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#### SMI Subsea R&D Workshop

Subsea Production System – Current and Future Trends





20121126 Subsea Processing

**FMC**Technologies

### **Key Industrial Observations**

- Demand for oil & gas will continue to grow.
- NOC control most of the world current oil and gas reserves.
- Oil Companies are moving towards more difficult reserves (heavy oil, sub-salt, ultradeep, Arctic).
- As E&P moves towards deeper water and difficult to access reserves, well equipment are moving towards HPHT as well as long step out solution.
- Oil companies are focusing on both project and operation cost.
- They are also looking for increase reservoir utilization ultimate hydrocarbon recovery – IOR.
- Environment Friendly Oil and gas development.
- Subsea Completion is favored over other completion.



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## The Future of Subsea

Broadly, the influence could be look into as 3 areas:

- Subsea Field Development
- Increase Oil Recovery and
- Subsea Processing



#### ment Increased Oil Recovery



#### **Subsea Processing**





## Subsea Field Development

- Flexible Field Architecture
- Standardization to lower cost
- Enhance Control and Data management System
- HPHT
- Deep Water
- Long Distance
- Arctic Development





# **Increased Oil Recovery**

- Light Well Intervention
- Coil Tubing Intervention
- Through Tubing Rotary Drilling
- Condition Monitoring



Light Well Intervention



# Subsea Processing

- Separation
- Pumping / Boosting
- Gas Compression
- Reinjection water/gas
- Combination of all to form a system.



**Gravity Separation** 



Compact Separation System



Raw Seawater/gas Injection



**Boosting Station** 



Heavy oil applications



Subsea Compression station



Subsea to Market



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#### FMC's Subsea Processing Major Projects

Activity in every major deepwater basin



### Petrobras - Cascade and Chinook Project

- Subsea ESP boosting
- Challenges:
  - Ultra Deep water
  - Viscous oil



- Artificial lift required to enable production
- First delivered seabed Horizontal ESP packaging
- First Seabed ESPs in series



### **Total - Pazflor Project**

- Gas/Liquid separation + L Boosting
- Challenges with the Miocene Reservoir
- Main Challenge:
  - Low energy reservoir
  - Deep water ~ 800m
  - High viscosity and stable emulsion
    - Large pressure drop in flowlines and risers
- → Free flow is not possible





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#### Shell - Perdido Project

- Vertical ESP + G/L Separator
- World deepest subsea processing in 2,500m
- G/L separation effected by cylindrical cyclonic process in caisson.
- Overcome back pressure from riser.
- Liquid boosted by ESP.





#### Shell - BC-10 Project

- Vertical ESP + G/L Separator (Booster station)
- First full-field Gas-Liquid Caisson Separation system in Brazil
- Separator are part of Manifold





#### StatoilHydro – Tordis Project

- Enhance Brownfield oil recovery
- First full-scale subsea separation system
- Gas/Oil/Water/Sand Separation
- Injection of Produced water
- To overcome limited topside water handling capacity







#### Petrobras – Marlim Project

- Enhance Brownfield oil recovery
- Gas/Oil/Water/Sand Separator
- Subsea separation of Heavy oil in deep water, matured field
- Advance compact separation System Pipe separator
- Water treatment Hydro Cyclones
- Reinjection of water into production reservoir







