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DEPARTMENT OF ENVIRONMENTAL QUALITY
STATE A Q PROGRAM

P4 Production, LLC

Soda Springs Plant
1853 Highway 34
P.O. Box 816
Soda Springs, Idaho 83276-0816
Phone: (208) 547-4300
Fax: (208) 547-3312

April 6, 2012

VIA CERTIFIED MAIL; EG 588838563 US
RETURN RECEIPT REQUESTED – ~~7010 2780 0002 0464 3057~~

Mr. Bill Rogers
Air Quality Division
Department of Environmental Quality
1410 North Hilton
Boise, ID 83706

RE: MBACT Tier II Permit Application

Dear Mr. Rogers:

Per IDAPA 58.01.01.402.a.ii. P4 Production, LLC (P4) is submitting the enclosed Tier II Permit application and Mercury Best Available Control Technology (MBACT) Analysis.

Modeling is not included with this application, as it was provided when the existing equipment was permitted and installed. Also, we were unable to determine what air pollution control form should be used for the dust knockout chambers that are integrated into kiln emission control. We would be happy to provide this information, if required, in a format requested by your agency.

In accordance with IDAPA 58.01.01.123, I certify based on information and belief formed after reasonable inquiry, that the statements and information in this document are true, accurate, and complete. If you have any questions regarding this submittal, please contact Mr. Jim McCulloch at (208) 547-1233.

Sincerely,

Allegra Beehler for S.D. Alver

Sheldon Alver
Plant Manager

enclosures

DEQ AIR QUALITY PROGRAM
1410 N. Hilton, Boise, ID 83706
For assistance, call the
Air Permit Hotline – 1-877-5PERMIT

Cover Sheet for Air Permit Application – Tier II **Form CSTII**

Please see instructions on page 2 before filling out the form.

COMPANY NAME, FACILITY NAME, AND FACILITY ID NUMBER

1. Company Name	P4 Production, LLC		
2. Facility Name	Soda Springs Facility	3. Facility ID No.	029-00001
4. Brief Project Description - One sentence or less	Mercury Best Available Control Technology (MBACT) Analysis		

PERMIT APPLICATION TYPE

5. ☒ Initial Tier II Permit ☐ Tier II Renewal: Permit No.:_____ Date Issued:_____
☐ Required by Enforcement Action – Case No. _____ ☐ Bank an Emissions Reduction Credit (Section 461)
☐ Tier II Facility Emissions Cap Permit Application ☐ Synthetic Minor Permit Application ☐ SIP Permit Application Required by DEQ

FORMS INCLUDED

Included	N/A	Forms	DEQ Verify
☒	☐	Form CSTII – Cover Sheet	☐
☒	☐	Form GI – Facility Information	☐
☒	☐	Form EU0 – Emissions Units General	☐
☐	☒	Form EU1– Industrial Engine Information Please specify number of EU1s attached: ____	☐
☐	☒	Form EU2– Nonmetallic Mineral Processing Plants Please specify number of EU2s attached: ____	☐
☐	☒	Form EU3– Spray Paint Booth Information Please specify number of EU3s attached: ____	☐
☐	☒	Form EU4– Cooling Tower Information Please specify number of EU4s attached: ____	☐
☐	☒	Form EU5 – Boiler Information Please specify number of EU5s attached: ____	☐
☐	☒	Form CBP– Concrete Batch Plant Please specify number of CBPs attached: ____	☐
☐	☒	Form HMAP – Hot Mix Asphalt Plant Please specify number of HMAPs attached: ____	☐
☐	☒	PERF – Portable Equipment Relocation Form	☐
☐	☒	Form AO – Afterburner/Oxidizer	☐
☐	☒	Form CA – Carbon Adsorber	☐
☒	☐	Form CYS – Cyclone Separator	☐
☐	☒	Form ESP – Electrostatic Precipitator	☐
☐	☒	Form BCE– Baghouses Control Equipment	☐
☒	☐	Form SCE– Scrubbers Control Equipment	☐
☒	☐	Form VSCE – Venturi Scrubber Control Equipment	☐
☐	☒	Form CAM – Compliance Assurance Monitoring	☐
☒	☐	Forms EI-CP1 - EI-CP4– Emissions Inventory– criteria pollutants (Excel workbook, all 4 worksheets)	☐
☒	☐	PP – Plot Plan	☐
☐	☒	Forms MI1 – MI4 – Modeling (Excel workbook, all 4 worksheets)	☐
☒	☐	Form FRA – Federal Regulation Applicability	☐

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General Information **Form GI**
Revision 7
2/18/10

Please see instructions on page 2 before filling out the form.

All information is required. If information is missing, the application will not be processed.

IDENTIFICATION

1. Company Name	2. Facility Name:
P4 Production, LLC	Soda Springs Facility

3. Brief Project Description:	Mercury Best Available Control Technology (MBACT) Analysis and Tier II Application as required by IDAPA 58.01.01.401.02.a.ii

FACILITY INFORMATION

4. Primary Facility Permit Contact Person/Title	Jim McCulloch		Sr. Environmental Engineer	
5. Telephone Number and Email Address	208-547-1233		james.r.mcculloch@monsanto.com	
6. Alternate Facility Contact Person/Title	Allegra Belknap		ESH Business Unit Lead	
7. Telephone Number and Email Address	(208) 547-1250		allegra.g.belknap@monsanto.com	
8. Address to Which the Permit Should be Sent	1853 Highway 34 North, PO Box 816			
9. City/County/State/Zip Code	Soda Springs	Caribou	Idaho	83276
10. Equipment Location Address (if different than the mailing address above)	1853 Highway 34 North, PO Box 816			
11. City/County/State/Zip Code	Soda Springs	Caribou	Idaho	83276
12. Is the Equipment Portable?	☐ Yes ☒ No			
13. SIC Code(s) and NAICS Code	Primary SIC: 2819	Secondary SIC:	NAICS: 325188	
14. Brief Business Description and Principal Product	Elemental phosphorus production			
15. Indentify any adjacent or contiguous facility that this company owns and/or operates	N/A			
16. Specify the reason for the application	☐ Permit to Construct (PTC) For Tier I permitted facilities only: If you are applying for a PTC then you must also specify how the PTC will be incorporated into the Tier I permit. ☐ Incorporate the PTC at the time of the Tier I renewal ☐ Co-process the Tier I modification and PTC ☐ Administratively amend the Tier I permit to incorporate the PTC upon your request (IDAPA 58.01.01.209.05.a, b, or c) ☐ Tier I Permit ☒ Tier II Permit ☐ Tier II/Permit to Construct			

CERTIFICATION

In accordance with **IDAPA 58.01.01.123 (Rules for the Control of Air Pollution in Idaho), I** certify based on information and belief formed after reasonable inquiry, the statements and information in the document(s) are true, accurate, and complete.

17. Responsible Official's Name/Title	Sheldon D. Alver	Plant Manager	
18. Responsible Official Address	1853 Highway 34 North, PO Box 816		
19. Responsible Official Telephone Number	(208) 547-4300		
20. Responsible Official Email Address	sheldon.d.alver@monsanto.com		
21. Responsible Official's Signature	Allegra Belknap	Date:	4/6/12

22. ☒ Check here to indicate that you would like to review the draft permit prior to final issuance.

for SD Alver

DEQ AIR QUALITY PROGRAM
1410 N. Hilton, Boise, ID 83706
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Emissions Unit - General **Form EU0**
Revision 4
08/28/08

Please see instructions on page 2 before filling out the form.

IDENTIFICATION

1. Company Name:	2. Facility Name:	3. Facility ID No:
P4 Production, LLC	Soda Springs Facility	029-00001

4. Brief Project Description:	MBACT Analysis

EMISSIONS UNIT (PROCESS) IDENTIFICATION & DESCRIPTION

5.	Emissions Unit (EU) Name:	PHOSPHATE ORE NODULIZING KILN
6.	EU ID Number:	P-1
7.	EU Type:	☐ New Source ☐ Unpermitted Existing Source ☐ Modification to a Permitted Source -- Previous Permit #: Date Issued:
8.	Manufacturer:	ALLIS CHAMBERS
9.	Model:	
10..	Maximum Capacity:	300 MMBTU/HR
11.	Date of Construction:	1965
12.	Date of Modification (if any):	
13.	Is this a Controlled Emission Unit?	☐ No ☒ Yes If Yes, complete the following section. If No, go to line 22.

EMISSIONS CONTROL EQUIPMENT

14. Control Equipment Name and ID:	C-1 Dust Knockout Chamber		
15. Date of Installation:	1965	16. Date of Modification (if any):	
17. Manufacturer and Model Number:	Allis Chambers		
18. ID(s) of Emission Unit Controlled:	P-1		
19. Is operating schedule different than emission units(s) involved?	☐ Yes ☒ No		
20. Does the manufacturer guarantee the control efficiency of the control equipment?	☐ Yes ☒ No (If Yes, attach and label manufacturer guarantee)		

	Pollutant Controlled					
	PM	PM10	SO_2	NOx	VOC	CO
Control Efficiency						

21. If manufacturer's data is not available, attach a separate sheet of paper to provide the control equipment design specifications and performance data to support the above mentioned control efficiency. See attached MBACT Determination

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

22.	Actual Operation:	7843 HOURS/YEAR
23.	Maximum Operation:	8760 HOURS/YEAR

REQUESTED LIMITS

24.	Are you requesting any permit limits?	☒ Yes ☐ No (If Yes, indicate all that apply below)
	☐ Operation Hour Limit(s):	
	☐ Production Limit(s):	
	☐ Material Usage Limit(s):	
	☐ Limits Based on Stack Testing:	Please attach all relevant stack testing summary reports
	☒ Other:	62.2 LB/MONTH ON A 12-MONTH ROLLING AVERAGE
25.	Rationale for Requesting the Limit(s):	SEE ATTACHED MBACT DETERMINATION

DEQ AIR QUALITY PROGRAM
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Emissions Unit - General **Form EU0**
Revision 4
08/28/08

Please see instructions on page 2 before filling out the form.

IDENTIFICATION

1. Company Name:	2. Facility Name:	3. Facility ID No:
P4 Production, LLC	Soda Springs Facility	029-00001

4. Brief Project Description:	MBACT Analysis

EMISSIONS UNIT (PROCESS) IDENTIFICATION & DESCRIPTION

5.	Emissions Unit (EU) Name:	PHOSPHATE ORE NODULIZING KILN
6.	EU ID Number:	P-1
7.	EU Type:	☐ New Source ☐ Unpermitted Existing Source ☐ Modification to a Permitted Source -- Previous Permit #: Date Issued:
8.	Manufacturer:	ALLIS CHAMBERS
9.	Model:	
10..	Maximum Capacity:	300 MMBTU/HR
11.	Date of Construction:	1965
12.	Date of Modification (if any):	
13.	Is this a Controlled Emission Unit?	☐ No ☒ Yes If Yes, complete the following section. If No, go to line 22.

EMISSIONS CONTROL EQUIPMENT

14. Control Equipment Name and ID:	C-2 North Spray Tower		
15. Date of Installation:	1999	16. Date of Modification (if any):	
17. Manufacturer and Model Number:	Monsanto		
18. ID(s) of Emission Unit Controlled:	P-1		
19. Is operating schedule different than emission units(s) involved?	☐ Yes ☒ No		
20. Does the manufacturer guarantee the control efficiency of the control equipment?	☐ Yes ☒ No (If Yes, attach and label manufacturer guarantee)		

	Pollutant Controlled					
	PM	PM10	SO_2	NOx	VOC	CO
Control Efficiency						

21. If manufacturer's data is not available, attach a separate sheet of paper to provide the control equipment design specifications and performance data to support the above mentioned control efficiency. See attached MBACT Determination

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

22.	Actual Operation:	7843 HOURS/YEAR
23.	Maximum Operation:	8760 HOURS/YEAR

REQUESTED LIMITS

24.	Are you requesting any permit limits?	☒ Yes ☐ No (If Yes, indicate all that apply below)
	☐ Operation Hour Limit(s):	
	☐ Production Limit(s):	
	☐ Material Usage Limit(s):	
	☐ Limits Based on Stack Testing:	Please attach all relevant stack testing summary reports
	☒ Other:	62.2 LB/MONTH ON A 12-MONTH ROLLING AVERAGE
25.	Rationale for Requesting the Limit(s):	SEE ATTACHED MBACT DETERMINATION

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Emissions Unit - General **Form EU0**
Revision 4
08/28/08

Please see instructions on page 2 before filling out the form.

IDENTIFICATION

1. Company Name:	2. Facility Name:	3. Facility ID No:
P4 Production, LLC	Soda Springs Facility	029-00001

4. Brief Project Description:	MBACT Analysis

EMISSIONS UNIT (PROCESS) IDENTIFICATION & DESCRIPTION

5. Emissions Unit (EU) Name:	PHOSPHATE ORE NODULIZING KILN
6. EU ID Number:	P-1
7. EU Type:	☐ New Source ☐ Unpermitted Existing Source ☐ Modification to a Permitted Source -- Previous Permit #: Date Issued:
8. Manufacturer:	ALLIS CHAMBERS
9. Model:	
10.. Maximum Capacity:	300 MMBTU/HR
11. Date of Construction:	1965
12. Date of Modification (if any):	
13. Is this a Controlled Emission Unit?	☐ No ☒ Yes If Yes, complete the following section. If No, go to line 22.

EMISSIONS CONTROL EQUIPMENT

14. Control Equipment Name and ID:	C-3a, b, c, d - Four Parallel Cyclonic Separators
15. Date of Installation:	1987 16. Date of Modification (if any):
17. Manufacturer and Model Number:	Hydro-Sonics
18. ID(s) of Emission Unit Controlled:	P-1
19. Is operating schedule different than emission units(s) involved?	☐ Yes ☒ No
20. Does the manufacturer guarantee the control efficiency of the control equipment?	☐ Yes ☒ No (If Yes, attach and label manufacturer guarantee)

	Pollutant Controlled					
	PM	PM10	SO_2	NOx	VOC	CO
Control Efficiency						

21. If manufacturer's data is not available, attach a separate sheet of paper to provide the control equipment design specifications and performance data to support the above mentioned control efficiency. See attached MBACT Determination

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

22. Actual Operation:	7843 HOURS/YEAR
23. Maximum Operation:	8760 HOURS/YEAR

REQUESTED LIMITS

24. Are you requesting any permit limits?	☒ Yes ☐ No (If Yes, indicate all that apply below)
☐ Operation Hour Limit(s):	
☐ Production Limit(s):	
☐ Material Usage Limit(s):	
☐ Limits Based on Stack Testing:	Please attach all relevant stack testing summary reports
☒ Other:	62.2 LB/MONTH ON A 12-MONTH ROLLING AVERAGE
25. Rationale for Requesting the Limit(s):	SEE ATTACHED MBACT DETERMINATION

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Emissions Unit - General **Form EU0**
Revision 4
08/28/08

Please see instructions on page 2 before filling out the form.

IDENTIFICATION

1. Company Name:	2. Facility Name:	3. Facility ID No:
P4 Production, LLC	Soda Springs Facility	029-00001

4. Brief Project Description:	MBACT Analysis

EMISSIONS UNIT (PROCESS) IDENTIFICATION & DESCRIPTION

5.	Emissions Unit (EU) Name:	PHOSPHATE ORE NODULIZING KILN
6.	EU ID Number:	P-1
7.	EU Type:	☐ New Source ☐ Unpermitted Existing Source ☐ Modification to a Permitted Source -- Previous Permit #: Date Issued:
8.	Manufacturer:	ALLIS CHAMBERS
9.	Model:	
10..	Maximum Capacity:	300 MMBTU/HR
11.	Date of Construction:	1965
12.	Date of Modification (if any):	
13.	Is this a Controlled Emission Unit?	☐ No ☒ Yes If Yes, complete the following section. If No, go to line 22.

