089-00382 Indiana Harbor Coke

File

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OCT 1 6 2000

State of Indiana
Dept. of Environmental Mgmt.
Office of Air Management

October 18, 2000

Mr. Paul Dubenetzky
Chief, Permits Branch
Office of Air Management
Indiana Department of Environmental Management
100 North Senate Avenue
Post Office Box 6015
Indianapolis, IN 46206-6015

Re: Supplement to Request for Administrative Changes for Indiana Harbor Coke and Cokenergy Construction Permits

Dear Paul:

This letter follows up on the August 25, 2000 meeting with you and your staff and presents certain additional information relating to the April 27, 2000 Request for Administrative Changes submitted by Indiana Harbor Coke Company ("IHCC") and Cokenergy, Inc. ("Cokenergy"). Specifically, you indicated in the meeting that you believed IDEM would re-allocate the emissions as necessary, but would only consider re-allocation of both condensible and filterable portions of the particulate matter emissions. You asked that the parties develop a netting worksheet that included both filterable and condensible emission calculations. You also asked that they provide that information as part of a total report that discusses the entire emission venting issue.

In response to your request, I have enclosed an October 2000 white paper entitled "Venting Report." The "Venting Report" specifically discusses the causes of venting, potential solutions considered, and process and equipment changes implemented. It also provides a netting table that confirms that the requested approval for venting will not cause emissions to increase above those levels contemplated by the initial permit, even when condensibles are included.

As was discussed, the proposed permit modifications are essential to IHCC and Cokenergy. As described in the report, venting has been reduced as much as possible. Accordingly, the IHCC and Cokenergy permits require the following modifications:

- <u>Allow limited venting</u>. Revise the permits to allow venting up to 19% on a 24-hour basis and 14% on an annual basis.

- Reallocate emissions. The current permits establish limits for PM, SO_2, NO_x, VOC, and lead from the coke oven waste gas emitted from the main stack (Stack 201). Reallocate these as combined emissions from the vent and main stacks.

- Revise PM emission limits to include the condensible portion. The limits would be:

- Main stack total PM limits – 50 lb/hour, 219.0 tons/year

- Vent stacks total PM limits – 12 lb/hour/stack, 116.7 tons/year[1]

- Total PM limit from coke oven flue gases – 335.7 tons/year

Thank you for your attention to this matter. Please do not hesitate to contact me to discuss this further or for additional information.

Sincerely,

Tony Sullivan

Anthony C. Sullivan

ACS:naw
Enclosure
Via Hand Delivery (w/four copies)
cc: Mark McCormick, Esquire (w/o enc.)
Richard W. Westbrook, P.E. (w/o enc.)
Mr. George Bradley (w/o enc.)
Mr. Tom Steiner (w/o enc.)
John R. Carson, P.E. (w/o enc.)

[1]Venting an average of 14% of the flue gases.

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State of Indiana
Dept. of Environmental Mgmt.
Office of Air Management

Venting Report

October 2000

Prepared by:
Indiana Harbor Coke Company
Cokenergy Inc.
Radian International

VENTING REPORT

Prepared by:

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October 2000

1.0 OVERVIEW

Indiana Harbor Coke Company ("IHCC") operates the first heat recovery coke plant of its kind in the world at the Ispat Inland Inc. ("Inland") facility in East Chicago, Indiana. Cokenergy Inc. ("Cokenergy") operates an energy recovery facility that produces electricity from the hot flue gases generated as the only "by-product" from the coke plant.

IHCC's coke plant differs from conventional byproduct coke plants in that the coal volatiles are fully oxidized in the oven system instead of being recovered as chemical products. Following partial combustion in the oven crown, the gases pass through the oven sole flues and an afterburner tunnel where uncombusted gases are oxidized. The afterburner tunnel system routes the hot flue gases to heat recovery steam generators ("HRSGs"), and the resulting heat is recovered as steam that is used to produce electricity. Equipment to remove sulfur dioxide (SO_2) and particulate matter (PM) from the oven gases (lime spray dryer and fabric filter) are downstream of the HRSGs. Flue gases leaving the spray dryer and fabric filter are exhausted from the main stack.

