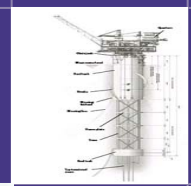
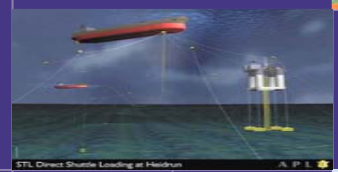
LOC

IUMI COMPENHAGEN CONFERENCE

11th September 2007

FUTURE DEVELOPMENTS IN OFFSHORE FLOATING TECHNOLOGY





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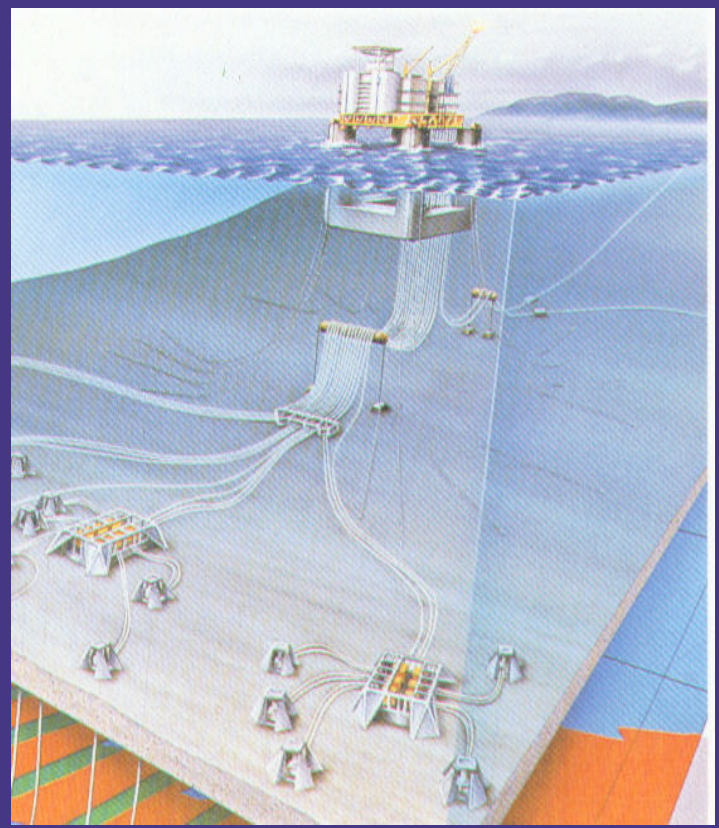
SCOPE OF PRESENTATION

- Examples of Offshore Floating Technology
- Developments in technology of hulls, moorings and risers
- Comments on the influence of developments on construction risks
- Focus on technical challenges of future deepwater developments and in the Arctic (Barents Sea)

WHAT IS FLOATING TECHNOLOGY?

- Buoyant platform
- Moorings
- Risers
- Compliant and dynamic system
- Engineering of acceptable solution



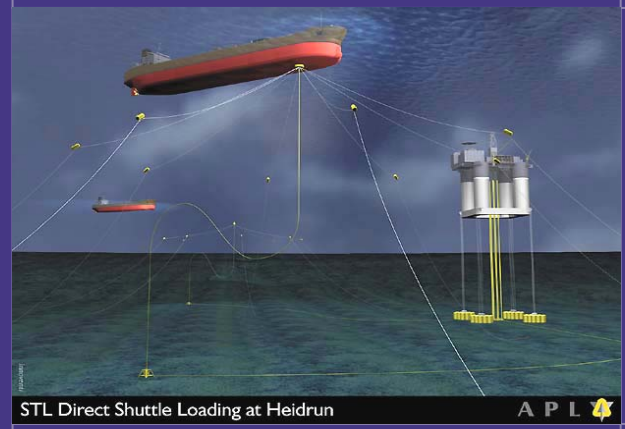
SPAR

- Constitution Spar in 1,515m water depth, Gulf of Mexico
  - Single Cylindrical Hull, 30 m diameter, 168m long weighing 14,800t.
  - Topside Payload 10,770t

TENSION LEG PLATFORM (TLP)

