IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF INDIANA

UNITED STATES OF AMERICA, and THE STATE OF INDIANA, Plaintiffs, v. INDIANA HARBOR COKE COMPANY, and SUNCOKE ENERGY, INC., and COKENERGY, LLC, Defendants.	Civil Action No. 18-cv-35

CONSENT DECREE

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CONSENT DECREE

WHEREAS, the United States of America ("United States"), on behalf of the United States Environmental Protection Agency ("EPA"), and the State of Indiana ("Indiana"), on behalf of the Indiana Department of Environmental Management ("IDEM") (collectively, "Plaintiffs"), filed a Complaint in this action pursuant to Sections 113(b), 167 and 304(a)(1) of the Clean Air Act ("CAA" or the "Act"), 42 U.S.C. §§ 7413(b), 7477 and 7604(a)(1), and pursuant to the laws of Indiana, alleging in relevant part that Defendants Indiana Harbor Coke Company, L.P. ("IHCC"), SunCoke Energy, Inc. ("SunCoke") and/or Cokenergy, LLC ("Cokenergy") (together the "Defendants") violated: (1) the National Emission Standards for Hazardous Air Pollutants ("NESHAP") provisions of the Act, 42 U.S.C. § 7412, and the NESHAP regulations codified at 40 C.F.R. Part 61, Subpart L, 40 C.F.R. Part 63, and 40 C.F.R. Part 63, Subpart CCCCC; (2) the provisions of the federally-enforceable state implementation plan ("SIP") for Indiana that incorporates the relevant requirements of the NESHAP; (3) CAA Title V, 42 U.S.C. §§ 7661–7661f, and the implementing regulations for CAA Title V set forth at 40 C.F.R. Parts 70 and 71; (4) the Indiana Title V Clean Air Act Permit Program, 326 Indiana Administrative Code ("IAC") § 2-7; and (5) Defendants' Title V operating permits: IHCC Title V Permit No. 089-36826-00382 and Cokenergy Title V Permit No. 089-36965-00383;

WHEREAS, the Complaint alleges that the above violations took place at the coking and power generation facility in East Chicago, Indiana, owned and operated by Defendants;

WHEREAS, the United States and Indiana seek civil penalties and injunctive relief for the alleged violations pursuant to Section 113(b) of the CAA, 42 U.S.C. § 7413(b), and Indiana additionally seeks such relief pursuant to Ind. Code §§ 13-13-5-1 and 13-13-5-2;

WHEREAS, over the past several years, IHCC has carried out a number of projects, including repairs and replacements of coke ovens and hot common tunnel sections; replacement of all bypass vent stack lids with new lids that were designed to minimize potential leakage; rebuilding two quench towers designed to reduce PM emissions; and implementation of an improved maintenance and repair program;

WHEREAS, Cokenergy has completed retubing of all its Heat Recovery Steam Generators ("HRSGs"), including enhancements such as increased tube wall thickness, adjusted fin spacing, three pass seal welds, and other improvements at an estimated cost of $32.3 million;

WHEREAS, Cokenergy has installed the requisite controls and infrastructure to allow for the operation of dual Spray Dryer Absorbers ("SDAs") and made other improvements to the flue gas desulfurization ("FGD") system, including new SDA isolation dampers, upgraded FGD controls and instrumentation, improvements to the atomizer, and installation of new bags in the Baghouse;

WHEREAS, IHCC has installed new push-charge machines to reduce the release of PM and lead emissions during charging and pushing operations;

WHEREAS, the Defendants do not admit any liability to the United States or the State arising out of the transactions or occurrences alleged in the Complaint and have worked cooperatively with the Plaintiffs to settle this matter;

WHEREAS, the United States, the State, and the Defendants (the "Parties") recognize, and the Court by entering this Consent Decree finds, that this Consent Decree has been negotiated by the Parties in good faith and will avoid protracted and expensive litigation among the Parties and that this Consent Decree is fair, reasonable, and in the public interest;

NOW, THEREFORE, before the taking of any testimony, without the adjudication or admission of any issue of fact or law except as provided in Section I (Jurisdiction and Venue), and with the consent of the Parties, IT IS HEREBY ADJUDGED, ORDERED, AND DECREED as follows:

I. JURISDICTION AND VENUE

1. This Court has jurisdiction over the subject matter of this action pursuant to 28 U.S.C. §§ 1331, 1345, 1355, 1362, and 1367, and Section 113(b) of the CAA, 42 U.S.C. § 7413(b), and over the Parties. Venue lies in this District pursuant to Section 113(b) of the CAA, 42 U.S.C. § 7413(b), and 28 U.S.C. §§ 1391(b) and (c) and 1395(a), because the violations alleged in the Complaint are alleged to have occurred in, and Defendants conduct business in, this judicial district. Defendants consent to this Court's jurisdiction over this Consent Decree and any action to enforce this Consent Decree, and to venue in this judicial district.

2. For purposes of this Consent Decree, Defendants agree that the Complaint states claims upon which relief may be granted pursuant to Sections 111, 165 and 502 of the CAA, 42 U.S.C. §§ 7411, 7475 and 7661a.

3. Notice of the commencement of this action has been given to the State of Indiana as required by Section 113 of the CAA, 42 U.S.C. § 7413.

II. APPLICABILITY

4. The obligations of this Consent Decree apply to and are binding upon the United States and the State, and upon Defendants and their officers, employees, agents, successors, assigns, and other entities or persons otherwise bound by law.

5. A Defendant may transfer its interest in the facility without relieving that Defendant of its Consent Decree obligations, without consent, and without modification of the Consent Decree, so long as: (i) the transferee agrees in writing to comply with the obligations of the Consent Decree, and (ii) written notice of the transfer, together with a copy of the transferee's assumption of Consent Decree obligations, is provided to EPA Region 5, the United States Attorney for the Northern District of Indiana, the United States Department of Justice, and the State of Indiana in accordance with Section XV (Notices). A Defendant may be relieved of its Consent Decree obligations only upon Court approval of a modification to the Consent Decree, substituting the transferee for the transferor, and providing that the transferee will implement the terms of the Consent Decree; provided, however, that the United States, after consultation with the State of Indiana, may refuse to approve such a modification to the Consent Decree if it determines that the proposed transferee does not possess the requisite technical abilities, and/or financial means to implement the Consent Decree. If the United States opposes

the substitution, the issue shall be subject to dispute resolution pursuant to Section XI (Dispute Resolution). If the United States, after consultation with the State of Indiana, agrees to the substitution, the parties will file an unopposed motion with the Court seeking such substitution.

6. Defendants shall provide a copy of this Consent Decree to all officers, employees, and agents whose duties might reasonably include compliance with any provision of this Decree, as well as to any contractor retained to perform work required under this Consent Decree. Defendants shall condition any such contract upon performance of the work in conformity with the terms of this Consent Decree.

7. In any action to enforce this Consent Decree, no Defendant shall raise as a defense the failure by any of its officers, directors, employees, agents, or contractors to take any actions necessary to comply with the provisions of this Consent Decree. Nothing in this Paragraph shall preclude Defendants from invoking Force Majeure pursuant to Section X.

III. DEFINITIONS

8. Terms used in this Consent Decree that are defined in the CAA or in federal and state regulations promulgated pursuant to the CAA shall have the meaning assigned to them in the CAA or such regulations, unless otherwise provided in this Decree. Whenever the terms set forth below are used in this Consent Decree, including attached appendices, the following definitions shall apply:

a. "Battery" shall mean all Coke Ovens linked on a single common tunnel. IHCC has four batteries denoted A, B, C, and D. Each Battery includes multiple banks of 16 or 17 Ovens.

b. "Bypass Vent Stack" shall mean each vent stack located between the Coke Oven battery common tunnel and each HRSG.

c. "Bypass Venting" shall mean the redirection of a flue gas stream through the Bypass Vent Stacks directly to the atmosphere for any reason. Bypass Venting through a Bypass Vent Stack commences when a Bypass Vent Stack lid opens and continues until the Bypass Vent Stack lid closes.

d. "Bypass Venting Incident" shall mean all Bypass Venting that results in an exceedance of the 19% daily bypass venting limit.

e. "Bypass Venting Incident Root Cause Failure Analysis" or "Bypass Venting Incident RCFA" shall mean an assessment conducted pursuant to Paragraph 18 of this Consent Decree to determine the primary cause and any contributing cause of a Bypass Venting Incident.

f. "Bypass Venting Percentage" shall mean the venting as tracked through the Emissions Tracking System, which tracks the percentage of Bypass Venting in daily and 3-hour block averages.

g. "Coal Sulfur Content" or "Sulfur Content" shall mean the elemental composition of sulfur in coal by weight as determined by methods approved in the Permits.

h. "Coke Oven" or "Oven" shall mean any heat recovery oven at Batteries A, B, C, or D.

i. "Coke Oven Door Leak" shall mean emissions during a Coking Cycle from a Coke Oven door that do not comply with 40 C.F.R. § 63.303(b)(1) or (c)(2).

j. "Coke Oven Fugitive Emissions" shall mean all emissions from a Coke Oven during a Coking Cycle that are not emitted through either the Main Stack or the Bypass Vent Stacks.

k. "Coke Oven Leak" or "Leak" shall mean any Coke Oven Door Leak or Crown Opacity. Visible emissions that occur during a Lightning Stand-Down shall not be considered a Coke Oven Leak provided the visible emissions do not continue for longer than 15, 30, or 45 minutes, as applicable pursuant to Paragraph 12, after the Lightning Stand-Down is over.

l. "Coke Oven Leak RCFA Trigger Level" or "RCFA Trigger Level" shall mean either (a) when an oven experiences Coke Oven Leaks in two consecutive Coking Cycles, or (b) when an oven experiences Coke Oven Leaks in four or more Coking Cycles in a calendar month. Leaks that result from operator error (*e.g.*, failure to open dampers, close sole flues when a leak is detected, *etc.*) shall not count in determining whether the RCFA Trigger Level has been reached.

m. "Coke Oven Root Cause Failure Analysis" or "Coke Oven RCFA" shall mean an assessment conducted pursuant to Paragraph 13 of this Consent Decree to determine the primary cause and any contributing cause of triggering a Coke Oven Leak RCFA Trigger Level.

n. "Coking" shall mean the process where coal that has been placed in a Coke Oven undergoes destructive distillation to produce coke.

o. "Coking Cycle" shall mean the time that begins after the Oven has been charged with coal and both doors have been placed on the Oven and ends when a door is removed.

p. "Coking Operations" shall mean IHCC's operation of Coke Ovens and other coking equipment.

q. "Complaint" shall mean the complaint filed by the United States and the State of Indiana in this action.

r. "Consent Decree" or "Decree" shall mean this Decree and all appendices attached hereto.

s. "Crown Opacity" shall mean emissions during a Coking Cycle from a Coke Oven crown that causes at least 20% opacity for three (3) minutes using EPA Method 9. IHCC has the option to use EPA Alternative Method 082 in lieu of EPA Method 9.

t. "Day" shall mean a calendar day. In computing any period of time under this Consent Decree, where the last day would fall on a Saturday, Sunday, or federal or State holiday, the period shall run until the close of business of the next working day.

u. "Defendants" shall mean IHCC, SunCoke, and Cokenergy. For purposes of Section IV.A (Coke Ovens), "IHCC" shall mean IHCC and SunCoke.

v. "Effective Date" shall have the meaning given in Section XVI (Effective Date).

w. "Emissions Tracking System" or "ETS" shall mean the emissions tracking software used by Defendants to track bypass venting (*i.e.*, record the percentage of bypass venting in daily and 3-hour block averages) and main stack emissions and bypass vent stack emissions (SO_2, PM, and lead).

x. "EPA" shall mean the United States Environmental Protection Agency and any successor departments or agencies.

y. "Facility" shall mean the coking and power generation facility located in East Chicago, Indiana.

z. "Flue Gas Desulfurization unit" or "FGD" shall mean a dry scrubber and baghouse used to remove sulfur dioxide and particulate matter from the products of combustion or flue gases from gaseous waste streams before discharge to the atmosphere.

aa. "Full RCFA" shall mean a Coke Oven RCFA conducted pursuant to Paragraph 13.b.

bb. "Heat Recovery Steam Generator" or "HRSG" shall mean an energy recovery heat exchanger that recovers heat from a hot gas stream for the purpose of steam generation.

cc. "HRSG Outage" means the period of time when a HRSG is not operating.

dd. "HRSG Retubing" shall mean replacement of waterwalls, evaporator tubes, economizer tubes, and/or superheater module pendants within the HRSG, and replacement of exterior casing, insulation, and refractory as needed.

ee. "IDEM" shall mean the Indiana Department of Environmental Management and any successor departments or agencies.

ff. "Idle" shall mean to temporarily cease use of an Oven for Coking.

gg. "Indiana" or "State" shall mean the State of Indiana.

hh. "Lightning Stand-Down" shall mean when lightning is within a 10 mile radius of the Facility as determined by a third-party weather tracking service, and exposed outdoor work must be stopped in accordance with a Defendant's severe weather safety policy. A Lightning Stand-Down is over when an "all-clear" announcement is made after a 30 minute period of no strikes within the 10 mile clearance radius in accordance with a Defendant's severe weather safety policy.

ii. "Main Stack" shall mean the main stack (ID 201) located at the end of the control train after the FGD and baghouse.

jj. "Month" shall mean calendar month.

kk. "Oven Rebuilds" shall mean repairing Ovens by removal and replacement of the Oven floor and sole flues and repair of Oven wall cracks.

ll. "Paragraph" shall mean a portion of this Consent Decree identified by an Arabic numeral.

mm. "Particulate matter" or "PM" emissions shall mean all finely divided solid or liquid material, other than uncombined water, emitted to the ambient air as measured by applicable reference methods, or an equivalent or alternative method, specified in 40 C.F.R. Chapter 1, or by a test method specified in the Indiana State Implementation Plan.

nn. "Permits" shall mean (a) Cokenergy's Title V Operating Permit No. 089-36965-00383, effective November 14, 2016, and all final revisions, modifications, renewals, and successors to this permit, not inconsistent with Section IV.F of this Consent Decree; and (b) IHCC's Title V Operating Permit No. 089-36826-00382, effective March 15, 2016, and all final revisions, modifications, renewals, and successors to this permit, not inconsistent with Section IV.F of this Consent Decree.

oo. "Planned FGD Maintenance" shall mean preventive maintenance, inspection, and repair of FGD components as detailed in the FGD Preventive Maintenance and Operation Plan.

pp. "Planned HRSG Maintenance" shall mean preventive maintenance, cleaning, inspection, and/or repair of HRSG components, which is planned for and scheduled for the 16 HRSGs on an annual basis, as detailed in the HRSG Preventive Maintenance and Operation Plan.

qq. "Power Operations" shall mean Cokenergy's operation of the steam and power generation equipment.

rr. "Rebuilt Ovens" shall mean Ovens that have undergone Oven Rebuilds.

ss. "Root cause" shall mean the primary cause or causes of either (1) triggering a Coke Oven Leak RCFA Trigger Level as determined by the Coke Oven RCFA in Paragraph 13 of this Consent Decree or (2) a Bypass Venting Incident as determined by the Bypass Venting Incident RCFA in Paragraph 18 of this Consent Decree

tt. "Section" shall mean a portion of this Consent Decree identified by a Roman numeral.

uu. "SO_2" shall mean sulfur dioxide.

vv. "Solar Occultation Flux" or "SOF" shall mean a remote sensing method based upon measuring infrared intensity spectra of the sun, developed to identify and quantify fugitive emissions from a variety of emission sources, including large industrial sources.

ww. "Spray Dryer Absorber" or "SDA" shall mean a device that facilitates the combination of waste gas with a high-alkaline content slurry, in order to react with acid gases and form solid salts prior to entry into the baghouse for the collection and removal of particulate matter.

xx. "Structural Issues" shall mean issues involving the Oven structure (cracks or other damage to walls, floors, or flues; problems with Oven sealing; and/or other problems associated with the Oven structure) that cause Coke Oven Leaks.

yy. "Summary RCFA" shall mean a Coke Oven RCFA conducted pursuant to Paragraph 13.a.

zz. "Ton" or "tons" shall mean short ton or short tons. One ton equals 2,000 pounds.

aaa. "United States" shall mean the United States of America, acting on behalf of EPA.

bbb. "VOCs" shall mean volatile organic compounds.

IV. COMPLIANCE REQUIREMENTS

A. Coke Ovens

9. Batteries A, C, and D Oven Rebuilds. IHCC shall either complete all Oven Rebuilds for Batteries A, C, and D, or Idle any Ovens that will not be rebuilt, by December 31, 2018. An Idled Oven shall not be restarted until the Oven Rebuild is completed.

