Update on Jamnagar Gasification Project

by

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Reliance - An Overview

- India’s largest private sector enterprise
- India’s largest exporter
- Ranked 158th in revenue in Fortune Global 500
- World’s Largest Green-field Refinery & Petrochemical Complex
  - # 2 in polyesters
  - # 5 in PTA
  - # 6 in PP
  - # 7 in PX,
  - # 8 in MEG

⇒ Only one of its kind in India!
## Reliance - An Overview

<table>
<thead>
<tr>
<th>Financial Performance; FY15</th>
<th>$bn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue/turnover</td>
<td>62.2</td>
</tr>
<tr>
<td>Exports</td>
<td>36.6</td>
</tr>
<tr>
<td>Earnings, EBDIT</td>
<td>7.4</td>
</tr>
<tr>
<td>Cash profit</td>
<td>5.8</td>
</tr>
<tr>
<td>Net profit</td>
<td>3.8</td>
</tr>
<tr>
<td>Net worth</td>
<td>34.9</td>
</tr>
</tbody>
</table>

⇒ *Sets a new Benchmark every year!*
Milestones in Growth Journey

- 1958: Reliance Commercial Corporation – Trading House
- 1966: Naroda Textile Units – Vimal Fabric
- 1977: Reliance goes Public – Reliance IPO
- 1982-88: Patalganga Complex – POY/ PSF/ PTA/ LAB/ PX
- 1997-97: Hazira Phase II- PTA 1,2/ PFY/ PSF/ PET/ PP/ Naphtha Cracker
- 1999-00: Jamnagar DTA Refinery + Petrochemicals (J1)
- 2000-01: Reliance Info-comm
- 2005-06: Reliance Retail
- 2008-09: Jamnagar SEZ Refinery + Petrochemicals (J2)
- 2008-09: KG-D6 Offshore Gas Production/ Cross-Country Gas distribution pipe
- 2016-17: Gasification Project (J3), CBM-Gas Project
- 2016-17: Reliance Digital Services- Jio 4G

⇒ “Make in India” and Digital India!

What is good for India is also good for Reliance
Growth is Life

- Fundamental belief is …… ‘Growth is Life’
- Growth through Vision
- Growth by Design
- Every Result is foreseen
- Stop Growing .. You Perish .. You Vanish
- No Status-quo .. Either You GO UP .. or .. GO DOWN

⇒ To sustain Growth is to Sustain Life
Growth Strategies

Organic Growth

- Identify Opportunities for Backward Integration
- Identify Opportunities for New Business in Indian Economy
- Global Vision
- Product and Technology Selection
- Fast-Track Project Execution

Asset Sweating

- Debottlenecking/ Expansion
- Integration, Intensification
- Automation: APC/ RTO
- Up-gradation of Technologies/ Equipment
- Fuel Switching/ Energy conservation

→ Growth continues through-out the Project Life!
Inorganic Growth

- By Acquisition:
  - IPCL: Baroda, Dahej, Nagothane (2002-2007)
  - Polyester Sites: AFL, CIPL, IPL, RSL (2005 in IPCL)
  - Kuantan PTA Plant, Hualon (Recron) Malaysia (2012)

⇒ Mostly the strategy is “Make in India”!
Why Gasification?

- **J1- DTA Refinery with Delayed Coker**
  - Hydrogen through Gasification ruled out
  - Domestic market for Petocke developed

- **J2- SEZ Refinery with delayed Coker**
  - Improved Gasification Technologies
  - Increased Domestic Petcoke Production
  - Increased delta between Natural Gas Prices and Petcoke
  - Gasification Project now considered

- **J3- Gasification Project launched**

⇒ *Sustainable cost advantage with gasification*
Gasification Spin-Off

- Refinery Off-Gas Cracker and d/s Units
  1. Cracker  Technip  1.4 mmt/yr
  2. MEG      Dow     730 kt/yr
  3. LDPE     Lyondell 400 kt/yr
  4. LLDPE    Univation 550 kt/yr

