Appendix J -- Test Summary Results
(Power Plant Impacts)

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Progress Update on Chariton Valley Biomass Project

Prepared for: EPRI Biomass Interest Group

Provided by Greg Hudson, Alliant Energy and CVBP Project Team

November 15, 2006

Presentation Outline

- Objectives of Long Term Test Burn
- Photos & Layout for New Processing System
- Results from Long Term Test Burn
- Project Status / Next Steps

Acknowledgements

- Project Partners:
  - Chariton Valley RC&D
  - Alliant Energy
  - Dept. of Energy
  - USDA
- Team Members & Others:
  - OGS Plant Staff
  - PrairieLands Biomass LLC
  - Kelderman Manufacturing
  - Antares Group Inc.
  - Bradford, Conrad, Crow Engineering
  - Elsam Engineering (now Dong Energy)
  - TR Miles Consulting
  - Many other state & local organizations

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Switchgrass Cofiring
Ottumwa, Iowa

- Ottumwa Generating Station
  - Alliant Energy / Mid-American
  - 726 MW, PRB Coal, 1982 startup
  - Twin furnace T-fired PC boiler
  - 2.5 to 5% heat input from switchgrass, 12.5 ton/hr feed rate targeted
  - Separate biomass injection, 2 - 4 ports
- Long Term Test Objectives
  - 2000 hr continuous test to measure long term effects, refine/prove system operation
  - Long term test to investigate fouling, slagging, and corrosion impacts
  - Collect information on all operational costs & impacts for use in business planning
  - Burn up to 25,000 tons of switchgrass

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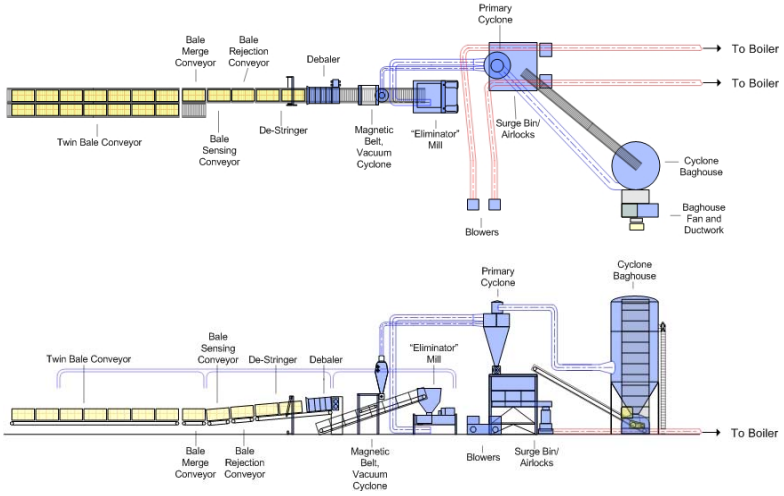
On-site Facilities at OGS

Processing & Fuel Delivery

Replacing up to 5% of this . . . .

with this . . . .

Processing System at OGS



Front End of Processing System . . .

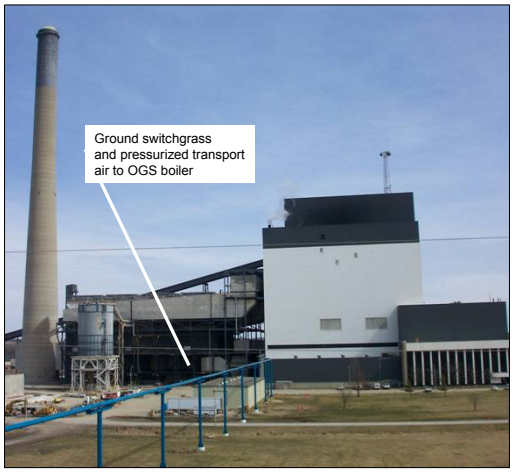
- Teleboom loading
- Automated bale handling
  - **Moisture, weight, reject, de-string, debale, metal removal, mill, blow, burn**

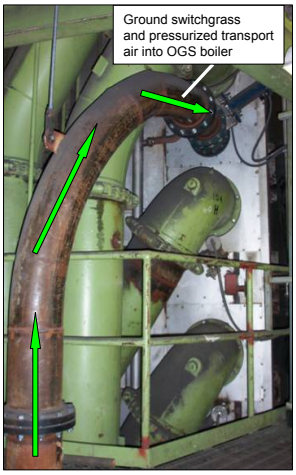
Back End of Processing System . . .

- 2-stage milling process to reduce particle size
- Final product fed into 2 blow lines to boiler

- High-efficiency cyclone and baghouse for dust control and filtering
- Emissions test last week

Pneumatic Transport to Boiler





Switchgrass blow lines transporting ground switchgrass into boiler house (left) and boiler (right).

Summary of Accomplishments

- Delivered, processed, and burned 31,568 bales of locally grown switchgrass, totaling 15,647 tons.
- Generated 19,607,000 kWhs of electricity from switchgrass--enough to provide 100% of the electricity needs for an entire year for over 1,874 average Iowa homes.
- Set a world record for electricity generation from switchgrass.
- Processed and burned switchgrass as fuel at OGS for more than 1,675 hours from mid-February mid-May, 2006.
- Processing hours per day improved significantly from the beginning of the test burn, with the facility operating without downtime nearly continuously throughout the past month of the test burn.
- Reduced emissions of sulfur dioxide (SO2) from OGS by about 62 tons.
- Reduced emissions of carbon dioxide (CO2) by a total estimated amount over 50,800 tons through reductions at the power plant, carbon neutral biomass fuel, and through sequestration on local farms.

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Summary of Accomplishments

- Generated about 626 tons of fly ash which has been approved for sale from the power plant for use in concrete and other valuable byproducts.
- Demonstrated that the processing system designed, installed, and operated by the project team throughout the test burn can be operated reliably at and above its designed process rate of 12.5 tons per hour, especially if the switchgrass delivered to the facility contains moisture contents of 12% and under. The average moisture content of switchgrass burned throughout the test burn has been about 13%.
- Average processing rate throughout the test burn was about 10 tons/hr.
- Maximum sustained feed rate was above 16 tons/hr.
- Replaced about 12,060 tons of coal purchased from Wyoming with switchgrass that was planted, grown, harvested, stored, delivered, and processed by local Iowa farmers.
- Generated 19,607 Renewable Energy Credits (RECs) that have received independent third-party certification under Environmental Resource Trust's EcoPower program.

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Summary of Accomplishments

- All permits in place for commercial operation.
- Resulted in development in new equipment for baling, bale handling, twine removal, debaling and secondary milling.
- Fly ash approved by Iowa DOT for use in concrete for cofiring rates up to 5% heat input from switchgrass.

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Process Equipment Development

Debaler Hammers 30,000 t/set Screens 8,000 t/set

Steffen Systems 2 t Bale Hooks

Attrition hammers 7,000 t/set

400hp De-baler 12tph, 2in screen, Warren & Baerg

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Control System Monitoring

- Parameters monitored throughout test burn:
  - At the "Grass Station" (Processing Facility):
    - Bale moisture, counts, feed rate, and weight
    - Power consumption (whole facility, each mill motor)
    - Default messages on all process equipment
    - Detailed trucking logs
  - At OGS:
    - Emissions
    - Fuel & air flows
    - Heat rate
    - Test "coupons" installed in boiler for corrosion, slagging, & fouling investigations

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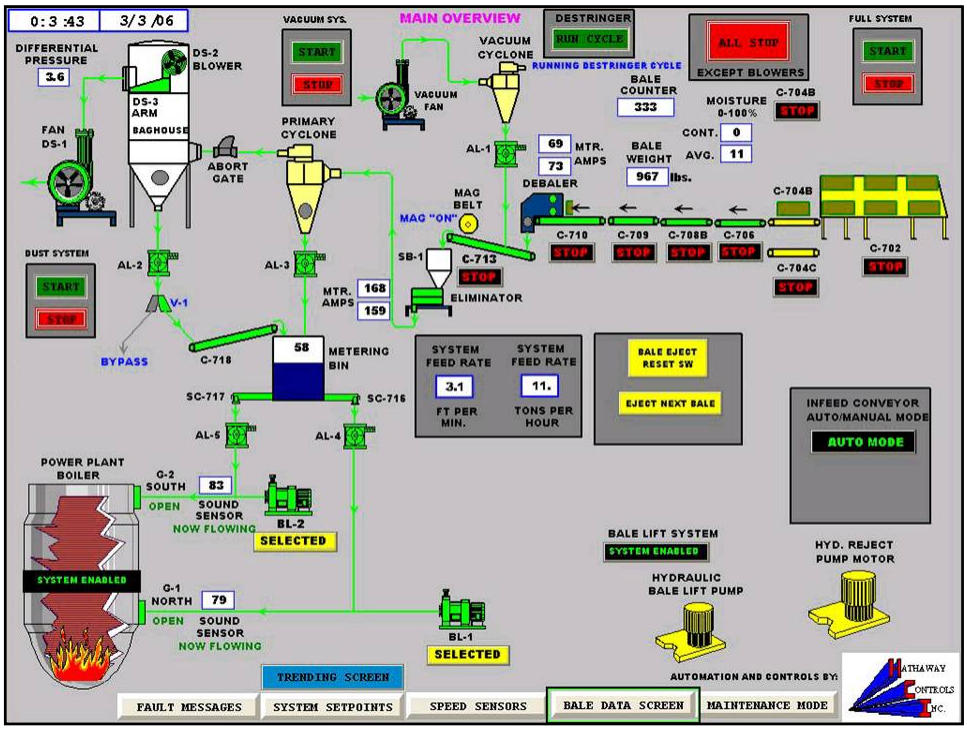
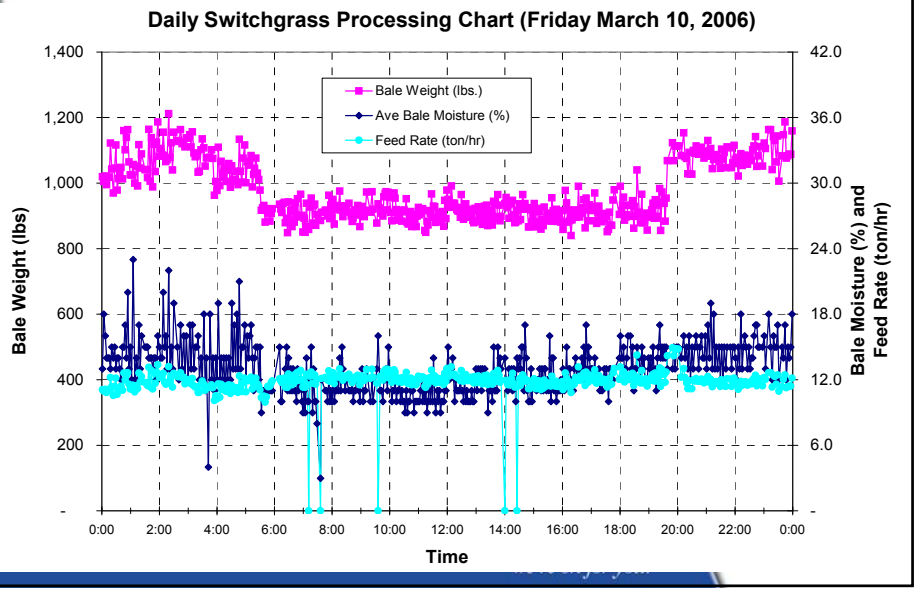


Sample Processing Day Profile



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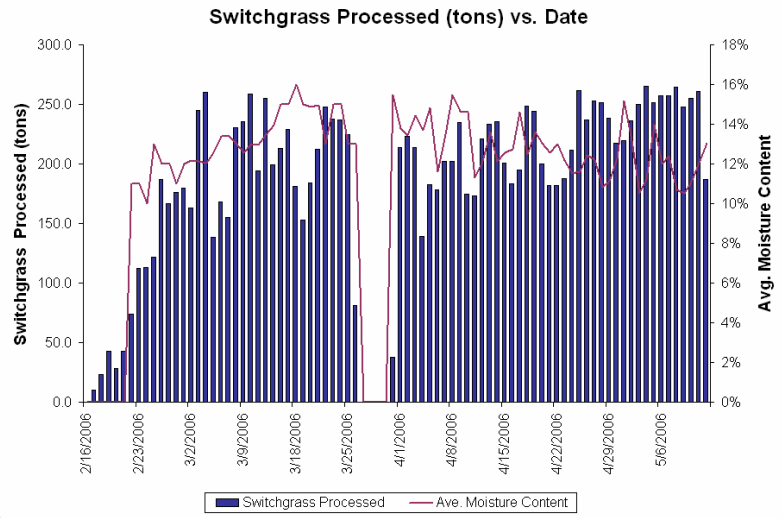
Daily Processing Profile



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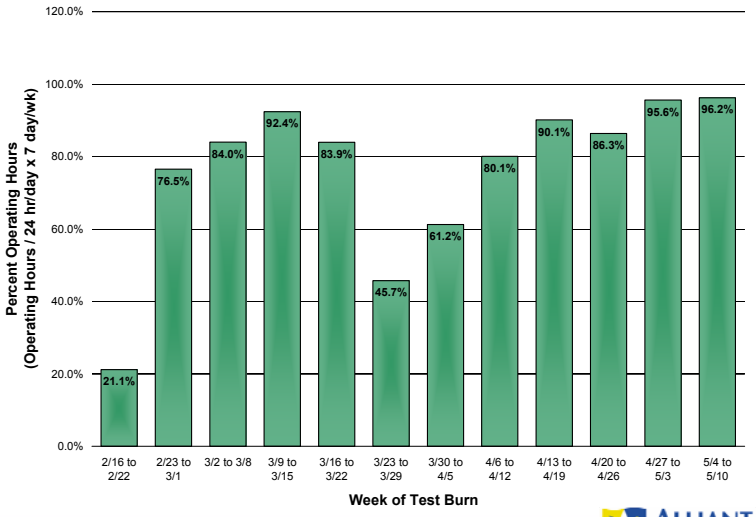
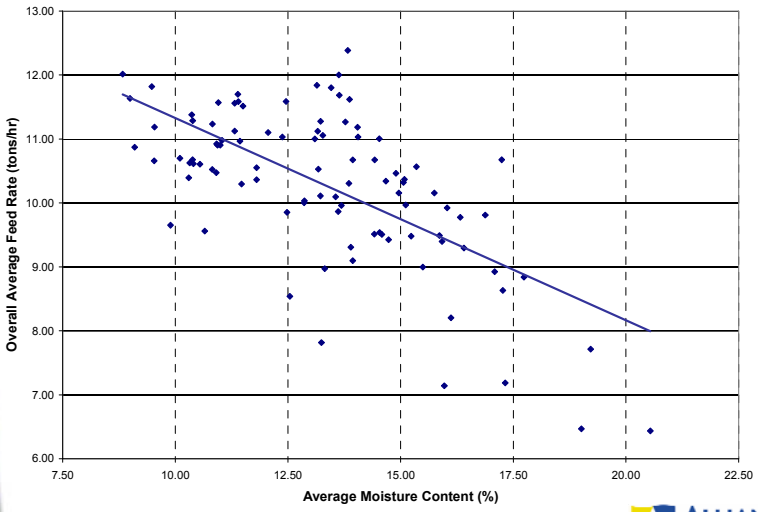
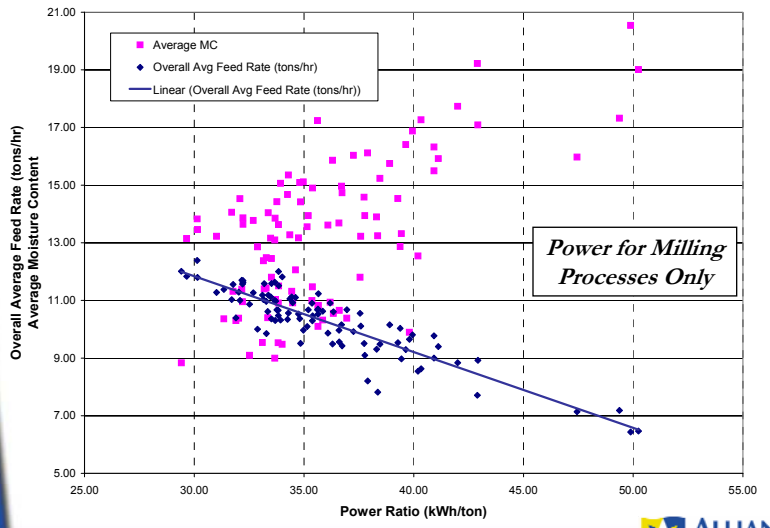
Processing System Availability



Moisture Content vs. Feed Rate



Feed Rate, Power, Moisture Content



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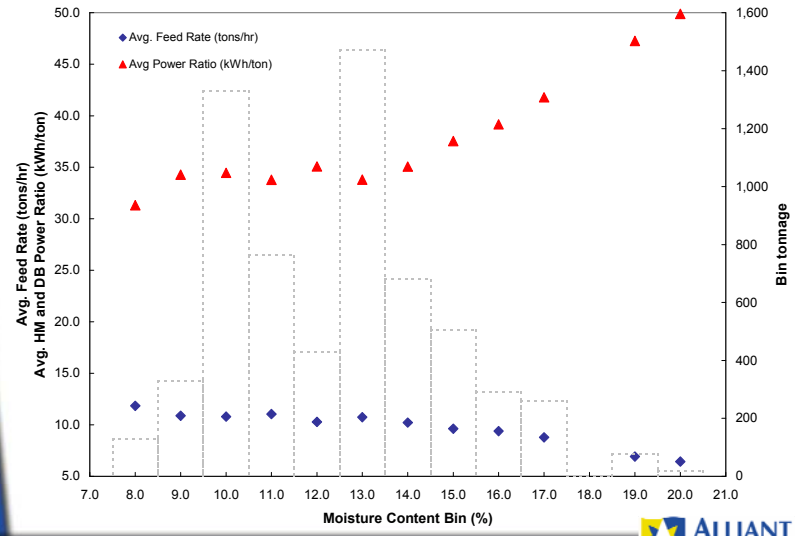
Feed Rate, Power, Moisture Content



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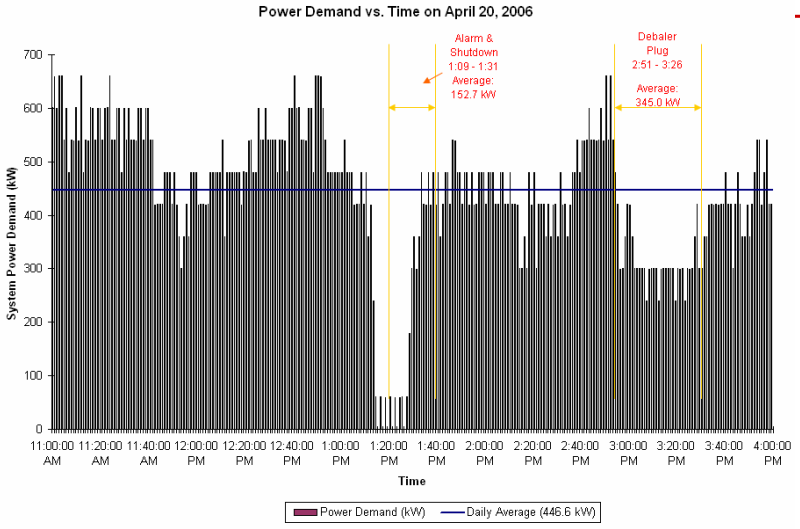
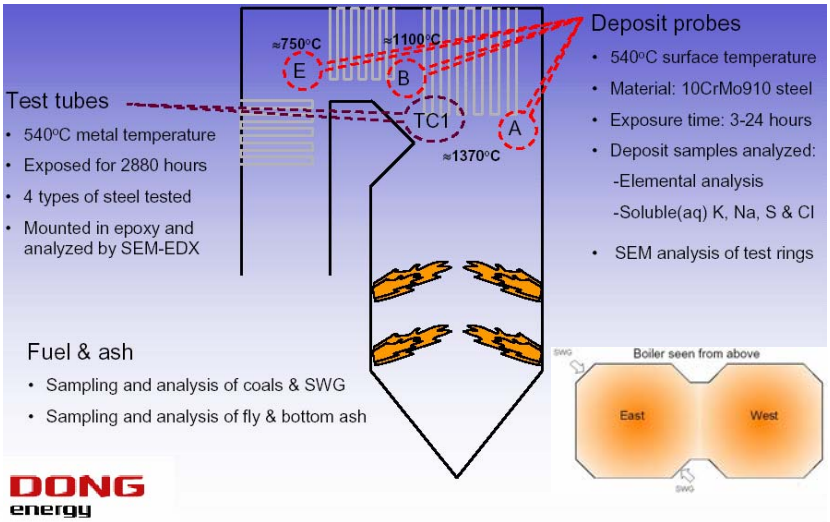
Daily Demand Profile (Entire Facility)



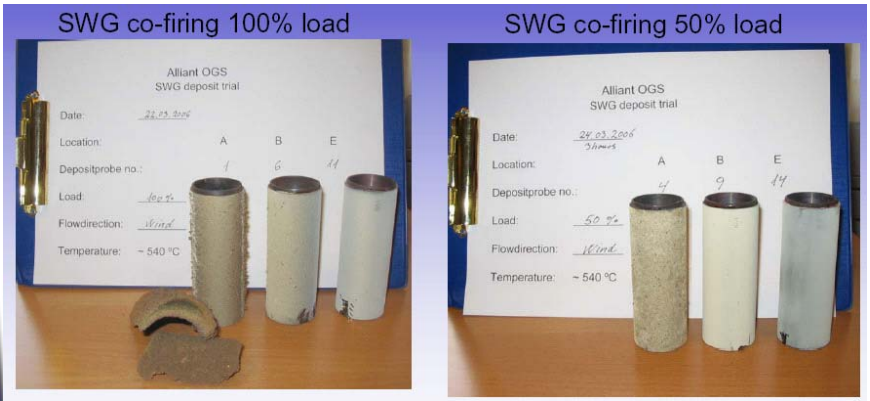
Summary of Impacts

- Emissions
  - Reduced SO2
  - Neutral on NOx
  - Reduced CO2
  - Neutral on CO (OGS has extremely low CO)
  - Increased Opacity (about 1 percentage point)
    - Required higher soda ash addition rates during test
- Other
  - Minimal Impact on Heat Rate (in the "noise")
  - Some unburned biomass in bottom ash
  - No significant impact on LOI in fly ash
  - Bale moisture, weed content, package quality has large impact on processing achievable rates

Corrosion / Slagging Testing



Example Probe Samples

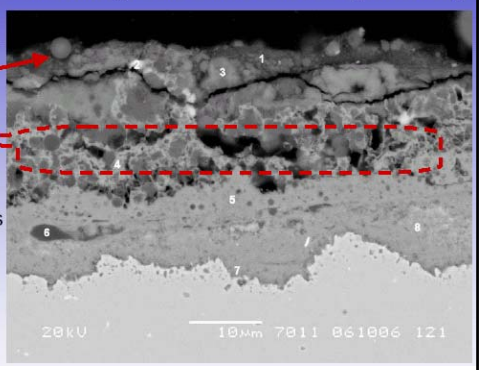


Corrosion Analysis Example

SEM image of test tube of 347H (pos. TC1)

SEM-EDX results

- Al, Ca & Si rich particles
- Inner deposit rich in Ca & S
- Outer oxide layer (#4,5): Fe-oxides
- Inner oxide layer (#7,8): Fe,Cr,Ni-oxides
- No traces of chlorine!!



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Corrosion / Slagging Results To Date

- A 1675 hours co-firing test with up to 5%-weight SWG has been successfully completed at Ottumwa Generation Station
- The deposition investigation indicated that:
  - The deposition flux to the super/re-heaters was unaffected by co-firing
  - The chemical composition of the deposits was not significantly influenced
  - A marginal increase in the concentration of water-soluble potassium of the deposits and fly ash was observed
  - Generally, the effects of co-firing 5% SWG were low compared to that of variations in the coal composition

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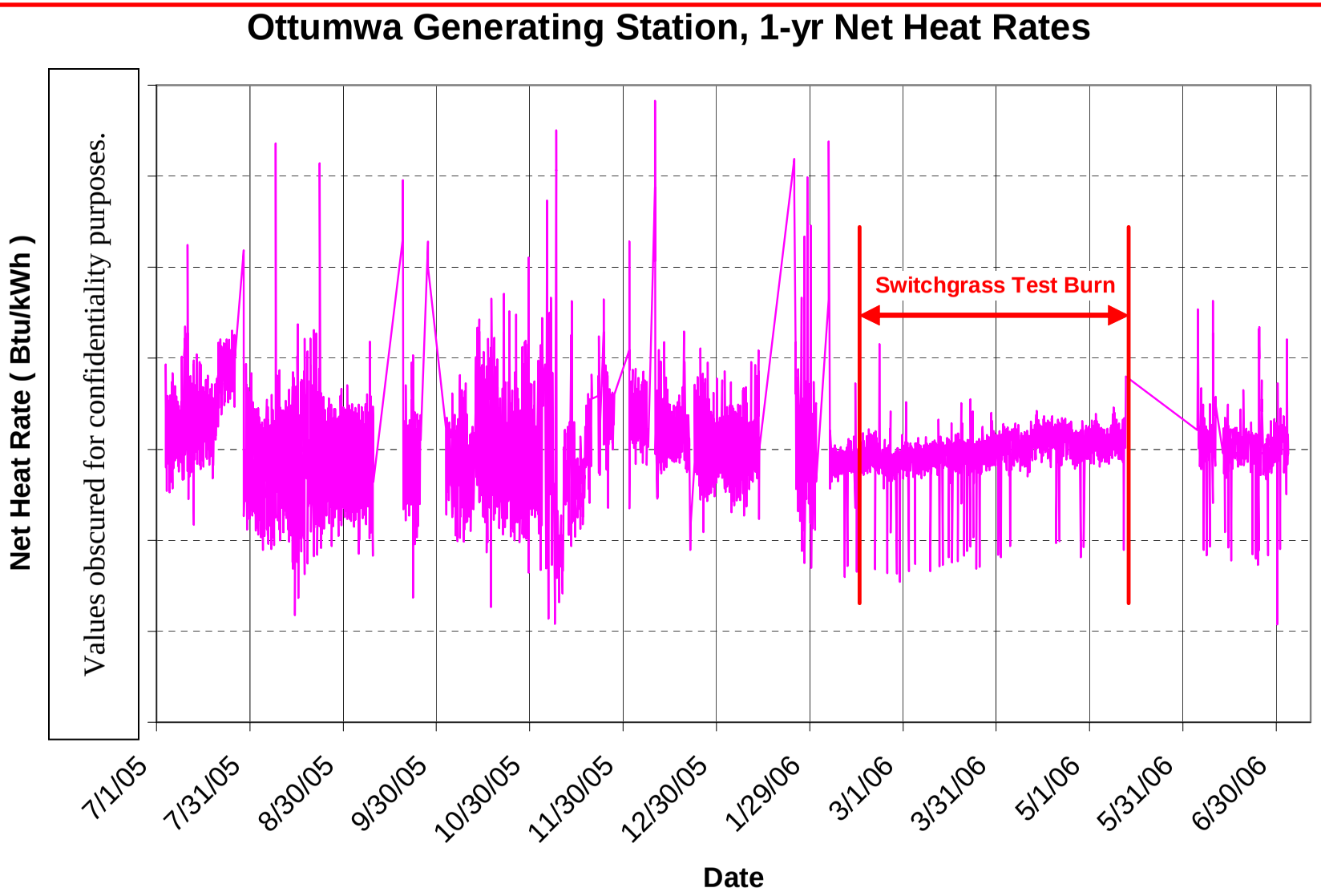
Corrosion / Slagging Results To Date

- The conducted corrosion studies indicated that SWG co-firing (up to 5%-weight) had virtually no influence on the corrosion behavior:
  - No evidence of chlorine-induced corrosion was observed
  - Only small amounts of potassium was found in the inner deposits
  - Sulfur played a dominating role in the corrosion mechanism. The sulfur input with SWG is negligible compared to that of the coals
  - No distinct difference in the corrosion resistance was observed between the four steel materials tested

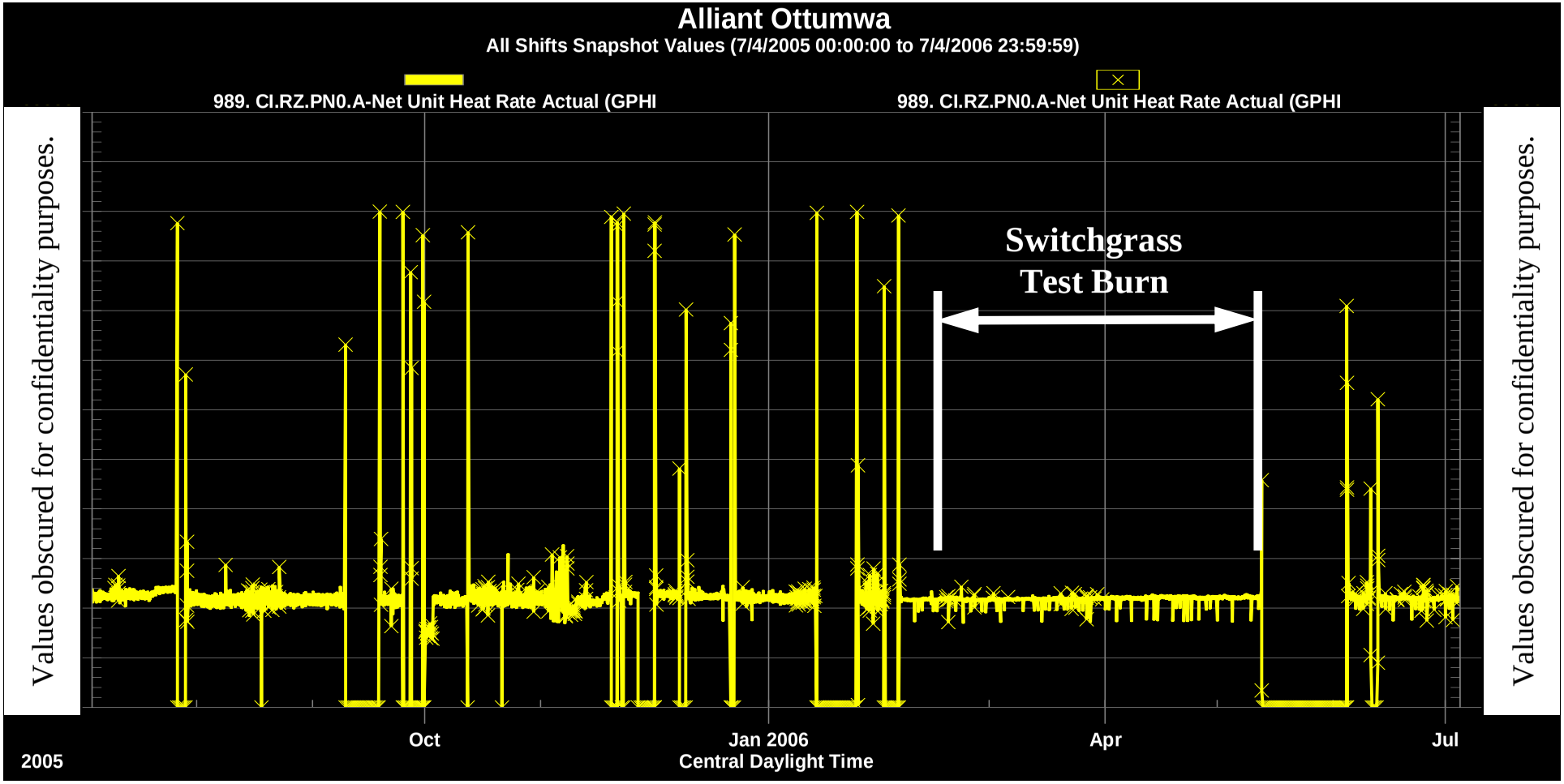
Next Steps . . . . .

- Complete Analyses from Long Term Test Burn
  - Coal-only tube and deposit analysis
- Complete Final Technical Reports
  - Overall Test Burn Results and Project Economics
  - Corrosion / Slagging / Fouling
- Complete sale of Carbon Credits on Chicago Climate Exchange
- Attempt to negotiate agreements for burning remaining switchgrass inventory and beginning commercial operation

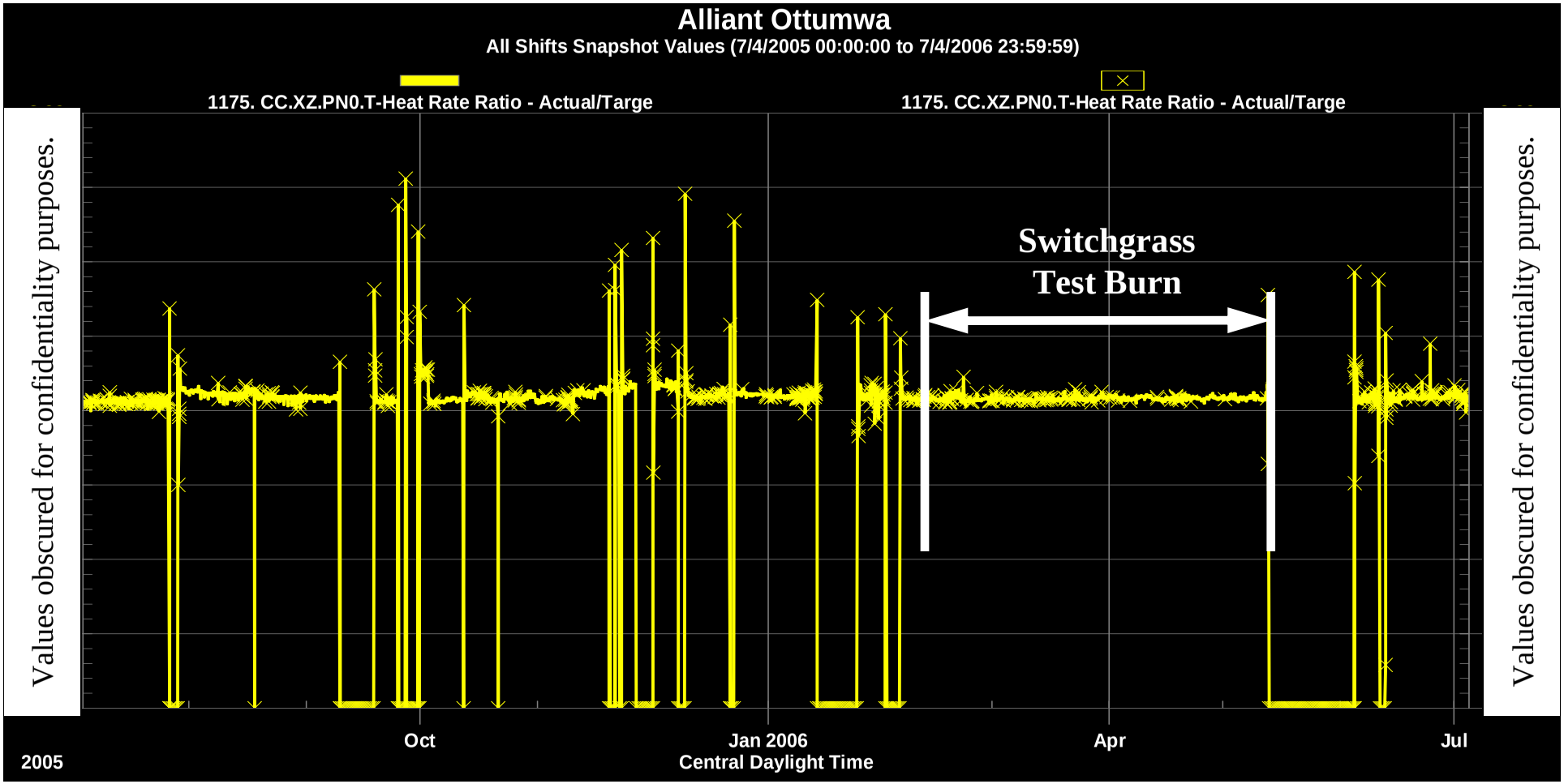
The graph below was generated using data straight from EtaPRO. Points with heat rates > 8,000 and < 15,000 Btu/kWh were removed to eliminate odd points at start-up & shut-down. Heat rates were NOT higher than normal during the cofire period.



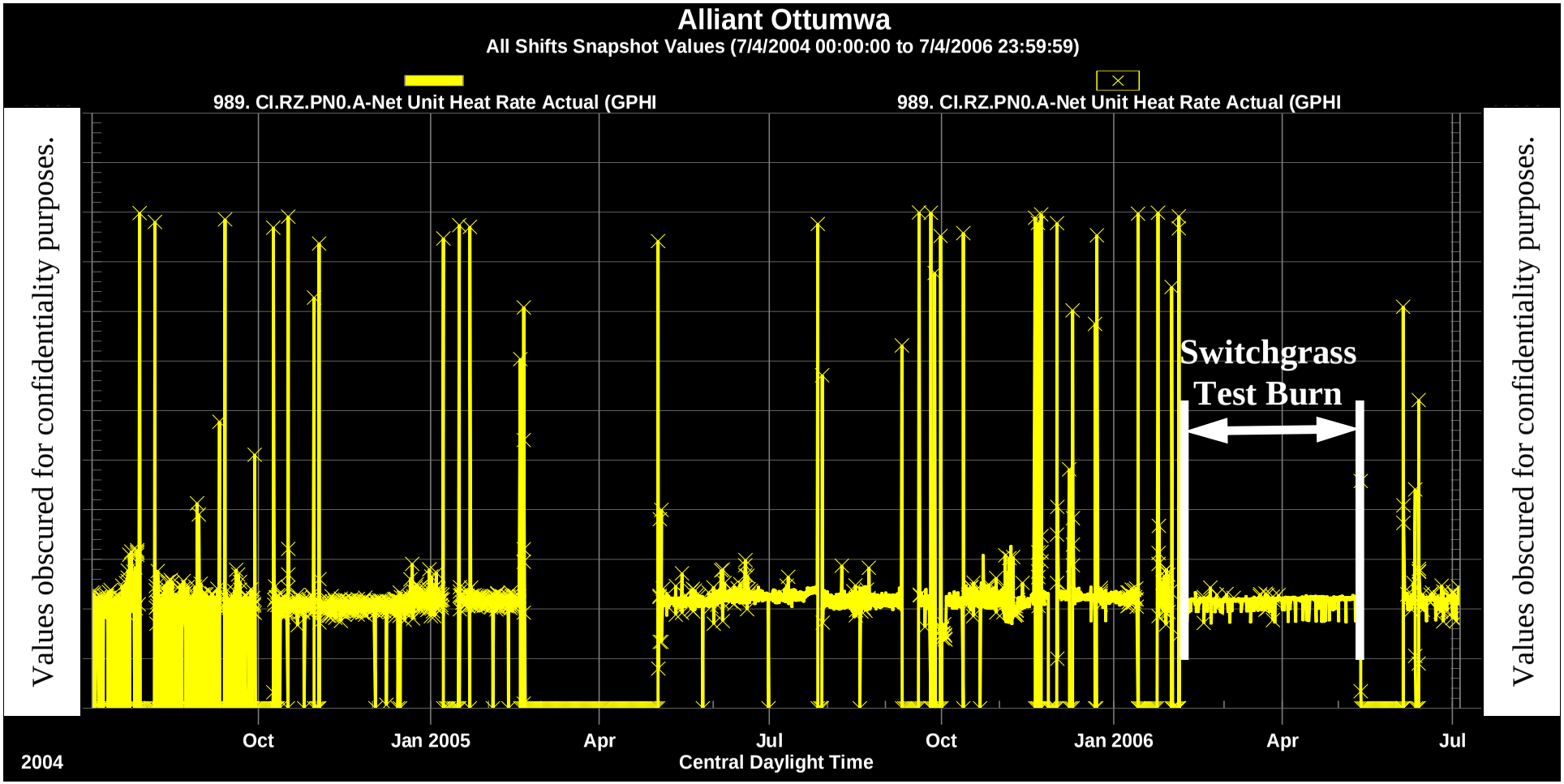
Net heat rate graph straight from EtaPRO, for 1 year including test burn.



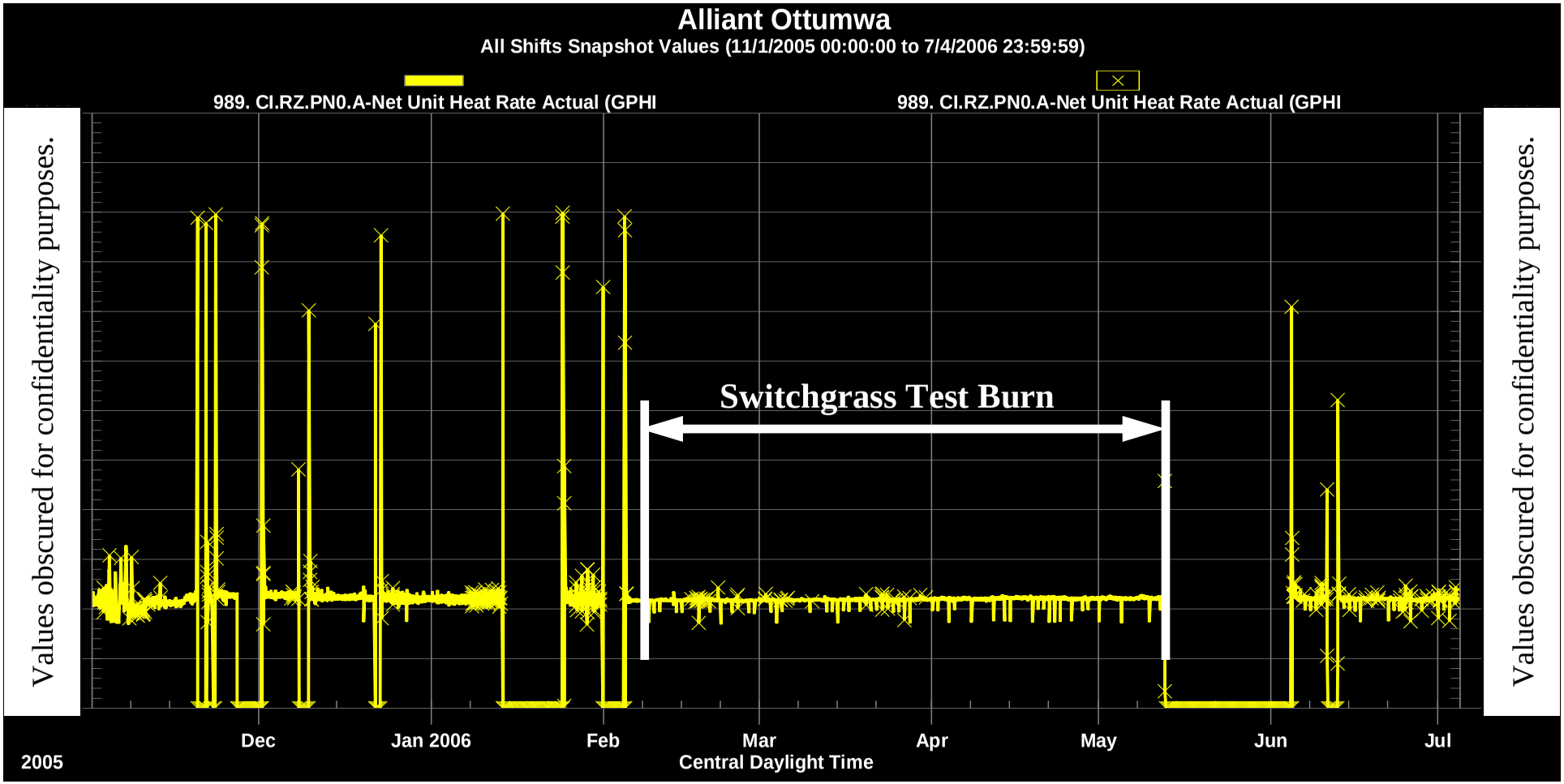
Heat rate ratio graph (Actual Heat Rate / Target Heat Rate) straight from EtaPRO, for 1 years including test burn.



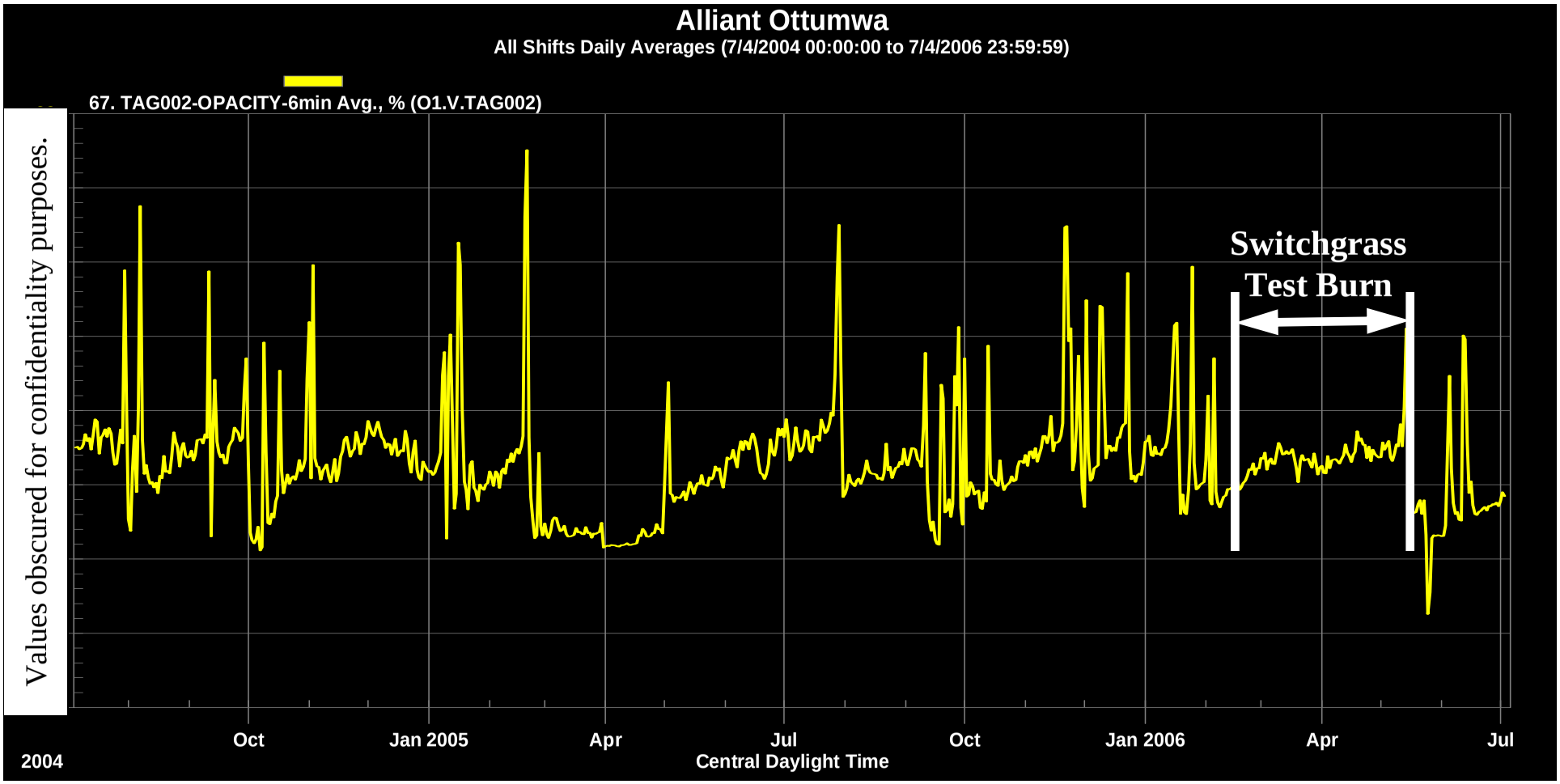
Net heat rate graph straight from EtaPRO, for 2 years including test burn.



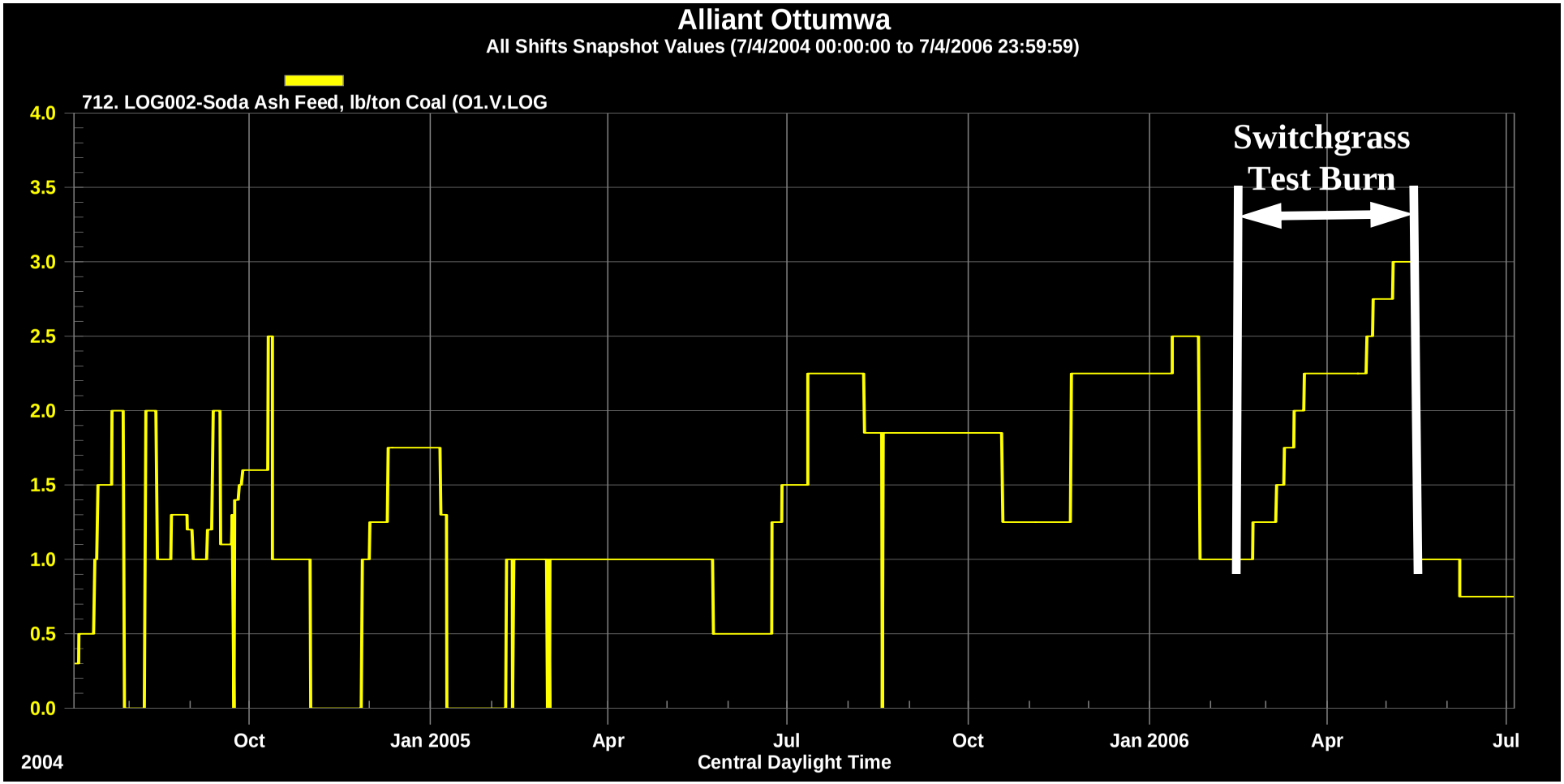
Net heat rate graph straight from EtaPRO, for 8-months including test burn.

