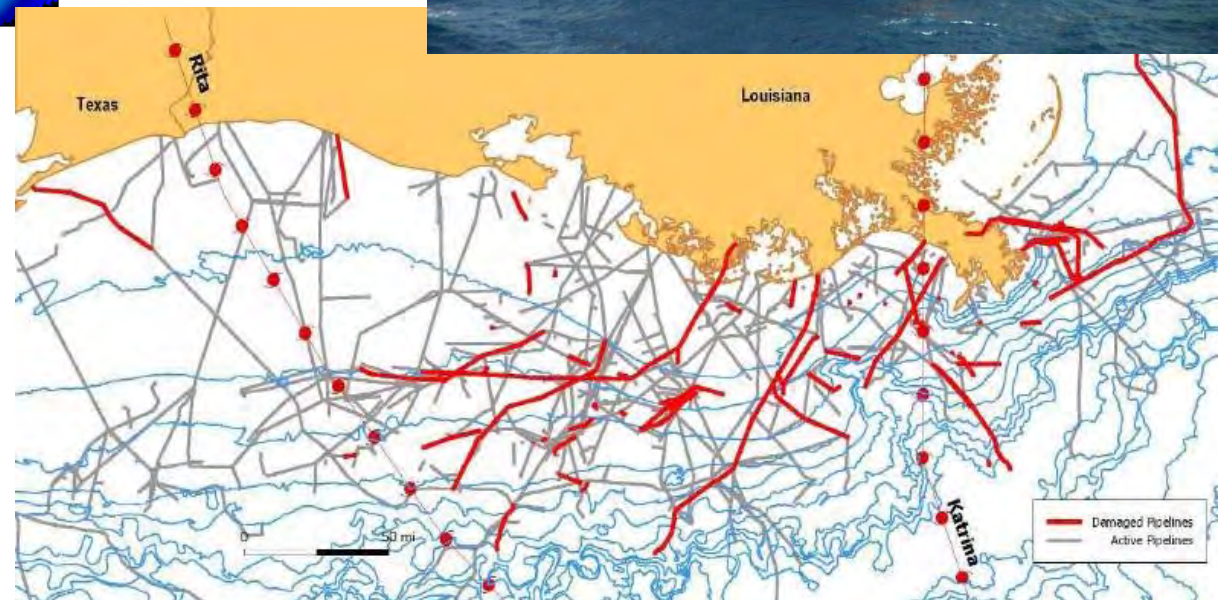
Stormy Weather aka Mayhem

2005: Offshore industry forced to rethink design codes



Map of Hs for Hurricane *Katrina*, with water depth effects included

Example of
Topsides
Damage Due
to Wind



Hurricane Damage to GoM Pipeline Network
(Source: MMS)



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

Less Mayhem – for a While

2006-2007: Serious progress

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

Major find: BP's *Kaskida* in Keathley Canyon, might be FPSO?

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

Industry realizes have to change FPSO designs to adapt to more severe storm criteria for US GoM;

2007 March Bids were solicited for the third FPSO in GoM but first

on US side - for a minimum lease of five (5) years + options 1 + 1 + 1 ;

May OTC: GoM design practices extensively revised, tightened;

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

First Jones Act shuttle tankers for US GoM assessed, fewer choices than for FPSO, time charters signed: 2 Handymax size from OSG;

Petrobras Pioneers (again)

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 a record 8,200 ft. w.d., 5+1+1+1 years with BW Offshore;

First disconnectable turret for GoM, free standing buoyed riser system.

Pioneer-ing 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



Good News and Bad News

- 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;
- 2010 April First FPSO for GoM: *BW Pioneer* arrives in GoM from Singapore;
- April *Macondo* disrupts everything;
- BW Pioneer assists
- 2011 Shuttle tankers available, diverted to Brazil;
- Installation difficulties for FPSO at *Cascade/Chinook* adds to delays from *Macondo*;
- 2012 Tide turns, good news for FPSOs in US GoM.



