

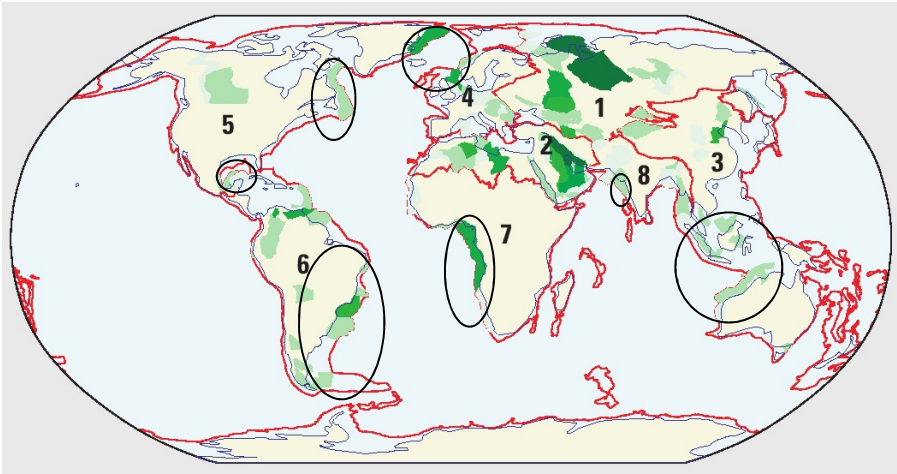
FPSOs – Key Regional Differences and Trends

Paris, Dec 2016

Agenda: FPSO Regional Differences and trends

- Industry Overview
- Key Design Drivers
- Regional Differences and Examples
- FPSO Market place and Future Industry Trends
- Conclusions

Global Reserves – USGS world oil endowment



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FPSO Regional Differences and Trends

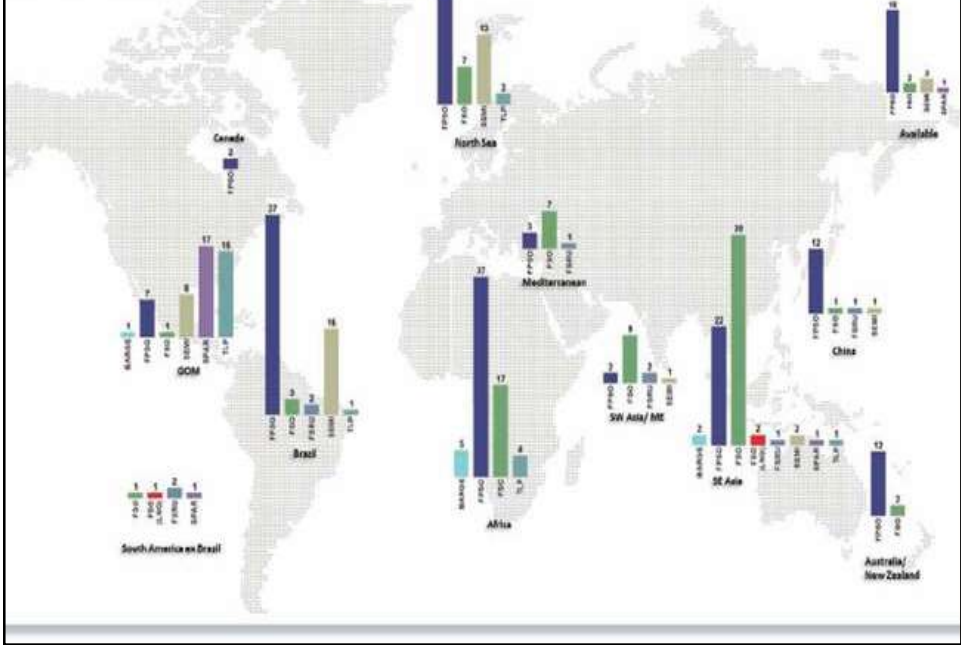
FPSO
FOCUS AREAS

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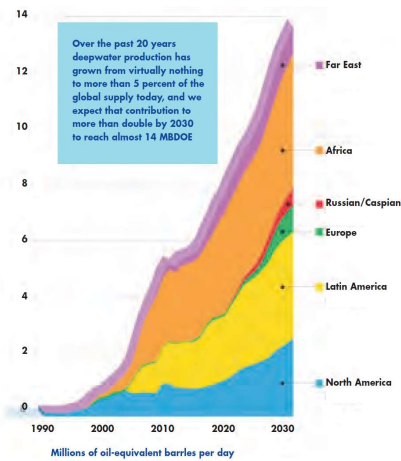
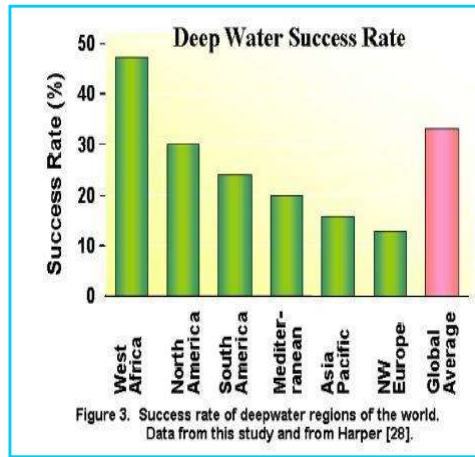
USA Data omitted

