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Chariton Valley Biomass Project

Summary of Fly Ash Sampling and Test Results from December 2003 Interim Test Burn at Ottumwa Generation Station

Presented to:
Iowa Department of Transportation
June 29, 2005

Overview of Meeting Objectives

- Project background and status update
- Review fly ash sampling methods and test results from Interim Test Burn (December 2003)
- Discuss Long Term Test Burn schedule
- Begin planning and approval for use of fly ash from Long Term Burn
- Discuss fly ash sampling and testing requirements for Long Term Burn

Overall Project Objectives

- Create a new business opportunity in Southern Iowa—using switchgrass as fuel at OGS
- 25,000 to 50,000 acres for supplying biomass fuel
- Environmental improvements
  - Air emissions
    - Reduced sulfur and greenhouse gas emissions
  - Water and soil quality
- New source of income from marginal farm lands in Southern Iowa

Equipment and Facilities

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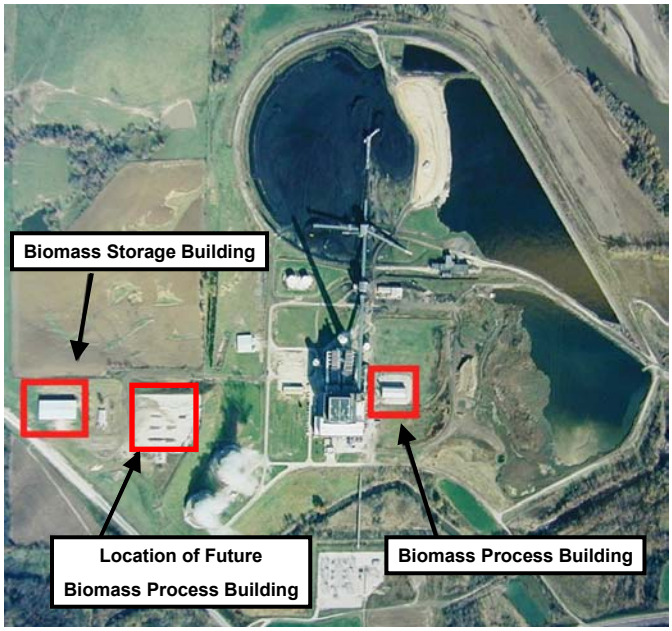
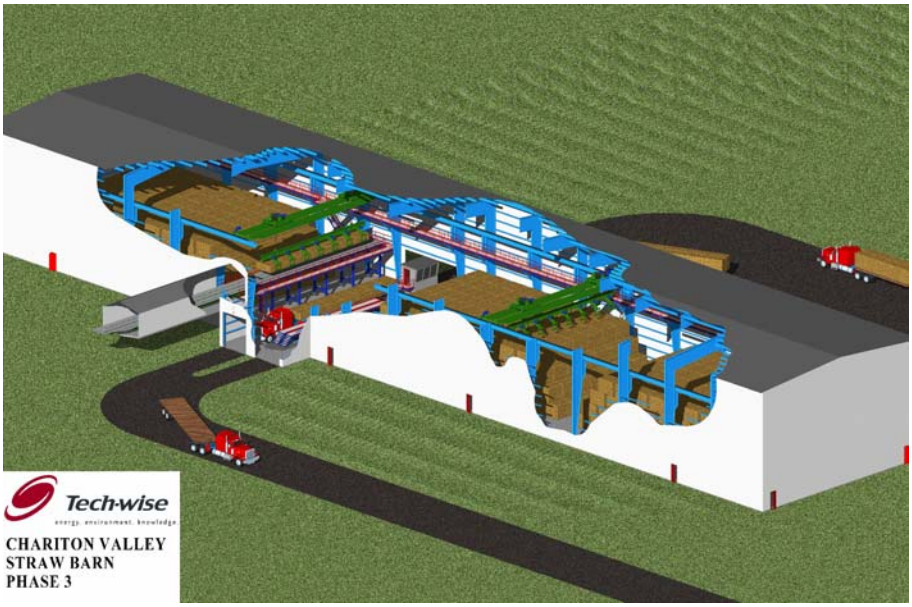
Existing OGS Site Layout