EMISSIONS CONTROL EQUIPMENT

14. Control Equipment Name and ID:	C-4 a, b, c, d - Four Parallel Hydro-sonic scrubbers/demisters
15. Date of Installation:	1987 16. Date of Modification (if any):
17. Manufacturer and Model Number:	Hydro-Sonics
18. ID(s) of Emission Unit Controlled:	P-1
19. Is operating schedule different than emission units(s) involved?	☐ Yes ☒ No
20. Does the manufacturer guarantee the control efficiency of the control equipment?	☐ Yes ☒ No (If Yes, attach and label manufacturer guarantee)

	Pollutant Controlled					
	PM	PM10	SO_2	NOx	VOC	CO
Control Efficiency						

21. If manufacturer's data is not available, attach a separate sheet of paper to provide the control equipment design specifications and performance data to support the above mentioned control efficiency. See attached MBACT Determination

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

22.	Actual Operation:	7843 HOURS/YEAR
23.	Maximum Operation:	8760 HOURS/YEAR

REQUESTED LIMITS

24.	Are you requesting any permit limits?	☒ Yes ☐ No (If Yes, indicate all that apply below)
	☐ Operation Hour Limit(s):	
	☐ Production Limit(s):	
	☐ Material Usage Limit(s):	
	☐ Limits Based on Stack Testing:	Please attach all relevant stack testing summary reports
	☒ Other:	62.2 LB/MONTH ON A 12-MONTH ROLLING AVERAGE
25.	Rationale for Requesting the Limit(s):	SEE ATTACHED MBACT DETERMINATION

DEQ AIR QUALITY PROGRAM
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Air Permit Hotline – 1-877-5PERMIT

Emissions Unit - General **Form EU0**
Revision 4
08/28/08

Please see instructions on page 2 before filling out the form.

IDENTIFICATION

1. Company Name:	2. Facility Name:	3. Facility ID No:
P4 Production, LLC	Soda Springs Facility	029-00001

4. Brief Project Description:	MBACT Analysis

EMISSIONS UNIT (PROCESS) IDENTIFICATION & DESCRIPTION

5.	Emissions Unit (EU) Name:	PHOSPHATE ORE NODULIZING KILN
6.	EU ID Number:	P-1
7.	EU Type:	☐ New Source ☐ Unpermitted Existing Source ☐ Modification to a Permitted Source -- Previous Permit #: Date Issued:
8.	Manufacturer:	ALLIS CHAMBERS
9.	Model:	
10..	Maximum Capacity:	300 MMBTU/HR
11.	Date of Construction:	1965
12.	Date of Modification (if any):	
13.	Is this a Controlled Emission Unit?	☐ No ☒ Yes If Yes, complete the following section. If No, go to line 22.

EMISSIONS CONTROL EQUIPMENT

14. Control Equipment Name and ID:	C-6 SO2 Scrubbing System (LCDA)
15. Date of Installation:	16. Date of Modification (if any):
17. Manufacturer and Model Number:	Monsanto
18. ID(s) of Emission Unit Controlled:	P-1
19. Is operating schedule different than emission units(s) involved?	☐ Yes ☒ No
20. Does the manufacturer guarantee the control efficiency of the control equipment?	☐ Yes ☒ No (If Yes, attach and label manufacturer guarantee)

	Pollutant Controlled					
	PM	PM10	SO_2	NOx	VOC	CO
Control Efficiency						

21. If manufacturer's data is not available, attach a separate sheet of paper to provide the control equipment design specifications and performance data to support the above mentioned control efficiency. See attached MBACT Determination

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

22.	Actual Operation:	7843 HOURS/YEAR
23.	Maximum Operation:	8760 HOURS/YEAR

REQUESTED LIMITS

24.	Are you requesting any permit limits?	☒ Yes ☐ No (If Yes, indicate all that apply below)
	☐ Operation Hour Limit(s):	
	☐ Production Limit(s):	
	☐ Material Usage Limit(s):	
	☐ Limits Based on Stack Testing:	Please attach all relevant stack testing summary reports
	☒ Other:	62.2 LB/MONTH ON A 12-MONTH ROLLING AVERAGE
25.	Rationale for Requesting the Limit(s):	SEE ATTACHED MBACT DETERMINATION

DEQ AIR QUALITY PROGRAM
1410 N. Hilton, Boise, ID 83706
For assistance, call the
Air Permit Hotline: 1-877-5PERMIT

Cyclone Separator - **Form CYS**
Revision 2
08/28/08

Please see instructions on page 3 before filling out the form.

IDENTIFICATION

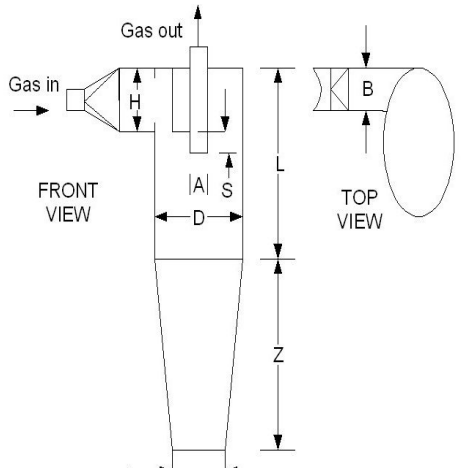
1. Company Name:	P4 Production, LLC	2. Facility Name:	Soda Springs Facility	3. Facility ID No.:	029-00001
4. Brief Project Description:	MBACT Analysis				

CYCLONE SEPARATOR INFORMATION

Equipment Description

5. Manufacturer:	Hydro-Sonics	6. Model Number:	

7. Dimensions



Give dimensions of cyclone. (See sample diagram above.)

1. B:	in.	5. Z:	in.
2. H:	in.	6. D:	in.
3. S:	in.	7. A:	in.
4. L:	in.	8. J:	in.

8. Particulate Size Distribution Data

Micron range	Particle size distribution weight %	Manufacturer's guaranteed removal efficiency for each micron range
0.5-1.0		
1.0-5.0		
5-10		
10-20		
Over 20		

9. Type of Cyclone	☐ Wet	☐ Dry
10. Type of Cyclone Unit	☐ Single ☐ Dual	☐ Quadruple ☐ Multiclone
11. Blower	Blower horsepower: hp Design flow rate: scfm Draft: ☐ Forced ☐ Induced	

12. Design Criteria	Cyclone configuration: ☐ Positive pressure	☐ Negative pressure	
13. Pre-Treatment Device	☐ Cyclone ☐ Precooler ☐ Preheater	☐ Knock-out chamber ☐ None	
14. Post-Treatment Device	☐ Baghouse/Cartridge ☐ HEPA ☐ Other:		

Process Stream Characteristics	
15. Brief Description of Process	.
16. Flow Data	Gas stream temperature: degrees F Moisture content: grams of water/cubic feet (ft^3) of dry air <u>Pressure drop range</u> High: in. H_2O Low: in. H_2O Dew point temperature of process stream: degrees F Inlet flow rate: ACFM
17. Dust Collection Device	☐ Pneumatic conveyor ☐ Rotary airlock values ☐ Screw conveyors ☐ Closed container ☐ Double dump ☐ Drag conveyor ☐ Manual discharge device: ☐ Slide gate OR ☐ Hinged doors or drawers
18. Operating Schedule	Normal: hours/day days/week weeks/year Maximum: hours/day days/week weeks/year

DEQ AIR QUALITY PROGRAM
1410 N. Hilton, Boise, ID 83706
For assistance, call the
Air Permit Hotline – 1-877-5PERMIT

Scrubber Control Equipment - **Form SCE**
Revision 5
08/28/08

Please see instructions on page 2 before filling out the form.

IDENTIFICATION					
1. Company Name:	P4 Production, LLC	2. Facility Name:	Soda Springs Facility	3. Facility ID No.:	029-00001
4. Brief Project Description:	MBACT Analysis				

EMISSION UNIT ID				SCRUBBER					
5.	6.	7.	8.	9.	10.	11.	12.	13	14.
Emission Unit	EU ID No.	CE ID No.	Stack ID No.	Manufacturer Name	Model No.	Type	Dimensions In Feet (Ht x Dia x L)	Water Flow (gpm)	Pressure Drop (in H_2O)
PHOSPHATE ORE NODULIZING KILN	P-1	C-2		Monsanto		spray tower	30' diameter x 60' tall	3200	4.86
PHOSPHATE ORE NODULIZING KILN	P-1	C-6		Hydro-Sonics		scrubbing system		≥ 900	≥ 38

DEQ AIR QUALITY PROGRAM
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Air Permit Hotline – 1-877-5PERMIT

Venturi Scrubber Control Equipment - **Form VSCE**
Revision 2
08/28/08

Please see instructions on page 2 before filling out the form.

IDENTIFICATION					
1. Company Name:	P4 Production, LLC	2. Facility Name:	Soda Springs Facility	3. Facility ID No.:	029-00001
4. Brief Project Description:	MBACT Analysis				

EMISSION UNIT ID				SCRUBBER						
5.	6.	7.	8.	9.	10.	11.	12.	13	14.	15.
Emission Unit	EU ID No.	CE ID No.	Stack ID No.	Manufacturer Name	Model No.	Efficiency (PM_{10}@70%, SO_2@50%, etc.)	Basis for Efficiency (i.e., guarantee, source test, etc.)	Design Scrubbing Liquid Flow (gpm)	Design Pressure Drop (in H_2O)	Design pH (for acid gas control)
PHOSPHATE ORE NODULIZING KILN	P-1	C-4		Hydro-Sonics		Hg@35%	source test and material analysis	>900	40	6.7

Describe the maintenance required to assure the scrubber operates as designed (i.e. frequency of inspection, nozzle inspection, nozzle cleaning, etc.). (Provide an attachment if necessary.) Flow and pressure drop are monitored continuously by the process control system and every 4 hours by the operator. Both flow and pressure drop are calibrated every 6 months. If flow or pressure drop falls outside permitted CAM limits, field inspections and maintenance activity is initiated.

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

Version 1, August 2010

Facility Wide Potential to Emit Emission Inventory

Application Template and Instructions

For new stationary sources provide the facility's potential to emit for all NSR Regulated Air Pollutants. The potential to emit provided here must match the emissions rates which are requested to be permitted.

For modifications to existing facilities (including the addition of new emissions units), if the existing facility classification is in question an existing facility wide potential to emit emission inventory will be required to be submitted[1]. Contact DEQ to determine if a facility wide emission inventory for the existing facility is required.

All emissions inventories must be submitted with thorough documentation. The emission inventories will be subjected to technical review. Therefore, prepare your application with sufficient documentation so that the public and DEQ can verify the validity of the emission estimates. **Applications submitted without sufficient documentation are incomplete. Follow the instructions provided on page 2; do not proceed until you have read the instructions.**

Applicants must use the Potential to Emit Summary table provided below.

Table 1. POTENTIAL TO EMIT FOR MERCURY

Emissions Unit	Mercury	Mercury	NSR Pollutant[a]	NSR Pollutant[a]	NSR Pollutant[a]	NSR Pollutant[a]
	Lbs/yr	Lbs/yr	T/yr	T/yr	T/yr	T/yr
Point Sources						
Facility-Wide Hg Emission Units	See Attached Table 2	757 lbs	-	-	-	-
Fugitive Sources *{For listed source categories only, see item 3 below in the instructions}*						
Facility-Wide Fugitive Hg	See Attachment Table 2	0.07 lbs	-	-	-	-
Totals		**757.07 lbs**	**-**	**-**	**-**	**-**

a) NSR Regulated air Pollutants are defined[2] as: Particulate Matter (PM, PM-10, PM-2.5), Carbon Monoxide, Lead, Nitrogen Dioxide, Ozone (VOC), Sulfur Dioxide, CO_2e[3], Green House Gases (GHG) mass, all pollutants regulated by NSPS (40 CFR 60)(i.e. TRS, fluoride, sulfuric acid mist) & Class I & Class II Ozone Depleting Substances (40 CFR 82)(i.e. CFC, HCFC, Halon, etc.)

Applicants are encouraged to call DEQ's Air Quality Permit Hotline (1-877-573-7648) to ask questions as they prepare the application.**Emission Inventory Instructions:**

---

[1] The applicant must determine if the existing facility is a major facility. If the facility is an existing PSD major facility and changes are being made to the facility the major modification test must be conducted.

[2] 40 CFR 52.21(b)(50), as incorporated by reference at IDAPA 58.01.01.107.03.d

[3] Multiply each green house gas (GHG) by the global warming potential (GWP) listed at 40 CFR 98, Table A- 1 of Subpart A then sum all values to determine CO_2e (GHGs are carbon dioxide, nitrous oxide, methane, hydrofluorcarbons, perfluorcarbons, sulfur hexafluoride). Be sure to show all calculations as described in the instructions.

1. Use the same emission unit name throughout the application (i.e. in air pollution control equipment forms and for modeling purposes).

2. The application must **show in detail all calculations** used to develop the PTE summary and include:

   - Electronic copies of any spreadsheets used to estimate emissions. If a spreadsheet is used submit an electronic copy of the spread sheet (i.e. Excel File).
   - Documentation of all calculations conducted by hand (i.e. show all calculations).
   - Clear statements on all assumptions relied upon in estimating emissions.
   - Documentation of the emissions factors used to estimate emissions. If the emissions factor documentation is readily available to DEQ, such as an EPA AP-42 emissions factor, a simple reference to the emissions factor suffices. If the emissions factor documentation is not readily available to DEQ the applicant must submit the documentation with the application; ask DEQ if you are uncertain. **Applications without sufficient documentation are incomplete.** Documentation may consist of manufacturer guarantees, research conducted by trade organizations, published emission factors, and source test results. **If there are multiple factors for a given operation, note why the factor used is the most representative.**
   - Copies of manufacturer guarantees upon which emission inventories are based.
   - The best available emission information (see DEQ's Guidance on Emission Data Hierarchy).
   - If source tests are used as the basis for emissions estimates the source test report must be submitted. If the source test report is on file with DEQ provide the date of the source test was submitted along with the name of the facility and the emission unit that was tested. Source data from similar emissions units may be considered reliable provided it is clearly described why the sources are similar. Similar sources are those that the applicant has shown serve a similar function, use similar raw materials, and have similar processing rates.

3. Fugitive emissions of NSR regulated air pollutants from the source categories listed below must be included in the emission inventory.

