marine technology SOCIETY

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Thursday 1 December 2011

At last, an FPSO in US GoM!

The people, the companies, the history and what might be next

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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: business reasons, not prejudice.

What may be next – an outlook.

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

1 Facility

Two main options

(a) Semisubmersible or Spar <u>without</u> storage

May allow well access (DVA), even drilling

(b) FPSO <u>with</u> storage + Disconnectable

DVA not usually possible

2. Transportation

Pipelines 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.

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 Debate so Far

Shallow to deep water now:

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):

d. Costs of 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 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

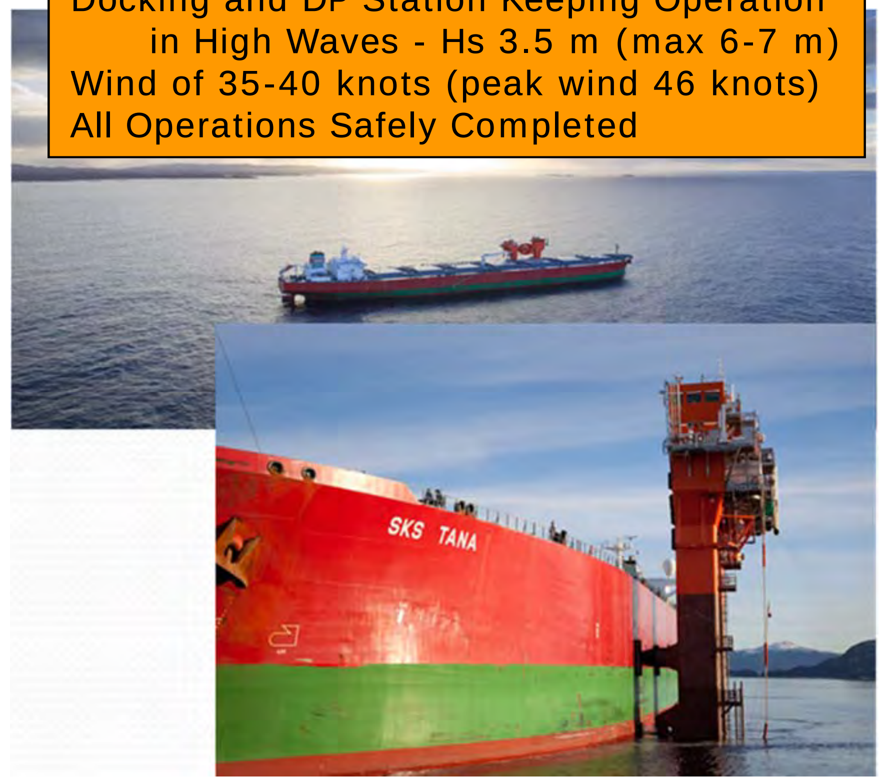
Traditional choices:

1. Pipeline: Long history of success in GoM;

2. Shuttle tankers + FPSO: First use at *Cascade/Chinook* in 2011, common in North Sea;

3. Shuttle tankers + FSO: Common elsewhere in world, studied for GoM;

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



New options:

4. Conventional tankers + HiLoad for FPSO: only new part is HiLoad prototype;

5. Conventional tankers + 2 HiLoads for Semi/Spar.

FPSOs Considered for US Waters for a Long Time

See how long it has taken!

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	*Cascade /Chinook*	GoM	Petrobras America	BW Offshore	Charters signed for FPSO + 2 shuttle tankers
2010 April	*BW Pioneer* arrives in GoM, 2 weeks before *Macondo*, delays, FPSO & shuttle tanker assist in spill				
2011 TODAY	*Cascade /Chinook*	GoM	Petrobras America	BW Offshore	Satisfy latest regulatory requirements, installation difficulties overcome

Shell in 1977: The first FPSO

Offshore Spain in 141 m. of water

Swivel: Swivel development for low pressure single point moorings and testing was an ongoing activity at the SBM premises in Kinderdijk, Holland.

Flexible riser: For a number of years Shell (SIPM) had been involved in a joint venture with IFP (Institute Francaise du Petrole) and Coflexip.

Tandem loading: Testing was conducted by the Wageningen Laboratory.

