MHI Air-Blown IGCC Technology
&
Application to Chinese Project

November, 2011

Outline of MHI Air-Blown IGCC System

Key is Engineering Ability to Integrate Total System Configuration Effectively

Stack
Pulverizer
Hopper
Cooling Water
Compressor
Air
Slag Hopper
Coal
Gas Turbine
Air
Generator
Transformer
Heat Recovery Steam Generator
Gasifier
Heat Exchanger
Recycled Char
Steam Turbine
Gas Treatment
ASU
Air
N2
O2

Features of MHI Air-Blown IGCC

- Air-Blown IGCC is MHI’s original technology and supplied only by MHI.
- MHI Air-Blown IGCC achieves the world highest efficiency.
  - Air-blown ➔ Lower auxiliary power (Large Capacity ASU units are not necessary)
  - Dry coal feed ➔ Lower heat loss than slurry feed

Compact ASU for N2 product: Byproduct O2 is effectively utilized as gasifying agent
Achieved Successful Operation!

- Full Load (250MW) : March, 2008
- 2,000hrs. Continuous Operation : Sep., 2009
- 5,000hrs. Durability Test : June, 2010

Unburnt carbon in slag: < 0.1wt%

Performance

<table>
<thead>
<tr>
<th>Performance</th>
<th>Target</th>
<th>Achievement</th>
<th>Future Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>250MW</td>
<td>250MW</td>
<td></td>
</tr>
<tr>
<td>Efficiency (LHV)</td>
<td>&gt; 48%</td>
<td>48.9%</td>
<td>&gt; 42%</td>
</tr>
<tr>
<td>Carbon Conversion</td>
<td>&gt; 99.9%</td>
<td>&gt; 99.9%</td>
<td></td>
</tr>
<tr>
<td>NOx</td>
<td>&lt; 5 ppm</td>
<td>&lt; 5 ppm</td>
<td>&lt; 4.8 ppm</td>
</tr>
<tr>
<td>Dust</td>
<td>&lt; 0.1 mg/m³</td>
<td>&lt; 0.1 mg/m³</td>
<td></td>
</tr>
</tbody>
</table>

Operational Flexibility

<table>
<thead>
<tr>
<th>Operational Flexibility</th>
<th>Target</th>
<th>Achievement</th>
<th>Future Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal Kinds</td>
<td>Bituminous</td>
<td>Sub-bituminous</td>
<td>Chinese PRB</td>
</tr>
<tr>
<td>Start-up Time</td>
<td>&lt; 18 hr</td>
<td>15 hr</td>
<td></td>
</tr>
<tr>
<td>Minimum Load</td>
<td>50%</td>
<td>Less than 50%</td>
<td></td>
</tr>
<tr>
<td>Ramping Rate</td>
<td>3% / min</td>
<td>3% / min</td>
<td></td>
</tr>
<tr>
<td>Long-Term Operation</td>
<td>5,000 hr</td>
<td>5,013 hr</td>
<td></td>
</tr>
<tr>
<td>Reliability Run</td>
<td>5,000 hr</td>
<td>5,013 hr</td>
<td></td>
</tr>
</tbody>
</table>

> All of the demonstration targets have been achieved.
> Future plan focuses on the further improvement of operational flexibility.
The earthquake (M9) and tsunami attacked the Demo. Plant on Mar. 11, 2011.
All facilities flooded 2 m above the ground level and piping, etc. damaged,
but the plant shut down quite in safe,
with neither dangerous situation like syngas leakage nor explosion.
No fatal damage due to the earthquake-resistant design of main equipments.
After 4.5 months restoration, the plant came back, and since July 28
it has been continuously operating for 1,500 hrs. right now at full load.

Present Status of 250MW IGCC Demonstration Project (Nakoso)

Mitsubishi Air Blown IGCC for Chinese Market
and Chinese IGCC FS with China Power Investment Corporation

Chinese IGCC Project for CPI
- NEDO FS Scheme -
Chinese IGCC Project for CPI
- PS Overall Schedule -

- Ongoing Design and Estimation with NCPE & DEC -

- Conceptual 3D model with Scope -

Chinese IGCC Project for CPI
- Overview -

Chinese IGCC Project for CPI
- Expected Performance of -

Note: Ambient condition; temp. 11.4°C, pressure 1.0152 bar, RH 61%.
Conclusion

1. Mitsubishi Air Blown IGCC
   1) Ready for commercial application
   2) World Highest Efficiency
      ⇒ Decrease CO₂ / Efficient use of coal resource

2. Cooperation with Chinese Partners
   (NCPE & DEC)
      ⇒ Competitive IGCC in China

3. Successful cooperation in China
   ⇒ Contribute to competitive IGCC worldwide

Commercial scale IGCC in China
   = Key for IGCC development worldwide

"Mitsubishi’s Contribution for Energy and Environment Solutions"

Thank you!!