Low-Cost Options for Moderate Levels of Mercury Control

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ABSTRACT

On March 15, 2005, EPA issued the Clean Air Mercury Rule (CAMR) (subsequently vacated in February 2008), which required phased-in reductions of mercury emissions from electric power generators. ADA-ES, Inc., with support from DOE/NETL and industry partners, conducted evaluations of EPRI's TOXECON II™ process and of high-temperature reagents to determine the capabilities of sorbent/reagent injection, including activated carbon, for mercury control on different coals and air emissions control equipment configurations in accordance with the existing CAMR regulations.

This is the final site report for TOXECON II™ tests conducted at Entergy's Independence Steam Electric Station (ISES), one of two sites evaluated in this DOE/NETL program. The other site in the program is MidAmerican's Louisa Station, where high-temperature reagent testing was conducted. This project was funded through the DOE/NETL Innovations for Existing Plants program. It was a Phase II project with the goal to develop mercury control technologies that can achieve 50–70% mercury capture at costs 25–50% less than baseline estimates of $50,000–$70,000/lb of mercury removed. Results from testing at Independence indicate that the DOE goal was successfully achieved. Further improvements in the process are recommended, however.

Independence typically burns Powder River Basin (PRB) coal in its 880-MW Unit 2. Various sorbent injection tests were conducted on 1/8 to 1/32 of the flue gas stream either within or in front of one of the four ESP boxes (SCA = 542 ft^2/kacfm). Initial mercury control evaluations indicated that, although significant mercury control could be achieved by using the TOXECON II™ design, the sorbent concentration required was higher than expected, possibly due to poor sorbent distribution. Subsequently, the original injection grid design was modeled and the results revealed that the sorbent distribution pattern was determined by the grid design, fluctuations in flue gas flow rates, and the structure of the ESP box. To improve sorbent distribution, the injection grid and delivery system was redesigned and its effectiveness evaluated. The results are summarized along with the impacts of the TOXECON II™ process on ESP operation and particulate emissions.

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INTRODUCTION

The power industry in the U.S. is faced with meeting new regulations to reduce the emissions of mercury compounds from coal-fired plants. Power plants that burn Powder River Basin (PRB) coal and have only cold-side electrostatic precipitators (ESPs) for air pollution control represent a challenging configuration for cost-effectively controlling mercury emissions. Full-scale field tests have confirmed that the average native mercury removal at these PRB units is low, typically < 25%. In addition, the effectiveness of injecting standard, non-chemically treated, activated carbon is greatly diminished by the low halogen concentrations in the flue gas.

ADA-ES, Inc., with support from the Department of Energy's National Energy Technology Laboratory (DOE/NETL) and industry partners, conducted a sorbent injection test program at Entergy's 880-MW Independence Steam Electric Station (ISES) Unit 2. During the program, the test team investigated the mercury capture and operational impacts of using the Electric Power Research Institute's (EPRI) patented TOXECON II™ process, a low-cost mercury control option that does not compromise fly ash sales. This report presents TOXECON II™ test results from two different configurations at a unit equipped with a cold-side ESP. It includes 1) the results on mercury control performance of injecting treated and untreated sorbents and a sorbent/ash recycle mixture, 2) a discussion of how the sorbent lance injection grid design influences its mercury removal performance and operability, and 3) the impacts of the TOXECON II™ process on ESP operation and particulate emissions.

EXECUTIVE SUMMARY

In order to further the understanding of potential mercury control systems for power plants burning Powder River Basin (PRB) coals and using cold-side ESPs for air pollution control, DOE selected ADA-ES, Inc., to conduct a sorbent injection test program at Entergy's Independence Steam Electric Station (ISES) for mercury control using activated carbon injection (ACI) in a EPRI TOXECON II™ configuration. During four months of field testing, the project team investigated the mercury capture and operational impacts of using the EPRI TOXECON II™ process, where activated carbon is injected into the flue gas stream in mid-ESP, thereby allowing power plants that do have the ability to sell the fly ash by-product to continue to do so for over 90% of the fly ash.

The primary objective of testing at Independence was to determine the cost and effects of sorbent injection using EPRI's TOXECON II™ for mercury control in stack emissions from Unit 2. Unit 2 was chosen for this evaluation because it is equipped with a medium-sized, cold-side ESP (SCA = 542 ft^2/kacfm) for particulate control.

Native mercury was primarily in the elemental form and removal was low. Less than 20% mercury removal was typically observed during four rounds of Baseline testing. While firing PRB coal, the ESP B inlet mercury averaged 7.9 lb/TBtu during Baseline tests while the ESP B outlet averaged 6.6 lb/TBtu. While firing ColoWyo coal, ESP B inlet mercury averaged 1.2 lb/TBtu. Independence typically fires PRB coal.

Ensuring proper sorbent distribution is critical for effective mercury control. Good distribution is more challenging with TOXECON II™ than injection upstream of the ESP for three primary reasons:

1) The flue gas velocity at full load within the typical medium-sized ESP is usually 3 to 4 ft/sec compared to 40 to 50 ft/sec in the duct upstream of the ESP. The air flow velocity is reduced by increasing the cross sectional area in the direction of flow within the ESP. The increased cross sectional area requires a much larger sorbent injection grid and poses a greater challenge for proper sorbent distribution within the ESP in comparison to the inlet ducting.

2) The penetration of the sorbent from the lance into the gas is affected by the velocity in the ESP, which can vary from nominally 1 to 4 ft/sec. Consequently, varying boiler load can significantly impact the pattern of sorbent distribution. In contrast, the velocity upstream of an ESP is typically 30 to 60 ft/sec and the sorbent penetration across the gas stream is minimal at all boiler loads. Using typical lance conveying air velocities of 10 ft/sec, the change in flue gas velocity in the duct from low to high load will result in a change in sorbent penetration of the flue gas stream by less than 30%. The same load change in the ESP, with it lower flue gas velocities, results in the doubling (or greater) of the plume size of the sorbent distribution pattern.

3) The distance between the injection lances and the downstream mechanical collection field is limited (nominally 3 feet at Independence Unit 2).

Significant effort was expended during the TOXECON II™ program at Independence to optimize sorbent distribution, including redesign of the sorbent injection grid and delivery system. Lance improvements resulted from extensive modeling efforts by ADA-ES (physical), NELS (physical), and Reaction Engineering International (CFD). Three lance designs were evaluated, including the original single multi-nozzle lance. The initial design was used to evaluate four powdered activated carbon (PAC) sorbents during Parametric testing: NORIT DARCO® Hg, DARCO® Hg-LH, DARCO® E-10, and DARCO® E-11. Results from these initial tests indicated that mercury removal was limited to less than 80% at injection concentrations up to 10 lb/MMacf. The four materials showed differences in their mercury removal performance, but not as great as was expected based on previous testing at PRB sites using treated and untreated PAC sorbents. In February and March 2007, tests with lances redesigned to improve the sorbent distribution yielded 89% mercury removal using DARCO® Hg-LH at 5 lb/MMacf.

Injecting PAC in the TOXECON II™ configuration resulted in particulate spikes during outlet field raps observed in the continuous particulate monitor and in the stack opacity during some testing periods. Increasing the ESP power and increasing the final field rapping cycle timing were effective at minimizing opacity spikes due to PAC injection. Although there was no indication of increased particulate emissions based upon outlet particulate EPA Method 5 measurements collected downstream of the ESP with and without PAC injection, additional testing is required to determine with any certainty whether TOXECON II™ implementation would result in a sufficient increase in particulate emissions to trigger a permit review.

As a budgetary estimate, a permanent sorbent injection system would cost $4.3M ± 25%, on an installed basis in 2007 dollars. Assuming the use of DARCO® Hg-LH at a rate of 5 lb/MMacf, which would provide nominally 80% removal, the annual operating costs would be approximately $8.69M ± 15% in 2007 dollars, including the cost of ash disposal and the revenue.

The goals for the program established by DOE/NETL were to reduce the uncontrolled mercury emissions by 50 to 70%, at a cost 25 to 50% lower than the target established by DOE of $60,000/lb mercury removed. This goal was exceeded at Independence. Results from testing indicated that 80% mercury removal could be achieved using DARCO® Hg-LH at a sorbent cost 75% lower than the benchmark. The estimated costs for control at Independence are 1.49 mills/kWh, or $14,500 per pound of mercury captured, while preserving the salability of the fly ash. Additional improvements to the injection system design to increase mercury removal by improving the sorbent distribution are anticipated with ongoing development of the technology.

DESCRIPTION OF OVERALL PROGRAM

The test program at Entergy's Independence Steam Electric Station (ISES) is part of a program funded by the Department of Energy's National Energy Technology Laboratory (DOE/NETL) and industry partners to obtain the necessary information to assess the feasibility and costs of controlling mercury from coal-fired utility plants using either high-temperature sorbents or EPRI's TOXECON II™ process. High-temperature sorbents were included in the test program at MidAmerican's Louisa Station. Sorbent injection into an electrostatic precipitator (ESP), TOXECON II™, is the focus of testing at Entergy's Independence Station. Both of the host sites fire Powder River Basin (PRB) coal and currently achieve less than 20% native mercury removal. At the onset of the program, American Electric Power's (AEP) Gavin Plant and MidAmerican Energy Company's Council Bluffs Station were also considered as potential host sites. After further consideration of the testing conditions at the AEP Gavin site, the test team dropped this site from the testing efforts. A portion of the funding allocated to testing at Gavin was transferred to a follow-on evaluation project at Independence in 4Q06. The Council Bluffs project was cancelled in 1Q07 due to lack of DOE project funding for FY 2008.

Key descriptive information for the final two host-site plants is included in Table 1. Table 2 shows the field test schedule for the final program. The technical approach followed during this program allowed the team to 1) evaluate various mercury control technologies at plants with different configurations, and 2) perform Long-Term testing at the optimum conditions for at least one month. These technical objectives were accomplished by following the series of tasks listed below. These tasks were repeated at both test sites.

Task 1: Site Coordination, Kickoff Meeting, Test Plan and QA/QC Plan

Task 2: Design and Install Site-Specific Equipment

Task 3: Sorbent Selection

Task 4–6: Field-Tests

Task 7: Data Analysis

Task 8: Sample Evaluation

Task 9: Site Report

Task 10: Technology Transfer

Task 11: Management and Reporting

A detailed description of each task is given in Appendix A1.

Table 1. Host site key descriptive information.

	Entergy Independence	MidAmerican Louisa
	TOXECON II™	**High-Temperature Sorbents**
Unit No.	1	1
Size (MW)	880	700
Test Portion (MW)	110/55	700
Coal	PRB	PRB
Heating Value (as rec'd.)	8,870	8,500
Sulfur (% by weight)	0.32	0.32
Chlorine (ppm)	50	50–100
Mercury (μg/g)	0.04	0.08
Particulate Control	Cold-Side ESP	Hot-Side ESP
SCA/fields (ft^2/kacfm)	542/4	459/5
Sulfur Control	Compliance Coal	Compliance Coal
Disposition of Ash	Sold	Sold
Typical Inlet Mercury (μg/dncm)	6–7	11.1–13.4
Typical Mercury Removal	10–20%	0–10%

Table 2. Field-testing schedule.

Site	2005		2006				2007	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Louisa								
Independence								

There are several organizations participating in this program. The organizations providing co-funding for tests at Independence include:

DOE/NETL
EPRI
ADA-ES, Inc.
Entergy – Independence Steam Electric Station*
Alliant
ATCO Power
DTE Energy
Oglethorpe Power
Southern Company
Xcel Energy
NORIT Americas Inc.
Arch Coal
EPCOR

**Indicates host site.*

Key members of the test team include:

Entergy Independence Station
- Project Manager: Richard Roberts
- Independence Project Engineers: Todd Bradberry, Steve Coker
- Environmental Specialist: Kellee Fletcher
- Fossil Environmental Support: Joe Hantz

ADA-ES, Inc.
- Project Manager: David Muggli/Sharon Sjostrom
- Project Engineer responsible for all Site Activities: Tom Campbell

DOE/NETL
- Project Manager: Andrew O'Palko

EPRI
- Project Manager: Ramsay Chang

Reaction Engineering International
- Connie Senior

INDEPENDENCE PROJECT OBJECTIVES AND TECHNICAL APPROACH

The main objective of testing at Entergy's Independence Steam Electric Station was to determine the cost and effects of sorbent injection using EPRI's TOXECON II™ for mercury control in stack emissions from Unit 2. Unit 2 typically fires 100% western subbituminous PRB coal from the North Antelope mine. The unit is equipped with an electrostatic precipitator (ESP) for particulate control and uses compliance coal for SO_x control. The technical approach for this project consisted of two primary field activities: the design and fabrication of the sorbent injection system and field-testing. The general approach for the field-testing was to follow a series of subtasks as listed below.

1. Sorbent selection and screening
2. Sample and data collection coordination
3. Baseline tests
4. Parametric tests
5. Long-Term tests
6. Ash Recycling tests

Parametric and Long-Term test conditions were chosen to meet an overall objective of evaluating the TOXECON II™ system for enhanced mercury removal at cold-side ESP units firing PRB coal. TOXECON II™ is a retrofit mercury control technology that requires minimal capital investment because it requires only minor retrofits to the ESP for the sorbent injection system instead of installing a separate, secondary particulate control device. A sketch of the concept is shown in Figure 1. The primary benefit of the TOXECON II™ process is that typically 90+% of the fly ash is collected in the ESP prior to sorbent injection, dependent upon the injection grid location. With TOXECON II™, sorbent is injected between the mechanical collection fields of an ESP, generally after the first two fields, allowing the untreated ash to be segregated from the treated sorbent/ash mixture through the design of the ash handling system. Thus, the advantage for plants such as Independence that typically sell fly ash for use in concrete is that TOXECON II™ maintains the salability of most of the ash.

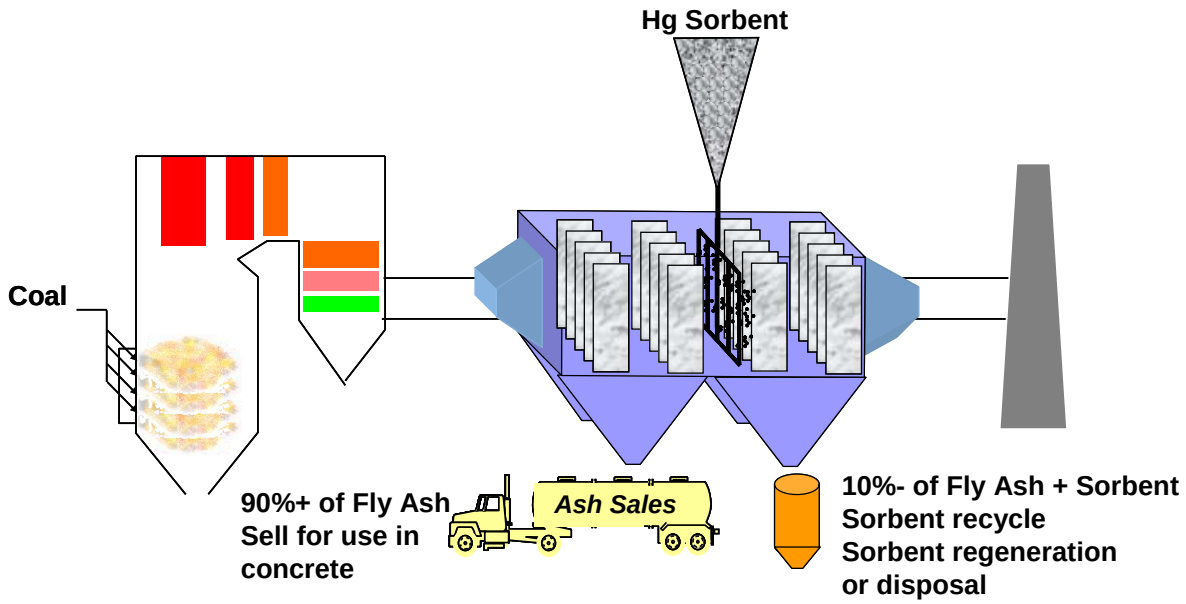


Figure 1. TOXECON II™ general arrangement.

The evaluation at Independence Unit 2 focused on activated carbon injection (ACI) using treated and untreated sorbents and the particulate pass through of the TOXECON II™ system. Reinjection of collected sorbent/ash mixture was also evaluated for mercury control.

Preliminary analyses indicated that the TOXECON II™ process required higher than expected sorbent concentrations to achieve significant mercury removal at Independence. Consequently, the test team established an additional objective: evaluate the possibility that the sorbent injection grid failed to distribute sorbent uniformly or its injection nozzles became plugged.

To determine further whether the sorbent usage requirements were a result of poor sorbent distribution, EPRI funded three independent modeling efforts:

1. Computational Fluid Dynamics (CFD) modeling by Reaction Engineering International
2. Physical modeling of the ESP and injection grid by NELS Consulting Services
3. Physical modeling of the lance design by ADA-ES

An outcome of the modeling efforts included redesigning the sorbent injection grid and delivery system and its subsequent evaluation. The results of this follow-on test program are also presented here. Most of the early evaluations were conducted on 1/8 of the 880-MW Unit 2 flue gas stream (Appendices A1–3 and A5); later evaluations were generally on 1/16 or 1/32 of the unit (Appendix A4).

Importance of Testing at Independence

The project team selected Independence Unit 2 as the TOXECON II™ test site because it was representative of a significant number of coal-fired plants constructed from 1970 to 1990. Independence is configured with a cold-side, large-sized ESP (SCA = 542 ft^2/kacfm)

and fires pulverized PRB coal. Moreover, the ESP is controlled by a Neundorfer control system, thus enabling several parameters to be monitored. Another key feature of Unit 2 is that it has the ability to modify its fly ash collection procedure. A percentage of the fly ash becomes mixed with sorbent downstream of the injection grid during the TOXECON II™ process. Because the sorbent/fly ash mixture from each row of collection hoppers could be separately collected, Entergy maintained the option to sell most of their fly ash and the effectiveness of recycling the sorbent/fly ash mixture could be tested.

The physical layout of the ESP and combination of control features allowed the TOXECON II™ process to be evaluated in two configurations: the first with PAC injection upstream of two collection fields and an effective SCA = 270 ft^2/kacfm and the second with injection upstream of a single collection field and an effective SCA = 135 ft^2/kacfm. Independence is operated as a swing load unit, therefore responding to rapid large swings in load conditions, allowing further evaluation of the performance of the mercury removal system.

Limited data are available for mercury removal using the TOXECON II™ injection configuration. In an earlier short-term test at the Great River Energy Coal Creek station (a lignite-coal-burning plant), TOXECON II™ showed a 50% reduction in mercury emissions at sorbent injection rates of 1.25 lb/MMacf. With these results, the overall mercury removal costs are only 10 to 15% of what was estimated in DOE and Environmental Protection Agency (EPA) cost projections. The project at Independence provided the opportunity to evaluate sorbent injection using the TOXECON II™ injection system through both short-term Parametric testing and over a 30-day Long-Term testing period. The Long-Term testing period was aimed at identifying balance-of-plant impacts that may not be apparent during the shorter test.

Independence Site Description

General Description of Unit 2

The Independence Steam Electric Station is located in Independence County, Arkansas, near the town of Newark and consists of two load-following 880-MW (gross) pulverized coal, electric generating units that burn PRB coal. The boiler is a balanced-draft Combustion Engineering tangentially fired divided-furnace. Compliance coal to control SO_x emissions and over-fire air is used to reduce NO_x emissions reductions. The combustion controls use a proprietary neural net scheme to monitor performance, limiting operator intervention and allowing long-term steady-state conditions. Gas exiting the boiler enters two Ljungström regenerative air preheaters (APH), each with its own outlet duct. The test unit (Unit 2) is equipped with a cold-side ESP for particulate removal. The ESP consists of four boxes arranged in a piggyback configuration, two on top and two on the bottom, operating in parallel. Further description of the ESP is provided below. Each APH outlet duct feeds one of the stacked pairs of ESP boxes. Key operating parameters for Unit 2 are included in Table 3.

Table 3. Independence Unit 2 key operating parameters.

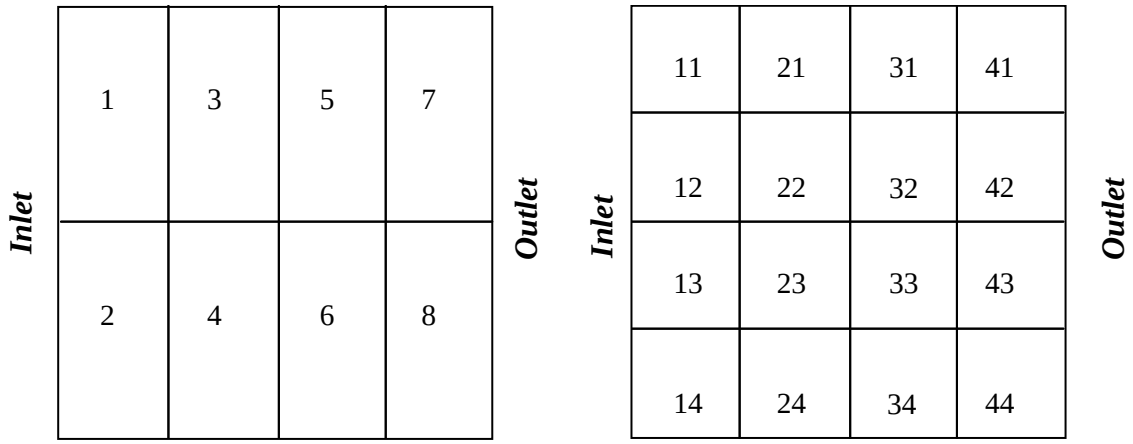
Unit	2
Size (MW)	880
Test Portion (MWe)	26 to 106
Flue Gas Flow (kacfm)	3,200
Coal	PRB
Heating Value (Btu/lb, as received)	8,600–8900
Sulfur (% by weight, dry)	< 0.4
Chlorine (%)	< 0.01
Mercury (μg/g)	0.03–0.08
Particulate Control	Cold-Side ESP (SCA = 542 ft^2/kacfm)
Sulfur Control	Compliance Coal
Air Pre-Heater	Regenerative
Ash Reuse	Sold

Independence is a load following plant; each unit provides load for a different electrical grid and can only be cross-connected with difficulty. A unit responds to the load dispatch requests for load changes as needed. The neural net control system used allows Unit 2 to change load at approximately 25 MW per minute, and can go from under 300 MW to over 800 MW in less than an hour.

ESP Test Box Description

Each of the four Unit 2 ESP boxes has eight transformer-rectifier (TR) sets and 16 ash collection hoppers, configured as shown in Figure 2. The boxes are a CE Walther rigid-frame construction and have collection plates running the width of a box with 12-inch plate-to-plate spacing. The structural steel and the plug flow between the collection plates minimize the crossover of the flue gas between the two halves of a box.

Each box was initially designed as a hot-side ESP prior to operation as a cold-side ESP. This design feature provides for lower velocities within the ESP box than typical for most cold-side ESPs. Duct flue gas flow velocities prior to the ESP inlet are maintained at normal rates (approximately 50 fps) through the addition of bluff bodies in the ductwork, restricting flow areas and increasing velocities. Approximately one-fourth of the total flue gas stream passes through each box. For a given stacked pair of boxes, both ends of one-half of one box are connected to the matching halves of its partner via vertical ducts; i.e., each pair has two inlet and two outlet ducts.



ESP Electrical Fields **ESP Ash Hoppers**

Figure 2. ESP electrical field and ash hopper configuration and numbering scheme.

The combination of the above features made it convenient to use one ESP box both for testing and as a control even though the two halves of the box are not physically divided. The lower ESP box (designated "B") of the northern pair of boxes was selected for testing purposes. Testing on B-box minimized the sorbent transport distance from the most convenient location for the injection system skid and PAC storage silo. The west side of B-box (containing electrical fields 1, 3, 5, and 7) was designated the test side and the east side (containing electrical fields 2, 4, 6, and 8) as the control side. A line schematic of the one-half of the gas flow is shown in Figure 3. A photo showing the north access to the ESP B/D pair of outlet ducts is given in Figure 4. Details of the sorbent injection grid and monitoring locations are described later. A photo of NELS' 1/12 scale physical model of the one-half of one ESP box is presented in Figure 5 for additional reference.

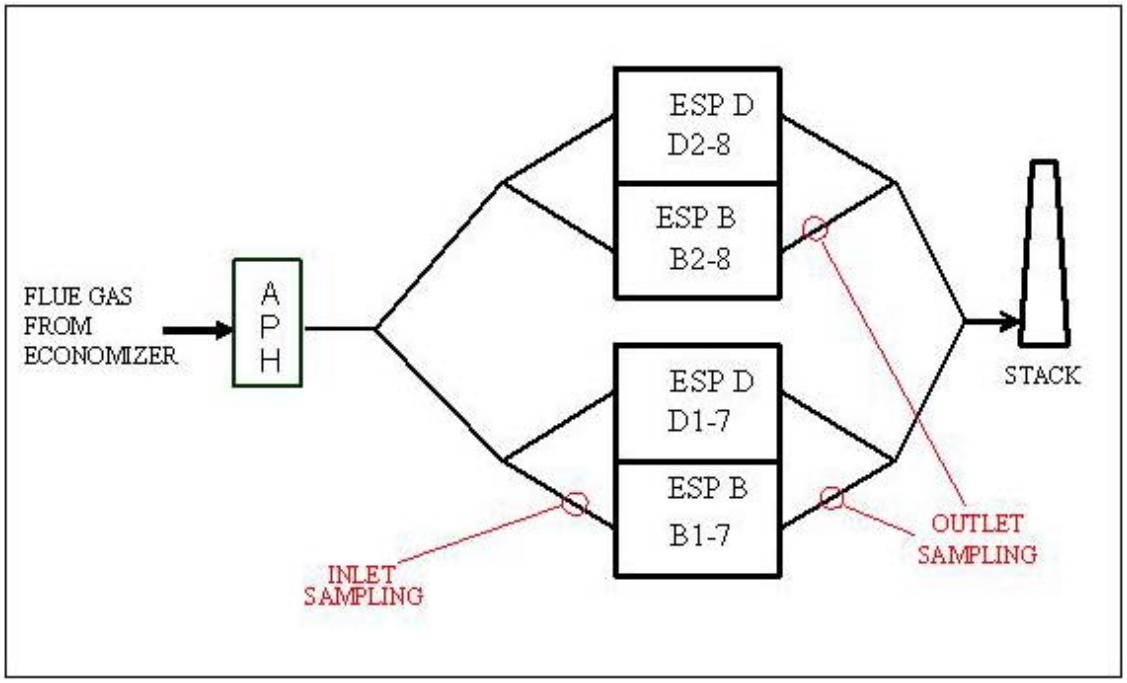


Figure 3. Line schematic of one-half of the Unit 2 flue gas flow.

Figure 4. Photo of north ESP B/D outlet duct–Unit 2.

Figure 5. Photo of NELS 1/12 scale model. One-half of one Unit 2 ESP box. (Third field plates removed in photo.)

ESP Control System

The plant has programmed the Neundorfer ESP control system to monitor the amount of ash each hopper collects. This feature allows differences in hopper collection to be monitored, e.g., during injection and non-injection periods and when injection locations are changed. Moreover, the ESP control system can easily change the plate and discharge electrode rapping cycle, both duration and timing, thereby providing data to analyze the impact of rapping changes to the ESP operating parameters.

Another function of the ESP control system is the Precipitator Optimization System (POS). This function allows the ESP control system to monitor several parameters such as plant opacity, back corona, etc., and to vary the entire ESP power output to minimize power usage while maintaining opacity within target limits. The POS also allows separate TR sets to be removed from its control and operated manually to quantify the impact of varying power levels on the particulate emissions.

Ash Handling System

The fly ash handling system is a dilute phase pressure system with pressure feeders at each ESP hopper outlet, and has two storage silos—typically one allocated for each generating unit. During test periods involving carbon injection and for separate Entergy-sponsored test runs of a Colorado-mined higher Btu coal, the system segregated the ash/carbon mixture from the hoppers under the corresponding test fields. Usually once per day, the plant would manually initiate the ash removal from the carbon-loaded hoppers for transport to the dedicated segregated storage silo. This practice allowed separate storage of the carbon/ash mixture for either disposal or for reclaim for use during the ash recycle testing. Although Independence Unit 2 normally burns 100% PRB coal, for several short periods during the testing, the plant burned a western bituminous coal from the ColoWyo mine. When the ColoWyo coal was burned, the plant transported all of the ash to the dedicated test silo.

Sorbent Injection and Monitoring Locations

Sorbent Injection Locations

Two independent sections each of sorbent injection grids were placed at two locations within the ESP B-box. The first dual injection location was between electrical fields B-3 and B-5 and the second dual injection location was between electrical fields B-5 and B-7. A representative sketch of the test configuration is given in Figure 6. As will be described in greater detail later, some injection tests used only a portion of the dual injection grid at a single injection location.

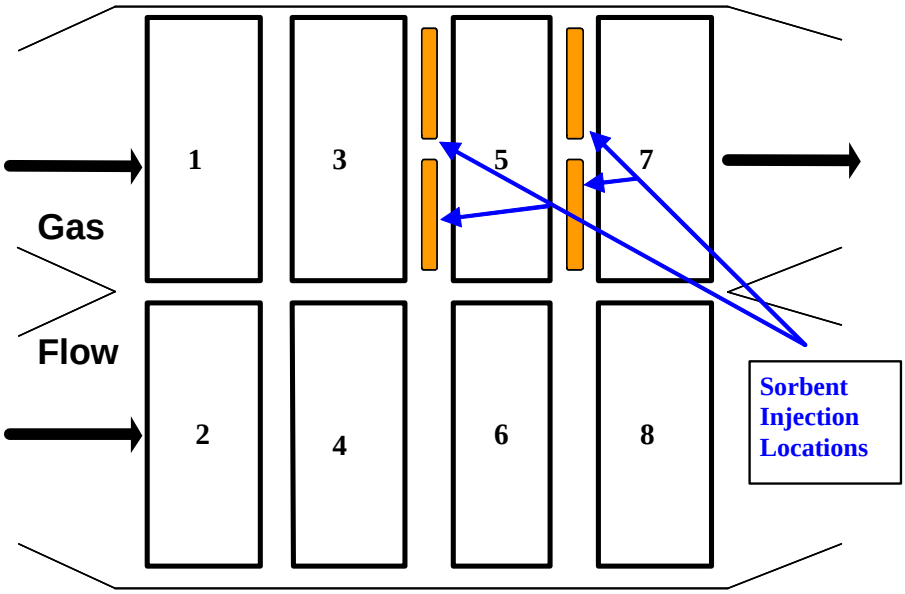


Figure 6. Plan view sketch of electrical fields for ESP B-box showing sorbent injection grid locations.

Flue Gas Sampling Locations

During testing on Unit 2, flue gas was sampled from the vertical inlet and outlet ducts of the ESP B-box. The inlet ducts to the box have an internal divider island resulting in a dead space in the center of each duct. This divider was installed during the hot to cold-side ESP conversion. It serves to maintain flue gas velocities and thus minimize fly ash from dropping out in the ducts. Both the inlet and outlet ducts contain a horizontal strip of access ports. The B-box test side inlet duct port locations and numbering as viewed from the top of the box are shown in Figure 7. The outlet port configuration differs slightly from the inlet. On the inlet duct, port 4 is approximately 10” closer to port 3 than on the outlet duct. Port 5 on the inlet is blocked by a diagonal structural brace. The outlet test port access was somewhat restricted due to interference from the TR sets.

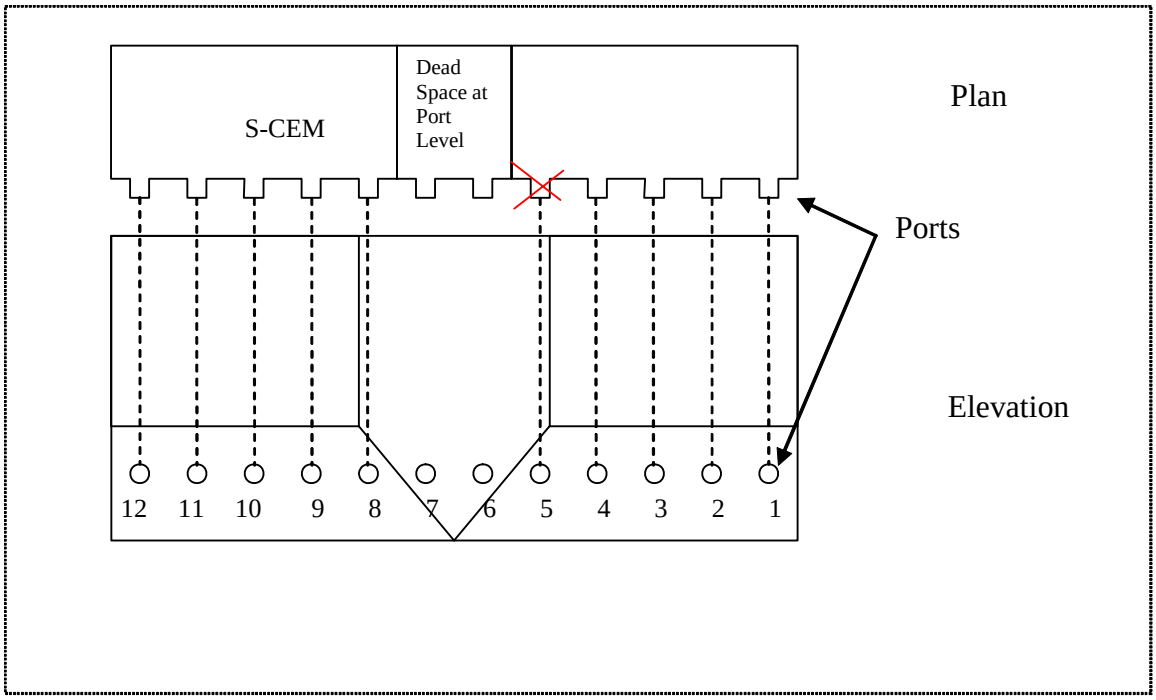


Figure 7. ESP B test side inlet duct access port configuration; plan view (top) and elevation view (bottom). Port 5 was blocked.

Two mercury Semi-Continuous Emissions Monitors (S-CEMs) were used during the test period to monitor both upstream and downstream of the ESP B-box. All upstream S-CEM mercury measurements were taken from the inlet duct on the test side of the B-box. Downstream mercury measurements were taken from the vertical outlet ducts on both the control side (Total Mercury Concentrations only) and test side (both Total and Elemental Mercury concentrations) of the B-box. During initial testing, port 9 on the test inlet duct and test outlet duct were used as the location for monitoring vapor-phase mercury on the ESP B-box. After the August 2005 tests, the test outlet monitoring location was primarily from port 8 when injecting across the entire injection grid or port 2 when injecting across half (west side) of the test side ESP. In addition to the S-CEM mercury monitoring, Sorbent Trap Method (STM) mercury measurements were taken from the B-box test side inlet and outlet ports throughout the test period. Continuous particulate monitors (CPMs), both opacity sampling (BHA CPM 5000) and direct particulate measurement (Thermo Scientific TEOM Series 7000) CPMs, were used to monitor particulate emissions in the outlet ducts of both the control side and test side of the B-box. The downstream monitoring locations were in-line with the sorbent injection grid lances to assure representative outlet measurements. The sketch in Figure 8 depicts the locations of the S-CEMs and the CPM (BHA CPM 5000) for the test side of the B-ESP. The TEOM Series 7000 was installed in one of the test side outlet ports next to the test side S-CEM. A second BHA CPM 5000 was installed on the control side of the B-ESP to monitor variations in opacity across the outlet ducts of the B-ESP during injection periods.

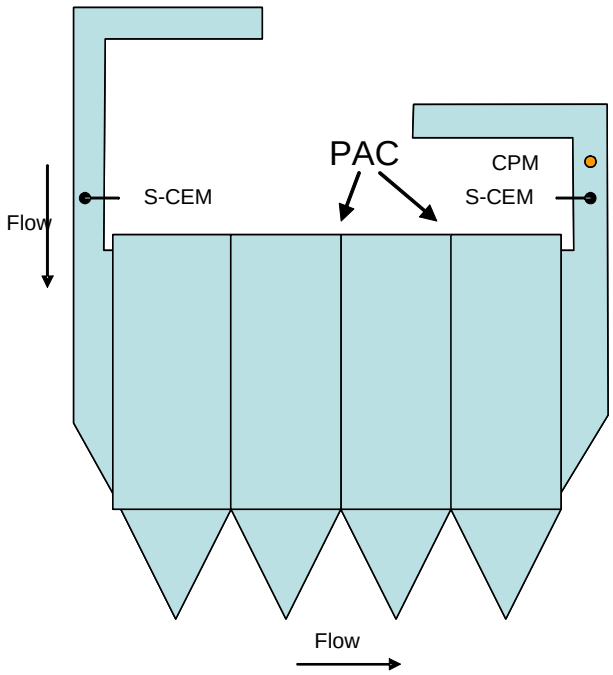


Figure 8. Elevation sketch of ESP B-box at Independence Unit 2. Indicates injection and monitoring locations for the west half of the box.

Equipment Descriptions

Sorbent Delivery Systems

Two separate methods were used to deliver sorbent for test injection: a NORIT Americas Porta-PAC™ system used for most Parametric testing and a silo delivery system used for Long-Term and ash recycling testing. Both methods use a similar feed system whereby the sorbent is metered by variable speed screw feeders into eductors. Regenerative blowers provide the conveying air to the eductor and the air-sorbent mixture then flows to the injection points. Figure 9 is a photo showing the Porta-PAC™, carbon injection silo, and feeder trains at the Independence test site.

Figure 9. Porta-PAC™ and carbon injection storage silo and feeder trains at the Independence test site.

The auger feed rate is calibrated by measuring the rate that sorbent flows into a collection bag for a given number of auger revolutions. The flow rate (lb/hr) is determined by dividing the weight of the collection bag by the collection time period. Adjustments to the controller set point compensated for feed screw wear as well as different sorbent densities. This calibration procedure applies to both the Porta-PAC™ and silo delivery systems.

The sorbent feeder was configured to adjust the feed rate based upon on a feed-forward signal from the plant representing the amount of coal fed into the boiler. An algorithm was developed to correlate coal feed rate to duct flow (using a load signal from the plant to the silo PLC) so that the sorbent injection concentration could be maintained with variations in load.

Prior to the TOXECON II™ follow-on testing period, the regenerative blower was replaced. The replacement blower is configured with a variable speed blower and has a maximum rated flow of 700 cfm. This flow rate was larger than required, but allowed for flexibility during the demonstration program. A photo of the blower is shown in Figure 10.

Figure 10. Upgraded blower system used in 2007.

Porta-PAC™ Delivery System

For most Parametric tests, sorbent was delivered by a NORIT Porta-PAC™ system, which consists of a portable blower/feeder train with a hoist for holding 900-lb super-sacks of sorbent. The sorbent filled super-sacks are delivered to the site on a flat bed trailer and are individually loaded onto the Porta-PAC™ unit, enabling an easy transition from one sorbent to another without contamination or waste. During testing at Independence Unit 2, flexible hose was used to transport the sorbent from the feeder to the distribution inlet manifolds located at the top of the ESP test B-box.

An individual super-sack contains sufficient sorbent for approximately 8 hours of testing at the typical Parametric test injection conditions at Independence (full load, steady state conditions). The Porta-PAC™ system can adjust the feed rate based on a plant load signal input into the feeder controller. However, the Porta-PAC™ feed rate was operated manually for Parametric testing because the plant was operating steadily at full load conditions. During Parametric testing, feed rate calibrations occurred once per day, immediately prior to the start of a test. If the feed rate appeared to have varied during the test, a second calibration was performed at the end of the test.

Storage Silo Delivery System

The ACI delivery system for the Long-Term tests consisted of a bulk-storage silo, with approximately 20-ton storage capacity, and twin blower/feeder trains. Powdered activated carbon (PAC) was delivered by bulk pneumatic truck and pneumatically conveyed into the silo which is equipped with a bin vent bag filter. Sorbent was fed from the silo into the feeder trains where it was mixed with transport air and conveyed to the distribution inlet manifolds at the top of the ESP test B-box. The transport air quantity was constant, but a variable speed screw feeder metered the sorbent into the transport air through an eductor. A programmable logic controller (PLC) system controlled the delivery system operation, allowing testing at various sorbent injection rates or the system to respond to load changes by the unit.

During Long-Term testing, feed rate calibrations occurred once per week and the actual feed rate continuously checked against the change in silo weight determined from load cells on the silo support legs. For Long-Term testing, actual feed rates were 1.1 times the indicated feed rate on the controller, e.g., an indicated feed rate of 4 lb/MMacf corresponded to an actual feed rate of 4.4 lb/MMacf. All test results are based on the actual feed rate.

TOXECON II™ Injection System

ADA-ES had previously performed a brief test of the TOXECON II™ concept at the Great River Energy Coal Creek station. Owing to the high levels of mercury removal observed at Coal Creek, its grid design was used as the basis for the initial grid design at Independence Unit 2 without an attempt to model the injection distribution. However, the Coal Creek design required higher than expected sorbent concentrations at Independence to achieve satisfactory performance. After the completion of the initial 30-day Long-Term and follow-on continuous injection period during October through December 2005, the injection grid was modeled and then redesigned in an attempt to improve its performance.

Initial Injection Lance Grid Design

The ESP B existing internal structural steel and the arrangement of the discharge electrode support frames dictated the design and placement of the sorbent injection grids. In order to maintain sufficient clearance between the injection grids and the energized discharge electrode frames, each injection location consisted of two separate grid assemblies. That is, two grids were placed side-by-side perpendicular to the air flow direction through the ESP between fields B-3 and B-5 and also between fields B-5 and B-7, for a total of four separate grids (see Figure 6 for a sketch of the grid locations).

Complete injection grids were installed within the test side of the B-box, each with a single inlet connection at the top of the box to minimize penetrations through the ESP insulator penthouse. An injection grid assembly consisted of a horizontal header with eight equally spaced vertical ports. Individual injection distribution pipes (lances) were suspended vertically from each port. Each lance had eleven nozzles of varying sizes to distribute the air-sorbent mixture between the electrical fields. The two outer lances, one on each side, had a lesser number of ports to minimize PAC distribution into the side wall and vertical

structural steel supports. The injection nozzles were spaced equally along a lance except for minor variations necessary to avoid PAC discharging directly onto diagonal structural steel members. A schematic showing two side-by-side injection grid assemblies is given in Figure 11.

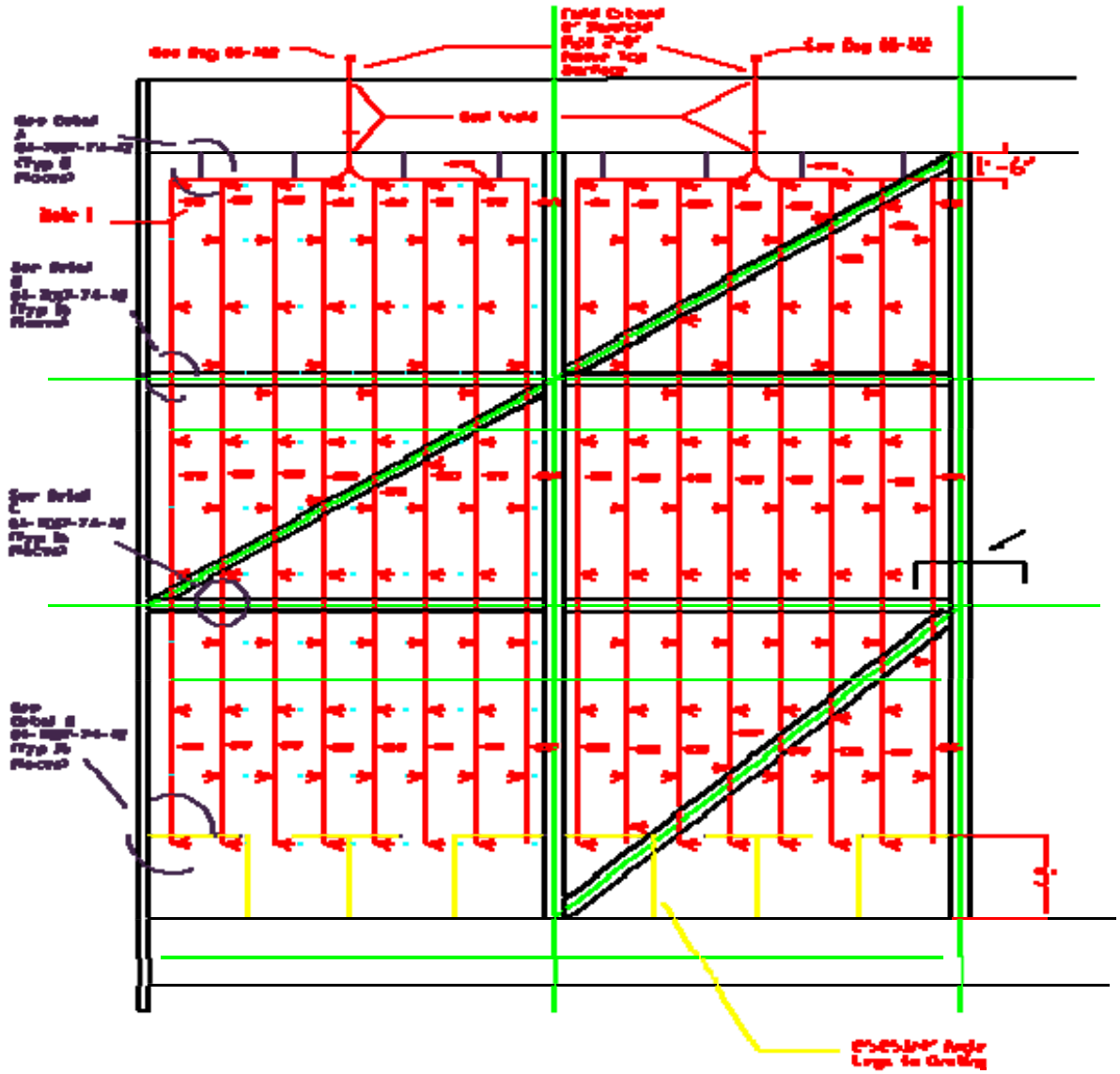


Figure 11. Schematic of injection grid.

The injection grids were located in the open space between the collection plates. To allow maximum residence time, the grids were placed upstream of the structural steel supports that separate each collection field. Grid placement was as close as possible to the structural steel supports to maximize distance between the grounded injection grid and the upstream high voltage discharge electrode frame. Figure 12 shows a photo of an injection grid within the Unit 2 B-box. This configuration provided approximately 1-second residence time before the PAC (injected at high unit load) entered the collection plates of the downstream field.

Figure 12. Injection grid between ESP fields.

Redesigned Injection Lance Grid

Redesigned injection lances were installed at Independence prior to the 2007 round of testing. The redesigned lances require additional carrier air delivered to the nozzles to achieve adequate carbon distribution in the TOXECON II™ configuration. This air delivery requirement could be met with the new regenerative blower that was installed prior to this round of testing.

The new injection grid consists of three lances installed into each of 8 injection ports. Each of the three lances treats a section of the ESP B-box approximately 15 feet deep through a series of eight injection nozzles placed on 3’ 8” centers (two nozzles are located at each elevation). Coverage across the ESP is achieved by overlapping the distribution patterns of adjacent lances. Figure 13 shows a sketch of the lance configuration. The initial design had a single ESP box penetration for each set of eight lances. This minimized the number of penetrations required through the penthouse, but prevented lance removal without bringing the unit off-line. The new design incorporated a means to remove lances on-line, allowing a much more cost effective approach to replacement and maintenance for the system.

A second redesign of the injection system was then made to minimize potential pluggage during operation. A multi-ported nozzle was placed at the bottom of each lance to maximize PAC spray dispersion from each nozzle. The nozzles in each adjacent port were offset in vertical height to increase PAC coverage. The penetrations through the ESP penthouse remained the same as on the first redesign.

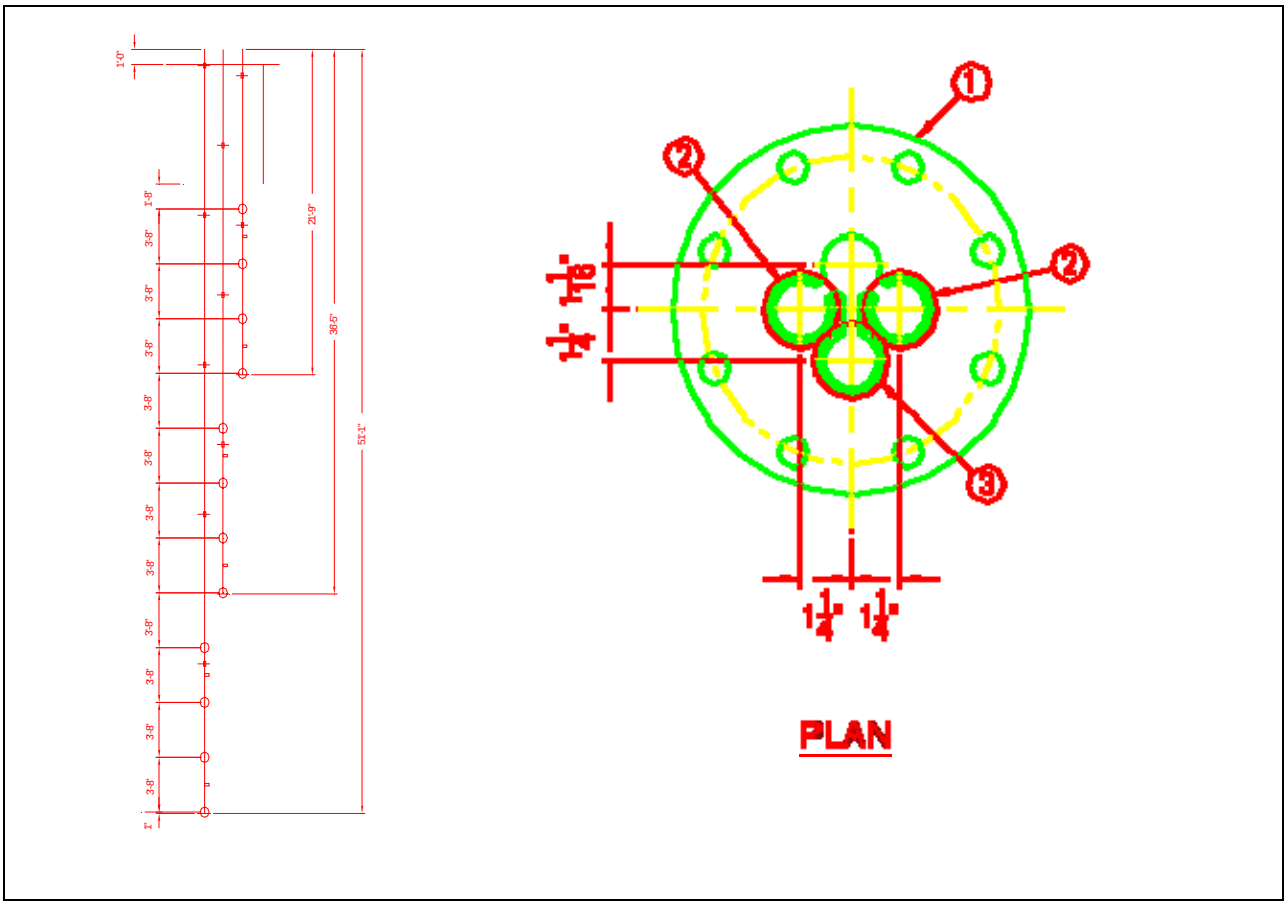


Figure 13. Redesigned multi-port lance.

Mercury Monitoring System

During the primary test program, two mercury S-CEMs were used to provide real-time feedback of the mercury levels in the flue gas entering and exiting the ESP B-box. During the extended test period, only one S-CEM was used. An S-CEM consists of a sample extraction and conditioning system connected to an analyzer system with a heated sample transport umbilical bundle. The extraction probe is an inertial separation design that separates the particulate matter from the sample with minimal sampling artifacts from fly ash or injected sorbent. Figure 14 shows a sketch of the system along with a picture of the mercury analyzer. An analyzer consists of a cold vapor atomic absorption spectrometer (CVAAS) coupled with a gold amalgamation system (Au-CVAAS) and is calibrated using vapor-phase elemental mercury.

