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

Access & develop remote oilfields onshore & offshore

Increase NPV of oilfield developments
• Gas pre-treatment
• Pre-reforming
• Reforming
• Waste heat recovery
• Process steam generation
• Syngas compression
• Fischer Tropsch synthesis
• FT cooling water system
• Tail gas recycling

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

World’s first modular fully integrated GTL facility!
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

- Client Funded Project Studies
  - GAZPROM Onshore Russia
  - Other IOC’s under NDA
  - Plants @ 200bpd to 5,000bpd

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

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

- Lab Scale Development
  - 12 Years rig operations & modelling
  - Reactor & catalyst development
  - Independent verification
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!
Approximately 800 oilfields with problematic associated gas at <50 MMscf/d

Analysis by Wood Mackenzie & Fugro Robertson
Options for Associated Gas

- **Reinjection & Flaring**
- **FLNG**
- **CNG**
- **Pipeline**

Distance to market for converted product [km]

- 500
- 400
- 200
- 50

Associated Gas MMscf/d

- 400
- 200
- 50

**Gas to Wire**

**Pipeline**
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

Reactor 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

Gas Re-Injection or Pipeline to Market

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

Integrated CompactGTL

- Facilities Capital Cost PV
- GTL Plant
- Operations & Tax PV
- GTL Opex
- Syncrude PV
- Crude Revenue PV
- Oilfield NPV

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

<table>
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<th>Economic Metrics</th>
<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>
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<td>-0.8</td>
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<td>3.7</td>
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<td>2015</td>
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Full Field Gross Cash Flow

- Full Field Annual Gross Cash Flow
- Full Field Cumulative Gross Cash Flow

Economics by Fugro Robertson
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 → Compact SMR Reactor → Compact FT Reactor

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

- Automated catalyst insertion & removal
- Brazed Plate-Fin reactor construction minimises metal content / weight
- Corrugated metallic catalyst inserts maximise active surface area per channel
SMR Reactor Core Construction
FT Reactor Core Construction
Process Overview

**Gas Treatment**
- Gas feed
  - Pre-wash
  - Mercury removal
  - Heating
  - Sulphur removal
- High CO₂ Possible!

**Syngas Production**
- SMR 1 reactor modules
- SMR 2 reactor modules
- Steam generation (WHP)
- Syngas compressor
- Water treatment
- HC rich tail-gas
- GT drivers
- H₂ rich tail-gas

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

**Note:** No Oxygen Required!
A ‘Win-Win’ for IOC's, NOC’s & Governments

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