

**Appendix H**  
**Air Quality Control Technology Costs**

**E.W. Brown**

Plant Name: Brown  
Unit: 1  
MW 110  
Project description High Level Emissions Control Study  
Revised on: 05/28/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
Fabric Filter	\$40,000,000	\$364	\$1,477,000	\$6,345,000
PAC Injection	\$1,599,000	\$15	\$614,000	\$809,000
Overfire Air	\$767,000	\$7	\$132,000	\$225,000
Low NOx Burners	\$1,156,000	\$11	\$0	\$141,000
Neural Networks	\$500,000	\$5	\$50,000	\$111,000
Total	\$44,022,000	\$400	\$2,273,000	\$7,631,000

**BROWN UNIT 1 - PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$1,969,000
Mechanical - Balance of Plant (BOP)	\$5,641,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$119,000
Control - DCS Instrumentation	\$133,000
ID Fans	\$1,166,000 Engineering Estimates

**Subtotal Purchase Contract** **\$9,028,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$1,752,000
Civil/Structural Construction - Sub-Structures	\$666,000
Mechanical/Chemical Construction	\$6,664,000
Electrical/Control Construction	\$2,250,000
Service Contracts & Construction Indirects	\$109,000
Demolition Costs	\$5,000,000 Engineering Estimates

**Subtotal Construction Contracts** **\$16,441,000**

**Construction Difficulty Costs** **\$11,508,700** Engineering Estimates

**Total Direct Costs** **\$36,977,700**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$1,426,000
EPC Construction Management (Includes G&A & Fee)	\$933,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$141,000
Sales Taxes	\$50,000
Project Contingency - 18%	\$526,000

**Total Indirect Costs** **\$3,076,000**

**Total Contracted Costs** **\$40,000,000**

**Cost Effectiveness** **\$364 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 44%

Maintenance labor and materials	\$1,200,000	(DC) X 3.0%
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**Subtotal Fixed Annual Costs** **\$1,200,000**

**Variable Annual Costs**

Byproduct disposal	\$6,000	210 lb/hr and	15 \$/ton
Bag replacement cost	\$91,000	2,740 bags and	100 \$/bag
Cage replacement cost	\$46,000	2,740 cages and	50 \$/cage
ID fan power	\$117,000	710 kW and	0.04266 \$/kWh
Auxiliary power	\$17,000	105 kW and	0.04266 \$/kWh

**Subtotal Variable Annual Costs** **\$277,000**

**Total Annual Costs** **\$1,477,000**

**Levelized Capital Costs** **\$4,868,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$6,345,000**

**EW Brown Unit 1  
110 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$92,670	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$60,897	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$84,726	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$10,591	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$39,716	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0			
Electrical system upgrades	\$254,179	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$13,239	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$556,018</u>			
Freight	\$14,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$570,000</u>			
Direct installation costs				
Foundation & supports	\$57,000	(PEC) X	10.0%	
Handling & erection	\$114,000	(PEC) X	20.0%	
Electrical	\$57,000	(PEC) X	10.0%	
Piping	\$29,000	(PEC) X	5.0%	
Insulation	\$11,000	(PEC) X	2.0%	
Painting	\$29,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$297,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$942,000</u>			
Indirect Costs				
Engineering	\$113,000	(DC) X	12.0%	
Owner's cost	\$113,000	(DC) X	12.0%	
Construction management	\$94,000	(DC) X	10.0%	
Start-up and spare parts	\$14,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$188,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$622,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$35,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$1,599,000</b>			
<b>Cost Effectiveness</b>	<b>\$15 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$28,000	(DC) X	3.0%	
Operating labor	\$123,000	1 FTE and	123,325 \$/year	Estimated manpower
Total fixed annual costs	<u>\$151,000</u>			
Variable annual costs				
Reagent (BPAC)	\$445,000	105 lb/hr and	2200 \$/ton	44 % capacity factor
Byproduct disposal cost	\$3,000	105 lb/hr and	15 \$/ton	
Auxiliary power	\$15,000	90 kW and	0.04266 \$/kWh	
Total variable annual costs	<u>\$463,000</u>			
<b>Total direct annual costs (DAC)</b>	<b>\$614,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$195,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$195,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$809,000</b>			

**EW Brown Unit 1  
110 MW  
High Level Emissions Control Study**

Technology: Overfire Air System Operation

Date: 7/8/2010

<b>Cost Item</b>	<b>\$</b>	<b>Remarks/Cost Basis</b>		
<b>CAPITAL COST</b>				
<b>Direct Costs</b>				
Purchased equipment costs				
Neuco NOx optimization package	\$13,000	B&V cost estimate		
NOx monitoring equipment	\$40,000	B&V cost estimate		
Water cannon system	\$317,000	B&V cost estimate		
Subtotal capital cost (CC)	<u>\$370,000</u>			
Freight	\$19,000	(CC) X	5.0%	
Total purchased equipment cost (PEC)	<u>\$389,000</u>			
Direct installation costs				
Foundation & supports	\$0	(PEC) X	0.0%	
Handling & erection	\$78,000	(PEC) X	20.0%	
Electrical	\$58,000	(PEC) X	15.0%	
Piping	\$8,000	(PEC) X	2.0%	
Insulation	\$0	(PEC) X	0.0%	
Painting	\$0	(PEC) X	0.0%	
Demolition	\$10,000	(PEC) X	2.5%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$154,000</u>			
Site preparation	\$0	N/A		
Buildings	\$0	N/A		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$543,000</u>			
Indirect Costs				
Engineering	\$54,000	(DC) X	10.0%	
Owner's cost	\$11,000	(DC) X	2.0%	
Construction management	\$27,000	(DC) X	5.0%	
Start-up and spare parts	\$11,000	(DC) X	2.0%	
Performance test	\$50,000	Engineering estimate		
Contingencies	\$54,000	(DC) X	10.0%	
Total indirect costs (IC)	<u>\$207,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$17,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$767,000</b>			
<b>Cost Effectiveness</b>	<b>\$7 /kW</b>			
<b>ANNUAL COST</b>				
<b>Direct Annual Costs</b>				
Fixed annual costs				
Maintenance materials	\$10,000	B&V cost estimate		
Maintenance labor	\$14,000	B&V cost estimate, 6 man weeks/yr		
Total fixed annual costs	<u>\$24,000</u>			
Variable annual costs				
Replacement power due to efficiency hit	\$108,000	Engineering estimates, 0.2% efficiency drop, and 0.05 \$/kWh		
Total variable annual costs	<u>\$108,000</u>			
<b>Total direct annual costs (DAC)</b>	<b><u>\$132,000</u></b>			
Indirect Annual Costs				
Cost for capital recovery	\$93,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$93,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$225,000</b>			

**EW Brown Unit 1  
110 MW  
High Level Emissions Control Study**

Technology: Upgraded Low NOx Burners

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
New coal elbow, nozzle with air vane, fuel injector barrel, air zone swirler and coal piping	\$602,000			
Subtotal capital cost (CC)	<u>\$602,000</u>			
Freight	<u>\$30,000</u>	(CC) X	5.0%	
Total purchased equipment cost (PEC)	<u>\$632,000</u>			
Direct installation costs				
Foundation & supports	\$0	(PEC) X	0.0%	
Handling & erection	\$126,000	(PEC) X	20.0%	
Electrical	\$63,000	(PEC) X	10.0%	
Piping	\$0	(PEC) X	0.0%	
Insulation	\$0	(PEC) X	0.0%	
Painting	\$0	(PEC) X	0.0%	
Demolition	\$16,000	(PEC) X	2.5%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$205,000</u>			
Site preparation	\$0	N/A		
Buildings	\$0	N/A		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$837,000</u>			
Indirect Costs				
Engineering	\$84,000	(DC) X	10.0%	
Owner's cost	\$17,000	(DC) X	2.0%	
Construction management	\$42,000	(DC) X	5.0%	
Start-up and spare parts	\$17,000	(DC) X	2.0%	
Performance test	\$50,000	Engineering estimate		
Contingencies	\$84,000	(DC) X	10.0%	
Total indirect costs (IC)	<u>\$294,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$25,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$1,156,000</b>			
<b>Cost Effectiveness</b>	<b>\$11 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
N/A	\$0	Similar annual costs as current LNB		
Total fixed annual costs	<u>\$0</u>			
Variable annual costs				
N/A	\$0	Similar annual costs as current LNB		
Total variable annual costs	<u>\$0</u>			
<b>Total direct annual costs (DAC)</b>	<b>\$0</b>			
Indirect Annual Costs				
Cost for capital recovery	\$141,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$141,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$141,000</b>			

Plant Name: Brown  
Unit: 2  
MW: 180  
Project description: High Level Emissions Control Study  
Revised on: 07/06/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$95,000,000	\$528	\$3,373,000	\$14,935,000
Fabric Filter	\$51,000,000	\$283	\$1,959,000	\$8,166,000
Lime Injection	\$2,739,000	\$15	\$1,155,000	\$1,488,000
PAC Injection	\$2,476,000	\$14	\$1,090,000	\$1,391,000
Neural Networks	\$500,000	\$3	\$50,000	\$111,000
Total	\$151,715,000	\$843	\$7,627,000	\$26,091,000

**BROWN UNIT 2 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$4,636,000	
Ductwork and Breeching	\$3,580,000	
Mechanical - Balance of Plant (BOP)	\$1,173,000	
Electrical - Equipment, Raceway	\$1,339,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$468,000	
Control - DCS Instrumentation	\$151,000	
Air Heater Modifications	\$3,135,000	Engineering Estimates
ID Fans	\$1,158,000	Engineering Estimates
Catalyst	\$1,883,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$1,643,000	

**Subtotal Purchase Contract** **\$19,666,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$2,854,000	
Civil/Structural Construction - Sub-Structures	\$742,000	
Mechanical/Chemical Construction	\$8,971,000	
Electrical/Control Construction	\$4,103,000	
Service Contracts & Construction Indirects	\$14,331,000	
Demolition Costs	\$6,500,000	Engineering Estimates

**Subtotal Construction Contracts** **\$37,501,000**

**Construction Difficulty Costs** **\$26,250,700** Engineering Estimates

**Total Direct Costs** **\$83,417,700**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$2,696,000	
EPC Construction Management (Includes G&A & Fee)	\$1,691,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$444,000	
Sales Taxes	\$627,000	
Project Contingency	\$6,326,000	

**Total Indirect Costs** **\$11,784,000**

**Total Contracted Costs** **\$95,000,000**

**Capital Cost Effectiveness** **\$528 /kW**

**ANNUAL COST**

Capacity Factor = 62%

**Fixed Annual Costs**

Operating labor	\$123,000	1 FTE and	123,325 \$/year
Maintenance labor & materials	\$2,503,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$2,676,000**

**Variable Annual Costs**

Reagent	\$309,000	215 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$186,000	940 kW and	0.03646 \$/kWh
Catalyst replacement	\$202,000	50 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$697,000**

**Total Annual Costs** **\$3,373,000**

**Levelized Capital Costs** **\$11,562,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$14,935,000**

**BROWN UNIT 2 - PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,646,000
Mechanical - Balance of Plant (BOP)	\$7,580,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$161,000
Control - DCS Instrumentation	\$178,000
ID Fans	\$535,000 Engineering Estimates

**Subtotal Purchase Contract** **\$11,100,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$2,355,000
Civil/Structural Construction - Sub-Structures	\$895,000
Mechanical/Chemical Construction	\$8,956,000
Electrical/Control Construction	\$3,024,000
Service Contracts & Construction Indirects	\$146,000
Demolition Costs	\$5,000,000 Engineering Estimates

**Subtotal Construction Contracts** **\$20,376,000**

**Construction Difficulty Costs** **\$14,263,200** Engineering Estimates

**Total Direct Costs** **\$45,739,200**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$2,334,000
EPC Construction Management (Includes G&A & Fee)	\$1,527,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$231,000
Sales Taxes	\$82,000
Project Contingency - 18%	\$860,000

**Total Indirect Costs** **\$5,034,000**

**Total Contracted Costs** **\$51,000,000**

**Cost Effectiveness** **\$283 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 62%

Maintenance labor and materials	\$1,530,000	(DC) X 3.0%
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**Subtotal Fixed Annual Costs** **\$1,530,000**

**Variable Annual Costs**

Byproduct disposal	\$5,000	120 lb/hr and	15 \$/ton
Bag replacement cost	\$129,000	3,880 bags and	100 \$/bag
Cage replacement cost	\$65,000	3,880 cages and	50 \$/cage
ID fan power	\$200,000	1,010 kW and	0.03646 \$/kWh
Auxiliary power	\$30,000	150 kW and	0.03646 \$/kWh

**Subtotal Variable Annual Costs** **\$429,000**

**Total Annual Costs** **\$1,959,000**

**Levelized Capital Costs** **\$6,207,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$8,166,000**

**Brown Unit 2  
180 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$133,800	From Previous Mill Creek BACT Study	
Short-term storage silo	\$88,800	From Previous Mill Creek BACT Study	
Air blowers	\$121,800	From Previous Mill Creek BACT Study	
Rotary feeders	\$19,800	From Previous Mill Creek BACT Study	
Injection system	\$80,400	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$0		
Electrical system upgrades	\$526,800	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$25,200	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$996,600</u>		
Freight	\$45,000	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$1,042,000</u>		
Direct installation costs			
Foundation & supports	\$104,000	(PEC) X	10.0%
Handling & erection	\$208,000	(PEC) X	20.0%
Electrical	\$104,000	(PEC) X	10.0%
Piping	\$52,000	(PEC) X	5.0%
Insulation	\$21,000	(PEC) X	2.0%
Painting	\$52,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$541,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$1,658,000</u>		
Indirect Costs			
Engineering	\$199,000	(DC) X	12.0%
Owner's cost	\$199,000	(DC) X	12.0%
Construction management	\$166,000	(DC) X	10.0%
Start-up and spare parts	\$25,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$332,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$1,021,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$60,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$2,739,000</b>		
<b>Cost Effectiveness</b>	<b>\$15 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$50,000	(DC) X	3.0%
Operating labor	\$123,000	1 FTE and 123,325 \$/year      Estimated manpower	
Total fixed annual costs	<u>\$173,000</u>		
Variable annual costs			
Lime	\$754,000	2,100 lb/hr and 132.19 \$/ton      62 % capacity factor	
Byproduct disposal cost	\$208,000	2,400 lb/hr and 15 \$/ton	
Auxiliary power	\$20,000	100 kW and 0.03646 \$/kWh	
Total variable annual costs	<u>\$982,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$1,155,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$333,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$333,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$1,488,000</b>		

**Brown Unit 2  
180 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$151,641	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$99,650	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$138,643	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$17,330	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$64,989	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0			
Electrical system upgrades	\$415,930	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$21,663	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$909,847</u>			
Freight	\$23,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$933,000</u>			
Direct installation costs				
Foundation & supports	\$93,000	(PEC) X	10.0%	
Handling & erection	\$187,000	(PEC) X	20.0%	
Electrical	\$93,000	(PEC) X	10.0%	
Piping	\$47,000	(PEC) X	5.0%	
Insulation	\$19,000	(PEC) X	2.0%	
Painting	\$47,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$486,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$1,494,000</u>			
Indirect Costs				
Engineering	\$179,000	(DC) X	12.0%	
Owner's cost	\$179,000	(DC) X	12.0%	
Construction management	\$149,000	(DC) X	10.0%	
Start-up and spare parts	\$22,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$299,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$928,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$54,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$2,476,000</b>			
<b>Cost Effectiveness</b>	<b>\$14 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$45,000	(DC) X	3.0%	
Operating labor	\$123,000	1 FTE and	123,325 \$/year	Estimated manpower
Total fixed annual costs	<u>\$168,000</u>			
Variable annual costs				
Reagent (BPAC)	\$896,000	150 lb/hr and	62 %	capacity factor
Byproduct disposal cost	\$6,000	150 lb/hr and	2200 \$/ton	
Auxiliary power	\$20,000	100 kW and	15 \$/ton	
Total variable annual costs	<u>\$922,000</u>	0.03646 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$1,090,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$301,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$301,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$1,391,000</b>			

Plant Name: Brown  
Unit: 3  
MW 457  
Project description High Level Emissions Control Study  
Revised on: 05/28/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
Fabric Filter	\$61,000,000	\$133	\$3,321,000	\$10,745,000
PAC Injection	\$5,426,000	\$12	\$2,330,000	\$2,990,000
Neural Networks	\$1,000,000	\$2	\$100,000	\$222,000
Total	\$67,426,000	\$148	\$5,751,000	\$13,957,000

**BROWN UNIT 3 - PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$4,628,000
Mechanical - Balance of Plant (BOP)	\$13,257,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$281,000
Control - DCS Instrumentation	\$312,000
ID Fans	\$1,930,000 Engineering Estimates

**Subtotal Purchase Contract** **\$20,408,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$4,118,000
Civil/Structural Construction - Sub-Structures	\$1,565,000
Mechanical/Chemical Construction	\$15,663,000
Electrical/Control Construction	\$5,289,000
Service Contracts & Construction Indirects	\$255,000
Demolition Costs	\$500,000 Engineering Estimates

**Subtotal Construction Contracts** **\$27,390,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$47,798,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$5,925,000
EPC Construction Management (Includes G&A & Fee)	\$3,877,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$586,000
Sales Taxes	\$209,000
Project Contingency - 18%	\$2,183,000

**Total Indirect Costs** **\$12,780,000**

**Total Contracted Costs** **\$61,000,000**

**Cost Effectiveness** **\$133 /kW**

**ANNUAL COST**

**Fixed Annual Costs** Capacity Factor = 57%

Maintenance labor and materials \$1,830,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$1,830,000**

**Variable Annual Costs**

Byproduct disposal	\$11,000	290 lb/hr and	15 \$/ton
Bag replacement cost	\$588,000	17,630 bags and	100 \$/bag
Cage replacement cost	\$294,000	17,630 cages and	50 \$/cage
ID fan power	\$460,000	2,540 kW and	0.03624 \$/kWh
Auxiliary power	\$138,000	760 kW and	0.03624 \$/kWh

**Subtotal Variable Annual Costs** **\$1,491,000**

**Total Annual Costs** **\$3,321,000**

**Levelized Capital Costs** **\$7,424,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$10,745,000**

**EW Brown Unit 3  
457 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$350,000	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$230,000	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$320,000	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$40,000	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$150,000	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0			
Electrical system upgrades	\$960,000	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$50,000	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$2,100,000</u>			
Freight	\$53,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$2,153,000</u>			
Direct installation costs				
Foundation & supports	\$215,000	(PEC) X	10.0%	
Handling & erection	\$431,000	(PEC) X	20.0%	
Electrical	\$215,000	(PEC) X	10.0%	
Piping	\$108,000	(PEC) X	5.0%	
Insulation	\$43,000	(PEC) X	2.0%	
Painting	\$108,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$1,120,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$3,348,000</u>			
Indirect Costs				
Engineering	\$402,000	(DC) X	12.0%	
Owner's cost	\$402,000	(DC) X	12.0%	
Construction management	\$335,000	(DC) X	10.0%	
Start-up and spare parts	\$50,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$670,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$1,959,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$119,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$5,426,000</b>			
<b>Cost Effectiveness</b>	<b>\$12 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$100,000	(DC) X	3.0%	
Operating labor	\$123,000	1 FTE and	123,325 \$/year	Estimated manpower
Total fixed annual costs	<u>\$223,000</u>			
Variable annual costs				
Reagent (BPAC)	\$2,060,000	375 lb/hr and	57 %	capacity factor
Byproduct disposal cost	\$14,000	375 lb/hr and	2200 \$/ton	
Auxiliary power	\$33,000	180 kW and	15 \$/ton	
Total variable annual costs	<u>\$2,107,000</u>	0.03624 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$2,330,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$660,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$660,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,990,000</b>			

**E.W. Brown**  
**AQC Technology Options**

Plant Name: Brown  
 Unit: 1  
 MW: 110  
 Project description: High Level Emissions Control Study  
 Revised on: 07/01/10

**Option 2: New SCR**

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$59,000,000	\$536	\$2,075,000	\$9,255,000
Fabric Filter	\$40,000,000	\$364	\$1,477,000	\$6,345,000
PAC Injection	\$1,599,000	\$15	\$614,000	\$809,000
Lime Injection	\$2,181,000	\$12	\$624,000	\$889,000
Neural Networks	\$500,000	\$5	\$50,000	\$111,000
<b>Total</b>	<b>\$103,280,000</b>	<b>\$939</b>	<b>\$4,840,000</b>	<b>\$17,409,000</b>

**BROWN UNIT 1 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$3,450,000	
Ductwork and Breeching	\$2,664,000	
Mechanical - Balance of Plant (BOP)	\$873,000	
Electrical - Equipment, Raceway	\$996,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$349,000	
Control - DCS Instrumentation	\$112,000	
Air Heater Modifications	\$1,500,000	Engineering Estimates
ID Fans	\$1,158,000	Engineering Estimates
Catalyst	\$1,402,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$1,223,000	

**Subtotal Purchase Contract** **\$14,227,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$2,124,000	
Civil/Structural Construction - Sub-Structures	\$552,000	
Mechanical/Chemical Construction	\$6,676,000	
Electrical/Control Construction	\$3,053,000	
Service Contracts & Construction Indirects	\$10,665,000	
Demolition Costs	\$15,000,000	Engineering Estimates

**Subtotal Construction Contracts** **\$38,070,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$52,297,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$1,647,000	
EPC Construction Management (Includes G&A & Fee)	\$1,034,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$271,000	
Sales Taxes	\$383,000	
Project Contingency	\$3,866,000	

**Total Indirect Costs** **\$7,201,000**

**Total Contracted Costs** **\$59,000,000**

**Capital Cost Effectiveness** **\$536 /kW**

**ANNUAL COST**

Capacity Factor = 44%

**Fixed Annual Costs**

Operating labor	\$123,000	1 FTE and	123,325 \$/year
Maintenance labor & materials	\$1,569,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$1,742,000**

**Variable Annual Costs**

Reagent	\$138,000	135 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$109,000	660 kW and	0.04266 \$/kWh
Catalyst replacement	\$86,000	30 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$333,000**

**Total Annual Costs** **\$2,075,000**

**Levelized Capital Costs** **\$7,180,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$9,255,000**

**BROWN UNIT 1 - PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$1,969,000
Mechanical - Balance of Plant (BOP)	\$5,641,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$119,000
Control - DCS Instrumentation	\$133,000
ID Fans	\$1,166,000 Engineering Estimates

**Subtotal Purchase Contract** **\$9,028,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$1,752,000
Civil/Structural Construction - Sub-Structures	\$666,000
Mechanical/Chemical Construction	\$6,664,000
Electrical/Control Construction	\$2,250,000
Service Contracts & Construction Indirects	\$109,000
Demolition Costs	\$5,000,000 Engineering Estimates

**Subtotal Construction Contracts** **\$16,441,000**

**Construction Difficulty Costs** **\$11,508,700** Engineering Estimates

**Total Direct Costs** **\$36,977,700**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$1,426,000
EPC Construction Management (Includes G&A & Fee)	\$933,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$141,000
Sales Taxes	\$50,000
Project Contingency - 18%	\$526,000

**Total Indirect Costs** **\$3,076,000**

**Total Contracted Costs** **\$40,000,000**

**Cost Effectiveness** **\$364 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 44%

Maintenance labor and materials	\$1,200,000	(DC) X 3.0%
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**Subtotal Fixed Annual Costs** **\$1,200,000**

**Variable Annual Costs**

Byproduct disposal	\$6,000	210 lb/hr and	15 \$/ton
Bag replacement cost	\$91,000	2,740 bags and	100 \$/bag
Cage replacement cost	\$46,000	2,740 cages and	50 \$/cage
ID fan power	\$117,000	710 kW and	0.04266 \$/kWh
Auxiliary power	\$17,000	105 kW and	0.04266 \$/kWh

**Subtotal Variable Annual Costs** **\$277,000**

**Total Annual Costs** **\$1,477,000**

**Levelized Capital Costs** **\$4,868,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$6,345,000**

**EW Brown Unit 1  
110 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$92,670	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$60,897	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$84,726	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$10,591	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$39,716	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0			
Electrical system upgrades	\$254,179	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$13,239	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$556,018</u>			
Freight	\$14,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$570,000</u>			
Direct installation costs				
Foundation & supports	\$57,000	(PEC) X	10.0%	
Handling & erection	\$114,000	(PEC) X	20.0%	
Electrical	\$57,000	(PEC) X	10.0%	
Piping	\$29,000	(PEC) X	5.0%	
Insulation	\$11,000	(PEC) X	2.0%	
Painting	\$29,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$297,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$942,000</u>			
Indirect Costs				
Engineering	\$113,000	(DC) X	12.0%	
Owner's cost	\$113,000	(DC) X	12.0%	
Construction management	\$94,000	(DC) X	10.0%	
Start-up and spare parts	\$14,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$188,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$622,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$35,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$1,599,000</b>			
<b>Cost Effectiveness</b>	<b>\$15 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$28,000	(DC) X	3.0%	
Operating labor	\$123,000	1 FTE and	123,325 \$/year	Estimated manpower
Total fixed annual costs	<u>\$151,000</u>			
Variable annual costs				
Reagent (BPAC)	\$445,000	105 lb/hr and	2200 \$/ton	44 % capacity factor
Byproduct disposal cost	\$3,000	105 lb/hr and	15 \$/ton	
Auxiliary power	\$15,000	90 kW and	0.04266 \$/kWh	
Total variable annual costs	<u>\$463,000</u>			
<b>Total direct annual costs (DAC)</b>	<b>\$614,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$195,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$195,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$809,000</b>			

