

Next Generation FPSO:
The Engineering & Construction
Contractor Solution

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FPSO in GoM?

- ◆ No company has yet submitted an FPSO application for a GoM field
- ◆ Many companies are preparing for that eventuality
- ◆ Conceptual design for a 900,000 bbl GoM suitable FPSO presented at 2002 OTC
- ◆ Conceptual designs for a combined oil/gas FPSO also in progress
- ◆ Varying differences between North Sea and Gulf of Mexico

GoM Situation

- ◆ Existing pipeline infrastructure for oil and gas export in GoM
- ◆ FPSOs will be in deeper water and away from infrastructure
- ◆ Export alternatives in addition to pipelines may be considered (shuttle tankers, CNG, gas conversion)
- ◆ These may connect to existing facilities or to shore

Existing FPSOs Issues

- ◆ Current FPSOs focus primarily on oil production, associated gas utilization is presently not a prime concern
- ◆ Current method of gas disposal - reinjection, flaring is not permitted
- ◆ In future operators may be forced to look at alternatives to gas reinjection - GoM is not an exception

Gas Utilization Alternatives

- ◆ Gas gathering and transmission by pipeline
- ◆ Volume reduction and transport by sea (LNG, CNG, hydrates)
- ◆ Conversion through chemical change and transport by sea (MeOH, GTL, DME, Ammonia)
- ◆ Conversion to other energy (power and transmission by subsea cable)

Utilization Alternatives on Combined FPSO

- ◆ Liquefied Natural (LNG)
- ◆ Compressed Natural Gas (CNG)
- ◆ Gas-to-Liquids (Methanol and Fischer-Tropsch liquids)
- ◆ Power generation
- ◆ Oil production 50,000 to 150,000 BPD, GOR 700 scf/bbl

Gas Available for Utilization

- ◆ Gross Gas: 35 to 105 MMSCFD
- ◆ Fuel usage: about 19%
- ◆ Shrinkage (Propane, Butanes and Condensate recovery): about 11%
- ◆ Net gas gas available for conversion: 24.5 to 73.5 MMSCFD, heating value 1,080 Btu/scf

Conversion Rates and Capacities

Technology	Conversion/ MMBtu	Low End Range	High End Range
Methanol	30/tonne	882 TPD	2,646 TPD
Fischer- Tropsch	10/bbl	2,646 BPD	7,938 BPD
LNG	51.5/tonne	0.19 TPY	0.57 TPY
CNG	0.95	23.3 MMscfd	69.8 MMscfd
Power	195/MW	136 MW	407 MW

Combined Topsides Weight and Vessel Size (150,000 BPD case)

Case	Gas Process	Oil Production	Total Topsides	Vessel Size (DWT)
CNG	Incl.	19,800	19,800	198,000
Power	7,200	19,800	27,000	270,000
LNG	11,500	19,800	31,300	313,000
Methanol	17,000	19,800	36,800	368,000
GTL	25,500	19,800	45,300	453,000

Technology Status

- ◆ Methanol - technically and commercially viable, no offshore applications
- ◆ LNG - technically and commercially viable, no offshore applications
- ◆ GTL - technically viable, still expensive at low capacities, no offshore application
- ◆ CNG - simple technology, no commercial applications
- ◆ Power - many offshore applications

Combined FPSO Issues

- ◆ Complex and more sophisticated processing (controls, metallurgy, catalytic processes)
- ◆ Equipment suitable for marine environment and vessel motion
- ◆ Multiple storage and offloading requirements
- ◆ Process must “fit” available hull requirements
- ◆ Regulatory issues (HSE, certification, etc.)

Project and Program Management Challenges

- ◆ Complex downstream process added to an “upstream” vessel
- ◆ Manage a number of contributors in a manner similar to large integrated onshore project
- ◆ Requirement for highly skilled and diversified Program Manager

Program Manager

- ◆ Must understand upstream and downstream processes
- ◆ Must understand marine and hull systems
- ◆ Must be able to manage and coordinate a multitude of “players”: e.g. licensors, engineers, vendors, fabricators, equipment manufacturers

Program Manager (cont'd)

- ◆ Must be skilled at Global Logistics and Planning
- ◆ Must be skilled at integrating multiple schedules into overall Master Plan
- ◆ Must be skilled at managing complex interfaces between multiple entities in diverse locations

Fabrication and Integration Issues

- ◆ Larger, heavier, more complex modules
- ◆ Presence of reactors, columns, specialty exchangers
- ◆ Sophisticated electrical and control system
- ◆ More complex installation requirements
- ◆ Increased testing and commissioning requirements

Fabrication and Installation Issues (cont'd)

- ◆ Multiple fabrication sites:
 - Packaged equipment
 - Topsides modules
 - Hull fabrication
 - FPSO integration

Fabrication and Installation Issues (cont'd)

- ◆ Installation, commissioning and testing of complex process systems and equipment:
 - Synthesis gas reformers
 - Fischer-Tropsch reactors
 - LNG main exchangers
 - Oxygen plants
 - Heaters and waste energy boilers

Final Observations

- ◆ GoM FPSO will be in deeper water and away from existing infrastructure
- ◆ Export alternatives to pipeline may be considered for economics reasons
- ◆ Many gas utilization or conversion options on a combined FPSO are technically feasible

Final Observations (cont'd.)

- ◆ Final option selection will be influenced by product marketability
- ◆ Vessel practical size limit is probably current VLCC Super Tanker (~ 380,000 DWT)
- ◆ First combined FPSO will probably deal with lower complexity options (CNG, LNG) and is not too far down the road

Final Observations (cont'd.)

- ◆ Required engineering skills for a combined FPSO are coming from downstream business - mind change
- ◆ Probably a handful of E&C contractors can handle this size of projects from a single office
- ◆ Work-share and joint ventures are the options for others
- ◆ Fluor and Amec have a worldwide joint venture agreement for floating production

Final Observations (cont'd)

- ◆ Worldwide material management is a must
- ◆ Multiple fabrication yards are used
- ◆ Probably not a single company has all the required skills
- ◆ Situation similar to large integrated offshore projects
- ◆ Need for a Program Manager to manage “best in class” subcontracts