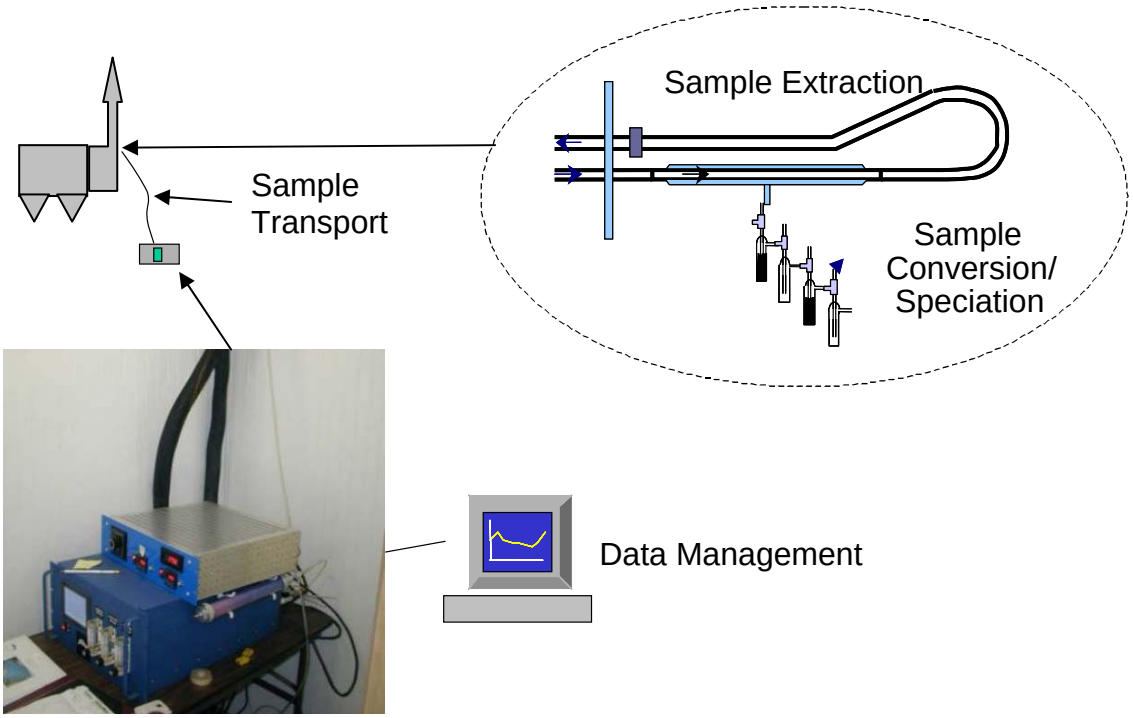


Figure 14. Sketch of mercury measurement system.

The analyzer measures both total vapor-phase mercury and elemental vapor-phase mercury. It determines total vapor-phase mercury concentrations by chemically reducing all of the oxidized mercury to the elemental form near the extraction location. The oxidized mercury is then removed, allowing the elemental mercury to pass through without alteration for measurement.

Sorbent Trap Equipment and Analysis

The method of using activated carbon traps for measuring mercury at coal-fired power plants has been given several acronyms over the past few years such as Quick SEM or QSEM (EPRI trademark), and used as the basis for EPA Draft Method 324 or M324, Appendix K of Title 40 CFR Part 75 under the title "Quality Assurance and Operating Procedures for Sorbent Trap Monitoring System," and most recently EPA Method 30B. For this report, it will be referred to as the Sorbent Trap Method (STM). The method involves inserting a glass tube filled with activated carbon into a gas stream and drawing a measured amount of gas across the carbon trap. The paired traps can then be sent to a lab and analyzed for mercury. The test program at Independence included use of equipment manufactured by Apex Instruments, Environmental Supply Company (ESC), and a gas metering box designed by ADA-ES. Further details of STM are contained in Appendix B.

Particulate Monitors

The test program used two different kinds of particulate monitors to characterize the ESP outlet flue gas particulate emissions during Baseline testing and sorbent injection: the Thermo Electron TEOM Series 7000 Source Particulate Monitor and the BHA CPM 5000 monitor. Emissions data gathered with these devices at the outlet ducts of ESP B-box were analyzed to better quantify the effects of injecting sorbent on ESP collection efficiency.

Thermo Electron TEOM Series 7000

The TEOM Series 7000 Source Particulate Monitor is a single point continuous particulate monitoring device that determines flue gas velocity, collects particles isokinetically on a filter for gravimetric analysis, and performs a direct measurement of their mass over time to give a continuous particulate loading indication. The particulate matter (PM) concentration in a flue gas stream can be made directly because the monitor's mass transducer, along with the collection filter, is placed inside of the duct or stack. The Series 7000 monitor performs its filter-based mass measurement using an industrially hardened tapered element oscillating microbalance. This system has received conditional test method approval for U.S. EPA Methods 17 and 5 (front half) and meets all of the requirements of the new American Society of Testing and Materials (ASTM) Standard Test Method D6831-02.

One TEOM Series 7000 monitor was installed in the ESP B-box test outlet duct. The device is designed only for short-term unattended operation. Consequently while in use during the testing at Independence, the sample probe had to be pulled from the outlet duct every few days to change the filter element. Prior to conducting tests, the test team performed a duct temperature/velocity traverse to provide a reasonable approximation of particulate loading for the entire duct and subsequently to position the sampling point of the monitor to sample at an average duct flow point.

BHA CPM 5000

The CPM 5000 monitor is an optical measurement device that measures particle flow across a beam of visible light. The device is sensitive to particle size, distribution, and characteristics. A transmitter and receiver are placed on opposite sides of the stack or duct. When dust particles pass between the transmitter and receiver, they momentarily block the light causing the receiver to see a modulating signal from the transmitter. The signal modulation is proportional to dust concentration. Because the device does not measure mass directly, it requires calibration using an EPA Method 5 or 17 duct traverse test.

BHA CPM 5000 particulate monitors were installed across the outlet ducts of both the test and control sides of the ESP B-box. The CPM 5000 instruments were calibrated against the TEOM Series 7000 and the Method 17 runs during Baseline testing.

In-Situ Fly Ash Sampling Device

The in-situ fly ash sampling device consists of a cyclone separator, venturi flow meter, and an eductor. The PM2.5 cyclone was designed to measure particulate emissions under Method 201A. The cyclone is designed to collect particulate 2.5 microns in diameter and greater. By operating the cyclone at higher than design flow rates, smaller diameter particles can be collected. A photo of the cyclone sampler is included in Figure 15.

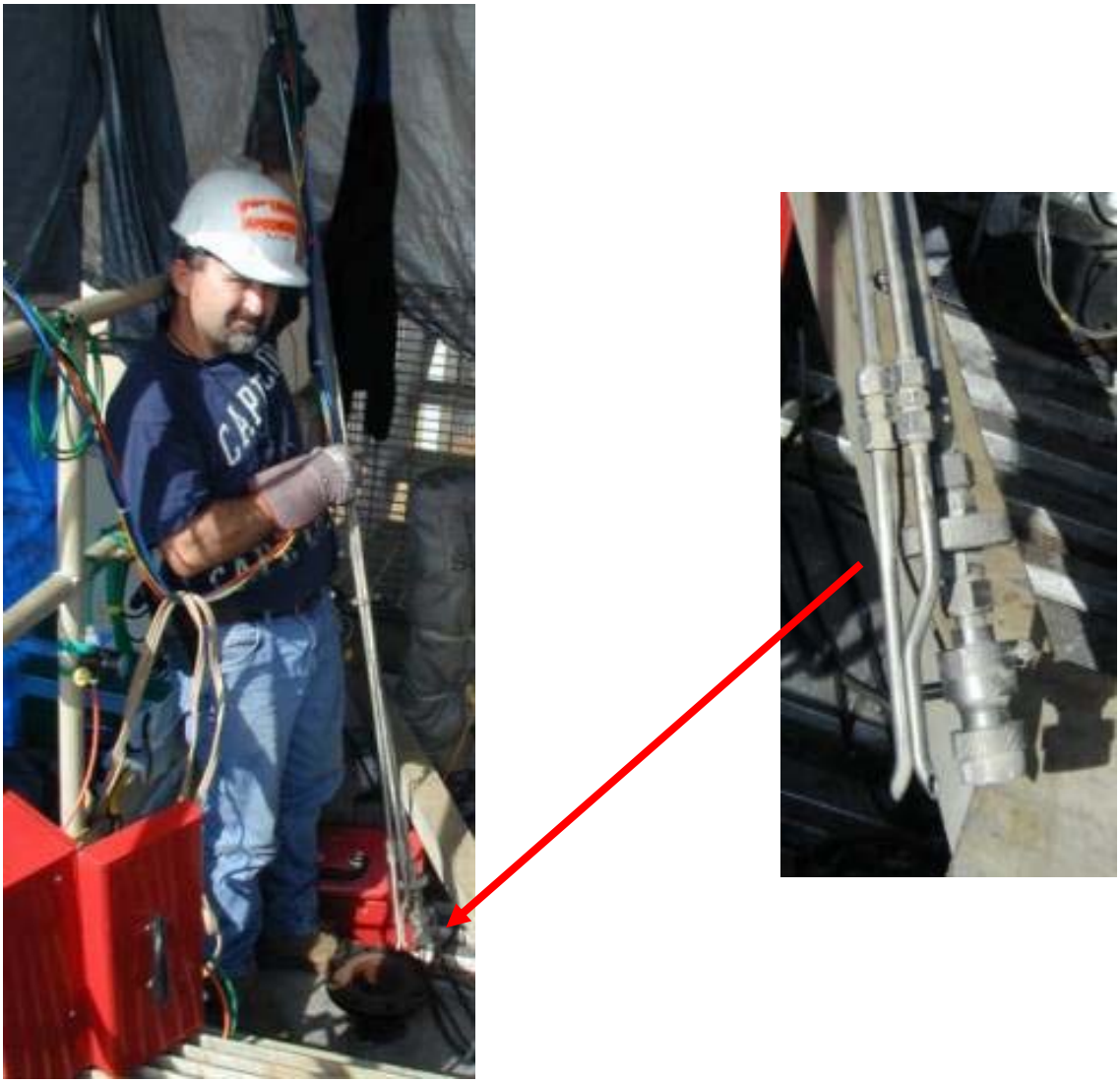


Figure 15. In-situ fly ash sampling device.

Description of Field Testing Subtasks

The Independence field tests were accomplished through a series of four subtasks: 1) sample and data coordination, 2) Baseline testing, 3) Parametric testing, and 4) Long-Term testing. The subtasks are independent from each other in that they each have specific goals and tests. However, they are also interdependent, as the results from each subtask influenced the test parameters of subsequent tasks. A separate field subtask, evaluating ash/carbon recycling was also undertaken.

The initial testing schedule was interrupted due to plant equipment outage. When the equipment became operational, a second round of Baseline and Parametric testing was conducted prior to commencing Long-Term tests. At the conclusion of the originally scheduled test sequence, the test program was extended through supplemental EPRI funding to include additional Baseline, Parametric, and Long-Term testing of a redesigned injection grid and delivery system. A summary of each subtask is presented in the following sections.

The complete test sequence is presented in Table 4. For more details on the test program, reference Appendix A for Test Plans 1–5 and Appendix C for Field Test Logs 1–3.

Table 4. Field-test sequence at Independence.

Test Description	Test Dates	Parameters/Comments
Preliminary	8/01/05– 8/05/05, 8/08/05– 8/12/05	Days 1–2: Equipment setup Days 3–5: Duct traversal to determine sample ports Day 5: S-CEMs and CPMs operational Day 7: Dual sample STM inlet and outlet Days 8–9: Single sample STM outlet
Baseline (Round 1)	8/15/05– 8/21/05	Day 1: Baseline measurements Days 2–4: ASTM M6784-02, M26A, M5/17 Day 5: Baseline measurements
Parametric Testing (Round 1)	8/22/05– 8/25/05	Day 1: DARCO® Hg: 3, 6 lb/MMacf; upstream of field B-5[a] Day 2: DARCO® Hg-LH: 1, 3, 6 lb/MMacf; upstream of field B-5 Day 3: DARCO® Hg E-10: 3, 6 lb/MMacf; upstream of field B-5 Day 4: DARCO® Hg E-11: 3, 6 lb/MMacf; upstream of field B-5 (Ongoing: monitor particulate emissions and ESP electrical conditions)
		No testing
Parametric Testing (Supplemental opacity)	9/08/05– 9/09/05	Day 4: DARCO® Hg-LH: 3, 6 lb/MMacf; upstream of field B-5 Day 5: DARCO® Hg: 3, 6 lb/MMacf; upstream of field B-5
		No testing during plant repairs
Baseline (Round 2)	9/28/05– 9/30/05	Days 1–3: Baseline measurements (Ongoing: monitor particulate emissions and ESP electrical conditions)
Parametric Testing (Round 2)	10/01/05– 10/08/05	Day 1: DARCO® Hg E-10: 3, 6 lb/MMacf; upstream of field B-7[b] Day 2: DARCO® Hg E-11: 3, 6 lb/MMacf; upstream of field B-7 Day 3: DARCO® Hg: 1, 3 lb/MMacf; upstream of field B-7 Day 4: DARCO® Hg: 6, 8 lb/MMacf; upstream of field B-7 Day 5: DARCO® Hg-LH: 0.5, 1 lb/MMacf; upstream of field B-7 Day 6: DARCO® Hg-LH: 3, 6 lb/MMacf; upstream of field B-7 Day 7: DARCO® Hg-LH: 3 lb/MMacf; upstream of fields B-5 and B-7, separately Day 8: DARCO® Hg-LH: 3 lb/MMacf; upstream of field B-5 or B-7, dual injection (Ongoing: monitor particulate emissions and ESP electrical conditions)
Extended Testing (Round 1a)	10/10/05– 10/21/05	DARCO® Hg-LH throughout testing; Days 1–6: PRB, 4 lb/MMacf; upstream of field B-7 Days 7–8: PRB, 5 lb/MMacf; upstream of field B-7 Days 9–10: PRB, 5 lb/MMacf, OH + STM; upstream of field B-7 Days 11–12: PRB, 5 lb/MMacf; upstream of field B-7 (Ongoing: monitor particulate emissions and ESP electrical conditions)

[a] Sorbent injection location before ESP B-box field 5.
[b] Sorbent injection location before ESP B-box field 7.

Extended Testing (Round 1b)	10/22/05–11/08/05	DARCO® Hg-LH throughout testing; Days 1–3: PRB, 5 lb/MMacf; upstream of field B-5 Days 4–5: PRB, 5 lb/MMacf, OH + STM; upstream of field B-5 Days 6–8: PRB, 5 lb/MMacf; upstream of field B-5 Day 9: PRB, 5, 8 lb/MMacf; upstream of field B-5 Day 10: ColoWyo, 5 lb/MMacf; upstream of field B-5 Days 11–12: ColoWyo, 5 lb/MMacf, OH + STM; upstream of field B-5 Day 13: PRB, 5 lb/MMacf; upstream of field B-5 Days 14–17: PRB, 3 lb/MMacf; upstream of field B-5 Day 18: ColoWyo, 5 lb/MMacf; upstream of field B-5 (Ongoing: monitor particulate emissions and ESP electrical conditions)
Ash Recycle	11/09/05–11/13/05	Recycled DARCO® Hg-LH Days 1–2: ColoWyo Carbon/Ash 1 lb/MMacf; upstream of field B-5 Day 3: PRB Carbon/Ash 2 lb/MMacf; upstream of field B-5 Day 4: PRB Carbon/Ash 4 lb/MMacf; upstream of field B-5 Day 5: PRB Carbon/Ash 6 lb/MMacf; upstream of field B-5
Long-Term Testing (Extended)	11/16/05–03/10/06	DARCO® Hg-LH throughout testing; PRB, 4 lb/MMacf; upstream of field B-5
Parametric Testing (Redesigned Grid System)	01/16/07–01/18/07, 01/26/07	
Baseline (Round 3)	01/29/07–02/04/07	Mercury monitoring across test side of ESP B-box Particulate measurements collected at stack
Long-Term Testing (Redesigned Grid System)	02/05/07–03/07/07	DARCO® Hg-LH throughout testing; PRB, 5 lb/MMacf; upstream of field B-5 (Ongoing: monitor particulate emissions and ESP electrical conditions)

Because Independence is a load following plant, advance scheduling was required for the plant to respond to test requests for specific loads. Full load conditions were requested and granted for all Parametric and manual test periods. All Parametric and manual results reflect these steady-state, full-load conditions. Throughout most of the extended and Long-Term test sequence, Unit 2 operated without restrictions. Normal operation for Independence consisted of full load for the majority of the day from early spring to mid fall. During the evening hours, with the exception of exceptionally hot, humid days and nights, the plant would run at lower loads, but usually steady output. During the winter months, the full load times were less consistent, and the plant would make large load swings to respond to grid power demands. During the coldest days and nights in Arkansas, the plant operated at higher loading and steadier plant conditions in response to grid power needs. An exception occurred after Hurricane Rita struck in October 2005. The high voltage grid that Unit 2 supplied was essentially down as all the large power consumers on the Texas and Louisiana coast were shut down. Although Unit 1 continued running near full load, Unit 2 was limited to low load for several days in the middle of the initial Long-Term test sequence.

Sorbent Selection and Description

A key component of the planning process for these evaluations is identifying potential sorbents for testing. The budget and schedule for this test program allowed up to four different sorbents to be evaluated. These sorbents, and a brief description of each, are listed below:

- DARCO® Hg, a sorbent derived from a Texas lignite coal, is manufactured by NORIT Americas. This sorbent has been tested in various lab, pilot, and full-scale mercury control demonstrations and is considered the benchmark for performance comparisons. DARCO® Hg has a bulk density of 25–30 lb/scf.
- DARCO® Hg-LH, a sorbent derived from a Texas lignite coal and treated with bromine, is manufactured by NORIT Americas. DARCO® Hg-LH has been tested in a multi-site DOE/NETL program and was effective at increasing mercury capture compared to Baseline results at the test sites while firing PRB coal. It has physical characteristics similar to DARCO® Hg.
- DARCO® E-10 and DARCO® E-11, experimental sorbents derived from DARCO® Hg, were supplied by NORIT Americas. Their purpose is to minimize ESP reentrainment and particulate pass-through. The PAC in the E-10 is air classified and the PAC in E-11 is coarsely ground; two approaches that minimize fines production.

Sorbents were evaluated during Parametric testing against the following criteria. The first criterion was the ability of the sorbent to remove vapor-phase mercury from the flue gas stream across ESP B-box. The second criterion was the sorbent performance relative to its impact on balance-of-plant operating factors such as opacity and particulate emissions. A third criterion would apply if a bromine-treated sorbent was selected for Long-Term testing. In such a case, measurements would be made over the course of Long-Term testing to determine the additional release of halogens to the flue gas. Although a sorbent tested over the short term may yield different responses when used for long-term operation, it is likely that the comparative performance ranking of sorbents tested in the short term would be similar during long-term operation. As such, the sorbent with the best performance during the Parametric tests was selected for Long-Term testing.

Sample and Data Coordination

Collecting, analyzing, and archiving samples and plant operating data are key aspects of any field test program. A copy of the Sample Collection and Management Plan for the test program at Independence is included as Appendix F. Table 5 presents an example of samples and data collected during testing.

Table 5. Data collected during field-testing at Independence Unit 2.

Parameter	Sample/Signal/Test	Baseline	Parametric/ Long-Term
Coal	Batch sample	Yes	Yes
Coal	Plant signals: burn rate (lb/hr), quality (lb/MMBTU, % ash)	Yes	Yes
Fly Ash	Batch sample	Yes	Yes
Unit Operation	Plant signals: boiler load, etc.	Yes	Yes
Temperature	Plant signal at AH inlet and ESP inlet/outlet	Yes	Yes
Temperature	Full traverse at ESP inlet/outlet	Yes	No
Duct Gas Velocity	Full traverse at ESP inlet/outlet	Yes	No
Mercury (total and speciated)	Hg Monitors at ESP inlet/outlet	Yes	Yes
Mercury (total and speciated)	ASTM M6784-02 (Ontario Hydro) at ESP inlet/outlet	Yes (1 set)	No/Yes (3 sets)
HCl, HF, Br	EPA Method 26A at ESP inlet/outlet	Yes	Yes
Sorbent Injection Rate	PLC, lb/min	No	Yes
Plant CEM Data (NO_x, O_2, SO_2, CO)	Plant data—stack	Yes	Yes
Outlet Duct Particulate Mass	BHA CPM 5000: test and control ducts TEOM Series 7000: test duct	Yes Yes	Yes/Yes Yes/No
Stack Opacity	Plant data – Stack	Yes	Yes
Pollution Control Equipment	Plant data (Sec mA, Sec. Voltage, Sparks, etc.)	Yes	Yes

Various kinds of plant operating data were collected and made available immediately to the testing program via a workstation that the test team had connected to the plant control and information system. Grab samples of ash were collected from the ESP hoppers each day of testing and analyzed for mercury. A sketch of the ESP hopper configuration showing how the hoppers were numbered is presented in Figure 2. In the sketch, the first two rows of hoppers are on the test side of the ESP, the last two rows on the control side. Coal samples were batch sampled daily from the coal feed belt going to the coal bunkers and provided for analysis.

Baseline Testing (No Sorbent Injection)

Baseline testing began August 15, 2005. The following day, plant staff informed the test team that the outlet field on the test portion of the ESP B-box was non-operational and the second collection field on the test side of that box was operating at a reduced capacity. Because the first field at Independence collects the majority of fly ash (approximately 90%), reduced collection capacity later in the box would have minor impact on Baseline

measurements. Hence, the Baseline testing was continued as planned though Friday, August 19, 2005. The Baseline data were used to characterize native mercury removal across the ESP in the absence of sorbent and to evaluate normal plant operating parameters. During the Baseline test period, Unit 2 was maintained at standard full-load conditions, about 880 MW, between the hours of 10:00 a.m. and 10:00 p.m.

A second round of Baseline testing began September 28 after the plant corrected the problems with TR B-7, the outlet electrical field on the test side of ESP B-box. Three days of tests were conducted to re-establish the unit's mercury and particulate Baseline measurements and native mercury removal. Throughout the Baseline test periods, mercury measurements were made at the ESP inlet and outlet with the mercury S-CEMs. During three days of the first round of Baseline testing, several manual measurements were also conducted at the inlet and outlet of the ESP, including the following (Appendix D1):

- ASTM M6784-02 Ontario Hydro Method (Speciated Mercury)
- STM, based in part, on the method described in 40 CFR Part 75 Appendix K (previously EPA draft Method 324); taken at outlet only
- EPA M17 (Particulate Concentrations)
- EPA M26A (Halogen and Hydrogen Halide Concentrations)

Because of the influence of HBr, HCl, and HF on sorbent effectiveness, HBr, HCl, and HF measurements (Method 26A) were made at the same time the Ontario Hydro samples were collected to better characterize the flue gas. The outlet particulate emissions are a key parameter to assess the impact of carbon injection on ESP performance. Therefore, particulate emission measurements were made with EPA Method 17 at both the ESP inlet and outlet.

During the extended test portion of the program, a third round of Baseline testing was conducted from January 29, 2007, to February 4, 2007. A single S-CEM mercury monitor was used to measure total vapor-phase mercury at the inlet and outlet test ducts of the ESP B-box. Particulate measurements were collected from the stack during this Baseline period.

Parametric Testing

Parametric tests were conducted at Independence Unit 2 to evaluate the TOXECON II™ process using four PAC sorbents: DARCO® Hg, DARCO® Hg-LH, and two experimental DARCO® sorbents, DARCO® E-10 and DARCO® E-11. Each of these sorbents was injected at different concentrations to determine mercury removal effectiveness and to characterize sorbent impact on plant operation on a short-term test basis. During the Parametric test period, Unit 2 was maintained at standard full-load conditions, about 880 MW, between the hours of 10:00 a.m. and 10:00 p.m.

As mentioned above, during the initial Baseline testing period, the plant reported that the test side of ESP B-box had problems with two electrical fields: B-3 and B-7. Field B-3 was operating at reduced or shutoff power levels. This field had operated at a reduced capacity well before the testing started, and previous efforts to recover the field had not been successful. Reduced power on this field meant a slight increase in the amount of fly ash that would go to the next field, B-5. This impact was not considered significant enough to modify test protocol.

The other problem electrical field, ESP B-7, was non-operational. This problem was of concern for two reasons. First, sorbent injection would be limited to the mid-box location because the rear injection grid was positioned directly before field B-7. Second, injection at the mid-box location would correspond to an effective SCA of 135 ft^2/kacfm, rather than the anticipated SCA of 270 ft^2/kacfm that would be available if B-7 were operational. Consequently, the test team decided to carry out an abbreviated Parametric test sequence (round 1) using a single injection location with a reduced SCA. Once field B-7 was again operational, the full testing sequence was rescheduled and Parametric testing was resumed (round 2).

Stages 1 and 2

The first stage of Parametric testing was conducted from August 22–25, 2005. The portable sorbent delivery system was used throughout this test sequence. During the first round of Parametric testing, there was an increase in opacity spikes during ESP raps that appeared related to injecting DARCO® Hg and Hg-LH under some conditions. To verify these results, these two sorbents were retested on September 8–9, 2005, (one day for each sorbent) and opacity measurements taken.

The second sequence of Parametric tests ran from October 1–8, 2005. All four of the original PAC sorbents were evaluated in various combinations of injection rates and injection fields. During this sequence of tests, TR set B-3 failed to an "Off" status. From this point on, the plant ran TR set B-3 on an "as available" basis.

The portable sorbent delivery system was used for the first six days of the second stage of Parametric testing. The final two days of testing included the use of both injection locations simultaneously, a procedure that required the capabilities of two feeders and blowers. Because the Porta-PAC system is a single feeder and blower arrangement, the silo delivery system was used during these days to deliver DARCO® Hg-LH.

Follow-On Stage

During the extended test portion of the program, a third stage of Parametric testing was conducted from January 16–18, 2007, with repeat tests conducted on January 26, 2007 (Appendix A4). The tests were aimed at evaluating the redesigned injection grid and delivery system. Mercury measurements were conducted with the single S-CEM configuration. No particulate testing was performed during this round of testing.

Long-Term Testing

Long-Term testing of the TOXECON II™ system at Independence Unit 2 followed the second round of Parametric testing, commencing on October 10, 2005, and continuing without interruption until November 9, 2005. A single PAC, DARCO® Hg-LH, was selected based on its performance during the Parametric tests for further evaluation. Twice during this time period, the plant shifted from burning PRB to 3-day test burns of western bituminous ColoWyo coal. During the Long-Term testing period, three sets of Ontario Hydro, M17, and M26A measurements were conducted at the inlet and outlet of the ESP along with STM measurements (Appendices D2–4).

Long-Term testing was conducted at settings determined by the Parametric tests and approved by the DOE and Entergy Independence. The DOE intended that these settings represent the most cost-effective conditions for a moderate level of mercury control (i.e., 30–60%). To achieve the highest possible level of mercury removal would require higher concentrations of sorbent and thus increase program costs, but such a goal would best test the performance boundaries of the TOXECON II™ injection system and allow a stronger assessment of its balance-of-plant impacts. Deciding upon test settings was also influenced by the current (2005) federal and state regulatory environment: some states are now legislating very high removal rates for coal-fired plants, on the order of 80 to 90%. To assess the feasibility of testing at a higher sorbent concentration, the costs were reviewed and it was determined that the increased sorbent cost would remain within the budget of the test program. Consequently, the decision was made to choose settings that would evaluate the system limits.

This initial Long-Term test period was divided into two phases. The first phase lasted 12 days. Initially, 4 lb/MMacf of sorbent was continuously injected in the rear injection grid—i.e., directly upstream of ESP B-box field B-7. Because the mercury removal rate was less than expected during the first half of this round, the sorbent concentration was increased to 5 lb/MMacf for the remainder of the round. In addition to gathering data on mercury removal, the objective of this test phase was to determine the effects of PAC injection on opacity and particulate pass through when using a relatively small ESP collection area (effective SCA = 135 ft^2/kacfm) downstream of the injection point.

The second phase of Long-Term testing immediately followed the first and lasted for 18 days. During the second round, the injection location was changed to the mid-box injection grid (i.e., directly upstream of ESP B-box field B-5) and injection concentrations were maintained at approximately 5 lb/MMacf, with several test runs at higher and lower injection concentrations to test several key parameters. During these individual test periods, several hours in duration each, the injection concentration varied from 1 to 8 lb/MMacf. Data gathered under these conditions could be used to verify Parametric test results that indicated PAC injection with a mid-sized collection area (SCA = 270 ft^2/kacfm) is slightly more effective than with a smaller one. Moreover, it could be expected that injecting upstream of the larger collection area would have less of an impact on particulate emissions and opacity than that observed during the first round. A drawback to injecting in the upstream field meant that the final two hopper rows would have to be segregated for ash recycle and disposal. To better evaluate the TOXECON II™ system, this round of Long-Term testing involved several objectives that included the following: to obtain data on mercury removal efficiency, to determine the effects on ESP operation, to determine the effects on combustion byproducts, to evaluate the impacts to the balance-of-plant equipment, and to determine the process economics.

Immediately following the Long-Term tests, an ash/carbon recycle test was performed. Shortly after the ash recycle tests ended, a Long-Term operational demonstration commenced. Testing of DARCO® Hg-LH continued on a near continuous basis for two periods: the end of November through most of December 2005 and then from late January to early March 2006. During these periods, injection occurred at various rates and injection locations using the initial injection grid design.

The redesigned injection grid and delivery system was evaluated under Long-Term conditions from February 6 through March 7, 2007. Mercury measurements were conducted with a single S-CEM measuring total vapor phase mercury across the inlet and outlet ducts of the test side of ESP B. Particulate testing was conducted both at the stack and on the test and control side of the west ESP B-box outlet duct.

Ash Recycle Testing

As a separate part of the overall program, a short ash/carbon recycle test was conducted from November 9–13, 2005. Approximately 18,000 lbs of ash/sorbent mixture collected during the Parametric and Long-Term testing period from the hoppers downstream of the ESP B-box injection locations was transferred to the test injection silo. The mixture was injected into the injection grid placed before B-box field B-5 at an average concentration of 1 lb/MMacf (PAC equivalent). During the first two days of this testing, the plant burned ColoWyo coal, then switched back to PRB on the third day. Grid injection ceased on November 13 because the injection grid appeared to be plugged. The ash/sorbent mixture remaining in the silo was then injected through two of the inlet ports on the test side of the ESP B-box, one on either side of the splitter in the inlet duct. This procedure allowed data to be gathered on the effectiveness of the ash/sorbent mixture on mercury removal in a pre-ESP injection configuration.

RESULTS FROM INDEPENDENCE TESTING

The initial field-testing program of the TOXECON II™ system at Independence was divided into three periods: Baseline, Parametric, and Long-Term (Appendix A1). During Baseline testing, no sorbent was injected into the ESP. During Parametric testing, the mercury removal performance of four sorbents was evaluated. During Long-Term testing, the performance of one sorbent was evaluated during a 30-day continuous injection period. Results from each test series are included in this section. The program was extended to include modeling of the sorbent injection grid and subsequent redesign of the grid and delivery system. Results from the modeling efforts and field-testing of the redesigned grid system are included here, too. Ash/carbon recycling tests were also conducted as part of the initial field test program and the results are presented below.

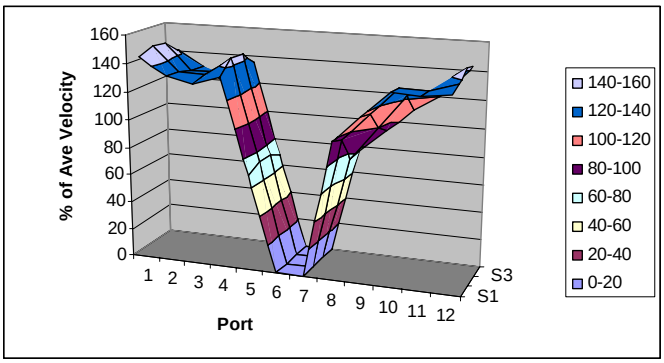
Velocity and Temperature Profiles

Prior to the Baseline test sequence, equipment set-up, installation, and operational check-out were performed. One of the preliminary tests performed was a velocity profile of the inlet and outlet ducts of the test side of the ESP B-box. The design premise of the TOXECON II™ injection system installed at Independence was that the flue gas flow would be relatively uniform. The design of the injection grid was intended to provide an even distribution of sorbent from top to bottom and side to side. S-CEM extraction probe locations were identified based on the preliminary velocity traversal measurements.

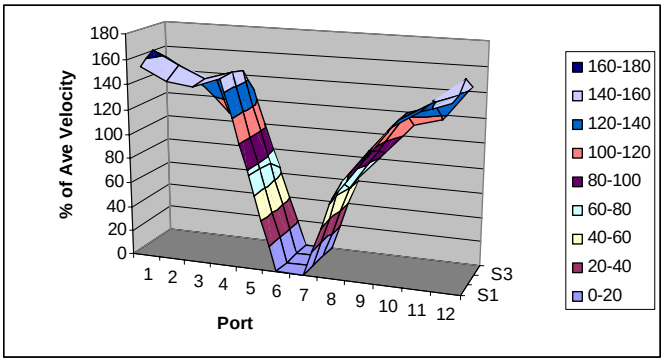
When the series of Ontario Hydro/M17/M26A tests were conducted during the August 2005 Baseline and late October 2005 Long-Term tests, velocity and temperature traverses were performed along the test inlet and outlet ducts of ESP B. Six runs of pressure differentials, as determined by a pitot tube, and temperatures were measured at four depths from 8 of the 12 ports during both the Baseline and Long-Term test period. (Further details are provided in the METCO reports included in Appendices D1–4.) Because the boiler load was high (> 750 MW) during each run, the data values were averaged for each sample point during both test periods. Plots of the velocity profiles are given in Figure 16. Velocity (fpm) was calculated at each sample point using the following equation:

$$V = 60xC_p\sqrt{\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_d + 460) \times \Delta P}{12 \times \rho_{air} \times P_d \times MW \times (T_{std} + 460)}}$$

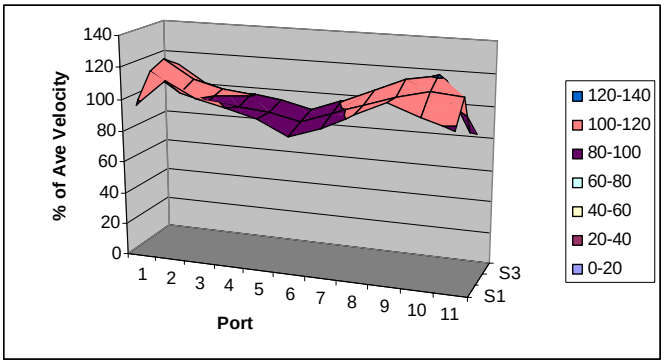
Where	$C_p =$		Pitot Tube Calibration Factor
	$g =$	32.174 ft/sec^2	Acceleration of gravity
	$\rho_{man} =$	62.32 lb/ft^3	Density of manometer oil
	$P_{std} =$	29.92”H_2O	Standard Pressure
	$MW_{air} =$	28.96 lb/lb-mole	Molecular Weight of air
	$T_d =$	º F	Duct Temperature
	$\Delta P =$		Differential Pressure
	$\rho_{air} =$	0.0752 lb/ft^3	Density of air
	$P_d =$	” H_2O	Duct Pressure
	$MW =$	lb/lb-mole	Molecular Weight of duct gas
	$T_{std} =$	68º F	Standard Temperature



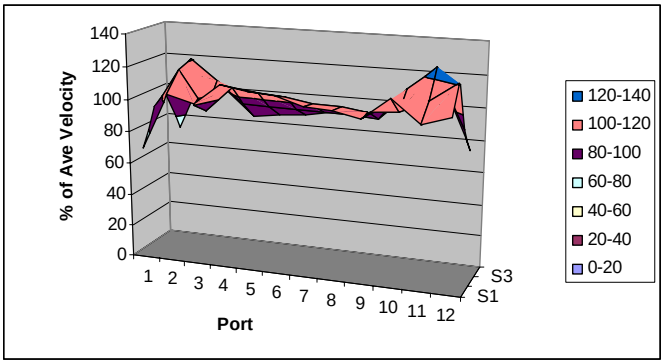
(a) Vav = 3100 fpm



(b) Vav = 2850 fpm



(c) Vav = 2900 fpm

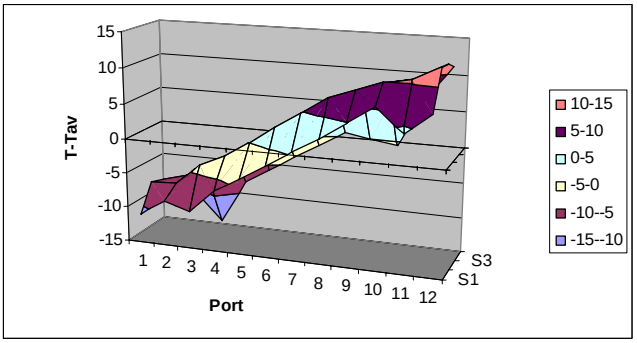


(d) Vav = 3000 fpm

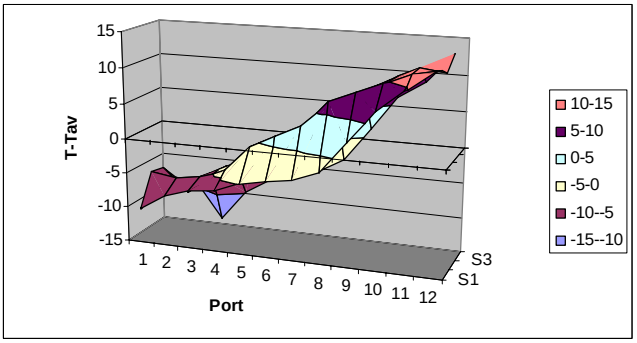
Figure 16. ESP duct velocity profile expressed as Percentage of Average Velocity (Vav).
(a) Inlet: Baseline 2005. (Velocity values at Ports 9 and 5 are interpolated.)
(b) Inlet: Long-Term 2005. (Velocity values at Ports 9 and 5 are interpolated.)
(c) Outlet: Baseline 2005. (Velocity values at Ports 4–6 and Port 9 are interpolated.)
(d) Outlet: Long-Term 2005. (Velocity values for Ports 5–8 are interpolated.)

The general shapes of the of the inlet and outlet velocity profiles are similar for both the test periods. The asymmetry of the inlet profile around the internal divider may partially be an artifact as the values at the (nonexistent) port 5 were interpolated. As expected, the average velocity at the outlet of the ESP is less than that of the inlet during Baseline testing. The increase in average velocity at the outlet relative to the inlet during the Long-Term tests may be an artifact as the values for the midsection (ports 5–8) were interpolated and may be high. Moreover, results from the physical modeling of the outlet duct suggest that the midsection of the outlet duct would not exhibit the fairly flat profile as shown here. The ESP duct configuration may also have influenced the results. The ports in the inlet duct were located 2.61 equivalent duct diameters (edd) downstream from a bend and 0.67 edd upstream from an expansion whereas the ports in the outlet duct were located 0.71 edd downstream from a constriction and 0.33 edd upstream from a bend.

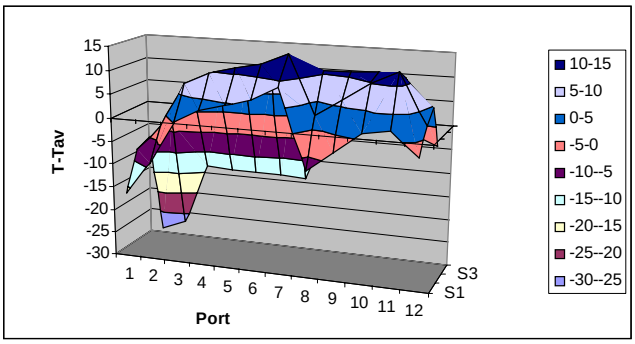
Temperature profiles of the test inlet and outlet ducts of the ESP B-box during the August 2005 Baseline and late October 2005 Long-Term tests are shown in Figure 17. As can be seen in the figure, there is a temperature gradient of approximately 20º along the length of the inlet duct. Although a gradient is still apparent (and more pronounced) in the Long-Term profile of the outlet duct, such a gradient is not apparent in the profile of the outlet duct for the Baseline test. The average temperature at the outlet duct was slightly higher than that of the inlet duct during the Long-Term testing period. This may be an artifact as the values at the mid section of all four profiles were interpolated.



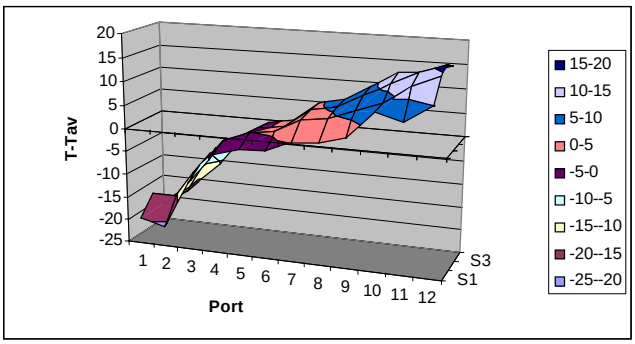
(a) Tav = 324 ºF



(b) Tav = 312 ºF



(c) Tav = 323 ºF



(d) Tav = 314 ºF

Figure 17. ESP duct temperature profile.
Values are the differences between the average temperature at a given sample point (T) and the average of the duct (Tav).
(a) Inlet: Baseline 2005. (Temperature values at port 9 and from ports 7–5 are interpolated.)
(b) Inlet: Long -Term 2005. (Temperature values at port 9 and ports 7–5 are interpolated.)
(c) Outlet: Baseline 2005. (Temperature values at ports 4–6 and port 9 are interpolated.)
(d) Outlet: Long-Term 2005. (Temperature values at ports 5–8 are interpolated.)

Baseline Mercury Removal

Four rounds of Baseline tests (no sorbent injection) were conducted: (1) August 15–21, 2005; (2) September 28–30, 2005; and (3) January 15, 2007, and then January 29, 2007, through February 4, 2007. Prior to the first round of tests, some data were also gathered from August 6–14, 2005. Several different methods were used to measure mercury at Independence. These included flue gas measurements using the STM, Ontario Hydro (OH), mercury analyzers (S-CEM), and analysis of mercury in coal and ash samples. Results from the latter two are presented later in this report. During the first round of Baseline tests, three Ontario Hydro runs were conducted across the ESP B-box. S-CEM and (ESP outlet) STM data were collected concurrently with the Ontario Hydro runs. The results of these three methods for the level of mercury (corrected to 3% O_2) at the outlet of ESP B-box are presented in Table 6. The full Ontario Hydro test reports are included in Appendix D. Recall that the Ontario Hydro method is a measure of total mercury (elemental, oxidized, and particulate) while S-CEM and STM provide a measure of total vapor-phase mercury. Because the presence of fly ash can significantly affect mercury speciation, the Ontario Hydro method has the potential for sampling bias. Such potential is lower with the S-CEM and STM because these approaches minimize ash-vapor contact.

Table 6. Comparison of ESP B-box outlet Hg levels obtained by different methods during 2005 Baseline OH runs.

August 17–18, 2005	OH (μg/dNm^3)	S-CEM (μg/dNm^3)	STM (μg/dNm^3)
Run 1	16.48	9.7	12.7
Run 2	10.60	9.4	11.4
Run 3	8.75	9.4	13.5

OH is Hg^{2+} + Hg^0; S-CEM and STM are total vapor-phase mercury.

The average total vapor-phase mercury concentrations (corrected to 3% O_2) at the inlet and outlet of the ESP B-box during the pre-Baseline and Baseline August test period are shown in Figure 18. As expected at a PRB plant using a cold side ESP for particulate control, the native removal capability is very low. The average removal efficiency measured with the S-CEMs during the first two rounds of Baseline testing was typically very low. Often during load changes, the outlet mercury concentration spiked above the inlet concentrations as measured by the SCEM. The Ontario Hydro results (taken during the first round of testing) showed an average removal efficiency of 12.2%. During these tests, the inlet SCEM was reading slightly higher than the outlet when corrected to 3% O_2. Problems encountered with adjusting the S-CEMs during August may partially account for much of the variability observed in levels of mercury across the ESP and the particularly low removal level measured as the average removal for the September round of tests was 2%.

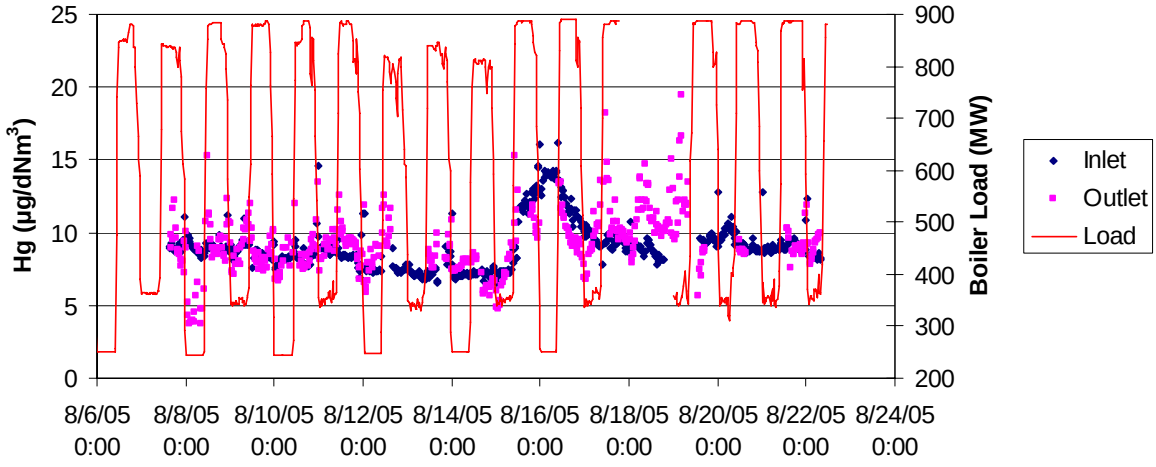


Figure 18. Average 30-minute total vapor-phase mercury concentrations for 2005 pre-Baseline and Baseline test period.

Figure 19 shows the average mercury measured at the inlet and outlet of the ESP during the Baseline testing runs with the three measurement methods. All results are converted to dry normal and corrected to 3% O_2.

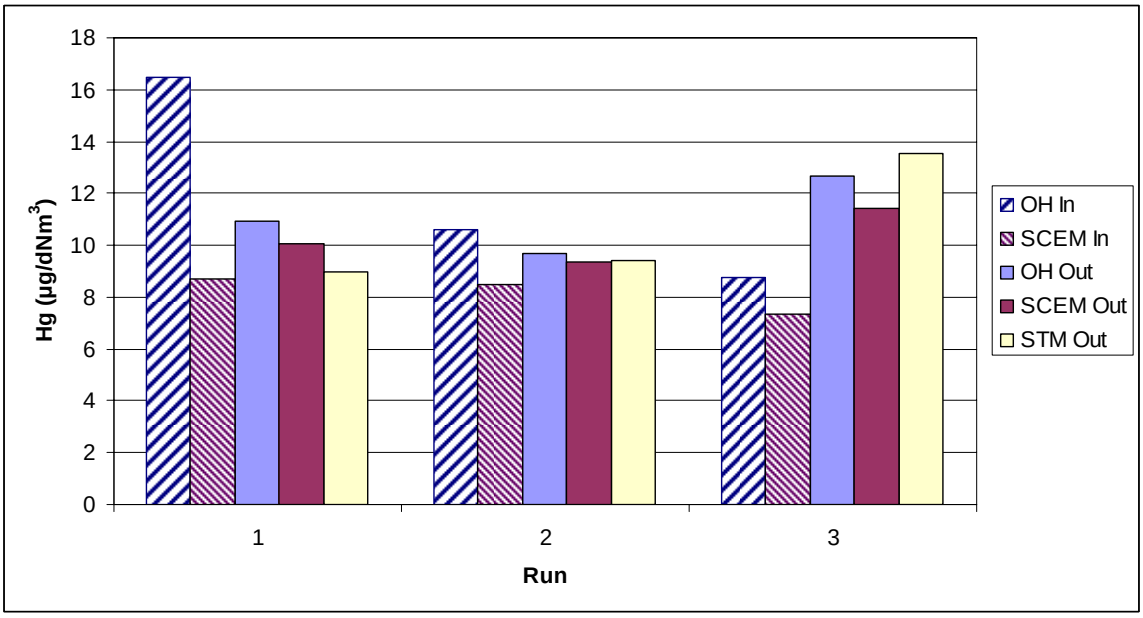


Figure 19. Average total mercury at the inlet and outlet of the ESP B-box during 2005 Baseline testing.

Of interest during the Baseline testing was the speciation of vapor-phase mercury across the ESP B-box test side. While total vapor-phase mercury numbers vary little, the percentage of elemental drops from an average of 80% at the inlet to ESP to less than 50% at the outlet of the ESP. As can be seen in Figure 20, this magnitude of change in speciation is consistent for the Baseline test series independent of unit load. The increased fraction of oxidized mercury could be associated with both the large SCA for the Independence ESP and potential intermittent back corona. UV resulting from back corona in the electrical field

could cause oxidation of the elemental mercury. For reference, the averaged percent elemental mercury ($Hg^0/(Hg^{2+} + Hg^0)$) at the inlet and outlet as determined by the OH tests during Baseline are also shown in Figure 20. As can be seen, the OH results did not show as marked a difference in the percent of elemental mercury at the inlet and outlet of the ESP as the S-CEM did. This may indicate a sampling artifact from the S-CEMs.

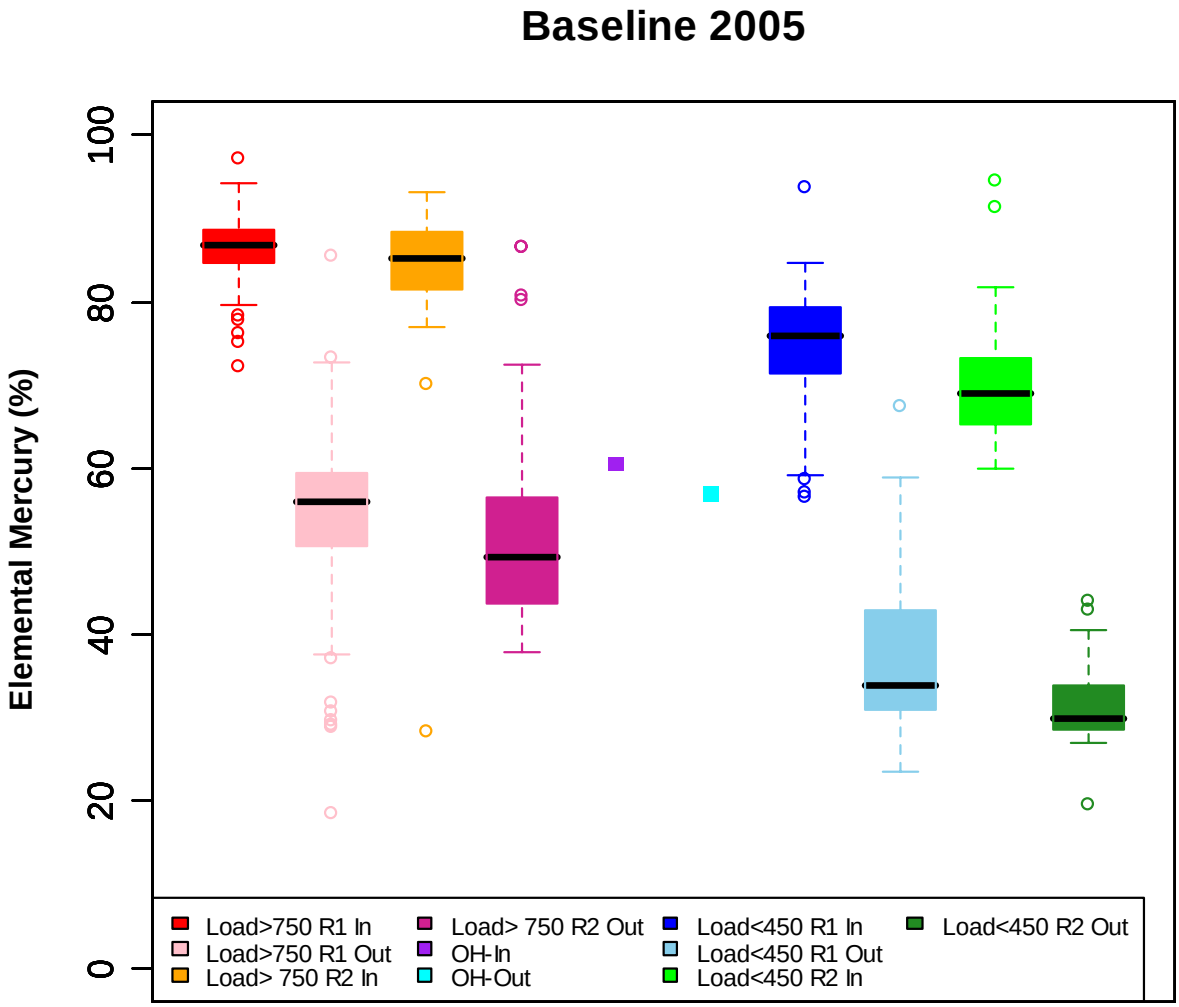


Figure 20. Fraction of elemental mercury across the ESP B-box during 2005 Baseline testing.

The average mercury concentration in the flue gas during the 2007 Baseline level given by the S-CEM was slightly lower than that observed during the 2005 Baseline tests; however, the average removal efficiency remained quite low (see Table 7 and Figure 21). As shown in Figure 21, the boiler load remained high during the last few days of January which corresponded to a period of cold ambient temperatures. Lower mercury concentrations from the afternoon of the January 29 through midday on the January 30 indicate a period when the plant was firing ColoWyo coal.

Table 7. Average total vapor-phase mercury across the ESP B-box during 2007 Baseline testing. Values corrected to 3% O_2.