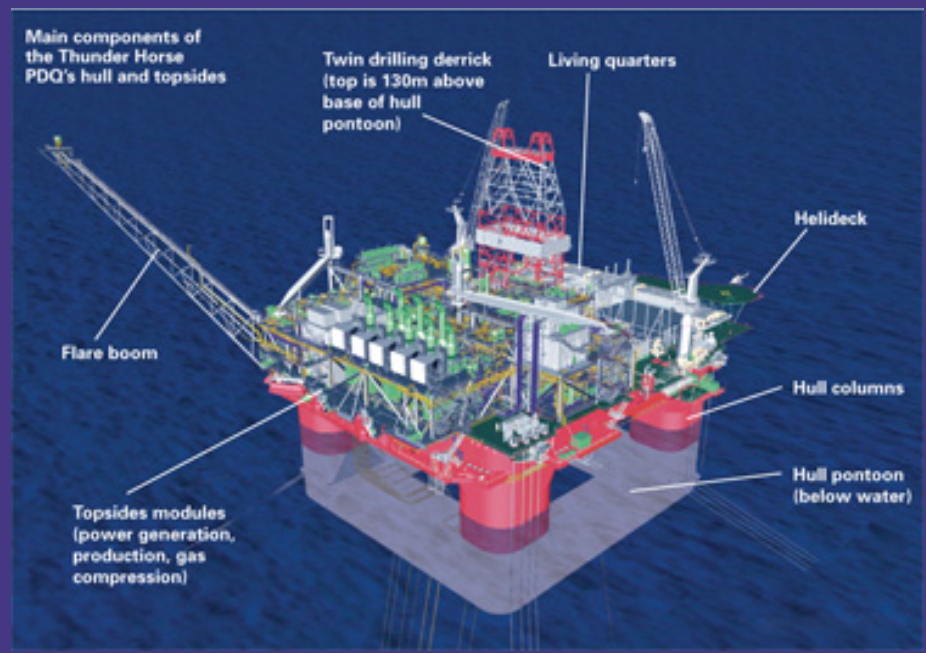
- Statoil's "Heidrun" – one of the largest TLP's. Concrete construction, moored by 16 steel tendons off Norway.

- "Typhoon" moored by 6 steel tendons in 609m water depth in Gulf of Mexico. Capsized in Hurricane Katrina.



SEMISUBMERSIBLE

- BP's Thunder Horse - the largest FPS
  - Water depth 1,844m
  - Hull displacement 120,000t
  - Height to upper deck 57.5m, draft 30m
  - Main deck 112m x 136m
  - Mooring, 16, semi-taught steel wire and chain lines connected to suction pile anchors



HOW MANY MORE UNITS

Facility Type	Operational	Build	Prospects
FPSO	100	26	103
FPS	43	13	27
TLP	20	2	9
Spar	14	2	9

Source: www.infield.com

DRIVERS FOR CHOICE OF TECHNOLOGY FOR DEEPWATER

- Preference / Familiarity (Track record)
- Reservoir and Production Data
- Location
- Environment
- Cost
- Schedule

SEMI SUBMERSIBLE / EXAMPLE

- Deep draft semi submersible in 3050m water depth (Ultra Deepwater)
- Length and width overall 73m; height of hull 52m; displacement 55,000t (approx)
- Pipe in pipe (PIP) steel catenary risers (SCR's) for high pressure high temperature (HPHT) product
- High integrity pressure protection system
- Synthetic moorings

Source: OTC 2007 - H Banon, BP America et al

CONCLUSION OF STUDY

- Deep drafted semi is an acceptable solution in ultra deepwater
- High weight of risers causes installation dangers
- In deeper water hook load available from the installation vessel limits anchor installation
- Fatigue damage to risers from vessel motions and vortex induced motion/vibration can be adequately improved in the design of the mooring system