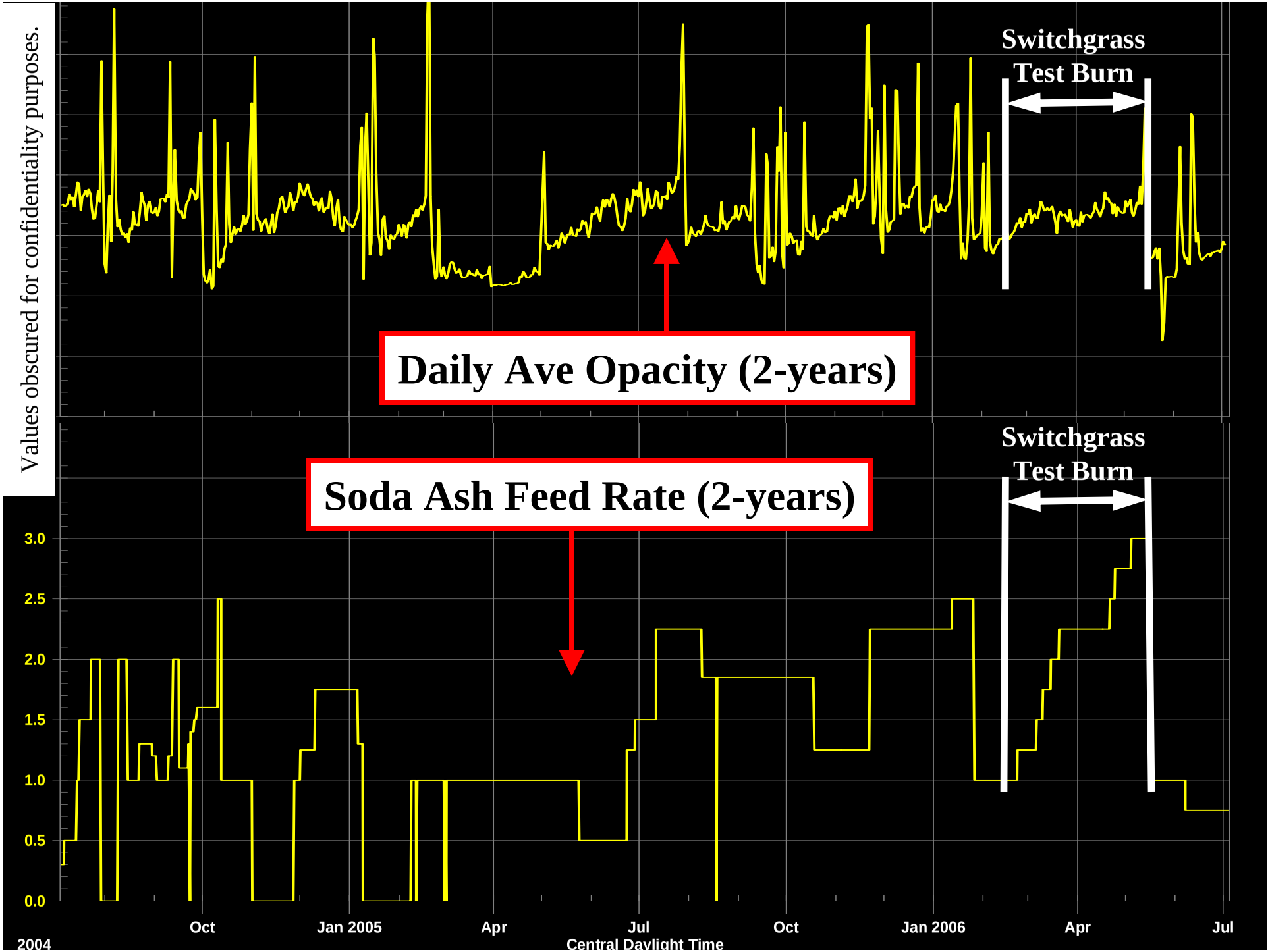


Daily averages of opacity graph straight from EtaPRO, for 2 years including test burn.



Soda ash feed rate graph straight from EtaPRO, for 2 years including test burn. There is a definite increase in soda ash addition rate during the test burn, but the opacity is also lower over the course of the test burn as compared to a typical run (see previous graph, and next graph).




Values obscured for confidentiality purposes.
Switchgrass Test Burn
Daily Ave Opacity (2-years)
Switchgrass Test Burn
Soda Ash Feed Rate (2-years)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2004
Oct
Jan 2005
Apr
Jul
Oct
Jan 2006
Apr
Jul
Central Daylight Time

Appendix K -- Laboratory Analysis Sample Photos and Results

Bale Counting & Flow to Boiler

D-Stringer (bottom right) counts bales and displays running total on operator panel In “Biosilo” control room (bottom right). Ultrasonic ON/OFF sensor on biomass supply pipe (bottom left).

Other Measurements at Biosilo

Weighing bale (top left) on digital scale (bottom left). Infrared moisture balance, scales, and sampling supplies (top right). Electric meter at “Biosilo” (bottom right).

Emissions Monitoring (GE Mostardi Platt)

Emissions Probe In Outlet Duct

GE's Mobile Emissions Lab

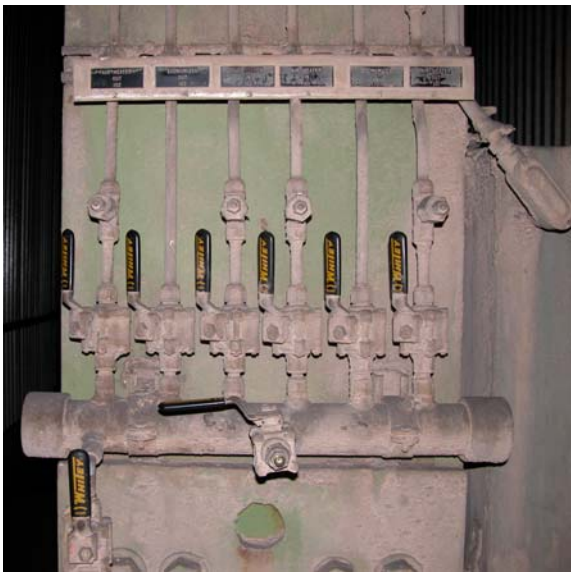
GE's Emissions Vans at Stack

Emissions Equipment at OGS

CEMS Probes In Outlet Duct

Portable Emissions Monitor

Valved Emissions Sampling Header for Portable Combustion Analyzer



Using a portable combustion analyzer, this header allows flue gas sampling from the Economizer Outlets, Air Heater Inlets, and Air Heater Outlets on both sides of the OGS Boiler.

Other Sampling

Bottom Ash Liquids

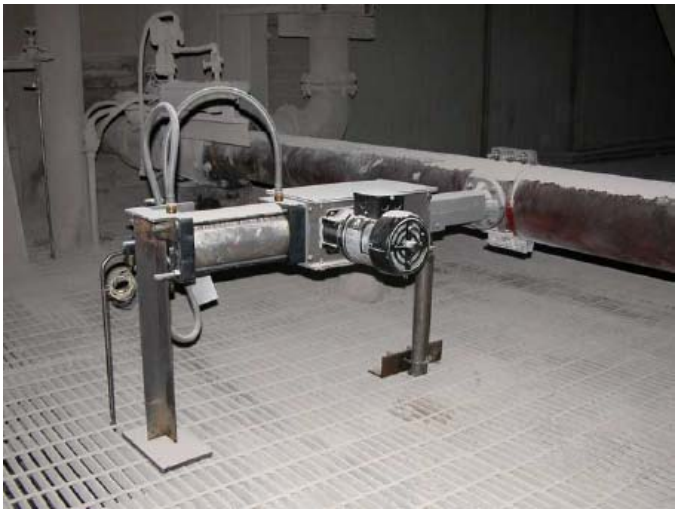
Economizer Ash

Fly Ash Auto Sampler

Bottom Ash

Bulk Fly Ash

Automated Flyash Sampler



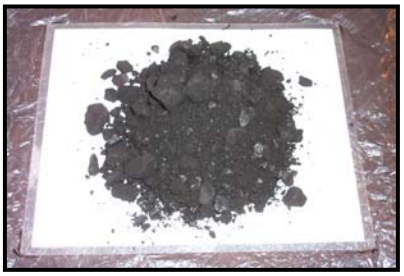
Debaled and Ground Switchgrass

Debaled Switchgrass

Ground Switchgrass

Ash & Coal Samples

As-received Coal



Economizer Ash

Bottom Ash

Fly Ash

The Following Pages Include the Laboratory Test Spec and Test Results from the LTB.

Specification of Laboratory Testing Requirements for Fuel and Ash Samples from Chariton Valley Biomass Project Interim Test Burn

Background: From December 1 to 12, 2003, the Chariton Valley Biomass Project (including its utility partner, Alliant Energy), conducted a test burn at the Ottumwa Generating Station (OGS) in Chillicothe, Iowa. Ottumwa Generating Station is a 726 MWe tangentially-fired pulverized coal unit that typically obtains 100 percent of its fuel input from Powder River Basin coal. The test burn involved cofiring coal with switchgrass. During the testing period, there were several baseline days (where only coal was fired) and several cofiring test days. In order to help determine the impacts of cofiring on plant operations, a range of samples were collected daily. The samples included:

- Raw coal (coal from the coal yard, before pulverizing)
- Debaled switchgrass (switchgrass taken from a conveyor after being "debaled" by a grinder with a 2 inch screen at its discharge)
- Ground switchgrass (switchgrass taken from the discharge of a mill)
- Bottom ash solids (solid material collected through a strainer at the bottom ash discharge pipe)
- Bottom ash liquids (water samples collected from the bottom ash holding tank)
- Economizer ash (solid material collected from the discharge of an economizer hopper)
- Fly ash (solid material collected from a discharge pipe from the electrostatic precipitator hoppers)

Duplicates of all samples were obtained in case additional material volumes are required for completing the requested laboratory testing.

Purpose: The purpose of this document is to provide the information required to solicit bids for performing laboratory testing services on the samples collected during the test burn described above, and to serve as instructions for performing the requested tests on each sample provided (once the testing has been authorized). This document provides a brief physical description of each type of sample collected, including sample size (weight or volume) and container. A summary table for the testing services sought for each type of sample is also provided, including the total number of repetitions (separate samples for analysis) sought for each type of laboratory test requested. Sample inventory lists for each test day are attached in an appendix. These inventory lists identify each sample collected, the shipping box number that each sample is stored in, and all tests requested for each individual sample.

Sample Descriptions:

Raw Coal—Raw or bulk coal samples were collected and stored in 16 ounce wide-mouth polypropylene jars with unlined plastic lids. One pair of samples was collected daily during testing. Each jar contains about 400 to 500 grams of coal,

with particle sizes ranging from powder size to 1-inch chunks. Each jar contains a label as shown below. A sample taken at 6:00 am on Dec 12, 2003 will be listed as *COAL121203—0600* on our daily sample inventory lists. A photo of the contents of a typical sample jar is also shown below.

RAW COAL
(2 jars per sample)

Date: _____ ; Time: _____
(24 hr military format)

Name of Sampler: _____

Example label for raw coal sample

Coal sample on 8-½" x 11" graph paper

Debaled Switchgrass—Debaled switchgrass samples were collected and stored in one gallon plastic ziplock bags. On each day switchgrass was cofired with coal, debaled switchgrass samples were taken on approximately one-hour intervals. Each sample bag contains about 140 to 180 grams of switchgrass, with particle sizes ranging from powder size to 6-inch stalks. Each bag contains a label as shown below. A sample taken at 3:50 pm on Dec 8, 2003 will be listed as *DBLSWG120803—1550* on our daily sample inventory lists. A photo of the *partial* contents of a typical sample bag is also shown below.

DEBALED SWITCHGRASS
(from Takeaway Conveyor sample hatch)

Switchgrass Flow Rate: _____ tph ; _____ Hz

Date: _____ ; Time: _____
(24 hr military format)

Name of Sampler: _____

Example label for debaled switchgrass

Debaled switchgrass sample on 8-½" x 11" graph paper

Ground Switchgrass—Ground switchgrass samples were collected and stored in one gallon plastic ziplock bags. On each day switchgrass was cofired with coal, ground switchgrass samples were taken on approximately one-hour intervals. Each sample bag contains about 360 to 460 grams of switchgrass, with particle sizes ranging from powder size to 2-inch stalks. Each bag contains a label as shown below. A sample taken at 3:45 pm on Dec 8, 2003 will be listed as

GRNDSWG120803—1545 on our daily sample inventory lists. A photo of the *partial* contents of a typical sample bag is also shown below.

GROUND SWITCHGRASS
(from baghouse exit)

Switchgrass Flow Rate: _____ tph ; _____ Hz

Date: _____ ; Time: _____
(24 hr military format)

Name of Sampler: _____

Example label for ground switchgrass

Ground switchgrass sample on 8-½" x 11" graph paper

Bottom Ash Solids— Bottom ash solids samples were collected and stored in 16 ounce wide-mouth polypropylene jars with unlined plastic lids. One pair of samples was collected daily during testing. Each jar contains about 400 to 500 grams of material, with particle sizes ranging from powder size to ¾-inch chunks. Each container contains a label as shown below. A sample taken at 1:05 pm on Dec 8, 2003 will be listed as *B-ASH-S120803—1305* on our daily sample inventory lists. A photo of the contents of a typical sample jar is also shown below.

BOTTOM ASH SOLIDS
(2 jars per sample)

Date: _____ ; Time: _____
(24 hr military format)

Name of Sampler: _____

Example label for bottom ash solids

Bottom ash solids sample on 8-½" x 11" graph paper

Bottom Ash Liquids— Bottom ash liquids samples were collected and stored in 1-liter narrow-mouth polypropylene bottles. One pair of samples was collected daily during testing from a bottom ash holding tank overflow weir. Each bottle contains a label as shown below. A sample taken at 1:10 pm on Dec 8, 2003 will be listed as *B-ASH-L120803—1310* on our daily sample inventory lists.

Economizer Ash— Economizer ash samples were collected and stored in 16 ounce wide-mouth polypropylene jars with unlined plastic lids. One pair of samples was collected daily during testing. Each jar contains about 350 to 450 grams of material, with particle sizes ranging from powder size to 1-inch chunks. Each jar contains a label as shown below. A sample taken at 1:35 pm on Dec 8, 2003 will be listed as *E-ASH120803—1335* on our daily sample inventory lists. A photo of the contents of a typical sample jar is also shown below.

ECONOMIZER ASH
(2 jars per sample)

Date: _____ ; Time: _____
(24 hr military format)

Name of Sampler: _____

Example label for economizer ash

Economizer ash sample on 8-½" x 11" graph paper

Fly Ash— Fly ash samples were collected and stored in 1-gallon unlined aluminum paint cans. Samples will be transferred to 16 ounce wide-mouth polypropylene jars with unlined plastic lids prior to shipping out for laboratory analysis. Over the testing period, two baseline (coal-only) fly ash samples and three cofire fly ash samples were collected for laboratory analysis. Each 16-oz jar will contain about 650 grams of material, with all particles being powder sized. Each jar will contain a label as shown below. A sample taken on Dec 5, 2003 will be listed as *F-ASH120503* on our fly ash sample inventory list. A photo of the contents of a typical sample jar is also shown below.

FLY ASH

☐ Coal Only ☐ Coal/Switchgrass

Date: _____

Time Range: _____ (24 hr military format)

Name of Sampler: _____

Example label for fly ash

Fly ash sample on 8-½" x 11" graph paper

Types of Testing Requested:
This laboratory testing request is intended to characterize the following: the switchgrass that was co-fed with the normal coal feed, the bulk coal feed (without soda ash additive) that is the main boiler fuel, the ash that is produced during both cofiring and coal-only operations (fly ash, bottom ash, and economizer ash), and the particle size distribution of both debaled and ground switchgrass samples.

The tests that are requested are as follows:

Water Soluble Alkalis: Leachable sodium and potassium using deionized water. These tests are requested for raw coal samples, debaled and ground switchgrass samples, bottom ash liquids samples, and bottom ash, economizer ash, and fly ash samples as specified in the sample inventory and testing lists in the Appendix.

Ultimate with Chlorine & Mercury + Proximate + BTU analysis: Elemental analysis (C, H, N, S, O by difference, and chlorine and mercury), % moisture, % volatiles, % fixed carbon, % ash and BTU/lb. These tests are requested for all raw coal samples, some (one or two per day) of the debaled switchgrass samples, and a few of the ground switchgrass samples.

Proximate with Sulfur, Chlorine, & Mercury + BTU analysis: Sulfur, Chlorine, Mercury, % moisture, % volatiles, % fixed carbon, % ash and BTU/lb. These tests are requested for most (all *except* one or two per day) of the debaled switchgrass samples.

Ash analysis + Chlorine/CO_2 : Elemental analysis of normal ash elements (SiO_2, Al_2O_3, Na_2O, K_2O, MgO, CaO, Fe_2O_3, TiO_2, P_2O_5 and S) plus chloride and carbon from char and carbonates. These tests are requested for nearly all raw coal samples, some (one or two per day) of the debaled switchgrass samples, and a few of the ground switchgrass samples.

Fusion Temperatures of Ash: Fusion (melting) temperatures of ash in both oxidizing and reducing atmospheres. These tests are requested for nearly all raw coal samples, some (one or two per day) of the debaled switchgrass samples, a few of the ground switchgrass samples, and four of each type of ash sample.

RCRA trace metals: ICP scan of RCRA metals (As, Ba, Cr, Cd, Pb, Hg, Ag and Se). These tests are requested for nearly all raw coal samples, some (one or two per day) of the debaled switchgrass samples, a few of the ground switchgrass samples, and four of each type of ash sample.

Loss on Ignition (LOI): Determination of residual char in ash sample. These tests are requested for all fly ash, bottom ash, and economizer ash samples.

Sieve analysis: Stack of sieves--3 mesh, 50 mesh, 200 mesh, 325 mesh and 400 mesh--to determine particle size distribution of all debaled and ground switchgrass samples, and all bottom ash solids samples.

Resistivity of flyash: Electrical resistivity of flyash samples. This test is requested for all fly ash samples provided. Please provide details on the testing method your lab will use.

Summary of Total Testing Services Requested:
The table below lists the total number of tests requested for each sample type and test type. A fill-in-the blank table is provided in the appendix to allow bidders to state the costs for providing the services requested.

Types of Test	Sample Types							
	Raw Coal	Debaled Switchgrass	Ground Switchgrass*	Fly Ash	Bottom Ash Liquids	Bottom Ash Solids	Economizer Ash	TOTAL
Ultimate (w/ Cl & Hg) + Proximate + Btu	12	8	4	0	0	0	0	**24**
Proximate (w/ S, Cl, & Hg) + Btu	0	44	0	0	0	0	0	**44**
Ash Analysis (w/ Cl & CO2)	10	8	4	10	0	4	4	**40**
Fusion Temperatures of Ash	10	8	4	10	0	4	4	**40**
Loss on Ignition (LOI)	0	0	0	10	0	11	10	**31**
Sieve Analysis (Particle Distribution)	0	39	41	3	0	11	0	**94**
Water Soluable Alkalis	10	8	4	10	4	4	4	**44**
RCRA Trace Metals	10	8	4	10	4	4	4	**44**
Resistivity	0	0	0	10	0	0	0	**10**
Total Number of Samples	**12**	**44**	**41**	**10**	**4**	**11**	**10**	**132**

* NOTE: Included under the 'Ground Switchgrass' totals is testing for one sample of baghouse fines collected on 12/04/03 for which the following tests are requested: 1) Ultimate (w/ Cl & Hg) + Proximate + Btu, 2) Ash Analysis (w/ Cl & CO2), 3) Fusion Temperatures of Ash, 4) Sieve Analysis (Particle Distribution), 5) Water Soluable Alkalis, and 6) RCRA Trace Metals.

All sample preparation fees should be included in the quotation for the requested testing services. Please also include expenses for archiving the excess sample materials for a period of at least 60 days following the reporting of the test results (in case additional testing is desired). If your laboratory is **unable** to perform one or more of the analyses requested, please clearly note which services are ***not*** covered in the quotation. If possible, the Chariton Valley Biomass Project would like to have a person present to observe during the laboratory analyses. Please indicate whether your laboratory will allow someone to observe the testing.

In addition to the test items specified above, we are interested in being able to quantify not only the total amount of unburned carbon in bottom ash and fly ash, but if possible, for days when both coal and switchgrass were being burned, we would also like to know the fraction of the unburned carbon that is from unburned switchgrass and the fraction of the unburned carbon that is from unburned coal. If your laboratory can make this determination, please indicate the costs for doing so.

Reporting and Transmitting Results:
Test results are desired in both hardcopy and electronic formats. Microsoft Excel is the preferred electronic format. Test results should be provided to each of the parties cited below. Electronic files containing the test results can be provided via e-mail or on a disk (3-1/2" floppy, or CD-ROM) along with the hardcopy results in the mail. CD-ROM and/or email is the preferred electronic media.

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APPENDIX

1. Fill-in-the-Blank Cost Form for Bidders

2. Daily Sample Inventory Lists and Test Specifications for Individual Samples

Cost Form for Laboratory Analyses

Types of Test	Sample Types							TOTAL
	Raw Coal	Debaled Switchgrass	Ground Switchgrass	Fly Ash	Bottom Ash Liquids	Bottom Ash Solids	Economizer Ash	
Ultimate (w/ Cl & Hg) + Proximate + Btu				n/a	n/a	n/a	n/a	$ -
Proximate (w/ S, Cl, & Hg) + Btu	n/a		n/a	n/a	n/a	n/a	n/a	$ -
Ash Analysis (w/ Cl & CO2)					n/a			$ -
Fusion Temperatures of Ash					n/a			$ -
Loss on Ignition (LOI)	n/a	n/a	n/a		n/a			$ -
Sieve Analysis (Particle Distribution)	n/a			n/a	n/a		n/a	$ -
Water Soluable Alkalis	n/a	n/a						$ -
RCRA Trace Metals								$ -
Resistivity	n/a	n/a	n/a		n/a	n/a	n/a	$ -
Sample Preparation Fee								$ -
Misc. Other Fees (sample archiving, etc.)								$ -
Subtotal by Sample Type	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Summary of Requested Laboratory Testing

(The table below lists the number of each type of test requested for each type of sample.)

Types of Test	Sample Types							TOTAL
	Raw Coal	Debaled Switchgrass	Ground Switchgrass	Fly Ash	Bottom Ash Liquids	Bottom Ash Solids	Economizer Ash	
Ultimate (w/ Cl & Hg) + Proximate + Btu	12	15	4	0	0	0	0	**31**
Proximate (w/ S, Cl, & Hg) + Btu	0	38	0	0	0	0	0	**38**
Ash Analysis (w/ Cl & CO2)	12	15	4	10	0	11	10	**62**
Fusion Temperatures of Ash	12	15	4	10	0	11	10	**62**
Loss on Ignition (LOI)	0	0	0	10	0	11	10	**31**
Sieve Analysis (Particle Distribution)	0	62	64	0	0	11	0	**137**
Water Soluable Alkalis	0	0	1	10	11	11	10	**43**
RCRA Trace Metals	12	15	4	10	11	11	10	**73**
Resistivity	0	0	0	10	0	0	0	**10**
Total Number of Samples	**12**	**62**	**64**	**10**	**11**	**11**	**10**	**180**

Miscellaneous Other Items:

Please answer the following questions.

Is your laboratory able to perform all of the analyses requested above? If not, please clearly note which services are not covered in the quotation.

Please indicate whether your laboratory will allow someone to observe the testing. **Yes** / **No** (circle one)

In addition to the test items specified above, we are interested in being able to quantify not only the total amount of unburned carbon in bottom ash and fly ash, but if possible, for days when both coal and switchgrass were being burned, we would also like to know the fraction of the unburned carbon that is from unburned switchgrass and the fraction of the unburned carbon that is from unburned coal. If your laboratory can make this determination, please indicate the costs for doing so.

What media will your laboratory use to provide electronic results? **Email** / **CD-ROM** / **Floppy Disk** (Circle all that apply)

Results from ITB Laboratory Testing

Sample Type	COAL				DEBALED SWITCHGRASS (Detailed Analysis)				DEBALED SWITCHGRASS (Brief Analysis)				GROUND SWITCHGRASS (Detailed Analysis)				BAGHOUSE FINES	
Statistic	Average	Min.	Max.	Count	Average	Min.	Max.	Count	Average	Min.	Max.	Count	Average	Min.	Max.	Count	Average	Count
	Proximate + Btu Analysis (As-received basis)								Proximate + Btu Analysis (As-received basis)									
Moisture, %	24.80	23.13	25.88	12	5.99	5.44	8.29	8	5.68	3.56	13.82	44	7.32	6.96	7.63	3	9.36	1
Vol. Matter, %	33.33	32.18	33.86	12	72.24	70.64	74.02	8	72.93	66.15	76.12	44	70.31	69.65	71.33	3	57.33	1
Fixed Carbon, %	36.10	35.25	37.07	12	16.99	15.88	17.52	8	15.82	13.62	17.72	44	15.89	15.29	16.97	3	12.45	1
Ash, %	5.45	4.11	7.95	12	4.63	4.08	5.27	8	5.43	3.51	8.52	44	6.38	5.39	7.82	3	20.76	1
Sulfur, %	0.31	0.29	0.33	12	0.09	0.07	0.12	8	0.07	0.03	0.14	44	0.10	0.06	0.16	3	0.10	1
Chlorine, %	0.00	0.00	0.00	12	0.06	0.03	0.08	8	0.07	0.03	0.14	44	-	-	-	3	-	1
Btu/lb (HHV)	8,942	8,680	9,114	12	7,479	7,410	7,579	8	7,471	6,850	7,680	44	7,280	6,996	7,432	3	5,767	1
	Proximate + Btu Analysis (dry basis)								Proximate + Btu Analysis (dry basis)									
Vol. Matter, %	44.34	41.86	45.52	12	76.85	75.82	78.64	8	77.32	74.39	80.41	44	75.87	74.86	77.01	3	63.25	1
Fixed Carbon, %	48.43	47.80	49.88	12	18.23	17.03	18.71	8	16.92	15.07	18.56	44	17.25	16.59	18.43	3	13.85	1
Ash, %	7.24	5.49	10.34	12	4.92	4.33	5.60	8	5.76	3.71	9.16	44	6.88	5.84	8.40	3	22.90	1
Btu/lb (HHV)	11,893	11,292	12,107	12	7,956	7,836	8,115	8	7,921	7,545	8,118	44	7,856	7,519	8,025	3	6,363	1
MAF Btu/lb.	12,821	12,594	12,951	12	8,368	8,248	8,501	8	8,406	7,946	8,628	44	8,434	8,209	8,572	3	8,253	1
	Ultimate Analysis (dry basis)								Ultimate Analysis (dry basis)				Ultimate Analysis (dry basis)					
Ash, %	7.24	5.49	10.34	12	4.92	4.33	5.60	8	5.76	3.71	9.16	44	6.88	5.84	8.40	3	22.90	1
Carbon, %	69.15	65.98	70.20	12	47.99	47.58	48.51	8	n/a	n/a	n/a	n/a	46.34	45.59	47.03	3	39.07	1
Organic C, %	68.98	65.97	70.19	10	47.98	47.58	48.51	8	n/a	n/a	n/a	n/a	46.34	45.59	47.03	3	38.87	1
Inorganic C, %	0.01	0.01	0.01	10	0.01	<0.01	0.02	8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	0.20	1
Hydrogen, %	4.70	4.37	5.04	12	5.70	5.63	5.78	8	n/a	n/a	n/a	n/a	5.62	5.41	5.87	3	4.71	1
Nitrogen, %	1.02	0.92	1.08	12	0.32	0.17	0.50	8	n/a	n/a	n/a	n/a	0.64	0.32	0.85	3	1.02	1
Oxygen, %	17.48	16.90	18.66	12	40.91	40.39	41.77	8	n/a	n/a	n/a	n/a	40.41	39.58	40.88	3	32.19	1
Sulfur, %	0.41	0.39	0.45	12	0.09	0.07	0.13	8	0.07	0.03	0.15	44	0.10	0.06	0.17	3	0.11	1
Chlorine, %	0.00	0.00	0.00	12	0.06	0.04	0.08	8	0.07	0.03	0.16	44						
ppm Chlorine	27	13	45	12	627	361	850	8	744	315	1,564	44						
	Water Soluable Alkali (ppm dry basis, except where noted)								Water Soluable Alkali (ppm dry basis, except where noted)									
Soluble Na	490	440	520	10	55	46	60	8	n/a	n/a	n/a	n/a	49	49	50	3	103	1
Soluble K	34.3	25.2	42.6	10	3,533.4	2,365.0	4,948.0	8	n/a	n/a	n/a	n/a	2,974.0	2,457.0	3,509.0	3	4,684.0	1
	Loss On Ignition, Wt % (dry basis)								Loss On Ignition, Wt % (dry basis)									
%LO	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Major Ash Elements, Wt % Ash (Ignited to 750 Deg. C) except where noted																	
SiO2	34.45	30.53	44.76	10	60.81	57.62	62.75	8	n/a	n/a	n/a	n/a	65.03	63.08	67.02	3	71.62	1
Al2O3	16.75	13.98	19.84	10	1.53	1.23	2.04	8	n/a	n/a	n/a	n/a	2.17	0.99	3.86	3	5.37	1
TiO2	1.37	1.17	1.91	10	0.09	0.07	0.11	8	n/a	n/a	n/a	n/a	0.13	0.05	0.20	3	0.27	1
Fe2O3	4.73	3.96	5.42	10	6.12	3.74	10.11	8	n/a	n/a	n/a	n/a	5.50	1.93	9.95	3	2.27	1
CaO	22.37	15.72	24.83	10	9.81	9.15	10.36	8	n/a	n/a	n/a	n/a	9.88	9.72	10.04	3	9.78	1
MgO	3.85	3.02	4.12	10	3.85	3.28	4.55	8	n/a	n/a	n/a	n/a	3.49	2.77	4.14	3	3.12	1
Na2O	1.25	0.98	1.41	10	0.31	0.20	0.39	8	n/a	n/a	n/a	n/a	0.35	0.16	0.60	3	0.50	1
K2O	0.37	0.15	0.77	10	8.03	6.01	9.64	8	n/a	n/a	n/a	n/a	5.49	3.87	7.62	3	2.94	1
P2O5	1.25	0.74	1.63	10	5.17	4.12	5.96	8	n/a	n/a	n/a	n/a	4.04	2.73	4.79	3	2.64	1
SO3	12.06	8.50	14.08	10	3.25	2.85	3.76	8	n/a	n/a	n/a	n/a	2.66	2.25	2.89	3	1.17	1
Oxide Total	98.45	97.65	99.73	10	98.95	97.56	100.45	8	n/a	n/a	n/a	n/a	98.74	98.41	99.03	3	99.68	1
	Ash Fusion Temperatures, Reducing Deg. F								Ash Fusion Temperatures, Reducing Deg. F									
Initial Deformation	2,116	2,076	2,206	10	1,898	1,832	1,975	8	n/a	n/a	n/a	n/a	2,068	1,898	2,154	3	2,370	1
Spherical (H=W)	2,146	2,095	2,253	10	2,107	2,013	2,209	8	n/a	n/a	n/a	n/a	2,214	2,097	2,280	3	2,450	1
Hemispherical (H=1/2W)	2,179	2,120	2,350	10	2,378	2,210	2,457	8	n/a	n/a	n/a	n/a	2,507	2,459	2,595	3	2,654	1
Fluid	2,210	2,146	2,386	10	2,427	2,301	2,547	8	n/a	n/a	n/a	n/a	2,588	2,513	2,656	3	2,712	1
	Ash Fusion Temperatures, Oxidizing Deg. F								Ash Fusion Temperatures, Oxidizing Deg. F									
Initial Deformation	2,152	2,098	2,269	10	2,046	1,963	2,122	8	n/a	n/a	n/a	n/a	2,128	1,987	2,220	3	2,332	1
Spherical (H=W)	2,190	2,138	2,318	10	2,227	2,151	2,274	8	n/a	n/a	n/a	n/a	2,268	2,225	2,310	3	2,407	1
Hemispherical (H=1/2W)	2,236	2,176	2,380	10	2,401	2,372	2,438	8	n/a	n/a	n/a	n/a	2,437	2,415	2,476	3	2,595	1
Fluid	2,268	2,201	2,424	10	2,447	2,425	2,475	8	n/a	n/a	n/a	n/a	2,526	2,493	2,548	3	2,783	1
	RCRA Trace Metals, ppm Dry Weight Basis (except where noted)																	
Ag	0.05	0.04	0.06	10	0.01	0.01	0.01	8	n/a	n/a	n/a	n/a	0.02	0.01	0.04	3	0.05	1
As	1.10	0.76	1.40	10	0.24	0.09	0.54	8	n/a	n/a	n/a	n/a	0.43	0.11	0.89	3	1.31	1
Ba	294.00	261.40	325.65	10	35.32	24.35	65.86	8	n/a	n/a	n/a	n/a	46.31	29.67	72.09	3	166.52	1
Cd	0.08	0.05	0.11	10	0.05	0.02	0.10	8	n/a	n/a	n/a	n/a	0.07	0.04	0.12	3	0.29	1
Cr	3.72	2.55	6.31	10	6.05	3.29	8.81	8	n/a	n/a	n/a	n/a	8.49	5.46	12.06	3	7.14	1
Hg	0.09	0.07	0.12	12	0.02	0.02	0.03	8	0.02	0.01	0.02	44	0.03	0.02	0.03	3	0.03	1
Pb	2.44	2.01	2.88	10	0.73	0.38	1.11	8	n/a	n/a	n/a	n/a	1.62	0.57	2.66	2	3.74	1
Se	0.77	0.54	1.22	10	0.79	0.53	1.22	8	n/a	n/a	n/a	n/a	0.66	0.59	0.77	3	0.93	1

Sample Type	BOTTOM ASH Liquid (Baseline Test Days / Coal-only)				BOTTOM ASH Liquid (Cofire Test Days)				BOTTOM ASH (Baseline Test Days / Coal-only)				BOTTOM ASH (Cofire Test Days)			
Statistic	*Average*	*Min.*	*Max.*	*Count*	*Average*	*Min.*	*Max.*	*Count*	*Average*	*Min.*	*Max.*	*Count*	*Average*	*Min.*	*Max.*	*Count*
	Proximate + Btu Analysis (As-received basis)								***Proximate + Btu Analysis (As-received basis)***							
Moisture, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vol. Matter, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fixed Carbon, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ash, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sulfur, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chlorine, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Btu/lb (HHV)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Proximate + Btu Analysis (dry basis)								***Proximate + Btu Analysis (dry basis)***							
Vol. Matter, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fixed Carbon, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ash, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Btu/lb (HHV)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
MAF Btu/lb.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Ultimate Analysis (dry basis)								***Ultimate Analysis (dry basis)***				***Ultimate Analysis (dry basis)***			
Ash, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Carbon, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.68	0.18	1.17	2	1.02	0.26	1.77	2
Organic C, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.66	0.17	1.14	2	1.00	0.24	1.76	2
Inorganic C, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.02	0.01	0.03	2	0.02	0.01	0.02	2
Hydrogen, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Nitrogen, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Oxygen, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sulfur, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	155.50	150.00	161.00	2	155.00	100.00	210.00	2
Chlorine, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
ppm Chlorine	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Water Soluable Alkali (ppm dry basis, except where noted)								***Water Soluable Alkali (ppm dry basis, except where noted)***							
Soluble Na	464	455	472	2	455	433	477	2	497	480	513	2	457	415	499	2
Soluble K	43.9	42.1	45.7	2	41.9	40.7	43.0	2	93.0	<10.0	176.0	2	182.9	84.7	281.0	2
	Loss On Ignition, Wt % (dry basis)								***Loss On Ignition, Wt % (dry basis)***							
%LOI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	7.44	0.31	22.97	4	1.63	0.17	5.01	7
	Major Ash Elements, Wt % Ash (Ignited to 750 Deg. C) except where noted															
SiO2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	46.98	45.49	48.46	2	45.30	44.89	45.71	2
Al2O3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	17.89	17.47	18.31	2	18.22	17.98	18.45	2
TiO2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.50	1.40	1.60	2	1.46	1.40	1.52	2
Fe2O3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5.70	5.30	6.10	2	5.54	5.35	5.72	2
CaO	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	20.10	18.85	21.35	2	19.95	18.85	21.05	2
MgO	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.54	3.39	3.69	2	3.57	3.40	3.73	2
Na2O	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.50	2.49	2.50	2	2.49	2.49	2.49	2
K2O	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.48	0.33	0.63	2	0.58	0.48	0.68	2
P2O5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.95	0.87	1.03	2	1.05	1.00	1.09	2
SO3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.37	0.28	0.45	2	0.26	0.12	0.40	2
Oxide Total	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100.00	99.31	100.68	2	98.40	97.54	99.26	2
	Ash Fusion Temperatures, Reducing Deg. F								***Ash Fusion Temperatures, Reducing Deg. F***							
Initial Deformation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,107	2,101	2,113	2	2,114	2,093	2,134	2
Spherical (H=W)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,133	2,126	2,140	2	2,143	2,120	2,166	2
Hemispherical (H=1/2W)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,160	2,155	2,165	2	2,160	2,145	2,175	2
Fluid	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,227	2,200	2,254	2	2,256	2,216	2,296	2
	Ash Fusion Temperatures, Oxidizing Deg. F								***Ash Fusion Temperatures, Oxidizing Deg. F***							
Initial Deformation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,118	2,115	2,120	2	2,125	2,110	2,139	2
Spherical (H=W)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,166	2,158	2,174	2	2,168	2,148	2,187	2
Hemispherical (H=1/2W)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,215	2,195	2,234	2	2,217	2,188	2,246	2
Fluid	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,302	2,260	2,344	2	2,304	2,252	2,355	2
	RCRA Trace Metals, ppm Dry Weight Basis (except where noted)															
Ag	0.21	<0.1	0.32	2	0.14	<0.1	0.18	2	0.66	0.66	0.66	2	0.68	0.66	0.69	2
As	17.75	17.60	17.90	2	18.30	17.20	19.40	2	4.97	4.22	5.71	2	4.72	3.80	5.63	2
Ba	366.50	355.00	378.00	2	416.50	415.00	418.00	2	4,194.00	3,453.00	4,935.00	2	4,563.50	4,502.00	4,625.00	2
Cd	0.87	0.65	1.08	2	0.62	0.58	0.65	2	0.51	0.50	0.51	2	0.49	0.44	0.53	2
Cr	6.35	3.70	9.00	2	3.10	2.80	3.40	2	42.25	41.70	42.80	2	43.25	40.60	45.90	2
Hg	0.01	0.01	0.01	2	0.01	0.01	0.01	2	0.01	0.01	0.02	2	0.01	0.01	0.02	2
Pb	<0.1	<0.1	<0.1	2	<0.1	<0.1	<0.1	2	9.01	7.12	10.90	2	8.85	8.34	9.35	2
Se	10.55	10.00	11.10	2	10.95	9.90	12.00	2	0.22	0.14	0.29	2	0.17	0.17	0.17	2

Sample Type	ECONOMIZER ASH (Baseline Test Days / Coal-only)				ECONOMIZER ASH (Cofire Test Days)				FLY ASH (Baseline Test Days / Coal-only)				FLY ASH (Cofire Test Days)			
Statistic	Average	Min.	Max.	Count	Average	Min.	Max.	Count	Average	Min.	Max.	Count	Average	Min.	Max.	Count
	Proximate + Btu Analysis (As-received basis)								*Proximate + Btu Analysis (As-received basis)*							
Moisture, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vol. Matter, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fixed Carbon, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ash, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sulfur, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chlorine, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Btu/lb (HHV)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Proximate + Btu Analysis (dry basis)				*Proximate + Btu Analysis (dry basis)*				*Proximate + Btu Analysis (dry basis)*							
Vol. Matter, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fixed Carbon, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ash, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Btu/lb (HHV)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
MAF Btu/lb.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Ultimate Analysis (dry basis)				*Ultimate Analysis (dry basis)*				*Ultimate Analysis (dry basis)*							
Ash, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Carbon, %	0.07	0.06	0.08	2	0.43	0.05	0.81	2	0.14	0.04	0.25	3	0.19	0.03	0.69	7
Organic C, %	0.05	0.04	0.06	2	0.41	0.03	0.79	2	0.13	0.03	0.23	3	0.18	0.01	0.69	7
Inorganic C, %	0.02	0.02	0.02	2	0.02	0.02	0.02	2	0.01	0.01	0.02	3	0.02	<0.01	0.02	7
Hydrogen, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Nitrogen, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Oxygen, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sulfur, %	2.15	2.00	2.30	2	1.90	1.40	2.40	2	0.83	0.70	1.00	3	0.86	0.60	1.00	7
Chlorine, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
ppm Chlorine	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Water Soluable Alkali (ppm dry basis, except where noted)								*Water Soluable Alkali (ppm dry basis, except where noted)*							
Soluble Na	3,072	2,015	4,128	2	2,778	2,357	3,198	2	1,845	1,123	2,919	3	2,045	1,134	2,785	7
Soluble K	350.0	245.0	455.0	2	721.0	322.0	1,120.0	2	46.6	35.5	63.8	3	94.3	56.3	131.0	7
					Loss On Ignition, Wt % (dry basis)								*Loss On Ignition, Wt % (dry basis)*			
%LOI	0.03	0.01	0.07	3	0.26	0.02	0.76	7	0.27	0.22	0.31	3	0.31	0.18	0.35	7
	Major Ash Elements, Wt % Ash (Ignited to 750 Deg. C) except where noted															
SiO2	34.36	34.01	34.70	2	36.29	34.54	38.03	2	37.43	36.26	38.10	3	38.05	35.59	41.13	7
Al2O3	17.94	17.63	18.24	2	17.35	16.93	17.77	2	18.85	18.28	19.77	3	19.21	18.79	19.81	7
TiO2	1.63	1.58	1.67	2	1.53	1.50	1.55	2	1.58	1.51	1.68	3	1.53	1.46	1.59	7
Fe2O3	5.93	5.90	5.95	2	5.92	5.76	6.07	2	5.50	5.45	5.60	3	5.18	4.88	5.62	7
CaO	25.50	24.81	26.19	2	24.17	24.07	24.27	2	24.96	24.07	26.30	3	24.02	21.74	25.15	7
MgO	4.46	4.37	4.55	2	4.31	4.27	4.34	2	4.60	4.28	5.21	3	4.39	3.86	4.97	7
Na2O	3.36	3.27	3.45	2	3.09	2.90	3.28	2	2.99	2.33	3.71	3	3.39	2.60	3.68	7
K2O	0.35	0.29	0.40	2	0.65	0.42	0.87	2	0.36	0.34	0.38	3	0.55	0.47	0.63	7
P2O5	1.13	1.11	1.14	2	1.21	1.11	1.30	2	1.36	1.14	1.68	3	1.19	1.04	1.33	7
SO3	5.47	5.18	5.75	2	4.90	3.57	6.22	2	2.18	1.76	2.62	3	2.26	1.55	2.68	7
Oxide Total	100.10	99.56	100.63	2	99.39	99.19	99.58	2	99.82	99.39	100.27	3	99.76	98.65	100.37	7
	Ash Fusion Temperatures, Reducing Deg. F								*Ash Fusion Temperatures, Reducing Deg. F*							
Initial Deformation	2,141	2,110	2,171	2	2,097	2,080	2,114	2	2,108	2,094	2,130	3	2,105	2,088	2,151	7
Spherical (H=W)	2,153	2,127	2,179	2	2,117	2,104	2,129	2	2,126	2,114	2,145	3	2,126	2,114	2,175	7
Hemispherical (H=1/2W)	2,166	2,143	2,188	2	2,132	2,118	2,145	2	2,136	2,134	2,139	3	2,147	2,132	2,196	7
Fluid	2,201	2,183	2,218	2	2,176	2,175	2,176	2	2,185	2,178	2,189	3	2,189	2,170	2,217	7
	Ash Fusion Temperatures, Oxidizing Deg. F								*Ash Fusion Temperatures, Oxidizing Deg. F*							
Initial Deformation	2,110	2,102	2,118	2	2,092	2,083	2,100	2	2,099	2,083	2,115	3	2,100	2,082	2,146	7
Spherical (H=W)	2,145	2,136	2,154	2	2,132	2,123	2,141	2	2,141	2,130	2,156	3	2,149	2,127	2,197	7
Hemispherical (H=1/2W)	2,170	2,164	2,175	2	2,155	2,145	2,165	2	2,170	2,162	2,177	3	2,183	2,152	2,237	7
Fluid	2,206	2,197	2,214	2	2,212	2,208	2,215	2	2,223	2,220	2,225	3	2,243	2,216	2,322	7
	RCRA Trace Metals, ppm Dry Weight Basis (except where noted)															
Ag	0.88	0.85	0.91	2	0.87	0.85	0.88	2	1.22	1.02	1.62	3	1.35	1.01	1.91	7
As	21.20	20.20	22.20	2	19.40	17.50	21.30	2	26.87	19.80	32.90	3	21.34	17.20	24.60	7
Ba	5,373.00	5,285.00	5,461.00	2	4,987.00	4,919.00	5,055.00	2	5,904.33	5,527.00	6,141.00	3	5,471.14	4,808.00	6,010.00	7
Cd	2.44	2.38	2.49	2	3.62	3.10	4.13	2	1.46	1.33	1.55	3	1.80	1.36	2.76	7
Cr	62.60	59.40	65.80	2	62.65	58.60	66.70	2	58.93	53.30	62.60	3	61.79	56.00	68.00	7
Hg	0.02	0.02	0.02	2	0.02	0.02	0.02	2	0.03	0.02	0.04	3	0.02	0.02	0.03	7
Pb	29.00	26.60	31.40	2	32.60	32.10	33.10	2	44.93	40.40	48.20	3	44.96	36.00	51.30	7
Se	0.76	0.38	1.14	2	0.49	0.45	0.53	2	8.35	6.08	10.10	3	8.02	5.21	10.52	7

Specification of Laboratory Testing Requirements for Fuel and Ash Samples from Chariton Valley Biomass Project Long Term Test Burn

Background: From February 16 to May12, 2006, the Chariton Valley Biomass Project (including its utility partner, Alliant Energy), conducted a test burn at the Ottumwa Generating Station (OGS) in Chillicothe, Iowa. Ottumwa Generating Station is a 726 MWe tangentially-fired pulverized coal unit that typically obtains 100 percent of its fuel input from Powder River Basin coal. The test burn involved cofiring coal with switchgrass. During the testing period, cofiring occurred continuously. Another testing period is planned for July 2006 to obtain baseline samples (only coal firing). In order to help determine the impacts of cofiring on plant operations, a range of samples were collected daily. The samples included:

- Raw coal (coal from the coal yard, before pulverizing)
- Ground switchgrass (switchgrass taken from the discharge of a mill)
- Bottom ash solids (solid material collected through a strainer at the bottom of the bottom ash discharge pipe)
- Silo fly ash (solid material collected from silo downstream of electrostatic precipitator)
- Auto sampler fly ash (solid material collected from a discharge pipe from the electrostatic precipitator hoppers)

Duplicates of all samples were obtained in case additional material volumes are required for completing the requested laboratory testing.

Purpose: The purpose of this document is to provide the information required to solicit bids for performing laboratory testing services on the samples collected during the test burn described above, and to serve as instructions for performing the requested tests on each sample provided (once the testing has been authorized). This document provides summary table for the testing services sought for each type of sample, including the total number of repetitions (separate samples for analysis) sought for each type of laboratory test requested.

Types of Testing Requested:
This laboratory testing request is intended to characterize the following: the switchgrass that was co-fed with the normal coal feed, the bulk coal feed (without soda ash additive) that is the main boiler fuel, the ash that is produced during cofiring operations (fly ash and bottom ash), and the particle size distribution of ground switchgrass samples.

The tests that are requested are as follows:

Water Soluble Alkalis: Leachable sodium and potassium using deionized water. These tests are requested for all raw coal samples, ground switchgrass samples, silo fly ash samples, and auto sampler fly ash samples as specified in the sample inventory and testing lists in the Appendix.

Ultimate with Chlorine & Mercury + Proximate + BTU analysis: Elemental analysis (C, H, N, S, O by difference, and chlorine and mercury), % moisture, % volatiles, % fixed carbon, % ash and BTU/lb. These tests are requested for all raw coal samples, and all ground switchgrass samples.

Ash analysis + Chlorine/CO_2 : Elemental analysis of normal ash elements (SiO_2, Al_2O_3, Na_2O, K_2O, MgO, CaO, Fe_2O_3, TiO_2, P_2O_5 and S) plus chloride and carbon from char and carbonates. These tests are requested for all samples. ***We will also want to make sure the switchgrass samples are ashed at 550^oC instead of 750^oC to avoid loss of potassium by volatilization.***

Fusion Temperatures of Ash: Fusion (melting) temperatures of ash in both oxidizing and reducing atmospheres. These tests are requested for all raw coal samples, all silo and auto sampler fly ash samples, and all bottom ash samples.

RCRA trace metals: ICP scan of RCRA metals (As, Ba, Cr, Cd, Pb, Hg, Ag and Se). These tests are requested for all samples.

Loss on Ignition (LOI): Determination of residual char in ash sample. These tests are requested for all silo fly ash, auto sampler fly ash, and bottom ash samples.

Sieve analysis: Stack of sieves—2", 1", ¾", ½", ¼", 7 mesh, 14 mesh, 25 mesh, 40 mesh, 60 mesh, 100 mesh, 200 mesh, pan--to determine particle size distribution of all ground switchgrass samples.

Summary of Total Testing Services Requested:
The table below lists the total number of tests requested for each sample type and test type. A fill-in-the blank table is provided in the appendix to allow bidder to state the costs for providing the services requested.

Summary of Requested Laboratory Testing

(The table below lists the number of each type of test requested for each type of sample.)

Types of Test	Sample Types					TOTAL
	Raw Coal	Ground Switchgrass	Silo Fly Ash	Auto Sampler Fly Ash	Bottom Ash Solids	
Ultimate (w/ Cl & Hg) + Proximate + Btu	5	11				**16**
Proximate (w/ S, Cl, & Hg) + Btu	5	11				**16**
Ash Analysis (w/ Cl & CO2)	5	11	4	6	5	**31**
Fusion Temperatures of Ash	5		4	6	5	**20**
Loss on Ignition (LOI)			4	6	5	**15**
Sieve Analysis (Particle Distribution)		11				**11**
Water Soluable Alkalis	5	11	4	6		**26**
RCRA Trace Metals	5	11	4	6	5	**31**
Total Number of Samples	**30**	**66**	**20**	**30**	**20**	**166**

All sample preparation fees should be included in the quotation for the requested testing services. Please also include expenses for archiving the excess sample materials for a period of at least 60 days following the reporting of the test results (in case additional testing is desired). If your laboratory is **unable** to perform one or more of the analyses requested, please clearly note which services are ***not*** covered in the quotation. If possible, the Chariton Valley Biomass Project would like to have a person present to observe during the laboratory analyses. Please indicate whether your laboratory will allow someone to observe the testing.

Reporting and Transmitting Results:
Test results are desired in both hardcopy and electronic formats. Microsoft Excel is the preferred electronic format. Test results should be provided to each of the parties cited below. Electronic files containing the test results can be provided via e-mail along with the hardcopy results in the mail.