DLC

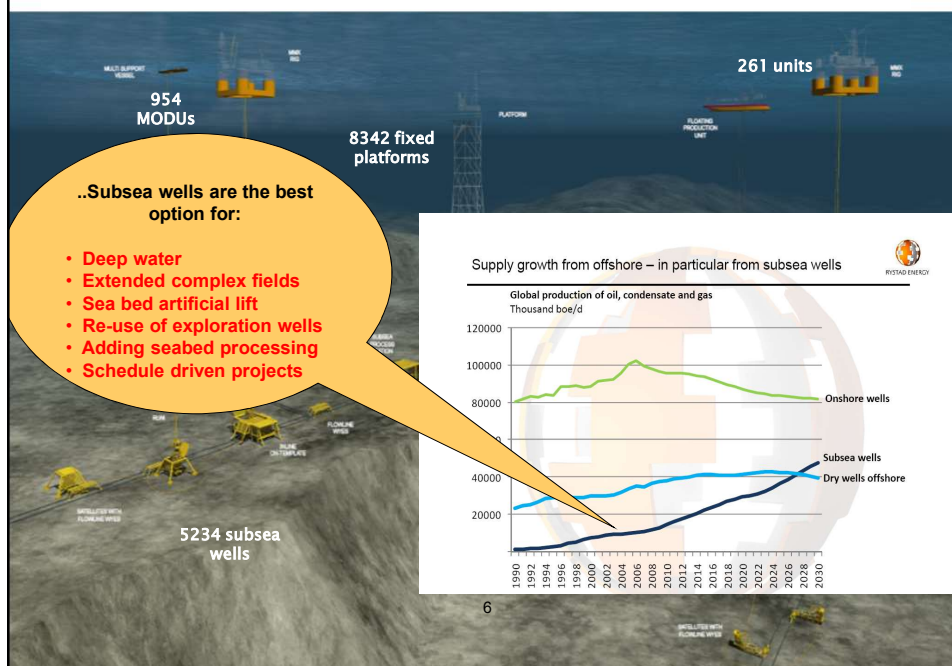
Fig 27. Global Distribution of Installed Units by Type
(165 FPSOs)



Deepwater – High Success Rates



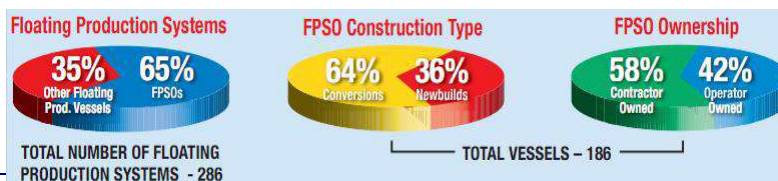
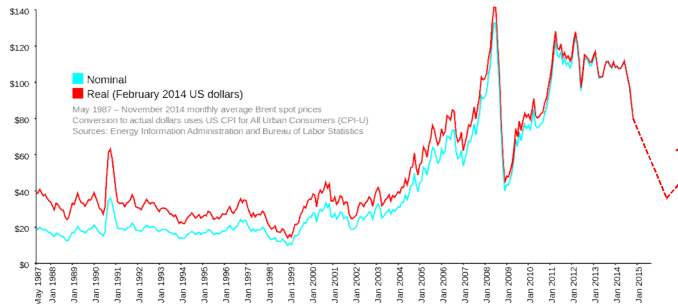
Why is Floating production becoming so Important?



Industry Overview – Floating Production



- Last decade:
stable average annual
growth 5% – 10%
until 2015

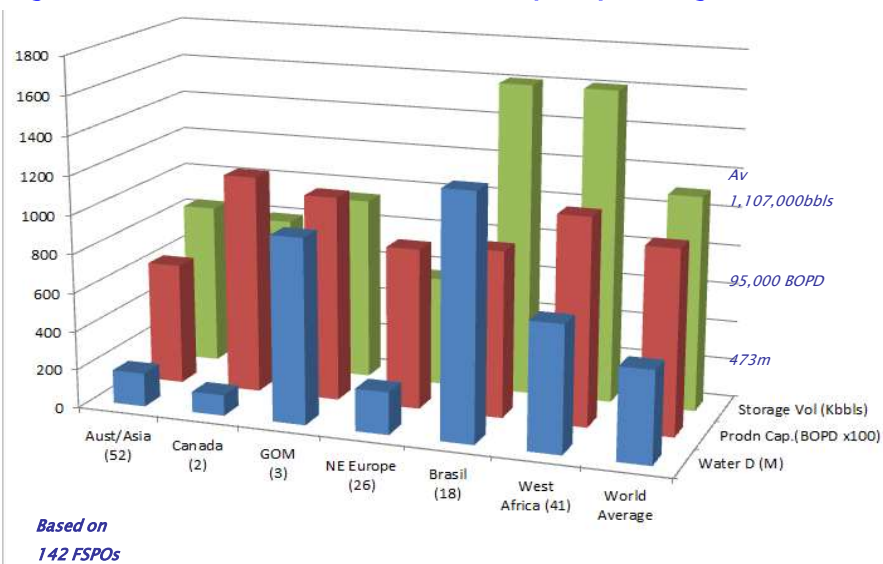


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Regional differences – WD, Production Capacity, Storage



