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FPSOs and the US Gulf of Mexico:

The Differences, the 14 year Journey to the First FPSO in GoM and the Future

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Today's Themes - Understanding FPSOs for GoM

1 Reservoirs, infrastructure and history;

2 Regulatory environment and climate;

3 Pipelines, shuttle tankers and the Jones Act;

4 The new world of The Lower Tertiary;

5 What may be ahead for FPSOs in GoM.

Words of Wisdom!

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*

FPSO Most Widely Used Hull Type – but not in GoM!

The world fleet in service at the end of 2008 comprised:

Floating Production Storage Offloading (FPSOs)	144	) Mostly tanker
		) conversions,
Floating Storage Offloading (FSO) vessels	86	) some newbuilds
Semisubmersibles	42	)
		) Generally
Tension Leg Platforms (TLPs)	22	) field specific
		) newbuilds
Spars	16	)
Production Barges	6	Various
Floating Storage Re-liquefaction Units (FSRU)	2	Conversions

	318	

Source: International Maritime Associates

No FPSOs (Yet) in GoM, Where "Offshore" Started

1. First offshore production happened in GoM, first time out of sight of land in 1947 (Kerr McGee), extending platform and pipeline technologies from the inshore marshes;

2. Fixed platforms and then floating platforms gradually evolved as water depths grew and became more remote and in deepwater water. Wells often drilled from platforms & required intervention;

3. First FPSO in the US Gulf of Mexico in mid 2010 - applying technology used elsewhere in the world but a latecomer to a mature offshore region with established export infrastructure and regulatory hurdles;

4. Shuttle tankers in the US Gulf of Mexico - restrictive laws (Jones Act) for crude oil transport from production vessel to port: tankers must be by US flag, US owned tankers. High costs make it difficult;

5. After a laborious 14 year journey the use of FPSOs and shuttle tankers will be achieved in the US Gulf of Mexico (GoM) next year.

Remote Deep Wells Stretch Drillers, And Slow Field Developments

Extreme depths: 30,000+ ft. RKB not unusual, e.g. BP's *Tiber* discovery in Keathley Canyon, announced September 2009 is a 35,000+ ft. well depth!

Extreme pressures in reservoirs, e.g. 18-22,000 psi;

Mountainous seabed;

Reservoir rocks with little production history;

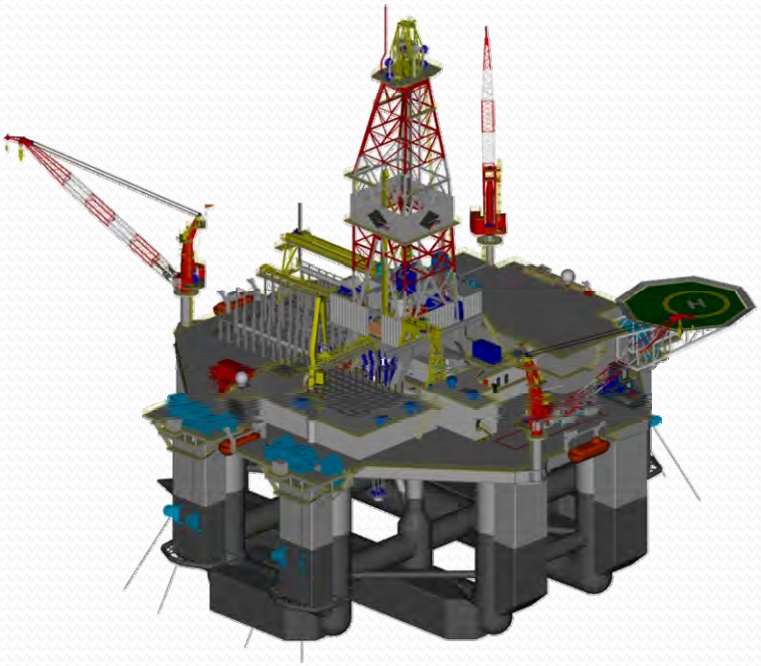
MODU availability limited, long deliveries;

Experienced people in operator, drilling contractor and vendor organizations are more critical than ever for wells like these;

But these people are in short supply.

Drilling Economics Affect Development Strategy

Drilling and completion for one well may take six (6) to nine (9) months in the Lower Tertiary and an investment in the region of $250+ million per producing well;



Well costs dramatically high for the Lower Tertiary: partly day rates, partly well characteristics;

Facility choices more driven by drilling than 5-10 years ago: well CAPEX about 2/3 now of field development, instead of 1/3 before;

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

History and Hurdles for Facility and Transportation Systems in GoM

	Technology	Hi/Low Tech?	Significance	Barriers	Timing: Serious Study to First Commercial Use
1	Traditional Facility: GoM Production Platforms	Originally Low, now High	A new way of doing things, a game changer	Risking production on success of a new technology, water depths	1947-2009: evolution over 63 years
2	Traditional Transportation: GoM Pipeline Networks	Originally Low, now High	Traditionally laid over flat alluvial sea bottom, economical and efficient	2005 hurricane season revealed serious vulnerabilities, water depths	1947-2009: evolution over 63 years
3	The New Facility in GoM: FPSOs	Medium	Been used everywhere else in world	Competition of other production systems / regulatory acceptance	1996-2010: almost 14 years
4	New Transportation Method for GoM: Shuttle Tankers	Low	Modest version of North Sea precedent	Competition of pipeline network / Jones Act (US protectionism)	2000-2010: roughly 10 years

A Sound Business Case Can Exist for FPSO and Shuttle Tankers in GoM

i. Export matters: Shuttle tanker export may indeed offer an economic benefit over pipelines, even for large fields in the remote ultra deepwater of GoM (e.g. Lower Tertiary): could be in the order of a $Billion saving over field life;

ii. Downside risks: In the event of a field being a bust, FPSO and tankers being re-deployable mitigate risks on export service commitments. Pipelines are not good at being reeled up and redeployed!

iii. Aggregation: Large enough volumes enable an economic pipeline system - more difficult in the Lower Tertiary than closer to shore. A pipeline is economically difficult for EPS - risks and economics favor tankers;

iv. Flexibility: Tankers can easily change destinations for maximum margin from production - and in event of hurricane damage can be re-directed to alternate delivery points.

v. Producibility: Can one reliably depend in remote field developments producing from unproven formations?

FPSOs in US GoM – The History

Although FPSOs used widely elsewhere in the world, starting in the 1970s, they are new to the US GoM, even though GoM saw the first production offshore (1947, Kerr McGee) and has been a consistent pioneer in offshore operations and technology.

History

1996	First approach by US operators to the regulators (MMS & USCG) concerning approval of FPSOs in GoM;
1997	Studies started by two operators on the use of an FPSO in GoM. Ultimately one development was non commercial and the other decided to use a semisubmersible as the development solution;8
1998	Start of DeepStar funded work on an Environmental Impact Statement by MMS, with USCG support, for approval in principle to enable FPSOs to be in operators' development "toolbox";
2000	One operator considered FPSO and FSO solutions for a GoM complex but the regulatory position was not clear, competition was close and another system was chosen in mid 2001;

More on History of FPSOs in GoM

2001 In December MMS issued the Record of Decision approving use of FPSOs and shuttle tankers in US waters;

2002-2005 Despite all the earlier efforts, very little operator interest in FPSOs for GoM;

2006 Petrobras and partners announce plans for first FPSO at *Cascade/Chinook*;

2007 Bids were solicited for the third FPSO in GoM - and first on US side – for a minimum lease of five years. Stiff competition, contract signed with BW Offshore;

2010 *BW Pioneer* to enter service.