Listed Source Categories for Inclusion of Fugitive Emissions

- Coal cleaning plants (with thermal dryers)
- Kraft pulp mills
- Portland cement plants
- Primary zinc smelters
- Iron and steel mills
- Primary aluminum ore reduction plants
- Primary copper smelters
- Municipal incinerators -250 T/day of refuse
- Hydrofluoric, sulfuric, or nitric acid plants
- Petroleum refineries
- Lime plants
- Phosphate rock processing plants
- Coke oven batteries
- Sulfur recovery plants
- Carbon black plants (furnace process)
- Primary lead smelters
- Fuel conversion plants
- Sintering plants
- Secondary metal production plants
- Chemical process plants (excluding ethanol plants by natural fermentation).
- Fossil-fuel fired boilers totaling more than 250 MMBtu/hr
- Petroleum storage and transfer units with total capacity of 300,000 barrels
- Taconite ore processing plants
- Glass fiber processing plants
- Charcoal production plants
- Fossil fuel-fired steam electric plants greater than 250 MMBtu/hr)
- Categories regulated by NSPS or NESHAP prior to 8/7/80

Table 2 - Determination of Potential Hg Emissions for P4 Productions, Soda Springs, Idaho

Emission Source	2006 Mercury Emissions (lb/yr)	2007 Mercury Emissions (lb/yr)	2008 Mercury Emissions (lb/yr)	2009 Mercury Emissions (lb/yr)	2010 Mercury Emissions (lb/yr)	2011 Mercury Emissions (lb/yr)	Average 2006 - 2011 Hg Emissions (lb/yr)	Potential Emissions[1, 2] (lb/yr)
Kiln Hydrosonics Stacks (Total)	656.11921	486.79771	609.20227	510.7019	583.84731	616.07465	577.12384	753
Nodule Crushing and Screening Scrubber Stack	2.5794089	1.8028905	2.1496504	1.5910945	2.1136017	2.2804197	2.0861776	2.72
Cooler Spray Tower Stack	0.2522395	0.2608637	0.7525532	0.5186095	0.6089667	0.6487775	0.5070017	0.6615
#7 THFC Stack	0.0251087	0.0255169	0.0614224	0.0429264	0.0663623	0.0666655	0.0480003	0.0626
#9 THFC Stack	0.0240382	0.0003801	0.0076329	0.0055505	0.0083459	0.0083773	0.0090542	0.0118
#8 THFC Stack	0.0226331	0.0181862	0.0552896	0.0457573	0.0489486	0.0570844	0.0413166	0.0539
SDM Bin Vent Stack	0.0002493	0.0002493	0.0001506	0.0001502	0.0001498	0.0001502	0.0001832	2.39E-04
Coke Handling Baghouse Stack	0.0001365	0.000141	1.633E-05	1.236E-05	1.746E-05	1.821E-05	5.698E-05	7.43E-05
Nodule Reclaim Baghouse Stack	7.021E-05	7.316E-05	7.367E-05	7.332E-05	7.398E-05	7.447E-05	7.313E-05	9.54E-05
Scaleroom Baghouse Stack	6.571E-05	6.251E-05	6.415E-05	4.817E-05	6.59E-05	6.878E-05	6.253E-05	8.16E-05
Main Furnace Baghouse Stack	2.015E-05	1.915E-05	2.317E-05	1.74E-05	2.382E-05	2.487E-05	2.142E-05	2.80E-05
No. 9 CO Dust Baghouse Stack	1.781E-05	1.669E-05	1.645E-06	1.196E-06	1.798E-06	1.805E-06	6.825E-06	8.90E-06
No. 8 CO Dust Baghouse Stack	1.522E-05	1.508E-05	2.567E-06	2.125E-06	2.273E-06	2.651E-06	6.651E-06	8.68E-06
Dryer Baghouse Stack	1.032E-05	1.238E-05	1.391E-05	1.048E-05	1.403E-05	1.454E-05	1.261E-05	1.64E-05
#309 Coke Fines Bin Vent Stack	7.827E-06	3.193E-06	1.771E-06	1.81E-06	4.096E-06	4.364E-06	3.844E-06	5.01E-06
No. 7 CO Dust Baghouse Stack	7.73E-06	7.293E-06	1.09E-06	7.62E-07	1.178E-06	1.183E-06	3.206E-06	4.18E-06
#9 CO Dust Collection Bypass Stack	5.136E-06	2.589E-06	3.77E-07	1.549E-06	7.896E-07	2.929E-07	1.789E-06	2.33E-06
#8 CO Dust Collection Bypass Stack	5.06E-06	6.189E-06	3.948E-07	5.018E-06	8.405E-08	1.095E-07	2.809E-06	3.67E-06
#305 Coke Fines Bin Vent Stack	3.667E-06	5.376E-07	5.231E-08	2.018E-07	1.198E-06	2.135E-06	1.299E-06	1.69E-06
#307 Coke Fines Bin Vent Stack	2.895E-06	1.397E-06	4.219E-07	8.286E-07	1.262E-06	2.673E-06	1.58E-06	2.06E-06
#7 CO Dust Collection Bypass Stack	2.83E-06	1.807E-06	1.256E-07	6.552E-07	5.242E-08	5.678E-08	9.212E-07	1.20E-06
105 Baghouse Stack	1.975E-06	4.894E-06	6.962E-06	5.025E-06	7.045E-06	7.478E-06	5.563E-06	7.26E-06
#304 Coke Fines Bin Vent Stack	6.856E-07	1.152E-07	3.064E-07	1.584E-07	5.895E-07	9.882E-07	4.739E-07	6.18E-07
#308 Coke Fines Bin Vent Stack	6.275E-07	3.028E-07	4.988E-07	5.594E-07	7.59E-07	2.201E-06	8.248E-07	1.08E-06
104 Baghouse Stack	6.016E-07	6.904E-07	0.0007294	0.0008036	0.0008046	0.0006746	0.0005022	6.55E-04
#306 Coke Fines Bin Vent Stack	3.051E-07	4.11E-07	3.404E-07	4.82E-07	6.052E-07	1.272E-06	5.692E-07	7.43E-07
Coke Bunker Baghouse Stack	1.076E-07	4.569E-08	2.604E-09	4.438E-08	5.063E-08	0	4.182E-08	5.46E-08
Bulk Storage Bin Baghouse Stack	8.883E-09	2.723E-09	1.982E-09	2.136E-09	9.704E-09	1.556E-08	6.831E-09	8.91E-09
Vactor Truck Vent Stack	7.125E-09	7.125E-09	7.125E-09	7.125E-09	7.125E-09	7.125E-09	7.125E-09	9.30E-09
Vactor Truck Vent Stack	4.744E-09	4.744E-09	2.372E-09	2.372E-09	2.372E-09	2.372E-09	3.163E-09	4.13E-09
Vactor Truck Vent Stack	4.744E-09	4.744E-09	2.372E-09	2.372E-09	2.372E-09	2.372E-09	3.163E-09	4.13E-09
Vactor Truck Vent Stack	4.339E-09	4.339E-09	4.821E-10	4.821E-10	4.821E-10	4.821E-10	1.768E-09	2.31E-09
Vactor Truck Vent Stack	2.666E-09	2.666E-09	2.222E-09	2.222E-09	2.222E-09	2.222E-09	2.37E-09	3.09E-09
Vactor Truck Vent Stack	2.309E-09	2.309E-09	2.309E-09	2.309E-09	2.309E-09	2.309E-09	2.309E-09	3.01E-09
Vactor Truck Vent Stack	2.147E-09	2.147E-09	2.147E-09	2.147E-09	2.147E-09	2.147E-09	2.147E-09	2.80E-09
Vactor Truck Vent Stack	2.074E-09	2.074E-09	2.074E-09	2.074E-09	2.074E-09	2.074E-09	2.074E-09	2.71E-09
Vactor Truck Vent Stack	3.418E-10	3.418E-10	3.418E-10	3.418E-10	3.418E-10	3.418E-10	3.418E-10	4.46E-10
Total Point Sources:	**659.02327**	**488.90616**	**612.2299**	**512.90698**	**586.6947**	**619.13703**	**579.8**	**757**
Total Fugitive Sources:	0.0374474	0.0342805	0.035594	0.0324296	0.038339	0.1240351	**0.050**	**0.07**

Note 1 - Potential Emissions have been determined by increasing the average actual emission rate for each point source by the ratio of Kiln PTE/Kiln Average Actual Hg Emissions

Note 2 - Hg Emissions of 753 lbs per year from the Nodulizing Kiln determined as follows:

Mercury emission test results:

Gaseous mercury: 0.0765 lb/hr (2002 stack test)
Ore throughput during 2002 gaseous test: 230 ton/hr
Particulate mercury: 0.00193 lb/hr (2002 stack test)
Ore throughput during 2002 particulate test: 238.5 ton/hr

Gaseous Hg emission factor:
(0.0765 lb/hr)/(230 ton/hr) = 3.33×10^{-4} lb/ton

Particulate Hg emission factor:
(0.00193 lb/hr)/(238.5 ton/hr) = 8.09×10^{-6} lb/ton

Overall Hg emission factor:
3.33×10^{-4} lb/ton + 8.09×10^{-6} lb/ton = 3.41×10^{-4} lb/ton
Maximum ore throughput:
(252 ton/hr) x (8,760 hr/yr) = 2,207,520 ton/yr

Maximum emissions (Potential to Emit):

$$(3.41 \times 10^{-4} \text{ lb/ton}) \times (2{,}207{,}520 \text{ ton/yr}) = 753 \text{ lb/yr}$$

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Revision 6
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For each box in the table below, CTRL+click on the blue underlined text for instructions and information.

IDENTIFICATION	
1. Company Name:	2. Facility Name:
P4 Production, LLC	Soda Springs Facility
3. Brief Project Description:	MBACT Analysis

APPLICABILITY DETERMINATION	
4. List applicable subparts of the New Source Performance Standards (NSPS) (40 CFR part 60). Examples of NSPS affected emissions units include internal combustion engines, boilers, turbines, etc. The applicant must thoroughly review the list of affected emissions units.	List of applicable subpart(s): ☑ Not Applicable
5. List applicable subpart(s) of the National Emission Standards for Hazardous Air Pollutants (NESHAP) found in 40 CFR part 61 and 40 CFR part 63. Examples of affected emission units include solvent cleaning operations, industrial cooling towers, paint stripping and miscellaneous surface coating. EPA has a web page dedicated to NESHAP that should be useful to applicants.	List of applicable subpart(s): ☑ Not Applicable
6. For each subpart identified above, conduct a complete a regulatory analysis using the instructions and referencing the example provided on the following pages. **Note** - Regulatory reviews must be submitted with sufficient detail so that DEQ can verify applicability and document in legal terms why the regulation applies. Regulatory reviews that are submitted with insufficient detail will be determined incomplete.	☐ A detailed regulatory review is provided (Follow instructions and example). ☐ DEQ has already been provided a detailed regulatory review. Give a reference to the document including the date.

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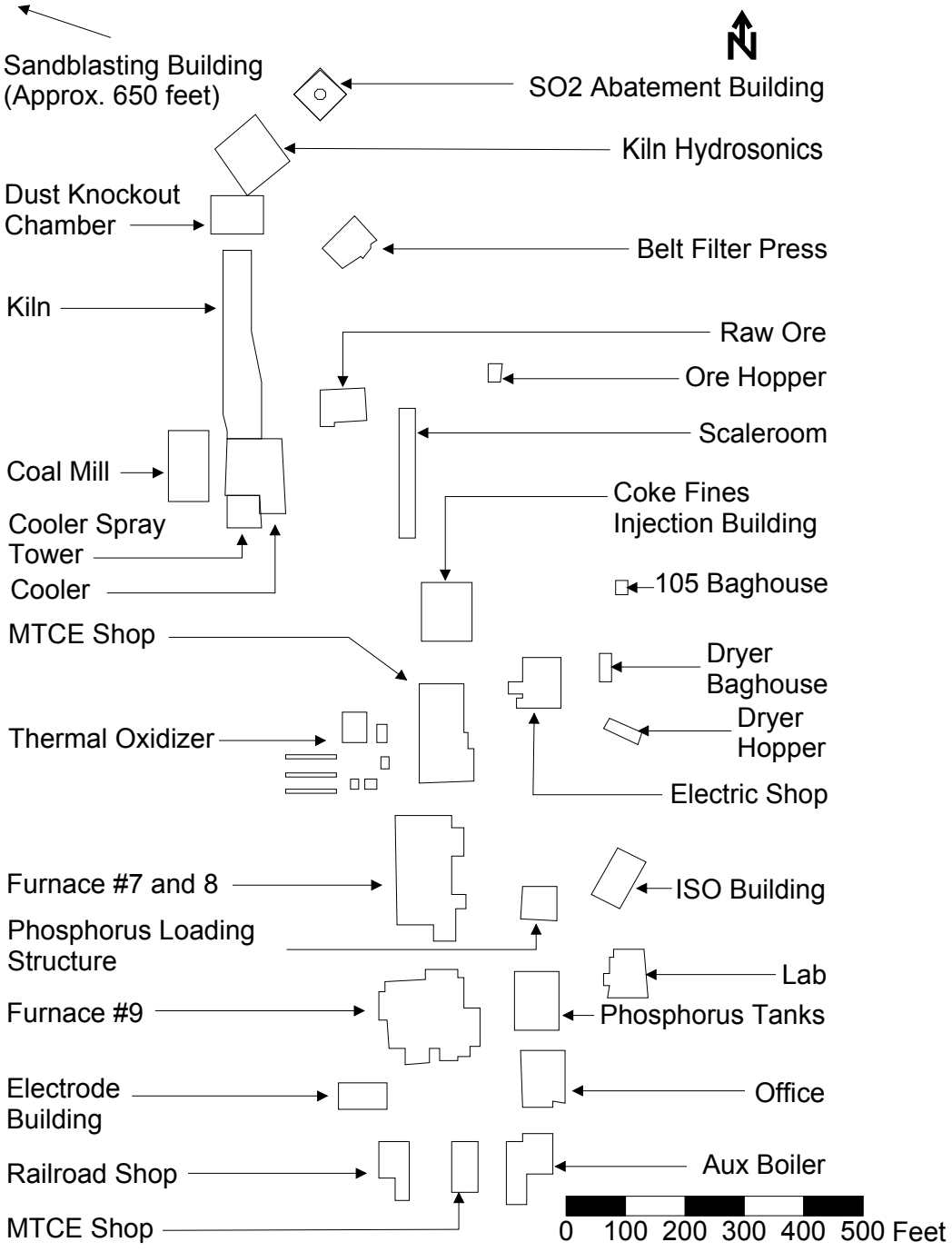
It is emphasized that it is the applicant's responsibility to satisfy all technical and regulatory requirements, and that DEQ will help the applicant understand what those requirements are prior to the application being submitted but that DEQ will not perform the required technical or regulatory analysis on the applicant's behalf.