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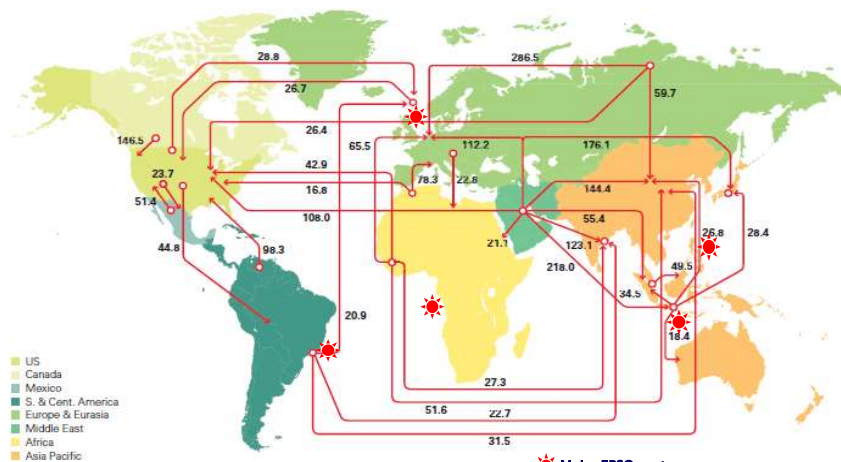
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FPSO Industry Overview – Summary

- Deepwater exploitation since the 90's has been funded by an increasing oil price
- Discoveries have demanded a flexible and robust production solution
- Subsea wells have been the preferred reservoir development option
- Oil and Gas Pipeline infrastructure in these new areas is limited
- The FPSO has been the most attractive solution because it provides:
 - a flexible, adaptable system that can act as a pipeline and a processing platform
 - low cost "offshore real estate" that can be reused elsewhere
 - opportunities for fast track projects, and large or small developments
 - choice of low tech / high tech process options (inc. FLNG).
- FPSOs are producing between 11 and 14% of world oil.

Design Drivers – Storage volumes

Major trade movements 2012
Trade flows worldwide (trillion barrels)

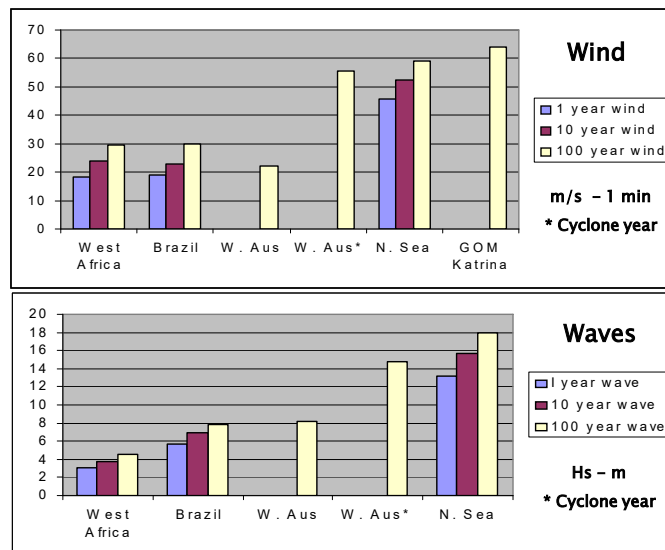


Major FPSO centre

1 FPSO @ 100mBOD = 5M tons/yr

2Mbbbl tanker = 0.3M tons

Design Drivers: Metocean



Regional Operating Differences



	Metoccean	Water Depth	Infrastructure	Crude Export	Regulatory	Other
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West of Shetland – Q 204



- 100 miles West of Shetland
- W.D. = 250 to 600m
- 2 FPSO's + 3 Shuttle Tankers
- 9 Drill Centres
- Biggest Subsea Development in the UKCS
- Schiehallion/Loyal/Foinaven – 1998 start-up
- Harsh Environment

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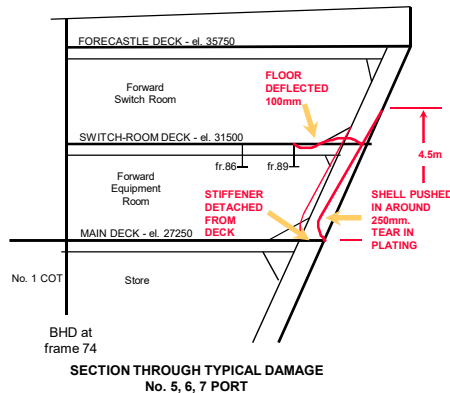
West of Shetland Lessons learned



Harsh Weather Damage – North Sea

Bow slamming (old Schiehallion)

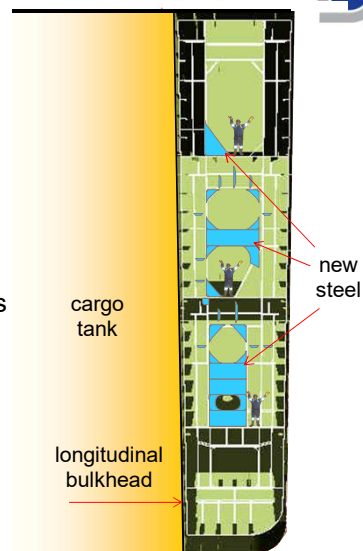
- Wave damage to forecastle in 1998
- Significant lost production for repair