**Brown Unit 1  
110 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 6/14/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$104,067	From Previous Mill Creek BACT Study	
Short-term storage silo	\$69,067	From Previous Mill Creek BACT Study	
Air blowers	\$94,733	From Previous Mill Creek BACT Study	
Rotary feeders	\$15,400	From Previous Mill Creek BACT Study	
Injection system	\$62,533	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$0		
Electrical system upgrades	\$409,733	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$19,600	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$775,133</u>		
Freight	<u>\$35,000</u>	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$810,000</u>		
Direct installation costs			
Foundation & supports	\$81,000	(PEC) X	10.0%
Handling & erection	\$162,000	(PEC) X	20.0%
Electrical	\$81,000	(PEC) X	10.0%
Piping	\$41,000	(PEC) X	5.0%
Insulation	\$16,000	(PEC) X	2.0%
Painting	\$41,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$422,000</u>		
Site preparation	\$0	N/A	
Buildings	<u>\$75,000</u>	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$1,307,000</u>		
Indirect Costs			
Engineering	\$157,000	(DC) X	12.0%
Owner's cost	\$157,000	(DC) X	12.0%
Construction management	\$131,000	(DC) X	10.0%
Start-up and spare parts	\$20,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	<u>\$261,000</u>	(DC) X	20.0%
Total indirect costs (IC)	<u>\$826,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$48,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$2,181,000</b>		
<b>Cost Effectiveness</b>	<b>\$12 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$39,000	(DC) X	3.0%
Operating labor	<u>\$123,000</u>	1 FTE and 123,325 \$/year      Estimated manpower	
Total fixed annual costs	<u>\$162,000</u>		
Variable annual costs			
Lime	\$321,000	1,260 lb/hr and 132.19 \$/ton      44 % capacity factor	
Byproduct disposal cost	\$125,000	1,440 lb/hr and 15 \$/ton	
Auxiliary power	\$16,000	100 kW and 0.04266 \$/kWh	
Total variable annual costs	<u>\$462,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$624,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$265,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$265,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$889,000</b>		

Plant Name: Brown  
 Unit: 1  
 MW: 110  
 Project description: High Level Emissions Control Study  
 Revised on: 07/01/10

**Option 3: Combined PJFF**

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
Fabric Filter	\$26,000,000	\$236	\$1,057,000	\$4,221,000
PAC Injection	\$1,599,000	\$15	\$614,000	\$809,000
Overfire Air	\$767,000	\$7	\$132,000	\$225,000
Low NOx Burners	\$1,156,000	\$11	\$0	\$141,000
Neural Networks	\$500,000	\$5	\$50,000	\$111,000
<b>Total</b>	<b>\$30,022,000</b>	<b>\$273</b>	<b>\$1,853,000</b>	<b>\$5,507,000</b>

**BROWN UNIT 1 - COMBINED PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$1,751,000
Mechanical - Balance of Plant (BOP)	\$4,012,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$106,000
Control - DCS Instrumentation	\$118,000
ID Fans	\$516,000

**Subtotal Purchase Contract** **\$6,503,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$1,189,000
Civil/Structural Construction - Sub-Structures	\$452,000
Mechanical/Chemical Construction	\$4,523,000
Electrical/Control Construction	\$1,527,000
Service Contracts & Construction Indirects	\$74,000
Demolition Costs	\$1,707,000
Engineering Estimates	

**Subtotal Construction Contracts** **\$9,472,000**

**Construction Difficulty Costs** **\$6,630,400** Engineering Estimates

**Total Direct Costs** **\$22,605,400**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$1,426,000
EPC Construction Management (Includes G&A & Fee)	\$933,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$141,000
Sales Taxes	\$50,000
Project Contingency - 18%	\$526,000

**Total Indirect Costs** **\$3,076,000**

**Total Contracted Costs** **\$26,000,000**

**Cost Effectiveness** **\$236 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 44%

Maintenance labor and materials	\$780,000	(DC) X 3.0%
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**Subtotal Fixed Annual Costs** **\$780,000**

**Variable Annual Costs**

Byproduct disposal	\$6,000	210 lb/hr and	15 \$/ton
Bag replacement cost	\$91,000	2,740 bags and	100 \$/bag
Cage replacement cost	\$46,000	2,740 cages and	50 \$/cage
ID fan power	\$117,000	710 kW and	0.04266 \$/kWh
Auxiliary power	\$17,000	105 kW and	0.04266 \$/kWh

**Subtotal Variable Annual Costs** **\$277,000**

**Total Annual Costs** **\$1,057,000**

**Levelized Capital Costs** **\$3,164,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$4,221,000**

**EW Brown Unit 1  
110 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$92,670	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$60,897	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$84,726	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$10,591	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$39,716	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0			
Electrical system upgrades	\$254,179	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$13,239	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$556,018</u>			
Freight	\$14,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$570,000</u>			
Direct installation costs				
Foundation & supports	\$57,000	(PEC) X	10.0%	
Handling & erection	\$114,000	(PEC) X	20.0%	
Electrical	\$57,000	(PEC) X	10.0%	
Piping	\$29,000	(PEC) X	5.0%	
Insulation	\$11,000	(PEC) X	2.0%	
Painting	\$29,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$297,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$942,000</u>			
Indirect Costs				
Engineering	\$113,000	(DC) X	12.0%	
Owner's cost	\$113,000	(DC) X	12.0%	
Construction management	\$94,000	(DC) X	10.0%	
Start-up and spare parts	\$14,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$188,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$622,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$35,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$1,599,000</b>			
<b>Cost Effectiveness</b>	<b>\$15 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$28,000	(DC) X	3.0%	
Operating labor	\$123,000	1 FTE and	123,325 \$/year	Estimated manpower
Total fixed annual costs	<u>\$151,000</u>			
Variable annual costs				
Reagent (BPAC)	\$445,000	105 lb/hr and	2200 \$/ton	44 % capacity factor
Byproduct disposal cost	\$3,000	105 lb/hr and	15 \$/ton	
Auxiliary power	\$15,000	90 kW and	0.04266 \$/kWh	
Total variable annual costs	<u>\$463,000</u>			
<b>Total direct annual costs (DAC)</b>	<b>\$614,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$195,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$195,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$809,000</b>			

**EW Brown Unit 1  
110 MW  
High Level Emissions Control Study**

Technology: Overfire Air System Operation

Date: 7/8/2010

<b>Cost Item</b>	<b>\$</b>	<b>Remarks/Cost Basis</b>		
<b>CAPITAL COST</b>				
<b>Direct Costs</b>				
Purchased equipment costs				
Neuco NOx optimization package	\$13,000	B&V cost estimate		
NOx monitoring equipment	\$40,000	B&V cost estimate		
Water cannon system	\$317,000	B&V cost estimate		
Subtotal capital cost (CC)	<u>\$370,000</u>			
Freight	\$19,000	(CC) X	5.0%	
Total purchased equipment cost (PEC)	<u>\$389,000</u>			
Direct installation costs				
Foundation & supports	\$0	(PEC) X	0.0%	
Handling & erection	\$78,000	(PEC) X	20.0%	
Electrical	\$58,000	(PEC) X	15.0%	
Piping	\$8,000	(PEC) X	2.0%	
Insulation	\$0	(PEC) X	0.0%	
Painting	\$0	(PEC) X	0.0%	
Demolition	\$10,000	(PEC) X	2.5%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$154,000</u>			
Site preparation	\$0	N/A		
Buildings	\$0	N/A		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$543,000</u>			
Indirect Costs				
Engineering	\$54,000	(DC) X	10.0%	
Owner's cost	\$11,000	(DC) X	2.0%	
Construction management	\$27,000	(DC) X	5.0%	
Start-up and spare parts	\$11,000	(DC) X	2.0%	
Performance test	\$50,000	Engineering estimate		
Contingencies	\$54,000	(DC) X	10.0%	
Total indirect costs (IC)	<u>\$207,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$17,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$767,000</b>			
<b>Cost Effectiveness</b>	<b>\$7 /kW</b>			
<b>ANNUAL COST</b>				
<b>Direct Annual Costs</b>				
Fixed annual costs				
Maintenance materials	\$10,000	B&V cost estimate		
Maintenance labor	\$14,000	B&V cost estimate, 6 man weeks/yr		
Total fixed annual costs	<u>\$24,000</u>			
Variable annual costs				
Replacement power due to efficiency hit	\$108,000	Engineering estimates, 0.2% efficiency drop, and 0.05 \$/kWh		
Total variable annual costs	<u>\$108,000</u>			
<b>Total direct annual costs (DAC)</b>	<b><u>\$132,000</u></b>			
Indirect Annual Costs				
Cost for capital recovery	\$93,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$93,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$225,000</b>			

**EW Brown Unit 1  
110 MW  
High Level Emissions Control Study**

Technology: Upgraded Low NOx Burners

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
New coal elbow, nozzle with air vane, fuel injector barrel, air zone swirler and coal piping	\$602,000			
Subtotal capital cost (CC)	<u>\$602,000</u>			
Freight	<u>\$30,000</u>	(CC) X	5.0%	
Total purchased equipment cost (PEC)	<u>\$632,000</u>			
Direct installation costs				
Foundation & supports	\$0	(PEC) X	0.0%	
Handling & erection	\$126,000	(PEC) X	20.0%	
Electrical	\$63,000	(PEC) X	10.0%	
Piping	\$0	(PEC) X	0.0%	
Insulation	\$0	(PEC) X	0.0%	
Painting	\$0	(PEC) X	0.0%	
Demolition	\$16,000	(PEC) X	2.5%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$205,000</u>			
Site preparation	\$0	N/A		
Buildings	\$0	N/A		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$837,000</u>			
Indirect Costs				
Engineering	\$84,000	(DC) X	10.0%	
Owner's cost	\$17,000	(DC) X	2.0%	
Construction management	\$42,000	(DC) X	5.0%	
Start-up and spare parts	\$17,000	(DC) X	2.0%	
Performance test	\$50,000	Engineering estimate		
Contingencies	\$84,000	(DC) X	10.0%	
Total indirect costs (IC)	<u>\$294,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$25,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$1,156,000</b>			
<b>Cost Effectiveness</b>	<b>\$11 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
N/A	\$0	Similar annual costs as current LNB		
Total fixed annual costs	<u>\$0</u>			
Variable annual costs				
N/A	\$0	Similar annual costs as current LNB		
Total variable annual costs	<u>\$0</u>			
<b>Total direct annual costs (DAC)</b>	<b>\$0</b>			
Indirect Annual Costs				
Cost for capital recovery	\$141,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$141,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$141,000</b>			

**Brown Unit 1  
110 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 6/14/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$104,067	From Previous Mill Creek BACT Study	
Short-term storage silo	\$69,067	From Previous Mill Creek BACT Study	
Air blowers	\$94,733	From Previous Mill Creek BACT Study	
Rotary feeders	\$15,400	From Previous Mill Creek BACT Study	
Injection system	\$62,533	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$0		
Electrical system upgrades	\$409,733	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$19,600	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$775,133</u>		
Freight	<u>\$35,000</u>	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$810,000</u>		
Direct installation costs			
Foundation & supports	\$81,000	(PEC) X	10.0%
Handling & erection	\$162,000	(PEC) X	20.0%
Electrical	\$81,000	(PEC) X	10.0%
Piping	\$41,000	(PEC) X	5.0%
Insulation	\$16,000	(PEC) X	2.0%
Painting	\$41,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$422,000</u>		
Site preparation	\$0	N/A	
Buildings	<u>\$75,000</u>	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$1,307,000</u>		
Indirect Costs			
Engineering	\$157,000	(DC) X	12.0%
Owner's cost	\$157,000	(DC) X	12.0%
Construction management	\$131,000	(DC) X	10.0%
Start-up and spare parts	\$20,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	<u>\$261,000</u>	(DC) X	20.0%
Total indirect costs (IC)	<u>\$826,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$48,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$2,181,000</b>		
<b>Cost Effectiveness</b>	<b>\$12 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$39,000	(DC) X	3.0%
Operating labor	<u>\$123,000</u>	1 FTE and 123,325 \$/year      Estimated manpower	
Total fixed annual costs	<u>\$162,000</u>		
Variable annual costs			
Lime	\$321,000	1,260 lb/hr and 132.19 \$/ton      44 % capacity factor	
Byproduct disposal cost	\$125,000	1,440 lb/hr and 15 \$/ton	
Auxiliary power	\$16,000	100 kW and 0.04266 \$/kWh	
Total variable annual costs	<u>\$462,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$624,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$265,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$265,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$889,000</b>		

Plant Name: Brown  
 Unit: 2  
 MW: 180  
 Project description: High Level Emissions Control Study  
 Revised on: 07/06/10

**Option 2: Combined PJFF**

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$95,000,000	\$528	\$3,373,000	\$14,935,000
Fabric Filter	\$42,000,000	\$233	\$1,689,000	\$6,800,000
Lime Injection	\$2,739,000	\$15	\$1,155,000	\$1,488,000
PAC Injection	\$2,476,000	\$14	\$1,090,000	\$1,391,000
Neural Networks	\$500,000	\$3	\$50,000	\$111,000
<b>Total</b>	<b>\$142,715,000</b>	<b>\$793</b>	<b>\$7,357,000</b>	<b>\$24,725,000</b>

**BROWN UNIT 2 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$4,636,000	
Ductwork and Breeching	\$3,580,000	
Mechanical - Balance of Plant (BOP)	\$1,173,000	
Electrical - Equipment, Raceway	\$1,339,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$468,000	
Control - DCS Instrumentation	\$151,000	
Air Heater Modifications	\$3,135,000	Engineering Estimates
ID Fans	\$1,158,000	Engineering Estimates
Catalyst	\$1,883,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$1,643,000	

**Subtotal Purchase Contract** **\$19,666,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$2,854,000	
Civil/Structural Construction - Sub-Structures	\$742,000	
Mechanical/Chemical Construction	\$8,971,000	
Electrical/Control Construction	\$4,103,000	
Service Contracts & Construction Indirects	\$14,331,000	
Demolition Costs	\$6,500,000	Engineering Estimates

**Subtotal Construction Contracts** **\$37,501,000**

**Construction Difficulty Costs** **\$26,250,700** Engineering Estimates

**Total Direct Costs** **\$83,417,700**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$2,696,000	
EPC Construction Management (Includes G&A & Fee)	\$1,691,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$444,000	
Sales Taxes	\$627,000	
Project Contingency	\$6,326,000	

**Total Indirect Costs** **\$11,784,000**

**Total Contracted Costs** **\$95,000,000**

**Capital Cost Effectiveness** **\$528 /kW**

**ANNUAL COST**

Capacity Factor = 62%

**Fixed Annual Costs**

Operating labor	\$123,000	1 FTE and	123,325 \$/year
Maintenance labor & materials	\$2,503,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$2,676,000**

**Variable Annual Costs**

Reagent	\$309,000	215 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$186,000	940 kW and	0.03646 \$/kWh
Catalyst replacement	\$202,000	50 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$697,000**

**Total Annual Costs** **\$3,373,000**

**Levelized Capital Costs** **\$11,562,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$14,935,000**

**BROWN UNIT 2 - COMBINED PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,864,000
Mechanical - Balance of Plant (BOP)	\$6,565,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$174,000
Control - DCS Instrumentation	\$193,000
ID Fans	\$845,000

**Subtotal Purchase Contract** **\$10,641,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$1,946,000
Civil/Structural Construction - Sub-Structures	\$740,000
Mechanical/Chemical Construction	\$7,400,000
Electrical/Control Construction	\$2,499,000
Service Contracts & Construction Indirects	\$120,000
Demolition Costs	\$2,793,000
Engineering Estimates	

**Subtotal Construction Contracts** **\$15,498,000**

**Construction Difficulty Costs** **\$10,848,600** Engineering Estimates

**Total Direct Costs** **\$36,987,600**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$2,334,000
EPC Construction Management (Includes G&A & Fee)	\$1,527,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$231,000
Sales Taxes	\$82,000
Project Contingency - 18%	\$860,000

**Total Indirect Costs** **\$5,034,000**

**Total Contracted Costs** **\$42,000,000**

**Cost Effectiveness** **\$233 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 62%

Maintenance labor and materials	\$1,260,000	(DC) X 3.0%
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**Subtotal Fixed Annual Costs** **\$1,260,000**

**Variable Annual Costs**

Byproduct disposal	\$5,000	120 lb/hr and	15 \$/ton
Bag replacement cost	\$129,000	3,880 bags and	100 \$/bag
Cage replacement cost	\$65,000	3,880 cages and	50 \$/cage
ID fan power	\$200,000	1,010 kW and	0.03646 \$/kWh
Auxiliary power	\$30,000	150 kW and	0.03646 \$/kWh

**Subtotal Variable Annual Costs** **\$429,000**

**Total Annual Costs** **\$1,689,000**

**Levelized Capital Costs** **\$5,111,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$6,800,000**

**Brown Unit 2  
180 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$133,800	From Previous Mill Creek BACT Study	
Short-term storage silo	\$88,800	From Previous Mill Creek BACT Study	
Air blowers	\$121,800	From Previous Mill Creek BACT Study	
Rotary feeders	\$19,800	From Previous Mill Creek BACT Study	
Injection system	\$80,400	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$0		
Electrical system upgrades	\$526,800	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$25,200	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$996,600</u>		
Freight	\$45,000	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$1,042,000</u>		
Direct installation costs			
Foundation & supports	\$104,000	(PEC) X	10.0%
Handling & erection	\$208,000	(PEC) X	20.0%
Electrical	\$104,000	(PEC) X	10.0%
Piping	\$52,000	(PEC) X	5.0%
Insulation	\$21,000	(PEC) X	2.0%
Painting	\$52,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$541,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$1,658,000</u>		
Indirect Costs			
Engineering	\$199,000	(DC) X	12.0%
Owner's cost	\$199,000	(DC) X	12.0%
Construction management	\$166,000	(DC) X	10.0%
Start-up and spare parts	\$25,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$332,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$1,021,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$60,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$2,739,000</b>		
<b>Cost Effectiveness</b>	<b>\$15 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$50,000	(DC) X	3.0%
Operating labor	\$123,000	1 FTE and 123,325 \$/year      Estimated manpower	
Total fixed annual costs	<u>\$173,000</u>		
Variable annual costs			
Lime	\$754,000	2,100 lb/hr and 132.19 \$/ton      62 % capacity factor	
Byproduct disposal cost	\$208,000	2,400 lb/hr and 15 \$/ton	
Auxiliary power	\$20,000	100 kW and 0.03646 \$/kWh	
Total variable annual costs	<u>\$982,000</u>		
Total direct annual costs (DAC)	<u>\$1,155,000</u>		
Indirect Annual Costs			
Cost for capital recovery	\$333,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$333,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$1,488,000</b>		

**Brown Unit 2  
180 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$151,641	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$99,650	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$138,643	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$17,330	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$64,989	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0			
Electrical system upgrades	\$415,930	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$21,663	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$909,847</u>			
Freight	\$23,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$933,000</u>			
Direct installation costs				
Foundation & supports	\$93,000	(PEC) X	10.0%	
Handling & erection	\$187,000	(PEC) X	20.0%	
Electrical	\$93,000	(PEC) X	10.0%	
Piping	\$47,000	(PEC) X	5.0%	
Insulation	\$19,000	(PEC) X	2.0%	
Painting	\$47,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$486,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$1,494,000</u>			
Indirect Costs				
Engineering	\$179,000	(DC) X	12.0%	
Owner's cost	\$179,000	(DC) X	12.0%	
Construction management	\$149,000	(DC) X	10.0%	
Start-up and spare parts	\$22,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$299,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$928,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$54,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$2,476,000</b>			
<b>Cost Effectiveness</b>	<b>\$14 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$45,000	(DC) X	3.0%	
Operating labor	\$123,000	1 FTE and	123,325 \$/year	Estimated manpower
Total fixed annual costs	<u>\$168,000</u>			
Variable annual costs				
Reagent (BPAC)	\$896,000	150 lb/hr and	62 %	capacity factor
Byproduct disposal cost	\$6,000	150 lb/hr and	2200 \$/ton	
Auxiliary power	\$20,000	100 kW and	15 \$/ton	
Total variable annual costs	<u>\$922,000</u>	0.03646 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$1,090,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$301,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$301,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$1,391,000</b>			

**Ghent**

Plant Name: Ghent  
Unit: 1  
MW 541  
Project description High Level Emissions Control Study  
Revised on: 05/28/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
Fabric Filter	\$131,000,000	\$242	\$5,888,000	\$21,831,000
PAC Injection	\$6,380,000	\$12	\$4,208,000	\$4,984,000
Neural Networks	\$1,000,000	\$2	\$100,000	\$222,000
Total	\$138,380,000	\$256	\$10,196,000	\$27,037,000

## GHENT UNIT 1 - PJFF COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$5,121,000
Mechanical - Balance of Plant (BOP)	\$14,669,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$311,000
Control - DCS Instrumentation	\$345,000
ID Fans	\$2,493,000 Engineering Estimates

**Subtotal Purchase Contract** **\$22,939,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$4,557,000
Civil/Structural Construction - Sub-Structures	\$1,732,000
Mechanical/Chemical Construction	\$17,332,000
Electrical/Control Construction	\$5,853,000
Service Contracts & Construction Indirects	\$283,000
Demolition Costs	\$6,000,000 Engineering Estimates

**Subtotal Construction Contracts** **\$35,757,000**

**Construction Difficulty Costs** **\$57,211,200** Engineering Estimates

**Total Direct Costs** **\$115,907,200**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$7,014,000
EPC Construction Management (Includes G&A & Fee)	\$4,590,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$693,000
Sales Taxes	\$247,000
Project Contingency - 18%	\$2,585,000

**Total Indirect Costs** **\$15,129,000**

**Total Contracted Costs** **\$131,000,000**

**Cost Effectiveness** **\$242 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 81%

Maintenance labor and materials \$3,930,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$3,930,000**

#### Variable Annual Costs

Byproduct disposal	\$0	0 lb/hr and	15 \$/ton
Bag replacement cost	\$786,000	23,590 bags and	100 \$/bag
Cage replacement cost	\$393,000	23,590 cages and	50 \$/cage
ID fan power	\$600,000	3,400 kW and	0.02487 \$/kWh
Auxiliary power	\$179,000	1,015 kW and	0.02487 \$/kWh

**Subtotal Variable Annual Costs** **\$1,958,000**

**Total Annual Costs** **\$5,888,000**

**Levelized Capital Costs** **\$15,943,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$21,831,000**

**Ghent Unit 1  
514 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$414,333	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$272,276	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$378,818	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$47,352	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$177,571	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0			
Electrical system upgrades	\$1,136,455	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$59,190	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$2,485,996</u>			
Freight	\$62,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$2,548,000</u>			
Direct installation costs				
Foundation & supports	\$255,000	(PEC) X	10.0%	
Handling & erection	\$510,000	(PEC) X	20.0%	
Electrical	\$255,000	(PEC) X	10.0%	
Piping	\$127,000	(PEC) X	5.0%	
Insulation	\$51,000	(PEC) X	2.0%	
Painting	\$127,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$1,325,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$3,948,000</u>			
Indirect Costs				
Engineering	\$474,000	(DC) X	12.0%	
Owner's cost	\$474,000	(DC) X	12.0%	
Construction management	\$395,000	(DC) X	10.0%	
Start-up and spare parts	\$59,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$790,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$2,292,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$140,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$6,380,000</b>			
<b>Cost Effectiveness</b>	<b>\$12 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$118,000	(DC) X	3.0%	
Operating labor	\$121,000	1 FTE and	121,000 \$/year	Estimated manpower
Total fixed annual costs	<u>\$239,000</u>			
Variable annual costs				
Reagent (BPAC)	\$3,903,000	500 lb/hr and	81 %	capacity factor
Byproduct disposal cost	\$27,000	500 lb/hr and	2200 \$/ton	
Auxiliary power	\$39,000	220 kW and	15 \$/ton	
Total variable annual costs	<u>\$3,969,000</u>	0.02487 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$4,208,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$776,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$776,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$4,984,000</b>			

Plant Name: Ghent  
Unit: 2  
MW: 517  
Project description: High Level Emissions Control Study  
Revised on: 07/06/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$232,000,000	\$449	\$7,234,000	\$35,468,000
Fabric Filter	\$120,000,000	\$232	\$5,002,000	\$19,606,000
Lime Injection	\$5,483,000	\$11	\$2,775,000	\$3,442,000
PAC Injection	\$6,109,000	\$12	\$2,880,000	\$3,623,000
Neural Networks	\$1,000,000	\$2	\$100,000	\$222,000
Total	\$364,592,000	\$705	\$17,991,000	\$62,361,000

## GHENT UNIT 2 - SCR COSTS

### CAPITAL COST

#### **Purchase Contracts**

Civil/Structural	\$8,731,000	
Ductwork and Breeching	\$6,743,000	
Mechanical - Balance of Plant (BOP)	\$2,208,000	
Electrical - Equipment, Raceway	\$2,522,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$882,000	
Control - DCS Instrumentation	\$284,000	
Air Heater Modifications	\$5,200,000	Engineering Estimates
ID Fans	\$2,858,000	Engineering Estimates
Catalyst	\$3,547,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$3,094,000	

**Subtotal Purchase Contract** **\$36,569,000**

#### **Construction Contracts**

Civil/Structural Construction - Super Structures	\$5,375,000	
Civil/Structural Construction - Sub-Structures	\$1,397,000	
Mechanical/Chemical Construction	\$16,896,000	
Electrical/Control Construction	\$7,727,000	
Service Contracts & Construction Indirects	\$26,991,000	
Demolition Costs	\$9,000,000	Engineering Estimates

**Subtotal Construction Contracts** **\$67,386,000**

**Construction Difficulty Costs** **\$94,340,400** Engineering Estimates

**Total Direct Costs** **\$198,295,400**

#### **Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$7,743,000	
EPC Construction Management (Includes G&A & Fee)	\$4,858,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$1,275,000	
Sales Taxes	\$1,800,000	
Project Contingency	\$18,169,000	

**Total Indirect Costs** **\$33,845,000**

**Total Contracted Costs** **\$232,000,000**

**Capital Cost Effectiveness** **\$449 /kW**

### ANNUAL COST

Capacity Factor = 71%

#### **Fixed Annual Costs**

Operating labor	\$121,000	1 FTE and	121,000 \$/year
Maintenance labor & materials	\$5,949,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$6,120,000**

#### **Variable Annual Costs**

Reagent	\$459,000	285 lb/hr and	517.55 \$/ton
Auxiliary and ID fan power	\$355,000	2,320 kW and	0.02459 \$/kWh
Catalyst replacement	\$300,000	65 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$1,114,000**

**Total Annual Costs** **\$7,234,000**

**Levelized Capital Costs** **\$28,234,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$35,468,000**

## GHENT UNIT 2 - PJFF COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$4,984,000	
Mechanical - Balance of Plant (BOP)	\$14,275,000	
Electrical - Equipment, Raceway, Switchgears, MCC	\$302,000	
Control - DCS Instrumentation	\$336,000	
ID Fans	\$1,319,000	Engineering Estimates

**Subtotal Purchase Contract** **\$21,216,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$4,435,000	
Civil/Structural Construction - Sub-Structures	\$1,686,000	
Mechanical/Chemical Construction	\$16,866,000	
Electrical/Control Construction	\$5,695,000	
Service Contracts & Construction Indirects	\$275,000	
Demolition Costs	\$6,000,000	Engineering Estimates