Notes:

(a) The first two FPSOs in GoM were in Mexican waters:

1st FPSO	1989	Owned by Pemex
1st FSO	1998	Charter from Modec
2nd FPSO	2007	Charter from BW Offshore

(b) For service in US waters FPSOs can be owned and built anywhere. In contrast shuttle tankers must be owned, built and crewed in US.

Key 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

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

January 2002: MMS Announces "Open for FPSO Business"

MMS News Releases

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

FOR RELEASE: January 2, 2002

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MMS Reaches Decision about FPSO's in Gulf of Mexico

The Minerals Management Service (MMS) announced today its decision to accept applications for the use of floating production, storage and offloading systems (FPSO's) in the Gulf of Mexico. FPSO's, currently in use around the world, offer an option to develop areas in the Gulf that challenge or exceed current infrastructure or technologies and to help meet the nation's growing need for energy resources.

"MMS has completed a rigorous environmental and safety review of FPSO's for use in the deepwater areas of the Central and Western Gulf of Mexico. We examined the environmental risks and found them comparable to other types of production systems currently accepted for use in these deepwater areas. Therefore, we have concluded not to categorically exclude them from use as an offshore production system," said MMS's Acting Director Lucy Querques Denett. "While we will accept applications for the use of FPSO's, each will be considered on a case-by-case basis," according to Denett.

The decision is documented in the Record of Decision, which is the culmination of the programmatic environmental impact statement (EIS) process on the potential use of FPSO's. The EIS evaluated a permanently moored, double-hulled, ship-shaped FPSO with up to 1 million barrels of crude oil storage capability. FPSO's store crude oil in tanks located in the hull of the vessel and periodically offload the crude to shuttle tankers or ocean-going barges for transport to shore. Consideration of the proposed action covered a 10-year period, 2001 through 2010. Rapidly changing technologies make projections beyond that time frame very uncertain.

"While this programmatic level decision does not approve any specific FPSO site or project, it provides a foundation for considering a specific request by a company to use an FPSO for a project. When a specific project is applied for, MMS will still conduct a site-specific environmental assessment as well as a project-specific technical and operational review before a project is approved. A review for projects that fall within the base case can now be completed in less time, since an EIS has already been prepared," noted Denett.

Further technical and environmental evaluation will be required for specific FPSO proposals. The MMS will require submission and approval of a deepwater operations plan and a development operations and coordination document before any FPSO operation could occur. Any proposed FPSO operation that is not within the range of operations evaluated in the programmatic EIS will require a more extensive environmental review and National Environmental Policy Act documentation than would a proposed operation within the range addressed in the EIS.

FPSO operations have not previously been proposed or approved for use in the U.S. Gulf of Mexico; however, there are more than 70 FPSO's currently installed and in use around the world. "Today's programmatic decision provides an additional production system option for industry to consider as companies develop projects in the deepwater areas of the Gulf of Mexico," said Associate Director for Offshore Minerals Management Carolita Kallaur.

"Industry is encountering a variety of situations in the more than 100 discoveries of oil and gas in the deep waters of the Central and Western Gulf of Mexico," said Kallaur. "Sometimes these discoveries are small and sometimes they are distant from existing infrastructure. These types of discoveries represent potential use of FPSO's to produce oil and gas resources that would not be developed using current technology and infrastructure. This decision simply gives industry the opportunity to submit a plan to use an FPSO for a specific project, and gives MMS the ability to consider this type of development project."

Today's decision excludes the use of FPSO's in a 471-block area just off the continental shelf from Galveston to New Orleans, part of the U.S. Coast Guard lightering-prohibited areas. The MMS will not approve the use of FPSO's in this area for a period of two years while it continues discussions with the Coast Guard. The two-year period will allow a fuller discussion of what measures might be necessary to protect the environment should FPSO's be considered for use within the lightering-prohibited areas. The environmental assessment completed 10 years ago by the Coast Guard in support of the rulemaking that established the lightering-prohibited areas will also be reviewed for applicability during this two-year period. In addition, the MMS will continue to work with the Coast Guard to delineate jurisdictional issues on the basis of the memorandum of understanding between the two agencies.

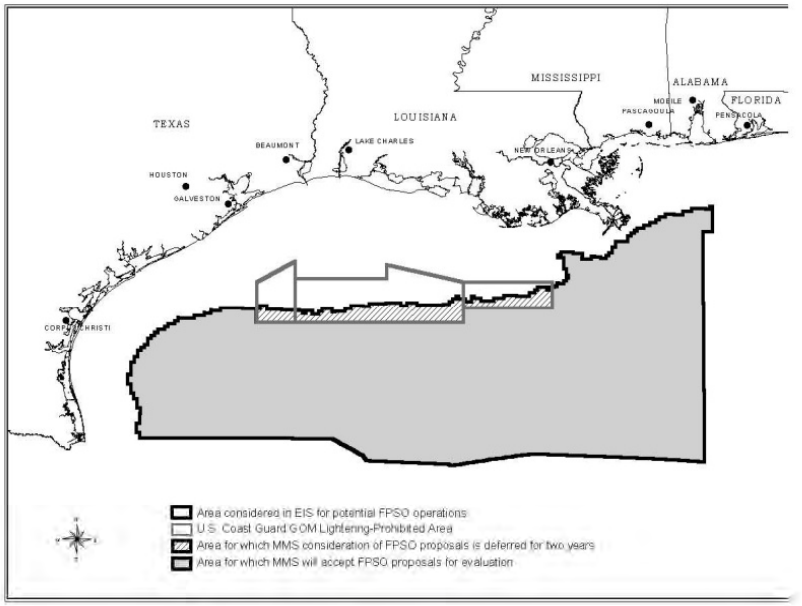
The MMS has worked closely with the Coast Guard to assess all aspects of FPSO's. The Coast Guard was an advisory agency in the preparation of the EIS and was heavily involved in the preparation of a comparative risk analysis (CRA) prepared under contract by Offshore Technology Research Center. The MMS-funded CRA was performed to compare the relative risks of an FPSO system with three other deepwater development systems: fixed platform production hub, a spar, and a tension leg platform. The overall intent of the CRA was to provide MMS context and perspective for FPSO risks, and to help in MMS decisions regarding the potential use of FPSO's in the Gulf. The CRA was also designed to help MMS understand the risk contributions of the various components (subsystems) and phases of operation.

Kallaur noted that, "MMS has a strong regulatory framework to evaluate the technical merits, including safety and environmental measures for an FPSO proposal. This was confirmed with the rigorous review that has occurred over the past two years."

The MMS gathered information from the international community to learn about FPSO systems during the early stages of the FPSO regulatory model development. Much of this effort was targeted at gaining a clear understanding of the historical operating experiences. This effort engaged representatives from all facets of offshore oil and gas development, including lease operators, contractors, consultants, classification societies, and regulatory agencies from numerous countries with FPSO developments. The domestic and international resources involved in this effort represent a significant segment of the world's deepwater experience and expertise in equipment design, construction, operation, and risk studies. The technical expertise and practical experience of the engineering personnel involved have allowed the successful development of a sound regulatory framework. Key components of this regulatory framework include the deepwater operations plan (NTL 2000-N06) and the development operations coordination document (30 CFR 250.204) with associated conservation reviews (NTL 2000-N05) and environmental reviews (NTL 2000-G21). Additional engineering reviews of the facility and safety systems will ensure the FPSO can operate safely. Once an FPSO system is installed, MMS inspectors will examine the facility on a routine basis.