- Integration with Refinery & Petrochemical, world’s largest PX
  1. PX       CBI     2.2 mmt/yr
  2. Benzene  CBI     560 kt/yr

⇒ Boost (Refinery + Pet-chem) margins through Gasification Project!
Refinery

Crude → Refinery → Gasification → PX-4 → Future Chemicals

Gasification: Pivot for refinery + petrochemicals integration

− Existing
− New

C₂ + C₂= H₂ → ROG Cracker → MEG, LDPE, LLDPE

SNG → Syngas/cogen fuel

Pet coke → H₂ → Syngas/cogen fuel

Return → Reformate

Syngas/new htr fuel

PX → PX-4 → Benzene

Future Chemicals:
Methanol/ DME
MTO
Oxo-alcohols
Syn-Crude / FT

Aromatics

Ammonia/ Urea
Acetic acid

Olefins

⇒ Gasification: Pivot for refinery + petrochemicals integration
Gasification Configuration: BFD

**Config**
- 10 Gasifiers
- 4 in DTA refinery; 6 in SEZ refinery
- Modular design, 2 gasifiers /modules

**Feed**
- 1,150 MWth gasifier largest in the world
- 100% petcoke feed, ~2,900 tpd per gasifier
- 65% petcoke + 35% coal feed blend flexibility

**ASU**
- 5 ASU, 1 ASU/ gasifier module
- 5,250 t/d 99% O₂

**Product**
- 2.3 mmscmd NG equiv / gasifier (272 kNm³/hr)
- Repower 1,300 MW CPP with syngas and 1,700 tph of steam
- 1,160 t/d H₂, 2-4 mmscmd SNG (balancing product)
Gasification-Refinery Integration

Jamnagar – Now a highly Integrated Complex!!
## Syngas Distribution

<table>
<thead>
<tr>
<th>Syngas</th>
<th>mmscmd,NG eq</th>
<th>%</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cogen fuel</td>
<td>12.0</td>
<td>52</td>
<td>Power &amp; steam</td>
</tr>
<tr>
<td>$H_2$</td>
<td>5.4</td>
<td>23</td>
<td>Refinery clean fuels</td>
</tr>
<tr>
<td>SNG</td>
<td>4.1</td>
<td>18</td>
<td>Existing process heaters</td>
</tr>
<tr>
<td>Heater fuel</td>
<td>1.7</td>
<td>7</td>
<td>New process heaters</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>23.2</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

$\Rightarrow$ **100% captive consumption of syngas**
## Gasification : Processing Blocks

<table>
<thead>
<tr>
<th>Processing</th>
<th>Name</th>
<th>Purpose</th>
<th>Licensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasification</td>
<td>E- Gas</td>
<td>Gasification of petcoke/coal</td>
<td>CB&amp;I</td>
</tr>
<tr>
<td>ASU</td>
<td>Air Separation Unit</td>
<td>Supply O₂ for gasification</td>
<td>Linde</td>
</tr>
<tr>
<td>Shift</td>
<td>Water gas shift</td>
<td>Convert CO to H₂</td>
<td>Fluor</td>
</tr>
<tr>
<td>AGR</td>
<td>Acid Gas Removal</td>
<td>Removal of H₂S + CO₂ from syngas</td>
<td>Linde</td>
</tr>
<tr>
<td>PSA</td>
<td>Press Swing Adsorption</td>
<td>Recovery of H₂ from shifted syngas</td>
<td>Linde</td>
</tr>
<tr>
<td>SNG</td>
<td>Substitute Natural Gas</td>
<td>Methanation of syngas</td>
<td>JM Davy</td>
</tr>
<tr>
<td>LTGC</td>
<td>Low Temp Gas Cooling</td>
<td>Cool syngas to ambient</td>
<td>Fluor</td>
</tr>
<tr>
<td>SRU</td>
<td>Sulphur Recovery Unit</td>
<td>Recover sulphur @99.9%</td>
<td>WorleyParsons</td>
</tr>
<tr>
<td>SFU</td>
<td>Sulphur Forming Unit</td>
<td>Formed S product as granules</td>
<td>Enersul</td>
</tr>
<tr>
<td>SWS</td>
<td>Sour Water Stripper</td>
<td>Remove H₂S + CO₂ + NH₃</td>
<td>Fluor</td>
</tr>
</tbody>
</table>
Execution Challenges