**Subtotal Construction Contracts** **\$34,957,000**

**Construction Difficulty Costs** **\$48,939,800** Engineering Estimates

**Total Direct Costs** **\$105,112,800**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$6,703,000	
EPC Construction Management (Includes G&A & Fee)	\$4,386,000	
Startup Spare Parts (Included)	\$0	
Construction Utilites (Power & Water) - Included	\$0	
Project Insurance	\$662,000	
Sales Taxes	\$236,000	
Project Contingency - 18%	\$2,470,000	

**Total Indirect Costs** **\$14,457,000**

**Total Contracted Costs** **\$120,000,000**

**Cost Effectiveness** **\$232 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 71%

Maintenance labor and materials \$3,600,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$3,600,000**

#### Variable Annual Costs

Byproduct disposal	\$5,000	115 lb/hr and	15 \$/ton
Bag replacement cost	\$592,000	17,770 bags and	100 \$/bag
Cage replacement cost	\$296,000	17,770 cages and	50 \$/cage
ID fan power	\$392,000	2,560 kW and	0.02459 \$/kWh
Auxiliary power	\$117,000	765 kW and	0.02459 \$/kWh

**Subtotal Variable Annual Costs** **\$1,402,000**

**Total Annual Costs** **\$5,002,000**

**Levelized Capital Costs** **\$14,604,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$19,606,000**

**Ghent Unit 2**  
**517 MW**  
**High Level Emissions Control Study**

Technology: Sorbent Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$279,493	From Previous Mill Creek BACT Study	
Short-term storage silo	\$185,493	From Previous Mill Creek BACT Study	
Air blowers	\$254,427	From Previous Mill Creek BACT Study	
Rotary feeders	\$41,360	From Previous Mill Creek BACT Study	
Injection system	\$167,947	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$0		
Electrical system upgrades	\$1,100,427	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$52,640	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$2,081,787</u>		
Freight	\$94,000	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$2,176,000</u>		
Direct installation costs			
Foundation & supports	\$218,000	(PEC) X	10.0%
Handling & erection	\$435,000	(PEC) X	20.0%
Electrical	\$218,000	(PEC) X	10.0%
Piping	\$109,000	(PEC) X	5.0%
Insulation	\$44,000	(PEC) X	2.0%
Painting	\$109,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$1,133,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$3,384,000</u>		
Indirect Costs			
Engineering	\$406,000	(DC) X	12.0%
Owner's cost	\$406,000	(DC) X	12.0%
Construction management	\$338,000	(DC) X	10.0%
Start-up and spare parts	\$51,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$677,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$1,978,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$121,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$5,483,000</b>		
<b>Cost Effectiveness</b>	<b>\$11 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$102,000	(DC) X	3.0%
Operating labor	\$121,000	1 FTE and 121,000 \$/year	
Total fixed annual costs	<u>\$223,000</u>		
Variable annual costs			
Lime	\$2,233,000	5,450 lb/hr and 131.78 \$/ton	
Byproduct disposal	\$291,000	6,230 lb/hr and 15 \$/ton	
Auxiliary power	\$28,000	180 kW and 0.02459 \$/kWh	
Total variable annual costs	<u>\$2,552,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$2,775,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$667,000	(TCI) X	12.17% CRF
Total indirect annual costs (IDAC)	<u>\$667,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$3,442,000</b>		

**Ghent Unit 2  
517 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$395,952	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$260,197	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$362,013	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$45,252	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$169,694	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0			
Electrical system upgrades	\$1,086,039	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$56,565	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$2,375,711</u>			
Freight	\$59,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$2,435,000</u>			
Direct installation costs				
Foundation & supports	\$244,000	(PEC) X	10.0%	
Handling & erection	\$487,000	(PEC) X	20.0%	
Electrical	\$244,000	(PEC) X	10.0%	
Piping	\$122,000	(PEC) X	5.0%	
Insulation	\$49,000	(PEC) X	2.0%	
Painting	\$122,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$1,268,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$3,778,000</u>			
Indirect Costs				
Engineering	\$453,000	(DC) X	12.0%	
Owner's cost	\$453,000	(DC) X	12.0%	
Construction management	\$378,000	(DC) X	10.0%	
Start-up and spare parts	\$57,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$756,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$2,197,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$134,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$6,109,000</b>			
<b>Cost Effectiveness</b>	<b>\$12 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$113,000	(DC) X	3.0%	
Operating labor	\$121,000	1 FTE and	121,000 \$/year	Estimated manpower
Total fixed annual costs	<u>\$234,000</u>			
Variable annual costs				
Reagent (BPAC)	\$2,600,000	380 lb/hr and	71 %	capacity factor
Byproduct disposal cost	\$18,000	380 lb/hr and	2200 \$/ton	
Auxiliary power	\$28,000	180 kW and	15 \$/ton	
Total variable annual costs	<u>\$2,646,000</u>	0.02459 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$2,880,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$743,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$743,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$3,623,000</b>			

Plant Name: Ghent  
Unit: 3  
MW 523  
Project description High Level Emissions Control Study  
Revised on: 05/28/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
Fabric Filter	\$138,000,000	\$264	\$6,122,000	\$22,917,000
PAC Injection	\$6,173,000	\$12	\$4,134,000	\$4,885,000
Neural Networks	\$1,000,000	\$2	\$100,000	\$222,000
Total	\$145,173,000	\$278	\$10,356,000	\$28,024,000

## GHENT UNIT 3 - PJFF COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$10,036,000
Mechanical - Balance of Plant (BOP)	\$14,374,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$305,000
Control - DCS Instrumentation	\$338,000
ID Fans	\$2,654,000 Engineering Estimates

**Subtotal Purchase Contract** **\$27,707,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$8,931,000
Civil/Structural Construction - Sub-Structures	\$3,395,000
Mechanical/Chemical Construction	\$16,984,000
Electrical/Control Construction	\$5,735,000
Service Contracts & Construction Indirects	\$277,000
Demolition Costs	\$1,500,000 Engineering Estimates

**Subtotal Construction Contracts** **\$36,822,000**

**Construction Difficulty Costs** **\$58,915,200** Engineering Estimates

**Total Direct Costs** **\$123,444,200**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$6,781,000
EPC Construction Management (Includes G&A & Fee)	\$4,437,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$670,000
Sales Taxes	\$239,000
Project Contingency - 18%	\$2,499,000

**Total Indirect Costs** **\$14,626,000**

**Total Contracted Costs** **\$138,000,000**

**Cost Effectiveness** **\$264 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 78%

Maintenance labor and materials \$4,140,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$4,140,000**

#### Variable Annual Costs

Byproduct disposal	\$4,000	85 lb/hr and	15 \$/ton
Bag replacement cost	\$799,000	23,960 bags and	100 \$/bag
Cage replacement cost	\$399,000	23,960 cages and	50 \$/cage
ID fan power	\$601,000	3,455 kW and	0.02544 \$/kWh
Auxiliary power	\$179,000	1,030 kW and	0.02544 \$/kWh

**Subtotal Variable Annual Costs** **\$1,982,000**

**Total Annual Costs** **\$6,122,000**

**Levelized Capital Costs** **\$16,795,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$22,917,000**

**Ghent Unit 3  
523 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$400,547	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$263,217	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$366,214	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$45,777	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$171,663	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0			
Electrical system upgrades	\$1,098,643	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$57,221	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$2,403,282</u>			
Freight	\$60,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$2,463,000</u>			
Direct installation costs				
Foundation & supports	\$246,000	(PEC) X	10.0%	
Handling & erection	\$493,000	(PEC) X	20.0%	
Electrical	\$246,000	(PEC) X	10.0%	
Piping	\$123,000	(PEC) X	5.0%	
Insulation	\$49,000	(PEC) X	2.0%	
Painting	\$123,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$1,280,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$3,818,000</u>			
Indirect Costs				
Engineering	\$458,000	(DC) X	12.0%	
Owner's cost	\$458,000	(DC) X	12.0%	
Construction management	\$382,000	(DC) X	10.0%	
Start-up and spare parts	\$57,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$764,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$2,219,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$136,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$6,173,000</b>			
<b>Cost Effectiveness</b>	<b>\$12 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$115,000	(DC) X	3.0%	
Operating labor	\$121,000	1 FTE and	121,000 \$/year	Estimated manpower
Total fixed annual costs	<u>\$236,000</u>			
Variable annual costs				
Reagent (BPAC)	\$3,833,000	510 lb/hr and	78 %	capacity factor
Byproduct disposal cost	\$26,000	510 lb/hr and	2200 \$/ton	
Auxiliary power	\$39,000	225 kW and	15 \$/ton	
Total variable annual costs	<u>\$3,898,000</u>	0.02544 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$4,134,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$751,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$751,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$4,885,000</b>			

Plant Name: Ghent  
Unit: 4  
MW 526  
Project description High Level Emissions Control Study  
Revised on: 05/28/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
Fabric Filter	\$117,000,000	\$222	\$5,363,000	\$19,602,000
PAC Injection	\$6,210,000	\$12	\$3,896,000	\$4,652,000
Neural Networks	\$1,000,000	\$2	\$100,000	\$222,000
Total	\$124,210,000	\$236	\$9,359,000	\$24,476,000

## GHENT UNIT 4 - PJFF COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$5,035,000	
Mechanical - Balance of Plant (BOP)	\$14,424,000	
Electrical - Equipment, Raceway, Switchgears, MCC	\$306,000	
Control - DCS Instrumentation	\$339,000	
ID Fans	\$2,574,000	Engineering Estimates

**Subtotal Purchase Contract** **\$22,678,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$4,481,000	
Civil/Structural Construction - Sub-Structures	\$1,703,000	
Mechanical/Chemical Construction	\$17,042,000	
Electrical/Control Construction	\$5,755,000	
Service Contracts & Construction Indirects	\$278,000	
Demolition Costs	\$1,500,000	Engineering Estimates

**Subtotal Construction Contracts** **\$30,759,000**

**Construction Difficulty Costs** **\$49,214,400** Engineering Estimates

**Total Direct Costs** **\$102,651,400**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$6,820,000	
EPC Construction Management (Includes G&A & Fee)	\$4,463,000	
Startup Spare Parts (Included)	\$0	
Construction Utilites (Power & Water) - Included	\$0	
Project Insurance	\$674,000	
Sales Taxes	\$240,000	
Project Contingency - 18%	\$2,513,000	

**Total Indirect Costs** **\$14,710,000**

**Total Contracted Costs** **\$117,000,000**

**Cost Effectiveness** **\$222 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 77%

Maintenance labor and materials \$3,510,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$3,510,000**

#### Variable Annual Costs

Byproduct disposal	\$0	0 lb/hr and	15 \$/ton
Bag replacement cost	\$758,000	22,730 bags and	100 \$/bag
Cage replacement cost	\$379,000	22,730 cages and	50 \$/cage
ID fan power	\$551,000	3,280 kW and	0.0249 \$/kWh
Auxiliary power	\$165,000	980 kW and	0.0249 \$/kWh

**Subtotal Variable Annual Costs** **\$1,853,000**

**Total Annual Costs** **\$5,363,000**

**Levelized Capital Costs** **\$14,239,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$19,602,000**

**Ghent Unit 4  
526 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$402,845	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$264,726	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$368,315	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$46,039	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$172,648	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0			
Electrical system upgrades	\$1,104,945	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$57,549	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$2,417,068</u>			
Freight	\$60,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$2,477,000</u>			
Direct installation costs				
Foundation & supports	\$248,000	(PEC) X	10.0%	
Handling & erection	\$495,000	(PEC) X	20.0%	
Electrical	\$248,000	(PEC) X	10.0%	
Piping	\$124,000	(PEC) X	5.0%	
Insulation	\$50,000	(PEC) X	2.0%	
Painting	\$124,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$1,289,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$3,841,000</u>			
Indirect Costs				
Engineering	\$461,000	(DC) X	12.0%	
Owner's cost	\$461,000	(DC) X	12.0%	
Construction management	\$384,000	(DC) X	10.0%	
Start-up and spare parts	\$58,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$768,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$2,232,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$137,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$6,210,000</b>			
<b>Cost Effectiveness</b>	<b>\$12 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$115,000	(DC) X	3.0%	
Operating labor	\$121,000		1 FTE and	121,000 \$/year Estimated manpower
Total fixed annual costs	<u>\$236,000</u>			
Variable annual costs				
Reagent (BPAC)	\$3,599,000		485 lb/hr and	77 % capacity factor 2200 \$/ton
Byproduct disposal cost	\$25,000		485 lb/hr and	15 \$/ton
Auxiliary power	\$36,000		215 kW and	0.0249 \$/kWh
Total variable annual costs	<u>\$3,660,000</u>			
<b>Total direct annual costs (DAC)</b>	<b>\$3,896,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$756,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$756,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$4,652,000</b>			

# **Cane Run**

Plant Name: Cane Run  
 Unit: 4  
 MW: 168  
 Project description: High Level Emissions Control Study  
 Revised on: 06/22/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$63,000,000	\$375	\$2,219,000	\$9,886,000
WFGD	\$160,000,000	\$952	\$8,666,000	\$28,138,000
Fabric Filter	\$33,000,000	\$196	\$1,924,000	\$5,940,000
Lime Injection	\$2,569,000	\$15	\$983,000	\$1,296,000
PAC Injection	\$2,326,000	\$14	\$1,087,000	\$1,370,000
Neural Networks	\$500,000	\$3	\$50,000	\$111,000
Total	\$261,395,000	\$1,556	\$14,929,000	\$46,741,000

## CANE RUN UNIT 4 - SCR COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$4,448,000	
Ductwork and Breeching	\$3,435,000	
Mechanical - Balance of Plant (BOP)	\$1,125,000	
Electrical - Equipment, Raceway	\$1,285,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$449,000	
Control - DCS Instrumentation	\$145,000	
Air Heater	\$2,910,000	Engineering Estimates
ID Fans	\$1,717,000	Engineering Estimates
Catalyst	\$1,807,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$1,576,000	

**Subtotal Purchase Contract** **\$19,397,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$2,738,000	
Civil/Structural Construction - Sub-Structures	\$712,000	
Mechanical/Chemical Construction	\$8,607,000	
Electrical/Control Construction	\$3,937,000	
Service Contracts & Construction Indirects	\$13,750,000	
Demolition Costs	\$2,754,000	Engineering Estimates

**Subtotal Construction Contracts** **\$32,498,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$51,895,000**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$2,516,000	
EPC Construction Management (Includes G&A & Fee)	\$1,579,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$414,000	
Sales Taxes	\$585,000	
Project Contingency	\$5,904,000	

**Total Indirect Costs** **\$10,998,000**

**Total Contracted Costs** **\$63,000,000**

**Capital Cost Effectiveness** **\$375 /kW**

### ANNUAL COST

Capacity Factor = 60%

#### Fixed Annual Costs

Operating labor	\$127,000	1 FTE and	126,882 \$/year
Maintenance labor & materials	\$1,557,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$1,734,000**

#### Variable Annual Costs

Reagent	\$202,000	145 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$146,000	965 kW and	0.0288 \$/kWh
Catalyst replacement	\$137,000	35 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$485,000**

**Total Annual Costs** **\$2,219,000**

**Levelized Capital Costs** **\$7,667,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$9,886,000**

## CANE RUN UNIT 4 - WFGD COSTS

### CAPITAL COST

#### **Purchase Contracts**

Civil/Structural	\$1,712,000
Ductwork and Breeching	\$2,638,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$56,758,000
Electrical - Equipment, Raceway	\$6,304,000
VFDs, Motors and Couplings	\$3,705,000
Switchgear and MCCs	\$3,825,000
Control - DCS Instrumentation	\$3,537,000
ID Fans	\$1,189,000 Engineering Estimates

**Subtotal Purchase Contract** **\$79,668,000**

#### **Construction Contracts**

Civil/Structural Construction - Super Structures	\$6,373,000
Civil/Structural Construction - Sub-Structures	\$621,000
Mechanical/Chemical Construction	\$14,560,000
Electrical/Control Construction	\$5,969,000
Service Contracts & Construction Indirects	\$11,344,000
Demolition Costs	\$7,918,000 Engineering Estimates

**Subtotal Construction Contracts** **\$46,785,000**

#### **Construction Difficulty Costs**

**\$0** Engineering Estimates

#### **Total Direct Costs**

**\$126,453,000**

#### **Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$4,849,000
EPC Construction Management (Includes G&A & Fee)	\$6,369,000
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$653,000
Sales Taxes	\$26,000
Project Contingency	\$21,236,000

**Total Indirect Costs** **\$33,133,000**

#### **Total Contracted Costs**

**\$160,000,000**

#### **Cost Effectiveness**

**\$952 /kW**

### ANNUAL COST

#### **Fixed Annual Costs**

Capacity Factor = 60%

Operating labor	\$2,538,000	20 FTE and	126,882 \$/year
Maintenance labor and materials	\$3,794,000	(DC) X 3.0%	

**Subtotal Fixed Annual Costs** **\$6,332,000**

#### **Variable Annual Costs**

Reagent	\$479,000	15,795 lb/hr and	11.54 \$/ton
Byproduct disposal	\$1,071,000	27,170 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$607,000	4,010 kW and	0.03 \$/kWh
Water	\$177,000	280 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs** **\$2,334,000**

#### **Total Annual Costs**

**\$8,666,000**

#### **Levelized Capital Costs**

**\$19,472,000** (TCI) X 12.17% CRF

#### **Levelized Annual Costs**

**\$28,138,000**

## CANE RUN UNIT 4 - PJFF COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$2,539,000
Mechanical - Balance of Plant (BOP)	\$7,272,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$154,000
Control - DCS Instrumentation	\$171,000
ID Fans	\$793,000 Engineering Estimates

**Subtotal Purchase Contract** **\$10,929,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$2,259,000
Civil/Structural Construction - Sub-Structures	\$859,000
Mechanical/Chemical Construction	\$8,592,000
Electrical/Control Construction	\$2,901,000
Service Contracts & Construction Indirects	\$140,000
Demolition Costs	\$2,754,000 Engineering Estimates

**Subtotal Construction Contracts** **\$17,505,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$28,434,000**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$2,178,000
EPC Construction Management (Includes G&A & Fee)	\$1,425,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$215,000
Sales Taxes	\$77,000
Project Contingency - 18%	\$803,000

**Total Indirect Costs** **\$4,698,000**

**Total Contracted Costs** **\$33,000,000**

**Cost Effectiveness** **\$196 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 60%

Maintenance labor and materials \$990,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$990,000**

#### Variable Annual Costs

Byproduct disposal	\$551,000	13,975 lb/hr and	15 \$/ton
Bag replacement cost	\$134,000	4,030 bags and	100 \$/bag
Cage replacement cost	\$67,000	4,030 cages and	50 \$/cage
ID fan power	\$159,000	1,050 kW and	0.03 \$/kWh
Auxiliary power	\$23,000	155 kW and	0.03 \$/kWh

**Subtotal Variable Annual Costs** **\$934,000**

**Total Annual Costs** **\$1,924,000**

**Levelized Capital Costs** **\$4,016,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$5,940,000**

**Cane Run Unit 4  
168 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis			
<b>CAPITAL COST</b>					
Direct Costs					
Purchased equipment costs					
Long-term storage silo (with truck unloading sys.)	\$124,880	From Previous Mill Creek BACT Study			
Short-term storage silo	\$82,880	From Previous Mill Creek BACT Study			
Air blowers	\$113,680	From Previous Mill Creek BACT Study			
Rotary feeders	\$18,480	From Previous Mill Creek BACT Study			
Injection system	\$75,040	From Previous Mill Creek BACT Study			
Ductwork modifications, supports, platforms	\$0				
Electrical system upgrades	\$491,680	From Previous Mill Creek BACT Study			
Instrumentation and controls	\$23,520	From Previous Mill Creek BACT Study			
Subtotal capital cost (CC)	<u>\$930,160</u>				
Freight	\$42,000	(CC) X	4.5%		
Total purchased equipment cost (PEC)	<u>\$972,000</u>				
Direct installation costs					
Foundation & supports	\$97,000	(PEC) X	10.0%		
Handling & erection	\$194,000	(PEC) X	20.0%		
Electrical	\$97,000	(PEC) X	10.0%		
Piping	\$49,000	(PEC) X	5.0%		
Insulation	\$19,000	(PEC) X	2.0%		
Painting	\$49,000	(PEC) X	5.0%		
Demolition	\$0	(PEC) X	0.0%		
Relocation	\$0	(PEC) X	0.0%		
Total direct installation costs (DIC)	<u>\$505,000</u>				
Site preparation	\$0	N/A			
Buildings	\$75,000	Engineering estimate			
Total direct costs (DC) = (PEC) + (DIC)	<u>\$1,552,000</u>				
Indirect Costs					
Engineering	\$186,000	(DC) X	12.0%		
Owner's cost	\$186,000	(DC) X	12.0%		
Construction management	\$155,000	(DC) X	10.0%		
Start-up and spare parts	\$23,000	(DC) X	1.5%		
Performance test	\$100,000	Engineering estimate			
Contingencies	\$310,000	(DC) X	20.0%		
Total indirect costs (IC)	<u>\$960,000</u>				
Allowance for Funds Used During Construction (AFDC)	\$57,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)	
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$2,569,000</b>				
<b>Cost Effectiveness</b>	<b>\$15 /kW</b>				
<b>ANNUAL COST</b>					
Direct Annual Costs					
Fixed annual costs					
Maintenance labor and materials	\$47,000	(DC) X	3.0%		
Operating labor	\$127,000			1 FTE and 126,882 \$/year	Estimated manpower
Total fixed annual costs	<u>\$174,000</u>				
Variable annual costs					
Lime	\$702,000			2,020 lb/hr and 132.19 \$/ton	60 % capacity factor
Byproduct disposal	\$91,000			2,310 lb/hr and 15 \$/ton	
Auxiliary power	\$16,000			105 kW and 0.0288 \$/kWh	
Total variable annual costs	<u>\$809,000</u>				
<b>Total direct annual costs (DAC)</b>	<b>\$983,000</b>				
Indirect Annual Costs					
Cost for capital recovery	\$313,000	(TCI) X	12.17%	CRF	
Total indirect annual costs (IDAC)	<u>\$313,000</u>				
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$1,296,000</b>				

**Cane Run Unit 4  
168 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis			
<b>CAPITAL COST</b>					
Direct Costs					
Purchased equipment costs					
Long-term storage silo (with truck unloading sys.)	\$141,532	Ratio from Brown Unit 3 BACT Analysis			
Short-term storage silo	\$93,007	Ratio from Brown Unit 3 BACT Analysis			
Air blowers	\$129,400	Ratio from Brown Unit 3 BACT Analysis			
Rotary feeders	\$16,175	Ratio from Brown Unit 3 BACT Analysis			
Injection system	\$60,656	Ratio from Brown Unit 3 BACT Analysis			
Ductwork modifications, supports, platforms	\$0				
Electrical system upgrades	\$388,201	Ratio from Brown Unit 3 BACT Analysis			
Instrumentation and controls	\$20,219	Ratio from Brown Unit 3 BACT Analysis			
Subtotal capital cost (CC)	<u>\$849,190</u>				
Freight	\$21,000	(CC) X	2.5%		
Total purchased equipment cost (PEC)	<u>\$870,000</u>				
Direct installation costs					
Foundation & supports	\$87,000	(PEC) X	10.0%		
Handling & erection	\$174,000	(PEC) X	20.0%		
Electrical	\$87,000	(PEC) X	10.0%		
Piping	\$44,000	(PEC) X	5.0%		
Insulation	\$17,000	(PEC) X	2.0%		
Painting	\$44,000	(PEC) X	5.0%		
Demolition	\$0	(PEC) X	0.0%		
Relocation	\$0	(PEC) X	0.0%		
Total direct installation costs (DIC)	<u>\$453,000</u>				
Site preparation	\$0	N/A			
Buildings	\$75,000	Engineering estimate			
Total direct costs (DC) = (PEC) + (DIC)	<u>\$1,398,000</u>				
Indirect Costs					
Engineering	\$168,000	(DC) X	12.0%		
Owner's cost	\$168,000	(DC) X	12.0%		
Construction management	\$140,000	(DC) X	10.0%		
Start-up and spare parts	\$21,000	(DC) X	1.5%		
Performance test	\$100,000	Engineering estimate			
Contingencies	\$280,000	(DC) X	20.0%		
Total indirect costs (IC)	<u>\$877,000</u>				
Allowance for Funds Used During Construction (AFDC)	\$51,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)	
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$2,326,000</b>				
<b>Cost Effectiveness</b>	<b>\$14 /kW</b>				
<b>ANNUAL COST</b>					
Direct Annual Costs					
Fixed annual costs					
Maintenance labor and materials	\$42,000	(DC) X	3.0%		
Operating labor	\$127,000	1 FTE and	126,882 \$/year	Estimated manpower	
Total fixed annual costs	<u>\$169,000</u>				
Variable annual costs					
Reagent (BPAC)	\$896,000	155 lb/hr and	2200 \$/ton	60 % capacity factor	
Byproduct disposal	\$6,000	155 lb/hr and	15 \$/ton		
Auxiliary power	\$16,000	105 kW and	0.0288 \$/kWh		
Total variable annual costs	<u>\$918,000</u>				
<b>Total direct annual costs (DAC)</b>	<b>\$1,087,000</b>				
Indirect Annual Costs					
Cost for capital recovery	\$283,000	(TCI) X	12.17%	CRF	
Total indirect annual costs (IDAC)	<u>\$283,000</u>				
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$1,370,000</b>				

Plant Name: Cane Run  
 Unit: 5  
 MW: 181  
 Project description: High Level Emissions Control Study  
 Revised on: 06/22/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$66,000,000	\$365	\$2,421,000	\$10,453,000
WFGD	\$168,000,000	\$928	\$9,056,000	\$29,502,000
Fabric Filter	\$35,000,000	\$193	\$2,061,000	\$6,321,000
Lime Injection	\$2,752,000	\$15	\$1,089,000	\$1,424,000
PAC Injection	\$2,490,000	\$14	\$1,120,000	\$1,423,000
Neural Networks	\$500,000	\$3	\$50,000	\$111,000
Total	\$274,742,000	\$1,518	\$15,797,000	\$49,234,000

**CANE RUN UNIT 5 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$4,651,000	
Ductwork and Breeching	\$3,592,000	
Mechanical - Balance of Plant (BOP)	\$1,176,000	
Electrical - Equipment, Raceway	\$1,344,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$470,000	
Control - DCS Instrumentation	\$151,000	
Air Heater	\$3,135,000	Engineering Estimates
ID Fans	\$1,864,000	Engineering Estimates
Catalyst	\$1,890,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$1,648,000	