10. Battery B Initial Oven Rebuilds. IHCC completed five Oven Rebuilds for Battery B ("Initial Oven Rebuilds") on or about March 31, 2017.

a. Battery B Evaluation. On or before March 31, 2018, IHCC shall evaluate the five rebuilt Ovens in Battery B to determine whether the Battery B Oven Rebuilds were

successful as of the date of the evaluation. By April 30, 2018, IHCC will notify EPA and IDEM, in writing, of its determination as to whether the Battery B Oven Rebuilds were successful. IHCC's written conclusion that the Oven Rebuilds were successful shall be subject to approval by EPA pursuant to Section VIII of the Consent Decree. If EPA has not approved or disapproved of IHCC's written determination within sixty (60) Days, then IHCC may proceed to implement the remaining Battery B Oven Rebuilds without requiring approval.

i. If at least two of the Battery B Initial Oven Rebuilds have not experienced Coke Oven Leaks resulting in a Full RCFA that requires an Oven Rebuild during the preceding nine consecutive months, IHCC shall either complete all Battery B Oven Rebuilds or Idle any Battery B Ovens that will not be rebuilt by November 30, 2019. An Idled Oven shall not be restarted until the Oven Rebuild is completed.

ii. If fewer than two of the Battery B Initial Oven Rebuilds have not experienced Coke Oven Leaks resulting in a Full RCFA that requires an Oven Rebuild during the preceding nine consecutive months, IHCC shall shut down Battery B and permanently retire all Battery B coking operations by December 31, 2018.

11. Coke Oven Leaks from Non-Rebuilt Ovens. As of the Effective Date, IHCC shall undertake good air pollution control practices to minimize emissions from Coke Oven Leaks from Non-Rebuilt Ovens, including taking the following actions, if practicable:

a. In response to a Coke Oven Leak, taking response measures, such as adjusting oven damper position to optimize oven draft as soon as possible after the Leak is observed to minimize emissions from Non-Rebuilt Ovens;

b. Reducing the coal charge at each affected Non-Rebuilt Oven to no more than a thirty-seven and a half (37.5) ton average on a wet weight basis; and

c. Minimizing Sulfur Content of coal charged to each affected Non-Rebuilt Oven to the extent practicable.

12. Coke Oven Leaks from Rebuilt Ovens.

a. Beginning on January 1, 2019, and continuing until the Consent Decree is terminated, if visible emissions from a Rebuilt Oven are observed from a Coke Oven door, either during daily inspections pursuant to Paragraph 23 or at any other time during an Oven's Coking Cycle, IHCC shall stop the visible emissions within fifteen (15) minutes on the push side and forty-five (45) minutes on the coke shed side from the time the leak is first observed. Visible emissions from a Coke Oven door may be stopped from the push side within forty-five (45) minutes from the time the visible emissions are first observed for a maximum of two times per Battery in any semi-annual reporting period.

b. Beginning on January 1, 2019, and continuing until the Consent Decree is terminated, if visible emissions from a Rebuilt Oven are observed from a Coke Oven crown, or

from any other part of the Coke Oven that is not the Coke Oven Door, either during daily inspections pursuant to Paragraph 23.a or at any other time during an Oven's Coking Cycle, IHCC shall stop the visible emissions within thirty (30) minutes.

i. If visible emissions are observed from a Coke Oven crown and those emissions continue for longer than thirty (30) minutes from the time they are first observed, IHCC shall conduct a Method 9 observation as soon as practicable thereafter, but not later than one-hundred twenty (120) minutes after the emissions are first observed, to determine whether it constitutes Crown Opacity, provided conditions identified in Method 9 allow for an observation pursuant to Method 9. IHCC shall utilize a third party to conduct the Method 9 observation, if practicable.

c. Coke Oven Leak RCFA Trigger Level. Beginning on January 1, 2019, and continuing until the Consent Decree is terminated, if Coke Oven Leaks at a Rebuilt Oven reach the RCFA Trigger Level, Defendants, led by IHCC, shall:

i. Undertake a Coke Oven RCFA, to be completed within sixty (60) Days from the end of the Coking Cycle causing the RCFA Trigger Level to be reached, according to the requirements in Paragraph 13;

ii. Complete all corrective actions necessary to prevent or reduce the likelihood of a recurrence of Coke Oven Leaks, as determined by the RCFA; and

iii. If an Oven must be Idled to undertake repairs necessary to address Leaks from that Oven or another Oven, discontinue use of the Oven that must be Idled for all coking activities from the time repairs commence until all corrective actions pursuant to Paragraph 13 are completed.

iv. If, within fifteen months after corrective actions have been completed pursuant to a Full RCFA that finds Structural Issues and an Oven has resumed operating at normal temperatures and charge weights, the Oven experiences Coke Oven Leaks resulting in a second Full RCFA, then IHCC must, after the conclusion of that Oven's Coking Cycle, discontinue use of the Oven for all coking activities (except to keep the Oven sufficiently hot for repairs) until additional corrective actions pursuant to Paragraph 13 are completed and the Oven can operate without Coke Oven Leaks.

v. If, after completion of two Oven Rebuilds pursuant to Full RCFAs, an Oven experiences Coke Oven Leaks resulting in a third Full RCFA that requires an Oven Rebuild, then the Oven shall be permanently retired.

d. Exception to Paragraph 12.c. If IHCC is unable to take a Coke Oven out of service without causing Bypass Venting or causing damage to Ovens under or adjacent to a Bypass Vent Stack, IHCC may leave that Oven in service until it can take that Oven out of service without causing Bypass Venting or causing damage to Ovens under or adjacent to a Bypass Vent Stack.

13. Coke Oven RCFA. An RCFA conducted pursuant to Paragraph 12.c shall be included in the semi-annual report required by Section VIII and shall meet the following requirements:

a. Summary RCFA. If IHCC determines that any of the Coke Oven Leaks triggering the RCFA were caused by high winds, equipment maintenance or malfunction that is unrelated to Structural Issues with the Oven, impacts from another Oven within the same bank of 16 or 17 Ovens, or acts or omissions not related to equipment owned or operated by Defendants, then IHCC shall conduct a Summary RCFA that includes, at a minimum:

i. The date and time that the Coke Oven Leaks were observed, and the duration of the Leaks, to the extent known;

ii. If the Coke Oven Leaks were caused by high winds, wind speed and direction data for the time of the Coke Oven Leaks;

iii. If the Coke Oven Leaks were caused by impacts from adjacent Ovens, identification of the causes of those impacts;

iv. Identification of any actions taken to stop the Coke Oven Leaks, pursuant to Paragraph 12.a or 12.b;

v. A description of corrective action(s) available to Defendants that are necessary to prevent or reduce the likelihood of a recurrence of Coke Oven Leaks at the Oven and the date of implementation of the corrective action(s).

b. Full RCFA. For Coke Oven Leaks triggering an RCFA that are not addressed by a Summary RCFA, Defendants, led by IHCC, shall conduct a Full RCFA that includes, at a minimum:

i. The date and time that the Coke Oven Leaks were observed, and the duration of the Leaks, to the extent known. If the Coke Oven Leaks involved multiple time periods of emissions, the starting and ending dates and times of each time period shall be set forth, to the extent known;

ii. Identification of any actions taken to stop the Coke Oven Leaks, pursuant to Paragraph 12.a or 12.b;

iii. A detailed analysis that sets forth the root cause(s) and all contributing causes of the Coke Oven Leaks, to the extent determinable, and the steps, if any, that were taken to limit the duration and/or quantity of emissions associated with the Coke Oven Leaks;

iv. An analysis of the measures, if any, that are reasonably available to prevent or reduce the likelihood of a recurrence of Coke Oven Leaks resulting at the Coke Oven from the same root cause(s) and contributing causes in the future. The analysis shall evaluate design, operational, and maintenance changes, if any; the probable effectiveness of each such measure; the likely cost of each measure; whether or not an outside consultant should be retained to assist in the analysis; and whether the same issue would have an impact on other Ovens;

v. A description of corrective action(s) implemented under this Section and the date of implementation of the corrective action(s), or, if not already implemented, a schedule for its (their) implementation, including proposed commencement and completion dates, or an explanation that corrective action(s) is (are) not required;

vi. To the extent that investigations of the causes and/or possible corrective actions still are underway on the due date of the semi-annual report, a statement of the anticipated date by which a follow-up report fully conforming to the requirements of this Paragraph will be submitted; provided, however, that if a report or a series of reports containing the information required to be submitted under this Paragraph is not submitted within sixty (60) Days (or such additional time as EPA may allow) after the semi-annual reporting period during which the RCFA is to be submitted, the stipulated penalty provisions of Section IX (Stipulated Penalties) shall apply for failure to timely submit the report. Nothing in this Paragraph shall be deemed to excuse investigation, reporting, and corrective action obligations under this Section for any Coke Oven Leak RCFA Trigger Level that occurs after another Coke Oven Leak RCFA Trigger Level for which an extension of time is requested under this Paragraph; and

vii. To the extent that completion of the implementation of corrective action(s), if any, is not finalized at the time of the submission of the report required under this Paragraph, the status of the corrective actions will be reported in subsequent semi-annual reports until the status has been reported as complete.

B. <u>Bypass Venting</u>

14. Annual Bypass Venting Limit. Defendants shall limit annual Bypass Venting as follows:

a. From January 1, 2017, through December 31, 2019, a maximum of 12% of the Coke Oven waste gases leaving the common tunnel shall be allowed to be vented to the atmosphere through the Bypass Vent Stacks, as determined on an annual basis.

b. Beginning January 1, 2020, a maximum of 13% of the Coke Oven waste gases leaving the common tunnel shall be allowed to be vented to the atmosphere through the Bypass Vent Stacks, as determined on an annual basis.

c. Exception to Paragraph 14.b. Beginning on January 1, 2020, if Cokenergy undertakes HRSG Retubing, then in that calendar year a maximum of 14% of the Coke Oven waste gases leaving the common tunnel shall be allowed to be vented to the atmosphere through the Bypass Vent Stacks, as determined on an annual basis, provided the Bypass Venting Percentage resulting from HRSG Retubing accounts for at least 3.25% annual Bypass Venting. Bypass Venting resulting from tube leaks, inspections, routine cleaning or maintenance, or unplanned HRSG Outages shall not count in calculating the Bypass Venting Percentage resulting from HRSG Retubing.

15. Daily Bypass Venting Limit. A maximum of 19% of the Coke Oven waste gases leaving the common tunnel shall be allowed to be vented to the atmosphere through the Bypass Vent Stacks on a twenty-four (24) hour basis.

16. SO_2 Daily Limit. Defendants shall limit SO_2 emissions from the Main Stack and Bypass Vent Stacks to 1,656 lbs/hr total for a twenty-four (24) hour average.

17. Emissions Minimization. During all Bypass Venting Incidents at the Facility, Defendants shall minimize Bypass Venting emissions. Accordingly, Defendants shall, if practicable, take the following actions (beginning forty-eight (48) hours prior to the Bypass Venting Incident if practicable, and if that is not practicable, as soon as the Facility can do so), or if not taken, shall indicate in the RCFA required by Paragraph 18 why the steps were not taken:

a. IHCC shall reduce the coal charge at each Oven from which gases are being bypassed to no more than a forty (40) ton average on a wet weight basis. If the Bypass Venting Incident is caused by a HRSG Outage, Defendants need only reduce the coal charged to the Ovens under the affected Bypass Vent Stack; and

b. Cokenergy shall minimize the duration of the Bypass Venting Incidents contributed to by HRSG Retubing or Planned HRSG Maintenance to the extent practicable.

18. Bypass Venting Incident Root Cause Failure Analysis.

a. Contents and Timing of Reports. Defendants, led by Cokenergy, shall complete a Bypass Venting RCFA within sixty (60) Days from the conclusion of any Bypass Venting Incident. Defendants shall include the RCFA(s) in the semi-annual report required by

Section VIII. Such reports shall set forth the following information concerning the Bypass Venting Incident:

i. The date and time that the Bypass Venting Incident started and ended;

ii. An estimate of the quantity of SO_2, PM, and lead emissions that were emitted and the calculations that were used to determine that quantity;

iii. Identification of the steps taken and not taken pursuant to Paragraph 17, along with (1) an explanation of why any steps identified in Paragraph 17 were not taken, (2) an estimate of the Sulfur Content of the coal charged into each Coke Oven whose emissions are bypassed, and (3) an estimate of the corresponding charge weights associated with each such Coke Oven;

iv. A detailed analysis that sets forth the root cause(s) and all contributing causes of that Bypass Venting Incident, to the extent determinable, and the steps, if any, that were taken to limit the duration and/or quantity of emissions associated with the Bypass Venting Incident;

v. An analysis of the measures, if any, that are reasonably available to prevent or reduce the likelihood of a recurrence of the Bypass Venting Incident from the same root cause(s) and contributing causes in the future. The analysis shall evaluate design, operational, and maintenance changes, if any; the probable effectiveness of each such measure; the likely cost of each measure; and whether an outside consultant should be retained to assist in the analysis;

vi. Either a description of corrective action(s) implemented under this Section or, if not already implemented, a schedule for its (their) implementation, including proposed commencement and completion dates, or an explanation that corrective action(s) is (are) not required;

vii. To the extent that investigations of the causes and/or possible corrective actions still are underway on the due date of the report, a statement of the anticipated date by which a follow-up report fully conforming to the requirements of this Paragraph will be submitted; provided, however, that if a report or a series of reports containing the information required to be submitted under this Paragraph is not submitted within sixty (60) Days (or such additional time as EPA may allow) after the due date for the initial report for any Event, the stipulated penalty provisions of Section IX (Stipulated Penalties) shall apply for failure to timely submit the report. Nothing in this Paragraph shall be deemed to excuse investigation, reporting, and corrective action obligations under this Section for any Bypass Venting Incident which occurs after another Bypass Venting Incident for which an extension of time is requested under this Paragraph; and

viii. To the extent that completion of the implementation of corrective action(s), if any, is not finalized at the time of the submission of the report required under this Paragraph, the status of the corrective actions will be reported in subsequent semi-annual reports until the status has been reported as complete.

ix. For a Bypass Venting Incident that is a result of Planned FGD Maintenance, Planned HRSG Maintenance, or HRSG Retubing, only the information in subparagraphs (i), (ii), and (iii) above must be provided.

b. Corrective Actions Required. In response to any Bypass Venting Incident other than those referenced in Paragraph 18.a.ix, interim and/or long-term corrective actions, if any, as are reasonable and consistent with good engineering practices pursuant to Paragraph 18.a.v, shall be implemented as expeditiously as possible to minimize the likelihood of a recurrence of the root causes and any contributing causes of that Bypass Venting Incident.

i. EPA and IDEM do not, by their agreement to the entry of this Consent Decree or by their failure to object to any corrective action that may be taken in the future, warrant or aver in any manner that any corrective actions taken in the future will result in compliance with the provisions of the CAA or its implementing regulations. Notwithstanding EPA's and IDEM's review of any plans, reports, corrective action taken, or procedures under this Paragraph, Defendants shall remain solely responsible for compliance with the CAA and its implementing regulations. Nothing in this Paragraph shall be construed as a waiver of EPA's or IDEM's rights under the CAA for future violations of the CAA or its regulations.

ii. If EPA, after consultation with IDEM, believes that additional corrective action(s) are necessary and/or that the proposed schedule(s) of implementation are inadequate, EPA shall provide notification of that fact within sixty (60) Days following receipt of the RCFA required by this Paragraph. If EPA and Defendants cannot agree on the appropriate corrective action(s), if any, to be taken in response to a particular Bypass Venting Incident, any Party may invoke the Dispute Resolution provisions of Section XI of the Consent Decree (Dispute Resolution).

C. Enhanced Monitoring

19. Permanent Flow Monitor. As soon as practicable, but no later than ninety (90) Days after the Effective Date of this Consent Decree, Cokenergy shall install, operate, and maintain a permanent flow monitor to continuously measure the flow rate in the Main Stack.

20. Meteorological Station. By no later than thirty (30) Days after the Effective Date of this Consent Decree, IHCC shall install, operate, and maintain either a meteorological station at the Facility that is representative of local wind conditions, or purchase, operate, and maintain a handheld weather device such as the Ambient Weather WM-4 Handheld Weather Station. If IHCC chooses to comply with this Paragraph through the meteorological station, it shall, at a minimum, continuously record wind speed and wind direction. If IHCC chooses to comply with this Paragraph through use of the handheld weather monitor, IHCC shall utilize the handheld weather monitor to record wind speed and wind direction that is representative of weather conditions at the Facility.

21. ETS Updates. As soon as practicable, but no later than one hundred eighty (180) Days after the installation of the Permanent Flow Monitor pursuant to Paragraph 19, Defendants, led by IHCC, shall modify ETS in order to report emissions using actual flow data from the Main Stack flow monitor. ETS shall continue to utilize in its emissions calculations a monthly average for Sulfur Content and moisture content, which shall be measured daily.

