



August 17, 2009
Project No. G06783F

Ms. Melissa Byrnes, Senior Permit Engineer
Air Quality Division
Michigan Department of Environmental Quality
Constitution Hall, 3rd Floor, North
525 West Allegan Street
Lansing, MI 48933

Re: Response to Comments on Wolverine Power Supply Cooperative, Inc. (Wolverine)
Draft Permit to Install No. 317-07

Dear Ms. Byrnes:

At the request of the Michigan Department of Environmental Quality (MDEQ), enclosed are two supplements to the BACT assessments for the Wolverine Clean Energy Venture (WCEV) Project.

BACT Supplement – Attachment 1 provides supplemental information to our original BACT analysis.

Fuel BACT Supplement – Attachment 2 addresses questions raised by the MDEQ regarding our original Fuel BACT analysis submitted on June 19, 2009.

If you have any questions regarding any of these documents, please contact Mr. Brian Warner of Wolverine at 231-775-5700 or me at (517) 887-4024.

Sincerely,

FISHBECK, THOMPSON, CARR & HUBER, INC.

John F. Caudell, P.E.

tc

Enclosures

By e-mail and U.S. Mail

- cc/enc: Ms. Mary Ann Dolehanty – MDEQ (By e-mail and U.S. mail)
- Ms. Janis Denman – MDEQ (By e-mail and U.S. mail)
- Mr. Brian Warner, CHMM – Wolverine (By e-mail)
- Mr. Eugene E. Smary – Warner Norcross & Judd, LLP (By e-mail)
- Mr. Steven C. Kohl – Warner Norcross & Judd, LLP (By e-mail)
- Mr. Michael L. Robinson – Warner Norcross & Judd, LLP (By e-mail)
- Mr. William Campbell III – AECOM Environment (By e-mail)
- Mr. Michael Zebell – AECOM Environment (By e-mail)
- Mr. John Lagomarsino – Burns and Roe Enterprises, Inc. (By e-mail)
- Mr. James A. Susan, P.E. – FTC&H (By e-mail)
- Ms. Jacquelyn F. Linck, P.E. – FTC&H (By e-mail)
- Mr. David M. Yanochko, P.E. – FTC&H (By e-mail)

1515 Arboretum Dr., SE
Grand Rapids, MI
49546
ph: 616.575.3824
fax: 616.575.8155
www.ftch.com

AECOM Environment

W239 N2890, Pewaukee Road, Unit D, Pewaukee, WI 53072
 T 262.523.2040 F 262.523.2059 www.aecom.com

Memorandum

Date: August 17, 2009
 To: Brian Warner – Wolverine Power Cooperative
 From: Michael Zebell
 Subject: Clarification of Permit Submittals Wolverine Clean Energy Venture (PTI No. 317-07).
 Distribution: William Campbell David Yanochko John Caudell

This memorandum has been prepared at the request of the Michigan Department of Environmental Quality (MDEQ) to clarify some issues related to recent document submittals made in supplementation of the air pollution control permit application for the proposed Wolverine Clean Energy Venture (WCEV) project (PTI No. 317-07). This memorandum deals with clarifications of the cost of control for the selected control devices included in the Best Available Control Technology (BACT) review.

In the “top down” BACT process the “cost of control” is typically not determined and presented for the top ranked air pollution control device or emission control strategy that is selected as BACT, because economic considerations have not played a role in the determination of BACT; however, MDEQ has requested that WCEV provide information on the direct and incremental cost between higher ranked technologies eliminated on a cost basis and the selected technology. The only top rated technology considered for control of air pollutant emissions from the circulating fluidized bed (CFB) boiler that was eliminated on a cost basis is a wet flue gas desulfurization (WFGD) system for sulfur dioxide (SO₂) control. An estimate of the direct cost of control of a polishing scrubber is included in Attachment 1 to this memorandum. The results are summarized in Table 1.