For more information about FPSO's, including frequently asked questions, the EIS and the CRA, go to: http://www.gomr.mms.gov/homepg/offshore/fpsooffsh.html

MMS is the federal agency in the U.S. Department of the Interior that manages the nation's oil, natural gas, and other mineral resources on the outer continental shelf in federal offshore waters. The agency also collects, accounts for, and disburses mineral revenues from federal and Indian leases. These revenues totaled nearly $8 billion last year and more than $110 billion since the agency was created in 1962. Annually, nearly $1 billion from those revenues go into the Land and Water Conservation Fund for the acquisition and development of state and federal park and recreation lands.



-MMS-GOM-
MMS's Website Address: http://www.mms.gov
Return to News Releases

Note the expected areas for FPSOs and the lightering areas

Marine Safety & The Valdez Syndrome

Oil spills from tankers still loom large in the US public mind
– but simple prescriptions are available to prevent nightmares!

THE HOUSTON CHRONICLE ★★ INTERNATIONAL BUSINESS Thursday, January 17, 2008

Total fined in France's worst oil spill

For first time, court awards environmental case damages

By PIERRE-ANTOINE SOUCHARD
ASSOCIATED PRESS

PARIS — A court on Wednesday convicted Total in France's worst oil spill and ordered the petroleum giant and three other defendants to pay $285 million in compensation, the first time a French court has awarded damages for harming the environment.

The ruling found Total guilty of maritime pollution for shipping fuel in a rusty tanker that broke apart in a 1999 storm and stained 250 miles of coast with oil. Compensation was ordered paid to 101 civil parties, mainly associations involved in the cleanup or ecology groups.

The decision, coming after a four-month trial that ended last June, raised hopes among environmentalists that unseaworthy ships will be forced from international waters.

"The message is that a society that sends 'garbage boats' to sea must pay the consequences," said Dominique Voynet, a former environment minister and now a Green Party senator.

Ecology Minister Jean-Louis Borloo said the verdict "marks a very important step" by recognizing "the notion of an ecological harm resulting from an attack on the environment."

"The notion of responsibility is at the heart of sustainable development," Borloo said.

Far less punishing for Total was a $555,000 fine, the maximum for maritime pollution.

The court faulted Total for "carelessness" in leasing the 23-year-old Maltese-registered vessel Erika, which had sailed under eight names and numerous owners. Despite the ship's certification, the tanker bore "suspect shadowy zones of substantial corrosion," the court said.

Also convicted were Italian company Registro Italiano Navale, which inspected the vessel; the ship's Italian owner, Giuseppe Savarese; and Antonio Pollara, head of Italian company Panship, which was operating the vessel.

The verdict was less harsh than it might have been.

Total was acquitted of complicity in endangering people in the spill of 3 million gallons of oil that soiled miles of Atlantic beaches on the Brittany peninsula.

The fine and a share of the damages amount to small change for Total, which reported $4.64 billion in net profit in the third quarter of 2007. Nevertheless, Total's lawyer, Daniel Soulez-Lariviere, said he would counsel the company to appeal.

Later Wednesday, Total suggested it was studying whether to appeal the case. It has 10 days to do so.

"The charterer is not responsible for inspecting and classifying vessels," a Total statement said.

Ten defendants were acquitted, including the Indian captain of the Erika, Karun Mathur.

The case followed a tortuous path through the courts and growing anger toward Total over a spill that killed up to 75,000 birds. Demonstrators dumped dead, oil-coated birds at the company's Paris headquarters and massed as many as 20,000 people in protests.

On Dec. 12, 1999, rough seas tore at the tanker, which was carrying fuel oil owned by a unit of Total. The Erika split in two and eventually sank about 40 miles off Brittany.

France's Bureau of Inquiries into Sea Accidents blamed lack of maintenance and corrosion aboard the tanker as the main causes of the spill.

MICHEL EULER : ASSOCIATED PRESS

COMPANY CONVICTED: Total's lawyer, Daniel Soulez-Lariviere, reacts after the verdict in the Erika trial in Paris on Wednesday.

Marine industry best practices are very safe - hundreds of millions of barrels "on the water" every day worldwide, about 6 mmbbl/day imported into US.

The Two Linked & Ongoing Debates: "The Coming Shoot-out at the LT Corral"

Transportation Choices

Pipeline

OR

Shuttle Tanker OR FSO + Shuttle Tankers

OR Hiload + Conventional Tankers

But: Aggregation risks:

+ Lining up multiple developments for an area wide pipeline export system is tough, a risk;
+ Incrementally easier with tankers.

AND: Facility Choices

Semisubmersible or Spar

+ Drilling from the Platform
+ Mostly dry trees with a few subsea tiebacks
+ "Fixed" platform

OR

FPSO

+ Disconnectable
+ All subsea completions

The Two Linked & Ongoing Debates: Facility and Transportation

Facility Two main options:-

(a) Semisubmersible or Spar

Not disconnectable

Without storage

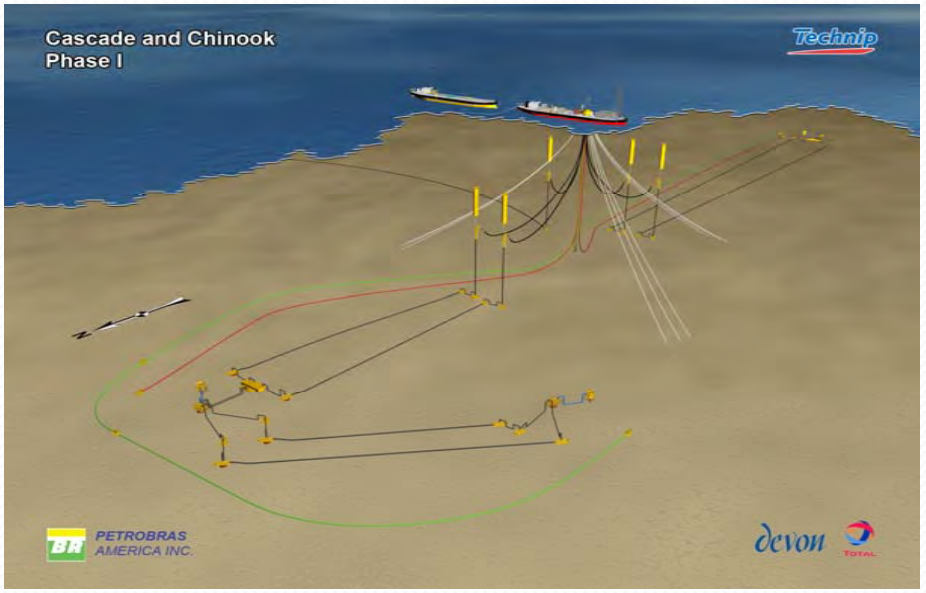
Example: *Independence Hub*, entered service 2008