"Biosilo"

Proposed Commercial Construction



Project Status Update

- Completed Interim Test Burn (Dec. 2003) – 12.5 ton/hr target
- Completed emissions analysis for Interim Test Burn
  - Submitted final report to IDNR
  - Submitted permit applications
  - Received permits for commercial operation at 25 ton/hr
- Design of facility for Long Term Test Burn completed
- Construction under way for Long Term Test Burn facility
- Completed fly ash testing
  - Seeking IDOT approval for use of fly ash from Long Term Test
- Long Term Test Burn—Winter/Spring 2006

Loading 900 - 1000 lb. Bale

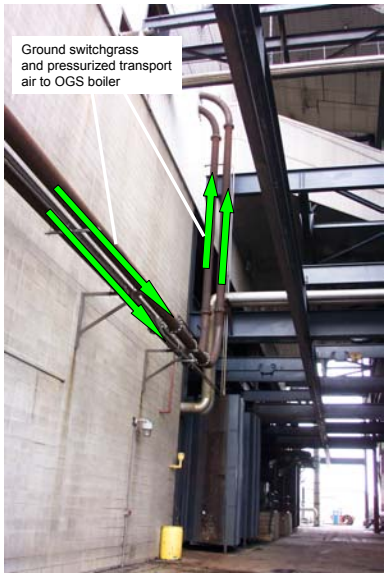
400 Hp De-baler (Hammer-mill)

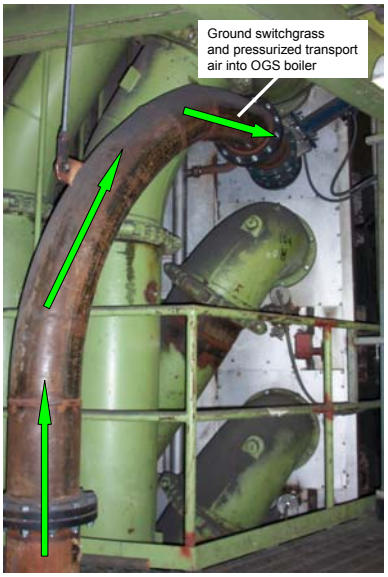
"Eliminator" Infeed (Hammermill)

Debaled and Ground Switchgrass

Debaled Switchgrass

Ground Switchgrass





Switchgrass Blow Lines Transporting Ground Switchgrass into Boiler House (left) and Boiler (right).

Key Objectives of Interim Test Burn

- Test & Optimize Biomass Processing Equipment Performance
- Detailed Monitoring & Reporting Air Emissions
- Obtain OGS & Biosilo Performance Data
  - Power consumption, bale weights & moisture, boiler efficiency, ash resistivity, particle size distribution, bulk densities, etc.
- Collect & Characterize Coal, SWG, and Ash Samples
- Determine SWG Effect on Fly Ash Marketability

Required Test Parameters

- Maintain plant load above 90% during testing
  - Accomplished: Ave Load = 95%
- Constant soda ash addition rate
  - Accomplished, except 2 final optional test days
- Uniform coal & SWG supplies across test period
  - Accomplished
- Sample and analyze daily samples of coal & SWG
  - Accomplished
- Collect more than enough fly ash for ISU & IDOT testing
  - Accomplished

Test Burn Statistics

- Co-fired 1,673 bales of SWG (781 tons)
  - Average Weight of 931 lbs.
  - Average Moisture 12.9%
- Gathered nearly 300 samples for lab analysis
  - Raw Coal Samples
  - SWG Samples (baled, debaled, ground)
  - Ash Samples (Bottom ash, Fly ash, Economizer)
  - Liquids (bottom ash)
- Collected 2,760 lbs. of Fly Ash for Analysis & Testing
  - 160 lbs. from auto sampler (5 gallon buckets)
  - 2,600 lbs. from bulk samples (55 gallon drums)

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Test Burn Statistics (cont.)