Consideration of a “tail-end” selective catalytic reduction (SCR) system for control of emissions of nitrogen oxides (NO_x) is presented in the original application under a configuration that would have such a system installed at the end of an air pollution control train that includes a selective non-catalytic reduction (SNCR) system for NO_x control, a polishing scrubber for SO₂ control, and a fabric filter for particulate matter control. Although technically feasible, a tail-end SCR has never been applied to a CFB boiler. The hypothetical control provided by the addition of the tail-end SCR was considered and the incremental cost presented in the original application. That evaluation assumed the additional control provided is 0.02 lb/MMBtu. An estimate of the direct cost of control for application of an SNCR system and a tail-end SCR achieving 0.05 lb/MMBtu with no upstream SNCR is included in Attachment 2 of this memorandum. The results are summarized in Table 1.

Table 1 – Summary of Control Costs

Emission Unit/Pollutant	Control Device	Control Cost (\$/ton)	
		Direct	Incremental
Sulfur Dioxide	Polishing Scrubber	1,475	-----
	Wet Scrubber	11,000	150,121
Oxides of Nitrogen	SNCR	1,620	-----
	Tail-End SCR	21,000	118,700

The original BACT review also included consideration of a fabric filter and electrostatic precipitator (ESP) technology for particulate control. A fabric filter is considered the top ranked option for particulate control on a CFB boiler. A wet ESP (WESP) was evaluated for condensable particulate removal after a fabric filter and excluded, in part, based on cost. The polishing scrubber and fabric filter provide a high level of condensable particulate removal as established in other submittals (PM_{2.5} BACT review).

However, a WESP is not suitable as a primary control device for particulate control from a CFB boiler due to the cementitious and pozzolanic properties of the lime/limestone/ash mixture that comprises the solid material collected by the primary device. No WESP has been deployed on a CFB boiler and the technology has not been demonstrated to be practical for the type and size of units proposed for the WCEV. A WESP includes a quench section followed by a set of tubes or parallel plates (collection surfaces). The purpose of the quench is to completely saturate the exhaust gas with water to ensure that the collection surface of the WESP is always wet and has a continuous flow of water down the length of the surface for proper operation. A periodic deluge of water does a thorough cleaning of the collection surfaces similar to the air pulse in a pulse-jet fabric filter or the plate rapping of a dry ESP. With the level of particulate loading at the polishing scrubber outlet, a WESP would require a massive amount of water to ensure proper wetting of the collection surface. The amount of water required would be impractical to control the build-up and subsequent hardening of the particulate matter could occur.

One of the main advantages of the WESP is its ability to capture acid gases (H₂SO₄). However, for this project, the WESP would follow the polishing scrubber which effectively removes the acid gasses prior to the flue gas entering the WESP, so there would be no advantage in using a WESP on the WCEV project, even if the technology could be applied.

Attachment 1

Polishing Scrubber Cost Estimate

Wolverine Clean Energy Venture - BACT Analysis
Polishing Scrubber

Control Efficiency Polishing Scrubber	92.0%
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Facility Input Data

Item	Value
Operating Schedule	
Shifts per day	3
Hours per day	24
Days per week	7
Total Hours per year	8760
Economic Life, years	30
Interest Rate (%)	7
Source(s) Controlled	CFB Boilers
Temperature (F)	165
Total Flowrate (acfm)	1,948,000
SO ₂ Emissions (tpy)	5,236
Site Specific Electricity Cost (\$/kWh)	0.050
Site Specific Operating Labor Cost (\$/hr)	\$37.00
Site Specific Maint. Labor Cost (\$/hr)	\$37.00