The original design of the coke plant intended that all the flue gases would pass through the HRSGs and scrubbing equipment and exhaust out the main stack except during malfunctions and emergency situations. Actual operations have demonstrated that not all the gases can be routed through the main stack under all circumstances. IHCC operating experience has shown that some venting of the flue gases prior to the HRSGs but downstream of the afterburner tunnel system is necessary to maintain the negative draft that is required for the operation of the coke plant.

The IHCC and Cokenergy permits require certain revisions in order to provide needed operational flexibility. These revisions will not result in an increase of pollutant emissions above the amount contemplated by the construction permit. It is notable that condensible PM was not included in the original application, netting analysis, or initial construction permit. This report addresses the condensible emissions.

2.0 FACILITY DESIGN

During coke production from both heat recovery and byproduct ovens, the volatile fraction of the coal is driven off in a reducing atmosphere. Coke is essentially the remaining carbon and ash. In the case of byproduct ovens, the volatiles and combustion products are collected downstream of the oven chamber and refined in a chemical plant to produce coke oven gas and other products such as tar, ammonia, and light oils. In the case of heat recovery ovens, all the coal volatiles are oxidized to release heat. Some of the heat is retained in the oven structure to start the next coking cycle without the need for firing any other fuels. Most of the heat is recovered and used to make steam and electricity.

Each technology has its own set of design objectives that affect emissions. The ovens at both byproduct and heat recovery plants are typically constructed of refractory brick shapes and other materials that, through normal operation, can form small cracks in the refractory and around the removable parts. Byproduct ovens are kept at a positive pressure to avoid oxidizing recoverable products and overheating the ovens. Heat recovery ovens are kept at a negative pressure, adding ambient air to oxidize all volatile matter and to release the heat of combustion within the oven system. This opposite operating pressure condition and combustion within the oven system are important design differences between heat recovery ovens and byproduct ovens. Small openings or cracks in byproduct ovens allow raw coke oven gas (and other hazardous air pollutants) to leak into the atmosphere. The openings or cracks in the heat recovery ovens simply allow additional air to be drawn into the oven.

Figure 1 is a cut-away drawing of a heat recovery oven. Coal is charged onto the oven floor at the beginning of the cycle. Some air is added to the oven crown. Partially combusted gases pass into a sole flue system beneath the oven floor where essentially all combustion is completed. The gases then pass into an afterburner tunnel where any remaining uncombusted gases are oxidized. The afterburner tunnel system collects the hot flue gases from groups of approximately 17 ovens and routes them to HRSGs. The heat from the flue gases is transferred to steam that is used to produce electricity. The connection between the waste heat tunnel and the HRSG and the vent stacks can be seen in a picture of IHCC during construction (Figure 2). Four HRSGs per battery collect the hot flue gases from 67 ovens. The waste heat tunnel is continuous over the ovens so that the gases can be shared between HRSGs during times of high gas evolution. Other HRSG connections and several vent stacks are visible in Figure 2. Equipment to remove SO_2 and PM from the oven gases (lime spray dryer and fabric filter) are downstream of the HRSGs. Flue gases leaving the spray dryer and fabric filter are exhausted from the main stack.

3.0 CAUSES OF VENTING

The pressure in heat recovery ovens must be negative to achieve the desired level of combustion in all parts of the oven. Maintaining adequate negative pressure is the critical consideration in IHCC's operation of its plant. Venting may be required to maintain negative pressure in the ovens in two circumstances, namely during certain peak gas periods and HRSG maintenance.

During some peak gassing periods, the induced draft system cannot produce enough suction to maintain negative pressure in the ovens. Accordingly, a vent stack is opened and some (variable amount) of the gases is vented, while the rest of the gas passes through the HRSGs, spray dryer, and fabric filter, and then discharges from the main stack. The underlying cause of this venting is the inability of the gas cleaning and induced draft systems to handle peak conditions.