- Daily Switchgrass Feed Rates
  - Average = 8.9 tph (1.9% of heat input to boiler)
  - Range: 5.6 to 10.6 tph (1.1% to 2.2% of heat input to boiler)
  - Maximum *Instantaneous* Feed Rate: 11.6 tph

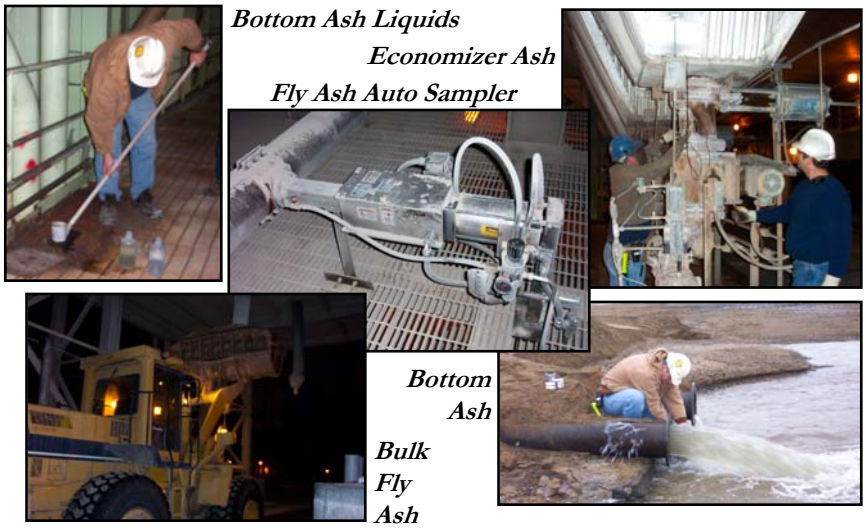
Average Feed Rates & F-Factors

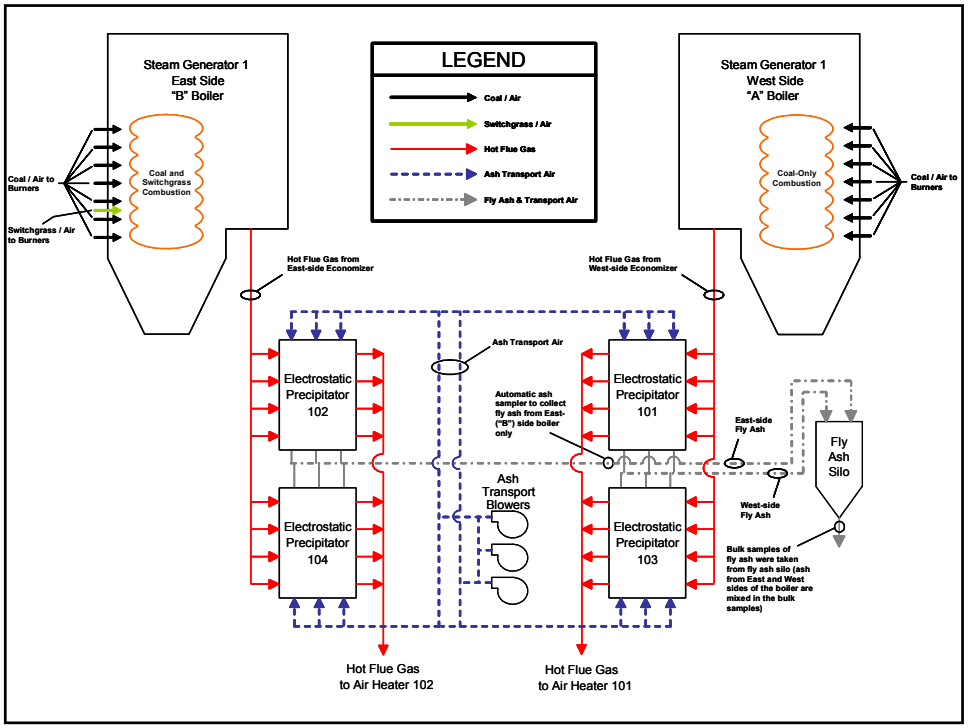
Date	Average SWG Flow Rate (tons/hr)	Average Heat Input from SWG [1]	Average Coal Fuel Factor	Average Switchgrass Fuel Factor	Average Combined Fuel Factor	Soda Ash Feed Rate (lb per ton of Coal)
12/1/2003	10.6	2.1%	1,876	1,929	1,876	2.50 to 3.00 [2]
12/2/2003	8.6	1.8%	1,873	1,946	1,873	3.00
12/3/2003	8.4	1.6%	1,867	1,919	1,867	3.00
12/4/2003	5.9	1.1%	1,862	1,905	1,862	3.00
12/5/2003	10.1	2.1%	1,865	1,959	1,865	3.00
12/6/2003	n/a	n/a	1,863	n/a	1,863	3.00
12/7/2003	n/a	n/a	1,856	n/a	1,856	3.00
12/8/2003	8.4	1.9%	1,857	1,939	1,857	3.00
12/9/2003	n/a	n/a	1,851	n/a	1,851	3.00
12/10/2003	9.5	2.0%	1,869	1,926	1,869	3.00
12/11/2003	9.6	2.2%	1,890	1,968	1,896	3.00 to 3.25 [2]
12/12/2003	n/a	n/a	1,870	n/a	1,870	3.25
Total	**8.9**	**1.9%**	1,866	1,936	1,867	

