SHELL IN GASIFICATION: DELIVERING PERFORMANCE TODAY AND DEVELOPING AND DEPLOYMENT SOLUTIONS FOR TOMORROW

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SHELL HAS 30+ YEARS OF GTL DEVELOPMENT

1973
LABORATORY AMSTERDAM
grams/d

1983
PILOT PLANT AMSTERDAM
3bbl/d

1993
BINTULU SMDS MALAYSIA
Current capacity 14,700 bbl/d

2011
PEARL GTL QATAR
Start-up 140,000 bbl/d

CONTINUED TECHNOLOGY DEVELOPMENT
PEARL GTL: INTEGRATED GAS-TO-LIQUIDS PROJECT

- 1.6 Bcf/d of Wet Gas
- 120 kbbl/d NGLs/Ethane
- 140 kbbl/d GTL products
- Major construction completed Q4 2010
- 2011 ramp-up ~12 months, full production mid 2012
- ~$18-$19 billion development cost
- Project 100% funded by Shell
- No gas feedstock cost – operating costs of $6/boe upstream production
- Shell receives cost recovery of investment and shares profit with state of Qatar.

Full integration from offshore to refined products

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# PEARL GTL: A MAJOR ENGINEERING FEAT

## MATERIAL STATISTICS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CONCRETE</th>
<th>STEEL</th>
<th>REACTOR TUBES</th>
<th>CABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Offloading Facility: Imported &gt;2 mln freight tonnes</td>
<td>750,000 m³ ~8 Wembley Stadiums or 2 Burj Khalifas</td>
<td>Erected 2.5 Eiffel Towers/month in pipe &amp; structural steel at peak</td>
<td>GTL synthesis reactor tubes end to end would stretch from Doha to Tokyo</td>
<td>~13,000 km of cables: Doha to Houston</td>
</tr>
</tbody>
</table>

## PROCESS STATISTICS

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>WATER FOR STEAM &amp; COOLING</th>
<th>STEAM FOR POWERGEN</th>
<th>OXYGEN FOR GTL</th>
<th>CATALYSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2 GW of rotating equipment</td>
<td>~45,000 m³/day cleaned Town of 140,000 people</td>
<td>Steam 8,000 tonnes/hr 3 Olympic size swimming pools/hr</td>
<td>28,000 tonnes/day produced</td>
<td>Surface area equivalent to 18x surface area of Qatar</td>
</tr>
</tbody>
</table>
Shell Gasification Process (SGP)
- based on Partial Oxidation (POX)
- 9 SGPs per train
- Reaction temperature ~1300 °C
- Refractory clad reactor

Heavy Paraffin Synthesis (HPS)
- 12 reactors of 1,200 tons per train
- Tens of thousands of tubes containing 200 tons of Cobalt-based FT catalyst per reactor

Heavy Paraffin Conversion (HPC)
- Largest hydrocracker in Shell
- Platinum-based catalyst dedicated to GTL
- Maximizing yield of gasoil and BO
SHELL GASIFICATION PROCESS

Concept:
- Partial oxidation
- Refractory clad pressure vessel

Challenges:
- Severe conditions (reducing, \( \sim 1350^\circ C \))
- Materials of construction
- Burner design and control
- High pressure

Advantages:
- No catalyst, no steam, favouring efficiency
- High conversion efficiency
- >40 years experiences (>100 units)

Performance:
- Good burner reliability (> 2 years)
- Excellent overall availability (>99%)
PEARL GTL HSSE PERFORMANCE

LARGE WORKFORCE, COMPLEX PROJECT

- Pearl GTL workforce - at peak circa 53,000
- Pearl Village community established
- In 2010 LTIF < 0.04/mln hrs
- Shell Record – Onshore - 77 mln hrs LTI free
- 270mln km driven without serious accident

10 TIMES LOWER LTI THAN INDUSTRY AVERAGE

PM congratulates CCC Safety Manager on achieving 75 million hrs without LTI
PEARL GTL: A WORLD CLASS INTEGRATED GTL PROJECT

**Offshore production**
- Qatar North Field: 1.6 bcf/d

**GTL plant**
- Gas processing: 120 kboe/d
- GTL gasoil: >1 mtpa
- Base oil: >1 mtpa
- Gasoil: >2 mtpa
- Kerosene: Synthetic Base Oil

**Upstream**
- Development & Production Sharing Agreement

**Downstream**
- Marketing
PEARL GTL: BUILDING A NEW HEARTLAND

WORLD’S LARGEST GTL PLANT

- 120,000 boe/d of natural gas liquids and ethane and 140,000 b/d of liquid hydrocarbon products
- First cargo loaded 13th June 2011.
MAJOR NEW INNOVATIONS

UNCONVENTIONAL GAS

- Active in shale gas, tight gas and Coal Bed Methane projects globally
- Focus on cost reduction through innovation in drilling & fracking
- Arrow, 50/50 JV Shell/PetroChina; develop CBM to LNG project in Queensland, Australia

PEARL GTL (QATAR)

- World’s largest GTL plant when on stream
- Capacity of 120 kboe/d of natural gas liquids and 140 kboe/d of GTL products
- Major construction completed end 2010, production ramp up in 2011

FLOATING LIQUEFACTION

- Shell Floating LNG
- Capacity: field specific Prelude FLNG: 5.3 mtpa in total liquids
- Shell DMR (Dual Mixed Refrigerant) technology
- FID taken in 2011 for Prelude in Western Australia
ENERGY FOR A CHANGING WORLD

THANK YOU

Discover more at www.shell.com