Floating Production, Storage and Offloading (FPSO) Facilities
Presentation Content

• History of Floating Production Systems
• Introduction to Field Layouts
• What is an FPSO..?
• Advantages of an FPSO
• Types of Processing Unit
• Major milestones affecting FPSO use
• Demand for FPSOs
• Examples of FPSO records; largest, smallest etc.
• Summary
History

• Offshore locations have been producing oil since the late 1940s

• Originally all oil platforms sat on the seabed in shallow water and exported via tanker or pipeline

• As exploration moved to deeper waters in the 1970s Condeeps and Floating production systems came into use
Condeep Concrete Platforms

1975
Beryl A
3 shafts
120m
Mobil
Norway

1975
Brent B
3 shafts
140m
Shell
UK

1975
Brent D
3 shafts
140m
Shell
UK

1976
Frigg TCP2
2 shafts
104m
Elf
Norway

1977
Statfjord A
3 shafts
146m
Mobil
Norway

1981
Statfjord B
3 shafts
146m
Mobil
Norway

1984
Statfjord C
4 shafts
146m
Mobil
Norway

1986
Gulfaks A
4 shafts
135m
Statoil
Norway

1986
Gulfaks B
3 shafts
142m
Statoil
Norway

1988
Oseberg A
4 shafts
109m
Norske Hydro
Norway

1989
Gulfaks C
4 shafts
216m
Statoil
Norway

1991/3
Sleipner A
4 shafts
82m
Shell
Norway

1993
Draugen
1 shaft
251m
Shell
Norway

1995 – Troll A
4 shafts, 303m
Norske Shell, Norway

1995
–
Subsea Production Template
What is an FPSO..?

• A converted tanker or purpose built vessel
  -- may be ship shaped, multi-hull production semi-submersible or a cylindrical shaped production spar / Mono Hull
• Hydrocarbon processing facilities are installed on board
• Processes well stream fluids into Oil, LPG or LNG
• Units without processing facilities are referred to as an FSO or Floating Storage & Offload Unit
What does an FPSO do..?

- Processes hydrocarbons received from local production wells i.e. from a platform or subsea template
- Well stream is processed & stored on the vessel, offloaded to a shuttle tanker or exported via a pipeline
Why use an FPSO..?

- Fixed platforms enable production to an average max depth of 1,400 feet (425m)
- FPSOs allow production far deeper than fixed platforms
- FPSOs allow development of short-lived, marginal fields in remote locations where a fixed platform is impractical & uneconomical
- FPSOs can be relocated to new locations and reused
FPSO Mooring Systems

- There are three main types;
  - Spread Mooring
    - FPSO is moored in a fixed position
  - Single Point Mooring (SPM) Systems
    - FPSO Weathervanes around a fixed point
  - Dynamic Positioning (DP)
    - Does not require anchor wires/chains or piled/seabed anchors. This system is the most accurate for station keeping but the most expensive to operate
FPSO Advantages

• They eliminate the need for costly long-distance pipelines to an onshore terminal.

• Particularly effective in remote or deep water locations where seabed pipeline are not cost effective.

• In bad weather situations (cyclones, icebergs etc.) FPSOs release mooring/risers and steam to safety.

• On field depletion FPSOs can be relocated to a new field.
Types of Processing Units

Process/Product Types

- **OIL** – oil, gas & water from the well stream are separated. Gas & water may be injected into well to increase reservoir pressure or gas may be exported
- **LPG** – has onboard liquid petroleum gas processing and export facilities
- **LNG** – takes well stream and separates out the natural gas (primarily methane and ethane) and produces LNG
FPSO Milestones

- First Oil FPSO built in Spain in 1977 – Shell Castellon
- First Liquid Petroleum Gas (LPG) FPSO build completed 2005 – “Sanha”, operates on the Chevron/Texaco Sanha Field in Angola
- First Liquid Natural Gas (LNG) FPSO was conversion of LNG Carrier Golar by Keppel in Singapore in 2007
Growth in Demand

- Global demand is expected to double this decade
- 127 of the planned 200 projects in the next 8 years will use FPSOs
- Brazil is the fastest growing development area with 28 FPSOs in service and 41 currently in the tendering or planning phase
- Since January 2010, there have been 11 FPSO contracts awarded in Brazil
- Even in the mature region of the North Sea, there remains an active FPSO market
- Harsh weather and proliferation of smaller, marginal fields lend themselves to the use of FPSOs
- There are currently 22 FPSOs in operation with a further 28 planned projects, up from only 15 projects one year ago
1999-2009 witnessed a 9% Compound annual growth rate in use of FPS facilities.
Change in Demand