ESP Inlet Hg (µg/dNm^3)	ESP Outlet Hg (µg/dNm^3)	Removal Efficiency (%)
7.1 ± 1.9	6.5 ± 2.0	3.4 ± 23.1

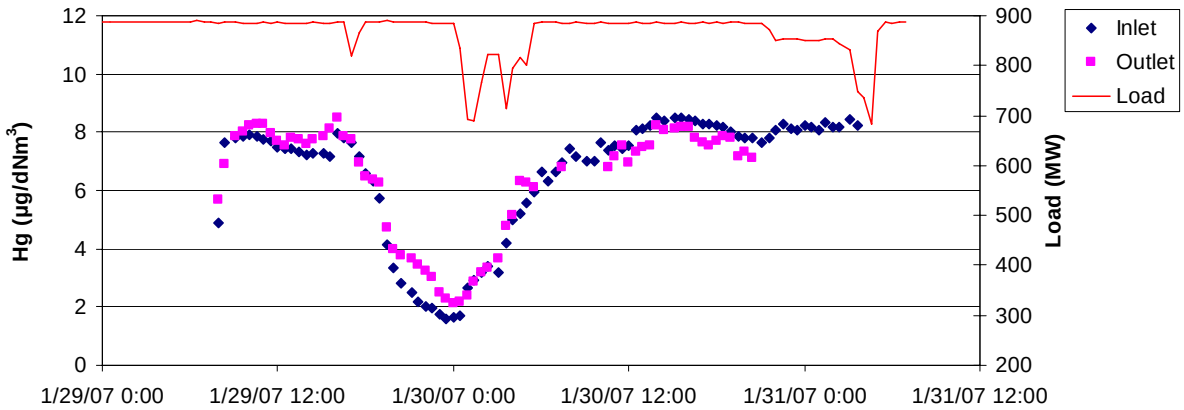


Figure 21. Trend plot of average total vapor-phase mercury across the ESP B-box during 2007 Baseline tests. Values corrected to 3% O_2.

Parametric Mercury Removal

Parametric testing to evaluate the performance of four different sorbents was undertaken in three stages. The first stage was conducted in late August 2005 with the ESP outlet field, T/R field B-7, out of service. This stage was followed by a two-day set of limited tests in early September 2005 to confirm particulate/opacity readings from the first stage of testing. A complete series of Parametric testing following the original test plan scheme was completed in early October 2005 when field B-7 was again in service. During testing, the varying power levels for field B-3 had no correlation with varying vapor-phase mercury removal trends.

When it became apparent that the original PAC delivery and injection system did not provide sufficient PAC distribution, the system was redesigned. After the redesigned injection grid was constructed, a final stage of Parametric tests was completed in January 2007. The results from these various stages of testing follow.

Stage I

As mentioned previously, ESP TR field set B-3 was operating at reduced or shutoff power levels and field B-7 was non-operational during the first stage of Parametric testing (August 21–25, 2005). Consequently, sorbent was injected mid-box (i.e., between fields B-3 and B-5). Figure 22 shows box-whisker plots of the average total vapor-phase mercury removal efficiency of the four different test sorbents at various injection concentrations during August 2005.

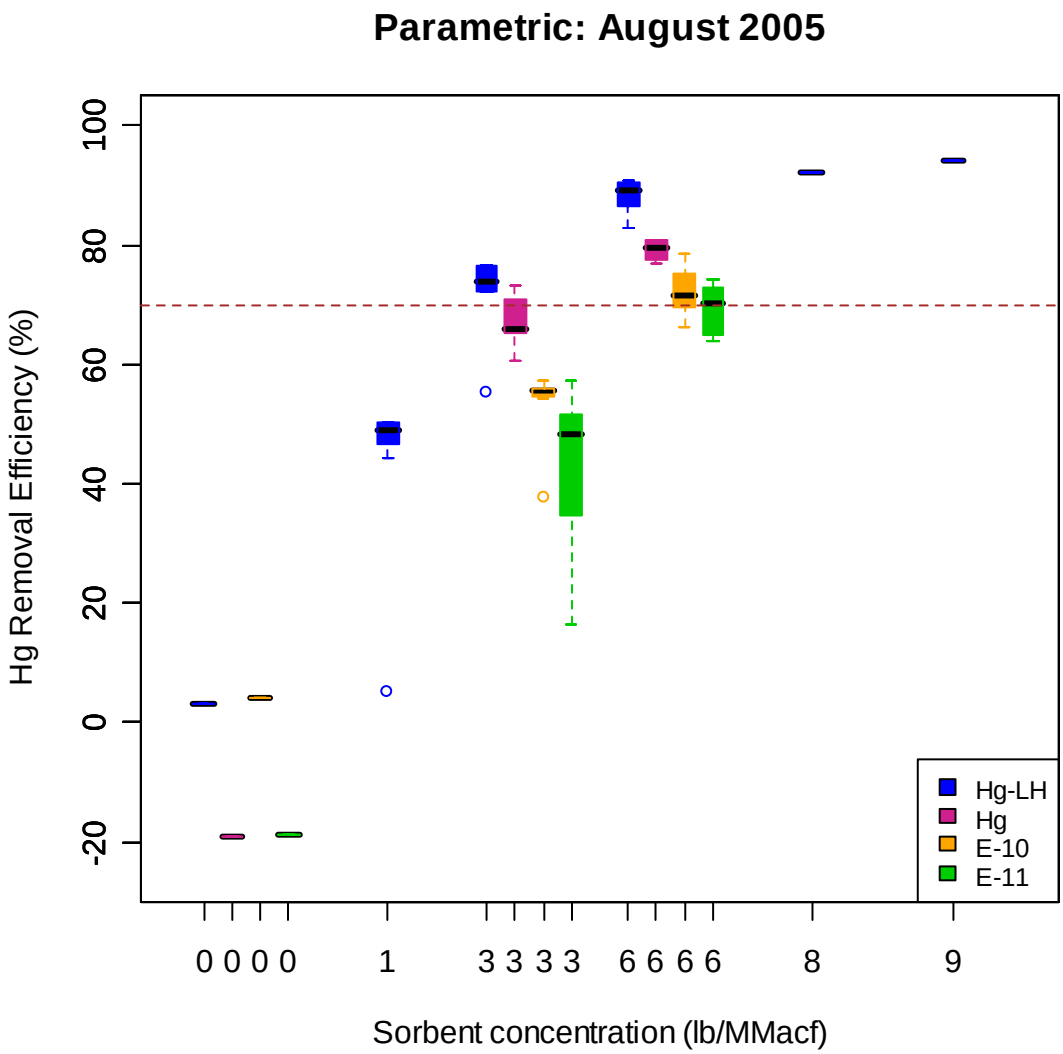


Figure 22. Comparison of sorbent performance during the first stage of Parametric tests. Midbox injection, field B-7 down, field B-3 low/no power. Dashed line at 70%.

During this round of tests, readings of elemental mercury were also taken. The average percentage of elemental mercury relative to the total vapor-phase mercury at the inlet and outlet of the test side of ESP B for each of the test sorbents is shown as box-whisker plots in Figure 23. The S-CEMs recorded a decrease in the fraction of elemental mercury across the ESP prior to injection and for each sorbent at each injection concentration. In addition, injecting non-bromine treated sorbents resulted in an increase in the fraction of elemental mercury measured at the outlet of the ESP as the concentration of sorbent increased. This suggests that the non-bromine treated sorbents are more effective at removing oxidized mercury than elemental mercury. The fraction of elemental mercury measured at the outlet of the ESP during DARCO® Hg-LH injection, the only bromine-treated PAC tested during this period, concentration did not vary significantly with sorbent concentration. This suggests that DARCO® Hg-LH was equally effective at removing both elemental and oxidized mercury. None of the sorbents demonstrated an increase in the fraction of oxidized mercury across the ESP as has been observed at other sites.

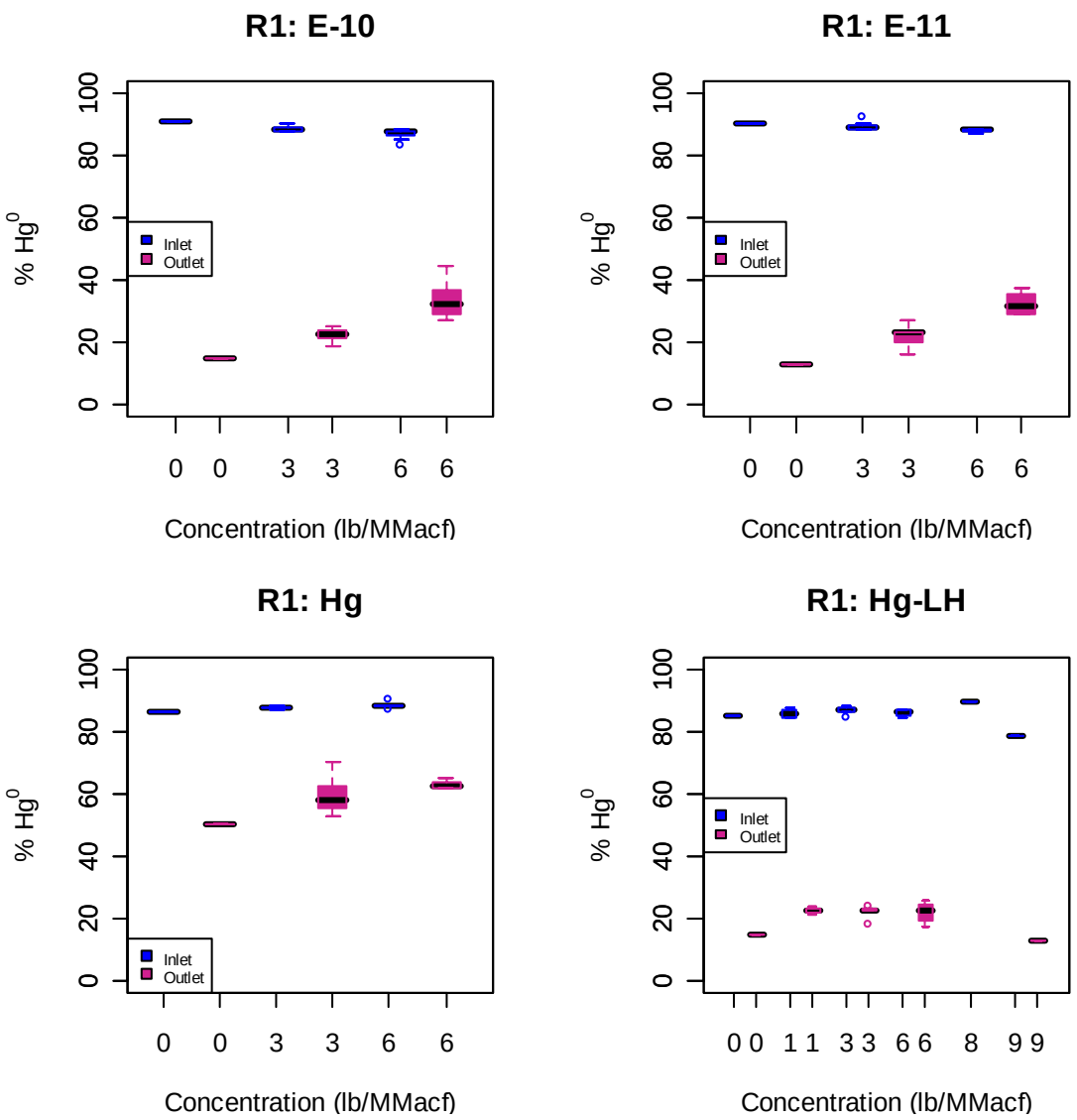


Figure 23. Average percentage of elemental mercury across the test side of ESP B during the first stage of Parametric tests (August 2005). ESP field B-7 non-operational; mid-box injection.

An unscheduled outage in late September 2005 allowed the plant to repair field B-7. The cause appeared to be a discharge electrode wire that was shorting to the collector plate. During this outage, ADA-ES was on site to perform a visual inspection of the injection grid. Access to the grids included the upper and lower sections of the field B-7 grid and the lower sections of the field B-5 grid. Internally, the vertical lances appeared to be clean, with the lower injection ports being clean and free of any material. There was some build up of ash on the leading and trailing edges of the injection lances, but the lance sides perpendicular to the flue gas flow, where the injection ports are located, were clean. PAC deposits on the collection plates were evident on the lower sections of the trailing edge of field B-5 and the leading edge of field B-7. There were no evident deposits of PAC in the higher section of the field B-7 grid or in the space between ESP fields B-3 and B-5, where the field B-5 injection grid is located.

Physical tracing of the injection supply lines confirmed that the injection during the initial Parametric tests occurred through the field B-5 injection grid. Although the PAC deposits on the ESP collection plates were not evenly spaced, factors other than the actual grid injection system could impact the PAC deposition pattern. For example, the effects of gravity on the PAC could account for the absence of PAC high in the field B-7 spacing. As the PAC drifts further downstream from the injection point, the natural tendency of the PAC at the low air velocity in the ESP, less than 3.3 fps, would be to trend down. The reduced carrying capacity in the ESP relative to the flue gas stream in the ducts (usually greater than 50 fps) is inherent in its design such that fly ash and re-entrained material will drop into the ESP collection hoppers.

Based on the visual inspection, the performance during the first Parametric testing and using the previous TOXECON II™ system results as a guide, there was little evidence to suggest any issues with PAC distribution at this time in testing.

Stage II

Parametric tests were continued after ESP field B-7 was repaired. The test sorbents were injected in the rear of the ESP B-box, between fields B-5 and B-7, and their performance evaluated at different concentration levels. From this stage onwards, readings of mercury levels across both the test and control side of ESP B-box were taken (total vapor-phase mercury only). All inlet S-CEM mercury measurements were taken on the vertical duct on the ESP B test side. Outlet mercury measurements were taken on the vertical outlet ducts on both the control side and test side of ESP B. Monitoring the control side outlet gave a continuing verification of the native removal without PAC injection.

Figure 24 shows box-whisker plots of 30-minute averages of mercury removal efficiency for the test sorbents at various concentrations during the second stage of Parametric tests (October 1–7, 2005). The corresponding averages across control side of the ESP are also indicated. The results from one day (October 8, 2005) of sorbent injection to both the mid and rear ESP box locations are given in Figure 25. As can be seen in these figures, there is some evidence of PAC appearing to impact the control-side mercury measurement, particularly at high injection concentrations.

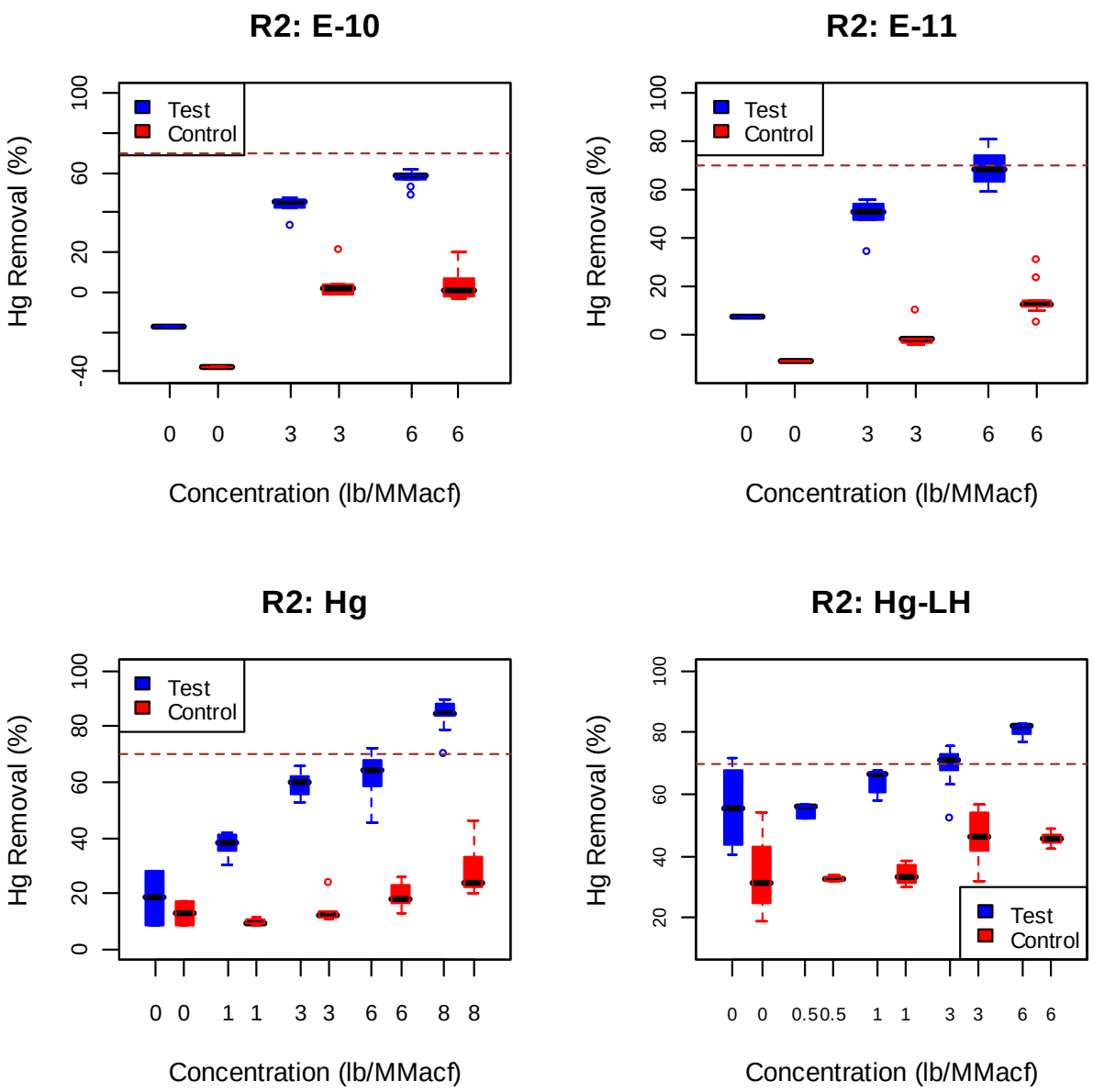


Figure 24. Average mercury removal efficiency for test sorbents at various injection concentrations across the test side and control side of ESP B-box during the second stage of Parametric tests (October 2005). ESP field B-7 operational; rear box injection.

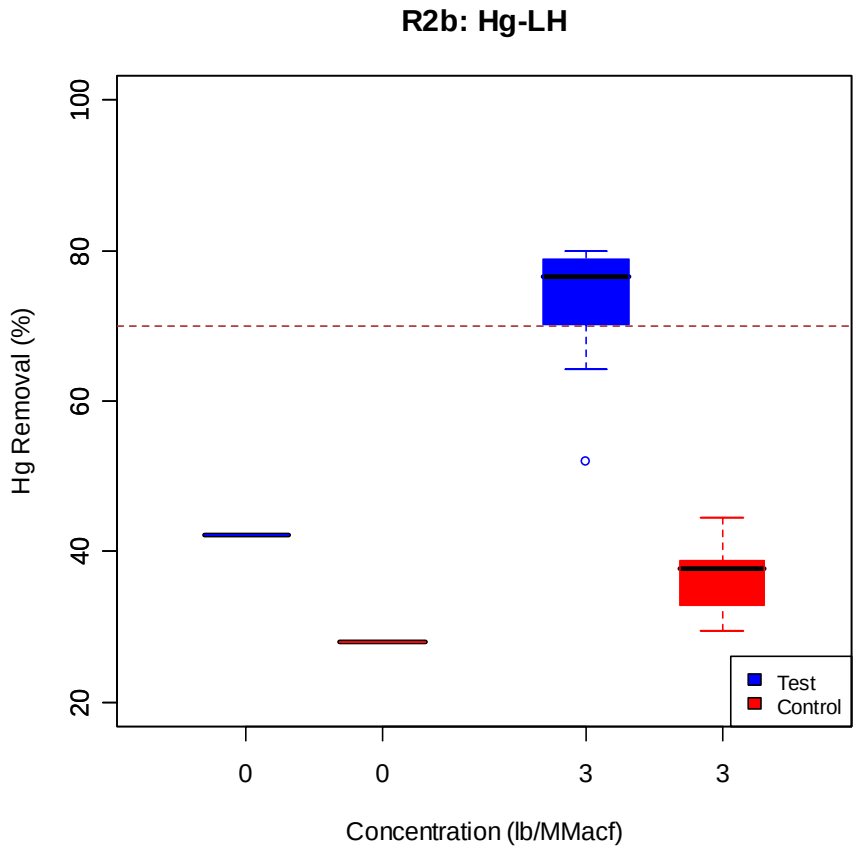


Figure 25. Average mercury removal efficiency for test sorbent DARCO® Hg-LH at single injection concentration across the test side and control side of ESP B-box during the second stage of Parametric tests (October 2005). ESP field B-7 operational; dual injection to both mid and rear box.

The final stage of Parametric testing in 2005 involved only a single sorbent, DARCO® Hg-LH. Before looking at the results from that stage, it is worth noting that the results from the first two stages of Parametric testing indicate that a particular sorbent, its concentration, and the injection location impact mercury removal efficiency across the ESP. Several comments on the comparative performance of the sorbents follow.

NORIT's DARCO® Hg-LH compared favorably to the benchmark test sorbent, DARCO® Hg, and its derivatives, Hg E-10 and E-11. The two derivatives of DARCO® Hg are test products designed to study the impacts of particle sizing on particulate pass through and opacity. The two products were not designed to enhance the mercury removal capability of DARCO® Hg. Specifically, NORIT predicted prior to testing that the two derivative PAC materials would not perform as well as the Baseline DARCO® Hg. The validity of this prediction can be seen in Figure 22 and Figure 24.

Although DARCO® Hg-LH exhibited higher mercury removal efficiency than DARCO® Hg, its relative performance was not as favorable as expected for a site firing a PRB coal and configured with an ESP Performance limitations resulting from poor sorbent distribution may have limited the relative difference between the sorbents, as will be discussed later.

In general, sorbents performed better when injected at the ESP mid-box location and in higher concentrations. An exception was the injection of DARCO® Hg-LH at low concentrations (0.5 to 1 lb/MMacf), when injection in the rear-box grid outperforms injection in the mid-box (65.5% vs. 43.4%). Similarly, injection of DARCO® E-11 at a concentration of 3 lb/MMacf in the rear-box grid showed a slight improvement in performance over the mid-box location (48.9% vs. 43.7%). When DARCO® Hg-LH was injected simultaneously in both the mid-box and rear-box locations at 3 lb/MMacf, it performed slightly better than either the mid-box or rear-box only injections at the same concentration (73.1% vs. 71.3% and 68.8%, respectively), but this performance was still lower than when it was injected at higher concentrations in either the mid-box or rear-box locations.

During the second stage of Parametric tests, relatively high levels of native mercury removal were observed directly prior to injecting DARCO® Hg and also DARCO® Hg-LH (see Figure 24 and Figure 25). As with all Parametric testing, one potential pitfall of the test results was a failure to allow proper time for the system to reestablish baseline conditions prior to attempting to establish a new sorbent trend data point. Residual effects from the previous day's Parametric run may partially account for the unusually high levels of mercury removal in the absence of sorbent injection and may also have influenced the relatively high performance observed at low injection concentrations.

Stage III

The third stage of Parametric testing was conducted in 2007 from January 16 through January 18, with repeat tests conducted on January 26 using DARCO® Hg-LH and a redesigned injection grid. The results indicate that the new lance design and conveying system were an improvement from the original lance design. Mercury removal was measured at three different carrier air flow settings through the lances: modeled flow based on laboratory test results, 36% more carrier air flow than modeled, and 27% less air flow than modeled. No significant difference in the mercury removal results was noted at these flows, as shown in Figure 26. However, some degradation in performance was noted when the tests were repeated a week later. This was a precursor of the operational difficulties encountered during 2007 Long-Term testing and discussed in the next section.

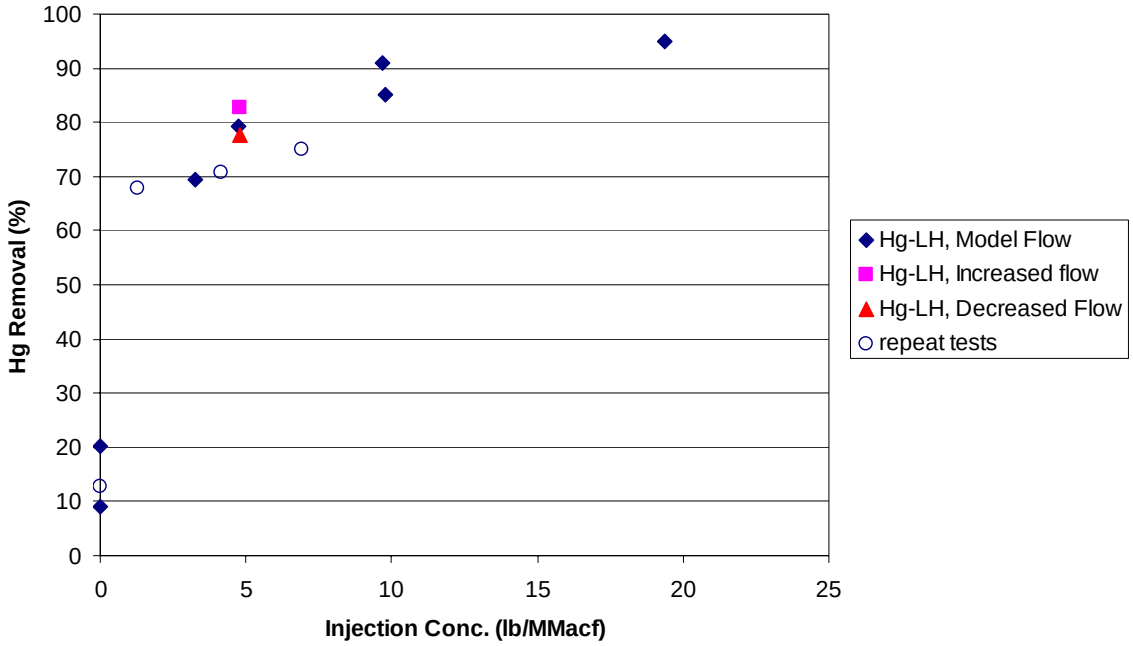


Figure 26. Mercury removal efficiency of Hg-LH during 2007 Parametric tests and using redesigned lances.

Long-Term Mercury Removal

Based on the slightly better removal rates for the DARCO® Hg-LH, minimal opacity spiking during ESP plate rapping, and discussions with other project participants, DARCO® Hg-LH was chosen for the Long-Term tests. The initial 30-day Long-Term test was carried out October 10 through November 9, 2005. A Long-Term operational demonstration commenced mid-November through mid-December 2005 and resumed the end of January through early March 2006. Long-Term tests of the redesigned grid delivery and injection system were conducted in 2007. The results from these different periods are presented below.

Original Grid: 30-Day Continuous Injection

The Long-Term test period was divided into two phases:

Phase I: Determine the minimum amount of sorbent needed to maintain effective mercury removal in accordance with project guidelines on the ESP field 7 (rear-box) injection grid (October 10 through 21) while monitoring particulate emissions.

Phase 2: Determine the minimum amount of sorbent needed to maintain effective mercury removal in accordance with project guidelines on the ESP field 5 (mid-box) injection grid (October 21 through November 9) while monitoring particulate emissions.

Independence typically burns a PRB coal. However, the plant burned coal from the ColoWyo Mine, which is significantly lower in mercury, on October 31 through November 2 and again on November 7 through the end of the Long-Term test period. Thus, the second phase of the Long-Term test includes data obtained while ColoWyo coal was burned.

In general, mercury removal during the Long-Term test period was not as high as was expected, based on previous results at other PRB power plants. The average mercury removal during this period was 69.6 ± 13.8%. In contrast to the trends observed during Baseline testing, mercury removal fluctuated with boiler load (Figure 26). During the length of the Long-Term test phases, these unexpected results were analyzed and potential reasons for them are detailed in the following sections. As was observed during the Parametric tests, sorbent injection does appear to impact mercury removal on the control side of the ESP box. This effect is most evident when the sorbent is injected in the rear-box location (Figure 25). This was also evident during post-injection visual inspections of the ESP B-box, which found PAC deposits spaced across the entire outlet wall of ESP B.

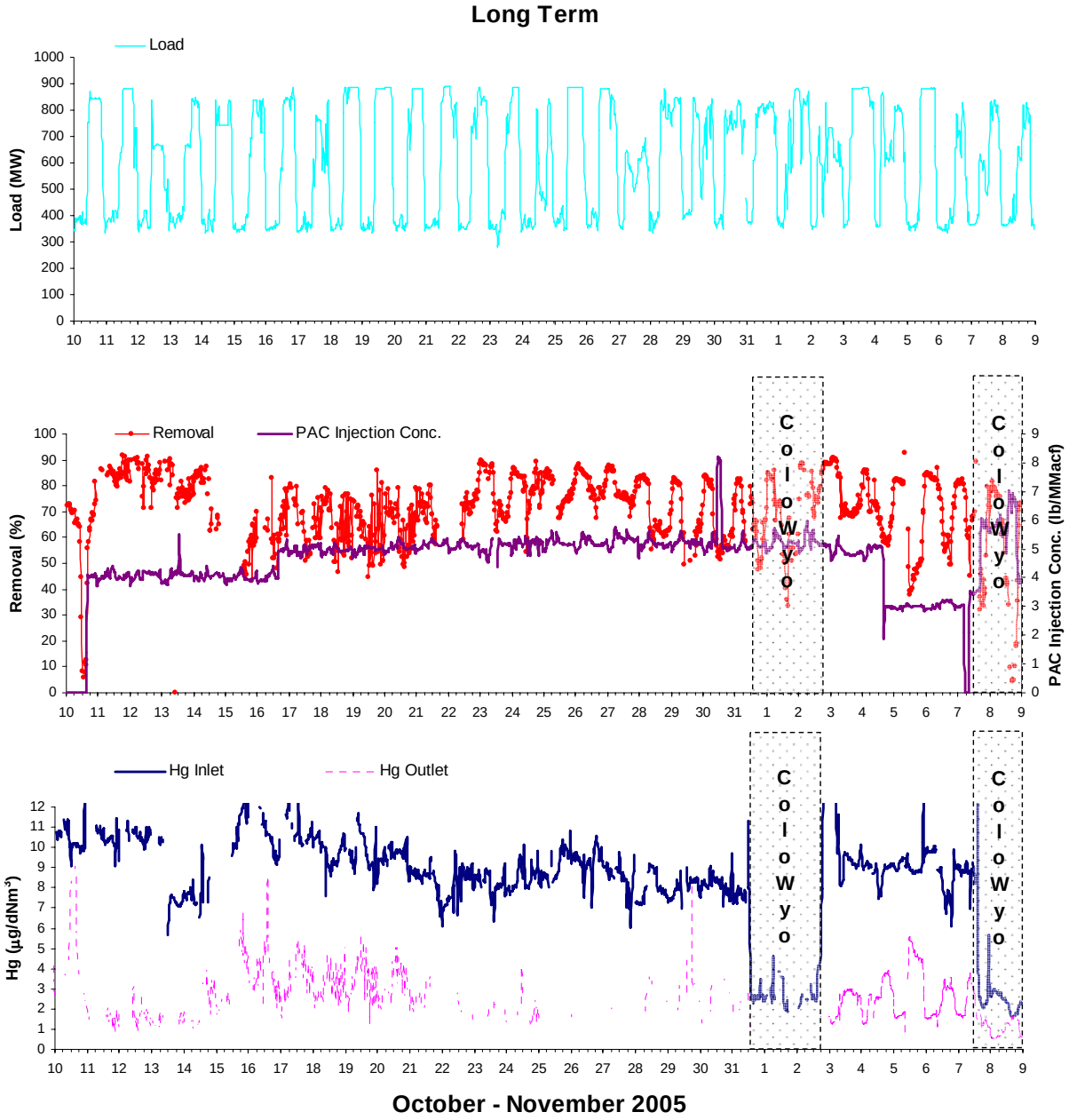


Figure 27. Mercury removal trends during Long-Term testing: October–November 2005. (Hg levels corrected to 3% O_2.)

In the middle of the first week of Long-Term testing, it became apparent that the S-CEM mercury analyzers were giving aberrant readings, particularly the outlet measurement, because the outlet mercury levels showed little variability. To verify the result of the S-CEM analyzers, a calibration was performed using a mercury calibrator through the probes. The results clearly indicated that the mercury removal results of the previous four days were questionable as the outlet filter was scrubbing a significant amount of mercury from the flue gas stream. Operating procedures were changed, and the frequency of calibrations increased, to prevent this situation from arising again. Subsequently, the PAC injection concentration

was increased from 4 to 5 lb/MMacf to increase mercury removal efficiency to the target removal of 60–70% at full load.

Box-whisker plots of the total vapor-phase mercury removal efficiency (averaged over 30-minute intervals) of DARCO® Hg-LH during mid-box and rear-box injections at high (> 750 MW) and low (< 450 MW) boiler loads are given in Figure 28 and Figure 29. In Figure 28, the two left plots include the average OH Results for Total Hg removal efficiency for reference. In Figure 29, the upper half of the figure shows box-whisker plots of the average total vapor-phase mercury removal efficiency across the test and control sides of ESP B-box for various injection concentrations at the mid-ESP box injection location for boiler loads > 750 MW or < 450 MW while ColoWyo coal is burned. The lower half of the figure shows box-whisker plots of the total vapor-phase mercury levels at the test side inlet and outlet to ESP B-box for the same conditions. In the upper left plot, the average OH results for total Hg removal efficiency for this period is shown for reference. In the lower left plot, the average OH results for total Hg at the ESP inlet and outlet for this period are shown for reference. (OH values corrected to 3% O_2.)

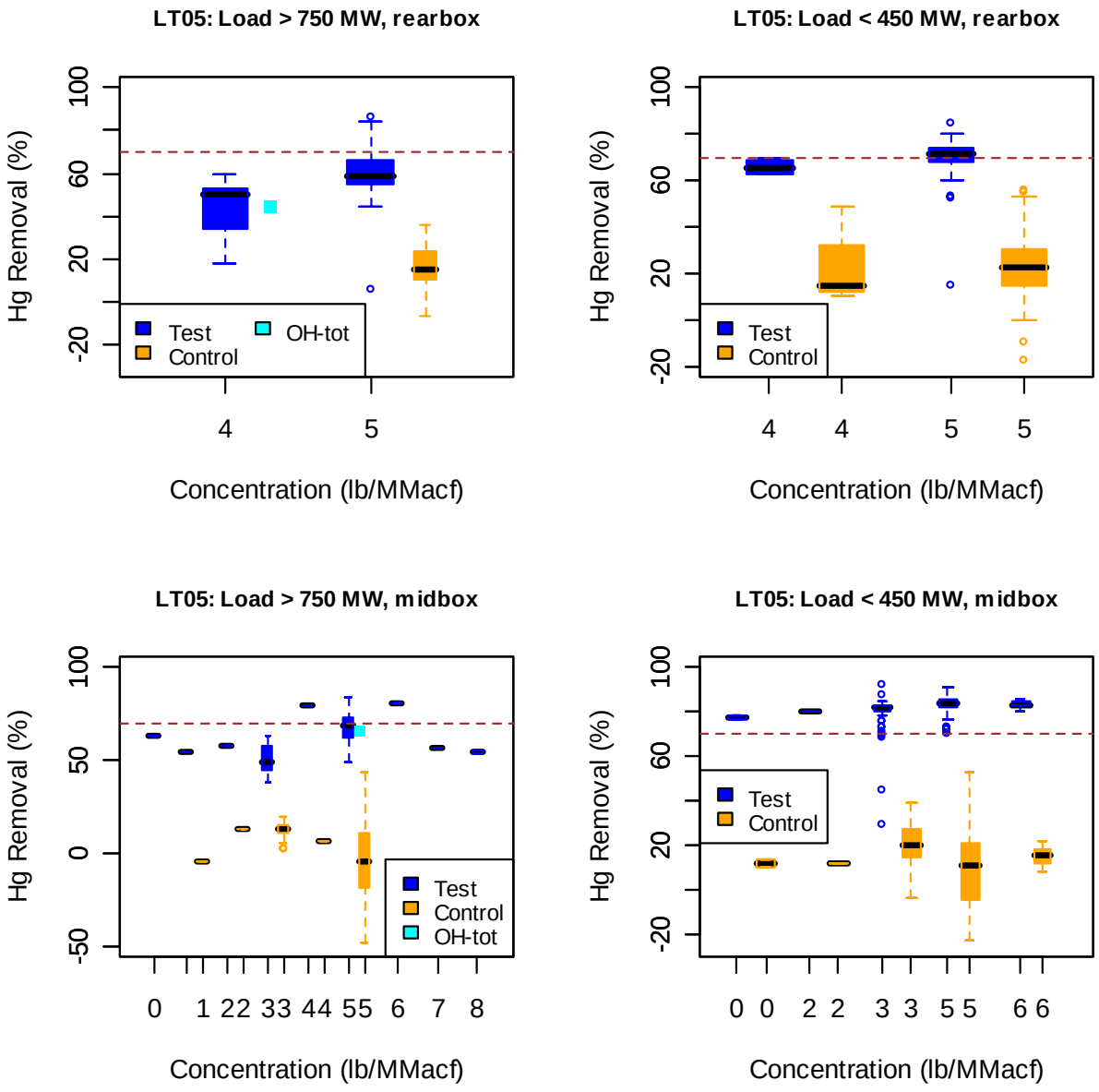


Figure 28. Average total vapor-phase mercury removal efficiency during DARCO® Hg-LH injection upstream of the final field.

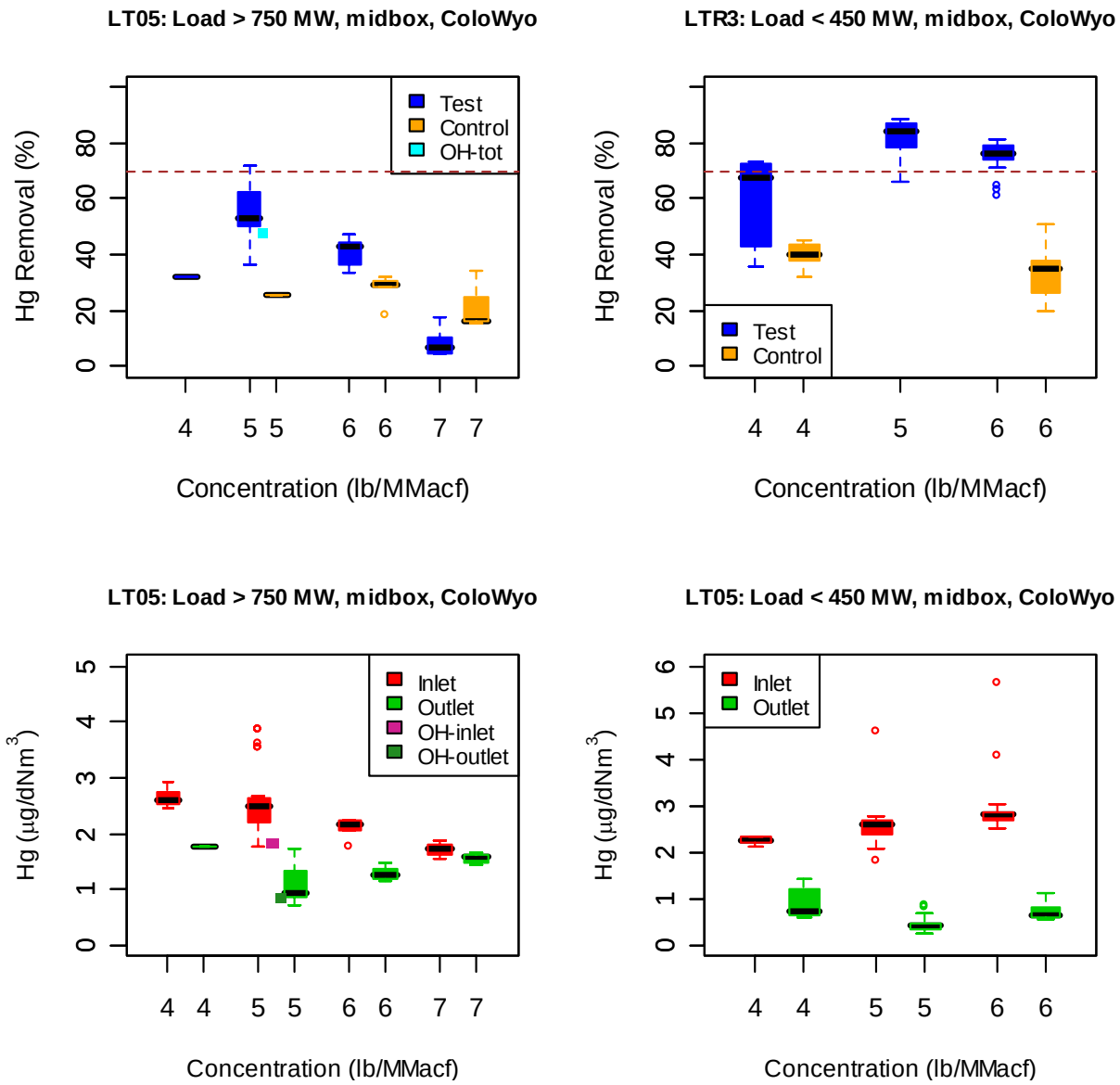


Figure 29. Average total vapor-phase mercury removal efficiency during DARCO® Hg-LH injection upstream of the middle collection field.

The relatively high mercury removal efficiencies observed during mid-box injection at low or no PAC concentrations are likely to be anomalies. These low injection concentrations were of short duration and the results likely to be influenced by the residual effects of preceding, higher injection concentrations that would include conditioning the duct work and ESP with PAC. The average efficiencies are given in Table 8.

Table 8. Average total vapor-phase mercury removal efficiency during 2005 Long-Term testing.

Boiler Load	Rear-Box Injection	Mid-Box Injection	Mid-Box Injection, ColoWyo
> 750 MW	59.7 ± 11.67%	65.4 ± 9.38%	45.4 ± 18.20%
< 450 MW	70.0 ± 8.22%	82.4 ± 5.95%	75.4 ± 10.89%

Sorbent performance under high load conditions when ColoWyo coal was burned was relatively poor. However, the average concentration of total vapor-phase mercury at the ESP inlet during Long-Term testing when PRB was burned was 9.07 ± 1.44 μg/dNm^3 in contrast to 2.54 ± 0.59 μg/dNm^3 when ColoWyo coal was burned (values corrected to 3% O_2). Moreover, it was not the intent of this test program to test the effectiveness of DARCO® Hg-LH with ColoWyo coal.

Three sets of triplicate Ontario Hydro runs were conducted during both Long-Term test phases and when ColoWyo coal was burned. A comparison of the OH results with average S-CEM readings and the average of duplicate STM run results from the corresponding times as the OH runs are presented in Table 9 (rear-box injection), Table 10 (mid-box injection), and Table 11 (mid-box injection, ColoWyo burned). As can be seen in the tables, except for the ESP inlet mercury levels for the first two runs of the first set of OH tests, the S-CEM and STM results tended to be higher than the OH results at the inlet to the ESP.

Not shown on the tables is the fraction of mercury reported as particulate mercury on the outlet Ontario Hydro filters. Recall that there can be a bias using the Ontario Hydro Method because the sample gas flows through a cake of ash that forms on the sampling filter. If the particulate has an affinity for mercury, this filter cake may scrub mercury from the sample gas stream. For the tests shown in Tables 9 through 11, the fraction of mercury reporting as particulate mercury on the outlet sampling filters ranged from 62 to 85% (Table 9 data), 44 to 78% (Table 10 data), and 16 to 29% (Table 11 data). At the inlet where much more ash was present, but no activated carbon, the fraction of mercury reporting as particulate mercury was typically less than 2%. These data suggest some activated carbon with remaining capacity for mercury was exiting the ESP to bias the Ontario Hydro speciation results. A bias is suspected because the total mercury measured with the Ontario Hydro Method matches the S-CEM vapor-phase measurements fairly well. The full Ontario Hydro reports are included in Appendix D.

Table 9. Mercury levels across ESP B-box obtained by different methods during injection of 5 lb/MMacf DARCO® Hg-LH in the rear-box location. (OH is Hg^{2+} + Hg^0; S-CEM is total vapor-phase mercury; all values given in μg/dNm^3 and corrected to 3% O_2.)

Oct. 18–19, 2005	OH (In)	OH (Out)	S-CEM (In)	S-CEM (Out)
Run 1	12.39	6.24	9.0 ± 0.31	3.65 ± 0.64
Run 2	10.45	3.97	9.42 ± 0.22	3.80 ± 0.81
Run 3	8.52	6.63	10.45 ± 0.26	4.35 ± 1.08

Table 10. Hg levels across ESP B-box obtained by different methods during injection of 5 lb/MMacf DARCO® Hg-LH in the mid-box location. (OH is Hg^{2+} + Hg^0; S-CEM and STM are total vapor-phase mercury; all values given in µg/dNm^3 and corrected to 3% O_2.)

Oct. 25–26, 2005	OH (In)	OH (Out)	S-CEM (In)	S-CEM (Out)	STM (In)	STM (Out)
Run 1	7.99	2.31	8.96 ± 0.45	2.50 ± 0.9	NA	2.67 ± 0.97
Run 2	7.21	2.22	9.90 ± 0.28	2.50 ± 0.11	NA	2.55 ± 0.41
Run 3	7.08	2.99	9.21 ± 0.24	2.12 ± 0.11	12.79 ± 7.00	NA

Table 11. Hg levels across ESP B-box obtained by different methods during injection of 5 lb/MMacf DARCO® Hg-LH in the mid-box location. ColoWyo coal burned. (OH is Hg^{2+} + Hg^0; S-CEM and STM are total vapor-phase mercury; all values given in µg/dNm^3 and corrected to 3% O_2.) NB: Run 2 was aborted.

Nov. 1–2, 2005	OH (In)	OH (Out)	S-CEM (In)	S-CEM (Out)	STM (In)	STM (Out)
Run 1	1.39	1.11	2.38 ± 0.62	1.45 ± 0.19	2.7 ± 2.01	NA
Run 3	2.24	0.56	3.13 ± 0.83	0.74 ± 0.11	NA	1.45 ± 0.49

Run 2 of the third triplicate run of Ontario Hydro data was shut down as a result of the plant having to respond to a load change request. As a result, the data from the run were compromised and were not analyzed.

Long-Term Speciation Results

Given the speciation results obtained during Parametric testing and the desire to monitor the total vapor-phase outlet mercury levels on the control side, limited speciation measurements were made with the S-CEM at the ESP B test outlet during the Long-Term test period. Speciation measurements were made with the S-CEM during the second phase of Long-Term testing (mid-box injection) in conjunction with Ontario Hydro testing. The averaged percent elemental mercury (Hg^0/(Hg^{2+} + Hg^0)) as determined by the Ontario Hydro tests conducted during the first phase of Long-Term tests (October 17–18, 2005; rear-box injection of 5 lb/MMacf DARCO® Hg-LH) was 73.3 ± 8.37% at the inlet and 55.6 ± 21.1% the outlet. During these tests, particle bound mercury comprised 57% of the total mercury measured at the ESP outlet. Thus, it is worthwhile to note the averaged amount of elemental mercury relative to the total mercury (i.e., elemental + oxidized + particulate) across the ESP as determined by the same round OH tests: 76.5 ± 8.57% at the inlet and 21.9 ± 9.37%.

Results under the conditions when 5 lb/MMacf of DARCO® Hg-LH was injected in the mid-ESP box location at high (> 750 MW) and low (< 450 MW) boiler loads and while PRB or ColoWyo coal was burned are presented in Figure 30. The OH tests conducted in late October, like those a week earlier, also indicated that particle bound mercury comprised a significant portion of the total mercury at the ESP outlet. Thus, the elemental mercury

relative to elemental and oxidized mercury and relative to total mercury (elemental + oxidized + particulate) mercury as determined by the OH tests when PRB was burned are both shown in the figure. As was observed during the Parametric tests, there is a substantial drop across the ESP in the percentage of elemental mercury present.

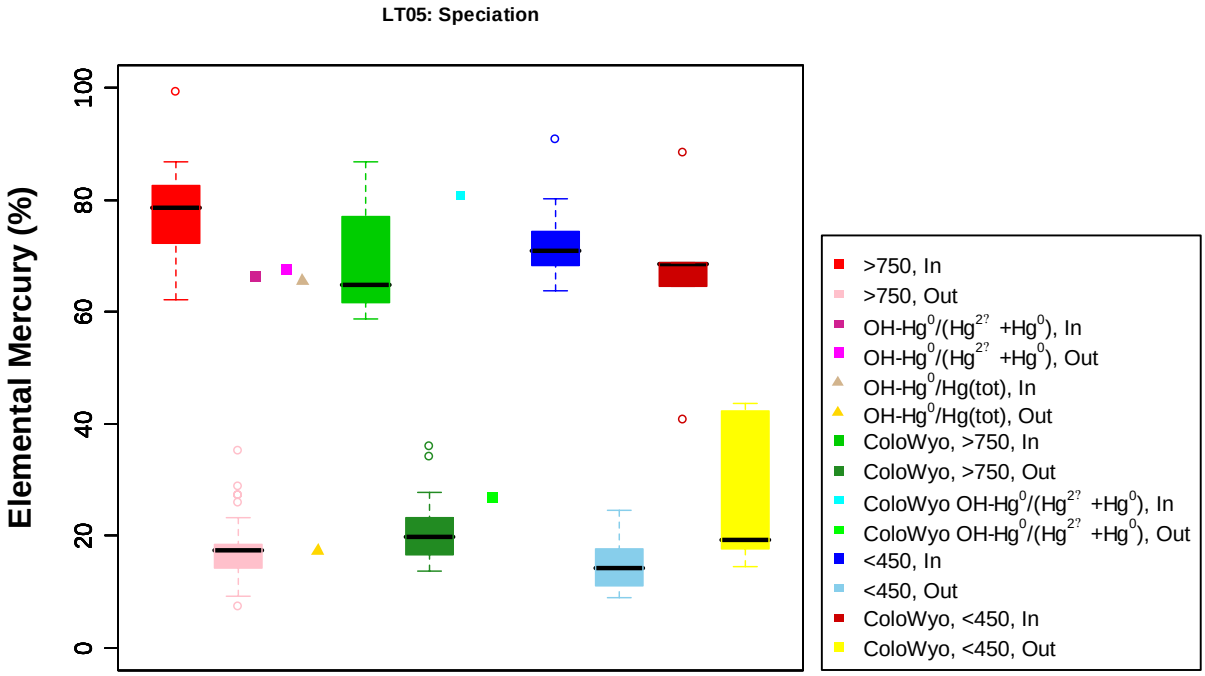


Figure 30. Comparison of mercury speciation across the ESP B-box at the mid-box injection location with 5 lb/MMacf of sorbent under high (> 750 MW) and low (< 450 MW) boiler load conditions that overlapped times when Ontario Hydro tests were conducted during Long-Term testing 2005.

Long-Term and Parametric Comparison

A comparison of the average performance of DARCO® Hg and DARCO® Hg-LH at various injection concentrations during the 2005 Parametric and Long-Term test sequences is shown in Figure 31. The higher removal rates during the Long-Term testing occurred during lower unit load, and the lower removal rates occurred during higher unit load. The points generally show that removal rate increases with injection concentration. This trend agrees with the general trends from other testing programs on PRB plants without SO_3 flue gas conditioning, although for the TOXECON II™ process, the required injection concentration for a given removal rate is higher.

Another statistical anomaly is the difference in removal rates at the same injection concentrations between Parametric testing and Long-Term testing. During the several Parametric test sequences, removal rates approached that expected for a brominated PAC being injected upstream of an ESP on a plant firing PRB coal. The mercury removal measured during Long-Term testing was much lower. It is believed that the difference in performance is mainly a result of pluggage in the TOXECON II™ injection grid. There is extensive discussion concerning injection system design later in the report.

The performance of DARCO® Hg compared to DARCO® Hg-LH during Parametric testing is also interesting. Typically, injection of a bromine-treated PAC results in significantly better performance in a halogen-deficient gas stream, such as PRB-derived flue gas. At Independence, the mercury removal with DARCO® Hg were not significantly worse than the mercury removal achieved with DARCO® Hg-LH. It is likely that limitations resulting from poor sorbent distribution affected the performance. It is also possible that DARCO® Hg benefited from the high baseline mercury oxidation across the ESP, often as high as 60%. The traditional injection location is upstream of the ESP, where no corona-induced oxidized mercury is present. Thus, the TOXECON II™ configuration and the specific electrical characteristics of Independence may have contributed to the performance of DARCO® Hg.

