A Study of Lignite-Based Advanced Generation Technology Systems

Contractor: Burns & McDonnell

Subcontractor: Microbeam Technologies, Inc.

Objective: Complete an advanced lignite generation technologies assessment for a new 500-750 MW base load unit using coal that is not upgraded, as well as coal that is upgraded.

Cost: $140,000 NDIC

Duration: August 1, 2009 – January 31, 2010 (6 months)

Scope of Work (Summary):

Task 1 & 2 – Investigation of ND Lignite Properties & Impact on Combustion Technologies

- Evaluate behavior of high moisture & high sodium-containing ash and its impact on the design, operations, & reliability of combustion & gasification systems
- Evaluate air pollution control devices
- Evaluation of past performance in existing lignite boilers & lignite gasification systems
- Evaluation of the applicability of supercritical pulverized coal (PC), ultra-supercritical PC, oxycombustion, atmospheric & pressurized fluidized bed combustion, integrated gasification combined cycle, & co-firing with both natural gas & biomass

Task 3 & 4 – Technology Assessment

Specific solid fuel-fired technology alternatives including supercritical and ultra-supercritical PC, CFB and IGCC will be evaluated to define screening level cost & operating parameters & assess their relative suitability/feasibility for lignite development.

Technology Alternatives:

- Supercritical PC
- Ultra-supercritical PC
- CFB
- IGCC
- Oxycombustion in a supercritical PC boiler
- Supercritical PC with natural gas co-firing
- Supercritical PC with biomass co-firing

NOx reduction technologies (hot, low-dust, tail gas SCR & SNCR), CO₂ capture technologies to be included in screening-level plant performance & cost estimates, and emission control technologies for Sox, particulates & mercury.
The following will be addressed:

- Development stages of each technology and if not yet commercial, steps required towards commercialization
- Industry trends and case studies of proven and leading edge technologies, either deployed or under development
- Technology risks and benefits along with risk mitigation options
- Technology building lock sizes for fuel combustion and environmental controls
- Expected permit level emissions required for each technology according to its implication on selection of boiler & air quality control technologies
- Equipment and technology’s applicability and experience utilizing high sodium lignite coals
- Performance and cost impact if using upgrade lignite.

Cost estimates will be prepared for technology alternatives, incorporating estimated requirements for emissions control technologies assuming a generic “Greenfield” site in North Dakota.

The specific solid fuel-fired technology assessment will be summarized in a table presentation identifying commercial status, capital and operating costs, and performance estimates for 500-750 MW applications.

The following screening-level data for each technology scenario will be provided:

- Net plant output, heat rate and heat input with & without CO2 capture
- Differential performance of the various technologies
- Power island cost $/kW; Busbar cost $/MWh; O&M costs
- Emission parameters
- Reliability
- Startup time, ramp rate and turn down capability

Task 5 – Kepner-Tregoe Analysis
A systematic decision making process commonly used, which will show the most promising technology system.

Task 6 – Reporting. A kick-off meeting, 1-quarterly report, draft final report, final report and presentation detailing the study findings in Bismarck.