BW Offshore's *BW Pioneer* in GoM

At last! First oil: 25 February 2012



Source: Petrobras

Shell's *Stones* Development

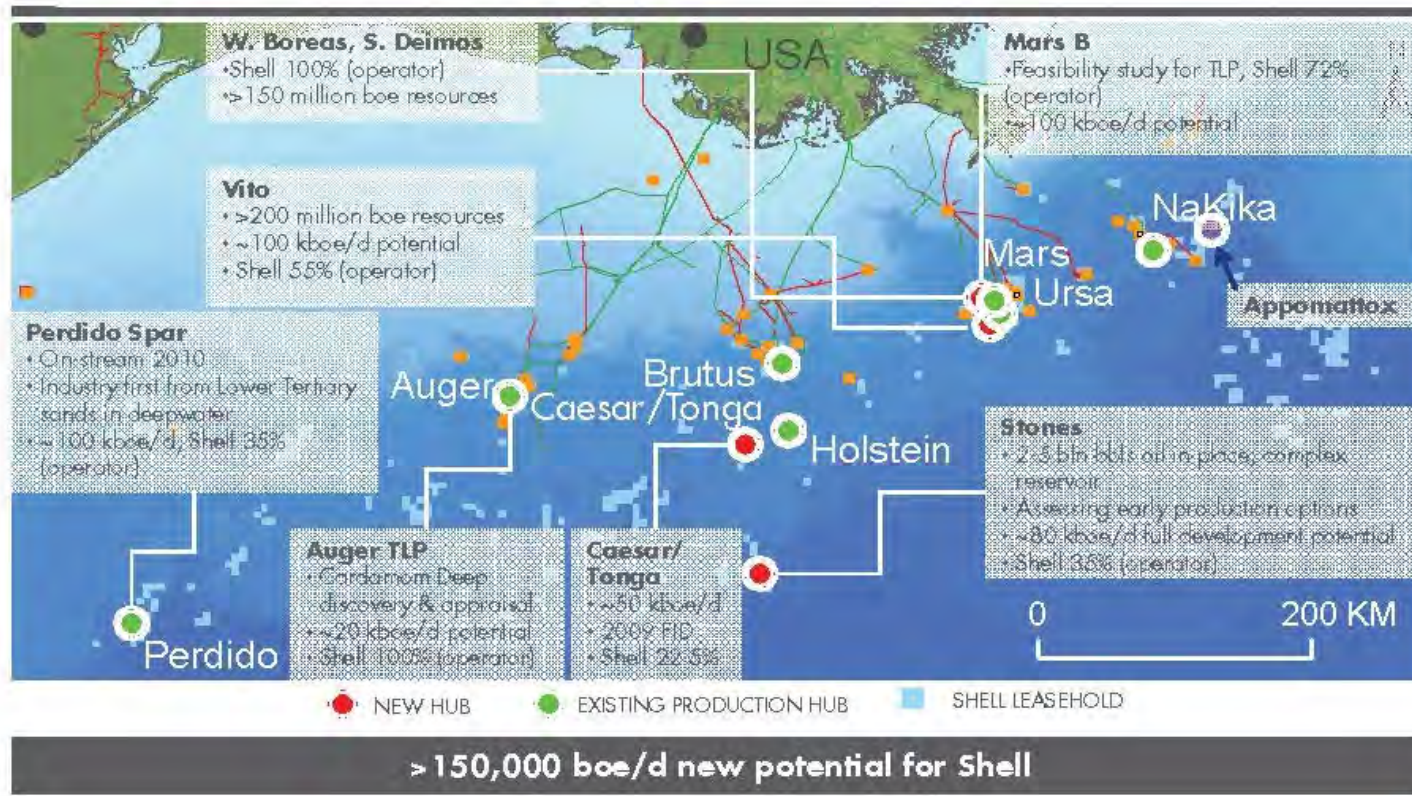
Walker Ridge 508 drilled to 28,560 ft. in 9,576 ft. w.d.

FPSO has been chosen as the development solution

DEEPWATER GULF OF MEXICO

Ownership, %:

- 35 Shell, operator
- 20 Marathon
- 20 Petrobras
- 15 ENI



Needs about 45,000 bopd FPSO for EPS service

FEED complete

Copyright of Royal Dutch Shell plc 16/03/2010



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

BP's *Tiber* Discovery

Keathley Canyon 102, drilled to 35,055 ft. in 4,132 ft. w.d.

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]

30 April 2012: Reuters – appraisal well likely 2013

How Many FPSOs in the UDW in US GoM?

