Project Status of 250MW Air-blown IGCC Demonstration Plant

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by
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Executive Vice President
Clean Coal Power R&D Co., Ltd
Clean Coal Power
R&D Co., LTD

Established: June 15, 2001

Purpose: Design, Construction and Operation of Japanese IGCC Demonstration Plant

Shareholders: 10 Japanese Electric Power Companies

Officers: President & CEO Mr. H. Onishi
Executive Vice President Mr. S. Kaneko
Managing Director Mr. S. Honda
Clean Coal Power
R&D Co., Ltd.

30% subsidy

Joint Project Agreement

Hokkaido EPCo.
Tohoku EPCo.
Tokyo EPCo.
Chubu EPCo.
Hokuriku EPCo.
Kansai EPCo.
Chugoku EPCo.
Shikoku EPCo.
Kyushu EPCo.
Electric Power Development Co.
CRIEPI

70% contribution

Personnel

METI

METI : Ministry of Economy, Trade and Industry
EPCo. : Electric Power Company
CRIEPI : Central Research Institute of Electric Power Industry
Demonstration Plant
—Final Stage to Commercial Plant

High Efficiency
Economy
Reliability
Environmental Performance

Clean Coal Power
Energy Sources for Power Generation in Japan (2000)

**Capacity**
- LNG: 25%
- Oil: 21%
- Coal: 13%
- Nuclear: 20%
- Hydro: 19%
- Others: 2%

**Total Capacity: 229 GW**

**Power Generation**
- LNG: 26%
- Oil: 10%
- Coal: 18%
- Nuclear: 34%
- Hydro: 10%
- Others: 2%

**Total Power Generation: 941 x 10^3 GWh**

Clean Coal Power
Clean Coal Power

Conventional Coal Fired Power Plant

- 1000MW class
- USC steam condition
  - 24.1MPa (3495 psi)
  - 600/610 deg-C (1112/1130 deg-F)
  - Net Efficiency: 42% LHV
- High Environmental Performance
  - SOx: 50ppm vol.
  - NOx: 45ppm vol. 6%O₂
  - PM: 10mg/m³N 6%O₂
Trend on Coal Fired Power Plant Efficiency

- **Conventional:**
  - 24.1MPa
  - 538/566 deg-C

- **Demonstration Plant**
  - 566/566

- **Commercial Plant**
  - 1500 deg-C G/T

Net Power Plant Efficiency (LHV%)

(year)

Clean Coal Power
**CO₂ Emission by Fuel and Cycle**

- **Coal**
  - Conventional (538/566°C)
  - Conventional (600/610°C)
  - IGCC (1500°C G/T)

- **Oil**
  - Conventional (538/566°C)

- **Nat. Gas**
  - Conventional (538/566°C)
  - Combined (1500°C G/T)
Nakoso Power Station

IGCC site
Conceptual Drawing of IGCC Demonstration Plant

- Gasifier
- Gas Cleanup
- Air Separation Unit
- Turbine Train
Schematic Diagram of IGCC

- Air-blown Gasifier
- Gasifier
- Syngas
- Porous Filter
- Char
- Dry Coal Feed
- Air
- N₂
- O₂
- ASU
- Gypsum Recovery
- Gypsum Recovery
- Combustor
- Air Separation Unit
- Combined Cycle System
- Clean Coal Power
### Design of IGCC Demonstration Plant

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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Fuel Capacity</strong></td>
<td>1700 tons/day</td>
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<tr>
<td><strong>G/T</strong></td>
<td>701DA</td>
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<td>TIT:1200 C(2190 F)class</td>
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<td><strong>Gross Output</strong></td>
<td>250 MW (GT:130 MW)</td>
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<tr>
<td><strong>Net Plant Efficiency</strong></td>
<td>42 % (LHV)</td>
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<td><strong>Emission Level</strong></td>
<td>SOx / NOx / PMs:</td>
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<td>8ppm / 5ppm / 4mg/m³N</td>
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**Air-blow Entrained Flow Gasifier**

**Air-Blown**
- Lower auxiliary power consumption than oxygen-blown

**Two Stage**
- Best balance of syngas calorie for GT combustion and high temperature for melting ash
- Effective gas/slag quenching at the 2nd stage with coal gasification endothermic reaction

**Dry-Coal-Fed**
- Higher thermally efficient than Slurry-Coal-fed
Oxygen-blown v.s. Air-blown IGCC in Plant Efficiency (based on 1300 deg-C G/T)

- Higher net power plant efficiency
- Best system for power generation
### History of Development of Air-blown IGCC

<table>
<thead>
<tr>
<th>Year</th>
<th>PDU and Pilot Plant</th>
<th>Demonstration Plant</th>
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<tbody>
<tr>
<td>1986</td>
<td>2 t/d PDU</td>
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<tr>
<td>1990</td>
<td>200 t/d Pilot Plant</td>
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<td>1995</td>
<td>24 t/d Confirmation Plant</td>
<td>Basic Research for Demo. Plant</td>
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<td>2000</td>
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<td>2005</td>
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<td>2009</td>
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- **PDU and Pilot Plant**
  - 2 t/d PDU
  - 200 t/d Pilot Plant
  - 24 t/d Confirmation Plant
  - Basic Research for Demo. Plant

- **Demonstration Plant**
  - Demo. Plant
  - Design, Construction, Operation
200t/d Pilot Plant -1986〜1996-  
Total Operating Hours : 4770hrs

Gas cleanup (hot)
Gasifier
Control Room
G/T

Clean Coal Power
200t/d Pilot Plant

- National R&D Project
  (MITI/NEDO/IGC/MHI etc)
- Site
  Nakoso Power Station
  at Iwaki City, Fukushima Pref.
- Key Dates of the Project
  - Start of Erection : Jan.27 ’88
  - Start of Gasification : Jul.23 ’91
  - Completion of Test : Mar. ’96

- Accumulative Total Operating Hours
  - Gasifier : 4770hrs
  - Gas clean up : 2981hrs
  - Power Generation : 1643hrs
  (as of Mar.1996)

- Maximum Continuous Operating Hours
  - 789hrs
  (Mar.3 ’95 - Apr.5 ’95)
Pressurized 24t/d IGCC Confirmation Test Plant
## Schedule of IGCC Demonstration Plant Project

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
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<tbody>
<tr>
<td><strong>Demonstration Plant Tests</strong></td>
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<td>Design of plant</td>
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<td>Construction of plant</td>
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<td><strong>Environmental Impact Assessment</strong></td>
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Environmental Impact Assessment (EIA)

- Takes 3 years or more due to Japanese Regulation
- Includes variety of viewpoints:
  Air Pollution, Sea Water Pollution/Warming,
  Biology, Disposals, Global Warming and Landscape
EIA (Ambient Air Measurement)
EIA (Underwater Environment Survey)
Conclusion

1. Clean Coal Power R&D Co., was established by 10 Japanese Utilities.
2. CCP to construct 250MW Air-blown IGCC Demonstration Plant
3. Nakoso, northern Japan, was chosen for Demo plant Site.
4. Environmental Impact Assessment underway