HRSG maintenance is required because the HRSGs periodically "foul" with ash build-up on the heat exchanger tubes. The build-up insulates those tubes from the gas stream, preventing the HRSGs from removing the heat from the hot flue gases. When this occurs, the affected HRSG must be taken off line and manually cleaned. During cleaning periods, the adjacent vent stack is opened and the gases from approximately 17 coke ovens are vented. Once again, the remaining gases pass through the HRSGs, spray dryer, and fabric filter, then discharge from the main stack. The underlying cause of this venting is the inability of the waste heat tunnel and other HRSGs to handle the entire gas volume when one HRSG must be shut down for tube cleaning.

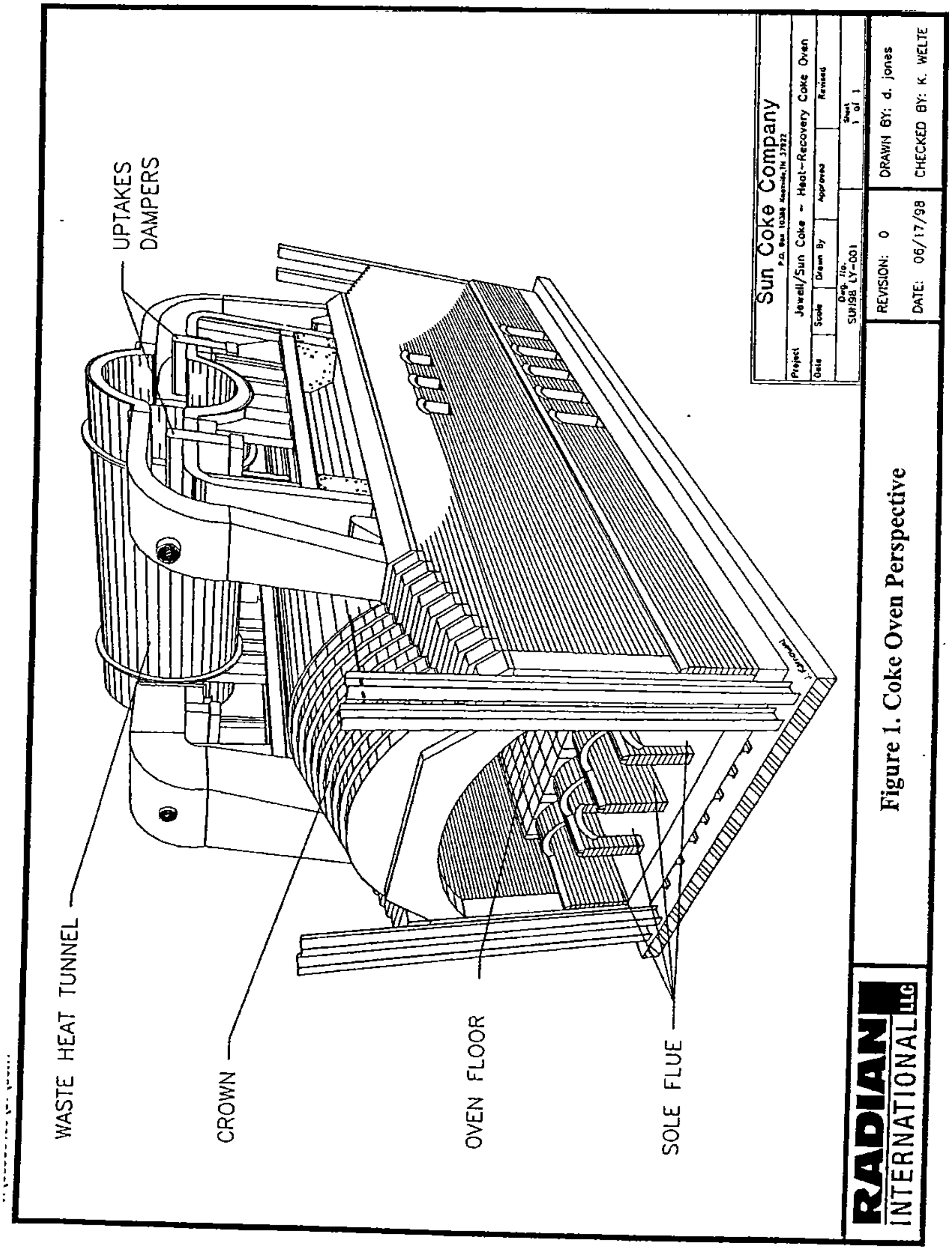

Figure 1. Coke Oven Perspective

Figure 2. IHCC During Construction

4.0 ANALYSIS OF POTENTIAL SOLUTIONS

4.1 Peak Conditions

Venting during peak conditions can be reduced by process modifications, including:

(a) increasing the time between charging adjacent ovens to flatten out the gassing peak from groups of ovens (known as "staggered charging");
(b) optimizing production levels and coal blends to produce less gas; and
(c) improving seals around dampers and access doors to minimize air leakage and excess air to the ovens[1] (known as "air management").

As described in Section 5.0, all of these process changes have been implemented.

4.2 HRSG Maintenance

Venting during HRSG maintenance can be reduced by:

(a) arranging work schedules so that a crew can clean a HRSG quickly and minimize the time offline;

[1] Oxygen analyzers have also been installed at each HRSG to monitor excess air.

(b) adding soot blowers to the existing HRSGs in order to keep each unit online as long as possible; and
(c) scheduling HRSG cleaning so that only 1 of the 16 units is offline at a time.

As described in Section 5.0, all of these maintenance measures have been implemented.

4.3 Plant Production

Heat generated during heat recovery coking is used to sustain the oven temperature for charging coal during the next production cycle. That requirement necessitates a "floor" on the coal tonnage that must be charged. That "floor" varies depending upon the volatile matter content of the coal blend being charged.