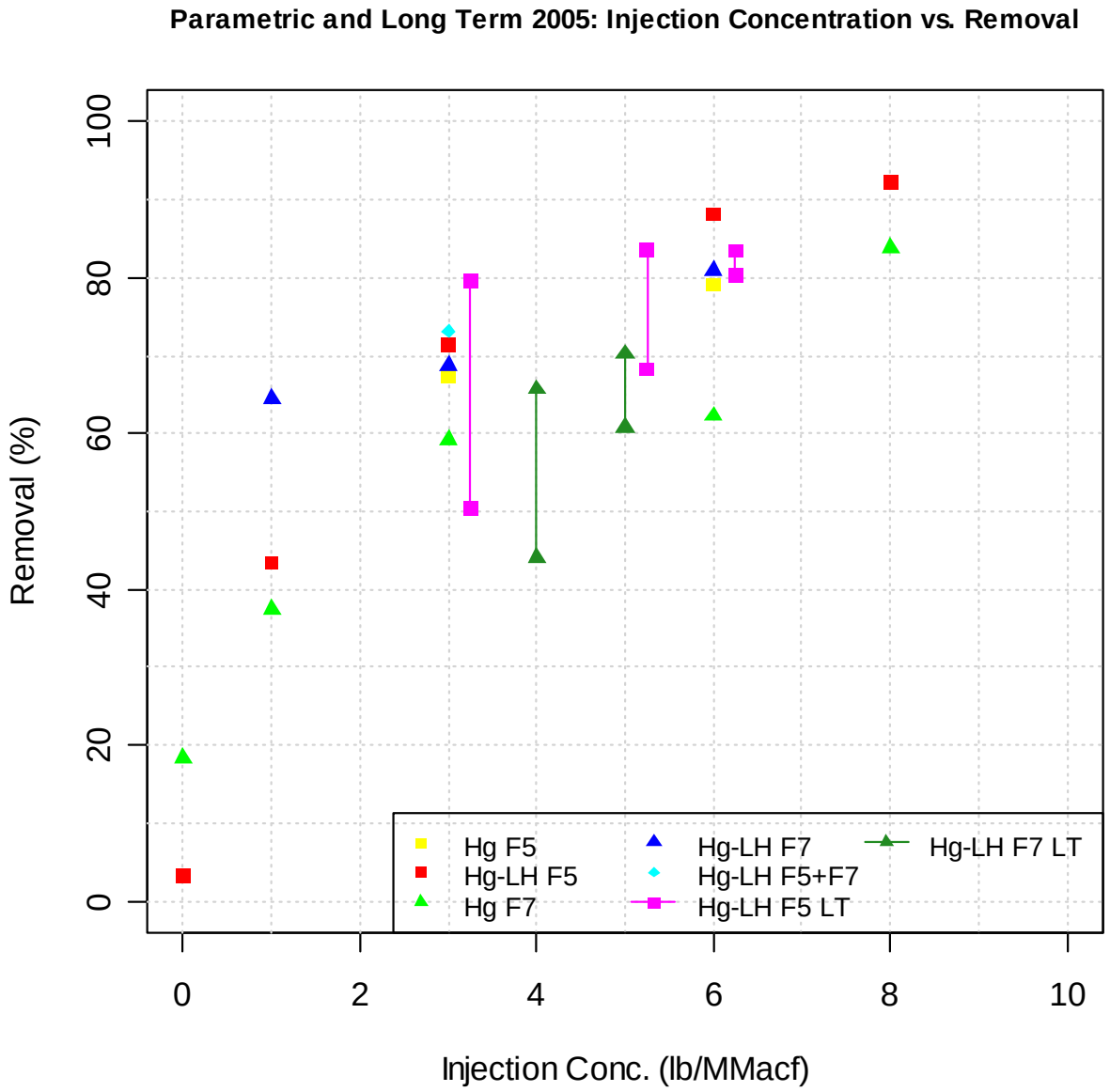


Figure 31. Comparison of DARCO® Hg and Hg-LH performance from Parametric and Long-Term (LT) tests at the mid-ESP (F5) and rear-ESP (F7) injection locations.

Long-Term Operational Demonstration

After completion of the ash recycling tests in mid-November, a Long-Term operational demonstration injecting DARCO® Hg-LH was conducted from November 16 through 21, November 29 through December 20, 2005, and January 23 through March 10, 2006. Prior to commencing the demonstration, both the mid-and rear-ESP box injection grids were inspected. The ash recycle mixture had been injected into the grid in front of ESP field B-5 and this grid was severely plugged. The grid in front of ESP field B-7 was relatively clear. The injection grids were cleaned and the bottom portion of the grid in front of ESP field B-5 was replaced. During the demonstration period, mercury removal rates essentially duplicated the results attained during Long-Term testing under similar conditions such as injection concentration, coal type, injection location, and boiler load. During several days of the demonstration (November 29 through December 2, 2005), the ID fan for the ESP A-C pair of boxes was down and Unit 2 ran at reduced load. Overlapping with this period, the ESP B field 7 was at low or no power (November 30 through December 12, 2005).

The first week of the demonstration period provided on opportunity to investigate one possible explanation for the difference in sorbent performance at high and low boiler loads, a phenomenon not observed at other test sites. Because flue gas temperatures increase with boiler load, flue gas flows also increase. Consequently, residence time within the ESP decreases with increasing load. At high loads, the residence time prior to the entry of the flue gas–PAC mixture was approximately one second. At lower loads, the residence time could increase approximately four-fold. The question was whether the residence time within the spacing between the T/R fields long enough at high load conditions to allow for the complex vapor-phase mercury–halogenated activated carbon interaction. Injecting sorbent in the mid-box location (field B-5) while the middle field (T/R set B-5) is off effectively increases residence time. T/R set B-5 was turned off from the morning of November 17 through the morning of November 19, 2005, and the total vapor-phase mercury across the ESP was measured. A comparison of the mercury removal efficiency when the T/R set B-5 was on and off is given in Figure 32. As shown in the figure, turning off T/R set B-5 did not produce an improvement in performance at either high (> 750 MW) or low (< 450 MW) boiler loads.

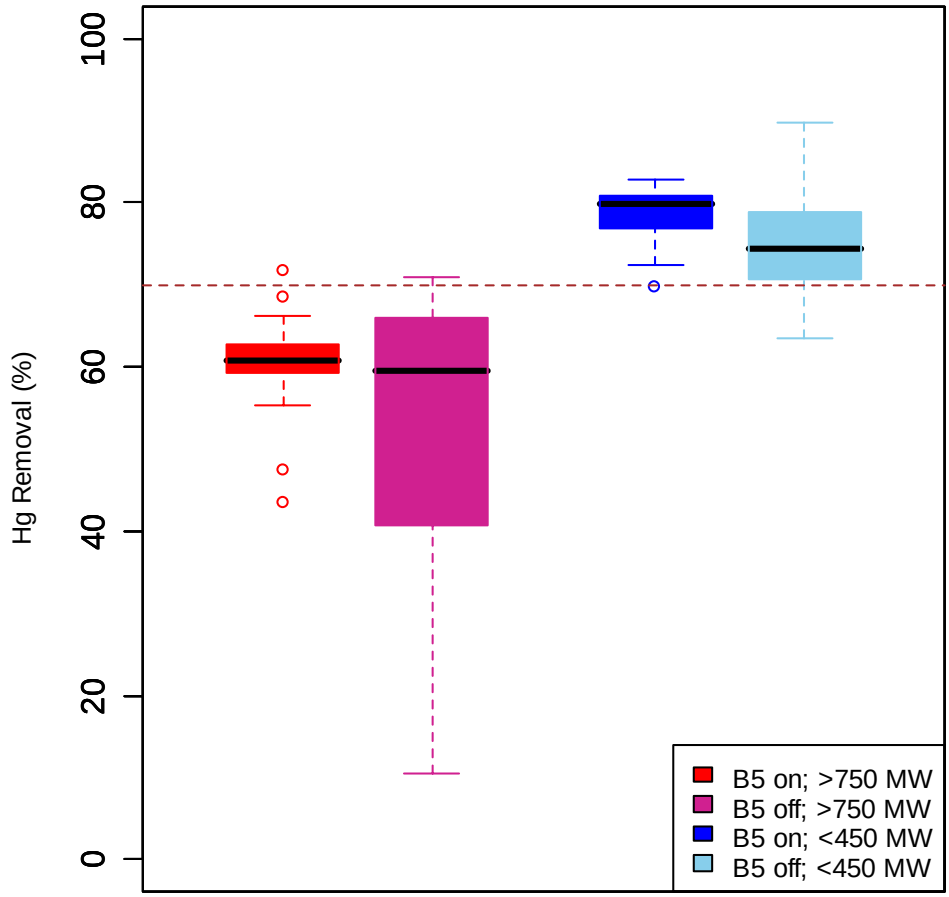


Figure 32. Box-whisker plots of the 30-minute averages of mercury removal efficiency at high (> 750 MW) and low (< 450 MW) boiler loads when 4–5.5 lb/MMacf of DARCO® Hg-LH was injected mid-box and the middle field (B5) was on or off.

If mercury concentrations are stratified within the ESP, this stratification may be limiting the efficacy of the TOXECON II™ system. On December 13, 2005, an STM carbon trap traverse of the ESP B test side outlet duct was carried out using a two-point depth sample of three ports. The results are shown in Figure 33 along with the corresponding average mercury concentration at the ESP inlet and outlet as given by the S-CEMs during the STM sampling period. All tests were conducted during high (> 750 MW) boiler load. As can be seen in the figure, the mercury concentration varies considerably depending upon the depth of the sampling probe. The mercury concentration at a depth of 50 inches is near the inlet concentration, suggesting that very little PAC was present at this depth. This is a strong indication that PAC distribution was poor. These measurements were collected following the ash/PAC recycle tests when lance pluggage was experienced, as discussed in the ash/PAC recycle section of the report included below. The data also suggest stratification from side-to-side across the ESP. The STM measurements were collected at two depths within a particular port simultaneously, but approximately 1.5 hours separated measurements in the different ports. The SCEM reported a significant change in the mercury concentration at the ESP outlet during the time elapsed between STM measurements. If the STM measurements were normalized to the SCEM measurements, a significant variation in the relative mercury would be apparent.

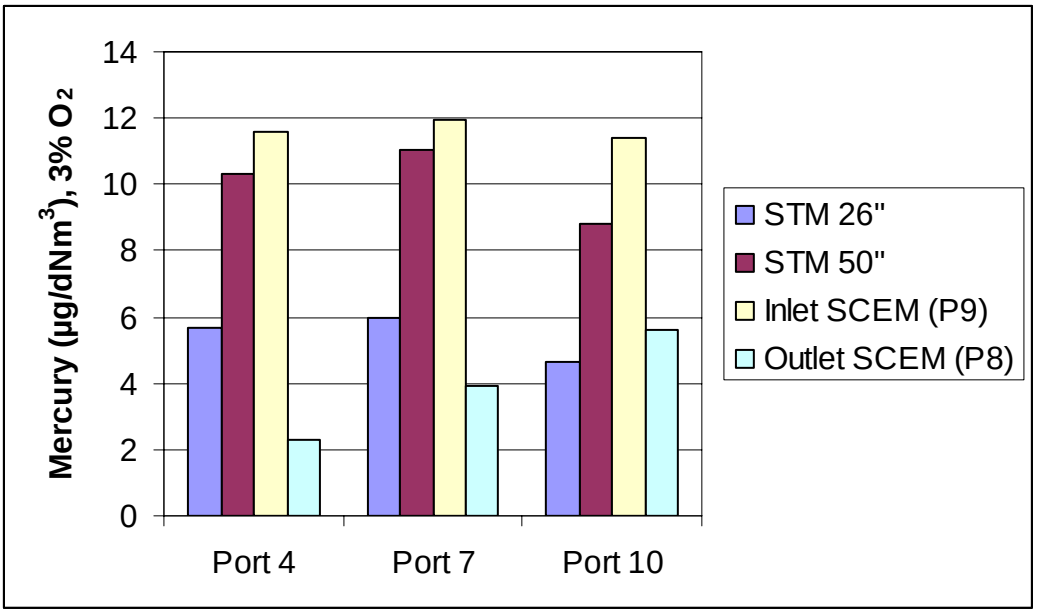


Figure 33. Total vapor-phase mercury at various locations in the test side of ESP B-box when 5.5 lb/MMacf of DARCO® Hg-LH was injected mid-box during high (> 750 MW) boiler load on December 13, 2005. Data for outlet ports 4, 7, and 10 are STM results. Concurrent S-CEM readings at the inlet and outlet are shown for reference with the corresponding port location denoted as either P9 (inlet port 9) or P8 (outlet port 8). Values corrected to 3% O_2.

A possible explanation for sorbent performance to fluctuate with changes in the boiler load is that changes in flue gas flow rates influence sorbent distribution patterns within the ESP. Injecting sorbent upstream of the ESP allows the sorbent to be dispersed more uniformly within the flue gas stream that passes through the ESP. Near the end of the demonstration period (March 5 through 7, 2006), DARCO® Hg-LH was injected at various concentrations into the test inlet to ESP B-box and the results are shown in Figure 34. During this segment of the test sequence, the boiler load remained above 640 MW. As can be seen in the figure, sorbent performance exceeded the target removal efficiency of 70% for all injection concentrations. The average mercury removal efficiency during this test segment was 81.18 ± 6.70%. Moreover, the pre-ESP injection at a relatively low concentration of 1 lb/MMacf exceeded previous tests results when sorbent was injected in either the mid- or rear-box locations. Although the pre-ESP test does not prove that the sorbent distribution within the ESP varies with load, it lends support to this possibility. Additional evidence for poor sorbent distribution is provided by the modeling results discussed later in this report.

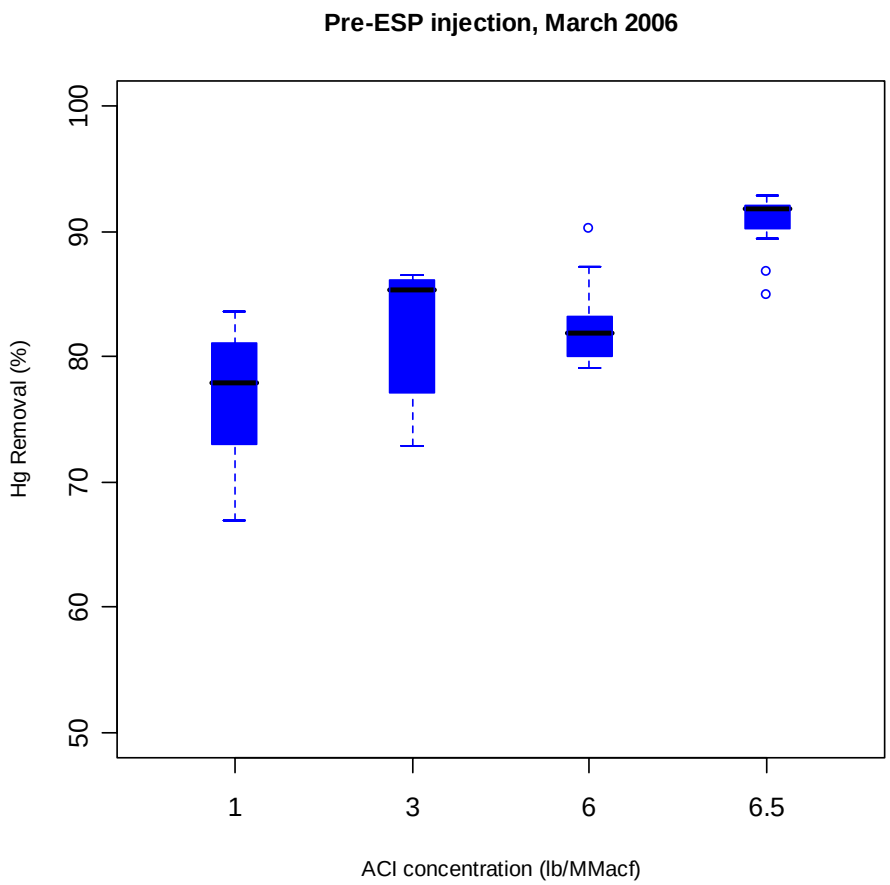


Figure 34. Box-whisker plots of mercury removal efficiency across the ESP when DARCO® Hg-LH was injected at the inlet of the ESP at various injection concentrations.

Extended Test with Redesigned Grid

Based upon the positive results achieved during 2007 Parametric testing, the decision was made to continue testing for a 30-day trial to evaluate long-term removal trends and operational constraints on the new lance design.

During the initial few days of testing, operational problems associated with the silo feed controls were encountered that prevented injection at PAC concentrations below 3 lb/MMacf. In addition, difficulties maintaining appropriate air flow through lances were encountered that were a result of PAC depositing in lances and/or distribution system. These problems continued to create operational difficulties throughout the 30-day test.

A summary of the mercury removal achieved during the 30-day test is shown in Figure 35. Data from previous test periods are included for reference. As shown, the mercury removal with the TOXECON II™ arrangement and the modified lances was similar to the removal achieved with injection upstream of the ESP. Little mercury removal performance difference was noted across a wide range of PAC injection system operating parameters. It is unclear whether the characterization of differences in mercury removal from changing the operational parameters was clouded by the operational difficulties encountered.

A trend graph showing inlet and outlet vapor-phase mercury, mercury removal, and injection concentration is presented in Figure 36. The injection concentration is shown per injection train. There are two injection trains on the feed system installed at Independence. Operating the west train was more problematic than operating the east train. For a period, the west train was isolated and the system was only feeding carbon the east train. This resulted in higher mercury measurements at the outlet of the ESP, likely due to the location of the S-CEM and difficulties measuring representative flue gas when only 1/32 of the unit was being treated.

Some S-CEM data were lost during the test following a computer malfunction. Since only one S-CEM was in use to measure both the inlet and outlet locations, no data are shown on the trend graph for either location following the data loss.

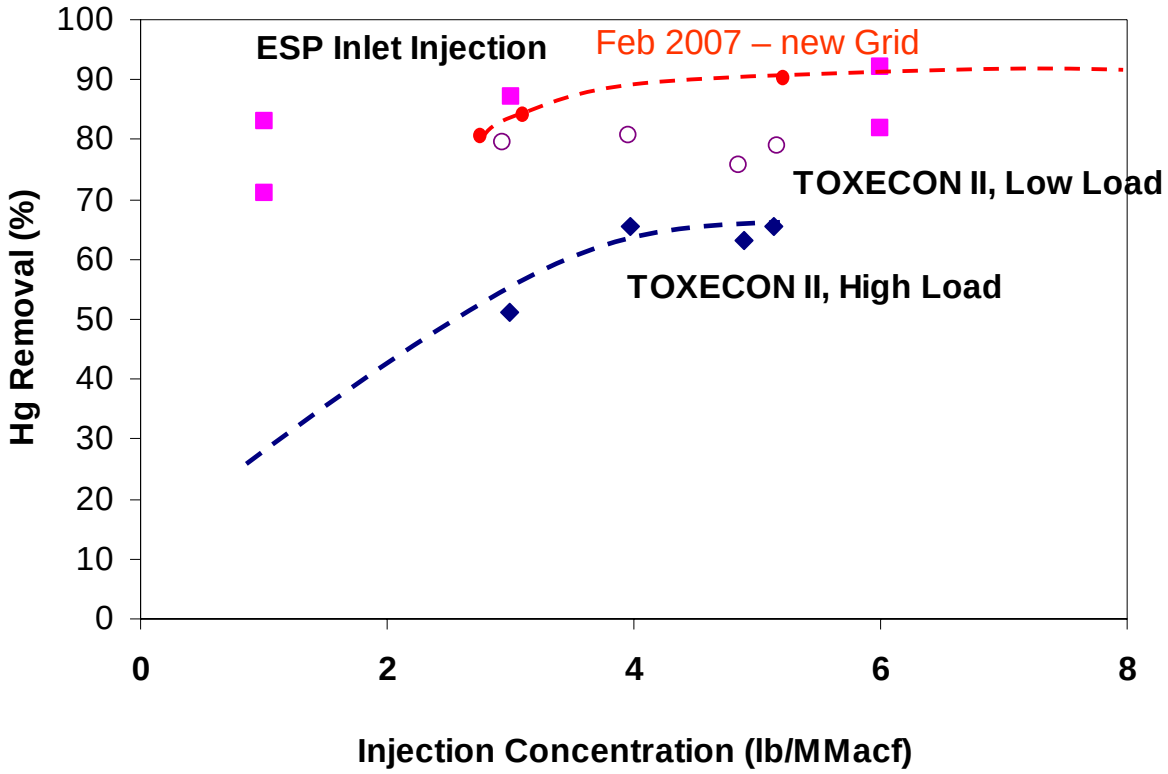


Figure 35. Mercury removal comparison of injection location and grid design.

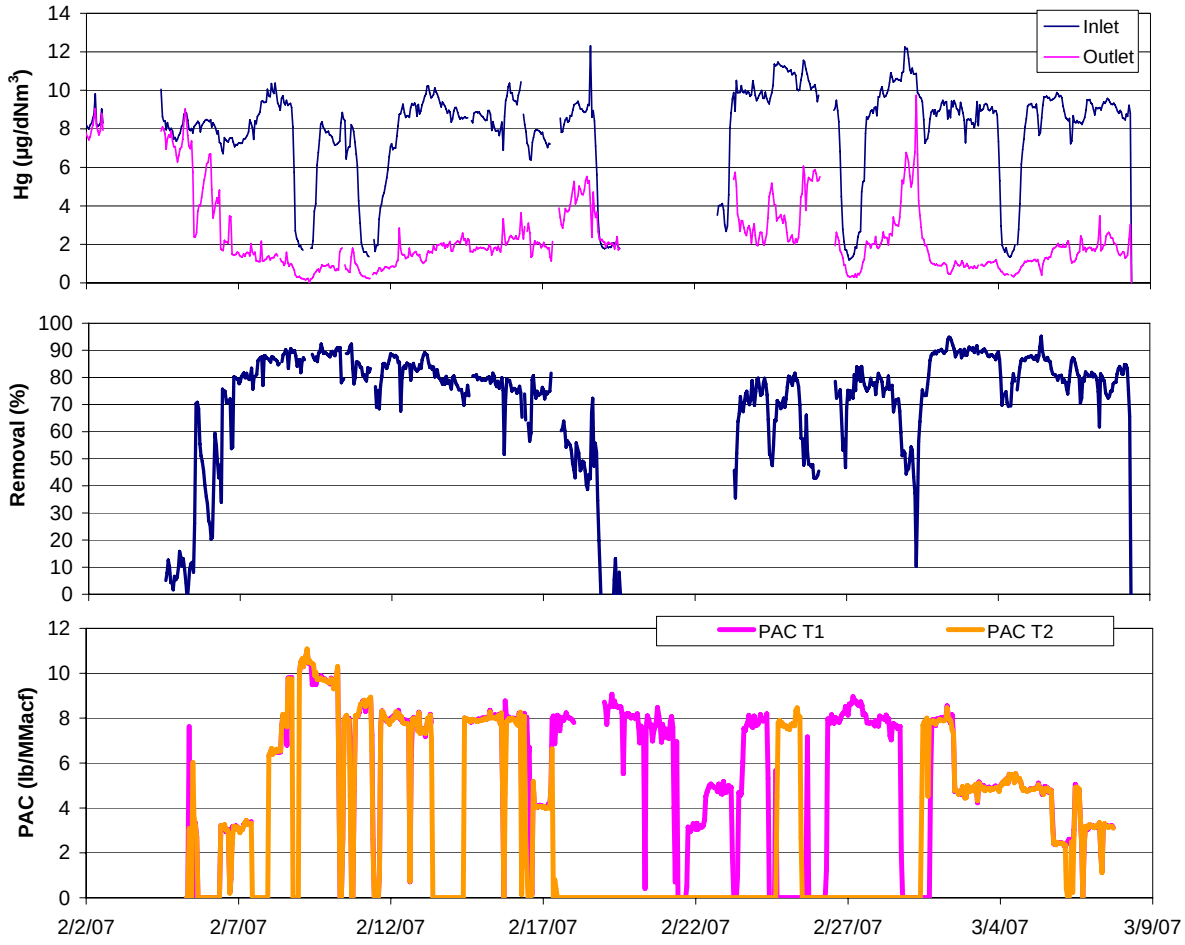


Figure 36. Mercury removal comparison of injection location and grid design.

Ash/Carbon Recycle Test Results

During most of the ash recycle test (November 9–13, 2005), the recycle mixture was injected in the mid-ESP location. The recycle mixture was initially estimated to contain approximately 20 to 30% carbon, based on the average % LOI results of ash samples that were taken from the rear hoppers during Parametric and Long-Term testing. Based on later ash analysis from the actual injection material, the PAC percentage could have been as low as 12%.

Some challenges operating the injection system were encountered during the recycle test. Differences in material handling characteristics and density of the mixture compared to either ash or carbon alone were noted during the ash/carbon recycle test at Independence. Although the bulk density of the test PACs is approximately half that of the fly ash at Independence, the silo delivery system was able to feed the ash/carbon mixture into the injection system. However, calibrating the auger feed rate proved challenging because the density of the ash/carbon mixture varied from 2 to 2 1/2 times that of PAC alone. Prior to recycling testing at Independence, the ash/carbon mixture had been stored in the test silo over an extended period, longer than the normal storage times for fly ash that was sold. Owing to

the relatively high humidity of the area and the use of plant air to fluidize while transporting, a significant percentage of moisture may have penetrated the recycle material. The presence of moisture in the recycle material could account for both the increase and the variation in density observed.

Another challenge during the recycle test was monitoring the fraction of carbon in the mixture. The carbon content of ash/PAC mixture samples from the recycle tests was 12 to 13% based upon LOI analyses of this material. This required a higher injection rate to achieve the desired carbon injection concentration. The expected carbon content was nominally 33%, based upon the carbon in DARCO® Hg-LH (derived from lignite coal and contains nominally 25% ash) and the baseline ash (LOI analyses of the baseline fly ash from Independence indicates nominally 0.25% LOI carbon). LOI analyses of ash collected downstream of the injection grid during Long-Term testing ranged from 25 to 55% LOI. The ash/PAC recycle material was collected in the segregated ash storage silo at Independence. This system was also used to segregate all the ash from burning ColoWyo coal. The ColoWyo coal ash had to be segregated at the request of the Arkansas DEQ since it had not been analyzed for use in the post-combustion ash utilization streams. The plant performed two 3-day test burns of the ColoWyo coal in the preceding two weeks prior to the ash recycle test. Additional dilution occurred when the segregated silo was brought on-line prior to emptying the downstream ash hoppers and did not switch back to the main ash silo until after the upstream hoppers began to empty and all PAC-laden ash was cleared from the conveying system. This procedure prevented the PAC from entering the normal ash collection silo but resulted in additional ash in the segregated ash silo.

As mentioned above, the recycle test sequence was curtailed when it was evident that the recycle material was not entering the ESP test fields. A subsequent inspection of the injection grid revealed that the ash/carbon mixture had plugged the injection lances, particularly in the lower section of the injection grid. While the injection grid had experienced some pluggage during the Long-Term test using standard PAC materials for injection, the change in the composition of the injection material lead to increased significant pluggage issues. STM measurements conducted in December indicated lance pluggage in the lower sections. A subsequent internal inspection of the ESP provided an opportunity to remove the lower sections of the injection lances for inspection. The color change from DARCO® Hg-LH to ash-Hg-LH mixtures was clearly evident in the removed sections of injection lances. The lower sections of the lances had pluggage from standard PAC, and then above that, there was substantially increased pluggage from just several days of ash recycle testing. This increased pluggage could well have occurred due to the potential higher moisture content of the recycled ash mixture.

Figure 37 shows the mercury removal efficiency attained during the ash recycle tests at various carbon concentrations at high (> 750 MW) and low (< 450 MW) boiler loads. Consistent with the results from the Long-Term tests, the recycle mixture performance improved at low boiler loads. Overall, mercury removal during the ash/carbon recycle testing was considerably less than that observed when using DARCO™ Hg-LH alone. However, the concentration of carbon injected during the ash recycle sequence was much less than that during either the Parametric or Long-Term tests.

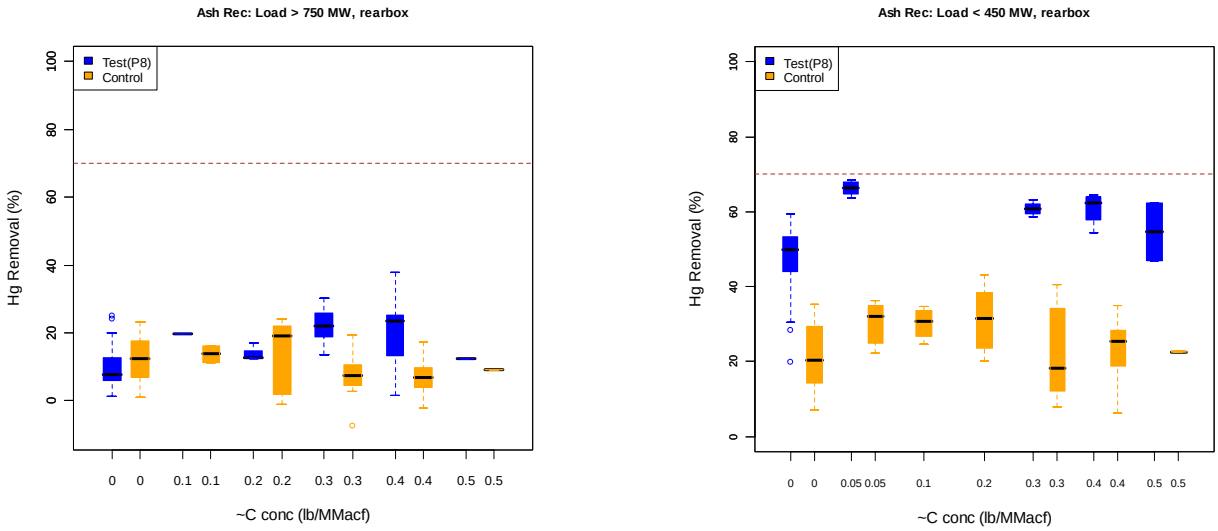


Figure 37. Box-whisker plots of the mercury removal efficiency across the ESP during the Ash Recycling tests.

At the completion of the ash recycle testing (November 14, 2005), the mixture remaining in the silo was injected into inlet test duct of the ESP B-box at high rates (~600 lb/hr). During this portion of the test, two sample probes from an S-CEM were placed at the ESP B test outlet duct at depths of 26 inches (port 9) and 50 inches (probe 8). Figure 38 shows trend plots the mercury concentration at the sample points along with the carbon concentration and boiler load. As can be seen in the figure, the mercury levels are quite low, indicating that injecting large amounts of the ash mixture (carbon concentrations of approximately 4 lb/MMacf) is effective at removing a significant amount of mercury. The results also indicate little stratification was present as the total vapor-phase mercury measurements at the two sample depths were very close and trended together.

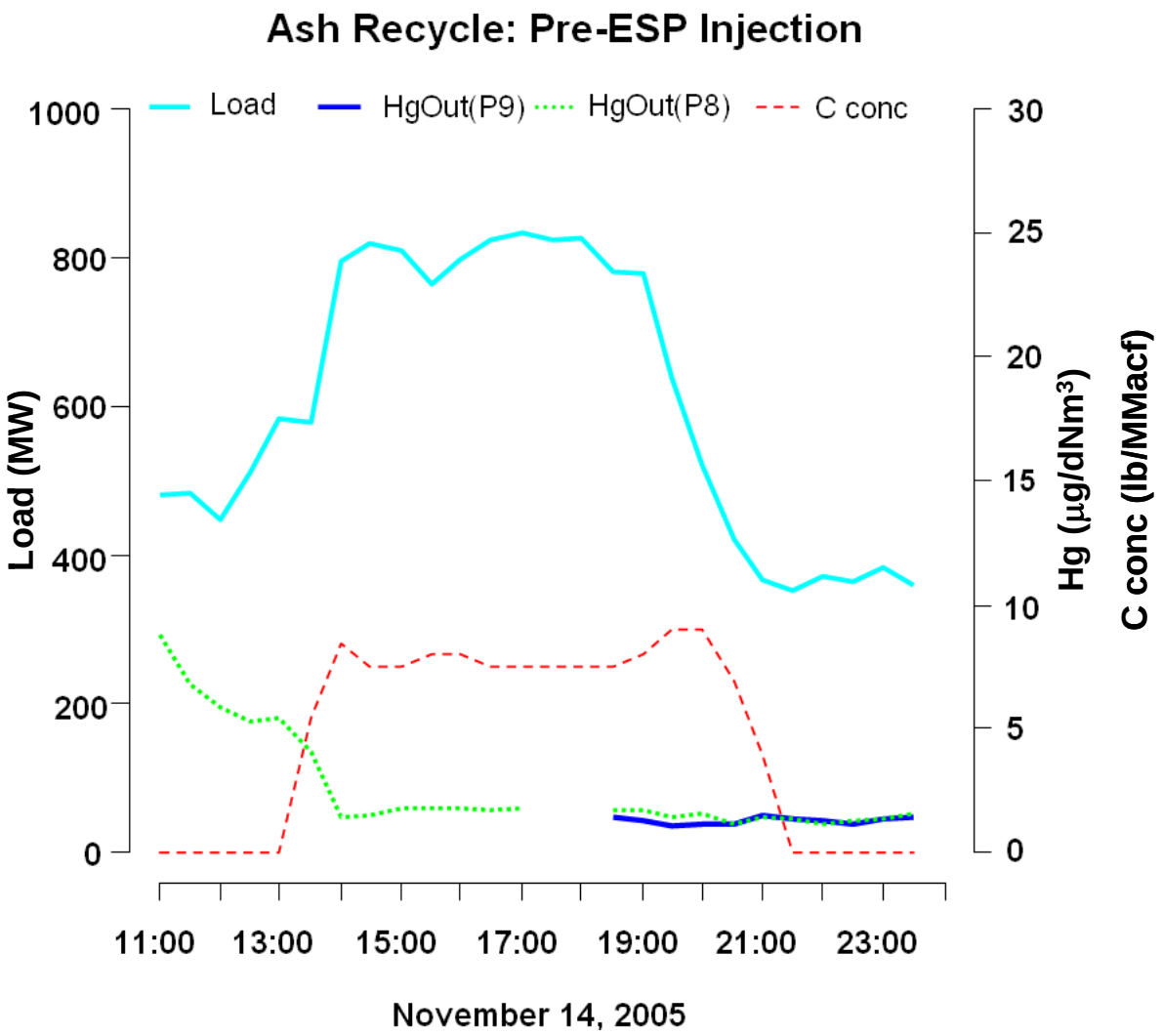


Figure 38. Plot of total vapor-phase mercury at ESP B 23 inches into outlet duct at port 9 and 50 inches into outlet duct at port 8. Also included is the boiler load and approximate concentration of carbon injected into the inlet duct of the ESP during the ash recycle test (November 14, 2005).

Modeling Results

During the testing sequence, it became evident that the injection grid and delivery system suffered design flaws that resulted in poor sorbent distribution and potential pluggage and subsequent lower than expected levels of mercury removal. Three modeling efforts were undertaken to better characterize the limitations of the original system and to redesign a more effective system. One approach (carried out by REI) employed computational fluid dynamics (CFD) to model (a) the PAC and transport air distribution in four lances (Appendix E1) and (b) the PAC, transport air, and flue gas distribution traveling through ESP (Appendices E2–3). A second approach (carried about at NELS) involved testing (a) a full-scale section of the injection grid in a wind tunnel and (b) a 1/12 scale model of one-half of one ESP box (Appendix E4). The third approach (carried out by ADA-ES) involved a physical testing of (a) a single nozzle to determine powder spray patterns, (b) the effects of

various nozzle configurations, and (c) a full-size lance to measure sorbent mass loading. In general, results from the physical modeling indicate a defined jet and plume from a round hole, CFD modeling show transport air and PAC channeling between ESP plates, and CFD modeling show some vertical dispersion of plume within ESP plate space. Further details of these efforts are included below.

CFD Modeling of Grid and ESP

Results from the REI's CFD models indicate that transport air from lances is uniform among holes. However, PAC distribution varies with particle size. REI places relatively high confidence in the CFD technique for accurately modeling the transport air and lower confidence in the technique for accurately modeling PAC distribution. In particular, the latter models indicate possible trends, not absolute distribution. The CFD results for PAC distribution relative to the grid are summarized in Figure 39.

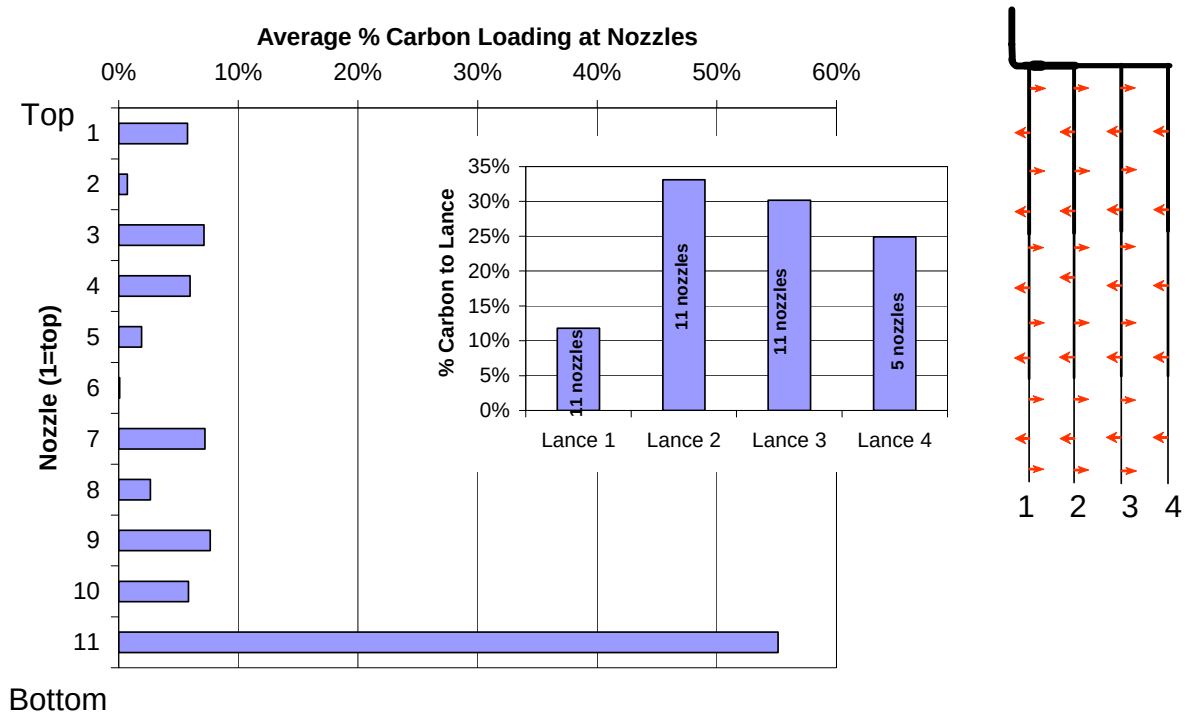
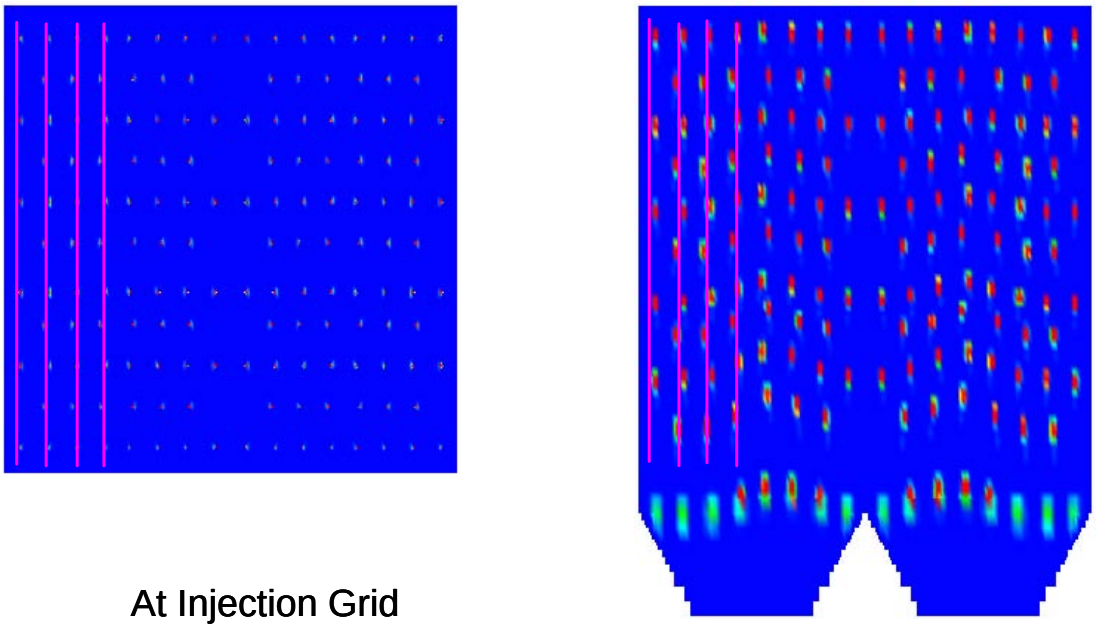


Figure 39. CFD model of average carbon distribution from nozzles along the length of an injection lance as well as from one-half of the injection grid system.

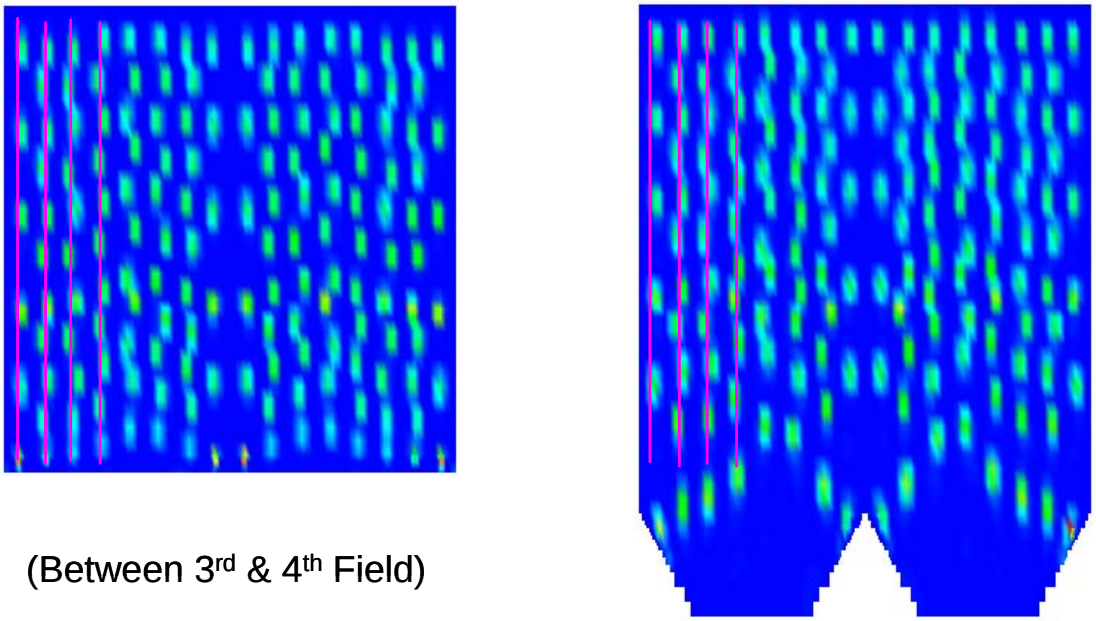
When modeling the ESP, REI mirrored the half grid model from grid modeling efforts. The CFD ESP model does not consider PAC collection on plates. Overall, the results show PAC is channeling between ESP plates, is bound by the plates, and diffuses up and down but not side to side. Snapshots of the CFD model results of carbon particle distribution in the middle and rear of the ESP box are given in Figure 40 and Figure 41, respectively.



At Injection Grid
(Between 2nd & 3rd Fields)

Mid 3rd Field

Figure 40. CFD model results of carbon particle distribution in the middle of the ESP.



(Between 3rd & 4th Field)

Mid 4th Field

Figure 41. CFD model results of carbon particle distribution in the rear of the ESP.

The conclusions from the REI report are that:

1. Sorbent carrier air does not mix well with flue gas—there are low carrier air concentration gaps due to the existence of collection plates.
2. Particle distribution has negligible effect on carrier air distribution inside the ESP.
3. Activated carbon particles are not well dispersed in the third and fourth collection fields
   a. Very limited particle penetration along ESP width.
   b. Some gaps between collection plates have almost no particles entering.
4. Higher particle bulk densities are predicted near the hopper
   a. The hole at the bottom of the lance has higher particle flow rate, especially for large particles
   b. Flue gas tends to circulate through the hoppers, re-entraining the carbon particles.

Physical Modeling of ESP B-box

The physical modeling that NELS carried out in a wind tunnel using existing holes in the original lance design and smoke rather than PAC indicated that (1) penetration varies with nozzle exit velocity and (2) the jet starts out cohesive, then plumes (Figure 42). Research showed that there were no commercial dilute phase nozzles for powder distribution. Of the commercial liquid nozzles tested, the nozzles exhibited various spray patterns, usually pluming right at the nozzle.

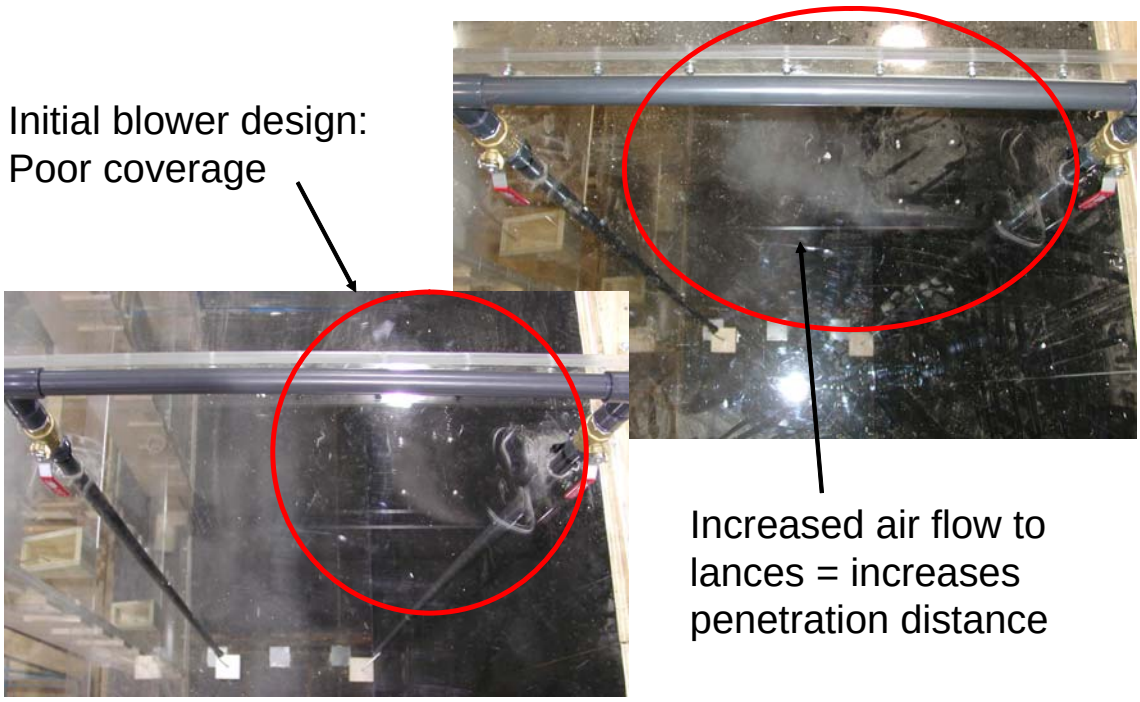


Figure 42. NELS physical modeling of plume penetration.

The NELS physical model suggests there are two issues with the current design of the Independence Unit 2 ESP box that may be contributing to particulate emissions. Only one of these issues directly relates to potential increases in emissions due to PAC injection. "The existing outlet plenum with no flow devices is a problem area by itself having high velocities along the top section of the last collection field and again causing particulate re-entrainment and opacity spiking" (NELS). This velocity distribution issue is evident in Figure 43.

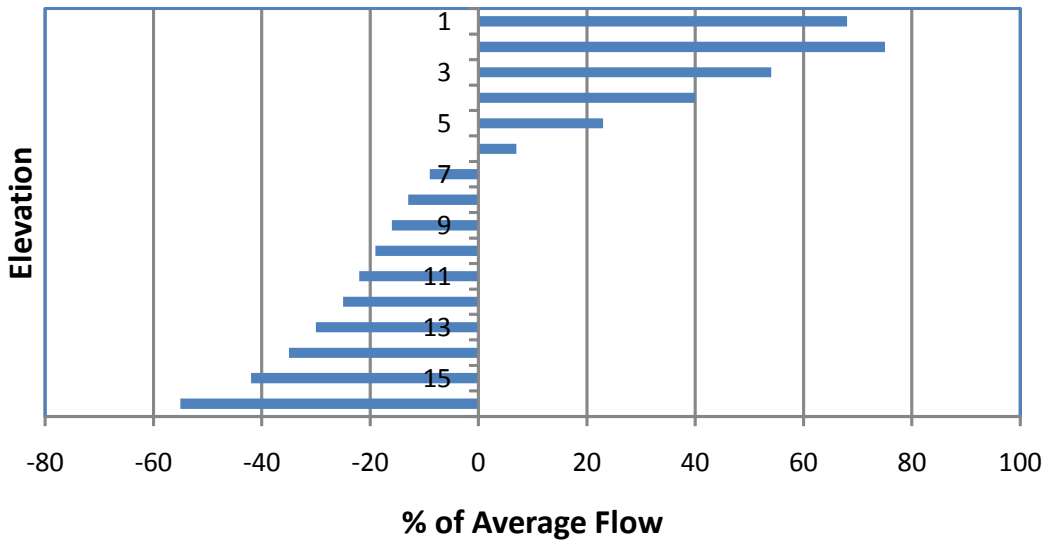


Figure 43. NELS physical modeling of ESP B B-7 outlet field exit.

Physical Modeling of Injection Grid

The modeling effort undertaken by ADA-ES included several injection concepts. In general, particle penetration results using single holes were consistent with NELS efforts as were those using commercial nozzles. At the penetration velocities desired, a simple hole pattern, whether arranged in a multi-hole vertical lance or arranged around a single cap, appeared to be the most functional.

Physical modeling in the ADA-ES lab, and supported by the data from NELS, indicated that because of poor sorbent penetration, sorbent may not have been reaching at least 30% of the ESP during high-load operation (Figure 44). On Figure 44, a sketch of the injection grid is shown with vertical lances on the left of the Figure. On the right, the lances are shown horizontally in bold with the top of the lance on the left and the bottom of the lance on the right. This convention is also followed in Figures 45 and 46. During low-load operation, the flow through the ESP is lower and the resulting sorbent penetration into the ESP is greater (Figure 45). The change in sorbent penetration from high- to low-load operation helps explain the limited removal observed during high load compared to low load during testing with the original grid design at Independence.

Models were conducted with nozzle orientation ranging from counter to co-current to control the penetration of sorbent across the ESP. As a result of these studies, the redesigned lance design incorporated two nozzles at each of four elevations along the length of each lance section. Three lance sections were used in each injection port to better control sorbent mass distribution. The nozzle orientation was varied along the length of each lance section to

provide uniform penetration depth from top to bottom. Figure 46 shows the results of the physical model for sorbent penetration at high load using the redesigned injection grid system. The conveying air flow could also be adjusted to control the overall penetration depth. Varying the carrier air flow resulted in varying penetration depths during physical modeling but, as noted earlier, no significant change in mercury removal was noted as a function of carrier air flow during full-scale testing.

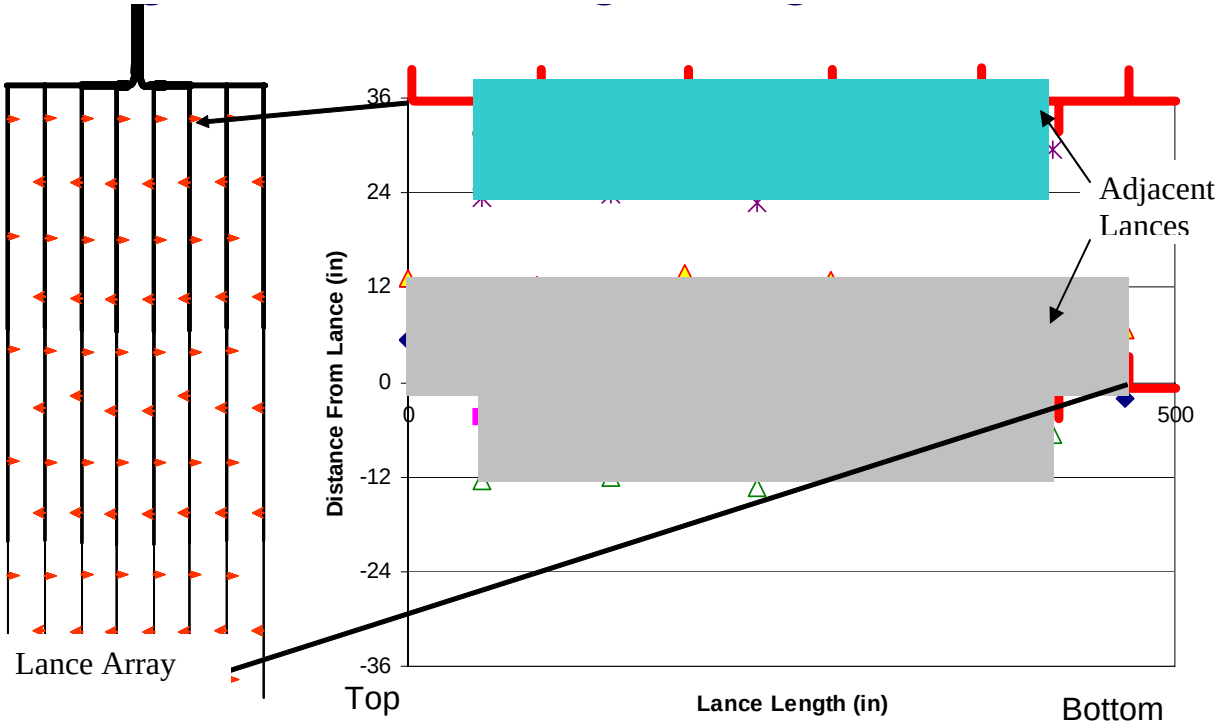


Figure 44. Carbon penetration at high load using the original grid design.