P4 Production, LLC Soda Springs Facility Plot Plan

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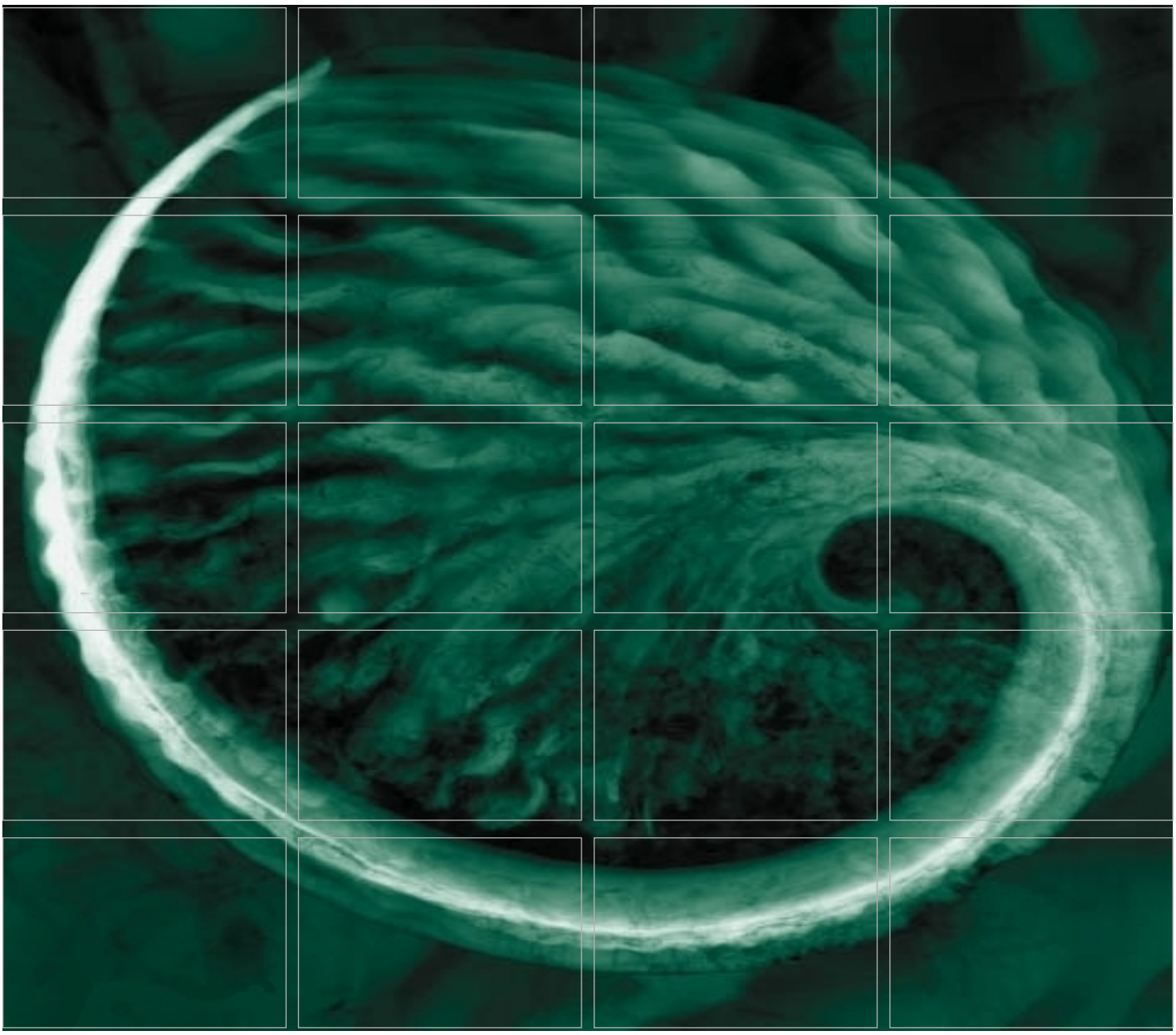

MBACT for Elemental Phosphorus Process

P4 Production, L.L.C.
Soda Springs, Idaho

March 2012

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FINAL REPORT

P4 Production, L.L.C.

MBACT for Elemental Phosphorus Process

Soda Springs, Idaho

March 2012

Project Number: 0155562

David R. Jordan
Principal-in-Charge

Bernard Evans
Project Manager

Environmental Resources Management
700 West Virginia Street, Suite 601
Milwaukee, WI 53204

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1.0 INTRODUCTION

Under State of Idaho rules at IDAPA 58.01.01.401.02.a.ii, existing sources with mercury air emissions above 62 pounds per year are required to perform a Mercury Best Available Control Technology (MBACT) analysis and submit a Tier II permit application for review and approval of the MBACT analysis by the Idaho Department of Environmental Quality (IDEQ). The MBACT analysis and Tier II application must be submitted to the IDEQ by April 7, 2012. This MBACT analysis is prepared to fulfill the requirements of IDAPA 58.01.01.401.02.a.ii. for sources of mercury emissions at the P4 Production, L.L.C., facility in Soda Springs, Idaho.

1.1 FACILITY DESCRIPTION

P4 Production, L.L.C. owns and operates an elemental phosphorous production facility (Facility) near Soda Springs, Idaho. The Facility processes phosphate ore to produce elemental phosphorus (P4) for sale. There are two primary departments at the Facility – the Burden Preparation Department and the Furnace Department.

The Burden Preparation Department includes activities associated with handling and beneficiation of raw materials (coke, quartzite, and phosphate ore) to produce a suitable feedstock for processing by the Furnace Department to produce elemental phosphorus. Ore is received and stockpiled onsite. Ore is then conveyed to a nodulizing kiln for processing. The resulting nodules are cooled and stockpiled or sent directly to the nodule sizing and scale room from the cooler. In the scale room the nodules are blended with coke and quartzite. The coke and quartzite are received and stockpiled separately at the Facility and are dried to a desired moisture content, if necessary, prior to blending with the nodules. The nodule-coke-quartzite blend (burden) is then sent to the Furnace Department for processing. Fuel used in the nodulizing kiln is primarily carbon monoxide (CO) off-gas from the furnace process which is supplemented with small quantities of natural gas and coal. The kiln off-gas is treated with existing air pollution control equipment including a series of dust bins, a spray tower, and four parallel hydrosonic venturi scrubbers. The hydrosonic venturi scrubbers are fed with lime concentrated dual alkali (LCDA) solution to scrub acid gases, primarily SO2, from the gas flow.

The Furnace Department operations utilize electric arc furnaces to melt the burden, chemically react the components, and create off-gases containing elemental phosphorus. The burden enters one of three electric

furnaces (No. 7, No. 8, and No. 9) that operate on a continuous basis at temperatures of 1,400 to 1,500°C (2,550 to 2732°F). The reducing environment in the furnaces reacts phosphate from the nodules to form phosphorus gas, carbon monoxide gas, and molten slag and ferrophosphorus. The furnace gases, composed of mainly carbon monoxide and phosphorus, are drawn through electrostatic precipitator (ESP) dust collectors where particulate matter is removed. The cleaned gases are then sent through water spray condensers where the gases are cooled - condensing the phosphorus. The condensed phosphorus is pumped to settling/storage tanks for further solids removal and product storage. The stored phosphorus is loaded into water-blanketed railroad cars for shipment to market.

After the removal of phosphorus, the furnace off-gas is composed primarily of CO and water vapor. The CO is then sent to the nodulizing kiln as fuel. Excess CO is combusted by CO flares where it is oxidized to carbon dioxide and emitted to the atmosphere. A thermal oxidizer (TO) unit is being constructed to replace the flares, and the TO will combust excess furnace gas and scrub the resulting off-gas.

The furnaces are periodically tapped to remove accumulated molten slag and ferrophosphorus. Slag taps occur about 45-48 times per day per furnace and last about 15 minutes per tap. The ferrophosphorus is tapped once or twice per day per furnace. The tapping gases pass through a high-energy venturi scrubber equipped with a cyclonic separator before discharge to the atmosphere.

The molten slag is tapped into cast steel ladles that are transported and poured onto the slag storage pile at the site. The ferrophosphorus is also collected in ladles, cooled, and stockpiled on-site.

1.2 MERCURY EMISSIONS

The phosphate ore and various other raw materials used in the process contain trace amounts of mercury (Hg). Hg leaves the process either in solid process intermediates or in air emissions. An estimate of the amount of mercury from various process points is shown at the end of this section in Table 1. In addition, information on the form of mercury in the nodulizing kiln exhaust stack, the largest source of Hg air emissions, is presented in Table 2.

Mercury is a naturally-occurring metal normally found in trace amounts in rock and mineral formations. In the P4 production process, mercury exists in trace amounts in the ore and to a lesser extent other raw

materials. Mercury has three possible valence states; elemental mercury (Hg^0), mercuric state (Hg^{2+}), and mercurous (Hg^+). Particle-bound mercury (Hg_{PB}) refers to mercury contained in particles in the gas stream. The exact speciation of Hg in raw phosphate ore is uncertain; however, at high temperatures within the kiln (~1500 °C) it is theorized that most of the Hg in the ore is volatilized and enters the process air stream as elemental mercury, Hg^0. This is supported by low relative quantities of Hg observed in discrete samples of ore and nodules. As the process gases are cooled, the interactions of the gaseous elemental Hg^0 with other constituents in the gas results in a portion of the Hg^0 being converted to other forms. Generally, some amount of the Hg^0 is oxidized to Hg^{2+} or Hg^+. In theory, the oxidized Hg^{2+} compounds in the process gas include mercury chloride ($HgCl_2$), mercury oxide (HgO), and mercury sulfate ($HgSO_4$). There is no evidence that Hg^+ exists in the P4 processes. Some amount of mercury in the process exhaust gas exists as Hg_{PB}.

The oxidized and particle-bound forms of mercury are the readily controlled forms, while control of elemental Hg^0 is more challenging. In general, the mercury control strategies include maximizing the control of the Hg^{2+} and Hg_{PB} forms of mercury, and forcing the Hg^0 in the flue gas to the controllable forms.

The mercury emission estimates for the Facility show that approximately 99.5% of the mercury emitted to the atmosphere at the Facility is from the nodulizing kiln. An approximate material balance has shown that 35% of the mercury in the system is isolated from the system in the solid process intermediates and is not emitted to the atmosphere. The maximum potential mercury emissions from the nodulizing kiln are estimated to be 753 lb/yr based on Hg(g) and Hg(PM) stack test data on a maximum kiln throughput basis.

<u>Nodulizing Kiln Emission Factor Calculation</u>

Mercury emission test results:
Gaseous mercury: 0.0765 lb/hr (2002 stack test)
Ore throughput during 2002 gaseous test: 230 ton/hr
Particulate mercury: 0.00193 lb/hr (2002 stack test)
Ore throughput during 2002 particulate test: 238.5 ton/hr

Gaseous Hg emission factor:
(0.0765 lb/hr)/(230 ton/hr) = 3.33×10^{-4} lb/ton

Particulate Hg emission factor:
(0.00193 lb/hr)/(238.5 ton/hr) = 8.09×10^{-6} lb/ton

Overall Hg emission factor:

3.33×10^{-4} lb/ton + 8.09×10^{-6} lb/ton = 3.41×10^{-4} lb/ton
Maximum ore throughput:
(252 ton/hr) x (8,760 hr/yr) = 2,207,520 ton/yr

Maximum emissions (Potential to Emit):

(3.41×10^{-4} lb/ton) x (2,207,520 ton/yr) = 753 lb/yr

Table 1 shows the potential emissions of mercury for all sources at the Facility that emit mercury. The information in Table 1 is estimated based on P4 Production's methodology for the annual reporting under the Toxic Release Inventory (TRI) regulation, and the potential to emit calculation above. The TRI values were scaled-up to a potential to emit using the nodulizing kiln potential to emit and assuming that the other sources are proportional to that value. The estimates in Table 1 suggest there are two sources of mercury air emissions with total Hg emissions greater than 1 lb/yr; the nodulizing kiln and the nodule crushing and screening scrubber stack. In the nodule crushing and screening process, nodules are crushed and separated into fine, medium, and course grades as required for use as furnace feedstock. The sized nodules are routed into the scaleroom bins for proportioning into the furnace feedstock. The nodule crushing, sizing, and screening processes generates both point and fugitive particulate matter that is controlled by a wet scrubbing system and a baghouse. The low mercury content evaluated in grab samples of raw materials (nodules, coke, and quartzite) fed to the furnaces is consistent with the low emissions measured at the THFC stacks and other point sources. Because the mercury emission estimate for the nodulizing kiln are estimated to be greater than two orders of magnitude higher than emissions from the nodule crushing and screening process or any other source of mercury emissions at the Facility, this MBACT review focuses on control of mercury from the nodulizing kiln.

Table 1 – Estimated Potential Mercury Emissions

Emission Source	Emission Estimate (lb/yr)
Kiln Hydrosonics Stacks (Total)	753
Nodule Crushing and Screening Scrubber Stack	2.72
Cooler Spray Tower Stack	0.6615
#7 THFC Stack	0.0626
#9 THFC Stack	0.0118
#8 THFC Stack	0.0539
SDM Bin Vent Stack	2.39E-04
Coke Handling Baghouse Stack	7.43E-05
Nodule Reclaim Baghouse Stack	9.54E-05
Scaleroom Baghouse Stack	8.16E-05
Main Furnace Baghouse Stack	2.80E-05
No. 9 CO Dust Baghouse Stack	8.90E-06
No. 8 CO Dust Baghouse Stack	8.68E-06
Dryer Baghouse Stack	1.64E-05
#309 Coke Fines Bin Vent Stack	5.01E-06
No. 7 CO Dust Baghouse Stack	4.18E-06
#9 CO Dust Collection Bypass Stack	2.33E-06
#8 CO Dust Collection Bypass Stack	3.67E-06
#305 Coke Fines Bin Vent Stack	1.69E-06
#307 Coke Fines Bin Vent Stack	2.06E-06
#7 CO Dust Collection Bypass Stack	1.20E-06
105 Baghouse Stack	7.26E-06
#304 Coke Fines Bin Vent Stack	6.18E-07
#308 Coke Fines Bin Vent Stack	1.08E-06
104 Baghouse Stack	6.55E-04
#306 Coke Fines Bin Vent Stack	7.43E-07
Coke Bunker Baghouse Stack	5.46E-08
Bulk Storage Bin Baghouse Stack	8.91E-09
Vactor Truck Vent Stack	9.30E-09
Vactor Truck Vent Stack	4.13E-09
Vactor Truck Vent Stack	4.13E-09
Vactor Truck Vent Stack	2.31E-09
Vactor Truck Vent Stack	3.09E-09
Vactor Truck Vent Stack	3.01E-09
Vactor Truck Vent Stack	2.80E-09
Vactor Truck Vent Stack	2.71E-09
Vactor Truck Vent Stack	4.46E-10
Total:	**757**

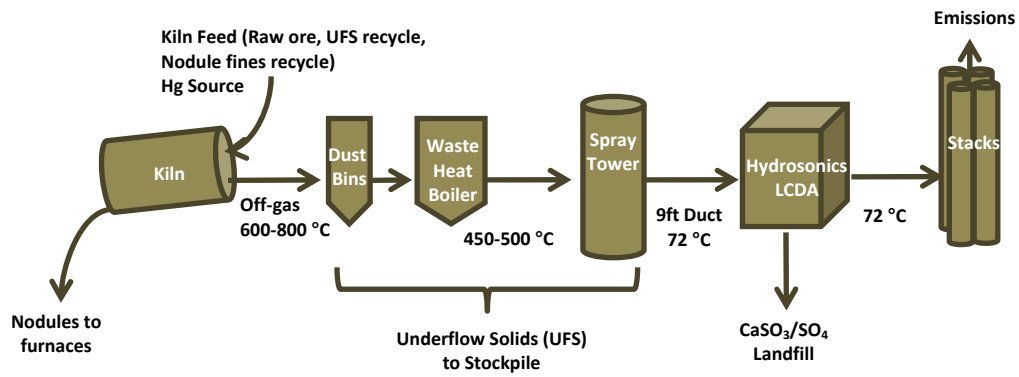
The estimated speciation of mercury air emissions from the nodulizing kiln are shown in Table 2. The information shown in Table 2 is from the 2002 emission tests (Ontario-Hydro Method, ASTM D6784-02) conducted on one of the four nodulizing kiln stacks. This data indicates that elemental mercury, the most difficult and costly form to control, is the predominant species in the nodulizing kiln stack emissions.

Table 2 - Mercury Speciation from Emissions Test Data – Nodulizing Kiln

Hg Species	lb/hr	Percent of Total
Hg_{PB}	0.0019	6%
Hg^{2+}	0.00047	1%
Hg^{0}	0.0298	93%
Total	0.032	100%

A representative process flow diagram of the nodulizing kiln is presented in Figure 1. This process flow diagram is the basis for discussion in the step by step control technology discussion in the following review.

Figure 1 – Nodulizing Kiln Process Flow Diagram



As noted in Figure 1, emissions from the kiln are exhausted in an air stream of approximately 260,000 acfm and an elevated temperature of 600 to 800 °C. The temperature of the air stream drops to approximately 450-550 ° C following the waste heat boiler and further to 72°C as it exits the Spray Tower. The total exhaust at the four stacks is approximately 300,000 acfm.