Structural repairs in Service

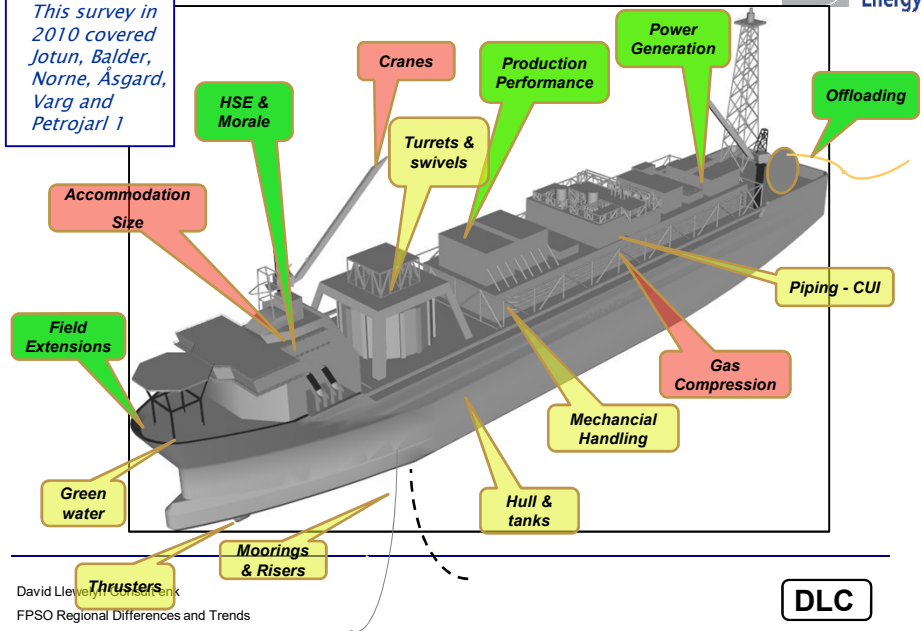
Repair scope

- Major in-service repair - 33 frames >400t steel
- 25 man team 2003 onwards
- Approx \$170m OPEX cost
- FPSO being replaced 2015

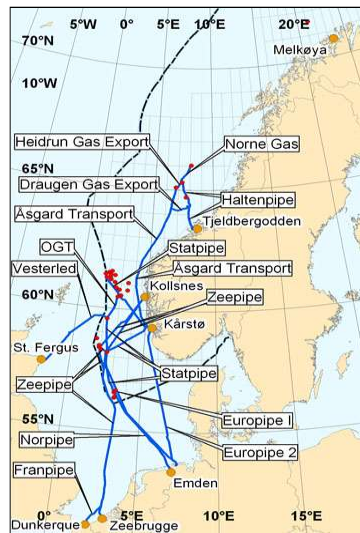


10 years Norwegian FPSO Experience vs Expectations

This survey in 2010 covered Jotun, Balder, Norne, Åsgard, Varg and Petrojarl 1

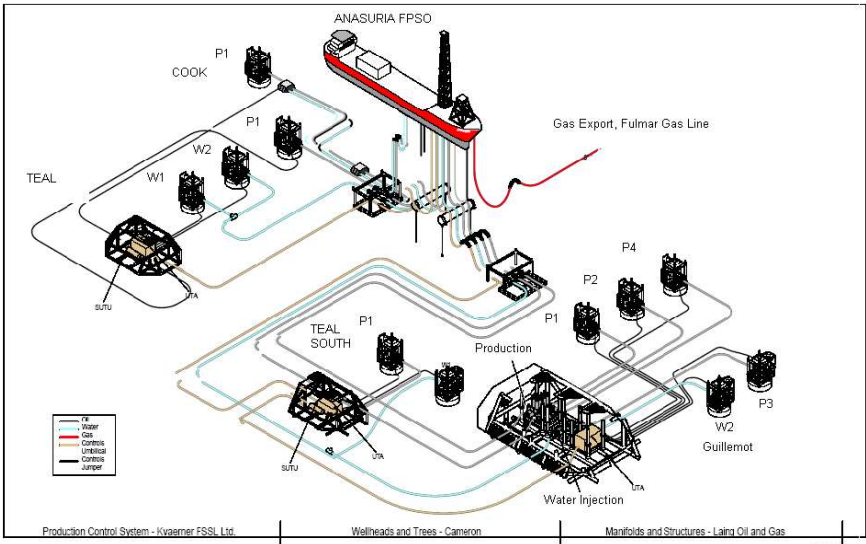


Gas Market Maturity –Europe



- Extensive Network of Pipelines
- Increasing gas prices
- Able to hook-up gas export system
- Combined gas lift – fuel gas – gas export compression train
- Requires sales quality gas+metering