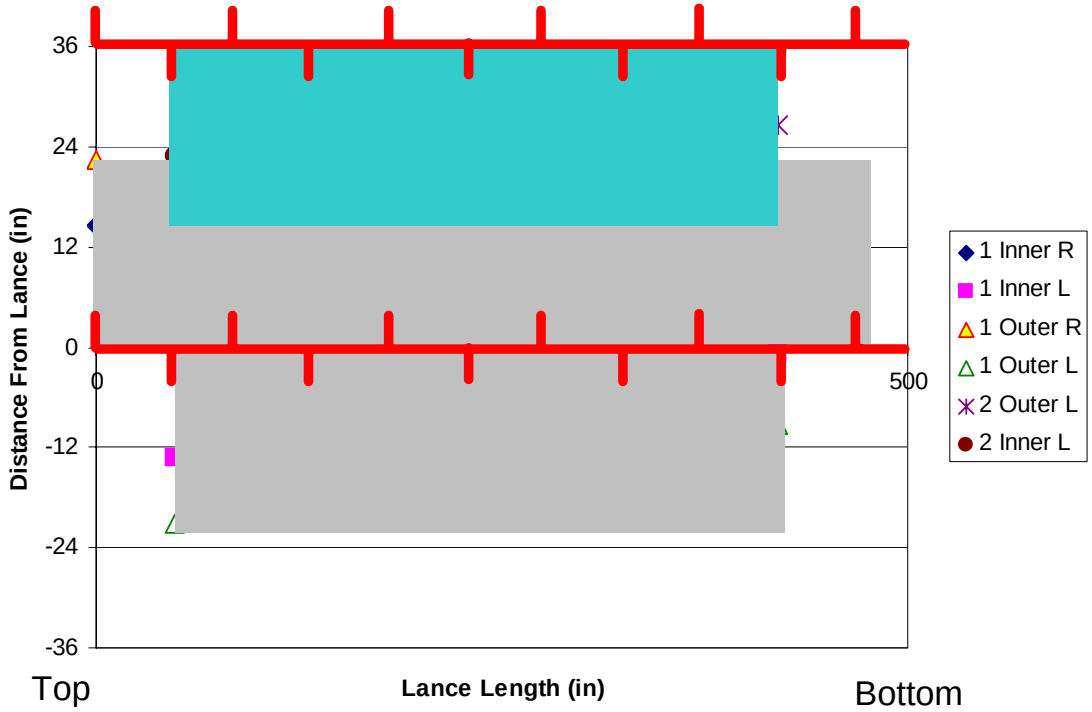


Figure 45. Carbon penetration at low load using the original grid design.

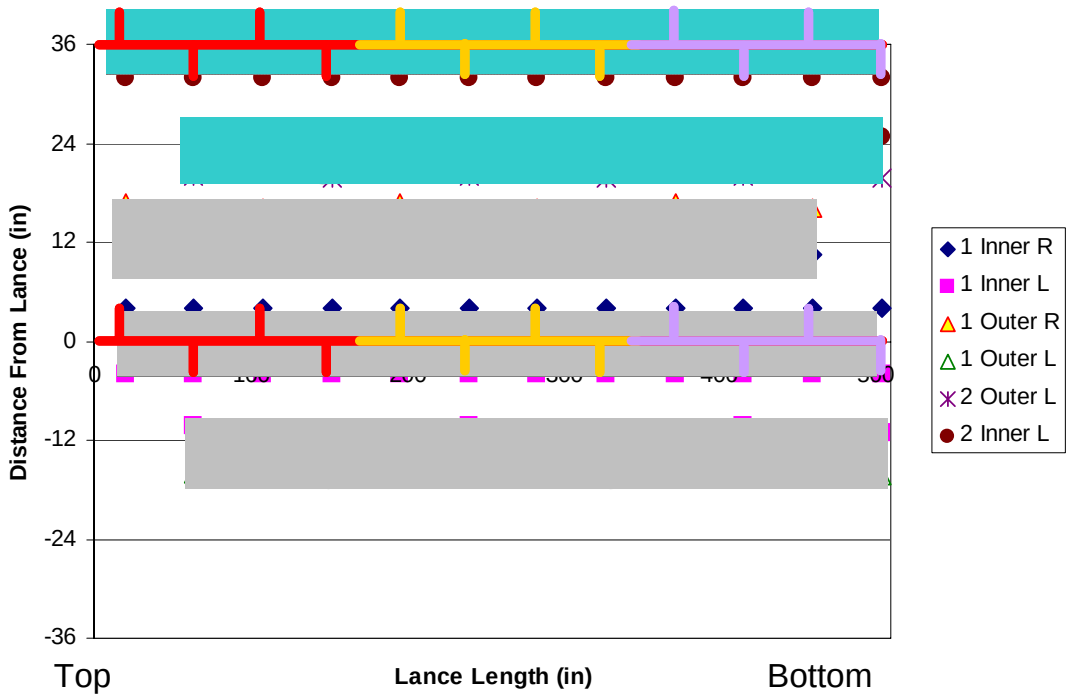


Figure 46. Carbon penetration at high load using the redesigned injection grid system.

Injection lance carbon distribution based on physical modeling conducted at ADA-ES were similar to CFD predictions developed by REI (Figure 47), with the nozzle furthest from the injection header (also the bottom of each lance section) demonstrating the highest mass loading. Several variations of a single multi-nozzle injection lance were tested, incorporating various hole sizes and lance section lengths. To minimize the maldistribution of sorbent along the height of the ESP, the lances were segmented into 3 sections. The mass loading results for the original lance are presented in Figure 47 and the corresponding results from the redesigned lance arrangement are given in Figure 48. Comparison of the mass distribution results shown in Figures 47 and 48 suggest a significant improvement in the sorbent distribution along the height of the ESP.

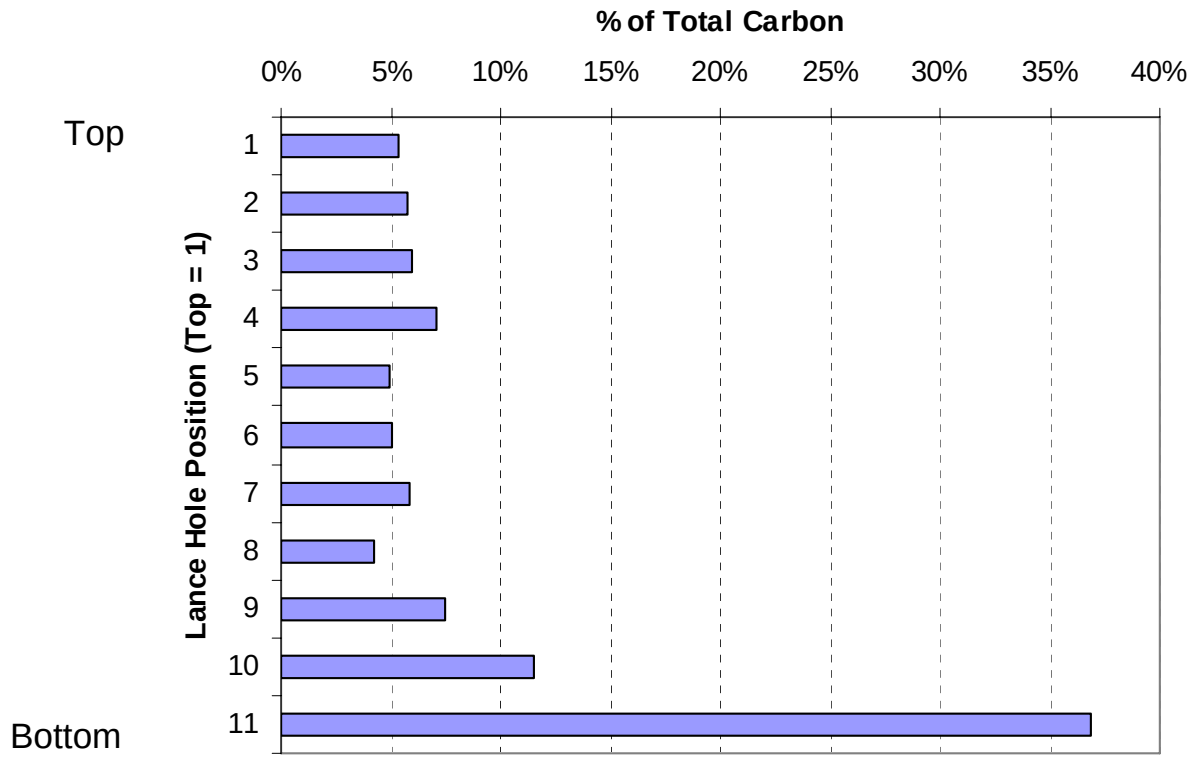


Figure 47. Physical model of carbon distribution from original lance.

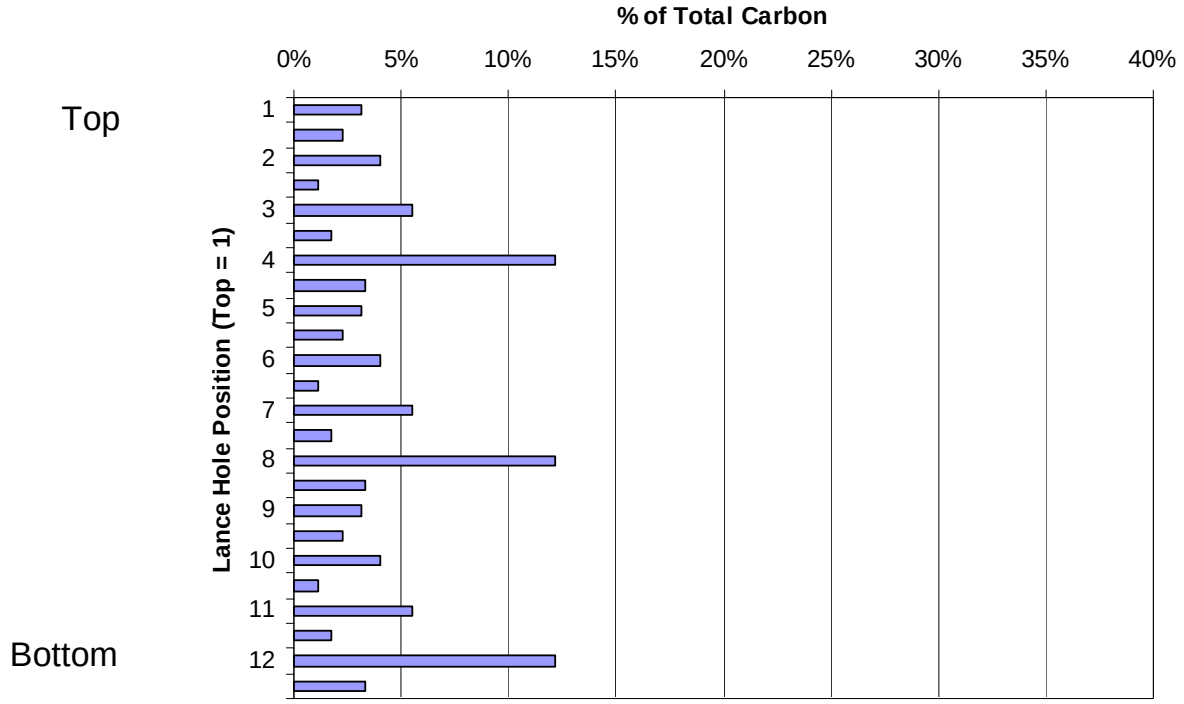


Figure 48. Physical model of carbon distribution from redesigned lance arrangement.

Using three lance sections instead of a long single lance (three sections with nozzles along 13 feet each, compared to one lance with nozzles along a length of more than 40 feet) provided a significant improvement in the vertical sorbent mass distribution. This resulted in higher mercury removal during the Parametric tests in 2007; however, the multiple holes were still prone to pluggage. A further refinement modeled and field-tested was the installation of a compressed air tap on the bottom of the lance. This tap could be used to both unplug the lance, if plugged, or if operated continuously, could alter the bias of the sorbent. With proper tuning, the bias could be shifted to allow an even (+/- 15%) sorbent flow through each nozzle. The air back pressure would have to be tuned to account for changes in ESP pressures and ambient conditions and plant load changed, but would result in more even flows. This was a functional concept, but resulted in a significantly more complex grid design than a passive grid. Consider that 1/16 of the Independence Unit 2 ESP, or 55 MW equivalent, required 24 lances installed into 8 ports. The treatment area was nominally 40 feet high by 10 feet wide. Treating the entire Unit 2 ESP with this grid design would require 384 separate lances. Rather than pursuing this design further, the design team began working towards a simpler design with lower maintenance and operating requirements. This effort was conducted outside of the DOE program.

Characterization of Process Solids and Liquids

Several types of process samples were collected during TOXECON II™ testing at Independence. Analyses conducted included ultimate, proximate, mercury and halogens for select coal samples, mercury analyses of most fly ash samples collected, and stability determinations of select fly ash samples through leaching tests. The LOI carbon content of several ash samples was also determined. Results from these analyses are presented below.

Grab samples of coal and fly ash collected throughout testing were analyzed for mercury content. Mercury concentrations in the coal samples can be used to estimate mercury concentration in the flue gas by assuming all of the mercury in the coal volatilizes and forms vapor-phase mercury. This value can be compared to the mercury concentration measured with the mercury S-CEM. Since the mercury S-CEM only measures vapor-phase mercury, the two values may not compare well if there is a significant fraction of particulate-phase mercury at the inlet to the ESP. Mercury concentrations in the fly ash samples can be used to estimate the amount of mercury being collected on the fly ash and removed from the vapor-phase.

Mercury Emissions (lb/TBtu) = $Hg_d F_c (1-B_{ws}) 100/\%CO_{2w}$

Where: Hg_d = Mercury Concentration (lb/dscf)
$F_c = 10^6[321\%C_d]/GCV_d$
B_{ws} = Moisture Fraction of flue gas
$\%CO_{2w}$ = Percent CO_2 in flue gas
%Cd = Percent carbon in coal from ultimate analysis (dry basis)
GCVd = Gross Calorific Value of coal from ultimate analysis, dry basis (BTU/lb)

Coal Analysis

Plant personnel collected coal samples daily throughout the evaluation. To collect a representative sample of the as-fired composition of the coal, samples were collected at the Unit 2 coal feeder belts upstream of the coal silos. Approximately 1-liter samples were collected and select samples were analyzed from each test period. These coal samples were typically collected midmorning during each test day to represent the coal fired 5 to 6 hours after collection. Therefore, a coal sample collected at 9 to 10 a.m. would match the coal combusted mid-afternoon.

A key criterion for this test program was to test at a site that burned 100% PRB coal; a criterion Unit 2 met as it normally burns 100% PRB coal. On several occasions during the testing period, however, the plant shifted to a 100% western bituminous coal from the ColoWyo mine for 2 to 3 days at a time. The impact of this alternate fuel source on plant operating conditions was evaluated as part of Entergy's goal to increase fuel supply reliability. The primary coal source during the test period was PRB from the North Antelope mine. Moisture levels for the "as received" samples were approximately 27% for the North Antelope coal and approximately 20% for the ColoWyo coal. The "as received" HHV Btu contents were 8750 BTU/lb and 9946 BTU/lb, respectively. For the purposes of this report, unless specifically noted, all results are based on the 100% PRB coal conditions.

Results from the ultimate, proximate, chlorine, fluorine, and mercury coal analyses during the two Baseline test periods and from Long-Term testing are presented in Table 12. Both coal analyses from Baseline testing represent results for North Antelope coal and were averaged. The table compares the results for coal burned during the Long-Term test phase with a ColoWyo coal sample collected on November 1, and an average of North Antelope coal samples on October 11, 13, 18, and 25. The chlorine content for all samples was very low. The sulfur levels for the North Antelope and ColoWyo are comparable. As indicated above, the heating value for the ColoWyo coal is higher than the North Antelope coal.

Table 12. Results from Baseline and Long-Term coal analyses (dry basis).

	Baseline Test Phases North Antelope August 17 and September 30, 2005	Long-Term North Antelope October 2005	Long-Term ColoWyo November 1, 2005
Element			
Hg (ng/g)	61.5	68.4	13.1
Cl (μg/g)	1.4	1.35	1.0
Br (μg/g)	37.3	6.3	11.0
F (μg/g)	--	78.0	100.0
Proximate			
Ash (wt%)	6.6	6.59	7.13
Volatile Matter (wt%)	43.68	43.24	38.84
Fixed Carbon (wt%)	49.73	50.18	54.03
Heating Value (BTU/lb)	12,083	12,009	12,415
Total Sulfur (wt%)	0.30	0.26	0.34
Ultimate			
Ash (wt%)	6.6	6.59	7.13
Carbon (wt%)	71.04	70.05	71.52
Hydrogen (wt%)	4.73	4.76	4.78
Nitrogen (wt%)	0.91	0.88	1.54
Total Sulfur (wt%)	0.30	0.26	0.34
Oxygen (by difference) (wt%)	16.43	17.47	14.69

Carbon and Mercury in Ash

The carbon and mercury content of several ash samples collected at Independence was analyzed and results are included in this section. The carbon content was estimated by comparing the weight difference between a dried sample and a sample heated to 800ºC for 2 hours. This is the typical analysis technique used to measure unburned carbon, or loss on ignition (LOI) content and the results are reported here as LOI in reference to the analysis technique. For samples containing activated carbon, LOI is primarily a measure of both the

unburned carbon from the fuel and the activated carbon injected into the system. For very low levels of carbon, there can be a difference between the actual carbon content measured with a carbon analyzer and the change in weight from combustion using an LOI analysis, with the LOI analysis biased slightly high. LOI analysis should be a good representation of the carbon content of the ash during sorbent injection.

A summary of the LOI in fly ash samples collected during the 2005 Baseline (Figure 49 and Figure 50) and Long-Term tests is shown in Figure 51. LOI and mercury are shown together to highlight trends, if any, between native LOI carbon and mercury in the ash. The results are separated by hopper. It is clear that ash collected in the first collection field, which represents the majority of the Unit 2 ash, contains very little LOI carbon with all samples less than 0.25%. This is fairly representative of a well operating PRB PC boiler without low-NO_x burners.

The corresponding mercury in the ash for these samples is also fairly low, all less than 150 ng/g. A rough calculation of the fraction of mercury captured with the ash can be conducted as follows:

$$\text{Hg in ash/Hg in coal} = \frac{(AshHg)(CoalAsh)(ESPAsh)(Field1Ash)}{(CoalHg)}$$

Where:

AshHg = mercury content of ash (ng/g)

CoalAsh = fraction of ash in coal from Ultimate or Proximate analysis

ESPAsh = fraction of ash entering ESP (estimated at 85% for PC boiler)

Field1Ash = collection efficiency of Field 1 (estimated at 80%)

CoalHg = mercury content of coal (ng/g)

Using values from Table 12, at 150 ng/g mercury, the fraction of the mercury in the coal that is captured with the ash in the first field of the ESP is:

$$\text{Hg in ash/Hg in coal} = \frac{(150)(0.066)(0.85)(0.8)}{(61.5)} = 0.11$$

Thus, ash mercury concentrations less than 150 mg/g in the first collection field represent mercury capture of at most 11% of the incoming mercury, which is consistent with the SCEM measurements. Analysis of one sample from the second collection field indicated nearly 600 ng/g mercury in the ash. Using the approach outlined above, and estimating that the collection efficiency of the second field is also 80%, 600 ng/g mercury represents roughly 9% of the coal mercury as follows:

$$\text{Hg in ash/Hg in coal} = \frac{(600)(0.066)(0.85)(0.2)(0.8)}{(61.5)} = 0.09$$

Where (0.85)(0.2) is the fraction of ash exiting the first collection field. Each subsequent hopper represents a lower portion of the overall ash collected.

The LOI value in the 2005 Baseline samples in the first two collection fields ranged from 0.14 to 0.38. The highest LOI fraction was present in the last collection field (0.6 to 3.35%). It is fairly common to have higher fractions of carbon in the downstream collection hoppers. Recent research by Gerry Klemm of Southern Company[1] indicates that this is a result of lighter carbon particles "floating" out of the collection hoppers and into the downstream hopper following an ESP plate rapping cycle. Figure 50 indicates that the higher carbon fraction in the fourth field hoppers does not necessarily correspond to higher mercury concentrations. The field 4 trend shown in the figure suggests that the highest LOI. 3.5% corresponds to the lowest mercury concentration from the fourth field, 39 ng/g and the lowest LOI, 0.6%, corresponded to the highest mercury, 250 ng/g. Higher levels of native LOI often do not correlate with higher mercury concentrations in the ash. This is probably due to the characteristics of the carbon, such as particle size or surface morphology, that may affect the mercury capture potential. No analyses were conducted during this program to analyze the characteristics of the LOI carbon.

The mercury and LOI concentrations in the downstream fields on the test side of ESP B were much higher during the Long-Term test period. During the first half of the Long-Term test, carbon was injected upstream of the last collection field. Through October 21, PAC was injected between collection fields 3 and 4. The LOI and mercury concentrations in the test side third field hopper (hoppers 31 and 32) are elevated above baseline during this period, which could be either a carryover from Parametric testing or an indication that some PAC was blown into the upstream fields. It is interesting to note that after the injection location was moved upstream of the third collection field, the LOI in the hopper 3 ash increased significantly, but the mercury concentration did not show a correspondingly large increase. This suggests that significant carbon may have been removed before removing mercury from the flue gas. This could be an indication of the poor sorbent distribution discussed earlier in this report.

Another indication that the activated carbon may not have been as effective as expected can be seen in Figure 52. This graph shows the mercury to carbon ratio (calculated by dividing the Hg concentration by the LOI) for the four collection fields. As shown, the lowest mercury to carbon ratio, less than 20 ppm, was in the field 3 ash collected when PAC was injected upstream of field 3. The next lowest ratio is the field 4 ash when PAC was injected upstream of field 4. Both are lower than the average ratio of mercury to native LOI carbon in fields 1 and 2, 58 ppm. For comparison, the ratio of mercury to ash in the TOXECON™ baghouse at Presque Isle Power Plant during carbon injection in 2007 ranged from 35 to 80 ppm.[2]

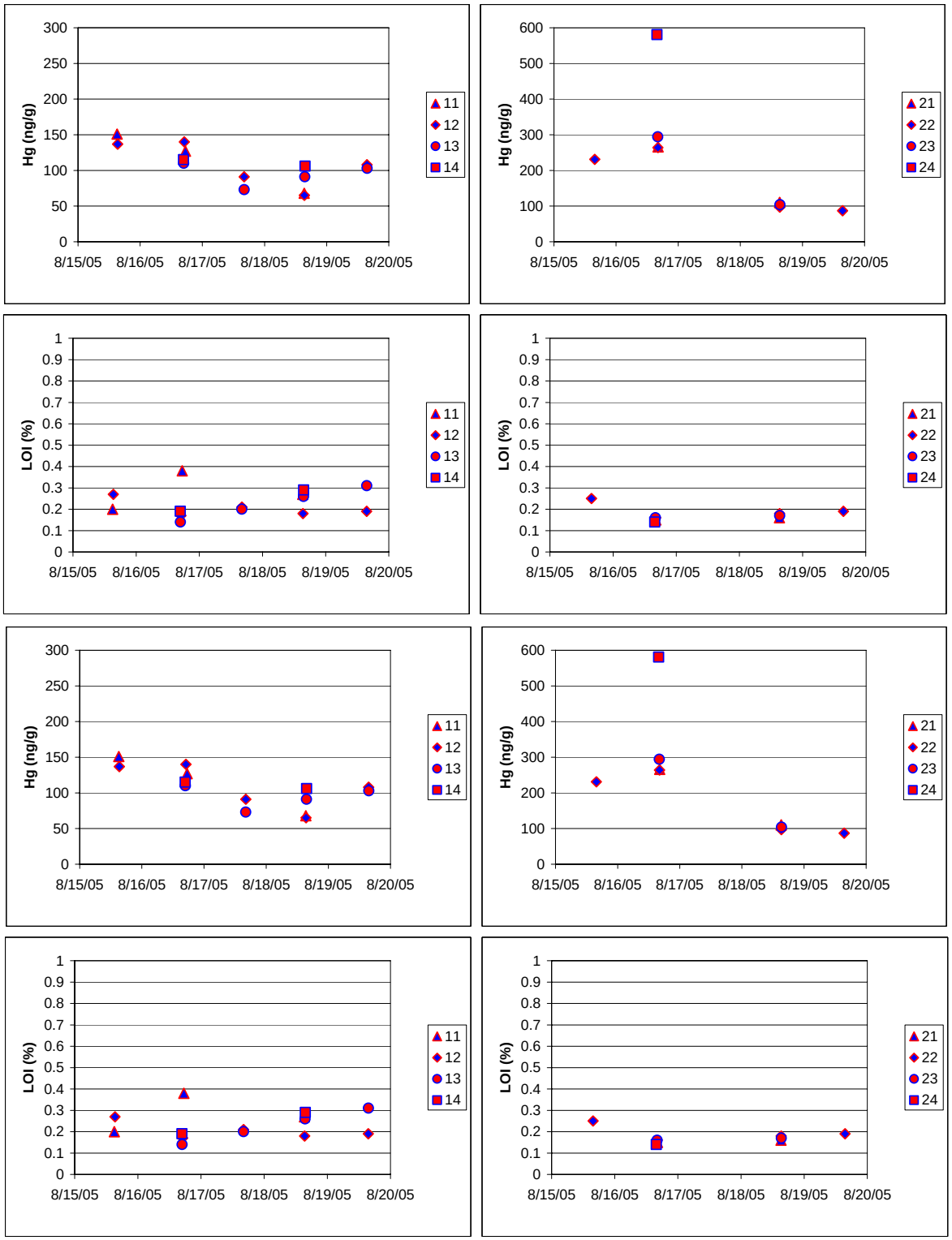


Figure 49. Baseline Mercury and LOI of fly ash samples collected from B-ESP hoppers on Test and Control (Ctrl) sides of the ESP during 2005 testing.

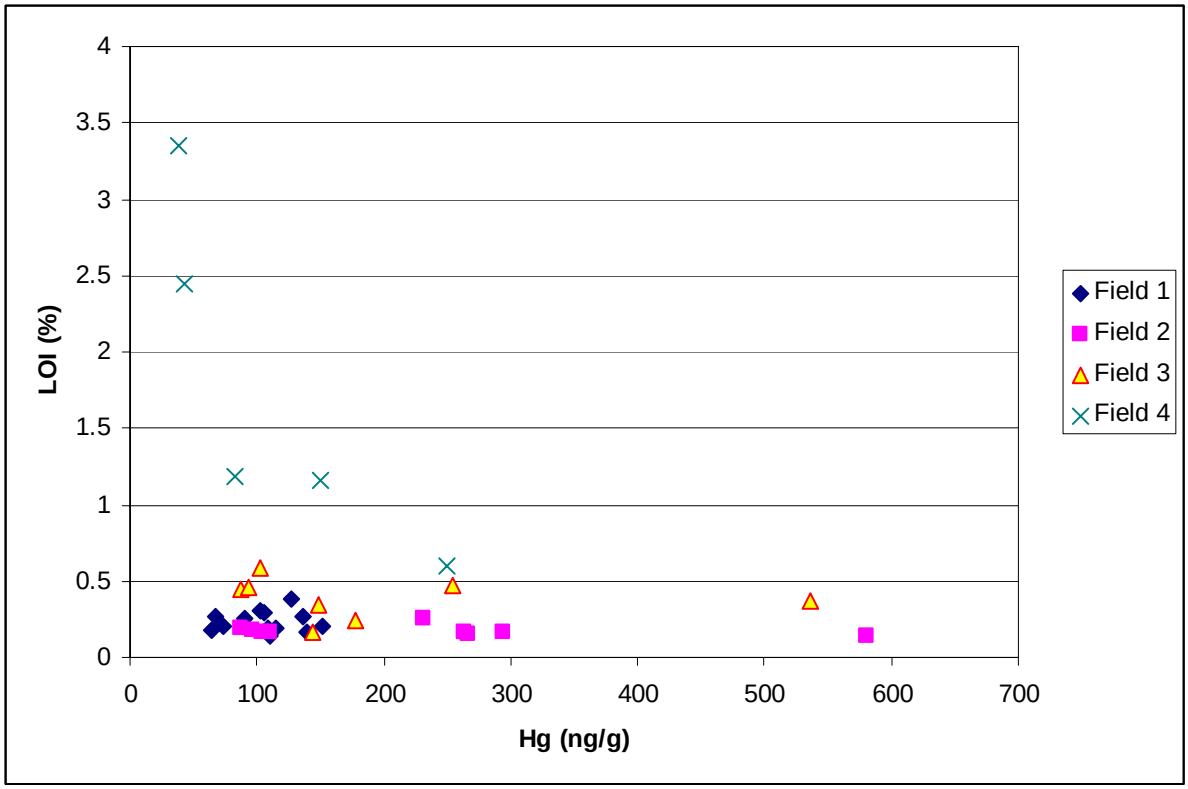


Figure 50. Mercury and LOI in hopper ash samples collected during Baseline testing.

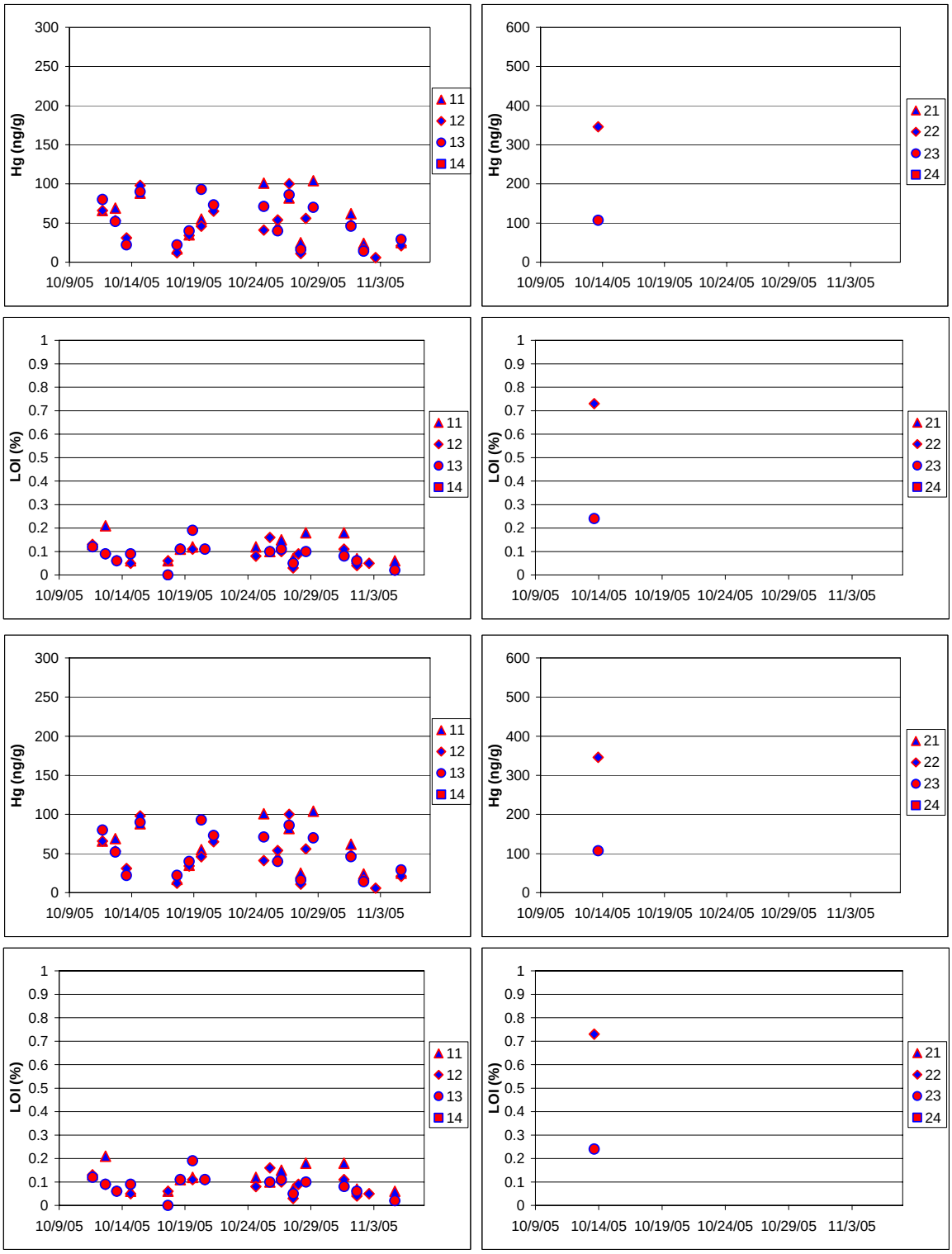


Figure 51. Long-term Mercury and LOI of fly ash samples collected from B-ESP fields on Test and Control (Ctrl) sides during 2005 testing when Colo Wyo was burned. DARCO® Hg-LH was injected either mid-box (i.e., between the 2nd and 3rd set of fields on the Test side) or rear-box (i.e., between the 3rd and 4th set).

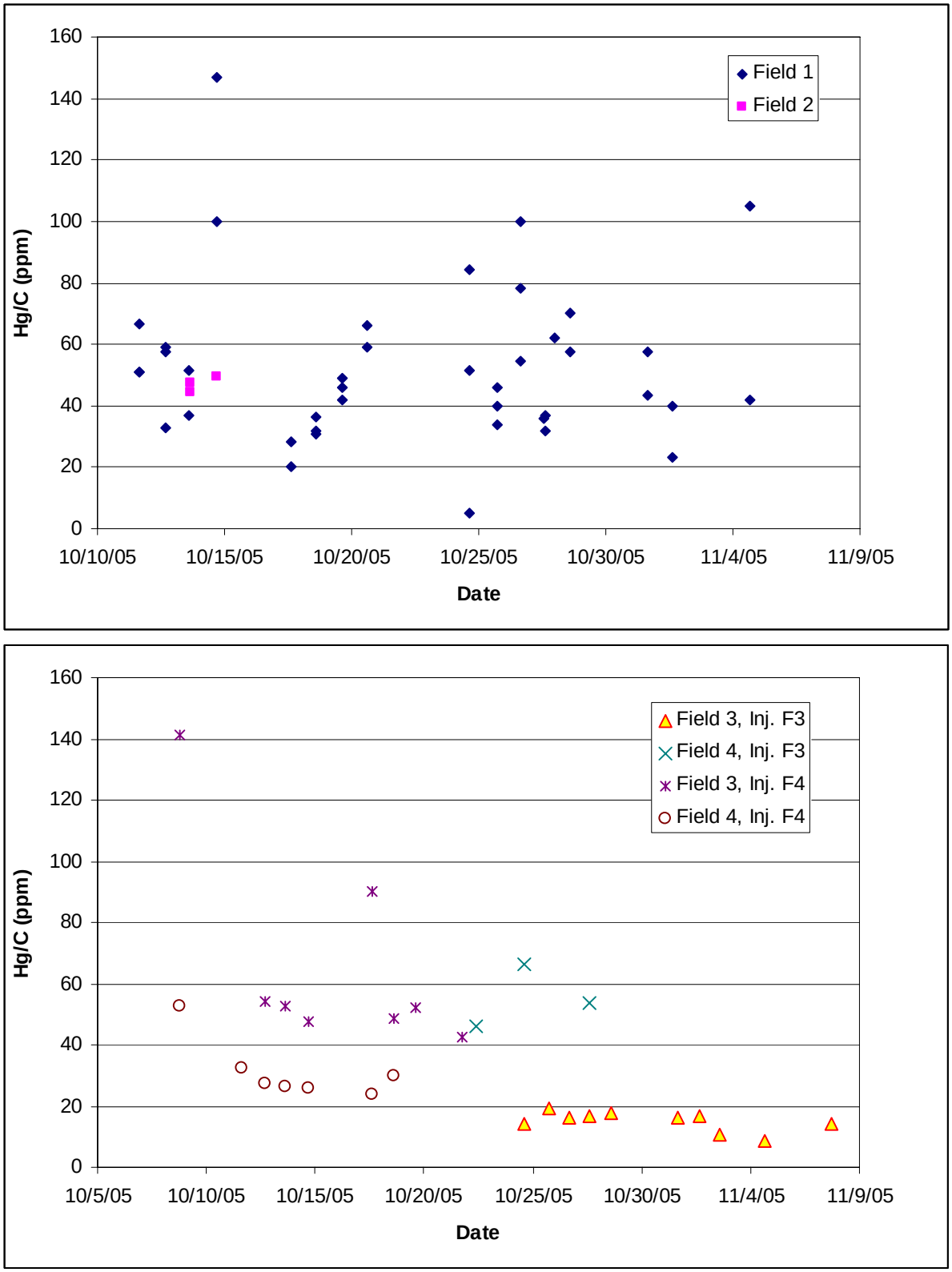


Figure 52. Mercury normalized to carbon content for hopper ash samples collected during Baseline testing.

Leaching Stability (Hg, Other Metals, and Halogens)

As part of the coal byproduct analysis, select ash samples were collected during the Baseline and Long-Term testing phases to determine the stability of mercury, bromine, arsenic, selenium, chlorine, fluorine, and iodine. Two leaching procedures were conducted: Method 1311, Toxicity Characteristic Leaching Procedure (TCLP), and the Synthetic Groundwater Leaching Procedure (SGLP). The TCLP procedure measures metal mobility, primarily As, Ba, Cd, Br, Se, and Ag, in a sanitary landfill.

The TCLP extraction fluid recipes were developed by computer modeling to simulate a worst-case scenario where the waste is co-disposed with municipal solid waste. For highly alkaline samples, such as those from Independence, a solution with a pH of 4.93, buffered using sodium hydroxide, is used. TCLP is the only leaching procedure approved for characterizing hazardous waste under the Resource Conservation and Recovery Act **(**RCRA).

The SGLP procedure was developed by Debra Pflughoeft-Hassett at EERC to better simulate the pH of groundwater to determine if mercury will leach from the samples under conditions designed to simulate actual field conditions, and addresses the incorporation of species into insoluble molecular matrices in a more static and arid environment . The SGLP consists of 100g sample dissolved into 2000 milliliters of distilled deionized water (or synthetic ground water) to achieve a liquid-to-solids ratio (L/S) of 20:1. The sample is rotated end-over-end, at 30 revolutions per minute, for 18 hours. The leachate is then filtered to remove all solids greater than 0.45 micrometers. For 30-day samples, the above treatment process is repeated.

The SGLP results for fly ash collected during Long-Term testing from the front field hoppers as well as the mid-ESP hoppers are presented in Table 13. An analysis of each element contained in the sample is also included in Table 13 as “total in sample.” The percent of each element leaching from the samples is provided in Table 14.

The TCLP results of one of the Long-Term and Baseline testing samples are provided in Table 15.

Since mercury concentrations were below the detection limit of the primary analysis laboratory, leachate was sent to Frontier GeoSciences Inc. for a trace level analysis. The FGS results are the mercury results posted in Table 13. The mercury concentrations were 3.56 µg/g in the test hopper and 0.14835 µg/g on the control side hopper. A very small amount of arsenic leaching was measured, but the levels in most cases are near the detection limit, the exception being the baseline control side SGLP and TCLP results performed on the Long-Term test side and the baseline control side hoppers where the value is factor of 5 and 6 times higher respectively. For both the 18-hour and 30-day leach, bromine in the leachate was higher for Long-Term test. This is expected since the test side sample was collected while bromine-treated activated carbon was being injected into the system.

Table 13. SGLP results from Independence (mg/L) during Long-Term testing while injecting mid-ESP.

Test Period	Long-Term			Long-Term		
ID	3926			3923		
Location	Hopper B-32			Hopper B-11		
	Downstream Sorbent Injection			Upstream Sorbent Injection		
Date	10/24/05			10/24/05		
	Total in Sample (µg/g)	18-hour (µg/g)	30-day (µg/g)	Total in Sample (µg/g)	18-hour (µg/g)	30-day (µg/g)
As:	16	< 0.01	< 0.01	120	0.08	< 0.01
Br:	24,000	890	860	< 20	2.68	1.88
Hg:	3.560	7.76E-6	5E-6	0.14835	2.47E-5	5.86E-6
Se:	17	0.02	0.03	5	< 0.01	0.01
Cl:	8000	14	12	< 100	< 1	< 1
F:	2000	1.48	4.31	27	< 0.02	0.84

Table 14. Percent of "Total in Sample" element concentration leaching from ash sample.

Test Period	Long-Term		Long-Term	
ID	3926		3923	
Location	Hopper B-32		Hopper B-11	
Date	10/24/05		10/24/05	
	18-hour	30-day	18-hour	30-day
As:	< 0.63%	< 0.063%	0.07%	< 0.01%
Br:	4%	4%	< 13.4%	9.4%
Hg:	0.0002%	0.18%	0.016%	0.004%
Se:	0.12%	0.18%	< 0.2%	0.2%
Cl:	0.2%	0.2%	< 1%	< 1%
F:	0.074%	0.22%	< 0.07%	3.11%

Table 15. TCLP results from Independence (mg/L).

Test Period	Baseline	Long-Term
ID	3564	3924
Location	Hopper B-12	Hopper B-12
Date	8/15/05	10/24/05
As	0.05	0.06
Hg	< 0.0002	< 0.0002
Se	0.05	0.05

Balance-of-Plant-Impacts

In conjunction with the mercury removal testing at Independence, the second parameter of concern was the potential of the TOXECON II™ configuration to affect other balance-of-plant issues. The primary concern was whether injecting PAC within the ESP would effect the operation of the ESP and the subsequent particulate emissions. Since the ESP collects the majority of the ash in the first fields, the ash loading in the rear ESP fields is significantly less than in the first fields. In the case of Independence, the first two fields remove 96% of the incoming fly ash based on data collected from the Neundorfer ash collection data system. Thus, the collection efficiency of the rear ESP fields is more dependent on the properties of the sorbent/ash mixture, rather than just the ash because the sorbent comprises a significant fraction of the total mixture. As discussed in the section on byproduct analysis, the carbon content of the third collection field increased by 20 to 30% when injecting using the mid-ESP injection grid, indicating that the particulate load to the third collection field increased by approximately 30 to 40%, since DARCO® PAC contains nominally 30% ash. The particulate loading percentage was higher when injecting in the rear grid due to the lower levels of ash in the flue gas downstream of three collection fields. This mixture could have a significantly different resistivity than ash alone, which could affect collection efficiency. As discussed previously, carbon may migrate from hopper to hopper because of the density difference between the carbon and the ash. Also, sorbent injection in the mid-ESP will increase the particulate loading in the rear fields, which can further affect total particulate exiting the fields.

ESP Operation and Particulate Emissions

Particulate emissions were monitored during testing at Independence using three techniques: periodic EPA Method 5 and 17 measurements (Appendices D1–5), TEOM Series 7000 continuous particulate monitor measurements, and CPM 5000 measurements. Stack opacity was also monitored, but was not as useful because only 1/32 to 1/8 of the Unit 2 flow was treated with PAC. The TEOM Series 7000 was used periodically through the second round of Parametric testing until weather-related equipment problems were encountered. When compared against a Method 5 on the outlet duct during Baseline test period, the TEOM Series 7000 was reading within 10% of the Method 17 results. These measurements were not collected concurrently because the TEOM Series 7000 was removed during Method 5 measurements to allow a traverse of the duct.

Baseline ESP Performance

Stack opacity and ESP parameters such as particulate emissions, power levels, and spark rates during the Baseline test series were of interest in establishing benchmarks against which the performance of the Parametric and Long-Term tests could be measured. Recall that the ESP B-box electrical field B-7 was non-operational during the August 2005 test period and well into September 2005. Figure 53 depicts the relationship between the unit load and opacity during the September 2005 Baseline period.

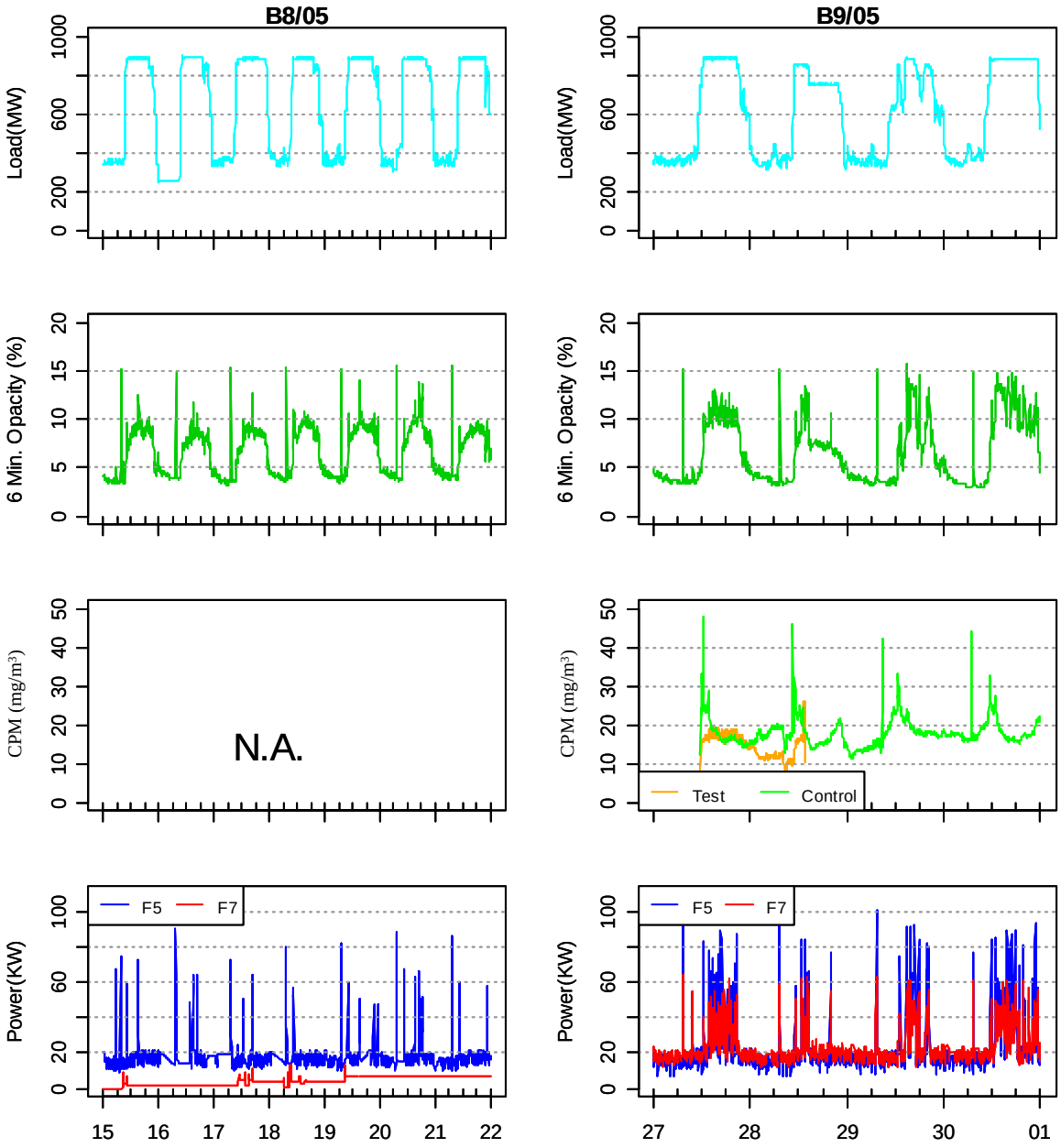
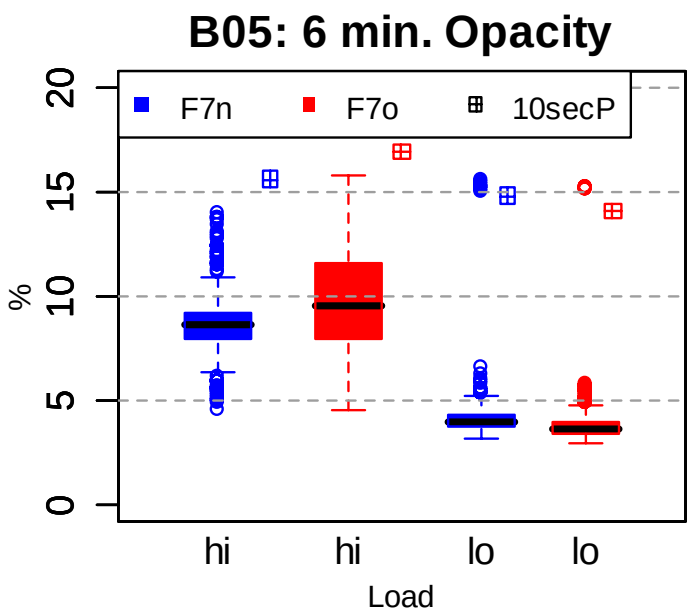


Figure 53. ESP operation and (6-minute) opacity during August and September 2005 Baseline testing. Opacity represents stack data.

Figure 54 summarizes the baseline 6-minute stack opacity averages at high (> 750 MW) and low (< 450 MW) boiler loads during round I (August 2005, F7 down) and round II (September 2005, F7 up). During both rounds, opacity was clearly higher during high boiler loads. Similar trends are evident in the average CPM values shown in Table 16.



Average 6 Min. Opacity (%)	
Aug 05: overall	6.6 ± 2.3
Sept 05: overall	6.5 ± 3.3
Aug 05: > 750 MW	8.6 ± 1.1
Aug 05: < 450 MW	4.2 ± 1.1
Sept 05: > 750 MW	9.8 ± 2.2
Sept 05: < 450 MW	3.8 ± 1.1

(a) **(b)**

Figure 54. (a) Box whisker plots of stack opacity (6-minute) percentages during Baseline 2005 testing when B-F7 was non-operational (F7n, August)) and operational (F7o, September) at boiler loads > 750 MW (hi) and < 450 MW (lo). Also shown are peak 10-second opacity (10secP) percentages for the same conditions. (b) The same data shown as averages.

Table 16. Average CPM values at ESP B outlet duct on the Test and Control Sides during September 2005 Baseline testing.

	ESP B Test Side ($\mu g/m^3$)	ESP B Control Side ($\mu g/m^3$)
Sept 05: Overall	15 ± 3.2	18 ± 3.7
Sept 05: > 750 MW	17 ± 2.2	19 ± 3.9
Sept 05: < 450 MW	12 ± 1.4	16 ± 3.0

EPA Method 17 test results during the August 2005 Baseline test period are summarized in Table 17. As seen in the table, the results indicate that the precipitators at Independence are highly efficient, removing over 99% of the particulate matter entering the ESP B precipitator box. The full details of the results are included in Appendix D.

Table 17. EPA Method 17 results for Unit 2 during Baseline testing August 17–18, 2005.

	ESP B Inlet Duct	ESP B Outlet Duct	
Run #	**gr/dscf**	**gr/dscf**	**% Decrease**
1	1.78	0.01	99.4
2	1.51	0.01	99.2
3	1.84	0.01	99.3
Average	1.71	0.01	99.3

The power in ESP B-box rear electrical fields for the same high and low load conditions are shown in Figure 55. As seen in these figures, the last field on the control side of ESP B-box (F8) was consistently higher than the other rear fields regardless of load or round of recording. The average power levels in all electrical fields on the Test side of ESP B-box during both rounds are summarized in Table 18. Recall that the T/R set on ESP B field 3 (F3) had a long-term condition affecting its output. As seen in the table, it had a relatively low power level. Moreover, it would inconsistently power up and down throughout testing without detectable impact on performance relative to TOXECON II™ evaluation. The table also indicates that the average power level for the first and fourth test side electrical fields was higher during round II than for round I, and that the difference in power between high and low loads for these fields was larger. Recall that mercury speciation was also slightly higher during round II than round I. The theoretical relationship to which speciation changes are attributable across an ESP is the presence of ozone resulting from "back corona" effects. Table 18 would indicate that there is potential for "back corona" to be occurring due to the higher power levels during the second round of Baseline testing.