Key pioneers included:

Leon M J Vincken	SIPM	Originator of the idea involved in all aspects and overall in charge
Wim van Heijst	SBM	Head engineering team
Frank Eijkhout	SIPM	Head development and installation team SIPM
Joop Langevelt	SIPM	Development of Single Point Mooring
Alan Beare	SIPM	Development and testing of Coflexip riser

Source: Cobie Loper, SBM

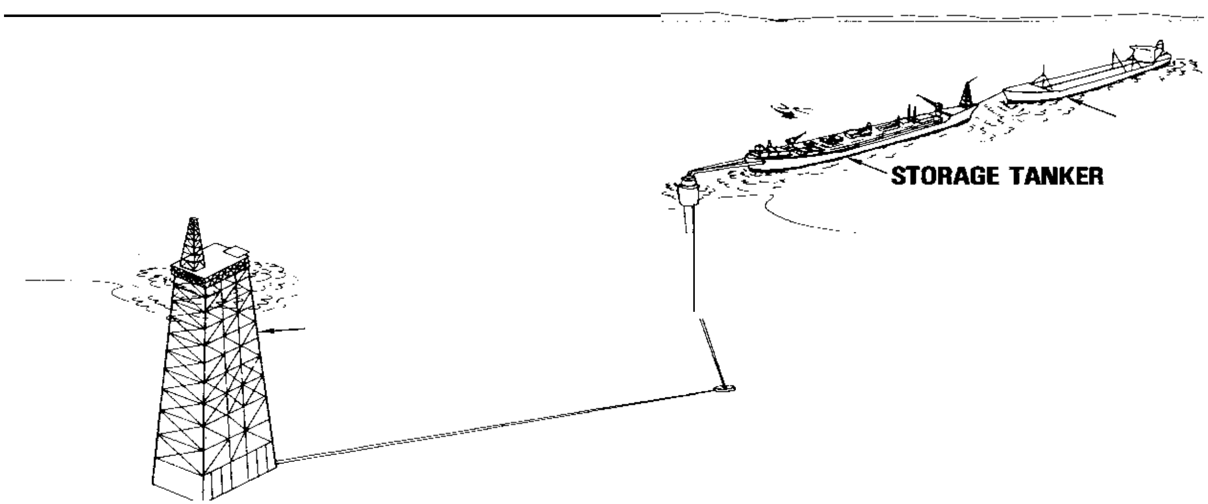
Exxon in 1981: First FPSO in US waters

"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 of Exxon

Campaign Starts for FPSOs in US GoM

1997-2001: doing something about FPSOs in GoM - roots in DeepStar

Allen Verret is a 30-year veteran of Texaco's Offshore Gulf of Mexico Operations and is presently the Executive Director of the Industry's 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 technolgies by multiple 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 - Pioneering 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 is 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 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
Carolita U. Kallaur
Associate Director for
Offshore Minerals Management

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

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;

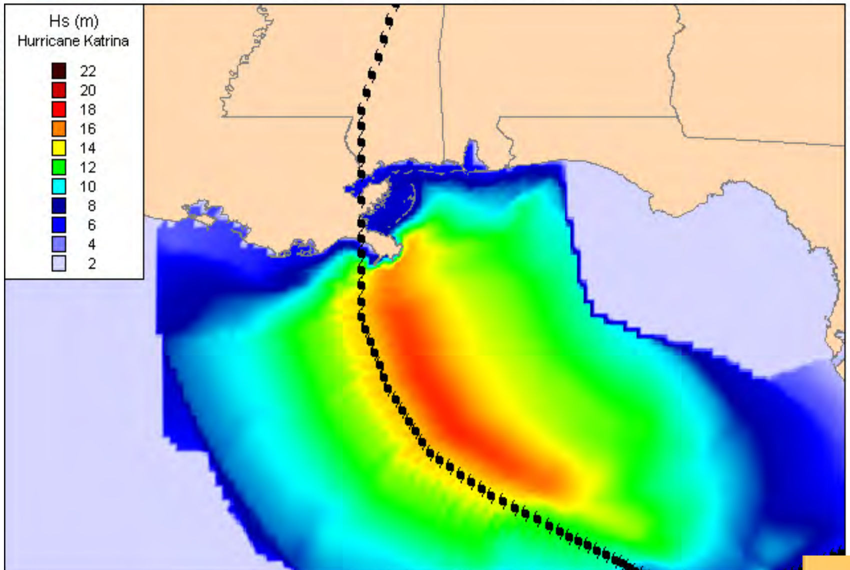
d. 50:50 with Petrobras at *Cascade*;

