

# IBC FPSO Training Course

Paris 2016

## Introduction to FPSO Design and Technology

### Part 1

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## Agenda

### Part 1: Introduction to FPSO Technology

- FPSO role
- FPSO key components
- Terminology
- Alternative lay-out configurations
- Alternative mooring configurations
- New developments

### Part 2: Introduction to FPSO Design

- New build or conversion?
- Initial hull sizing (new build)
- The design spiral

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## Floating Production Storage and Offloading Units



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## FPSO Role



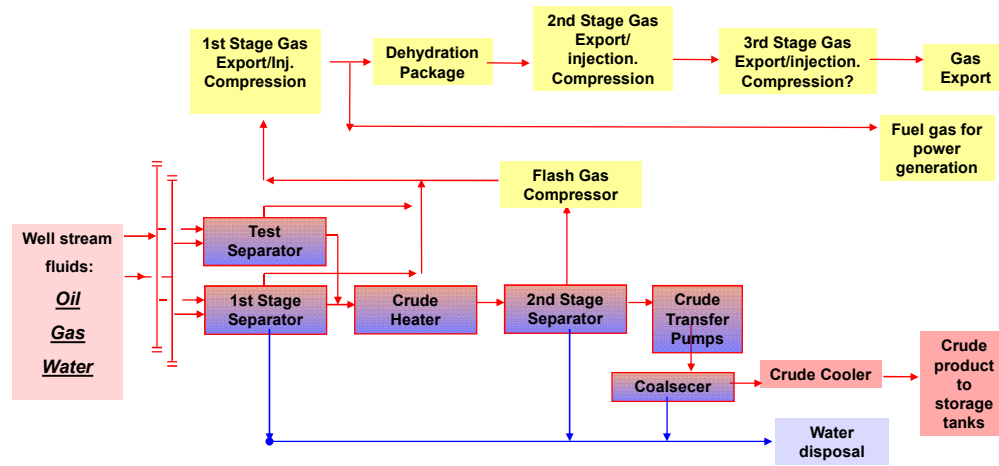
- ✓ Provide a **safe environment** for production operations;
- ✓ Provide a suitable "platform" for oil production, crude oil storage & offloading;
- ✓ Provide facilities to separate, export or dispose of any associated fluids and contaminants;
- ✓ Provide suitable utilities and accommodation to support production operations;
- ✓ Provide facilities which will deliver a high level of production uptime;
- ✓ Provide facilities with the reliability & integrity for life of field operations.

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## What are we doing on an FPSO? - Process



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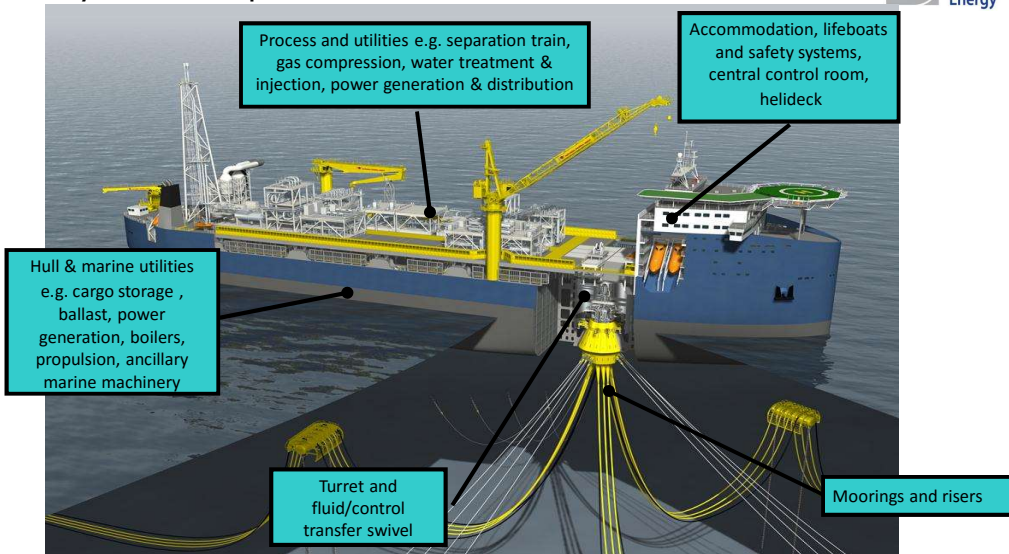
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## Key FPSO components