**Subtotal Purchase Contract** **\$20,421,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$2,864,000	
Civil/Structural Construction - Sub-Structures	\$744,000	
Mechanical/Chemical Construction	\$9,001,000	
Electrical/Control Construction	\$4,117,000	
Service Contracts & Construction Indirects	\$14,379,000	
Demolition Costs	\$2,967,000	Engineering Estimates

**Subtotal Construction Contracts** **\$34,072,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$54,493,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$2,711,000	
EPC Construction Management (Includes G&A & Fee)	\$1,701,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$446,000	
Sales Taxes	\$630,000	
Project Contingency	\$6,361,000	

**Total Indirect Costs** **\$11,849,000**

**Total Contracted Costs** **\$66,000,000**

**Capital Cost Effectiveness** **\$365 /kW**

**ANNUAL COST**

Capacity Factor = 62%

**Fixed Annual Costs**

Operating labor	\$127,000	1 FTE and	126,882 \$/year
Maintenance labor & materials	\$1,635,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$1,812,000**

**Variable Annual Costs**

Reagent	\$273,000	190 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$155,000	1,005 kW and	0.02835 \$/kWh
Catalyst replacement	\$181,000	45 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$609,000**

**Total Annual Costs** **\$2,421,000**

**Levelized Capital Costs** **\$8,032,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$10,453,000**

## CANE RUN UNIT 5 - WFGD COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$1,791,000
Ductwork and Breeching	\$2,759,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$59,354,000
Electrical - Equipment, Raceway	\$6,592,000
VFDs, Motors and Couplings	\$3,874,000
Switchgear and MCCs	\$4,000,000
Control - DCS Instrumentation	\$3,698,000
ID Fans	\$1,291,000 Engineering Estimates

**Subtotal Purchase Contract** **\$83,359,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$6,665,000
Civil/Structural Construction - Sub-Structures	\$649,000
Mechanical/Chemical Construction	\$15,226,000
Electrical/Control Construction	\$6,242,000
Service Contracts & Construction Indirects	\$11,862,000
Demolition Costs	\$8,902,000 Engineering Estimates

**Subtotal Construction Contracts** **\$49,546,000**

#### Construction Difficulty Costs

**\$0** Engineering Estimates

#### Total Direct Costs

**\$132,905,000**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$5,147,000
EPC Construction Management (Includes G&A & Fee)	\$6,760,000
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$693,000
Sales Taxes	\$27,000
Project Contingency	\$22,541,000

**Total Indirect Costs** **\$35,168,000**

#### Total Contracted Costs

**\$168,000,000**

#### Cost Effectiveness

**\$928 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 62%

Operating labor	\$2,538,000	20 FTE and	126,882 \$/year
Maintenance labor and materials	\$3,987,000	(DC) X 3.0%	

**Subtotal Fixed Annual Costs** **\$6,525,000**

#### Variable Annual Costs

Reagent	\$542,000	17,310 lb/hr and	11.54 \$/ton
Byproduct disposal	\$1,216,000	29,850 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$617,000	4,010 kW and	0.03 \$/kWh
Water	\$156,000	240 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs** **\$2,531,000**

#### Total Annual Costs

**\$9,056,000**

#### Levelized Capital Costs

**\$20,446,000** (TCI) X 12.17% CRF

#### Levelized Annual Costs

**\$29,502,000**

## CANE RUN UNIT 5 - PJFF COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$2,655,000	
Mechanical - Balance of Plant (BOP)	\$7,605,000	
Electrical - Equipment, Raceway, Switchgears, MCC	\$161,000	
Control - DCS Instrumentation	\$179,000	
ID Fans	\$861,000	Engineering Estimates

**Subtotal Purchase Contract** **\$11,461,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$2,362,000	
Civil/Structural Construction - Sub-Structures	\$898,000	
Mechanical/Chemical Construction	\$8,985,000	
Electrical/Control Construction	\$3,034,000	
Service Contracts & Construction Indirects	\$146,000	
Demolition Costs	\$2,967,000	Engineering Estimates

**Subtotal Construction Contracts** **\$18,392,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$29,853,000**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$2,347,000	
EPC Construction Management (Includes G&A & Fee)	\$1,536,000	
Startup Spare Parts (Included)	\$0	
Construction Utilites (Power & Water) - Included	\$0	
Project Insurance	\$232,000	
Sales Taxes	\$83,000	
Project Contingency - 18%	\$865,000	

**Total Indirect Costs** **\$5,063,000**

**Total Contracted Costs** **\$35,000,000**

**Cost Effectiveness** **\$193 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 62%

Maintenance labor and materials \$1,050,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$1,050,000**

#### Variable Annual Costs

Byproduct disposal	\$624,000	15,315 lb/hr and	15 \$/ton
Bag replacement cost	\$134,000	4,030 bags and	100 \$/bag
Cage replacement cost	\$67,000	4,030 cages and	50 \$/cage
ID fan power	\$162,000	1,050 kW and	0.03 \$/kWh
Auxiliary power	\$24,000	155 kW and	0.03 \$/kWh

**Subtotal Variable Annual Costs** **\$1,011,000**

**Total Annual Costs** **\$2,061,000**

**Levelized Capital Costs** **\$4,260,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$6,321,000**

**Cane Run Unit 5  
181 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis			
<b>CAPITAL COST</b>					
Direct Costs					
Purchased equipment costs					
Long-term storage silo (with truck unloading sys.)	\$134,543	From Previous Mill Creek BACT Study			
Short-term storage silo	\$89,293	From Previous Mill Creek BACT Study			
Air blowers	\$122,477	From Previous Mill Creek BACT Study			
Rotary feeders	\$19,910	From Previous Mill Creek BACT Study			
Injection system	\$80,847	From Previous Mill Creek BACT Study			
Ductwork modifications, supports, platforms	\$0				
Electrical system upgrades	\$529,727	From Previous Mill Creek BACT Study			
Instrumentation and controls	\$25,340	From Previous Mill Creek BACT Study			
Subtotal capital cost (CC)	<u>\$1,002,137</u>				
Freight	\$45,000	(CC) X	4.5%		
Total purchased equipment cost (PEC)	<u>\$1,047,000</u>				
Direct installation costs					
Foundation & supports	\$105,000	(PEC) X	10.0%		
Handling & erection	\$209,000	(PEC) X	20.0%		
Electrical	\$105,000	(PEC) X	10.0%		
Piping	\$52,000	(PEC) X	5.0%		
Insulation	\$21,000	(PEC) X	2.0%		
Painting	\$52,000	(PEC) X	5.0%		
Demolition	\$0	(PEC) X	0.0%		
Relocation	\$0	(PEC) X	0.0%		
Total direct installation costs (DIC)	<u>\$544,000</u>				
Site preparation	\$0	N/A			
Buildings	\$75,000	Engineering estimate			
Total direct costs (DC) = (PEC) + (DIC)	<u>\$1,666,000</u>				
Indirect Costs					
Engineering	\$200,000	(DC) X	12.0%		
Owner's cost	\$200,000	(DC) X	12.0%		
Construction management	\$167,000	(DC) X	10.0%		
Start-up and spare parts	\$25,000	(DC) X	1.5%		
Performance test	\$100,000	Engineering estimate			
Contingencies	\$333,000	(DC) X	20.0%		
Total indirect costs (IC)	<u>\$1,025,000</u>				
Allowance for Funds Used During Construction (AFDC)	\$61,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)	
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$2,752,000</b>				
<b>Cost Effectiveness</b>	<b>\$15 /kW</b>				
<b>ANNUAL COST</b>					
Direct Annual Costs					
Fixed annual costs					
Maintenance labor and materials	\$50,000	(DC) X	3.0%		
Operating labor	\$127,000			1 FTE and 126,882 \$/year	Estimated manpower
Total fixed annual costs	<u>\$177,000</u>				
Variable annual costs					
Lime	\$793,000			2,210 lb/hr and 132.19 \$/ton	62 % capacity factor
Byproduct disposal	\$103,000			2,530 lb/hr and 15 \$/ton	
Auxiliary power	\$16,000			105 kW and 0.0288 \$/kWh	
Total variable annual costs	<u>\$912,000</u>				
<b>Total direct annual costs (DAC)</b>	<b>\$1,089,000</b>				
Indirect Annual Costs					
Cost for capital recovery	\$335,000	(TCI) X	12.17%	CRF	
Total indirect annual costs (IDAC)	<u>\$335,000</u>				
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$1,424,000</b>				

**Cane Run Unit 5  
181 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$152,484	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$100,204	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$139,414	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$17,427	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$65,350	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0			
Electrical system upgrades	\$418,241	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$21,783	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$914,902</u>			
Freight	\$23,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$938,000</u>			
Direct installation costs				
Foundation & supports	\$94,000	(PEC) X	10.0%	
Handling & erection	\$188,000	(PEC) X	20.0%	
Electrical	\$94,000	(PEC) X	10.0%	
Piping	\$47,000	(PEC) X	5.0%	
Insulation	\$19,000	(PEC) X	2.0%	
Painting	\$47,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$489,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$1,502,000</u>			
Indirect Costs				
Engineering	\$180,000	(DC) X	12.0%	
Owner's cost	\$180,000	(DC) X	12.0%	
Construction management	\$150,000	(DC) X	10.0%	
Start-up and spare parts	\$23,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$300,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$933,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$55,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$2,490,000</b>			
<b>Cost Effectiveness</b>	<b>\$14 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$45,000	(DC) X	3.0%	
Operating labor	\$127,000	1 FTE and	126,882 \$/year	Estimated manpower
Total fixed annual costs	<u>\$172,000</u>			
Variable annual costs				
Reagent (BPAC)	\$926,000	155 lb/hr and	2200 \$/ton	62 % capacity factor
Byproduct disposal	\$6,000	155 lb/hr and	15 \$/ton	
Auxiliary power	\$16,000	105 kW and	0.0288 \$/kWh	
Total variable annual costs	<u>\$948,000</u>			
<b>Total direct annual costs (DAC)</b>	<b>\$1,120,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$303,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$303,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$1,423,000</b>			

Plant Name: Cane Run  
 Unit: 6  
 MW: 261  
 Project description: High Level Emissions Control Study  
 Revised on: 06/22/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$86,000,000	\$330	\$2,793,000	\$13,259,000
WFGD	\$214,000,000	\$820	\$10,816,000	\$36,860,000
Fabric Filter	\$45,000,000	\$172	\$2,672,000	\$8,149,000
Lime Injection	\$3,873,000	\$15	\$1,367,000	\$1,838,000
PAC Injection	\$3,490,000	\$13	\$1,336,000	\$1,761,000
Neural Networks	\$500,000	\$2	\$50,000	\$111,000
Total	\$352,863,000	\$1,352	\$19,034,000	\$61,978,000

**CANE RUN UNIT 6 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$5,794,000	
Ductwork and Breeching	\$4,475,000	
Mechanical - Balance of Plant (BOP)	\$1,465,000	
Electrical - Equipment, Raceway	\$1,673,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$585,000	
Control - DCS Instrumentation	\$189,000	
Air Heater	\$4,700,000	Engineering Estimates
ID Fans	\$2,349,000	Engineering Estimates
Catalyst	\$2,354,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$2,053,000	

**Subtotal Purchase Contract** **\$26,137,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$3,567,000	
Civil/Structural Construction - Sub-Structures	\$927,000	
Mechanical/Chemical Construction	\$11,211,000	
Electrical/Control Construction	\$5,128,000	
Service Contracts & Construction Indirects	\$17,911,000	
Demolition Costs	\$4,279,000	Engineering Estimates

**Subtotal Construction Contracts** **\$43,023,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$69,160,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$3,909,000	
EPC Construction Management (Includes G&A & Fee)	\$2,453,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$644,000	
Sales Taxes	\$909,000	
Project Contingency	\$9,172,000	

**Total Indirect Costs** **\$17,087,000**

**Total Contracted Costs** **\$86,000,000**

**Capital Cost Effectiveness** **\$330 /kW**

**ANNUAL COST**

Capacity Factor = 54%

**Fixed Annual Costs**

Operating labor	\$127,000	1 FTE and	126,882 \$/year
Maintenance labor & materials	\$2,075,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$2,252,000**

**Variable Annual Costs**

Reagent	\$207,000	165 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$194,000	1,360 kW and	0.03018 \$/kWh
Catalyst replacement	\$140,000	40 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$541,000**

**Total Annual Costs** **\$2,793,000**

**Levelized Capital Costs** **\$10,466,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$13,259,000**

**Cane Run Unit 6  
261 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$194,010	From Previous Mill Creek BACT Study	
Short-term storage silo	\$128,760	From Previous Mill Creek BACT Study	
Air blowers	\$176,610	From Previous Mill Creek BACT Study	
Rotary feeders	\$28,710	From Previous Mill Creek BACT Study	
Injection system	\$116,580	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$0		
Electrical system upgrades	\$763,860	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$36,540	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$1,445,070</u>		
Freight	\$65,000	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$1,510,000</u>		
Direct installation costs			
Foundation & supports	\$151,000	(PEC) X	10.0%
Handling & erection	\$302,000	(PEC) X	20.0%
Electrical	\$151,000	(PEC) X	10.0%
Piping	\$76,000	(PEC) X	5.0%
Insulation	\$30,000	(PEC) X	2.0%
Painting	\$76,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$786,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,371,000</u>		
Indirect Costs			
Engineering	\$285,000	(DC) X	12.0%
Owner's cost	\$285,000	(DC) X	12.0%
Construction management	\$237,000	(DC) X	10.0%
Start-up and spare parts	\$36,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$474,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$1,417,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$85,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$3,873,000</b>		
<b>Cost Effectiveness</b>	<b>\$15 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$71,000	(DC) X	3.0%
Operating labor	\$127,000	1 FTE and 126,882 \$/year      Estimated manpower	
Total fixed annual costs	<u>\$198,000</u>		
Variable annual costs			
Lime	\$1,019,000	3,260 lb/hr and 132.19 \$/ton      54 % capacity factor	
Byproduct disposal	\$132,000	3,730 lb/hr and 15 \$/ton	
Auxiliary power	\$18,000	125 kW and 0.03018 \$/kWh	
Total variable annual costs	<u>\$1,169,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$1,367,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$471,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$471,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$1,838,000</b>		

**Cane Run Unit 6  
261 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$219,880	Ratio from Brown Unit 3 BACT Analysis	
Short-term storage silo	\$144,492	Ratio from Brown Unit 3 BACT Analysis	
Air blowers	\$201,033	Ratio from Brown Unit 3 BACT Analysis	
Rotary feeders	\$25,129	Ratio from Brown Unit 3 BACT Analysis	
Injection system	\$94,234	Ratio from Brown Unit 3 BACT Analysis	
Ductwork modifications, supports, platforms	\$0		
Electrical system upgrades	\$603,098	Ratio from Brown Unit 3 BACT Analysis	
Instrumentation and controls	\$31,411	Ratio from Brown Unit 3 BACT Analysis	
Subtotal capital cost (CC)	<u>\$1,319,278</u>		
Freight	\$33,000	(CC) X	2.5%
Total purchased equipment cost (PEC)	<u>\$1,352,000</u>		
Direct installation costs			
Foundation & supports	\$135,000	(PEC) X	10.0%
Handling & erection	\$270,000	(PEC) X	20.0%
Electrical	\$135,000	(PEC) X	10.0%
Piping	\$68,000	(PEC) X	5.0%
Insulation	\$27,000	(PEC) X	2.0%
Painting	\$68,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$703,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,130,000</u>		
Indirect Costs			
Engineering	\$256,000	(DC) X	12.0%
Owner's cost	\$256,000	(DC) X	12.0%
Construction management	\$213,000	(DC) X	10.0%
Start-up and spare parts	\$32,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$426,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$1,283,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$77,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$3,490,000</b>		
<b>Cost Effectiveness</b>	<b>\$13 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$64,000	(DC) X	3.0%
Operating labor	\$127,000	1 FTE and	126,882 \$/year      Estimated manpower
Total fixed annual costs	<u>\$191,000</u>		
Variable annual costs			
Reagent (BPAC)	\$1,119,000	215 lb/hr and	54 %      2200 \$/ton      capacity factor
Byproduct disposal	\$8,000	215 lb/hr and	15 \$/ton
Auxiliary power	\$18,000	125 kW and	0.03018 \$/kWh
Total variable annual costs	<u>\$1,145,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$1,336,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$425,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$425,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$1,761,000</b>		

# **Mill Creek**

Plant Name: Mill Creek  
 Unit: 1  
 MW: 330  
 Project description: High Level Emissions Control Study  
 Revised on: 05/28/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$97,000,000	\$294	\$3,366,000	\$15,171,000
WFGD	\$297,000,000	\$900	\$14,341,000	\$50,486,000
Fabric Filter	\$81,000,000	\$245	\$3,477,000	\$13,335,000
Electrostatic Precipitator	\$32,882,000	\$100	\$3,581,000	\$7,583,000
Lime Injection	\$4,480,000	\$14	\$2,024,000	\$2,569,000
PAC Injection	\$4,412,000	\$13	\$2,213,000	\$2,750,000
Neural Networks	\$1,000,000	\$3	\$100,000	\$222,000
Total	\$517,774,000	\$1,569	\$29,102,000	\$92,116,000

**MILL CREEK UNIT 1 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$6,669,000	
Ductwork and Breeching	\$5,151,000	
Mechanical - Balance of Plant (BOP)	\$1,687,000	
Electrical - Equipment, Raceway	\$1,926,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$674,000	
Control - DCS Instrumentation	\$217,000	
Air Heater Modifications	\$1,704,000	Engineering Estimates
ID Fans	\$3,262,000	Engineering Estimates
Catalyst	\$2,709,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$2,363,000	

**Subtotal Purchase Contract** **\$26,862,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$4,106,000	
Civil/Structural Construction - Sub-Structures	\$1,067,000	
Mechanical/Chemical Construction	\$12,906,000	
Electrical/Control Construction	\$5,902,000	
Service Contracts & Construction Indirects	\$20,617,000	
Demolition Costs	\$4,104,000	Engineering Estimates

**Subtotal Construction Contracts** **\$48,702,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$75,564,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$4,942,000	
EPC Construction Management (Includes G&A & Fee)	\$3,101,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$814,000	
Sales Taxes	\$1,149,000	
Project Contingency	\$11,597,000	

**Total Indirect Costs** **\$21,603,000**

**Total Contracted Costs** **\$97,000,000**

**Capital Cost Effectiveness** **\$294 /kW**

**ANNUAL COST**

Capacity Factor = 68%

**Fixed Annual Costs**

Operating labor	\$133,000	1 FTE and	132,901 \$/year
Maintenance labor & materials	\$2,267,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$2,450,000**

**Variable Annual Costs**

Reagent	\$418,000	265 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$233,000	1,815 kW and	0.02156 \$/kWh
Catalyst replacement	\$265,000	60 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$916,000**

**Total Annual Costs** **\$3,366,000**

**Levelized Capital Costs** **\$11,805,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$15,171,000**

**MILL CREEK UNIT 1 - WFGD COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,568,000
Ductwork and Breeching	\$3,956,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$85,104,000
Electrical - Equipment, Raceway	\$9,452,000
VFDs, Motors and Couplings	\$5,555,000
Switchgear and MCCs	\$5,736,000
Control - DCS Instrumentation	\$5,303,000
ID Fans	\$2,510,000 Engineering Estimates

**Subtotal Purchase Contract \$120,184,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$9,556,000
Civil/Structural Construction - Sub-Structures	\$931,000
Mechanical/Chemical Construction	\$21,832,000
Electrical/Control Construction	\$8,950,000
Service Contracts & Construction Indirects	\$17,009,000
Demolition Costs	\$12,313,000 Engineering Estimates

**Subtotal Construction Contracts \$70,591,000**

**Construction Difficulty Costs \$49,414,000 Engineering Estimates**

**Total Direct Costs \$240,189,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$8,322,000
EPC Construction Management (Includes G&A & Fee)	\$10,930,000
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$1,121,000
Sales Taxes	\$44,000
Project Contingency	\$36,445,000

**Total Indirect Costs \$56,862,000**

**Total Contracted Costs \$297,000,000**

**Cost Effectiveness \$900 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 68%

Operating labor	\$2,658,000	20 FTE and	132,901 \$/year
Maintenance labor and materials	\$7,206,000	(DC) X 3.0%	

**Subtotal Fixed Annual Costs \$9,864,000**

**Variable Annual Costs**

Reagent	\$713,000	31,765 lb/hr and	7.54 \$/ton
Byproduct disposal	\$2,444,000	54,715 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$963,000	7,495 kW and	0.02156 \$/kWh
Water	\$357,000	500 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs \$4,477,000**

**Total Annual Costs \$14,341,000**

**Levelized Capital Costs \$36,145,000 (TCI) X 12.17% CRF**

**Levelized Annual Costs \$50,486,000**

## MILL CREEK UNIT 1 - PJFF COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$4,568,000
Mechanical - Balance of Plant (BOP)	\$13,085,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$277,000
Control - DCS Instrumentation	\$308,000
ID Fans	\$1,757,000
Engineering Estimates	

**Subtotal Purchase Contract** **\$19,995,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$4,065,000
Civil/Structural Construction - Sub-Structures	\$1,545,000
Mechanical/Chemical Construction	\$15,460,000
Electrical/Control Construction	\$5,221,000
Service Contracts & Construction Indirects	\$252,000
Demolition Costs	\$4,104,000
Engineering Estimates	

**Subtotal Construction Contracts** **\$30,647,000**

**Construction Difficulty Costs** **\$21,452,900** Engineering Estimates

**Total Direct Costs** **\$72,094,900**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$4,279,000
EPC Construction Management (Includes G&A & Fee)	\$2,800,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$423,000
Sales Taxes	\$151,000
Project Contingency - 18%	\$1,577,000

**Total Indirect Costs** **\$9,230,000**

**Total Contracted Costs** **\$81,000,000**

**Cost Effectiveness** **\$245 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 68%

Maintenance labor and materials \$2,430,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$2,430,000**

#### Variable Annual Costs

Byproduct disposal	\$0	0 lb/hr and	15 \$/ton
Bag replacement cost	\$471,000	14,140 bags and	100 \$/bag
Cage replacement cost	\$236,000	14,140 cages and	50 \$/cage
ID fan power	\$262,000	2,040 kW and	0.02156 \$/kWh
Auxiliary power	\$78,000	610 kW and	0.02156 \$/kWh

**Subtotal Variable Annual Costs** **\$1,047,000**

**Total Annual Costs** **\$3,477,000**

**Levelized Capital Costs** **\$9,858,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$13,335,000**

**Mill Creek Unit 1  
330 MW  
High Level Emissions Control Study**

Technology: Electrostatic Precipitator (ESP)

Date: 7/8/2010

Cost Item	\$	Remarks
<b>CAPITAL COST</b>		
Direct Costs		
Purchased equipment costs		
ESP	\$7,399,831	From Previous Study
Ash handling system	\$538,703	From Previous Study
ID fan	\$501,831	Apportioned Engineering Estimate
Flue gas ductwork	\$2,000,000	Engineering Estimate
Subtotal capital cost (CC)	<u>\$10,440,365</u>	
Instrumentation and controls	\$209,000	(CC) X 2.0%
Taxes	\$731,000	(CC) X 7.0%
Freight	\$522,000	(CC) X 5.0%
Total purchased equipment cost (PEC)	<u>\$11,902,000</u>	
Direct installation costs		
Foundation & supports	\$1,785,000	(PEC) X 15.0%
Handling & erection	\$1,190,000	(PEC) X 10.0%
Electrical	\$2,380,000	(PEC) X 20.0%
Piping	\$298,000	(PEC) X 2.5%
Insulation	\$238,000	(PEC) X 2.0%
Painting	\$60,000	(PEC) X 0.5%
Demolition	\$2,052,000	Engineering Estimate
Relocation	\$1,000	(PEC) X 0.01%
Total direct installation costs (DIC)	<u>\$8,004,000</u>	
Site preparation	\$200,000	Estimate
Total direct costs (DC) = (PEC) + (DIC)	<u>\$20,106,000</u>	
Indirect Costs		
Engineering	\$2,413,000	(DC) X 12.0%
Owners Cost	\$603,000	(DC) X 3.0%
Construction and field expenses	\$2,011,000	(DC) X 10.0%
Contractor fees	\$2,011,000	(DC) X 10.0%
Start-up	\$603,000	(DC) X 3.0%
Performance test	\$40,000	(DC) X 0.2%
Contingencies	\$3,016,000	(DC) X 15.0%
Total indirect costs (IC)	<u>\$10,697,000</u>	
Allowance for Funds Used During Construction (AFDC)	\$2,079,000	[(DC)+(IC)] X 4.5%      3 years (project time length)
<b>Total Capital Investment (TCI) = (DC) + (IC)</b>	<b>\$32,882,000</b>	
<b>Cost Effectiveness</b>	<b>\$100 /kW</b>	
<b>ANNUAL COST</b>		
Direct Annual Costs		
Fixed annual costs		
Maintenance labor and materials	\$2,155,000	Engineering Estimates
Total fixed annual costs	<u>\$2,155,000</u>	
Variable annual costs		
Byproduct disposal	\$1,255,000	28,100 lb/hr and 68 % capacity factor 15 \$/ton
ID fan power	\$103,000	800 kW and 0.02156 \$/kWh
Auxiliary power	\$68,000	530 kW and 0.02156 \$/kWh
Total variable annual costs	<u>\$1,426,000</u>	
<b>Total direct annual costs (DAC)</b>	<b><u>\$3,581,000</u></b>	
Indirect Annual Costs		
Cost for capital recovery	\$4,002,000	(TCI) X 12.17% CRF
Total indirect annual costs (IDAC)	<u>\$4,002,000</u>	
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$7,583,000</b>	