22. Bypass Vent Stack and Main Stack Testing.

a. Lead Testing. Within five years of the Effective Date of this Consent Decree, Defendants shall conduct two stack tests measuring the emission rate of lead at the Main Stack and at least one Bypass Vent Stack in accordance with the applicable requirements of 40 C.F.R. Part 60, Appendix A. The two stack tests shall be conducted at least eighteen months apart, unless conducting the stack tests eighteen months apart would result in noncompliance with the Permits. A stack test for lead conducted pursuant to compliance testing required by IDEM under the Permits shall satisfy the requirements for one of the two stack tests required by Paragraph 22.a. Defendants shall use best efforts to ensure accurate measurements of coke production during each test run.

b. VOC Testing. Within five years of the Effective Date of this Consent Decree, Defendants shall conduct one stack test measuring the emission rate of VOCs at the Main Stack and at least one Bypass Vent Stack in accordance with the applicable requirements of 40 C.F.R. Part 60, Appendix A. A stack test for VOCs conducted pursuant to compliance testing required by IDEM under the Permits shall satisfy the requirements of Paragraph 22.b. Defendants shall use best efforts to ensure accurate measurements of coke production during each test run.

D. Preventive Maintenance and Operation Plans

23. By no later than June 29, 2018, IHCC (for the Coking Operations) and Cokenergy (for the Power Operations) shall separately submit to EPA for review and approval pursuant to Section VIII (Reporting Requirements) Preventive Maintenance and Operation Plans ("PMO Plans") based on the ownership of the equipment noted in the titles to subparagraphs (a) and (b) below to implement enhanced maintenance and operation of the Coke Ovens, HRSGs, and the FGD. The PMO Plans shall be a compilation of each of the Defendants' approaches for exercising good operating and air pollution control practices and for minimizing emissions at the Facility. If a Defendant makes changes to a PMO Plan related to minimizing Bypass Venting

and/or emissions, such changes shall be summarized and reported to EPA and IDEM pursuant to Section VIII (Reporting Requirements) of the Consent Decree. Such changes may be implemented immediately, but nonetheless shall be subject to approval under Section VIII of this Consent Decree. The PMO Plans shall include, at a minimum, provisions addressing the following:

a. IHCC PMO Plan for Rebuilt Coke Ovens.

i. Quarterly internal and external oven health inspections by trained inspectors to assess each oven's health, following oven inspection procedures and recommended repairs as set forth in the PMO Plan;

ii. Quarterly visual inspections of common tunnel to identify any potential blockages;

iii. Installation and monitoring of additional common tunnel differential pressure ("DP") cells, as set forth in the IHCC PMO Plan;

iv. Training of operators to visually identify Coke Oven Leaks and Coke Oven health indicators;

v. Visual inspection from the ground, once per day, of the exterior ends of each Oven to identify Coke Oven Leaks;

vi. Use of EPA Alternative Method 082 to periodically confirm Method 9 opacity readings in the course of training employees in performing Method 9 readings;

vii. Daily operation and maintenance checklist, including but not limited to the results from each visual inspection at each Coke Oven identified in Paragraph 23.a.v above, any observed Coke Oven Leaks, and any items needing repair;

viii. Ongoing maintenance and repairs to be performed on a regular frequency, tracked as part of SunCoke's Enterprise Asset Management ("EAM") software system, including but not limited to items identified by the daily operation and maintenance checklist;

ix. Coordination of maintenance to minimize bypass venting; and

x. Recordkeeping requirements, including records detailing observed individual Oven Coke Oven Leaks, Oven health indicators, and any maintenance or repairs performed in response to Coke Oven Leaks.

b. Cokenergy PMO Plan for HRSGs and FGD. The Cokenergy PMO Plan shall provide for continuous operation of the HRSGs and FGD between planned maintenance periods with minimization of emissions. The Cokenergy PMO Plan shall include, but not be

limited to, emissions minimization plans, emergency procedures, and procedures to coordinate FGD maintenance and Planned HRSG Maintenance.

c. Compliance Assurance. IHCC and Cokenergy shall include requirements listed below for a Compliance Assurance Plan ("CAP") in the PMO Plans to address potential periods of higher production levels, as follows.

i. IHCC shall evaluate monthly production and monthly sulfur content of dry coal to identify when they exceed both of the levels indicated in the following chart in two consecutive months ("High Production Level Months").

Average Monthly Sulfur Content of Dry Coal	Between 0.7% and 0.9%	>0.9%
Average Monthly Tons of Dry Coal Charged	144,000	128,000

ii. Defendants shall evaluate whether subsequent High Production Level Months will cause exceedances of PM or SO_2 limits in the Companies' Permits and this Consent Decree, and if so, the steps that will be taken to prevent those exceedances.

1. IHCC shall evaluate the CAP actions related to production and coal sulfur.

2. Cokenergy shall evaluate the CAP actions related to operability and control of the FGD and HRSG equipment.

iii. Both Companies' CAP sections shall be submitted pursuant to Paragraph 51.j for review and comment, but not for approval.

d. Defendants shall comply with the PMO Plans at all times, including periods of startup, shutdown, and malfunction of the HRSG and FGD.

E. Mitigation Measures

24. Dual SDA Operation. By the Effective Date of this Consent Decree, Cokenergy shall operate the two SDAs within the FGD system concurrently, to the extent practicable, in a manner that achieves an annual reduction in SO_2 emitted from the Facility to 6,165 tons/year. Cokenergy shall operate the FGD system in accordance with the Cokenergy PMO Plan to allow equipment inspection, repair, and preventive maintenance, in a manner consistent with good air pollution control practices.

25. Operation of Two Rebuilt Quench Towers. IHCC has rebuilt two quench towers in place of previously existing quench towers. IHCC has equipped and shall maintain each tower with 1.5" thick, 2" x 6" wooden baffles placed 30 degrees to the gas stream, and placed 3" apart, in order to achieve an annual reduction in PM emitted per tower of 30.5 tons.

F. Permits.

26. Where any compliance obligation under this Section requires a Defendant to obtain a federal, state, or local permit or approval, Defendant shall separately submit timely and complete applications. The inability of a Defendant to obtain a permit in adequate time to allow compliance with the deadlines stated in this Consent Decree shall be considered a Force Majeure event if the Defendant demonstrates that it exercised best efforts to timely fulfill its permitting obligations.

27. Applications for Permits Incorporating the Requirements in Section IV.

a. By no later than ninety (90) Days after the Effective Date, Defendants shall submit to IDEM an application in accordance with 326 IAC 2-7-12, to incorporate into Defendants' respective Title V operating permit(s): (1) the annual Bypass Venting limits in Paragraph 14; (2) the requirement to operate and maintain a permanent flow monitor in Paragraph 19 (for Cokenergy); and (3) a compliance schedule that consists of the terms and conditions set forth in Paragraphs 9 and 10 (for IHCC).

b. By no later than ninety (90) Days after the Effective Date, the Defendants shall submit to IDEM an application to seek a site-specific revision to the Indiana State Implementation Plan ("SIP") at 326 IAC 7-4.1-7 and 326 IAC 7-4.1-8, to incorporate: (1) the annual Bypass Venting limits in Paragraph 14; and (2) the requirement to operate and maintain a permanent flow monitor in Paragraph 19 (for Cokenergy).

28. Following submission of the complete permit application, Defendants shall cooperate with the permitting authority by promptly submitting all available information that it seeks following its receipt of the permit materials.

29. For any permit applications required by this Section that are filed after the Effective Date, Defendants shall submit to EPA in the manner set forth in Section XV (Notices), a copy of each application, as well as a copy of any permit proposed as a result of such application, to allow for timely participation in any public comment opportunity. If, as of the Effective Date, Defendants have already received any permit necessary to implement the requirements of this Consent Decree, and if EPA has not already received such permits, then no later than thirty (30) Days after the Effective Date, Defendants shall submit copies of such permits to EPA in the manner set forth in Section XV (Notices).

V. SOF TESTING

30. SOF Testing. By no later than November 30, 2020, IHCC shall conduct SOF testing in accordance with this Paragraph 30 and Appendix 2 of this Consent Decree. Cokenergy

shall provide access to the HRSGs, associated ductwork, and Stack 201 to conduct the testing and cooperate with IHCC in conducting the testing.

a. By no later than sixty (60) Days prior to the SOF Testing, IHCC shall submit to EPA for review and approval pursuant to Section VIII (Reporting Requirements) a proposed test plan that complies with "GD-42 – Preparation and Review of Site Specific Test Plans" (Revised March 1999) and "GD 43 – Preparation and Review of Emission Test Reports" (December 1998). The proposed test plan shall include the proposed dates for testing.

b. By no later than ninety (90) Days after completion of SOF testing, IHCC shall submit a draft report to EPA that includes a summary of the results, a description of operations and throughput, and all data from the testing. By no later than one hundred fifty (150) Days after completion of SOF testing, IHCC shall submit a final report to EPA.

VI. CIVIL PENALTY

31. Within thirty (30) Days after the Effective Date, Defendants shall pay the sum of $2,500,000 as a civil penalty to the United States, together with interest accruing from the Effective Date, at the rate specified in 28 U.S.C. § 1961. Defendants shall pay the civil penalty due by FedWire Electronic Funds Transfer (EFT) to the U.S. Department of Justice in accordance with written instructions to be provided to Defendants following entry of the Consent Decree, by the Financial Litigation Unit of the U.S. Attorney's Office for the Northern District of Indiana. At the time of payment, Defendants shall send a copy of the EFT authorization form and the EFT transaction record, together with a transmittal letter, which shall state that the payment is for the civil penalty owed pursuant to the Consent Decree in *United States, et al. v. Indiana Harbor Coke Company, et al.*, and shall reference the civil action number, DJ #90-5-2-1-08555/1, to the United States in the manner set forth in Section XV (Notices); by email to acctsreceivable.CINWD@epa.gov; and by mail to:

EPA Cincinnati Finance Office
26 Martin Luther King Drive
Cincinnati, Ohio 45268

32. Within thirty (30) Days after the Effective Date, Defendants shall pay a civil penalty of $2,5000,000 to the State of Indiana, together with interest accruing from the Effective Date, at the rate specified in 28 U.S.C. § 1961. Payment shall be wired through an EFT to Indiana. To receive wire instructions, Defendants shall call or email the following point of contact:

Kathleen Hurst
Accounts Receivable Manager
Indiana Department of Environmental Management
Phone: 317-233-2394
Email: khurst1@idem.in.gov

Defendants shall also notify the same point of contact within two (2) business days after the transfer occurs to confirm receipt.

33. Interest. If any portion of the civil penalty due to the United States is not paid when due, Defendants shall pay interest on the amount past due, accruing from the Effective Date through the date of payment, at the rate specified in 28 U.S.C. § 1961. If any portion of the civil penalty due to the State of Indiana is not paid when due, Defendants shall pay interest on the amount past due, accruing from the Effective Date through the date of payment, at the rate specified in 28 U.S.C. § 1961. Interest payment under this Paragraph shall be in addition to any stipulated penalty due.

34. Defendants shall be jointly and severally liable for the total $2,500,000 civil penalty due to the United States, plus interest, as set forth in Paragraph 31 and 33. Defendants shall be jointly and severally liable for the total $2,500,000 civil penalty due to the State of Indiana, plus interest, as set forth in Paragraph 32 and 33.

35. Defendants shall not deduct any penalties paid under this Decree pursuant to this Section or Section IX (Stipulated Penalties) in calculating their federal or state or local income tax.

VII. SUPPLEMENTAL ENVIRONMENTAL PROJECTS

36. In accordance with the requirements and schedule set forth in this Section VII, Cokenergy shall spend no less than $250,000 in Eligible Costs, as defined in Paragraph 40, to implement the following Supplemental Environmental Project ("SEP"), designed to reduce the exposure to lead in schools, day-care centers, and/or other buildings where owners are unable to afford lead hazard abatement work, with priority given to facilities with young children and/or pregnant women, in Lake County, Indiana as further described herein ("Lead Hazard Reduction SEP").

37. Cokenergy is responsible for the satisfactory completion of the Lead Hazard Reduction SEP as provided in this Consent Decree. Cokenergy may use contractors or consultants in planning and implementing the SEP.

a. If Cokenergy completes work pursuant to the SEP Plan in Paragraph 42 and expends more than $225,000 but less than the entire amount specified in Paragraph 36, Cokenergy shall either pay a stipulated penalty equal to the difference between the amount expended as demonstrated in the certified cost report and the amount specified in Paragraph 36 or perform additional lead hazard abatement work in accordance with Paragraph 36.

38. Cokenergy shall complete the Lead Hazard Reduction SEP by contracting with an entity that is experienced in conducting lead-based paint hazard reduction work, including, where window replacement is necessary, using energy efficient windows that meet EPA Energy Star criteria and removing PCB containing caulk, as needed. Cokenergy shall conduct the SEP according to all applicable federal and state work practice and notification requirements including, but not limited to, the United States Department of Housing and Urban

Development's ("HUD's") Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing and Indiana requirements.

39. Cokenergy shall conduct an initial screening to determine which structures built prior to 1978 are likely to contain lead paint. Cokenergy shall consult with the Indiana Health Department to identify structures in East Chicago, Indiana, with the highest potential risk of childhood lead exposure based on building age, last replacement of windows, and reported elevated blood lead levels in children attending the school/daycare. Cokenergy shall utilize an Indiana-licensed lead risk assessor to conduct a risk assessment of the building(s) upon which Cokenergy intends to perform the Lead Hazard Reduction SEP.

40. "Eligible Costs" shall include all costs of conducting the lead hazard reduction work in compliance with the HUD Guidelines, such as lead inspections/risk assessments, remediation and clearance, purchase of materials (including energy-efficient windows), and associated costs allowed by HUD Guidelines. No greater than ten percent of the total SEP costs shall be used for administrative support and outreach costs (this includes the costs for any necessary initial risk assessments).

41. Cokenergy's own personnel costs in overseeing the implementation of the SEP shall not be considered "Eligible Costs."

42. Within 180 Days from the Effective Date of this Consent Decree, Cokenergy shall submit a "SEP Plan" to the United States and IDEM for review in accordance with Section XV (Notices) outlining the Lead Hazard Reduction SEP. At a minimum, such a SEP Plan shall include: the address of the proposed affected structure(s), the approximate number and ages of currently enrolled students or attendees, the planned scope of work (include area to be remediated, number of windows to be replaced, whether the site contains PCB caulk, etc.), a break-down of the estimated costs for each project, and contact information for all parties involved. Cokenergy shall complete the Lead Hazard Reduction SEP within two years after the Effective Date, provided that this date may be extended by mutual agreement of Cokenergy and the United States in writing.

43. With regard to the Lead Hazard Reduction SEP, Cokenergy certifies the truth and accuracy of each of the following:

a. that, as of the date of executing this Decree, Cokenergy is not required to perform or develop the SEP by any federal, state, or local law or regulation and is not required to perform or develop the SEP by agreement, grant, or as injunctive relief awarded in any other action in any forum;

b. that the Lead Hazard Reduction SEP is not a project that Cokenergy was planning or intending to construct, perform, or implement other than in settlement of the claims resolved in this Decree;

c. that Cokenergy has not received and will not receive credit for the SEP in any other enforcement action;

d. that Cokenergy will not receive any reimbursement for any portion of the SEP from any other person; and

e. Cokenergy will certify as follows in the SEP Completion Report:

> I certify that I am not a party to any open federal financial assistance transaction that is funding or could be used to fund the same activity as the SEP. I further certify that, to the best of my knowledge and belief after reasonable inquiry, there is no such open federal financial assistance transaction that is funding or could be used to fund the same activity as the SEP, nor has the same activity been described in an unsuccessful federal financial assistance transaction proposal to EPA within two years of the date of this settlement (unless the project was barred from funding as statutorily ineligible). For purposes of this certification, the term "open federal financial assistance" refers to a grant, cooperative agreement, loan, federally-guaranteed loan guarantee, or other mechanism for providing federal financial assistance whose performance period has not yet expired.

44. SEP Completion Report. Within sixty (60) Days after the date set for completion of the Lead Hazard Reduction SEP, Cokenergy shall submit a SEP Completion Report to the United States in accordance with Section XV (Notices). The SEP Completion Report shall contain the following information:

a. the address of each remediated structure;

b. a detailed description of all work completed in each structure (including before and after photos);

c. a description of any problems encountered in completing the SEP and the solutions thereto;

d. an itemized list of all Eligible Costs;

e. certification that the Lead Hazard Reduction SEP has been fully implemented pursuant to the provisions of this Decree (including verification that each building and area has passed a lead detection wipe test); and

f. to the extent possible, documentation supporting the quantification of the environmental and public health benefits resulting from implementation of the SEP and an explanation of how such benefits were measured or estimated.

45. EPA may, in its sole discretion, require information in addition to that described in the preceding Paragraph, in order to evaluate the SEP Completion Report.

46. After receiving the SEP Completion Report, the United States, after consultation with the State of Indiana, shall notify Cokenergy whether or not Cokenergy has satisfactorily completed the Lead Hazard Reduction SEP. If Cokenergy has not completed the SEP in

accordance with this Consent Decree, stipulated penalties may be assessed under Section IX (Stipulated Penalties).

47. Disputes concerning the satisfactory performance of the Lead Hazard Reduction SEP and the amount of Eligible Costs shall be resolved under Section XI (Dispute Resolution).

48. Each submission required under this Section shall be signed by an official with knowledge of the Lead Hazard Reduction SEP and shall bear the certification language set forth in Paragraph 55.