Historic Market 2010-2014

25% Small Independent
31% Leased Operator
24% Large Independent
18% NOC
2% Major

2010-2014

41% Small Independent
30% Leased Operator
14% Large Independent
3% NOC
12% Major

Data courtesy of Infield Data Analysts
New FPSOs by Region

Data courtesy of Infield Data Analysts
Deployment of FPSOs

Historic Market

Redeployment: 14%
Conversion: 57%
New Build: 29%

Data courtesy of Infield Data Analysts

2010-2014

Redeployment: 10%
Conversion: 19%
New Build: 71%

Data courtesy of Infield Data Analysts
Records – Deepest Water

• FPSO Pioneer
  – BW Offshore operated on behalf of Petrobras Americas Inc.
  – 8,530 feet (2,600m) depth of water (DOW) in Gulf of Mexico
  – 100,000bbl/d (16,000 m³/d)
  – EPIC contract was awarded 2007
  – First oil Q3 2011
  – FPSO conversion at Keppel Shipyards in Singapore
  – Vessel has disconnectable turret so it can disconnect for hurricanes and reconnect with minimal downtime
Records – Shallowest Water

• FPSO Armada Perkasa
  – Located in Okoro field in Nigeria, West Africa for Afren Energy
  – 43 feet (13m) DOW in the Bass Strait between Australia and Tasmania
  – Spread moored (fixed orientation)
  – Uses 100mm, 150mm and 200mm bore DeepFlex non-steel flexible risers in a double lazy wave formation to offset extreme waves and currents
Records – Biggest FPSO

• FPSO Kizomba
  – Operated by Esso Exploration Angola (Exxon Mobil)
  – 3,940 feet (1,200m) DOW in Atlantic Ocean off Angola
  – 2.2 million barrels (350,000 m³) storage capacity
  – Built by Hyundai Heavy Industry in Ulsan, Korea
  – Weighs 81,000 tonnes
  – 935 feet (285m) long, 207 feet (63m) wide and 105 feet (32m) high
**Records – Smallest FPSO**

- **FPSO Crystal Ocean**
  - Operated by AGR Asia Pacific on behalf of Roc Oil (Sydney based E&P company)
  - 450 feet (137m) DOW in the Bass Strait between Australia and Tasmania
  - 5,000 bbl/d (790 m³/d) production
Records – Longest FPSO

- FPSO Girassol
  - Operated by TotalFinaElf
  - Located of NNW Luanda, Angola - 1350m of water
  - 300m Long x 59.6m Wide, 30.5m High
  - Average draught 23m
  - Displacement 396,288 tons
Records – Most Advanced

• FPSO Scarv
  – Developed & engineered by Aker Solutions for BP Norge
  – Gas condensate and oil development
  – Ties in 5 sub-sea templates with several smaller wells in future
  – Handles 19 million cubic metres/day of gas
  – 292m long, 50.6m wide & 29m deep
  – Accommodates 100 people in single cabins
Records – Largest Conversion

- **FSO Ailsa Craig**
  - Largest FSO/FSU conversion when carried out
  - Converted tanker with external turret
  - Used on the Emerald Field, North Sea

*View from forward to aft while under construction in Rotterdam*
Records – Largest FSU/FSO

- FSO Khalij-E-Fars
  - Largest purpose built FSU/FSO
  - Registered in Bushehr
  - 335m long, 60m breadth, 33m deep & draft of 10m
  - Built in China 2011
  - Due to sail from Dalian to Iran April 2012

Vessel nearing completion in STX Yard at Chang Xing island China
Records – Largest Planned

• Shell Prelude FLNG
  – Due on station 2017, North-western coast of Australia in 820 feet (250m) DOW (25 years permanently moored)
  – Built by Samsung Heavy Industries (SHI)
  – SHI & Technip consortium will engineer, procure, construct & install Capable of producing 5.3 million tons per annum (Mtpa) of liquids – 3.6Mtpa of LNG, 1.3 Mtpa of condensate and 0.4 Mtpa of LPG
  – 1,600 feet (488m) bow to stern (longer than four soccer fields)
  – 243 feet (74m) wide
  – 600,000t when loaded, 260,000t of which will be steel
  – Six times heavier than the worlds largest aircraft carrier
  – Chills natural gas to -162°C shrinking the volume by 600 times
  – Worlds largest floating offshore facility
Summary

- Demand for FPSOs continues to rise at a healthy rate of approximately 9% compound annually.
- Five year forecast shows capex for production floater orders is expected to total between $80 billion to $115 billion.
- Between 24 and 35 units annually over the next five years, 80% of which will be FPSOs (120 to 175 FPSOs total).
- LNG and LPG FPSOs are increasing in numbers faster than ever.
- Demand for FPSOs most prevalent in Brazil, Asia and West Africa.
- Following the 2009 slump FPSO orders have recovered well.
Thank You

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