**Mill Creek Unit 1  
330 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$223,000	From Previous Mill Creek BACT Study	
Short-term storage silo	\$148,000	From Previous Mill Creek BACT Study	
Air blowers	\$203,000	From Previous Mill Creek BACT Study	
Rotary feeders	\$33,000	From Previous Mill Creek BACT Study	
Injection system	\$134,000	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$26,000	Ratio from Brown Unit 3 BACT Analysis	
Electrical system upgrades	\$878,000	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$42,000	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$1,687,000</u>		
Freight	\$76,000	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$1,763,000</u>		
Direct installation costs			
Foundation & supports	\$176,000	(PEC) X	10.0%
Handling & erection	\$353,000	(PEC) X	20.0%
Electrical	\$176,000	(PEC) X	10.0%
Piping	\$88,000	(PEC) X	5.0%
Insulation	\$35,000	(PEC) X	2.0%
Painting	\$88,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$916,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,754,000</u>		
Indirect Costs			
Engineering	\$330,000	(DC) X	12.0%
Owner's cost	\$330,000	(DC) X	12.0%
Construction management	\$275,000	(DC) X	10.0%
Start-up and spare parts	\$41,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$551,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$1,627,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$99,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,480,000</b>		
<b>Cost Effectiveness</b>	<b>\$14 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$83,000	(DC) X	3.0%
Operating labor	\$133,000	1 FTE and 132,901 \$/year      Estimated manpower	
Total fixed annual costs	<u>\$216,000</u>		
Variable annual costs			
Lime	\$1,428,000	4,060 lb/hr and 118.13 \$/ton      68 % capacity factor	
Byproduct disposal cost	\$360,000	4,640 lb/hr and 15 \$/ton	
Auxiliary power	\$20,000	155 kW and 0.02156 \$/kWh	
Total variable annual costs	<u>\$1,808,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$2,024,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$545,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$545,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,569,000</b>		

**Mill Creek Unit 1  
330 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$278,009	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$182,691	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$254,179	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$31,772	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$119,147	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$23,829	Ratio from Brown Unit 3 BACT Analysis		
Electrical system upgrades	\$762,538	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$39,716	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$1,691,882</u>			
Freight	\$42,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$1,734,000</u>			
Direct installation costs				
Foundation & supports	\$173,000	(PEC) X	10.0%	
Handling & erection	\$347,000	(PEC) X	20.0%	
Electrical	\$173,000	(PEC) X	10.0%	
Piping	\$87,000	(PEC) X	5.0%	
Insulation	\$35,000	(PEC) X	2.0%	
Painting	\$87,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$902,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,711,000</u>			
Indirect Costs				
Engineering	\$325,000	(DC) X	12.0%	
Owner's cost	\$325,000	(DC) X	12.0%	
Construction management	\$271,000	(DC) X	10.0%	
Start-up and spare parts	\$41,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$542,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$1,604,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$97,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,412,000</b>			
<b>Cost Effectiveness</b>	<b>\$13 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$81,000	(DC) X	3.0%	
Operating labor	\$133,000	1 FTE and	132,901 \$/year	Estimated manpower
Total fixed annual costs	<u>\$214,000</u>			
Variable annual costs				
Reagent (BPAC)	\$1,966,000	300 lb/hr and	68 %	capacity factor
Byproduct disposal cost	\$13,000	300 lb/hr and	2200 \$/ton	
Auxiliary power	\$20,000	155 kW and	15 \$/ton	
Total variable annual costs	<u>\$1,999,000</u>	0.02156 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$2,213,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$537,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$537,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,750,000</b>			

Plant Name: Mill Creek  
 Unit: 2  
 MW: 330  
 Project description: High Level Emissions Control Study  
 Revised on: 05/28/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$97,000,000	\$294	\$3,401,000	\$15,206,000
WFGD	\$297,000,000	\$900	\$14,604,000	\$50,749,000
Fabric Filter	\$81,000,000	\$245	\$3,518,000	\$13,376,000
Electrostatic Precipitator	\$32,882,000	\$100	\$3,664,000	\$7,666,000
Lime Injection	\$4,480,000	\$14	\$2,117,000	\$2,662,000
PAC Injection	\$4,412,000	\$13	\$2,340,000	\$2,877,000
Neural Networks	\$1,000,000	\$3	\$100,000	\$222,000
Total	\$517,774,000	\$1,569	\$29,744,000	\$92,758,000

**MILL CREEK UNIT 2 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$6,669,000	
Ductwork and Breeching	\$5,151,000	
Mechanical - Balance of Plant (BOP)	\$1,687,000	
Electrical - Equipment, Raceway	\$1,926,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$674,000	
Control - DCS Instrumentation	\$217,000	
Air Heater Modifications	\$1,704,000	Engineering Estimates
ID Fans	\$3,262,000	Engineering Estimates
Catalyst	\$2,709,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$2,363,000	

**Subtotal Purchase Contract** **\$26,862,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$4,106,000	
Civil/Structural Construction - Sub-Structures	\$1,067,000	
Mechanical/Chemical Construction	\$12,906,000	
Electrical/Control Construction	\$5,902,000	
Service Contracts & Construction Indirects	\$20,617,000	
Demolition Costs	\$4,104,000	Engineering Estimates

**Subtotal Construction Contracts** **\$48,702,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$75,564,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$4,942,000	
EPC Construction Management (Includes G&A & Fee)	\$3,101,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$814,000	
Sales Taxes	\$1,149,000	
Project Contingency	\$11,597,000	

**Total Indirect Costs** **\$21,603,000**

**Total Contracted Costs** **\$97,000,000**

**Capital Cost Effectiveness** **\$294 /kW**

**ANNUAL COST**

Capacity Factor = 70%

**Fixed Annual Costs**

Operating labor	\$133,000	1 FTE and	132,901 \$/year
Maintenance labor & materials	\$2,267,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$2,450,000**

**Variable Annual Costs**

Reagent	\$431,000	265 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$247,000	1,860 kW and	0.02169 \$/kWh
Catalyst replacement	\$273,000	60 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$951,000**

**Total Annual Costs** **\$3,401,000**

**Levelized Capital Costs** **\$11,805,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$15,206,000**

**MILL CREEK UNIT 2 - WFGD COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,568,000
Ductwork and Breeching	\$3,956,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$85,104,000
Electrical - Equipment, Raceway	\$9,452,000
VFDs, Motors and Couplings	\$5,555,000
Switchgear and MCCs	\$5,736,000
Control - DCS Instrumentation	\$5,303,000
ID Fans	\$2,510,000 Engineering Estimates

**Subtotal Purchase Contract \$120,184,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$9,556,000
Civil/Structural Construction - Sub-Structures	\$931,000
Mechanical/Chemical Construction	\$21,832,000
Electrical/Control Construction	\$8,950,000
Service Contracts & Construction Indirects	\$17,009,000
Demolition Costs	\$12,313,000 Engineering Estimates

**Subtotal Construction Contracts \$70,591,000**

**Construction Difficulty Costs \$49,414,000 Engineering Estimates**

**Total Direct Costs \$240,189,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$8,322,000
EPC Construction Management (Includes G&A & Fee)	\$10,930,000
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$1,121,000
Sales Taxes	\$44,000
Project Contingency	\$36,445,000

**Total Indirect Costs \$56,862,000**

**Total Contracted Costs \$297,000,000**

**Cost Effectiveness \$900 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 70%

Operating labor	\$2,658,000	20 FTE and	132,901 \$/year
Maintenance labor and materials	\$7,206,000	(DC) X	3.0%

**Subtotal Fixed Annual Costs \$9,864,000**

**Variable Annual Costs**

Reagent	\$754,000	32,620 lb/hr and	7.54 \$/ton
Byproduct disposal	\$2,584,000	56,195 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$1,023,000	7,695 kW and	0.02169 \$/kWh
Water	\$379,000	515 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs \$4,740,000**

**Total Annual Costs \$14,604,000**

**Levelized Capital Costs \$36,145,000 (TCI) X 12.17% CRF**

**Levelized Annual Costs \$50,749,000**

**MILL CREEK UNIT 2 - PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$4,568,000
Mechanical - Balance of Plant (BOP)	\$13,085,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$277,000
Control - DCS Instrumentation	\$308,000
ID Fans	\$1,757,000
Engineering Estimates	

**Subtotal Purchase Contract** **\$19,995,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$4,065,000
Civil/Structural Construction - Sub-Structures	\$1,545,000
Mechanical/Chemical Construction	\$15,460,000
Electrical/Control Construction	\$5,221,000
Service Contracts & Construction Indirects	\$252,000
Demolition Costs	\$4,104,000
Engineering Estimates	

**Subtotal Construction Contracts** **\$30,647,000**

**Construction Difficulty Costs** **\$21,452,900** Engineering Estimates

**Total Direct Costs** **\$72,094,900**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$4,279,000
EPC Construction Management (Includes G&A & Fee)	\$2,800,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$423,000
Sales Taxes	\$151,000
Project Contingency - 18%	\$1,577,000

**Total Indirect Costs** **\$9,230,000**

**Total Contracted Costs** **\$81,000,000**

**Cost Effectiveness** **\$245 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 70%

Maintenance labor and materials	\$2,430,000	(DC) X 3.0%
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**Subtotal Fixed Annual Costs** **\$2,430,000**

**Variable Annual Costs**

Byproduct disposal	\$0	0 lb/hr and	15 \$/ton
Bag replacement cost	\$484,000	14,520 bags and	100 \$/bag
Cage replacement cost	\$242,000	14,520 cages and	50 \$/cage
ID fan power	\$279,000	2,095 kW and	0.02169 \$/kWh
Auxiliary power	\$83,000	625 kW and	0.02169 \$/kWh

**Subtotal Variable Annual Costs** **\$1,088,000**

**Total Annual Costs** **\$3,518,000**

**Levelized Capital Costs** **\$9,858,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$13,376,000**

**Mill Creek Unit 2  
330 MW  
High Level Emissions Control Study**

Technology: Electrostatic Precipitator (ESP)

Date: 7/8/2010

Cost Item	\$	Remarks
<b>CAPITAL COST</b>		
Direct Costs		
Purchased equipment costs		
ESP	\$7,399,831	From Previous Study
Ash handling system	\$538,703	From Previous Study
ID fan	\$501,831	Apportioned Engineering Estimate
Flue gas ductwork	\$2,000,000	Engineering Estimate
Subtotal capital cost (CC)	<u>\$10,440,365</u>	
Instrumentation and controls	\$209,000	(CC) X 2.0%
Taxes	\$731,000	(CC) X 7.0%
Freight	\$522,000	(CC) X 5.0%
Total purchased equipment cost (PEC)	<u>\$11,902,000</u>	
Direct installation costs		
Foundation & supports	\$1,785,000	(PEC) X 15.0%
Handling & erection	\$1,190,000	(PEC) X 10.0%
Electrical	\$2,380,000	(PEC) X 20.0%
Piping	\$298,000	(PEC) X 2.5%
Insulation	\$238,000	(PEC) X 2.0%
Painting	\$60,000	(PEC) X 0.5%
Demolition	\$2,052,000	Engineering Estimate
Relocation	\$1,000	(PEC) X 0.01%
Total direct installation costs (DIC)	<u>\$8,004,000</u>	
Site preparation	\$200,000	Estimate
Total direct costs (DC) = (PEC) + (DIC)	<u>\$20,106,000</u>	
Indirect Costs		
Engineering	\$2,413,000	(DC) X 12.0%
Owners Cost	\$603,000	(DC) X 3.0%
Construction and field expenses	\$2,011,000	(DC) X 10.0%
Contractor fees	\$2,011,000	(DC) X 10.0%
Start-up	\$603,000	(DC) X 3.0%
Performance test	\$40,000	(DC) X 0.2%
Contingencies	\$3,016,000	(DC) X 15.0%
Total indirect costs (IC)	<u>\$10,697,000</u>	
Allowance for Funds Used During Construction (AFDC)	\$2,079,000	[(DC)+(IC)] X 4.5%      3 years (project time length)
<b>Total Capital Investment (TCI) = (DC) + (IC)</b>	<b>\$32,882,000</b>	
<b>Cost Effectiveness</b>	<b>\$100 /kW</b>	
<b>ANNUAL COST</b>		
Direct Annual Costs		
Fixed annual costs		
Maintenance labor and materials	\$2,155,000	Engineering Estimates
Total fixed annual costs	<u>\$2,155,000</u>	
Variable annual costs		
Byproduct disposal	\$1,327,000	28,860 lb/hr and 70 % capacity factor 15 \$/ton
ID fan power	\$110,000	825 kW and 0.02169 \$/kWh
Auxiliary power	\$72,000	545 kW and 0.02169 \$/kWh
Total variable annual costs	<u>\$1,509,000</u>	
<b>Total direct annual costs (DAC)</b>	<b><u>\$3,664,000</u></b>	
Indirect Annual Costs		
Cost for capital recovery	\$4,002,000	(TCI) X 12.17% CRF
Total indirect annual costs (IDAC)	<u>\$4,002,000</u>	
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$7,666,000</b>	

**Mill Creek Unit 2  
330 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$223,000	From Previous Mill Creek BACT Study	
Short-term storage silo	\$148,000	From Previous Mill Creek BACT Study	
Air blowers	\$203,000	From Previous Mill Creek BACT Study	
Rotary feeders	\$33,000	From Previous Mill Creek BACT Study	
Injection system	\$134,000	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$26,000	Ratio from Brown Unit 3 BACT Analysis	
Electrical system upgrades	\$878,000	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$42,000	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$1,687,000</u>		
Freight	\$76,000	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$1,763,000</u>		
Direct installation costs			
Foundation & supports	\$176,000	(PEC) X	10.0%
Handling & erection	\$353,000	(PEC) X	20.0%
Electrical	\$176,000	(PEC) X	10.0%
Piping	\$88,000	(PEC) X	5.0%
Insulation	\$35,000	(PEC) X	2.0%
Painting	\$88,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$916,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,754,000</u>		
Indirect Costs			
Engineering	\$330,000	(DC) X	12.0%
Owner's cost	\$330,000	(DC) X	12.0%
Construction management	\$275,000	(DC) X	10.0%
Start-up and spare parts	\$41,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$551,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$1,627,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$99,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,480,000</b>		
<b>Cost Effectiveness</b>	<b>\$14 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$83,000	(DC) X	3.0%
Operating labor	\$133,000	1 FTE and 132,901 \$/year      Estimated manpower	
Total fixed annual costs	<u>\$216,000</u>		
Variable annual costs			
Lime	\$1,510,000	4,170 lb/hr and 118.13 \$/ton      70 % capacity factor	
Byproduct disposal cost	\$370,000	4,770 lb/hr and 15 \$/ton	
Auxiliary power	\$21,000	155 kW and 0.02169 \$/kWh	
Total variable annual costs	<u>\$1,901,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$2,117,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$545,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$545,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,662,000</b>		

**Mill Creek Unit 2  
330 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$278,009	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$182,691	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$254,179	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$31,772	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$119,147	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$23,829	Ratio from Brown Unit 3 BACT Analysis		
Electrical system upgrades	\$762,538	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$39,716	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$1,691,882</u>			
Freight	\$42,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$1,734,000</u>			
Direct installation costs				
Foundation & supports	\$173,000	(PEC) X	10.0%	
Handling & erection	\$347,000	(PEC) X	20.0%	
Electrical	\$173,000	(PEC) X	10.0%	
Piping	\$87,000	(PEC) X	5.0%	
Insulation	\$35,000	(PEC) X	2.0%	
Painting	\$87,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$902,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,711,000</u>			
Indirect Costs				
Engineering	\$325,000	(DC) X	12.0%	
Owner's cost	\$325,000	(DC) X	12.0%	
Construction management	\$271,000	(DC) X	10.0%	
Start-up and spare parts	\$41,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$542,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$1,604,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$97,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,412,000</b>			
<b>Cost Effectiveness</b>	<b>\$13 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$81,000	(DC) X	3.0%	
Operating labor	\$133,000	1 FTE and	132,901 \$/year	Estimated manpower
Total fixed annual costs	<u>\$214,000</u>			
Variable annual costs				
Reagent (BPAC)	\$2,091,000	310 lb/hr and	70 %	capacity factor
Byproduct disposal cost	\$14,000	310 lb/hr and	2200 \$/ton	
Auxiliary power	\$21,000	155 kW and	15 \$/ton	
Total variable annual costs	<u>\$2,126,000</u>	0.02169 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$2,340,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$537,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$537,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,877,000</b>			

Plant Name: Mill Creek  
Unit: 3  
MW 423  
Project description High Level Emissions Control Study  
Revised on: 05/28/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
WFGD	\$392,000,000	\$927	\$18,911,000	\$66,617,000
Fabric Filter	\$114,000,000	\$270	\$4,923,000	\$18,797,000
PAC Injection	\$5,592,000	\$13	\$3,213,000	\$3,894,000
Neural Networks	\$1,000,000	\$2	\$100,000	\$222,000
Total	\$512,592,000	\$1,212	\$27,147,000	\$89,530,000

**MILL CREEK UNIT 3 - WFGD COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,980,000
Ductwork and Breeching	\$4,591,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$98,775,000
Electrical - Equipment, Raceway	\$10,970,000
VFDs, Motors and Couplings	\$6,447,000
Switchgear and MCCs	\$6,657,000
Control - DCS Instrumentation	\$6,155,000
ID Fans	\$2,445,000 Engineering Estimates

**Subtotal Purchase Contract \$139,020,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$11,091,000
Civil/Structural Construction - Sub-Structures	\$1,080,000
Mechanical/Chemical Construction	\$25,339,000
Electrical/Control Construction	\$10,387,000
Service Contracts & Construction Indirects	\$19,741,000
Demolition Costs	\$15,784,000 Engineering Estimates

**Subtotal Construction Contracts \$83,422,000**

**Construction Difficulty Costs \$100,106,000 Engineering Estimates**

**Total Direct Costs \$322,548,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$10,150,000
EPC Construction Management (Includes G&A & Fee)	\$13,332,000
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$1,367,000
Sales Taxes	\$54,000
Project Contingency	\$44,453,000

**Total Indirect Costs \$69,356,000**

**Total Contracted Costs \$392,000,000**

**Cost Effectiveness \$927 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 75%

Operating labor	\$2,658,000	20 FTE and	132,901 \$/year
Maintenance labor and materials	\$9,676,000	(DC) X	3.0%

**Subtotal Fixed Annual Costs \$12,334,000**

**Variable Annual Costs**

Reagent	\$1,027,000	41,470 lb/hr and	7.54 \$/ton
Byproduct disposal	\$3,520,000	71,435 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$1,518,000	9,910 kW and	0.02331 \$/kWh
Water	\$512,000	650 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs \$6,577,000**

**Total Annual Costs \$18,911,000**

**Levelized Capital Costs \$47,706,000 (TCI) X 12.17% CRF**

**Levelized Annual Costs \$66,617,000**

## MILL CREEK UNIT 3 - PJFF COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$5,302,000	
Mechanical - Balance of Plant (BOP)	\$15,187,000	
Electrical - Equipment, Raceway, Switchgears, MCC	\$322,000	
Control - DCS Instrumentation	\$357,000	
ID Fans	\$1,467,000	Engineering Estimates

**Subtotal Purchase Contract** **\$22,635,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$4,718,000	
Civil/Structural Construction - Sub-Structures	\$1,793,000	
Mechanical/Chemical Construction	\$17,944,000	
Electrical/Control Construction	\$6,059,000	
Service Contracts & Construction Indirects	\$292,000	
Demolition Costs	\$5,262,000	Engineering Estimates

**Subtotal Construction Contracts** **\$36,068,000**

**Construction Difficulty Costs** **\$43,282,000** Engineering Estimates

**Total Direct Costs** **\$101,985,000**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$5,485,000	
EPC Construction Management (Includes G&A & Fee)	\$3,589,000	
Startup Spare Parts (Included)	\$0	
Construction Utilites (Power & Water) - Included	\$0	
Project Insurance	\$542,000	
Sales Taxes	\$193,000	
Project Contingency - 18%	\$2,021,000	

**Total Indirect Costs** **\$11,830,000**

**Total Contracted Costs** **\$114,000,000**

**Cost Effectiveness** **\$270 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 75%

Maintenance labor and materials \$3,420,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$3,420,000**

#### Variable Annual Costs

Byproduct disposal	\$5,000	95 lb/hr and	15 \$/ton
Bag replacement cost	\$635,000	19,040 bags and	100 \$/bag
Cage replacement cost	\$317,000	19,040 cages and	50 \$/cage
ID fan power	\$420,000	2,745 kW and	0.02331 \$/kWh
Auxiliary power	\$126,000	820 kW and	0.02331 \$/kWh

**Subtotal Variable Annual Costs** **\$1,503,000**

**Total Annual Costs** **\$4,923,000**

**Levelized Capital Costs** **\$13,874,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$18,797,000**

**Mill Creek Unit 3  
423 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$356,357	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$234,177	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$325,812	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$40,726	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$152,724	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$30,545	Ratio from Brown Unit 3 BACT Analysis		
Electrical system upgrades	\$977,435	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$50,908	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$2,168,685</u>			
Freight	\$54,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$2,223,000</u>			
Direct installation costs				
Foundation & supports	\$222,000	(PEC) X	10.0%	
Handling & erection	\$445,000	(PEC) X	20.0%	
Electrical	\$222,000	(PEC) X	10.0%	
Piping	\$111,000	(PEC) X	5.0%	
Insulation	\$44,000	(PEC) X	2.0%	
Painting	\$111,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$1,155,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$3,453,000</u>			
Indirect Costs				
Engineering	\$414,000	(DC) X	12.0%	
Owner's cost	\$414,000	(DC) X	12.0%	
Construction management	\$345,000	(DC) X	10.0%	
Start-up and spare parts	\$52,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$691,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$2,016,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$123,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$5,592,000</b>			
<b>Cost Effectiveness</b>	<b>\$13 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$104,000	(DC) X	3.0%	
Operating labor	\$133,000	1 FTE and	132,901 \$/year	Estimated manpower
Total fixed annual costs	<u>\$237,000</u>			
Variable annual costs				
Reagent (BPAC)	\$2,927,000	405 lb/hr and	75 %	capacity factor
Byproduct disposal cost	\$20,000	405 lb/hr and	2200 \$/ton	
Auxiliary power	\$29,000	190 kW and	15 \$/ton	
Total variable annual costs	<u>\$2,976,000</u>	0.02331 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$3,213,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$681,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$681,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$3,894,000</b>			

Plant Name: Mill Creek  
Unit: 4  
MW 525  
Project description High Level Emissions Control Study  
Revised on: 05/28/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
WFGD	\$455,000,000	\$867	\$21,775,000	\$77,149,000
Fabric Filter	\$133,000,000	\$253	\$5,804,000	\$21,990,000
PAC Injection	\$6,890,000	\$13	\$3,858,000	\$4,697,000
Neural Networks	\$1,000,000	\$2	\$100,000	\$222,000
Total	\$595,890,000	\$1,135	\$31,537,000	\$104,058,000

**MILL CREEK UNIT 4 - WFGD COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$3,392,000
Ductwork and Breeching	\$5,227,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$112,444,000
Electrical - Equipment, Raceway	\$12,488,000
VFDs, Motors and Couplings	\$7,339,000
Switchgear and MCCs	\$7,578,000
Control - DCS Instrumentation	\$7,007,000
ID Fans	\$5,018,313 Engineering Estimates

**Subtotal Purchase Contract** **\$160,493,313**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$12,626,000
Civil/Structural Construction - Sub-Structures	\$1,230,000
Mechanical/Chemical Construction	\$28,846,000
Electrical/Control Construction	\$11,825,000
Service Contracts & Construction Indirects	\$22,473,000
Demolition Costs	\$19,590,000 Engineering Estimates

**Subtotal Construction Contracts** **\$96,590,000**

**Construction Difficulty Costs** **\$115,908,000** Engineering Estimates

**Total Direct Costs** **\$372,991,313**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$12,065,000
EPC Construction Management (Includes G&A & Fee)	\$15,847,000
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$1,625,000
Sales Taxes	\$64,000
Project Contingency	\$52,840,000

**Total Indirect Costs** **\$82,441,000**

**Total Contracted Costs** **\$455,000,000**

**Cost Effectiveness** **\$867 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 75%

Operating labor	\$2,658,000	20 FTE and	132,901 \$/year
Maintenance labor and materials	\$11,190,000	(DC) X	3.0%

**Subtotal Fixed Annual Costs** **\$13,848,000**

**Variable Annual Costs**

Reagent	\$1,250,000	50,465 lb/hr and	7.54 \$/ton
Byproduct disposal	\$4,284,000	86,935 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$1,770,000	12,055 kW and	0.02235 \$/kWh
Water	\$623,000	790 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs** **\$7,927,000**

**Total Annual Costs** **\$21,775,000**

**Levelized Capital Costs** **\$55,374,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$77,149,000**

**MILL CREEK UNIT 4 - PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$6,036,000
Mechanical - Balance of Plant (BOP)	\$17,289,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$366,000
Control - DCS Instrumentation	\$407,000
ID Fans	\$3,010,988 Engineering Estimates

**Subtotal Purchase Contract** **\$27,108,988**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$5,371,000
Civil/Structural Construction - Sub-Structures	\$2,042,000
Mechanical/Chemical Construction	\$20,427,000
Electrical/Control Construction	\$6,898,000
Service Contracts & Construction Indirects	\$333,000
Demolition Costs	\$6,530,000 Engineering Estimates

**Subtotal Construction Contracts** **\$41,601,000**

**Construction Difficulty Costs** **\$49,921,000** Engineering Estimates

**Total Direct Costs** **\$118,630,988**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$6,807,000
EPC Construction Management (Includes G&A & Fee)	\$4,454,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$673,000
Sales Taxes	\$240,000
Project Contingency - 18%	\$2,508,000

**Total Indirect Costs** **\$14,682,000**

**Total Contracted Costs** **\$133,000,000**

**Cost Effectiveness** **\$253 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 75%

Maintenance labor and materials	\$3,990,000	(DC) X 3.0%
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**Subtotal Fixed Annual Costs** **\$3,990,000**

**Variable Annual Costs**

Byproduct disposal	\$1,000	30 lb/hr and	15 \$/ton
Bag replacement cost	\$768,000	23,050 bags and	100 \$/bag
Cage replacement cost	\$384,000	23,050 cages and	50 \$/cage
ID fan power	\$509,000	3,325 kW and	0.02331 \$/kWh
Auxiliary power	\$152,000	995 kW and	0.02331 \$/kWh