As noted in Section 4.1, coal blends are being utilized that produce significantly less gas when compared with coal blends previously utilized at the facility. The corresponding trade-off is that reducing coal blend tonnages to the "floor" for the current (less gas producing) blend will not significantly alleviate the need for venting. Accordingly, reducing plant production is not a practicable solution.

4.4 Major System Modifications

Implementing major system modifications to the *entire* gas handling system could theoretically reduce venting. Those theoretical modifications include, at a minimum:

(a) increasing the size of the waste heat tunnel;
(b) adding redundant HRSGs or, alternatively,
replacing the existing HRSGs with a different design;
(c) installing larger ductwork from the HRSGs to the fabric filter;
(d) increasing the number of fabric filter modules[2]; and
(e) installing additional fan capacity.[3]

However, even though theoretically possible, implementing all these modifications will irreparably damage the facility. Construction requires shutting down the coke plant. Any such shut down will cause the coke ovens to fall apart because the silica bricks utilized to fabricate the coke ovens "spall" or break when cooled. Moreover, the oven walls (which support the refractory ductwork and HRSGs) cannot support the weight of additional refractory ductwork or HRSGs in any case. Consequently, these modifications cannot be implemented.

A subset of these modifications could be implemented without shutting down the facility. These include replacing the existing HRSGs, installing larger ductwork between the HRSGs and the fabric filter, modifying the fabric filter, and installing additional fan capacity. However without increasing the size of the waste heat tunnel, a significant cause of venting during peak conditions and maintenance would not be addressed. In addition, it would be necessary to vent

[2] The facility design included spare fabric filter modules (that could be maintained while offline). Current practice is to operate the system with all the fabric filter compartments online.
[3] The facility design also included a spare fan. Current practice is to operate both fans.

the uncontrolled flue gases from all the ovens for approximately 1 year as the current equipment is replaced.