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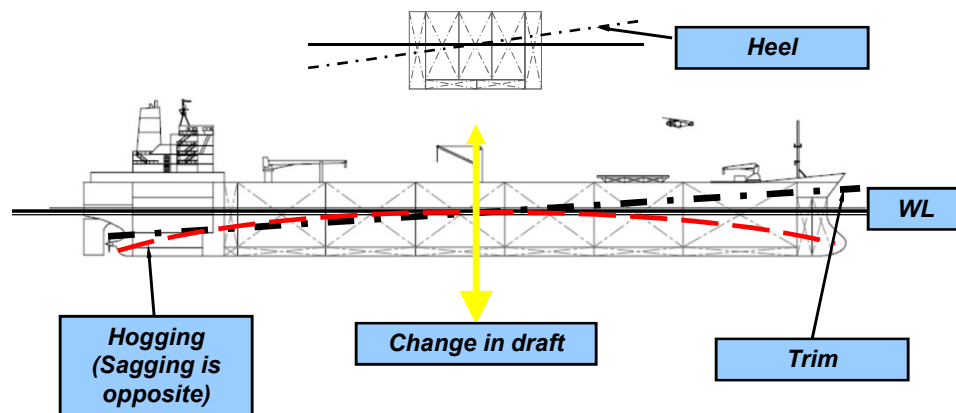
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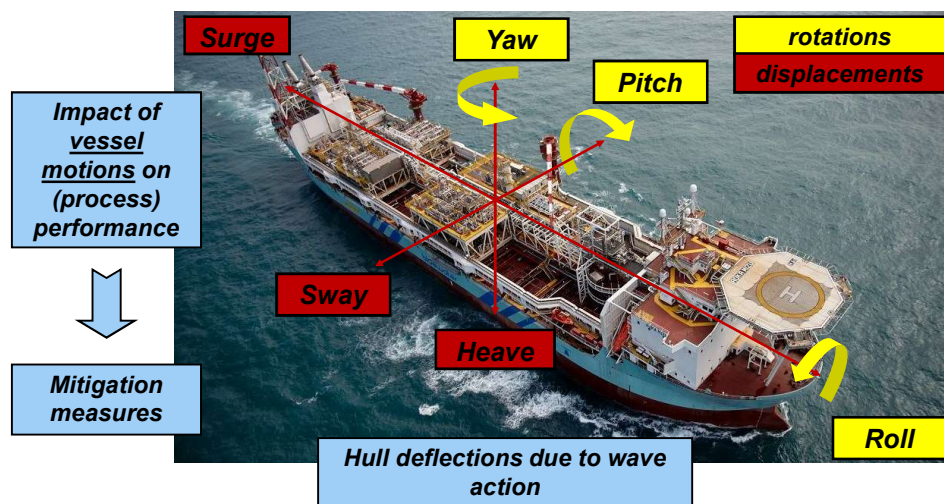
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## Terminology - Static changes in equilibrium



## Terminology - motions



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## Hull layout-aft accommodation



## Hull layout -fwd accommodation



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## Mooring options



### Weather-vaning (see next slide for definition)

#### ☐ Turret Mooring System (permanent or disconnect-able)

- Internal Turret
- External Turret

#### ☐ Soft Yoke Mooring System (permanent)

#### ☐ Dynamic Positioning (disconnect-able)



### Fixed Heading

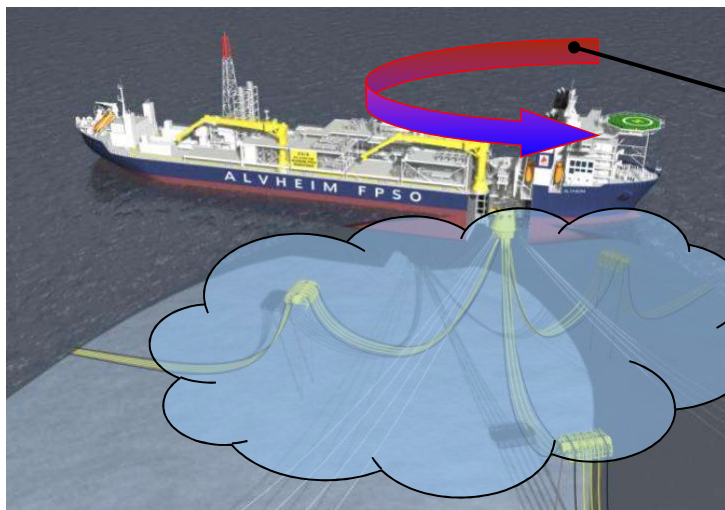
#### ☐ Spread mooring (permanent)

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## Weathervaning FPSOs



**FPSO rotates  
around turret and  
fluid swivel**

**Mooring and  
risers fixed to  
sea bed and are  
"geostationary"**

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## Mooring key selection criteria



- ❑ Prevailing met-ocean conditions:
  - Severity of conditions, frequency and nature of severe events;
  - Directionality and co-linearity of conditions (dominant direction).
- ❑ Water depth;
- ❑ Required production uptime and offloading availability; (see Reference OCIMF paper);
- ❑ Number of risers, well control requirements and power from shore;
- ❑ Economics (capital cost versus operating uptime);
- ❑ Hull and other structure fatigue.