Capital Costs

		Basis
Direct Capital Costs		
Purchased Equipment Costs		
Control Device w/ Instrumentation	\$27,000,000	EPA-452/F-03-034
Shipping (5% Control Device Cost)	\$1,350,000	0.05 x A
Foundation & Ductwork (6% Control Device Cost)	\$1,620,000	0.06 x A
Taxes (0% of Purchased Cost)	\$1,350,000	0.05 x A
Total Purchased Equipment Cost (PEC)	\$31,320,000	B = 1.16 x A
Installation Costs		
Foundations, supports (8% PEC)	\$2,505,600	0.08 x B
Handling and Erection (14% PEC)	\$4,384,800	0.14 x B
Electrical (4% PEC)	\$1,252,800	0.04 x B
Piping (2% PEC)	\$626,400	0.02 x B
Insulation (1% PEC)	\$313,200	0.01 x B
Painting (1% PEC)	\$313,200	0.01 x B
Total Installation Costs	\$9,396,000	1.30 x B
Total Direct Capital Cost (TDCC)	\$40,716,000	Sum PEC + TIC
Indirect Capital Costs		0.10 x B
Construction Management (10% TDCC)	\$4,071,600	0.05 x B
Construction Field Expenses (5% TDCC)	\$2,035,800	0.05 x B
Construction Fee (10% TDCC)	\$4,071,600	0.10 x B
Contingency (3% TDCC)	\$1,221,480	0.03 x B
Startup (2% TDCC)	\$814,320	0.02 x B
Performance Testing (1% TDCC)	\$407,160	0.01 x B
Total Indirect Capital Cost	\$12,622,000	1.36 x B
Total Capital Cost (TCC)¹	\$53,338,000	Sum TDCC + TICC

¹ Consistent with BRE cost estimate.

Wolverine Clean Energy Venture - BACT Analysis
Polishing Scrubber

Annual Cost

OPERATING COSTS

Direct Operating Costs		Basis	Source
Operating Labor	\$40,515	1 hour per shift	OAQPS
Maintenance Labor	\$121,545	3 hour per shift	
Supervision	\$24,309	15% of Operation & O&M Labor	
Maintenance Materials	\$200,000	Estimate	
Utilities			
Water	-----		BRE Technology Study Estimate
Chemical Use (Limestone - tpy)	10,000	Molar Ratio of 1:1	
Chemical Cost	\$60,000	Limestone at \$6/ton	
Electrical Cost - Pumping	\$131,400		
Total Annual Direct Operating Cost	\$577,800		
Indirect Operating Costs			
Overhead	\$97,236	60% of O&M Costs	OAQPS
Property Tax	\$533,380	1% of Total Capital Investment	OAQPS
Insurance	\$533,380	1% of Total Capital Investment	OAQPS
Administration	\$1,066,760	2% of Total Capital Investment	OAQPS
Total Annual Indirect Operating Cost	\$2,230,800		
Total Annual Operating Cost	\$2,808,600		
Annualized Capital Cost	\$4,298,300		
Total Annual Cost	\$7,106,900		
Total SO2 Controlled (tpy)	4,817		
Cost Effectiveness (\$/ton)	\$1,475		

Attachment 2

Tail-End and SNCR Cost Estimate

Wolverine Clean Enevery Venture - BACT Analysis
"Tail-End" Selective Catalytic Reduction for Control of NOx

Control Efficiency (%)	68
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Facility Input Data

Item	Value
Operating Schedule	
Shifts per day	3
Hours per day	24
Days per week	7
Total Hours per year	8760
Economic Life, years	30
Interest Rate (%)	7
Source(s) Controlled	CFB
Temperature (°F after reheat)	650
Total Flowrate (acfm)	1,948,000
NOx From CFB Operation w/o SNCR (TPY)	5,037
Site Specific Electricity Cost (\$/kWh)	0.060
Site Specific Operating Labor Cost (\$/hr)	\$37.00
Site Specific Maint. Labor Cost (\$/hr)	\$37.00