49. Any public statement, oral or written, in print, film, or other media, made by Cokenergy making reference to the SEP under this Decree shall include the following language: "This project was undertaken in connection with the settlement of an enforcement action, *United States v. Indiana Harbor Coke Company, SunCoke Energy, and Cokenergy*, taken on behalf of the U.S. Environmental Protection Agency and the State of Indiana under the Clean Air Act."

50. For federal income tax purposes, Cokenergy agrees that it will neither capitalize into inventory or basis nor deduct any costs or expenditures incurred in performing the SEP.

VIII. REPORTING REQUIREMENTS

51. Progress Reports. To the extent relevant to their obligations, each Defendant shall submit, in the manner set forth in Section XV (Notices), a semi-annual progress report no later than April 30 and October 31 of each year, with the first semi-annual report due on the first April 30 or October 31 that occurs more than ninety (90) Days after the Effective Date. Each semi-annual report shall contain the following information with respect to, respectively, the half-year between October 1 and March 31, or the half-year between April 1 and September 30, commencing on the Effective Date:

a. Work performed and progress made toward implementing the requirements of Section IV (Compliance Requirements), including completion of any milestones;

b. Any significant modifications to previously-submitted design specifications of any pollution control system, or to monitoring equipment, required to comply with the requirements of Section IV (Compliance Requirements);

c. Any significant problems encountered or anticipated in complying with the requirements of Section IV (Compliance Requirements), including implemented or proposed solutions;

d. A summary of the emissions monitoring and testing data collected to demonstrate compliance with any requirement of this Consent Decree;

e. A list of all violations of Paragraph 12.a and 12.b, with the date, time, and location of visible emissions and the status of any Coke Oven RCFA conducted;

f. All failures to comply with the emission minimization requirements of Paragraph 17 of this Consent Decree;

g. All RCFAs required by Paragraphs 13 and 18 of this Consent Decree;

h. The status of any corrective actions required under Paragraphs 13 and 18 that were not completed at the time of the submission of any previous report required under Paragraphs 13 and 18;

i. Any updated PMO Plan required by Paragraph 23 of this Consent Decree or any failure to follow a PMO Plan;

j. Submittal of the CAP when required by Paragraph 23.c of this Consent Decree, any updates to the CAP, and any instances when the CAP had to be implemented to ensure compliance with PM or SO_2 limits;

k. Status of permit applications and a summary of all permitting activity pertaining to compliance with this Consent Decree;

l. A description of all noncompliance with the requirements in Section VII (Supplemental Environmental Projects);

m. All failures to comply with the reporting requirements in Paragraphs 51 through 55;

n. Copies of all Quarterly Deviation and Compliance Monitoring Reports and semi-annual and annual compliance certifications required under Defendants' Permits to both EPA and IDEM;

o. The dates, times, and duration of any Lightning Stand-Downs during the reporting period;

p. The dates, times, and duration of any power outages during the reporting period; and

q. The dates, times, and duration of any Coke Oven Leaks caused by high winds and wind speed and direction data for the time of the Coke Oven Leaks.

52. If Defendants have reason to believe that they have violated or may violate any requirement of this Consent Decree for which notice is not provided in Paragraph 51.a-q above, for which an RCFA is not required pursuant to Paragraphs 13 or 18, or for which notice is not provided in the semi-annual or annual compliance certifications or quarterly deviation reports that are submitted to the State of Indiana pursuant to the CAA and attached to the semi-annual progress reports submitted pursuant to Paragraph 51 and Section XV (Notices), Defendants shall notify the United States and the State of Indiana of such violation or potential violation of this Consent Decree and its duration or anticipated likely duration, in writing, within forty-five (45) Days of the Day Defendants first become aware of the violation or likely violation, with an

explanation of the violation's likely cause and of the remedial steps taken, or to be taken, to prevent or minimize such violation. If the cause of the violation cannot be fully explained at the time the report is due, Defendants shall so state in the report. Defendants shall investigate the cause of the violation and shall then submit an amendment to the report, including a full explanation of the cause of the violation, within thirty (30) Days of the Day Defendants become aware of the cause of the violation. Nothing in this Paragraph or the following Paragraph relieves Defendants of their obligation to provide the notice required by Section X (Force Majeure), although notice provided pursuant to Section X (Force Majeure) also satisfies this Paragraph with respect to the event(s) in such notice.

53. Whenever a Defendant has reason to believe that any violation of this Consent Decree or of any applicable permits or any other event affecting IHCC's performance under this Decree for the Coking Operations or Cokenergy's performance under this Decree for the Power Operations may pose an immediate threat to the public health or welfare or the environment, the Defendant shall notify EPA and IDEM orally or by electronic or facsimile transmission as soon as possible, but no later than twenty-four (24) hours after the Defendant first knew or should have known that the violation or event may pose an immediate threat to the public health or welfare or the environment. This procedure is in addition to the requirements set forth in Paragraphs 13 and 18 (RCFAs), and is in addition to any other state or federal reporting requirements that may be applicable.

54. All reports shall be submitted to the persons and in the manner designated in Section XV (Notices). Within seven Days of submission pursuant to Section XV (Notices), Defendants shall also provide copies of all reports to the East Chicago Public Libraries located at 2401 E. Columbus Drive and 1008 W. Chicago Avenue in East Chicago, Indiana.

55. Each report submitted by each Defendant under this Section shall be signed by a plant manager, a corporate official responsible for environmental management and compliance, or a corporate official responsible for plant engineering management and shall include the following certification:

> *I certify under penalty of law that this information was prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my directions and my inquiry of the person(s) who manage the system, or the person(s) directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.*

This notification requirement does not apply to emergency or similar notifications where compliance would be impractical.

56. The reporting requirements of this Consent Decree do not relieve Defendants of any reporting obligations required by the CAA or implementing regulations, or by any other federal, state, or local law, regulation, permit, or other requirement. The reporting requirements

of this Section are in addition to any other reports, plans, or submissions required by other Sections of this Consent Decree.

57. Any information provided pursuant to this Consent Decree may be used by the United States or the State of Indiana in any proceeding to enforce the provisions of this Consent Decree and as otherwise permitted by law. All information and documents submitted by Defendants to the United States or Indiana pursuant to this Consent Decree shall be subject to public inspection unless identified and supported as confidential business information (CBI) in accordance with 40 C.F.R. Part 2. Under no circumstances shall emissions data be identified or considered CBI.

58. Approval of Deliverables.

a. After review of any plan, report, or other item that is required to be submitted for approval pursuant to this Consent Decree, EPA, after consultation with the State of Indiana, shall in writing: (a) approve the submission; (b) approve the submission upon specified conditions; (c) approve part of the submission and disapprove the remainder; or (d) disapprove the submission. If EPA does not respond within sixty (60) Days, then Defendants may proceed to implement the plan, report, or other item.

b. If the submission is approved pursuant to Paragraph 58.a, Defendants shall take all actions required by the plan, report, or other document, in accordance with the schedules and requirements of the plan, report, or other document, as approved. If the submission is conditionally approved or approved only in part, pursuant to Paragraph 58.a, Defendants shall, upon written direction from EPA, after consultation with the State of Indiana, take all actions required by the approved plan, report, or other item that EPA, after consultation with the State, determines are technically severable from any disapproved portions, subject to Defendants' right to dispute only the specified conditions or the disapproved portions under Section XI (Dispute Resolution).

c. If the submission is disapproved in whole or in part pursuant to Paragraph 58, Defendants shall, within sixty (60) Days of such disapproval, or such other time as the Parties agree to in writing, correct all deficiencies and resubmit the plan, report, or other item, or disapproved portion thereof, for approval, in accordance with the preceding Paragraphs. If the resubmission is approved in whole or in part, Defendants shall proceed in accordance with the preceding Paragraph.

d. Any stipulated penalties applicable to the original submission, as provided in Section IX (Stipulated Penalties), shall accrue during the 60-Day period or other specified period, but shall not be payable unless the resubmission is untimely or is disapproved in whole or in part; provided that, if the original submission was so deficient as to constitute a material breach of Defendants' obligations under this Decree, the stipulated penalties applicable to the original submission shall be due and payable notwithstanding any subsequent resubmission.

e. If a resubmitted plan, report, or other item, or portion thereof, is disapproved in whole or in part, EPA, after consultation with the State of Indiana, may again require Defendants to correct any deficiencies, in accordance with the preceding Paragraphs, or

may itself/themselves correct any deficiencies, subject to Defendants' right to invoke Dispute Resolution and the right of EPA and the State to seek stipulated penalties as provided in the preceding Paragraphs.

IX. STIPULATED PENALTIES

59. Each Defendant, as applicable, shall be liable for stipulated penalties to the United States and to the State of Indiana for violations of this Consent Decree as specified below, unless excused under Section X (Force Majeure). A violation includes failing to perform any obligation required by the terms of this Decree, including any work plan or schedule approved under this Decree, according to all applicable requirements of this Decree and within the specified time schedules established by or approved under this Decree.

60. Late Payment of Civil Penalty. If a Defendant fails to pay the civil penalties required to be paid under Section VI (Civil Penalty) when due, that Defendant shall pay a stipulated penalty of $1,000 per Day for each Day that the payment is late.

61. For each day of failure to complete all Oven Rebuilds or to Idle Ovens in accordance with Paragraphs 9 and 10, IHCC shall pay:

Period of Delay	Penalty per Day
Days 1-30	$1,750
Days 31-60	$3,000
Days 61 and over	$5,000 or an amount equal to 1.2 times the economic benefit of delayed compliance, whichever is greater

62. For each failure to minimize emissions from Coke Oven Leaks from Non-Rebuilt Ovens by taking the actions identified in Subparagraphs 11.a-11.c, IHCC shall pay: $500 per day.

63. Coke Oven Leaks from Rebuilt Ovens.

a. For the failure to stop Coke Oven Leaks in accordance with Paragraph 12.a or b, IHCC shall pay the following stipulated penalties:

Percentage of Coking Cycles Experiencing a Coke Oven Leak	Stipulated Penalty per Coking Cycle with a Coke Oven Leak
2% or less	$15
More than 2% and up to 4%	$50 per Additional Coking Cycle with a Coke Oven Leak Beyond 2%
More than 4% and up to 5%	$175 per Additional Coking Cycle with a Coke Oven Leak Beyond 4%
More than 5% and up to 6%	$200 per Additional Coking Cycle with a Coke Oven Leak Beyond 5%

More than 6% and up to 7%	$250 per Additional Coking Cycle with a Coke Oven Leak Beyond 6%
More than 7% and up to 8%	$300 per Additional Coking Cycle with a Coke Oven Leak Beyond 7%
More than 8%	$600 per Additional Coking Cycle with a Coke Oven Leak Beyond 8%

The percentage of Coking Cycles experiencing a Coke Oven Leak shall be determined by the following equation: x/y, where x is the number of Coking Cycles in a calendar year in which a Coke Oven Leak occurs, and y is the number of total Coking Cycles in that calendar year during which at least two visual inspections for Coke Oven Leaks were performed.

b. IHCC shall not incur stipulated penalties pursuant to this Paragraph if a Coke Oven Leak is the result of (1) Oven Rebuilds conducted pursuant to Paragraphs 9-10 of this Consent Decree and subsequent Oven startup not to exceed thirty (30) Days following completion of Oven Rebuilds; (2) impacts from repairs undertaken pursuant to this Consent Decree to address Coke Oven Leaks at another Oven within the same bank of 16 or 17 Ovens; (3) HRSG Retubing; or (4) power outages, high winds, and other events arising from causes beyond the control of Defendants, provided that best efforts have been undertaken to prevent such Coke Oven Leaks.

64. For each failure to comply with the annual Bypass Venting limit in accordance with Paragraph 14, IHCC and Cokenergy shall each pay one-half of: $75,000.

65. For each failure to comply with the daily Bypass Venting limit in accordance with Paragraph 15, Cokenergy shall pay: $3,000. Cokenergy shall not incur stipulated penalties pursuant to this Paragraph if the Bypass Venting Incident is the result of (a) Oven Rebuilds conducted pursuant to Paragraphs 9-10 of this Consent Decree or (b) power outages and other events arising from causes beyond the control of Defendants, provided that best efforts have been undertaken to prevent such Bypass Venting.

66. For each failure to comply with the daily SO_2 limit in accordance with Paragraph 16, IHCC and Cokenergy shall each pay one-half of: $3,000. Defendants shall not incur stipulated penalties pursuant to this Paragraph if the failure to comply with the daily SO_2 limit is the result of power outages and other events arising from causes beyond the control of Defendants, provided that best efforts have been undertaken to prevent such failures to comply.

67. For each failure to minimize Bypass Venting emissions during a Bypass Venting Incident lasting longer than twenty-four hours by taking the actions identified in Subparagraphs 17.a-17.b, IHCC and Cokenergy shall each pay one-half of: $1,000.

68. For each failure to perform Bypass Vent Stack and Main Stack testing in accordance with Paragraph 22, IHCC and Cokenergy shall each pay one-half of: $37,500.

69. For each failure to comply with the requirements in Paragraphs 19, 20, 21, and 30, and for each failure to comply with the PMO Plan provisions required by Paragraphs 23.a and 23.b, the following stipulated penalties will apply to that Defendant:

Period of Noncompliance	Penalty per Day per Violation
Days 1-30	$500
Days 31-60	$1,500
Days 61 and over	$2,000

70. For each failure of IHCC or Cokenergy, as applicable, to submit plans, schedules, reports, or permit applications as required by this Consent Decree, the following stipulated penalties will apply to that Defendant:

Period of Noncompliance	Penalty per Day per Violation
Days 1-30	$500
Days 31-60	$1,500
Days 61 and over	$2,000

71. For each violation of the requirement to operate the two SDAs within the FGD system in accordance with Paragraph 24, and for each violation of the requirement to operate the quench towers in accordance with Paragraph 25, the following stipulated penalties will apply to that Defendant:

Period of Noncompliance	Penalty per Day per Violation
Days 1-30	$500
Days 31-60	$1,500
Days 61 and over	$2,000

72. Except as provided in Paragraph 37, if Cokenergy fails to implement the SEP, or halts or abandons work on the SEP, Cokenergy shall pay a stipulated penalty to the United States equal to the difference between $250,000 and the amount expended as demonstrated in the certified cost reports in satisfactory performance of the SEP, plus $25,000. The penalty under this Paragraph shall accrue as of the date specified for completing the SEP or the date performance ceases, whichever is earlier.

73. Defenses: Each Defendant may raise force majeure, as determined pursuant to Section X (Force Majeure), as an affirmative defense in response to a demand by the United States or Indiana for stipulated penalties.

74. Defendants (as applicable to each Defendant) shall either pay stipulated penalties within thirty (30) Days after receipt of a written demand by the United States or Indiana or shall initiate dispute resolution pursuant to Section XI (Dispute Resolution).

75. Waiver of Payment. The United States, or the State, or both, may in the unreviewable exercise of its discretion, reduce or waive stipulated penalties otherwise due it under this Consent Decree.

76. Demand for Stipulated Penalties. A written demand for the payment of stipulated penalties will identify the particular violation(s) to which the stipulated penalty relates; the stipulated penalty amount that the United States or Indiana is demanding for each violation (as can be best estimated); the calculation method underlying the demand; and the grounds upon which the demand is based. The Party making a demand for payment of a stipulated penalty shall simultaneously send a copy of the demand to the other applicable Party.

77. Stipulated Penalties' Accrual. Stipulated penalties will begin to accrue on the Day after performance is due or the day a violation occurs, whichever is applicable, and will continue to accrue until performance is satisfactorily completed or the violation ceases, whichever is applicable. Stipulated penalties shall accrue simultaneously for separate violations of this Consent Decree.

78. Stipulated Penalties Payment Due Date. Stipulated penalties shall be paid no later than thirty (30) Days after receipt of a written demand by the United States or Indiana unless the demand is subject to Section XI (Dispute Resolution). Defendant(s) shall pay fifty percent of the total stipulated penalty amount due to the United States and fifty percent to the State of Indiana.

79. Manner of Payment of Stipulated Penalties. Stipulated penalties owing to the United States and/or the State of Indiana will be paid in the manner set forth in Section VI (Civil Penalty). All transmittal correspondence shall state that the payment is for stipulated penalties, shall identify the violations to which the payment relates, and shall include the same identifying information required by this Section.

80. Disputes over Stipulated Penalties. Stipulated penalties shall continue to accrue as provided in Paragraph 77, during any Dispute Resolution, but need not be paid until the following:

a. If the dispute is resolved by agreement or by a decision of the United States or Indiana that is not appealed to the Court, Defendants shall pay accrued penalties determined to be owing, together with interest, to the United States and/or Indiana, as applicable, within thirty (30) Days of the effective date of the agreement or the receipt of EPA's or Indiana's decision or order.

b. If the dispute is appealed to the Court and the United States or Indiana prevails in whole or in part, Defendants shall pay all accrued penalties determined by the Court to be owing, together with interest, within sixty (60) Days of receiving the Court's decision or order, except as provided in subparagraph c, below.

c. If any Party appeals the District Court's decision, Defendants shall pay all accrued penalties determined to be owing, together with interest, within fifteen (15) Days of receiving the final appellate court decision.