(b) FPSO

Disconnectable

With storage

Example: *Cascade/Chinook* enters service 2010



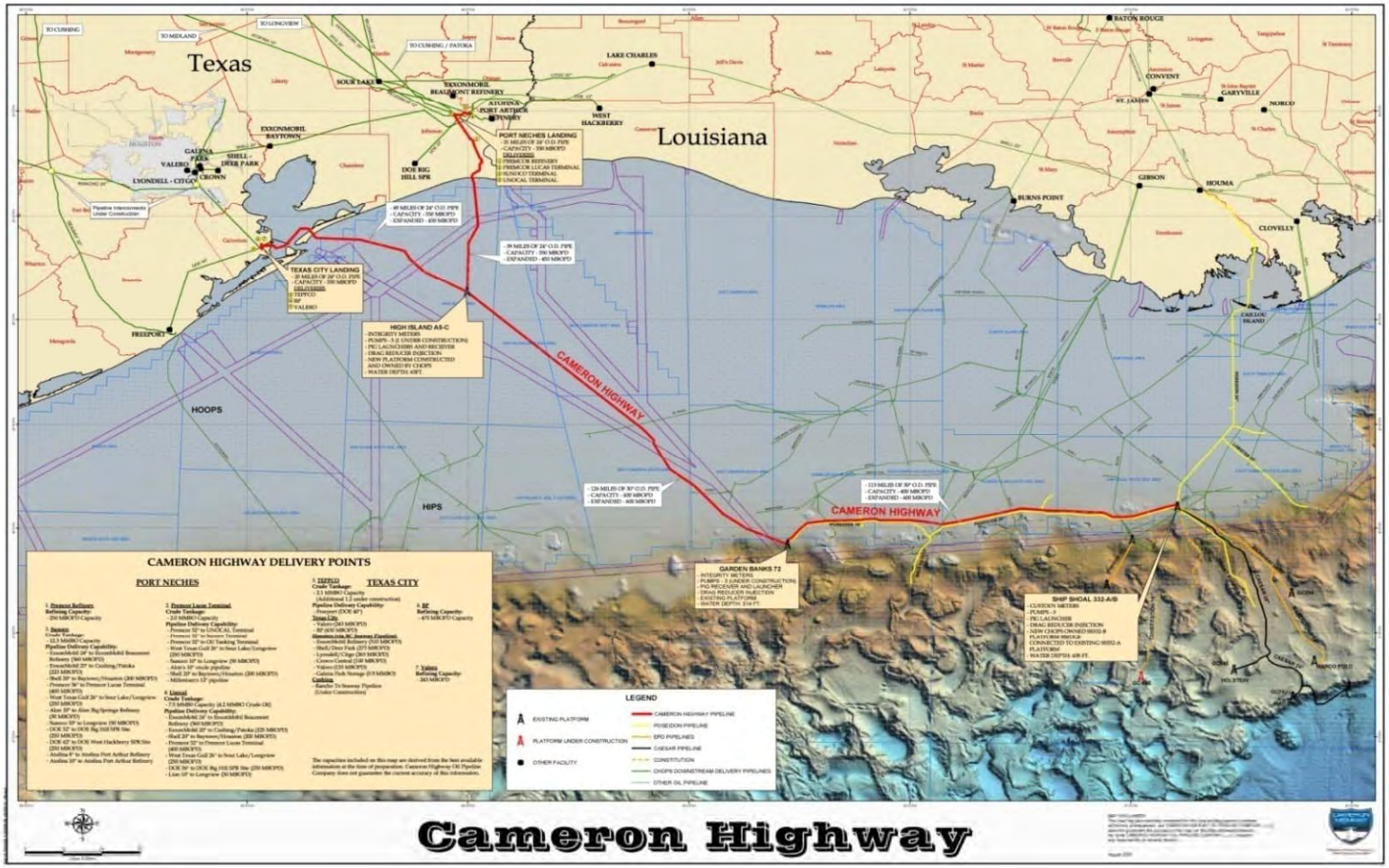
Probable FPSO Locations
Lower Tertiary Discoveries in WR & KC

Transportation: Existing pipelines come close to some discoveries; Shuttle tankers can easily reach all locations.

Shuttle Tankers Face Serious Pipeline Competition

Shipping lanes are already well travelled by lightering tankers.

Many pipeline breaks occurred in the 2005 hurricane season - in an emergency shuttle tankers could deliver to East Coast refineries, e.g. Philadelphia.



Flat

Mountains of the moon!

Special Requirements for Shuttle Tankers in GoM

US law requires shuttle tankers to be Jones Act compliant:
- US built, 75+% US owned,
- US crewed,

and OPA 90 compliant (double hull);

Port drafts dictate maximum 40 ft. draft, hence maximum of about 550,000 bbl capacity;

Current limited market for shuttle tanker service demands backup trade, hence use of tankers that can work in the products trade, i.e. about 330,000 bbl capacity.

Additional features:
- Bow Loading System,
- Added maneuverability for maximum safety: CPP / Thrusters / DP2

GoM Shuttle Tankers Compared to North Sea Precedent

Two time charters signed August 2007 by Petrobras America with OSG America for shuttle tanker service at *Cascade/Chinook*.

Region	Typical capacity, bbl	Constraint on where built	Max. draft at port	Design features	Hold off tug?
North Sea	up to 1,000,000	None	No limit	DH, BLS, DP2	No
US GoM at *Cascade / Chinook*	340,000	US only	40 feet	DH, not DP, but bow thrusters, CPP	Yes

Despite their small size, "low tech" design and relatively short charter period, shuttle tankers in GoM proved competitive economically.

The Merchant Marine Act of 1920 (The "Jones Act")

Senator Wesley Livsey Jones (1863-1932), Republican from the state of Washington, author of the Jones Act, intended to protect his state's trade with Alaska. Jones served five terms in the House of Representatives and then 22 years in the U.S. Senate.

a. The Jones Act applies to ships engaged in coastwise trade: a production platform is considered a US port, not subject to the Jones Act.

b. From the protectionist era of the 1920s, through wartime objectives, the Jones Act has evolved in 2009 to have a powerful alliance of lobbies, e.g. shipyards, ship owners, pipelines, truckers, railroads, unions.

c. There are attempts about every ten years to do away with the Jones Act – it is said to cost the country $10billion per year – but none has succeeded. Last attempt was in 2001 by Senator John McCain, trying to eliminate waste in the marine industry (Marad and Jones Act).

Politically Expedient in US to Support the Jones Act

"America needs a strong and vibrant US Flag Merchant Marine. That is why you … can continue to count on me to support the Jones Act (which also includes the Passenger Vessel Services Act) and the continued exclusion of maritime services in international trade agreements."

Barack Obama, August 28, 2008

"The United States needs a maritime policy tailored to 21st century needs. Programs that have contributed to the growth of our domestic fleet, such as the Jones Act … should be maintained."

President George W. Bush, 2004

"My Administration … continues to support the Jones Act as essential to the maintenance of the nation's commercial and defense maritime interests."

President William J. Clinton, 1997

"Sealift is essential to both executing this country's forward defense strategy and to maintaining a wartime economy… . [T]he U.S.-owned commercial ocean carrier industry … will be relied upon to provide sealift in peace, crisis and war."

President George H.W. Bush, 1989

Limited US Commercial Shipbuilding Capacity

Traditionally US commercial shipbuilding has been very expensive (2.5+ times Far East) and that is still true in 2009.

Delivery time has historically been unreliable and usually late.

In 2008-2009 that has all changed at Aker Philadelphia shipyard: a complete yard rebuild, plus changes in management of operations down to shop level with full labor cooperation.