**Subtotal Variable Annual Costs** **\$1,814,000**

**Total Annual Costs** **\$5,804,000**

**Levelized Capital Costs** **\$16,186,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$21,990,000**

**Mill Creek Unit 4**  
**##**  
**High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$442,287	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$290,646	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$404,376	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$50,547	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$189,551	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$37,910	Ratio from Brown Unit 3 BACT Analysis		
Electrical system upgrades	\$1,213,129	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$63,184	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$2,691,630</u>			
Freight	\$67,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$2,759,000</u>			
Direct installation costs				
Foundation & supports	\$276,000	(PEC) X	10.0%	
Handling & erection	\$552,000	(PEC) X	20.0%	
Electrical	\$276,000	(PEC) X	10.0%	
Piping	\$138,000	(PEC) X	5.0%	
Insulation	\$55,000	(PEC) X	2.0%	
Painting	\$138,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$1,435,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$4,269,000</u>			
Indirect Costs				
Engineering	\$512,000	(DC) X	12.0%	
Owner's cost	\$512,000	(DC) X	12.0%	
Construction management	\$427,000	(DC) X	10.0%	
Start-up and spare parts	\$64,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$854,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$2,469,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$152,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$6,890,000</b>			
<b>Cost Effectiveness</b>	<b>\$13 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$128,000	(DC) X	3.0%	
Operating labor	\$133,000	1 FTE and	132,901 \$/year	Estimated manpower
Total fixed annual costs	<u>\$261,000</u>			
Variable annual costs				
Reagent (BPAC)	\$3,541,000	490 lb/hr and	75 %	capacity factor
Byproduct disposal cost	\$24,000	490 lb/hr and	2200 \$/ton	
Auxiliary power	\$32,000	220 kW and	15 \$/ton	
Total variable annual costs	<u>\$3,597,000</u>	0.02235 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$3,858,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$839,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$839,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$4,697,000</b>			

**Mill Creek  
AQC Technology Options**

Plant Name: Mill Creek  
 Unit: 1  
 MW: 330  
 Project description: High Level Emissions Control Study  
 Revised on: 07/01/10

**Option 2: Combined WFGD**

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$97,000,000	\$294	\$3,366,000	\$15,171,000
WFGD	\$254,000,000	\$770	\$13,279,000	\$44,191,000
Fabric Filter	\$81,000,000	\$245	\$3,477,000	\$13,335,000
Electrostatic Precipitator	\$32,882,000	\$100	\$3,581,000	\$7,583,000
Lime Injection	\$4,480,000	\$14	\$2,024,000	\$2,569,000
PAC Injection	\$4,412,000	\$13	\$2,213,000	\$2,750,000
Neural Networks	\$1,000,000	\$3	\$100,000	\$222,000
Total	\$474,774,000	\$1,439	\$28,040,000	\$85,821,000

**MILL CREEK UNIT 1 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$6,669,000	
Ductwork and Breeching	\$5,151,000	
Mechanical - Balance of Plant (BOP)	\$1,687,000	
Electrical - Equipment, Raceway	\$1,926,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$674,000	
Control - DCS Instrumentation	\$217,000	
Air Heater Modifications	\$1,704,000	Engineering Estimates
ID Fans	\$3,262,000	Engineering Estimates
Catalyst	\$2,709,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$2,363,000	

**Subtotal Purchase Contract** **\$26,862,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$4,106,000	
Civil/Structural Construction - Sub-Structures	\$1,067,000	
Mechanical/Chemical Construction	\$12,906,000	
Electrical/Control Construction	\$5,902,000	
Service Contracts & Construction Indirects	\$20,617,000	
Demolition Costs	\$4,104,000	Engineering Estimates

**Subtotal Construction Contracts** **\$48,702,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$75,564,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$4,942,000	
EPC Construction Management (Includes G&A & Fee)	\$3,101,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$814,000	
Sales Taxes	\$1,149,000	
Project Contingency	\$11,597,000	

**Total Indirect Costs** **\$21,603,000**

**Total Contracted Costs** **\$97,000,000**

**Capital Cost Effectiveness** **\$294 /kW**

**ANNUAL COST**

Capacity Factor = 68%

**Fixed Annual Costs**

Operating labor	\$133,000	1 FTE and	132,901 \$/year
Maintenance labor & materials	\$2,267,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$2,450,000**

**Variable Annual Costs**

Reagent	\$418,000	265 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$233,000	1,815 kW and	0.02156 \$/kWh
Catalyst replacement	\$265,000	60 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$916,000**

**Total Annual Costs** **\$3,366,000**

**Levelized Capital Costs** **\$11,805,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$15,171,000**

**MILL CREEK UNIT 1 - COMBINED WFGD COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,140,500
Ductwork and Breeching	\$3,957,500
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$70,946,500
Electrical - Equipment, Raceway	\$7,879,500
VFDs, Motors and Couplings	\$4,631,000
Switchgear and MCCs	\$4,781,500
Control - DCS Instrumentation	\$4,421,000
ID Fans	\$2,510,000 Engineering Estimates

**Subtotal Purchase Contract** **\$101,267,500**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$7,966,500
Civil/Structural Construction - Sub-Structures	\$776,000
Mechanical/Chemical Construction	\$18,200,000
Electrical/Control Construction	\$7,461,000
Service Contracts & Construction Indirects	\$14,179,000
Demolition Costs	\$12,313,000 Engineering Estimates

**Subtotal Construction Contracts** **\$60,895,500**

**Construction Difficulty Costs** **\$42,627,000** Engineering Estimates

**Total Direct Costs** **\$204,790,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$7,244,500
EPC Construction Management (Includes G&A & Fee)	\$9,515,500
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$976,000
Sales Taxes	\$38,500
Project Contingency	\$31,727,500

**Total Indirect Costs** **\$49,502,000**

**Total Contracted Costs** **\$254,000,000**

**Cost Effectiveness** **\$770 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 68%

Operating labor	\$2,658,000	20 FTE and	132,901 \$/year
Maintenance labor and materials	\$6,144,000	(DC) X	3.0%

**Subtotal Fixed Annual Costs** **\$8,802,000**

**Variable Annual Costs**

Reagent	\$713,000	31,765 lb/hr and	7.54 \$/ton
Byproduct disposal	\$2,444,000	54,715 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$963,000	7,495 kW and	0.02156 \$/kWh
Water	\$357,000	500 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs** **\$4,477,000**

**Total Annual Costs** **\$13,279,000**

**Levelized Capital Costs** **\$30,912,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$44,191,000**

## MILL CREEK UNIT 1 - PJFF COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$4,568,000
Mechanical - Balance of Plant (BOP)	\$13,085,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$277,000
Control - DCS Instrumentation	\$308,000
ID Fans	\$1,757,000
Engineering Estimates	

**Subtotal Purchase Contract** **\$19,995,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$4,065,000
Civil/Structural Construction - Sub-Structures	\$1,545,000
Mechanical/Chemical Construction	\$15,460,000
Electrical/Control Construction	\$5,221,000
Service Contracts & Construction Indirects	\$252,000
Demolition Costs	\$4,104,000
Engineering Estimates	

**Subtotal Construction Contracts** **\$30,647,000**

**Construction Difficulty Costs** **\$21,452,900** Engineering Estimates

**Total Direct Costs** **\$72,094,900**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$4,279,000
EPC Construction Management (Includes G&A & Fee)	\$2,800,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$423,000
Sales Taxes	\$151,000
Project Contingency - 18%	\$1,577,000

**Total Indirect Costs** **\$9,230,000**

**Total Contracted Costs** **\$81,000,000**

**Cost Effectiveness** **\$245 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 68%

Maintenance labor and materials \$2,430,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$2,430,000**

#### Variable Annual Costs

Byproduct disposal	\$0	0 lb/hr and	15 \$/ton
Bag replacement cost	\$471,000	14,140 bags and	100 \$/bag
Cage replacement cost	\$236,000	14,140 cages and	50 \$/cage
ID fan power	\$262,000	2,040 kW and	0.02156 \$/kWh
Auxiliary power	\$78,000	610 kW and	0.02156 \$/kWh

**Subtotal Variable Annual Costs** **\$1,047,000**

**Total Annual Costs** **\$3,477,000**

**Levelized Capital Costs** **\$9,858,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$13,335,000**

**Mill Creek Unit 1  
330 MW  
High Level Emissions Control Study**

Technology: Electrostatic Precipitator (ESP)

Date: 7/8/2010

Cost Item	\$	Remarks
<b>CAPITAL COST</b>		
Direct Costs		
Purchased equipment costs		
ESP	\$7,399,831	From Previous Study
Ash handling system	\$538,703	From Previous Study
ID fan	\$501,831	Apportioned Engineering Estimate
Flue gas ductwork	\$2,000,000	Engineering Estimate
Subtotal capital cost (CC)	<u>\$10,440,365</u>	
Instrumentation and controls	\$209,000	(CC) X 2.0%
Taxes	\$731,000	(CC) X 7.0%
Freight	\$522,000	(CC) X 5.0%
Total purchased equipment cost (PEC)	<u>\$11,902,000</u>	
Direct installation costs		
Foundation & supports	\$1,785,000	(PEC) X 15.0%
Handling & erection	\$1,190,000	(PEC) X 10.0%
Electrical	\$2,380,000	(PEC) X 20.0%
Piping	\$298,000	(PEC) X 2.5%
Insulation	\$238,000	(PEC) X 2.0%
Painting	\$60,000	(PEC) X 0.5%
Demolition	\$2,052,000	Engineering Estimate
Relocation	\$1,000	(PEC) X 0.01%
Total direct installation costs (DIC)	<u>\$8,004,000</u>	
Site preparation	\$200,000	Estimate
Total direct costs (DC) = (PEC) + (DIC)	<u>\$20,106,000</u>	
Indirect Costs		
Engineering	\$2,413,000	(DC) X 12.0%
Owners Cost	\$603,000	(DC) X 3.0%
Construction and field expenses	\$2,011,000	(DC) X 10.0%
Contractor fees	\$2,011,000	(DC) X 10.0%
Start-up	\$603,000	(DC) X 3.0%
Performance test	\$40,000	(DC) X 0.2%
Contingencies	\$3,016,000	(DC) X 15.0%
Total indirect costs (IC)	<u>\$10,697,000</u>	
Allowance for Funds Used During Construction (AFDC)	\$2,079,000	[(DC)+(IC)] X 4.5%      3 years (project time length)
<b>Total Capital Investment (TCI) = (DC) + (IC)</b>	<b>\$32,882,000</b>	
<b>Cost Effectiveness</b>	<b>\$100 /kW</b>	
<b>ANNUAL COST</b>		
Direct Annual Costs		
Fixed annual costs		
Maintenance labor and materials	\$2,155,000	Engineering Estimates
Total fixed annual costs	<u>\$2,155,000</u>	
Variable annual costs		
Byproduct disposal	\$1,255,000	28,100 lb/hr and 68 % capacity factor 15 \$/ton
ID fan power	\$103,000	800 kW and 0.02156 \$/kWh
Auxiliary power	\$68,000	530 kW and 0.02156 \$/kWh
Total variable annual costs	<u>\$1,426,000</u>	
<b>Total direct annual costs (DAC)</b>	<b><u>\$3,581,000</u></b>	
Indirect Annual Costs		
Cost for capital recovery	\$4,002,000	(TCI) X 12.17% CRF
Total indirect annual costs (IDAC)	<u>\$4,002,000</u>	
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$7,583,000</b>	

**Mill Creek Unit 1  
330 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$223,000	From Previous Mill Creek BACT Study	
Short-term storage silo	\$148,000	From Previous Mill Creek BACT Study	
Air blowers	\$203,000	From Previous Mill Creek BACT Study	
Rotary feeders	\$33,000	From Previous Mill Creek BACT Study	
Injection system	\$134,000	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$26,000	Ratio from Brown Unit 3 BACT Analysis	
Electrical system upgrades	\$878,000	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$42,000	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$1,687,000</u>		
Freight	\$76,000	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$1,763,000</u>		
Direct installation costs			
Foundation & supports	\$176,000	(PEC) X	10.0%
Handling & erection	\$353,000	(PEC) X	20.0%
Electrical	\$176,000	(PEC) X	10.0%
Piping	\$88,000	(PEC) X	5.0%
Insulation	\$35,000	(PEC) X	2.0%
Painting	\$88,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$916,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,754,000</u>		
Indirect Costs			
Engineering	\$330,000	(DC) X	12.0%
Owner's cost	\$330,000	(DC) X	12.0%
Construction management	\$275,000	(DC) X	10.0%
Start-up and spare parts	\$41,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$551,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$1,627,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$99,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,480,000</b>		
<b>Cost Effectiveness</b>	<b>\$14 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$83,000	(DC) X	3.0%
Operating labor	\$133,000	1 FTE and 132,901 \$/year      Estimated manpower	
Total fixed annual costs	<u>\$216,000</u>		
Variable annual costs			
Lime	\$1,428,000	4,060 lb/hr and 118.13 \$/ton      68 % capacity factor	
Byproduct disposal cost	\$360,000	4,640 lb/hr and 15 \$/ton	
Auxiliary power	\$20,000	155 kW and 0.02156 \$/kWh	
Total variable annual costs	<u>\$1,808,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$2,024,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$545,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$545,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,569,000</b>		

**Mill Creek Unit 1  
330 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$278,009	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$182,691	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$254,179	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$31,772	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$119,147	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$23,829	Ratio from Brown Unit 3 BACT Analysis		
Electrical system upgrades	\$762,538	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$39,716	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$1,691,882</u>			
Freight	\$42,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$1,734,000</u>			
Direct installation costs				
Foundation & supports	\$173,000	(PEC) X	10.0%	
Handling & erection	\$347,000	(PEC) X	20.0%	
Electrical	\$173,000	(PEC) X	10.0%	
Piping	\$87,000	(PEC) X	5.0%	
Insulation	\$35,000	(PEC) X	2.0%	
Painting	\$87,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$902,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,711,000</u>			
Indirect Costs				
Engineering	\$325,000	(DC) X	12.0%	
Owner's cost	\$325,000	(DC) X	12.0%	
Construction management	\$271,000	(DC) X	10.0%	
Start-up and spare parts	\$41,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$542,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$1,604,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$97,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,412,000</b>			
<b>Cost Effectiveness</b>	<b>\$13 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$81,000	(DC) X	3.0%	
Operating labor	\$133,000	1 FTE and	132,901 \$/year	Estimated manpower
Total fixed annual costs	<u>\$214,000</u>			
Variable annual costs				
Reagent (BPAC)	\$1,966,000	300 lb/hr and	68 %	capacity factor
Byproduct disposal cost	\$13,000	300 lb/hr and	2200 \$/ton	
Auxiliary power	\$20,000	155 kW and	15 \$/ton	
Total variable annual costs	<u>\$1,999,000</u>	0.02156 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$2,213,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$537,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$537,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,750,000</b>			

Plant Name: Mill Creek  
 Unit: 1  
 MW: 330  
 Project description: High Level Emissions Control Study  
 Revised on: 07/01/10

**Option 3: Delete New ESP**

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$97,000,000	\$294	\$3,366,000	\$15,171,000
WFGD	\$297,000,000	\$900	\$14,341,000	\$50,486,000
Fabric Filter	\$72,000,000	\$218	\$4,462,000	\$13,224,000
Lime Injection	\$4,480,000	\$14	\$2,024,000	\$2,569,000
PAC Injection	\$4,412,000	\$13	\$2,213,000	\$2,750,000
Neural Networks	\$1,000,000	\$3	\$100,000	\$222,000
Total	\$475,892,000	\$1,442	\$26,506,000	\$84,422,000

**MILL CREEK UNIT 1 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$6,669,000	
Ductwork and Breeching	\$5,151,000	
Mechanical - Balance of Plant (BOP)	\$1,687,000	
Electrical - Equipment, Raceway	\$1,926,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$674,000	
Control - DCS Instrumentation	\$217,000	
Air Heater Modifications	\$1,704,000	Engineering Estimates
ID Fans	\$3,262,000	Engineering Estimates
Catalyst	\$2,709,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$2,363,000	

**Subtotal Purchase Contract** **\$26,862,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$4,106,000	
Civil/Structural Construction - Sub-Structures	\$1,067,000	
Mechanical/Chemical Construction	\$12,906,000	
Electrical/Control Construction	\$5,902,000	
Service Contracts & Construction Indirects	\$20,617,000	
Demolition Costs	\$4,104,000	Engineering Estimates

**Subtotal Construction Contracts** **\$48,702,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$75,564,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$4,942,000	
EPC Construction Management (Includes G&A & Fee)	\$3,101,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$814,000	
Sales Taxes	\$1,149,000	
Project Contingency	\$11,597,000	

**Total Indirect Costs** **\$21,603,000**

**Total Contracted Costs** **\$97,000,000**

**Capital Cost Effectiveness** **\$294 /kW**

**ANNUAL COST**

Capacity Factor = 68%

**Fixed Annual Costs**

Operating labor	\$133,000	1 FTE and	132,901 \$/year
Maintenance labor & materials	\$2,267,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$2,450,000**

**Variable Annual Costs**

Reagent	\$418,000	265 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$233,000	1,815 kW and	0.02156 \$/kWh
Catalyst replacement	\$265,000	60 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$916,000**

**Total Annual Costs** **\$3,366,000**

**Levelized Capital Costs** **\$11,805,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$15,171,000**

**MILL CREEK UNIT 1 - WFGD COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,568,000
Ductwork and Breeching	\$3,956,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$85,104,000
Electrical - Equipment, Raceway	\$9,452,000
VFDs, Motors and Couplings	\$5,555,000
Switchgear and MCCs	\$5,736,000
Control - DCS Instrumentation	\$5,303,000
ID Fans	\$2,510,000 Engineering Estimates

**Subtotal Purchase Contract \$120,184,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$9,556,000
Civil/Structural Construction - Sub-Structures	\$931,000
Mechanical/Chemical Construction	\$21,832,000
Electrical/Control Construction	\$8,950,000
Service Contracts & Construction Indirects	\$17,009,000
Demolition Costs	\$12,313,000 Engineering Estimates

**Subtotal Construction Contracts \$70,591,000**

**Construction Difficulty Costs \$49,414,000 Engineering Estimates**

**Total Direct Costs \$240,189,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$8,322,000
EPC Construction Management (Includes G&A & Fee)	\$10,930,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$1,121,000
Sales Taxes	\$44,000
Project Contingency	\$36,445,000

**Total Indirect Costs \$56,862,000**

**Total Contracted Costs \$297,000,000**

**Cost Effectiveness \$900 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 68%

Operating labor	\$2,658,000	20 FTE and	132,901 \$/year
Maintenance labor and materials	\$7,206,000	(DC) X	3.0%

**Subtotal Fixed Annual Costs \$9,864,000**

**Variable Annual Costs**

Reagent	\$713,000	31,765 lb/hr and	7.54 \$/ton
Byproduct disposal	\$2,444,000	54,715 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$963,000	7,495 kW and	0.02156 \$/kWh
Water	\$357,000	500 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs \$4,477,000**

**Total Annual Costs \$14,341,000**

**Levelized Capital Costs \$36,145,000 (TCI) X 12.17% CRF**

**Levelized Annual Costs \$50,486,000**

**MILL CREEK UNIT 1 - PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$4,568,000
Mechanical - Balance of Plant (BOP)	\$13,085,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$277,000
Control - DCS Instrumentation	\$308,000
ID Fans	\$1,757,000
Engineering Estimates	

**Subtotal Purchase Contract** **\$19,995,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$4,065,000
Civil/Structural Construction - Sub-Structures	\$1,545,000
Mechanical/Chemical Construction	\$15,460,000
Electrical/Control Construction	\$5,221,000
Service Contracts & Construction Indirects	\$252,000
Demolition Costs	\$4,104,000
Engineering Estimates	

**Subtotal Construction Contracts** **\$30,647,000**

**Construction Difficulty Costs** **\$12,258,800** Engineering Estimates

**Total Direct Costs** **\$62,900,800**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$4,279,000
EPC Construction Management (Includes G&A & Fee)	\$2,800,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$423,000
Sales Taxes	\$151,000
Project Contingency - 18%	\$1,577,000

**Total Indirect Costs** **\$9,230,000**

**Total Contracted Costs** **\$72,000,000**

**Cost Effectiveness** **\$218 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 68%

Maintenance labor and materials \$2,160,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$2,160,000**

**Variable Annual Costs**

Byproduct disposal	\$1,255,000	28,100 lb/hr and	15 \$/ton
Bag replacement cost	\$471,000	14,140 bags and	100 \$/bag
Cage replacement cost	\$236,000	14,140 cages and	50 \$/cage
ID fan power	\$262,000	2,040 kW and	0.02156 \$/kWh
Auxiliary power	\$78,000	610 kW and	0.02156 \$/kWh

**Subtotal Variable Annual Costs** **\$2,302,000**

**Total Annual Costs** **\$4,462,000**

**Levelized Capital Costs** **\$8,762,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$13,224,000**

**Mill Creek Unit 1  
330 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$223,000	From Previous Mill Creek BACT Study	
Short-term storage silo	\$148,000	From Previous Mill Creek BACT Study	
Air blowers	\$203,000	From Previous Mill Creek BACT Study	
Rotary feeders	\$33,000	From Previous Mill Creek BACT Study	
Injection system	\$134,000	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$26,000	Ratio from Brown Unit 3 BACT Analysis	
Electrical system upgrades	\$878,000	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$42,000	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$1,687,000</u>		
Freight	\$76,000	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$1,763,000</u>		
Direct installation costs			
Foundation & supports	\$176,000	(PEC) X	10.0%
Handling & erection	\$353,000	(PEC) X	20.0%
Electrical	\$176,000	(PEC) X	10.0%
Piping	\$88,000	(PEC) X	5.0%
Insulation	\$35,000	(PEC) X	2.0%
Painting	\$88,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$916,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,754,000</u>		
Indirect Costs			
Engineering	\$330,000	(DC) X	12.0%
Owner's cost	\$330,000	(DC) X	12.0%
Construction management	\$275,000	(DC) X	10.0%
Start-up and spare parts	\$41,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$551,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$1,627,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$99,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,480,000</b>		
<b>Cost Effectiveness</b>	<b>\$14 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$83,000	(DC) X	3.0%
Operating labor	\$133,000	1 FTE and 132,901 \$/year      Estimated manpower	
Total fixed annual costs	<u>\$216,000</u>		
Variable annual costs			
Lime	\$1,428,000	4,060 lb/hr and 118.13 \$/ton      68 % capacity factor	
Byproduct disposal cost	\$360,000	4,640 lb/hr and 15 \$/ton	
Auxiliary power	\$20,000	155 kW and 0.02156 \$/kWh	
Total variable annual costs	<u>\$1,808,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$2,024,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$545,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$545,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,569,000</b>		

**Mill Creek Unit 1  
330 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$278,009	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$182,691	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$254,179	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$31,772	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$119,147	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$23,829	Ratio from Brown Unit 3 BACT Analysis		
Electrical system upgrades	\$762,538	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$39,716	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$1,691,882</u>			
Freight	\$42,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$1,734,000</u>			
Direct installation costs				
Foundation & supports	\$173,000	(PEC) X	10.0%	
Handling & erection	\$347,000	(PEC) X	20.0%	
Electrical	\$173,000	(PEC) X	10.0%	
Piping	\$87,000	(PEC) X	5.0%	
Insulation	\$35,000	(PEC) X	2.0%	
Painting	\$87,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$902,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,711,000</u>			
Indirect Costs				
Engineering	\$325,000	(DC) X	12.0%	
Owner's cost	\$325,000	(DC) X	12.0%	
Construction management	\$271,000	(DC) X	10.0%	
Start-up and spare parts	\$41,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$542,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$1,604,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$97,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,412,000</b>			
<b>Cost Effectiveness</b>	<b>\$13 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$81,000	(DC) X	3.0%	
Operating labor	\$133,000	1 FTE and	132,901 \$/year	Estimated manpower
Total fixed annual costs	<u>\$214,000</u>			
Variable annual costs				
Reagent (BPAC)	\$1,966,000	300 lb/hr and	68 %	capacity factor
Byproduct disposal cost	\$13,000	300 lb/hr and	2200 \$/ton	
Auxiliary power	\$20,000	155 kW and	15 \$/ton	
Total variable annual costs	<u>\$1,999,000</u>	0.02156 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$2,213,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$537,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$537,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,750,000</b>			

Plant Name: Mill Creek  
 Unit: 2  
 MW: 330  
 Project description: High Level Emissions Control Study  
 Revised on: 07/01/10

**Option 2: Combined WFGD**

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$97,000,000	\$294	\$3,401,000	\$15,206,000
WFGD	\$254,000,000	\$770	\$13,542,000	\$44,454,000
Fabric Filter	\$81,000,000	\$245	\$3,518,000	\$13,376,000
Electrostatic Precipitator	\$32,882,000	\$100	\$3,664,000	\$7,666,000
Lime Injection	\$4,480,000	\$14	\$2,117,000	\$2,662,000
PAC Injection	\$4,412,000	\$13	\$2,340,000	\$2,877,000
Neural Networks	\$1,000,000	\$3	\$100,000	\$222,000
Total	\$474,774,000	\$1,439	\$28,682,000	\$86,463,000

**MILL CREEK UNIT 2 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$6,669,000	
Ductwork and Breeching	\$5,151,000	
Mechanical - Balance of Plant (BOP)	\$1,687,000	
Electrical - Equipment, Raceway	\$1,926,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$674,000	
Control - DCS Instrumentation	\$217,000	
Air Heater Modifications	\$1,704,000	Engineering Estimates
ID Fans	\$3,262,000	Engineering Estimates
Catalyst	\$2,709,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$2,363,000	

**Subtotal Purchase Contract** **\$26,862,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$4,106,000	
Civil/Structural Construction - Sub-Structures	\$1,067,000	
Mechanical/Chemical Construction	\$12,906,000	
Electrical/Control Construction	\$5,902,000	
Service Contracts & Construction Indirects	\$20,617,000	
Demolition Costs	\$4,104,000	Engineering Estimates

**Subtotal Construction Contracts** **\$48,702,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$75,564,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$4,942,000	
EPC Construction Management (Includes G&A & Fee)	\$3,101,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$814,000	
Sales Taxes	\$1,149,000	
Project Contingency	\$11,597,000	

**Total Indirect Costs** **\$21,603,000**

**Total Contracted Costs** **\$97,000,000**

**Capital Cost Effectiveness** **\$294 /kW**

**ANNUAL COST**

Capacity Factor = 70%

**Fixed Annual Costs**

Operating labor	\$133,000	1 FTE and	132,901 \$/year
Maintenance labor & materials	\$2,267,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$2,450,000**

**Variable Annual Costs**

Reagent	\$431,000	265 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$247,000	1,860 kW and	0.02169 \$/kWh
Catalyst replacement	\$273,000	60 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$951,000**

**Total Annual Costs** **\$3,401,000**

**Levelized Capital Costs** **\$11,805,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$15,206,000**

**MILL CREEK UNIT 2 - COMBINED WFGD COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,140,500
Ductwork and Breeching	\$3,957,500
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$70,946,500
Electrical - Equipment, Raceway	\$7,879,500
VFDs, Motors and Couplings	\$4,631,000
Switchgear and MCCs	\$4,781,500
Control - DCS Instrumentation	\$4,421,000
ID Fans	\$2,510,000 Engineering Estimates

