Carbon Dioxide Recovery (CDR) Project
Established in December 1979

Joint-Venture between the Government of Bahrain, SABIC & PIC

Utilizes Natural Gas as raw material

Started production in 1985: Ammonia, Methanol

Started Urea Production in 1998

Started production in 1985: Ammonia, Methanol and Urea

MHI CDR plant commissioned in 2009
Our Mission

To add value to our customers and shareholders by meeting their expectations whilst:

Producing high quality products

Focusing on customers

Optimising business in a cost effective, safe, environmentally friendly and socially responsible way

Embracing knowledge, creativity and best practices

Our Vision

To be a global, dynamic world-class petrochemical and fertilizer company of choice recognized for excellence.
GPIC Mission & Vision

GPIC Core Values

- Excellence
- Integrity & Fairness
- Respect
- Transparency
- Safety
- Professionalism
- Social Resp.
Total Production

Total of 1.6 Million TPY

Urea
(684,000 TPY)

Ammonia
(454,860 TPY)

Methanol
(444,030 TPY)
Marketing & Export

Annual export of **1.2 Million tonnes** to the International Market through cooperation and coordination with GPIC’s Shareholders

Carbon Dioxide Recovery (CDR) Project
Objective of CDR Project

Increase Production

- Urea production by ~26,400 MT per annum
- Methanol production by ~39,600 MT per annum

Preserve Environment

- Reduce the emission of greenhouse gases
- Recovery of 148,500 MT per annum of CO$_2$

Objectives of the CDR Project
GPIC President

Project Manager

Project Coordinator

GPIC Project

GPIC President

Project Manager

Project Coordinator

Senior Engineer (Process)

Process Engineer

Senior Engineer (Engg)

Project Engineer

Maint. Supdt (Mech. Equipment)

Mechanical Engineer

Senior Engineer (Inst. & Elect System)

Instrument Engineer

Utilities Supdt (Utilities)

Util. Plant Engineer

Planning Supdt (Project Planning)

Sr. Planning Engineer

Senior Finance Accountant

Budget Controller

Carbon Dioxide Recovery (CDR) Project
Project Materialization

CDR Project Feasibility Study

• Explore the market and price outlook for both Methanol and Urea in the medium and long term
• Explore technology options and project cost
• Assess the economics (e.g. ROI, IRR)
Strategic outlines during Project conceptualization

GPIC strategic outlines were in terms of....

- Selection criteria for the CDR plant Capacity
- Selection criteria for the Technology
- Selection criteria for the EPC Contractor
Selection criteria for the CDR plant Capacity

- Proven production capacity
- Capacity similar to regional and international practice
- Capacity compatible with GPIC raw materials (i.e. similar flue gases) and space availability for the Project

450 MTPD capacity of CDR Plant
Selection Criteria for the Technology

• Proven technology

• Reliable in terms of operation and maintenance

• Positive Environmental impact

MHI’s CDR technology
Selection criteria for the EPC Contractor

• Contractor with relevant experience

• Contractor with proven records (financially and operationally)

• Competitive offer

Technimont ICB
(Italian-Indian joint venture Company)
Compilation of ITB

CDR team compiled the Specs, standards and Scope of Works and all the requirements identified during the conceptualization and planning phases of the Project in the ITB.
Requirements During Project Planning Phase

• Maximum involvement of GPIC’s operation, maintenance, engineering, and finance since inception of the Project.

• EPC Contractor to accommodate operation, maintenance and training requirements during the basic and detailed engineering phases.

• GPIC’s approval is a “must” for Vendors and Subcontractors’ selection.
Requirements During Project Planning Phase

• Visits to be arranged to similar operating plants to learn from their experience

• Project Management shall be through GPIC project team

• Synergy and Integration study with the existing plant to be carried out

• Third party inspection of critical equipment

• Commissioning of the plant shall by the owner’s personnel, under the supervision of the EPC Contractor
Requirements During Project Planning Phase

- Use of effective Planning and Scheduling tools.
- HAZOP review should be carried out during development, engineering and implementation of the Project.
- Pre Start-up Safety Review and Hazard study at the end of the construction stage prior to start up.
- Carry out the Environment Impact Assessment & Business Risk Assessment for the Project.
# CDR Milestones

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date</th>
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<tbody>
<tr>
<td>CDR Agreement Signing</td>
<td>25&lt;sup&gt;th&lt;/sup&gt; October 2007</td>
</tr>
<tr>
<td>KS1 Solution Agreement Signing</td>
<td>4&lt;sup&gt;th&lt;/sup&gt; April 2008</td>
</tr>
<tr>
<td>Construction Works Commencement</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; June 2008</td>
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<tr>
<td>Inauguration by GPIC MD</td>
<td>27&lt;sup&gt;th&lt;/sup&gt; August 2008</td>
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<tr>
<td>Electrical Works Completion</td>
<td>25&lt;sup&gt;th&lt;/sup&gt; November 2009</td>
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<tr>
<td>Mechanical Completion</td>
<td>25&lt;sup&gt;th&lt;/sup&gt; November 2009</td>
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<tr>
<td>Instrument Works Completion</td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; December 2009</td>
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<tr>
<td>Boiler Commissioning</td>
<td>5&lt;sup&gt;th&lt;/sup&gt; December 2009</td>
</tr>
<tr>
<td>CO&lt;sub&gt;2&lt;/sub&gt; Production</td>
<td>20&lt;sup&gt;th&lt;/sup&gt; December 2009</td>
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List of tie-ins

- Flue gas (at reformer stack)
- Service water
- Product CO$_2$ (at urea B/L)
- Natural gas
- SW supply / return
- FCW supply / return
- LH steam
- Potable water
- Nitrogen
List of tie-ins

- Plant air
- Instrument control power
- Electric power
- DM water
- Fire water
- Instrument air
- Steam condensate
Technical Features of MHI’s Technology

MHI’s flue gas CO$_2$ capturing technology uses a solvent which is patented as KS-1, an amine based solvent.

Following are the main features:

- Solvent has high loading rate
- Low residual CO$_2$ in the lean solvent, overall recovery process efficient
- KS-1 solvent not very corrosive
- Formation of heat stable salts – minimum
- Frequency of reclamation – very low
- Incinerator required to dispose off the degraded solvent.
CO₂ Gas Balance after CDR

**Ammonia Plant**
- 1300 MTPD
- 29,000 Nm³/h

**CDR unit**
- 450 MTPD
- 9,550 Nm³/h

**Flue Gases**
- (123,000 Nm³/h)

**Methanol Plant**
- 1230 MTPD
- 23,000 Nm³/h
- 6,000 Nm³/h

**Urea Plant**
- Approx 1950 MTPD
- 32,550 Nm³/h

Carbon Dioxide Recovery (CDR) Project
CDR Safety

ONE Million man hours worked without LTA

- Safety procedures
- Daily toolbox talks
- Emergency procedures
- Frequent safety audits
- Designated safety watch
CDR Benefits

- GPIC urea and methanol production increased by 200 MTPD.

- The specific energy consumption per ton of Methanol and Urea has reduced post CDR operation.
CDR Photos
CDR Photos

CDR Construction Site Aerial View
Carbon Dioxide Recovery (CDR) Project
Thank You