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APPENDIX

1. Fill-in-the-Blank Cost Form for Bidders
2. Test Specifications for Individual Samples

Cost Form for Laboratory Analyses

Types of Test	Sample Types					TOTAL
	Raw Coal	Ground Switchgrass	Silo Fly Ash	Auto Sampler Fly Ash	Bottom Ash Solids	
Ultimate (w/ Cl & Hg) + Proximate + Btu			n/a	n/a	n/a	$ -
Proximate (w/ S, Cl, & Hg) + Btu			n/a	n/a	n/a	$ -
Ash Analysis (w/ Cl & CO2)						$ -
Fusion Temperatures of Ash		n/a				$ -
Loss on Ignition (LOI)	n/a	n/a				$ -
Sieve Analysis (Particle Distribution)	n/a		n/a	n/a	n/a	$ -
Water Soluable Alkalis					n/a	$ -
RCRA Trace Metals						$ -
Sample Preparation Fee						$ -
Misc. Other Fees (sample archiving, etc.)						$ -
Subtotal by Sample Type	$ -	$ -	$ -	$ -	$ -	$ -

Summary of Requested Laboratory Testing

(The table below lists the number of each type of test requested for each type of sample.)

Types of Test	Sample Types					TOTAL
	Raw Coal	Ground Switchgrass	Silo Fly Ash	Auto Sampler Fly Ash	Bottom Ash Solids	
Ultimate (w/ Cl & Hg) + Proximate + Btu	5	11				**16**
Proximate (w/ S, Cl, & Hg) + Btu	5	11				**16**
Ash Analysis (w/ Cl & CO2)	5	11	4	6	5	**31**
Fusion Temperatures of Ash	5		4	6	5	**20**
Loss on Ignition (LOI)			4	6	5	**15**
Sieve Analysis (Particle Distribution)		11				**11**
Water Soluable Alkalis	5	11	4	6		**26**
RCRA Trace Metals	5	11	4	6	5	**31**
Total Number of Samples	**30**	**66**	**20**	**30**	**20**	**166**

Miscellaneous Other Items:

Please answer the following questions.

Is your laboratory able to perform all of the analyses requested above? If not, please clearly note which services are not covered in the quotation.

Please indicate whether your laboratory will allow someone to observe the testing. **Yes** / **No** (circle one)

In addition to the test items specified above, we are interested in being able to quantify not only the total amount of unburned carbon in bottom ash and fly ash, but if possible, for days when both coal and switchgrass were being burned, we would also like to know the fraction of the unburned carbon that is from unburned switchgrass and the fraction of the unburned carbon that is from unburned coal. If your laboratory can make this determination, please indicate the costs for doing so.

What media will your laboratory use to provide electronic results? **Email** / **CD-ROM** / **Floppy Disk** (Circle all that apply)

Biosilo Test Sample Log Sheet
Ottumwa Generating Station Switchgrass Test Burn

Date	Time	Sample ID	Recommended Tests	Comments
3/22/2006	0900	GSWG-CF-T1-0322-1	AA,PA,RTE,SA,UL,WSA	Full Load
3/22/2006	2300	GSWG-CF-T2-0322-1	AA,PA,RTE,SA,UL,WSA	50% Load
3/23/2006	0900	GSWG-CF-T3-0323-1	AA,PA,RTE,SA,UL,WSA	Full Load
3/23/2006	2330	GSWG-CF-T4-0323-1	AA,PA,RTE,SA,UL,WSA	50% Load
3/24/2006	0400	GSWG-CF-T5-0324-1	AA,PA,RTE,SA,UL,WSA	Full Load
3/24/2006	1600	GSWG-CF-T5-0324-2	AA,PA,RTE,SA,UL,WSA	Sampling Period: 1600 to 2200, Full Load
3/24/2006	2200	GSWG-CF-T5-0324-3	AA,PA,RTE,SA,UL,WSA	Sampling Period: 2200 to 0400, Full Load
4/20/2006		GSWG-CF-R1-0420	AA,PA,RTE,SA,UL,WSA	High SWG Content, LOW Moisture
4/20/2006		GSWG-CF-R2-0420	AA,PA,RTE,SA,UL,WSA	High SWG Content, High Moisture
4/20/2006		GSWG-CF-R3-0420	AA,PA,RTE,SA,UL,WSA	High Foxtail
4/21/2006		GSWG-CF-R5-0421	AA,PA,RTE,SA,UL,WSA	Wildlife Mix
3/22/2006	0900	COAL-CF-T1-0322-1	AA,AFT,PA,RTE,UL,WSA	Full Load
3/22/2006	2330	COAL-CF-T2-0322-1	AA,AFT,PA,RTE,UL,WSA	50% Load
3/23/2006	0800	COAL-CF-T3-0323-1	AA,AFT,PA,RTE,UL,WSA	Full Load
3/24/2006	0000	COAL-CF-T4-0324-1	AA,AFT,PA,RTE,UL,WSA	50% Load
3/24/2006	0800	COAL-CF-T5-0324-1	AA,AFT,PA,RTE,UL,WSA	Full Load
3/22/2006	0900	AFA-CF-T1-0322-1	AA,AFT,LOI,RTE,WSA	Sampling Period: 0900 - 1430 Full Load
3/22/2006	2300	AFA-CF-T2-0322-1	AA,AFT,LOI,RTE,WSA	50% Load
3/23/2006	0730	AFA-CF-T3-0323-1	AA,AFT,LOI,RTE,WSA	Sampling Period: 730 - 1240 Full Load
3/23/2006	2340	AFA-CF-T4-0323-1	AA,AFT,LOI,RTE,WSA	50% Load
3/24/2006	0400	AFA-CF-T5-0324-1	AA,AFT,LOI,RTE,WSA	Sampe Period: 0400 3/24 to 0400 3/25, Full Load
3/21/2006	1300	AFA-CF-NT-0321-1	AA,AFT,LOI,RTE,WSA	
3/21/2006	1100	SFA-CF-NT-0321-1	AA,AFT,LOI,RTE,WSA	
3/22/2006	1230	SFA-CF-T1-0322-1	AA,AFT,LOI,RTE,WSA	Full Load
3/23/2006	0930	SFA-CF-T3-0323-1	AA,AFT,LOI,RTE,WSA	Full Load
3/24/2006	0615	SFA-CF-T5-0324-1	AA,AFT,LOI,RTE,WSA	Full Load
3/22/2006	1700	BA-CF-T1-0322-1	AA,AFT,LOI,RTE	Full Load
3/23/2006	1200	BA-CF-T2-0323-1	AA,AFT,LOI,RTE	Full Load
3/23/2006	1800	BA-CF-T3-0323-1	AA,AFT,LOI,RTE	Full Load
3/24/2006	0400	BA-CF-T4-0324-1	AA,AFT,LOI,RTE	50% Load
3/24/2006	1600	BA-CF-T5-0324-1	AA,AFT,LOI,RTE	Full Load

KEY: Red - Switchgrass samples to be tested Green - Coal Samples for Testing Blue - Other Samples to be tested

ID Nomenclature

AFA - Auto Sampler Fly Ash
BA - Bottom Ash
BAL - Bottom Ash Liquid
CF - Cofire
CO - Coal Only
DSWG - Debaled Switchgrass
GSWG - Ground Switchgrass
NT - No Test
SFA - Silo Fly Ash
T* - Test Number

Tests

AA - Ash Analysis w/Cl & CO_2
AFT - Ash Fusion Temperatures
LOI - Loss on Ignition
MAE - Major Ash Elements
PA - Proximate Analysis
R - Resistivity
RTE - RCRA Trace Elements
SA - Sieve Analysis (mesh sizes: 2", 1", 3/4", 1/2", 1/4", 7 mesh, 14 mesh, 25 mesh, 40 mesh, 60 mesh, 100 mesh, 200 mesh, pan
UL - Ultimate Analysis
WSA - Water Soluble Alkalis

CONSOL ENERGY

Customer: Kevin Comer
Company: Antares Group
Date: 8/1/2006
Project # 1650-1-1
General Description: Chariton Valley Biosilo Test Sample Results
PO# LTB-296-025

Switchgrass Sieve Results

		Weight %									
Anlytical #	Sample Identification	>1/4"	1/4"x 6 mesh	6 x 14	14 x 20	20 x 40	40 x 60	60 x 100	100 x 200	< 200 mesh	Total
62983	GSWG-CF-R1-0420	<0.01	5.17	25.07	23.02	25.38	12.46	5.74	1.97	1.19	100.00
62984	GSWG-CF-R2-0420	<0.01	5.14	31.85	29.96	19.66	8.60	2.83	0.82	1.14	100.00
92985	GSWG-CF-R3-0420	<0.01	3.99	32.02	35.14	18.29	6.75	2.10	0.50	1.21	100.00
62986	GSWG-CF-R5-0421	<0.01	2.51	28.00	28.55	17.48	12.13	6.33	2.71	2.29	100.00
62987	GSWG-CF-T5- 0324-1	<0.01	2.95	22.43	31.76	20.66	11.54	6.05	1.75	2.86	100.00
62988	GSWG-CF-T5- 0324-2	<0.01	3.46	27.04	33.04	19.27	10.41	4.27	1.20	1.31	100.00
62989	GSWG-CF-T5- 0324-3	<0.01	4.29	25.91	28.16	20.07	11.78	6.20	2.14	1.45	100.00
62990	GSWG-CF-T1-0322-1	<0.01	5.42	30.33	30.56	18.73	9.28	3.39	1.00	1.29	100.00
62991	GSWG-CF-T2-0322-1	<0.01	5.51	25.27	32.68	20.41	9.35	3.72	1.09	1.97	100.00
62992	GSWG-CF-T3-0323-1	<0.01	4.19	20.38	26.43	21.41	12.81	7.62	2.57	4.59	100.00
62993	GSWG-CF-T4-0324-1	<0.01	3.90	25.77	31.29	18.58	10.49	5.47	1.53	2.97	100.00

Appendix L – Air Permit Application Documentation

Plant ID (DNR Use only): Project Number (DNR Use only): **FI**

AIR QUALITY BUREAU
ATTN: Application Log in
7900 Hickman Rd., Suite 1
Urbandale, IA 50322

AIR CONSTRUCTION PERMIT APPLICATION

Form FI: Facility Information
Please see instructions on reverse side

ALL INFORMATION IS REQUIRED FOR PROCESSING – IF INFORMATION IS MISSING PERMIT WILL NOT BE ISSUED

FACILITY INFORMATION

1) Company Name	**Interstate Power & Light Company**
2) Facility Name (if different than #1)	**Ottumwa Generating Station**
3) Primary Facility Permit Contact Person/Title	Alan J. Arnold, Sr. Environmental Specialist
4) Telephone Number and Email Address	319-786-4476 alanarnold@alliantenergy.com
5) Secondary Facility Permit Contact Person	Barry Richmond, Environmental and Safety Specialist
6) Telephone Number and Email Address	319-786-2904
7) Address Permit should be sent to	20775 Power Plant Road
8) City/State/Zip	Ottumwa, IA 52501
9) Equipment Location Address (if different than #7)	
10) City/State/Zip	
11) Is the Equipment Portable?	☐ Yes ☒ No
12) SIC Code (if known)	4911
13) Provide Brief Business Description and Principal Product	The Ottumwa Generating Station is a coal fired, electric utility steam generator unit. This permit request is being made to add "switchgrass" as a permanent fuel to the boiler, Emission Unit 1, Emission Point 1, IDNR Construction Permit 78-A-019-S3.
14) Identify any adjacent or contingent facility that this company owns and/or operates	N/A

PERMIT PREPARER

THIS SECTION IS REQUIRED IF APPLICATION WAS PREPARED BY SOMEONE OTHER THAN A COMPANY EMPLOYEE

15) Name	Company Employee
16) Address	
17) City/State/Zip Code	
18) Phone Number and Email Address	
19) Iowa P.E. Number (IAC 567 22.1(3)"b")	
20) SIGNATURE	

CERTIFICATION

I CERTIFY THAT BASED ON INFORMATION AND BELIEF FORMED AFTER REASONABLE INQUIRY, THE ENCLOSED DOCUMENTS INCLUDING THE ATTACHMENTS ARE TRUE, ACCURATE, AND COMPLETE. LEGAL ENTITLEMENT TO INSTALL AND OPERATE THE EQUIPMENT COVERED BY AND ON THE PROPERTY IDENTIFIED IN THE PERMIT APPLICATION HAS BEEN OBTAINED.

21) Responsible Official's Name/Title	Chris Burke, Plant Manager – Ottumwa Generating Station
22) RESPONSIBLE OFFICIAL SIGNATURE	
23) Date	

APPLICATION FORMS ATTACHED

24. ☐ EU (Number of forms:), ☐ CS (#:), ☒ EC(#: 1), ☒ EI, ☒ Plot Plan, ☐ MI2, ☒ FRA

Other Forms and Attachments: Switchgrass Processing Facility Application Documents; Air Dispersion Modeling Report, Switchgrass Emissions Report

Plant ID (DNR Use only): Project Number (DNR Use only): **FI**

AIR QUALITY BUREAU
ATTN: Application Log in
7900 Hickman Rd., Suite 1
Urbandale, IA 50322

AIR CONSTRUCTION PERMIT APPLICATION

Form FI: Facility Information
Please see instructions on reverse side

ALL INFORMATION IS REQUIRED FOR PROCESSING – IF INFORMATION IS MISSING PERMIT WILL NOT BE ISSUED

FACILITY INFORMATION

1) Company Name	Chariton Valley Resource Conservation & Development, Inc.
2) Facility Name (if different than #1)	OGS Switchgrass Processing Facility
3) Primary Facility Permit Contact Person/Title	Paul Koffman, President, Board of Directors
4) Telephone Number and Email Address	(641) 437-4376; cvrcd@cvrcd.org
5) Secondary Facility Permit Contact Person	Jenna Arnold, Chariton Valley Biomass Project Coordinator
6) Telephone Number and Email Address	(641) 437-4376; jarnold@cvrcd.org
7) Address Permit should be sent to	19229 Hwy 5
8) City/State/Zip	Centerville, IA 52544
9) Equipment Location Address (if different than #7)	20775 Power Plant Road
10) City/State/Zip	Chillicothe, IA 52501
11) Is the Equipment Portable?	☐ Yes ☒ No
12) SIC Code and NAISC Code (if known)	SIC: NAISC:
13) Provide Brief Business Description and Principal Product	Receive & process switchgrass bales, deliver (blow) processed switchgrass to the Ottumwa Generating Station (OGS) boiler.
14) Identify any adjacent or contingent facility that this company owns and/or operates	N/A – Located adjacent to Interstate Power & Light's OGS

PERMIT PREPARER

THIS SECTION IS REQUIRED IF APPLICATION WAS PREPARED BY SOMEONE OTHER THAN A COMPANY EMPLOYEE

15) Name	Company employee
16) Address	
17) City/State/Zip Code	
18) Phone Number and Email Address	
19) Iowa P.E. Number (IAC 567 22.1(3)"b")	
20) SIGNATURE	

CERTIFICATION

I CERTIFY THAT BASED ON INFORMATION AND BELIEF FORMED AFTER REASONABLE INQUIRY, THE ENCLOSED DOCUMENTS INCLUDING THE ATTACHMENTS ARE TRUE, ACCURATE, AND COMPLETE. LEGAL ENTITLEMENT TO INSTALL AND OPERATE THE EQUIPMENT COVERED BY AND ON THE PROPERTY IDENTIFIED IN THE PERMIT APPLICATION HAS BEEN OBTAINED.

21) Responsible Official's Name/Title	Paul Koffman, President, Board of Directors
22) RESPONSIBLE OFFICIAL SIGNATURE	
23) Date	

APPLICATION FORMS ATTACHED

24. ☒ EU (Number of forms: 1), ☒ CS (#: 2), ☒ EC(#: 2), ☒ EI, ☒ Plot Plan, ☐ MI2, ☒ FRA

Other Forms and Attachments

EU-2A, EU-11, CS-18A, CS-19A, EC-3A, EC-4A
Project Description & Emissions-related Issues report, PM10 Dispersion Modeling report

EU

AIR QUALITY BUREAU
ATTN: Application Log in
7900 Hickman Rd., Suite 1
Urbandale, IA 50322

AIR CONSTRUCTION PERMIT APPLICATION

Form EU: Emission Unit Information

Please see instruction on reverse side

Company Name:	**CHARITON VALLEY RESOURCE CONSERVATION& DEVELOPMENT, INC.**

EMISSION UNIT (PROCESS) IDENTIFICATION & DESCRIPTION

1) **Emission Unit (EU) Name:**	**SWITCHGRASS 1**
2) **EU ID Number:**	**SWG1**

3) **EU** Type: ☒ New Source ☐ Unpermitted Existing Source ☐ Modification to a Permitted Source Previous Permit # is:

4) **Manufacturer:**	**CUSTOM-DESIGNED SWITCHGRASS PROCESSING SYSTEM**
5) **Model:**	**CUSTOM**
6) **Maximum Capacity:**	**12.5 tons of switchgrass input per hour**
7) **Date of Construction:**	**MARCH 1, 2005--proposed**
8) **Date of Modification (if applicable)**	

9) Is this a Controlled Emission Unit? ☐ **No** ☒ **Yes** If Yes, Control Equipment name/ID are: **SWG BAGHOUSE#1, CYCLONE#1**

EMISSION UNIT OPERATING SCHEDLULE (hours/day, hours/year, or other)

10) **Actual Operation**	**8,760 hours/year**
11) **Maximum Operation**	**8,760 hours/year**

REQUESTED LIMITS

12) **Are you requesting any permit limits?** ☒ **No** ☐ **Yes** **If Yes, check below and write down all that apply**

☐ **Operation Hour Limits:**	
☐ **Production Limits:**	
☐ **Material Usage Limits**	
☐ **Other:**	
Rationale for Requesting the Limit(s):	

PROCESS DESCRIPTION

13 Provide a description **AND** a drawing to show quantitatively how **product or material** flows through this emission unit. Include product input and output, fuel throughput, and any parameters which impact air emissions. If space below is insufficient, attach a separate sheet labeled EU-11A.

Switchgrass bales are processed by two hammmermills. The first mill "debales" the 3 ft x 4 ft x 8 ft bales while the second hammermill processes the switchgrass to a size that can be efficiently burned in the OGS boiler. Both hammermills are held under negative pressure by an induced draft fan (IDF). The switchgrass is then conveyed from the second mill to a cyclone, where 80% of the total material on a mass basis is removed and sent to a surge bin. The remaining 20% of the total material is pneumatically conveyed to the baghouse at a maximum air flow rate of 23,019 cfm, where the airstream with the smaller particles passes through bag filters with a 99.9+% collection efficiency. The material collected in the bag filters will be periodically removed by air pulsing and transported to the same surge bin into which the cyclone dumps. The emissions rate for the baghouse and IDF is 0.010 grains per cubic foot, or 0.0010 tons per hour if an 80% efficient cyclone is used upstream of the baghouse. See attached sheet EU-11A for a diagram of the process. The surge bin conveys the processed switchgrass through a pair of rotary airlocks and into blow lines which carry the material to a pair of burners in the OGS boiler. A more thorough description of the switchgrass processing system, including detailed construction drawings is attached and titled "Growing Switchgrass in Southern Iowa to Cofire with Coal at Ottumwa Generating Station: Project Description and Emissions Issues for the Chariton Valley Biomass Project."

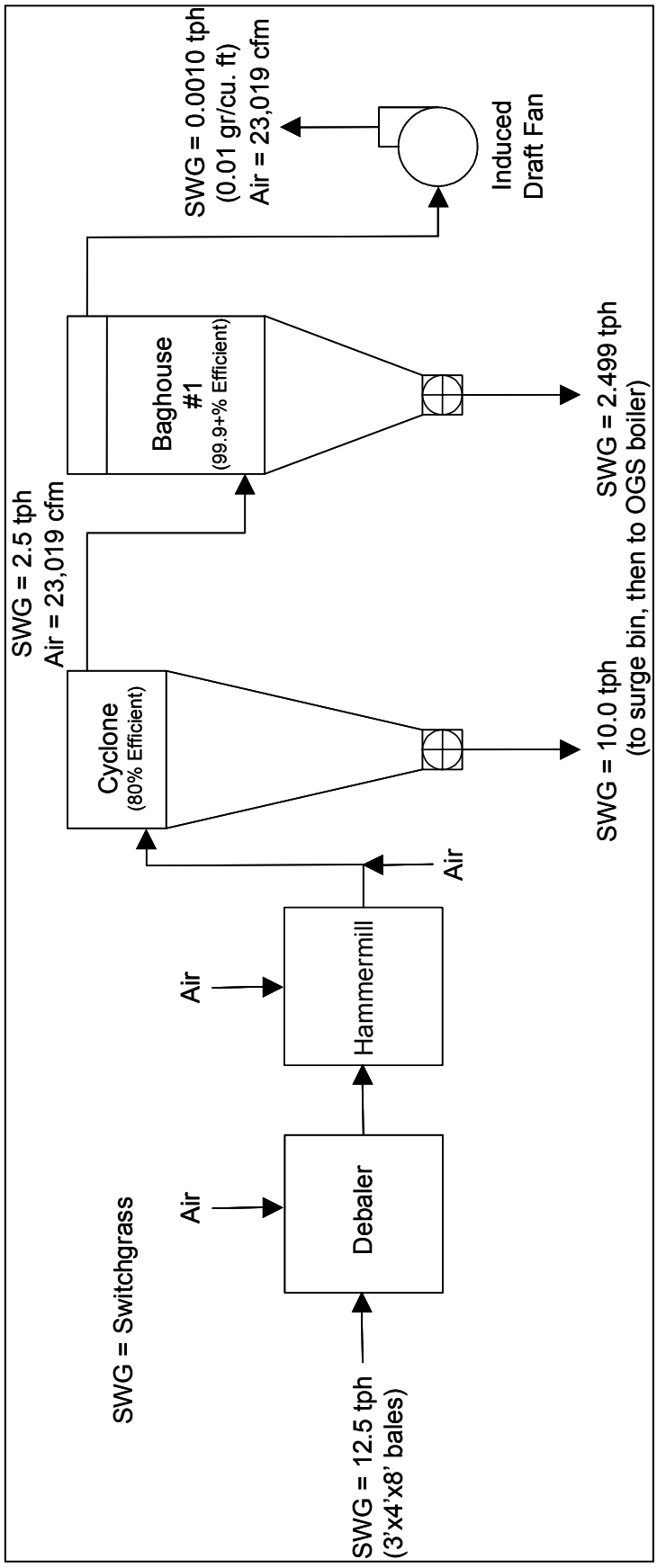
ATTACHMENT EU-2A
Identification of Multiple Identical Emissions Units

Two identical switchgrass processing lines are planned for this switchgrass processing facility. Each process line will be designed to operate at a switchgrass feed rate of 12.5 tons per hour. The first process line is described in Form EU (and again below). The identical second line is also identified below, and is shown in the attached detailed construction drawings (in the "Growing Switchgrass in Southern Iowa to Cofire with Coal at Ottumwa Generating Station: Project Description and Emissions Issues for the Chariton Valley Biomass Project" document).

Emission Unit #1: SWITCHGRASS 1
EU ID Number: SWG1
Date of Construction: March 1, 2005 (proposed)

Emission Unit #2: SWITCHGRASS 2
EU ID Number: SWG2
Date of Construction: To Be Determined (no sooner than March 1, 2006)

ATTACHMENT EU-11
Process Description Drawing (Switchgrass 1)



AIR QUALITY BUREAU
ATTN: Application Log in
7900 Hickman Rd., Suite 1
Urbandale, IA 50322

IOWA DNR Air Construction Permit Application

Form CS Control Equipment and Stack/Vent Information
Please see instructions on the reverse side

Company Name

1) EP Number ID: Switchgrass 1 (SWG1)

2) Stack Opening size: ☐ circular, diameter (inches) _ _____ ☒ other size (inches x inches) ___32x24_____

3) Height from ground (feet): 20 ft above ground at switchgrass processing building (56 ft above ground level of OGS boiler house)

4) Height from highest building level (feet): 30 ft below switchgrass processing building highest roof level (201 ft below OGS boiler house roof level)

5) Distance from the nearest property line (feet): 220

6) Discharge Style (check one)	
	☐ Vertical (without rain cap or with unobstructing rain cap)
	☒ VR (Vertical, with obstruction rain cap)
	☐ D (Downward discharge; for example, a goose neck stack)
	☐ H (Horizontal discharge)
	☐ I (Inside-Vent inside building)

Exhaust Information

7) Moisture Content % (if known): n/a (approx. ambient)

8) Exit Temperature (Fahrenheit): Ambient + 5 deg. F

9) Rated Flow Rate: ☒ ACFM __23,019_____ ☐ SCFM __ _____

Control Equipment

10) Control Equipment Name and ID (if none, stop): SWG BAGHOUSE #1, CYCLONE #1

11) Capture Hood involved: ☐Yes ☒No

12) Capture Hood Efficiency (percentage):

13) Date of Installation: March 1, 2005 (approx.)

14) Date of Modification (if any):

15) Manufacturer and Model Number: Camfil Farr 11 - 231 BRF 10, Big Round Filter (BRF) Dust Collector

16) ID(s) of Emission Unit Controlled: SWG1

17) Is operating schedule different than emission units(s) involved: ☐ Yes ☒ No

18) Control efficiency documents (Must check one and provide documents as attachments as CS-18A)
☒Yes ☐No

Pollutant Controlled

	PM	PM10	SO_2	NOx	VOC	CO
Control Efficiency	99.9+%	99.9+%				

19) If manufacturer's data is not available attach a separate sheet of paper (labeled CS-19A) to provide the control equipment design specifications and performance data to support the above mentioned control efficiency.

AIR QUALITY BUREAU
ATTN: Application Log in
7900 Hickman Rd., Suite 1
Urbandale, IA 50322

IOWA DNR Air Construction Permit Application

Form CS Control Equipment and Stack/Vent Information
Please see instructions on the reverse side

Company Name

1) EP Number ID: Switchgrass 2 (SWG2)

2) Stack Opening size: ☐ circular, diameter (inches) _ _____ ☒ other size (inches x inches) ___32x24_____

3) Height from ground (feet): 20 ft above ground at switchgrass processing building (56 ft above ground level of OGS boiler house)

4) Height from highest building level (feet): 30 ft below switchgrass processing building highest roof level (201 ft below OGS boiler house roof level)

5) Distance from the nearest property line (feet): 220

6) Discharge Style (check one)	
	☐ Vertical (without rain cap or with unobstructing rain cap)
	☒ VR (Vertical, with obstruction rain cap)
	☐ D (Downward discharge; for example, a goose neck stack)
	☐ H (Horizontal discharge)
	☐ I (Inside-Vent inside building)

Exhaust Information

7) Moisture Content % (if known): n/a (approx. ambient)

8) Exit Temperature (Fahrenheit): Ambient + 5 deg. F

9) Rated Flow Rate: ☒ ACFM __23,019_____ ☐ SCFM __ _____

Control Equipment

10) Control Equipment Name and ID (if none, stop): SWG BAGHOUSE #2, CYCLONE #2

11) Capture Hood involved: ☐ Yes ☒ No

12) Capture Hood Efficiency (percentage):

13) Date of Installation: T.B.D. (after March 1, 2006)

14) Date of Modification (if any):

15) Manufacturer and Model Number: Camfil Farr 11 - 231 BRF 10, Big Round Filter (BRF) Dust Collector

16) ID(s) of Emission Unit Controlled: SWG2

17) Is operating schedule different than emission units(s) involved: ☐ Yes ☒ No

18) Control efficiency documents (Must check one and provide documents as attachments as CS-18A)
☒ Yes ☐ No

Pollutant Controlled

	PM	PM10	SO_2	NOx	VOC	CO
Control Efficiency	99.9+%	99.9+%				

19) If manufacturer's data is not available attach a separate sheet of paper (labeled CS-19A) to provide the control equipment design specifications and performance data to support the above mentioned control efficiency.

ATTACHMENT CS-18A
Documentation of Manufacturer's Guaranteed Emissions Rate (SWG Baghouse #1)

FARR
Air Pollution Control

Emission Warranty
For
SEGA

Airflow: 20,000 ACFM @ 140 degree F. Maximum
Material Filtered: Switch Grass
Air/Cloth ratio: Not to exceed 6:1
Grain Loading: 30 grains per DSCF
Emission Limit: .01 grains per DSCF

This warranty includes an emission limit not to exceed .01 DSCF. The following conditions will apply to this warranty:

(1) The emission test will be conducted within 60 days of start up of equipment. The emission testing will be conducted by a qualified independent company.
(2) If the emission limits stated are not met during the initial testing, Farr Company will have 30 days to make modifications to the equipment in order to comply with the emission warranty.
(3) The warranty will be considered satisfied after successful completion of test.
(4) All costs associated with testing will be the responsibility of the buyer.
(5) The collectors will be operated per industry standard practices, (Reference Collector Operating Instruction Manual)
(6) Upset conditions, as defined as excessive oil or hydrocarbons, excessive moisture, abrasion due to improper evacuation of dust collector hopper, or exceeding air flow specified, may void this warranty.
(7) Under no circumstances will Farr be liable for incidental or consequential damages

John Dauber
Regional Sales Manager

ATTACHMENT CS-19A
Particulates Control Efficiency Calculations for Switchgrass Processing Facility at Ottumwa Generating Station

Particulate Emissions from Switchgrass Processing Facility (Per Line)

NOTE : For a 25 ton per hour system, there will be 2 bale processing lines, EACH of which will have the emissions noted below.

Assumptions/Inputs:

Switchgrass Feed:	109,500	tons/yr	(12.5 ton/hr x 8,760 hr/yr = 109,500 tons/yr)
	12.5	tons/hr	
Cyclone Efficiency:	80%		
Bagouse Loading:	2.50	tons/hr	
Baghouse Efficiency:	99.961%		(guaranteed emissions rate of 0.01 grains/ft^3 at a 30 grains/ft^3 loading)
Baghouse Air Flow:	23,019	scfm	

Cyclone Particulate Emission Results (Baghouse Loading):

PM Emissions:	2.5	tons/hr =	21,900	tons/yr
	5,000	lbs/hr		
	3.62E-03	lbs/cubic ft		
	25.3	grains/cubic ft		
	57,990.1	mg/cubic m		

Baghouse Particulate Emission Results:

PM Emissions:	0.0010	tons/hr =	8.6	tons/yr
	1.97	lbs/hr		
	1.42E-06	lbs/cubic ft		
	0.0100	grains/cubic ft		
	22.8	mg/cubic m		

Velocity, Temperature, and Location of Baghouse Discharge:

Baghouse ID Fan Discharge Width:	23.8	inches		
Baghouse ID Fan Discharge Hieght:	31.8	inches		
Baghouse ID Fan Discharge Area:	5.26	sq. ft		
Height above ground for Baghouse ID Fan Discharge Area:	20	ft, as determined by dispersion model		
Baghouse ID Fan Discharge Velocity:	4,376	ft/min =	72.9	ft/sec
Baghouse Fan Discharge Temp.:	5	^oF above ambient		
Height above ground level of OGS boiler house:	56	feet		
Distance below maximum roof level of bale processing building:	30	feet		
Distance below maximum roof level of OGS boiler house:	201	feet		
Distance from OGS Property Line:	220	feet (minimum distance)		

AIR QUALITY BUREAU ATTN:
Application Log in Desk
7900 Hickman Rd., Suite 1
Urbandale, IA 50322

AIR CONSTRUCTION PERMIT APPLICATION

Form EC: Emission Calculations
Please see instructions on reverse side

1) Company Name: Interstate Power & Light Company

2) Emission Point (Stack/Vent) Number:
EP1 (OGS Stack)

3) Air Emissions Pathway Diagram
(see examples on reverse-side)

see attached diagram EC-3A

4) Potential Emission Calculation. This calculation is based on (check all that apply):
☐ Emission Factors ☐ Mass Balance ☒ Testing Data ☐ Other: Vendor warranty

☐ Requested Limit(s) (Note: A requested limit that is not based on emission factors, mass balance or stack testing data will need to be verified through initial compliance stack test.)

Calculations:

see attached calculations page EC-4A

Notes:
1) The emissions calculations shown on attachment EC-4A and on Form EI are estimates of the annual incremental impacts of this project on emissions at OGS.
2) The emissions rates shown in the table in block #5 below are based on the measured emissions rates that were obtained during a two week test burn period during December 2003. The rates in the table are the difference between the rates obtained when cofiring switchgrass and the rastes obtained when firing only coal. Negative numbers indicate reduced emissions rates when cofiring switchgrass.
3) The emissions rates below and in the calculations on attachment EC-4A are based on average measured results when firing switchgrass at a 12.5 ton per hour rate. They are not extrapolated to reflect 25.0 ton per hour operation. Emissions reductions are expected to be higher at a 25.0 ton per hour rate. All measured emissions rates either decreased or remained the same when cofiring with switchgrass as compared to coal-only operation during the stack testing.
4) The emissions calculations on attachment EC-4A are based on an annual switchgrass use of 109,500 tons per year. This annual quantity was determined as follows: 12.5 tons/hr x 8760 hr/yr = 109,500 tons/yr.

SUMMARY OF EMISSIONS FROM THIS EMISSION POINT

5) Emissions (After control if applicable):	Pollutant	PM	PM_{10}	SO_2	NOx	VOC	CO	Lead	Single HAP	Total HAPs
	Concentration,Unit:	- 0.0015 lb/MMBtu	- 0.0035 lb/MMBtu	- 0.032 lb/MMBtu	0.0 lb/MMBtu	n/a	- 0.00001 lb/MMBtu	n/a	n/a	n/a
	lbs/hr	0.0056	- 0.013	- 0.12	0	n/a	- 0.000038	n/a	n/a	n/a
	tons/year	- 49	- 115	- 1,048	0	n/a	- 0.33	n/a	n/a	n/a

AIR QUALITY BUREAU ATTN:
Application Log in Desk
7900 Hickman Rd., Suite 1
Urbandale, IA 50322

AIR CONSTRUCTION PERMIT APPLICATION

Form EC: Emission Calculations
Please see instructions on reverse side

1) Company Name: Chariton Valley Resource Conservation & Development, Inc.

2) Emission Point (Stack/Vent) Number:
SWG1

3) Air Emissions Pathway Diagram
(see examples on reverse-side)

see attached diagram EC-3A

4) Potential Emission Calculation. This calculation is based on (check all that apply):
☐ Emission Factors ☒ Mass Balance ☐ Testing Data ☒ Other: Vendor warranty

☐ Requested Limit(s) (Note: A requested limit that is not based on emission factors, mass balance or stack testing data will need to be verified through initial compliance stack test.)

Calculations:
PM = FRswg x (1 - EFFc) x (1 - EFFbh) x Hmax = 12.5 ton/yr x (1 - 0.80) x (1 - 0.99961) x 8760 hr/yr = 8.6 tons/yr
where FRswg = maximum switchgrass feed rate, 12.5 tons/hr
EFFc = cyclone efficiency, 0.80 (no units)
EFFbh = baghouse efficiency, 0.99961 (no units) (based on vendor warranty terms)
Hmax = maximum annual operational hours, 8760 hr/yr
PM = 8.6 tons/yr x (2000 lbs/ton) / (8760 hr/yr) = 1.97 lbs/hr
PM = 1.97 lbs/hr x (7000 grains/lb) / (60 min/hr) / (23,019 scf / min) = 0.01 gr/scf

Assumptions:
1) The guaranteed emissions rate from the baghouse vendor is 0.01 grains/DSCF at an input loading rate of 30 grains/DSCF. It is assumed that the emissions rate from the baghouse is 0.01 grains/DSCF even though the anticipated input loading rate with a 12.5 ton/hr switchgrass feed rate, an 80% efficient cyclone, and an air flow rate of 23,019 scfm would be less than the input loading on the vendor's warranty (for these expected maximum conditions, the baghouse input loading would be about 25.3 grains/scf, as shown on ATTACHMENT CS-19A). This is a conservative assumption.
2) The emissions rate for PM10 is assumed to be less than the PM emissions rate calculated above, but the difference has not been quantified.

SUMMARY OF EMISSIONS FROM THIS EMISSION POINT

5) Emissions (After control if applicable):	Pollutant	PM	PM_{10}	SO_2	NOx	VOC	CO	Lead	Single HAP	Total HAPs
	Concentration,Unit:	0.01 gr/scf	< 0.01 gr/scf	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	lbs/hr	1.97	< 1.97	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	tons/year	8.6	< 8.6	n/a	n/a	n/a	n/a	n/a	n/a	n/a

AIR QUALITY BUREAU ATTN:
Application Log in Desk
7900 Hickman Rd., Suite 1
Urbandale, IA 50322

AIR CONSTRUCTION PERMIT APPLICATION

Form EC: Emission Calculations
Please see instructions on reverse side

1) Company Name: Chariton Valley Resource Conservation & Development, Inc.

2) Emission Point (Stack/Vent) Number:
SWG2

3) Air Emissions Pathway Diagram
(see examples on reverse-side)

see attached diagram EC-3A

4) Potential Emission Calculation. This calculation is based on (check all that apply):
☐ Emission Factors ☒ Mass Balance ☐ Testing Data ☒ Other: Vendor warranty

☐ Requested Limit(s) (Note: A requested limit that is not based on emission factors, mass balance or stack testing data will need to be verified through initial compliance stack test.)

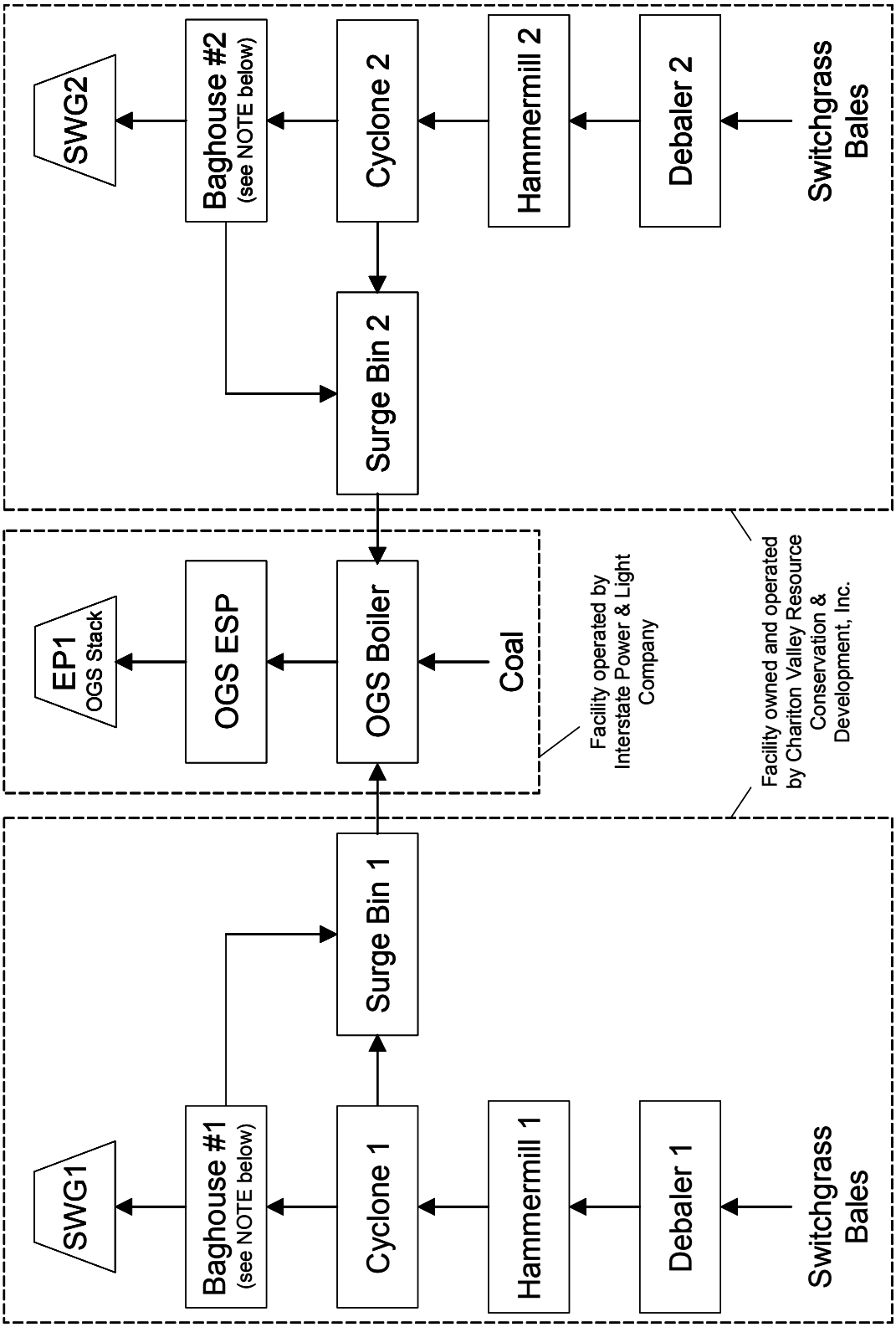
Calculations:
PM = FRswg x (1 - EFFc) x (1 - EFFbh) x Hmax = 12.5 ton/yr x (1 - 0.80) x (1 - 0.99961) x 8760 hr/yr = 8.6 tons/yr
where FRswg = maximum switchgrass feed rate, 12.5 tons/hr
EFFc = cyclone efficiency, 0.80 (no units)
EFFbh = baghouse efficiency, 0.99961 (no units) (based on vendor warranty terms)
Hmax = maximum annual operational hours, 8760 hr/yr
PM = 8.6 tons/yr x (2000 lbs/ton) / (8760 hr/yr) = 1.97 lbs/hr
PM = 1.97 lbs/hr x (7000 grains/lb) / (60 min/hr) / (23,019 scf / min) = 0.01 gr/scf

Assumptions:
1) The guaranteed emissions rate from the baghouse vendor is 0.01 grains/DSCF at an input loading rate of 30 grains/DSCF. It is assumed that the emissions rate from the baghouse is 0.01 grains/DSCF even though the anticipated input loading rate with a 12.5 ton/hr switchgrass feed rate, an 80% efficient cyclone, and an air flow rate of 23,019 scfm would be less than the input loading on the vendor's warranty (for these expected maximum conditions, the baghouse input loading would be about 25.3 grains/scf, as shown on ATTACHMENT CS-19A). This is a conservative assumption.
2) The emissions rate for PM10 is assumed to be less than the PM emissions rate calculated above, but the difference has not been quantified.

SUMMARY OF EMISSIONS FROM THIS EMISSION POINT

5) Emissions (After control if applicable):	Pollutant	PM	PM_{10}	SO_2	NOx	VOC	CO	Lead	Single HAP	Total HAPs
	Concentration,Unit:	0.01 gr/scf	< 0.01 gr/scf	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	lbs/hr	1.97	< 1.97	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	tons/year	8.6	< 8.6	n/a	n/a	n/a	n/a	n/a	n/a	n/a

ATTACHMENT EC-3A
Air Emissions Pathway Diagram



NOTE: Baghouse #1 and Baghouse #2 are Big Round Filter Dust Collectors manufactured by Farr Air Pollution Control. Each of these units is a combined cyclone and baghouse.

ATTACHMENT EC-4A (Page 1 of 2)
Calculations for Project Impacts on OGS Stack Emissions

Measured Emissions Results from December 2003 Switchgrass Cofire Test Burn at OGS[2]

Pollutant	Ave Coal lb/MMBtu	Ave Cofire lb/MMBtu	% Change[1]	Source
SO2	0.681	0.649	-4.7%	CEMS data analysis, 12/1/03 to 12/12/03, 8 am to 6 pm
NOx	0.362	0.362	0.0%	
PM	3.39E-02	3.24E-02	-4.4%	General Electric/Mostardi Platt (GE-MP) measurements
PM-10	2.56E-02	2.21E-02	-13.7%	
CO	2.60E-04	2.50E-04	-3.8%	

NOTES:

1) Negative numbers indicate decreases relative to coal-only operation.

2) Complete details and analysis regarding the testing from which these emissions measurements were obtained has been provided to IDNR in the following reports and presentation:

i) "*Chariton Valley Biomass Project Interim Test Burn: Emissions Test Report* (Test Burn of Switchgrass with Coal at Ottumwa Generating Station, Unit #1, Chillicothe, IA)," prepared by Antares Group Inc., Landover, MD, August 25, 2004.

ii) GE Mostardi Platt Report M22E0343A, *Particulate and Gaseous Emissions Study* , Elmhurst, IL, January 20, 2004

iii) "*Summary of Activities and Results from December 2004 Interim Test Burn at Ottumwa Generation Station* ," presented to Iowa Department of Natural Resources, presented by Chariton Valley Biomass Project team members (Chariton Valley Resource Conservation & Development, Inc., Alliant Energy, and Antares Group Inc.), September 9, 2004.

EMISSIONS IMPACT CALCULATIONS

ASSUMPTIONS:

Ave HHV Switchgrass (HHV_{SWG}) = 7,476 Btu/lb

% Heat Input from Switchgrass ($Q_{IN,SWG\%}$) = 2.5 %

Annual Switchgrass Input to OGS Boiler (M_{SWG}) = 109,500 ton / yr

CALCULATIONS:

First, calculate the Total Heat Input from Switchgrass per year ($Q_{IN,SWG}$)

$Q_{IN,SWG} = M_{SWG} \times HHV_{SWG} \times 2000$ lb / ton = 1,637,244 MMBtu/yr

Then, calculate the Total Heat Input to OGS Boiler ($Q_{IN,TOTAL}$)

$Q_{IN,TOTAL} = Q_{IN,SWG} / Q_{IN,SWG\%}$ = 65,489,760 MMBtu/yr

Calculate the change in SO2 emissions when cofiring switchgrass:

SO_2 change = (($SO2_{COFIRE}$ - $SO2_{COAL}$) x $Q_{IN,TOTAL}$) / 2,000 lb / ton

= ((0.649 - 0.681) lb/MMBtu x 65,489,760 MMBtu/yr) / 2,000 lb/ton

SO_2 change = -1,048 tons SO_2 / yr

Calculate the change in NOx emissions when cofiring switchgrass:

NO_x change = ((NOx_{COFIRE} - NOx_{COAL}) x $Q_{IN,TOTAL}$) / 2,000 lb / ton

= ((0.362 - 0.362) lb/MMBtu x 65,489,760 MMBtu/yr) / 2,000 lb/ton

NO_x change = 0 tons NO_x / yr

ATTACHMENT EC-4A (Page 2 of 2)
Calculations for Project Impacts on OGS Stack Emissions

EMISSIONS IMPACT CALCULATIONS (continued)

Calculate the change in PM emissions when cofiring switchgrass:

PM change = ((PM_{COFIRE} - PM_{COAL}) x $Q_{IN,TOTAL}$) / 2,000 lb / ton
= ((0.0324 - 0.0339) lb/MMBtu x 65,489,760 MMBtu/yr) / 2,000 lb/ton
PM change = -49 tons PM / yr

Calculate the change in PM-10 emissions when cofiring switchgrass:

PM_{10} change = (($PM10_{COFIRE}$ - $PM10_{COAL}$) x $Q_{IN,TOTAL}$) / 2,000 lb / ton
= ((0.0221 - 0.0256) lb/MMBtu x 65,489,760 MMBtu/yr) / 2,000 lb/ton
PM_{10} change = -115 tons PM_{10} / yr

Calculate the change in CO emissions when cofiring switchgrass:

CO change = ((CO_{COFIRE} - CO_{COAL}) x $Q_{IN,TOTAL}$) / 2,000 lb / ton
= ((0.00025 - 0.00026) lb/MMBtu x 65,489,760 MMBtu/yr) / 2,000 lb/ton
CO change = -0.33 tons CO / yr

AIR QUALITY BUREAU
ATTN: Application Log in
7900 Hickman Rd., Suite 1
Urbandale, IA 50322

IOWA DNR Air Construction Permit Application

Form EI Facility Emission Inventory

Please see instructions on the reverse side

Company Name: Interstate Power & Light Company / Chariton Valley RC&D, Inc. **PSD Classification:** ☒ Major ☐ Minor ☐ Unknown

STACK/VENT EMISSIONS SUMMARY

(1) EP ID	(2) EU ID	(3) Source Description	(4) Construction Date	(5) Permit Number	(6) Potential or Permitted Emission Rate (tons/yr)								
					PM	PM_{10}	SO_2	NOx	VOC	CO	Lead		
EP1	EU1	OGS Boiler Stack	1978	78-A-019-53	- 49	- 115	- 1,048	0	n/a	- 0.33	n/a		
		Emissions noted above are incremental changes resulting from this project.											
SWG1	SWG1	Switchgrass process line #1	March 2005	T.B.D.	8.6	< 8.6	n/a	n/a	n/a	n/a	n/a		
SWG2	SWG2	Switchgrass process line #2	after March 2006	T.B.D.	8.6	< 8.6	n/a	n/a	n/a	n/a	n/a		
(7) Total Stack Emissions					- 31.8	- 97.8	- 1,048	0	n/a	- 0.33	n/a		

Fugitive Emission Summary

(8) Source ID:											
	On-site switchgrass bale transportation	11.8	3.1								
(9) Total Fugitive Emissions		11.8	3.1								
(10) Total Plant Emissions		- 20.0	- 94.7	- 1,048	0	n/a	- 0.33	n/a			

FORM MI - 1 Modeling Information (Plot Plan)

SITE PLAN

FOR CHARITON VALLEY BIOMASS PROJECT
FOR THE PROPOSED AUTOMATED 25 TPH
SWITCHGRASS FEED ADDITION TO
ALLIANT ENERGY SITE

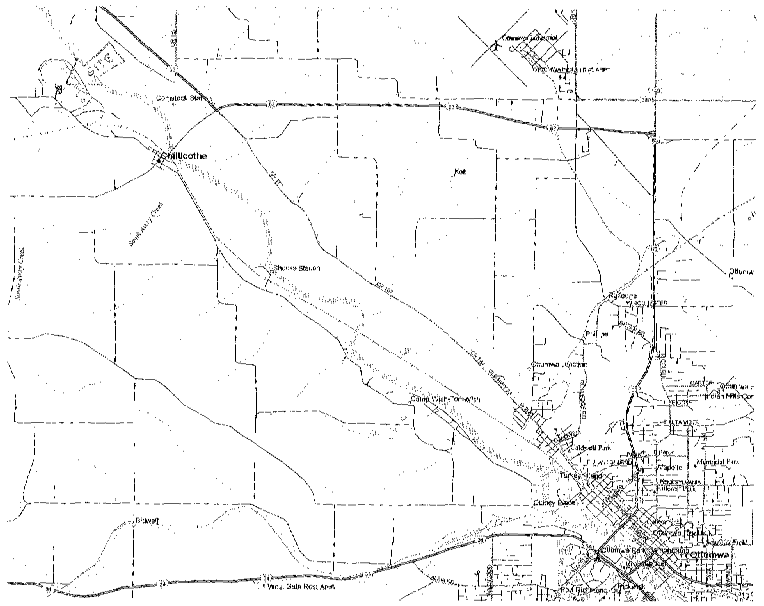
SITE ADDRESS: 20991 POWER PLANT ROAD
OTTUMWA, IOWA 52548

CONSTRUCTION TYPE: II-N

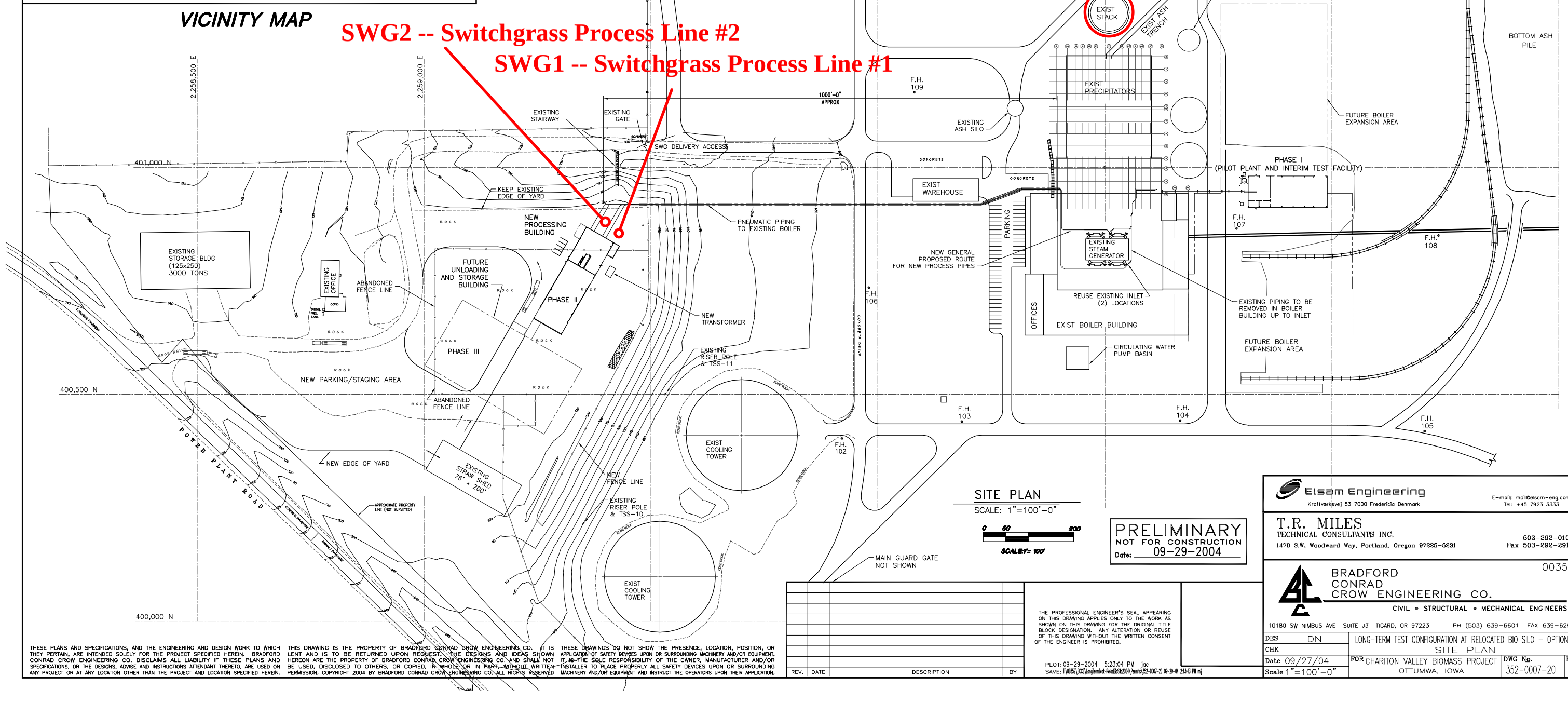
OCCUPANCY: S-1, SWITCH GRASS STORAGE & GALLERY BUILDINGS,
F-1, PROCESSING BUILDING FOR POWER GENERATION

FLOOR AREAS: PROPOSED PROCESSING BUILDING 7,000 SF (PHASE II),
ADDITIONAL 7,000 SF (PHASE III)
NEW SWITCHGRASS BARN APPROX 27,000 SF (PHASE II),
ADDITIONAL 24,000 SF (PAHSE III)
GALLERY 2000 SF

LAND USE
CLASSIFICATION: I-2 (HEAVY INDUSTRIAL)



VICINITY MAP



SITE PLAN
SCALE: 1"=100'-0"

0 50 200
SCALE: 1" = 100'

PRELIMINARY
NOT FOR CONSTRUCTION
Date: 09-29-2004

REV.	DATE	DESCRIPTION	BY

THE PROFESSIONAL ENGINEER'S SEAL APPEARING ON THIS DRAWING APPLIES ONLY TO THE WORK AS SHOWN ON THIS DRAWING FOR THE ORIGINAL TITLE BLOCK DESIGNATION. ANY ALTERATION OR REUSE OF THIS DRAWING WITHOUT THE WRITTEN CONSENT OF THE ENGINEER IS PROHIBITED.