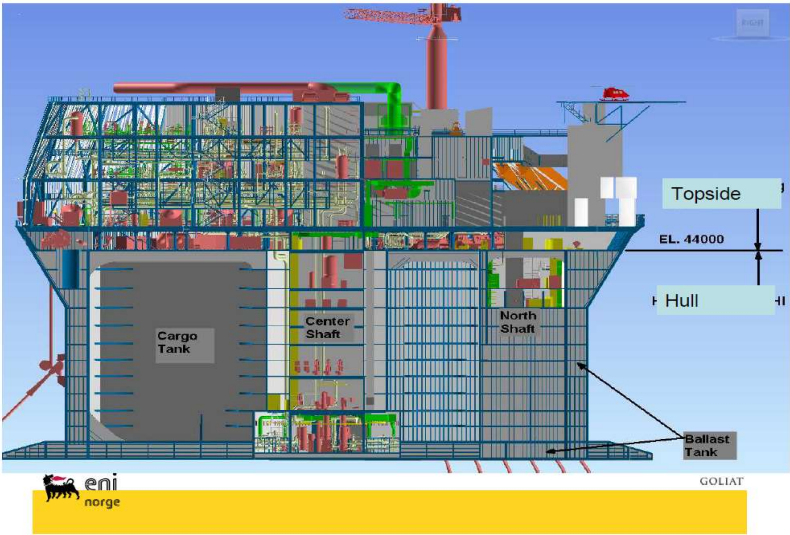
Anasuria – Typical N Sea Field



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Barents sea FPSO – Goliat (71° N)



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Goliat with full winterisation – ready to go!



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Regional Operating Differences

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West African Reservoirs



- ❑ Dominated by 3 ancient river basins – Niger, Congo & Kwanza
- ❑ Large sandstone and turbidite reservoir layers
- ❑ Deep water but some Shallow Reservoirs
- ❑ High-angle drilling & multiple drill centres
- ❑ Large areal extent = many wells

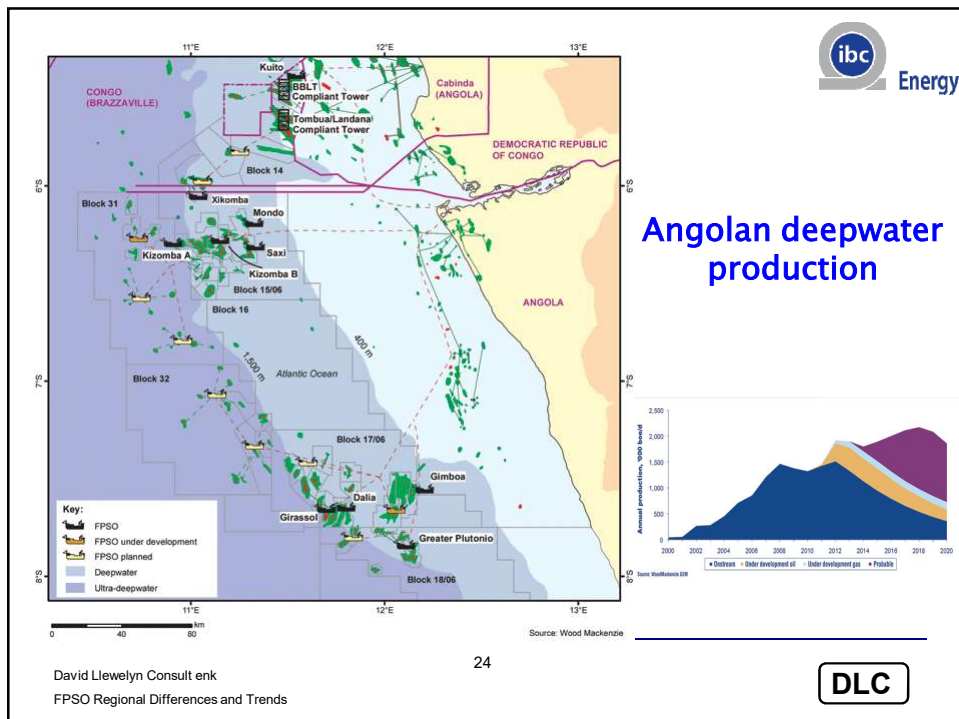


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Image: PCS

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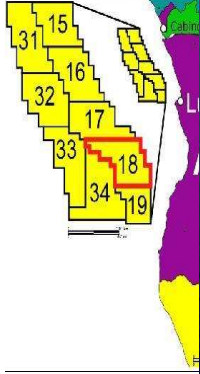
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Deepwater Giant Field – Greater Plutonio

Rate: 220 mbod, WD 1500m, Storage 2M bbls



BP's Cesio-1 Discover
Block 18, Angola



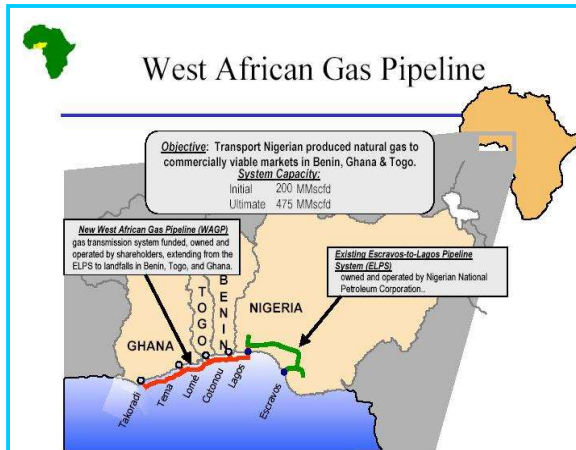
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Image: BP

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Proposed Major regional gas pipelines



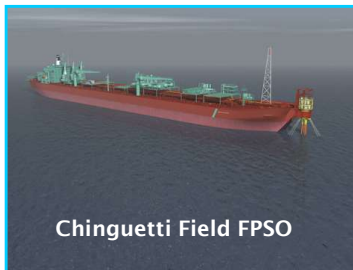
However in Angola the state owns the gas....and is converting it to LNG

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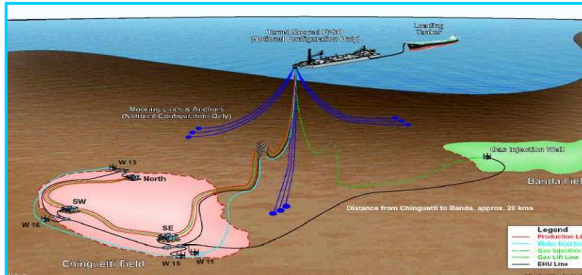
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Mauritania – a new deepwater frontier?