Capital Costs

	Value	Basis
Direct Costs		
1.) Purchased Equipment Cost		
a.) Equipment cost + auxiliaries	\$55,200,000	Permit Information at \$92/kW, A
b.) Instrumentation	\$0	Included
c.) Sales taxes	\$0	Included
d.) Freight	\$0	Included
Total Purchased equipment cost, (PEC)	\$55,200,000	B
2.) Direct installation costs		
a.) Foundations and supports	\$2,760,000	0.10 x B
b.) Handling and erection	\$11,040,000	0.20 x B
c.) Electrical	\$552,000	0.01 x B
d.) Piping	\$552,000	0.01 x B
e.) Insulation for ductwork & painting	\$552,000	0.01 x B
f.) Stack modification	\$1,104,000	0.02 x B
Total direct installation cost	\$16,560,000	0.30 x B
3.) Site preparation	NA	As Required, SP
4.) Buildings	NA	As Required, Bldg.
Total Direct Cost, DC	\$71,760,000	1.30B + SP + Bldg.
Indirect Costs (installation)		
5.) Engineering	\$1,104,000	0.02 x B
6.) Construction and field expenses	\$2,760,000	0.05 x B
7.) Contractor fees	\$5,520,000	0.10 x B
8.) Start-up	\$1,104,000	0.02 x B
9.) Performance test	\$552,000	0.01 x B
10.) Contingencies	\$8,280,000	0.15 x B
Total Indirect Cost, IC	\$19,320,000	0.35 x B + Other
Total Capital Investment (TCI) = DC + IC	\$91,080,000	1.61B + SP + Bldg. + Other

Wolverine Clean Enevery Venture - BACT Analysis
"Tail-End" Selective Catalytic Reduction for Control of NOx

Control Efficiency (%)	68
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Annual Costs

Item	Value	Basis	Source
1) Electricity			
Fan Power Requirement (kW)	7,000		Estimate
Electric Power Cost (\$/kWh)	0.060		
Cost (\$/yr)	\$3,679,200		
2) Operating Costs			
Operating Labor Requirement (hr/shift)	1	1 hour per shift	Estimate
Unit Cost (\$/hr)	\$40.00	Facility Data	Estimate
Labor Cost (\$/yr)	\$43,680		
3) Ammonia Costs (\$/lb)	0.13		Estimate
Hourly Requirement (Lbs/hour)	3,526		
Annual requirement (Lbs/year)	30,886,884		
Total Ammonia Costs (\$/year)	\$3,860,861		
4) Fuel Oil Reheat			
Heat input (MMBtu/hr)	325		
Heating value of #2 Fuel Oil (Btu/gal)	140,000		
#2 Fuel Oil cost (\$/gal)	\$2.5		
Total Cost	\$50,839,286		
Total Operating Costs	\$58,423,026		Estimate
4) Supervisory Labor			
Cost (\$/yr)	\$6,550	15% Operating Labor	OAQPS
5) Maintenance			
Maintenance Labor Req. (hr/year)	182.5	1/2 hour per day	Estimate
Catalyst Replacement Labor Req. (hr/yr)	586.7	8 men for 220 hours every 3 yrs	Estimate
Unit Cost (\$/hr)	\$45.00	Facility Data	Estimate
Labor Cost (\$/yr)	\$34,610		
Material Cost (\$/yr)	\$34,610	100% of Maintenance Labor	OAQPS
Total Cost (\$/yr)	\$69,220		
6) Catalyst Replacement			
Catalyst Cost (\$)	\$9,620,000	Catalyst @ \$370/cf & 26,000 cf	Vendor
Sales Tax (\$)	\$0	0% Sales Tax	
Catalyst Life (yrs)	3	n	Estimate
Interest Rate (%)	7	i	
CRF	0.38	Ammortization of Catalyst	OAQPS
Annual Cost (\$/yr)	\$3,665,720	(Volume)(Unit Cost)(CRF)	
7) Indirect Annual Costs			
Overhead	\$71,670	60% of O&M Costs	OAQPS
Administration	\$1,821,600	2% of Total Capital Investment	OAQPS
Property Tax	\$910,800	1% of Total Capital Investment	OAQPS
Insurance	\$910,800	1% of Total Capital Investment	OAQPS
Capital Recovery	\$6,564,570	30 yr life; 7% interest (-cat. cost)	OAQPS
Total Indirect (\$/yr)	\$10,279,440		
Total Annualized Cost (\$/yr)	\$72,444,000		
Total Controlled (tpy)	3444.4		
Cost Effectiveness (\$/ton)	\$21,000		