PLOT: 09-29-2004 5:23:04 PM joc
SAVE: I:\BDCP\2003\Completed-Projects\352-0007-20 Permit\352-0007-20 09-29-04 2-LS1 PW.mi

Elsam Engineering
Kraftværksvej 53 7000 Fredericia Denmark
E-mail: mail@elsam-eng.com
Tel: +45 7923 3333

T.R. MILES
TECHNICAL CONSULTANTS INC.
1470 S.W. Woodward Way, Portland, Oregon 97225-6231
503-292-0107
Fax 503-292-2919

00352
BRADFORD CONRAD CROW ENGINEERING CO.
CIVIL • STRUCTURAL • MECHANICAL ENGINEERS
10180 SW NIMBUS AVE SUITE J3 TIGARD, OR 97223 PH (503) 639-6601 FAX 639-6251

DBS	DN
CHK	
Date	09/27/04
Scale	1"=100'-0"

LONG-TERM TEST CONFIGURATION AT RELOCATED BIO SILO - OPTION 7
SITE PLAN
FOR CHARITON VALLEY BIOMASS PROJECT
OTTUMWA, IOWA
DWG No. 352-0007-20
REV —

FRA

AIR QUALITY BUREAU
ATTN: Application Log in
7900 Hickman Rd., Suite 1
Urbandale, IA 50322

AIR CONSTRUCTION PERMIT APPLICATION

FEDERAL REGULATION APPLICABILITY

Please see instructions on the reverse side

Company Name: Chariton Valley Resource Conservation & Development, Inc. / Interstate Power & Light Company

APPLICABILITY DETERMINATION

1)	Will this project be subject to 1990 CAA Section 112(g) (Case-by-Case MACT)	☒ NO ☐ YES* ☐ DON'T KNOW * If YES then applicant must submit an application for a case-by-case MACT determination [IAC 567 22-1(3)"b" (8)]	
2)	Will this project be subject to a New Source Performance Standard? (40 CFR part 60)	☒ NO ☐ YES* ☐ DON'T KNOW *If YES please identify sub-part _____	
3)	Will this project be subject to a MACT (Maximum Achievable Control Technology) Regulation? (40 CFR part 63) THIS ONLY APPLIES IF THE PROJECT EMITS A HAZARDOUS AIR POLLUTANT – SEE TABLE A FOR LIST	☒ NO ☐ YES* ☐ DON'T KNOW *If YES please identify sub-part _____	
4)	Will this project be subject to a NESHAP (National Emission Standards for Hazardous Air Pollutants) Regulation? (40 CFR part 61)	☒ NO ☐ YES* ☐ DON'T KNOW *If YES please identify sub-part _____	
5)	Will this project be subject to PSD (Prevention of Significant Deterioration) ? (40 CFR section 52.21)	☒ NO ☐ YES ☐ DON'T KNOW	
6)	Was netting done for this project to avoid PSD?	☒ NO ☐ YES* ☐ DON'T KNOW *If YES please attach netting calculations	

IF YOU ARE UNSURE HOW TO ANSWER ANY OF THESE QUESTIONS CALL 1-877 AIR IOWA

FEDERAL REGULATIONS APPLICABILITY FORM INSTRUCTIONS

This form is designed to provide the review engineer information regarding applicable federal regulations. This project may be subject to a federal regulation. These regulations have also been adopted by the state of Iowa in IAC 567 23.1(1), 23.1(2), 23.1(3), 23.1(4) and 23.1(5).

1) The 112(g) provision is a transitional measure to ensure that facilities protect the public from hazardous air pollutants until EPA issues MACT standards that apply to the facilities. If this project is already subject to a MACT regulation it will not be subject to the provisions of 112 (g).

2) New Source Performance Standards are Federal Regulations that apply to a wide range of sources of criteria air pollutants. To locate the rule go to http://www.access.gpo.gov/nara/cfr/waisidx_01/40cfr60_01.html

3) MACT regulations apply to sources of hazardous air pollutants. See Table A for a list of hazardous air pollutants. To locate the rule - go to: www.epa.gov/ttn/atw/mactfnl.html.

4) NESHAP regulations apply to sources of the following pollutants: beryllium, mercury, vinyl chloride, radionuclides, benzene, asbestos and arsenic. To locate the rule - go to www.access.gpo.gov/nara/cfr/waisidx_02/40cfr61_02.html

5) If you are a PSD major source and the net emissions increase from this project exceeds significance levels (as defined by 40 CFR 52.21) this project will be subject to PSD regulations. Please contact DNR prior to application submission.

GROWING SWITCHGRASS IN SOUTHERN IOWA TO COFIRE WITH COAL AT OTTUMWA GENERATING STATION: PROJECT DESCRIPTION AND EMISSIONS ISSUES FOR THE CHARITON VALLEY BIOMASS PROJECT

Introduction

Alliant Energy's utility subsidiary, Interstate Power & Light (IPL), and Chariton Valley Resource Conservation and Development, Inc. (CVRC&D) are seeking to obtain all necessary air emission permits to allow cofiring switchgrass and coal on a commercial basis at IPL's Ottumwa Generating Station (OGS) in Chillicothe, IA. OGS is a 726 MWe tangentially-fired unit fueled with Powder River Basin coal. IPL and its partners in the Chariton Valley Biomass Project (CVBP) completed a two-week test burn in December 2003 during which detailed fuel and emissions characterizations were performed. The test was an important part of the activities of the CVBP, a multi-year project seeking to demonstrate the technical and commercial feasibility of producing power from a locally grown and harvested renewable fuel resource: switchgrass. The project is being cost-shared by the U.S. Department of Energy through Chariton Valley Resource Conservation and Development, Inc. ***The project seeks to develop a new business opportunity for local farmers, while creating environmental benefits by developing a new renewable energy resource in Iowa, improving air emissions (primarily SO_2 and net greenhouse gas emissions reductions), improving soil conditions on local farm lands, and reducing run-off from farm lands into local surface waters.***

Following a thorough test plan that was developed in coordination with IDNR staff, IPL monitored SO_2, NO_x, CO, PM, and PM_{10} emissions during both coal-only and cofire test runs. Using the average measured results for the emissions monitored during the test burn, all of these emissions are expected to either decrease slightly or remain unchanged during the planned commercial operation. An emissions test report[1] has been submitted to IDNR and results were presented in detail to IDNR staff during a meeting during September of 2004. Using information from the test burn, design parameters for the planned switchgrass processing facility, and information from IDNR's existing air quality dispersion model for OGS, Stanley Consultants Incorporated modeled the impact of the new switchgrass processing facility on the predicted PM_{10} concentrations at OGS. This dispersion modeling was performed to demonstrate that predicted concentrations of PM_{10} will comply with the National Ambient Air Quality Standards (NAAQS) after installation of the new switchgrass processing facility at OGS. The dispersion modeling demonstrated that the total PM_{10} concentrations are below the NAAQS of 50 $\mu g/m^3$ and 150 $\mu g/m^3$ for annual and 24-hr periods respectively, and are therefore in compliance with the NAAQS (see attached report for details).[2] ***Based on these results, project partners would like to work with IDNR and EPA to obtain the necessary permits to add switchgrass as a permanent fuel supply for the Ottumwa Generating Station.***

[1] "*Chariton Valley Biomass Project Interim Test Burn: Emissions Test Report (Test Burn of Switchgrass with Coal at Ottumwa Generating Station, Unit #1, Chillicothe, IA)*," prepared by Antares Group Inc., Landover, MD, August 25, 2004.

[2] "*Switchgrass PM_{10} NAAQS Dispersion Modeling: Ottumwa Generating Station*," prepared by Stanley Consultants Inc., Coralville, IA, December, 2004.

This document presents a brief overview of the proposed commercial operation, including aspects related to emissions ranging from farm activities to the power plant. Results from the December 2003 test burn emissions testing are summarized and projected to an annual basis for the commercial operation.

Environmental Benefits at the Farm

The Chariton Valley Biomass Project will produce environmental benefits at OGS and on Iowa farms. Extensive research on the environmental impacts of this project on Iowa farmlands and their neighboring rivers and lakes has been led by Iowa State University over the past decade. At the farm, the project will benefit the soil quality, water quality, and local wildlife. Research has shown that switchgrass can reduce sediment yield by 55% relative to the baseline condition. Switchgrass produces average sediment yields that are a magnitude less than land in row crop production. Switchgrass production would help the water quality at Rathbun Lake, which provides water to more than 60,000 residents in 18 counties. Its watershed consists of around 354,000 acres, where 60% of the land is used for row crop production, 25% is used for pasture and hayland, and one-third is highly erodible cropland, nearly half of which is enrolled in the Conservation Reserve Program (CRP). The lake has been contaminated by agricultural soil loss from highly erodible land; sediment containing farm chemicals is filling the lake three times faster than originally anticipated. In addition to the erosion control and water quality benefits, the growing of switchgrass also provides an alternative crop for landowners in an area of the state where many of these highly erodible soils are not suitable for row crop production. Switchgrass fields grown for biomass also provide cover habitat for grassland birds and other wildlife, and nest success rates in the fields should support stable bird populations. A 1999 Rathbun Lake Watershed report found that 27% of the watershed (94,884 acres) has a high potential for wildlife quality improvement, 57% (203,221 acres) has a moderate potential, and 16% (55,939 acres) has a low potential. In addition, of the 189,327 acres with favorable soil characteristics for perennial grasses, approximately 51,000 acres are located on land that has a high potential for wildlife quality improvement. The switchgrass will be harvested from September through November, after the first killing frost, when most of the bird populations have migrated South.

Overview of Commercial Operation

The Chariton Valley Biomass Project will grow switchgrass as a source of renewable energy in southern Iowa. Project partners intend to cofire this biomass fuel with coal to continuously generate up to 35 MW of biomass-derived electric power at the Ottumwa Generating Station (OGS). To accomplish this, the project will require up to 200,000 tons of switchgrass annually from 50,000 acres, and will involve as many as 500 farmers.

The switchgrass will be grown within 70 miles of OGS (see attached map). The main area of switchgrass production will occur in the Chariton River watershed. This watershed encompasses about 740,000 acres in southern Iowa. Common crops in southern Iowa are corn, soybeans, a variety of cool season forages and pasture species, and woodlots. The main limitations to crop

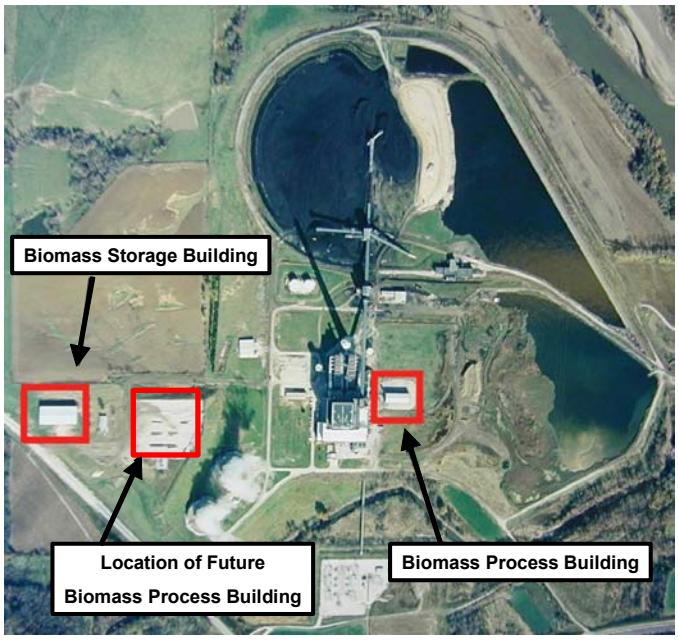
production in southern Iowa have been steep, erosive landscapes, clayey soils that alternate between being too wet and too dry, and acidic subsoils. As a result, a large proportion of the land is enrolled in the Conservation Reserve Program, with corresponding areas being planted to switchgrass. These types of lands will provide much of the switchgrass used as fuel at OGS.

Switchgrass production (farming) and delivery are major steps required to supply 200,000 tons to OGS annually. Off-site storage (storage not at OGS) will be required for the switchgrass not transported directly to OGS during harvest season. Production steps include establishing, fertilizing, harvesting, and baling the crop. Delivery steps will usually involve moving the switchgrass from the field to off-site storage facilities, and eventually transporting the switchgrass to OGS for consumption. The farmers will use trucks with 53-ft. extended flatbed trailers to supply large square (3' x 4' x 8') bales of switchgrass to OGS. Each trailer will be loaded with bales stacked three high, two wide, and seven deep for a total of 42 bales per truck and a payload weight of about 42,000 lbs (1,000 lbs per bale), or 21 tons. During commercial operations, the switchgrass processing facility at OGS will require deliveries from about 200 flatbed trailers per week, or about 40 per day for a five-day delivery schedule. A map of the existing off-site storage facilities and the locations of the fields that have supplied the switchgrass for the test burns is attached. To date, all switchgrass storage facilities are fully-enclosed steel or hoop buildings. The average transportation distance to deliver the switchgrass from farm or remote storage to OGS will probably be about 40 to 50 miles.

Switchgrass Process Facility at OGS

The Chariton Valley Biomass Project will process up to 200,000 tons per year of switchgrass at a rate up to 25 tons per hour for 8,000 hours per year.[3] The switchgrass will provide up to 5.0% of the heat input to the boiler at OGS at full-load conditions. As shown in Exhibit 1, the new switchgrass processing facility will be located on the small hill just west of the existing boiler plant facility (approximately 1,000 feet away). Engineering drawings of the site plans and proposed construction are also attached (Dwg. Nos. 352-0007-20 & 352-0007-21). The building where the switchgrass processing was performed for the test burns completed in 2001 and 2003 is labeled as "Biomass Process Building" in Exhibit 1 and is adjacent to

Exhibit 1 Aerial View of OGS



[3] It should be noted that, to avoid production limitations or reporting requirements, the permit paperwork and emissions estimates are based on an annual production rate of 219,000 tons per year, corresponding to 25 tons per hour for 8760 hours per year.

the existing boiler house on the East side. This location is not feasible for a permanent switchgrass processing facility because it is reserved for a possible new coal-fired boiler that could be built at OGS in the future. The proposed location for commercial operations, labeled as "Location of Future Biomass Process Building" in Exhibit 1, will not present any interference with the existing coal and ash hauling traffic and is therefore a logistically attractive location. The following paragraphs describe the operation and equipment that will be resident inside the new processing facility.

Various plan and section views of the new switchgrass processing facility and the enclosed equipment are attached as drawings 352-0007-22 through 352-0007-26. A simplified schematic diagram of the process is attached as drawing 352-0007-27. All of the processing equipment will be fully-enclosed in the steel building, with the exception of the dust collector (cyclone/baghouse). Delivery trucks will be unloaded by fork trucks, which will either place the bales in temporary storage inside the building or on the receiving conveyor. Twine is automatically removed from each bale by a "de-stringer" machine. The twine is dropped into a collection bin for disposal. The bales are then fed into a debaler, which is a hammermill that will process the bales into pieces less than two inches in length. The debaled switchgrass drops out of the debaler onto a conveyor which feeds the material into an attrition mill for final size reduction. The final length of the processed material is less than one-half inch. This material is discharged from the hammermill and sucked into a cyclone which separates dust from the larger particles. The cyclone drops the larger particles into a surge bin. The dust continues to a cyclone/baghouse which filters the dust from the transport air and drops the dust onto a fully-enclosed conveyor. This conveyor transports the dust to the surge bin. The processed switchgrass is fed by two screw conveyors in the bottom of the surge bin into two rotary airlocks. The airlocks feed the material into steel blow lines which will transport it about 1000 feet, through two burners, and into the OGS boiler.

The concentration of particulate matter released to the atmosphere from the hammermill and de-baler (non-combustion sources) will not exceed 50 $\mu g/m^3$. All of the processing and handling equipment where dust could be generated will be maintained under negative pressure to avoid dust accumulation within the processing facility. This includes the debaler, conveyors, the hammermill, and the surge bin. All of the dust generated from the processing operations is passed through the cyclone, and then the cyclone/baghouse.

Impact on Boiler Stack Emissions at OGS

At OGS, the project will reduce greenhouse gas emissions on a CO_2-eq. basis by nearly 176,000 tons per year when operating at an average feed rate of 25 tons per hour. On average, the December 2003 test burn showed reductions in sulfur dioxide, PM, PM_{10}, and carbon monoxide by 4.7%, 4.4%, 13.7%, and 3.8% respectively (at average daily switchgrass feed rates up to 10.6 tons per hour). The test burn also demonstrated that the nitrogen oxides will not be higher than during baseline coal operations. The summary of the expected emissions changes for commercial operation at 12.5 tons per hour are shown below in Exhibit 2, based on measurements obtained during coal-only and cofire test periods from the December 2003 test burn. *To be conservative, the expected emissions changes for sulfur dioxide, PM, PM_{10}, and*

carbon monoxide were not extrapolated for the 25 tons per hour processing rate. The project partners believe that at a higher 25 tons per hour feed rate the air emissions will be further reduced beyond the levels shown in Exhibits 2 through 4, however the emissions changes may not be doubled. Emission testing has not been performed at the 25 tons per hour level to quantify the exact reduction.

Exhibit 2 Estimated Emissions Changes at OGS Stack - Percentage

Pollutant	Ave Coal lb/MMBtu	Ave Cofire lb/MMBtu	% Change[1]	Source
SO2	0.681	0.649	-4.7%	CEMS data analysis, 12/1/03 to 12/12/03, 8 am to 6 pm
NOx	0.362	0.362	0.0%	
PM	3.39E-02	3.24E-02	-4.4%	General Electric/Mostardi Platt (GE-MP) measurements
PM-10	2.56E-02	2.21E-02	-13.7%	
CO	2.60E-04	2.50E-04	-3.8%	

NOTE:
1) Negative numbers indicate decreases relative to coal-only operation.

The emission rates shown in Exhibit 2 above were used to calculate the emissions changes per year. Exhibit 3 shows a sample calculation and methodology used to estimate the change in tons of each pollutant per year.

Exhibit 3 Sample Calculation for SO_2 Impacts at OGS Stack

Assumptions:

Ave HHV Switchgrass (HHV_{SWG}) =	7,476	Btu/lb
% Heat Input from Switchgrass ($Q_{IN,SWG\%}$) =	2.5	%
Annual Switchgrass Input to OGS Boiler (M_{SWG}) =	109,500	ton / yr
SO2 Ave Coal, lb/MMBtu ($SO2_{COAL}$) =	0.681	lb/MMBtu
SO2 Ave Cofire, lb/MMBtu ($SO2_{COFIRE}$) =	0.649	lb/MMBtu

Calculations:

First, calculate the Total Heat Input from Switchgrass per year ($Q_{IN,SWG}$)

$Q_{IN,SWG} = M_{SWG} \times HHV_{SWG} \times 2000$ lb / ton $\times 10^{-6}$ MMBtu/Btu = 1,637,244 MMBtu/yr

Then, calculate the Total Heat Input to OGS Boiler ($Q_{IN,TOTAL}$)

$Q_{IN,TOTAL} = Q_{IN,SWG} / Q_{IN,SWG\%}$ = 65,489,760 MMBtu/yr

Calculate the change in SO2 emissions when cofiring switchgrass:

SO2 change = (($SO2_{COFIRE}$ - $SO2_{COAL}$) x $Q_{IN,TOTAL}$) / 2,000 lb / ton

= ((0.649 - 0.681) lb/MMBtu x 65,489,760 MMBtu/yr) / 2,000 lb/ton

SO2 change = -1,048 tons SO2 / yr

After performing similar calculations for NO_x, PM, PM_{10}, and CO, the estimated changes in emissions for these pollutants are shown in Exhibit 4.

Exhibit 4 Estimated Emissions Changes at OGS Stack – Tons Pollutant per Year

Pollutant	Emissions Impact of CVBP Commercial Operation,[1,2] tons/yr
SO2	-1,048
NOx	0
PM	-49
PM-10	-115
CO	-0.33

NOTES:

1) Negative numbers indicate decreases relative to coal-only operation.

2) Commercial operation estimates are based on firing 109,500 tons of switchgrass per year at 2.5% average heat input from switchgrass.

Impact on Fugitive Dust Emissions

Fugitive emissions will be generated in several aspects of this project: 1) processing the switchgrass bales to an acceptable fuel size for firing in the OGS boiler; 2) transporting the baled switchgrass from the fields or remote storage facilities to the switchgrass processing facility at OGS, and 3) on-farm activities related to growing, harvesting, and transporting the switchgrass. The farming operations are exempt from air permitting requirements for fugitives. Estimates of fugitive emissions from processing and transporting switchgrass are provided below.

Fugitive Emissions from Switchgrass Processing Facility

While fugitive emissions will be generated during the bale processing operations at OGS, these emissions will be minimized by maintaining a negative pressure on all equipment where dust could be generated. This dust will be passed through a cyclone and then filtered in a high-efficiency baghouse. Two cyclone and baghouse systems will be placed in parallel when the operation is processing at 25.0 tons per hour, with each process line having a rated load of 12.5 ton per hour. The *designed* collection efficiency of each cyclone for the facility will be 80% or 10 tons of switchgrass per hour at the rated load of 12.5 ton per hour, thus the cyclones will deliver 2.5 tons per hour of switchgrass to each of the baghouses. The collection efficiency of each baghouse is 99.961% at 1 micron and above, which is based on the baghouse manufacturer's specified emissions rate for straw dust: 0.01 grains per DSCF with an input loading rate of 30 grains per DSCF. Therefore, the estimated particulates emissions from the

switchgrass processing facility at the maximum 219,000 ton per year switchgrass feed rate will be 17.2 tons per year. The calculation is shown below:

$$PM = 2 \times (1 - 0.99961) \times (1 - 0.80) \times 12.5 \frac{tons}{hr} \times 8760 \frac{hr}{yr} = 17.2 \frac{tons}{yr}$$

The switchgrass processing facility will be owned and operated by Chariton Valley Resource Conservation & Development, Inc. throughout the duration of the Department of Energy funding period (through September 30, 2006). If the project continues on a commercial basis, the ownership and operation of the facility will transfer to PrairieLands Bioproducts, LLC (a cooperative of switchgrass farmers/suppliers). PrairieLands Bioproducts, LLC would sell the processed switchgrass fuel to IPL under a commercially operating project.

Fugitive Emissions from Transporting Switchgrass

The traffic on the unpaved area immediately surrounding the switchgrass processing facility at OGS will produce some fugitive emissions even though the vehicles will be traveling at slow speeds. As shown in Exhibit 5, EPA's AP-42 procedures were followed to estimate the fugitive emissions resulting from vehicles traveling on unpaved surfaces at an industrial site. The annual particulates emissions from re-suspended road surface materials are estimated as follows: 11.8 tons per year of Total Suspended Particulates (TSP), and 3.1 tons per year of PM_{10}. Neither particulate emissions from truck exhaust, nor the fugitive emissions generated from traveling from the farm to the plant gate during bale transportation were included in this calculation.

Exhibit 5 Estimated Fugitive Emissions from Bale Transportation at OGS

Estimate of Particulate Emissions from Vehicles Traveling on Unpaved Surfaces at Industrial Sites

$E = k (s / 12)^a (W / 3)^b$

Surface material silt content (%), s	5.1	(assumed plant road for western surface coal mining) (EPA AP-42 Table 13.2.2-1)	
Mean Vehicle Weight ("W") :	36.8	tons (based on assumptions below)	
Weight (trucks):	40	tons	92% of total traffic
Weight (cars):	2	tons	8% of total traffic
Switchgrass Delivered per Truck	21	tons	
Total Switchgrass Delivered per Year	219,000	tons	
Deliveries per Year :	10,429		
Number of Employees:	4		
Working Days per Year:	240		
Car Deliveries per Year	960		
Average Travel per Delivery (on plant roads):	0.25	miles per delivery	
Total Annual Vehicle Miles Travelled ("VMT") :	2,847		

Multipliers and Emissions Factors for Unpaved Road Equation :

	k	a	b
Size Range	**lb/VMT**		
PM-2.5	0.23	0.90	0.45
PM-10	1.50	0.90	0.45
PM-30 (TSP)	4.90	0.70	0.45

k, a, and b are empirical constants (EPA AP-42 Table 13.2.2-2.)

	Emissions Factors (E_{ext})	Particulate Emissions from Road Surface Materials	
Size Range	**lb/VMT**	**lb/yr**	**ton/yr**
PM-2.5	0.32899	937	0.5
PM-10	2.14561	6,109	3.1
PM-30 (TSP)	8.31722	23,680	11.8

Summary of Emissions Impacts from Chariton Valley Biomass Project

Exhibit 6 summarizes the complete range of emissions-related impacts for the CVBP, and the overall net emissions impacts for the project. It should be noted that exhaust emissions from bale delivery trucks and fugitive emissions from delivery trucks during transportation from the farms to the power plant are not included in the table. Those delivery truck emission estimates can be provided if required by IDNR and EPA.

Exhibit 6 Summary of Emissions Impacts from Chariton Valley Biomass Project (CVBP)

(for 80% Efficient Cyclone in Bale Processing System)

Pollutant	Emissions Impact of CVBP Commercial Operation,[1,2] tons/yr
OGS Stack Emissions Impacts [3]	
SO_2	-1,048
NO_x	0
PM	-49
PM_{10}	-115
CO	-0.33
Switchgrass Processing Facility [4]	
PM	17.2
PM_{10}	17.2
Switchgrass Bale Transportation [5]	
PM	11.8
PM_{10}	3.1
Overall Net Project Emissions Impacts	
SO_2	-1,048
NO_x	0
PM	-19.9
PM_{10}	-94.7
CO	-0.33

NOTES:

1) Negative numbers indicate decreases relative to coal-only operation.

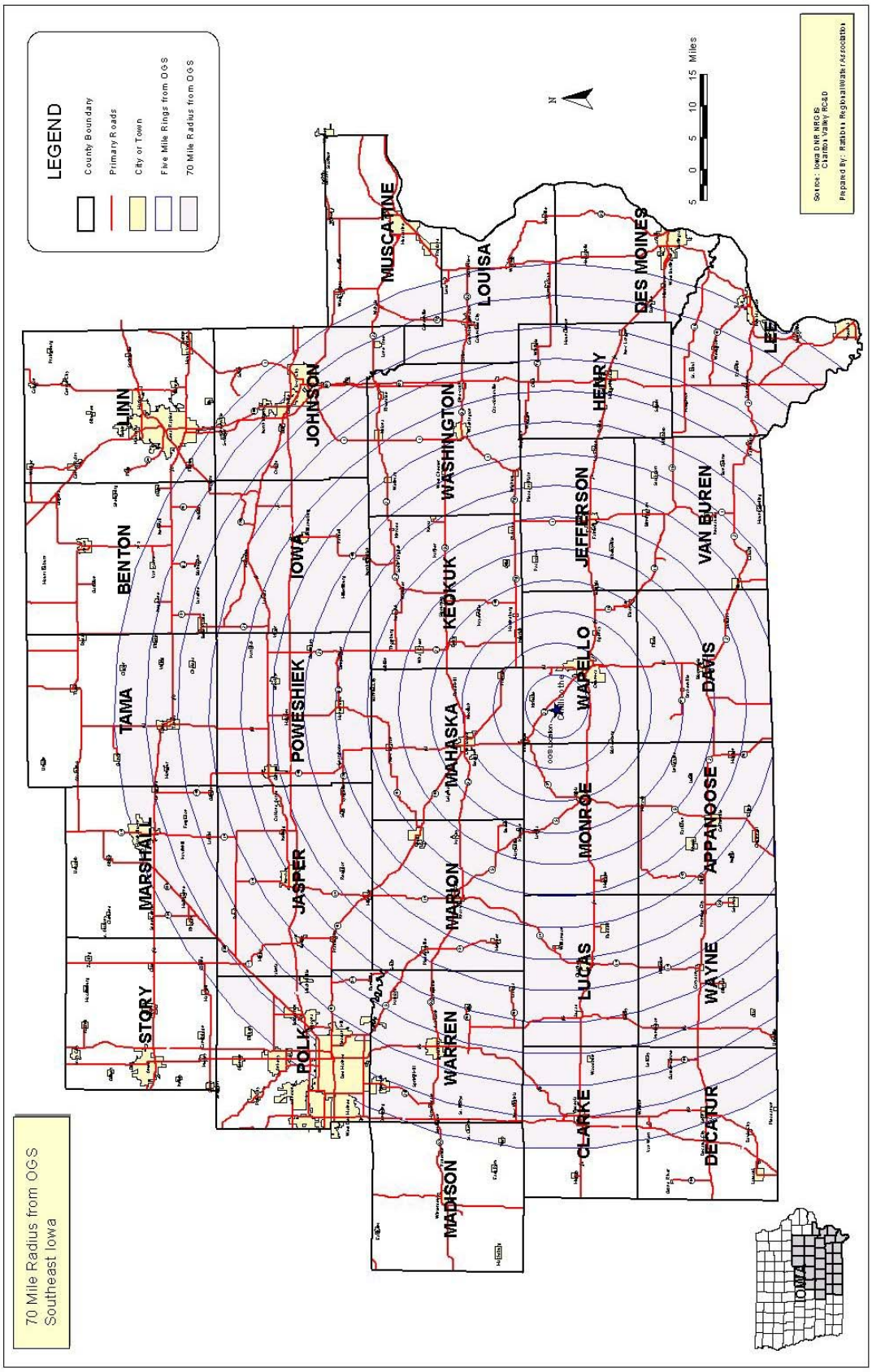
2) Commercial operation estimates are based on firing 219,000 tons of switchgrass per year at 5.0% average heat input from switchgrass at OGS.

3) These emissions are based on average measured results when firing switchgrass at a 12.5 ton per hour rate. They are not extrapolated to reflect 25.0 ton per hour operation. Emissions reductions are expected to be higher at a 25.0 ton per hour rate.

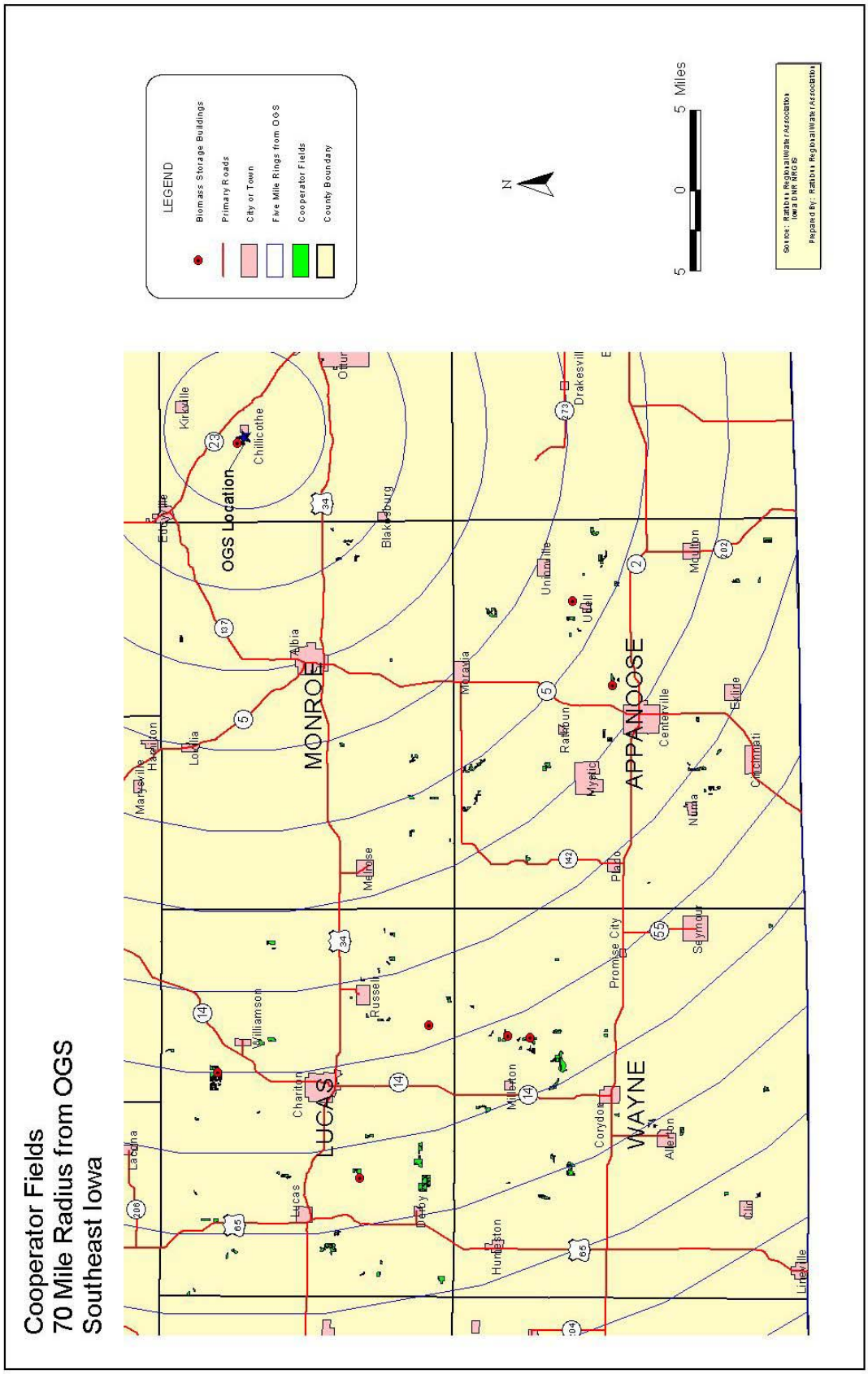
4) This facility will be initially owned and operated by Chariton Valley Resource Conservation & Development.

5) These estimates are for particulate emissions from re-suspended unpaved road surface materials at the plant. They do not include exhaust emissions from delivery trucks or other re-suspended road surface materials associated with the truck delivery outside the plant.

Map of Primary Switchgrass Supply Region:
70-mile Radius Surrounding Ottumwa Generating Station in Chillicothe, IA



Map of Fields and Remote Storage Buildings
Providing Switchgrass for Test Burns at OGS



Appendix M -- Air Permit Documents

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

14 APR 2005

Alan Arnold
Senior Environmental Specialist, IPL
Alliant Energy
200 First Street SE
P.O. Box 351
Cedar Rapids, Iowa 52406-0351

Dear Mr. Arnold:

Enclosed please find a copy of EPA's PSD clarification clearing the way for Alliant Energy to burn switchgrass as a renewable fuel substitute for coal in its Ottumwa Generating Station. We encourage you to include a copy of this clarification with the original PSD permit issued by our office on December 1, 1976 and March 30, 1978, respectively.

If you have any questions, please contact Jon Knodel, Air Permitting and Compliance Branch, at (913) 551-7622 or knodel.jon@epa.gov.

Sincerely,

JoAnn M. Heiman
Chief
Air Permitting and Compliance Branch

Enclosures

cc: Catherine Fitzsimmons
Iowa Department of Natural Resources

Clarifying Statement for the Federal PSD Permit for Alliant Energy, Ottumwa Generating Station

Summary

On February 23, 2005, following evaluation of an extended test burn program, the Iowa Department of Natural Resources (IDNR) approved the use of switchgrass as a renewable fuel substitute for coal for the Ottumwa Generating Station (OGS). The permit application, upon which the final permits are based, indicates that OGS will burn up to 200,000 tons of switchgrass per year at a rate of 25 tons per hour for 8,000 hours per year, or up to 5% of the heat input to the boiler at full load conditions. Based on our review of the record, EPA Region 7 acknowledges that when OGS combusts switchgrass as a fuel replacement for coal, the operation of Boiler 1 will be governed by the emission limitations set forth in the permit issued by the Iowa Department of Natural Resources, and all other relevant conditions of the federal PSD permit. Conversely, when OGS burns fossil fuels alone, without any heat input contribution from switchgrass, the federal PSD permit and associated conditions continue to apply in full.

Background

On December 1, 1976, EPA Region 7 approved construction of OGS Unit 1, under the federal prevention of significant deterioration of air quality (PSD) regulation, 40 CFR §52.21. As a prerequisite to permit issuance, EPA determined that compliance with NSPS Subpart D would constitute compliance with the PSD best available control technology (BACT) requirements. This permit was later revised on March 30, 1978, to incorporate requirements for particulate matter. Based on the PSD rules applicable at the time, which provided that sources subject to an NSPS could meet BACT simply by complying with the NSPS, EPA performed no analysis on the merits of combusting switchgrass or any other non-fossil alternative fuel. As a consequence, combustion of alternative fuels are not explicitly authorized or prohibited under the originally federally-issued and revised PSD permits.

EPA no longer implements the Iowa PSD program and as a consequence has no legal authority to initiate an independent review of BACT for new or modified source operations, except in limited circumstances as specified in 40 CFR §52.833. Instead, the IDNR now carries out these responsibilities under its federally approved PSD permitting program. The request to combust switchgrass involves physical and operational changes potentially subject to review by IDNR. On February 23, 2005, IDNR made its final recommendation to approve the use of switchgrass as an alternate fuel and issued permits authorizing the changes. The operational restrictions on the source, when switchgrass is burned, would be consistent with the federal PSD limitations. Further, the stack test results for combustion of switchgrass summarized in Alliant's "Emissions Test Report" dated August 25, 2004, show that emissions of SO_2, NO_x, CO, and PM_{10} are at or below the limits established by the federal PSD permit. Since the project will not result in a significant net emission increase under the PSD program, the physical and operational changes were not required to undergo further PSD review. The relevant permits incorporate

essential information from the federal PSD permit and establish other operational restrictions on the total amount of switchgrass that may be burned.

EPA Clarification

The Region has determined that the conditions in the federal PSD permit do not explicitly authorize or prohibit the use of switchgrass in OGS Unit 1. Therefore, Alliant may burn switchgrass in OGS Unit 1 in accordance with the Iowa Permit Nos. 78-A-019-S5, 05-A-233, and 05-A-234, dated February 23, 2005, and in accordance with other relevant provisions of the federal PSD permit as discussed below.

This clarification does not constitute a formal revision to the federal PSD permit, but acknowledges the use of the switchgrass as an approved fuel in addition to coal, natural gas, and other approved fossil fuels. All conditions of the federal PSD permit shall apply when the unit is fired exclusively on coal, with natural gas or other approved fossil fuels as a startup fuel. When switchgrass is fired in OGS Unit 1, the emission-related requirements imposed in the IDNR permit will apply along with all other relevant conditions in the federal PSD permit, including but not limited to any continuous emission monitoring, record keeping, and reporting requirements.

Additionally, since the IDNR permit review did not explicitly evaluate or approve the use of alternate coal supplies – in particular those with higher sulfur contents which when used in conjunction with switchgrass can continue to demonstrate compliance with the current PSD limits – we continue to reserve our discretion to evaluate any future fuel switches that deviate from those evaluated during the original PSD review. For example, if Alliant Energy seeks to expand its fuel flexibility in the future to include higher sulfur coals, the appropriate review shall be performed pursuant to PSD or consistent with other federally-approved state requirements.

This clarification is based solely on the representations made by Alliant Energy in its March 15, 2005, submission to EPA and supplemental information provided by the IDNR and on the federal PSD regulations applicable to the source. Therefore, it should not be considered to establish precedent for any future determinations. Further, this clarification will continue to apply as long as appropriate state-imposed emission limits exist. Alliant Energy must inform EPA Region 7 of any subsequent revision to any limits made by the IDNR. The notification shall be by letter postmarked no later than seven (7) calendar days after the revisions. This clarification may be modified or withdrawn if Alliant Energy is unable to comply with the state or federal permit conditions or if the state permit conditions are otherwise withdrawn or inappropriately modified.

Region 7 has determined that the actions carried out by this clarification are nonsubstantive in nature. Since the approval granted by IDNR does not result in increased emissions from the plant and the emission limitations in the federal PSD permit have not been

revised, we have determined that there is no additional benefit to offering the clarification for public review and comment.

This clarification is effective immediately upon the date specified below. A copy of the clarifying statement will be provided to both IDNR and Alliant Energy.

for William A. Spratlin, ~~Director~~
Air, RCRA, and Toxics Division

4/11/05
Date

Iowa
Fields of Opportunities

RECEIVED
2/28/05

STATE OF IOWA

THOMAS J. VILSACK, GOVERNOR
SALLY J. PEDERSON, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
JEFFREY R. VONK, DIRECTOR

February 23, 2005

CERTIFIED MAIL

Paul Koffman
Chariton Valley Resource Conservation & Development, Inc. – OGS Switchgrass Processing Facility
19229 Hwy 5
Centerville, IA 52544

Re: Plant Number 90-07-002, Project Number 05-104, Permit Numbers 05-A-233 & 05-A-234.

Dear Mr. Koffman:

This letter transmits the following permits for the listed emission units and their control equipment at your facility as described in your construction permit applications.

Emission Unit Description	Control	Testing Required	IDNR Permit Number
Switchgrass 1 (EP SWG1)	Cyclone followed by a baghouse	Yes (PM, PM_{10}, and opacity)	05-A-233
Switchgrass 2 (EP SWG2)	Cyclone followed by a baghouse	Yes (PM, PM_{10}, and opacity)	05-A-234

Your attention is directed toward the specified permit conditions contained within the permit especially Permit Conditions 14 & 15. Based on the information submitted in your applications, the Department has made the following determinations:

1) These emission units are not subject to New Source Performance Standards (NSPS) at this time.
2) These emission units are not subject to National Emissions Standards for Hazardous Air Pollutants (NESHAPS) at this time.
3) The switchgrass processing operations for Chariton Valley Resource Conservation & Development are considered a supporting operation to Ottumwa Generating Station (OGS). Since OGS is one of the 28 listed source categories for Prevention of Significant Deterioration (PSD) and is major for PSD, Chariton Valley is considered part of a major stationary source. This project is a minor modification to a major source for PSD purposes.
4) Since this facility is considered part of OGS it is considered part of a major stationary source for the Title V operating permit program. Please contact the Title V section concerning this program. If you have any questions, please contact Jason Marcel at (515) 242-5014.

Please find attached to this letter the amended permit and two (2) copies of the Department's "Air Quality Equipment Notification Form." When requesting a modification to the permit, use the permit number and your plant number for identification. If you have any questions, feel free to contact Chris Roling at (515) 242-6002.

Sincerely,

Gary Smith
Environmental Engineer Senior
Air Quality Bureau, IDNR

C: Field Office 6 (w/ attachments)

Air Quality Equipment Notification Form

Facility and Equipment Information:

Company	Chariton Valley Resource Conservation & Development, Inc. – OGS Switchgrass Processing Facility
Equipment Location	20775 Power Plant Road Chillicothe, IA 52501 Check (√) here for portable equipment ☐
Facility Number (**Not** EIQ Number)	90-07-002
Emission Unit	
Emission Point #	
Construction Permit #	

Notification Type (check the appropriate box or boxes):

☐ **Date Construction, Installation, or Alteration Started:** _____

*Notification must be postmarked within **30 days** after construction starts.*

☐ **Intended Date of Equipment Start Up:** _____

****This applies only to sources subject to a NSPS (see Section 13)****

*Notification must be postmarked at least **10 days** before the equipment or control equipment is placed in operation.*

☐ **Date of Actual Equipment Start Up:** _____

*Notification must be postmarked within **15 days** after equipment is placed into operation.*

Signature of Company Official:

Signature _____ Date _____

Name (please print) _____

Title _____

Phone Number _____

This form is also available on the Internet at
http://www.state.ia.us/epd/airconst/conaps/aqcnap.htm

Please mail form to (no faxes please):
Mr. Chuck Corell
Compliance Unit Supervisor
Air Quality Bureau
Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, IA 50322

Air Quality Equipment Notification Form

Facility and Equipment Information:

Company	Chariton Valley Resource Conservation & Development, Inc. – OGS Switchgrass Processing Facility
Equipment Location	20775 Power Plant Road Chillicothe, IA 52501 Check (√) here if equipment is portable ☐
Facility Number (**Not** EIQ Number)	90-07-002
Emission Unit	
Emission Point #	
Construction Permit #	

Notification Type (check the appropriate box or boxes):

☐ **Date Construction, Installation, or Alteration Started:** _____

*Notification must be postmarked within **30 days** after construction starts.*

☐ **Intended Date of Equipment Start Up:** _____

****This applies only to sources subject to a NSPS (see Section 13)****

*Notification must be postmarked at least **10 days** before the equipment or control equipment is placed in operation.*

☐ **Date of Actual Equipment Start Up:** _____

*Notification must be postmarked within **15 days** after equipment is placed into operation.*

Signature of Company Official:

Signature _____ Date _____

Name (please print) _____

Title _____

Phone Number _____

This form is also available on the Internet at
http://www.state.ia.us/epd/airconst/conaps/aqcnap.htm

Please mail form to (no faxes please):
Mr. Chuck Corell
Compliance Unit Supervisor
Air Quality Bureau
Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, IA 50322

Iowa Department of Natural Resources
Air Quality Construction Permit

Permit Holder

Firm: Chariton Valley Resource Conservation & Development, Inc. –
OGS Switchgrass Processing Facility

Contact:

Paul Koffman
President, Board of Directors

(641) 437-4376

19229 Hwy 5
Centerville, IA 52544

Responsible Party:

Paul Koffman
President, Board of Directors

(641) 437-4376

19229 Hwy 5
Centerville, IA 52544

Permitted Equipment

Emission Unit(s): Switchgrass 1 (EU SWG1, 12.5 tons/hr)

Control Equipment: Cyclone followed by a baghouse

Emission Point: SWG1

Equipment Location: 20775 Power Plant Road
Chillicothe, IA 52501

Plant Number: 90-07-002

Permit No.	Proj. No.	Description	Date	Testing
05-A-233	05-104	Original permit.	2/23/05	Yes

Under the Direction of the Director of
the Department of Natural Resources

PERMIT CONDITIONS

The permit holder, owner and operator of the facility shall assure that the installation, operation, and maintenance of this equipment is in compliance with all of the conditions of this permit.

1. Departmental Review

This permit is issued based on information submitted by the applicant. Any misinformation, false statements or misrepresentations by the applicant shall cause this permit to be void. In addition, the applicant may be subject to criminal penalties according to Iowa Code Section 455B.146A.

This permit is issued under the authority of 567 Iowa Administrative Code (IAC) 22.3. The proposed equipment has been evaluated for conformance with Iowa Code Chapter 455B; 567 IAC Chapters 20-31; and 40 CFR Parts 51, 52, 60, 61 and 63 and has the potential to comply.

No review has been undertaken on the engineering aspects of the equipment or control equipment other than the potential of that equipment for reducing air contaminant emissions. The DNR assumes no liability, directly or indirectly, for any loss due to damage to persons or property caused by, resulting from, or arising out of the design, installation, maintenance or operation of the proposed equipment.

2. Transferability

As limited by 567 IAC 22.3(3)"f", this permit is not transferable from one location to another or from one piece of equipment to another, unless the equipment is portable. When portable equipment for which a permit has been issued is to be transferred from one location to another, the DNR shall be notified in writing at least thirty (30) days prior to transferring to the new location (See 8.A.6). The owner will be notified at least ten (10) days prior to the scheduled relocation if the relocation will cause a violation of the National Ambient Air Quality Standards. In such case, a supplemental permit shall be required prior to the initiation of construction of additional control equipment or equipment modifications needed to meet the standards.

This permit is for the construction and operation of the specific emission unit(s), control equipment and emission point as described in this permit and in the application for this permit. Any owner or operator of the specified emission unit(s), control equipment or emission point, including any person who becomes an owner or operator subsequent to the date on which this permit is issued, is responsible for compliance with the provisions of this permit. No person shall construct, install, reconstruct or alter this emission unit, control equipment or emission point without the required revisions to this permit.

3. Construction

This permit shall become void if construction on the proposed project has not been initiated within eighteen (18) months after the date of the issuance of this permit and completed within thirty-six (36) months after the date of the issuance of this permit.