Chinguetti Field FPSO



Reserves: 123 MM
downgraded to 53MM

Depth: 500 m

Tie backs now
underway Current
prodn c 8k BOPD

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The First FDPSO



Azurite FDPSO

WD: 1400m

Capacity: 40,000 bbl/d

Gas capacity: 18 mmscfd

Storage 1,350,000 bbl

Mooring: Spread

Location/field: Congo

Customer: Murphy

Now out of work!

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Local Content in West Africa

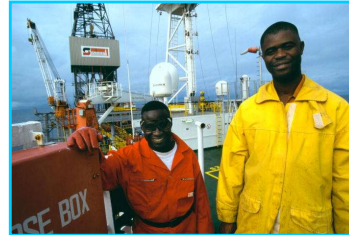


What is local content?

- ❑ Based on legislation and policy
- ❑ Responsibility of *Licensee/Contractors*
- ❑ Necessitates Investment, Training & employment
- ❑ Involves in-country company registration
- ❑ Considers local & community benefits
- ❑ Can be up to 50% of new contracts
- ❑ New integration yard proposed for Lagos

Assessed in terms of national interest & value created!

Gas may be considered a National asset

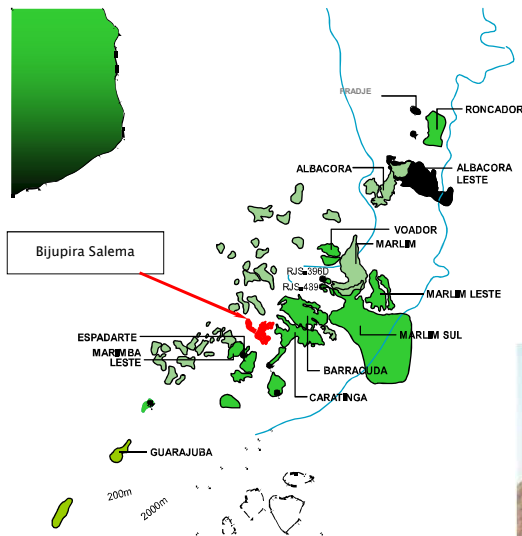


Regional Operating Differences



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Offshore Brasil – Campos Basin



- Mature deepwater province
- Sloping seabed 200 –3000m wd
- Only Petrobras Ops pre 2002
- Multiple DW solutions
17 FPSOs, 20 semis
- Gas pipeline/ shuttle T. export



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Bijupira Salema – Fluminense



Singapore – Mar 2003
First Non Petrobras Production in Brasil (70MBD 600mwd, 1.1Mbbls)



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Lost cost Option – Sevan/Teekay SSP



Significant Cost savings available

Why?

- ☐ Simple process (first 2 units)
- ☐ Straightforward to Construct
- ☐ No turret / swivel
- ☐ Low POB (crew of 28)

Uncertainties:

- ☐ Motions
- ☐ Offloading
- ☐ Operability

**4 units contracted
Construction options for 14 more secured**



Sevan's SSP – on location



Brasil, New discoveries – more FPSOs



FPSOs for Pre-salt – start 2012

+ 15 for Petrobras

(partners BG/Galp/Repsol)

ExxonMobil

– Oil discoveries in Santos Basin. Azulão field. Expected reserves 5–8 billion boe

CHEVRON

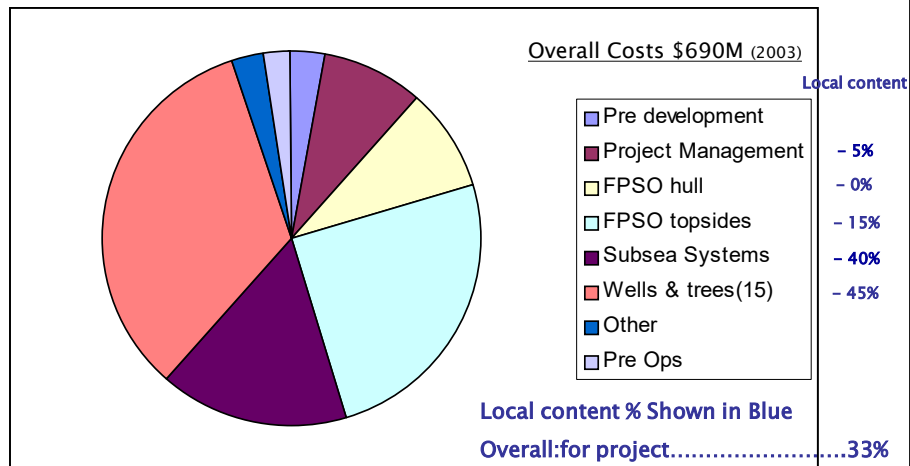
– Frade, Maromba, Papa Terra, Atlanta and Oliva fields.