In addition, Figure 1 shows the existing control equipment on the nodulizing kiln. The existing air emissions control system on the nodulizing kiln includes a series of dust bins, spray tower, and venturi scrubber system. The hydrosonic venturi scrubbers are fed with LCDA solution to scrub acid gases, primarily SO_2, from the gas flow. Based on the approximate mass balance from grab samples and analytical test results, the existing air emission control system has an estimated control efficiency of approximately 35%, such that approximately 35% of the mercury in the ore leaves the system in the solids streams and 65% in the

exhaust gas. This MBACT review investigates technologies that can reduce the gaseous elemental mercury that remains in the nodulizing kiln exhaust gas.

2.0 TOP-DOWN MBACT PROCESS

MBACT requirements are intended to ensure that the subject emission unit will incorporate control systems that reflect the latest demonstrated practical techniques for that particular emission unit for an applicable pollutant. The MBACT evaluation requires the documentation of performance levels achievable for control technology on a pollutant-by-pollutant basis. MBACT is defined in the IDEQ regulations (IDAPA 58.01.01.006.67) as:

> *An emission standard for mercury based on the maximum degree of reduction practically achievable as specified by the Department on an individual case-by-case basis taking into account energy, economic and environmental impacts, and other relevant impacts specific to the source.*

This MBACT analysis will use an analysis process that is recommended by USEPA for determining Best Available Control Technology (MBACT), a similar control standard. USEPA recommends that a "top-down" approach be taken when evaluating available air pollution control technologies. This approach to the MBACT process involves determining the most stringent control technique available, Lowest Achievable Emission Rate (LAER), for a similar or identical emission source. If it can be shown that the LAER is technically, environmentally, or economically impractical on a case-by-case basis for the particular source, then the next most stringent level of control is determined and similarly evaluated. The process continues until a control technology and associated emission level is determined which cannot be eliminated by any technical, environmental, or economic objections. The top-down MBACT evaluation process is described in the USEPA draft document "New Source Review Workshop Manual." The five steps of a top-down MBACT evaluation are:

1. Identify all available control options with practical potential for application to the specific emission unit for the regulated pollutant under evaluation;

2. Eliminate technically infeasible or unavailable technology options;

3. Rank remaining control technologies by control effectiveness;

4. Evaluate most effective controls and document results; if top option is not selected as MBACT, evaluate next most effective control option; and

5. Select MBACT, which will be the most effective practical option not rejected based on energy, environmental, and economic impacts.

The "top-down" approach is used in this analysis to evaluate available pollution controls for each of the pollutants subject to MBACT from each source of those emissions proposed.

2.1 *LOWEST ACHIEVABLE EMISSION RATES*

While the proposed project is not subject to the requirement to install LAER for any pollutant, in a "Top Down" control technology analysis LAER is used as the starting point since it establishes the lowest emission level that has been demonstrated in practice for a similar unit. The processes at the Facility are unique as the Facility is the only known elemental phosphorus process in North America. LAER, as defined in the "New Source Review Workshop Manual" (USEPA 1990), is derived from either of the following definitions:

> "*The most stringent emission limitation contained in the implementation plan of any State for such class or category of source; or the most stringent emission limitation achieved in practice by such class or category of source.*"

The LAER standard is typically intended to be more stringent than MBACT, since it is applied to sources in non-attainment areas and considers only the technical feasibility of the best level of control that has been achieved in practice on another similar unit, without consideration of potential adverse economic, environmental, or energy impacts. It does, however, represent a useful starting point in the evaluation of potentially achievable levels of control. To determine the applicable emission limitations that would be representative of LAER the EPA MBACT/RACT/LAER Clearinghouse (RBLC) was consulted.

An emission limit proposed in a permit application does not automatically mean that that limit has been "achieved in practice" on a similar unit. Many PSD permits have been issued over the years for projects that were never constructed. There are also instances where incorrect limits have been posted to the RBLC or where the ultimate permit limits were subsequently modified prior to permit issuance. In some cases an applicant may have proposed very stringent limits without a meaningful commercial guarantee, perhaps to avoid a more onerous requirement or an unacceptable air quality impact, and not be able to continuously achieve the limits in practice. An emission rate based on a MBACT finding must be met continuously under normal operations, not just at one optimal design point. Therefore, there must be a reasonable assurance that each MBACT limit evaluated is truly "demonstrated in practice" on a similar unit, and can be continuously achieved under all expected operating conditions.

2.2 *COST ESTIMATES*

Cost analyses of certain technically feasible control alternatives were prepared and are presented to compare capital and annual costs in terms of cost effectiveness (i.e., dollars per ton of pollutant removed). Capital costs include the initial cost of components intrinsic to the complete control system (for example including a reactor vessel, catalysts or internals, support steel, ductwork, reagent storage, piping, rotating equipment, instrumentation, monitoring equipment and installation costs). Annual operating costs consist of the financial requirements to operate the control system on an annual basis and include overhead, maintenance, outages, labor, raw materials, and utilities.

2.2.1 *Capital Costs*

The capital cost estimating technique used in this analysis is based on a factored method of determining direct and indirect installation costs. This technique is a modified version of the "Lang Method," whereby installation costs are expressed as a function of estimated equipment costs. This method is consistent with the latest USEPA guidance manual (OAQPS Control Cost Manual) on estimating control technology costs (USEPA, February 1996). The estimation factors used to calculate total capital costs are shown in Table 3.

Purchased equipment costs represent the delivered cost of the control equipment, auxiliary equipment, and instrumentation. Auxiliary equipment consists of all structural, mechanical, and electrical components required for efficient operation of the device. These include such items as reagent storage and supply piping and distributed controls. Auxiliary equipment costs are taken as a straight percentage of the basic equipment cost, the percentage being based on the average requirements of typical systems and their auxiliary equipment (USEPA, February 1996). In this control alternatives evaluation, basic equipment costs were estimated based on published cost estimating methodologies. Instrumentation, usually not included in the basic equipment cost, is estimated at 10 percent of the basic equipment cost (major components).

Direct installation costs consist of the direct expenditures for materials and labor for site preparation, foundations, structural steel, erection, piping, electrical, painting, and facilities. Indirect installation costs include engineering and supervision of contractors, construction and field expenses, construction fees, and contingencies. Direct installation costs are expressed as a function of the purchased equipment cost based on average installation requirements of typical systems and may tend to underestimate actual costs in a northern climate installation such as Soda

Springs. Indirect installation costs are designated as a percentage of the total direct cost (purchased equipment cost plus the direct installation cost) of the system. Other indirect costs include equipment startup and performance testing, working capital, and interest during construction. In addition, costs such as lost production or rental fees for temporary equipment can be included if appropriate.

Table 3 - Capital Cost Estimation Factors

Item	Basis
Direct Costs	
Purchased Equipment Cost	
Equipment cost + auxiliaries	A
Instrumentation	0.10 x A
Freight	0.05 x A
Total Purchased equipment cost, (PEC)	B = 1.15 x A
Direct installation costs	
Foundations and supports	0.08 x B
Handling and erection	0.14 x B
Electrical	0.04 x B
Piping	0.02 x B
Insulation for ductwork	0.01 x B
Painting	0.01 x B
Total direct installation cost	0.30 x B
Site Preparation	As Required
Buildings	As Required
Total Direct Cost, DC	1.30B + SP + Bldg.
Indirect Costs (installation)	
Engineering	0.10 x B
Construction and field expenses	0.05 x B
Contractor fees	0.10 x B
Start-up and Performance test	0.03 x B
Contingencies (for Routine Application of Technology)	0.03 x B
Working Capital (30 days O&M cost)	Not Used
Total Indirect Cost, IC	0.31B + WC
Total Capital Investment (TCI) = DC + IC	**1.61B+ SP + Bldg. + WC**

2.2.2 *Annualized Costs*

Annualized costs are comprised of direct and indirect operating costs. Direct costs include labor, maintenance, replacement parts, raw materials, utilities, and waste disposal. Indirect operating costs include plant overhead, taxes, insurance, general administration, and capital charges. Annualized cost factors used to estimate total annualized cost are listed in Table 4. Annualized cost factors were obtained from the latest USEPA guidance manual on estimating control technology costs (USEPA, February 1996).

Direct operating labor costs vary according to the system operating mode and operating time. Labor supervision is estimated as 15 percent of operating labor. Maintenance costs are calculated as 3 percent of total direct cost (TDC). Raw material and utility costs are based upon estimated annual consumption and the unit costs are summarized in Table 4.

With the exception of overhead, indirect operating costs are calculated as a percentage of the total capital cost. The indirect capital costs are based on the capital recovery factor (CRF), defined as:

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

Where i is the annual interest rate and n is the equipment economic life (years). A control system's economic life is typically 10 to 20 years (USEPA, February 1996). In this analysis, a 10 year equipment economic life (typical length of financing) was used. The average interest rate is assumed to be 7 percent (USEPA, February 1996). CRF is therefore calculated to be 0.081.

Table 4 - Annualized Cost Factors

Item	Cost Factor	Unit Cost
Direct Annual Costs, DC		
Operating labor		
Operator	variable hr/shift	$45.00/hr
Supervisor	15% Operating Labor	NA
Maintenance		
Labor Req.	variable hr/shift	$52.50/hr
Material	100% Maintenance Labor	NA
Supervisor	15% Labor	NA
Utilities		
Electricity	NA	**$0.043/kWh**
Indirect Annual Costs, IC		
Overhead	44% of DL + 12% ML	
Administrative Charges	2% TCI	
Insurance	1% TCI	
Capital Recovery	CRF x TCI	
Total Indirect ($/yr)		
Total Annual Cost (TAC) ($)		Sum of Annual Costs
Total Pollutant Controlled (ton/yr) Based on Max. PTE	As Calculated	
Cost Effectiveness ($/lb) Based on Max. PTE		**TAC/lb/yr controlled**

2.2.3 *Cost Effectiveness*

The cost-effectiveness of an available control technology is based on the annualized cost of the available control technology and its potential annual pollutant emission reduction. Cost effectiveness for a given control technology is calculated by dividing the annualized cost of the control technology by the theoretical pounds of mercury removed by the control technology each year.

2.3 *RBLC SEARCH*

The EPA compiles and maintains a national database of facilities with permitted air emissions, by industrial classification. The database includes information by facility and individual emission units. A complete RBLC listing for a given facility will include the date of issuance of the permit, the permitted air pollutants and the corresponding emission limits as well as the control technologies employed to meet those limits.

A database search was conducted for the following industrial source categories:

- Phosphorous Production Plants (90.013)
- Phosphate Fertilizer Production (61.009)
- Phosphoric Acid Manufacturing (62.010)
- Calciners, Dryers and Mineral Processing Facilities (90.017)
- Portland Cement (90.028)
- Phosphate Rock Processing (90.026)
- Municipal Waste Combustion (21.400)

The searches were conducted for permits issued after January 1, 2000. In addition to the above source categories, a search was conducted for any reference to mercury in an air permit. Appendix A shows all facilities that had some reference to mercury emission controls and/or standards. A majority of these facilities do not incorporate mercury control technologies specifically; some refer to material balance to arrive at mercury limits while others control mercury as a co-benefit of existing, multi-pollutant controls.

Most of the sources identified through the RBLC review have no mercury control listed and appear to have mass balance based limits. Of the sources with add-on control listed, activated carbon injection is the most prominent control technology with flue gas scrubbing as the next most common control. Both of these technologies have potential for mercury removal at the Facility and will be further evaluated as part of the MBACT analysis.

2.4 *REGULATORY REVIEW*

As a part of the MBACT analysis, a review was performed to determine if there are any current or proposed regulatory requirements that would limit mercury emissions from the Facility, or would limit mercury emissions from similar types of sources to those operated by P4. There are no current or proposed National Emission Standards for Hazardous Air Pollutant (NESHAP) regulations that would limit mercury emissions from P4's operations, nor are there any NESHAP regulations that would limit mercury emissions from new sources comparable to P4.

3.0 MBACT ANALYSIS

The following section presents the 5-step MBACT review process for the affected process at the Facility. The available control technologies are identified including potentially transferable technologies from other industries applied to similar sources. For the purpose of this evaluation, similar sources are gas streams with trace amounts of mercury in the gas stream. Technologies that are technically infeasible are then eliminated from further consideration. Technical feasibility is related to specific challenges in applying a given technology due to physical or chemical characteristics of the process.

The technologies found to be technically feasible are then ranked by control effectiveness and evaluated further based on cost. Finally, the control technology that represents MBACT for the nodulizing kiln is selected and a numerical emission limit is proposed.

3.1 STEP 1 - IDENTIFY CONTROL TECHNOLOGIES

Potentially applicable control technologies were identified through review of available literature, the RBLC, vendor information, and through discussions with vendors. The following common technologies are identified for control of dilute mercury emissions from the nodulizing kiln:

- ACI and bromated activated carbon injection (BACI),
- Non-carbon sorbent/reactant injection,
- Halogen injection and BACI,
- Fixed-Bed Oxidation catalysts,
- Ore pre-treatment, and
- Mercuric chloride scrubbing.

Each of these control technologies is discussed in more detail in the following subsections. Because the Facility operations are unique, all technologies identified represent a transfer of technology from another source type. Technology transfer and retrofit issues present a challenge to application of any of the technologies identified. No control technology vendor or engineer, procure and construct contractor would offer a

guarantee of performance for such a system. Potential control technologies that are in the laboratory stage of development or theorized as potentially effective are not included on the list of identified technologies and were not evaluated in the 5-step process.

3.1.1 *Activated Carbon Injection (ACI) and Bromated Activated Carbon Injection (BACI)*

The leading mercury control technology for control of trace amounts of mercury in a gas stream is ACI upstream of a particulate control device. A variant of the ACI technology is the use of halogenated activated carbon. Elemental mercury reacts with all the halides to give Hg^{2+} salts as follows:

$$Hg + F_2 \rightarrow HgF_2$$
$$Hg + Cl_2 \rightarrow HgCl_2$$
$$Hg + Br_2 \rightarrow HgBr_2$$
$$Hg + I_2 \rightarrow HgI_2$$

Thus, halogenated activated carbon promotes the oxidation of elemental mercury to the controllable Hg^{2+} form via scrubbing and sorption onto AC surface. Bromine is the halogen of choice because of cost and effectiveness.

Both ACI and BACI have been studied in the electric power generation industry for application on coal-fired power plants and have the potential to achieve moderate to high levels of mercury control. Control efficiencies of 70% to 90% or higher are achievable on coal-fired power applications. The mechanism of capture with ACI and BACI is adsorption where the target pollutant chemically bonds to adsorption sites on the surface of the carbon, and then the carbon is removed from the gas steam in the particulate collection device(s) and kept from reaching the atmosphere, although shifted to potential land or water impacts.

The performance of activated carbon is related to its physical and chemical characteristics. Generally, the physical properties of interest are surface area, pore size distribution, and particle size distribution, and as with any chemical treatment system, the reaction temperature, good mixing, and residence time are important to the design of an ACI or BACI system. The capacity for Hg capture generally increases with increasing surface area and pore volume. ACI systems perform best at flue gas temperatures between 200° and 400° F.

The ability of Hg and other gas constituents to penetrate into the interior of an ACI or BACI particle is related to pore size distribution. The pores

of the carbon sorbent must be large enough to provide free access to internal surface area by Hg^{2+} while avoiding excessive blockage by previously adsorbed mercury and non-target gas constituents (i.e., SO_2, other metals, etc.) As the carbon particle sizes decrease, access to the internal surface area of the particle increases along with potential adsorption rates.