The "3P Estimate"

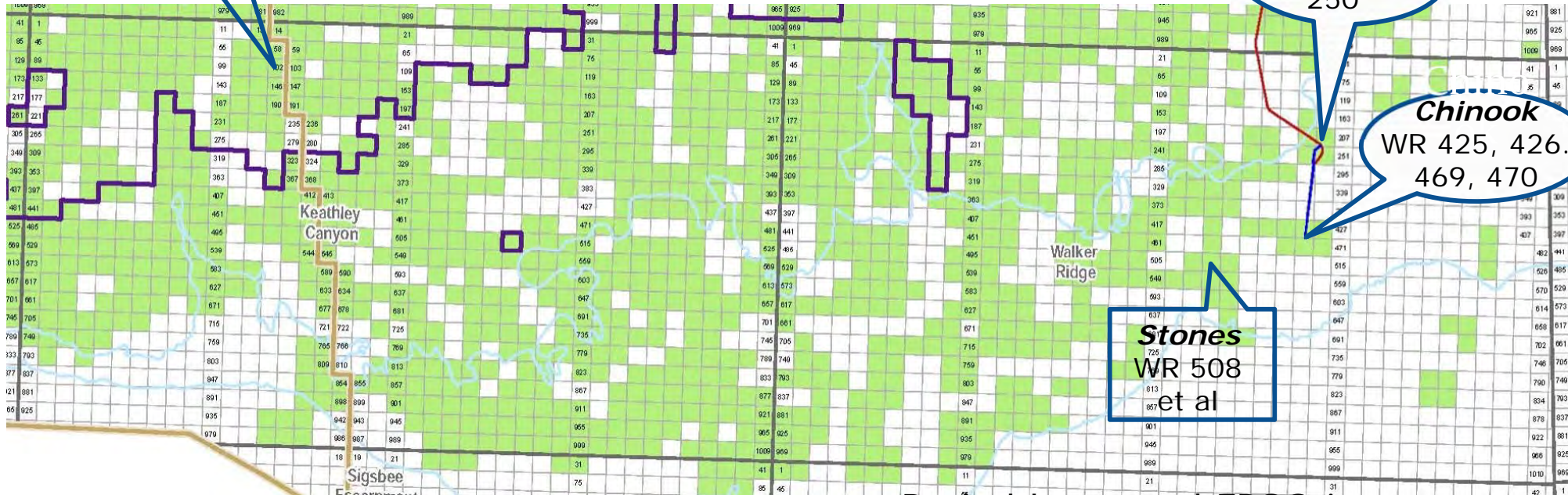
Petrobras operated *Cascade* & *Chinook* producing to *BW Pioneer*, the first FPSO in US GoM

Tiber
KC 102 et al
Possible third FPSO in US GoM: BP operated *Tiber*, at studies stage

Cascade
WR 206, 249
250

Chinook
WR 425, 426.
469, 470

Stones
WR 508
et al



Probable second FPSO in US GoM: Shell operated *Stones*, FEED complete, awaiting FID

Map credit:
BOEM, 12 April 2012, same as slide 3,
available on U.S. BOEM website

Requirements for an FPSO in the UDW in US GoM?

- a. Disconnectable: Run before storms like in Far East. This time to avoid collisions with loose MODUs and spill risks. Added benefit of easier to modify, expand or maintain during production life;
- b. Uncertain field life: Lower Tertiary fields may produce for as long as 30-40 years, i.e. about double past field lives, important effect on “full field life” facility design and its exposure to extreme storm events. BUT, reservoir performance uncertainties argue for removable FPSO to mitigate downside;
- c. New more remote areas: Lower Tertiary turning out to be very prospective, with potential for high rates. Examples: BP’s discoveries at *Kaskida* in 2006 and *Tiber* in 2009, Shell’s *Stones*;
- d. Long way out, over mountainous seabeds: Pipeline routes much longer, more circuitous and more expensive than hitherto. Coupled with reservoir risks, choice of development solution may favor FPSOs;
- e. Pressure to cut the cycle time: Intent to improve economics is countered by risks of reservoirs performing differently from expectations;
- f. FPSO can make business sense as an Early Production System (EPS).

Conclusions

- a. There are links in US GoM between reservoir conditions, well established extensive pipeline infrastructure and the choice of development solutions other than FPSOs;
- b. Operator risk and field development philosophy IS a factor, e.g. compare Chevron and Petrobras: *Jack/St. Malo* and *Cascade/Chinook*;
- c. Fields that are particularly remote, with uncertain reservoir conditions, can favor another EPS such as *BW Pioneer*;
- d. Shuttle tankers are expensive and may be on the critical path;
- d. FPSOs are now considered more than ever for GoM, e.g. another FPSO like *BW Pioneer* is on the cards for Shell's *Stones*.
- e. An FPSO is not a sure thing for full field development in UDW in the US GoM.
- f. There will be spills with the worldwide fleet of FPSOs, a *Macondo* feasible.



Thank you

Questions?

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