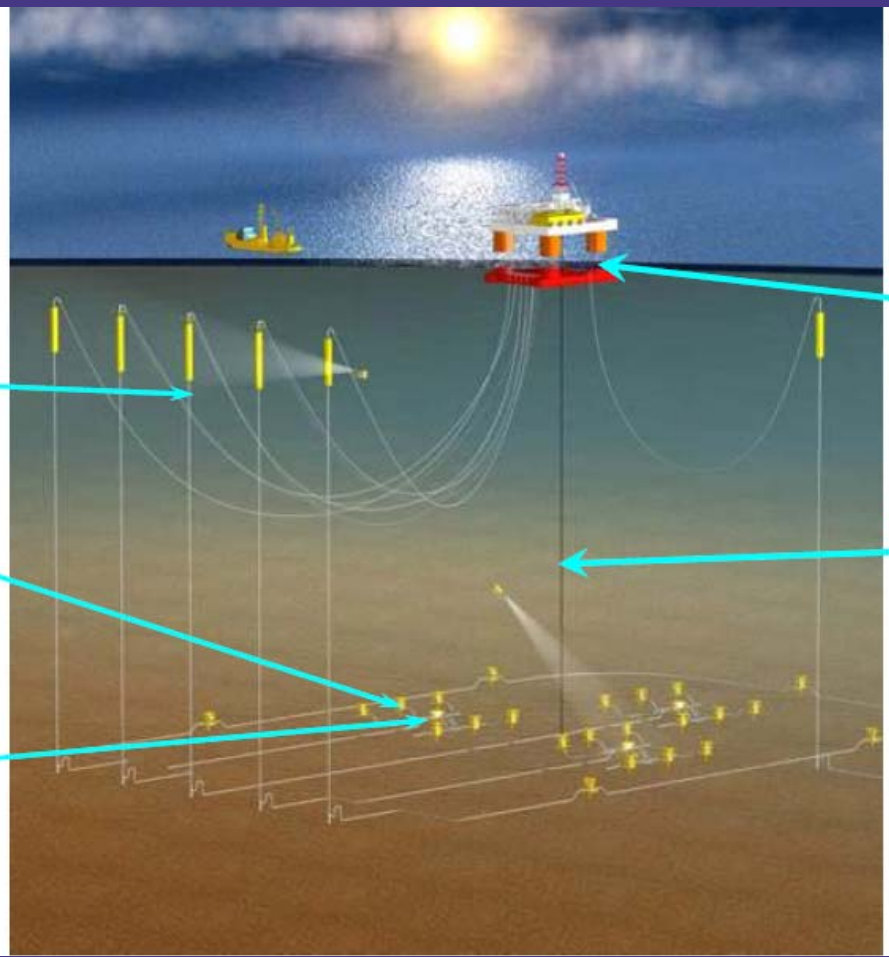
REDUCTION IN PAYLOAD

- Minimising the payload to be supported by the hull will reduce the dimensions and cost of the unit. The payload that the FPS, SPAR or TLP supports will be reduced by developments in:

  – The use of light weight synthetic moorings.
  – Sub sea processing
  – Alternative riser arrangements

