TRIG™ Technology & Project Updates

Faisal Mohmand
Vice President, Coal Monetization
TRIG™ Technology Updates

Technology Delivery

KBR-SGT Alliance Technology Solutions

Market Impact

China IGCC Economics
Local supply

Project Updates

New Developments
Commercial Projects
KBR-SGT TRIG™ Alliance Signed Oct 2012

**KBR-Southern Alliance:**

- Technology available globally through KBR for all **Industrial and Power** applications of TRIG™ using low-rank coals
- Collaborative blending of skills and strengths of each company for global customers
- KBR leads all marketing and licensing activities

* Southern Generation Technologies (SGT) is a wholly owned affiliate of Southern Co.

©2013 KBR, Inc. All Rights Reserved | 3
KBR Focus is Technology Solutions

- **Lower CAPEX**
  - 5000 TPD single-gasifier coal capacity
  - High reliability
  - Superior environmental performance

- **Lower OPEX**
  - Enable low cost, low rank coal use
  - High efficiency

- **Maximize Returns**
  - Smart Integration
  - High value products
  - Low long-term COP

---

Coal

---

TRIG™

TRANSPORT INTEGRATED GASIFIER

---

Power

SNG

Chemicals/Fertilizers

CTL

Liquid Fuels

Syngas for DRI/Steel

---

Coal

---

O2/Air

Steam

---

Riser

Syngas

---

Loop-Seal

O2/Air

Char

---

J-Leg

---

Standpipe

---

Cyclones

---

Ash

---

©2013 KBR, Inc. All Rights Reserved
Access to Technologies Makes Solutions Possible

**Refining**
- ROSE
- Visbreaking
- Hydrocracking
- Hydrotreating
- FCC
- VCC

**Coal Monetization**
- TRIG™
- Power applications
- Industrial applications

**Olefins**
- Catalytic Olefins
- SCORE

**Chemicals**
- Phenol
- Advanced TransAlkylation
- Paraffin Olefin Separation
- C4 Acetylene Converter

**Ammonia and Syngas**
- Ammonia
- Fertilizers
- Syngas
- Hydrogen

**Advanced Chemical Engineering**
- OTS
- OMS
- Technical Services

**Proprietary Equipment**
- Refining
- Coal Monetization
- Olefins
- Chemicals
- Ammonia and Syngas

©2013 KBR, Inc. All Rights Reserved
## KBR Technology Solutions Utilizing TRIG™ Platform for Low Rank Coals

<table>
<thead>
<tr>
<th>KBR Solution</th>
<th>Comprehensive Technology Supply</th>
<th>Overall Guarantees</th>
<th>Integrated for Max Efficiency</th>
<th>Opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power - IGCC</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>800 MW, 2 Gasifiers, 43+% efficiency (LHV)</td>
</tr>
<tr>
<td>Ammonia - Grassroots</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>$150+ per ton ammonia feedstock cost savings ($25/ton coal vs $6/MMBTU gas)</td>
</tr>
<tr>
<td>Ammonia - Revamps</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>COP savings + add’l capacity</td>
</tr>
<tr>
<td>SNG</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>4 Bn NM³/yr: 60+% efficiency 8 gasifiers vs 20+</td>
</tr>
</tbody>
</table>

**KBR is actively developing these and other technology-based solutions which:**

- Leverage KBR’s portfolio (olefins, chemicals, refining, syngas, etc.)
- Access strategic partner technologies and capabilities
- Combine expertise to deliver better overall value for each customer
# Market Impact of TRIG™ Technology

Previous IGCC experience = market “fatigue”

KBR-SGT exploring possibilities with advanced TRIG™ technology to make IGCC a reality in China & globally

<table>
<thead>
<tr>
<th>Issue</th>
<th>Previous Evaluations</th>
<th>TRIG™ Possibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal Cost</td>
<td>Higher (market rate) w/higher quality coals</td>
<td>Low w/low rank coal</td>
</tr>
<tr>
<td>Capacity Limit</td>
<td>&lt;3000 TPD</td>
<td>5000 TPD coal feed</td>
</tr>
<tr>
<td>ASU Cost</td>
<td>High – oxygen needed</td>
<td>Eliminated – air blown</td>
</tr>
<tr>
<td>Environmental</td>
<td>Challenging, costly</td>
<td>Advanced performance</td>
</tr>
<tr>
<td>Drying</td>
<td>Tight requirements</td>
<td>Moderate, low impact</td>
</tr>
</tbody>
</table>
Market Impact of TRIG™ Technology

China IGCC Cost Study Status

- Assessed impact of advanced technology
- Maximized local content
- Improved economics to acceptable levels

July 2013
Study commissioned

Dec 2013
Present results in Beijing IGCC workshop

2014
Launch Project FS
Development Activities

SK Innovation Green Coal Program

- 3 MTPD TRIG™ Pilot Plant Operating since 2011
- Expand SK’s Global Energy & Chemicals Business
- Collaborating with KBR for developments & integrated commercial projects
  - Efficient drying of coal
  - Optimization of system integration

Shaanxi Yanchang Petroleum (YCPC)

- Adapt Transport Gasifier for higher rank coals with:
  - High capacity, reliability
  - High efficiency, environmental performance
  - Lower cost
- 100 MTPD Demonstration Unit (BED Completed)
- Begin coal testing program in 2015
**TRIG™ Commercial Project Updates**

### Kemper IGCC
- First fire of CT complete
- Update by Southern (Session 3)

### Dongguan IGCC Retrofit
- Syngas to replace diesel fuel (120 MW)
- Gasifier Fabrication Complete
- Awaiting Restart of Construction

### Berun Coal to MEG
- Gasifier Fabrication Complete
- Refractory Installation Starting
- Site Activities Expected to Start in 2014