Excelsior Energy’s Mesaba Energy Project

Benefits Presentation

Clean Coal Power Initiative
- Round 2 -

Next-generation Full-scale Integrated Gasification Combined Cycle (IGCC)
Using ConocoPhillips’ E-Gas™ Technology

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National Energy Technology Laboratory
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  - Coal-fired power plant emission comparison
  - Combustion utilization by-products
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Executive Summary

• Excelsior Energy’s Mesaba Energy Project will utilize next-generation Integrated Gasification Combined Cycle (IGCC) technology to achieve higher plant efficiencies and availability, lower emissions (including Hg), and lower operating costs (fuel flexibility and by-product marketability).

• The facility will test the 1600 operational lessons learned from eight years of hands-on experience at the DOE Clean Coal Technology (CCT) Wabash Coal Gasification Repowering Project in Terre Haute, IN (Wabash River).
Executive Summary (continued)

- The Mesaba Energy Project is the first phase (600 MWe) of a planned 2-phase operation that will also test multiple feedstocks.
- Avoided emissions through use of Mesaba contribute to a cleaner environment.
- Marketable by-products provide a potential positive annual cash flow stream at Mesaba.
Project Information

Plant, Fuel, Cost, Schedule, and Location

- Design, construction and operation of a new utility scale IGCC power plant using ConocoPhillips’ E-Gas™ technology for coal gasification at the Mesaba Energy Project (Mesaba)
- Nominal plant generation capacity 600 MWe (net)
- Plant designed to be fuel flexible
  - Base case fuel - bituminous coal (Illinois Basin No. 6)
  - Predominant case fuel - blended sub-bituminous coal (Powder River Basin) and petroleum coke
- Total project cost: $1.97 billion (DOE share: $36 million)
- Schedule
  - 2006 Project Start
  - 2006 to 2011 Construction
  - 2011 to 2012 Operations
Project Information (continued)

*Plant, Fuel, Cost, Schedule, and Location*

- **Preferred project location is West Range plant site**
  - Greenfield, land designated for auxiliary mining purposes
  - Iron Range near Taconite and Bovey, approximately 70 miles northwest of Duluth, MN
  - Remote location, near natural gas pipelines, high voltage transmission line corridors and viable rail service

- **Alternate project location is the East Range plant site**
  - Iron Range near Hoyt Lakes, approximately 50 miles north of Duluth, MN
  - Greenfield, former taconite mining operations are located nearby
  - Access to water and feed-stock transportation options
Project Information (continued)

Team Members

- **Excelsior Energy (Minnetonka, MN)**
  - Partner
- **Fluor Enterprises (Aliso Viejo, CA)**
  - Engineering, procurement and construction
- **ConocoPhillips (Houston, TX)**
  - Technology rights holder
Project Information (continued)

IGCC and ConocoPhillips E-Gas™ Process

- The Mesaba project will improve commercial scale IGCC performance as a result of:
  - DOE funded investigations of potential performance and technological upgrades
  - 1600 operational lessons learned from the CCT Wabash River Coal Gasification Repowering Project in Terre Haute, IN (Wabash River)
  - Research and development efforts of the DOE team and the ConocoPhillips team
Project Information (continued)

Mesaba Process Configuration
**Project Information (continued)**

**Air Emissions**

- Greater than 90% Hg removal from coal input
- Better than 99% S removal when combusting bituminous coal, slightly less for sub-bituminous coal
- $\text{NO}_x$ emissions reduced to 15 ppmvd @ 15% $\text{O}_2$
- Very low particulate matter emissions, i.e., on order of natural gas
- $\text{CO}_2$ emissions reduced by 15%
- $\text{CO}_2$ capture adaptable
Estimated Benefits

Approach

- Quantify emissions and those avoided emissions on an annual basis for Mesaba
- Compare emissions against those for other conventional coal-burning technologies
## Estimated Benefits (continued)

### Annual Emissions Reductions

<table>
<thead>
<tr>
<th>Air Emissions Avoided</th>
<th>100% Sub-Bituminous Coal (Tons/year)</th>
<th>100% Bituminous Coal (Tons/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur Dioxide (SO₂)</td>
<td>19,400</td>
<td>108,000</td>
</tr>
<tr>
<td>Nitrogen Oxides (NOₓ)</td>
<td>2,400</td>
<td>3,300</td>
</tr>
<tr>
<td>Carbon Dioxide (CO₂)</td>
<td>850,000</td>
<td>750,000</td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>0.12</td>
<td>0.16</td>
</tr>
</tbody>
</table>
## Estimated Benefits (continued)