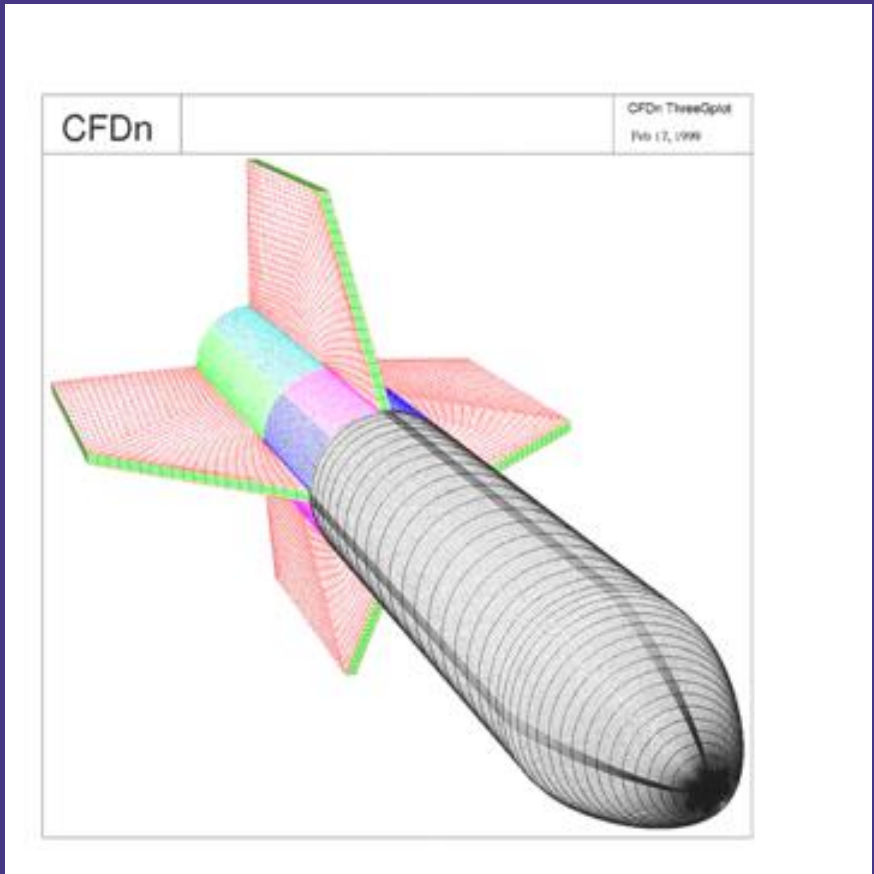
FREE STANDING RISERS AND LOW COST SEMI

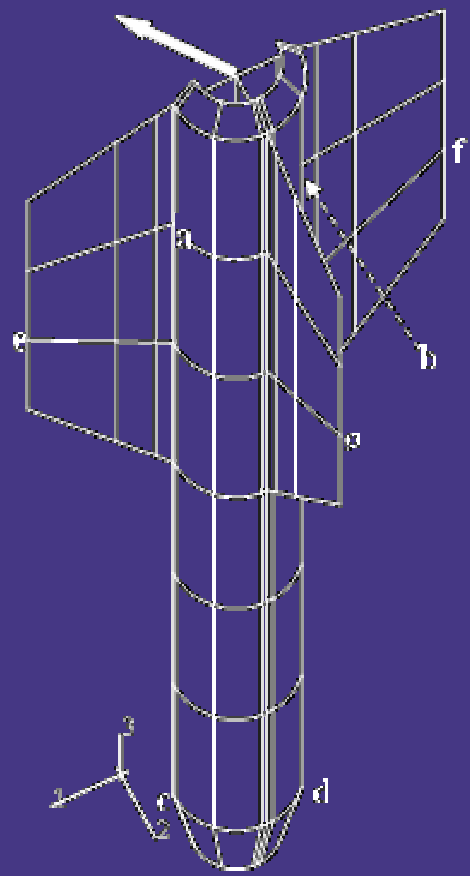
- Picture from 2H showing use of single line offset risers.



Source: http://www.2hoffshore.com

DEEP PENETRATING ANCHOR AND NEW CONCEPT



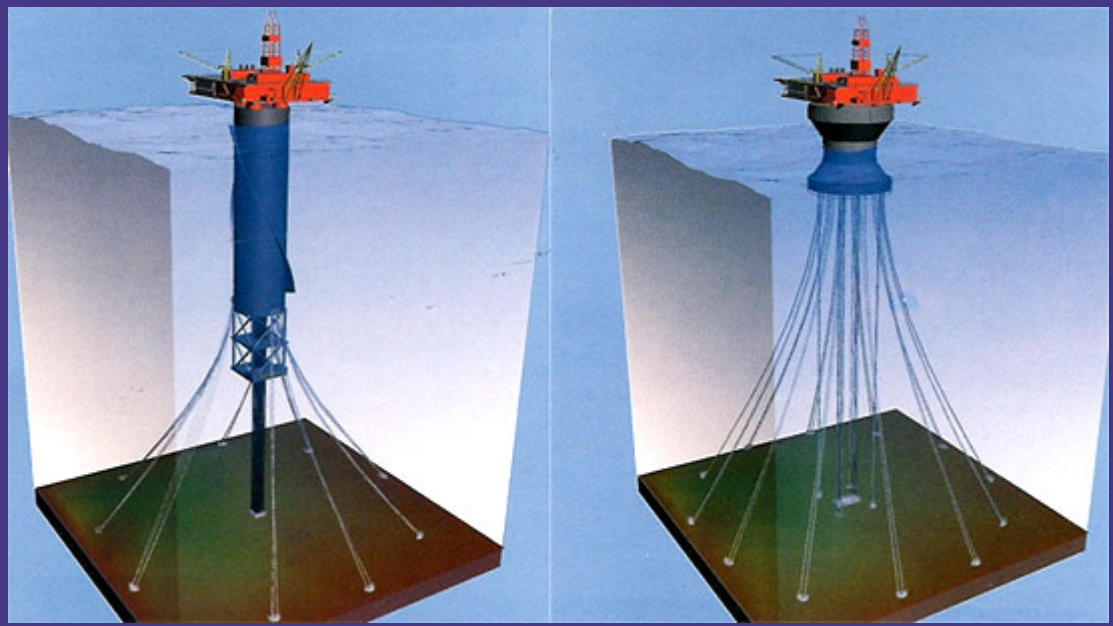


Source: www.geoprobing.com

EXTREME COLD TEMPERATURE AREAS

- Developments are planned in Arctic areas subject to ice conditions posing particular challenges to floating systems.
- Structures and mooring systems have to cater for extremes of ice loading and any additional fatigue or wear that may arise.
- The Shtokman Field development in the Barents Sea is planned. This is within the Arctic circle in 350m water depth.

SPAR AND TLP PROPOSED FOR SHTOKMAN



CHANGES IN RISK

- Ordinary marine installation risks likely to increase – harsher environment and remoteness of deep water sites.

- Increased installation times in deep water may cause greater exposure to bad weather events

- New technology may cause surprises but should be offset by increases in safety factors

- New technology may assist in reducing risk by minimising time required for critical marine operations.

ACCIDENTS HAPPEN

BUT RECOVERABLE IN THIS CASE

CONCLUSIONS

- Future Deep and Ultra Deepwater projects will utilize developments to tested floating technology
- Technology developments in design of risers and moorings will drive changes in design of the floating surface unit
- TLP's, SPARS and SEMI's are likely to continue to be adopted for increasing water depths.
- The size of these units is likely to be minimized by drawing on new technology
- Overall installation risks are likely to increase with developments in increasing water depth.

Presentation to
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