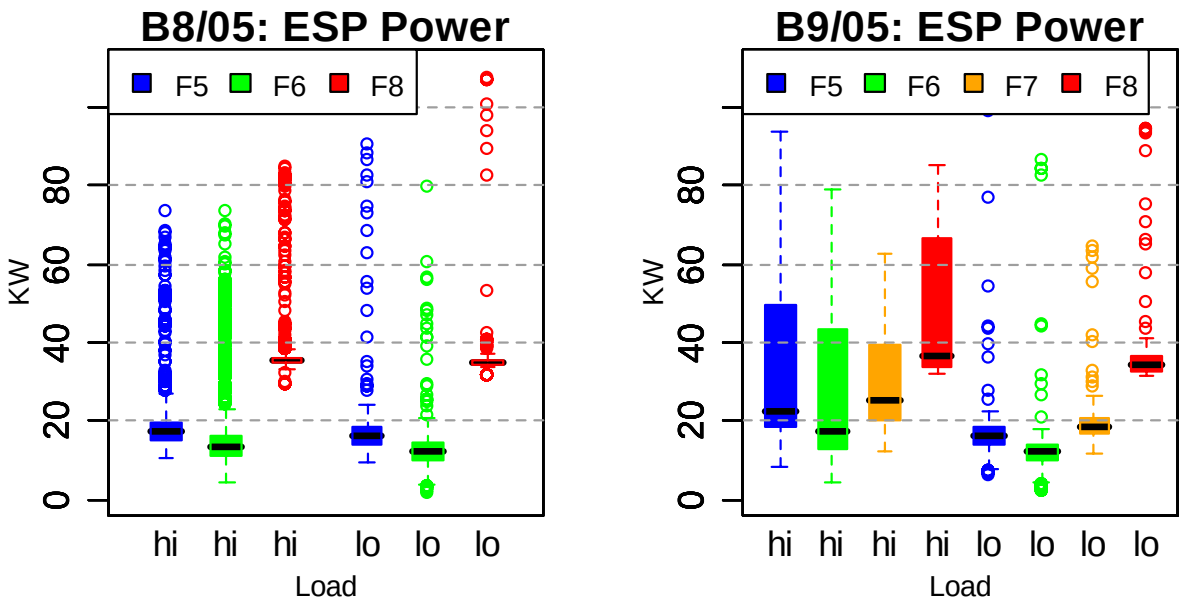


Figure 55. Box-whisker plots of power in ESP B-box rear electrical fields during August and September 2005 Baseline Testing. F5 and F6 are the third fields on the test and control sides, respectively; F7 and F8 are the last fields on the test and control sides, respectively. Plot contrasts power levels when boiler load is > 750 MW (hi) and < 450 MW (lo).

Table 18. Test-side ESP B average power levels during Baseline testing.

Test	F1 KW	F3 KW	F5 KW	F7 KW
Aug 05: Overall	19 ± 7	14 ± 8	18 ± 8	4 ± 3
Sept 05: Overall	27 ± 18	8 ± 3	24 ± 17	24 ± 10
Aug 05: > 750 MW	20 ± 6	19 ± 7	19 ± 8	5 ± 2
Sept 05: > 750 MW	33 ± 22	6 ± 2	30 ± 20	27 ± 12
Aug 05: < 450 MW	17 ± 8	9 ± 5	17 ± 8	4 ± 3
Sept 05: < 450 MW	19 ± 8	9 ± 4	17 ± 8	19 ± 6

The average spark rate during Baseline testing for the last two pairs of electrical fields in the ESP B-box is given in Figure 56.

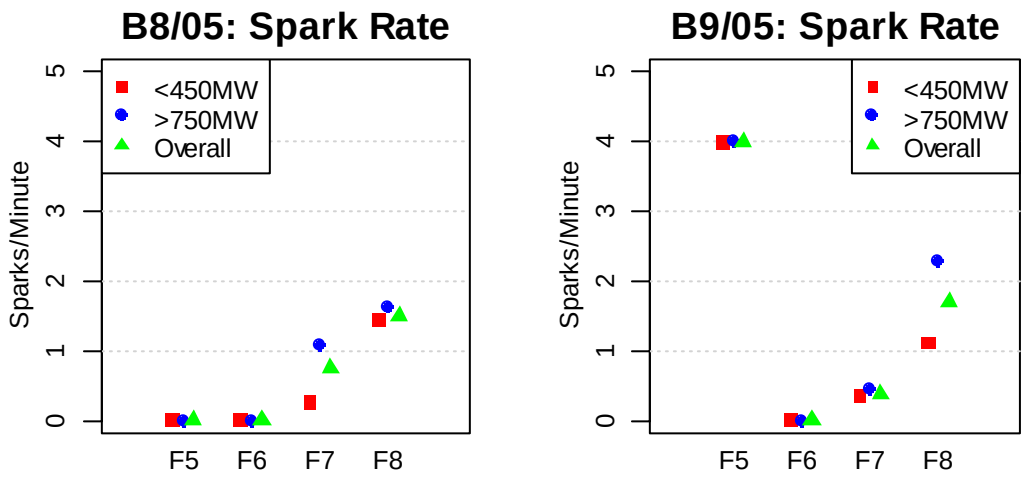


Figure 56. Average Spark Rate in ESP B-box electrical fields during 2005 Baseline testing. F5 and F6 are the third fields on the test and control sides, respectively; F7 and F8 are the last fields on the test and control sides, respectively. Plot contrasts overall spark rates with those when boiler load is at high loads (> 750 MW) and low load (< 450 MW).

Parametric ESP Performance

Trend charts of ESP performance during the 2005 Parametric test period are shown in Figure 57 through Figure 70. Each sorbent tested is shown in a separate figure to facilitate examination of the correlation between ESP power levels, sorbent injection, and plant opacity and Unit 2 B particulate emissions (from the CPM monitor). The data indicate that during the August and September tests, injection of any sorbent resulted in both opacity and CPM spikes. Although PAC was injected into only 1/8 of Unit 2, each time the final field was rapped during August and September while PAC was injected into either field 5 or 7, the spikes were clearly visible on the stack opacity.

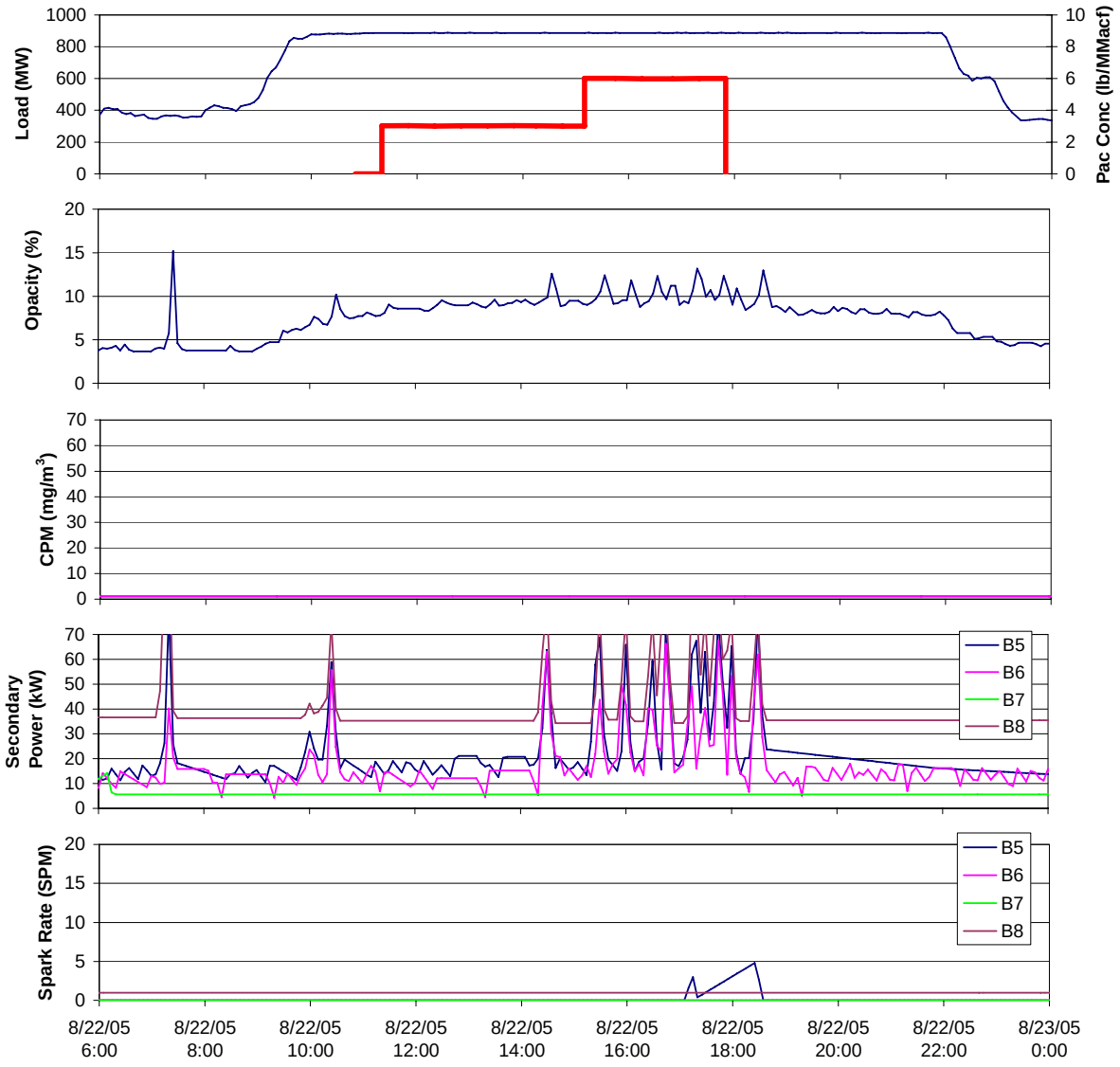


Figure 57. Operating trends during DARCO® Hg injection upstream of field 5.

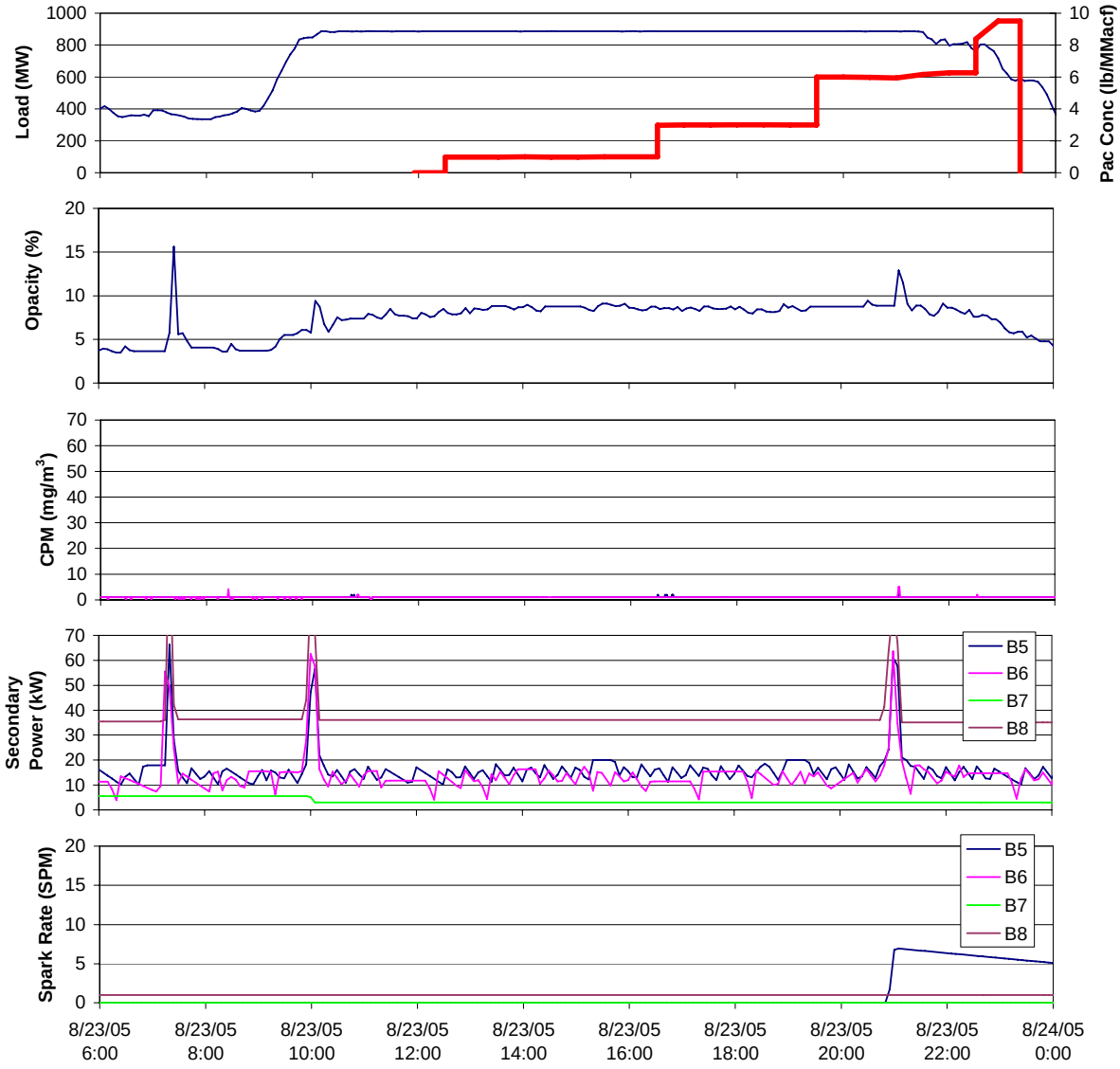


Figure 58. Operating trends during DARCO® Hg-LH injection upstream of field 5.

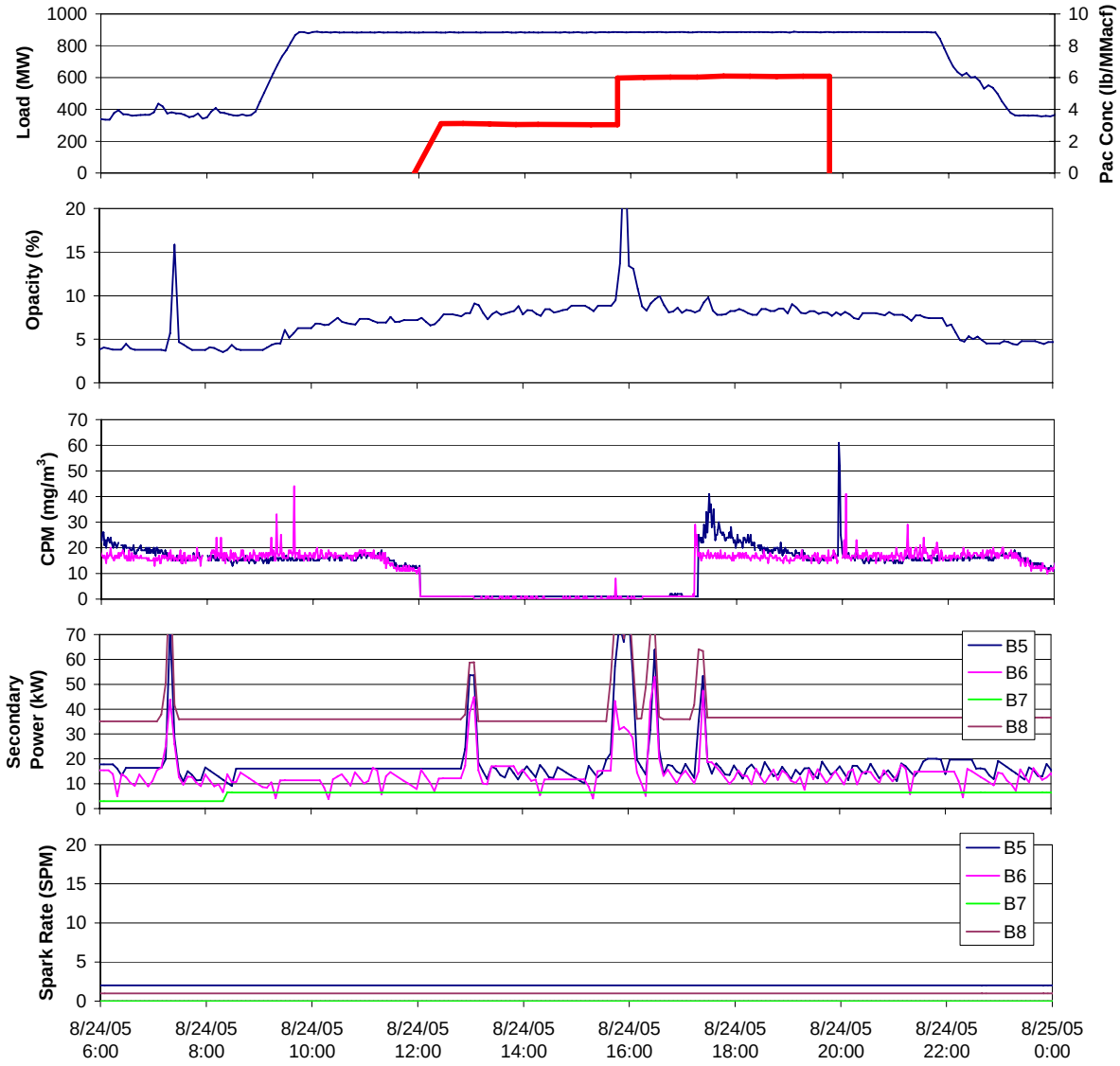


Figure 59. Operating trends during DARCO® E10 injection upstream of field 5.

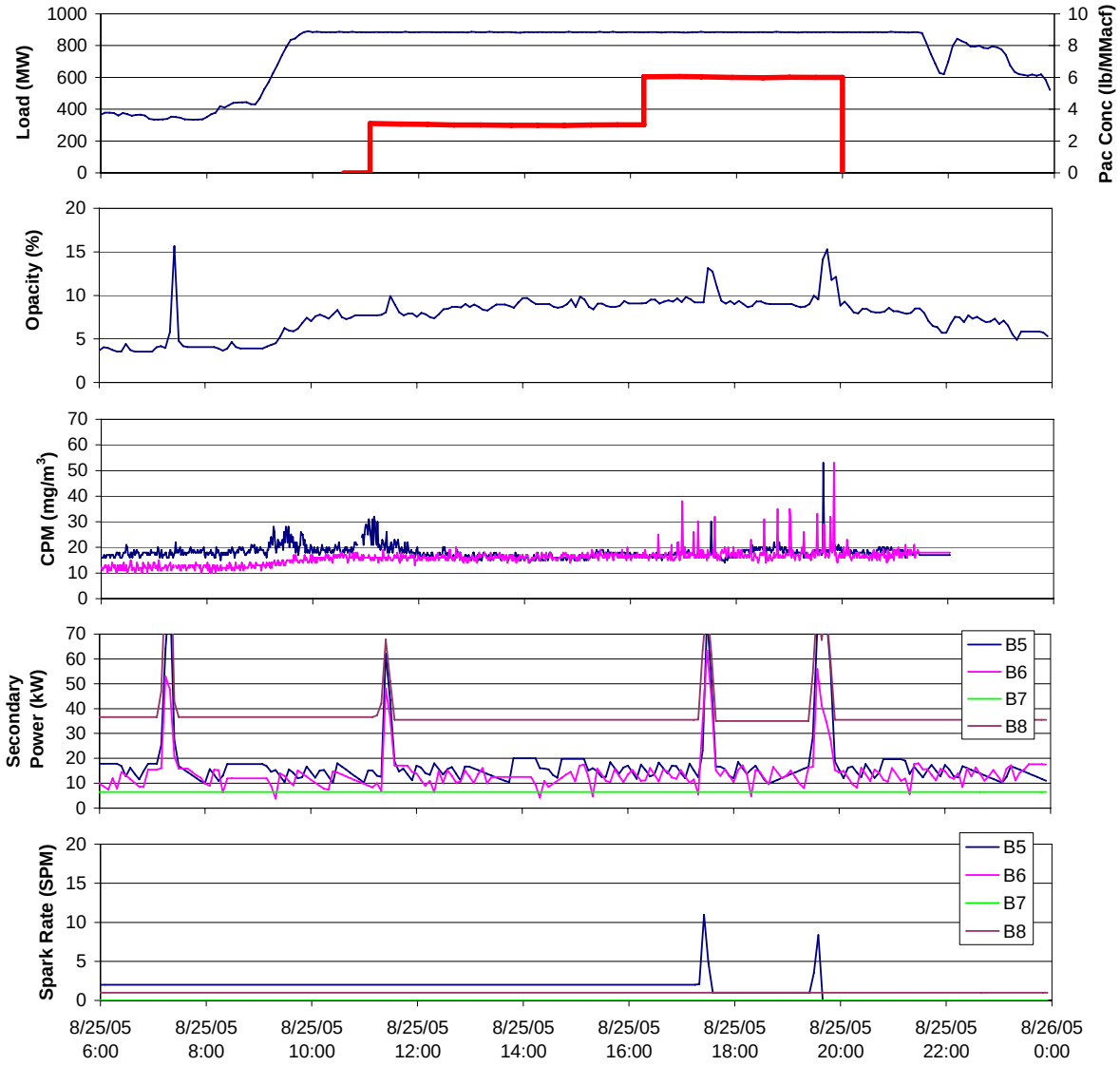


Figure 60. Operating trends during DARCO® E11 injection upstream of field 5.

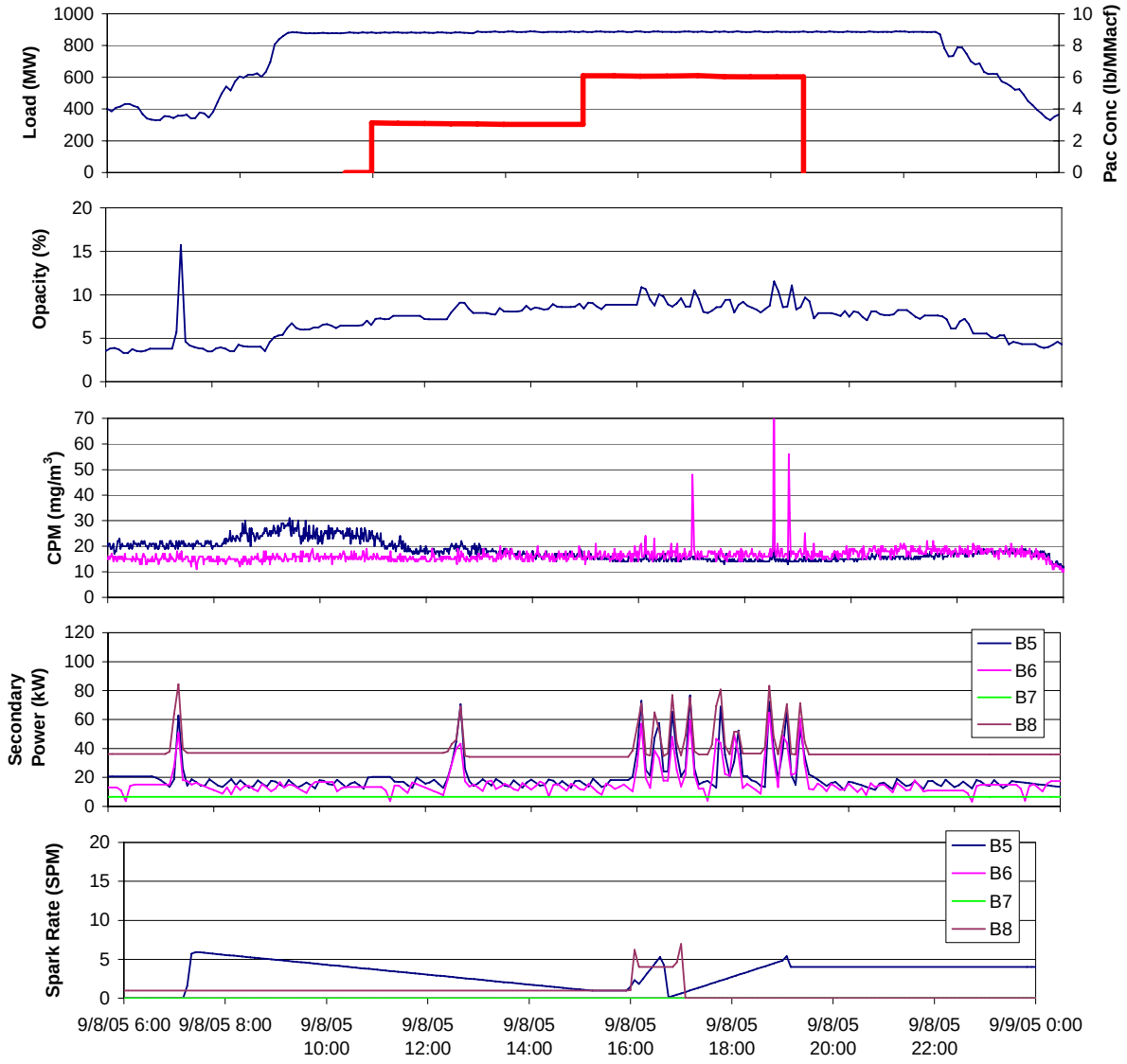


Figure 61. Operating trends during DARCO® Hg-LH injection upstream of field 5.

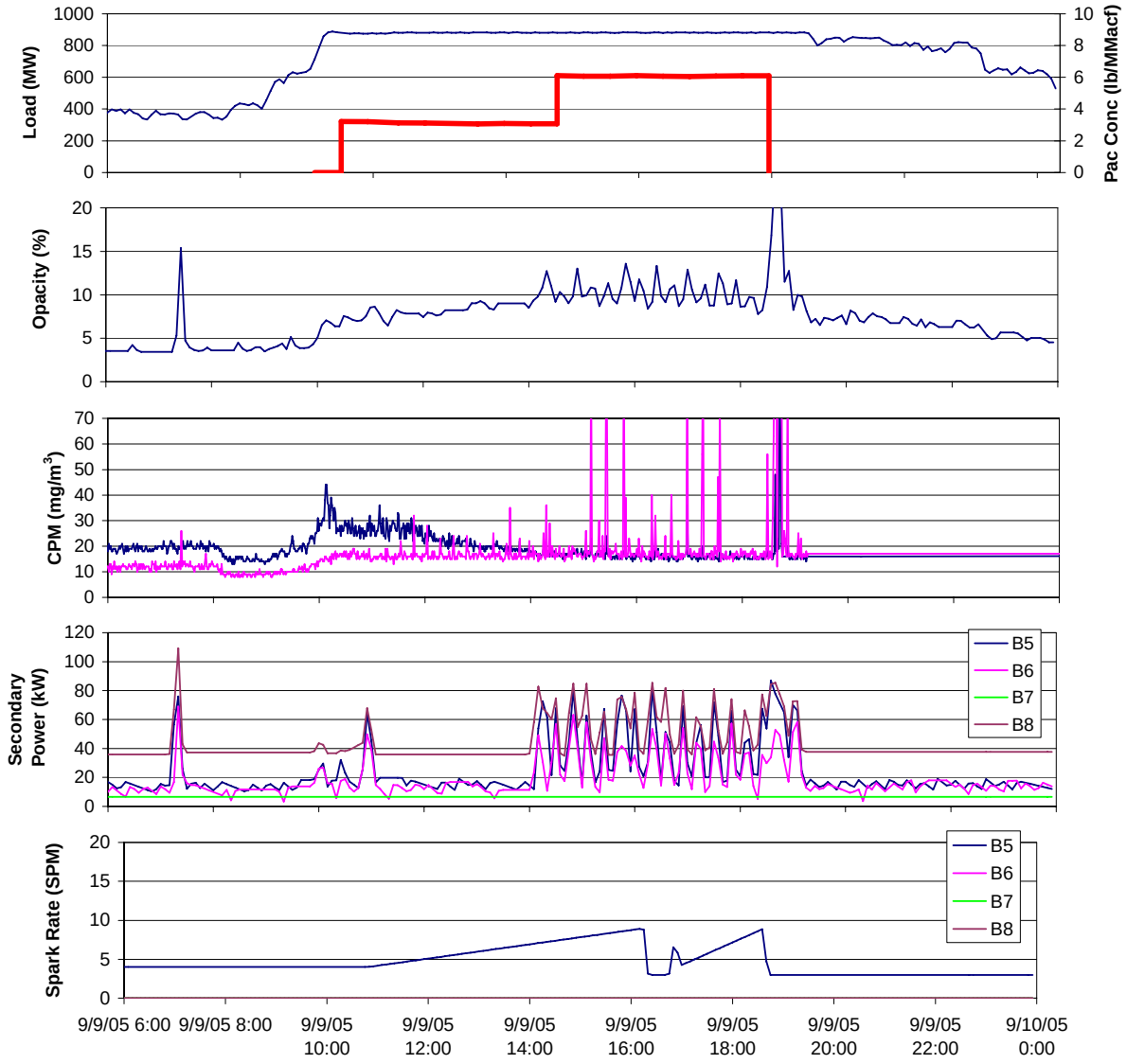


Figure 62. Operating trends during DARCO® Hg injection upstream of field 5.

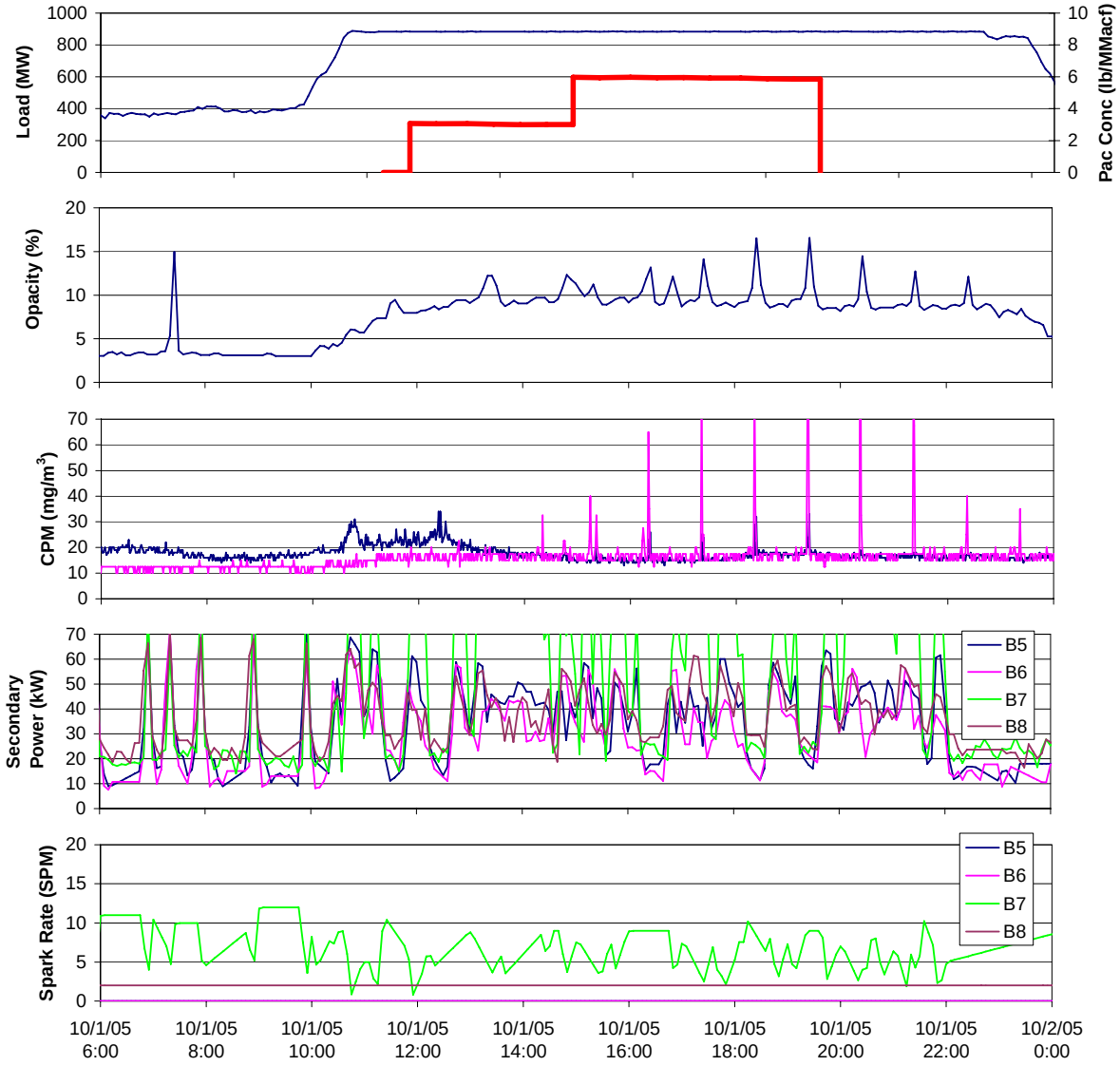


Figure 63. Operating trends during DARCO® E10 injection upstream of field 7.

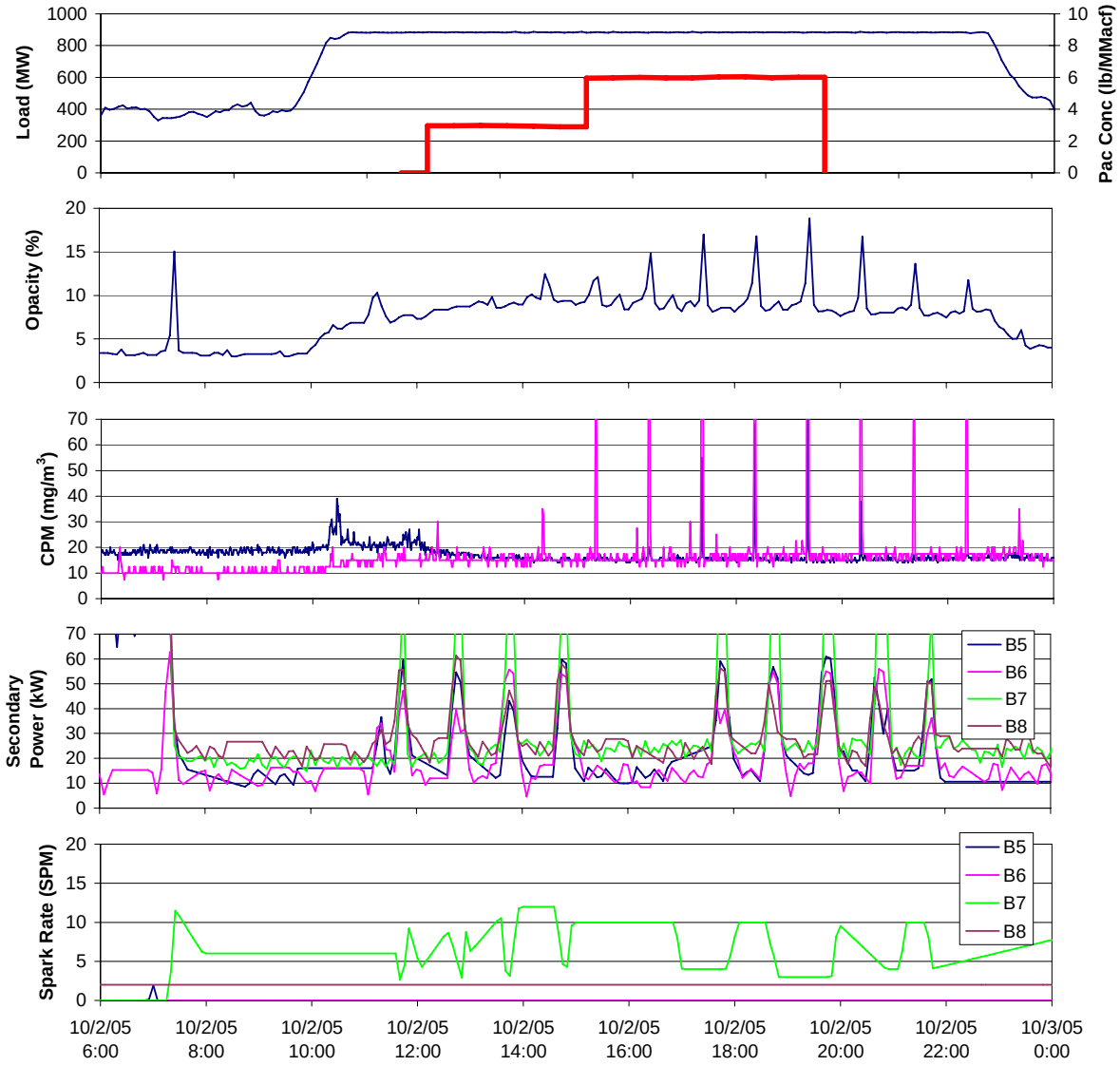


Figure 64. Operating trends during DARCO® E11 injection upstream of field 7.

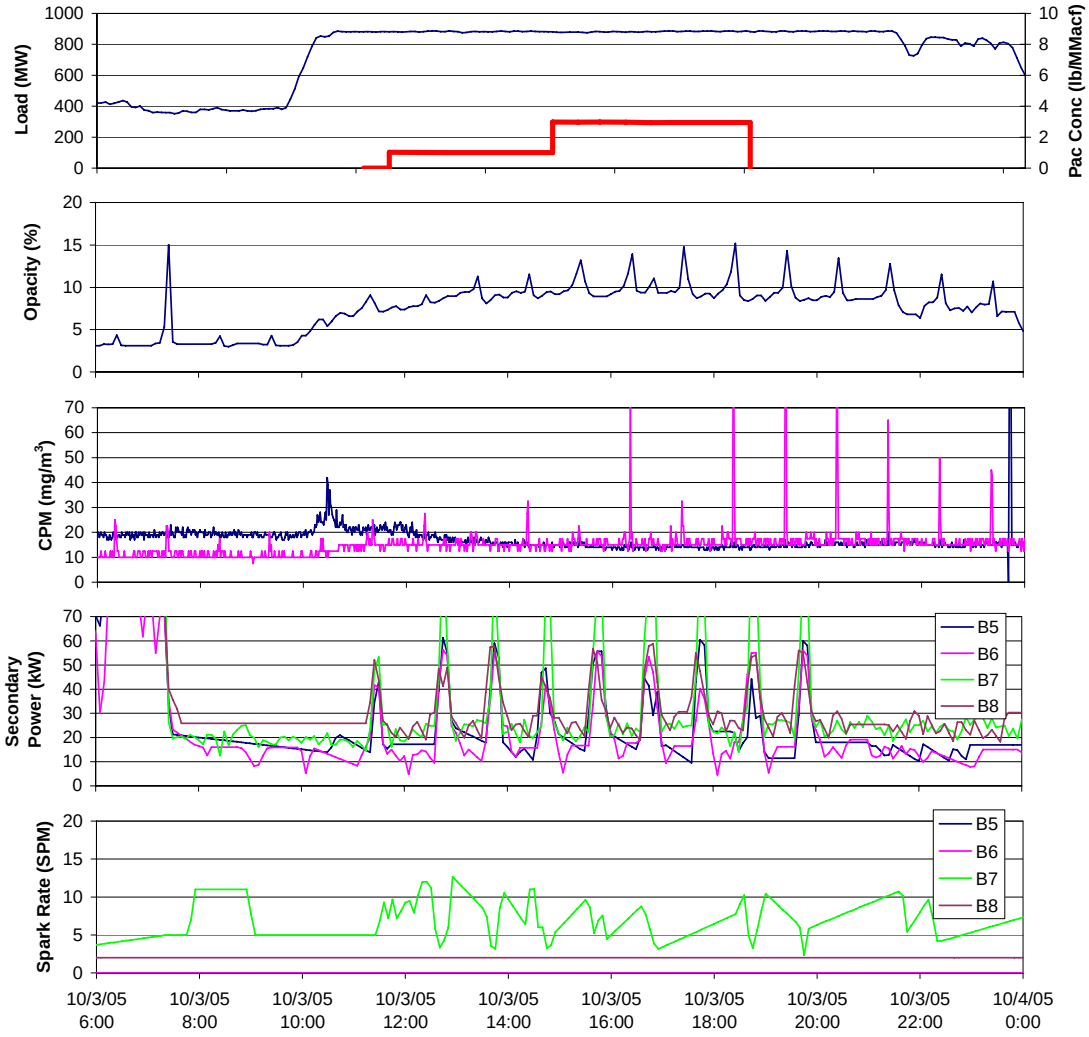


Figure 65. Operating trends during DARCO® Hg injection upstream of field 7.

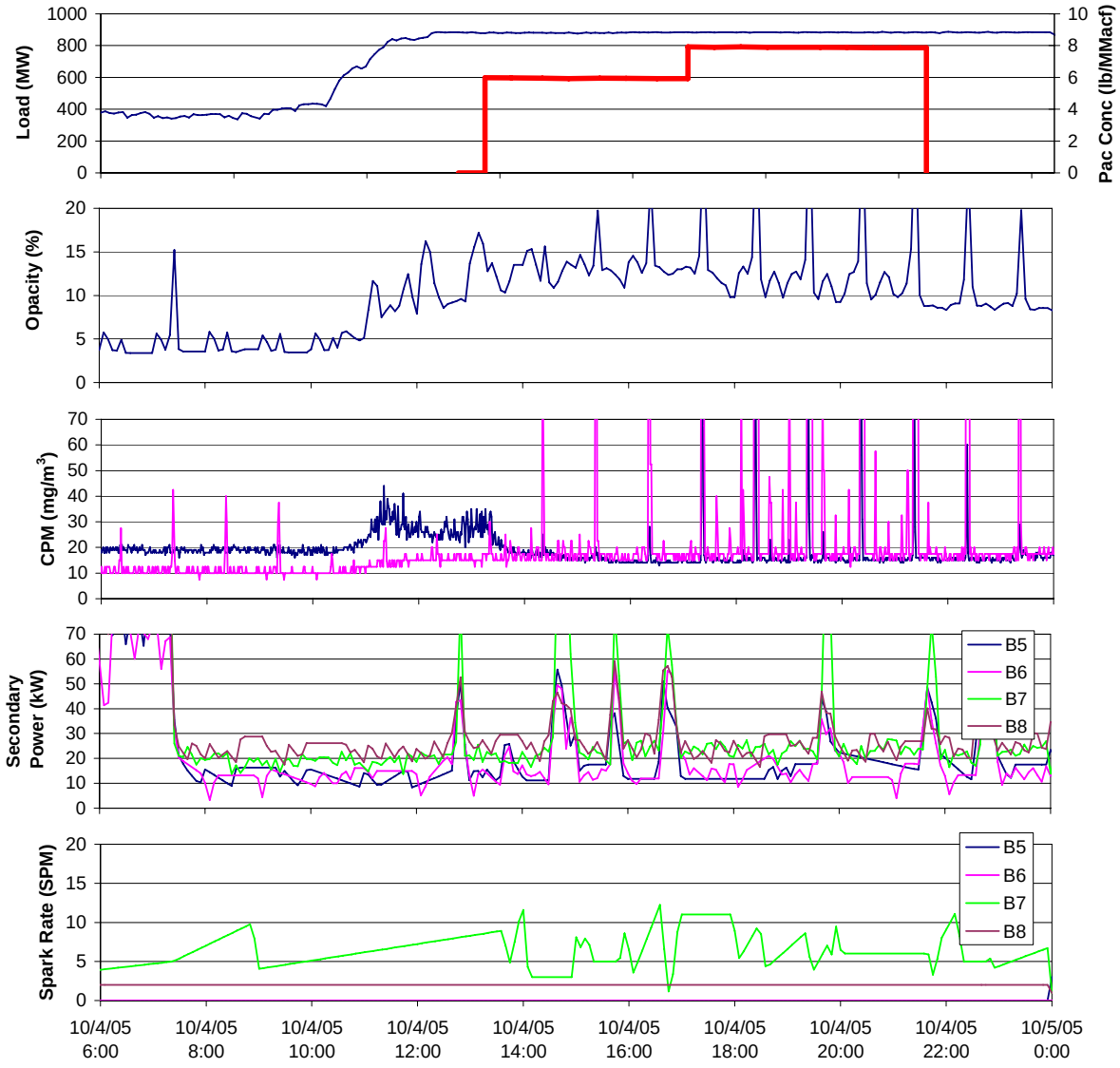


Figure 66. Operating trends during DARCO® Hg injection upstream of field 7.

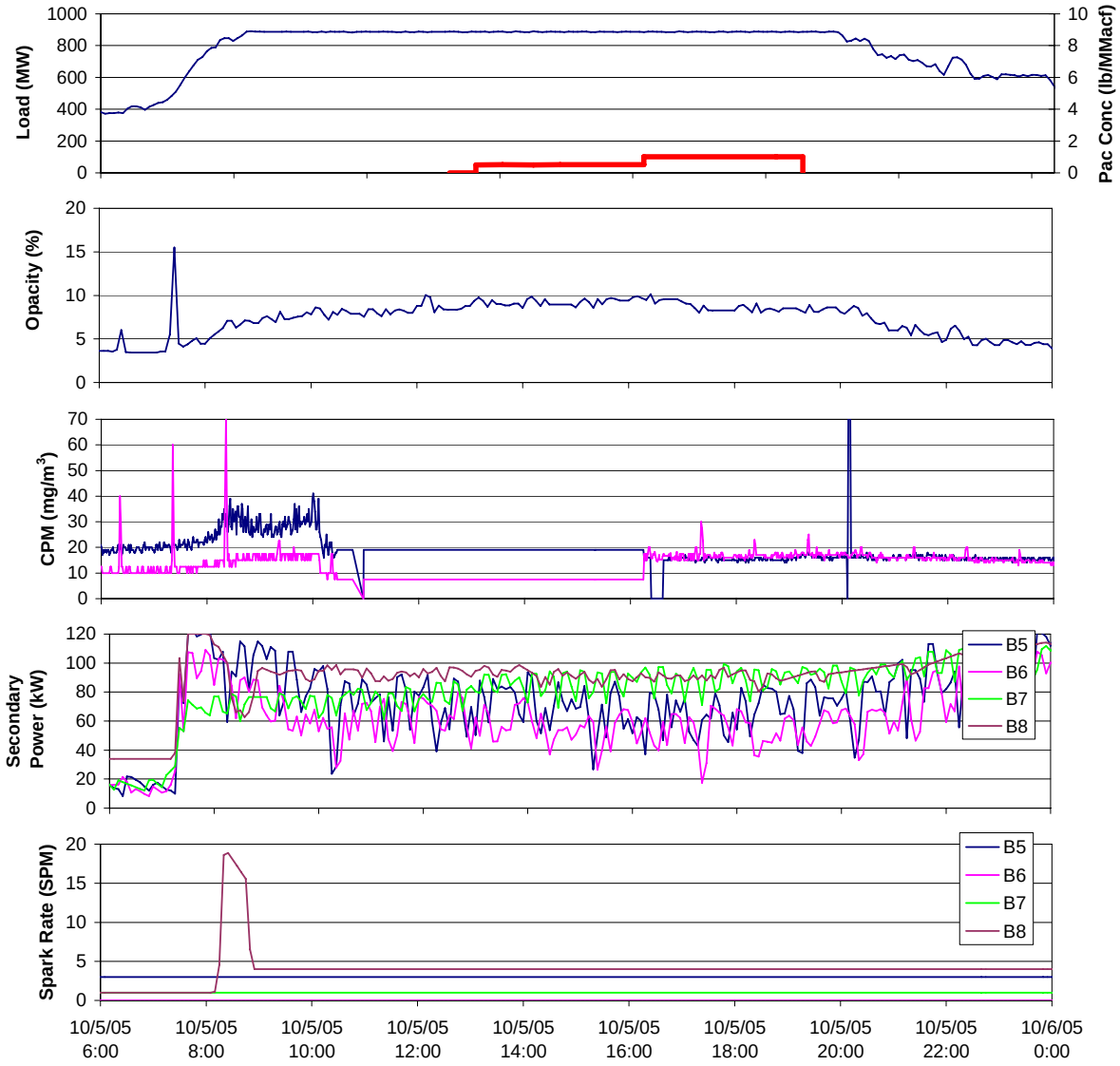


Figure 67. Operating trends during DARCO® Hg-LH injection upstream of field 7.

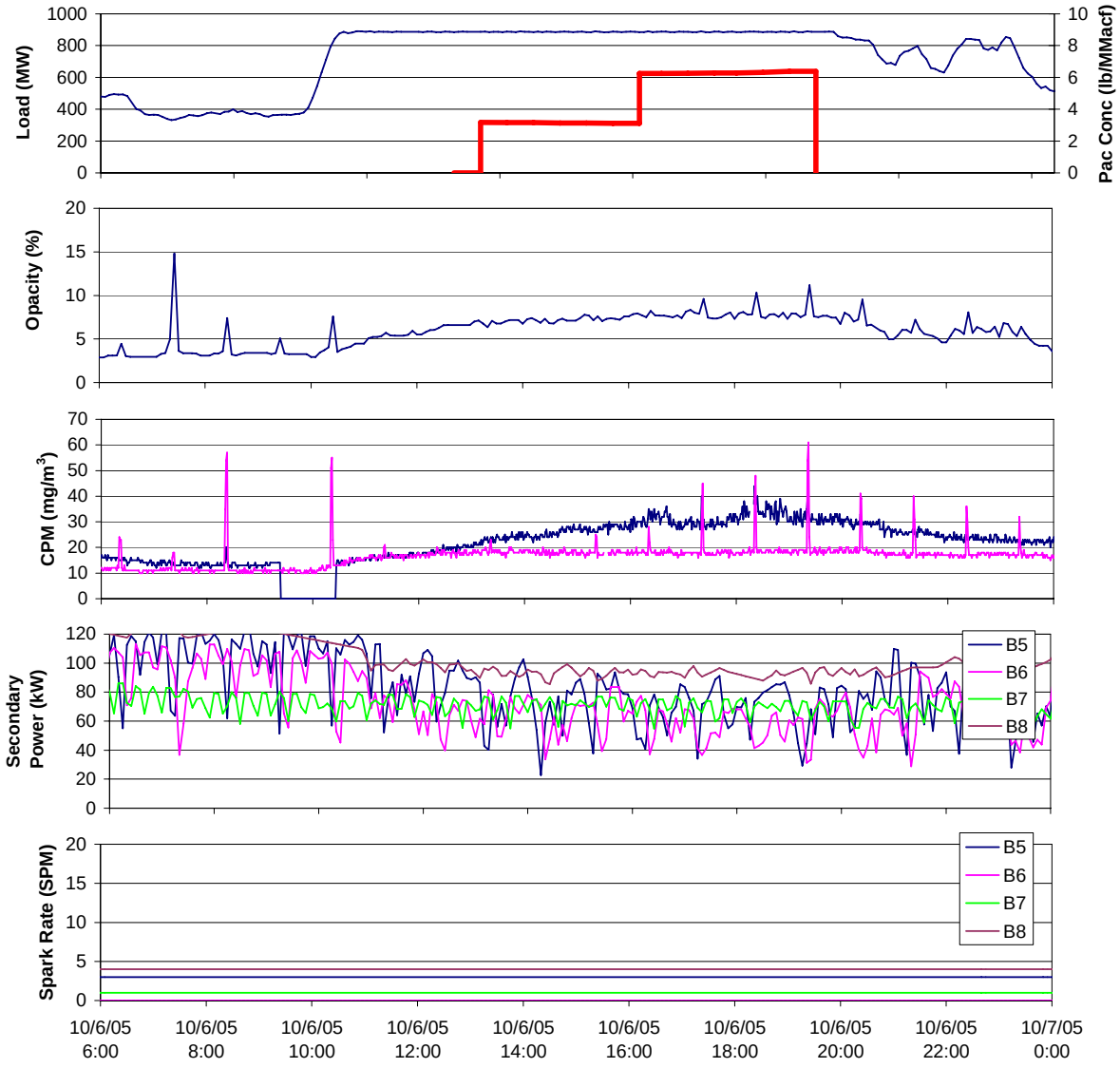


Figure 68. Operating trends during DARCO® Hg-LH injection upstream of field 7.

