Offshore application of Gas to Liquid Technology to cut flaring on FPSOs

Francesco Criminisi
Kees Willemse
Iain Baxter
1. Introduction to SBM
2. Compact GTL Technology
3. GTL on FPSO applications
4. Conclusions
Introduction to SBM
The Company
5 Project execution centres
11 Shore bases
4 Representative offices
9,900 Employees

Lease Fleet
15 FPSOs
2 FSOs
1 Semi Sub
1 MOPU

Financials FY 2013 in US$
- Turnover: 3,4 billion
- Backlog: 23 billion
- Market Cap: 4,2 billion

Performance
- 200 years of operations
- 99% Uptime
- ~5,000 Tanker Offloads
SBM Gas solutions portfolio

- **FPSO with GTL**
- **Twin Hull FLNG internal Turret**
- **Twin Hull FLNG external Turret**

- **Turrets for Large Scale FLNGs**

**Environment (Hs):**
- >8m
- <8m

**Gas Capacity:**
- 100 MMSCFD
- 300 MMSCFD
7 Years of FLNG Development in SBM

- Generic - Niche
- Petrobras - DMR
- Cash Maple - SMR
- Prelude Turret
- Generic - SMR
- Twin Hull™ - Dual N₂
Mid-scale Twin Hull FLNG

CO₂ precooled Dual Nitrogen Cycle
12 months shorter schedule than newbuild FLNG
18% lower cost than newbuild FLNG
2 MTPA
Compact GTL Technology
Process overview

1. **Gas pretreatment**
   - Natural Gas
   - Mercury, Sulphur, Nickel

2. **Steam Methane Reforming**
   - \( \text{CH}_4 + \text{H}_2\text{O} \rightarrow \text{CO} + \text{H}_2 \)
   - Catalytic reaction
   - Low pressure
   - High Temperature

3. **Fischer Tropsh**
   - \( \text{CO} + \text{H}_2 \rightarrow \text{C}_n\text{H}_{2n+2} \)
   - Catalytic reaction
   - High pressure
   - Low Temperature

4. **Heating**

5. **Cooling**

   - \( \text{H}_2 \) & Tail Gas

---

Compact GTL
The modular solution
Compact GTL Technology

- Automated catalyst insertion and removal
- Corrugated metallic catalyst inserts maximise active surface area per channel
- Brazed plate-fin reactor construction minimises metal content and weight
Commercial Demonstration Plant
Aracaju, Brazil 2010

- > 2 years operations
- > 90% availability
- Project fully funded by Petrobras
- Associated gas feed from offshore
- Fully integrated GTL process
- Commercial scale reactors – Sumitomo
- Catalysts – Johnson Matthey

Technology approval by Petrobras 2011

© SBM Offshore & Compact GTL 2013. All rights reserve www.sbmoffshore.com & www.compactgtl.com
Kazakhstan agreement signed for 3000bpd plant

7th March 2014: Memorandum of Cooperation between CompactGTL and Kazakhstan Ministry of Oil & Gas

- Cooperation to build the World’s First commercially deployed small scale GTL plant
- 3000bpd diesel production planned
- Reduction in flaring by over 300 MMcm/annum
- 12 months engineering
- Fully functioning by 2017
- Cost estimated at 300m USD
What if we could put it in Offshore?

- **Gas pretreatment**
- **Steam Methane Reforming**
  \[ CH_4 + H_2O \rightarrow CO + H_2 \]
- **Fischer Tropsch**
  \[ CO + H_2 \rightleftharpoons C_nH_{2n+2} \]

- **Cooling**
- **Heating**
- **Tail Gas**

Mercury, Sulphur, Nickel

Liquids
Why FPSO with GTL?

GTL is an excellent Gas Disposal Alternative in an Offshore Application

- **Flaring Restrictions**
  - New fields not allowed to flare
  - Existing fields risk shut-in or financial penalties

- **Gas Re-injection**
  - High cost: in deep water can cost up to $250 million
  - Gas breakthrough risks, threat to reserves

- **Gas Infrastructure Issues**
  - High cost of pipelines in remote or deep water
  - Multi-party, complex infrastructure
GTL on FPSO applications
Benefits of Integration

- Power generation
- Separation & Pre-treatment
- Steam Methane Reforming
- Process Heating
- Fresh Water System
- Heating
- Cooling
- Fischer Tropsh
- Synthetic Oil
- Crude Oil
- Common Utilities: Water Treatment, N₂ generation, Cooling Water system,
- Common Oil Storage
- Well Fluid
What is an Extended Well Test (EWT)?

- Confirms well productivity estimates / reservoir pressure behaviour / fluid properties
- But there is a strong drive from regulatory & environmental authorities to minimise flaring
- Current EWT may have production rates limits which seriously limit the EWT benefits
- EWT vessel with GTL ⇒ no flaring ⇒ maximise EWT benefits
Application of the concept: Full Field Development

Remote (>100 km) oilfields with enforced gas flaring legislation

Gas re-injection is:
- Not feasible or..
- Expensive or..
- A risk to the reservoir

GTL is a project enabler for “stranded oil”

No infrastructure

Gas export is:
- Not feasible or..
- Expensive or..
- Has no fair gas buyer

GTL is the best solution if distance >100 km and Gas flow rate <100 MMSCFD
Mooring solutions

GTL on FPSO

Extended Well Test (EWT) FPSO

Dynamic Positioning DP2+

Full Field Development

Permanently Moored

Disconnectable Riser

6 x 5MW External Azimuthing Thrusters
EWT with GTL Concept - Fly Through
Conclusions
GTL: the SBM's green solution to associated gas

- Referenced Technology Partner
- Oil Company approved GTL technology
- Generic study complete, ready for FEED
- Approval in principle by DNV
- 24+ months operational experience onshore plant Brazil
- World class GTL and FPSO component supply chain established
- Oil Company approved GTL technology
- Generic study complete, ready for FEED
- Approval in principle by DNV
- 24+ months operational experience onshore plant Brazil
- World class GTL and FPSO component supply chain established
Thank You!