BUILDING A WORLD OF DIFFERENCE

March 10, 2011

THE NON-SOLID FUEL PATHWAY FOR BOILER MACT COMPLIANCE

Ajay N. Kasarabada, P.E

Diane Fischer, P.E

BLACK & VEATCH
Building a world of difference.

WHY SHOULD YOU BE INTERESTED?

- **You are directly affected - solid fuel (coal and biomass) industrial boilers and utility boilers < 25 MW located at Major HAP facilities (>10/25 tpy)**
  - Traditional approach of install back-end AQC equipment can have issues
  - Rule uncertainty – Will target emission limits survive a legal challenge?
  - What if AQC is installed and the rule is struck down – Money well spent?
  - Remaining life of existing units vs. life extension vs. new solid fuel boilers – Are new unit emission limits technically feasible to meet?
- **Your customers/clients are directly affected**
  - Vendors for alternate generation technologies
  - Vendors of BOP equipment
  - Technical and economic feasibility studies

Compliance timeline clock has started ticking

THE NON-SOLID FUEL PATHWAY

- **Convert existing boilers to Gas 1 or "other Gas 1" category units**
  - Gas 1: natural gas, refinery gas
  - Other gas 1 fuel: < 40 µg/m^3 of Hg and < 4 ppmv H_2S.
- **Decommission existing solid fuel fired boilers and install new gas 1 fuel fired package boilers**
- **Install gas 1 fuel fired cogeneration systems (CHP) that utilize combustion turbines**
- **A combination of boiler gas conversion and cogeneration systems**

Gas 1 units, other Gas 1 units and combustion turbines do not have to meet BMACT emission limits

NON-SOLID FUEL PATHWAY – OVERALL ISSUES

- Compliance schedule
- Compliance requirements
- Technical issues
- Economic issues

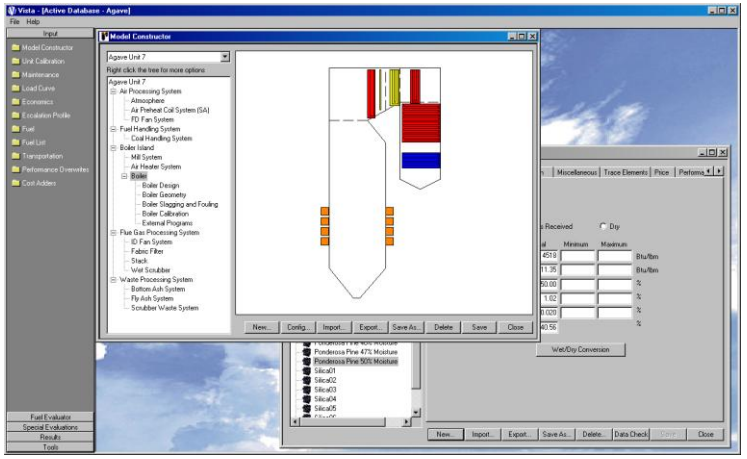
GAS CONVERSION STUDY ITEMS

- Determine permitting impacts
- Review the boiler and auxiliary equipment limitations
- Determine gas metering, cleanup equipment needs
- Determine the maximum practical gas load capability
- Evaluate modifications required to achieve current Boiler Maximum Continuous Rating (BMCR) with gas
- Develop estimated costs

Feasibility studies are critical

VISTA IS AN EXCELLENT TOOL TO STUDY GAS CONVERSION

- **Gas co-firing and repowering modeling capability**
- **B&V has studied the following fuels using VISTA:**
  - Natural gas
  - Bio-gas
  - Gasifier product gas
  - Refinery gas
  - Coke-oven
  - Blast furnace gas
  - Ethane and propane



- **Vista used in 2GW of coal-gas conversion studies in the last year.**
- **Key results include:**
  - Heat rate and efficiency.
  - Derate risk and equipment margins.
  - Emissions predictions
  - Maintenance differentials and equivalent availability changes.
  - Total fuel-related cost.

GAS CONVERSION - ESTIMATE OF CAPITAL AND OPERATING COSTS

- **Estimate of capital costs for the repowering**
  - Major equipment (including boiler modifications)
  - BOP and construction costs
  - Indirect costs
- **Estimate of incremental O&M costs**
  - Vista™ model results
  - Typically include:
    - Differential fuel cost
    - Potential environmental credits
    - Reduction in AQCS sorbent and catalyst materials
    - Differences in auxiliary power requirements.
    - Impacts to potential unit output
    - Maintenance requirements for non-essential equipment

An accurate pro forma analysis is required

COGENERATION BENEFITS

Key Metrics	Benefits
Efficiency	•Less fuel and less transmission losses
Reliability	•Operate independent of outside grid issues
Environmental	• Less fuel burned per each unit of energy output
Economic	•High efficiency and hedge against unstable energy costs

CHPs are ideal where thermal loads are high and electricity costs are > $0.07/kW-hr avg.

COGENERATION – CHP STUDY ITEMS

- Current thermal and power requirements
- Price prediction of gaseous fuels
- Price paid for purchased peak and non-peak power
- Capital costs
- Electrical interconnections and capability to put surplus power back on to the grid
- Reusing existing steam turbines
- Number of units and space issues
- Duct firing and HRSG/OTSG selection
- Integration with existing power and steam infrastructure
- Government incentives for implementing CHP systems – EPA's CHP Partnership

CHPs dramatically improve plant efficiencies

CHP DEVELOPMENT STAGES

- Qualification
- Level 1 feasibility analysis
- Level 2 feasibility analysis
- Procurement, and
- Operations and Maintenance

RECOMMENDED STEPS

- Determine MACT applicability
- Gather intelligence on your facility
- Develop compliance flowcharts and checklists
- Explore feasibility of back-end control (traditional AQC) and front-end fuel conversion and CHP technologies
- Conduct economic analyses
- Set internal deadlines and finalize strategy
- Agency interaction and execution of strategies

Proven steps to ensure Owner/Contractor collaboration

QUESTIONS?

B&V CONTACT:
Ajay Kasarabada
(913) 458-9837 KasarabadaAN@bv.com

Diane Fischer
(913) 458-7926 FischerDM@bv.com

Building a world of difference.®

Together

BLACK & VEATCH