US built tankers can now be delivered on a schedule set years in advance, to the nearest week, just like Korea: important for offshore production.

Shuttle Tankers in GoM - History

Demand Side

2000-2001 Consideration of FSO, FPSO and shuttle tankers for *Mardi Gras* complex;

2002-2006 Several inquiries for shuttle tankers in competition to existing pipeline offerings. *Magnolia* and *Perdido* were the most serious. Word on the street was that shuttle tankers helped oil companies hammer down the pipeliners' rates!

First competitive bidding for *Cascade/Chinook* development.

Supply Side

2001 Conoco's Seahorse Shuttling LLC formed;

2001 Navion Shuttle Tankers from North Sea "tests the waters";

Navion/Skaugen form American Shuttle Tankers LLC;

2005 Teekay completes acquisition of American Shuttle Tankers, then in effect abandons this business;

First time charters for 5+1+1+1 and 4+1+1+1 for shuttle tankers.

2010 First shuttle tanker enters service in US GoM.

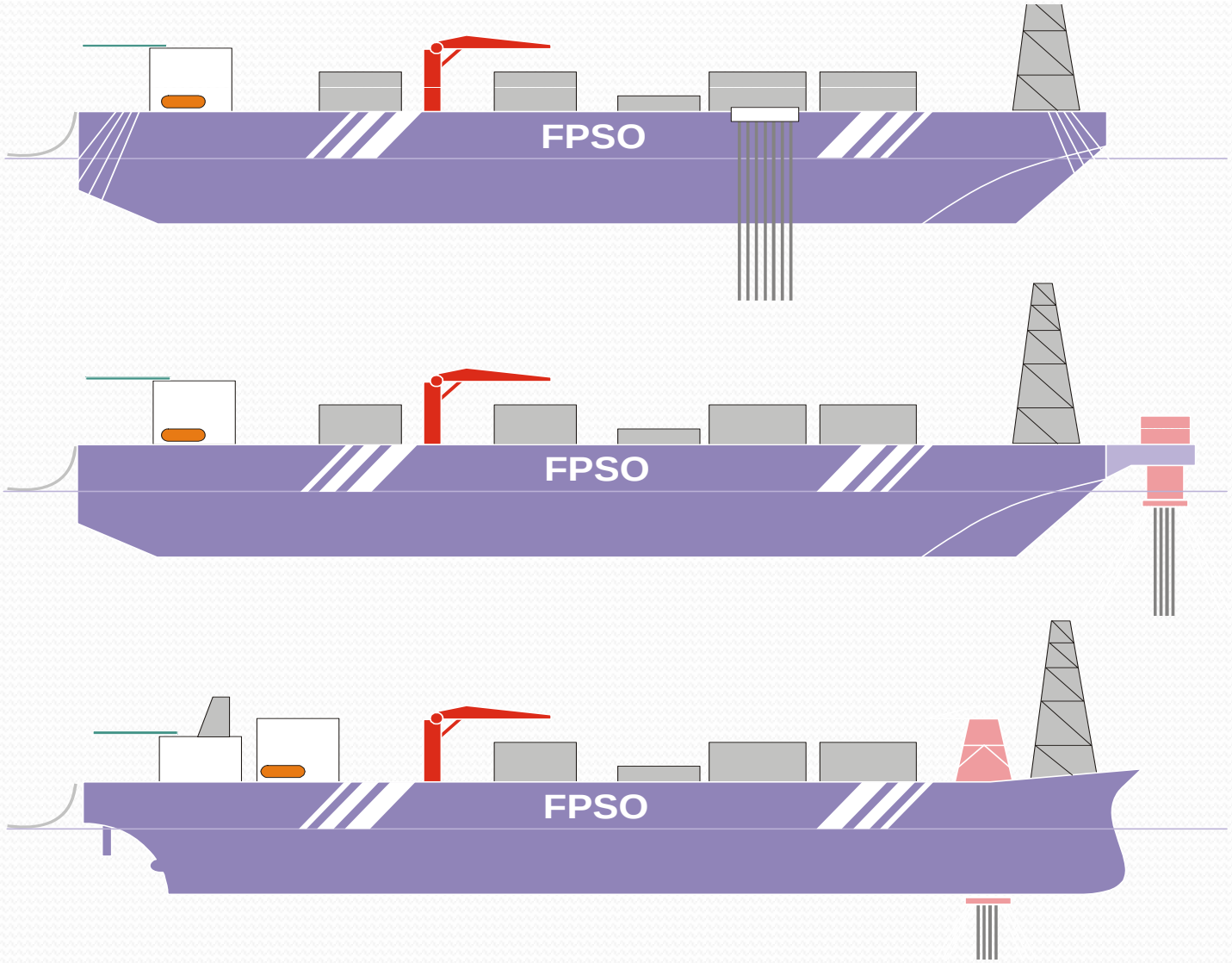
FPSO Export by Tanker in GoM
Generally similar to elsewhere in world

The closest to “rocket science” in the FPSO business

Like North Sea, US GoM operations employ shuttle tankers on short trips from FPSO to refineries and back.

Shown is back up hawser mooring to shuttle tanker while loading (black hose)

Applicable FPSO Configurations in GoM
Full Field Development (FFD)

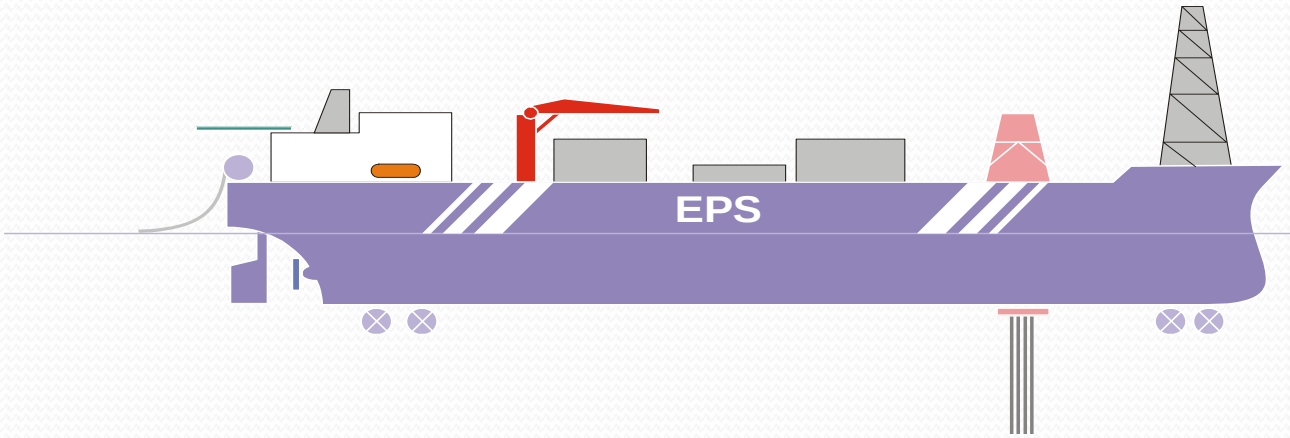


Spread moored, risers over the side, converted tanker (NO)

Custom built newbuild, shown with external turret (YES, disconnectable)