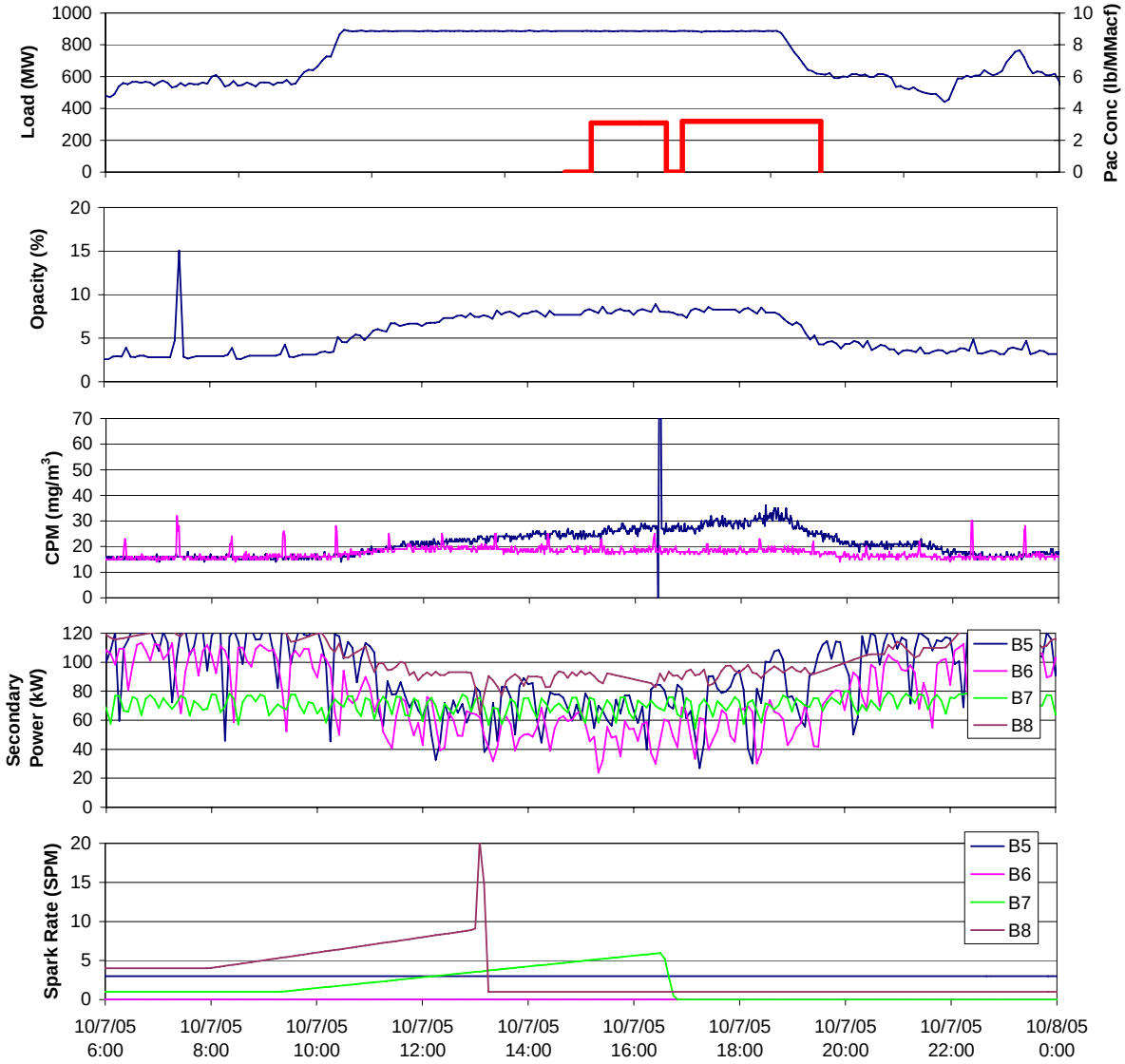


Figure 69. Operating trends during DARCO® Hg-LH injection upstream of fields 5 (first period) and 7 (second period).

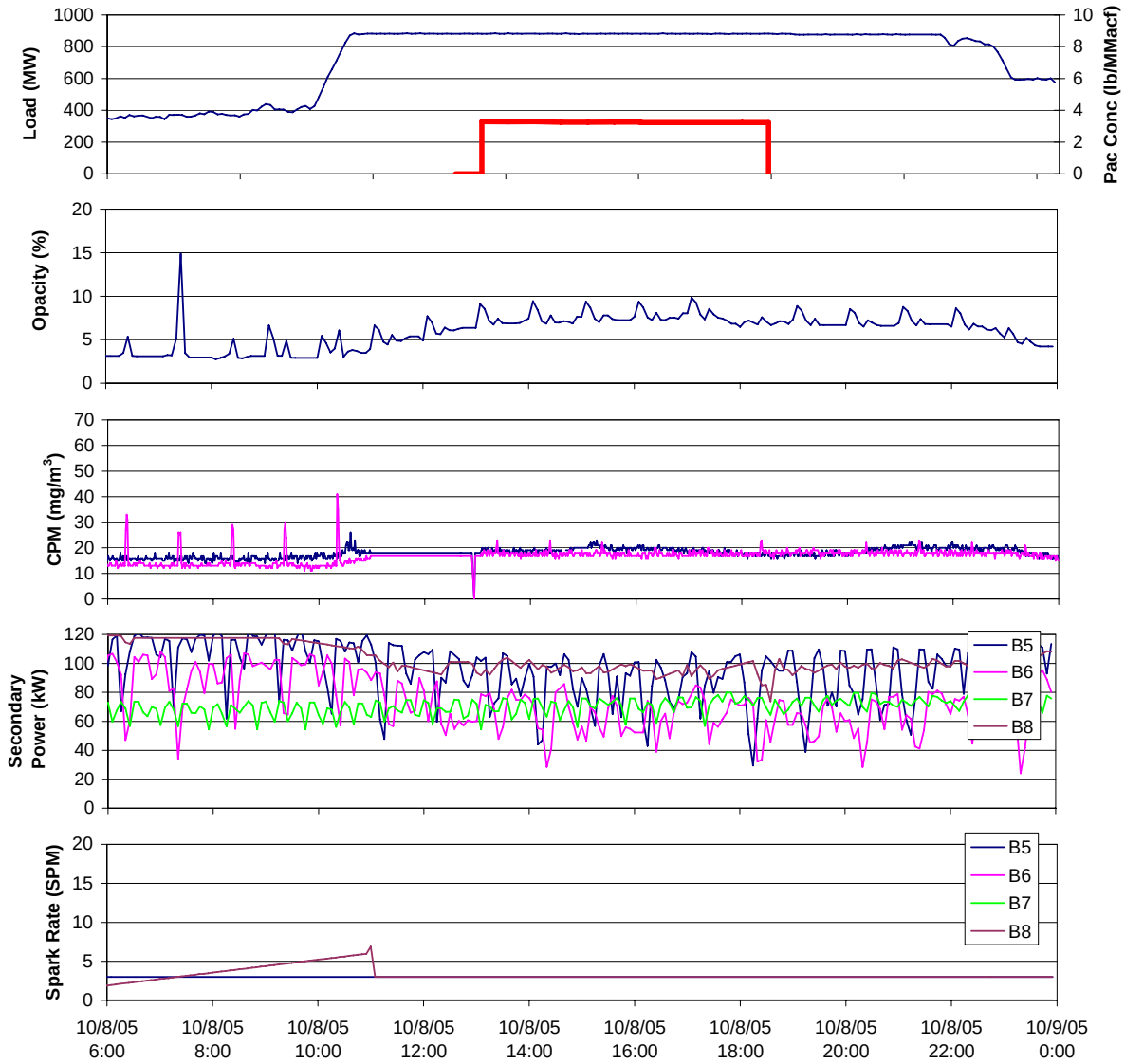


Figure 70. Operating trends during DARCO® Hg-LH injection upstream of fields 5 and 7.

Based on the August trend charts, DARCO® Hg-LH appeared to have slightly less impact on ESP operation than DARCO® Hg or the two derivative DARCO® Hg materials, E-10 and E-11 (Figure 57 through Figure 60). To verify the observed trends at Independence, a two-day supplemental test sequence was carried out in early September 2005 (Figure 61 and Figure 62). During the supplemental testing, the order of testing was reversed from the August test order, with DARCO® Hg-LH being injected in the middle of ESP B-box on September 8, and DARCO® Hg on September 9, 2005. No changes were made in the ESP Power Optimization System. The data suggest that the POS system was not optimized for PAC injection. During injection, the power levels in the T/R sets would often spike up, followed by a period when the power levels returned to a fairly low level. If a rap occurred during the period with low power, there was often a spike in the CPM and opacity measurements. Whisker plots of the opacity results are summarized in Figure 71.

Figure 71 indicates that higher concentrations of DARCO® Hg are associated with increased opacity values when the POS system is operating, especially when the sorbent is injected in the rear injection location (i.e., between F5 and F7). Table 19 shows the averaged (6-minute) stack opacity percentages during 2005 Parametric tests. With the exception of DARCO® Hg, the values are comparable to those during Baseline testing under similar conditions (i.e., high boiler load and rear electrical field B-F7 either non-operational or operational). These findings are not unexpected as only 1/8 of the flue gas stream was treated with PAC mid-ESP which may have been small enough to result in undetectable changes at the stack level. Data from the S-CEM analyzers placed at the test side and control side outlet ducts of ESP B-box can be examined to better evaluate the impact of sorbent injection on particulate emissions exiting the ESP.

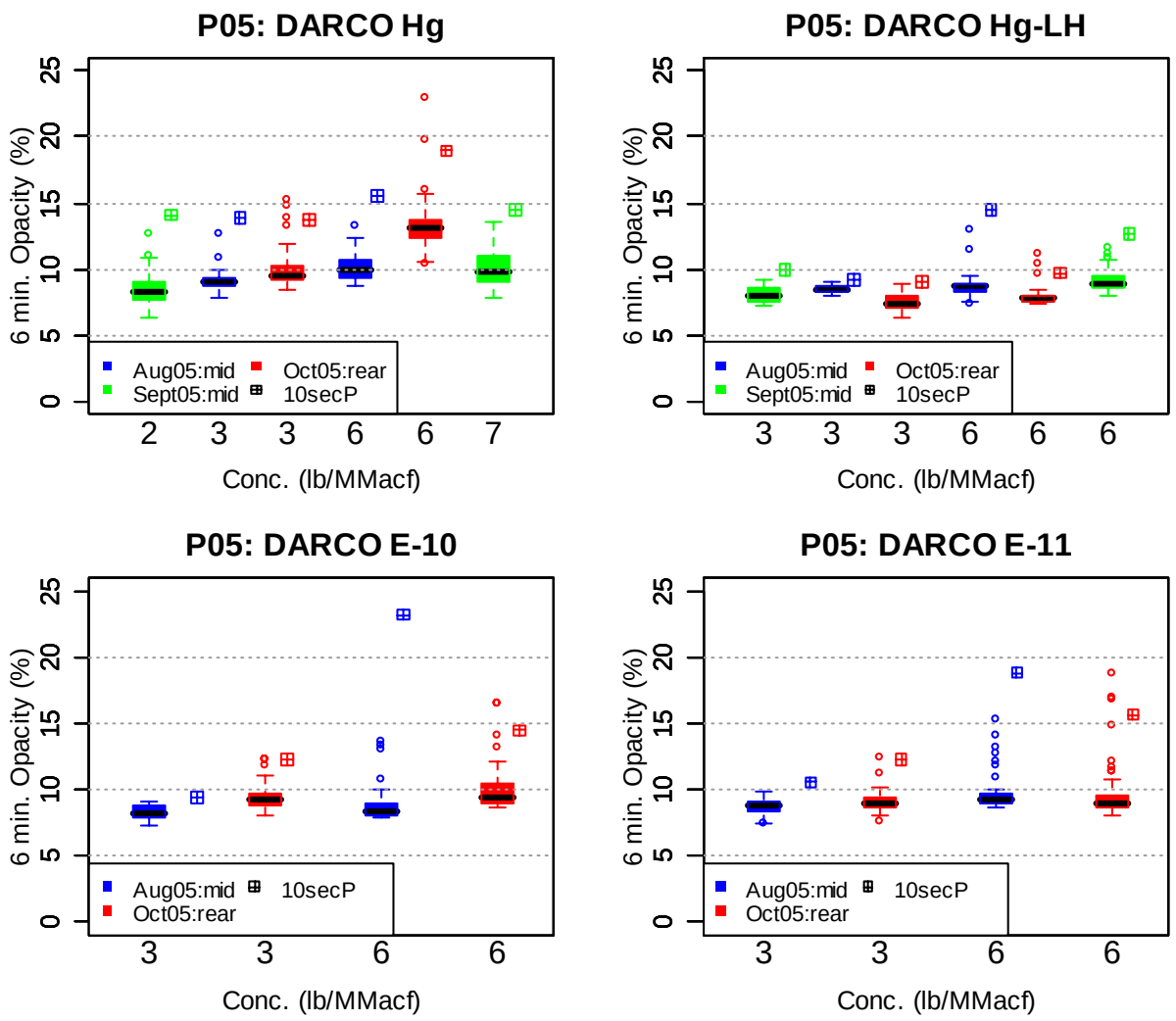


Figure 71. Box whisker plots of (6-minute) stack opacity during 2005 Parametric testing. One-eighth of flue gas stream was treated when PAC was injected either in the mid(dle) or rear of the test side of ESP-B-box during high (> 750 MW) boiler load.

During the October 2005 test sequence, unusually high particulate and opacity spiking was observed during the injection of DARCO® Hg and its derivatives, E-10 and E-11, on October 1–4 while the POS was in operation. The POS was disabled for the remaining PAC injection tests (October 5–8) and the power levels on fields 5 and 7 were increased. This change in ESP operation minimized but did not completely eliminate the spikes in the CPM and Unit 2 opacity measurements during PAC injection (DARCO® Hg-LH).

Table 19. Average (6-minute) stack opacity (%) during 2005 Parametric testing. One-eighth of flue gas stream was treated when PAC was injected either in the mid(dle) or rear of the test side of ESP-B-box during high (> 750 MW) boiler load.

	August 2005: Mid Injection			**September 2005: Rear Injection**		
DARCO®	3 lb/MMacf	6 lb/MMacf	Average	3 lb/MMacf	6 lb/MMacf	Average
Hg	9.1 ± 0.7	10 ± 1.2	9.6 ± 1.1	10 ± 1.5	13 ± 2.2	11.6 ± 2.5
Hg-LH	8.5 ± 0.2	8.7 ± 1.0	8.5 ± 0.7	7.5 ± 0.6	8 ± 0.8	8.3 ± 0.7
E-10	8.2 ± 0.5	9.2 ± 3.1	8.8 ± 2.3	9.5 ± 1.2	10 ± 1.7	9.8 ± 1.5
E-11	8.7 ± 0.6	9.9 ± 1.6	9.1 ± 1.2	9.1 ± 0.9	9.7 ± 2.3	9.5 ± 1.8

Table 20 gives the average CPM values at the ESP B-box outlet ducts on the test and control sides during October 2005 Parametric tests. When DARCO® Hg-LH was injected at a concentration of 3 lb/MMacf, the CPM values were slightly higher than when the other sorbents were injected and September 2005 baseline CPM values during high boiler load conditions. However, the average CPM value remained unchanged when DARCO® Hg-LH was injected at 6 lb/MMacf while the values increased when each of the other sorbents were injected at the higher concentration. With the exception of DARCO® Hg-LH, the average CPM values on the ESP B-box Control Side during Parametric testing are similar to those observed during September Baseline testing.

Table 20. Average CPM values on test and control sides of ESP B-box during October 2005 Parametric testing. One-eighth of flue gas stream was treated when PAC was injected in the rear of the test side of ESP B-box during high (> 750 MW) boiler load.

	ESP B-box Test Side (mg/m^3)			**ESP B-box Control Side (mg/m^3)**		
DARCO®	3 lb/MMacf	6 lb/MMacf	Average	3 lb/MMacf	6 lb/MMacf	Average
Hg	17 ± 4.3	20 ± 14.1	24 ± 31.8	14 ± 0.5	17 ± 3.3	17 ± 4.9
Hg-LH	19 ± 4.8	19 ± 3.4	18 ± 3.8	26 ± 3.7	32 ± 4.1	25 ± 8.0
E-10	17 ± 0.8	18 ± 5.1	17 ± 4.0	19 ± 3.3	16 ± 1.7	18 ± 2.9
E-11	16 ± 1.7	21 ± 15.0	19 ± 11.9	16 ± 1.2	16 ± 2.7	16 ± 2.2

Box-whisker plots of the power in ESP B-box third and fourth pairs of electrical fields during 2005 Parametric testing are shown in Figure 72. During the August Parametric tests when F7 was non-operational, power in the remaining rear electrical fields was comparable to levels seen during the August baseline levels at high boiler loads with the exception of DARCO® Hg. When DARCO® Hg was injected at a concentration of 6 lb/MMacf in F5 during August, the power in F5 and F6 was slightly elevated over baseline conditions. During the September Parametric tests when F7 was operational, injections of DARCO® Hg-LH and DARCO® E-10 corresponded to considerably elevated power levels in both pairs of the third and fourth electrical fields.

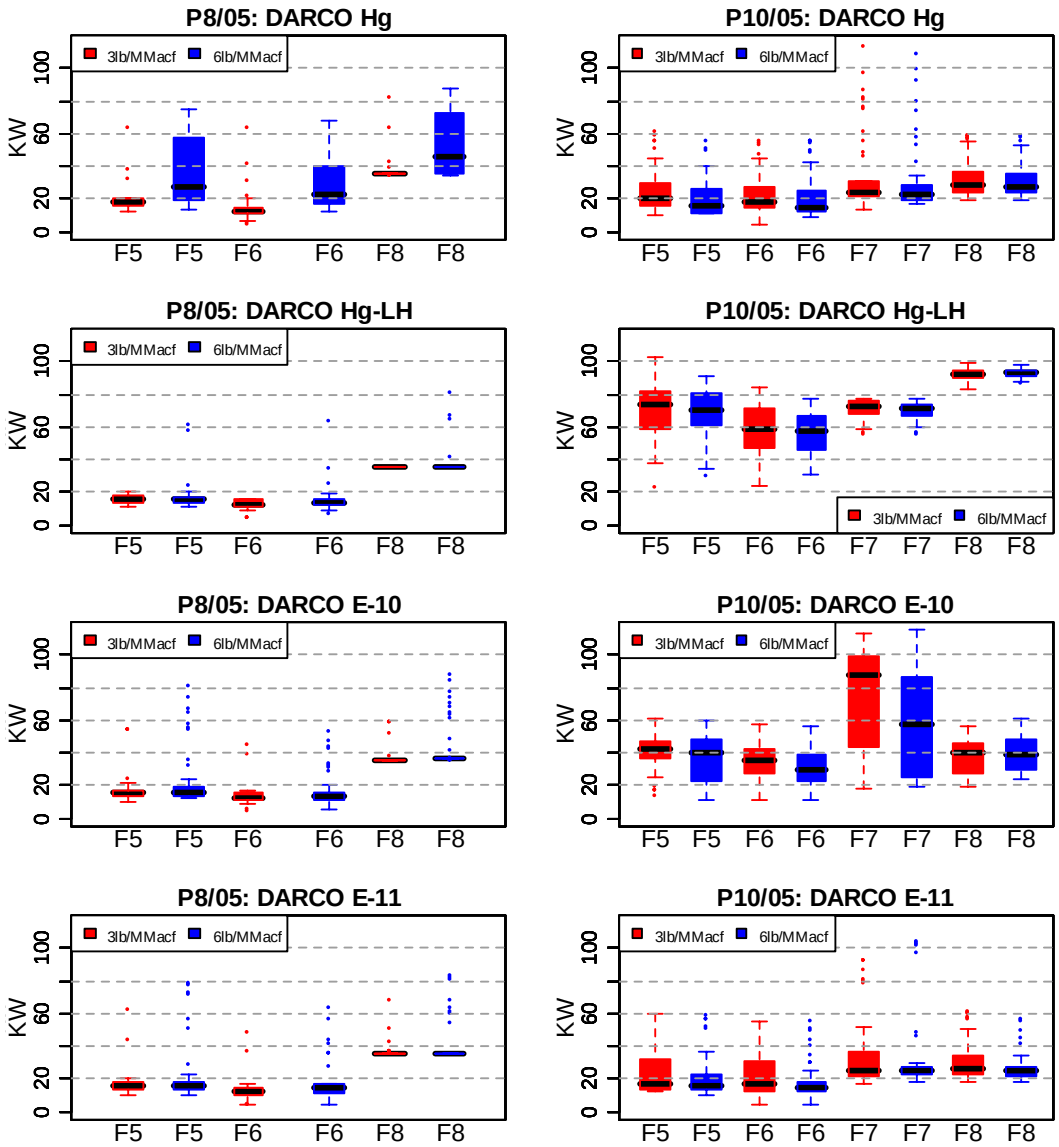


Figure 72. Box-whisker plots of power in ESP B-box rear electrical fields during 2005 Parametric tests. F5 and F6 are the third pair of fields on the test and control sides, respectively; F7 and F8 are the fourth fields on the test and control sides, respectively. One-eighth of flue gas stream was treated when PAC was injected either between F3 and F5 (8/05) or between F5 and F7 (10/05) of the ESP B-box during high (> 750 MW) boiler load.

The average spark rate for the ESP B-box third and fourth pairs of electrical fields during 2005 Parametric testing is shown Figure 73. During injection of DARCO® Hg-LH at a concentration of 6 lb/MMacf, the spark rate in F5 (directly upstream of the injection location) was nearly 4 sparks/min. compared to the August baseline rate of 0. Injection of either 3 or 6 lb/MMacf of both DARCO® E-10 and DARCO® E-11 also corresponded to an increased spark rate in F5. Injection of DARCO® Hg-LH in the rear location (i.e., between F5 and F7) in October corresponded to a spark rate in F5 of 3 sparks/min., which is slightly lower than the September baseline level but higher than the rates observed during injection of the other sorbents. In contrast, the spark rate in F7 during October was considerably elevated over the September baseline level during injection of all sorbents except DARCO® Hg-LH.

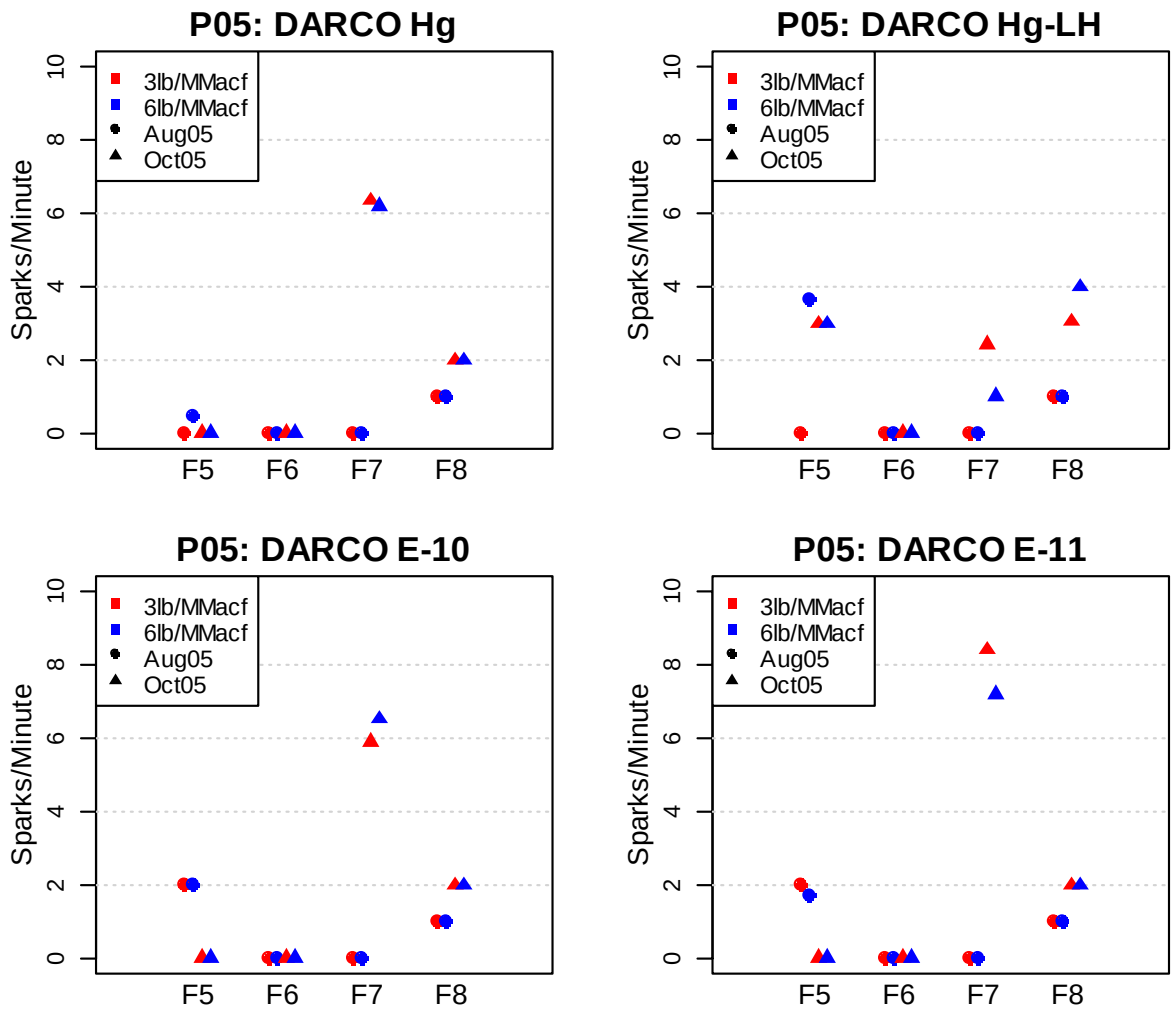


Figure 73. Average spark rates for the ESP B-box last two pairs of electrical fields during 2005 Parametric tests. F5 and F6 are the third pair of fields on the test and control sides, respectively; F7 and F8 are the fourth fields on the test and control sides, respectively. One-eighth of flue gas stream was treated when PAC was injected either directly upstream of F5 (8/05) or directly upstream of F7 (10/05) of the ESP B-box during high (> 750 MW) boiler load.

If the testing protocol for TOXECON II™ were based solely upon an ability to remove mercury, the sorbent of choice for the initial Long-Term test would have been DARCO® Hg. It compared favorably to DARCO® Hg-LH, and as an untreated sorbent, costs approximately half of what the halogenated DARCO® Hg-LH (and other comparable halogenated carbon-based sorbents) cost. At a site utilizing a 100% PRB fuel from the North Antelope mine, a coal source that has been used at other ADA-ES tested sites using PRB fuels, this was an unexpected result and is likely related to the poor sorbent distribution discussed earlier in this report. However, because DARCO® Hg-LH appeared to have favorable particulate control characteristics, it was chosen for the Long-Term testing period.

Long-Term ESP Performance

Based on the 2005 Parametric test results, it was expected that DARCO® Hg-LH would have minimal impact on ESP performance during Long-Term testing. Figure 74 shows trend charts of ESP performance for the entire test period (10/10/05–11/08/05). Recall that the initial Long-Term test sequence was divided into two main phases. During the first phase, sorbent was injected between the last two fields on the test side of ESP B-box. During the second phase, injection was shifted to mid-box (i.e., between the second and third fields). Results from these phases, which are depicted in trend charts, are presented below.

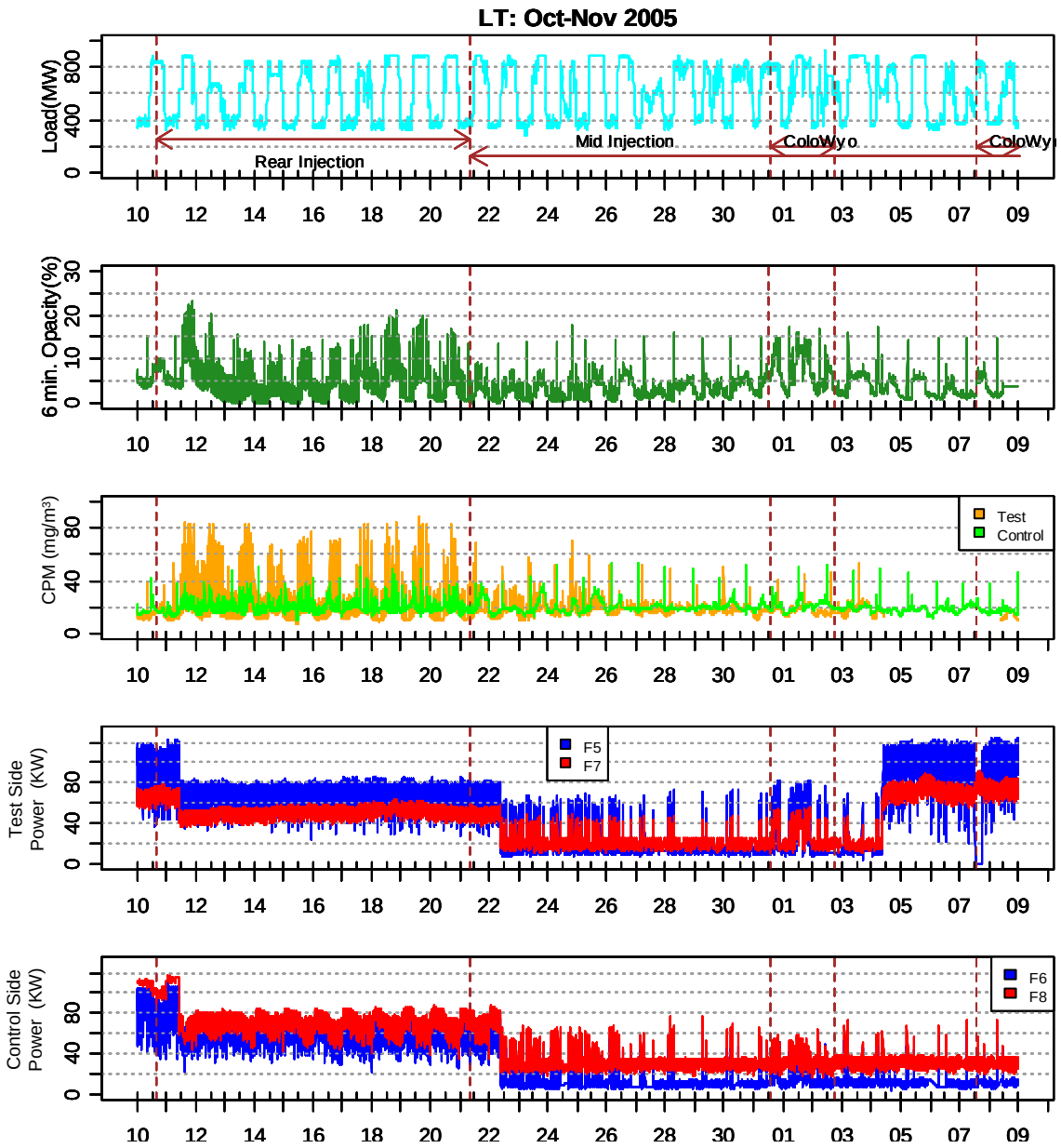


Figure 74. ESP Operation and (6-minute) opacity during October and November 2005 Long-Term testing. Opacity represents stack data. One-eighth of flue gas stream was treated when PAC was injected in the test side of ESP-B.

During the second day of Phase I Long-Term testing, Independence plant personnel expressed concern over the increase in the 6-minute average as well as the peak opacity being reached when using the 10-second instantaneous opacity results. As is evident in the opacity trend chart (Figure 74), opacity levels were exceeding 20% at high boiler loads. The high opacity values were spikes that coincided with rapping which occurred every hour and lasted for 140 seconds. The average 6-minute opacity values were indistinguishable from those observed during September 2005 Baseline testing whether the overall average is considered or the averages at high and low boiler loads (see Figure 75 and Table 21). In an attempt to decrease the opacity spike amplitude, the CE rapper duration for field B-F7, the ESP B test side outlet collection plate, was decreased from 140 seconds to 70 seconds. As can be seen in Figure 76, the 6-minute average opacity spikes dropped from above 15% during the field B-7 rap to below 10% after the shift to a shorter duration cycle. In general 6-minute average opacity also decreased (see Figure 75 and Table 21). The rap duration change lowered not only the 6-minute average opacity, but also the peak opacity spikes as measured by the 10-second instantaneous opacity. However, this may be an aberration introduced by the data collection algorithm for the 10-second opacity measurement. When the continuously measured peak opacity was viewed on the data screens in a continuous graphical format, the spike height appeared to remain the same whether the rap cycle lasted 140 or 70 seconds. During the last few days of October testing when the CPM and opacity monitor recorded few spikes resulting from Hg-LH injection, B-F5 power was typically between 60 and 80 kW. B-F7 power was typically near 100 kW. During the initial Long-Term testing period, the B-F7 power was less than 80 kW. Before the CPM and opacity spikes began, power levels on B-F5 and B-F7 were both decreased.

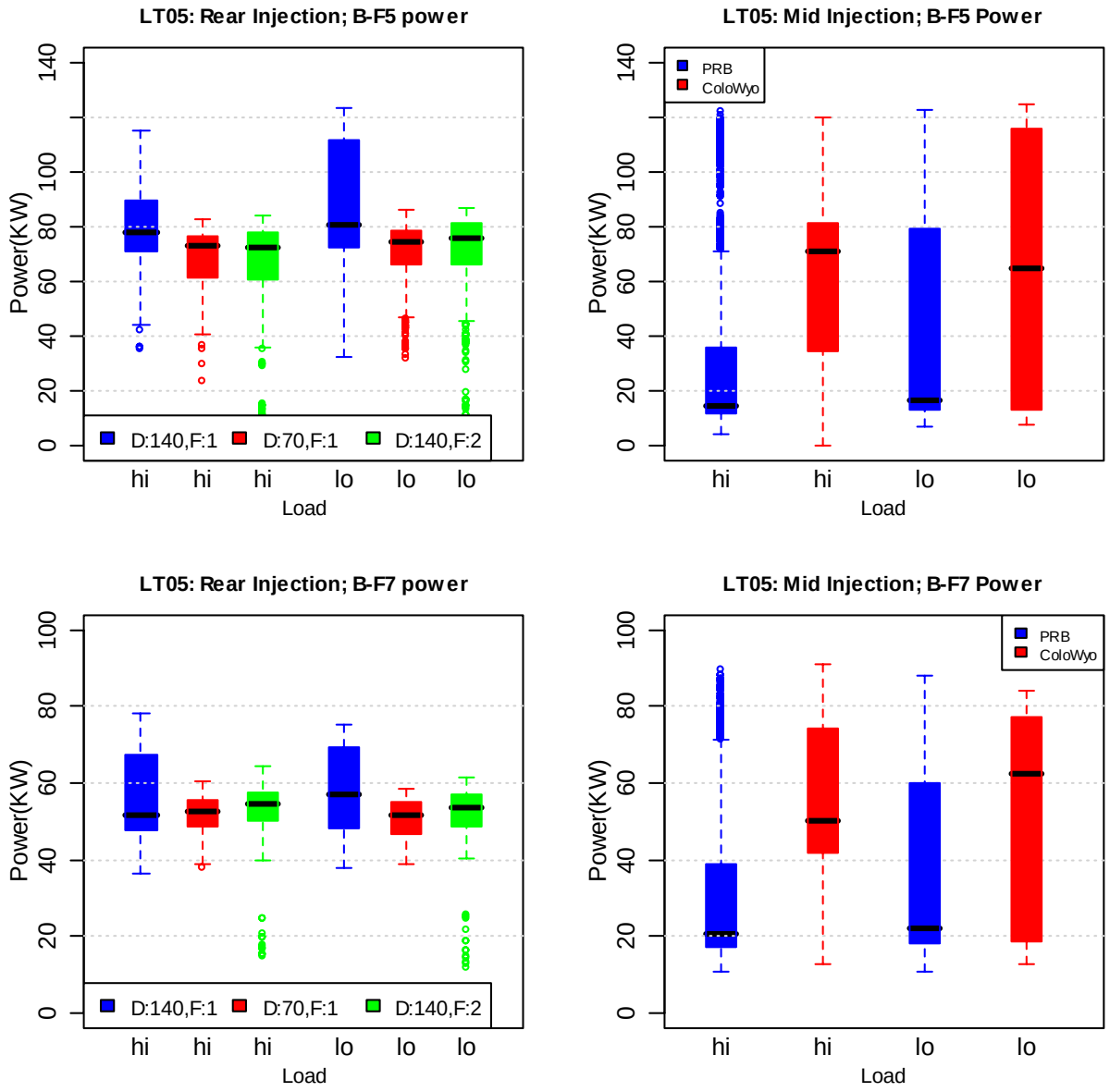


Figure 75. Box whisker plots of power in the two rear electrical fields on the test side of ESP B-box during 2005 Long-Term testing. (See caption for Figure 78 for explanation of sorbent injection conditions.)

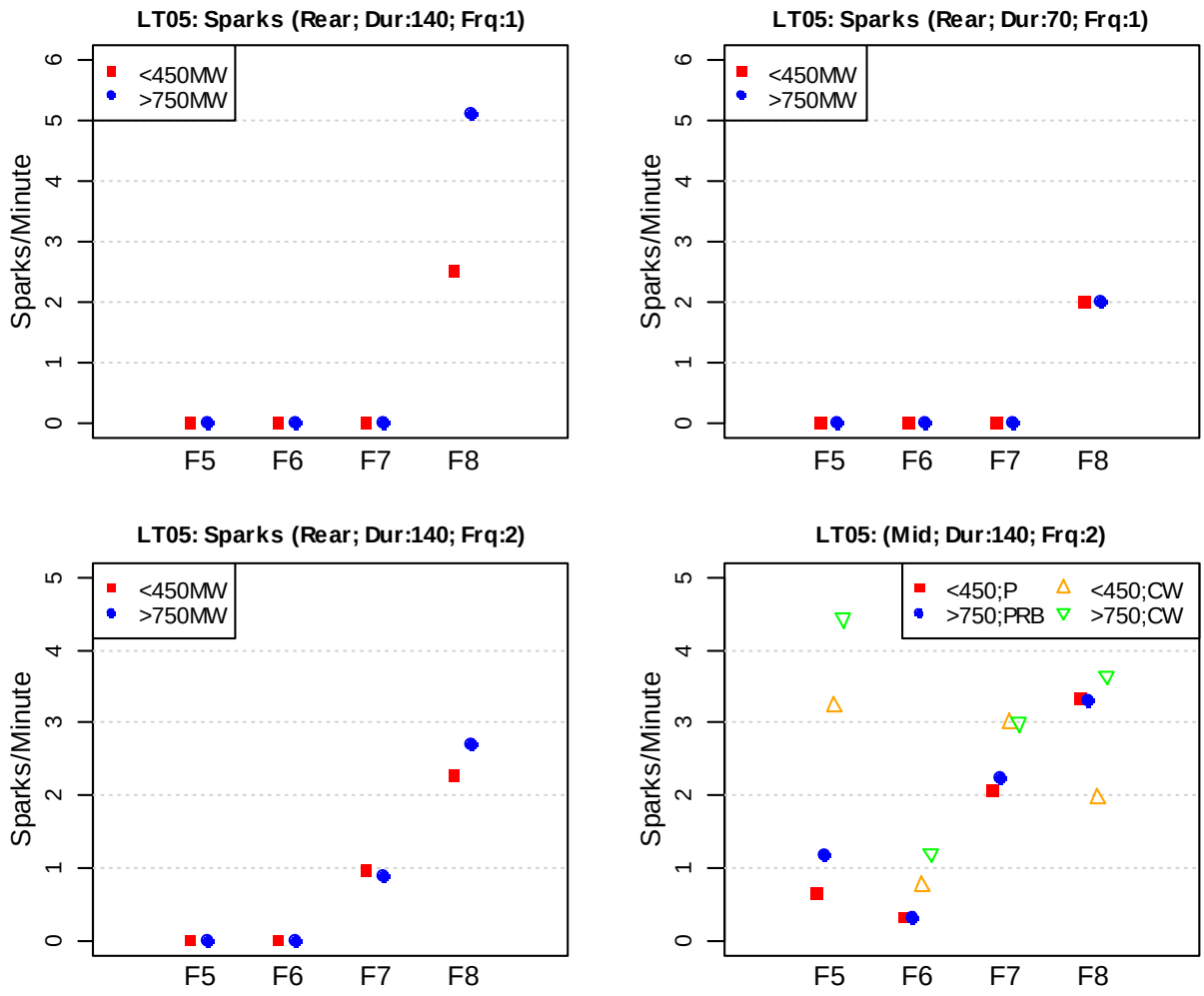


Figure 76. Average spark rate in ESP B-box electrical fields during 2005 Long-Term testing. F5 and F6 are the third fields on the test and control sides, respectively; F7 and F8 are the last fields on the test and control sides, respectively. Plot contrasts overall spark rates with those when boiler load is at high loads (> 750 MW) and low load (< 450 MW). (See caption for Figure 78 for description of ACI conditions.)

Recall that on October 16, the injection concentration was increased from nominally 4 lb/MMacf to nominally 5 lb/MMacf in an effort to improve mercury removal across the ESP B-box. No discernable changes in opacity levels were detected with the increase in sorbent concentration. On October 17, the rapping cycle for B-F7 was extended from once per hour to every other hour. To prevent an unusual build up of material on the plates, the same amount of rapping per 24-hour period was achieved by increasing the rap duration to 140 seconds. The opacity trend chart in Figure 77 clearly depicts the shift in rapping frequency. Also evident is the increase in opacity spike amplitude at high load most likely due to the increase in rap duration to 140 seconds. However, the 6-minute opacity levels in general did not show such a pronounced increase (Figure 78 and Table 21).

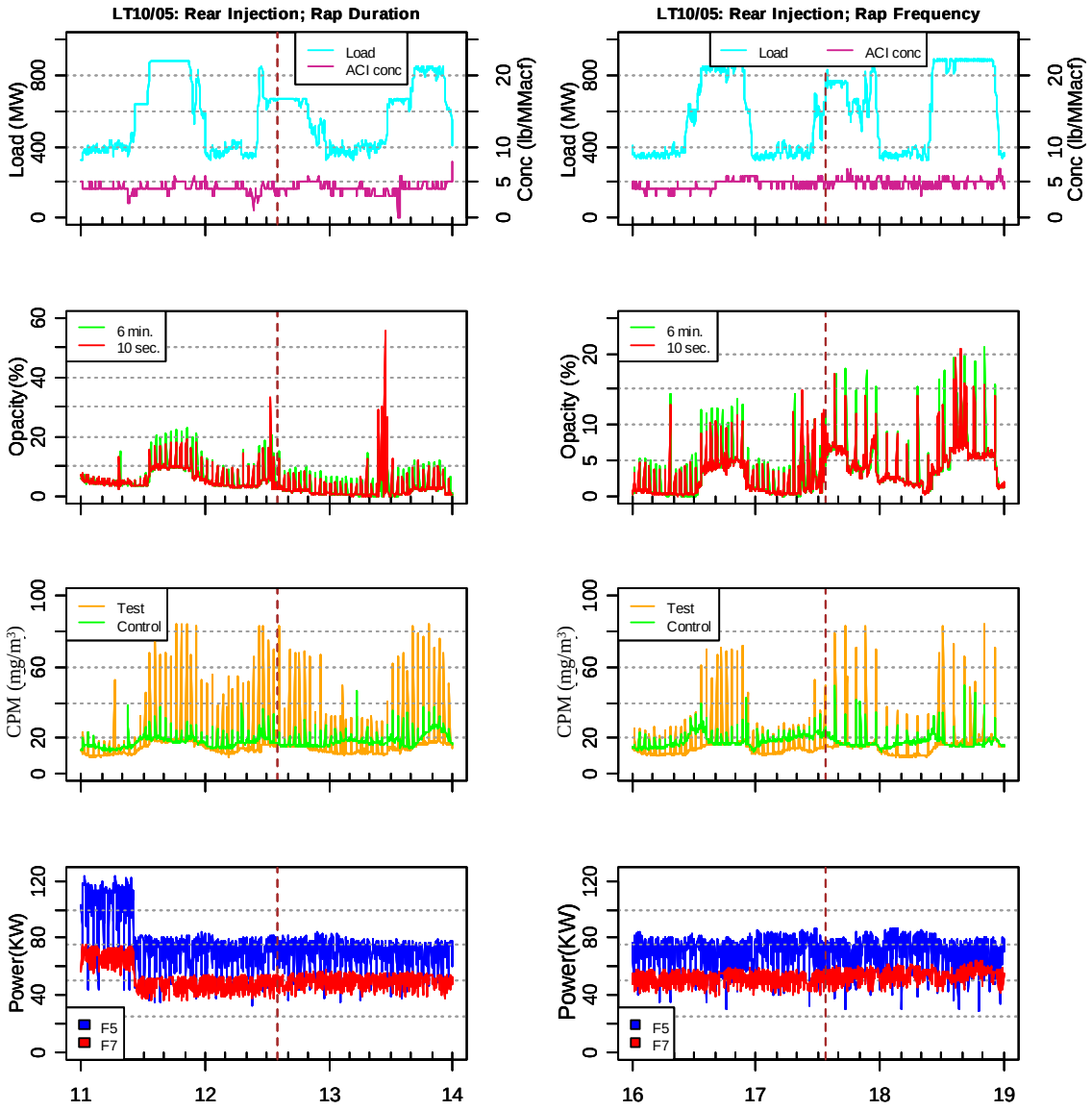


Figure 77. ESP Operation and (6-minute) opacity during shifts in CE rapper B-F7 rap duration and frequency. The vertical dashed line in the left charts indicates the shift in rap duration from 140 seconds to 70 second once per hour. The vertical dashed line in the right charts indicates the shift in rap duration back to 140 seconds accompanied by a decrease in frequency to every two hours.

The CPM trend charts in Figure 77 also show spikes that coincide with the rapping cycle. The amplitude of the spikes is well above 2005 Baseline levels. In general, Phase I CPM levels were slightly elevated over September 2005 Baseline levels for similar load conditions regardless of rapping duration or frequency (see Figure 79 and Table 22).

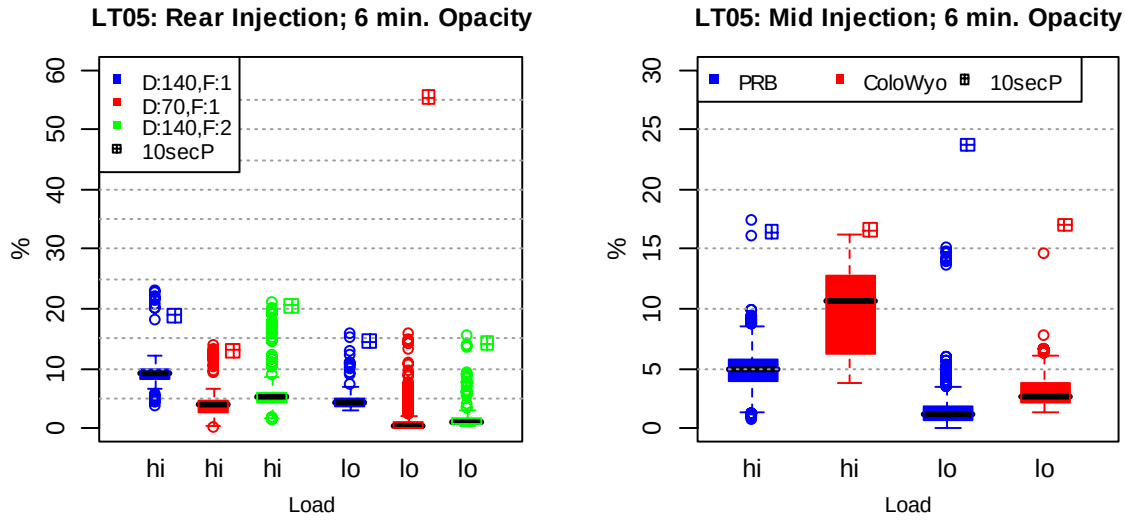


Figure 78. Box whisker plots of (6-minute) stack opacity during 2005 Long-Term testing. One-eighth of flue gas stream was treated when PAC was injected either in the mid(dle) or rear of the test side of ESP B-box during hi (> 750 MW) and lo (< 450 MW) boiler loads. Rear injection included three different rapper protocols for field B-F7: (1) duration of 140 seconds once per hour (D:140,F:1), (2) duration of 70 seconds once per hour (D:70,F:1), and (3) duration of 140 seconds once every 2 hours. Also shown is the 10-second peak opacity value for the same conditions. During the mid injection phase, coal from the ColoWyo mine was burned in place of the typical PRB coal during two short periods.

Table 21. Average (6-minute) stack opacity during 2005 Long-Term testing. (See caption for Figure 78 for description of ACI conditions.)

	Average 6-Minute Opacity (%)		
ACI Conditions	< 450 MW	> 750 MW	Overall
Rear Injection Rap Duration: 140 seconds Frequency: 1 hour	4.6 ± 1.7	9.5 ± 3	6.4 ± 3.4
Rear Injection Rap Duration: 70 seconds Frequency: 1 hour	1.1 ± 2.2	4.3 ± 2.5	2.1 ± 2.6
Rear Injection Rap Duration: 140 seconds Frequency: 2 hours	1.6 ± 1.7	5.8 ± 3	3.6 ± 3.1
Mid Injection	1.4 ± 1.3	4.9 ± 1.4	3 ± 2.0
Mid Injection (ColoWyo)	3.1 ± 1.5	9.5 ± 3.7	6 ± 3.8

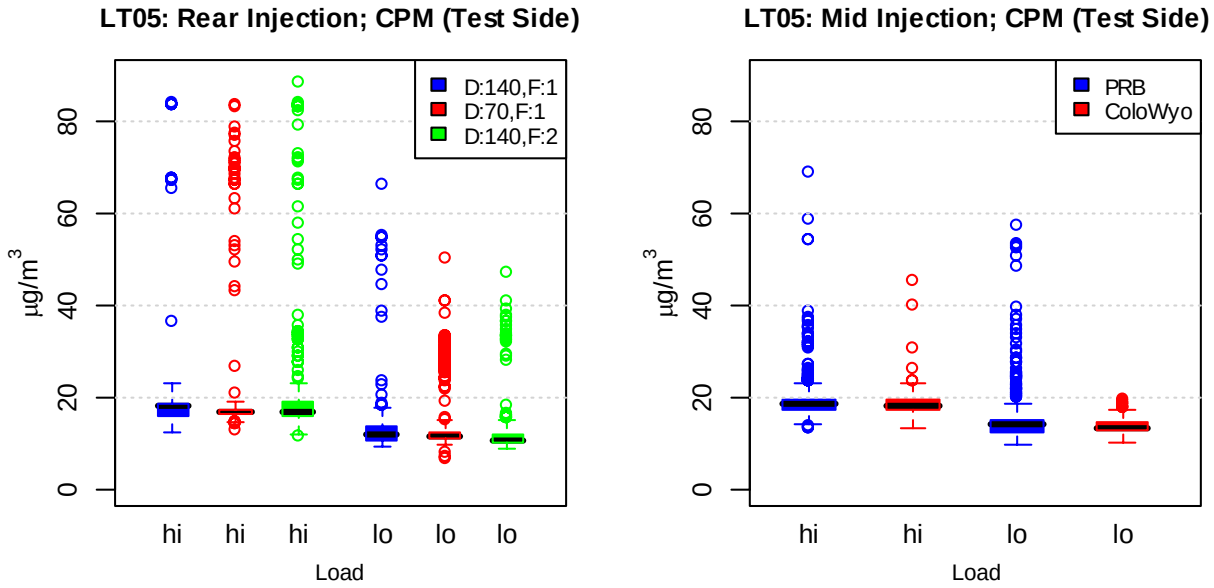


Figure 79. Box whisker plots of CPM values at the test and control outlet ducts of ESP B-box during 2005 Long-Term testing. (See caption for Figure 78 for explanation of sorbent injection conditions.)

Table 22. Average CPM values at the test outlet duct of ESP B-box during 2005 Long-Term testing. (See caption for Figure 78 for explanation of sorbent injection conditions.)

	ESP B-box (test side) Average CPM (mg/m^3)		
ACI Conditions	< 450 MW	> 750 MW	Overall
Rear Injection Rap Duration: 140 seconds Frequency: 1 hour	14 ± 8.5	21 ± 13	17 ± 12
Rear Injection Rap Duration: 70 seconds Frequency: 1 hour	13 ± 5.3	21 ± 15	17 ± 11
Rear Injection Rap Duration: 140 seconds Frequency: 2 hours	12 ± 4.9	21 ± 12	16 ± 10
Mid Injection	15 ± 4.1	19 ± 3.4	17 ± 4.1
Mid Injection (ColoWyo)	14 ± 1.8	19 ± 3.0	16 ± 3.3

In general, power in the ESP B-box rear electrical fields was higher during Phase I of Long-Term testing than during 2005 Baseline testing. Moreover, from the morning of the second day of testing through the end of Phase I, power levels remained within approximately the same range regardless of load in B-F5 and (a slightly lower range for) B-F7 (Figure 74 and Figure 75).

The average spark rate during Long-Term Phase I testing for the last two pairs of electrical fields in the ESP B-box is shown in Figure 76. In general, spark rates are the same or lower than those during 2005 Baseline and Parametric testing. An exception is the spark rate in B-F8, which tends to be higher than was observed during baseline. Also, the spark rate in B-F7 when rapping duration was 140 seconds every two hours was slightly higher than baseline but lower than the rate observed during the Parametric tests.

Trend charts indicating the shift between Phase I (rear-box injection) and Phase II (mid-box injection). Long-Term tests are shown in Figure 80. A decrease in opacity was expected when moving the injection location from rear to mid-box as the effective SCA available for particle capture doubled. (A collection field at Independence was rated at an effective SCA = 135 ft^2/kacfm.) Figure 74 shows more clearly the difference between the two phases in ESP performance. For example, a decrease in both the 6 min. opacity spike amplitude and CPM spike amplitude is evident. In general, 6-minute opacity remained below 15% during Phase II. From the plant's viewpoint this decrease was a significant change as it allowed a margin of error to prevent a reportable opacity violation.

Figure 78 and Table 21 summarize the 6-minute stack opacity values and Figure 79 and Table 22 summarizes the CPM values for Phase II. Although opacity values decrease during Phase II, CPM values do not show much change and remain slightly elevated relative to Baseline conditions. In contrast, EPA Method 17 tests conducted during Phase II show elevated PM levels at the inlet to ESP B-box but decreased levels at the outlet to ESP B-box relative to those conducted during 2005 Baseline tests (see Table 23 and Appendix D for the full report). For reference, Figure 81 shows trend charts for the days when the M17 tests were conducted.

