Siemens Gasification Technology at the World’s Largest Coal to Polypropylene Plant

Gasification Technologies Conference
San Francisco, October 2011

Siemens: Frank Hannemann
Wang De Hui
SNCG: Yang Jia Yi
Huang Bin
Siemens AG – Strategy Review
Reorganization in order to better serve our customers

The planned structure as of October 1, 2011

Industry
- Industry Automation
- Drive Technologies
- Service

Infrastructure & Cities
- Power Distribution/
  Smart Grid Applications
- Building Technologies
- Mobility

Energy
- Fossil Power Generation
  Gasification
- Renewable Energy
- Power Transmission
- Oil & Gas
- Energy Service

Healthcare
- Imaging & Therapy
- Clinical Products
- Diagnostics
- Customer Solutions

Industry Solutions
- Osram

Osram
Building Technologies
Mobility

Power Distribution
Siemens products and solutions along the entire Energy Conversion Chain
Shenhua Ningxia Coal Industry Group Co., Ltd.

- Registered capital: US$ 1.6 billion (51% Shenhua, 49% Ningxia government)
- Total assets: > US$ 9.4 billion by 12/2009
- > 50,000 employees
- Current coal production: > 60 million t/a
- Aim: coal production: > 100 million t/a

GSP China Technology CO., Ltd.
- Joint Venture: 50/50 SNCG / Siemens AG
- Set up on 23rd May, 2005
- Exclusive GSP Licensor for China

Operating SNCG projects
- NCPP I
- 2 Coal to MeOH and DME

Planned projects
- NCPP II (500kt/a PP based on Lurgi MTP)
- CTL (under design) (>20 x 500 MW SFG gasifier)
- SNG (planning)
Evolution of CTC/CTL in China
— Plants in Operation —

Coal is dominant in China
→ annual coal production 2,300 Mt (2007), 3,200 Mt (2010)
Before 2005: Coal to chemical industry used mostly fixed bed gasifiers to produce ammonia and methanol
After 2005: Entrained flow gasification considered mature and available to bring coal chemical industry into modern stage

Demonstration of coal to SNG
- DaTang: 2 projects under construction, 4 billion Nm³/a each
- CPI: project in the range of 6 Billion Nm³/a

Large Coal to Liquid
- ShenHua Ningxia CTL 3.6 Mt/a (starting late 2011)
- YiTai 5.4 Mt/a CTL (gasification technology selection)

<table>
<thead>
<tr>
<th>Milestone projects in China</th>
<th>Capacity</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ShenHua Direct Coal To Liquid</td>
<td>1 Mt/a diesel</td>
<td>2008</td>
</tr>
<tr>
<td>2. Shenhua Baotou CTO</td>
<td>1.8 Mt/a methanol</td>
<td>2010</td>
</tr>
<tr>
<td>3. ShenHua NingXia CTP</td>
<td>500 kt/a PP</td>
<td>2011</td>
</tr>
</tbody>
</table>
Plant Concept of Ningxia Coal to Polypropylene (NCPP I)

Technical features
- 540,000 Nm³/h (CO+H₂)
- CO₂ carrier gas for coal feeding
- LPG/Syngas as pilot burner gas

SIEMENS Scope
- PDP+
- Gasifier, Feeder Vessel, Feeding Internals, Burners, Coal Flow Measurement
- DCS / SIS controls
- Technical Field Assistance (TFA)
NCPP Project
Site Impression

Gasifier Building
Slag Formation on Cooling Screen

Water Treatment Plant
CO Shift
Gasifier Building

Page 8
GTC 2011
Siemens Energy Sector
NCPP | Main-Achievements

Passed milestones

- Start Erection (SIEMENS Proprietary Equipment) January 2009
- TFA Service July 2009
- Start Cold Commissioning September 2010

Oct 31\textsuperscript{st}, 2010  \hspace{1cm} \rightarrow \hspace{1cm} \textbf{FIRST FIRE PILOT BURNER}
On October 31\textsuperscript{st}, 2010 at 04:20 pm (local Chinese time) the first SFG-500 gasifier (NCPP unit 3) was started-up.

Dec 31\textsuperscript{st}, 2010  \hspace{1cm} \rightarrow \hspace{1cm} \textbf{FIRST METHANOL PRODUCTION}
On December 31\textsuperscript{st}, 2010 at 06:36 am (local Chinese time) the first methanol (from Line 4 and 5) was produced. Syngas production was stable and syngas quality was very good (CO+H\textsubscript{2} > 84 %).

Since April, 2011  \hspace{1cm} \rightarrow \hspace{1cm} \textbf{Start Pre-Commercial Operation to Produce Polypropylene and successful Commissioning by joint efforts of SFGT and SNCG}

September, 2011  \hspace{1cm} \rightarrow \hspace{1cm} \textbf{Performance test run of gasifiers completed}
Gasifier Performance

Main Parameters

- > 75 t/h coal flow
- > 40,000 Nm³/h O₂ flow
- > 120,000 Nm³/h syngas flow
Siemens Fuel Gasifier (SFG-500)
Technology Highlights

Dry feeding
- high efficiency
- high carbon conversion rate (> 98 %)

Cooling screen
- short start-up / shut-down
- low maintenance and high availability