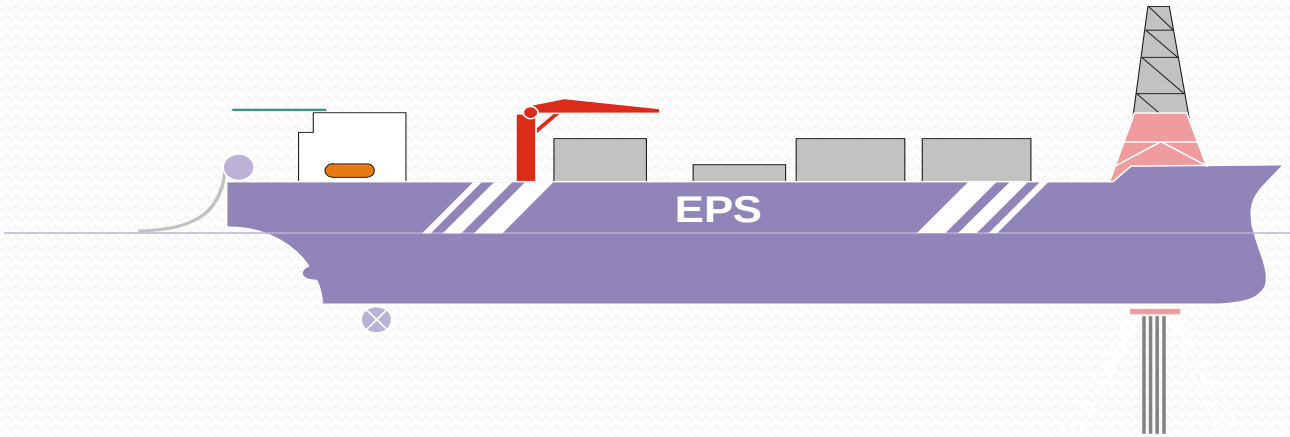
Converted tanker with internal turret (YES, disconnectable)

FPSO Configurations for GoM: Extended Well Test (EWT) or Early Production System (EPS)



Dynamically positioned hull (thrusters fore and aft), single drillpipe riser in moonpool for EWT service.

Example: *Seillean* offshore Brazil, 1990 to date.



Moored hull via internal turret, multiple risers via turret, possibly aft thruster, for EPS service.

Example: *BW Pioneer*, 2010 in GoM

Disconnectability after Katrina and Rita in 2005

a. In 2001 the EIS assumed permanent mooring of FPSOs;

b. A DeepStar paper at OTC in May 2005 had talked of permanently moored FPSOs in GoM as "state of the art". Never again!

c. In 2005 along came hurricanes Katrina and Rita, wreaking wide destruction of platforms, pipelines and onshore facilities, worse than ever seen by the US offshore industry:

+ Many MODUs adrift;
+ One knocked over a TLP;
+ The idea of a MODU colliding with an oil laden FPSO conjured up disaster and nightmare;

d. Everyone agreed disconnectable FPSOs were now necessary;

e. Design codes were revised in 2007 for harsher metocean conditions;

Design Conditions at First FPSO in GoM

FPSO and systems designed for 100 year winter storm;

Disconnectable FPSO: Time to disconnect and sailing speed must be sufficient to move away from the path of a hurricane that may be born in the GoM;

Target: disconnect in <1 hr. at design wave height of 4.5 meters. Riser excursion limit may govern some disconnects.

<u>Internal Turret</u>

5 Free standing hybrid risers
- 4 Production
- 1 Gas Export line

4 Catenary umbilicals;

Tandem Offloading;

Producing from two fields;

250 miles from New Orleans.

Contracting the First FPSO in US GoM

Lease signed in August 2007;

BW Pioneer is due to start production at the Petrobras operated *Cascade/Chinook* development in US GoM in May 2010.

Cascade is 50:50 Petrobras:Devon, *Chinook* is 2/3:1/3 Petrobras:Total

BW Pioneer shown under construction in Singapore in 1Q09:

+ 600,000 bbl storage,

+ 80,000 bopd production,

+ Export: Shuttle tankers for oil, pipeline for associated gas.

Achievements for the First FPSO in GoM

The FPSO at *Cascade/Chinook* is an Early Production System (EPS), to gain production experience in the Lower Tertiary;

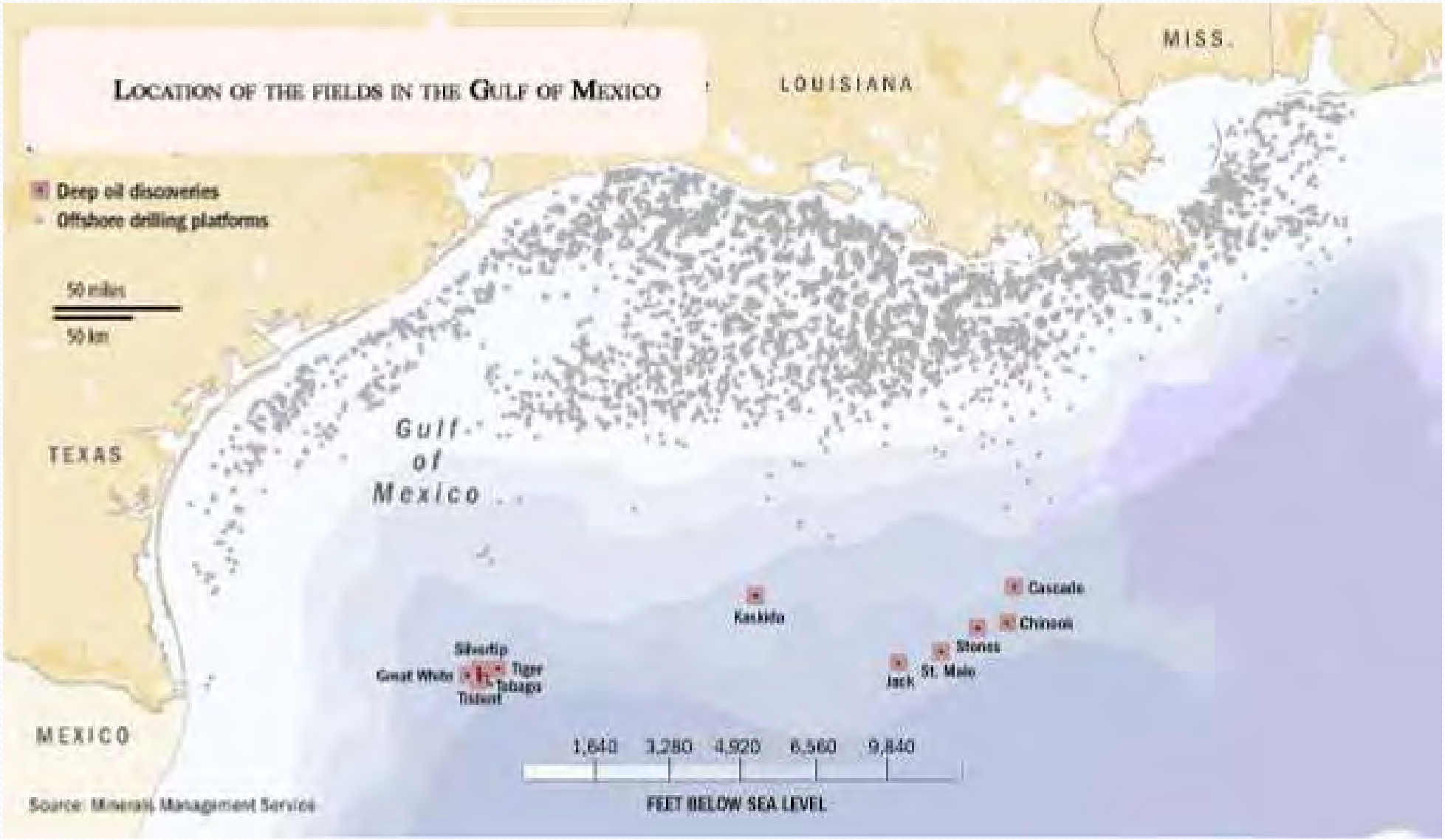
A full field development solution not yet decided, not necessarily an FPSO;

An FPSO record of 8,200 ft. water depth;

Coincident with this commitment is the first use of Jones Act shuttle tankers In GOM;

Other operators are now starting to consider FPSOs seriously for remote deep waters of GoM.