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

Stormy Weather aka Mayhem

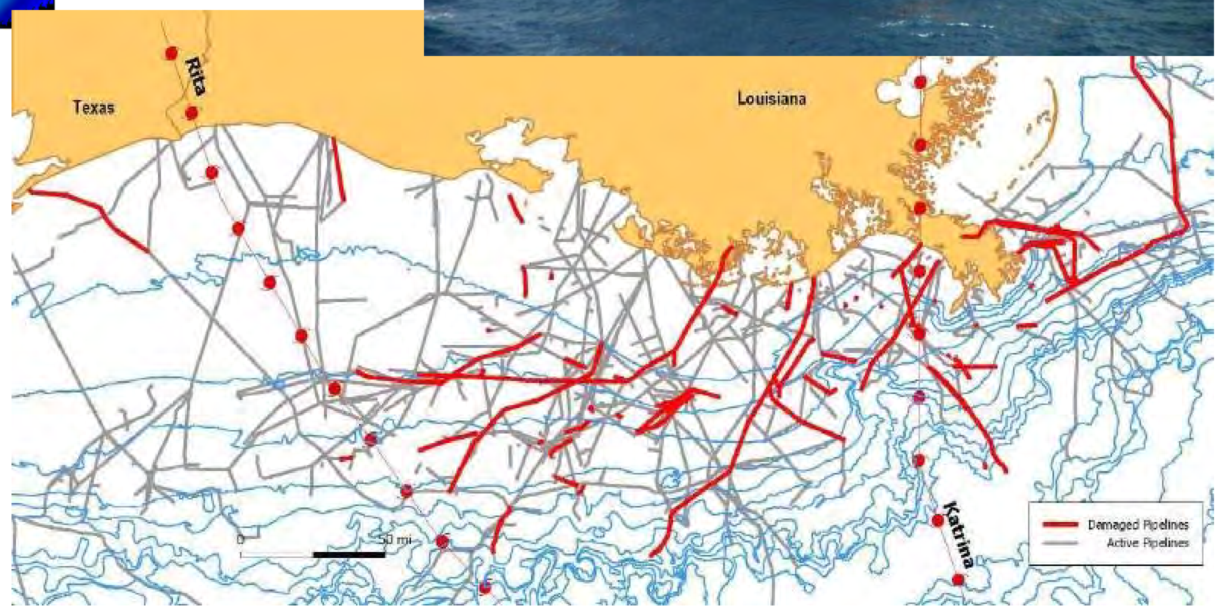
2005: Offshore industry forced to rethink design codes



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

Example of Topsides Damage Due to Wind

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

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 - <u>and first on US side</u> – 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;

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 any day now.

Pioneering for US GoM

FPSO conversion in Singapore, shuttle tankers built in Philadelphia

The *BW Pioneer* in GoM waters

Source: Petrobras

Conversion at KeppelFels

US construction of shuttle tankers

Shuttle tankers owned by US company, crewed by US citizens

BW Offshore's *BW Pioneer* in GoM

Now ready for first oil

Source: Petrobras

What's Ahead for FPSOs in GoM?

a. Disconnectable: Run before storms like in Far East. Also benefit of easier to modify, expand or maintain;

b. Long field life: Lower Tertiary fields may produce for as long as 30-50 years, i.e. about double past field lives. Important effect on facility design and on exposure to extreme storm events;

c. New more remote areas: Lower Tertiary turning out to be very prospective (potential for high rates). Examples: BP's discoveries at *Kaskida* in 2006 and *Tiber* in 2009;

d. Long way out, over mountainous seabeds: Pipeline routes much longer, more circuitous and more expensive than hitherto (export economics may favor FPSOs);

e. Pressure to cut the cycle time: Intent to improve economics is countered by risks of reservoirs performing differently from expectations.

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. 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. <u>Commercial</u> 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.

Talk on the Street . . .