- **Construction Safety**
  - Safety Commitment & Implementation

- **Construction QMS**
  - Quality Performance Index
  - In-Process Quality Control

- **Process Safety Hazards: Handling of Toxic & Flammable Chemicals**
  - Conservative designs – compliance to international standards (AIGA/EIGA)
  - Design-in Safety – Controls, Alarms, and Safety Interlocks
  - Consequence Analysis Studies for various scenarios, Emergency Response Plan

⇒ **No compromise on safety!**
Successful Gasifier operation depends on:

- **Consistent quality of feed-stock (Petcoke + Coal)**
- **Proper blend of fluxant**
  - Study on effect of fluxant to feed ratio on ash viscosity with temperature – Optimized fluxant to feed ratio
- **Slurry properties like PSD, stability, strength, and viscosity (Flowability / Pumpability)**
  - Study on slurry preparation using optimized fluxant to feed ratio – Optimized slurry stability, strength, and viscosity
- **Life of slurry mixer (burner)**
- **Slag flow characteristics & Refractory Life**
- **Identify scale-up issues if any**
  - Study using optimized slurry for understanding the reaction kinetics using equipment in entrained flow environment
  - Validating scaled up Gasifier design using kinetics and CFD modeling

⇒ **Flawless and smooth Start-up!**
Operational Preparedness

Extensive Dynamic simulation study of:

- Gasification module to validate control philosophy provided by Licensor
- Network analysis for Syngas, Steam and Oxygen headers covering all the units of Gasification complex
- Integration of Gasification complex with rest of the existing refinery complex
- Extensive use of OTS for operational training

⇒ Facilitating Flawless and smooth Start-up!
Project - Scope & Status

Project Engineering:
- PFD, #: 115
- P & ID, #: 1,690

Equipment:
- Equipment, #: 2,920
- Piping isometrics, #: 200,000

Materials:
- Concrete, million cum: 1.1
- Structural steel, kt: 210
- Piping, million in m: 14.1
- Electrical cable, km: 3,900
- Instru. cable, km: 6,500

Status, % complete
- Gasifier: DTA 4, SEZ 6
- Engineering: DTA 99, SEZ 99
- Procurement: DTA 99, SEZ 85
- Construction: DTA 70, SEZ 47

World’s largest construction site
- Construction workers > 100,000
- Cranes > 1700

⇒ Mega project: 2016-17 = years of startup
Future Vistas

- Value add gasification waste products
  - Recover NH\textsubscript{3} from sour water from gasification + refinery
  - Recover metals from gasification slag: Vanadium/ Nickel / Titanium
  - Utilize CO\textsubscript{2} for enhanced oil recovery (EOR)
- Syngas to Chemicals
  - Ammonia/ Urea
  - Methanol/ DME/ MTO
  - Acetic Acid/ Acetyl Complex
  - Oxo-Alcohols
  - Syngas to MEG
  - Syngas to SynCrude/ FT

⇒ Gasification can be a springboard for future value addition
Photo Gallery
World’s largest ASU
Gasification : Model

World’s largest Gasifier Reactor
AGR : Model

Propylene Refrigeration Section
SRU tail gas wash column
Unshifted Methanol wash column
CO2/ Tail gas vent stack (140 m)
Hot Regenerator (2*60%)
Tail gas column
CO2 product column
Shifted Methanol Wash Column (2 nos)
Petcoke Dome Storage

⇒ Petcoke storage with stacker + reclaimer
Gasification Island

Gasification Reactor

High Temp Heat Recovery (HTHR)
Acid Gas Removal

AGR-Regeneration column

AGR Methanol Wash Column
Air Separation Unit
RIL Gasification Complex

Global landmark in Gasification

Path-breaker for Indian Energy Sector
Thank You