81. No amount of the stipulated penalties paid by Defendants shall be used to reduce their federal or state tax obligations.

82. If Defendant(s) fail to pay stipulated penalties required by this Consent Decree, Defendant(s) shall be liable for interest on such penalties at the rates specified in Section VI (Civil Penalty), accruing as of the date payment became due. Except as provided by Paragraph 83 below, nothing in this Paragraph shall be construed to limit the United States or Indiana from seeking any remedy otherwise provided by law for Defendants' failure to pay any stipulated penalties.

83. Subject to the provisions of Section XIII (Effect of Settlement/Reservation of Rights), the stipulated penalties provided for in this Decree shall be in addition to any other rights, remedies, or sanctions available to the United States or Indiana for a violation of this Consent Decree or applicable law. If the violations result in excess emissions, then the United States and Indiana may elect to seek compensatory emissions reductions equal to or greater than the excess amounts emitted in addition to injunctive relief or stipulated penalties; provided, however, that with respect to monetary relief, the United States and Indiana must elect between filing a new action for such monetary relief or seeking stipulated penalties under this Consent Decree, if stipulated penalties are also available for the alleged violation(s).

X. FORCE MAJEURE

84. "Force Majeure," for purposes of this Consent Decree, is defined as any event arising from causes beyond the control of Defendant(s), of any entity controlled by Defendant(s), or of Defendants' contractors, which delays or prevents the performance of any obligation under this Consent Decree despite Defendants' best efforts to fulfill the obligation. The requirement that Defendant(s) exercise "best efforts to fulfill the obligation" includes using best efforts to anticipate any potential force majeure event and best efforts to address the effects of any such event (a) as it is occurring and (b) after it has occurred to prevent or minimize any resulting delay to the greatest extent possible. "Force Majeure" does not include Defendants' financial inability to perform any obligation under this Consent Decree.

85. If any event occurs or has occurred that may delay the performance of any obligation under this Consent Decree, whether or not caused by a force majeure event, Defendant(s) shall provide notice orally or by electronic mail or facsimile transmission to EPA and Indiana within seventy-two (72) hours of when Defendant(s) first knew that the event might cause a delay. Within seven (7) Days thereafter, Defendant(s) shall provide in writing to EPA and Indiana an explanation and description of the reasons for the delay; the anticipated duration of the delay; all actions taken or to be taken to prevent or minimize the delay; a schedule for implementation of any measures to be taken to prevent or mitigate the delay or the effect of the delay; Defendants' rationale for attributing such delay to a force majeure event if it intends to assert such a claim; and a statement as to whether, in the opinion of Defendant(s), such event may cause or contribute to an endangerment to public health, welfare or the environment. Defendant(s) shall include with any notice all available documentation supporting the claim that the delay was attributable to a force majeure event. Failure to comply with the above requirements shall preclude Defendant(s) from asserting any claim of force majeure for that

event for the period of time of such failure to comply, and for any additional delay caused by such failures. Defendant(s) shall be deemed to know of any circumstance of which Defendant(s), any entity controlled by Defendant(s), or Defendants' contractors knew or should have known.

86. If EPA, after a reasonable opportunity for review and comment by Indiana, agrees that the delay or anticipated delay is attributable to a force majeure event, the time for performance of the obligations under this Consent Decree that are affected by the force majeure event will be extended by EPA, after a reasonable opportunity for review and comment by Indiana, for such time as is necessary to complete those obligations. An extension of the time for performance of the obligations affected by the force majeure event shall not, of itself, extend the time for performance of any other obligation. EPA will notify Defendant(s) in writing of the length of the extension, if any, for performance of the obligations affected by the force majeure event.

87. If EPA, after a reasonable opportunity for review and comment by Indiana, does not agree that the delay or anticipated delay has been or will be caused by a force majeure event, EPA will notify Defendant(s) in writing of its decision.

88. If Defendant(s) elect to invoke the dispute resolution procedures set forth in Section XI (Dispute Resolution), it shall do so no later than fifteen (15) Days after receipt of EPA's notice. In any such proceeding, Defendant(s) shall have the burden of demonstrating by a preponderance of the evidence that the delay or anticipated delay has been or will be caused by a force majeure event, that the duration of the delay or the extension sought was or will be warranted under the circumstances, that best efforts were exercised to avoid and mitigate the effects of the delay, and that Defendant(s) complied with the requirements of Paragraphs 84 and 85 above. If Defendant(s) carry this burden, the delay at issue shall be deemed not to be a violation by Defendant(s) of the affected obligation of this Consent Decree identified to EPA and the Court.

XI. DISPUTE RESOLUTION

89. Unless otherwise expressly provided for in this Consent Decree, the dispute resolution procedures of this Section shall be the exclusive mechanism to resolve disputes arising under or with respect to this Consent Decree. Defendant(s)' failure to seek resolution of a dispute under this Section shall preclude Defendant(s) from raising any such issue as a defense to an action by the United States or Indiana to enforce any obligation of Defendant(s) arising under this Decree.

90. Informal Dispute Resolution. Any dispute subject to Dispute Resolution under this Consent Decree shall first be the subject of informal negotiations. The dispute shall be considered to have arisen when Defendant(s) send the United States and Indiana a written Notice of Dispute. Such Notice of Dispute shall state clearly the matter in dispute. The period of informal negotiations shall not exceed ninety (90) Days from the date the dispute arises, unless that period is modified by written agreement. If the Parties cannot resolve a dispute by informal negotiations, then the United States or Indiana shall provide Defendant(s) with a written

summary of its position regarding the dispute. The position advanced by the United States, after consultation with the State of Indiana, or Indiana if the United States is not party to the dispute, shall be considered binding unless, within forty-five (45) Days of Defendants' receipt of the written Summary of the United States' or Indiana's position, as applicable, Defendant(s) file with the Court a petition that describes the nature of the dispute.

91. Formal Dispute Resolution. Defendant(s) shall invoke formal dispute resolution procedures, within the time period provided in the preceding Paragraph, by serving on the United States and Indiana and filing with the Court a petition regarding the matter in dispute. The Petition shall include, but need not be limited to, any factual data, analysis, or opinion supporting Defendant(s)' position and any supporting documentation relied upon by Defendant(s).

92. The United States or Indiana, as applicable, shall serve its response to Defendant(s)' petition within forty-five (45) Days of receipt of Defendant(s)' petition. The United States' or Indiana's Statement of Position will include, but need not be limited to, any factual data, analysis, or opinion supporting that position and any supporting documentation relied upon by the United States or Indiana.

93. Standard of Review. In any dispute under this Section XI (Dispute Resolution), Defendant(s) shall bear the burden of proof pursuant to applicable principles of law.

94. The invocation of dispute resolution procedures under this Section XI (Dispute Resolution) shall not, by itself, extend, postpone, or affect in any way any obligation of Defendant(s) under this Consent Decree, unless and until final resolution of the dispute so provides. Stipulated penalties with respect to the disputed matter shall continue to accrue from the first Day of noncompliance, but payment shall be stayed pending resolution of the dispute. If Defendant(s) do not prevail on the disputed issue, stipulated penalties shall be assessed and paid as provided in Section IX (Stipulated Penalties).

XII. INFORMATION COLLECTION AND RETENTION

95. The United States and Indiana, and their representatives, including attorneys, contractors, and consultants, shall have the right of entry into the Facility, at all reasonable times, upon presentation of credentials, to:

a. monitor the progress of activities required under this Consent Decree;

b. verify any data or information submitted to the United States or Indiana in accordance with the terms of this Consent Decree;

c. obtain samples and, upon request, splits of any samples taken by Defendants or their representatives, contractors, or consultants in connection with their performance under this Consent Decree;

d. obtain documentary evidence, including photographs and similar data, relevant to compliance with the terms of this Consent Decree; and

e. assess Defendants' compliance with this Consent Decree.

96. Until at least three (3) years after the termination of this Consent Decree, Defendants shall retain, and shall instruct their contractors and agents to preserve, all non-identical copies of all documents, records, or other information in electronic form in their or their contractors' or agents' possession or control, or that come into their or their contractors' or agents' possession or control, and that relates in any manner to Defendants' performance of their obligations under this Consent Decree. This information-retention requirement shall apply regardless of any contrary corporate or institutional policies or procedures. At any time during this information-retention period, the United States or Indiana may request copies of any documents, records, or other information required to be maintained under this Paragraph. For the purposes of this Paragraph, outside counsel is not a contractor or agent.

97. At the conclusion of the information retention period specified in the preceding Paragraph, Defendants shall notify the United States and Indiana at least ninety (90) Days prior to destroying any document(s), record(s), or other information subject to the requirements of the preceding Paragraph and, upon request by the United States or Indiana, Defendants shall deliver any such document(s), record(s), or other information to the Plaintiffs. Defendants may assert that certain documents, records, or other information are privileged under the attorney-client privilege or any other privilege recognized by federal law. If Defendants assert such a privilege, they shall provide the following: (1) the title of the document, record, or information; (2) the date of the document, record, or information; (3) the name and title of each author of the document, record, or information; (4) the name and title of each addressee and recipient; (5) a description of the subject of the document, record, or information; and (6) the privilege asserted by Defendants. However, no documents, records, data, or other information required to be generated by this Consent Decree shall be withheld on grounds of privilege.

98. Defendants may also assert that information required to be provided under this Section is protected as CBI under 40 C.F.R. Part 2. As to any information that Defendants seek to protect as CBI, Defendants shall follow the procedures set forth in 40 C.F.R. Part 2.

99. This Consent Decree in no way limits or affects any right of entry and inspection, or any right to obtain information, held by the United States or Indiana pursuant to applicable federal or state laws, regulations, or permits, nor does it limit or affect any duty or obligation of Defendants to maintain documents, records, or other information imposed by applicable federal or state laws, regulations, or permits.

XIII. EFFECT OF SETTLEMENT/RESERVATION OF RIGHTS

100. This Consent Decree resolves the civil claims of the United States and the State of Indiana through the Date of Lodging for the violations alleged in the Complaint filed in this action, and the violations alleged in the Notices of Violation sent to Defendants by EPA prior to the Date of Lodging referenced in Appendix 1. This Consent Decree also resolves the civil claims of the United States and the State for the regulatory and permit provisions for which violations are alleged in the Complaint resulting from Defendants' performance of the

requirements set forth in Section IV.A ("Coke Ovens"), conditioned upon satisfactory performance of the requirements set forth therein.

101. The United States and the State of Indiana reserve all legal and equitable remedies available to enforce the provisions of this Consent Decree, except as expressly stated in Paragraph 100. This Consent Decree shall not be construed to limit the rights of the United States or Indiana to obtain penalties or injunctive relief under the CAA or implementing regulations, or under other federal or state laws, regulations, or permit conditions, except as expressly specified in Paragraph 100. The United States and Indiana further reserve all legal and equitable remedies to address any imminent and substantial endangerment to the public health or welfare or the environment arising at, or posed by, the Facility, whether related to the violations addressed in this Consent Decree or otherwise.

102. In any subsequent administrative or judicial proceeding initiated by the United States or Indiana for injunctive relief, civil penalties, other appropriate relief relating to the Facility or Defendants' violations, Defendants shall not assert, and may not maintain, any defense or claim based upon the principles of waiver, res judicata, collateral estoppel, issue preclusion, claim preclusion, claim-splitting, or other similar defenses based upon any contention that the claims raised by the United States or Indiana in the subsequent proceeding were or should have been brought in the instant case, except with respect to claims that have been specifically resolved pursuant to Paragraph 100 of this Decree.

103. This Consent Decree is not a permit, or a modification of any permit, under any federal, State, or local laws or regulations. Nothing in this Consent Decree alters, amends, or restricts the ability of any federal, State, or local permitting authority to issue permits, including permits applied for pursuant to Section IV (Compliance Requirements), in a manner consistent with applicable law and guidance. Defendants are responsible for achieving and maintaining complete compliance with all applicable federal, State, and local laws, regulations, and permits; and Defendants' compliance with this Consent Decree shall be no defense to any action commenced pursuant to any such laws, regulations, or permits, except as set forth herein. The United States and Indiana do not, by their consent to the entry of this Consent Decree, warrant or aver in any manner that Defendants' compliance with any aspect of this Consent Decree will result in compliance with provisions of the CAA, or with any other provisions of federal, State, or local laws, regulations, permits, or future permitting requirements.

104. Except as otherwise provided by law, this Consent Decree does not limit or affect the rights of Defendants, the United States, or Indiana against any third parties not party to this Consent Decree, nor does it limit the rights of third parties, not party to this Consent Decree, against Defendants.

105. This Consent Decree shall not be construed to create rights in, or grant any cause of action to, any third party not a party to this Consent Decree.

XIV. COSTS

106. The Parties shall bear their own costs of this action, including attorneys' fees, except that the United States and Indiana shall be entitled to collect the costs (including attorneys' fees), against Defendants incurred in any action necessary to collect (a) any portion of the civil penalty or (b) any stipulated penalties due that were not paid by Defendants, subject to Defendants' right to invoke dispute resolution pursuant to Section XI (Dispute Resolution).

XV. NOTICES

107. Unless otherwise specified herein, whenever notifications, submissions, or communications are required by this Consent Decree, they shall be made in writing and addressed to the (i) United States Department of Justice; (ii) EPA; and (iii) the State of Indiana. The contact information for the parties to the Consent Decree is set forth in Attachment A. Electronic submissions may be made in accordance with Attachment A.

108. Any Party may, by written notice to the other Parties, change its designated notice recipient(s) or notice address(es) provided in Attachment A. Notices submitted pursuant to this Section shall be deemed submitted upon mailing, unless otherwise provided in this Consent Decree or by mutual agreement of the Parties in writing.

XVI. EFFECTIVE DATE

109. The Effective Date of this Consent Decree shall be the date this Consent Decree is entered by the Court, or a motion to enter is granted, whichever occurs first, as recorded on the Court's docket.

XVII. RETENTION OF JURISDICTION

110. The Court shall retain jurisdiction over this case until termination of this Consent Decree for the purpose of resolving disputes arising under this Decree pursuant to Section XI (Dispute Resolution), or entering orders modifying this Decree pursuant to Section XVIII (Modification), or effectuating or enforcing compliance with the terms of this Decree.

111. Any disputes concerning modification of this Decree, including any attached appendices, shall be resolved pursuant to Section XI (Dispute Resolution), provided, however, that, instead of the burden of proof provided by Paragraph 93, the Party seeking the modification bears the burden of demonstrating that it is entitled to the requested modification in accordance with Federal Rule of Civil Procedure 60(b).

XVIII. MODIFICATION

112. The terms of this Consent Decree may be modified only by a subsequent written agreement signed by the United States, Indiana, and Defendants. Where the modification constitutes a material change to any term of this Consent Decree, it shall be effective only upon approval by the Court.

XIX. TERMINATION

113. This Consent Decree shall be subject to termination upon motion by the United States or Defendants under the conditions identified in this Section XIX (Termination). A Defendant may seek termination of this Consent Decree upon either (1) completion and satisfaction of all of the following requirements of this Paragraph, or (2) any time after the permanent shutdown of, and relinquishment of all operating permits, provided that such Defendant has complied with the requirements of subparagraph 113.c below. For purposes of demonstrating compliance with the Consent Decree such that a Defendant can seek termination, SunCoke and IHCC may seek termination upon completion of subparagraphs a-c and e-g below and Cokenergy may seek termination upon completion of subparagraphs b-f below.

a. Completion of Oven Rebuild requirements, as specified in this Consent Decree;

b. Compliance with all provisions contained in this Consent Decree, which compliance may be established for specific parts of the Consent Decree in accordance with Paragraphs 113.c-g and 114, below;

c. Payment of all penalties and other monetary obligations due under the terms of the Consent Decree; no penalties or other monetary obligations due hereunder can be outstanding or owed to the United States or Indiana;

d. Completion of the SEP, as specified in Section VII;

e. Incorporation of (1) the annual Bypass Venting limits in Paragraph 14; and (2) the requirement to operate and maintain a permanent flow monitor in Paragraph 19 (for Cokenergy), into (a) Indiana Environmental Rules Board's approval of site-specific SIP revisions for Defendants and (b) Defendants' Title V operating permits, as applicable; and

f. Operation for at least eighteen (18) months in satisfactory compliance with the emission limits established in Paragraph 14, 15, and 16, and certification of such compliance submitted following the conclusion of the compliance period.

g. Operation for at least eighteen (18) months in satisfactory compliance with the requirements related to Coke Oven Leaks in Paragraph 12, and certification of such compliance submitted following the conclusion of the compliance period.