Even if the irreparable damage to the facility could somehow be prevented, the estimated cost of these modifications is $88,000,000.00. Accordingly, any benefit derived from these modifications is far outweighed by the cost of implementing the modifications.[4]

5.0 CURRENT OPERATION

Venting has been significantly reduced as a consequence of implementation by IHCC and Cokenergy of all the foregoing process changes and maintenance measures. Process changes and maintenance measures that have been implemented include (i) utilizing coal blends with lower volatile content when compared with coal blends previously used in the production of coke at the coke plant; (ii) implementing staggered charging for all batteries; (iii) installing oxygen analyzers at each HRSG to monitor excess air; (iv) scheduling HRSG cleaning so that only one unit is offline at a time; (v) operating with the spare fabric filter compartments online (originally designed to be offline during maintenance) while running both the main and spare fans at the same time; (vi) upgrading the seals around all dampers and access doors; and (vii) adding soot blowers to all the HRSGs at a cost of $7,700,000.

The result of these changes has been continual reduction of venting since plant startup. Under normal operation, no more than 19% of the waste flue gases are vented on a 24-hour basis.[5] No more than 14% of the waste flue gases are vented annually.[6] Because venting cannot be reduced further by any reasonable means, the proposed permit modification is essential to continued operation of the coke plant and the energy recovery facility.

6.0 IMPACTS OF VENTING

Given that there is no additional combustion or nitrogen oxide (NO_x) formation in the relatively cool ductwork downstream of the HRSGs (<400°F), the emissions of NO_x, carbon monoxide, and volatile organic compounds (VOCs) are the same regardless of whether those gases are released from the vent stacks or whether those gases travel through the HRSGs, the lime spray dryer, and the fabric filter. Furthermore, although there is a potential for higher SO_2 emissions during venting (because these emissions bypass the control equipment), such increases can be offset by increased spray dryer operation. Lastly, even with venting filterable PM, emissions comply with the emission limits set forth in the initial permit. Therefore, current total emissions from the facility conform to requirements for total emissions set forth in the original permit application, netting analysis, and initial construction permit. Table 1 compares the SO_2 and PM from the original permit application with current emissions.

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[4] It is unlikely that these modifications will completely eliminate venting. For example, HRSG cleaning and inspections will still be required.

[5] This is equivalent to venting 3 of the 16 stacks.

[6] This is equivalent to venting approximately 2 stacks.

Table 1. Comparison of Current and Permit Application SO_2 and PM

Unit	Permit Application		Current Operation[a]	
	SO_2 (tons/year)	PM/PM_{10} [b] (tons/year)	SO_2 [c] (tons/year)	PM/PM_{10} [b] (tons/year)
Main Stack	7255.8	181.7	<5521.3	<121.2
Vent Stack	0	0	<1734.5	<60.5
Total	7255.8	181.7	<7255.8	<181.7

[a]Annual vent rate = 14%.
[b]Filterable PM.
[c]Allocation between main and vent stacks may vary with coal sulfur.

7.0 EMISSION MONITORING PROGRAM

IHCC and Cokenergy currently monitor the combined emissions of SO_2 and PM from the main stack and the vent stacks. This monitoring program is described in a report previously submitted to the Indiana Department of Environmental Management (IDEM).[7]

8.0 PERMIT ISSUES

8.1 Permit History

The construction of the coke plant and energy recovery facilities (collectively, the "Project") was authorized under a construction permit issued to Inland Steel Company, December 30, 1996 (CP-089-6919-00316). That permit was subsequently split into three permits, one each for IHCC, Cokenergy, and Inland, on February 26, 1998. The Project was determined to be a minor modification using creditable emission decreases from Inland. The original permit application, netting analysis, and initial construction permit were based on filterable PM. Venting does not affect this netting analysis.

8.2 Definition of Particulate Matter and the Design Basis for the Plant

PM is defined by ambient air filtration methods as total suspended particulate (TSP), which includes particles less than or equal to 10 microns (PM_{10}). Use of specific test methods can subdivide PM into filterable and condensible fractions. PM measured by collection on a filter is "filterable," whereas "condensible" PM is collected by bubbling gases (downstream of the filter) through water. The gas stream is cooled to <68°F. This technique can overstate the quantity of "condensible" PM because compounds may be collected that do not form particulate in the atmosphere.