It shall be the responsibility of the owner to ensure that construction conforms to the final plans and specifications as submitted and that adequate operation and maintenance is provided to ensure that no condition of air pollution is created. A supplement to this permit shall be obtained if the owner proposes changes to the final submitted plans and specifications.

4. Credible Evidence

As stated in 567 IAC 21.5 and also in 40 CFR Part 60.11(g), where applicable, any credible evidence may be used for the purpose of establishing whether a person has violated or is in violation of any provisions specified in this permit or any provisions of 567 IAC Chapters 20 through 31.

5. Owner Responsibility

Issuance of this permit shall not relieve the owner or operator of the responsibility to comply fully with applicable provisions of the State Implementation Plan (SIP), and any other requirements of local, state, and federal law.

The owner or operator of any emission unit or control equipment shall maintain and operate the equipment and control equipment at all times in a manner consistent with good practice for minimizing emissions, as required by paragraph 567 IAC 24.2(1) *"Maintenance and Repair"*.

6. Disposal of Contaminants

The disposal of materials collected by the control equipment shall meet all applicable rules.

7. Excess Emissions

Excess emissions during a period of startup, shutdown, or cleaning of control equipment are not a violation of the emission standard if it is accomplished expeditiously and in a manner consistent with good practice for minimizing emissions except when another regulation applicable to the unit or process provides otherwise. Cleaning of control equipment, which does not require the shutdown of process equipment, shall be limited to one six-minute period per one-hour period. An incident of excess emissions other than the above is a violation and may be subject to criminal penalties according to Iowa Code 455B.146A. If excess emissions are occurring, either the control equipment causing the excess shall be repaired in an expeditious manner, or the process generating the emissions shall be shutdown within a reasonable period of time, as specified in 567 IAC 24.1.

An incident of excess emissions shall be orally reported to the appropriate DNR field office within eight (8) hours of, or at the start of, the first working day following the onset of the incident (See section 8.B.1). A written report of an incident of excess emissions shall be submitted as a follow-up to all required oral reports within seven (7) days of the onset of the upset condition.

8. Notification, Reporting and Recordkeeping

A. The owner shall furnish the DNR the following written notifications:
   1. The date construction, installation, or alteration is initiated postmarked within thirty (30) days following initiation of construction, installation, or alteration;
   2. The actual date of startup, postmarked within fifteen (15) days following the start of operation;
   3. The date of each compliance test required by Permit Condition 12, at least thirty (30) days before the anticipated compliance test date;
   4. The date of each pretest meeting, at least fifteen (15) days before the proposed meeting date. The owner shall request a proposed test plan protocol questionnaire at least sixty (60) days prior to each compliance test date. The completed questionnaire shall be received by the DNR at least fifteen (15) days before the pretest meeting date;
   5. Transfer of equipment ownership, within 30 days of the occurrence;
   6. Portable equipment relocation, at least thirty (30) days before equipment relocation.

8. Notification, Reporting and Recordkeeping (Continued)

B. The owner shall furnish DNR with the following reports:
1. Oral excess emissions reports, in accordance with 567 IAC 24.1;
2. A written compliance demonstration report for each compliance testing event, whether successful or not, postmarked not later than forty-five (45) days after the completion of the test period unless other regulations provide for other notification requirements. In that case, the more stringent reporting requirement shall be met;
3. Operation of this emission unit(s) or control equipment outside of those limits specified in Permit Conditions 10 and 14 and according to the schedule set forth in 567 IAC 24.1.

C. The owner shall send correspondence regarding this permit to the following addresses:

Construction Permit Supervisor
Air Quality Bureau
Iowa Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, IA 50322
Telephone: (515) 281-8189
Fax: (515) 242-5094

D. The owner shall send correspondence concerning stack testing to:

Stack Testing Coordinator
Air Quality Bureau
Iowa Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, Iowa 50322
Telephone: (515) 242-6001
FAX: (515) 242-5127

E. The owner shall send reports and notifications to:

Compliance Unit Supervisor Air Quality Bureau Iowa Department of Natural Resources 7900 Hickman Road, Suite 1 Urbandale, IA 50322 Telephone: (515) 281-8448 Fax: (515) 242-5127	Field Office 6 1023 West Madison Street Washington, IA 52353 Telephone: (319) 653-2135 Fax: (319) 653-2856

F. All data, records, reports, documentation, construction plans, and calculations required under this permit shall be available at the plant during normal business hours for inspection and copying by federal, state, or local air pollution regulatory agencies and their authorized representatives, for a minimum of two (2) years from the date of recording.

9. Permit Violations

Knowingly committing a violation of this permit may carry a criminal penalty of up to $10,000 per day fine and 2 years in jail according to Iowa Code Section 455B.146A.

10. Emission Limits

Pollutant	lb/hr[1]	Tons/Yr[2]	Additional Limits	Reference (567 IAC)
Particulate Matter (PM)	1.29[3]	NA	0.1 gr/dscf	23.3(2)"a"
PM_{10}	1.29[3]	NA	NA	NAAQS
Opacity	NA	NA	40%[4]	23.3(2)"d"
Sulfur Dioxide (SO_2)	NA	NA	NA	NA
Nitrogen Oxides (NO_X)	NA	NA	NA	NA
Volatile Organic Compounds	NA	NA	NA	NA
Carbon Monoxide (CO)	NA	NA	NA	NA
Lead (Pb)	NA	NA	NA	NA
(Single HAP)	NA	NA	NA	NA
(Total HAP)	NA	NA	NA	NA

[1] Standard is expressed as the average of 3 runs
[2] Standard is a 12-month rolling total.
[3] Emission rate used to demonstrate that the project is minor for Prevention of Significant Deterioration (PSD) purposes.
[4] An exceedance of the indicator opacity of "no visible emissions" will require the owner/operator to promptly investigate the emission unit and make corrections to operations or equipment associated with the exceedance. If exceedances continue after the corrections, the DNR may require additional proof to demonstrate compliance (e.g., stack testing).

11. Emission Point Characteristics

This emission point shall conform to the specifications listed below.

Parameter	Value
Stack Height, (ft, from the ground)	20
Discharge Style	Obstructed vertical
Stack Opening, (inches, dia.)	32 x 24
Exhaust Temperature (°F)	70
Exhaust Flowrate (scfm)	23,000

The temperature and flow rate are intended to be representative and characteristic of the design of the permitted emission point. The Department recognizes that the temperature and flow rate may vary with changes in the process and ambient conditions. If it is determined that any of the emission point design characteristics are different than the values stated above, the owner/operator must notify the Department and obtain a permit amendment, if required.

12. Initial Performance Testing Requirements

Pollutant	Testing Required	Test Run Time	Test Method
PM (federal)	No	1 hour	40 CFR 60, Appendix A, Method 5
PM (state)	Yes[1]	3 hours	Iowa Compliance Sampling Manual Method 5
PM_{10}	Yes[1]	5 hours	40 CFR 51, Appendix M, 201A with 202
Opacity	Yes	1 hour	40 CFR 60, Appendix A, Method 9
SO_2	No	1 hour	40 CFR 60, Appendix A, Method 6C
NO_X	No	1 hour	40 CFR 60, Appendix A, Method 7E
VOC	No	1 hour	40 CFR 60, Appendix A, Method 25A
CO	No	1 hour	40 CFR 60, Appendix A, Method 10
Pb	No	1 hour	40 CFR 60, Appendix A, Method 12
Other			

[1] This test may be waived by the Department if EP SWG2 (permit number 05-A-234) demonstrates compliance with the emission limits listed in this permit.

If specified above, the owner shall verify compliance with the emission limitations contained in Permit Condition 10 within sixty (60) days after achieving maximum production rate and no later than one hundred eighty (180) days after the initial startup date of the proposed equipment. The unit(s) being sampled should be operated in a normal manner at its maximum continuous output as rated by the equipment manufacturer, or the rate specified by the owner as the maximum production rate at which this unit(s) will be operated. In cases where compliance is to be demonstrated at less than the maximum continuous output as rated by the manufacturer, and it is the owner's intent to limit the capacity to that rating, the owner may submit evidence to the department that this unit(s) has been physically altered so that capacity cannot be exceeded, or the department may require additional testing, continuous monitoring, reports of operating levels, or any other information deemed necessary by the department to determine whether this unit(s) is in compliance.

Each emissions compliance test must be approved by the DNR. Unless otherwise specified by the DNR, each test shall consist of three separate runs. The arithmetic mean of three acceptable test runs shall apply for compliance, unless otherwise indicated by the DNR. The test methods and run times to be used are those stated above unless otherwise approved by the DNR.

A pretest meeting shall be held at a mutually agreeable site no less than fifteen (15) days prior to the date of each test. Representatives from the DNR shall attend this meeting, along with the owner and the testing firm, if any. It shall be the responsibility of the owner to coordinate and schedule the pretest meeting. The owner shall be responsible for the installation and maintenance of test ports. The DNR shall reserve the right to impose additional, different, or more detailed testing requirements.

13. NSPS and NESHAP Applicability

This emission unit is not subject to the New Source Performance Standards (NSPS) or the National Emission Standards for Hazardous Air Pollutants (NESHAP) at this time.

14. Operating Limits

No operating limits are required for this emission unit at this time.

15. Operating Condition Monitoring

No operating condition monitoring is required for this emission unit at this time.

16. Continuous Emission Monitoring

Continuous emission monitoring is not required by this permit at this time.

17. Descriptions of Terms and Acronyms

acfm	Actual cubic feet per minute
Applicant	The owner, company official or authorized agent
CFR	Code of Federal Regulations
Department	Iowa Department of Natural Resources
DNR	Iowa Department of Natural Resources
gr/dscf	Grains per dry standard cubic foot
HAP	Hazardous Air Pollutant(s)
IAC	Iowa Administrative Code
MMBtu	One million British thermal units
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NO_X	Nitrogen Oxides
Owner	The owner or authorized representative
Permit	This document including permit conditions and all submitted application materials
PM_{10}	Particulate Matter equal to or less than 10 microns in aerodynamic diameter
scfm	Standard cubic feet per minute
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
VOC	Volatile Organic Compound

END OF PERMIT CONDITIONS

Iowa Department of Natural Resources
Air Quality Construction Permit

Permit Holder

Firm: Chariton Valley Resource Conservation & Development, Inc. –
OGS Switchgrass Processing Facility

Contact:

Paul Koffman
President, Board of Directors

(641) 437-4376

19229 Hwy 5
Centerville, IA 52544

Responsible Party:

Paul Koffman
President, Board of Directors

(641) 437-4376

19229 Hwy 5
Centerville, IA 52544

Permitted Equipment

Emission Unit(s): Switchgrass 2 (EU SWG2, 12.5 tons/hr)

Control Equipment: Cyclone followed by a baghouse

Emission Point: SWG2

Equipment Location: 20775 Power Plant Road
Chillicothe, IA 52501

Plant Number: 90-07-002

Permit No.	Proj. No.	Description	Date	Testing
05-A-234	05-104	Original permit.	2/23/05	Yes

Under the Direction of the Director of
the Department of Natural Resources

PERMIT CONDITIONS

The permit holder, owner and operator of the facility shall assure that the installation, operation, and maintenance of this equipment is in compliance with all of the conditions of this permit.

1. Departmental Review

This permit is issued based on information submitted by the applicant. Any misinformation, false statements or misrepresentations by the applicant shall cause this permit to be void. In addition, the applicant may be subject to criminal penalties according to Iowa Code Section 455B.146A.

This permit is issued under the authority of 567 Iowa Administrative Code (IAC) 22.3. The proposed equipment has been evaluated for conformance with Iowa Code Chapter 455B; 567 IAC Chapters 20-31; and 40 CFR Parts 51, 52, 60, 61 and 63 and has the potential to comply.

No review has been undertaken on the engineering aspects of the equipment or control equipment other than the potential of that equipment for reducing air contaminant emissions. The DNR assumes no liability, directly or indirectly, for any loss due to damage to persons or property caused by, resulting from, or arising out of the design, installation, maintenance or operation of the proposed equipment.

2. Transferability

As limited by 567 IAC 22.3(3)"f", this permit is not transferable from one location to another or from one piece of equipment to another, unless the equipment is portable. When portable equipment for which a permit has been issued is to be transferred from one location to another, the DNR shall be notified in writing at least thirty (30) days prior to transferring to the new location (See 8.A.6). The owner will be notified at least ten (10) days prior to the scheduled relocation if the relocation will cause a violation of the National Ambient Air Quality Standards. In such case, a supplemental permit shall be required prior to the initiation of construction of additional control equipment or equipment modifications needed to meet the standards.

This permit is for the construction and operation of the specific emission unit(s), control equipment and emission point as described in this permit and in the application for this permit. Any owner or operator of the specified emission unit(s), control equipment or emission point, including any person who becomes an owner or operator subsequent to the date on which this permit is issued, is responsible for compliance with the provisions of this permit. No person shall construct, install, reconstruct or alter this emission unit, control equipment or emission point without the required revisions to this permit.

3. Construction

This permit shall become void if construction on the proposed project has not been initiated within eighteen (18) months after the date of the issuance of this permit and completed within thirty-six (36) months after the date of the issuance of this permit.

It shall be the responsibility of the owner to ensure that construction conforms to the final plans and specifications as submitted and that adequate operation and maintenance is provided to ensure that no condition of air pollution is created. A supplement to this permit shall be obtained if the owner proposes changes to the final submitted plans and specifications.

4. Credible Evidence

As stated in 567 IAC 21.5 and also in 40 CFR Part 60.11(g), where applicable, any credible evidence may be used for the purpose of establishing whether a person has violated or is in violation of any provisions specified in this permit or any provisions of 567 IAC Chapters 20 through 31.

5. Owner Responsibility

Issuance of this permit shall not relieve the owner or operator of the responsibility to comply fully with applicable provisions of the State Implementation Plan (SIP), and any other requirements of local, state, and federal law.

The owner or operator of any emission unit or control equipment shall maintain and operate the equipment and control equipment at all times in a manner consistent with good practice for minimizing emissions, as required by paragraph 567 IAC 24.2(1) *"Maintenance and Repair"*.

6. Disposal of Contaminants

The disposal of materials collected by the control equipment shall meet all applicable rules.

7. Excess Emissions

Excess emissions during a period of startup, shutdown, or cleaning of control equipment are not a violation of the emission standard if it is accomplished expeditiously and in a manner consistent with good practice for minimizing emissions except when another regulation applicable to the unit or process provides otherwise. Cleaning of control equipment, which does not require the shutdown of process equipment, shall be limited to one six-minute period per one-hour period. An incident of excess emissions other than the above is a violation and may be subject to criminal penalties according to Iowa Code 455B.146A. If excess emissions are occurring, either the control equipment causing the excess shall be repaired in an expeditious manner, or the process generating the emissions shall be shutdown within a reasonable period of time, as specified in 567 IAC 24.1.

An incident of excess emissions shall be orally reported to the appropriate DNR field office within eight (8) hours of, or at the start of, the first working day following the onset of the incident (See section 8.B.1). A written report of an incident of excess emissions shall be submitted as a follow-up to all required oral reports within seven (7) days of the onset of the upset condition.

8. Notification, Reporting and Recordkeeping

A. The owner shall furnish the DNR the following written notifications:
   1. The date construction, installation, or alteration is initiated postmarked within thirty (30) days following initiation of construction, installation, or alteration;
   2. The actual date of startup, postmarked within fifteen (15) days following the start of operation;
   3. The date of each compliance test required by Permit Condition 12, at least thirty (30) days before the anticipated compliance test date;
   4. The date of each pretest meeting, at least fifteen (15) days before the proposed meeting date. The owner shall request a proposed test plan protocol questionnaire at least sixty (60) days prior to each compliance test date. The completed questionnaire shall be received by the DNR at least fifteen (15) days before the pretest meeting date;
   5. Transfer of equipment ownership, within 30 days of the occurrence;
   6. Portable equipment relocation, at least thirty (30) days before equipment relocation.

8. Notification, Reporting and Recordkeeping (Continued)

B. The owner shall furnish DNR with the following reports:
1. Oral excess emissions reports, in accordance with 567 IAC 24.1;
2. A written compliance demonstration report for each compliance testing event, whether successful or not, postmarked not later than forty-five (45) days after the completion of the test period unless other regulations provide for other notification requirements. In that case, the more stringent reporting requirement shall be met;
3. Operation of this emission unit(s) or control equipment outside of those limits specified in Permit Conditions 10 and 14 and according to the schedule set forth in 567 IAC 24.1.

C. The owner shall send correspondence regarding this permit to the following addresses:

Construction Permit Supervisor
Air Quality Bureau
Iowa Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, IA 50322
Telephone: (515) 281-8189
Fax: (515) 242-5094

D. The owner shall send correspondence concerning stack testing to:

Stack Testing Coordinator
Air Quality Bureau
Iowa Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, Iowa 50322
Telephone: (515) 242-6001
FAX: (515) 242-5127

E. The owner shall send reports and notifications to:

Compliance Unit Supervisor Air Quality Bureau Iowa Department of Natural Resources 7900 Hickman Road, Suite 1 Urbandale, IA 50322 Telephone: (515) 281-8448 Fax: (515) 242-5127	Field Office 6 1023 West Madison Street Washington, IA 52353 Telephone: (319) 653-2135 Fax: (319) 653-2856

F. All data, records, reports, documentation, construction plans, and calculations required under this permit shall be available at the plant during normal business hours for inspection and copying by federal, state, or local air pollution regulatory agencies and their authorized representatives, for a minimum of two (2) years from the date of recording.

9. Permit Violations

Knowingly committing a violation of this permit may carry a criminal penalty of up to $10,000 per day fine and 2 years in jail according to Iowa Code Section 455B.146A.

10. Emission Limits

Pollutant	lb/hr[1]	Tons/Yr[2]	Additional Limits	Reference (567 IAC)
Particulate Matter (PM)	1.29[3]	NA	0.1 gr/dscf	23.3(2)"a"
PM_{10}	1.29[3]	NA	NA	NAAQS
Opacity	NA	NA	40%[4]	23.3(2)"d"
Sulfur Dioxide (SO_2)	NA	NA	NA	NA
Nitrogen Oxides (NO_X)	NA	NA	NA	NA
Volatile Organic Compounds	NA	NA	NA	NA
Carbon Monoxide (CO)	NA	NA	NA	NA
Lead (Pb)	NA	NA	NA	NA
(Single HAP)	NA	NA	NA	NA
(Total HAP)	NA	NA	NA	NA

[1] Standard is expressed as the average of 3 runs
[2] Standard is a 12-month rolling total.
[3] Emission rate used to demonstrate that the project is minor for Prevention of Significant Deterioration (PSD) purposes.
[4] An exceedance of the indicator opacity of "no visible emissions" will require the owner/operator to promptly investigate the emission unit and make corrections to operations or equipment associated with the exceedance. If exceedances continue after the corrections, the DNR may require additional proof to demonstrate compliance (e.g., stack testing).

11. Emission Point Characteristics

This emission point shall conform to the specifications listed below.

Parameter	Value
Stack Height, (ft, from the ground)	20
Discharge Style	Obstructed vertical
Stack Opening, (inches, dia.)	32 x 24
Exhaust Temperature (°F)	70
Exhaust Flowrate (scfm)	23,000

The temperature and flow rate are intended to be representative and characteristic of the design of the permitted emission point. The Department recognizes that the temperature and flow rate may vary with changes in the process and ambient conditions. If it is determined that any of the emission point design characteristics are different than the values stated above, the owner/operator must notify the Department and obtain a permit amendment, if required.

12. Initial Performance Testing Requirements

Pollutant	Testing Required	Test Run Time	Test Method
PM (federal)	No	1 hour	40 CFR 60, Appendix A, Method 5
PM (state)	Yes[1]	3 hours	Iowa Compliance Sampling Manual Method 5
PM_{10}	Yes[1]	5 hours	40 CFR 51, Appendix M, 201A with 202
Opacity	Yes	1 hour	40 CFR 60, Appendix A, Method 9
SO_2	No	1 hour	40 CFR 60, Appendix A, Method 6C
NO_X	No	1 hour	40 CFR 60, Appendix A, Method 7E
VOC	No	1 hour	40 CFR 60, Appendix A, Method 25A
CO	No	1 hour	40 CFR 60, Appendix A, Method 10
Pb	No	1 hour	40 CFR 60, Appendix A, Method 12
Other			

[1] This test may be waived by the Department if EP SWG2 (permit number 05-A-234) demonstrates compliance with the emission limits listed in this permit.

If specified above, the owner shall verify compliance with the emission limitations contained in Permit Condition 10 within sixty (60) days after achieving maximum production rate and no later than one hundred eighty (180) days after the initial startup date of the proposed equipment. The unit(s) being sampled should be operated in a normal manner at its maximum continuous output as rated by the equipment manufacturer, or the rate specified by the owner as the maximum production rate at which this unit(s) will be operated. In cases where compliance is to be demonstrated at less than the maximum continuous output as rated by the manufacturer, and it is the owner's intent to limit the capacity to that rating, the owner may submit evidence to the department that this unit(s) has been physically altered so that capacity cannot be exceeded, or the department may require additional testing, continuous monitoring, reports of operating levels, or any other information deemed necessary by the department to determine whether this unit(s) is in compliance.

Each emissions compliance test must be approved by the DNR. Unless otherwise specified by the DNR, each test shall consist of three separate runs. The arithmetic mean of three acceptable test runs shall apply for compliance, unless otherwise indicated by the DNR. The test methods and run times to be used are those stated above unless otherwise approved by the DNR.

A pretest meeting shall be held at a mutually agreeable site no less than fifteen (15) days prior to the date of each test. Representatives from the DNR shall attend this meeting, along with the owner and the testing firm, if any. It shall be the responsibility of the owner to coordinate and schedule the pretest meeting. The owner shall be responsible for the installation and maintenance of test ports. The DNR shall reserve the right to impose additional, different, or more detailed testing requirements.

13. NSPS and NESHAP Applicability

This emission unit is not subject to the New Source Performance Standards (NSPS) or the National Emission Standards for Hazardous Air Pollutants (NESHAP) at this time.

14. Operating Limits

No operating limits are required for this emission unit at this time.

15. Operating Condition Monitoring

No operating condition monitoring is required for this emission unit at this time.

16. Continuous Emission Monitoring

Continuous emission monitoring is not required by this permit at this time.

17. Descriptions of Terms and Acronyms

acfm	Actual cubic feet per minute
Applicant	The owner, company official or authorized agent
CFR	Code of Federal Regulations
Department	Iowa Department of Natural Resources
DNR	Iowa Department of Natural Resources
gr/dscf	Grains per dry standard cubic foot
HAP	Hazardous Air Pollutant(s)
IAC	Iowa Administrative Code
MMBtu	One million British thermal units
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NO_X	Nitrogen Oxides
Owner	The owner or authorized representative
Permit	This document including permit conditions and all submitted application materials
PM_{10}	Particulate Matter equal to or less than 10 microns in aerodynamic diameter
scfm	Standard cubic feet per minute
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
VOC	Volatile Organic Compound

END OF PERMIT CONDITIONS

Iowa
Fields of Opportunities

RECEIVED
2/28/05

STATE OF IOWA

THOMAS J. VILSACK, GOVERNOR
SALLY J. PEDERSON, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
JEFFREY R. VONK, DIRECTOR

February 23, 2005

CERTIFIED MAIL

Paul Koffman
Chariton Valley Resource Conservation & Development, Inc. – OGS Switchgrass Processing Facility
19229 Hwy 5
Centerville, IA 52544

Re: Plant Number 90-07-002, Project Number 05-104, Permit Numbers 05-A-233 & 05-A-234.

Dear Mr. Koffman:

This letter transmits the following permits for the listed emission units and their control equipment at your facility as described in your construction permit applications.

Emission Unit Description	Control	Testing Required	IDNR Permit Number
Switchgrass 1 (EP SWG1)	Cyclone followed by a baghouse	Yes (PM, PM_{10}, and opacity)	05-A-233
Switchgrass 2 (EP SWG2)	Cyclone followed by a baghouse	Yes (PM, PM_{10}, and opacity)	05-A-234

Your attention is directed toward the specified permit conditions contained within the permit especially Permit Conditions 14 & 15. Based on the information submitted in your applications, the Department has made the following determinations:

1) These emission units are not subject to New Source Performance Standards (NSPS) at this time.
2) These emission units are not subject to National Emissions Standards for Hazardous Air Pollutants (NESHAPS) at this time.
3) The switchgrass processing operations for Chariton Valley Resource Conservation & Development are considered a supporting operation to Ottumwa Generating Station (OGS). Since OGS is one of the 28 listed source categories for Prevention of Significant Deterioration (PSD) and is major for PSD, Chariton Valley is considered part of a major stationary source. This project is a minor modification to a major source for PSD purposes.
4) Since this facility is considered part of OGS it is considered part of a major stationary source for the Title V operating permit program. Please contact the Title V section concerning this program. If you have any questions, please contact Jason Marcel at (515) 242-5014.

Please find attached to this letter the amended permit and two (2) copies of the Department's "Air Quality Equipment Notification Form." When requesting a modification to the permit, use the permit number and your plant number for identification. If you have any questions, feel free to contact Chris Roling at (515) 242-6002.

Sincerely,

Gary Smith
Environmental Engineer Senior
Air Quality Bureau, IDNR

C: Field Office 6 (w/ attachments)

Air Quality Equipment Notification Form

Facility and Equipment Information:

Company	Chariton Valley Resource Conservation & Development, Inc. – OGS Switchgrass Processing Facility
Equipment Location	20775 Power Plant Road Chillicothe, IA 52501 Check (√) here for portable equipment ☐
Facility Number (**Not** EIQ Number)	90-07-002
Emission Unit	
Emission Point #	
Construction Permit #	

Notification Type (check the appropriate box or boxes):

☐ **Date Construction, Installation, or Alteration Started:** _____

*Notification must be postmarked within **30 days** after construction starts.*

☐ **Intended Date of Equipment Start Up:** _____

****This applies only to sources subject to a NSPS (see Section 13)****

*Notification must be postmarked at least **10 days** before the equipment or control equipment is placed in operation.*

☐ **Date of Actual Equipment Start Up:** _____

*Notification must be postmarked within **15 days** after equipment is placed into operation.*

Signature of Company Official:

Signature _____ Date _____

Name (please print) _____

Title _____

Phone Number _____

This form is also available on the Internet at
http://www.state.ia.us/epd/airconst/conaps/aqcnap.htm

Please mail form to (no faxes please):
Mr. Chuck Corell
Compliance Unit Supervisor
Air Quality Bureau
Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, IA 50322

Air Quality Equipment Notification Form

Facility and Equipment Information:

Company	Chariton Valley Resource Conservation & Development, Inc. – OGS Switchgrass Processing Facility
Equipment Location	20775 Power Plant Road Chillicothe, IA 52501 Check (√) here if equipment is portable ☐
Facility Number (**Not** EIQ Number)	90-07-002
Emission Unit	
Emission Point #	
Construction Permit #	

Notification Type (check the appropriate box or boxes):

☐ **Date Construction, Installation, or Alteration Started:** _____

*Notification must be postmarked within **30 days** after construction starts.*

☐ **Intended Date of Equipment Start Up:** _____

****This applies only to sources subject to a NSPS (see Section 13)****

*Notification must be postmarked at least **10 days** before the equipment or control equipment is placed in operation.*

☐ **Date of Actual Equipment Start Up:** _____

*Notification must be postmarked within **15 days** after equipment is placed into operation.*

Signature of Company Official:

Signature _____ Date _____

Name (please print) _____

Title _____

Phone Number _____

This form is also available on the Internet at
http://www.state.ia.us/epd/airconst/conaps/aqcnap.htm

Please mail form to (no faxes please):
Mr. Chuck Corell
Compliance Unit Supervisor
Air Quality Bureau
Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, IA 50322

Iowa Department of Natural Resources
Air Quality Construction Permit

Permit Holder

Firm: Chariton Valley Resource Conservation & Development, Inc. –
OGS Switchgrass Processing Facility

Contact:

Paul Koffman
President, Board of Directors

(641) 437-4376

19229 Hwy 5
Centerville, IA 52544

Responsible Party:

Paul Koffman
President, Board of Directors

(641) 437-4376

19229 Hwy 5
Centerville, IA 52544

Permitted Equipment

Emission Unit(s): Switchgrass 1 (EU SWG1, 12.5 tons/hr)

Control Equipment: Cyclone followed by a baghouse

Emission Point: SWG1

Equipment Location: 20775 Power Plant Road
Chillicothe, IA 52501

Plant Number: 90-07-002

Permit No.	Proj. No.	Description	Date	Testing
05-A-233	05-104	Original permit.	2/23/05	Yes

Under the Direction of the Director of
the Department of Natural Resources

PERMIT CONDITIONS

The permit holder, owner and operator of the facility shall assure that the installation, operation, and maintenance of this equipment is in compliance with all of the conditions of this permit.

1. Departmental Review

This permit is issued based on information submitted by the applicant. Any misinformation, false statements or misrepresentations by the applicant shall cause this permit to be void. In addition, the applicant may be subject to criminal penalties according to Iowa Code Section 455B.146A.

This permit is issued under the authority of 567 Iowa Administrative Code (IAC) 22.3. The proposed equipment has been evaluated for conformance with Iowa Code Chapter 455B; 567 IAC Chapters 20-31; and 40 CFR Parts 51, 52, 60, 61 and 63 and has the potential to comply.

No review has been undertaken on the engineering aspects of the equipment or control equipment other than the potential of that equipment for reducing air contaminant emissions. The DNR assumes no liability, directly or indirectly, for any loss due to damage to persons or property caused by, resulting from, or arising out of the design, installation, maintenance or operation of the proposed equipment.

2. Transferability

As limited by 567 IAC 22.3(3)"f", this permit is not transferable from one location to another or from one piece of equipment to another, unless the equipment is portable. When portable equipment for which a permit has been issued is to be transferred from one location to another, the DNR shall be notified in writing at least thirty (30) days prior to transferring to the new location (See 8.A.6). The owner will be notified at least ten (10) days prior to the scheduled relocation if the relocation will cause a violation of the National Ambient Air Quality Standards. In such case, a supplemental permit shall be required prior to the initiation of construction of additional control equipment or equipment modifications needed to meet the standards.

This permit is for the construction and operation of the specific emission unit(s), control equipment and emission point as described in this permit and in the application for this permit. Any owner or operator of the specified emission unit(s), control equipment or emission point, including any person who becomes an owner or operator subsequent to the date on which this permit is issued, is responsible for compliance with the provisions of this permit. No person shall construct, install, reconstruct or alter this emission unit, control equipment or emission point without the required revisions to this permit.

3. Construction

This permit shall become void if construction on the proposed project has not been initiated within eighteen (18) months after the date of the issuance of this permit and completed within thirty-six (36) months after the date of the issuance of this permit.

It shall be the responsibility of the owner to ensure that construction conforms to the final plans and specifications as submitted and that adequate operation and maintenance is provided to ensure that no condition of air pollution is created. A supplement to this permit shall be obtained if the owner proposes changes to the final submitted plans and specifications.

4. Credible Evidence

As stated in 567 IAC 21.5 and also in 40 CFR Part 60.11(g), where applicable, any credible evidence may be used for the purpose of establishing whether a person has violated or is in violation of any provisions specified in this permit or any provisions of 567 IAC Chapters 20 through 31.

5. Owner Responsibility

Issuance of this permit shall not relieve the owner or operator of the responsibility to comply fully with applicable provisions of the State Implementation Plan (SIP), and any other requirements of local, state, and federal law.

The owner or operator of any emission unit or control equipment shall maintain and operate the equipment and control equipment at all times in a manner consistent with good practice for minimizing emissions, as required by paragraph 567 IAC 24.2(1) *"Maintenance and Repair"*.

6. Disposal of Contaminants

The disposal of materials collected by the control equipment shall meet all applicable rules.

7. Excess Emissions

Excess emissions during a period of startup, shutdown, or cleaning of control equipment are not a violation of the emission standard if it is accomplished expeditiously and in a manner consistent with good practice for minimizing emissions except when another regulation applicable to the unit or process provides otherwise. Cleaning of control equipment, which does not require the shutdown of process equipment, shall be limited to one six-minute period per one-hour period. An incident of excess emissions other than the above is a violation and may be subject to criminal penalties according to Iowa Code 455B.146A. If excess emissions are occurring, either the control equipment causing the excess shall be repaired in an expeditious manner, or the process generating the emissions shall be shutdown within a reasonable period of time, as specified in 567 IAC 24.1.

An incident of excess emissions shall be orally reported to the appropriate DNR field office within eight (8) hours of, or at the start of, the first working day following the onset of the incident (See section 8.B.1). A written report of an incident of excess emissions shall be submitted as a follow-up to all required oral reports within seven (7) days of the onset of the upset condition.

8. Notification, Reporting and Recordkeeping

A. The owner shall furnish the DNR the following written notifications:
   1. The date construction, installation, or alteration is initiated postmarked within thirty (30) days following initiation of construction, installation, or alteration;
   2. The actual date of startup, postmarked within fifteen (15) days following the start of operation;
   3. The date of each compliance test required by Permit Condition 12, at least thirty (30) days before the anticipated compliance test date;
   4. The date of each pretest meeting, at least fifteen (15) days before the proposed meeting date. The owner shall request a proposed test plan protocol questionnaire at least sixty (60) days prior to each compliance test date. The completed questionnaire shall be received by the DNR at least fifteen (15) days before the pretest meeting date;
   5. Transfer of equipment ownership, within 30 days of the occurrence;
   6. Portable equipment relocation, at least thirty (30) days before equipment relocation.

8. Notification, Reporting and Recordkeeping (Continued)

B. The owner shall furnish DNR with the following reports:
1. Oral excess emissions reports, in accordance with 567 IAC 24.1;
2. A written compliance demonstration report for each compliance testing event, whether successful or not, postmarked not later than forty-five (45) days after the completion of the test period unless other regulations provide for other notification requirements. In that case, the more stringent reporting requirement shall be met;
3. Operation of this emission unit(s) or control equipment outside of those limits specified in Permit Conditions 10 and 14 and according to the schedule set forth in 567 IAC 24.1.

C. The owner shall send correspondence regarding this permit to the following addresses:

Construction Permit Supervisor
Air Quality Bureau
Iowa Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, IA 50322
Telephone: (515) 281-8189
Fax: (515) 242-5094

D. The owner shall send correspondence concerning stack testing to:

Stack Testing Coordinator
Air Quality Bureau
Iowa Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, Iowa 50322
Telephone: (515) 242-6001
FAX: (515) 242-5127

E. The owner shall send reports and notifications to:

Compliance Unit Supervisor Air Quality Bureau Iowa Department of Natural Resources 7900 Hickman Road, Suite 1 Urbandale, IA 50322 Telephone: (515) 281-8448 Fax: (515) 242-5127	Field Office 6 1023 West Madison Street Washington, IA 52353 Telephone: (319) 653-2135 Fax: (319) 653-2856

F. All data, records, reports, documentation, construction plans, and calculations required under this permit shall be available at the plant during normal business hours for inspection and copying by federal, state, or local air pollution regulatory agencies and their authorized representatives, for a minimum of two (2) years from the date of recording.

9. Permit Violations

Knowingly committing a violation of this permit may carry a criminal penalty of up to $10,000 per day fine and 2 years in jail according to Iowa Code Section 455B.146A.

10. Emission Limits

Pollutant	lb/hr[1]	Tons/Yr[2]	Additional Limits	Reference (567 IAC)
Particulate Matter (PM)	1.29[3]	NA	0.1 gr/dscf	23.3(2)"a"
PM_{10}	1.29[3]	NA	NA	NAAQS
Opacity	NA	NA	40%[4]	23.3(2)"d"
Sulfur Dioxide (SO_2)	NA	NA	NA	NA
Nitrogen Oxides (NO_X)	NA	NA	NA	NA
Volatile Organic Compounds	NA	NA	NA	NA
Carbon Monoxide (CO)	NA	NA	NA	NA
Lead (Pb)	NA	NA	NA	NA
(Single HAP)	NA	NA	NA	NA
(Total HAP)	NA	NA	NA	NA

[1] Standard is expressed as the average of 3 runs
[2] Standard is a 12-month rolling total.
[3] Emission rate used to demonstrate that the project is minor for Prevention of Significant Deterioration (PSD) purposes.
[4] An exceedance of the indicator opacity of "no visible emissions" will require the owner/operator to promptly investigate the emission unit and make corrections to operations or equipment associated with the exceedance. If exceedances continue after the corrections, the DNR may require additional proof to demonstrate compliance (e.g., stack testing).

11. Emission Point Characteristics

This emission point shall conform to the specifications listed below.

Parameter	Value
Stack Height, (ft, from the ground)	20
Discharge Style	Obstructed vertical
Stack Opening, (inches, dia.)	32 x 24
Exhaust Temperature (°F)	70
Exhaust Flowrate (scfm)	23,000

The temperature and flow rate are intended to be representative and characteristic of the design of the permitted emission point. The Department recognizes that the temperature and flow rate may vary with changes in the process and ambient conditions. If it is determined that any of the emission point design characteristics are different than the values stated above, the owner/operator must notify the Department and obtain a permit amendment, if required.

12. Initial Performance Testing Requirements

Pollutant	Testing Required	Test Run Time	Test Method
PM (federal)	No	1 hour	40 CFR 60, Appendix A, Method 5
PM (state)	Yes[1]	3 hours	Iowa Compliance Sampling Manual Method 5
PM_{10}	Yes[1]	5 hours	40 CFR 51, Appendix M, 201A with 202
Opacity	Yes	1 hour	40 CFR 60, Appendix A, Method 9
SO_2	No	1 hour	40 CFR 60, Appendix A, Method 6C
NO_X	No	1 hour	40 CFR 60, Appendix A, Method 7E
VOC	No	1 hour	40 CFR 60, Appendix A, Method 25A
CO	No	1 hour	40 CFR 60, Appendix A, Method 10
Pb	No	1 hour	40 CFR 60, Appendix A, Method 12
Other			

[1] This test may be waived by the Department if EP SWG2 (permit number 05-A-234) demonstrates compliance with the emission limits listed in this permit.

If specified above, the owner shall verify compliance with the emission limitations contained in Permit Condition 10 within sixty (60) days after achieving maximum production rate and no later than one hundred eighty (180) days after the initial startup date of the proposed equipment. The unit(s) being sampled should be operated in a normal manner at its maximum continuous output as rated by the equipment manufacturer, or the rate specified by the owner as the maximum production rate at which this unit(s) will be operated. In cases where compliance is to be demonstrated at less than the maximum continuous output as rated by the manufacturer, and it is the owner's intent to limit the capacity to that rating, the owner may submit evidence to the department that this unit(s) has been physically altered so that capacity cannot be exceeded, or the department may require additional testing, continuous monitoring, reports of operating levels, or any other information deemed necessary by the department to determine whether this unit(s) is in compliance.

Each emissions compliance test must be approved by the DNR. Unless otherwise specified by the DNR, each test shall consist of three separate runs. The arithmetic mean of three acceptable test runs shall apply for compliance, unless otherwise indicated by the DNR. The test methods and run times to be used are those stated above unless otherwise approved by the DNR.

A pretest meeting shall be held at a mutually agreeable site no less than fifteen (15) days prior to the date of each test. Representatives from the DNR shall attend this meeting, along with the owner and the testing firm, if any. It shall be the responsibility of the owner to coordinate and schedule the pretest meeting. The owner shall be responsible for the installation and maintenance of test ports. The DNR shall reserve the right to impose additional, different, or more detailed testing requirements.

13. NSPS and NESHAP Applicability

This emission unit is not subject to the New Source Performance Standards (NSPS) or the National Emission Standards for Hazardous Air Pollutants (NESHAP) at this time.

14. Operating Limits

No operating limits are required for this emission unit at this time.

15. Operating Condition Monitoring

No operating condition monitoring is required for this emission unit at this time.

16. Continuous Emission Monitoring

Continuous emission monitoring is not required by this permit at this time.

17. Descriptions of Terms and Acronyms

acfm	Actual cubic feet per minute
Applicant	The owner, company official or authorized agent
CFR	Code of Federal Regulations
Department	Iowa Department of Natural Resources
DNR	Iowa Department of Natural Resources
gr/dscf	Grains per dry standard cubic foot
HAP	Hazardous Air Pollutant(s)
IAC	Iowa Administrative Code
MMBtu	One million British thermal units
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NO_X	Nitrogen Oxides
Owner	The owner or authorized representative
Permit	This document including permit conditions and all submitted application materials
PM_{10}	Particulate Matter equal to or less than 10 microns in aerodynamic diameter
scfm	Standard cubic feet per minute
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
VOC	Volatile Organic Compound

END OF PERMIT CONDITIONS

Iowa Department of Natural Resources
Air Quality Construction Permit

Permit Holder

Firm: Chariton Valley Resource Conservation & Development, Inc. –
OGS Switchgrass Processing Facility

Contact:

Paul Koffman
President, Board of Directors

(641) 437-4376

19229 Hwy 5
Centerville, IA 52544

Responsible Party:

Paul Koffman
President, Board of Directors

(641) 437-4376

19229 Hwy 5
Centerville, IA 52544

Permitted Equipment

Emission Unit(s): Switchgrass 2 (EU SWG2, 12.5 tons/hr)

Control Equipment: Cyclone followed by a baghouse

Emission Point: SWG2

Equipment Location: 20775 Power Plant Road
Chillicothe, IA 52501

Plant Number: 90-07-002

Permit No.	Proj. No.	Description	Date	Testing
05-A-234	05-104	Original permit.	2/23/05	Yes

Under the Direction of the Director of
the Department of Natural Resources

PERMIT CONDITIONS

The permit holder, owner and operator of the facility shall assure that the installation, operation, and maintenance of this equipment is in compliance with all of the conditions of this permit.

1. Departmental Review

This permit is issued based on information submitted by the applicant. Any misinformation, false statements or misrepresentations by the applicant shall cause this permit to be void. In addition, the applicant may be subject to criminal penalties according to Iowa Code Section 455B.146A.

This permit is issued under the authority of 567 Iowa Administrative Code (IAC) 22.3. The proposed equipment has been evaluated for conformance with Iowa Code Chapter 455B; 567 IAC Chapters 20-31; and 40 CFR Parts 51, 52, 60, 61 and 63 and has the potential to comply.

No review has been undertaken on the engineering aspects of the equipment or control equipment other than the potential of that equipment for reducing air contaminant emissions. The DNR assumes no liability, directly or indirectly, for any loss due to damage to persons or property caused by, resulting from, or arising out of the design, installation, maintenance or operation of the proposed equipment.

2. Transferability

As limited by 567 IAC 22.3(3)"f", this permit is not transferable from one location to another or from one piece of equipment to another, unless the equipment is portable. When portable equipment for which a permit has been issued is to be transferred from one location to another, the DNR shall be notified in writing at least thirty (30) days prior to transferring to the new location (See 8.A.6). The owner will be notified at least ten (10) days prior to the scheduled relocation if the relocation will cause a violation of the National Ambient Air Quality Standards. In such case, a supplemental permit shall be required prior to the initiation of construction of additional control equipment or equipment modifications needed to meet the standards.

This permit is for the construction and operation of the specific emission unit(s), control equipment and emission point as described in this permit and in the application for this permit. Any owner or operator of the specified emission unit(s), control equipment or emission point, including any person who becomes an owner or operator subsequent to the date on which this permit is issued, is responsible for compliance with the provisions of this permit. No person shall construct, install, reconstruct or alter this emission unit, control equipment or emission point without the required revisions to this permit.

3. Construction

This permit shall become void if construction on the proposed project has not been initiated within eighteen (18) months after the date of the issuance of this permit and completed within thirty-six (36) months after the date of the issuance of this permit.

It shall be the responsibility of the owner to ensure that construction conforms to the final plans and specifications as submitted and that adequate operation and maintenance is provided to ensure that no condition of air pollution is created. A supplement to this permit shall be obtained if the owner proposes changes to the final submitted plans and specifications.

4. Credible Evidence

As stated in 567 IAC 21.5 and also in 40 CFR Part 60.11(g), where applicable, any credible evidence may be used for the purpose of establishing whether a person has violated or is in violation of any provisions specified in this permit or any provisions of 567 IAC Chapters 20 through 31.

5. Owner Responsibility

Issuance of this permit shall not relieve the owner or operator of the responsibility to comply fully with applicable provisions of the State Implementation Plan (SIP), and any other requirements of local, state, and federal law.

The owner or operator of any emission unit or control equipment shall maintain and operate the equipment and control equipment at all times in a manner consistent with good practice for minimizing emissions, as required by paragraph 567 IAC 24.2(1) *"Maintenance and Repair"*.

6. Disposal of Contaminants

The disposal of materials collected by the control equipment shall meet all applicable rules.

7. Excess Emissions

Excess emissions during a period of startup, shutdown, or cleaning of control equipment are not a violation of the emission standard if it is accomplished expeditiously and in a manner consistent with good practice for minimizing emissions except when another regulation applicable to the unit or process provides otherwise. Cleaning of control equipment, which does not require the shutdown of process equipment, shall be limited to one six-minute period per one-hour period. An incident of excess emissions other than the above is a violation and may be subject to criminal penalties according to Iowa Code 455B.146A. If excess emissions are occurring, either the control equipment causing the excess shall be repaired in an expeditious manner, or the process generating the emissions shall be shutdown within a reasonable period of time, as specified in 567 IAC 24.1.

An incident of excess emissions shall be orally reported to the appropriate DNR field office within eight (8) hours of, or at the start of, the first working day following the onset of the incident (See section 8.B.1). A written report of an incident of excess emissions shall be submitted as a follow-up to all required oral reports within seven (7) days of the onset of the upset condition.

8. Notification, Reporting and Recordkeeping

A. The owner shall furnish the DNR the following written notifications:
   1. The date construction, installation, or alteration is initiated postmarked within thirty (30) days following initiation of construction, installation, or alteration;
   2. The actual date of startup, postmarked within fifteen (15) days following the start of operation;
   3. The date of each compliance test required by Permit Condition 12, at least thirty (30) days before the anticipated compliance test date;
   4. The date of each pretest meeting, at least fifteen (15) days before the proposed meeting date. The owner shall request a proposed test plan protocol questionnaire at least sixty (60) days prior to each compliance test date. The completed questionnaire shall be received by the DNR at least fifteen (15) days before the pretest meeting date;
   5. Transfer of equipment ownership, within 30 days of the occurrence;
   6. Portable equipment relocation, at least thirty (30) days before equipment relocation.

8. Notification, Reporting and Recordkeeping (Continued)

B. The owner shall furnish DNR with the following reports:
1. Oral excess emissions reports, in accordance with 567 IAC 24.1;
2. A written compliance demonstration report for each compliance testing event, whether successful or not, postmarked not later than forty-five (45) days after the completion of the test period unless other regulations provide for other notification requirements. In that case, the more stringent reporting requirement shall be met;
3. Operation of this emission unit(s) or control equipment outside of those limits specified in Permit Conditions 10 and 14 and according to the schedule set forth in 567 IAC 24.1.

C. The owner shall send correspondence regarding this permit to the following addresses:

Construction Permit Supervisor
Air Quality Bureau
Iowa Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, IA 50322
Telephone: (515) 281-8189
Fax: (515) 242-5094

D. The owner shall send correspondence concerning stack testing to:

Stack Testing Coordinator
Air Quality Bureau
Iowa Department of Natural Resources
7900 Hickman Road, Suite 1
Urbandale, Iowa 50322
Telephone: (515) 242-6001
FAX: (515) 242-5127

E. The owner shall send reports and notifications to:

Compliance Unit Supervisor Air Quality Bureau Iowa Department of Natural Resources 7900 Hickman Road, Suite 1 Urbandale, IA 50322 Telephone: (515) 281-8448 Fax: (515) 242-5127	Field Office 6 1023 West Madison Street Washington, IA 52353 Telephone: (319) 653-2135 Fax: (319) 653-2856

F. All data, records, reports, documentation, construction plans, and calculations required under this permit shall be available at the plant during normal business hours for inspection and copying by federal, state, or local air pollution regulatory agencies and their authorized representatives, for a minimum of two (2) years from the date of recording.

9. Permit Violations

Knowingly committing a violation of this permit may carry a criminal penalty of up to $10,000 per day fine and 2 years in jail according to Iowa Code Section 455B.146A.

10. Emission Limits

Pollutant	lb/hr[1]	Tons/Yr[2]	Additional Limits	Reference (567 IAC)
Particulate Matter (PM)	1.29[3]	NA	0.1 gr/dscf	23.3(2)"a"
PM_{10}	1.29[3]	NA	NA	NAAQS
Opacity	NA	NA	40%[4]	23.3(2)"d"
Sulfur Dioxide (SO_2)	NA	NA	NA	NA
Nitrogen Oxides (NO_X)	NA	NA	NA	NA
Volatile Organic Compounds	NA	NA	NA	NA
Carbon Monoxide (CO)	NA	NA	NA	NA
Lead (Pb)	NA	NA	NA	NA
(Single HAP)	NA	NA	NA	NA
(Total HAP)	NA	NA	NA	NA

[1] Standard is expressed as the average of 3 runs
[2] Standard is a 12-month rolling total.
[3] Emission rate used to demonstrate that the project is minor for Prevention of Significant Deterioration (PSD) purposes.
[4] An exceedance of the indicator opacity of "no visible emissions" will require the owner/operator to promptly investigate the emission unit and make corrections to operations or equipment associated with the exceedance. If exceedances continue after the corrections, the DNR may require additional proof to demonstrate compliance (e.g., stack testing).

11. Emission Point Characteristics

This emission point shall conform to the specifications listed below.

Parameter	Value
Stack Height, (ft, from the ground)	20
Discharge Style	Obstructed vertical
Stack Opening, (inches, dia.)	32 x 24
Exhaust Temperature (°F)	70
Exhaust Flowrate (scfm)	23,000

The temperature and flow rate are intended to be representative and characteristic of the design of the permitted emission point. The Department recognizes that the temperature and flow rate may vary with changes in the process and ambient conditions. If it is determined that any of the emission point design characteristics are different than the values stated above, the owner/operator must notify the Department and obtain a permit amendment, if required.

12. Initial Performance Testing Requirements

Pollutant	Testing Required	Test Run Time	Test Method
PM (federal)	No	1 hour	40 CFR 60, Appendix A, Method 5
PM (state)	Yes[1]	3 hours	Iowa Compliance Sampling Manual Method 5
PM_{10}	Yes[1]	5 hours	40 CFR 51, Appendix M, 201A with 202
Opacity	Yes	1 hour	40 CFR 60, Appendix A, Method 9
SO_2	No	1 hour	40 CFR 60, Appendix A, Method 6C
NO_X	No	1 hour	40 CFR 60, Appendix A, Method 7E
VOC	No	1 hour	40 CFR 60, Appendix A, Method 25A
CO	No	1 hour	40 CFR 60, Appendix A, Method 10
Pb	No	1 hour	40 CFR 60, Appendix A, Method 12
Other			

[1] This test may be waived by the Department if EP SWG2 (permit number 05-A-234) demonstrates compliance with the emission limits listed in this permit.

If specified above, the owner shall verify compliance with the emission limitations contained in Permit Condition 10 within sixty (60) days after achieving maximum production rate and no later than one hundred eighty (180) days after the initial startup date of the proposed equipment. The unit(s) being sampled should be operated in a normal manner at its maximum continuous output as rated by the equipment manufacturer, or the rate specified by the owner as the maximum production rate at which this unit(s) will be operated. In cases where compliance is to be demonstrated at less than the maximum continuous output as rated by the manufacturer, and it is the owner's intent to limit the capacity to that rating, the owner may submit evidence to the department that this unit(s) has been physically altered so that capacity cannot be exceeded, or the department may require additional testing, continuous monitoring, reports of operating levels, or any other information deemed necessary by the department to determine whether this unit(s) is in compliance.