Wolverine Clean Energy Venture - BACT Analysis
Selective Non-Catalytic Reduction

Overall Control Efficiency of CFB & Polishing Scrubber	63%
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Facility Input Data

Item	Value
Operating Schedule	
Shifts per day	3
Hours per day	24
Days per week	7
Total Hours per year	8760
Economic Life, years	30
Interest Rate (%)	7
Source(s) Controlled	CFB Boilers
Temperature (F)	165
Total Flowrate (acfm)	1,948,000
Uncontrolled NOx Emissions (tpy)	5,037
Site Specific Electricity Cost (\$/kWh)	0.050
Site Specific Operating Labor Cost (\$/hr)	\$37.00
Site Specific Maint. Labor Cost (\$/hr)	\$37.00

Capital Costs

Item	Value	Basis
Direct Capital Costs		
Purchased Equipment Costs		
Control Device w/ Instrumentation	\$5,400,000	EPA-452/F-03-031
Shipping (5% Control Device Cost)	\$270,000	0.05 x A
Foundation & Ductwork (6% Control Device Cost)	\$324,000	0.06 x A
Taxes (0% of Purchased Cost)	\$270,000	0.05 x A
Total Purchased Equipment Cost (PEC)	\$6,264,000	B = 1.16 x A
Installation Costs		
Foundations, supports (8% PEC)	\$501,120	0.08 x B
Handling and Erection (14% PEC)	\$876,960	0.14 x B
Electrical (4% PEC)	\$250,560	0.04 x B
Piping (2% PEC)	\$125,280	0.02 x B
Insulation (1% PEC)	\$62,640	0.01 x B
Painting (1% PEC)	\$62,640	0.01 x B
Total Installation Costs	\$1,879,200	1.30 x B
Total Direct Capital Cost (TDCC)	\$8,143,200	Sum PEC + TIC
Indirect Capital Costs		0.10 x B
Construction Management (10% TDCC)	\$814,320	0.05 x B
Construction Field Expenses (5% TDCC)	\$407,160	0.05 x B
Construction Fee (10% TDCC)	\$814,320	0.10 x B
Contingency (3% TDCC)	\$244,296	0.03 x B
Startup (2% TDCC)	\$162,864	0.02 x B
Performance Testing (1% TDCC)	\$81,432	0.01 x B
Total Indirect Capital Cost	\$2,524,400	1.36 x B
Total Capital Cost (TCC)	\$10,667,600	Sum TDCC + TICC

Wolverine Clean Energy Venture - BACT Analysis
Selective Non-Catalytic Reduction

Annual Cost

OPERATING COSTS

Direct Operating Costs		Basis	Source
Operating Labor	\$40,515	1 hour per shift	OAQPS
Maintenance Labor	\$40,515	1 hour per shift	
Supervision	\$12,155	15% of Operation & O&M Labor	
Maintenance Materials	\$81,030	Estimate	
Utilities			
Water	-----		BRE Technology Study Estimate
Chemical Use (aqueous ammonia at 19% - TPY)	19,528	Application Page 3-6	
Chemical Cost	\$3,540,045	19% aqueous ammonia \$0.7/gal	
Electrical Cost - Pumping	\$101,144	\$0.02/gal	
Total Annual Direct Operating Cost	\$3,815,400		
Indirect Operating Costs			
Overhead	\$48,618	60% of O&M Costs	OAQPS
Property Tax	\$106,676	1% of Total Capital Investment	OAQPS
Insurance	\$106,676	1% of Total Capital Investment	OAQPS
Administration	\$213,352	2% of Total Capital Investment	OAQPS
Total Annual Indirect Operating Cost	\$475,300		
Total Annual Operating Cost	\$4,290,700		
Annualized Capital Cost	\$859,700		
Total Annualized Cost	\$5,150,400		
Total NO Controlled (tpy)	3,179		
Cost Effectiveness (\$/ton)	\$1,620		