Historically, IDEM has only considered the filterable portion of PM as regulated. For example, 326 Indiana Administrative Code (IAC) 3-6-5(a)(9) provides:

> The total particulate weight collected from the sampling nozzle, probe, cyclone (if used), filter holder (front half), and connecting glassware shall be reported

[7] "Emission Tracking Software Program for Indiana Harbor Coke Company," dated February 2000.

to the department. *Particulate analysis of the impinger catch is not required,* unless specified by the department. (Emphasis added.)

All PM test methods cited in the general sections of 326 IAC are methods to measure only filterable particulate. For example, the method listed in 326 IAC 6-1 [40 Code of Federal Regulations (CFR) 60] is a filterable PM procedure. 326 IAC 3-6-5 specifies the filterable procedure (40 CFR 60 Appendix A, Methods 5A, 5B, 5C, 5D, 5E, or 5F, as applicable). This method is also cited for compliance determination in nonattainment areas in 326 IAC 6-1-3 and for TSP in "Lake County PM(10) emission requirements," 326 IAC 6-1-10.1(f). In addition, the PM_{10} procedures listed in 326 IAC 6-1-10.1(f) are 40 CFR 51 Appendix M, Methods 201 and 201A, which only measure filterable PM.

Where IDEM required condensibles to be included in the calculation of PM, it has explicitly stated that requirement. The only citation in Indiana rules for condensible PM is 326 IAC 6-1-10(f)(5). That provision applies specifically to the sinter plant windbox stacks at USS Gary Works.

The 1996 permit issued to Inland addressed PM without reference to condensibles, and the plant was permitted, designed, and constructed to meet filterable particulate limits. All test data and emission factors used to prepare the construction permit application (October 16, 1996, with additional information submitted October 20, November 4, and November 8, 1996) were for filterable PM emissions. Similarly, all the PM increases and decreases used in the original netting analysis were based on filterable PM. No correspondence discussed condensible PM. The original construction permit issued December 30, 1996 does not refer to condensible PM. Nevertheless, based upon our meeting with representatives of IDEM on August 25, it is our understanding that IDEM requires that condensible PM be accounted for in determining both PM emissions and credits for the Project.

8.3 Condensible Particulate Matter

Because the requirement to include condensible PM was first added to the IHCC and Cokenergy permits in 1998 (i.e., when the original permit was split into three permits), no condensible particulate data were available for the heat recovery coking process until stack testing on the main stack (Stack 201) by IHCC and Cokenergy.[8] During the December 1999 compliance test of the main stack (Stack 201), condensible particulate emissions averaged 33.46 lb/hour at a production rate of 5,649 tons coal charged/day.[9] Annual condensible PM emissions at the permitted production rate (170,000 dry tons coal/month) would be 154 tons/year.

Although the original netting analysis for the Project did not address condensibles, adequate condensible particulate credits are available from shutdown of the 4AC station without considering contemporaneous condensible emission changes. Table 2 shows the netting analysis for the Project[10] revised by adding condensible PM to the emissions for the coke ovens. The

[8] Although the gases exhausted from the main stack have passed through the spray dryer and fabric filter, it is likely that condensible PM would pass through the fabric filter. Venting would therefore have no effect on the magnitude of condensible emissions.

[9] No venting occurred during the test.

[10] Netting analysis table attached to IDEM October 28, 1999 letter to IHCC's George Bradley

"Total TSP/PM" and "Total PM_{10}" are determined by summing the filterable PM and PM_{10} (from the original analysis) and condensible PM (from stack test data).

8.4 Requested Permit Revisions

The following modifications to the current permits are required for the Project:

(a) Allow venting up to 19% of the waste gases on a 24-hour basis and 14% on an annual basis;

(b) Reallocate PM, SO_2, NO_x, VOC, and lead emissions as combined emissions from both the vent and main stacks as opposed to solely from the main stack; and

(c) Revise PM emission limits to include the condensible portion. The limits would be:

- (i) Main stack total PM limits – 50 lb/hour, 219.0 tons/year;
- (ii) Vent stacks total PM limits – 12 lb/hour/stack, 116.7 tons/year (based on 14% venting); and
- (iii) Total PM limit from coke oven flue gases – 335.7 tons/year.