Barry Parker in Maritime Executive **March / April** 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:

<u>Bloomberg</u>

Discovery announced September 2009;

More than billion barrels recoverable according to partner Petrobras. IHS says 450 million, at least 3 billion barels 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

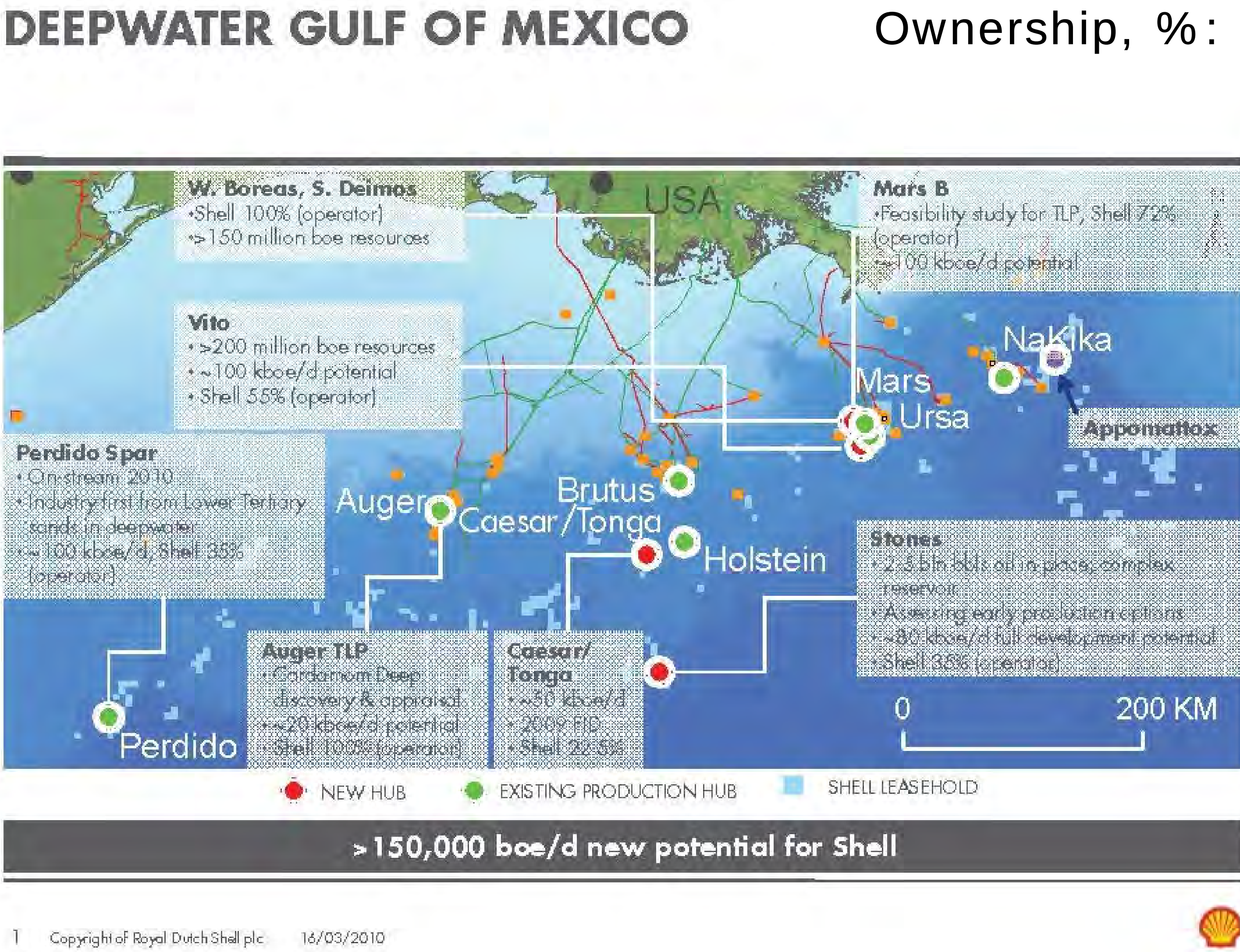
27 October 2011:

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



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

Walker Ridge 508
2,919 meters water depth

Rumored to use about 45,000 bopd EPS FPSO

FEED underway

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

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. Fields that are particularly remote, with uncertain reservoir conditions, can favor another EPS such as *BW Pioneer;*

c. Operator risk and field development philosophy IS a factor, e.g. compare Chevron and Petrobras: *Jack St. Malo* and *Cascade/Chinook*;

d. Some field development solutions in US GoM have got accepted more quickly than FPSOs, e.g. Spars and TLPs. Curiously these two have been slow to catch on elsewhere in the world, good fit for well conditions and available export (import) system in US GoM;

e. FPSOs are now considered more than ever for GoM, another FPSO like *BW Pioneer* is on the cards for Shell's *Stones.*

f. An FPSO not a sure thing for full field development in US GoM.

Thank you

Questions?

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