Each emissions compliance test must be approved by the DNR. Unless otherwise specified by the DNR, each test shall consist of three separate runs. The arithmetic mean of three acceptable test runs shall apply for compliance, unless otherwise indicated by the DNR. The test methods and run times to be used are those stated above unless otherwise approved by the DNR.

A pretest meeting shall be held at a mutually agreeable site no less than fifteen (15) days prior to the date of each test. Representatives from the DNR shall attend this meeting, along with the owner and the testing firm, if any. It shall be the responsibility of the owner to coordinate and schedule the pretest meeting. The owner shall be responsible for the installation and maintenance of test ports. The DNR shall reserve the right to impose additional, different, or more detailed testing requirements.

13. NSPS and NESHAP Applicability

This emission unit is not subject to the New Source Performance Standards (NSPS) or the National Emission Standards for Hazardous Air Pollutants (NESHAP) at this time.

14. Operating Limits

No operating limits are required for this emission unit at this time.

15. Operating Condition Monitoring

No operating condition monitoring is required for this emission unit at this time.

16. Continuous Emission Monitoring

Continuous emission monitoring is not required by this permit at this time.

17. Descriptions of Terms and Acronyms

acfm	Actual cubic feet per minute
Applicant	The owner, company official or authorized agent
CFR	Code of Federal Regulations
Department	Iowa Department of Natural Resources
DNR	Iowa Department of Natural Resources
gr/dscf	Grains per dry standard cubic foot
HAP	Hazardous Air Pollutant(s)
IAC	Iowa Administrative Code
MMBtu	One million British thermal units
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NO_X	Nitrogen Oxides
Owner	The owner or authorized representative
Permit	This document including permit conditions and all submitted application materials
PM_{10}	Particulate Matter equal to or less than 10 microns in aerodynamic diameter
scfm	Standard cubic feet per minute
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
VOC	Volatile Organic Compound

END OF PERMIT CONDITIONS

Appendix N -- Fly Ash Performance Test Results

Office of Materials, 800 Lincoln Way, Ames, IA 50010,
Phone: (515) 233-7837
Fax: (515) 239-1092

July 7, 2005

Ref. No. 435

Mr. Gary Greene
Headwaters Inc.
P.O. Box 585
Eddyville, IA 52553

Dear Gary:

Based on testing performed by Scott Schlorholtz at the MARL laboratory at Iowa State University, there are negligible differences between the standard fly ash at Ottumwa Generating Station and the fly ash co-fired with up to 5% switch grass. We understand that a longer test burn at a 2.5% rate is planned for the winter of 2005 to spring of 2006 and approval for use on Iowa DOT projects is requested.

Based on testing results obtained at ISU, the fly ash from Ottumwa Generating Station co-fired with up to 5% switch grass is approved for use on Iowa DOT paving and structural projects. Please note percentage of switch grass burned on test reports from the Ottumwa Generating Station.

If you have any questions, please contact me at the above number.

Sincerely,

Chengsheng Ouyang
Cement and Concrete Engineer
Materials

cc: K. Jones
T. Hanson
M. Coles
J. Smythe
L. Jesse
District Materials Engineers
District. Construction Engineers
District Local System Engineers
Resident Construction Engineers

Fly Ash Sampling Summary for Chariton Valley Biomass Project Interim Test Burn

Background:

From December 1 to 12, 2003, the Chariton Valley Biomass Project (including its utility partner, Alliant Energy, and its subsidiary Interstate Power & Light, IPL), conducted a test burn at the Ottumwa Generating Station (OGS) in Chillicothe, Iowa. Ottumwa Generating Station is a 726 MWe tangentially-fired pulverized coal unit that typically obtains 100 percent of its fuel input from Powder River Basin coal. The test burn involved cofiring coal with switchgrass. One of the primary objectives of the test burn was to collect fly ash samples of sufficient quality and volume to allow all of the necessary testing required for Alliant Energy, ISG Resources Inc., and Iowa State University (ISU) to work with the Iowa Department of Transportation (IDOT) to demonstrate that the fly ash generated during coal/switchgrass cofiring operations performs well enough to be used in the same markets that the coal-only fly ash from OGS typically serves. ISU and ISG will perform most of the ash testing and will present the results to IDOT. IDOT will also perform some independent tests. During the cofire testing period, there were several baseline days (where only coal was fired) and several cofiring test days. Preliminary cofire testing was performed between November 21 and 26, 2003. Switchgrass feed rates varied from 6 to 13 tons per hour (tph) during the pre-test and test periods. A switchgrass feed rate of 12.5 tph represents about 2.5% of the power plant's total heat input requirements at full load. OGS operated at close to full load throughout the entire pre-test and test periods, and was maintained at full load during the week of December 8 to 12. Coal from a single mine was used for the test days between December 1 to 12 (with the possible exception of some periods on the weekend days of December 6 and 7, and on parts of Dec 10 and 11 due to equipment problems in the coal handling yard). Coal and switchgrass samples were taken on each test day and have been sent out for complete laboratory analysis.

Purpose:

The purpose of this document is to describe the important aspects related to the sampling of fly ash during the Interim Test Burn. This document is intended to provide researchers at ISU and ISG, and engineers at IDOT all of the background information they will need to conduct the performance testing necessary to assess the ability of fly ash from coal/switchgrass cofiring at OGS to meet the requirements of the typical end-use markets for fly ash from OGS. IPL and the Chariton Valley Biomass Project hope that the result of this testing will lead to IDOT approval of fly ash from coal/switchgrass cofiring at OGS for use in the current end-use applications.

Fly Ash Collection at OGS:

Fly ash is collected at OGS using four essentially identical electrostatic precipitators (ESPs). Exhibit 1 shows the key components of the ESPs at OGS. The four ESPs are labeled Precipitators No. 101, 102, 103, and 104. Hot flue gas from the boiler flows from the economizer exit and into the precipitators. Each precipitator has four chambers. These chambers are gas-tight parallel paths through which the hot flue gas flows. Each chamber contains six fields (A, B, C, D, E, and F) which electrostatically collect dust from the flue gas. The gas passes through the fields in order, starting with "A" and ending with "F." After the gas has passed through the final field (F), it flows out of the precipitator and into the gas-side inlet of the air heater where it preheats the combustion air for the boiler. The collected dust is periodically dumped into hoppers located below each pair of fields. These hoppers are

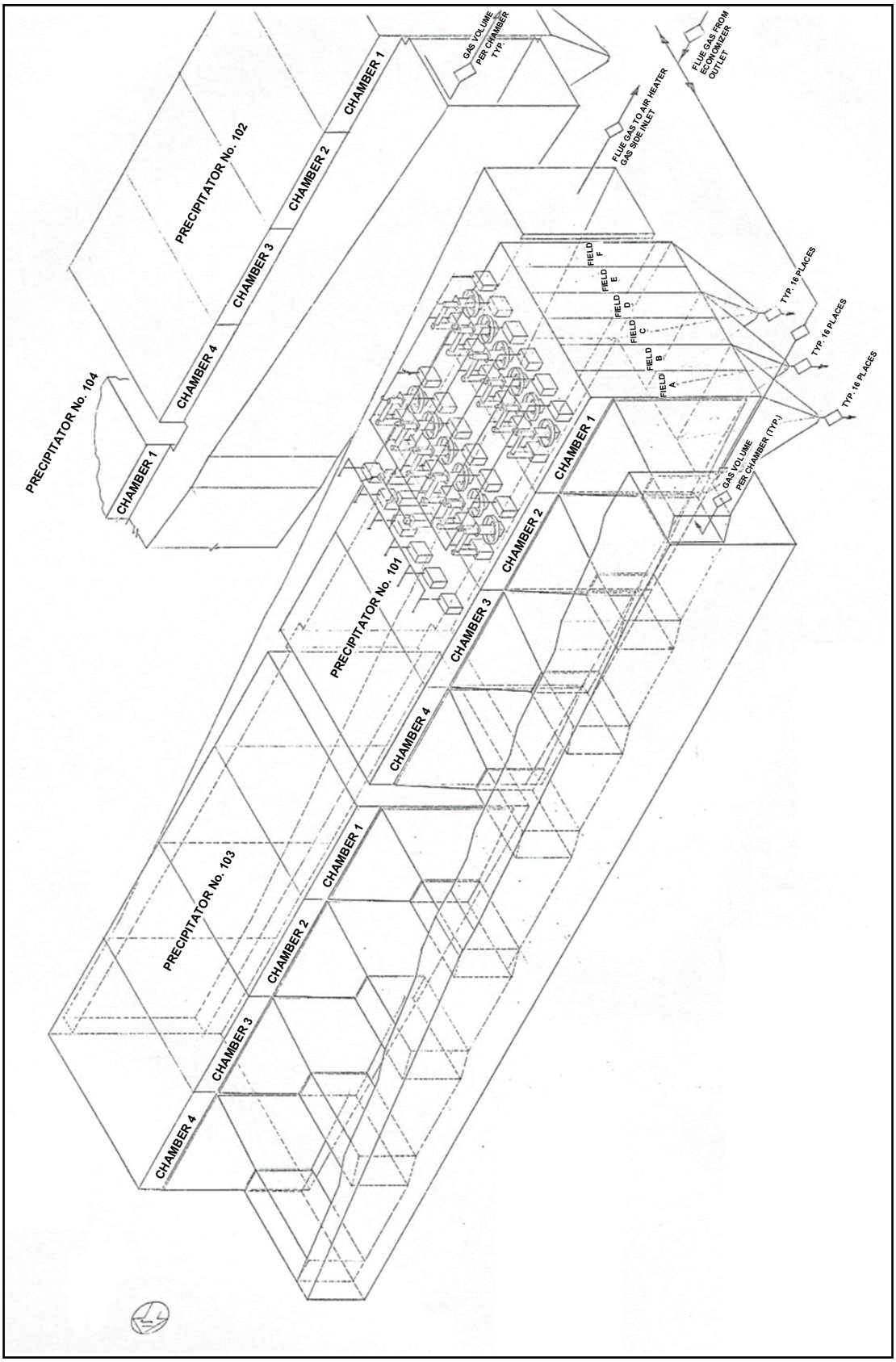


Exhibit 1: Ottumwa Generating Station's Electrostatic Precipitator

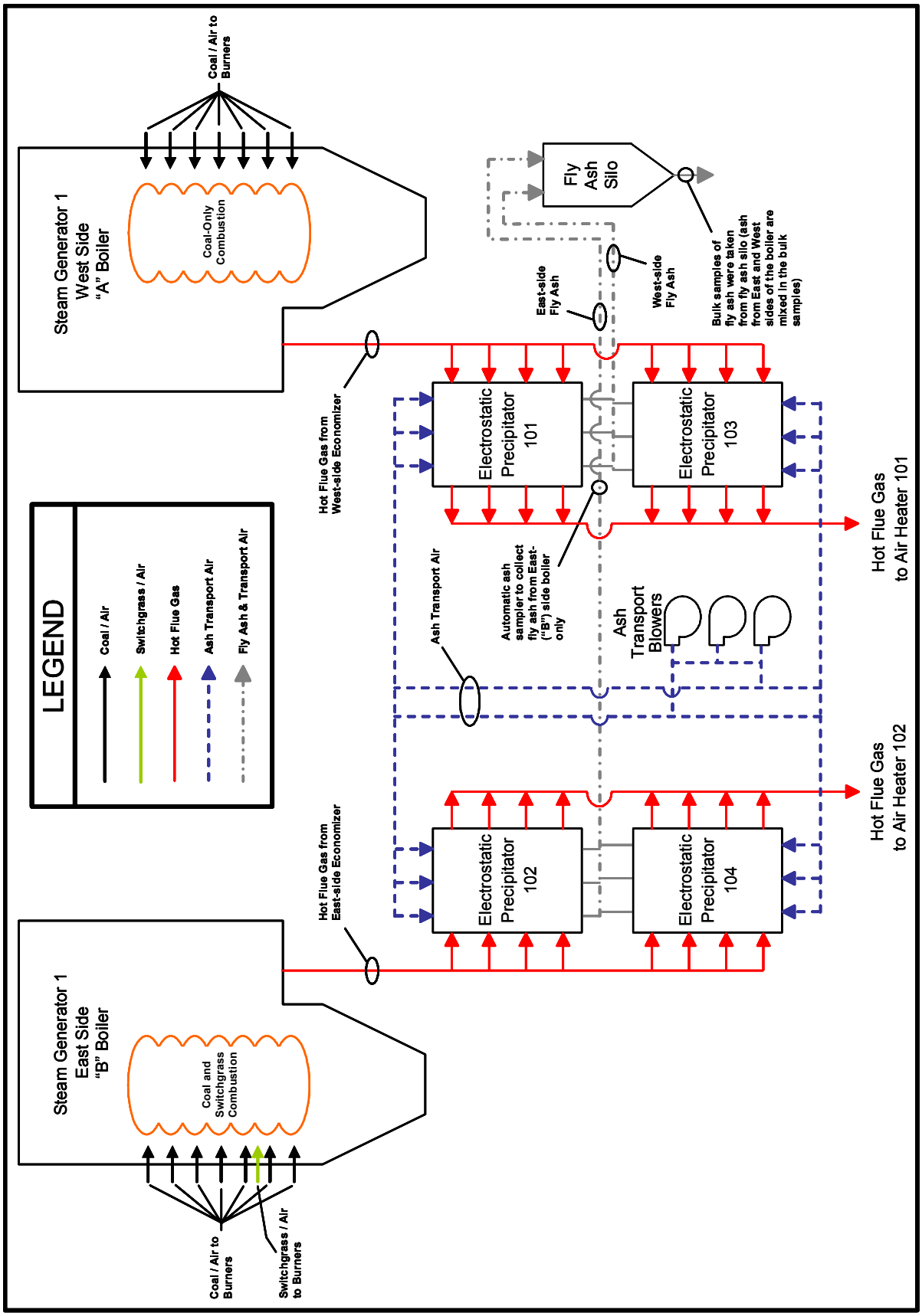


Exhibit 2: Schematic Diagram of OGS Fly Ash Collection System (Shows fly ash sampling locations for the Interim Test Burn

periodically dumped into ash transport lines which use pressurized air to carry the ash to the fly ash silo. Since the gas passes through the "A" and "B" fields first, most of the fly ash is collected by these two fields (according to floor and control room operators, more than half of the total fly ash is collected in the "A" and "B" fields). The least amount of ash is collected by the "E" and "F" fields. Under typical operations, an automated system manages the process of emptying fly ash from the hoppers. The system discharges ash in sequential order from the "A" through the "F" fields, allowing each field to empty before it switches to the next field. At full load, it takes about four hours to cycle through all of the hoppers on each side of the boiler.

Exhibit 2 shows a schematic of the flows of flue gas, ash transport air, and fly ash through the fly ash collection system at OGS. Two fuel injectors deliver switchgrass to the boiler, and both of those injectors are located on the East side (or "B"-side) of the boiler. Flue gas from the East side of the boiler flows into precipitators 102 and 104. A single transport pipe is used to carry all of the ash from precipitators 102 and 104 to the ash silo. During periods where switchgrass is being burned, this pipe carries ***all*** of the ash from the switchgrass. A ***separate*** pipe carries the ash from precipitators 101 and 103 to the silo. The fly ash from the East and West sides of the boiler does not get mixed until it enters the fly ash silo.

Fly Ash Sample Collection Methods:
During the Interim Test Burn, fly ash samples were collected from two locations: 1) the main ash transport pipe that carries ash from the 102 and 104 precipitators to the ash silo, and 2) the outlet of the ash silo. Both of these sampling locations are shown in Exhibit 2. During the cofire test runs, about 2.5% of the total heat input to the boiler was provided by switchgrass (at a switchgrass feed rate of 12 tons per hour). Laboratory tests on the coal and switchgrass from the Interim Test Burn have not been completed yet but are in progress. During the first cofire test burn in the Fall/Winter of 2000-2001, the coal and switchgrass had very similar ash contents (7.06 lb/MMbtu for coal, and 7.19 lb/MMBtu for switchgrass). Therefore, the project team anticipates that about 2.5% of the total ash generated during the cofire test runs for the Interim Test Burn was from switchgrass. So the project team anticipates that about 2.5% of the total fly ash collected during the cofire test runs and sent to the ash silo was from switchgrass. Since all of the switchgrass was burned on the East side of the boiler, the project team also expects that about 5% of the fly ash collected by the East side precipitators (102 & 104) was from switchgrass.

Fly ash samples were collected from both the ash silo and the main outlet pipe from the East side precipitators. The project team hopes that sampling ash in both locations will provide information not only on the performance characteristics of fly ash if switchgrass is burned at a rate of 12.5 tons per hours (as represented by the samples collected from the ash silo), but also if the switchgrass feed rate is doubled to about 25 tons per hour (as represented by the samples collected from the main ash transport pipe from the East-side precipitators). The procedures for collecting fly ash samples in both locations are described below. A table summarizing all of the fly ash samples collected and the corresponding test conditions is provided as Exhibit 10.

Procedure for Collecting Fly Ash from East-side Precipitators (Real-time, Automatic Sampling)
Fly ash samples were collected each day during the cofire testing using an automatic sampler installed on the main ash transport (discharge) pipe that carries ash from the East-side

precipitators to the fly ash silo. This location allows the sampler to collect ash that is discharged from both of the east-side precipitators before it gets mixed in the ash silo with the fly ash from the West (coal-only) side of the boiler. Exhibits 3, 4, 5, and 6 show different parts of the automatic sampler. The programmable controller was set to collect a sample every twenty seconds. The sampler collects ash by extending a sample probe (shown in Exhibit 6) into the ash transport pipe. The probe has a sample port that faces upstream, into the flow of ash in the pipe. The probe remained in the pipe for three seconds to allow ash to flow into the sample port. The sampler then retracted the probe from the transport pipe and emptied the sample using an auger located in the center of the probe. The sample was dropped through a discharge pipe into a 5-gallon sample collection bucket (shown in Exhibit 5). Each night, ash samples were transferred from the collection bucket into 1-gallon cans that were labeled and sealed. During the Interim Test Burn, the automatic sampler collected ash at a rate of about 4 pounds per hour.

On cofire test days, great care was taken to ensure that the sampler was only operated during periods when ash from ***cofiring operations*** *was passing through the discharge pipe*. ***After switchgrass firing began***, all of the ash hoppers on the East side of the boiler were completely emptied once before the automatic sampler was activated. Thus, all coal-only ash was discharged from the East-side hoppers before any samples were collected. The process to ensure this was as follows:

- Verify that all "B" (East) side fly ash hoppers are empty prior to 7 a.m. (As stated previously, switchgrass is only burned on the East-side of the boiler, so only the East-side hoppers collect the fly ash from switchgrass [and coal] during cofire operation. Floor operators verify that the hoppers are empty by striking "ringer" plates with a sledge hammer after the system empties each hopper. Floor operators can tell if the hoppers are fully empty by the sound created when the ringer plates are struck with the hammer.)
- Let "B" side fly ash hopper discharge system run in continuous auto mode with "A" through "F" rows selected in service throughout the test. (*"A" row* indicates the row of eight "A" fields in the East-side precipitators, as shown in Exhibit 1. *"F" row* is the row of eight "F" fields.)
- Place "A" row in service at 8 a.m. in continuous auto mode, with all rows selected for service. (This step resets the cycle sequence so when cofiring begins, the system will still be emptying the "A" row.)
- After the "B" side fly ash hopper discharge system has completed one full cycle and returns to "A" row, start the automatic fly ash sampler. (This step ensured that all ash collected during coal-only operations had been discharged from the "B" side hoppers ***before*** the automatic sampler was placed on-line.)
- Stop the automatic fly ash sampler *prior to* completing cofire operations for the day. (This ensured that no coal-only ash was collected during the cofire test run.)

Procedure for Collecting Fly Ash from the Fly Ash Silo (Bulk Sampling)
To ensure that enough fly ash was collected during testing to allow all of the required performance testing to be conducted (concrete cylinders, etc.), the project team collected several bulk fly ash samples from a discharge chute at the ash silo. Two 50 gallon drums were filled

with fly ash on November 21, 2003, prior to any cofiring activity, to establish a baseline sample. Two more 50 gallon drums were filled on December 10, which was a cofire test day. Exhibit 7 shows the ash silo and the discharge chutes from which the samples were collected. Exhibit 8 shows the sample being collected on December 10 by a front-end loader.

Since switchgrass was burned only during the daylight shift on cofire test days, with normal coal-only operation during all other hours, ISG emptied the ash silo prior to taking the cofire sample on December 10. The low level indication on the silo level indicator during the sample collection is shown in Exhibit 9. This ensured that the ash collected from the silo was from the cofire test period on that day. Two 30-gallon drums of sample were also collected on December 11; however, a frozen valve and a coal supply train that was blocking the route of the ash trucks through part of the morning prevented the silo from being completely emptied prior to taking the bulk samples on that day. The project team believes there is a high probability that the sample collected on December 11 will also contain only ash generated during the cofire test period for the following reasons:

- ash flows from the silo on a "last-in, first-out" basis (the last material dumped into the silo is the first material to be removed through the discharge chutes),
- cofire testing had been under way for at least 8 hours prior to taking the sample on December 11, and
- the silo had been completely emptied the prior day during cofire testing.

The bulk samples were collected using the front-end loader as shown in Exhibit 8, then immediately transferred to the storage drums in the garage of the adjacent ISG shop building. The drums were then sealed and a chain-of-custody sheet was prepared for each drum. Based on fly ash bulk density measurements that were made during the test period, it is estimated that each 50-gallon drum contains about 500 pounds of fly ash, and each 30-gallon drum contains about 300 pounds of ash. The bulk density of the fly ash was measured to be about 83 lbs/ft^3.

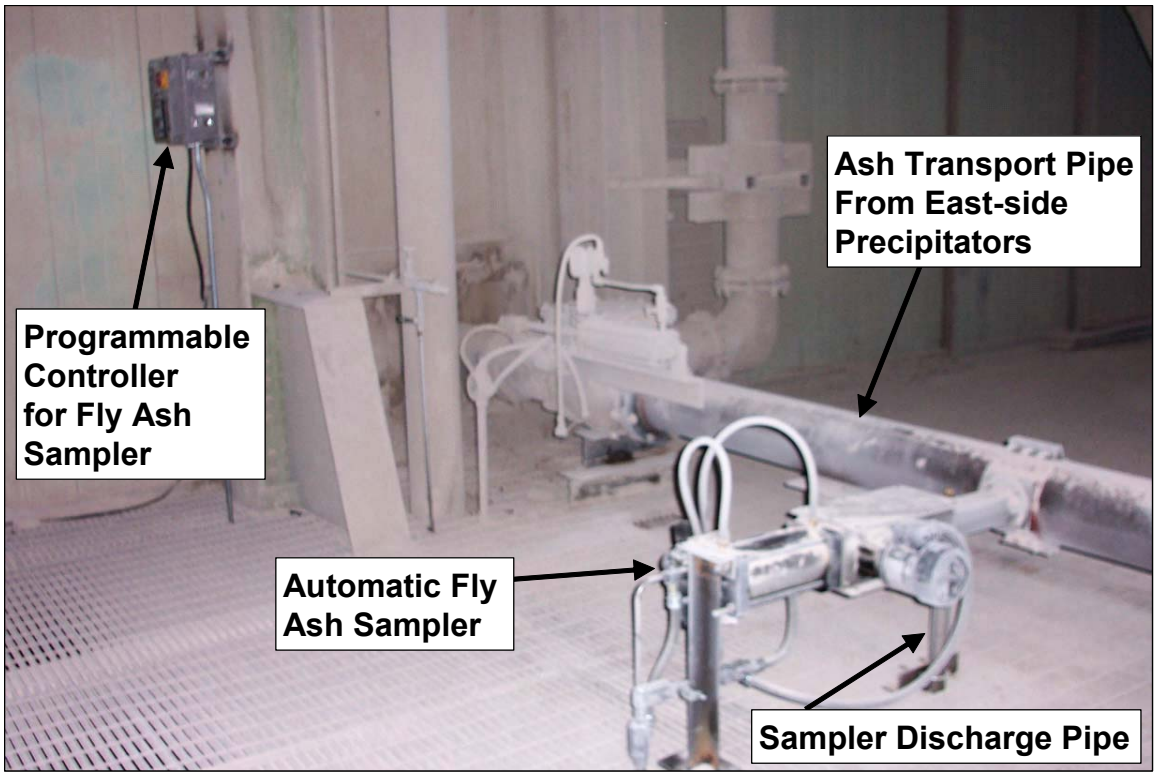


Exhibit 3: Automatic Fly Ash Sampler Installed on East-side Precipitator Discharge Pipe

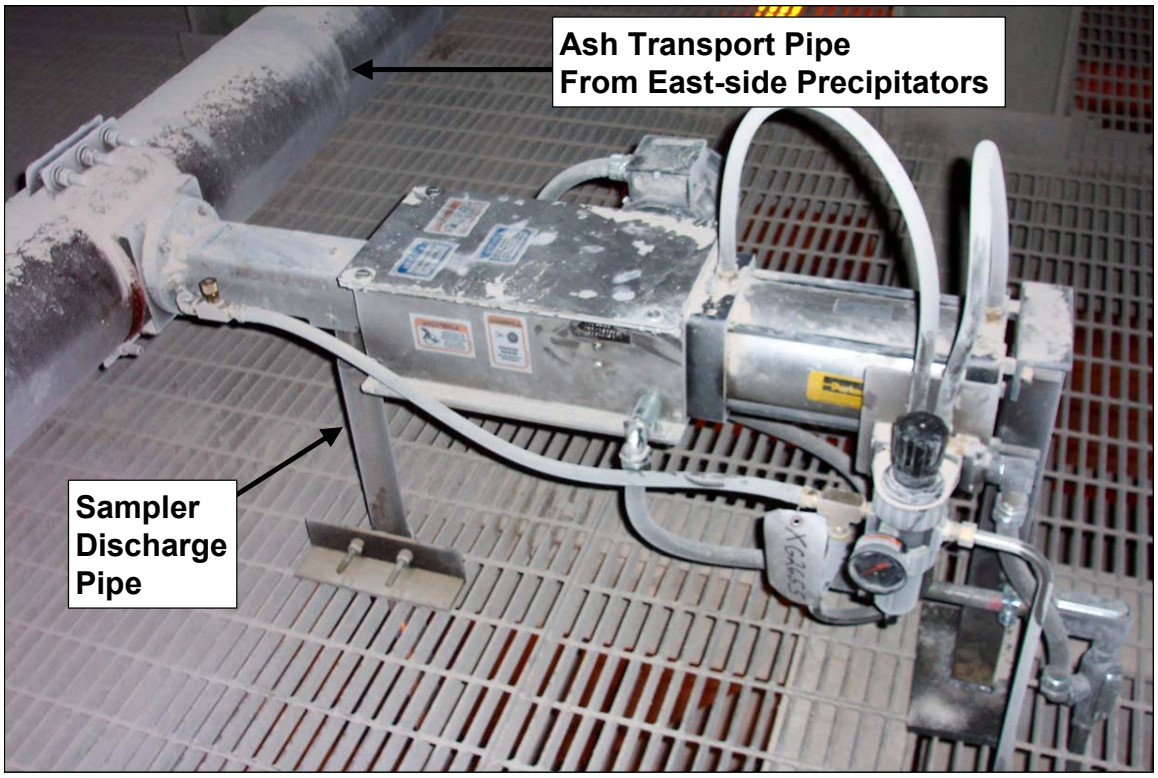


Exhibit 4: Close-up of Automatic Fly Ash Sampler

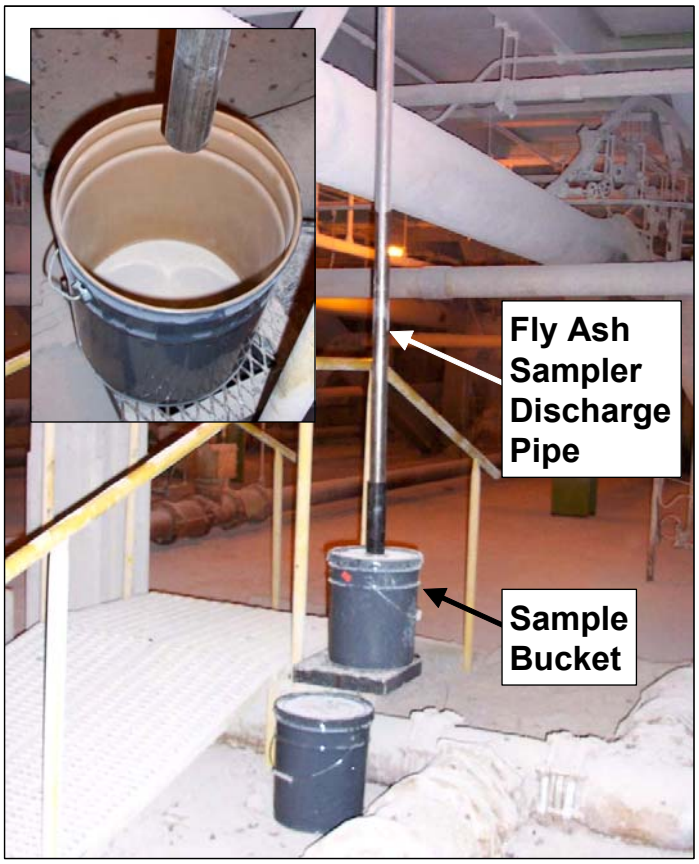


Exhibit 5: Discharge Pipe and Sample Collection Bucket for Automatic Fly Ash Sampler

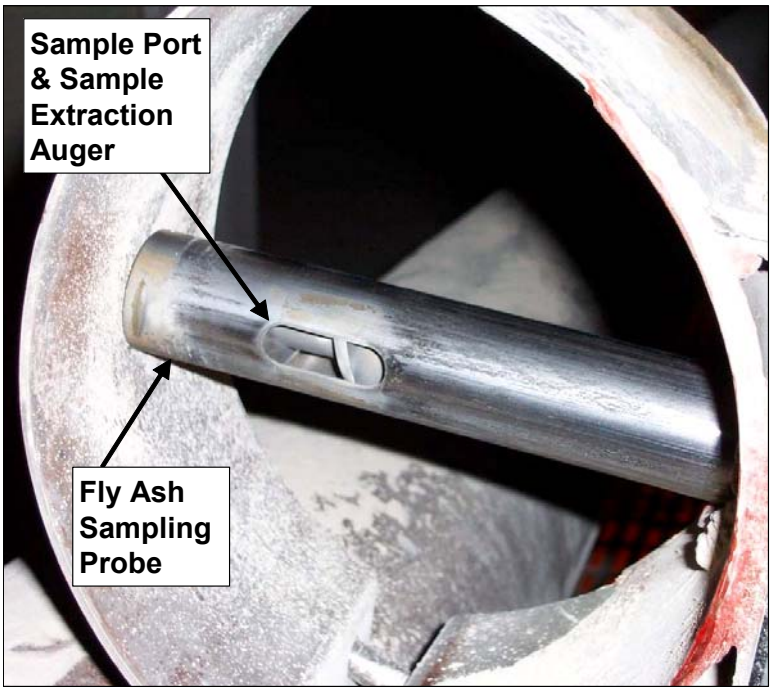


Exhibit 6: Sample Collection Probe for Automatic Fly Ash Sampler

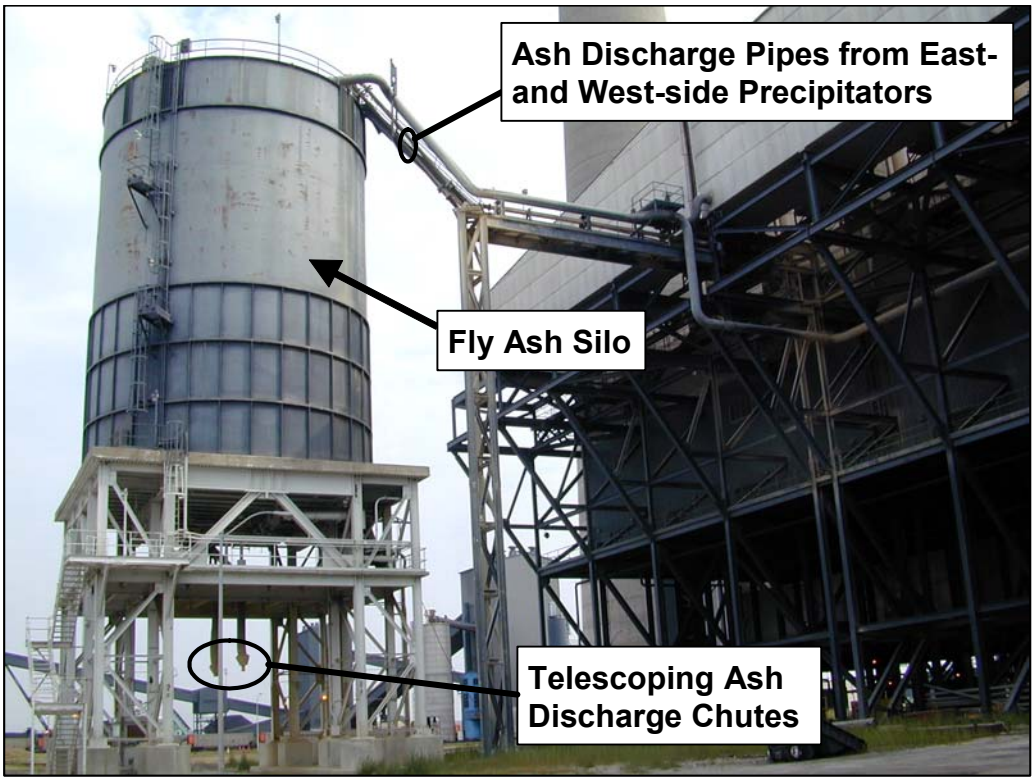


Exhibit 7: Fly Ash Silo at Ottumwa Generating Station

Exhibit 8: Collecting a Bulk Sample of Fly Ash from the Ash Silo Discharge Chute Using a Front-end Loader

Exhibit 9: Low Level Indication on the Fly Ash Silo Level Indicator, Just Prior to Taking the Bulk Sample of Fly Ash from Cofire Testing on December 10, 2003.

Test Burn and Fly Ash Sample Collection Schedule:
Exhibit 10 summarizes the daily activities during the Interim Test Burn, including the dates and amounts of fly ash collected both from the ash silo discharge chute and using the automatic sampler. The goal for fly ash collection using the automatic sampler was to collect 8 to 10 pounds of ash each test day. This was accomplished or exceeded on all days except two (a cofire test day on Dec 4, and a baseline test day on Dec 6), during which either a shortened test period or mechanical difficulties with the sampler prevented collection of the desired volume. In all, 105.4 pounds of fly ash were collected during cofire testing using the automatic sampler, and another 54.3 pounds were collected during baseline, coal-only test days. Of those amounts, about 81.4 pounds of ash collected during 8 cofire test days has been reserved for testing by ISU, and about 35.1 pounds of ash collected during 4 baseline test days has been reserved for ISU. The remainder of the samples collected using the automatic sampler are being retained as back-up, or have been sent out for separate lab analysis. To date, a total of 10.5 pounds of ash from the automatic sampler has been sent to Consol Energy (Pittsburgh, PA) for lab analysis. Consol Energy was the successful bidder for all lab analysis work associated with the Interim Test Burn.

In addition, about 1000 pounds of baseline fly ash and 1600 pounds of fly ash from cofiring operations were collected from the fly ash silo. Half of these quantities have been reserved for

testing by ISU, while the remainder will be held as back-up. About 4.5 pounds of ash collected in the bulk samples was sent to Consol for lab analysis.

Laboratory Testing of Fuel and Fly Ash Samples:
Daily samples of both coal and switchgrass were collected during the test burn and have been sent out for laboratory analysis. The results will be provided when they are available. These results will include ultimate and proximate analyses, ash and trace metal analyses, and fusion temperatures of the ash. Fly ash samples have been sent out for laboratory analysis to determine elemental and trace metal content of the ash, resistivity, and unburned carbon content.

Exhibit 10: Fly Ash Sampling Summary -- Ottumwa Generating Station Switchgrass Test Burn

Date	Description of Daily Testing Activities	Total No. of Bales Burned	Total Bale Weight Burned (tons)	Average Switchgrass Feed Rate (tons/hr)	Fly Ash Sampler Start Time	Fly Ash Sampler Stop Time	Coal-Only Test	Cofire Test	Sample Container Volume	Sample Weight (lb/oz)	Intended Use for Fly Ash
B-Side (East Side) Fly Ash Samples, Collected with Automatic Fly Ash Sampler											
11/25/2003	Maintenance, repair, and upgrade of switchgrass processing equipment; No cofire testing	0	n/a	n/a	11:00	17:00	x		1 gallon	11 lb 2 oz	ISU testing
									1 gallon	10 lb 12 oz	1.5 lbs for lab, remainder for reserve
12/1/2003	Cofire testing at 12.5 tph; Mostardi-Platt set-up day	111	50.0	10.4	14:33	17:20		x	1 gallon	10 lb 12 oz	ISU testing
12/2/2003	Cofire testing at 12.5 tph; Gaseous stack emissions testing by Mostardi-Platt	158	71.1	8.0	14:45	17:30		x	1 gallon	9 lb 0 oz	ISU testing, 1.5 lbs for lab
12/3/2003	Cofire testing at 12.5 tph; Gaseous stack emissions testing by Mostardi-Platt	144	64.8	9.2	13:37	17:05		x	1 gallon	8 lb 13 oz	ISU testing
									1 gallon	5 lb 4 oz	1.5 lbs for lab, remainder for reserve
12/4/2003	Cofire testing at 8 to 10 tph; Gaseous stack emissions testing by Mostardi-Platt	105	47.3	5.9	12:05	14:00		x	1 gallon	5 lb 0 oz	ISU testing
12/5/2003	Cofire testing at 10 to 12.5 tph	177	79.7	10.4	10:30	18:00		x	1 gallon	10 lb 11 oz	ISU testing
									1 gallon	10 lb 10 oz	reserved as back-up
									1 gallon	8 lb 2 oz	1.5 lbs for lab, remainder for reserve
12/6/2003	Coal only baseline day	0	n/a	n/a	10:00	11:00	x		1 gallon	3 lb 10 oz	ISU testing
12/8/2003	Cofire testing at 10 to 12 tph; Mostardi-Platt set up day	120	54.0	7.5	11:30	17:15		x	1 gallon	10 lb 8 oz	ISU testing
12/9/2003	Baseline stack testing for PM, PM-10, CO, & O2; 10 tph	0	n/a	n/a	09:20	17:00	x		1 gallon	8 lb 6 oz	1.5 lbs for lab, remainder for reserve
									1 gallon	10 lb 6 oz	ISU testing
12/10/2003	Cofire stack testing for PM, PM-10, CO, & O2; 10 tph	206	92.7	12.9	13:45	17:20		x	1 gallon	10 lb 1 oz	ISU testing
12/11/2003	Cofire stack testing for HCl & Hg, 10 tph	274	123.3	8.2	14:00	20:00		x	1 gallon	11 lb 9 oz	ISU testing
									1 gallon	5 lb 0 oz	1.5 lbs for lab, remainder for reserve
12/12/2003	Baseline stack testing for HCl & Hg	0	n/a	n/a	09:00	16:00	x		1 gallon	10 lb 0 oz	ISU testing
Bulk Fly Ash Samples, Collected from Ash Silo Discharge											
11/21/2003	Operational pre-testing of switchgrass processing equipment ; Preliminary cofire testing at 6 tph; ***ash collected prior to cofire***	8	3.7	6.0	14:00	n/a	x		50 gallon	500 lbs.	ISU testing
									50 gallon	500 lbs.	1.5 lbs for lab, remainder for reserve
12/10/2003	Cofire stack testing for PM, PM-10, CO, & O2; 10 tph	206	92.7	12.9	17:00	n/a		x	50 gallon	500 lbs.	ISU testing
									50 gallon	500 lbs.	1.5 lbs for lab, remainder for reserve
12/11/2003	Cofire stack testing for HCl & Hg, 10 tph	274	123.3	8.2	17:00	n/a		x	30 gallon	300 lbs.	ISU testing
									30 gallon	300 lbs.	1.5 lbs for lab, remainder for reserve

*** NOTE:** Weights of bulk fly ash samples are ***estimated*** based on average measured fly ash bulk density (83.0 lb / ft^3) and container volume.

Appendix O -- Slagging, Fouling, and Corrosion Test Results

The material from this appendix has been removed from the public version of this report because of copyright issues

Appendix P -- Commercial Fuel Supply Contract

The material from this appendix has been removed from the public version of this report for confidentiality reasons.

Appendix Q -- Long Term Test Burn
Fuel Processing Agreement

The material from this appendix has been removed from the public version of this report for confidentiality reasons.

Appendix R -- Value-Added Incentives Background Information

Form **8835**

Department of the Treasury
Internal Revenue Service

Renewable Electricity, Refined Coal, and Indian Coal Production Credit

► **Attach to your tax return.**

OMB No. 1545-1362

2006

Attachment Sequence No. **95**

Name(s) shown on return | **Identifying number**

Section A. Electricity produced at qualified facilities placed in service prior to October 23, 2004

1	Kilowatt-hours produced and sold (see instructions)	× 0.019	1	
2	Phaseout adjustment (see instructions)	$ ×	2	
3	Credit before reduction. Subtract line 2 from line 1		3	
	Reduction for government grants, subsidized financing, and other credits:			
4	Total of government grants, proceeds of tax-exempt government obligations, subsidized energy financing, and any federal tax credits allowed for the project for this and all prior tax years (see instructions)		4	
5	Total of additions to the capital account for the project for this and all prior tax years		5	
6	Divide line 4 by line 5. Show as a decimal carried to at least 4 places		6	.
7	Multiply line 3 by line 6		7	
8	Subtract line 7 from line 3		8	
9	Section A, renewable electricity production credit from partnerships, S corporations, cooperatives, estates, and trusts		9	
10	Add lines 8 and 9. Cooperatives, estates, and trusts, go to line 11; partnerships and S corporations, report this amount on Schedule K; all others, report this amount on Form 3800, line 1h		10	
11	Amount allocated to patrons of the cooperative or beneficiaries of the estate or trust (see instructions)		11	
12	**Cooperatives, estates, and trusts.** Subtract line 11 from line 10. Report the credit on Form 3800, line 1h		12	

Section B. Electricity and refined coal produced at qualified facilities placed in service after October 22, 2004, and Indian coal produced at facilities placed in service after August 8, 2005

Part I Current Year Credit

	Electricity produced at qualified facilities using wind, closed-loop biomass not modified for co-fire purposes, geothermal, and solar			
1	Kilowatt-hours produced and sold (see instructions)	× 0.019	1	
	Electricity produced at qualified facilities using open-loop biomass, small irrigation power, landfill gas, trash combustion, and hydropower			
2	Kilowatt-hours produced and sold (see instructions)	× .01	2	
3	Add lines 1 and 2		3	
4	Phaseout adjustment (see instructions)	$ ×	4	
5	Subtract line 4 from line 3		5	
	Refined coal produced at a qualified refined coal production facility			
6	Tons produced and sold (see instructions)	× $5.679	6	
7	Phaseout adjustment (see instructions)	$ ×	7	
8	Subtract line 7 from line 6		8	
	Indian Coal produced at a qualified Indian coal production facility			
9	Tons produced and sold (see instructions)	× $1.50	9	
10	Credit before reduction. Add lines 5, 8, and 9		10	
	Reduction for government grants, subsidized financing, and other credits:			
11	Total of government grants, proceeds of tax-exempt government obligations, subsidized energy financing, and any federal tax credits allowed for the project for this and all prior tax years (see instructions)		11	
12	Total of additions to the capital account for the project for this and all prior tax years		12	
13	Divide line 11 by line 12. Show as a decimal carried to at least 4 places		13	.
14	Multiply line 10 by the lesser of ½ or line 13		14	
15	Subtract line 14 from line 10		15	
	Electricity produced at qualified closed-loop biomass facilities modified to co-fire with coal, other biomass, or both			
16	Thermal content of closed-loop biomass used in the facilities		16	
17	Thermal content of all fuels used in the facilities		17	
18	Divide line 16 by line 17. Show as a decimal carried to at least two places		18	.
19	Kilowatt-hours produced and sold (see instructions)	× 0.019	19	
20	Multiply line 19 by line 18		20	
21	Phaseout adjustment (see instructions)	$ ×	21	

Part I *Continued*

22	Subtract line 21 from line 20	22		
23	Section B, renewable electricity, refined coal, and Indian coal production credit from partnerships, S corporations, cooperatives, estates, and trusts	23		
24	Add lines 15, 22, and 23. Partnerships and S corporations, report this amount on Schedule K; all others continue to line 25	24		
25	Renewable electricity, refined coal, and Indian coal production credit included on line 24 from passive activities (see instructions)	25		
26	Subtract line 25 from line 24	26		
27	Renewable electricity, refined coal, and Indian coal production credit allowed for 2006 from a passive activity (see instructions)	27		
28	Carryforward of renewable electricity, refined coal, and Indian coal production credit to 2006. (**Note.** If you have a credit from Form 8884, see instructions.)	28		
29	Carryback of renewable electricity, refined coal, and Indian coal production credit from 2007 (see instructions)	29		
30	Add lines 26 through 29. (**Note.** If you also have a credit from Form 6478, see instructions.) Cooperatives, estates, and trusts, go to line 31; all others, go to Part II	30		
31	Amount allocated to patrons of the cooperative or beneficiaries of the estate or trust (see instructions)	31		
32	**Cooperatives, estates, and trusts.** Subtract line 31 from line 30. Use this amount to complete Part II	32		

Part II Allowable Credit

33	Regular tax before credits (see instructions)			33	
34	Alternative minimum tax (see instructions)			34	
35	Add lines 33 and 34			35	
36a	Foreign tax credit	36a			
b	Credits from Form 1040, lines 48 through 54 (or Form 1040NR, lines 45 through 49)	36b			
c	Qualified electric vehicle credit (Form 8834, line 20)	36c			
d	Alternative motor vehicle credit (Form 8910, line 18)	36d			
e	Alternative fuel vehicle refueling property credit (Form 8911, line 19)	36e			
f	Add lines 36a through 36e			36f	
37	Net income tax. Subtract line 36f from line 35. If zero, skip lines 38 through 41 and enter-0- on line 42			37	
38	Net regular tax. Subtract line 36f from line 33. If zero or less, enter -0-			38	
39	Enter 25% (.25) of the excess, if any, of line 38 over $25,000 (see instructions)			39	
40	Subtract line 39 from line 37. If zero or less, enter -0-			40	
41	General business credit (see instructions)			41	
42	Subtract line 41 from line 40. If zero or less, enter -0-			42	
43	**Credit allowed for the current year. Cooperatives, estates, and trusts.** Enter the **smaller** of line 32 or line 42. Report this amount on Form 1041, Schedule G, line 2c; or Form 1120-C, Schedule J, line 5c. If line 42 is smaller than line 32, see instructions. **All others.** Enter the **smaller** of line 30 or line 42. Report this amount on Form 1040, line 55; Form 1040NR, line 50; Form 1120, Schedule J, line 5c; Form 1120-A, Part I, line 2; or the applicable line of your return. If line 42 is smaller than line 30, see instructions.			43	

General Instructions

Section references are to the Internal Revenue Code.

What's New

- We deleted Part II of Section A since the tax liability limit and the allowable credit for Section A is no longer figured on this form; instead, it must be figured on Form 3800, General Business Credit.
- Taxpayers that are not partnerships, S corporations, cooperatives, estates, or trusts, and whose only source of this credit is from those pass-through entities, are not required to complete or file Section A of this form. Instead, they can report this credit directly on line 1h of Form 3800.

Purpose of Form

Use Form 8835 to claim the renewable electricity, refined coal, and Indian coal production credit. The credit is allowed only for the sale of electricity, refined coal, or Indian coal produced in the United States or U.S. possessions from qualified energy resources at a qualified facility (see *Definitions* on page 3).

How To Figure the Credit

Generally, the credit is 1.5 cents per kilowatt-hour (kWh) for the sale of electricity produced by the taxpayer from qualified energy resources at a qualified facility during the credit period (see *Definitions* on page 3). The 1.5 cents credit amount is reduced by 1/2 for open-loop biomass, small irrigation, landfill gas, trash combustion, and hydropower facilities. In the case of a closed-loop biomass facility, the 1.5 cent amount is multiplied by the ratio of the thermal content of the closed-loop biomass used in the facility to the thermal content of all fuels used in the facility. The credit is $4.375 per ton for the sale of refined coal produced at a qualified facility during the credit period; see section 45(e)(8)(A). The credit is $1.50 per ton for the sale of Indian coal produced at a qualified facility during the credit period.

The credit for electricity produced is proportionately phased out over a 3-cent range when the reference price exceeds the 8-cent threshold price. The refined coal credit is proportionately phased out over an $8.75 range when the reference price of fuel used as feedstock exceeds 1.7 times the 2002 reference price. The 1.5-cent credit rate, the 8-cent threshold price, the $4.375 refined coal rate, and the reference price of fuel used as a feedstock are adjusted for inflation. The reference price and the inflation adjustment factor (IAF) for each calendar year are published during the year in the Federal Register. If the reference price is less than the threshold price (adjusted by the IAF), there is no reduction. For electricity produced, if the reference price is more than 3 cents over the adjusted threshold price, there is no credit; if the reference price is more than the threshold price, but not more than 3 cents over the

adjusted threshold price, there is a phaseout adjustment on line 2 of Section A and lines 4 and 21 of Section B. For refined coal produced, if the reference price is more than $8.75 over the adjusted threshold price, there is no credit; if the reference price is more than the threshold price, but not more than the $8.75 over the adjusted threshold price, there is a phaseout adjustment on line 7 of Section B.

Note. For calendar year 2006, the effective credit rate for electricity, refined coal, and Indian coal produced and sold is, respectively, 1.9 cents per kWh, $5.679 per ton and $1.50 per ton; there is no phaseout adjustment.

Section A example. If the reference price of electricity is 10.0¢ and the adjusted threshold price is 9.0¢, reduce the credit by 1/3 ((10.0¢ – 9.0¢) ÷ 3¢ = .3333). Enter the line 1 credit in the first entry space on line 2, .3333 in the second entry space, and multiply to figure the reduction.

Definitions

Resources means wind, closed-loop biomass, poultry waste, open-loop biomass, geothermal energy, solar energy, small irrigation power, municipal solid waste, hydropower production, refined coal, and Indian coal.

Closed-loop biomass is any organic material from a plant that is planted exclusively for use at a qualified facility to produce electricity.

Poultry waste is poultry manure and litter, including wood shavings, straw, rice hulls, and other bedding material for the disposition of manure.

Open-loop biomass is solid, nonhazardous, cellulosic waste material; lignin material; or agricultural livestock waste nutrients as defined in section 45(c)(3). See Notice 2006-88, 2006-42 I.R.B. 686, for rules related to open-loop biomass, including an expanded definition of a qualified facility and rules related to sales.

Geothermal energy is energy derived from a geothermal deposit as defined by section 613(e)(2).

Small irrigation power is power generated without any dam or impoundment of water. See section 45(c)(5).

Municipal solid waste is solid waste as defined under paragraph 27 of 42 U.S.C. 6903.

Refined coal is a liquid, gaseous, or solid fuel produced from coal or high carbon fly ash meeting the requirements of section 45(c)(7).

Hydropower production means the incremental hydropower production for the tax year from any hydroelectric dam placed in service on or before 8/8/2005 and the hydropower production from any nonhydroelectric dam described in section 45(c)(8)(C).

Indian coal means coal which is produced from coal reserves which on 6/14/05 were owned by an Indian tribe or held in trust by the United States for the benefit of an Indian tribe or its members.

Qualified facility is any of the following facilities owned by the taxpayer and used to produce electricity or, in the case of coal production facilities, refined and Indian coal. The facilities are broken down by form section.