114. Certification of Completion.

a. Prior to moving for termination as provided in Paragraph 113, a Defendant shall certify completion of the requirements in Paragraph 113.

b. The Defendant seeking termination shall submit a written report to the United States and Indiana describing the activities undertaken to comply with the requirements of this Consent Decree and certifying that the permits are issued in final form. Defendants must demonstrate that they have satisfied the conditions for termination set forth in Paragraph 113

above. The report shall contain the following statement, signed by a responsible corporate official of each Defendant:

> To the best of my knowledge, after appropriate investigation, I certify that the information contained in or accompanying this submission is true, accurate and complete. I am aware that there are penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

c. Upon receipt of a Defendant's certification, the United States, after reasonable opportunity for review and comment by Indiana, shall notify the Defendant whether the requirements set forth in the applicable Paragraphs have been completed in accordance with this Consent Decree. The Parties recognize that ongoing obligations under such Paragraphs remain and necessarily continue (*e.g.*, reporting and record keeping requirements), and that a Defendant's certification is that they are in current compliance with all such obligations.

i. If the United States, after consultation with Indiana, concludes that the requirements have not been fully complied with, the United States shall notify the Defendant as to the activities that must be undertaken to complete the applicable Paragraphs of the Consent Decree. The Defendant shall perform all activities described in the notice, subject to their right to invoke the dispute resolution procedures set forth in Section XI (Dispute Resolution). If the United States provides such notification, Defendants must resubmit the certification required under this Paragraph after the activities are undertaken to comply with the Consent Decree.

ii. If the United States, after consultation with Indiana, concludes that the requirements of the applicable Paragraphs have been completed in accordance with this Consent Decree, the United States will so notify the Defendant in writing. This shall constitute the Certification of Completion of the applicable Paragraphs for purposes of this Consent Decree.

d. Nothing in this Paragraph shall preclude the United States or Indiana from seeking stipulated penalties for a violation of any of the requirements of the Consent Decree regardless of whether a Certification of Completion has been issued under this Paragraph. In addition, nothing in this Paragraph shall permit Defendants to fail to implement any ongoing obligations under the Consent Decree regardless of whether a Certification of Completion has been issued under this Paragraph.

115. At such time as Defendants believe that they have satisfied the requirements for termination set forth in this Section, Defendants shall certify such compliance and completion pursuant to Paragraph 114 to the United States and Indiana in writing. Unless, within one hundred and twenty (120) Days of receipt of a Defendant's certification under Paragraph 114, either the United States or Indiana objects in writing with specific reasons, the Court may upon motion by the Defendant order that this Consent Decree be terminated. If the United States or

Indiana objects to the certification by the Defendant, then the matter shall be submitted to the Court for resolution under Section XI (Dispute Resolution). In such case, the Defendant shall bear the burden of proving that this Consent Decree should be terminated.

XX. PUBLIC PARTICIPATION

116. This Consent Decree shall be lodged with the Court for a period of not less than thirty (30) Days for public notice and comment in accordance with 28 C.F.R. § 50.7. The United States, after consultation with the State of Indiana, reserves the right to withdraw or withhold its consent if the comments regarding the Consent Decree disclose facts or considerations indicating that the Consent Decree is inappropriate, improper, or inadequate. Defendants consent to entry of this Consent Decree without further notice. Defendants agree not to oppose entry of this Consent Decree by the Court or to challenge any provision of the Decree, unless the United States has notified Defendants in writing that it no longer supports entry of the Decree.

XXI. SIGNATORIES/SERVICE

117. Each undersigned representative of Defendants, the State of Indiana, and the Assistant Attorney General for the Environment and Natural Resources Division of the Department of Justice (or his or her designee) certifies that he or she is fully authorized to enter into the terms and conditions of this Consent Decree and to execute and legally bind the Party he or she represents to this document.

118. This Consent Decree may be signed in counterparts, and its validity shall not be challenged on that basis.

119. Defendants agree to accept service of process by electronic mail and U.S. postal service with respect to all matters arising under or relating to this Consent Decree and to waive the formal service requirements set forth in Rules 4 and 5 of the Federal Rules of Civil Procedure and any applicable Local Rules of this Court including, but not limited to, service of a summons.

XXII. INTEGRATION

120. This Consent Decree and its Appendices constitute the final, complete, and exclusive agreement and understanding among the Parties with respect to the settlement embodied in this Consent Decree and its Appendices and supersede all prior agreements and understandings, whether oral or written, concerning the settlement embodied herein. No other document, except for any plans or other deliverables that are submitted and approved pursuant to this Decree, nor any representation, inducement, agreement, understanding, or promise, constitutes any part of this Decree or the settlement it represents, and no such extrinsic document or statement of any kind shall be used in construing the terms of this Decree.

XXIII. FINAL JUDGMENT

121. Upon approval and entry of this Consent Decree by the Court, this Consent Decree shall constitute a final judgment of the Court in this action as to the United States, the

State of Indiana, and Defendants. The Court finds that there is no just reason for delay and therefore enters this judgment as a final judgment under Fed. R. Civ. P. 54 and 58.

XXIV. APPENDICES

122. The following appendices are attached to and part of the Consent Decree:

Appendix 1 – List of Notices of Violation

Appendix 2 – SOF Testing

DATED this_____day of_____, 2018.

_____

UNITED STATES DISTRICT JUDGE
NORTHERN DISTRICT OF INDIANA

Signature Page for *United States and State of Indiana v. Indiana Harbor Coke Company, et al.* Consent Decree

FOR PLAINTIFF UNITED STATES OF AMERICA:

Date: 1/24/18

JEFFREY H. WOOD
Acting Assistant Attorney General
Environment & Natural Resources Division
United States Department of Justice

Date: 1/25/18

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Signature Page for *United States and State of Indiana v. Indiana Harbor Coke Company, et al.* Consent Decree

FOR PLAINTIFF UNITED STATES OF AMERICA:

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UNITED STATES ATTORNEY

Date: January 25, 2018

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Signature Page for *United States and State of Indiana v. Indiana Harbor Coke Company, et al.* Consent Decree

FOR THE U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 5:

Date: 1/23/2018

T. LEVERETT NELSON
Regional Counsel
U.S. Environmental Protection Agency
Region 5

Date: 1/23/2018

TCN for:
SUSAN TENNENBAUM
Associate Regional Counsel
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FOR THE U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENFORCEMENT AND COMPLIANCE ASSURANCE:

Date: 1/24/2018

SUSAN PARKER BODINE
Assistant Administrator
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency

Date: 1/24/2018

PHILLIP A. BROOKS
Director, Air Enforcement Division
Office of Civil Enforcement
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency

Date: 12/29/2017

TERESA DYKES
Air Enforcement Division
Office of Civil Enforcement
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency

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FOR PLAINTIFF STATE OF INDIANA:

CURTIS HILL
Attorney General of Indiana

Date: January 24, 2018

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Office of the Indiana Attorney General
Indiana Government Center South, Fifth Floor
302 W. Washington Street
Indianapolis, In 46204

Date: JANUARY 24, 2018

BENJAMIN J. LEGGE
Deputy Attorney General
Office of the Indiana Attorney General
Indiana Government Center South, Fifth Floor
302 W. Washington Street
Indianapolis, In 46204

Date: 12/21/17

BRUNO L. PIGOTT
Commissioner
Indiana Department of Environmental Management

Date: 12/27/17

ELIZABETH A. ZLATOS
Office of Legal Counsel
Indiana Department of Environmental Management

Signature Page for *United States and State of Indiana v. Indiana Harbor Coke Company, et al.* Consent Decree

FOR DEFENDANTS INDIANA HARBOR COKE COMPANY, L.P.
and SUNCOKE ENERGY, INC.:

SUNCOKE ENERGY. INC.

By: FREDERICK A. HENDERSON
Title: Executive Chairman
Address: 1011 Warrenville Rd.
Suite 600
Lisle, IL 60532

INDIANA HARBOR COKE COMPANY, L.P.
By: **Indiana Harbor Coke Company**,
its General Partner

By: DOVIE D. MAJORS
Title: President
Address: 1011 Warrenville Rd.
Suite 600
Lisle, IL 60532

Date: December 14, 2017

Signature Page for *United States and State of Indiana v. Indiana Harbor Coke Company, et al.* Consent Decree

FOR DEFENDANT COKENERGY, LLC:

Date: 12-13-17

MAURICE T. KLEFEKER
Chief Executive Officer
Primary Energy Recycling Corp
2215 South York Road, Suite 202
Oak Brook, IL 60523

ATTACHMENT A

Contact Information for the Parties to *United States and State of Indiana v. Indiana Harbor Coke Company, et al.*

Notice or submission to the United States:

Chief, Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice
Box 7611, Ben Franklin Station
Washington, DC 20044-7611
Re: DOJ No. 90-5-2-1-08555/1

Notice or submission to EPA:

Air Enforcement Division Director
U.S. Environmental Protection Agency
Office of Civil Enforcement
Air Enforcement Division
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW Mail Code: 2242A
Washington, DC 20460

and

Compliance Tracker
Air Enforcement and Compliance Assurance Branch
U.S. Environmental Protection Agency - Region 5
77 West Jackson Blvd. AE-18J
Chicago, Illinois 60604-3590

Including an electronic copy to:
r5airenforcement@epa.gov

and

Susan Tennenbaum
U.S. Environmental Protection Agency
Region 5
C-14J
77 West Jackson Blvd. Chicago, IL 60640

Including an electronic copy to:
tennenbaum.susan@epa.gov

Notice or submission to the State of Indiana:

Phil Perry
Indiana Department of Environmental Management
Chief, Air Compliance and Enforcement Branch
100 North Senate Avenue
MC-61-53, IGCN 1003
Indianapolis, IN 46204-2251

and

Elizabeth A. Zlatos
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Notice or submission to Defendants:

For Indiana Harbor Coke Company and SunCoke:

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Lisle, IL 60532
ktgates@suncoke.com

For Cokenergy:

Thor Ketzback
Bryan Cave LLP
161 North Clark Street, Suite 4300
Chicago, IL 60601
thor.ketzback@bryancave.com

and

Delauna Pack
Vice President Operations
Cokenergy LLC
3210 Watling Street – Mail Code 2-991
East Chicago, IN 46312
dpack@primaryenergy.com

APPENDIX 1 – LIST OF NOTICES OF VIOLATION

1. June 3, 2010
2. June 21, 2010
3. September 13, 2012
4. April 23, 2013
5. December 20, 2013
6. February 5, 2015
7. June 23, 2016

APPENDIX 2 – SOF TESTING

Ramboll Environ
att. Catherine Mukai
201 California Street, Suite 1200
San Fransisco, CA94111

San Diego, July 11,2016

Proposal for Emission Testing using Fluxsense Mobile Lab for SunCoke Energy Heat Recovery Coke Plant at 3210 Watling Street, East Chicago, Indiana

Please find below a proposal and associated costs outlining a Test Protocol for Emissions Testing as required by EPA letter of June 29, 2015 to perform emission testing to measure facility wide mass emission rate of SO2, Benzene, and total VOC compounds, providing temporal and specific emission flux data to assess emissions from the facility.

Proposed approach

The SunCoke Energy Heat Recovery Coke Plant is a complex facility. The plant has a multitude of plausible emission sources which are distributed over a large industrial area, the sources are located at different heights from ground level up to 300 ft, the production cycle also makes some of the emissions variable in time.

Fluxsense will use a combination of methodologies and techniques for the emissions testing. The instrumentation is integrated in the Fluxsense Inc. Mobile Lab which will be brought to the site to quantify and specify the emissions. Two mobile remote gas sensing techniques, SOF (Solar Occultation Flux) and Mobile SkyDOAS (Differential Optical Absorption Spectroscopy) will be used to estimate facility wide mass emission fluxes of VOCs and SO_2. These techniques will be complemented by the mobile extractive optical methods MeFTIR (Mobile extractive FTIR) and MWDOAS (Mobile White cell DOAS) to map facility specific concentrations of alkanes, methane and aromatic VOCs and to calculate inferred fluxes. The required wind information will be obtained using a stationary remote sensing wind-LIDAR and conventional wind mast measurements. See also enclosed Fluxsense Technology Platform

Due the complex task we propose to use both a fence-line approach studying the overall emissions emerging from the site combined with a bottom-up approach studying the emissions on a source by source basis. With these two approaches we can compare the overall emissions as obtained by the two strategies. The bottom-up approach will allow us to focus on individual source emissions giving better detail and speciation of the emissions from these.

The fence-line approach will use SOF and SkyDOAS to integrate vertical columns of VOC (alkanes, alkenes) and SO_2 throughout the plume cross section of the plant. Combining the integrated plume mass with wind field data, as measured with a wind LIDAR and wind masts, will give the emission from the plant as a whole (kg/hr). Benzene will be mapped along the fence line at ground level with the MWDOAS. The fence-line measurements are also important to establish any incoming interfering emission plumes from adjacent industries.

In the source by source approach we will use a point concentration strategy where any emissions are sampled closer to the source where concentrations are higher and can be distinguished between different sources. The sampling points will be mobile; by a moving van with instrumentation inside or by means of heated sample tubing elevated up into the source plume with a boom lift. In this way the plume from a specific source can be sampled, adapting to any shifts in wind and the sampling distance to the source can also easily be changed.

The concentrations of SO_2 and benzene will be analyzed with MWDOAS. The same plume sample will be analyzed for alkanes and alkenes by MEFTIR. To convert the concentration measurement in the source plume to an actual flux from the source we will release a tracer gas (N_2O) at the source. This release will pin-point the emission source and the known tracer gas release (typically 1 kg/h) will be dispersed and diluted from the source and downwind in the plume in the same manner as the source emission itself.

By analyzing the concentration ratio of benzene, SO_2, and other VOC to the tracer gas concentration, the flux of these gases can be estimated. This method also allows for time-resolved studies of the emissions.

In the same way as MWDOAS is used to analyze the benzene and BTEX concentration in the plume, canister or adsorption tube samples will be used in the plume for complimentary concentration data which, when put in relation to the tracer concentration, will provide a flux estimate. We will also use SOF and SkyDOAS close to the sources, combined with wind data, to obtain flux estimates of SO_2 and VOC (alkanes, alkenes) where applicable.

As for the fence-line approach the benzene and other VOC flux can also be derived from some of the single sources by comparing the SO_2 flux obtained from SkyDOAS with concentration ratios of benzene to SO_2 in the plume, without using tracer.

Fluxsense's Mobile Lab has been used in 100+ emission studies world wide; the SOF technique is also in Europe considered one of Best Available Technology (BAT) for measurements of fugitive emission of VOCs from refineries and similar facilities.

Method	SOF	Sky DOAS	MeFTIR	MWDOAS
Compounds	**Alkanes**: (C_nH_{2n+2}) **Alkenes:** C_2H_4, C_3H_6 **NH_3**	**SO_2** **NO_2**,	**CH_4** **Alkanes:** (C_nH_{2n+2}) **Alkenes:** C_2H_4, C_3H_6 **NH_3** **N_2O** (tracer)	**BTEX, Benzene** **SO_2**
Detection limit Column	0.1-5 mg/m^2	0.1-5 mg/m^2	1-10 ppbv	0.5-4 ppbv Benzene 0.5 ppbv, SO_2 4 ppbv
Detection limits Flux Direct flux - SOF, SkyDOAS Inferred flux -concentration ratios MeFTIR/MWDOAS combined with direct flux from SOF/SkyDOAS	0.2-1 kg/h	1 kg/h	0.2-2 kg/h	Benzene:0.15 kg/h BTEX: 0.25 kg/h
Detection limits with tracer release and MeFTIR +MWDOAS nearby (20-100 m) localized source			CH_4: 0.1 kg/h Alkanes: 0.25 kg/h Alkenes: 0.4 kg/h	Benzene: 0.1 kg/h SO_2: 0.15 kg/h BTEX: 0.2 kg/h
Wind Speed Tolerance	1.5-12 m/s	1.5-12 m/s		
Sampling Time Resolution	1-5 s	1-5 s	5-15 s	8-10 s
Measured Quantity [unit]	Integrated vertical column mass [mg/m^2]	Integrated vertical column mass [mg/m^2]	Mass concentration at Vehicle height [mg/m^3]	Concentration at Vehicle height [mg/m^3]
Inferred Quantity [unit]	Mass Flux [kg/h]	Mass Flux [kg/h]	1) Alkane ratio of ground plume combined with SOF gives mass flux [kg/h] and plume height information [m] 2) Alkane and CH_4 flux [kg/h] via tracer release	Combined with MeFTIR and SOF gives Mass Flux [kg/h] or combined with MeFTIR + tracer [kg/h]
Complementary data	Vehicle GPS-coordinates, Plume wind speed and direction	Vehicle GPS-coordinates, Plume wind speed and direction	Vehicle GPS-coordinates Plume wind direction	Vehicle GPS-coordinates, Plume wind direction

For SOF and SkyDOAS the flux is directly obtained by multiplying the measured mass columns across the source plume with the wind speed while the flux measurements by MWDOAS and MeFTIR are inferred. Using mass concentrations measurements of BTEX and alkanes in the source plume by MWDOAS and MeFTIR respectively, the inferred Benzene flux limit detection is about 0.15 kg/h.