**Subtotal Purchase Contract** **\$101,267,500**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$7,966,500
Civil/Structural Construction - Sub-Structures	\$776,000
Mechanical/Chemical Construction	\$18,200,000
Electrical/Control Construction	\$7,461,000
Service Contracts & Construction Indirects	\$14,179,000
Demolition Costs	\$12,313,000 Engineering Estimates

**Subtotal Construction Contracts** **\$60,895,500**

**Construction Difficulty Costs** **\$42,627,000** Engineering Estimates

**Total Direct Costs** **\$204,790,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$7,244,500
EPC Construction Management (Includes G&A & Fee)	\$9,515,500
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$976,000
Sales Taxes	\$38,500
Project Contingency	\$31,727,500

**Total Indirect Costs** **\$49,502,000**

**Total Contracted Costs** **\$254,000,000**

**Cost Effectiveness** **\$770 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 70%

Operating labor	\$2,658,000	20 FTE and	132,901 \$/year
Maintenance labor and materials	\$6,144,000	(DC) X	3.0%

**Subtotal Fixed Annual Costs** **\$8,802,000**

**Variable Annual Costs**

Reagent	\$754,000	32,620 lb/hr and	7.54 \$/ton
Byproduct disposal	\$2,584,000	56,195 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$1,023,000	7,695 kW and	0.02169 \$/kWh
Water	\$379,000	515 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs** **\$4,740,000**

**Total Annual Costs** **\$13,542,000**

**Levelized Capital Costs** **\$30,912,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$44,454,000**

**MILL CREEK UNIT 2 - PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$4,568,000
Mechanical - Balance of Plant (BOP)	\$13,085,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$277,000
Control - DCS Instrumentation	\$308,000
ID Fans	\$1,757,000
Engineering Estimates	

**Subtotal Purchase Contract** **\$19,995,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$4,065,000
Civil/Structural Construction - Sub-Structures	\$1,545,000
Mechanical/Chemical Construction	\$15,460,000
Electrical/Control Construction	\$5,221,000
Service Contracts & Construction Indirects	\$252,000
Demolition Costs	\$4,104,000
Engineering Estimates	

**Subtotal Construction Contracts** **\$30,647,000**

**Construction Difficulty Costs** **\$21,452,900** Engineering Estimates

**Total Direct Costs** **\$72,094,900**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$4,279,000
EPC Construction Management (Includes G&A & Fee)	\$2,800,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$423,000
Sales Taxes	\$151,000
Project Contingency - 18%	\$1,577,000

**Total Indirect Costs** **\$9,230,000**

**Total Contracted Costs** **\$81,000,000**

**Cost Effectiveness** **\$245 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 70%

Maintenance labor and materials	\$2,430,000	(DC) X 3.0%
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**Subtotal Fixed Annual Costs** **\$2,430,000**

**Variable Annual Costs**

Byproduct disposal	\$0	0 lb/hr and	15 \$/ton
Bag replacement cost	\$484,000	14,520 bags and	100 \$/bag
Cage replacement cost	\$242,000	14,520 cages and	50 \$/cage
ID fan power	\$279,000	2,095 kW and	0.02169 \$/kWh
Auxiliary power	\$83,000	625 kW and	0.02169 \$/kWh

**Subtotal Variable Annual Costs** **\$1,088,000**

**Total Annual Costs** **\$3,518,000**

**Levelized Capital Costs** **\$9,858,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$13,376,000**

**Mill Creek Unit 2  
330 MW  
High Level Emissions Control Study**

Technology: Electrostatic Precipitator (ESP)

Date: 7/8/2010

Cost Item	\$	Remarks		
<b>CAPITAL COST</b>				
<b>Direct Costs</b>				
Purchased equipment costs				
ESP	\$7,399,831	From Previous Study		
Ash handling system	\$538,703	From Previous Study		
ID fan	\$501,831	Apportioned Engineering Estimate		
Flue gas ductwork	\$2,000,000	Engineering Estimate		
Subtotal capital cost (CC)	<u>\$10,440,365</u>			
Instrumentation and controls	\$209,000	(CC) X	2.0%	
Taxes	\$731,000	(CC) X	7.0%	
Freight	\$522,000	(CC) X	5.0%	
Total purchased equipment cost (PEC)	<u>\$11,902,000</u>			
Direct installation costs				
Foundation & supports	\$1,785,000	(PEC) X	15.0%	
Handling & erection	\$1,190,000	(PEC) X	10.0%	
Electrical	\$2,380,000	(PEC) X	20.0%	
Piping	\$298,000	(PEC) X	2.5%	
Insulation	\$238,000	(PEC) X	2.0%	
Painting	\$60,000	(PEC) X	0.5%	
Demolition	\$2,052,000	Engineering Estimate		
Relocation	\$1,000	(PEC) X	0.01%	
Total direct installation costs (DIC)	<u>\$8,004,000</u>			
Site preparation	\$200,000	Estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$20,106,000</u>			
Indirect Costs				
Engineering	\$2,413,000	(DC) X	12.0%	
Owners Cost	\$603,000	(DC) X	3.0%	
Construction and field expenses	\$2,011,000	(DC) X	10.0%	
Contractor fees	\$2,011,000	(DC) X	10.0%	
Start-up	\$603,000	(DC) X	3.0%	
Performance test	\$40,000	(DC) X	0.2%	
Contingencies	\$3,016,000	(DC) X	15.0%	
Total indirect costs (IC)	<u>\$10,697,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$2,079,000	[(DC)+(IC)] X	4.50%	3 years (project time length)
<b>Total Capital Investment (TCI) = (DC) + (IC)</b>	<b>\$32,882,000</b>			
<b>Cost Effectiveness</b>	<b>\$100 /kW</b>			
<b>ANNUAL COST</b>				
<b>Direct Annual Costs</b>				
Fixed annual costs				
Maintenance labor and materials	\$2,155,000	Engineering Estimates		
Total fixed annual costs	<u>\$2,155,000</u>			
Variable annual costs				
Byproduct disposal	\$1,327,000	28,860 lb/hr and	70 %	capacity factor
ID fan power	\$110,000	825 kW and	15 \$/ton	
Auxiliary power	\$72,000	545 kW and	0.02169 \$/kWh	
Total variable annual costs	<u>\$1,509,000</u>			
<b>Total direct annual costs (DAC)</b>	<b>\$3,664,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$4,002,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$4,002,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$7,666,000</b>			

**Mill Creek Unit 2  
330 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$223,000	From Previous Mill Creek BACT Study	
Short-term storage silo	\$148,000	From Previous Mill Creek BACT Study	
Air blowers	\$203,000	From Previous Mill Creek BACT Study	
Rotary feeders	\$33,000	From Previous Mill Creek BACT Study	
Injection system	\$134,000	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$26,000	Ratio from Brown Unit 3 BACT Analysis	
Electrical system upgrades	\$878,000	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$42,000	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$1,687,000</u>		
Freight	\$76,000	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$1,763,000</u>		
Direct installation costs			
Foundation & supports	\$176,000	(PEC) X	10.0%
Handling & erection	\$353,000	(PEC) X	20.0%
Electrical	\$176,000	(PEC) X	10.0%
Piping	\$88,000	(PEC) X	5.0%
Insulation	\$35,000	(PEC) X	2.0%
Painting	\$88,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$916,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,754,000</u>		
Indirect Costs			
Engineering	\$330,000	(DC) X	12.0%
Owner's cost	\$330,000	(DC) X	12.0%
Construction management	\$275,000	(DC) X	10.0%
Start-up and spare parts	\$41,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$551,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$1,627,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$99,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,480,000</b>		
<b>Cost Effectiveness</b>	<b>\$14 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$83,000	(DC) X	3.0%
Operating labor	\$133,000	1 FTE and 132,901 \$/year      Estimated manpower	
Total fixed annual costs	<u>\$216,000</u>		
Variable annual costs			
Lime	\$1,510,000	4,170 lb/hr and 118.13 \$/ton      70 % capacity factor	
Byproduct disposal cost	\$370,000	4,770 lb/hr and 15 \$/ton	
Auxiliary power	\$21,000	155 kW and 0.02169 \$/kWh	
Total variable annual costs	<u>\$1,901,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$2,117,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$545,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$545,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,662,000</b>		

**Mill Creek Unit 2  
330 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$278,009	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$182,691	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$254,179	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$31,772	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$119,147	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$23,829	Ratio from Brown Unit 3 BACT Analysis		
Electrical system upgrades	\$762,538	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$39,716	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$1,691,882</u>			
Freight	\$42,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$1,734,000</u>			
Direct installation costs				
Foundation & supports	\$173,000	(PEC) X	10.0%	
Handling & erection	\$347,000	(PEC) X	20.0%	
Electrical	\$173,000	(PEC) X	10.0%	
Piping	\$87,000	(PEC) X	5.0%	
Insulation	\$35,000	(PEC) X	2.0%	
Painting	\$87,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$902,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,711,000</u>			
Indirect Costs				
Engineering	\$325,000	(DC) X	12.0%	
Owner's cost	\$325,000	(DC) X	12.0%	
Construction management	\$271,000	(DC) X	10.0%	
Start-up and spare parts	\$41,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$542,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$1,604,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$97,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,412,000</b>			
<b>Cost Effectiveness</b>	<b>\$13 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$81,000	(DC) X	3.0%	
Operating labor	\$133,000	1 FTE and	132,901 \$/year	Estimated manpower
Total fixed annual costs	<u>\$214,000</u>			
Variable annual costs				
Reagent (BPAC)	\$2,091,000	310 lb/hr and	70 %	capacity factor
Byproduct disposal cost	\$14,000	310 lb/hr and	2200 \$/ton	
Auxiliary power	\$21,000	155 kW and	15 \$/ton	
Total variable annual costs	<u>\$2,126,000</u>	0.02169 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$2,340,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$537,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$537,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,877,000</b>			

Plant Name: Mill Creek  
 Unit: 2  
 MW: 330  
 Project description: High Level Emissions Control Study  
 Revised on: 07/01/10

**Option 3: Delete New ESP**

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$97,000,000	\$294	\$3,401,000	\$15,206,000
WFGD	\$297,000,000	\$900	\$14,604,000	\$50,749,000
Fabric Filter	\$72,000,000	\$218	\$4,575,000	\$13,337,000
Lime Injection	\$4,480,000	\$14	\$2,117,000	\$2,662,000
PAC Injection	\$4,412,000	\$13	\$2,340,000	\$2,877,000
Neural Networks	\$1,000,000	\$3	\$100,000	\$222,000
<b>Total</b>	<b>\$475,892,000</b>	<b>\$1,442</b>	<b>\$27,137,000</b>	<b>\$85,053,000</b>

**MILL CREEK UNIT 2 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$6,669,000	
Ductwork and Breeching	\$5,151,000	
Mechanical - Balance of Plant (BOP)	\$1,687,000	
Electrical - Equipment, Raceway	\$1,926,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$674,000	
Control - DCS Instrumentation	\$217,000	
Air Heater Modifications	\$1,704,000	Engineering Estimates
ID Fans	\$3,262,000	Engineering Estimates
Catalyst	\$2,709,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$2,363,000	

**Subtotal Purchase Contract** **\$26,862,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$4,106,000	
Civil/Structural Construction - Sub-Structures	\$1,067,000	
Mechanical/Chemical Construction	\$12,906,000	
Electrical/Control Construction	\$5,902,000	
Service Contracts & Construction Indirects	\$20,617,000	
Demolition Costs	\$4,104,000	Engineering Estimates

**Subtotal Construction Contracts** **\$48,702,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$75,564,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$4,942,000	
EPC Construction Management (Includes G&A & Fee)	\$3,101,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$814,000	
Sales Taxes	\$1,149,000	
Project Contingency	\$11,597,000	

**Total Indirect Costs** **\$21,603,000**

**Total Contracted Costs** **\$97,000,000**

**Capital Cost Effectiveness** **\$294 /kW**

**ANNUAL COST**

Capacity Factor = 70%

**Fixed Annual Costs**

Operating labor	\$133,000	1 FTE and	132,901 \$/year
Maintenance labor & materials	\$2,267,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$2,450,000**

**Variable Annual Costs**

Reagent	\$431,000	265 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$247,000	1,860 kW and	0.02169 \$/kWh
Catalyst replacement	\$273,000	60 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$951,000**

**Total Annual Costs** **\$3,401,000**

**Levelized Capital Costs** **\$11,805,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$15,206,000**

**MILL CREEK UNIT 2 - WFGD COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,568,000
Ductwork and Breeching	\$3,956,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$85,104,000
Electrical - Equipment, Raceway	\$9,452,000
VFDs, Motors and Couplings	\$5,555,000
Switchgear and MCCs	\$5,736,000
Control - DCS Instrumentation	\$5,303,000
ID Fans	\$2,510,000 Engineering Estimates

**Subtotal Purchase Contract \$120,184,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$9,556,000
Civil/Structural Construction - Sub-Structures	\$931,000
Mechanical/Chemical Construction	\$21,832,000
Electrical/Control Construction	\$8,950,000
Service Contracts & Construction Indirects	\$17,009,000
Demolition Costs	\$12,313,000 Engineering Estimates

**Subtotal Construction Contracts \$70,591,000**

**Construction Difficulty Costs \$49,414,000 Engineering Estimates**

**Total Direct Costs \$240,189,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$8,322,000
EPC Construction Management (Includes G&A & Fee)	\$10,930,000
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$1,121,000
Sales Taxes	\$44,000
Project Contingency	\$36,445,000

**Total Indirect Costs \$56,862,000**

**Total Contracted Costs \$297,000,000**

**Cost Effectiveness \$900 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 70%

Operating labor	\$2,658,000	20 FTE and	132,901 \$/year
Maintenance labor and materials	\$7,206,000	(DC) X 3.0%	

**Subtotal Fixed Annual Costs \$9,864,000**

**Variable Annual Costs**

Reagent	\$754,000	32,620 lb/hr and	7.54 \$/ton
Byproduct disposal	\$2,584,000	56,195 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$1,023,000	7,695 kW and	0.02169 \$/kWh
Water	\$379,000	515 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs \$4,740,000**

**Total Annual Costs \$14,604,000**

**Levelized Capital Costs \$36,145,000 (TCI) X 12.17% CRF**

**Levelized Annual Costs \$50,749,000**

## MILL CREEK UNIT 2 - PJFF COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$4,568,000
Mechanical - Balance of Plant (BOP)	\$13,085,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$277,000
Control - DCS Instrumentation	\$308,000
ID Fans	\$1,757,000
Engineering Estimates	

**Subtotal Purchase Contract** **\$19,995,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$4,065,000
Civil/Structural Construction - Sub-Structures	\$1,545,000
Mechanical/Chemical Construction	\$15,460,000
Electrical/Control Construction	\$5,221,000
Service Contracts & Construction Indirects	\$252,000
Demolition Costs	\$4,104,000
Engineering Estimates	

**Subtotal Construction Contracts** **\$30,647,000**

**Construction Difficulty Costs** **\$12,258,800** Engineering Estimates

**Total Direct Costs** **\$62,900,800**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$4,279,000
EPC Construction Management (Includes G&A & Fee)	\$2,800,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$423,000
Sales Taxes	\$151,000
Project Contingency - 18%	\$1,577,000

**Total Indirect Costs** **\$9,230,000**

**Total Contracted Costs** **\$72,000,000**

**Cost Effectiveness** **\$218 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 70%

Maintenance labor and materials \$2,160,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$2,160,000**

#### Variable Annual Costs

Byproduct disposal	\$1,327,000	28,860 lb/hr and	15 \$/ton
Bag replacement cost	\$484,000	14,520 bags and	100 \$/bag
Cage replacement cost	\$242,000	14,520 cages and	50 \$/cage
ID fan power	\$279,000	2,095 kW and	0.02169 \$/kWh
Auxiliary power	\$83,000	625 kW and	0.02169 \$/kWh

**Subtotal Variable Annual Costs** **\$2,415,000**

**Total Annual Costs** **\$4,575,000**

**Levelized Capital Costs** **\$8,762,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$13,337,000**

**Mill Creek Unit 2  
330 MW  
High Level Emissions Control Study**

Technology: Lime Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$223,000	From Previous Mill Creek BACT Study	
Short-term storage silo	\$148,000	From Previous Mill Creek BACT Study	
Air blowers	\$203,000	From Previous Mill Creek BACT Study	
Rotary feeders	\$33,000	From Previous Mill Creek BACT Study	
Injection system	\$134,000	From Previous Mill Creek BACT Study	
Ductwork modifications, supports, platforms	\$26,000	Ratio from Brown Unit 3 BACT Analysis	
Electrical system upgrades	\$878,000	From Previous Mill Creek BACT Study	
Instrumentation and controls	\$42,000	From Previous Mill Creek BACT Study	
Subtotal capital cost (CC)	<u>\$1,687,000</u>		
Freight	\$76,000	(CC) X	4.5%
Total purchased equipment cost (PEC)	<u>\$1,763,000</u>		
Direct installation costs			
Foundation & supports	\$176,000	(PEC) X	10.0%
Handling & erection	\$353,000	(PEC) X	20.0%
Electrical	\$176,000	(PEC) X	10.0%
Piping	\$88,000	(PEC) X	5.0%
Insulation	\$35,000	(PEC) X	2.0%
Painting	\$88,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$916,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,754,000</u>		
Indirect Costs			
Engineering	\$330,000	(DC) X	12.0%
Owner's cost	\$330,000	(DC) X	12.0%
Construction management	\$275,000	(DC) X	10.0%
Start-up and spare parts	\$41,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$551,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$1,627,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$99,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,480,000</b>		
<b>Cost Effectiveness</b>	<b>\$14 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$83,000	(DC) X	3.0%
Operating labor	\$133,000	1 FTE and 132,901 \$/year      Estimated manpower	
Total fixed annual costs	<u>\$216,000</u>		
Variable annual costs			
Lime	\$1,510,000	4,170 lb/hr and 118.13 \$/ton      70 % capacity factor	
Byproduct disposal cost	\$370,000	4,770 lb/hr and 15 \$/ton	
Auxiliary power	\$21,000	155 kW and 0.02169 \$/kWh	
Total variable annual costs	<u>\$1,901,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$2,117,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$545,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$545,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,662,000</b>		

**Mill Creek Unit 2  
330 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$278,009	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$182,691	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$254,179	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$31,772	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$119,147	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$23,829	Ratio from Brown Unit 3 BACT Analysis		
Electrical system upgrades	\$762,538	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$39,716	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$1,691,882</u>			
Freight	\$42,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$1,734,000</u>			
Direct installation costs				
Foundation & supports	\$173,000	(PEC) X	10.0%	
Handling & erection	\$347,000	(PEC) X	20.0%	
Electrical	\$173,000	(PEC) X	10.0%	
Piping	\$87,000	(PEC) X	5.0%	
Insulation	\$35,000	(PEC) X	2.0%	
Painting	\$87,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$902,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$2,711,000</u>			
Indirect Costs				
Engineering	\$325,000	(DC) X	12.0%	
Owner's cost	\$325,000	(DC) X	12.0%	
Construction management	\$271,000	(DC) X	10.0%	
Start-up and spare parts	\$41,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$542,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$1,604,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$97,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$4,412,000</b>			
<b>Cost Effectiveness</b>	<b>\$13 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$81,000	(DC) X	3.0%	
Operating labor	\$133,000		1 FTE and 132,901 \$/year	Estimated manpower
Total fixed annual costs	<u>\$214,000</u>			
Variable annual costs				
Reagent (BPAC)	\$2,091,000		310 lb/hr and 2200 \$/ton	70 % capacity factor
Byproduct disposal cost	\$14,000		310 lb/hr and 15 \$/ton	
Auxiliary power	\$21,000		155 kW and 0.02169 \$/kWh	
Total variable annual costs	<u>\$2,126,000</u>			
<b>Total direct annual costs (DAC)</b>	<b>\$2,340,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$537,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$537,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$2,877,000</b>			

Plant Name: Mill Creek  
 Unit: 3  
 MW: 423  
 Project description: High Level Emissions Control Study  
 Revised on: 07/01/10

**Option 2: Larger WFGD**

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
WFGD	\$335,000,000	\$792	\$17,199,000	\$57,969,000
Fabric Filter	\$114,000,000	\$270	\$4,923,000	\$18,797,000
PAC Injection	\$5,592,000	\$13	\$3,213,000	\$3,894,000
Neural Networks	\$1,000,000	\$2	\$100,000	\$222,000
Total	\$455,592,000	\$1,077	\$25,435,000	\$80,882,000

**MILL CREEK UNIT 3 - LARGER WFGD COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,384,000
Ductwork and Breeching	\$3,673,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$79,020,000
Electrical - Equipment, Raceway	\$8,776,000
VFDs, Motors and Couplings	\$5,158,000
Switchgear and MCCs	\$5,326,000
Control - DCS Instrumentation	\$4,924,000
ID Fans	\$2,445,000 Engineering Estimates

**Subtotal Purchase Contract \$111,706,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$8,873,000
Civil/Structural Construction - Sub-Structures	\$864,000
Mechanical/Chemical Construction	\$20,271,000
Electrical/Control Construction	\$8,310,000
Service Contracts & Construction Indirects	\$15,793,000
Demolition Costs	\$15,784,000 Engineering Estimates

**Subtotal Construction Contracts \$69,895,000**

**Construction Difficulty Costs \$83,874,000 Engineering Estimates**

**Total Direct Costs \$265,475,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$10,150,000
EPC Construction Management (Includes G&A & Fee)	\$13,332,000
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$1,367,000
Sales Taxes	\$54,000
Project Contingency	\$44,453,000

**Total Indirect Costs \$69,356,000**

**Total Contracted Costs \$335,000,000**

**Cost Effectiveness \$792 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 75%

Operating labor	\$2,658,000	20 FTE and	132,901 \$/year
Maintenance labor and materials	\$7,964,000	(DC) X	3.0%

**Subtotal Fixed Annual Costs \$10,622,000**

**Variable Annual Costs**

Reagent	\$1,027,000	41,470 lb/hr and	7.54 \$/ton
Byproduct disposal	\$3,520,000	71,435 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$1,518,000	9,910 kW and	0.02331 \$/kWh
Water	\$512,000	650 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs \$6,577,000**

**Total Annual Costs \$17,199,000**

**Levelized Capital Costs \$40,770,000 (TCI) X 12.17% CRF**

**Levelized Annual Costs \$57,969,000**

## MILL CREEK UNIT 3 - PJFF COSTS

### CAPITAL COST

#### Purchase Contracts

Civil/Structural	\$5,302,000	
Mechanical - Balance of Plant (BOP)	\$15,187,000	
Electrical - Equipment, Raceway, Switchgears, MCC	\$322,000	
Control - DCS Instrumentation	\$357,000	
ID Fans	\$1,467,000	Engineering Estimates

**Subtotal Purchase Contract** **\$22,635,000**

#### Construction Contracts

Civil/Structural Construction - Super Structures	\$4,718,000	
Civil/Structural Construction - Sub-Structures	\$1,793,000	
Mechanical/Chemical Construction	\$17,944,000	
Electrical/Control Construction	\$6,059,000	
Service Contracts & Construction Indirects	\$292,000	
Demolition Costs	\$5,262,000	Engineering Estimates

**Subtotal Construction Contracts** **\$36,068,000**

**Construction Difficulty Costs** **\$43,282,000** Engineering Estimates

**Total Direct Costs** **\$101,985,000**

#### Indirect Costs

Engineering Costs (Includes G&A & Fee)	\$5,485,000	
EPC Construction Management (Includes G&A & Fee)	\$3,589,000	
Startup Spare Parts (Included)	\$0	
Construction Utilites (Power & Water) - Included	\$0	
Project Insurance	\$542,000	
Sales Taxes	\$193,000	
Project Contingency - 18%	\$2,021,000	

**Total Indirect Costs** **\$11,830,000**

**Total Contracted Costs** **\$114,000,000**

**Cost Effectiveness** **\$270 /kW**

### ANNUAL COST

#### Fixed Annual Costs

Capacity Factor = 75%

Maintenance labor and materials \$3,420,000 (DC) X 3.0%

**Subtotal Fixed Annual Costs** **\$3,420,000**

#### Variable Annual Costs

Byproduct disposal	\$5,000	95 lb/hr and	15 \$/ton
Bag replacement cost	\$635,000	19,040 bags and	100 \$/bag
Cage replacement cost	\$317,000	19,040 cages and	50 \$/cage
ID fan power	\$420,000	2,745 kW and	0.02331 \$/kWh
Auxiliary power	\$126,000	820 kW and	0.02331 \$/kWh

**Subtotal Variable Annual Costs** **\$1,503,000**

**Total Annual Costs** **\$4,923,000**

**Levelized Capital Costs** **\$13,874,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$18,797,000**

**Mill Creek Unit 3  
423 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$356,357	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$234,177	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$325,812	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$40,726	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$152,724	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$30,545	Ratio from Brown Unit 3 BACT Analysis		
Electrical system upgrades	\$977,435	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$50,908	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$2,168,685</u>			
Freight	\$54,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$2,223,000</u>			
Direct installation costs				
Foundation & supports	\$222,000	(PEC) X	10.0%	
Handling & erection	\$445,000	(PEC) X	20.0%	
Electrical	\$222,000	(PEC) X	10.0%	
Piping	\$111,000	(PEC) X	5.0%	
Insulation	\$44,000	(PEC) X	2.0%	
Painting	\$111,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$1,155,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$3,453,000</u>			
Indirect Costs				
Engineering	\$414,000	(DC) X	12.0%	
Owner's cost	\$414,000	(DC) X	12.0%	
Construction management	\$345,000	(DC) X	10.0%	
Start-up and spare parts	\$52,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$691,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$2,016,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$123,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$5,592,000</b>			
<b>Cost Effectiveness</b>	<b>\$13 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$104,000	(DC) X	3.0%	
Operating labor	\$133,000	1 FTE and	132,901 \$/year	Estimated manpower
Total fixed annual costs	<u>\$237,000</u>			
Variable annual costs				
Reagent (BPAC)	\$2,927,000	405 lb/hr and	75 %	capacity factor
Byproduct disposal cost	\$20,000	405 lb/hr and	2200 \$/ton	
Auxiliary power	\$29,000	190 kW and	15 \$/ton	
Total variable annual costs	<u>\$2,976,000</u>	0.02331 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$3,213,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$681,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$681,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$3,894,000</b>			

Plant Name: Mill Creek  
 Unit: 4  
 MW: 525  
 Project description: High Level Emissions Control Study  
 Revised on: 07/01/10