AECOM Environment

W239 N2890, Pewaukee Road, Unit D, Pewaukee, WI 53072
T 262.523.2040 F 262.523.2059 www.aecom.com

Memorandum

Date: August 17, 2009
To: Brian Warner – Wolverine Power Cooperative
From: Michael Zebell
Subject: Clarification of Permit Submittals Wolverine Clean Energy Venture (PTI No. 317-07).

Distribution: William Campbell David Yanochko John Caudell

This memorandum has been prepared at the request of the Michigan Department of Environmental Quality (MDEQ) to clarify some issues related to recent submittals made in supplementation of the air pollution control permit application for the proposed Wolverine Clean Energy Venture (WCEV) project (PTI No. 317-07). This memorandum deals with clarifications of the fuel Best Available Control Technology (BACT) review.

Fuel BACT

In the Fuel BACT submitted in June 2009 sulfur dioxide (SO₂) was identified as the only criteria pollutant subject to BACT that is affected by the fuel fired in the WCEV circulating fluidized bed (CFB) boilers. All of the other emissions subject to BACT were evaluated as not sensitive to the selection of the fuels evaluated for the project as documented in the Burns & Roe Enterprises (BRE) Fuel Study (original application, Appendix 2) or as otherwise discussed in the WCEV Fuel BACT Review (submitted June 22, 2009). To evaluate the effect of fuel selection relative to SO₂ emissions for the CFB units, three cases were identified in the June submittal consistent with the permit application and otherwise consistent with the original application and conditions within draft PTI 317-07 as follows:

- Case 1 – 70/30% blend of petcoke and PRB (base case);
- Case 2 – 100% PRB coal; and
- Case 3 – 20/80% blend of biomass and PRB.

Illinois Basin (IB) coal was not included in these comparison cases because the sulfur content of the IB coal as documented in the BRE Fuel Study falls inside the envelope of fuels created by Case 1 through Case 3 and IB coal is more expensive than the Case 1 and 2 fuels. Therefore, there is no basis to conclude that SO₂ pollution control beyond the Case 1 fuels would be provided by IB fuel and it is more costly. Consequently, a comparison case employing IB fuel was not carried forward in the Fuel BACT analysis; however, the information provided in Appendix A of the WCEV Fuel BACT Review has been now revised to include IB Coal as Case 4. In performing this revision, it was recognized that ash disposal costs for all the analyzed cases should be included. This inclusion of ash disposal costs changes the calculated values slightly. Attachment 1 to this memorandum presents the revised analysis including Case 4 – 100% IB Coal, and ash disposal costs for all cases.

In the cost analysis shown in Attachment 1 the incremental cost of Case 2 (100% PRB coal) and Case 3 (20/80% blend of biomass, PRB) was determined as compared to the base case (Case 1) of the 30/70 PRB/petcoke blend. The results of this analysis confirm that Case 4 is the most expensive option with an incremental cost over Case 1 of greater than \$139,000 per ton of SO₂ control. The incremental cost of control between Case 2 and Case 1 is over \$65,000 per ton. The incremental cost of control between Case 3 and Case 1 is over \$89,000 per ton. It should be noted that the Fuel BACT included an opinion from BRE as to the degree of emission reduction that may be technically possible for a given fuel case when determining the incremental cost between cases. Those levels of SO₂ emissions are not based on vendor guarantees for the project. The BACT determination supports 0.05 lb/MMBtu on an annual basis as BACT for the CFB units at WCEV.