For localized sources a tracer release at the source can be used to limit the uncertainty by the wind field data. MeFTIR and MWDOAS are then used to measure mass concentration ratios of for example alkanes, benzene and SO_2 versus the tracer concentration. With this approach detection limits of about 0.1 kg/h benzene, 0.15 kg/h SO_2 and 0.25 kg/h alkanes are achievable.

Emission Measurements

FluxSense plans to conduct a 12 day survey at the site. This will allow for different wind directions, covering many sample points, and for repeating measurements at identified key sources for a good statistical basis. It will also allow for some operational variations. Due to the complex topography and release points being at multiple height levels, the wind field will be measured by a wind LIDAR and a wind meter at a boom lift platform.

1) SOF will be used to measure overall fugitive VOC (alkane, alkene) emissions and establish any incoming emissions from neighboring sites

2) Mobile SkyDOAS will be used to measure overall fugitive SO_2 emissions and identify any incoming fluxes from neighboring sites

3) MWDOAS will be used to measure specifically benzene but also BTEX around the site and at specific locations. The on site real time mapping will allow for identification of any incoming fluxes from neighboring sites

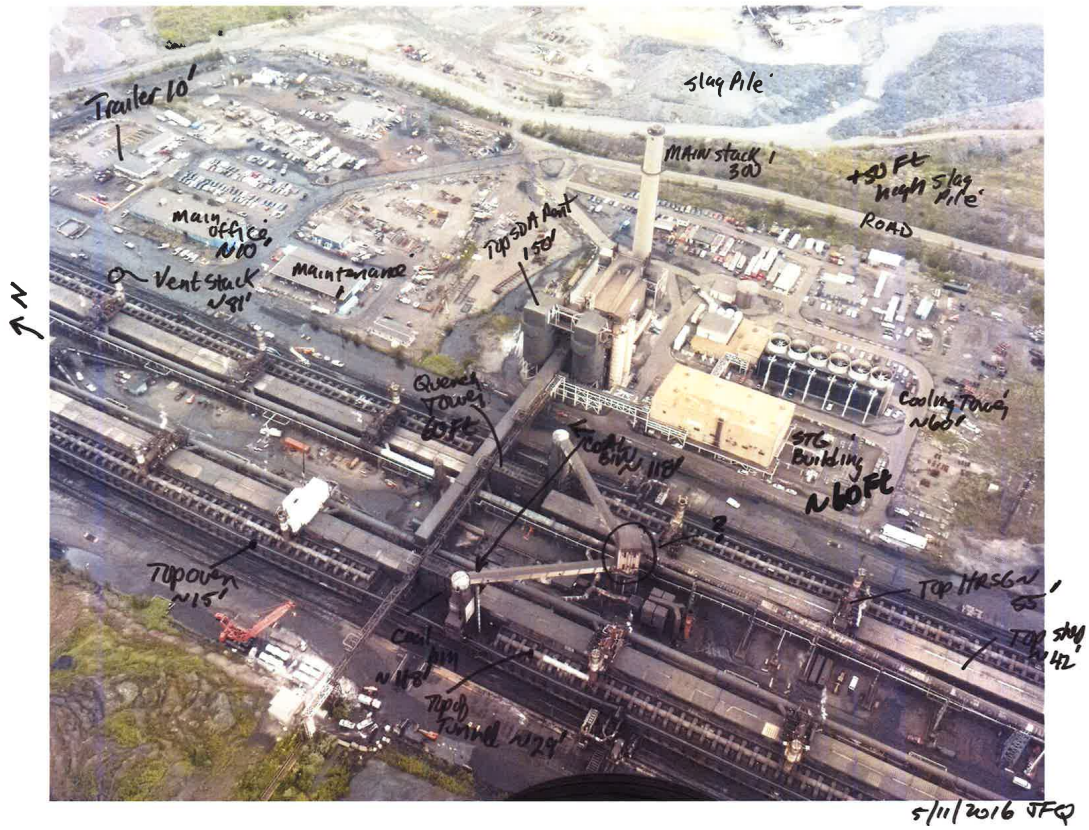
4) Canister/adsorption tube sampling will be used for further VOC speciation at key points. The sampling will be supported by real-time MWDOAS and MeFTIR monitoring to guide the sampling and obtain good quality plume samples of key sources

5) Specific release points (facility a-h, e.g. stacks, quench towers, ovens, by pass vents, coke conveyance, coke holding and transfer towers) will be studied by means of a boom lift with attached heated sample lines, connected to MeFTIR and MWDOAS instrumentation sampling alkanes, alkenes, SO_2, Benzene, and BTEX

6) The main waste gas stack will be measured by SkyDOAS and SOF, and mass concentration ratios of benzene, VOC and SO_2 will be sampled through the installed CEMS sample lines. A tracer will be injected in the waste gas stem to cross check flow rates, and thus validate the SkyDOAS/SOF approach

7) Tracer (N_2O, acetylene) will be released at some key release points to pin point observed emissions, and provide a tracer correlation method cross check to the measured emissions

As the EPA requests specific emission testing at certain locations we propose the following emission measurements:



Coke ovens: SOF, SkyDOAS, MWDOAS, MeFTIR mapping with van and boom lift assisted sampling

By pass vents: Boom lift assisted sampling with MeFTIR+MWDOAS and tracer. SkyDOAS SO_2 by van and aimed optical telescope

Heat recovery steam generators: SOF, SkyDOAS, MWDOAS, MeFTIR mapping with van and boom lift assisted. Tracer pin point to allow for more distant sampling.

Quench towers: Boom lift assisted sampling with MeFTIR+MWDOAS and tracer. SkyDOAS SO_2 by van and aimed optical telescope

Charging/pushing units: Mobile van sampling and boom lift assisted tracer

Waste gas stack: SOF, SkyDOAS complimented by mass ratio sampling through CEMS sample line, and tracer flow rate validation

Coke conveyance equipment: Mobile van sampling

Coke holding and transfer towers: Boom lift assisted sampling with MeFTIR+MWDOAS and tracer. SkyDOAS SO_2 by van and aimed optical telescope

We propose to do the emissions testing to start in April 2017, as the optical remote sensing technologies require fair weather conditions, and to allow for project planning and preparations.

Proposed Schedule

Please note that this reflects emission testing days and not the total number of days for the field survey

Day 1, 2	Facility Wide Measurements, Coke Conveyance Equipment
Day 3, 4	Coke Ovens
Day 5	Facility Wide Measurements
Day 6, 7	By-Pass vents and Heat Recovery Steam Generators
Day 8, 9	Quench Towers, Coke Holding and Transfer Towers
Day 9	Charging/pushing units
Day 10	Waste Gas Stack
Day 11,12	Follow up measurements at key findings and facility wide measurements

Reports of the emissions measurements will be available 90 days after completed testing.

Emission Testing Costs

Emission Testing and Reporting	$98,050
Site specific equipment	
Boom Lift rental incl. driver	$21,000
Site specific instrumentation	$24,900
Tracer gas, calibration gas, LN2	$ 3,000
Canister and absorption tube analysis	$ 4,500
Total Project Cost	$152,000

Sincerely,

Marianne Ericsson
CFO
FluxSense Inc.

Enclosed Fluxsense Technology Platform July 2016

FluxSense Technology Platform


The FluxSense Mobile Lab is equipped with four instruments for gas monitoring during the survey; SOF, SkyDOAS, MeFTIR and MW-DOAS. Individual measurement methods are described briefly in the subsections below. SOF and SkyDOAS both measure gas columns through the atmosphere by means of light absorption. SOF utilizes infrared light from the direct sun whereas SkyDOAS measure scattered ultraviolet light from the sky. MeFTIR and MW-DOAS both measure ground level concentrations of alkanes and BTEX respectively. A wind LIDAR is used to measure vertical profiles of wind speed and wind direction from 50-1000 m height. The LIDAR data is combined with data from several wind masts from fixed met network- and mobile stations.

Figure 1 gives a general overview of the measurement setup and the data flow. In order to derive final emission flux estimates, the GPS-tagged gas column measurements by SOF and SkyDOAS are combined with wind data and integrated across plume transects at the various source locations. Gas mass ratio measurements by MeFTIR and MW-DOAS are then used to infer emission estimates also for methane and BTEX. Tracer gas is used at localized sources to measure emissions directly with MeFTIR.

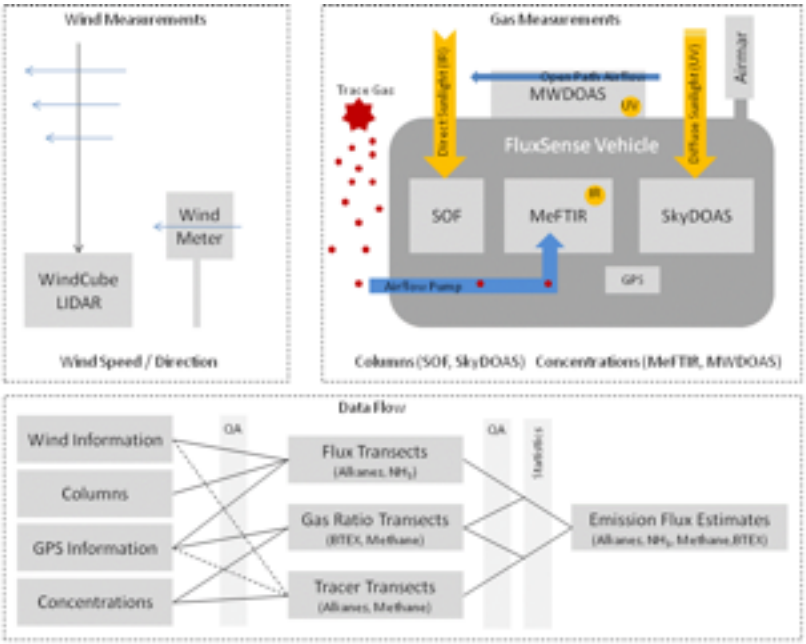


Figure 1 FluxSense four main instruments methods and data flow diagrams. .

Summary of FluxSense gas measurement techniques.

Method	SOF	Sky DOAS	MeFTIR	MWDOAS
Compounds	**Alkanes**: (C_nH_{2n+2}) **Alkenes:** C_2H_4, C_3H_6 **NH_3**	**SO_2** **NO_2**,	**CH_4** **Alkanes:** (C_nH_{2n+2}) **Alkenes:** C_2H_4, C_3H_6 **NH_3** **N_2O** (tracer)	**BTEX, Benzene** **SO_2**
Detection limit Column	0.1-5 mg/m^2	0.1-5 mg/m^2	1-10 ppbv	0.5-4 ppbv Benzene 0.5 ppbv, SO_2 4 ppbv
Detection limits Flux Direct flux - SOF, SkyDOAS Inferred flux -concentration ratios MeFTIR/MWDOAS combined with direct flux from SOF/SkyDOAS	0.2-1 kg/h	1 kg/h	0.2-2 kg/h	Benzene:0.15 kg/h BTEX: 0.25 kg/h
Detection limits with tracer release and MeFTIR +MWDOAS nearby (20-100 m) localized source			CH_4: 0.1 kg/h Alkanes: 0.25 kg/h Alkenes: 0.4 kg/h	Benzene: 0.1 kg/h SO_2: 0.15 kg/h BTEX: 0.2 kg/h
Wind Speed Tolerance	1.5-12 m/s	1.5-12 m/s		
Sampling Time Resolution	1-5 s	1-5 s	5-15 s	8-10 s
Measured Quantity [unit]	Integrated vertical column mass [mg/m^2]	Integrated vertical column mass [mg/m^2]	Mass concentration at Vehicle height [mg/m^3]	Concentration at Vehicle height [mg/m^3]
Inferred Quantity [unit]	Mass Flux [kg/h]	Mass Flux [kg/h]	1) Alkane ratio of ground plume combined with SOF gives mass flux [kg/h] and plume height information [m] 2) Alkane and CH_4 flux [kg/h] via tracer release	Combined with MeFTIR and SOF gives Mass Flux [kg/h] or combined with MeFTIR + tracer [kg/h]
Complementary data	Vehicle GPS-coordinates, Plume wind speed and direction	Vehicle GPS-coordinates, Plume wind speed and direction	Vehicle GPS-coordinates Plume wind direction	Vehicle GPS-coordinates, Plume wind direction

For SOF and SkyDOAS the flux is directly obtained by multiplying the measured mass columns across the source plume with the wind speed while the flux measurements by MWDOAS and MeFTIR are inferred. Using mass concentrations measurements of BTEX and alkanes in the source plume by MWDOAS and MeFTIR respectively, the inferred Benzene flux limit detection is about 0.15 kg/h.

For localized sources a tracer release at the source can be used to limit the uncertainty by the wind field data. MeFTIR and MWDOAS are then used to measure mass concentration ratios of for example alkanes, benzene and SO_2 versus the tracer concentration. With this approach detection limits of about 0.1 kg/h benzene, 0.15 kg/h SO_2 and 0.25 kg/h alkanes are achievable.

1. The SOF method

The SOF method [Mellqvist 1999, 2008, 2009a, 2009b, 2010; Kihlman 2005a; Johansson 2014] is based on the recording of broadband infrared spectra of the sun with a Fourier transform infrared spectrometer (FTIR) that is connected to a solar tracker. The latter is a telescope that tracks the sun and reflects the light into the spectrometer independent of the orientation of the vehicle. Using multivariate optimization it is possible from these solar spectra to retrieve the path-integrated concentrations (referred to as column concentrations), in the unit mg/m^2, of various species between the sun and the spectrometer. The system used in this project consists of a custom built solar tracker, transfer optics and a Bruker IRCube FTIR spectrometer with a spectral resolution of 0.5 cm^{-1}, equipped with a dual InSb (Indium Antimonide) / MCT (Mercury Cadmium Telluride) detector. A reference spectrum is taken outside the plume so that atmospheric background concentrations are removed. This means that all measured SOF columns are analyzed relative to the background column concentrations.

The system is installed in a measurement vehicle which allows consecutive column concentration measurements to be performed while driving. The flux of a species in a plume from an industry is measured by collecting spectra while driving the vehicle so that the light path from the sun to the instrument gradually cuts through the whole plume, preferably as orthogonally as possible to the wind direction, see Figure 2.

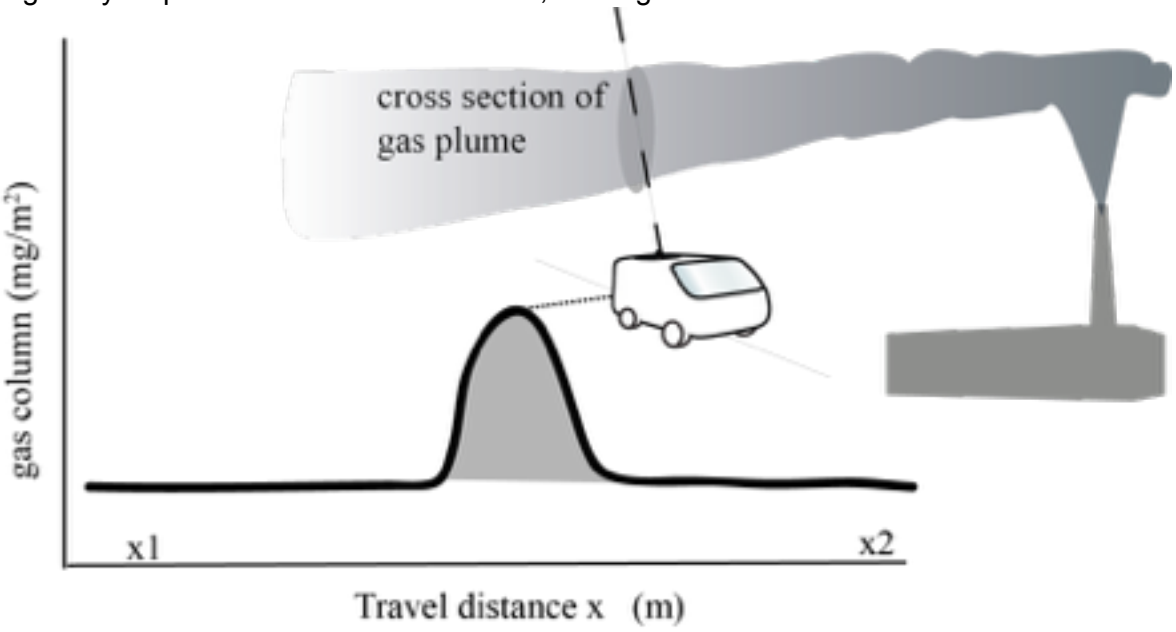


Figure 2 Schematic of the SOF measurement where the vehicle is driven across the prevailing wind so that the solar beam cuts through the emission plume while the sun is locked into the FTIR spectrometer by the solar tracking device on the roof. The VOC mass (or other compound of interest) is integrated through the plume cross section.

For each spectrum a column concentration of the species is retrieved using custom software (QESOF, i.e. *Quantitative evaluation of SOF*) [Kihlman 2005b]. These column concentrations, together with positions recorded with a GPS (Global Positioning System) receiver and the solar angle calculated from the time of the measurements, are used to calculate the area integrated column of the species in the intersection area between the plume and the light path. The flux of the species is then obtained by multiplying this area integrated concentration with the orthogonal wind speed vector component.