Completed Lab Testing

- Coal & SWG Samples Tested for:
  - Ultimate/Proximate Analysis, Heating Value, Major Ash Elements, Ash Fusion Temp, Water Soluble Alkalis; RCRA Trace Metals
- SWG Samples also Tested for:
  - Particle Size Distribution
- Ash Samples (Bottom, Fly, Economizer) tested for:
  - LOI, Major Ash Elements, Ash Fusion Temp, Water Soluble Alkalis; RCRA Trace Metals
  - Petrography (Carbon Origin Characterization)
  - Fly Ash Resistivity
- Fly ash properties and performance (ISU)

Ash Sampling

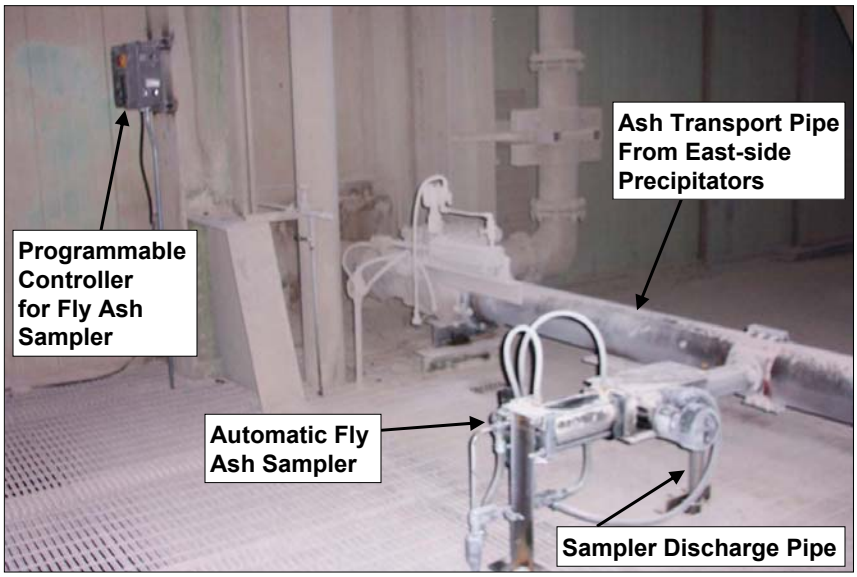




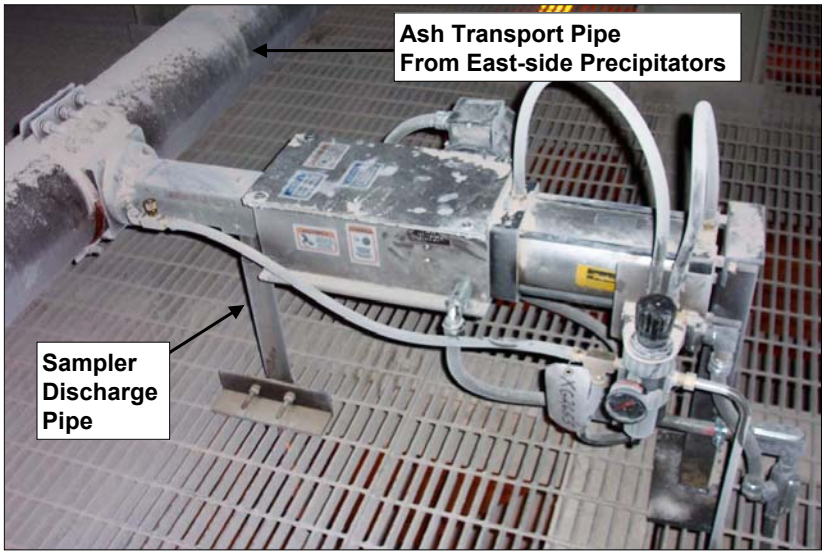
General Fly Ash Sampling Procedure

- Automatic Sampling
