Modular GTL – Industry Approved & Operating

World XTL 12 Summit : 21st to 23rd May 2012
London
Iain Baxter – Director of Business Development
Safe, operable & industry approved technology

Compact GTL
The modular gas solution

Access & develop remote oilfields onshore & offshore

Increase NPV of oilfield developments
World’s first modular fully integrated GTL facility!

Plant commissioned in December 2010. CompactGTL technology now approved by Petrobras for deployment.

- Gas pre-treatment
- Pre-reforming
- Reforming
- Waste heat recovery
- Process steam generation
- Syngas compression
- Fischer Tropsch synthesis
- FT cooling water system
- Tail gas recycling
3 Proven & Operational GTL Processes Today

World Scale GTL
Gas Monetization
300MMscf/d +

Modular GTL
Oilfield Access
<= 50MMscf/d
Conventional GTL vs CompactGTL

Shell Pearl - Qatar
140,000 bbl/d GTL Products
450 Football Fields

< 5,000 bbl/d
<< 1 Football Field
Development of the CompactGTL Process

- **Lab Scale Development**
  - 12 Years rig operations & modelling
  - Reactor & catalyst development
  - Independent verification

- **2000 -**

- **2008 -**

  - **UK Pilot Plant**
    - 4 Years operations
    - Reactor & catalyst manufacturer selection
    - Now an Operator training centre

- **2010 -**

  - **Brazil Commercial Demonstration Plant**
    - 18 Months operations
    - Process approval Dec 2011

- **2000 -**

  - **Client Funded Project Studies**
    - GAZPROM Onshore Russia
    - Other IOC’s under NDA
    - Plants @ 200bpd to 5,000bpd
Stranded Oil!
What makes some oil “stranded”?

Remote oilfields with enforced gas flaring legislation

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

No infrastructure

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

STOP!
≈ 800 Oilfields with Problematic Associated Gas @ <50MMscf/d

Analysis by Wood Mackenzie & Fugro Robertson
Options for Associated Gas

- Reinjection & Flaring
- FLNG
- CNG
- Gas to Wire
- Pipeline

Distance to market for converted product [km]

- 500
- 150
- 75
- 50

Associated Gas MMscf/d

- 400
- 200
- 50
Plants @ 2–50 MMscf/d

- Standardised mass produced SMR & FT modules
- Road / rail transportable reactor modules
- Bespoke balance of plant to suit client project

Blend Syncrude with the Crude Oil Export
Delivery – World Class Clients & Partners

Clients Include
Majors & IOC’s

Reactors Manufacture

FEED & PM / Execution

FPSO Integration & PM / Execution

Catalyst Manufacture
25MMscf/d GTL Integrated FPSO – SBM Offshore

- Fully Integrated Design
- Up to 50,000 bbl/d Crude Production
- 2,000 bbl/d GTL Liquids Production
Modular Plant – Critical for Oilfield Projects

- Inherent Reliability
- Scaleability
- Operability
- High Turn Down
- Access to Site
- Reactor Changeout

The number of active reactor modules can be adjusted to match the associated gas production profile over time.
Enhanced Oilfield NPV: GTL vs a feasible but high cost ANG option

Facilities Capital Cost PV
Gas Disposal
Operations & Tax PV
Penalties or Delay

Gas Re-Injection or Pipeline to Market
Oilfield NPV
Crude Revenue PV

Integrated CompactGTL
Oilfield NPV
Crude Revenue PV
Facilities Capital Cost PV
GTL Plant
Operations & Tax PV
GTL Opex

Syncrude PV
10MMscfd ANG Processed to 1,000 bpd Syncrude
Enhanced Oilfield NPV: GTL liberates shut-in production

Existing or Planned Field subject to ANG Flaring Cap

Integrated CompactGTL

10MMscfd ANG Flaring cut liberates 10,000 bpd Production @ GOR=1,000
Case Study – Onshore West Africa

- Existing oilfield operation
- GOR = 1,000  >15 years life remaining
- Flaring reduction targets restricting production
- Re-injection prohibitive
- Terrain & distance prevent gas gathering

CompactGTL Solution

- 10MMscf/d plant gives 1,000 bpd syncrude
- 10,000 bpd liberated crude production
- Incremental NPV US$80MM
- Low sensitivity to CAPEX & OPEX
## Case Study – Onshore West Africa Incremental Cash Flow

### Economic Metrics

<table>
<thead>
<tr>
<th>Undiscounted Profit $MM</th>
<th>NPV 10 $MM</th>
<th>Reserves MMboe</th>
<th>NPV10/Boe $/Boe</th>
<th>DPIR $/$</th>
<th>Payback Year</th>
<th>Maximum Exposure $MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.8</td>
<td>81.4</td>
<td>3.7</td>
<td>22.31</td>
<td>0.91</td>
<td>2015</td>
<td>102.5</td>
</tr>
</tbody>
</table>

### Full Field Gross Cash Flow

- **$ Million (Nominal)**
- **Year**

- Full Field Annual Gross Cash Flow
- Full Field Cumulative Gross Cash Flow
Small scale GTL for stranded gas?

- Small Scale Remote Gas & Shale Gas to Liquids
  - Projects must carry the cost of the whole gas field development

- Large Scale Gas to Liquids
  - Projects benefit from economies of scale, making it less sensitive to project costs & commodity prices

- Small Scale Associated Gas to Liquids
  - Projects only carry the incremental GTL costs and benefit from additional natural liquid revenues
Why is this now possible?

Conventional Tubular steam Reformer / ATR
Conventional FT reactor e.g. slurry phase

10x increase in specific throughput

CompactGTL reactors using brazed plate & fin construction
Mini-channel CompactGTL reactors

Automated catalyst insertion & removal

Corrugated metallic catalyst inserts maximise active surface area per channel

Brazed Plate-Fin reactor construction minimises metal content / weight
SMR Reactor Core Construction
FT Reactor Core Construction
Process Overview

**Gas Treatment**
- Pre-wash
- Mercury removal
- Heating
- Sulphur removal

**Syngas Production**
- SMR 1 reactor modules
- SMR 2 reactor modules
- Steam generation (WHB)
- Syngas compressor
- Water treatment

**FT Synthesis**
- FT cooling system
- FT 1 reactor modules
- FT 2 reactor modules
- Product flash

**Gas Feed**
- High CO₂ Possible!

**No Oxygen Required!**

**High CO₂ Possible!**

**HC rich tail-gas**
- GT drivers

**H₂ rich tail-gas**
- Syncrude
A ‘Win-Win’ for IOC’s, NOC’s & Governments

- Safe, operable & industry approved technology
- Access & develop remote oilfields onshore & offshore
- Increase NPV of oilfield developments
Modular GTL – Industry Approved & Operating

World XTL 12 Summit: 21st to 23rd May 2012
London
Iain Baxter – Director of Business Development