The SOF method can measure VOCs in two different modes. Most VOCs with C-H-bonds absorb strongly in the 3.3-3.7 µm (2700-3005 cm^{-1}) spectral region. This region is mainly used for **alkane** measurements using a spectral resolution of 8 cm^{-1}. **Alkenes** (including ethylene and propylene) are instead measured in the spectral region between 910 and 1000 cm^{-1} using a spectral resolution of 0.5 cm^{-1}. In the alkane mode – the IR light absorption is essentially sensitive to the total alkane mass (number of alkane C-H bonds) present in the plume. The absorption structures (cross sections) for the various alkane compounds are rather similar, with the absorption strength scaling to the mass of the alkane species. Hence, the actual mix of alkanes in the plume does not affect the retrieved total alkane mass flux much, although only cross sections from a subset of all alkanes (propane, n-butane and octane) are fitted in the spectral analysis. Typically the rare event of significant absorption from other species in the plume shows up as elevated residuals and is further investigated in the re-analysis. For the alkene mode the specificity of the measurements is good, since the absorption of different species is rather unique in this so called “fingerprint region” and absorption features are often sharp and well separable from each other at 0.5 cm^{-1} resolution.

The IR spectra recorded by the SOF instrument are analyzed by fitting a set of calibrated spectra from the HITRAN infrared database [Rothman 2003] and the PNL database [Sharpe 2004] in a least-squares fitting procedure. Atmospheric absorption is accounted for in the fitting procedure by including calibrated spectra (from the HITRAN database) for compounds present in the atmosphere with high enough abundance to have detectable absorption peaks in the wavelength region used by SOF, including water vapor, carbon dioxide and methane.

The spectral retrieval for SOF is handled by custom software (QESOF) [Kihlman 2005b] in which calibration spectra are fitted to the measured spectra using nonlinear multivariate analysis. Calibration data from the HITRAN database are used to simulate absorption spectra for atmospheric background species at the actual pressure, temperature and instrumental resolution of the measurements. The same approach is applied for several retrieval codes for high resolution solar spectroscopy developed within Network for the Detection of Atmospheric Composition Change (NDACC) [Rinsland 1991; Griffith 1996] and QESOF has been tested against these with good agreement, better than 3%. For the retrievals, high resolution spectra of ethylene, propene, propane, n-butane and n-octane were obtained from the PNL (Pacific Northwest Laboratory) database and these are degraded to the spectral resolution of the instrument by convolution with the instrument lineshape. The uncertainty in the absorption strength of the calibration spectra is about 3.5% for all five species.

2. Sky DOAS

Sky DOAS (Differential Optical Absorption Spectroscopy) measurements of scattered solar light in zenith direction were carried out in parallel with the SOF measurements in order to measure formaldehyde, NO2 and SO2. DOAS works in the ultraviolet (UV) and visible wavelength region while SOF works in the infrared region and hence there are large differences in spectroscopy and in the used spectrum evaluation methods. However, both methods measure vertical columns which are integrated along the measurement transect and multiplied by the wind to obtain the flux. The principle of flux-measurements using Mobile DOAS is hence the same as for SOF, although it is not necessary to compensate for any slant angle observations since the telescope is always pointing towards zenith. The DOAS system also works under cloudy conditions in contrast to SOF, although the most precise measurements are conducted under clear sky. The system is explained in appendix I and elsewhere (Johansson, 2013b).

The DOAS method was introduced in the 1970's (Platt 1979) and has since then become an increasingly important tool in atmospheric research and monitoring both with artificial light sources and in passive mode utilizing the scattered solar light. In recent time the multi axis DOAS method (scanning passive DOAS) has been applied in tropospheric research for instance measuring formaldehyde (Heckel 2005). Passive DOAS spectroscopy from mobile platforms has also been quite extensively applied in volcanic gas monitoring (Galle et al., 2002) for SO2 flux measurements and for mapping of formaldehyde flux measurements in megacities (Johansson 2009). Mobile DOAS has only been used to a limited extent for measurements of industrial emissions. For example, Rivera et al. (2009c) performed SO2 measurements on a power plant in Spain for validation purposes. The same research group also deployed a mobile DOAS to study emissions from an industrial conglomerate in Tula in Mexico (Rivera 2009d) and measured SO2, NO2 and HCHO during the 2006 TexAQS campaign (Rivera 2009a, 2009b). There are other groups in both China and Spain working with mobile mini DOAS systems.

3.Mobile extractive FTIR (MeFTIR)

Mobile Extractive FTIR (MeFTIR) (Galle 2001, Borjesson 2009) in combination with tracers has been used to quantify VOC emissions from refinery and petrochemical sources in Europe and in the U.S. Alkanes and alkenes are typically measured, but also methane (CH_4), ammonia (NH_3), nitrous oxide (N_2O) and other climate gases can be retrieved. MeFTIR is an optical technique capable of monitoring gas concentrations at ppb-sensitivity in mobile field operations. It is used both independently for concentration mapping and flux measurements, but often combined together with simultaneous SOF flux measurements to provide more detailed VOC speciation of plumes and for plume height assessments (Johansson et. al. 2013). The plume height can be estimated by dividing measured columns (mg/m^2) with ground concentrations (mg/m^3), assuming that the plume is evenly distributed up to the plume height (and zero above). MeFTIR +tracer gas correlation flux measurements in this study have been done using controlled emissions of N_2O as tracer gas.

The MeFTIR system contains a mid-infrared spectrometer with medium resolution (0.5 cm^{-1}). It utilizes an internal glow bar as an infrared radiation source, and by customized optics this light is transmitted through an optical multi-pass measurement cell with selectable path-length of 9.6-107.2 meters. The system is mounted on a vibration dampening platform to allow for real time plume mapping from a mobile platform, such as a vehicle or boat, see Figure 3.

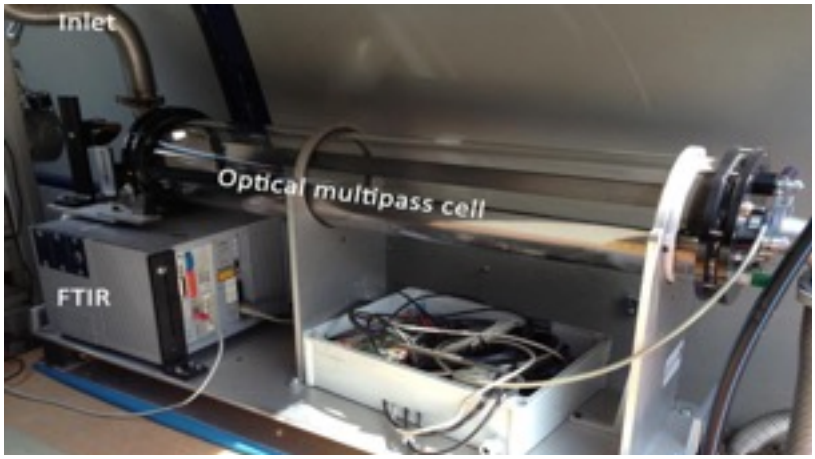


Figure 3 The MeFTIR instrumentation consisting of a Bruker FTIR spectrometer connected to an optical multi-pass cell.

The transmitted light is detected simultaneously with an InSb-detector (Indium Antimonide) in the 2.5–5.5 µm (1800–4000 cm^{-1}) region and a MCT (Mercury Cadmium Telluride) detector in the 8.3–14.3 µm (700–1200 cm^{-1}) region. Temperature and pressure in the cell are averaged over the duration of each measurement. Atmospheric air is continuously pumped at high flow rate through the optical cell from the outside, taking in plume air from the roof of the vehicle (2 m height) through a Teflon tube. A high flow pump is used to ensure that the gas volume in the cell is fully replaced within a few seconds. Spectra are typically recorded with an integration time of 10 seconds. A GPS-receiver is used to register the position of the vehicle every second. The concentration in the spectra is analyzed in real time by fitting a set of calibrated spectra from the Hitran infrared database (Rothman 2003) and the PNL database (Sharpe 2004) in a least-squares fitting procedure. Compounds being analyzed include ethylene, propylene, total alkane mass (based on fitting cross sections of ethane, propane, n-butane, i-pentane, n-octane), water, methane, CO, CO_2 and N_2O. The analysis routines are very similar to the ones for SOF, but less complex because strong absorption by atmospheric trace gases (water, methane, CO_2) has less consequence at the shorter path length in the MeFTIR measurement cell.

The MeFTIR tracer approach has been tested in a so called gas release “blind test” together with other techniques in U.S. (EREF 2011). In that test, methane was released from an area-distributed source in four different configurations and flow rates ranging from1.1-3.3 g/s. At a downwind distance of 400 meters MEFTIR retrieved the fluxes within 6% in 3 cases and 19% in the fourth. This is consistent with other validation experiments, showing a flux estimate accuracy of better than 20%. Concentration measurement by FTIR is a widely used procedure, and the main uncertainties are associated with the absorption cross sections (typically < 3.5%) and spectral retrieval, with an aggregate uncertainty better than 10% in the analysis. Concentrations are monitored in real time in order to detect emission plumes and to judge whether any interfering sources are being sampled. Unwanted signals from local traffic exhaust or from the measurement vehicle itself could be filtered out by looking at the carbon monoxide (typical exhaust compound) concentrations. A stationary source is, on the contrary to any local traffic plumes, characterized by recurrent downwind plumes. Transient and non repeatable observations are therefore excluded from the results. Furthermore, measurements of ambient concentrations of methane and carbon dioxide (with known atmospheric concentrations) are used for consistency check.

3. Mobile White Cell DOAS (MW-DOAS)

The ground level mass concentration of Benzene, Toluene, Ethylbenzene, meta- and para-Xylene (BTEX) was measured using a mobile real-time system: mobile Whitecell DOAS (MW-DOAS). The Mobile White cell DOAS system consists of an open, 2.5 m long optical White cell that is mounted on the roof of the measurement vehicle (see Figure 4). By multiple reflections in the White cell mirror system an overall path length of 210 m is obtained, resulting in low detection limits (ppb). The light signal from the internal lamp is transmitted through the White cell and then analyzed in a DOAS spectrometer, using the UV wavelength region 255 - 285 nm.

A measurement begins by acquiring a reference spectrum outside the plume, usually upwind of the facility. Spectra are then sampled and averaged continuously while driving through emission plumes. The averaging time is set to around 8 seconds in order to achieve acceptable SNR (see below). This is the lower limit of the temporal sampling between independent measurements, but the spatial sampling is also dependent by the vehicle’s velocity. A typical driving speed for MW-DOAS measurements is 10-20 km/h for sufficient plume sampling.

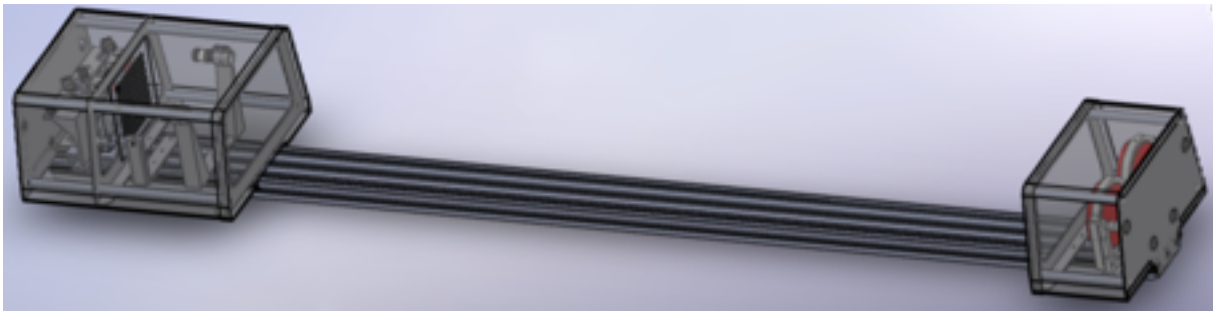


Figure 4 The open path MW-DOAS cell having an overall optical path-length of 210 m.

The spectra are geo-tagged and evaluated online using the standard DOAS technique, giving information of plume locations and constituents. The data is later post evaluated and merged with the corresponding MeFTIR data to produce a plume specific BTEX/Alkane mass ratio. The mass ratio of BTEX/Alkanes is then used to calculate the aromatic flux from individual sub areas where alkane fluxes have been measured by SOF. Specific area plumes are ideally probed at several times, and an overall average of all plume transect BTEX/Alkane ratios is then made. The method requires in situ access to the plume of the studied source, and as instrumentation typically are mounted on a truck, highly elevated sources with a strong plume lift like hot flares, chimneys and high process towers will not be possible to survey at close distance.

The MW-DOAS technique has been validated in various surveys by comparison with canister samples acquired at several different locations and which were subsequently analyzed by gas chromatography (GC-FID). The validation shows that the result from MW-DOAS lies well within 10% of the result of the certified canister results for BTEX. Due to an absorption cross-section too weak to be used with reliability in the DOAS analysis, the ortho isomer of the Xylene has been omitted in this comparison. When total Xylene is presented in the present survey, the sum of m-and p-Xylenes from the MW-DOAS measurement is multiplied by 1.32. This number comes from a ratio comparison of Xylene isomers in 49 canister samples analyzed by GC/FID and taken from eight refineries and tank parks from two countries. The standard deviation in this comparison was 0.07 and adds a 4.5% uncertainty to the total Xylene concentration. Hence, the Xylene concentration from MW-DOAS is defined as the sum of the measured m- and p-isomers and the inferred o-isomer.

The MW-DOAS system has been used in previous campaigns in USA during 2013 with good results. During the 2013 DISCOVER-AQ campaign in Houston, Texas, the system was run in parallel to a mobile Proton Transfer Mass spectrometer (PTrMS) lab as a validation check. The results of Benzene, Toluene and Styrene was compared and showed good agreement, with the PTrMS showing slightly elevated Benzene concentrations compared to the MW-DOAS. The sensitivity of MW-DOAS is less than 1 ppb for benzene, less than 3 ppb for Toluene, Ethylbenzene and m-Xylene and as good as 0.5 ppb for p-Xylene.Since the distribution of the BTEX constituents varies with source we also present the Benzene to alkane ratio to facilitate the calculation of benzene flux and identify specific Benzene sources.

Unwanted BTEX signals from local traffic exhausts are generally only significant in congestions (at traffic lights etc.) or in confined spaces, e.g. tunnels. Apart from this, large emitters are also occasionally seen elsewhere. They are generally recognized, partly by their typical gasoline composition signature and partly by their transient nature. A stationary BTEX source is, on the other hand, characterized by recurrent downwind plumes. Transient and non repeatable BTEX observations are therefore excluded from the result. Note that all concentrations are above the reference/background.

4. Wind Measurements and Auxiliary Data

Wind LIDAR

An infrared 3D wind LIDAR is used to measure vertical wind profiles of wind speed and wind direction. The unit , produced by Leosphere (France), provides wind profiles in the vertical range 40 to around 200 m above surface level with, or even further if atmospheric conditions allow it. Within this range data can be retrieved in 25 m vertical resolution. Stated wind speed accuracy is 0.5 m/s. Applicable radial wind speed range is -30 to 30 m/s. 10 minute averages are used for flux calculations. The principle of detection is based on the Doppler shift of the infrared pulse that the instrument sends out and retrieves. Numerous validation surveys attesting the accuracy of the WindCube LIDARs are available through: www.leosphere.com.

Figure 5The WindCube 100S (Leosphere) LIDAR

Wind Masts

Meteorological parameters are measured at selected sites using a portable 5-10 m mast. This mast is equipped with a calibrated RM Young 05108 “prop and vane” anemometer and a Campbell Scientific CR5000 data-logger. An additional wind mast with a Gill Wind Sonic ultrasonic sensor was occasionally used to measure wind speed and direction.

The weather mast is installed at an open location near the measured source and with un-obstructed fetch for wind directions for SOF measurements. The sensor is adjusted to point towards magnetic north but compensated to true north in the post-processing. Wind speed information from the 10-m mast is the main source of wind information for the sources at near distance since plumes are found to be closer to the ground as compared to large refinery plumes.

Airmar (Mobile Weather Station)

An Airmar WeatherStation (200 WX) sensor is installed on the roof of the measurement vehicle to complement the other wind measurements and give local ground winds at the vehicle.

The wind information from the car-based Airmar is not used for flux calculation since the wind field at street level can be heavily disturbed and turbulent. This Airmar only acts as a real-time aid to keep track of the plume directions when making the gas emission measurements.
The Airmar provides wind speed and direction relative to true north (compensating for vehicle position), air temperature, pressure and relative humidity. It also provides GPS positions which may be used as back-up to the other GPS-antenna.

GPS

The FluxSense vehicle is equipped with two standard USB GPS-L1 receivers (GlobalSat BU-353S4) hooked up to the SOF and DOAS-computers. They are placed horizontally by the windscreen and at the sun-roof for optimal reception. The receivers gives the position at a rate of 1 Hz.