  - Begin switchgrass firing
  - Empty East-side fly ash hoppers
  - Start auto-sampler
  - Stop switchgrass firing / Stop auto-sampler
- Bulk Sample Collection
  - Collect baseline sample (11/21/2003)
  - Bulk cofire samples
    - Begin emptying ash silo
    - Start switchgrass firing (morning)
    - Complete emptying ash silo
    - Collect bulk sample from ash silo
    - Stop switchgrass firing (evening)

Automatic Fly Ash Sampler

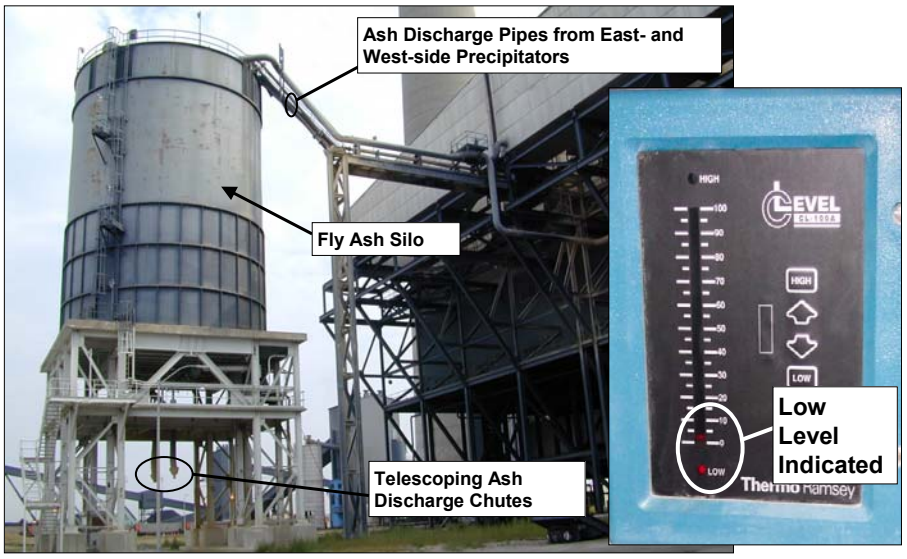


Automatic Fly Ash Sampler



Sample Collection

Bulk Fly Ash Sample Collection



Bulk Fly Ash Sample Collection

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