Reserves above 2 billion boe

Further discoveries in Santos Basin – may increase reserves from 13 to 55 billion boe



Typical Brasil Project Cost Breakdown and Locan Content – Conversion



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Cossak Pioneer – Disconnectable Turret



Operator – Woodside: av production 78 mbd (1995 until 2011)

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Belanak FPSO– Condensate and LPG production



Processing capacity: 100,000 b/d of oil/ condensate/ LPG, with up to 50,000 b/d of produced water
Storage capacity 1mm bbls (ConocoPhillips)

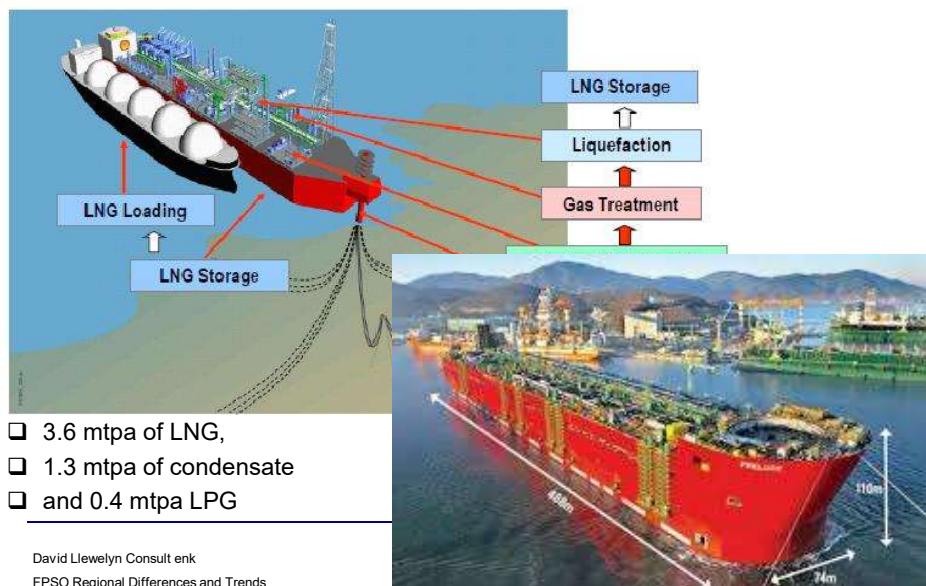
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Prelude FLNG – Shell (FID 2011 – S/up 2017)

5.3 million tonnes per annum (mtpa) of liquids:



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Regional Operating Differences



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Terra Nova – Suncor



- 125 MBOD
- 1mmbbls
- 100m wd
- Protected wells
- Disconnectable
- Ice strengthened tankers

+ White Rose
(Huskey)

Regional Operating Differences



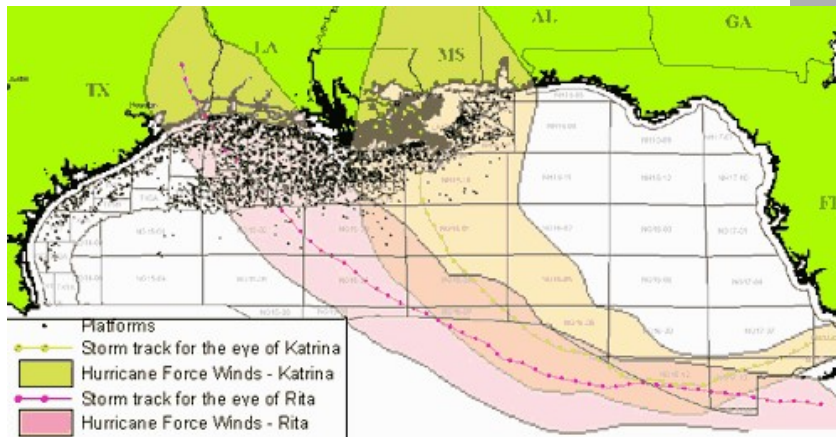
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	DW tertiary, Disconn. Turret, Db/Hull, Gas export, Jones Act Shuttles					

Gulf of Mexico



- ← Impact of Hurricane Katrina
- Disconnectable FPSOs are advisable
 - Offloading to US built STs (Jones Act)
 - Gas Export reqd

Gulf of Mexico Hurricanes



- Storm track relatively narrow 200miles wide
- Allows 36 hr release decision (24 hrs release – 12hrs transit)

The latest step forward in the GOM



BW Pioneer (Su Apr 2012)

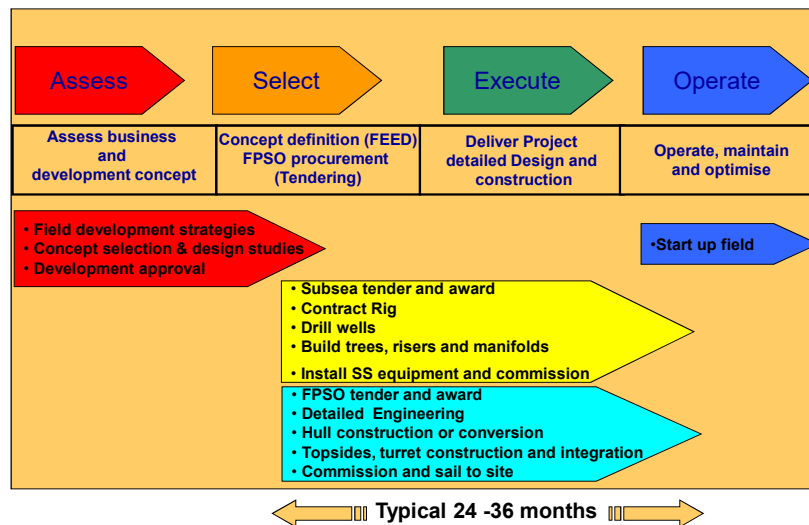
- Storage 600kbbbls
- Design 80k bopd
- Gas export 16mmscfd
- WD 2600m
- APL disconnectable turret