In a well designed system, mercury has a high affinity to activated carbon and there are minimum amounts of other trace gas constituents to compete with mercury for adsorption sites.

The resulting mercury-containing carbon is collected along with other particulates by a downstream control device, such as a wet scrubber, ESP, or fabric filter. Generally, the solid residue captured in the downstream particulate control device can be safely disposed of in a landfill or sent off-site for regenerated because mercury is chemically bound to the carbon and not susceptible to leaching out of the spent carbon.

3.1.2 Non-Carbon Sorbent/Reactant Injection

Research into sorbent alternatives to ACI and BACI is ongoing and is primarily focused on calcium and calcium silicate cased sorbents. Some of these sorbents have the potential to work at a higher temperature range than ACI and BACI and have been shown to be effective on both elemental and oxidized mercury. The following is a brief summary of the non-carbon absorbents under investigation:

- The mineral sorbent Minplus® was tested at a number of coal-fired power plants including Minnesota Power's Taconite Harbor Power Plant, and Richmond Power & Light's Whitewater Valley Power Plant. The Taconite Harbor test results were poor with little or no mercury removal reported. The Whitewater Valley test results showed a high level of mercury removal attributed to the high degree of mixing provided by the rotating opposed-fired air system of that particular unit. The injection point was at approximately 1,200 ˚F.

- Novinda Corporation is currently running full-scale, power plant tests of its amended silicates product, a clay-based sorbent designed to capture both elemental and oxidized mercury. The flue gas temperatures in these tests are around 300˚F.

- TDA Research has conducted slip-stream tests on the effectiveness of injection of their proprietary non-carbon sorbent at Xcel Energy's Pawnee Power Plant. The slip-stream tests showed promising results at injection temperatures up to 475 ˚F.

A promising non-carbon reagent injection system involves sodium tetrasulfide (Na_2S_4) as the reagent. This reagent is injected into the flue gas as an aqueous solution and converts vapor phase mercury to solid mercuric sulphide (HgS). Mercuric sulfide is a stable solid at normal temperatures that can be collected in a particulate control system and sent to disposal. Babcock Power reports that Na_2S_4 will remove both Hg^0 to Hg^{2+} based on pilot scale tests conducted at an injection temperature of 300°F.

Other studies have investigated iodine and chlorine to promote oxidation of mercury. The evaluations of iodine have shown that other gas constituents readily interfere with the iodine-mercury reaction. Chlorine is supplied by injecting chloric acid ($HClO_3$) and sodium hypochlorite (NaOCl) into the gas stream. The literature indicates very high dose rates of both reagents are necessary to achieve significant oxidation of elemental mercury, with NaOCl showing the best results with the lowest injection concentration. Neither of these approaches has been evaluated on full-scale industrial facilities.

3.1.3 *Halide Injection and ACI*

The following is a brief discussion of halogen addition to a gas stream with trace amounts of mercury to promote the oxidation of elemental mercury so that a carbon adsorption system such as ACI can be enhanced.

The addition of small amounts of bromide containing reagents into coal-fired boilers has been shown to drive the oxidation of elemental mercury in the flue gas. The preferred method is to spray a salt solution of calcium bromide ($CaBr_2$) onto the coal before it enters the boiler furnace. The $CaBr_2$ disassociates at high temperatures, with the bromide ionizing to initiate a complex mechanism to oxidize Hg^0 to form Hg^{2+} as the gas cools. Suppliers of this technology include Nalco Mobotec (Mercontrol) and Alstom Power (KNX), both of whom were consulted as part of this study.

3.1.4 *Fixed-Bed Oxidation Catalysts*

Experiments at coal-fired power plants have revealed the potential for catalyst beds to promote the oxidation of elemental mercury. Some catalysts lower the activation energy for the oxidation of elemental mercury. Catalyst materials are made from various metal oxides and metal alloys. URS Corporation and Babcock & Wilcox have both done extensive research in this area. At utility boilers, the precious metal catalysts used in selective catalytic reduction (SCR) systems installed to control boiler NOx emissions have the co-benefit of oxidizing elemental mercury. These catalysts are located in the optimum temperature

window for NOx reduction (above 700°F). One mercury control challenge presented by SCR is that a small portion of SO_2 in the gas stream is oxidized to SO_3 over the catalyst bed and SO_3 is a gas constituent that impedes mercury recovery.

3.1.5 *Ore Pre-Treatment*

This technology involves solid or liquid-phase separation of the mercury from the phosphate ore prior to its introduction into the Kiln. Possible techniques include acid wash or cyanide leaching. There is no ore pre-treatment process for the purpose of removal mercury at any operating facility. Further discussion of this option is presented in Step 2.

3.1.6 *HgCl2 Scrubbing and Other Metals Refining Hg Recovery Methods*

Mercury emissions control technologies used in metals refining include ore roasters equipped with chloride-based scrubbers, fixed-bed carbon filtration, scrubbing with sulfuric acid and selenium filters, autoclave treatment, and various retort technologies. Further discussion of this option is found in Step 2.

3.2 *STEP 2 - ELIMINATE TECHNICALLY INFEASIBLE CONTROL OPTIONS*

The following discussion considers the technical feasibility of application of control technologies identified in Step 1 of this review. The reasons for eliminating identified control technologies at this point of the review include commercial availability, and physical/chemical technical challenges associated with successful implementation of the control.

3.2.1 *ACI and BACI*

ACI and BACI are well studied in the coal-fired electric power generation industry; however, coal-fired power generation units have exhaust gas characteristics that are different from the nodulizing kiln at the Facility. The following differences are deemed to be important in considering ACI or BACI for the nodulizing kiln:

- Mercury Speciation,
- Compounds and ions present that compete for activated carbon sites,
- Temperatures out of range, and

- Particulate recovery efficiency in wet scrubber.

The affinity of Hg^{2+} for activated carbon is significantly greater than that for Hg^0. Hg^0 is the dominant mercury species in the kiln off-gas (80 to 90%) at the stack, and must first be oxidized in order to be adsorbed by the carbon. However, Hg^0 oxidation is inhibited by reaction kinetics at off-gas temperatures prior to the spray tower (842-1022 ˚F) coupled with the absence of suitable gas phase Hg^0 oxidants. In addition, it is important to consider the concentrations of other constituents of the gas stream including metal ion compounds and sulfur trioxide (SO_3) as these can also be adsorbed by the carbon, reducing its capacity to adsorb mercury.

In the case of P4, the kiln off-gas contains other metallic species with an affinity for AC at concentrations much greater than mercury. SO_3 concentrations in this gas stream, on the order of 5 to 10 ppmv, pose a lesser threat to compete with mercury. However, one utility test showed significantly impaired mercury capture at SO_3 concentrations of just a few ppmv in flue gas streams[1]. It appears likely that all of these constituents would compete with mercury to some degree and make an ACI or BACI system ineffective.

Additionally, ACI and BACI systems perform best at flue gas temperatures between 200 and 400°F, whereas the gas stream in the P4 process is either much higher (600 - 1,100^{o}F before the spray tower) or marginally lower (160° F after the spray tower). ADA Environmental Solutions (ADA-ES) reports optimum mercury capture at 200° F and other studies have shown that ACI effectiveness drops off above 300° F [2].

Finally, it is not clear that the venturi scrubbers can handle the additional loading of ACI or BACI. The venturi wet scrubbers operate with 40 inches (wc) of pressure drop can yield a 99% capture efficiency at particle sizes of more than 7 µm; however, the carbon particles would add an abrasive particle to the venturi throat and degrade the venturi performance.

All of the issues with ACI and BACI discussed above represent challenges to an effective control system These challenges include the temperature of the adsorption, the greater affinity of the nodulizer gas constituents other than mercury to activated carbon, and the ability to effectively remove the spent carbon from the gas flow before it is discharged to the atmosphere.

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[1] Meserole, F., Miller, S., Richardson, C., Implications of SO3 Removal on Mercury Capture, Proceedings of the 2006 Environmental Controls Conference USDOE NETL (2006)
[2] Communication with Robert Wewer, Technology Manager, ADA-ES Inc., November 17, 2099. USEPA Whitepaper, Control of Mercury from Coal-Fired Utility Boilers (www.epa.gov/ttn/atw/utility/hgwhitepaperfinal.pdf)

An ACI or BACI system could be designed downstream of the venturi scrubbers that would include ACI or BACI, reheating the flue gas to the target temperature and above the saturation temperature, and a baghouse or other pm removal device for carbon removal. For this reason, ACI and BACI are retained for further evaluation.

3.2.2 *Non-Carbon Sorbent*

The Minplus product, a non-carbon sorbent, is owned by Nalco Mobotec. A representative of Nalco Mobotec indicated that the company has dropped development of the technology in the United States and that product is currently only available in Europe. Because this is an unproven technology for application to an emission unit such as the nodulizer at the Facility and it is not currently available in the United States, Minplus is dropped from further consideration and eliminated as representing MBACT level control technology for the nodulizing kiln.

A representative of Novinda speculated that amended silicates might increase the gas viscosity and adversely affect the performance of the venturi scrubbers. For this reason, the Novinda amended silicates are eliminated from further consideration as representing MBACT from the nodulizing kilns.

TDA Research has conducted slip-stream tests on the effectiveness of injection of their proprietary non-carbon sorbent at Xcel Energy's Pawnee Power Plant; however at present no conclusions can be drawn as to its commercial effectiveness. In the context of a MBACT analysis, EPA states that a control technique is considered available if it has reached the licensing and commercial sales stage of development. The TDA Research proprietary sorbent is eliminated from further consideration as representing MBACT because it has not been demonstrated in practice and is not commercially available.

It is difficult to project the Babcock Power test results on the effectiveness of sodium tetrasulfide (Na_2S_4) onto controlling emissions from the nodulizing kiln. The Babcock Power pilot test injected the sorbent at gas temperatures of 300° F and collected the solid residue in a fabric filter (potentially prolonging the available reaction time). In addition, Na_2S_4 has not yet been commercialized despite the elapsed time since pilot testing began. Finally, Na_2S_4 was determined to be technically infeasible by Excel Energy for its King Generating Facility in Minnesota, based on contradictory results[3]. Because the technology is still under development

[3] Mercury Control Plan for the Allen S. King Plant: Pursuant to the Minnesota Mercury Emission Reduction Act of 2006, submitted by Excel Energy to the Minnesota Public Utilities Commission: December 21, 2007

and not commercially available, Na_2S_4 reagent injection is eliminated from further consideration as representing MBACT for the nodulizing kiln.

3.2.3 *Halide Injection and ACI*

For the purposes of this study, calcium bromide ($CaBr_2$) injection into the gas stream is included as an option for the cost review. Injection of calcium bromide upstream of the venturi scrubbers will promote the oxidation of elemental mercury. This option will make lining of the 9 foot diameter duct with fiber reinforced plastic necessary to protect against corrosion.

3.2.4 *Fixed-Bed Oxidation Catalysts*

Fixed-bed oxidation catalysts would not be effective with the nodulizing kiln off-gas. Placement of the catalyst in the high-dust environment upstream of the spray tower (see Figure 1) would cause erosion of the catalyst surface or fouling of active catalyst surface if accumulation of solids were to occur. Furthermore, the presence of high sulfur dioxide concentrations would promote formation of sulfur trioxide and inhibit the oxidation of mercury at the catalyst. If placed downstream from the spray tower a low-temperature catalyst would need to be used and there is little information in the literature to suggest that such a catalyst would promote mercury oxidation. Additionally, the same challenge with sulfur trioxide inhibiting the oxidation of mercury would exist at that location. In addition, the size of the fixed bed would be large and there are uncertainties around the durability of fixed-bed catalyst. Based on these concerns, a fixed-bed oxidation catalyst is eliminated from further consideration as representing MBACT for the nodulizing kiln.

3.2.5 *Ore Pre-Treatment*

This technology involves solid or liquid-phase separation of the mercury from the phosphate ore prior to its introduction into the Kiln. No precedent was found for this type of pretreatment of phosphate ore to capture mercury and would require significant process development. If effective pretreatment were developed, it would result in additional waste streams and environmental liabilities. Moreover, it would require radical process changes that exceed the scope of a MBACT analysis. When considering available control alternatives under MBACT, EPA has not considered the MBACT requirement as a means to redefine the design of the source. For this reason ore pre-treatment is eliminated from further consideration as representing MBACT for the nodulizing kiln.

3.2.6 *HgCl2 Scrubbing and Other Metals Refining Hg Recovery Methods*

All of the mining processes are designed to treat lower gas flow rates with higher mercury concentrations than those associated with the Kiln off gas (which has comparatively high flow rates of 300,000 acfm and comparatively low mercury concentrations of 0.3 mg/dscm). Fixed-bed filtration of the Kiln off-gas would employ a granular bed of carbon (possibly sulfur-impregnated) several feet thick, with a required surface area on the order of 2,000 ft2 (e.g. 40 ft x 50 ft). Along with impractical space requirements, energy consumption to move this volume of gas through the bed would be high. The potential also exists for blinding of the activated carbon sites by fine particulates that pass through the venturi scrubber system. Similar challenges exist with selenium filters. Autoclaves are used at Newmont's Twin Creek gold mine in Nevada, to recover mercury from ore with concentrations approaching 200 mg/kg, roughly 500 times more concentrated than the mercury in the Kiln feed. Similarly, mercury retort systems typically employ some form of mercury condensation designed for low-volume streams with high mercury vapor pressures.

The Boliden-Norzink process is used at some 50 installations around the world to recover mercury from ore roaster off-gas. These installations include gold mines as well as zinc, copper, lead, and pyrite smelters. A prominent application of this process occurs at Barrick Gold's Goldstrike Mine in northern Nevada, where some 133,000 lbs of Hg_2Cl_2 (mercurous chloride, or calomel) were reportedly recovered in 2002. An estimated 85% of the mercury recovered from gold mining in Nevada comes from Barrick, with the majority of this resulting from the Boliden-Norzink process. The process reacts aqueous $HgCl_2$ (mercuric chloride) with elemental mercury vapour (Hg^0) to form an Hg_2Cl_2 precipitate that can be captured and refined or sold to a mercury refiner. A portion of the Hg_2Cl_2 is combined with chlorine to regenerate Hg_2Cl_2 for recycle through the reactor, while the remainder is bled to the solids collection system. In evaluating this technology as a potential candidate to treat the nodulizing kiln off-gas, the kiln was assumed to replace the ore roaster as the source of high-temperature gas to be treated. Several factors led to the conclusion that the process used at Goldstrike is technically infeasible for this application as follows:

- Gas flow rates are an order of magnitude apart. The Barrick operation combines off-gas from two roasters, each emitting 12,000 normal cubic meters (Nm^3) per hour, into a common gas treatment system. This translates to roughly 14,000 acfm, as compared to the nodulizing kiln off-gas stack flow rate of 300,000 acfm. Despite the similar ore feed

rates, the Barrick roaster produces far less off-gas by utilizing oxygen rather than air, and by taking advantage of exothermic reactions in the roaster to supply a portion of the heat.

- Mercury concentrations are three orders of magnitude higher at Goldstrike. This poses issues of vessel sizing and gas-to-liquid contact ratios. The dilute concentrations of elemental mercury in the scrubbed nodulizing kiln off-gas create the potential for adding mercury to the exhaust gas (from the makeup mercuric chloride) rather than removing it.

- Temperatures would have to be lowered. Due to mercury vapor pressure concerns, the mercuric chloride scrubber at Goldstrike is operated at temperatures no higher than 40 ^{o}C. This constraint would necessitate further cooling of the nodulizing kiln off-gas.

For this reason $HgCl_2$ scrubbing and other metals refining and mercury recovery methods are eliminated from further consideration as representing MBACT for the nodulizing kiln.