The MDEQ requested that we calculate the average tonnage cost of “control” for each fuel case, without consideration to the other fuels - Table 1 shows this analysis. The intent of the analysis presented in Table 1 is to rank the fuel options in a systematic way. The analysis shown is based on the information provided in the BRE Fuel Study (original application, Appendix 2), and the results affirm the ranking presented in that study.

Table 1. Direct Cost of SO₂ Control for Each Fuel

Parameter	Units	Case 1 PRB/Petcoke Blend	Case 2 PRB	Case 3 Biomass /PRB Blend	Case 4 IB Coal
SO₂ Emissions					
Uncontrolled SO ₂ Emissions ¹	TPY	63,625	7,896	6,430	53,722
Controlled SO ₂ Emissions ¹	TPY	564	564	564	564
Emission Reduction	TPY	63,061	7,332	5,866	53,158
Fuel Cost Summary					
Annual Cost ²	\$/year	\$36,870,896	\$44,285,594	\$54,547,681	\$52,417,244
SO₂ Fuel Reduction Cost	\$/ton	\$580	\$6,040	\$9,300	\$990

¹ Values are based on an 85% capacity factor and at a level of 0.05 lb/MMBtu on an annual basis. This represents a realistic value of fuel use and cost on an annual basis. These values are linear and will not change relative to each other at a different capacity factor. To convert the numbers to a 100% capacity factor divide by 0.85.

² This cost includes fuel, limestone, lime, and ash disposal. The cost does not include capital expenditures.

Given the incremental cost comparison and the average cost of control of Case 1 (the design fuel of 30/70 PRB/petcoke blend) as compared to Case 2, Case 3, and Case 4, it is clear that Case 1 represents the most cost effective option on a cost per ton of SO₂ removal basis. IB coal is the second most cost effective option and the least cost effective option is Case 3 (20/80 biomass/PRB blend).

Attachment 1

Revised Fuel BACT Review Appendix A Information

Attachment 1
Wolverine Clean Eneveryg Venture - Fuel BACT
PRB/Petcoke, PRB, & Biomass Cases