Full quench
- simple and reliable
- ideal for CO sour shift

Multi-fuel gasifier
- accepts a wide variety of fuels
- fully assembled shipped

Single main burner with integrated pilot burner
- automatic start up without removal of start burner
- modular concept for simplified maintenance
- pilot burner secures hot stand by under full pressure

Key facts (SFG-500)
- Length: 18 meters
- Inside diameter: 3 meters
- Outside diameter: 3.5 meters
- Weight: 220 tons
Demonstration and Performance

**Improvements during commissioning**

- Usage of proper coal in the beginning → *slagging improved*
- NG replaces LPG for ignition → *more flexibility*
- Δp increase of coal feeding → *more stable/stability improved*
- Measures against erosion and blockages in black- and quench water system → *improved piping*
- I&C interlock optimization

**Further optimization**

- Improvement of measurement accuracy
- Gas cleaning and particle removal

---

**Graph:**

- Temperature [°C]
- Viscosity [Pa*s]

**Coal change for improved slagging**

**Protective covering downstream flash valve**

**Connection of water from venturi to K/O drum**
Future Collaboration of SNCG & Siemens

CTL project introduction

**Facts and Figures**
- > 20 x 500MW SFG gasifiers
- With increased local content

**Coal analysis [wt]**
- Moisture: 19 wt %
- Ash: 11 wt %
- Volatile: 23 wt.-%
- Fixed C: 47 wt %

**Schedule**
- End 2011: PDP
- Mid 2013: Gasifier delivery
- End 2016: Start commissioning

Worlds largest CtL plant close to NDRC approval
CPI Yinan
Coal-to-SNG Project

Client & Project:
- **Client:** CPI - China Power Investment Corporation
  One of first major utilities in China to build coal to SNG
- **Project:** First phase (2 bill Nm³/a) of a 6 bill Nm³/a SNG project
- **Location:** Yili City Xinjiang Province, PR China

Scope of SFGT:
**Supply of SIEMENS Proprietary Equipment:**
- PDP / BEDP (supported by Design Institute ECEC)
- Training, Technical Field Assistance
- 8 x 500 MW standard gasifier and burners
- 8 x Feeder vessels
- I&C system for burner management
- Coal dense flow measurement devices and feeding internals

Schedule:
- **Contract signed:** 27th July 2011
- **BEDP delivery:** April 2012
- **Gasifier supply:** early 2013
- **Start Commissioning:** mid 2014
Summit Power Group,
Texas Clean Energy Project, Odessa, TX

- 400 MWₑ “Polygen” IGCC project (Urea & Power)
- 90% carbon capture
  (2.7M tons of CO₂/year; CO₂ emissions only 20 to 30% of a natural gas combined cycle)
- Siemens to supply
  - SFG-500 gasifiers
  - SGCC6-5000F 1x1 operating on high H₂ syngas
  - Plant Operation and Maintenance services (JV with Linde)
- Will be build on an EPC basis by Linde/ SK Engineering (gas island and urea) & Siemens (power block)

Offtake Agreements finalized ➔ Financial Close targeted for end of 2011

Other recent IGCC projects with Siemens Gasturbines

- China: Huaneng Greengen Co. Ltd. Tianjin IGCC Project
  - 1 SGT5-2000E gas turbine and auxiliaries
- USA: Mississippi Power Plant Ratcliffe
  - 2 SGT6-5000F Gas Turbine Generators
Conclusion

SFG Technology

- Successful demonstration of SFG gasifiers in NCPP I
- Siemens gasification technology selected for 3 lighthouse projects
  - CPI, SNCG CTL and Summit

Future of Coal Gasification in China

- Large scale CTC demonstration plants in China moving forward
- China pioneers mega CTL and CTO technologies
- Polygeneration expected to further improve CTC application

SNCG (and Coal Chemical Base)

- Largest Coal to PP (NCPP I) in operation
- Demonstration of SFG 500 MW gasification class and Lurgi’s MTP process
- Ambition: build-up of coal chemical base containing ≥ 100 gasifier units including CTL, NCPP II and SNG plants
Disclaimer

This document contains forward-looking statements and information – that is, statements related to future, not past, events. These statements may be identified either orally or in writing by words as “expects”, “anticipates”, “intends”, “plans”, “believes”, “seeks”, “estimates”, “will” or words of similar meaning. Such statements are based on our current expectations and certain assumptions, and are, therefore, subject to certain risks and uncertainties. A variety of factors, many of which are beyond Siemens’ control, affect its operations, performance, business strategy and results and could cause the actual results, performance or achievements of Siemens worldwide to be materially different from any future results, performance or achievements that may be expressed or implied by such forward-looking statements. For us, particular uncertainties arise, among others, from changes in general economic and business conditions, changes in currency exchange rates and interest rates, introduction of competing products or technologies by other companies, lack of acceptance of new products or services by customers targeted by Siemens worldwide, changes in business strategy and various other factors. More detailed information about certain of these factors is contained in Siemens’ filings with the SEC, which are available on the Siemens website, www.siemens.com and on the SEC’s website, www.sec.gov. Should one or more of these risks or uncertainties materialize, or should underlying assumptions prove incorrect, actual results may vary materially from those described in the relevant forward-looking statement as anticipated, believed, estimated, expected, intended, planned or projected. Siemens does not intend or assume any obligation to update or revise these forward-looking statements in light of developments which differ from those anticipated.

Trademarks mentioned in this document are the property of Siemens AG, its affiliates or their respective owners.