3.3 STEP 3 - RANK REMAINING CONTROL TECHNOLOGIES

The control technologies that are carried forward for further evaluation are two conceptual control configurations. The two conceptual configurations are described below and ranked in descending order of potential control effectiveness:

- Conceptual Control 1 - A conceptual control configuration using a combination of halide injection to promote oxidation of mercury to Hg2+, gas reheat and a baghouse for ACI removal. The purpose of the gas re-heat is to achieve an optimum temperature for ACI injection and to bring the gas flow above the saturation temperature to prevent condensation in the baghouse. For the purposes of this conceptual design, ACI is evaluated because the halide injection will provide the oxidation of the mercury to the controllable Hg2+ oxidation state. The halide evaluated is calcium bromide and it would be injected in the 9 ft diameter duct. The gas re-heat would be achieved with an added heat exchanger down stream of the hydrosonic venturi scrubbers. Following the re-heat, ACI injection would be added with a baghouse downstream.

- Conceptual Control 2 - Gas re-heat with added heat exchanger down stream of the hydrosonic venturi scrubbers, followed by BACI injection, and baghouse (no halide injection).

The following section, Step 4, presents a more detailed description of the conceptual design, and rationale in making the cost estimates used in the evaluation.

3.4 *STEP 4 - EVALUATE MOST EFFECTIVE CONTROLS*

The conceptual control options presented here are intended to provide a basis for the cost evaluation to assess the cost effectiveness of the option. Given that the control of mercury emissions from the nodulizing kiln over and above the level of control already provided by the existing air pollution control equipment is a retrofit application, the normal course of design would be to evaluate the control options through a pilot scale, slip-stream study. Such a study would establish that the control scheme works and determine important parameters for moving forward in the design process.

3.4.1 *Conceptual Control Option 1*

Under Conceptual Control Option 1, a chemical oxidant, calcium bromide, is introduced in the gas stream down stream of the spray tower and upstream of the hydrosonic venturi scrubbers (see Figure 1) in the 9 ft diameter duct. To minimize corrosion in that duct, the duct would be lined with fiber reinforced plastic. Following the hydrosonic venturi scrubbers, a heat exchanger is added to re-heat the gas to 250°F, a temperature rise of approximately 88 ^{o}F. This is above the saturation temperature of the gas; therefore, gas cooling will not result in condensation and fouling of the BACI or blinding of the fabric in the baghouse.

It is estimated that this configuration will yield some conversion of Hg^0 to Hg^{2+}, and that the ACI will capture some portion of the Hg^{2+}. This is assumed equivalent to an overall Hg removal of 50%, or 376.5 lb/yr on a potential to emit basis. The assumption of 50% control is conservative because of the potential affects of gas constituents and other unknowns concerning the performance. The cost estimate is include in Appendix B and shows the cost of mercury removal for Conceptual Control Option 1 to be $29,700 per pound of mercury removed. This is based on a capital cost estimate for equipment and auxiliaries of $11.8 million. This level of cost is considered to be excessive; therefore, Conceptual Control Option 1 is eliminated from further consideration as representing MBACT for the nodulizing kiln.

3.4.2 *Conceptual Control Option 2*

Conceptual Control Option 2 is the same as Conceptual Control Option 1, except that there is no halide injection. This allows for elimination of a number of line items in the capital cost estimate including the chemical storage and injection, and fiber reinforced plastic lining of the ductwork. The cost estimate is included in Appendix C. Assuming that the BACI will provide 30% control, then 225.9 pounds of mercury will be controlled annually on a potential to emit basis. The assumption of 30% control is conservative because of the potential affects of gas constituents and other unknowns concerning the performance. The resulting cost of mercury controlled is $44,000 per pound of mercury removed. This is based on a capital cost estimate for equipment and auxiliaries of $11.4 million. This level of cost is economically infeasible; therefore, Conceptual Control Option 2 is eliminated from further consideration as representing MBACT for the mercury emissions from the nodulizing kiln.

3.5 *STEP 5 – SELECT MBACT*

Based on the technology review and assessment presented in this report, there is no technically or economically feasible means of enhancing the level of mercury control already in place at the Facility. The predominant source of mercury emissions at the Facility is the nodulizing kiln. The existing air emissions control system on the nodulizing kiln includes a series of dust bins, spray tower, and venturi scrubber system. Based on mass balance results the existing air pollution control devices on the nodulizing kiln provide some amount of mercury control. It is proposed that MBACT for the nodulizing kiln is the existing control.

Emissions will be limited to 62.2 lb/month on a 12-month rolling average. This emission level is based on historic mechanisms for estimating emissions including tests conducted in 2002. Compliance will be demonstrated by multiplying the monthly monitored ore throughput for the kiln by 3.41×10^{-4} lb of Hg per ton or ore processed.

4.0 SUMMARY

This MBACT review presents information concerning control of mercury emission from sources at the Facility. Based on the mercury emission inventory for the Facility (see Table 1), it is determined that the nodulizing kiln is the source of approximately 99.5% of the emissions at the Facility. A 5-step review process recommended by USEPA for MBACT review is applied to the nodulizing kiln mercury emissions. Through the 5-step MBACT review process six general control technology categories were identified and evaluated. Two control options were evaluated for cost effectiveness on a conceptual design basis including the following:

- Conceptual Control 1 - Halide injection with ACI (see Section 3.3 for more detail), and

- Conceptual Control 2 – BACI (see Section 3.3 for more detail).

These options are excluded as not economically feasible; therefore, it is demonstrated that there is no technically or economically feasible means of controlling the mercury emissions from the nodulizing kiln over and above the level provided by existing air pollution control technology. It is proposed that MBACT for the nodulizing kiln is the existing control.

Emissions will be limited to 62.2 lb/month on a 12-month rolling average. This emission level is based on historic mechanisms for estimating emissions including tests conducted in 2002. Compliance will be demonstrated by multiplying the monthly monitored ore throughput for the kiln by 3.41×10^{-4} lb of Hg per ton or ore processed.

Appendix A
RBLC Search Results

Facility/Fuel Miscellaneous Source Categories	State	Date of Permit Issuance	Technology	Limit
American Municipal Power Generating Station - PC boiler	OH	11/06/09	Sorbent/AC Injection	1.4 lb/Tbtu
Mahoning Renewable Energy – Waste Combustor	OH	1/07/10	ACI/FF	0.14 ton/yr
Ohio River Clean Fuels: F-T Catalyst Rotary Dryer - gas	OH	2/20/09	None	43.45 lb/yr
John W. Kirk Jr. Power Plant	AR	1/22/09	ACI	1.7 lb/Tbtu
Tate and Lyle Ingredients America, Inc. – corn fiber	IA	1/30/09	SDA/SCR/FF	0 lb/mmbtu
Ripley Heating Plant CFB boiler – wood and coal	MI	8/04/08	FF	0 lb/mmbtu
New Steel International, Inc, Haverhill – PC boiler	OH	2/09/10	None	0.0014 lb/hr
New Steel International, Inc, Haverhill – Rotary hearth furnace	OH	2/9/10	None	0.0014 lb/hr
New Steel International, Inc, Haverhill – Electric arc furnace	OH	2/9/10	Lignite injection	0.0066 lb/hr
New Steel International, Inc, Haverhill – Ladel metallurgy furnace	OH	2/9/10	Lignite injection	0.0066 lb/hr
Dry Fork Station – PC boiler	WY	4/20/09	ACI	0.0001 lb/Mwh
Spiritwood Station CFB – coal/lignite	ND	3/27/08	ACI/Baghouse	0.0002 lb/Mwh
Homeland Energy Solultions, LLC	IA	7/21/08	None	0.0094 lb/hr
North Brooksville Cement Plant – kiln	FL	4/21/09	None	41 ug/dscm
Sunnyside Ethanol, LLC – CFB boiler	PA	8/12/08	Limestone injection/FF	2.1 lb/hr
Hillsborough County Resource Recovery Facility -	FL	8/01/08	ACI	28 ug/dscm
Cargill, Inc. CFB boiler - coal	NE	2/13/07	Sorbent injection	0 lb/hr
Dallman Power Plant – coal	IL	1/08/09	SCR, scrubber, wet ESP, or sorbent injection	95% control
Sandy Creek Energy Station – PC boiler	TX	11/08/07	None	0.94 lb/hr
South Point Biomass Generation – wood fired boiler	OH	8/16/07	Baghouse	0.013 ton/yr
Branford Cement Plant - kiln	FL	3/03/06	Material balance	117.5 lb/yr
American Cement Company – kiln	FL	1/31/07	None	122 lb/yr
Sumter/Center Hill Cement Plant – kiln	FL	10/02/07	None	184 lb/yr
City Public Service JK Spruce Electric Generating Unit 2 – gas turbine	TX	11/20/07	None	0.43 lb/hr
North Star BHP Steel, LTD – Electric arc furnace	OH	5/24/07	Baghouse	0.095 lb/hr

Facility/Fuel Miscellaneous Source Categories	State	Date of Permit Issuance	Technology	Limit
City of Harrisburg Resource Recovery Facility – solid waste combustor	VA	8/23/06	Dry FGD using hydrated lime	0.08 mg/dscm
Texas Genco W.A. Parish Unit 8 – PC boiler	TX	4/28/09	None	1.71 lb/hr
Texas Genco W.A. Parish – coal and gas fired stack	TX	6/04/09	None	2.13 lb/hr
Republic Engineered Products, Inc. – electric arc furnace	OH	5/08/07	None	0.061 lb/hr
Nucor Steel Marion, Inc. – electric arc furnace stack emissions	OH	5/08/07	None	0.063 lb/hr
Nucor Steel Marion, Inc. – electric arc furnace fugitive emissions	OH	5/08/07	Segmented canopy hood, scavenger ducting, etc.	0.0025 ton/yr
River Hill Power Company, LLC – waste coal CFB	PA	9/17/07	None	17.4 lb/yr
Green Energy Resource Recovery Project – waste coal CFB	PA	6/26/08	None	20.05 lb/hr
Dow Chemical Plant B and Oyster Creek Light Hydrocarbons Plant – hydrocarbon fuel	TX	5/27/07	None	0.01 lb/hr
Auburn Nugget – gas fired rotary hearth steel furnace	IN	8/23/06	Wet scrubber	0.05 lb/hr
Wheeling Pittsburgh Steel Corporation – oxygen furnace	OH	7/06/05	None	0.0003 lb/hr
Wheeling Pittsburgh Steel Corporation – oxygen furnace	OH	7/06/05	None	0.056 lb/hr
Wheeling Pittsburgh Steel Corporation – electric arc furnace	OH	7/06/05	None	0.119 lb/hr
Brooksville Cement Plant – kiln	FL	7/29/05	Material balance	122 lb/yr
City Utilities of Springfield, Southwest Power Station – PC boiler	MO	7/19/06	None	0.09 ton/yr
Dow Texas Operations Freeport – gas fired combined cycle	TX	4/20/06	None	0.001 lb/hr
Dow Texas Operations Freeport – gas turbines	TX	4/20/06	None	0.001 lb/hr
Shiller Station – waste wood boiler	NH	11/05/04	SNCR with FF	3 lb/Tbtu
WPS-Weston Plant – PC boiler	WI	3/06/06	FF/Sorbent injection study	1.7 lb/Tbtu
WPS-Weston Plant – natural gas boiler	WI	3/06/06	Natural gas	0.0001 lb/hr
WPS-Weston Plant – diesel booster plant	WI	3/06/06	Good combustion	0 lb/hr
WPS-Weston Plant – diesel fire pump	WI	3/06/06	Good combustion	0 lb/hr

Facility/Fuel Miscellaneous Source Categories	State	Date of Permit Issuance	Technology	Limit
WPS-Weston Plant – natural gas station heater	WI	3/06/06	Natural gas	0 lb/hr
Fritz Enterprises – coke fired aluminum and iron production	MI	11/22/04	Scrap mgt. plan	35 lb/yr
Intermountain Power Generation Unit 3 – PC boiler	Utah	2/02/06	SCR, Wet FGD, FF	0 lb/MW-hr
Sevier Power Company – coal fired CFB boiler	Utah	2/1/06	Dry lime scrubber, FF	0 lb/MMbtu
PSI Energy, Madison Station – gas fired combined cycle	OH	6/20/05	None	0.0023 ton/yr
FDS Coke – coke oven batteries	OH	3/13/06	ACI	0.0006 lb/hr
FDS Coke – coal fired HRSG bypass	OH	3/13/06	None	0.081 lb/hr
Charter Steel – electric arc furnace	OH	6/20/05	Limit Hg in scrap	0.052 lb/hr
Maidsville – PC boiler	WV	8/10/05	SCR, dry solid injection w/ FF, wet limestone forced oxidation	0.0146 lb/hr
Santee Cooper Cross Generating Station – PC boiler	SC	7/01/04	SCR, FGD, ESP, LNB	3.6 lb/Tbtu
SMI Texas – steel mini-mill	TX	12/28/05	None	0.0005 lb/hr
SMI Texas – melt shop ventilation	TX	12/28/05	None	0.0001 lb/hr
SMI Texas – melt shop roof vent	TX	12/28/05	None	0.0002 lb/hr
SMI Texas – melt shop wall vent	TX	12/28/05	None	0 lb/hr
SMI Texas – east/west castor pray chamber stack	TX	12/28/05	None	0 lb/hr
SMI Texas – shredder/separator fabric filter stack	TX	12/28/05	None	0 lb/hr
SMI Texas – hammer mill	TX	12/28/05	Water flood	0.0001 lb/hr
Biomass Energy LLC, Southpoint Power – wood fired boiler	OH	4/25/03	None	0.013 ton/yr
Haverville North Coke Company – coke gas fired HRSG	OH	4/25/07	Bypass to controls	0.008 lb/hr
Macsteel Division – electric arc furnace	MI	10/13/05	Baghouse	0.069 ton/yr
WA Parish Electric Generating Station – PC boiler	TX	8/06/03	None	2.13 lb/hr
WA Parish Electric Generating Station – PC boiler	TX	8/06/03	None	1.86 lb/hr
Lee County Waste-to-Energy Facility – municipal waste combustor	FL	12/10/03	ACI	0.028 mg/dscm
MidAmerican Energy Company – PC boiler	IA	7/22/03	ACI	0 lb/MMbtu
Harrisonburg Resource Rec. – municipal waste combustor	VA	3/04/04	None	0.08 mg/dscm