Regional Operating Differences



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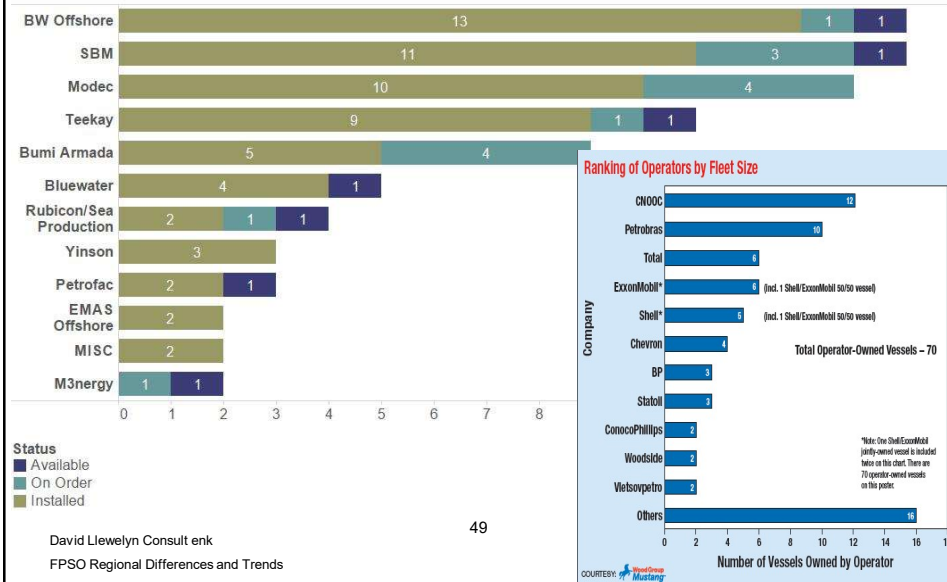
Another reason FPSOs are all different !



FPSO Ownership Comparisons (2014)

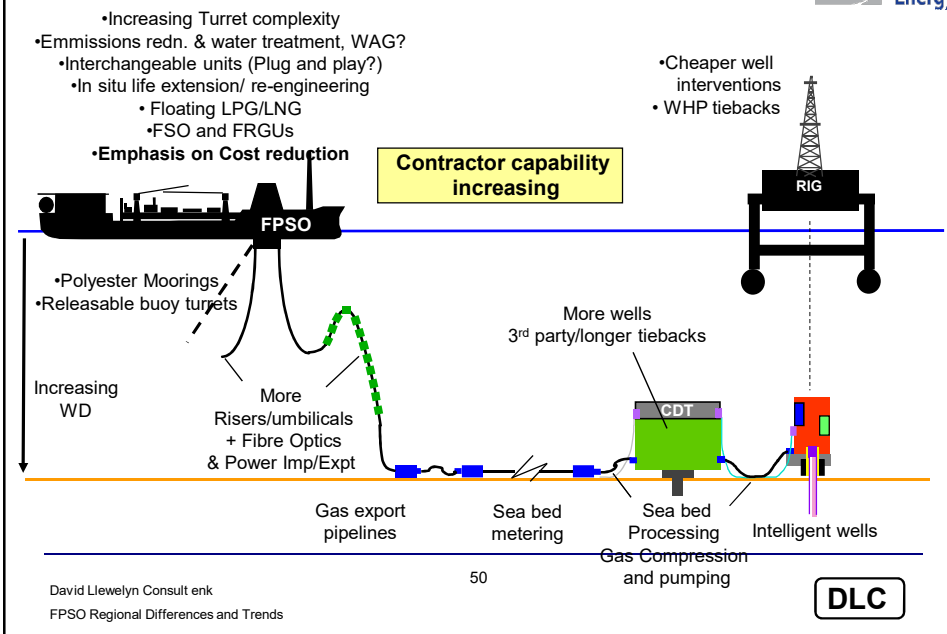


Top FPSO Leasing Contractors by Installed, On Order and Available Units



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FPSO and Deep Water Industry Trends



Conclusions

- The FPSO concept has, by using traditional and innovative shipping technology is meeting and overcoming the multiple challenges of developing the new generation of offshore fields
- In doing so FPSOs have proven more adaptable to meet the varied design requirements than all other current Floating Production technologies
- Project schedules have allowed engineers to be creative and design novel solutions for the different challenges, Multiple Contractors and Oil Co owners (around 50) have also had very different ideas
- As a result we have a fleet of very varied vessels (age, technology, size etc) with most well suited to their specific environment.
- However this threatens future market flexibility, with several redundant units ready for scrapping or re –engineering for future use
- We also have the opportunity to learn and compare past experience to ensure the “survival of the fittest designs” for the next generation

Thank-you!