**Option 2: Larger WFGD**

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
WFGD	\$390,000,000	\$743	\$19,826,000	\$67,289,000
Fabric Filter	\$133,000,000	\$253	\$5,804,000	\$21,990,000
PAC Injection	\$6,890,000	\$13	\$3,858,000	\$4,697,000
Neural Networks	\$1,000,000	\$2	\$100,000	\$222,000
Total	\$530,890,000	\$1,011	\$29,588,000	\$94,198,000

**MILL CREEK UNIT 4 - LARGER WFGD COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,714,000
Ductwork and Breeching	\$4,182,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$89,955,000
Electrical - Equipment, Raceway	\$9,991,000
VFDs, Motors and Couplings	\$5,872,000
Switchgear and MCCs	\$6,063,000
Control - DCS Instrumentation	\$5,605,000
ID Fans	\$5,018,313 Engineering Estimates

**Subtotal Purchase Contract** **\$129,400,313**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$10,101,000
Civil/Structural Construction - Sub-Structures	\$984,000
Mechanical/Chemical Construction	\$23,077,000
Electrical/Control Construction	\$9,460,000
Service Contracts & Construction Indirects	\$17,978,000
Demolition Costs	\$19,590,000 Engineering Estimates

**Subtotal Construction Contracts** **\$81,190,000**

**Construction Difficulty Costs** **\$97,428,000** Engineering Estimates

**Total Direct Costs** **\$308,018,313**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$12,065,000
EPC Construction Management (Includes G&A & Fee)	\$15,847,000
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$1,625,000
Sales Taxes	\$64,000
Project Contingency	\$52,840,000

**Total Indirect Costs** **\$82,441,000**

**Total Contracted Costs** **\$390,000,000**

**Cost Effectiveness** **\$743 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 75%

Operating labor	\$2,658,000	20 FTE and	132,901 \$/year
Maintenance labor and materials	\$9,241,000	(DC) X	3.0%

**Subtotal Fixed Annual Costs** **\$11,899,000**

**Variable Annual Costs**

Reagent	\$1,250,000	50,465 lb/hr and	7.54 \$/ton
Byproduct disposal	\$4,284,000	86,935 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$1,770,000	12,055 kW and	0.02235 \$/kWh
Water	\$623,000	790 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs** **\$7,927,000**

**Total Annual Costs** **\$19,826,000**

**Levelized Capital Costs** **\$47,463,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$67,289,000**

**MILL CREEK UNIT 4 - PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$6,036,000
Mechanical - Balance of Plant (BOP)	\$17,289,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$366,000
Control - DCS Instrumentation	\$407,000
ID Fans	\$3,010,988 Engineering Estimates

**Subtotal Purchase Contract** **\$27,108,988**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$5,371,000
Civil/Structural Construction - Sub-Structures	\$2,042,000
Mechanical/Chemical Construction	\$20,427,000
Electrical/Control Construction	\$6,898,000
Service Contracts & Construction Indirects	\$333,000
Demolition Costs	\$6,530,000 Engineering Estimates

**Subtotal Construction Contracts** **\$41,601,000**

**Construction Difficulty Costs** **\$49,921,000** Engineering Estimates

**Total Direct Costs** **\$118,630,988**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$6,807,000
EPC Construction Management (Includes G&A & Fee)	\$4,454,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$673,000
Sales Taxes	\$240,000
Project Contingency - 18%	\$2,508,000

**Total Indirect Costs** **\$14,682,000**

**Total Contracted Costs** **\$133,000,000**

**Cost Effectiveness** **\$253 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 75%

Maintenance labor and materials	\$3,990,000	(DC) X 3.0%
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**Subtotal Fixed Annual Costs** **\$3,990,000**

**Variable Annual Costs**

Byproduct disposal	\$1,000	30 lb/hr and	15 \$/ton
Bag replacement cost	\$768,000	23,050 bags and	100 \$/bag
Cage replacement cost	\$384,000	23,050 cages and	50 \$/cage
ID fan power	\$509,000	3,325 kW and	0.02331 \$/kWh
Auxiliary power	\$152,000	995 kW and	0.02331 \$/kWh

**Subtotal Variable Annual Costs** **\$1,814,000**

**Total Annual Costs** **\$5,804,000**

**Levelized Capital Costs** **\$16,186,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$21,990,000**

**Mill Creek Unit 4  
525  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$442,287	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$290,646	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$404,376	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$50,547	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$189,551	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$37,910	Ratio from Brown Unit 3 BACT Analysis		
Electrical system upgrades	\$1,213,129	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$63,184	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$2,691,630</u>			
Freight	\$67,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$2,759,000</u>			
Direct installation costs				
Foundation & supports	\$276,000	(PEC) X	10.0%	
Handling & erection	\$552,000	(PEC) X	20.0%	
Electrical	\$276,000	(PEC) X	10.0%	
Piping	\$138,000	(PEC) X	5.0%	
Insulation	\$55,000	(PEC) X	2.0%	
Painting	\$138,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$1,435,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$4,269,000</u>			
Indirect Costs				
Engineering	\$512,000	(DC) X	12.0%	
Owner's cost	\$512,000	(DC) X	12.0%	
Construction management	\$427,000	(DC) X	10.0%	
Start-up and spare parts	\$64,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$854,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$2,469,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$152,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$6,890,000</b>			
<b>Cost Effectiveness</b>	<b>\$13 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$128,000	(DC) X	3.0%	
Operating labor	\$133,000	1 FTE and	132,901 \$/year	Estimated manpower
Total fixed annual costs	<u>\$261,000</u>			
Variable annual costs				
Reagent (BPAC)	\$3,541,000	490 lb/hr and	75 %	capacity factor
Byproduct disposal cost	\$24,000	490 lb/hr and	2200 \$/ton	
Auxiliary power	\$32,000	220 kW and	15 \$/ton	
Total variable annual costs	<u>\$3,597,000</u>	0.02235 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$3,858,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$839,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$839,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$4,697,000</b>			

# **Trimble County**

Plant Name: Trimble County  
Unit: 1  
MW 547  
Project description High Level Emissions Control Study  
Revised on: 05/28/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
Fabric Filter	\$128,000,000	\$234	\$5,782,000	\$21,360,000
PAC Injection	\$6,451,000	\$12	\$4,413,000	\$5,198,000
Neural Networks	\$1,000,000	\$2	\$100,000	\$222,000
Total	\$135,451,000	\$248	\$10,295,000	\$26,780,000

**TRIMBLE COUNTY UNIT 1 - PJFF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$6,186,000
Mechanical - Balance of Plant (BOP)	\$17,720,000
Electrical - Equipment, Raceway, Switchgears, MCC	\$375,000
Control - DCS Instrumentation	\$417,000
ID Fans	\$2,493,000 Engineering Estimates

**Subtotal Purchase Contract** **\$27,191,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$5,505,000
Civil/Structural Construction - Sub-Structures	\$2,092,000
Mechanical/Chemical Construction	\$20,936,000
Electrical/Control Construction	\$7,070,000
Service Contracts & Construction Indirects	\$341,000
Demolition Costs	\$3,050,000 Engineering Estimates

**Subtotal Construction Contracts** **\$38,994,000**

**Construction Difficulty Costs** **\$46,793,000** Engineering Estimates

**Total Direct Costs** **\$112,978,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$7,092,000
EPC Construction Management (Includes G&A & Fee)	\$4,641,000
Startup Spare Parts (Included)	\$0
Construction Utilites (Power & Water) - Included	\$0
Project Insurance	\$701,000
Sales Taxes	\$250,000
Project Contingency - 18%	\$2,613,000

**Total Indirect Costs** **\$15,297,000**

**Total Contracted Costs** **\$128,000,000**

**Cost Effectiveness** **\$234 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 85%

Maintenance labor and materials	\$3,840,000	(DC) X 3.0%
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**Subtotal Fixed Annual Costs** **\$3,840,000**

**Variable Annual Costs**

Byproduct disposal	\$0	0 lb/hr and	15 \$/ton
Bag replacement cost	\$785,000	23,550 bags and	100 \$/bag
Cage replacement cost	\$393,000	23,550 cages and	50 \$/cage
ID fan power	\$588,000	3,395 kW and	0.02325 \$/kWh
Auxiliary power	\$176,000	1,015 kW and	0.02325 \$/kWh

**Subtotal Variable Annual Costs** **\$1,942,000**

**Total Annual Costs** **\$5,782,000**

**Levelized Capital Costs** **\$15,578,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$21,360,000**

**Trimble County Unit 1  
547 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis	
<b>CAPITAL COST</b>			
Direct Costs			
Purchased equipment costs			
Long-term storage silo (with truck unloading sys.)	\$418,928	Ratio from Brown Unit 3 BACT Analysis	
Short-term storage silo	\$275,295	Ratio from Brown Unit 3 BACT Analysis	
Air blowers	\$383,020	Ratio from Brown Unit 3 BACT Analysis	
Rotary feeders	\$47,877	Ratio from Brown Unit 3 BACT Analysis	
Injection system	\$179,540	Ratio from Brown Unit 3 BACT Analysis	
Ductwork modifications, supports, platforms	\$0		
Electrical system upgrades	\$1,149,059	Ratio from Brown Unit 3 BACT Analysis	
Instrumentation and controls	\$59,847	Ratio from Brown Unit 3 BACT Analysis	
Subtotal capital cost (CC)	<u>\$2,513,567</u>		
Freight	\$63,000	(CC) X	2.5%
Total purchased equipment cost (PEC)	<u>\$2,577,000</u>		
Direct installation costs			
Foundation & supports	\$258,000	(PEC) X	10.0%
Handling & erection	\$515,000	(PEC) X	20.0%
Electrical	\$258,000	(PEC) X	10.0%
Piping	\$129,000	(PEC) X	5.0%
Insulation	\$52,000	(PEC) X	2.0%
Painting	\$129,000	(PEC) X	5.0%
Demolition	\$0	(PEC) X	0.0%
Relocation	\$0	(PEC) X	0.0%
Total direct installation costs (DIC)	<u>\$1,341,000</u>		
Site preparation	\$0	N/A	
Buildings	\$75,000	Engineering estimate	
Total direct costs (DC) = (PEC) + (DIC)	<u>\$3,993,000</u>		
Indirect Costs			
Engineering	\$479,000	(DC) X	12.0%
Owner's cost	\$479,000	(DC) X	12.0%
Construction management	\$399,000	(DC) X	10.0%
Start-up and spare parts	\$60,000	(DC) X	1.5%
Performance test	\$100,000	Engineering estimate	
Contingencies	\$799,000	(DC) X	20.0%
Total indirect costs (IC)	<u>\$2,316,000</u>		
Allowance for Funds Used During Construction (AFDC)	\$142,000	[(DC)+(IC)] X	4.50%      1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$6,451,000</b>		
<b>Cost Effectiveness</b>	<b>\$12 /kW</b>		
<b>ANNUAL COST</b>			
Direct Annual Costs			
Fixed annual costs			
Maintenance labor and materials	\$120,000	(DC) X	3.0%
Operating labor	\$132,000	1 FTE and	132,491 \$/year      Estimated manpower
Total fixed annual costs	<u>\$252,000</u>		
Variable annual costs			
Reagent (BPAC)	\$4,095,000	500 lb/hr and	85 %      capacity factor 2200 \$/ton
Byproduct disposal cost	\$28,000	500 lb/hr and	15 \$/ton
Auxiliary power	\$38,000	220 kW and	0.02325 \$/kWh
Total variable annual costs	<u>\$4,161,000</u>		
<b>Total direct annual costs (DAC)</b>	<b>\$4,413,000</b>		
Indirect Annual Costs			
Cost for capital recovery	\$785,000	(TCI) X	12.17%      CRF
Total indirect annual costs (IDAC)	<u>\$785,000</u>		
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$5,198,000</b>		

# **Green River**

Plant Name: Green River  
Unit: 3  
MW 71  
Project description High Level Emissions Control Study  
Revised on: 07/06/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$29,000,000	\$408	\$1,040,000	\$4,569,000
CDS-FF	\$40,000,000	\$563	\$6,921,000	\$11,789,000
PAC Injection	\$1,112,000	\$16	\$323,000	\$458,000
Neural Networks	\$500,000	\$7	\$50,000	\$111,000
Total	\$70,612,000	\$995	\$8,334,000	\$16,927,000

**GREEN RIVER UNIT 3 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$2,126,000	
Ductwork and Breeching	\$1,642,000	
Mechanical - Balance of Plant (BOP)	\$538,000	
Electrical - Equipment, Raceway	\$614,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$215,000	
Control - DCS Instrumentation	\$69,000	
Air Heater	\$1,638,000	Engineering Estimates
ID Fans	\$718,534	Engineering Estimates
Catalyst	\$864,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$753,000	

**Subtotal Purchase Contract** **\$9,677,534**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$1,309,000	
Civil/Structural Construction - Sub-Structures	\$340,000	
Mechanical/Chemical Construction	\$4,113,000	
Electrical/Control Construction	\$1,881,000	
Service Contracts & Construction Indirects	\$6,571,000	
Demolition Costs	\$395,000	Engineering Estimates

**Subtotal Construction Contracts** **\$14,609,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$24,286,534**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$1,063,000	
EPC Construction Management (Includes G&A & Fee)	\$667,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$175,000	
Sales Taxes	\$247,000	
Project Contingency	\$2,495,000	

**Total Indirect Costs** **\$4,647,000**

**Total Contracted Costs** **\$29,000,000**

**Capital Cost Effectiveness** **\$408 /kW**

**ANNUAL COST**

Capacity Factor = 26%

**Fixed Annual Costs**

Operating labor	\$122,000	1 FTE and	121,547 \$/year
Maintenance labor & materials	\$729,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$901,000**

**Variable Annual Costs**

Reagent	\$60,000	100 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$37,000	470 kW and	0.03433 \$/kWh
Catalyst replacement	\$42,000	25 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$139,000**

**Total Annual Costs** **\$1,040,000**

**Levelized Capital Costs** **\$3,529,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$4,569,000**

**GREEN RIVER UNIT 3 - CDS-FF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$863,000
Ductwork and Breeching	\$554,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$114,000
Electrical - Equipment, Raceway	\$660,000
Cable Bus	\$180,000
Switchgear and MCCs	\$252,000
Control - DCS Instrumentation	\$166,000
CDS Fabric Filter	\$9,704,000
ID Fans	\$663,263 Engineering Estimates

**Subtotal Purchase Contract** **\$13,156,263**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$2,627,000
Civil/Structural Construction - Sub-Structures	\$1,780,000
Mechanical/Chemical Construction	\$3,996,000
Electrical/Control Construction	\$1,517,000
Service Contracts & Construction Indirects	\$7,004,000
Demolition Costs	\$1,564,000 Engineering Estimates

**Subtotal Construction Contracts** **\$18,488,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$31,644,263**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$2,623,000
EPC Construction Management (Includes G&A & Fee)	\$1,038,000
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$272,000
Sales Taxes	\$502,000
Project Contingency	\$3,858,000

**Total Indirect Costs** **\$8,293,000**

**Total Contracted Costs** **\$40,000,000**

**Cost Effectiveness** **\$563 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 26%

Operating labor	\$1,459,000	12 FTE and	121,547 \$/year
Maintenance labor and materials	\$949,000	(DC) X 3.0%	

**Subtotal Fixed Annual Costs** **\$2,408,000**

**Variable Annual Costs**

Reagent	\$3,431,000	22,790 lb/hr and	132.19 \$/ton
Byproduct disposal	\$914,000	53,535 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$138,000	1,760 kW and	0.03433 \$/kWh
Water	\$30,000	110 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs** **\$4,513,000**

**Total Annual Costs** **\$6,921,000**

**Levelized Capital Costs** **\$4,868,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$11,789,000**

**Green River Unit 3  
71 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$60,000	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$39,000	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$55,000	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$7,000	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$26,000	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0	From Ductwork Cost Calc		
Electrical system upgrades	\$164,000	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$9,000	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$360,000</u>			
Freight	\$9,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$369,000</u>			
Direct installation costs				
Foundation & supports	\$37,000	(PEC) X	10.0%	
Handling & erection	\$74,000	(PEC) X	20.0%	
Electrical	\$37,000	(PEC) X	10.0%	
Piping	\$18,000	(PEC) X	5.0%	
Insulation	\$7,000	(PEC) X	2.0%	
Painting	\$18,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$191,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$635,000</u>			
Indirect Costs				
Engineering	\$76,000	(DC) X	12.0%	
Owner's cost	\$76,000	(DC) X	12.0%	
Construction management	\$64,000	(DC) X	10.0%	
Start-up and spare parts	\$10,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$127,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$453,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$24,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$1,112,000</b>			
<b>Cost Effectiveness</b>	<b>\$16 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$19,000	(DC) X	3.0%	
Operating labor	\$122,000	1 FTE and	121,547 \$/year	Estimated manpower
Total fixed annual costs	<u>\$141,000</u>			
Variable annual costs				
Reagent (BPAC)	\$175,000	70 lb/hr and	26 %	capacity factor
Byproduct disposal	\$1,000	70 lb/hr and	2200 \$/ton	
Auxiliary power	\$6,000	75 kW and	15 \$/ton	
Total variable annual costs	<u>\$182,000</u>	0.03433 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$323,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$135,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$135,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$458,000</b>			

Plant Name: Green River  
Unit: 4  
MW 109  
Project description High Level Emissions Control Study  
Revised on: 07/06/10

AQC Equipment	Total Capital Cost	\$/kW	O&M Cost	Levelized Annual Costs
SCR	\$42,000,000	\$385	\$1,442,000	\$6,553,000
CDS-FF	\$57,000,000	\$523	\$10,362,000	\$17,299,000
PAC Injection	\$1,583,000	\$15	\$515,000	\$708,000
Neural Networks	\$500,000	\$5	\$50,000	\$111,000
Total	\$101,083,000	\$927	\$12,369,000	\$24,671,000

**GREEN RIVER UNIT 4 - SCR COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$3,138,000	
Ductwork and Breeching	\$2,423,000	
Mechanical - Balance of Plant (BOP)	\$794,000	
Electrical - Equipment, Raceway	\$906,000	
VFDs, Motors and Couplings	\$500,000	Engineering Estimates
Switchgear and MCCs	\$317,000	
Control - DCS Instrumentation	\$102,000	
Air Heater	\$1,638,000	Engineering Estimates
ID Fans	\$1,207,000	Engineering Estimates
Catalyst	\$1,275,000	
Selective Catalytic Reduction System (Including Ammonia System)	\$1,112,000	

**Subtotal Purchase Contract** **\$13,412,000**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$1,932,000	
Civil/Structural Construction - Sub-Structures	\$502,000	
Mechanical/Chemical Construction	\$6,072,000	
Electrical/Control Construction	\$2,777,000	
Service Contracts & Construction Indirects	\$9,700,000	
Demolition Costs	\$606,000	Engineering Estimates

**Subtotal Construction Contracts** **\$21,589,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$35,001,000**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$1,632,000	
EPC Construction Management (Includes G&A & Fee)	\$1,024,000	
Startup Spare Parts (Included)	\$0	
Construction Utilities (Power & Water) - Included	\$0	
Project Insurance	\$269,000	
Sales Taxes	\$380,000	
Project Contingency	\$3,831,000	

**Total Indirect Costs** **\$7,136,000**

**Total Contracted Costs** **\$42,000,000**

**Capital Cost Effectiveness** **\$385 /kW**

**ANNUAL COST**

Capacity Factor = 32%

**Fixed Annual Costs**

Operating labor	\$122,000	1 FTE and	121,547 \$/year
Maintenance labor & materials	\$1,050,000	(DC) X 3.0%	
Yearly emissions testing	\$25,000	Engineering Estimates	
Catalyst activity testing	\$5,000	Engineering Estimates	
Fly ash sampling and analysis	\$20,000	Engineering Estimates	

**Subtotal Fixed Annual Costs** **\$1,222,000**

**Variable Annual Costs**

Reagent	\$93,000	125 lb/hr and	530.03 \$/ton
Auxiliary and ID fan power	\$65,000	725 kW and	0.03187 \$/kWh
Catalyst replacement	\$62,000	30 m3 and	6,500 \$/m3

**Subtotal Variable Annual Costs** **\$220,000**

**Total Annual Costs** **\$1,442,000**

**Levelized Capital Costs** **\$5,111,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$6,553,000**

**GREEN RIVER UNIT 4 - CDS-FF COSTS**

**CAPITAL COST**

**Purchase Contracts**

Civil/Structural	\$1,190,000
Ductwork and Breeching	\$764,000
Mechanical - Balance of Plant (BOP) (includes reagent prep and dewatering systems)	\$158,000
Electrical - Equipment, Raceway	\$910,000
Cable Bus	\$249,000
Switchgear and MCCs	\$348,000
Control - DCS Instrumentation	\$229,000
CDS Fabric Filter	\$13,384,000
ID Fans	\$1,114,350 Engineering Estimates

**Subtotal Purchase Contract** **\$18,346,350**

**Construction Contracts**

Civil/Structural Construction - Super Structures	\$3,623,000
Civil/Structural Construction - Sub-Structures	\$2,454,000
Mechanical/Chemical Construction	\$5,511,000
Electrical/Control Construction	\$2,092,000
Service Contracts & Construction Indirects	\$9,660,000
Demolition Costs	\$2,436,000 Engineering Estimates

**Subtotal Construction Contracts** **\$25,776,000**

**Construction Difficulty Costs** **\$0** Engineering Estimates

**Total Direct Costs** **\$44,122,350**

**Indirect Costs**

Engineering Costs (Includes G&A & Fee)	\$4,027,000
EPC Construction Management (Includes G&A & Fee)	\$1,593,000
Startup Spare Parts (Included)	\$0
Construction Utilities (Power & Water) - Included	\$0
Project Insurance	\$418,000
Sales Taxes	\$770,000
Project Contingency	\$5,923,000

**Total Indirect Costs** **\$12,731,000**

**Total Contracted Costs** **\$57,000,000**

**Cost Effectiveness** **\$523 /kW**

**ANNUAL COST**

**Fixed Annual Costs**

Capacity Factor = 32%

Operating labor	\$1,459,000	12 FTE and	121,547 \$/year
Maintenance labor and materials	\$1,324,000	(DC) X 3.0%	

**Subtotal Fixed Annual Costs** **\$2,783,000**

**Variable Annual Costs**

Reagent	\$5,726,000	30,905 lb/hr and	132.19 \$/ton
Byproduct disposal	\$1,526,000	72,600 lb/hr and	15 \$/ton
Auxiliary and ID fan power	\$265,000	2,970 kW and	0.03187 \$/kWh
Water	\$62,000	185 gpm and	2 \$/1,000 gal

**Subtotal Variable Annual Costs** **\$7,579,000**

**Total Annual Costs** **\$10,362,000**

**Levelized Capital Costs** **\$6,937,000** (TCI) X 12.17% CRF

**Levelized Annual Costs** **\$17,299,000**

**Green River Unit 4  
109 MW  
High Level Emissions Control Study**

Technology: PAC Injection

Date: 7/8/2010

Cost Item	\$	Remarks/Cost Basis		
<b>CAPITAL COST</b>				
Direct Costs				
Purchased equipment costs				
Long-term storage silo (with truck unloading sys.)	\$92,000	Ratio from Brown Unit 3 BACT Analysis		
Short-term storage silo	\$60,000	Ratio from Brown Unit 3 BACT Analysis		
Air blowers	\$84,000	Ratio from Brown Unit 3 BACT Analysis		
Rotary feeders	\$10,000	Ratio from Brown Unit 3 BACT Analysis		
Injection system	\$39,000	Ratio from Brown Unit 3 BACT Analysis		
Ductwork modifications, supports, platforms	\$0	From Ductwork Cost Calc		
Electrical system upgrades	\$252,000	Ratio from Brown Unit 3 BACT Analysis		
Instrumentation and controls	\$13,000	Ratio from Brown Unit 3 BACT Analysis		
Subtotal capital cost (CC)	<u>\$550,000</u>			
Freight	\$14,000	(CC) X	2.5%	
Total purchased equipment cost (PEC)	<u>\$564,000</u>			
Direct installation costs				
Foundation & supports	\$56,000	(PEC) X	10.0%	
Handling & erection	\$113,000	(PEC) X	20.0%	
Electrical	\$56,000	(PEC) X	10.0%	
Piping	\$28,000	(PEC) X	5.0%	
Insulation	\$11,000	(PEC) X	2.0%	
Painting	\$28,000	(PEC) X	5.0%	
Demolition	\$0	(PEC) X	0.0%	
Relocation	\$0	(PEC) X	0.0%	
Total direct installation costs (DIC)	<u>\$292,000</u>			
Site preparation	\$0	N/A		
Buildings	\$75,000	Engineering estimate		
Total direct costs (DC) = (PEC) + (DIC)	<u>\$931,000</u>			
Indirect Costs				
Engineering	\$112,000	(DC) X	12.0%	
Owner's cost	\$112,000	(DC) X	12.0%	
Construction management	\$93,000	(DC) X	10.0%	
Start-up and spare parts	\$14,000	(DC) X	1.5%	
Performance test	\$100,000	Engineering estimate		
Contingencies	\$186,000	(DC) X	20.0%	
Total indirect costs (IC)	<u>\$617,000</u>			
Allowance for Funds Used During Construction (AFDC)	\$35,000	[(DC)+(IC)] X	4.50%	1 years (project time length X 1/2)
<b>Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)</b>	<b>\$1,583,000</b>			
<b>Cost Effectiveness</b>	<b>\$15 /kW</b>			
<b>ANNUAL COST</b>				
Direct Annual Costs				
Fixed annual costs				
Maintenance labor and materials	\$28,000	(DC) X	3.0%	
Operating labor	\$122,000	1 FTE and	121,547 \$/year	Estimated manpower
Total fixed annual costs	<u>\$150,000</u>			
Variable annual costs				
Reagent (BPAC)	\$355,000	115 lb/hr and	32 %	capacity factor
Byproduct disposal	\$2,000	115 lb/hr and	2200 \$/ton	
Auxiliary power	\$8,000	90 kW and	15 \$/ton	
Total variable annual costs	<u>\$365,000</u>	0.03187 \$/kWh		
<b>Total direct annual costs (DAC)</b>	<b>\$515,000</b>			
Indirect Annual Costs				
Cost for capital recovery	\$193,000	(TCI) X	12.17%	CRF
Total indirect annual costs (IDAC)	<u>\$193,000</u>			
<b>Total Annual Cost (TAC) = (DAC) + (IDAC)</b>	<b>\$708,000</b>			