Riley Power Inc.
Biomass Conversion of Existing Power Plants

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Biomass Power Plant

Typical Options

1) **New Biomass Power Plant**
   10 – 60 MWe

2) **Biomass Conversion of Existing Power Plants**
   (Original Coal Firing to 100% Biomass)
   10 – 60 MWe

3) **Biomass Co-firing with Coal** (Coal primary fuel)
   3 – 15% Biomass fuel (by heat input)
Conversions
Coal to Biomass Firing
Advantages

• Alternative to building a new power plants
  – Easier public acceptability since there is an existing power plant is in-place
  – Positive Public Perception of going from a dirty fuel to a Clean environmentally friendly Green fuel

• Reuses existing equipment / Offers a second life to older Power Plants
  – Saves development costs
  – Maintains trained plant employment

• Adds desirable renewable energy to a Utilities portfolio
Key Steps for a Biomass Conversion

Study 1  Biomass Fuel Study
Study 2  Boiler & Combustion System Study
Study 3  Emissions Study
Study 4  Plant Arrangement & Site Space
Study 1
Biomass Fuels Study
“It All Starts with the Fuel”

• Combustion System Design
  • Boiler Design
• Emissions Equipment Design
Biomass Energy Sources

Wood Fuels

Energy Crops

Bio-Diesel

Agricultural Residues

Landfill Gas

Waste Materials
Biomass Fuels

Fuel Availability “Rules of Thumb”

A) **Raw Fuels** (Examples: Wood Chips, Tree Tops, agricultural waste, etc.)
   Typically with-in 50 mile radius of plant

B) **Processed / Pelletized Fuels** (Example: Wood Pellets)
   Typically exceeds 50 mile radius of plant
   - Low Moisture Content
   - Pulverized
   - High Density
   - Higher Heating Value

Being evaluated in USA & Europe
Co-firing with Pulv. Coal Units
Biomass Fuels
Factors to Consider

• Fuel Characteristics
  - Heating Value
  - Moisture
  - Size
  - Fouling and Slagging
  - Corrosion
  - Erosion
  - Emissions

All must be taken into consideration in the final project design
Important Note

Biomass Fuel Flexibility

Being able to burn various biomass fuels is a big advantage to the plant economics.
Study 2
Boiler & Combustion System Study
Recommending a “phased” approach.

Allows the study to be stopped at any time if a “fatal flaw” is discovered.

Saves $ and time!

- Phase 1: Initial Screening (Is the plant a good candidate?)
- Phase 2: Feasibility Engineering Study
- Phase 3: Detail Engineering Design & Material Acquisition
- Phase 4: Constructability
Phase 1: Initial Screening “Quick Study”

Is the boiler a candidate for biomass conversion?

• Preferably 5-80 MW units (50-800 KPPH)

• Pulverized coal units more favorable

• Oil/gas units have smaller furnaces, tighter tube spacing. Typically not good for converting to Biomass

• Is there site space for biomass storage, fuel systems, and emissions equipment?
Step 3
Emissions Study
Biomass Environmental Considerations

Pollutants

- PM
- SO$_2$
- NO$_x$
- CO
- VOC
Particulate Control

• Electrostatic Precipitators (ESP’s):
  • Different chemical composition and smaller particle size
  • Resistivity typically within the range for an ESP
  • Major retrofits typically require lower PM emissions
    – Required emissions are typically 0.015/lbm/MBtu
    – May require modifications

• Fabric Filters:
  – Higher gas flows associated with biomass firing
  – May exceed the design air to cloth ratio
SOx Emissions Control

- Biomass typically has lower sulfur content than coal
- Alkalinity of biomass flyash can provide sufficient reduction in SO$_2$ and HCl without the need for further acid gas removal
- In most applications, no SO$_2$ control equipment is required
- Control Methods:
  - Sorbent Injection w/ Baghouse
  - Scrubber (Worst Case)
NOx Control for Biomass Applications

• Fuel bound N\textsubscript{2} lower
• Required NOx Reduction Not achievable with SNCR, OFA/FGR, ROFA with NH\textsubscript{3}
• Conventional SCR
  – Temperature requirements dictate location
  – High dust environment
  – Susceptible to poisons:
    • Sodium (Na), Potassium (K), Lead (Pb), Arsenic (As)
• Requires use of a tail end SCR
Biomass Tail-end SCR system

- After the particulate removal device
- Clean low temperature gas
- Mitigates poisoning issue
- Need high thermal efficiency for low operating cost
CO & VOC Control for Biomass Applications

- High moisture fuels produce more CO
- Proper OFA and furnace sizing will reduce CO emissions
- Tail-end SCR catalyst can make stringent CO emission guarantees
Emissions from a 100% Biomass Conversion

- Should not be viewed as an impediment to pursuing a biomass conversion project
- Controlled to low levels using proven and efficient technologies

4 commercial units in operation
2 with CO catalyst
5+ years of successful operation and REC qualification
Step 4

Plant Arrangement
Plant Arrangement

Challenging Tasks

- Existing Plant
  - Space restrictions
  - Equipment interferences
- Equipment arrangement must be flexible
- Designer must be experienced, open minded and “think out of the box”
- 3-D Models for interference checks
Thank You