Table 2. Heat Recovery Coke Plant PM Netting Analysis

Facilities	TSP/PM	PM_{10}	Condensible PM	Total TSP/PM	Total PM_{10}
Coal Thaw Shed/Rail Car Dump	1.36	1.74			
Coal Transfer Tower No. 1	0.06	0.02			
Coal Piles Stacking Unit	0.06	0.02			
Coal Storage Piles	3.04	1.52			
Coal Crusher and Screening Unit	1.58	1.58			
Coal Bin/Emergency Pile	0.15	0.15			
Coal Transfer Tower No. 2	0.06	0.02			
Coal Transfer Tower No. 3	0.06	0.02			
East and West Coal Silos	0.66	0.66			
Coal Weigh Belts/Diverter Gates	0.66	0.66			
Coke Conveying	2.93	2.93			
Coke Transfer Tower No. 1	0.99	0.99			
Coke Transfer Tower No. 2	0.66	0.66			
Run of Oven Coke Pile	0.11	0.06			
Coke Crusher/Screening Station	5.87	5.87			
Coke Transfer Tower No. 3	0.66	0.66			
Rail Car Coke Loading	0.93	0.33			
Coke Transfer Tower No. 4	0.33	0.33			
Existing Transfer Point	0.40	0.40			
Lime Storage Silos	0.05	0.02			
FGD Product Storage Silos	0.11	0.04			
Charging	8.25	8.25			
Coke Ovens	181.7	181.7	154.0[a]	335.7	335.7
Pushing	29.3	29.3			
Quenching	315.8	30.9			
Natural Gas-Fired Turbines	32.2	32.2			
Miscellaneous Combustion	14.1	14.1			
Increases from Modification	602.1	315.1	154.0	756.1	469.1
Decreases from 4AC Station	-265	-265	-220.6[b]	-485.6	-485.6
Net Project Emissions	337.1	50.1	-66.6	270.5	-16.5

Table 2. (Continued)

Facilities	TSP/PM	PM_{10}	Condensible PM	Total TSP/PM	Total PM_{10}
Contemporaneous Increases					
12 in. and 14 in. Mill Shotblaster	3.6	3.6			
PCI Facilities	10.7	10.7			
EAF Shop Ladle Met Rev	0.6	0.6			
No. 1 Normal Preht Replm	0.1	0.1			
Normalizer-New Anneal FCE	0.2	0.2			
PCI Upgrade	0.3	0.3			
5 Galv Rad Tube FCE Repl	0.2	0.2			
Contemporaneous Decreases					
No. 4 BOF Teeming	-42.3	-18.1			
Mold Foundry	-12.1	-6.4			
Pugh Ladles and Pig Control	-55.3	-33.8			
EAF Shop 1 FCE Oper	-104.4	-75.0			
EAF Shop 2 FCE Oper	—	—			
No. 11 Coke Battery	-377.5	—			
No. 6, 7, 9, 10 Coke Batteries	—	—			
No. 3 AC Station	-37.5	-35.4			
76 in. Hot Strip Mill	-1.4	-1.4			
100 in. Plate Mill	-4.7	-4.1			
No. 8 Coke Battery	—	—			
80 in. H/S-2 Pushers	—	—			
No. 4 Slabber	-1.2	-1.2			
No. 4 Slabber Scarfer	-9.2	-9.2			
Net Contemporaneous Emissions	-629.9	-168.9	?	-629.9[c]	-168.9[c]
"Net Emissions Increase"	-292.8	-118.8		-359.4[c]	-185.4[c]
PSD or Offset Significant Level	25	15		25	15

[a]Based on December 1999 Main Stack test.
[b]Cokenergy's estimate from September 15, 2000 letter to Mack Sims at IDEM.
[c]No contemporaneous condensible emissions included.