Section A

- Poultry waste facility placed in service after 12/31/99 and before 1/1/05.
- Wind facility placed in service after 12/31/93 and before 10/23/04.
- Closed-loop biomass facility placed in service after 12/31/92 and before 10/23/04.

Section B

- Wind facility placed in service after 10/22/04 and before 1/1/09.
- Closed-loop biomass facility placed in service after 10/22/04 and before 1/1/09.
- Closed-loop biomass facility modified to co-fire with coal or other biomass (or both), placed in service before 1/1/09. See section 45(d)(2).
- Open-loop biomass facility using cellulosic waste placed in service before 1/1/09.
- Open-loop biomass facility using agricultural livestock waste placed in service after 10/22/04 and before 1/1/09 and the nameplate capacity rating is not less than 150 kilowatts.
- Geothermal energy facility placed in service after 10/22/04 and before 1/1/09.
- Solar energy facility placed in service after 10/22/04 and before 1/1/06.
- Small irrigation power facility placed in service after 10/22/04 and before 1/1/09.
- Landfill gas or trash combustion facility using municipal solid waste placed in service after 10/22/04 and before 1/1/09.
- A refined coal production facility originally placed in service after 10/22/04 and before 1/1/09.
- Hydropower facility producing incremental hydroelectric production attributable to efficiency improvements or additions to capacity described in section 45(c)(8)(B) placed in service after 8/8/05 and before 1/1/09 and any other facility producing qualified hydroelectric production described in section 45(c)(8) placed in service after 8/8/05 and before 1/1/09.
- Indian coal production facility placed in service before 1/1/09.

A qualified facility does not include a refined coal production facility or landfill gas facility using municipal solid waste to produce electricity, if the production from that facility is allowed as a credit under section 45K.

Credit period is:

- 10 years for a wind, poultry waste, closed-loop biomass (not modified for co-fire purposes), or refined coal production facility, beginning on the date the facility was placed in service.
- 10 years for a closed-loop biomass facility modified to co-fire with coal, other biomass (or both), beginning on the date the facility was placed in service, but not earlier than 10/22/04.
- 10 years for a hydropower facility, beginning on the date the efficiency improvements or additions to capacity are placed in service.
- 7 years for an Indian coal production facility, beginning on the date the facility was placed in service, but not before 1/1/2006.
- 5 years for an open-loop biomass facility using agricultural livestock waste, geothermal, solar energy, small irrigation power, landfill gas, or trash combustion facility, beginning on the date the facility placed in service, if placed in service during the period after 10/22/04 and before 8/9/05. The credit period is 10 years if placed in service after 8/8/05.
- 5 years for an open-loop biomass facility using cellulosic waste, beginning on the date the facility was placed in service, but not earlier than 1/1/05.

United States and U.S. possessions include the seabed and subsoil of those submarine areas that are adjacent to the territorial waters over which the United States has exclusive rights according to international law.

Who Can Take the Credit

Generally, the owner of the facility is allowed the credit. In the case of closed-loop biomass facilities modified to co-fire with coal, other biomass, or both and open-loop biomass facilities, if the owner is not the producer of the electricity, the lessee or the operator of the facility is eligible for the credit.

Specific Instructions for Section A and Section B

Note. Where line references between Section A and B differ, the Section B line references are in parentheses.

Figure any renewable electricity, refined coal, and Indian coal production credit from your trade or business on lines 1 through 8 (lines 1 through 22 of Section B). Skip lines 1 through 8 (lines 1 through 22 of Section B) if you are only claiming a credit that was allocated to you from an S corporation, partnership, cooperative, estate, or trust.

Fiscal year taxpayers. If you have sales in 2006 and 2007 and the credit rate on line 1 (lines 1, 2, 6, 9, or 19 of Section B) or the phaseout adjustment on line 2 (lines 4, 7, or 21 of Section B) is different for 2007, make separate computations for each line. Use the respective sales, credit rate, and phaseout adjustment for each calendar year. Enter the total of the two computations on the credit rate line(s)—line 1 of Section A (lines 1, 2, 6, 9, or 19 of Section B)—or the phaseout adjustment line(s)—line 2 of Section A (lines 4, 7, or 21 of Section B). Attach the computations to Form 8835 and write FY in the margin.

Part I—Current Year Credit

Line 1 (Line 19, Section B)

Enter the kilowatt-hours of electricity produced at qualified facilities and multiply by $.019. Fiscal year filers with 2007 sales may have to refigure lines 1 and 19 as explained under *Fiscal year taxpayers* above.

Line 2, Section B only

Enter the kilowatt-hours of electricity produced and sold at qualified facilities and multiply by $.01. Fiscal filers with 2007 sales must figure line 2 as explained under *Fiscal year taxpayers* above.

Line 2, Section A (Lines 4 and 21, Section B)

Calendar year filers enter zero on lines 2, 4, and 21. Fiscal year filers with sales in 2007 also enter zero if the published 2007 reference price is equal to or less than the 2007 adjusted threshold price. See *How To Figure the Credit* on page 2 to figure the adjustment.

Line 6, Section B only

Enter the tons of refined coal produced and sold during 2006 from a qualified refined coal production facility and multiply by $5.679. Fiscal filers with 2007 sales must figure line 6 as explained under *Fiscal year taxpayers* above.

Line 7, Section B only

Calendar year filers enter zero on line 7. Fiscal year filers with sales in 2007 also enter zero if the published 2007 reference price is equal to or less than 1.7 times the 2002 reference price. See *How To Figure the Credit* on page 2 to figure the adjustment.

Line 9, Section B only

Enter the tons of Indian coal produced and sold from a qualified Indian coal facility and multiply by $1.50.

Line 4, Section A (Line 11, Section B)

Enter the sum, for this and all prior tax years, of:

- Grants provided by the United States, a state, or political subdivision of a state for the project;
- Proceeds of a tax-exempt issue of state or local government obligations used to provide financing for the project;
- Total of subsidized energy financing provided directly or indirectly under a federal, state, or local program provided for the project; and
- The amount of any federal tax credit allowable for any property that is part of the project.

Line 25, Section B

Enter the amount included on line 24 that is from a passive activity. Generally, a passive activity is a trade or business in which you did not materially participate. Rental activities are generally considered passive activities, whether or not you materially participate. For details, see Form 8582-CR, Passive Activity Credit Limitations (for individuals, trusts, and estates), or 8810, Corporate Passive Activity Loss and Credit Limitations (for corporations).

Line 27, Section B

Enter the passive activity credit allowed for the 2006 renewable electricity, refined coal, and Indian coal production credit from Form 8582-CR or Form 8810.

Line 28, Section B

Carryforward credit from Form 8884. If you have a carryforward credit from Form 8884, include that amount in the total for line 28. On the dotted line next to line 28, enter "From Form 8884" and the amount.

Line 29, Section B

Use only if you amend your 2006 return to carry back an unused renewable electricity, refined coal, and Indian coal production credit from 2007.

Line 30, Section B

Credit from Form 6478. If you have a current year credit from Form 6478 (line 13 for cooperatives, estates, and trusts; line 11 for all others), include that amount in the total for line 30. On the dotted line next to line 30, enter "From Form 6478" and the amount.

Line 11, Section A (Line 31, Section B)

Cooperative election to allocate credit to patrons. A cooperative described in section 1381(a) can elect to allocate any part of the renewable electricity, refined coal, and Indian coal production credit among the patrons of the cooperative. The credit is allocated among the patrons eligible to share in patronage dividends on the basis of the quantity or value of business done with or for such patrons for the tax year.

The cooperative is deemed to have made the election by completing line 11 or line 31, as applicable. However, the election is not effective unless (a) made on a timely filed return (including extensions) and (b) the organization designates the apportionment in a written notice mailed to its patrons during the payment period described in section 1382(d).

If you timely file your return without making an election, you can still make the election by filing an amended return within 6 months of the due date of the return (excluding extensions). Enter "Filed pursuant to section 301.9100-2" on the amended return.

Once made, the election cannot be revoked.

Estates and trusts. Allocate the credit on line 10 (line 30 of Section B) between the estate or trust and the beneficiaries in the same proportion as income was allocated and enter the beneficiaries' share on line 11 (line 31 of Section B).

Part II—Allowable Credit

The credit allowed for the current year may be limited based on your tax liability. If you are completing Section B, you must complete Part II to figure the allowable credit. If you are completing Section A, you must file Form 3800, General Business Credit, to figure the allowable credit.

Line 33, Section B

Enter the regular tax before credits from the following line of the appropriate form or schedule.

- Individuals. Enter the amount from Form 1040, line 44 (or Form 1040NR, line 41).
- Corporations. Enter the amount from Form 1120, Schedule J, line 2; Form 1120-A, Part I, line 1; or the applicable line of your return.
- Estates and trusts. Enter the sum of the amounts from Form 1041, Schedule G, lines 1a and 1b, or the amount from the applicable line of your return.

Line 34, Section B

Enter the alternative minimum tax (AMT) from the following line of the appropriate form or schedule.

- Individuals. Enter the amount from Form 6251, line 35.
- Corporations. Enter the amount from Form 4626, line 14.
- Estates and trusts. Enter the amount from Form 1041, Schedule I, line 56.

Line 36a, Section B

Enter the foreign tax credit and any American Samoa economic development credit allowed for the current year.

Line 39, Section B

See section 38(c)(5) for special rules that apply to married couples filing separate returns, controlled groups, regulated investment companies, real estate investment trusts, and estates and trusts.

Line 41, Section B

Enter the amount of the general business credit allowed for the current year. For purposes of this line, that amount is the total of line 19 of Form 3800 and line 26 of Form 8844.

Line 43, Section B

The credit allowed for the current year must be applied in the following order.

- Carryforward of the New York Liberty Zone business employee credit.
- Carryforward of the renewable electricity, refined coal, and Indian coal production credit from Section B.
- Current year credit from Section B and any current year credit from Form 6478. **Note.** There is no ordering rule to differentiate between these two credits.

If you cannot use all of the credit because of the tax liability limit, carry any unused current year credit back 1 year and then forward up to 20 years.

Paperwork Reduction Act Notice. We ask for the information on this form to carry out the Internal Revenue laws of the United States. You are required to give us the information. We need it to ensure that you are complying with these laws and to allow us to figure and collect the right amount of tax.

You are not required to provide the information requested on a form that is subject to the Paperwork Reduction Act unless the form displays a valid OMB control number. Books or records relating to a form or its instructions must be retained as long as their contents may become material in the administration of any Internal Revenue law. Generally, tax returns and return information are confidential, as required by section 6103.

The time needed to complete and file this form will vary depending on individual circumstances. The estimated burden for individual taxpayers filing this form is approved under OMB control number 1545-0074 and is included in the estimates shown in the instructions for their individual income tax return. The estimated burden for all other taxpayers who file this form is shown below.

Recordkeeping . . . . 21 hr., 16 min.

Learning about the law or the form . . . . . 1 hr.

Preparing and sending the form to the IRS . . . 1 hr., 22 min.

If you have comments concerning the accuracy of these time estimates or suggestions for making this form simpler, we would be happy to hear from you. See the instructions for the tax return with which this form is filed.

Appendix S -- Fuel Supply Invoices (Long Term Test Burn)

INVOICE

19229 Highway 5
Centerville, IA 52544
Phone: 641-437-4376
Fax: 641-437-4638
Web: http://www.cvrcd.org

Invoice No.: 1
Invoice Date: 17-Mar-06

Customer: Alliant Energy
Fossil Fuels Procurement Dept. - 3 South
4902 North Biltmore Lane
Madison, Wisconsin 53718-2132

Invoice for switchgrass processed between February 16, 2006 and March 15, 2006
Pricing based on the terms developed in the Test Burn Fuel Processing Agreement.
(supporting data available upon request)

	Tons	Unit Price	Total Price
Total Switchgrass Processed	4,223.7	$11.20	$47,305.44
Environmental Benefit, SO2 reductions	16.9	$998.42	$16,873.30
Amount Due this Period			$64,178.74
Last Invoiced Amount			$0.00
Amount Paid during Invoiced Period (February 16 to March 15)			$0.00
Current Amount Due			**$64,178.74**

I certify that this invoice is correct and proper for payment.

Authorized Official
Paul Koffman, President

Date

cc: Bill Morton, Alliant Energy
CVRC&D

INVOICE BACKUP DETAILS

Invoice Date: 17-Mar-06

Price = General (Processing Fee) + Environmental Benefit (EB)

Switchgrass Processing Date	Switchgrass Processed (tons)	Average Moisture Content
16-Feb-06	0.0	11.0%
17-Feb-06	10.0	11.0%
18-Feb-06	23.0	11.0%
19-Feb-06	43.0	11.0%
20-Feb-06	28.0	11.0%
21-Feb-06	43.0	11.0%
22-Feb-06	74.0	11.0%
23-Feb-06	112.0	11.0%
24-Feb-06	113.0	10.0%
25-Feb-06	122.0	13.0%
26-Feb-06	187.0	12.0%
27-Feb-06	167.0	12.0%
28-Feb-06	176.0	11.0%
1-Mar-06	180.0	12.0%
2-Mar-06	163.0	12.2%
3-Mar-06	245.0	12.1%
4-Mar-06	260.4	12.1%
5-Mar-06	138.4	12.6%
6-Mar-06	168.2	13.4%
7-Mar-06	155.2	13.4%
8-Mar-06	230.7	13.1%
9-Mar-06	235.2	12.5%
10-Mar-06	259.0	13.0%
11-Mar-06	194.5	13.0%
12-Mar-06	254.7	13.5%
13-Mar-06	199.2	14.0%
14-Mar-06	213.3	15.0%
15-Mar-06	228.8	15.0%
Monthly Totals	**4,223.7**	**12.7%**

General (Processing Fee) =HHV of fuel * Switchgrass Processed * C * Coal Price

where:

CT HHV of fuel	6,892	Btu/lb
SWG Processed	4,223.7	
C	0.002	lb-MMBtu / ton-Btu
Coal Price	$0.81	per MMBtu
Unit Price, CT	$11.17	
Unit Price, Btu Adjusted	$11.20	(Adjusted for Actual Moisture Content)
General Price	$47,305.44	

EB ($/ton) = (2*(BS-TARS)*(Monthly SO2 value/2000))*(CT HHV *2000 / 1,000,000)*K

where

BS	0.40	lb/MMBtu
TARS	0.11	lb/MMBtu
Monthly SO2 Value	$998.42	per ton (Feb. Average, from March 1 *Air Daily*)
CT HHV	6,892	Btu/lb
K	1.0	
Unit Price, CT	$3.99	per ton SWG
Unit Price, Btu Adjusted	$4.00	per ton SWG (Adjusted for Actual Moisture Content)
Sulfur Reductions	16.9	tons SO2 (Assuming K = 1)
EB Price	*$16,873.30*	

Total Price **$64,178.74**

Calculation of Sulfur Dioxide Emissions Reductions Due to Switchgrass Fuel Use: Invoice Date: 17-Mar-06

Equation:

SO2 Reduction = [S_{coal} - S_{swg}] x SO2cnv x (ton-SO_2 / 2000 lb-SO_2) x HV_{swg} x AF_{mc} x (1 MMBtu / 10^6 Btu) x T_{swg} x (2000 lb-swg / ton-swg) x (K factor)

Caluculation Inputs:

Sulfur Content, Coal (Scoal):	0.40	lb-S/MMBtu
Sulfur Content, Switchgrass (Sswg):	0.11	lb-S/MMBtu
Pounds of SO2 per Pound of Sulfur (SO2cnv):	2	lb-SO2/lb-S
Baseline Heating Value of Switchgrass (HVswg):	6,892	Btu/lb-swg (at 13% moisture content)
Baseline Switchgrass Moisture Content:	13.0%	
Measured Switchgrass Moisture Content:	12.7%	
Moisture Content Adjustment Factor:	1.00345	= (1 - Actual M.C.) / (1 - Baseline M.C.)
Processed Switchgrass Tons (Tswg):	4,223.7	tons
K Factor (see note below)	1.0	(initial assumption, to be adjusted after test burn based on actual emissions measurements)

NOTE: The "K Factor" multiplier is a factor to adjust for sulfur emissions reductions due to using switchgrass that are above and beyond the SO2 reductions that are anticipated strictly based on differences in the sulfur contents of coal and switchgrass. Previous test burns have shown that actual measured sulfur reductions are roughly twice the amount expected based on considering just the differences in fuel sulfur contents (e.g., K = 2). The actual value of "K" will be determined after all of the test burn emissions data have been analyzed.

Calculation:

SO2 Reduction = [S_{coal} - S_{swg}] x SO2cnv x (ton-SO_2 / 2000 lb-SO_2) x HV_{swg} x AF_{mc} x (1 MMBtu / 10^6 Btu) x T_{swg} x (2000 lb-swg / ton-swg) x (K factor)

= [0.40 - 0.11] (lb-S / MMBtu) x (2 lb-SO2 / lb-S) x (ton-SO2 / 2000 lb-SO2) x (6,892 Btu / lb-swg) x (1.00345) x (1 MMBtu / 10^6 Btu) x 4,223.7 ton-swg x (2000 lb-swg / ton-swg) x (1.0)

= [0.40 - 0.11] (lb-S / MMBtu) x (2 lb-SO2 / lb-S) x (ton-SO2 / 2000 lb-SO2) x (6,892 Btu / lb-swg) x (1.00345) x (1 MMBtu / 10^6 Btu) x 4,223.7 ton-swg x (2000 lb-swg / ton-swg) x (1.0)

SO2 Reduction = **16.94** tons SO2

16.9 tons SO2 (Rounded)

INVOICE

19229 Highway 5
Centerville, IA 52544
Phone: 641-437-4376
Fax: 641-437-4638
Web: http://www.cvrcd.org

Invoice No.: 2
Invoice Date: 28-Apr-06

Customer: Alliant Energy
Fossil Fuels Procurement Dept. - 3 South
4902 North Biltmore Lane
Madison, Wisconsin 53718-2132

Invoice for switchgrass delivered between March 16, 2006 and April 17, 2006
Pricing based on the terms developed in the Test Burn Supply Agreement of February 15, 2006 (supporting data available upon request)

	Tons	Unit Price	Total Price
Total Switchgrass Delivered	5,478.8	$11.06	$60,595.53
Environmental Benefit, SO2 reductions	21.7	$894.46	$19,409.78
Amount Due this Period			$80,005.31
Last Invoiced Amount			$64,178.74
Amount Paid during Invoiced Period (March 16 to April 17)			$0.00
Current Amount Due			**$144,184.05**

I certify that this invoice is correct and proper for payment.

Authorized Official
Paul Koffman

Date

cc: Bill Morton, Alliant Energy
CVRC&D

INVOICE BACKUP DETAILS

Invoice Date: 28-Apr-06

Switchgrass Delivery Date	Switchgrass Delivered (tons)	Ave. MC
16-Mar-06	168.3	13.9%
17-Mar-06	208.1	14.0%
18-Mar-06	181.4	15.7%
19-Mar-06	152.7	14.6%
20-Mar-06	184.0	14.9%
21-Mar-06	212.0	15.0%
22-Mar-06	247.9	13.2%
23-Mar-06	237.6	14.6%
24-Mar-06	237.2	14.9%
25-Mar-06	224.8	12.9%
26-Mar-06	81.1	13.3%
27-Mar-06	-	0.0%
28-Mar-06	-	0.0%
29-Mar-06	-	0.0%
30-Mar-06	-	0.0%
31-Mar-06	37.8	15.5%
1-Apr-06	213.5	13.8%
2-Apr-06	223.3	13.4%
3-Apr-06	213.6	14.4%
4-Apr-06	139.2	13.7%
5-Apr-06	182.5	14.8%
6-Apr-06	178.0	11.6%
7-Apr-06	202.3	13.5%
8-Apr-06	201.9	15.5%
9-Apr-06	234.4	14.6%
10-Apr-06	175.0	14.6%
11-Apr-06	173.4	11.3%
12-Apr-06	221.0	12.1%
13-Apr-06	233.6	13.6%
14-Apr-06	235.5	12.2%
15-Apr-06	200.9	12.6%
Reconciliation	278.0	13.3%
Monthly Totals	**5,478.8**	**13.8%**

Price = General (Processing Fee) + Environmental Benefit (EB)

General (Processing Fee) =HHV of fuel * Switchgrass Delivered * C * Coal Price

where:

CT HHV of fuel	6,892	Btu/lb
SWG Delivered	5,478.8	
C	0.002	lb-MMBtu / ton-Btu
Coal Price	$0.81	per MMBtu
Unit Price, CT	$11.17	/ton of switchgrass (base of 13% moisture)
Unit Price, Btu Adjusted	$11.06	/ton of switchgrass (adjusted for actual moisture)
General Price	*$60,595.53*	

EB ($/ton) = (2*(BS-TARS)*(Monthly SO2 value/2000))*(CT HHV *2000 / 1,000,000)*K

where

BS	0.40	lb/MMBtu
TARS	0.11	lb/MMBtu
Monthly SO2 Value	$894.46	per ton (March Average from April 3, 2006 *Air Daily*)
CT HHV	6,892	Btu/lb
K	1.0	
Unit Price, CT	$3.58	per ton SWG
Unit Price, Btu Adjusted	$3.54	per ton SWG
Sulfur Reductions	21.7	tons SO2 (Assuming K = 1)
EB Price	*$19,409.78*	

Total Price **$80,005.31**

(see attached explanation sheet for further explanation of this quantity--moisture content is overall average to date)

BACK-UP SUMMARY FOR RECONCILIATION BETWEEN TRUCK DELIVERY RECORDS AND AUTOMATED DATA SYSTEM LOGS:

Invoice Date: 28-Apr-06

Purpose: During the test burn, switchgrass facility control room operations staff noticed that the automated data logging system in the switchgrass processing facility was not recording data for bales processed during instances when a control system fault message was occuring at the same time that the bale was being weighed and inventoried. The controls program was updated to prevent this from occuring in the future. The following is a summary of the estimated tonnage of switchgrass that was processed but NOT RECORDED in the automated logging system.

Bales Delivered between Feb 3 and April 17, 2006 (from Daily Delivery Truck Logs):

Bales Delivered: 20,371 Tons Delivered: 9,840

Ave. Bale Weight (based on weigh sampling--not "official" weights): 966 lbs/bale (based on weights from 3-bales per Load)

Ave. Bale Weight through April 17, 2006 (from Automated system): 1,005 lbs/bale (based on automated scale in conveyor, weighing every bale)

Estimated Total Tons Delivered based on Automated Bale Weighing System: 10,236 tons (through midnight, April 17, 2006)

Bales and Tons in On-site Inventory at Midnight, April 17, 2006 (see Switchgrass Control Room Operator log):

Bales On-site: 350 Tons On-site: 175.9 tons (through midnight, April 17, 2006)

Rejected Bales Between Feb 15th and April 17th, 2006:

Bales Rejected: 16 Tons Rejected: 11.3 tons (through midnight, April 17, 2006)

Average Weight for Rejected Bales: 1,412.5 lbs/bale

Bales and Tons Logged by the Automated Control & Data System from Feb 15 through midnight April 17, 2006:

(as reported on Daliy Bale Processing report from the date ending April 17, 2006)

Bales Logged: 19,451 Tons Logged: 9,771 tons (through midnight, April 17, 2006)

Average Weight for Logged, Accpted Bales: 1,005 lbs/bale

Reconciled Processed Tonnage for April 28, 2006 Bale Processing Invoice (Unlogged Processed Tonnage):

(Difference between Delivered and Accepted Tons Processed based on Trucking Records, and Accepted Tons Logged by Data System)

Unlogged Processed Tonnage = Total Tons Delivered - Total Tons Logged - Tons in On-site Inventory - Rejected Tons

Unlogged Processed Tonnage = 10,236 tons - 9,771 tons - 176 tons - 11 tons

Unlogged Processed Tonnage = 278 tons

INVOICE

19229 Highway 5
Centerville, IA 52544
Phone: 641-437-4376
Fax: 641-437-4638
Web: http://www.cvrcd.org

Invoice No.: 3
Invoice Date: 31-May-06

Customer: Alliant Energy
Fossil Fuels Procurement Dept. - 3 South
4902 North Biltmore Lane
Madison, Wisconsin 53718-2132

Invoice for switchgrass delivered between April 16, 2006 and May 12, 2006
Pricing based on the terms developed in the Test Burn Supply Agreement of February 15, 2006 (supporting data available upon request)

	Tons	Unit Price	Total Price
Total Switchgrass Delivered	6,246.3	$11.27	$70,395.80
Environmental Benefit, SO2 reductions	25.2	$745.00	$18,774.00
Amount Due this Period			$89,169.80
Last Invoiced Amount			$144,184.05
Amount Paid during Invoiced Period (April 16 to May 12)			$144,184.05
Current Amount Due			**$89,169.80**

I certify that this invoice is correct and proper for payment.

Authorized Official
Paul Koffman

Date

cc: Bill Morton, Alliant Energy
CVRC&D

INVOICE BACKUP DETAILS

Invoice Date: 31-May-06

Switchgrass Delivery Date	Switchgrass Delivered (tons	Ave. MC
16-Apr-06	183.4	12.7%
17-Apr-06	194.9	14.6%
18-Apr-06	248.6	12.5%
19-Apr-06	244.5	13.6%
20-Apr-06	200.0	13.1%
21-Apr-06	181.9	12.6%
22-Apr-06	182.0	13.0%
23-Apr-06	188.0	12.2%
24-Apr-06	211.9	11.5%
25-Apr-06	261.7	11.6%
26-Apr-06	237.1	12.4%
27-Apr-06	252.9	12.2%
28-Apr-06	251.2	10.8%
29-Apr-06	238.3	11.1%
30-Apr-06	217.3	12.2%
1-May-06	219.8	15.2%
2-May-06	236.3	13.2%
3-May-06	249.8	10.5%
4-May-06	265.3	11.2%
5-May-06	251.3	14.0%
6-May-06	257.4	12.0%
7-May-06	257.6	12.4%
8-May-06	264.3	10.7%
9-May-06	247.7	10.5%
10-May-06	255.0	11.1%
11-May-06	261.1	12.0%
12-May-06	187.1	13.1%
13-May-06	0.0	0.0%
14-May-06	0.0	0.0%
15-May-06	0.0	0.0%
Reconciliation		
Monthly Totals	**6,246.3**	**12.2%**

Price = General (Processing Fee) + Environmental Benefit (EB)

General (Processing Fe =HHV of fuel * Switchgrass Delivered * C * Coal Price

where:

CT HHV of fuel	6,892	Btu/lb
SWG Delivered	6,246.3	
C	0.002	lb-MMBtu / ton-Btu
Coal Price	$0.81	per MMBtu
Unit Price, CT	$11.17	/ton of switchgrass (base of 13% moisture)
Unit Price, Btu Adjust	$11.27	/ton of switchgrass (adjusted for actual moisture)
General Price	*$70,395.80*	

EB ($/ton) = (2*(BS-TARS)*(Monthly SO2 value/2000))*(CT HHV *2000 / 1,000,000)*K

where

BS	0.40	lb/MMBtu
TARS	0.11	lb/MMBtu
Monthly SO2 Valu	$745.00	per ton (March Average from April 3, 2006 *Air Daily*
CT HHV	6,892	Btu/lb
K	1.0	
Unit Price, CT	$2.98	per ton SWG
Unit Price, Btu Adjust	$3.01	per ton SWG
Sulfur Reductions	25.2	tons SO2 (Assuming K = 1)
EB Price	*$18,774.00*	
Total Price	**$89,169.80**	

(programming corrections to the control system fixed previous problems with bale counting--this month's totals from the control sytem are accurate)

Calculation of Sulfur Dioxide Emissions Reductions Due to Switchgrass Fuel Use: Invoice Date: 31-May-06

Equation:

SO2 Reduction = [S_{coal} - S_{swg}] x SO2cnv x (ton-SO_2 / 2000 lb-SO_2) x HV_{swg} x AF_{mc} x (1 MMBtu / 10^6 Btu) x T_{swg} x (2000 lb-swg / ton-swg) x (K factor)

Caluculation Inputs:

Sulfur Content, Coal (Scoal):	0.40	lb-S/MMBtu
Sulfur Content, Switchgrass (Sswg):	0.11	lb-S/MMBtu
Pounds of SO2 per Pound of Sulfur (SO2cnv):	2	lb-SO2/lb-S
Baseline Heating Value of Switchgrass (HVsw	6,892	Btu/lb-swg (at 13% moisture content)
Baseline Switchgrass Moisture Content:	13.0%	
Measured Switchgrass Moisture Content:	12.2%	
Moisture Content Adjustment Factor:	1.0092	= (1 - Actual M.C.) / (1 - Baseline M.C.)
Processed Switchgrass Tons (Tswg):	6,246.3	tons
K Factor (see note below)	1.0	(initial assumption, to be adjusted after test burn based on actual emissions measurements)

NOTE: The "K Factor" multiplier is a factor to adjust for sulfur emissions reductions due to using switchgrass that are above and beyond the SO2 reductions that are anticipated strictly based on differences in the sulfur contents of coal and switchgrass. Previous test burns have shown that actual measured sulfur reductions are roughly twice the amount expected based on considering just the differences in fuel sulfur contents (e.g., K = 2). The actual value of "K" will be determined after all of the test bum emissions data have been analyzed.

Calculation:

SO2 Reduction = [S_{coal} - S_{swg}] x SO2cnv x (ton-SO_2 / 2000 lb-SO_2) x HV_{swg} x AF_{mc} x (1 MMBtu / 10^6 Btu) x T_{swg} x (2000 lb-swg / ton-swg) x (K factor)

= [0.40 - 0.11] (lb-S / MMBtu) x (2 lb-SO2 / lb-S) x (ton-SO2 / 2000 lb-SO2) x (6,892 Btu / lb-swg) x (1.00920) x (1 MMBtu / 10^6 Btu) x 6,246.3 ton-swg x (2000 lb-swg / ton-swg) x (1.0)

SO2 Reduction = **25.20** tons SO2

25.2 tons SO2 (rounded)

Calculation of Sulfur Dioxide Emissions Reductions Due to Switchgrass Fuel Use: Invoice Date: 28-Apr-06

Equation:

SO2 Reduction = [S_{coal} - S_{swg}] x SO2cnv x (ton-SO_2 / 2000 lb-SO_2) x HV_{swg} x AF_{mc} x (1 MMBtu / 10^6 Btu) x T_{swg} x (2000 lb-swg / ton-swg) x (K factor)

Caluculation Inputs:

Sulfur Content, Coal (Scoal):	0.40	lb-S/MMBtu
Sulfur Content, Switchgrass (Sswg):	0.11	lb-S/MMBtu
Pounds of SO2 per Pound of Sulfur (SO2cnv):	2	lb-SO2/lb-S
Baseline Heating Value of Switchgrass (HVswg	6,892	Btu/lb-swg (at 13% moisture content)
Baseline Switchgrass Moisture Content:	13.0%	
Measured Switchgrass Moisture Content:	13.8%	
Moisture Content Adjustment Factor:	0.9908	= (1 - Actual M.C.) / (1 - Baseline M.C.)
Processed Switchgrass Tons (Tswg):	5,478.8	tons
K Factor (see note below)	1.0	(initial assumption, to be adjusted after test burn based on actual emissions measurements)

NOTE: The "K Factor" multiplier is a factor to adjust for sulfur emissions reductions due to using switchgrass that are above and beyond the SO2 reductions that are anticipated strictly based on differences in the sulfur contents of coal and switchgrass. Previous test burns have shown that actual measured sulfur reductions are roughly twice the amount expected based on considering just the differences in fuel sulfur contents (e.g., K = 2). The actual value of "K" will be determined after all of the test burn emissions data have been analyzed.

Calculation:

SO2 Reduction = [S_{coal} - S_{swg}] x SO2cnv x (ton-SO_2 / 2000 lb-SO_2) x HV_{swg} x AF_{mc} x (1 MMBtu / 10^6 Btu) x T_{swg} x (2000 lb-swg / ton-swg) x (K factor)

= [0.40 - 0.11] (lb-S / MMBtu) x (2 lb-SO2 / lb-S) x (ton-SO2 / 2000 lb-SO2) x (6,892 Btu / lb-swg) x (0.99080) x (1 MMBtu / 10^6 Btu) x 5,478.8 ton-swg x (2000 lb-swg / ton-swg) x (1.0)

= [0.40 - 0.11] (lb-S / MMBtu) x (2 lb-SO2 / lb-S) x (ton-SO2 / 2000 lb-SO2) x (6,892 Btu / lb-swg) x (0.99080) x (1 MMBtu / 10^6 Btu) x 5,478.8 ton-swg x (2000 lb-swg / ton-swg) x (1.0)

SO2 Reduction = **21.70** tons SO2

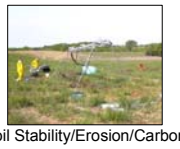
21.7 tons SO2 (rounded)

Appendix T – Renewable Energy Credit Certification Presentation & Report

Chariton Valley Biomass Project

Research / Reports


Crop Studies & Cost


Soil Stability/Erosion/Carbon


Harvest Impacts on Wildlife


Air/Ash/Water Impacts

Equipment Development


Baler Development


Bale Accumulator


Bale Handling


Biomass Processing

Processing Facility


June 2005


August 2005

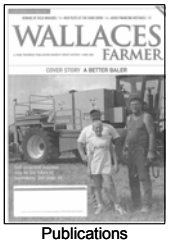

September 2005


November 2005

Outreach

Public Outreach


Web Outreach



Publications

Switchgrass Cofiring
Ottumwa, Iowa

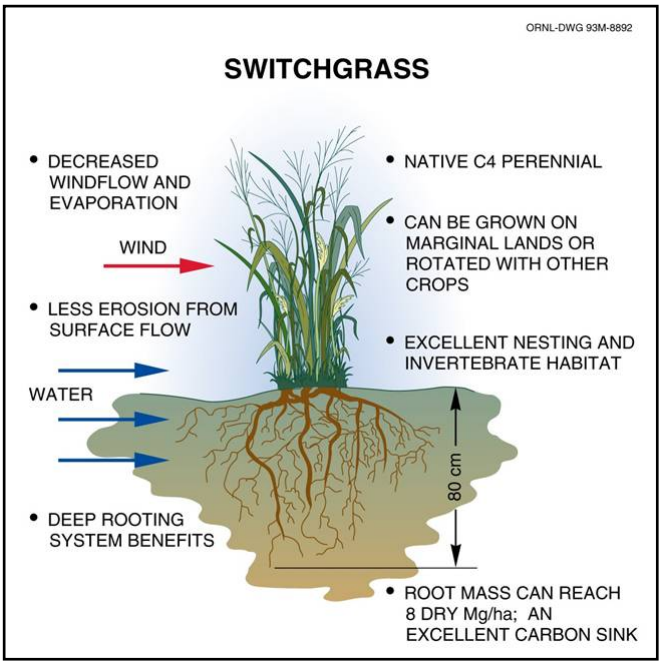
- Ottumwa Generating Station
  - Alliant Energy / Mid-American
  - 726 MW, PRB Coal, 1982 startup
  - Twin furnace T-fired PC boiler
  - 2.5 to 5% heat input from switchgrass, 12.5 to 25 ton/hr
  - Separate biomass injection, 2 - 4 ports

- Status
  - 2000 hr continuous test burn on-going
  - Newly constructed facility completed
  - Long term test to investigate fouling, slagging, and corrosion impacts

- Fuel
  - 3’ x 4’ x 8’ switchgrass bales
  - 2-step milling process to 1/8” minus

Project Characteristics

- Test Facility (The “Grass Station”)
  - Designed for 12.5 ton/hour
  - 25,000 tons of switchgrass for 2,000 hour continuous test burn accumulated from 4,000 acres over several years
  - Contains several innovative, first-of-a-kind pieces of equipment (which are working great)
  - 17.5 MW of BASELOAD Renewable Energy
  - Automated control & monitoring system
  - 24 hour data logging
  - Would require 100,000 tons/yr, from 25k to 75k acres initially
- Commercial Facility
  - Designed for 25 tons/hr
  - Designed for automated crane operation based on Danish straw-fired plants
  - 35.0 MW of BASELOAD Renewable Energy
  - Air permits already granted for construction on the merit of previous air emissions test results
  - Would require 200,000 tons/yr, from 50k to 150k acres initially



Growing Season

After Frost, Before Harvest

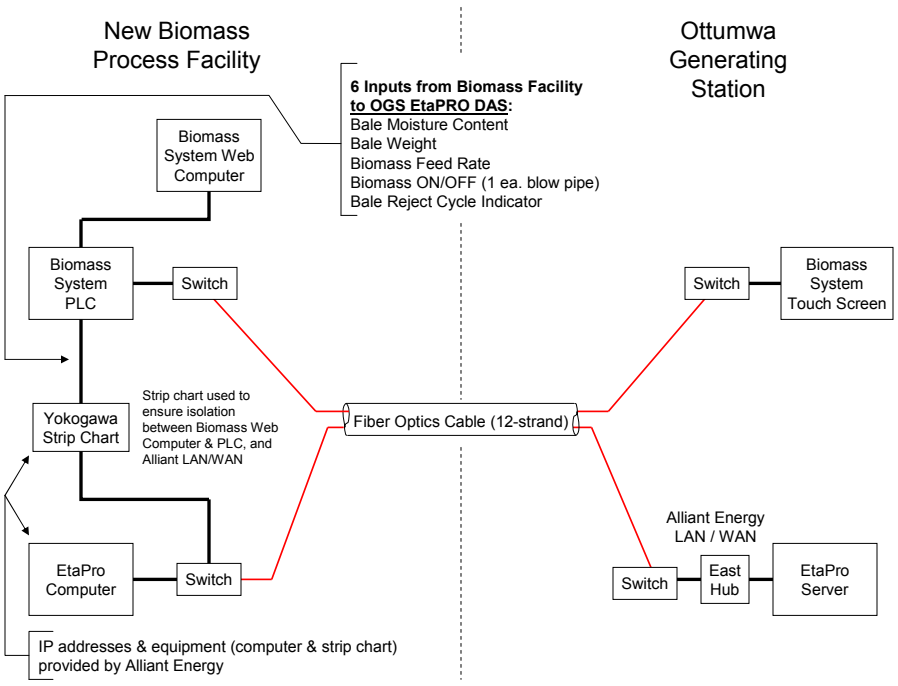
During Harvest

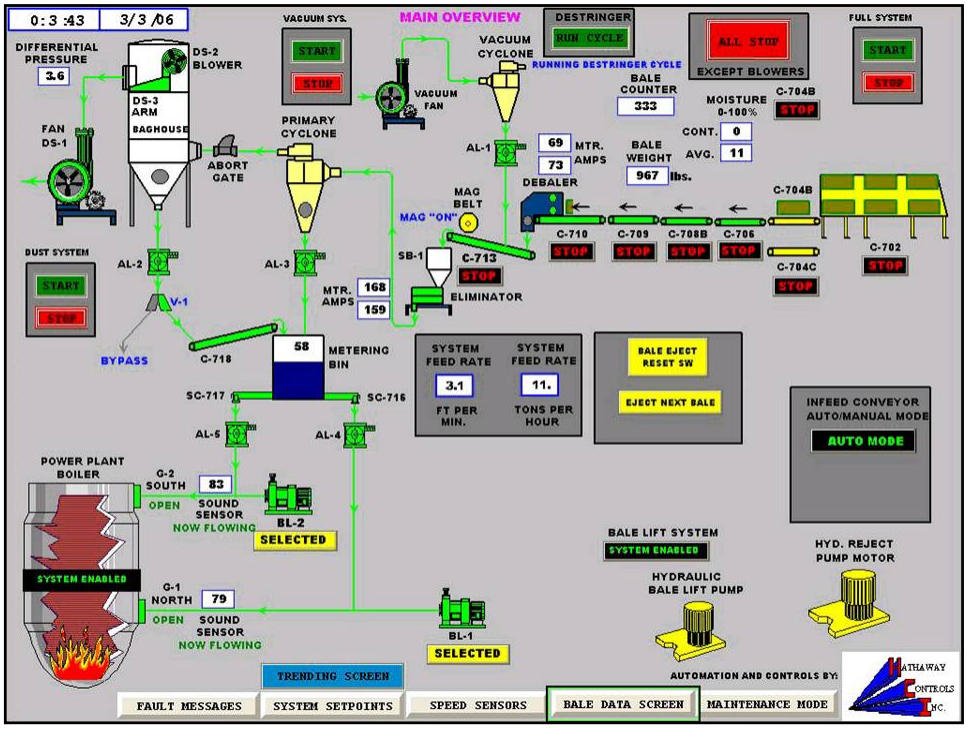
After Harvest

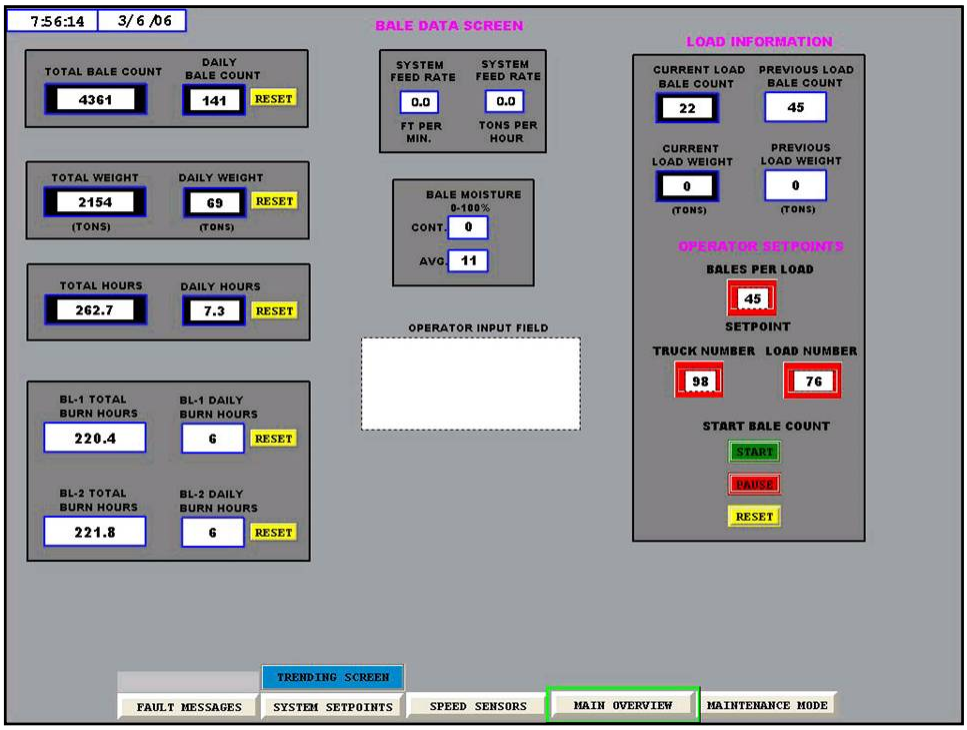
Replacing up to 5% of this . . . .

with this . . . .

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




0:3 :43
3/3 /06
MAIN OVERVIEW
VACUUM SYS.
START
STOP
DESTRINGER
RUN CYCLE
ALL STOP
EXCEPT BLOWERS
FULL SYSTEM
START
STOP
DIFFERENTIAL PRESSURE
3.6
DS-2 BLOWER
DS-3 ARM
BAGHOUSE
FAN DS-1
ABORT GATE
PRIMARY CYCLONE
VACUUM FAN
VACUUM CYCLONE
RUNNING DESTRINGER CYCLE
BALE COUNTER
333
MOISTURE 0-100%
C-704B
STOP
CONT.
0
AVG.
11
AL-1
69
MTR. AMPS
73
BALE WEIGHT
967
lbs.
DEBALER
MAG BELT
MAG "ON"
C-710
C-709
C-708B
C-706
C-704B
C-704C
C-702
STOP
DUST SYSTEM
AL-2
AL-3
SB-1
C-713
ELIMINATOR
MTR. AMPS
168
159
V-1
BYPASS
C-718
58
METERING BIN
SC-717
SC-716
AL-5
AL-4
SYSTEM FEED RATE
3.1
FT PER MIN.
SYSTEM FEED RATE
11.
TONS PER HOUR
BALE EJECT RESET SW
EJECT NEXT BALE
INFEED CONVEYOR AUTO/MANUAL MODE
AUTO MODE
POWER PLANT BOILER
G-2 SOUTH
83
OPEN
SOUND SENSOR
NOW FLOWING
BL-2
SELECTED
SYSTEM ENABLED
G-1 NORTH
79
OPEN
SOUND SENSOR
NOW FLOWING
BL-1
SELECTED
BALE LIFT SYSTEM
SYSTEM ENABLED
HYDRAULIC BALE LIFT PUMP
HYD. REJECT PUMP MOTOR
AUTOMATION AND CONTROLS BY:
HATHAWAY CONTROLS INC.
TRENDING SCREEN
FAULT MESSAGES
SYSTEM SETPOINTS
SPEED SENSORS
BALE DATA SCREEN
MAINTENANCE MODE


7:56:14
3/6 /06
BALE DATA SCREEN
TOTAL BALE COUNT
4361
DAILY BALE COUNT
141
RESET
TOTAL WEIGHT
2154
(TONS)
DAILY WEIGHT
69
(TONS)
RESET
TOTAL HOURS
262.7
DAILY HOURS
7.3
RESET
BL-1 TOTAL BURN HOURS
220.4
BL-1 DAILY BURN HOURS
6
RESET
BL-2 TOTAL BURN HOURS
221.8
BL-2 DAILY BURN HOURS
6
RESET
SYSTEM FEED RATE
0.0
FT PER MIN.
SYSTEM FEED RATE
0.0
TONS PER HOUR
BALE MOISTURE 0-100%
CONT.
0
AVG.
11
OPERATOR INPUT FIELD
LOAD INFORMATION
CURRENT LOAD BALE COUNT
22
PREVIOUS LOAD BALE COUNT
45
CURRENT LOAD WEIGHT
0
(TONS)
PREVIOUS LOAD WEIGHT
0
(TONS)
OPERATOR SETPOINTS
BALES PER LOAD
45
SETPOINT
TRUCK NUMBER
98
LOAD NUMBER
76
START BALE COUNT
START
PAUSE
RESET
TRENDING SCREEN
FAULT MESSAGES
SYSTEM SETPOINTS
SPEED SENSORS
MAIN OVERVIEW
MAINTENANCE MODE

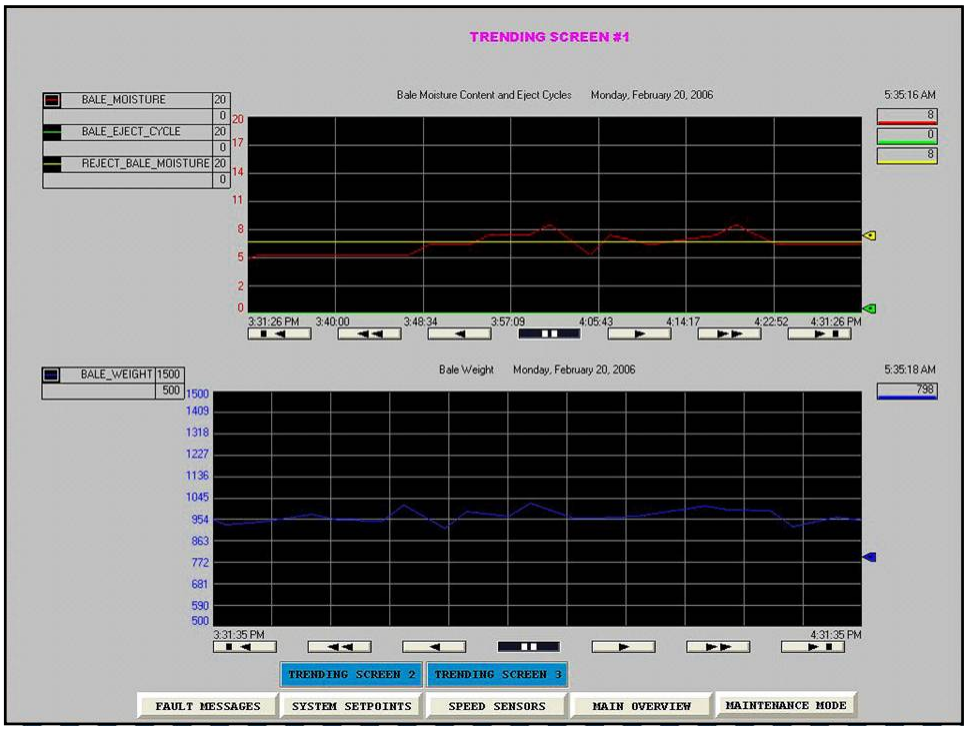
Summary Statistics to Date

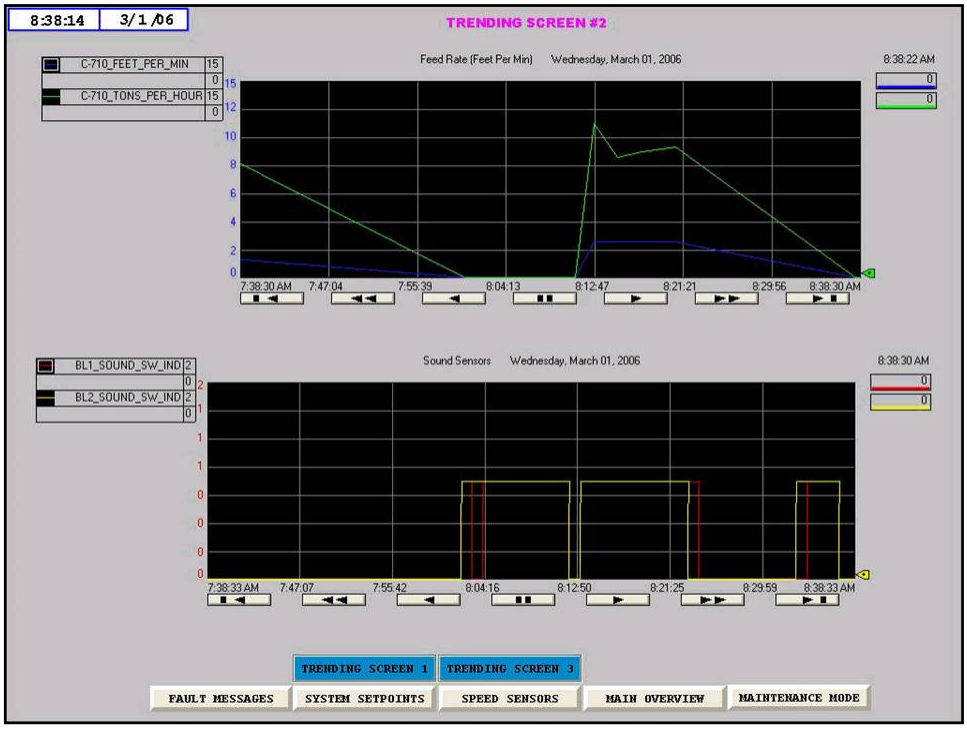
Summary Statistics:

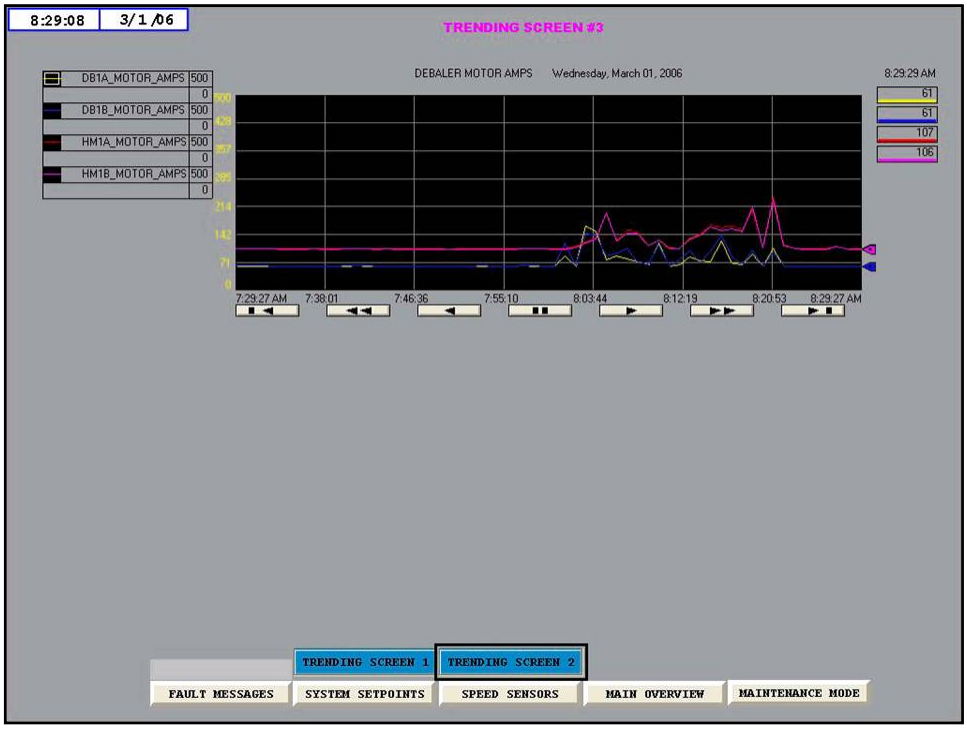
Date :	Wednesday, March 22, 2006	
Bale Count :	529	bales
Run Time :	24.0	hrs
Total Bale Weight :	247.9	tons
Max. Bale Weight :	1,353	lbs.
Min. Bale Weight :	743	lbs.
Average Bale Weight:	937	lbs.
Average Moisture Content:	13%	

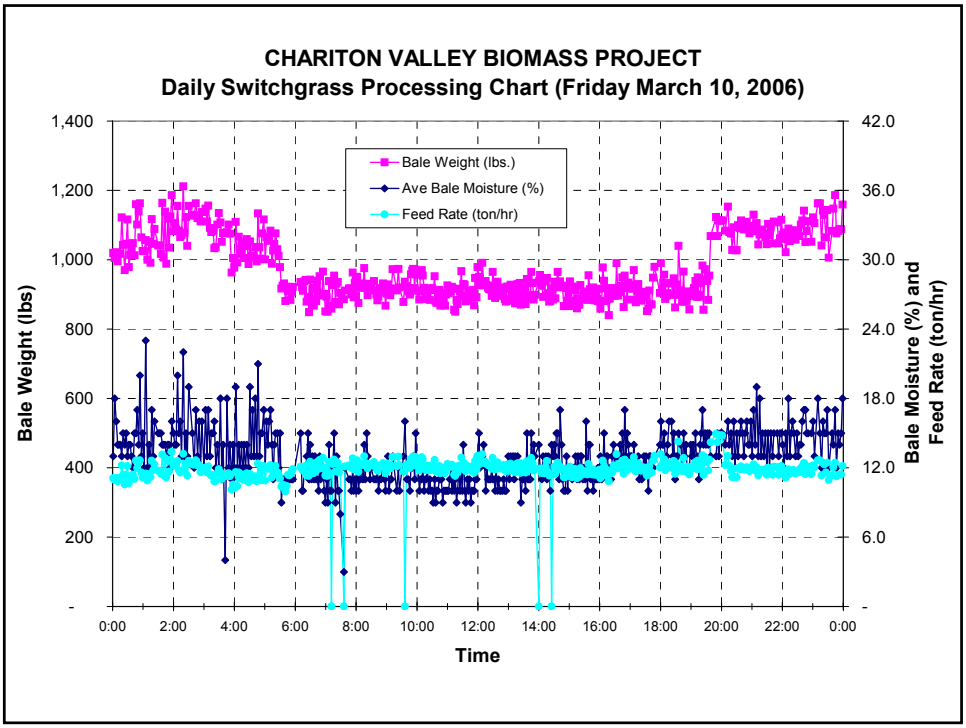
Overall Statistics (through midnight):		
Total Bales Processed (accepted) :	11,264	bales
Total Tons Processed (accepted) :	5,567	
Average Bale Weight:	988	lbs./bale
Total System Processing Hours:	627.6	hours
Percent of Run-hour Goal:	31%	of 2000 hour goal
Percent of Tonnage Goal:	22%	of 25,000 ton goal
Estimated Power Generated :	6,975	MWh
Time Remaining until May 12th Outage:	50	days
	1,200	hours

Average Iowa Homes Powered for Full Year : 667 average annual homes




8:38:14
3/1/06
TRENDING SCREEN #2
C-710_FEET_PER_MIN
C-710_TONS_PER_HOUR
Feed Rate (Feet Per Min) Wednesday, March 01, 2006
8:38:22 AM
7:38:30 AM
7:47:04
7:55:39
8:04:13
8:12:47
8:21:21
8:29:56
8:38:30 AM
BL1_SOUND_SW_IND
BL2_SOUND_SW_IND
Sound Sensors Wednesday, March 01, 2006
8:38:30 AM
7:38:33 AM
7:47:07
7:55:42
8:04:16
8:12:50
8:21:25
8:29:59
8:38:33 AM
TRENDING SCREEN 1
TRENDING SCREEN 3
FAULT MESSAGES
SYSTEM SETPOINTS
SPEED SENSORS
MAIN OVERVIEW
MAINTENANCE MODE


8:29:08
3/1/06
TRENDING SCREEN #3
DB1A_MOTOR_AMPS
DB1B_MOTOR_AMPS
HM1A_MOTOR_AMPS
HM1B_MOTOR_AMPS
DEBALER MOTOR AMPS Wednesday, March 01, 2006
8:29:29 AM
7:29:27 AM
7:38:01
7:46:36
7:55:10
8:03:44
8:12:19
8:20:53
8:29:27 AM
TRENDING SCREEN 1
TRENDING SCREEN 2
FAULT MESSAGES
SYSTEM SETPOINTS
SPEED SENSORS
MAIN OVERVIEW
MAINTENANCE MODE



Biopower Calculation

- Measure tons per hour and Btu biomass input in real-time using:
  - Digital scale on conveyor system
  - Microwave moisture content meter
  - Lab analysis of switchgrass samples (Btu/lb)
- Calculation
  - MW = $\frac{(12.5\ \text{ton/hr})(2000\ \text{lb/ton})(6980\ \text{Btu/lb})}{(11{,}000\ \text{Btu/kw-hr})(1000\ \text{kW/MW})}$

    13% m.c., ave

    FERC Form 1 OGS Heat Rate
  - MW = 15.86 MW
- We also measure reduction in coal flow as biomass flow increases

Emissions Monitoring (GE)

Emissions Probe In Outlet Duct

GE's Mobile Emissions Lab

GE's Emissions Vans at Stack

CO, NOx, O2, PM, PM10, Hg, Cl

Emissions Equipment at OGS

CEMS Probes In Outlet Duct

SO2, NOx, Opacity

Portable Emissions Monitor

CO, SO2, NOx, O2

Other Sampling

Bottom Ash Liquids

Economizer Ash

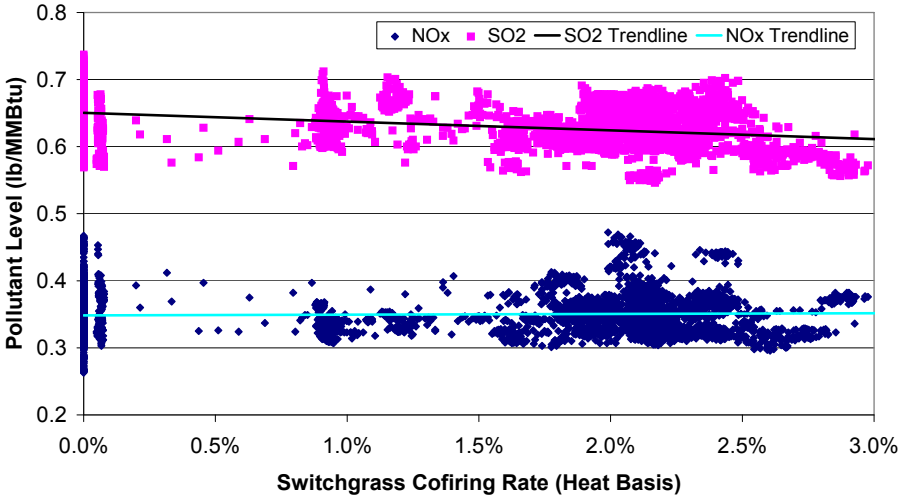
Fly Ash Auto Sampler

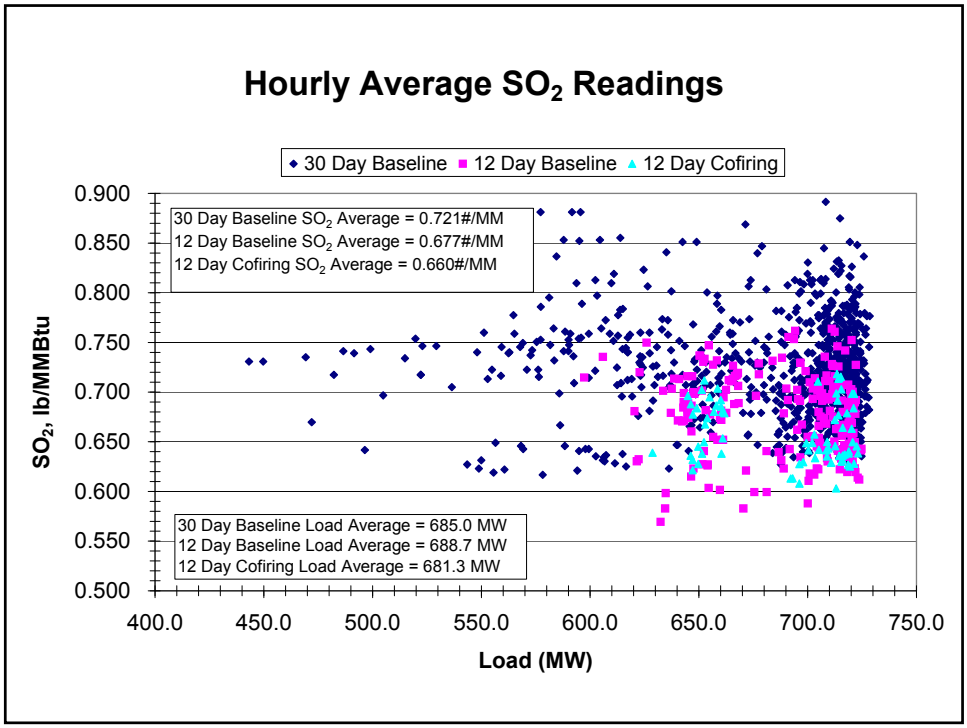
Bottom Ash

Bulk Fly Ash

Chariton Valley Biomass Project--Interim Test Burn
NOx & SO2 vs. Cofire Rate, Ottumwa Generating Station

Continuous Emissions Monitoring System Data for: December 1 to 5, December 8 to 12, 8 am to 6 pm





Summary: Emissions Results (Interim Test Burn)

- From Continuous Emissions Monitoring System:
  - 6000 minutes of emissions data collected and analyzed
  - 8 am – 6 pm on all test days
  - 53 hours cofiring, 47 hours coal-only
  - Average heat input from switchgrass was 1.9% of boiler total
  - **Results when cofiring:**
    - Average Sulfur Dioxide (SO2) emissions decreased by over 4%
    - Average Nitrogen Oxides (NOx) emissions did not change
- From Stack Emissions Testing:
  - Particulates decreased by 4% (PM), and 14% (PM10)
  - Carbon Monoxide (CO) emissions did not change

Income from these RECs will be put towards completing the demonstration project, with the ultimate goal to build a 25 ton/hr automated system . . . . . .

ENVIRONMENTAL
RESOURCES
TRUST, INC.

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Washington, DC
20006
(202) 785-8577
Fax: (202) 785-2739
Email: info@ert.net

April 6, 2006

Mr. Bill Belden
Project Manager
Chariton Valley Biomass Project
19229 Highway 5
Centerville, IA 52544

1st EcoPower® Certification Audit of Alliant Energy's Biomass Co-Fired Ottumwa Generating Station

The Environmental Resources Trust, Inc. (ERT) has performed its first audit of Alliant Energy's Ottumwa Generating Station in Iowa. We evaluated the raw materials on site and reviewed meter readings and plant generation data to determine;

1 The Amount of Renewable Energy Generation Available and Likely to be Available during the initial 2,000 hour test burn period and;
2 Whether the Renewable Energy Generation meets ERT's EcoPower renewable and net environmental benefit requirement.

Based on our initial audit, the biomass production meets our EcoPower requirement and will be generated in the approximate amounts during the period shown below:

Expected Total Quantity of EcoPower® Certificates: 31,300*
(February 17, 2006 – May 12, 2006)

* Data received at the end of the test run period may increase or decrease this amount and ERT reserves the right to issue EcoPower® Certificates based on actual audited data.

Beginning February 17, 2006, the Ottumwa Generating Station began generating Biomass Energy at the rate of 2.5 % of total plant output. As of March 23, 2006, 7,086 MWh of biomass renewable energy had been generated. Expected production is projected at approximately 11,270 MWh per month.

Renewable Energy Certificates from the Alliant Energy's Ottumwa Generating Station may now be offered for sale.

Sincerely,

Alden Hathaway
Director, EcoPower® Program

Ottumwa Biomass/Coal Co-Fired Power Plant Audit

Report 3/31/06

On March 23, 2006 ERT visited Alliant Energy's Ottumwa Generating Station for the purpose of conducting an audit for Biomass renewable energy to determine compliance with ERT's EcoPower standard.

Photo courtesy of Alliant Energy

Editor's Note: ERT did not conduct a rigorous assessment or substantiation of environmental benefits, except where required to meet ERT's EcoPower Standard, namely that carbon dioxide emissions are reduced relative to fuel or electricity being displaced by at least 50%. This report details how ERT determined the amount of available biomass renewable energy for certification as an EcoPower Renewable Energy Certificate.

Background

The Ottumwa Generating Station, located Chariton Valley of southern Iowa, is Iowa's largest coal-fired generating facility. In 1996, an initial feasibility study was conducted to investigate the use of switchgrass as a biomass alternative to a percentage of the coal used at the facility. Based on that study, funding was sought and received to continue to pursue the use the biomass at the facility. Currently, the project is in the process of a 2,000-hour test burn, which is the final stage of the demonstration project.

The Ottumwa Generating Station is a base load plant operating at 80-90% capacity. It burns bituminous coal, and uses modern emissions controls.

The Ottumwa Generating Station is now getting about 2.5% of its heat input from locally grown switchgrass, and hopes to ramp up to 5% after the data from the test burn period is evaluated. The current test facility is producing 17.5 MW of baseload renewable energy. The commercial facility that is under consideration would provide for 35 MW of baseload renewable energy, coming from 200,000 tons of switchgrass per year, requiring between 50,000 to 150,000 acres to grow initially.

Audit Details

ERT reviewed the following:

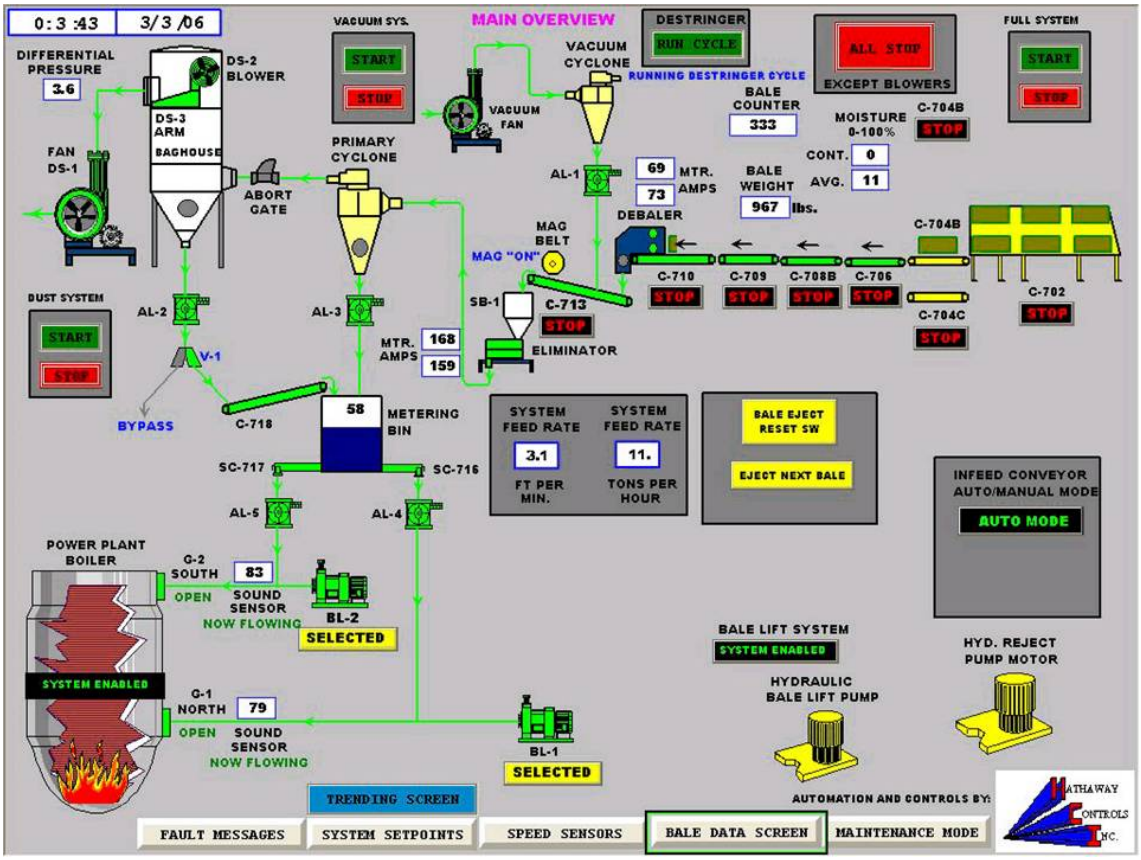
The switchgrass delivery and handling system
The coal delivery and handling system
The amount of coal and switchgrass being used
The electric generators ratings
Instantaneous meter readings while generating power, including;
- Emissions rates
- Power output

Historical energy generation data

Switchgrass Delivery and Handling

The switchgrass is delivered to the Ottumwa Generating Station on flat bed trucks in the form of 3' x 4' x 8' bales. The bales are loaded onto a conveyor system where they are mass and moisture content readings are taken. Bales are then de-stringed to eliminate possible toxics from the burning of plastic. They are also put through a magnetic field to extract any metal objects that might have been hidden in the bales. The switchgrass is then put through a 2-step milling process, which produces finely chopped (less that 1/8") switchgrass. It is then fed into transport pipes with compressed air for transport to the generating station where it has its own separate feed into the furnace.

Switchgrass bales are loaded onto the conveyor system.



Screen capture of biomass handling software system.

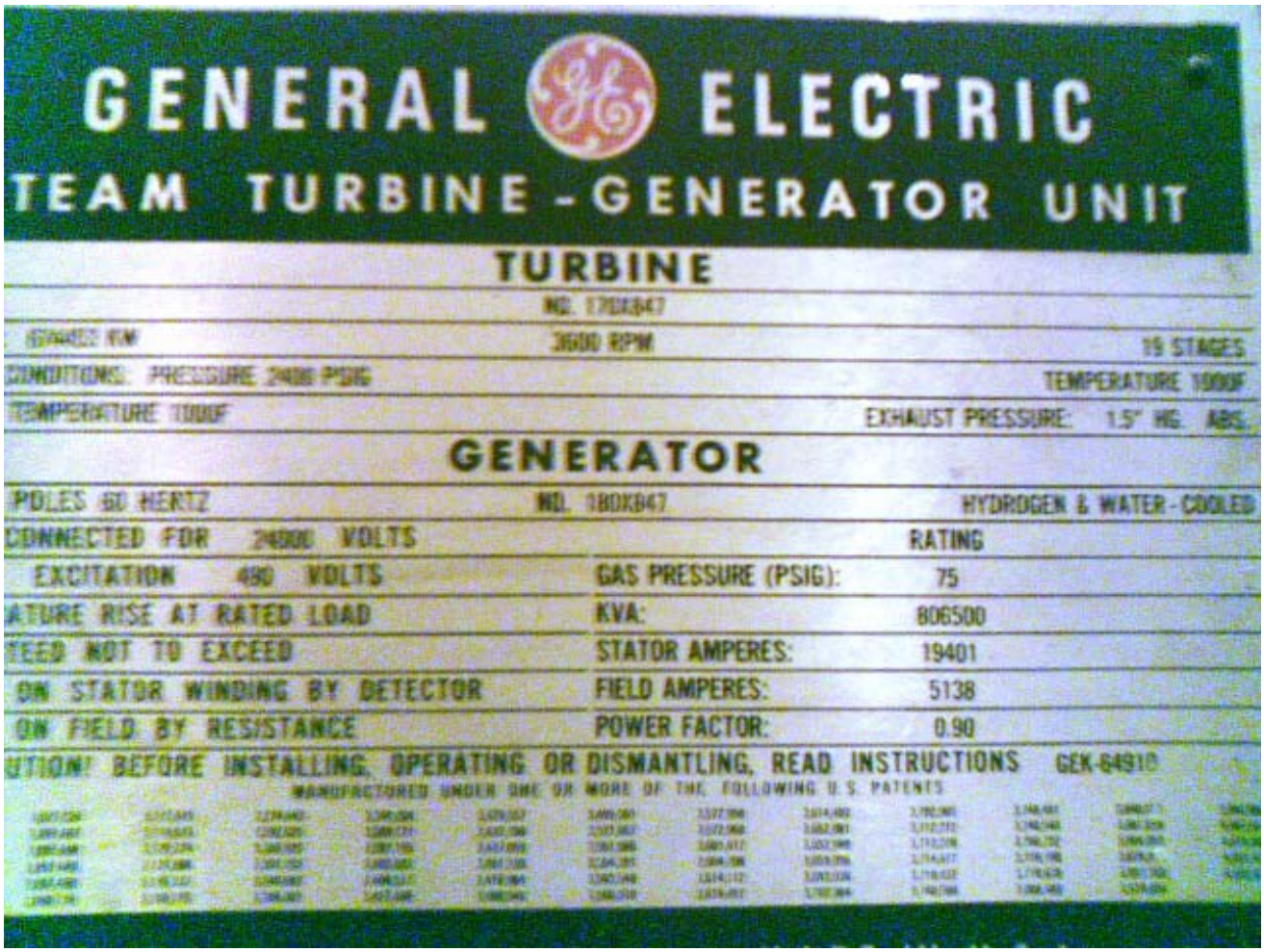
Coal Handling System

Coal is handled completely separately from the switchgrass, and has separate injecting into the furnace.

Photograph courtesy of Alliant Energy

Electric Generating Equipment

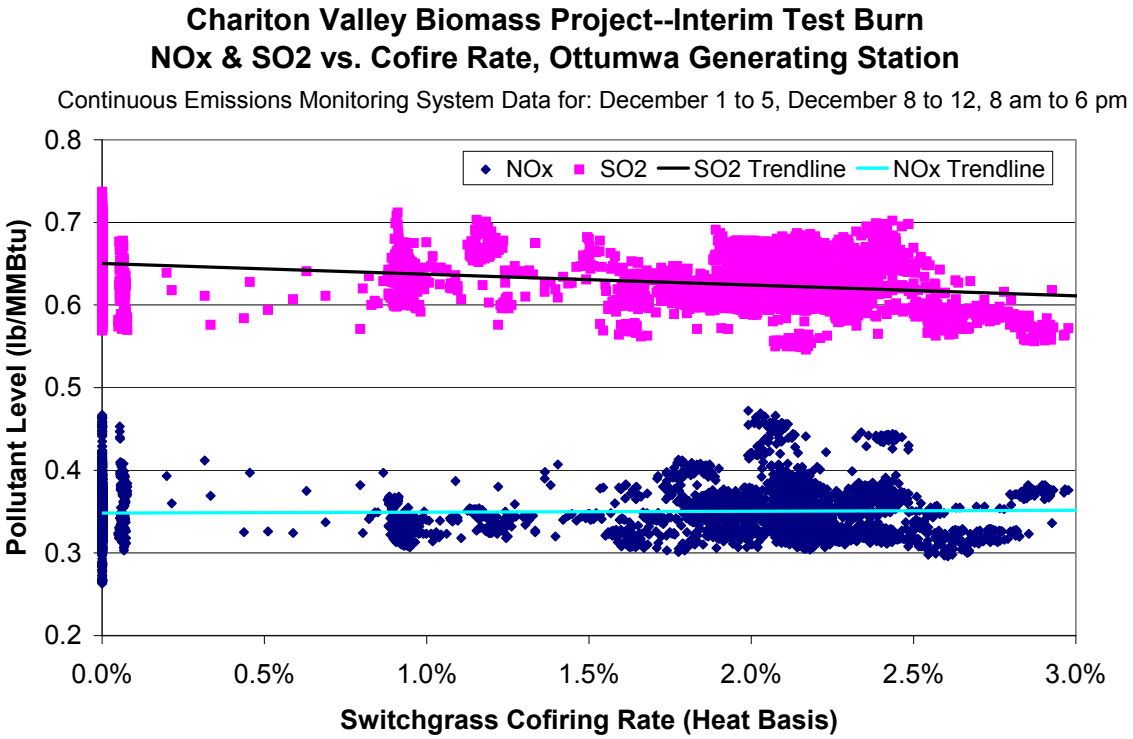
The Ottumwa Generating Station uses a 726 MW GE stream turbine generator, powered by a twin furnace T-fired PC boiler with a 1982 startup date. The furnace has separate injection ports for coal and biomass which can be individually controlled.



Audit of Instantaneous Meter Readings

ERT surveyed the control room while the generating station was operating under full capacity.

Power output reading for the generator and furnace temperature readout. ERT reviewed historical charts like the one show below for the for the test-burn period so far.



This chart shows that NOx levels have remained constant as more biomass is added, while SO2 levels have actually decreased by about 4%.

The Ottumwa Generating Station makes use of state of the art emissions monitoring hardware and software to accurately gauge the station's emissions. ERT found that there was no significant increase in emissions due to the burning of switchgrass.

Summary Statistics to Date

Summary Statistics:		
Date :	Wednesday, March 22, 2006	
Bale Count :	529	bales
Run Time :	24.0	hrs
Total Bale Weight :	247.9	tons
Max. Bale Weight :	1,353	lbs.
Min. Bale Weight :	743	lbs.
Average Bale Weight:	937	lbs.
Average Moisture Content:	13%	

Overall Statistics (through midnight):		
Total Bales Processed (accepted) :	11,264	bales
Total Tons Processed (accepted) :	5,567	
Average Bale Weight:	988	lbs./bale
Total System Processing Hours:	627.6	hours
Percent of Run-hour Goal:	31%	of 2000 hour goal
Percent of Tonnage Goal:	22%	of 25,000 ton goal
Estimated Power Generated :	6,975	MWh
Time Remaining until May 12th Outage:	50	days
	1,200	hours

Average Iowa Homes Powered for Full Year :	667	average annual homes

Follow-up Activities

ERT will return at the end of the test-burn period to verify that the generation estimates were correct and that the project has continued to work as planned. Emissions data will be reviewed to confirm that there was no significant increase in emissions.

The following page contains the certificate issued to Chariton Valley RC&D by ERT Ecopower for 19,607 MWh of EcoPower certificates.

Serial numbers:
R-583,857 -
R-603,463

Chariton Valley RC&D

19,607 MWh

This certifies that

CHARITON VALLEY RC&D

Is the owner of 19,607 megawatt-hours of EcoPower® certificates designated by the unique serial numbers displayed on this certificate. These EcoPower® certificates were generated at the Ottumwa Generating Station in the year 2006 from switchgrass processed at the Chariton Valley Biomass Project facility located in Chillicothe, Iowa.

ecopower®

Issued this 1st day of August 2006 and certified by

Alden Hathaway
Director, ERT EcoPower® Program

Appendix U – Carbon Emissions Reduction Justification & Credit Certification Documents

Farm Bureau Management Corp.
Carbon Credit Program
5400 University Ave
West Des Moines, Iowa 50266

Contract No.__XO-001_____

Date Sep 28, 2006

APPLICATION FOR PARTICIPATION IN CHICAGO CLIMATE EXCHANGE OFFSET PROGRAM and CREDIT SALE CONTRACT for EXCHANGE OFFSETS

Seller: Chariton Valley Resource Conservation & Development, Inc.
Chariton Valley Biomass Project
Contact_____ Bill Belden_____
Address__19229 Hwy 5_____ _____
City/State/Zip__ Centerville, IA 52544-8922 _____

Phone: 641-437-4376
Cell Phone: 641-437-4376_____
E-mail:___ bbelden@sirisonline.com _____

I, Paul Koffman , Board President, on behalf of Chariton Valley Resource Conservation & Development , Inc. hereby apply for registry of Exchange Offsets (XOs) with the Chicago Climate Exchange (CCX) for the years 2003-2006 from a project that was undertaken by the Chariton Valley Resource Conservation & Development, Inc. The project is commonly referred to as Chariton Valley Biomass Project. The project entails co-firing of biomass at the Ottumwa Generating Station in Chillicothe, Iowa.

Project Description: Co-firing switchgrass and coal in an electrical generating station. Project scope includes production, harvesting, storage, and processing of biomass fuel materials and delivery of such materials into the burn chamber at the generating station.

I hereby attest that Chariton Valley Resource Conservation & Development, Inc. (the "Company") does hold full legal title to the Greenhouse Gas mitigation rights registered as CCX Offsets that are associated with the facilities and sites included in the registered project. I hereby agree that the Company intends to reduce greenhouse gas emissions by substituting carbon-neutral biomass fuel materials for coal through co-firing in an electrical generating station. Total carbon emission reduction provided by the project is 35,650 metric tons of CO2. I further agree that the Company will abide by the rules of the CCX as they pertain to XOs and to the conditions for participation as set forth in this Agreement.

Purchaser agrees to buy and seller agrees to sell and deliver to purchaser free from liens and encumbrances at 5400 University Ave, West Des Moines, Iowa, the rights to the Exchange Offsets (XOs) created during the years 2003 through 2006.

Seller warrants that the XOs covered by this contract comply with all rules of the Chicago Climate Exchange.

***The transfer price of the XOs covered by this contract shall be the sales price as determined by sale through the Chicago Climate Exchange less a 10% service fee.**

*Exchange offset registration fees and offset verification costs are the responsibility of the offset project owner. With the consent of the Iowa Farm Bureau, offset registration fees may be deducted from proceeds at the time of distribution.

Sale of XOs covered by this contract shall be at the sole discretion of the Purchaser, however all XOs shall be priced no later than May 30, 2007. Payment for XOs covered by this contract shall occur no later than 180 days after pricing of the XOs through the Chicago Climate Exchange. The parties to this contract hereby agree that the title to the XOs shall be automatically delivered to the Purchaser on the date of the contract. Seller further warrants compliance with the terms and conditions contained in the Agreement for the covered period.

Additional documents to be submitted with the XO application:

- Project Description
- Test Burn Supply Agreement
- Carbon Reduction Calculations & Summary
- Copy of Renewable Energy Credit Certificate

_____Date_____ _____Date_____

Seller's Signature

Purchaser's Signature
Farm Bureau Management Corp

Terms and Conditions

CCX Offset Project Terms and Conditions: By registering a project with CCX, each project owner agrees to and acknowledges the following Terms and Conditions in relation to the project and the Exchange Offsets issued by CCX:

1. The enrolled project meets all applicable eligibility rules of the Chicago Climate Exchange.
2. CCX will issue to the CCX Registry account of the project owner or its designated aggregator a quantity of Exchange Offsets that conforms to the applicable CCX Rules.
3. Each sale of Exchange Offsets executed through the Chicago Climate Exchange shall represent a complete transfer of all legal rights associated with the mitigation of greenhouse gases that relate to the quantity and time periods associated with the Exchange Offsets that are established through fulfillment of the Terms of this contract.
4. The project owner or its CCX-registered aggregator may sell or retain the Exchange Offsets earned under the provisions of this agreement.
5. The project owner shall retain full legal ownership of all greenhouse gas mitigation rights that may accrue: (a) on lands or via activities not included in the CCX-registered project; (b) in excess of the quantity of Exchange Offsets issued by CCX to CCX-registered projects; (c) before or after the years 2003 through 2006 for the CCX-registered project.
6. CCX makes no warranty as to the marketability or market value of CCX Exchange Offsets.
7. Each project owner, and, when applicable, its aggregator, is required to periodically submit a signed project report that confirms conformance with the terms herein. Representatives of CCX may conduct on-site inspection of registered projects and related documents. Each project owner agrees to provide access in such cases in a prompt and cooperative manner. All CCX offsets projects and project reports and verification reports are subject to inspection and audit by the provider of regulatory services designated by CCX and by other independent experts as may be engaged by CCX.
8. CCX may request additional information and/or access to registered projects for the purpose of advancing understanding of greenhouse gas mitigation projects. Project owners may decline such access without penalty. In no cases shall research findings cause a reduction in the quantity of Exchange Offsets to be issued to a registered project.
9. Failure to conform to the rules provided herein may result in termination of enrollment in CCX and prohibition from all further participation in CCX.

CCX Eligibility Requirements: All CCX-eligible methane offset projects that produce less than 10,000 metric tons CO_2 equivalent of Exchange Offsets per year must be registered through a CCX-registered aggregator. Projects that are represented in CCX by an Aggregator are referred to as “pooled projects”. The “pool” refers to the multiple projects represented by the Aggregator. Each aggregator is assigned a CCX registry account which will hold all offsets issued to projects it represents. Aggregators shall also be Authorized Traders in the CCX Trading Platform for such offsets. Aggregators shall be responsible for receiving from individual projects the CCX-required project reports, and for submitting to CCX summary reports of projects they represent. The terms of the business and legal relationships between aggregators and project owners are left to the discretion of those parties.

Verifier: Is a technically expert entity that is approved by CCX to conduct verification of CCX Exchange Offset projects. CCX Methane Pool participants agree that a CCX-approved verifier may have access to the land and facilities covered by this contract and to conduct activities to verify CCX Exchange Offsets.

Offset Issuance: CCX-eligible greenhouse gas mitigation projects can be recorded in the CCX Registry and will be issued Exchange Offsets on the basis of mitigation tonnage realized during the years 2003, 2004, 2005 and 2006. All offset project mitigation effectiveness will be quantified on the basis of metric tons of CO_2 equivalence. Each Exchange Offset will represent one hundred metric ton of carbon dioxide (CO_2) and will be identified by annual vintage.

Vintage: The vintage of an instrument is defined as the first year the designated instrument may be used for compliance with the CCX emission reduction schedule, or, as applicable, the CCX electricity purchase reduction schedule.

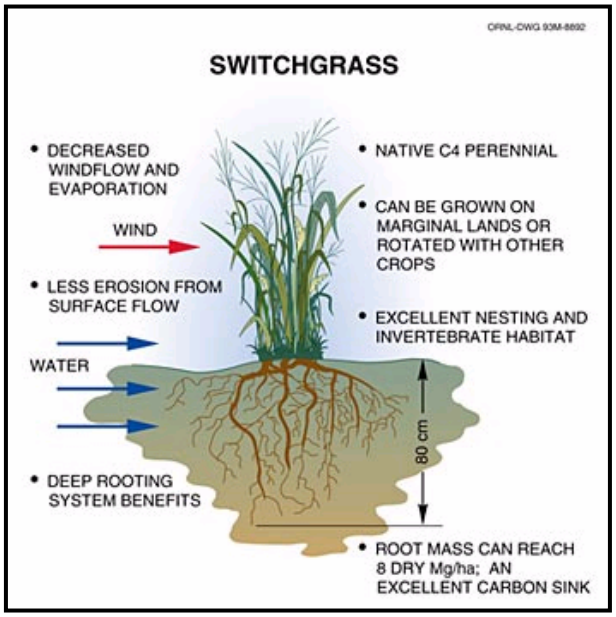
Trading Authority: Farm Bureau Management Corp. shall have sole authority to access the CCX Trading Platform and Registry account(s) holding the offsets issued to projects it represents and to execute sales on the CCX electronic trading platform on behalf of project owners and distribute sales proceeds to project owners in accordance with the terms stated in this contract.

Eligible projects and XO issuance rates: Exchange Offsets will be issued to owners of Greenhouse Gas emission reductions achieved by fuel substitution according to the rules of the Chicago Climate Exchange.

Carbon Reductions from Chariton Valley Biomass Project Long Term Test Burn

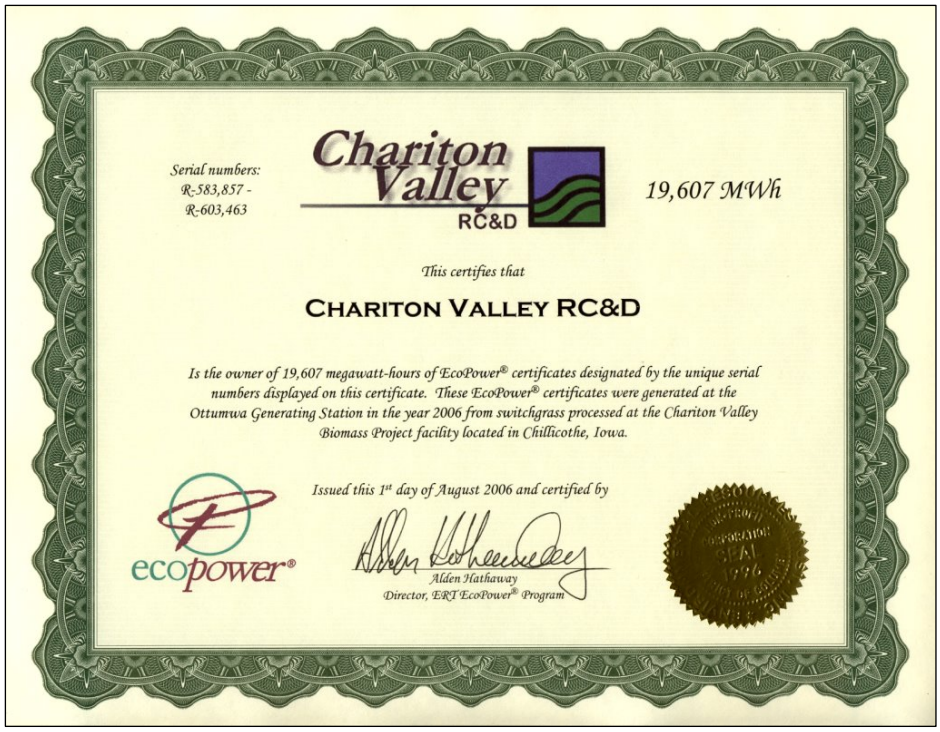
The Chariton Valley Biomass Project (CVBP) recently completed a 3-month test burn cofiring switchgrass with coal at Alliant Energy's Ottumwa Generating Station (OGS) in Chillicothe, IA. The CVBP project partners are seeking to quantify and sell the carbon credits associated with replacing coal with a renewable biomass fuel (switchgrass) during this recent test burn. The credits will be sold by Chariton Valley Resource Conservation and Development Inc., the managing organization for the project. This project has resulted in carbon dioxide (CO2) emissions reductions via three routes:

1) **Replacing a Non-renewable Fossil Fuel (Coal) with Carbon-Neutral Switchgrass Fuel** – Switchgrass is considered to be a carbon-neutral fuel supply. During its growth cycle, switchgrass absorbs CO2 from the atmosphere. When switchgrass is burned at the power plant, an equivalent amount of CO2 is release back into the atmosphere. This creates a closed-loop cycle for absorption and release of CO2. On the other hand, burning coal releases CO2 into the atmosphere from carbon that had been sequestered under ground for millennia.
2) **Immediate CO2 Reductions at the Power Plant due to Reduced Carbon Content in Switchgrass Compared to Coal –** Based on laboratory testing of coal and switchgrass samples throughout the project's test burn periods, switchgrass contains about 17 percent less carbon per Btu of heat content as compared to coal. This results in 17 percent lower CO2 emissions as compared to the CO2 that would have been emitted by obtaining the same amount of heat from burning coal. While these CO2 emissions reductions are real and immediate, the CVBP partners are not counting these CO2 emissions reductions as part of the carbon credits we are seeking to sell.
3) **Switchgrass Sequesters Carbon in the Soil on the Farm –** In addition to the CO2 that was absorbed from the atmosphere and converted to carbon in the portion of the plant that was harvested for fuel, a significant amount of additional carbon dioxide is absorbed during the plant's growth cycle. That carbon is sequestered under ground on the farm in the plant's extensive root system. According to Oak Ridge National Laboratory, as shown in the graphic on the right, the root mass of an established switchgrass stand can reach 8 dry Mg per hectare (3.56 tons per acre). While this on-farm CO2 sequestration is significant and real, CVBP project partners are not seeking to sell carbon credits for on-farm carbon sequestration at this time due to the emerging nature of quantifying and selling these types of carbon benefits, and the complexity involved with issues such as: prior use of the fields, timing of field establishment and harvesting, measured (or assumed) carbon sequestration per acre, lifetime of the switchgrass stand, etc.



The general statistics from the recent switchgrass test burn at Ottumwa Generating Station are as follows:

- The project team delivered, processed, and burned 32,188 bales of locally-grown switchgrass. Every bale was weighed throughout the test burn. The total weight of switchgrass burned was about 15,949 tons. This activity occurred on a 24-hour per day basis, 7 days per week, from Feb 17 to May 12, 2006.
- The average moisture content (m.c.) of the switchgrass throughout the test burn was 13%. Based on laboratory analysis of switchgrass samples taken throughout the test burn, the heating value of the switchgrass was 6,890 Btu/lb (as-received, at 13% m.c.) and the carbon content was 44.4% by weight (as-received).
- Based on laboratory analysis of coal samples taken throughout the test burn, the heating value of the coal was 8,942 Btu/lb (as-received, at 24.8% m.c.) and the carbon content was 69.2% by weight (as-received).
- The switchgrass fuel replaced about 12,289 tons of coal purchased from Wyoming with renewable switchgrass that was planted, grown, harvested, stored, delivered, and processed by local Iowa farmers. Coal flow reductions were measured and recorded electronically throughout the test burn using the data monitoring system at the power plant.
- The switchgrass fuel resulted in 19,607,000 kilowatt-hours of electricity generation. This is a world record for electricity generation from switchgrass. The project has obtained an independent third-party certification under Environmental Resource Trust's *EcoPower* program for 19,607 Renewable Energy Credits (RECs) resulting from this renewable electricity generation. Representatives from Environmental Resource Trust performed an independent on-site review of the operations during the test burn as part of their certification and verification process. They toured the entire operation, reviewed all of the data collection and record-keeping procedures, and inspected the equipment and instruments to ensure that the switchgrass tonnage measurements and electricity generation records were reasonable and accurate. An image of the certificate is shown below.



CARBON DIOXIDE REDUCTION CALCULATIONS:

The calculations used to estimate carbon dioxide (CO2) reductions for each of the three routes discussed on page 1 of this document are shown below. The basic information used in the calculations for CO2 reductions at the power plant is shown in Table 1.

Table 1:
Summary of Information Used for Calculating CO2 Reductions at the Power Plant

Parameter	Switchgrass	OGS Coal
Fuel Properties from Laboratory Analysis		
Carbon (% wt., as rec'd)	44.4%	69.2%
Moisture (% wt., as rec'd)	13.0%	24.8%
Higher Heating Value, HHV (Btu/lb)	6,890	8,942
Calculated Parameters		
lb-Carbon per Btu	6.44E-05	7.74E-05
lb. CO2 per MMBtu of Fuel Heat Content	236.3	283.8
Difference in Carbon per Btu vs. Coal	-17%	n/a
Ton CO2 Emitted per Ton of Fuel Burned	1.63	2.54
Ton Coal Displaced per Ton SWG Burned	0.77	
Ton CO2 Avoided per Ton SWG Burned	1.96	
Tons of CO2 Avoided from Burning 15,949 tons of Switchgrass at OGS	**31,181**	

NOTE: The "tons" in the table above are short tons.
1 short ton = 2000 lbs = 0.91 metric tons.

1) **Closed-cycle CO2 Benefits (Replacing a Non-renewable Fossil Fuel with Carbon-Neutral Switchgrass Fuel):**

A measured 15,949 tons of switchgrass replaced an estimated 12,289 tons of coal. The combustion process at OGS is very efficient and produces very small amounts of carbon monoxide and unburned carbon, so nearly all of the carbon in the fuel is converted to CO2 during the burning process. Therefore, the closed-cycle CO2 benefit from replacing coal with CO2-neutral switchgrass is estimated as the amount of CO2 that would have resulted from the combustion of the replaced coal. The molecular weight of carbon is 12. The molecular weight of CO2 is 44.

The CO2 emissions avoided through reduced coal burning are estimated as follows:

Reduced Coal Burned = 15,949 tons-swg x (6890 Btu/lb-swg) / (8942 Btu/lb-coal)
Reduced Coal Burned = 12,289 tons-coal

Closed-cycle CO2 Benefits = 12,289 tons-coal x (0.692 ton-C / ton-coal) x (44 ton-CO2 / 12 ton-C)
= 31,181 tons-CO2

Closed-cycle CO2 Benefits = 31,181 tons-CO2 x (1 metric ton / 1.1 ton) = 28,345 metric tons-CO2

⟶ Closed-cycle CO2 Benefits = 28,345 metric tons-CO2 = 28,345 carbon credits

2) **Immediate CO2 Reductions at the Power Plant due to Reduced Carbon Content in Switchgrass Compared to Coal:**

Immediate CO2 reductions at OGS = CO2 from Replaced Coal – CO2 from Switchgrass

CO2 from Replaced Coal = 31,181 tons-CO2 (as calculated above)

CO2 from Switchgrass = 15,949 tons-swg x (0.444 ton-C / ton-swg) x (44 ton-CO2 / 12 ton-C)
CO2 from Switchgrass = 25,965 tons-CO2

Immediate CO2 reductions at OGS = CO2 from Replaced Coal – CO2 from Switchgrass
Immediate CO2 reductions at OGS = 31,181 tons-CO2 - 25,965 tons-CO2
Immediate CO2 reductions at OGS = 5,216 tons-CO2 x (1 metric ton / 1.1 ton)
⟶ Immediate CO2 reductions at OGS = 4,742 metric tons-CO2

The immediate reductions of CO2 emissions from burning switchgrass at OGS throughout the test burn are quantified here for informational purposes only. Chariton Valley Biomass Project partners are not claiming these reductions in addition to the Closed-cycle CO2 Benefits calculated above (to avoid double-counting).

3) **CO2 Reductions from Carbon Sequestration in the Soil on the Farm:**

As mentioned previously, according to Oak Ridge National Laboratory, the root mass of an established switchgrass stand can reach 8 dry Mg per hectare (3.56 tons per acre). The average yield per harvested acre of switchgrass used for the test burn is conservatively estimated at 2 tons per acre. The following calculation provides a rough estimate of the possible carbon sequestration benefits associated with the switchgrass test burn.

Assume 1.0 ton of carbon is sequestered in the soil per acre harvested.

CO2 Reductions from Carbon Sequestration in the Soil =
15,949 tons-swg x (1 acre/2 ton-swg) x (1 ton-C/acre) x (44 ton-CO2/12 ton-C)
= 29,340 tons-CO2 x (1 metric ton / 1.1 ton) = 26,582 metric tons-CO2
⟶ CO2 Reductions from Carbon Sequestration in the Soil = 26,582 metric tons-CO2

TOTAL ESTIMATED CO2 REDUCTIONS FROM CVBP TEST BURN:

Total CO2 Reductions = Closed-cycle CO2 Benefits for Replacing Coal with Switchgrass at OGS + CO2 Reductions from Carbon Sequestration in the Soil (*Rough Estimate*)
Total CO2 Reductions = 28,345 metric tons-CO2 + 26,582 metric tons-CO2
⟶ Total CO2 Reductions = 54,927 metric tons-CO2

Appendix V – References

The research reports developed over the course of this project are listed below, and are available on the Internet at the following address: http://cvbmp.iowaswitchgrass.com/resources~reports.html.

Elsam Engineering A/S. "Long Term test Burn of switchgrass co-fired with coal at OGS. Corrosion and deposit tests." Chariton Valley Biomass Project. May 2007. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Schlorholtz, Scott. "Testing Program for the Evaluation of Co-combustion Fly Ash Produced at Ottumwa Generating Station; Phase 2 (Second Trial Burn)." Chariton Valley Biomass Project. June 2005. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Solow, John L. et al. "Estimating the Economic Impact of Substituting Switchgrass for Coal for Electric Generation in Iowa." Chariton Valley Biomass Project. March 29, 2005. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Kilborn, D.A. et al. "Site-specific Management for Biomass Production." Chariton Valley Biomass Project. May 2005. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Burras, Lee C. et al. "Soil Carbon and Quality in Seymour and Clarinda Soil Map Units, Chariton Valley, Iowa." Chariton Valley Biomass Project. March 24, 2005. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Moore, K.J et al. "Assessment of the Biomass Potential of Cool-Season Grasslands in Southern Iowa." Chariton Valley Biomass Project. August 2004. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

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Brummer E.C. et al. "Switchgrass Production in Iowa: Economic analysis, soil suitability, and varietal performance." Chariton Valley Biomass Project. September 2002. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Alliant Energy, ANTARES Group Inc., Bradford Conrad Crow Engineering Co., Tech-Wise A/S & T.R. Miles Technical Consultants. “Design Package.” Chariton Valley Biomass Project. July 12, 2002. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

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Alliant Energy & ANTARES Group Inc. “Alliant Energy’s Environmental Permitting Plan for the Chariton Valley Biomass Project.” Chariton Valley Biomass Project. May 17, 2002. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Chariton Valley RC&D & ANTARES Group Inc. “Draft Sales Contract Report.” Chariton Valley Biomass Project. August 30, 2002. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

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Murray, Les Danial. “Avian response to harvesting switchgrass for biomass in southern Iowa.” Chariton Valley Biomass Project. 2002. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Hintz, Roger L. & Kenneth J. Moore, Alison B. Tarr. “Cropping Systems Research for Biomass Energy Production.” Chariton Valley Biomass Project. April 1, 2002. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Amos, Wade A. “Summary of Chariton Valley Switchgrass Co-Fire Testing at the Ottumwa Generating Station in Chillicothe, Iowa.” Chariton Valley Biomass Project. February, 2002. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Burras, Lee & Julie McLaughlin. “Soil Organic Carbon in Fields of Switchgrass and Row Crops as well as Woodlots and Pastures Across the Chariton Valley, Iowa.” Chariton Valley Biomass Project. January 25, 2002. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Hipple, Patricia C. & Michael D. Duffy. “Farmers’ Motivations for Adoption of Switchgrass” Chariton Valley Biomass Project. 2002. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Brown, Robert C., Jerod Smeenk, and Glenn Norton. “Development of Analytical Techniques and Scrubbing Options for Contaminants in Gasifier Streams Intended for use in Fuel Cells.” Chariton Valley Biomass Project. September 30, 2001. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Brummer E.C., C.L. Burras, M.D. Duffy, & K.J. Moore. “Switchgrass Production in Iowa: Economic Analysis Soil Suitability, and Varietal Performance.” Chariton Valley Biomass Project. August, 2001. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>

Neppel, Jerry et al. “Modeling Switchgrass Production Effects on Runoff Water Quality.” Chariton Valley Biomass Project. <http://cvbmp.iowaswitchgrass.com/__docs/pdf/>