## DP FPSOs



Image courtesy of Roc Oil



Image courtesy of Frontier Drilling

- ❑ Crystal Ocean on the Basker Manta Gummy fields in the Bass Straits off Australia for Roc Oil; (ceased)
- ❑ Noble Seillean is a dynamically positioned, self-propelled deep-water FPSO that extracts oil via a rigid riser system. These capabilities allow Noble Seillean to mobilize to deep-water locations and quickly connect to sub-sea wells and commence production without the assistance of offshore support vessels.
- ❑ Noble Seillean has worked continuously in Brazil for Petrobras since late 1998. Noble Seillean's unique design is geared for early production and well-testing; (Currently layed-up).

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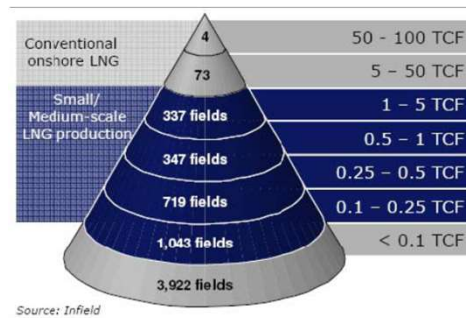
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## New developments & concepts - FLNG & Re-gas



### Why FLNG?

- ❑ Large infrastructure costs make conventional LNG uneconomic for smaller fields;
- ❑ FLNG has potential to open up some portion of circa ~300 smaller fields;
- ❑ Previously only major fields ~. 5TCF were viable using onshore LNG;
- ❑ Many "new entrants" targeting future FLNG market.



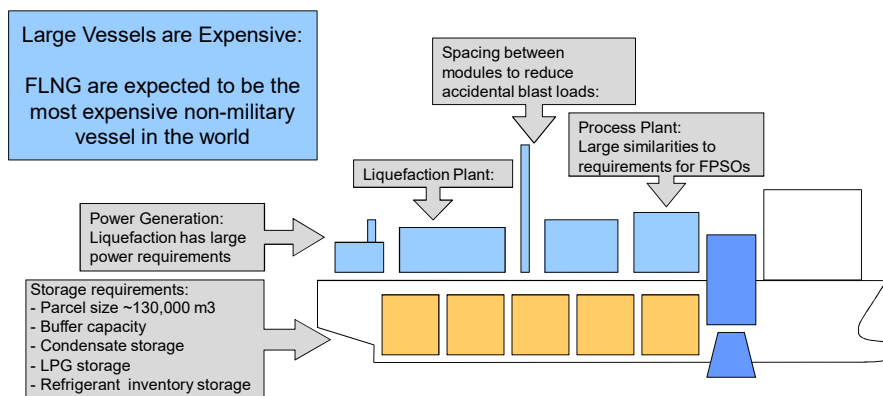
## New developments & concepts - FLNG & Re-gas



### Key issues for FLNG

- ❑ Liquefaction process – marinsation and compatibility with ship motions and space constraints;
- ❑ LNG containment system – challenges of sloshing due to partial filling and ship motions;
- ❑ Offloading – side by side or tandem – cryogenic hoses and relative motions;
- ❑ Process weight and space requirements – overall vessel size.

## Floating LNG – why are FLNG units so large?



## Floating LNG – the world's first FLNG unit?



"Shell is moving ahead with the world's first floating liquefied natural gas facility (FLNG). This will help to unlock new energy resources offshore and has the potential to revolutionise the way natural gas resources are developed."



Image courtesy of Shell

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## Floating LNG – the world's first FLNG unit?



"PETRONAS' first floating LNG facility is among the world's leading FLNG vessels, and arrived on field in June 2016. With a 1.2 million tonnes per annum capacity, it is expected to operate at Kanowit gas field, 180km offshore Bintulu."



Image courtesy of Petronas

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## New developments – the Sevan Hummingbird



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## Sevan 1000 FPSO for the ENI Goliat Field



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## New developments – Hi-Load



Images courtesy of Remora ASA

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## Sea Trial for Hi-Load DP



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## First Spar classed as an FPSO



- ❑ Spar for the Aasta Hansteen gas field;
- ❑ First Spar in Norwegian continental shelf;
- ❑ Largest ever installed Spar;
- ❑ Storage capacity 160,000 bbls;
- ❑ 23,000t topsides;
- ❑ Arrives Norway 2017;
- ❑ First gas now expected 2018.



Images courtesy of Statoil

Thank you  
Any questions?