Location of the First FPSO in US GoM



The Star of the Show – What All the Fuss is About!

So What's Ahead for FPSOs in GoM?

Disconnectable. Run before storms like in Far East. Becomes easier to modify, expand or maintain;

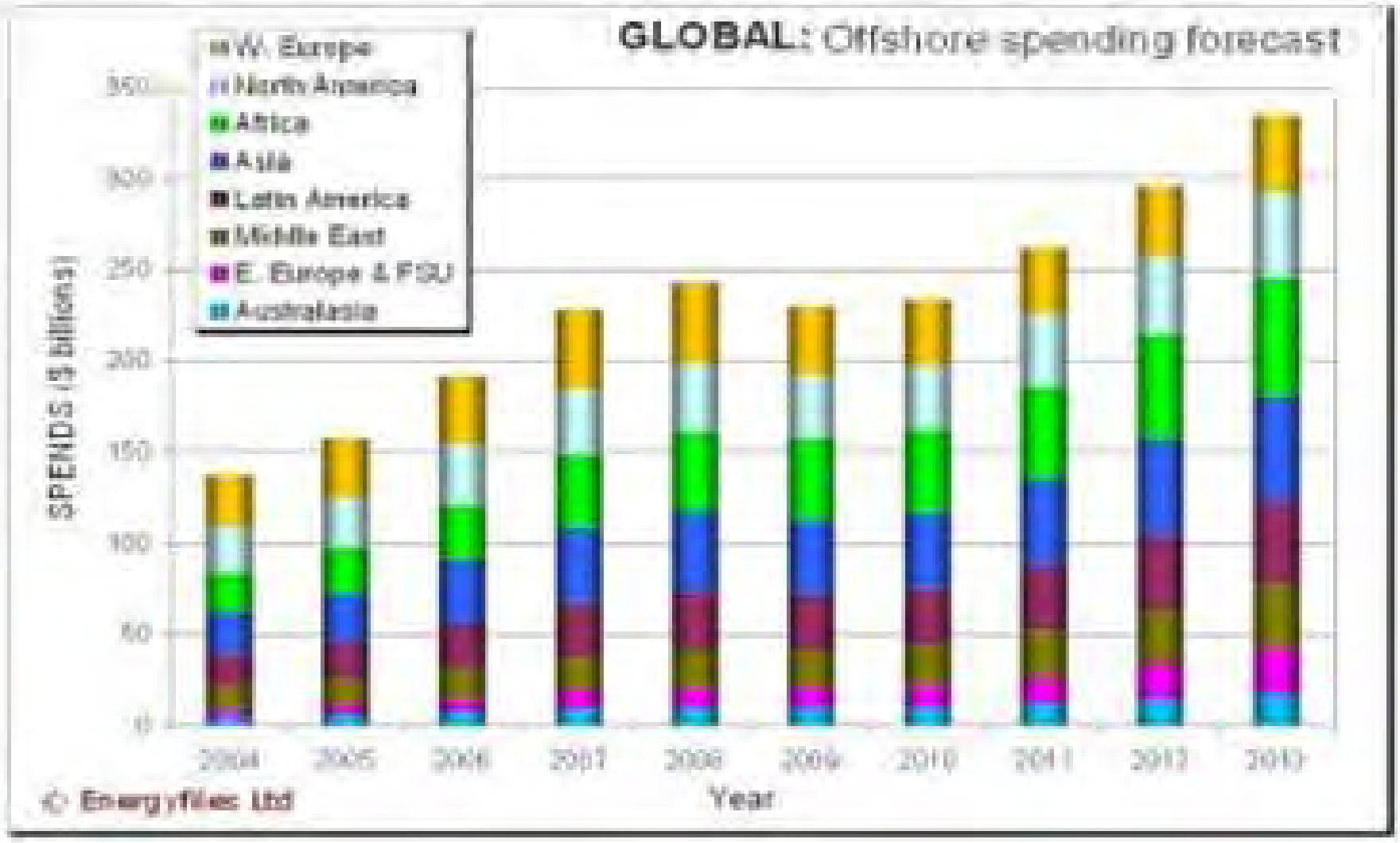
Long field life, e.g. Lower Tertiary fields may produce for as long as 30-50 years, i.e. about double past field lives. Important effect on facility design and on exposure to extreme storm events;

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

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

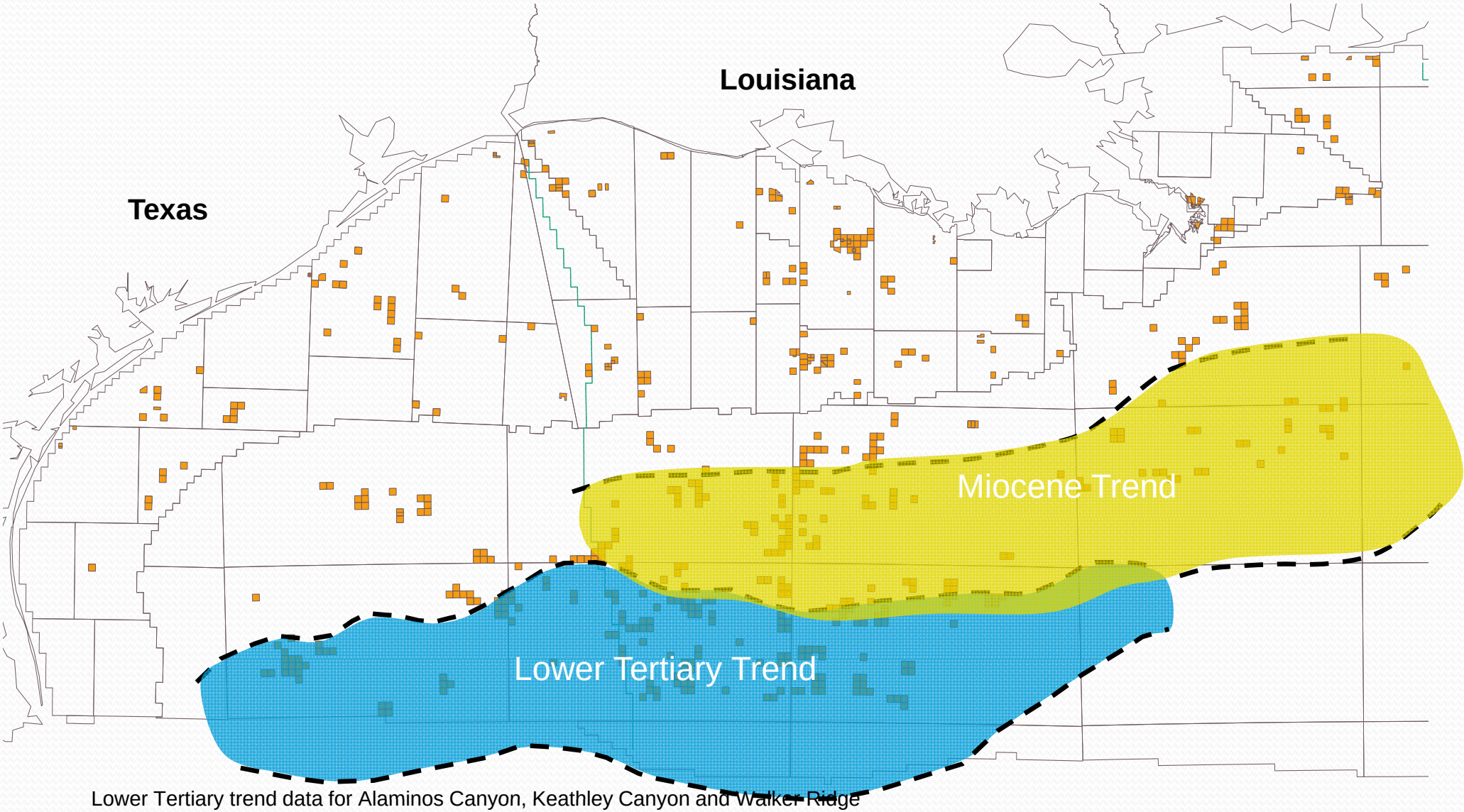
Pressure to cut the cycle time to improve economics is countered by risks of reservoirs performing differently from expectations (timing on a firm FPSO contract less clear than before);