### Coal-Fired Power Plant Emissions Comparison: 606 MWe (net) Basis, 90% Availability

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Supercritical Pulverized Coal (Tons/year)</th>
<th>Pulverized Coal with ESP &amp; FGD (Tons/year)</th>
<th>Circulating Fluidized Bed (Tons/year)</th>
<th>Mesaba IGCC (Tons/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO(_2)</td>
<td>3,370</td>
<td>4,140</td>
<td>3,500</td>
<td>560</td>
</tr>
<tr>
<td>NO(_x)</td>
<td>1,470</td>
<td>1,820</td>
<td>1,860</td>
<td>1,300</td>
</tr>
<tr>
<td>Hg</td>
<td>0.4</td>
<td>0.1</td>
<td>0.1</td>
<td>0.013</td>
</tr>
</tbody>
</table>
## Estimated Benefits (continued)

**Coal-Fired Power Plant Emissions Comparison:**

606 MWe (net) Basis, 90% Availability

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</tr>
</thead>
<tbody>
<tr>
<td>&gt;PM10</td>
<td>380</td>
<td>410</td>
<td>350</td>
<td>250</td>
</tr>
<tr>
<td>VOC</td>
<td>80</td>
<td>N/A</td>
<td>90</td>
<td>70</td>
</tr>
<tr>
<td>CO</td>
<td>2,530</td>
<td>2,270</td>
<td>2,560</td>
<td>760</td>
</tr>
</tbody>
</table>
## Estimated Benefits (continued)

### Combustion Utilization By-products

<table>
<thead>
<tr>
<th>Marketable Combustion By-Products</th>
<th>100% Sub-Bituminous Coal (Tons/year)</th>
<th>100% Bituminous Coal (Tons/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elemental Sulfur, TPY</td>
<td>9,700</td>
<td>54,000</td>
</tr>
<tr>
<td>Gasifier Slag, TPY</td>
<td>133,000</td>
<td>205,000</td>
</tr>
</tbody>
</table>

- A ready market exists for both by-products
- Existing transportation options provide cost effective access to these markets
Estimated Benefits (continued)

Regional

- **Reduced land disturbance**
  - Minimizes land and resource requirements
  - Recovered elemental sulfur and slag combustion utilization by-products offset both mining and landfill capacity for these materials

- **Reduced impact on local water sources**
  - Plant make-up water is readily available from existing abandoned mine pits
  - Zero liquid discharge system eliminates waste waters associated with contact cooling process
Estimated Benefits (continued)

Regional

- Remote location are not near major population center
- Both project locations zoned for industrial usage
- Construction employment could bring as many as 1000 temporary jobs
- Plant operation is anticipated to result in the addition of 300 to 400 permanent and support operations jobs to the area

Estimated Benefits (continued)
Estimated Benefits (continued)

National

- Will implement further refinements in IGCC, advancing the technology into mainstream national generation mix
  - Largely eliminates the uncertainty of emerging regulatory programs associated with greenhouse gas emissions, Hg, and fine particulate matter that would otherwise complicate the permitting of a conventional coal fired power plant
  - Availability increases to 90%, up from 77% at Wabash River, resulting in a smaller construction footprint
  - Integrated Air Separation Unit with Gas Turbine (first in U.S.) increases technology efficiency and reduces auxiliary electrical load
  - Standard replicable design configuration with sound basis for installed costs provides pathway for similar installations
  - Flexibility to process both high- and low-rank coals (and petroleum coke, which may have a negative economic value) into a clean synthesis gas that contains hydrogen
Estimated Benefits (continued)

National

- Reduced overall emissions, including CO₂
- Carbon capture adaptable
- Will utilize the Nation’s abundant coal resources and increase energy security as a result
- Further the President’s environmental initiatives for America:
  - FutureGen
  - Hydrogen Economy
Conclusions

- The Mesaba Project has excellent feedstock flexibility utilizing sub-bituminous and bituminous coal, as well as blends of sub-bituminous coal and petroleum coke.
- Mesaba will establish a standard replicable design configuration for future commercialization.
Visit the NETL web site for information on all Power Plant Improvement Initiatives and Clean Coal Power Initiative projects

www.netl.doe.gov/technologies/coalpower/cctc