Facility/Fuel Miscellaneous Source Categories	State	Date of Permit Issuance	Technology	Limit
Harrisonburg Resource Rec. – municipal waste combustor	VA	5/12/03	ACI and good combustion	0.08 mg/dscm
The Timken Company, Faircrest Plant – gas fired annealing furnace	OH	2/20/03	None	0.0037 lb/hr
Washington Parish Electric Generating Station – PC boiler	TX	9/02/03	None	2.13 lb/hr
Washington Parish Electric Generating Station – PC boiler	TX	9/02/03	None	1.86 lb/hr
Thoroughbred Generating Station – PC boiler	KY	4/28/04	ESP, WESP, WFGD	3.21 lb/Tbtu
East Kentucky Power Coop, Spurlock Power Station – coal fired CFB boiler	KY	5/12/04	Baghouse	2.65 lb/Tbtu
Lima Energy Company – syngas fired combined cycle	OH	4/24/03	None	0.0013 lb/hr
Camden Resource Recovery Facility – waste incinerators	NJ	3/22/02	ESP, scrubber	0.31 lb/hr
Meadwestvaco Kentucky, Inc./Wickliffe – pulp and paper mill recovery furnace	KY	5/12/04	None	3200 g/day
Riley Energy Systems of Lisbon Corp. – municipal waste combustors	CT	11/21/01	ACI/FF	0.165 lb/hr
Minergy Detroit LLC – sludge incinerator	MI	5/20/02	Quench, ACI/FF	0.0197 lb/hr
Dow Chemical – rotary kiln waste incinerator	MI	6/06/02	Venturi and feed rate limit	0.13 mg/dscm
Kentucky Pioneer Energy LLC – Trap – syngas fired combined cycle	KY	4/21/04	None	0.08 mg/dscm
Limestone Electric Generating Station – PC boiler	TX	8/08/03	None	0.4 lb/hr
Kentucky Mountain Power – coal fired CFB boiler	KY	4/19/04	Baghouse	81 lb/Tbtu
W.A. Parish Electric Generating Station – PC boiler	TX	12/30/02	None	1.17 lb/hr
Dade County Resource Recovery Facility – municipal waste combustor	FL	10/11/00	ACI	0.08 ton/yr
Chapparral Steel Midlothian Steel Mill – melt shop overhead canopy hoods A	TX	8/08/03	None	0.0031 lb/hr
Chapparral Steel Midlothian Steel Mill – melt shop overhead canopy hoods B	TX	8/08/03	None	0.0053 lb/hr
Chapparral Steel Midlothian Steel Mill – furnace evacuation system	TX	8/08/03	None	0.11 lb/hr

Facility/Fuel Miscellaneous Source Categories	State	Date of Permit Issuance	Technology	Limit
Source Category 90.028				
Cemex Cement Inc, North Brooksville Cement Plant	FL	6/27/07	not listed	190 lb/yr
Suwanne American Cement, Branford Cement Plant (Suwanne)	FL	3/30/06	not listed	117.5 lb/yr
American Cement Company LLC, American Cement Company	FL	2/10/06	not listed	122 lb/yr
Sumter Cement Company LLC, Sumter/Center Hill Cement Plant	FL	2/7/06	not listed	184 lb/yr
Florida Crushed Stone Company, Brooksville Cement Plant (FCS)	FL	12/20/04	not listed	122 lb/yr
Source Category 21.400				
Department of Solid Waste Management, Hillsborough County Resource Recover Facility	FL	11/3/06	ACI	28 µg/dscm
City of Harrisonburg, City of Harrisonburg Resource Recover Facility	VA	11/18/05	scrubber	80 µg/dscm
Lee County Solid Waste Division, Lee County Waste-To- Energy Facility	FL	10/13/03	ACI	28 µg/dscm
City of Harrisonburg, Harrisonburg Resource Rec.	VA	3/25/03	none	80 µg/dscm
City of Harrisonburg, Harrisonburg Resource Recover Facility	VA	3/24/03	ACI and good combustion	80 µg/dscm
Camden County Resource Recover Facility, Camden Resource Recover Facility	NJ	3/22/02	ESP and scrubber	0.005 lb/ton of waste incinerated
Riley Energy Systems of Lisbon Corp,. Riley Energy Systems of Lisbon Corp	CT	11/21/01	ACI and fabric filter	0.165 lb/hr
Dade County Dept of Solid Waste Management, Dade County Resource Recover Facility	FL	7/21/00	ACI	70 µg/dscm
Wheelabrator, Wheelabrator South Broward, Inc.	FL	9/28/99	source separation of mercury	0.019 lb/hr (based on 70 µg/dscm)
Wheelabrator, Wheelabrator North South Broward	FL	9/28/99	source separation of mercury	70 µg/dscm

Appendix B
Cost Spreadsheets for Conceptual Control Option 1

Appendix B
P4 Production, L.L.C. - Hg BACT Analysis
Conceptual Control Option 1
Nodulizing Kiln

Control Efficiency (%)	50.0

Facility Input Data

Item	Value
Operating Schedule	
Shifts per day	3
Hours per day	24
Days per week	7
Total Hours per year	8760
Economic Life, years	10
Interest Rate (%)	7
Source(s) Controlled	Nodulizer Kiln
Total Flowrate (acfm)	300,000
Hg from Kiln Operation (lb/hr)	0.086
Hg from Kiln Operation (lb/yr)	753
Site Specific Electricity Cost ($/kWh)	0.043
Site Specific Operating Labor Cost ($/hr)	$45.00
Site Specific Maint. Labor Cost ($/hr)	$45.00

Capital Costs

	Value	Basis
Direct Costs		
1.) Purchased Equipment Cost		
a.) Equipment cost + auxiliaries	$11,795,000	See Capital Cost Estimate, A
b.) Instrumentation	$0	Included
c.) Sales taxes	$0	Included
d.) Freight	$589,750	0.05 X A
Total Purchased equipment cost, (PEC)	$12,384,750	B
2.) Direct installation costs		
a.) Foundations and supports	$619,200	0.10 x B
b.) Handling and erection	$2,477,000	0.20 x B
c.) Electrical	$123,800	0.01 x B
d.) Piping	$123,800	0.01 x B
e.) Insulation for ductwork & painting	$123,800	0.01 x B
f.) Stack modification	$247,700	0.02 x B
Total direct installation cost	$3,715,425	0.30 x B
3.) Site preparation	$200,000	As Required, SP
4.) Buildings	NA	As Required, Bldg.
Total Direct Cost, DC	$16,300,200	1.30B + SP + Bldg.
Indirect Costs (installation)		
5.) Engineering	$247,700	0.02 x B
6.) Construction and field expenses	$619,200	0.05 x B
7.) Contractor fees	$1,238,500	0.10 x B
8.) Start-up	$247,700	0.02 x B
9.) Performance test	$123,800	0.01 x B
10.) Contingencies	$1,857,700	0.15 x B
Total Indirect Cost, IC	$4,334,600	0.35 x B + Other
Total Capital Investment (TCI) = DC + IC	**$20,634,800**	**1.61B + SP + Bldg. + Other**

Appendix B
P4 Production, L.L.C. - Hg BACT Analysis
Conceptual Control Option 1
Nodulizing Kiln

Control Efficiency (%)	50.0

Annual Costs

Item	Value	Basis	Source
1) Electricity			
Fan Power Requirement (kW)	1,648		Estimate
Electric Power Cost ($/kWh)	0.043		
Cost ($/yr)	$620,756		
2) Operating Costs			
Operating Labor Requirement (hr/shift)	1	1 hour per shift	Estimate
Unit Cost ($/hr)	$40.00	Facility Data	
Labor Cost ($/yr)	$43,680		
3) $CaBr_2$ Cost ($/gal)	9.00		
Hourly Requirerment (gal/hour)	14	Based on CaBr2:ACl ratio of 0.15	Estimate
Annual requirement (gal/year)	118,260		
Total NaOCl Costs ($/year)	$1,064,340		
4) Steam Reheat			
Temperature rise (^{o}F)	88		
Steam requirement (klb/hr)	59		Estimate
Steam cost ($/klb)	$9.0	Estimated	
Total Cost	$4,651,560		
5) AC Cost ($/lb)	$1		
Hourly Requirerment (Lbs/hour)	90	5 lb/MMacfm	Estimate
Annual requirement (Lbs/year)	788,400		
Total BAC Costs ($/year)	$788,400		
6) Residual Disposal			
Annual Quantity (TPY)	434		Esitamte
Cost ($/T)	$200	Special Waste Assumed	
Total Disposal Cost ($/year)	$86,724		
Total Operating Costs	**$7,255,460**		
7) Supervisory Labor			OAQPS
Cost ($/yr)	$6,550	15% Operating Labor	
8) Maintenance			
Maintenance Labor Req. (hr/year)	876.0	10% Operating Hours	Estimate
Unit Cost ($/hr)	$45.00	Facility Data	Estimate
Labor Cost ($/yr)	$39,420		
Material Cost ($/yr)	$39,420	100% of Maintenance Labor	OAQPS
Total Cost ($/yr)	$78,840		
9) Indirect Annual Costs			
Overhead	$77,440	60% of O&M Costs	OAQPS
Administration	$412,700	2% of Total Capital Investment	OAQPS
Property Tax	$206,350	1% of Total Capital Investment	OAQPS
Insurance	$206,350	1% of Total Capital Investment	OAQPS
Capital Recovery	$2,937,930	10 yr life; 7% interest	OAQPS
Total Indirect ($/yr)	$3,840,770		
Total Annualized Cost ($/yr)	**$11,181,600**		
Total Controlled (lb/yr)	**376.5**		
Cost Effectiveness ($/lb)	**$29,700**		

P4 Production, L.L.C - Hg BACT Analysis

BACI & Baghouse after the Hydrosonic Scrubbers

Capital Cost Estimate

Item	Cost Estimate	Basis
BACI System		
Storage and conveyance	$900,000	United Conveyor price list
Injectors	$80,000	Estimate
Oxidant Injection		(Included for Conceptual Control Option 1 only)
Storage (CaBr2)	$100,000	Tank cost estimate RS Means
Injection system	$80,000	Estimate
Steam Reheat		
Housing	$100,000	RS Means
Steam Line	$100,000	RS Means
Heat Exchanger	$1,000,000	AB&CO - TT Boilers (316 SS)
Ductwork, Dampers, & Fans		
FRP Liner to hydosonic scrubbers	$200,000	Est. (Included for Conceptual Control Option 1 only)
Dampers	$60,000	Estimate
Fans	$250,000	RS Means
Baghouse		
Baghouse	$7,800,000	EPA-452/F-03-025 (no secallation used)
Hopper	$60,000	Estimate
Residual Storage	$60,000	Estimate
Controls		
Integrated Control System	$1,005,000	10% of equipment cost
Capital Cost Total	$11,795,000	

Appendix C
Cost Spreadsheets for Conceptual Control Option 2

Appendix C
P4 Production, L.L.C. - Hg BACT Analysis
Conceptual Control Option 2
Nodulizing Kiln

Control Efficiency (%)	30.0

Facility Input Data

Item	Value
Operating Schedule	
Shifts per day	3
Hours per day	24
Days per week	7
Total Hours per year	8760
Economic Life, years	10
Interest Rate (%)	7
Source(s) Controlled	Nodulizer Kiln
Total Flowrate (acfm)	300,000
Hg from Kiln Operation (lb/hr)	0.086
Hg from Kiln Operation (lb/yr)	753
Site Specific Electricity Cost ($/kWh)	0.043
Site Specific Operating Labor Cost ($/hr)	$45.00
Site Specific Maint. Labor Cost ($/hr)	$45.00

Capital Costs

	Value	Basis
Direct Costs		
1.) Purchased Equipment Cost		
a.) Equipment cost + auxiliaries	$11,451,000	See Capital Cost Estimate, A
b.) Instrumentation	$0	Included
c.) Sales taxes	$0	Included
d.) Freight	$572,550	0.05 X A
Total Purchased equipment cost, (PEC)	$12,023,550	B
2.) Direct installation costs		
a.) Foundations and supports	$601,200	0.10 x B
b.) Handling and erection	$2,404,700	0.20 x B
c.) Electrical	$120,200	0.01 x B
d.) Piping	$120,200	0.01 x B
e.) Insulation for ductwork & painting	$120,200	0.01 x B
f.) Stack modification	$240,500	0.02 x B
Total direct installation cost	$3,607,065	0.30 x B
3.) Site preparation	$200,000	As Required, SP
4.) Buildings	NA	As Required, Bldg.
Total Direct Cost, DC	$15,830,600	1.30B + SP + Bldg.
Indirect Costs (installation)		
5.) Engineering	$240,500	0.02 x B
6.) Construction and field expenses	$601,200	0.05 x B
7.) Contractor fees	$1,202,400	0.10 x B
8.) Start-up	$240,500	0.02 x B
9.) Performance test	$120,200	0.01 x B
10.) Contingencies	$1,803,500	0.15 x B
Total Indirect Cost, IC	$4,208,300	0.35 x B + Other
Total Capital Investment (TCI) = DC + IC	**$20,038,900**	**1.61B + SP + Bldg. + Other**

Appendix C
P4 Production, L.L.C. - Hg BACT Analysis
Conceptual Control Option 2
Nodulizing Kiln

Control Efficiency (%)	30.0

Annual Costs

Item	Value	Basis	Source
1) Electricity			
Fan Power Requirement (kW)	1,648		Estimate
Electric Power Cost ($/kWh)	0.043		
Cost ($/yr)	$620,756		
2) Operating Costs			
Operating Labor Requirement (hr/shift)	1	1 hour per shift	Estimate
Unit Cost ($/hr)	$40.00	Facility Data	
Labor Cost ($/yr)	$43,680		
3) Steam Reheat			
Temperature rise (^{o}F)	88		
Steam requirement (klb/hr)	59		Estimate
Steam cost ($/klb)	$9.0	Estimated	
Total Cost	$4,651,560		
4) BAC Cost ($/lb)	$1		
Hourly Requirerment (Lbs/hour)	90	5 lb/MMacfm	Estimate
Annual requirement (Lbs/year)	788,400		
Total BAC Costs ($/year)	$788,400		
5) Residual Disposal			
Annual Quantity (TPY)	434		Esitamte
Cost ($/T)	$200	Special Waste Assumed	
Total Disposal Cost ($/year)	$86,724		
Total Operating Costs	**$6,191,120**		
6) Supervisory Labor			OAQPS
Cost ($/yr)	$6,550	15% Operating Labor	
7) Maintenance			
Maintenance Labor Req. (hr/year)	438.0	5% Operating Hours	Estimate
Unit Cost ($/hr)	$45.00	Facility Data	Estimate
Labor Cost ($/yr)	$19,710		
Material Cost ($/yr)	$19,710	100% of Maintenance Labor	OAQPS
Total Cost ($/yr)	$39,420		
8) Indirect Annual Costs			
Overhead	$53,790	60% of O&M Costs	OAQPS
Administration	$400,780	2% of Total Capital Investment	OAQPS
Property Tax	$200,390	1% of Total Capital Investment	OAQPS
Insurance	$200,390	1% of Total Capital Investment	OAQPS
Capital Recovery	$2,853,090	10 yr life; 7% interest	OAQPS
Total Indirect ($/yr)	$3,708,440		
Total Annualized Cost ($/yr)	**$9,945,500**		
Total Controlled (lb/yr)	**225.9**		
Cost Effectiveness ($/lb)	**$44,000**		

P4 Production, L.L.C - Hg BACT Analysis

BACI & Baghouse after the Hydrosonic Scrubbers

Capital Cost Estimate

Item	Cost Estimate	Basis
BACI System		
Storage and conveyance	$900,000	United Conveyor price list
Injectors	$80,000	Estimate
Oxidant Injection		(Included for Conceptual Control Option 1 only)
Storage (CaBr2)	$100,000	Tank cost estimate RS Means
Injection system	$80,000	Estimate
Steam Reheat		
Housing	$100,000	RS Means
Steam Line	$100,000	RS Means
Heat Exchanger	$1,000,000	AB&CO - TT Boilers (316 SS)
Ductwork, Dampers, & Fans		
FRP Liner to hydosonic scrubbers	$200,000	Est. (Included for Conceptual Control Option 1 only)
Dampers	$60,000	Estimate
Fans	$250,000	RS Means
Baghouse		
Baghouse	$7,800,000	EPA-452/F-03-025 (no secallation used)
Hopper	$60,000	Estimate
Residual Storage	$60,000	Estimate
Controls		
Integrated Control System	$1,005,000	10% of equipment cost
Capital Cost Total	$11,795,000	

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ERM's Milwaukee Office

700 W. Virginia Street
Suite 601
Milwaukee, Wisconsin 53204
Tel: 414-289-9505
Fax: 414-289-9552