Parameter	Units	Case 1 PRB/Petcoke Blend	Case 2 PRB Alone	Case 3 Biomass/PRB Blend	Case 4 IB Alone
Fuel					
% Biomass (Heat Input)	%	0%	0%	20%	0%
% PRB (Heat Input)	%	30%	100%	80%	0%
% Petcoke (Heat Input)	%	70%	0%	0%	0%
% ILB (Heat Input)	%	0%	0%	0%	100%
Plant Performance					
Capacity Factor	%	85%	85%	85%	85%
Fuel Heat Input at MCR (used for BACT)	MMBtu/hr	3,030	3,030	3,030	3,030
Fuel Heat Input at MCR (predicted)	MMBtu/hr	2,747	2,835	2,887	2,786
Annual Fuel Consumption considering CF	MMBtu/yr	22,561,380	22,561,380	22,561,380	22,561,380
Biomass					
Biomass Heating Value (as Received)	Btu/lb	5,100	5,100	5,100	5,100
Biomass Consumption	MMBtu/hr	0	0	606	0
Biomass Consumption	ton/hr	0	0	59	0
Annual Biomass Consumption considering CF	ton/year	0	0	442,380	0
Biomass Unit Cost*	\$/MMBtu	\$4.23	\$4.23	\$4.23	\$4.23
Sulfur Content	% by wgt	0.10%	0.10%	0.10%	0.10%
Sulfur Content	lbs/MMBtu	0.025	0.025	0.025	0.025
PRB					
PRB Heating Value	Btu/lb	8,864	8,864	8,864	8,864
PRB Consumption	MMBtu/hr	909	3,030	2,424	0
PRB Consumption	ton/hr	51	171	137	0
Annual PRB Consumption considering CF	ton/year	381,792	1,272,641	1,018,113	0
PRB Unit Cost*	\$/MMBtu	\$ 1.91	\$ 1.91	\$ 1.91	\$ 1.91
Sulfur Content	% by wgt	0.31%	0.31%	0.31%	0.31%
Sulfur Content	lbs/MMBtu	0.35	0.35	0.35	0.35
Petcoke					
Petcoke Heating Value	Btu/lb	13,948	13,948	13,948	13,948
Petcoke Consumption	MMBtu/hr	2,121	0	0	0
Petcoke Consumption	ton/hr	76	0	0	0
Annual Petcoke Consumption considering CF	ton/year	566,137	0	0	0
Petcoke Unit Price*	\$/MMBtu	\$ 1.32	\$ 1.32	\$ 1.32	\$ 1.32
Sulfur Content	% by wgt.	5.41%	5.41%	5.41%	5.41%
Sulfur Content	lbs/MMBtu	3.88	3.88	3.88	3.88
ILB					
ILB Heating Value	Btu/lb	11,801	11,801	11,801	11,801
ILB Consumption	MMBtu/hr	0	0	0	3,030
ILB Consumption	ton/hr	0	0	0	128
Annual ILB Consumption considering CF	ton/year	0	0	0	955,910
ILB Unit Price*	\$/MMBtu	\$ 2.17	\$ 2.17	\$ 2.17	\$ 2.17
Sulfur Content	% by wgt.	2.81%	2.81%	2.81%	2.81%
Sulfur Content	lbs/MMBtu	2.38	2.38	2.38	2.38
Limestone					
Limestone Consumption	ton/hr	41.25	7.16	4.41	34.48
Annual Limestone Consumption considering CF	ton/yr	307,170	53,320	32,822	256,711
Limestone Unit Price*	\$/ton	\$ 6.00	\$ 6.00	\$ 6.00	\$ 6.00
Lime					
Lime Consumption	ton/hr	0.55	0.53	0.52	0.82
Annual Lime Consumption considering CF	ton/yr	4,107	3,979	3,907	6,074
Lime Unit Price*	\$/ton	\$ 100.00	\$ 100.00	\$ 100.00	\$ 100.00
SO2 Emissions					
Uncontrolled Emissions	lb/MMBtu	5.64	0.70	0.57	4.76
Uncontrolled Emissions	lb/hr	17,090	2,121	1,727	14,430
SO2 Emissions	lb/MMBtu	0.05	0.040	0.033	0.040
SO2 Emissions	lb/hr	152	121	99	122
SO2 Emissions	ton/hr	0.08	0.06	0.05	0.06
Annual SO2 Emissions considering CF	ton/yr	564	451	367	452
Ash					
Ash Production	ton/hr	26.14	14.75	12.38	40.68
Annual Ash Production considering CF	ton/year	194,650	109,823	92,215	302,870
Ash Unit Price	\$/ton	\$ 4.33	\$ 4.33	\$ 4.33	\$ 4.33
Cost Summary					
Biomass Cost	\$/year	-	-	\$ 19,086,927	\$ -
PRB Cost*	\$/year	\$ 12,927,671	\$ 43,092,236	\$ 34,473,789	\$ -
Petcoke Cost*	\$/year	\$ 20,846,715	\$ -	\$ -	\$ -
ILB Cost*	\$/year	\$ -	\$ -	\$ -	\$ 48,958,195
Limestone and Lime Cost*	\$/year	\$ 2,253,674	\$ 717,826	\$ 587,674	\$ 2,147,623
Ash Cost*	\$/year	\$ 842,836	\$ 475,532	\$ 399,290	\$ 1,311,427
Total	\$/year	\$ 36,870,896	\$ 44,285,594	\$ 54,547,681	\$ 52,417,244
SO2 Emission Cost					
Fuel Cost Difference*	2007 USD		\$ 7,414,697	\$ 17,676,785	\$ 15,546,348
Difference in SO2 emissions	tons of SO2		112.8	196.6	111.7
SO2 Fuel Reduction Cost*	\$/ton		\$ 65,729	\$ 89,910	\$ 139,206

* Notes:
All costs are in 2007 USD