The Trend is Up for GoM too



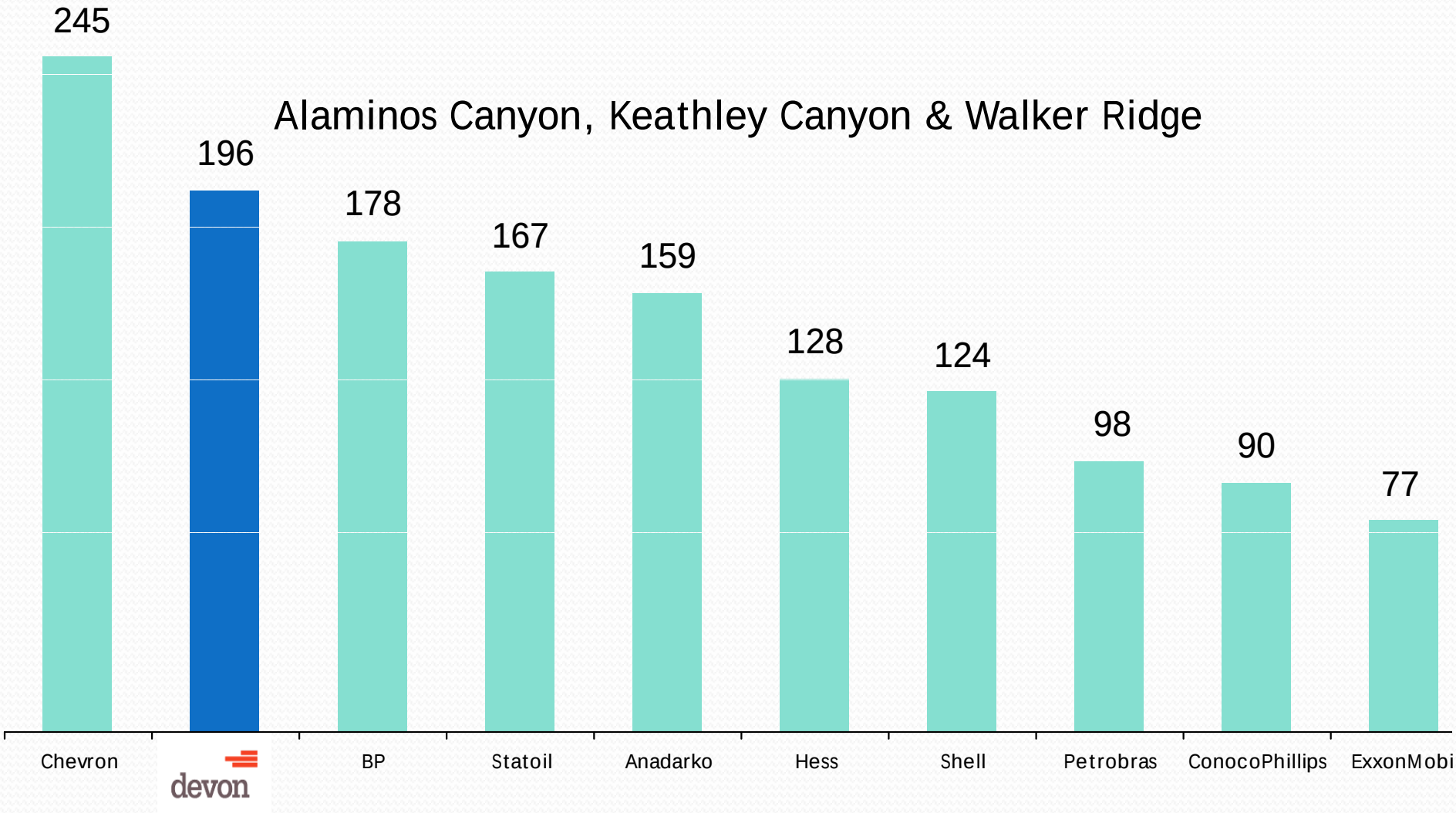
Source: Douglas Westwood

Today's Deepwater Gulf of Mexico: Exploration in Lower Tertiary Trend May be Conducive for FPSOs



Lower Tertiary trend data for Alaminos Canyon, Keathley Canyon and Walker Ridge
Miocene trend data for East Breaks, Garden Banks, Green Canyon, Atwater Valley, Mississippi Canyon

Lower Tertiary Block Ownership
Not a traditional line up for a frontier



Source: Devon, OWL Database ©1991-2007, Lexco Data Systems, Inc. – August 2008

Key Messages from the Lower Tertiary

i. Technical and financial risks for field developments are very high. BP's record *Tiber* discovery in Keathley Canyon was a 35,000+ ft. well. Simultaneous drilling of an appraisal well at *Kaskida* nearby was almost as deep and $250+million;

ii. Two thirds of field development investment being in drilling changes drives development strategy more;

iii. New field development flexibility desired to mitigate these risks, e.g. can an FPSO enable an earlier and lower risk start, yet not degrade economics?

iv. Arriving at a sanctionable development solution is taking longer than often expected, e.g. *Jack St. Malo*, *Kaskida;*

v. Producibility risks can demand dry trees and rule out FPSOs;

vi. Export economics are more important in these remote locations;

vii. Not much chance of FPSOs in GoM other than in deep remote waters of Lower Tertiary.

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, might 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;

e. Despite the ebb and flow of business since the 1940s, GoM based oil companies do remain a key influence in the worldwide market, and do seriously contemplate FPSOs for outside GoM waters;

f. FPSOs are now considered more than ever for GoM, but another FPSO after *BW Pioneer* is not a sure thing.

Thank you

Questions?

For more on the documents, presentations & history leading to the acceptance of FPSOs in GoM this link can help:
www.lovie.org/fpso.html

Similarly for more on shuttle tankers in GoM, please refer to:
www.lovie.org/shuttle.html

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