On October 24, the injection location was shifted from mid-box to rear-box and back to mid-box over the course of several hours (Figure 80). The system response to the change is most apparent during the second shift when there is a pronounced spike in both opacity (> 15%) and CPM levels which may be related to PAC build up on the rear collection plates. During Parametric testing it was noted that the effects of PAC build up on the ESP collection plates can take up to 18 hours to dissipate.

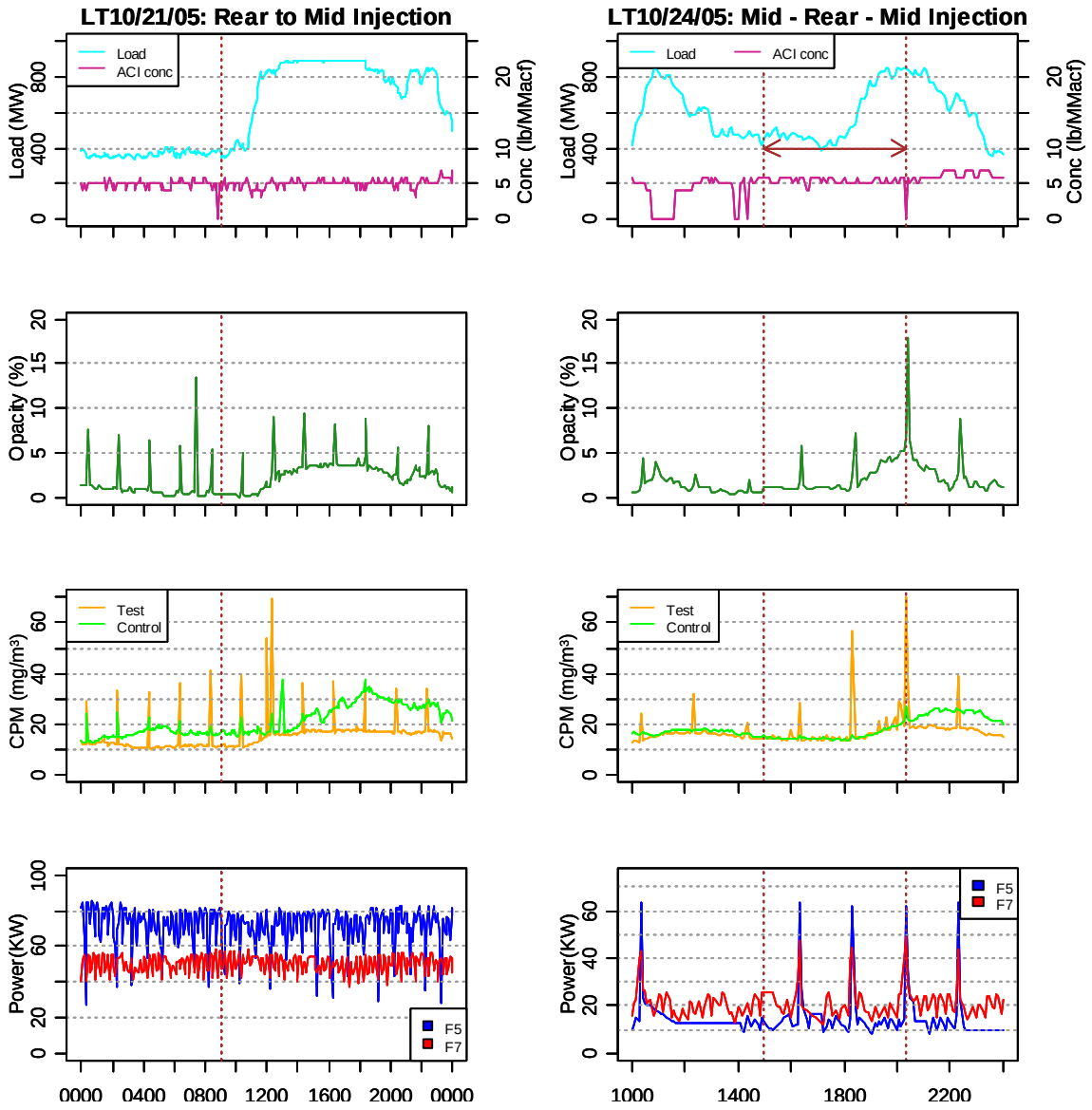


Figure 80. ESP operation and (6-minute) stack opacity during shifts in PAC injection location. The vertical dashed line in the left charts indicates the shift from injecting between ESP B-box F5 and F7 (rear-box) to between F3 and F5 (mid-box). The first vertical dashed line in the right charts indicates shift from mid-box to rear-box injection and the second line indicates the shift back to mid-box injection.

Table 23. Method 17 results for Unit 2 during 2005 Long-Term testing.

Run #	ESP B Inlet Duct gr/dscf	ESP B Outlet Duct gr/dscf	Decrease %
1 (10/25/05)	2.014	0.004	99.8
2 (10/25/05)	2.528	0.006	99.8
3 (10/26/05)	2.071	0.004	99.8
Average	2.204	0.005	99.8

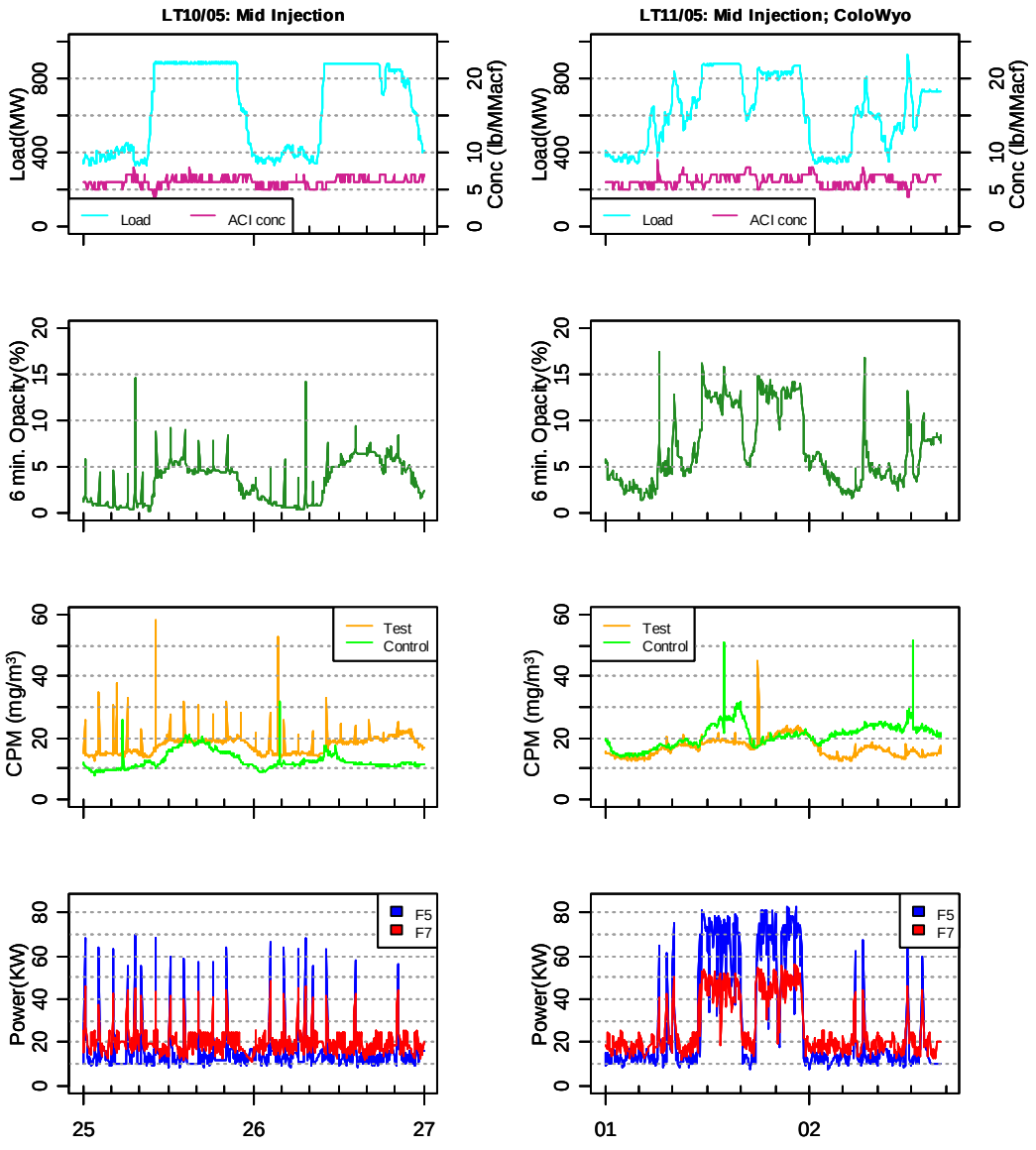


Figure 81. ESP Operation and (6-minute) stack opacity during days when M17 (October 25–26, 2005) and Ontario Hydro (both October 25–26 and November 1–2, 2005) tests were conducted while sorbent was injected into 1/8 of the flue gas stream in ESP B-box between fields F3 and F5 (mid-box).

As is evident in Figure 74 and Figure 75, power in the ESP B-box rear fields on the test side (F5 and F7) was much more variable during Phase II than Phase I. Moreover, spark rates tended to be higher in all rear fields during Phase II than Phase I. However, spark rates were similar to those observed during 2005 Parametric testing, including higher rates in F7 and F8 compared to 2005 Baseline.

On October 30, the sorbent injection concentration was temporarily increased from nominally 5 lb/MMacf to nominally 8 lb/MMacf (Figure 82). There was no noticeable increase in emissions rate for particulate as measured by the CPM data or the plant opacity meters.

On November 4, the rear fields of the test side of ESP B were removed from the controls of the Precipitator Optimization System (POS) for several hours. The POS is designed to react to changes in the plant opacity by raising and lowering the power output of the T/R sets. In Figure 82, the increase in field B-7 power can be clearly observed during the spikes in opacity in the morning of November 4.

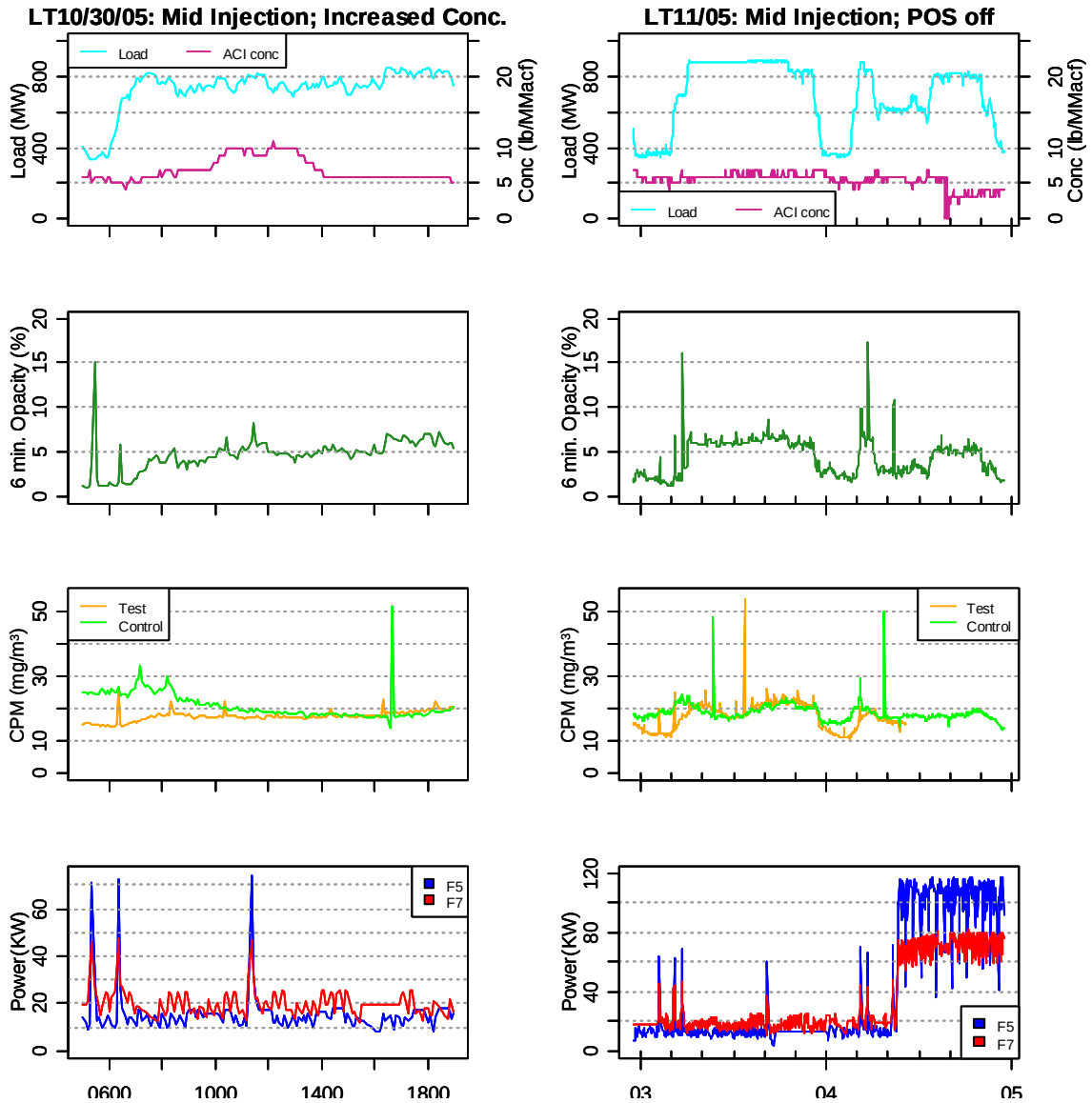


Figure 82. ESP Operation and (6-minute) stack opacity during a temporary increase in sorbent concentration (left charts) and while rear fields of the test side of ESP B were temporarily removed from the POS (right charts).

Twice during Phase II of Long-Term testing coal from the ColoWyo mine was burned as fuel. These periods are indicated in Figure 74. For reference, trend charts covering the same period as when Ontario Hydro tests were conducted in early November are given in Figure 81. In general, 6-minute stack opacity was elevated when ColoWyo was burned compared to PRB (Figure 78). Moreover, power in ESP B-F5 and F7 was more variable (Figure 75). However, CPM values at the ESP B-box outlet duct on the test side were comparable to those when PRB was burned (Figure 79 and Table 22).

Redesigned Grid

During evaluation of the redesigned injection grid and delivery system in 2007, particulate emissions measurements using EPA M5/202 were measured at three locations in the Independence gas stream: at the outlet of the west side of the B-West ESP (test-side), the east side of the B-West ESP (control-side) and at the stack (Appendix D5). Two continuous particulate monitors were installed and operated during testing: one across the outlet of the B-West ESP and one across the B-East ESP. The stack opacity monitor was also used to determine whether any excess emissions from testing on 1/32 to 1/16 of the unit resulted in an increase in the stack opacity.

A summary of the stack PM measurements is included in Table 24 along with average opacity and unit load for the sampling period. The stack data suggest that there was an increase in the PM emissions between the Baseline test period (January 29–February 2, 2007) and the stack testing during PAC injection (February 12–13, 2007) (see Table 25). The opacity trend shown in Figure 83 indicated that there was an increase in the stack opacity correlating to an increase in PAC injection into 1/16 of Unit 2 on February 8, 2007. Thus, the measured increase in particulate at the stack may have been caused by PAC injection and not another operational change at the plant. However, when PAC injection was stopped on March 9, there was not a significant corresponding decrease in the opacity, suggesting that there may be more than one contributor to the increase in opacity.

Table 24. Baseline PM measurements – stack.

	Run 1	Run 2	Run 3	Run 4	Run 5	Base Average
Test Date	1/29/07	1/30/07	1/31/07	2/1/07	2/2/07	
Time	0830–1533	0645–1336	0642–1320	0705–1342	0700–1336	
FPM (gr/dscf)	0.0032	0.0032	0.003	0.0031	0.0033	0.0032
CPM (gr/dscf)	0.003	0.0042	0.0035	0.0027	0.0033	0.0033
TPM (gr/dscf)	0.0062	0.0074	0.0065	0.0058	0.0066	0.0065
Load	886	887	890	891	891	
Opacity	6.5	7.0	6.7	7.1	7.5	

Table 25. PAC injection with redesigned grid PM measurements – stack.

	Run 1	Run 2	PAC Average
Test Date	2/12/07	2/13/07	
Time	0724–1405	0810–1446	
FPM (gr/dscf)	0.0041	0.0048	0.0045
CPM (gr/dscf)	0.0028	0.0052	0.0045
TPM (gr/dscf)	0.0069	0.01	0.009
Load	891	891	
Opacity	9.6	10.7	

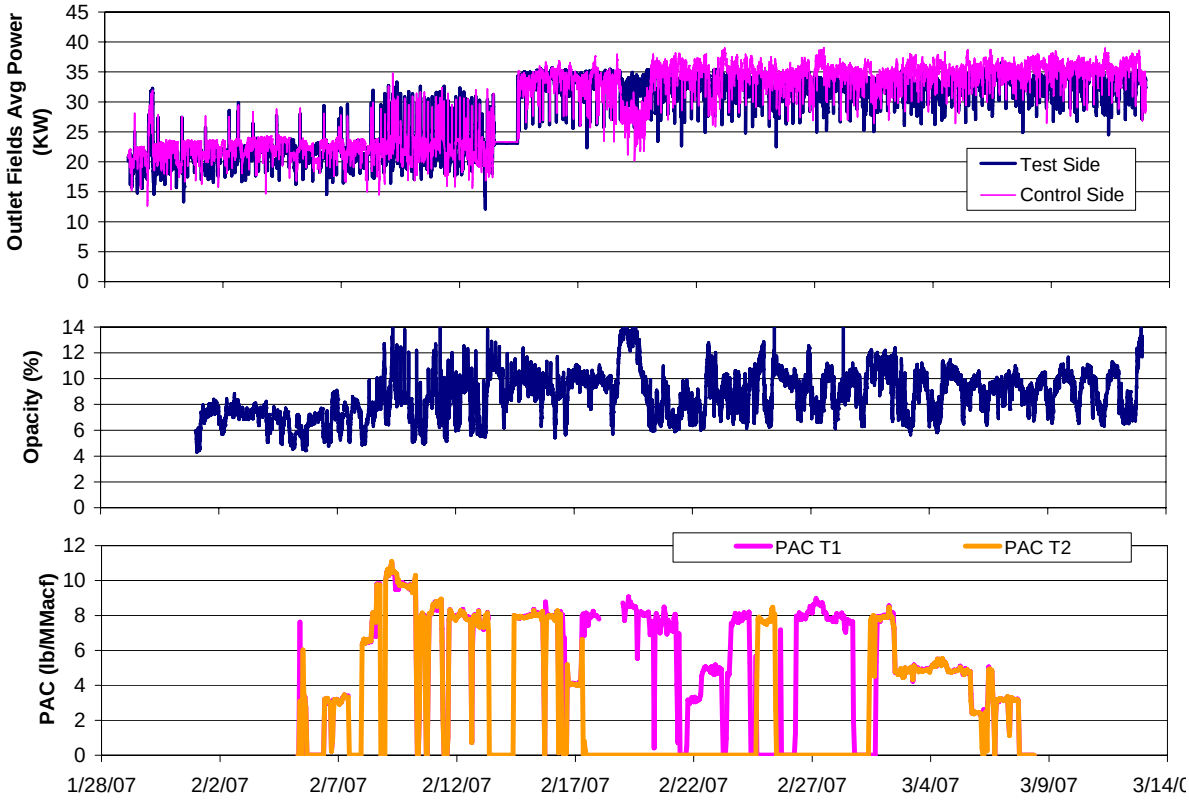


Figure 83. Opacity and ESP power trends with and without PAC injection (redesigned injection grid).

Recall that the CPM monitors were installed across the entire outlet ducts of the B-West ESP and the B-East ESP and that PAC was injected into one-half of the B-West ESP (i.e., 1/16 of the flue gas stream). When the CPM trace from the B-West ESP is compared to the stack opacity, a clear correlation between CPM spikes, caused by fourth field raps, and stack opacity spikes can be seen (Figure 84). On February 16, the rapping frequency was increased from once every four hours to once every one hour. Although this change decreased the amplitude of the rapping spikes, they are still observable at the B-ESP outlet and at the stack. No spikes were observed prior to PAC injection or on the B-East ESP CPM trace.

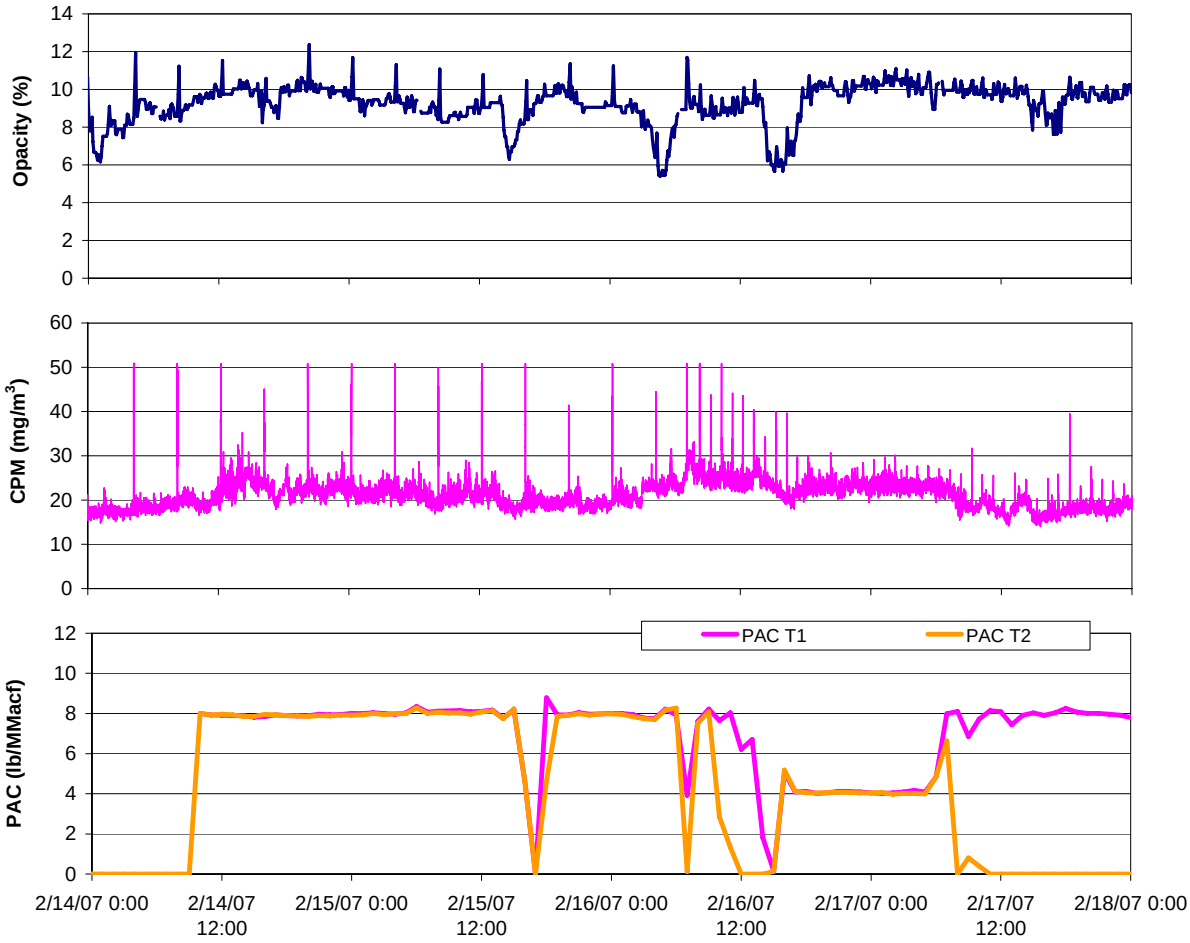


Figure 84. Opacity and ESP power trends with and without PAC injection (redesigned injection grid).

EPA M5/202 measurements were conducted at the outlet of the B-West ESP on February 15–19, 2007. Six-point traverse samples were collected from a single port on both the west half of the B-West ESP outlet and the east half of the B-West ESP outlet (control). Each port was roughly 5 feet from the centerline of the B-West outlet duct. Particulate data are summarized in Table 26, Table 27, and Figure 85. The results indicate that there was no significant difference in the outlet PM emissions at the outlet of the B-West ESP. This outcome is somewhat inconsistent with the data presented in the previous paragraphs. The

data also indicate that the filterable PM emissions are significantly higher at the outlet of the ESP than those measured at the stack. The former had an average of 0.0067 gr/dscf and the latter had 0.0032 gr/dscf during Baseline testing compared to 0.0076 gr/dscf and 0.0045 gr/dscf, respectively, during PAC injection.

Hour average CPM data from the B-West and B-East ESP, presented in Figure 86, indicate that the B-East ESP (no PAC injection) was often higher than the B-West ESP (PAC on one-fourth to one-half of box). Although there is no EPA M5 data available from the ESP outlets prior to PAC injection, the CPM data collected before and during PAC injection suggest there was little measurable change in the PM emissions at the ESP outlet due to PAC injection. As was observed during 2005–2006 testing, the B-East CPM appeared to be biased in reporting increased emissions. No bias was noted on the B-West CPM.

Table 26. B-west ESP east (no PAC) outlet PM measurements.

	Run 1	Run 2	Run 3	Run 4	Run 5	Average
Test Date	2/15/07	2/16/07	2/17/07	2/18/07	2/19/07	
Time	1111–1236	0921–1521	0736–1336	0720–1320	0721–1321	
FPM (gr/dscf)	0.0081	0.0089	0.0063	0.0064	0.0083	0.0076
CPM (gr/dscf)	0.0033	0.0029	0.0026	0.0029	0.007	0.0037
TPM (gr/dscf)	0.0114	0.0118	0.0089	0.0093	0.0153	0.0113
Load	891	835	889	906	900	
Opacity	9.2	8.6	9.9	9.6	13.1	

Table 27. B-west ESP west (PAC–redesigned injection grid) outlet PM measurements.

	Run 1	Run 2	Run 3	Run 4	Run 5	Average
Test Date	2/15/07	2/16/07	2/17/07	2/18/07	2/19/07	
Time	1103–1234	0802–1509	0730–1330	0714–1314	0715–1315	
FPM (gr/dscf)	0.0098	0.0093	0.0047	0.0046	0.0050	0.0067
CPM (gr/dscf)	0.0026	0.001	0.002	0.0018	0.0038	0.0022
TPM (gr/dscf)	0.0124	0.0103	0.0067	0.0064	0.0088	0.0089
Load	891	853	888	906	900	
Opacity	9.2	8.8	9.9	9.6	13.1	

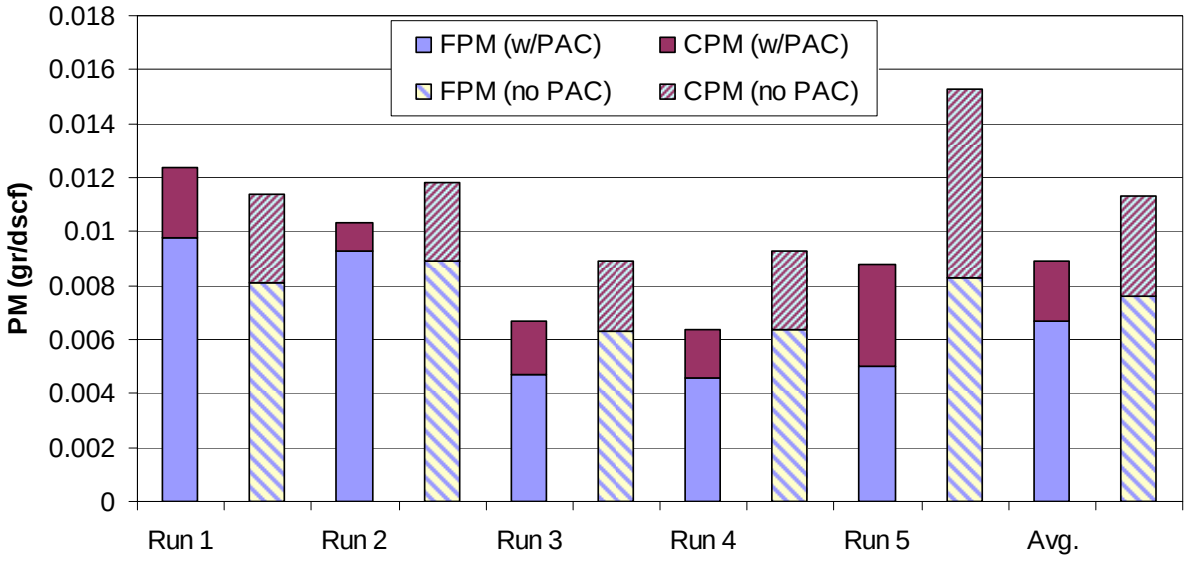


Figure 85. Summary of PM results collected at the ESP outlet with and without PAC (using redesigned injection grid).

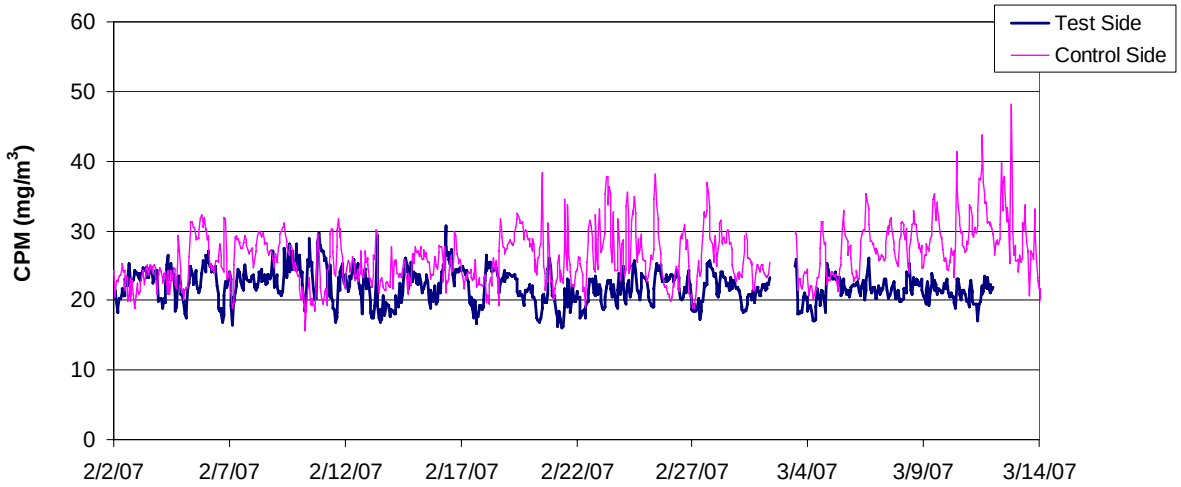


Figure 86. Trend of CPM data from B-West ESP (test—redesigned injection grid) and B-East ESP (control).

Manual Particulate Measurements

As can be seen in the data explained above concerning particulate emissions, one of the difficulties involved with the test program at Independence was determining a means to accurately measure particulate emissions. The two triggers for New Source Review (NSR) for particulate emissions at Independence are 25 tons/year PM increase and 15 tons/yr PM10 increase. The corresponding contribution of the ESP B outlet duct particulate loading that would result in an NSR is approximately 0.839 lb/hr at full load. This number was calculated by taking the required hourly particulate increase for a year divided by 8 and accounting for the annual unit capacity of 85% (Corresponding Increase (lb/hr) = (50,000 lbs/yr * 1/8 Unit)/ (365 days/hr * 24 hr/day *85%)). No analysis was completed to determine particle sizing and calculate the amount of PM10 increase as a result of PAC injection.

The Method 17 test results were the initial test results from the beginning of the test sequence. The Long-Term injection concentration was 5.5 lb/MMacf through the mid-field injection grid. These numbers in Table 28 would indicate that the injection of DARCO® Hg-LH would improve the performance of the ESP and would not trigger an NSR condition. Yet a comparison of any one of the Baseline M17 results against each other or against the average (with the exception of Run 2) would in itself trigger an NSR evaluation. The same comparison holds true for the Long-Term PAC Injection M17 results.

Table 28. 2005 Baseline/injection PM testing.

2005 Method 17 Test Results from ESP B Outlet Duct				
	Run 1	Run 2	Run 3	Average
Baseline	22.10	23.45	26.60	24.05
Long-Term PAC Injection	9.85	13.66	10.12	11.21

The one-hour Method 17 testing is suspect in a test regimen such as the one used at Independence. Testing in the outlet duct of the ESP creates the conditions were the test can be artificially biased. If some of the individual tests in a test series are conducted in between rapping cycles of the outlet field (as long as four hours between outlet field rap cycles was tested at Independence), then the bias is that the tests that are carried out in the absence of rapping should indicate lower particulate emissions.

In an effort to limit potential biasing of test results, ADA-ES designed a modified Method 5 test. This test was run both at the stack and at the ESP B outlet duct (Table 29). The modification was to run the test for 6 continuous hours. The test period should allow an averaging out of all particulate emission cycles, such as the rapping cycle. The tests would also run for 5 sequential days, each day consisting of one 6-hour run, to allow a complete look at any anomalies.

Table 29. 2007 Method 5 PM Measurements.

2007 Method 5 PM Measurements — Baseline and Injection Periods (lbs/hr)							
Location	**Condition**	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Average**
Stack	Baseline	13.78	16.84	14.80	13.24	15.13	14.76
Stack	PAC Injection	15.45	17.58				16.51
ESP B Outlet Duct	PAC Injection	25.58	23.23	19.73	20.25	32.46	24.25
ESP B Outlet Duct	Control Side (No Injection)	31.91	22.56	15.84	14.48	19.24	20.81

The particulate emission rates for the stack have been divided by 8 to provide an equivalent flue gas flow measurement to the duct outlet numbers. Unlike the earlier Method 17 testing, these results indicate that the injection of DARCO® Hg-LH would increase particulate emissions and trigger the 25 tons/yr limit. Even with the attempt to normalize the emissions particulate measurements across any particulate causing events still results in a potential issue. Any day-to-day comparison of the baseline numbers would in itself potentially trigger an NSR evaluation. On the other hand, on any given day, a side-to-side comparison of the particulate emissions during PAC injection could again indicate that overall emissions decreased.

Ash Sales

One of the primary advantages of TOXECON II™ for mercury control is to preserve the bulk of the fly ash at a saleable quality. During TOXECON II™ testing at Independence, all ash captured in the first two collection fields was sold for use in concrete. This represented the bulk of the ash collected from Unit 2. The balance of the ash, that containing PAC, was landfilled after a leaching analysis was performed and the ash met criteria established by the State of Arkansas.

A question that has been discussed within the project team, based upon concerns from an ash contractor, is whether the size distribution and resulting concrete properties will be adversely affected if the rear field ash is not included in the ash delivered for concrete use. The size distribution of ash collected in the first two fields, the material available for ash sale, was analyzed and results are included in Figure 87 and Table 30. Although there is a shift from the inlet hopper (B12) o the second hopper (B22), the distribution is fairly uniform. The ash from the inlet field represents the bulk of the fly ash captured in the ESP. Ash collected in the third and fourth fields represents at most four percent of the overall ash captured and it is unlikely that not including this in the ash provided for concrete use will impact the overall properties of the ash for this use.

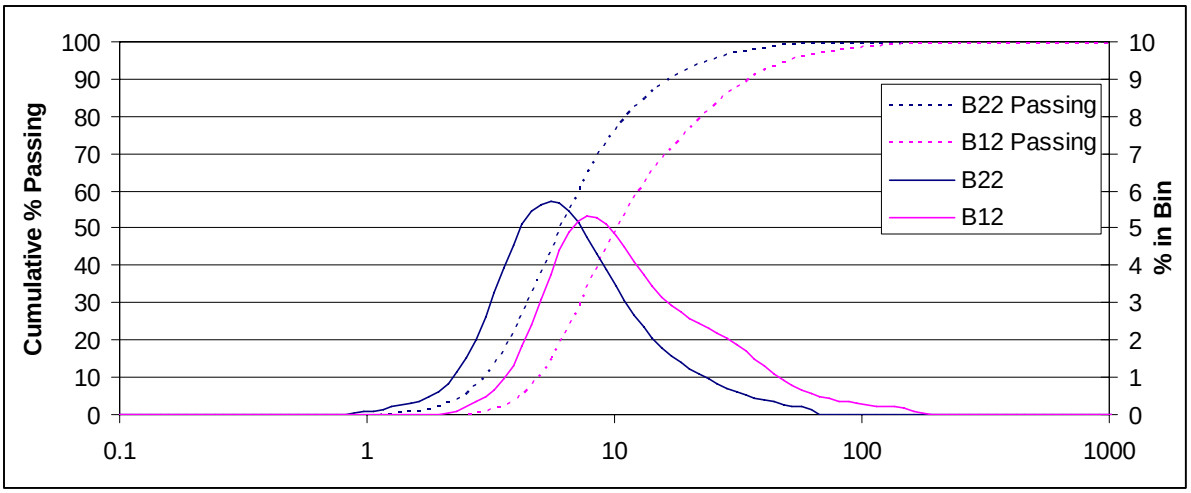


Figure 87. Size distribution of ash collected in first two fields.

Table 30. Size distribution of ash collected in first two fields.

Date	8/19/2005	8/19/2005
Location	Hopper B12 Inlet 1	Hopper B22 Inlet 2
Percent Passing	Size (µm)	Size (µm)
10	4.86	2.933
20	6.05	3.71
30	7.17	4.41
40	8.44	5.15
50	10.05	6
60	12.33	7.05
70	15.95	8.52
80	22.11	10.94
90	33.87	16.36
95	48.72	23.34

Results of Halide Measurements

Effect of DARCO® Hg-LH on Halide Emissions

To determine the halogen and hydrogen halide concentration in the flue gas, triplicate runs of the EPA Method 26A were conducted at the inlet and outlet of the ESP during the 2005 Baseline and Long-Term test periods. Results are summarized in Table 31. All values are quite low, which is representative of units firing PRB coal.

Table 31. Average values of Method 26A runs at ESP B-box.

	ESP Inlet		ESP Outlet	
	Baseline 8/17–18/2005	**Long-Term 10/25–26/2005**	**Baseline 8/17–18/2005**	**Long-Term 10/25–26/2005**
HCl (ppmv)	0.39	0.47	0.44	0.49
HF (ppmv)	0.83	1.62	1.53	1.58
HBr (ppmv)	0.01	0.02	0.02	0.68
Cl_2 (ppmv)	N.D.	0.02	N.D.	0.01
Br_2 (ppmv)	N.D.	0.01	N.D.	N.D.

(N.D. = none detected)

The total chlorine (HCl + Cl2) was almost unchanged from inlet to outlet for both the Baseline and Long-Term test periods. As a reference, coal samples taken on the same days as the Method 26A tests were run contained 37 μg/g Cl (Baseline) and 1 μg/g Cl (Long-Term).

The HBr noticeably increased across the ESP during the Long-Term test, from 0.02 ppmv at the inlet of the ESP to 0.68 ppmv at the outlet. As a reference, coal sampled throughout the test program contained an average of 1.3 μg/g of Br. The sorbent injected during the 30-day continuous test was treated with trace amounts of bromine compounds. The increase in HBr could be a result of a fraction of the bromine compounds released from the sorbent particle once injected into the flue gas stream. The M26A test reports are included in Appendix D.

ECONOMIC ANALYSIS

After completion of testing and analysis of the data, the requirements and costs for full-scale, permanent commercial implementation of the necessary equipment for mercury control using sorbent injection technology at the 880 MW Independence Station Unit 2 were determined. The cost of process equipment sized and designed based on the Long-Term test results for approximately 80% mercury control, and on the plant-specific requirements (sorbent storage capacity, plant arrangement, retrofit issues, winterization, controls interface, etc.) has been estimated. The system design was based on the criteria listed in Table 32.

Table 32. System design criteria for mercury control at Independence Unit 2. 5 lb/MMacf injection, > 90% mercury control.

Parameter	
Number of Silos	2
Number of injection trains	6 (2 spare)
Design feed capacity/train (lb/hr)	1920
Operating feed capacity/train (lb/hr)	960
Sorbent storage capacity/silo (lbs)	460,800
Conveying distance (ft)	200/400
Sorbent	DARCO® Hg-LH
Aerated Density (lb/ft^3)	18
Settled Density (lb/ft^3)	28
Particle MMD (microns)	18

The estimated uninstalled cost for a sorbent injection system and storage silo for the 880-MW Unit 2 is $2,730,000. Costs were estimated based on a long-term activated carbon injection concentration of 5 lb/MMacf. For Independence Unit 2, this would require an injection rate of nominally 960 lbs/hr at full load. Assuming a unit capacity factor of 85% and a delivered cost for DARCO® Hg-LH sorbent of $0.95/lb, the annual sorbent cost for injecting sorbent into the existing ESP would be about $6,791,000. This corresponds to a nominal sorbent cost of $15,850 per pound of mercury removed.

Results from the field tests conducted to date indicate different levels of mercury removal can be achieved depending on the air pollution control equipment and different flue gas conditions. Data collected from the Phase I DOE tests at Gaston indicate mercury removal levels of up to 90% were obtained with a COHPAC® (a baghouse) and DARCO® Hg sorbent injection. At Pleasant Prairie, 50 to 70% removal while injecting DARCO® Hg was the maximum achievable mercury control, with the configuration of an ESP collecting PRB ash. At Brayton Point, mercury removal levels of up to 90% were obtained with an ESP collecting bituminous ash with DARCO® Hg sorbent injection.[3] DOE Phase II testing at Holcomb showed mercury removal levels of 90% were obtained with a SDA and FF while injecting DARCO® Hg-LH.[4] Data from Independence and five other sites are summarized in Table 33.

Table 33. Summary of mercury removal efficiencies and costs for different APC configurations, coals, and sorbents.

Plant	APC Equipment	Coal	Sorbent	Removal %	Sorbent Cost (mills/kWh)
Gaston	COHPAC®	Bituminous	DARCO® Hg	90	0.43
Pleasant Prairie	ESP	PRB	DARCO® Hg	67	1.2
Brayton Point	ESP	Bituminous	DARCO® Hg	90	2.4
Holcomb	SDA + FF	PRB	DARCO® Hg-LH	90	0.44
Meramec	ESP	PRB	DARCO® Hg-LH	90	0.74
Independence	ESP	PRB	DARCO® Hg-LH	80	1.14

The results from Independence indicate that using DARCO® Hg-LH would result in higher mercury removal (80%) at less than the cost of the maximum achievable removal at Pleasant Prairie (67% mercury removal). Both units fire PRB coal and have ESPs installed for particulate control. The critical difference in the sorbent costs is the improved effectiveness of DARCO® Hg-LH over DARCO® Hg. These results are presented as mills/kWh in Table 33.

System Description

The permanent commercial activated carbon injection system for Independence will consist of two bulk storage silos and six (three per silo) dilute phase pneumatic conveying systems. Generic process diagrams and other sorbent injection system drawings are provided in Appendix A. While the basic system design will remain the same, specific components for the TOXECON II™ injection system will change as a result of extensive CFD modeling prior to commercial installation.

DARCO® Hg-LH sorbent will be received in 40,000-lb batches delivered by self-unloading pneumatic bulk tanker trucks. The silo is equipped with a pulse jet type bin vent filter to contain dust during the loading process. The silo is a shop-built, dry-welded tank with three mass flow discharge cones equipped with air fluidizing pads and nozzles to promote sorbent flow. Point level probes and weigh cells monitor sorbent level and inventory. Silo sizing was based on the capacity to hold approximately six truckloads of DARCO® Hg-LH sorbent, sufficient for 10 days of operation at the design injection rate.

The sorbent is fed from the discharge cones by rotary valves into feeder hoppers. From the hoppers the sorbent is metered into the conveying lines by volumetric feeders. Conveying air supplied by regenerative blowers passes through a venturi eductor, which provides suction to draw the sorbent into the conveying piping and carry it to distribution manifolds, where it splits equally to multiple injection lances. The blowers and feeder trains are contained beneath the silo within the skirted enclosure.

A programmable logic controller (PLC) is used to control all aspects of system operation. The PLC and other control components will be mounted in a NEMA 4 control panel. The control panel, MCCs and disconnects will be housed in a pre-fabricated power and control building located adjacent to the silo.

The system description is generic for a sorbent injection system. The actual design for the TOXECON II™ system will vary from the above description in several important categories that have not been finalized and are therefore not included in this report.

Balance-of-Plant Requirements

Some modifications and upgrades to the existing plant equipment will be required to accommodate the ACI system. These include upgrades to the electrical supply at Independence to provide new service to the ACI system. Instrument air, intercom phones, and area lighting will also be required.

It is not anticipated that the fly ash from downstream of the selected injection point from Independence can be sold if activated carbon injection is implemented. Cost estimates are included to account for the minimal (< 10%) loss of ash sales and for the increased costs of disposal.

Cost and Economic Methodology

Costs for the sorbent storage and injection equipment were provided by ADA-ES based on the design requirements in Table 32. ADA-ES has built and installed many similar systems at coal-fired power plants for mercury control. Estimated costs for the distribution manifold, piping and injection lances, an installation man-hour estimate and crane-hour estimate and an estimate for foundations including pilings are also included. As construction costs are rising rapidly, these costs are tentative and very dependent upon local labor conditions as well as current national demand for related equipment.

EPRI TAG methodology was used to determine the indirect costs. A project contingency of 15% was used. Since the technology is relatively simple, the process contingency was set at 5%. Based upon requested guarantee language, that contingency may increase to cover anticipated risks for a newer technology. ACI equipment can be installed in a few months; therefore, no adjustment was made for interest during construction, a significant cost factor for large construction projects lasting several years.

Operating costs include sorbent costs, electric power, operating labor, maintenance (labor and materials), and spare parts. An average incremental operating labor requirement of 1 hour per day was estimated to cover the incremental labor to operate and monitor the ACI system. The annual maintenance costs were based on 5% of the uninstalled equipment cost.

Levelized costs were developed based on a 20-year book life and are presented in constant dollars.

Capital Costs

The uninstalled ACI storage and feed equipment costs are estimated at $2,730,000. The estimated cost for a sorbent injection system and storage silo installed on the 880-MW Unit 2 is $4,330,000 and includes all process equipment, foundations, support steel, plant modifications utility interfaces, engineering, taxes, overhead, and contingencies. The capital and O&M costs are summarized in Table 34.

Table 34. Capital and operating and maintenance cost estimate summary for ACI system on Independence Unit 2. Annual basis 2007.

Capital Costs Summary	
Equipment, FOB Independence	2,730,000
Site Integration (materials and labor)	159,000
Installation (ACI silo and process equipment, foundations)	192,000
Taxes	185,000
Indirects/Contingencies	1,064,000
Total Capital Required	4,330,000
$/kW	4.92
Operating and Maintenance Costs Summary	
Sorbent @ $.95/lb	6,791,000
Power, labor, maintenance	185,000
Variable O&M for 2007 ($/kW)	8.74
Variable Mills/kW-hr	1.17

Operating and Levelized Costs

With the exception of the waste disposal costs, which are discussed below, the most significant operational cost of sorbent injection for mercury control is the DARCO® Hg-LH sorbent. Sorbent costs were estimated for an average of > 80% mercury control based on the long-term sorbent injection concentration of 5 lb/MMacf. For Independence Unit 2, this would require an injection rate of nominally 960 lbs/hr at full load. Assuming a unit capacity factor of 85% and a delivered sorbent cost of $0.95/lb, the 20-year levelized annual cost of injecting sorbent via a TOXECON II™ system would be $10,293,000. Included in this is other annual operating levelized costs including electric power, operating labor, and maintenance which are estimated to be approximately $236,000.

Based on these test program results and assuming that sorbent injection at the ESP inlet for mercury control is sustainable, an average of > 80% mercury control can be attained at Independence Unit 2 for an initial capital investment of $4,330,000 with first-year operating costs of $9.51/kW, or annual 20-year constant-dollar levelized costs of $11.70/kW. This information is summarized in Table 35.

The levelized costs reported in Table 34 are specific to Independence Unit 2.

Table 35. Levelized costs summary.

20-Year Levelized Costs Summary—$ Constant	
	Lost Ash Sales Revenue and Disposal Costs Not Included
Fixed Costs	367,000
Variable O&M	7,691,000
Total	10,293,000
Fixed Levelized Costs $/kW	0.58
First Year Operating Levelized Costs $/kW	9.51
Total 20-Year Levelized Costs $/kW	11.70
First-Year Operating Levelized Costs mills/kW-hr	1.28
Total 20-Year Levelized Costs mills/kW-hr	1.49
Total 20-Year Levelized Cost $/lb Hg removed	14,

CONCLUSIONS

The primary objective of testing at Entergy's Independence Steam Electric Station was to determine the cost and effects of sorbent injection using EPRI's TOXECON II™ for mercury control in stack emissions from Unit 2. Unit 2 was chosen for this evaluation because it fires PRB coal and is equipped with a medium sized, cold-side ESP (SCA = 542 ft^2/kacfm) for particulate control. General observations and conclusions include:

- Native mercury removal and speciation
  - Less than 20% mercury removal during four rounds of Baseline testing. While firing PRB coal, the ESP B inlet mercury averaged 7.9 lb/TBtu during Baseline tests while the ESP B outlet averaged 6.6 lb/TBtu. While firing ColoWyo coal, ESP B inlet mercury averaged 1.2 lb/TBtu. Independence typically fires PRB coal.

The inlet mercury during most of the Baseline tests was primarily elemental mercury, 65–70% (SCEM) and 65% (Ontario Hydro). During most of the tests, the fraction of elemental mercury at the outlet of the ESP was 37–55% (SCEM) and 55% (Ontario Hydro), indicating some oxidation in the ESP.

- Parametric Testing
  - DARCO® Hg-LH was the most effective sorbent evaluated at Independence during the DOE program. Short-term results indicate that 80% mercury removal was achieved at 2.4 lb/MMacf and nearly 90% at 4.8 lb/MMacf (injection between fields B-3 and B-5). Injecting downstream of field B-5 reduced mercury capture by nominally 10%.
  - Pre-ESP DARCO® Hg-LH injection resulted in 85% mercury removal at 5 lb/MMacf with a non-optimized injection grid.
  - During the 2005 tests, injection of any sorbent resulted in both opacity and CPM spikes. Although PAC was injected into only 1/8 of Unit 2, each time the final field was rapped during August and September while PAC was injected into either field 5 or 7, the spikes in indicated particulate emissions were clearly visible on the plant's permanently installed stack opacity monitor. Turning off the Power Optimization System and increasing ESP power in the rear fields minimized but did not completely eliminate the spikes in the CPM and Unit 2 opacity measurements during PAC injection (DARCO® Hg-LH).

- Long-Term Testing
  - Average mercury removal during the initial 30-day Long-Term test (October 2005) was 69% and the average outlet mercury concentration was 1.91 lb/TBtu. The average DARCO® Hg-LH injection concentration during this period was 5.5 lb/MMacf.
  - During subsequent continuous injection periods (typically 5-day or 30-day) using the TOXECON II™ injection system with modified lances, the average vapor-phase mercury capture ranged from 70–85% based on the lance design with an average sorbent injection concentration of 5–5.5 lb/MMacf.

- Balance-of-Plant
  - Increasing the ESP power and increasing the final field rapping cycle were effective at minimizing opacity spikes due to PAC injection.
  - Additional testing is required to determine whether TOXECON II™ implementation would result in a sufficient increase in particulate emissions to trigger a permit review.

The goals for the program established by DOE/NETL were to reduce the uncontrolled mercury emissions by 50 to 70% at a cost 25 to 50% lower than the target established by DOE of $60,000/lb mercury removed. This goal was exceeded at Independence. Results from testing indicated that 80% mercury removal could be achieved using DARCO® Hg-LH at a sorbent cost 75% lower than the benchmark. The estimated 20-year levelized costs for control at Independence are 1.49 mills/kWh or 14,500 $/lb mercury removed while preserving the salability of the fly ash. Additional improvements to the injection system design to increase mercury removal by improving the sorbent distribution are anticipated with ongoing development of the technology.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACI	Activated carbon injection
APC	Air pollution control
CFD	Computational Fluid Dynamics
DARCO® Hg	Sorbent manufactured by NORIT Americas. Formerly known as DARCO® FGD
DARCO® Hg-LH	Sorbent manufactured by NORIT Americas. Formerly known as DARCO® FGD-E3
DOE	Department of Energy
ESP	Electrostatic precipitator
FGD	Flue gas desulfurization
kacfm	Thousand actual cubic feet per minute
kW	Kilowatt
MMacf	Million actual cubic feet
MW	Megawatt
NETL	National Energy Technology Laboratory
O&M	Operating and Maintenance
PAC	Powdered activated carbon
PC	Pulverized coal
POS	Precipitator Optimization System
PRB	Powder River Basin
RCRA	Resource Conservation and Recovery Act
SCA	Specific collection area
SCR	Selective Catalytic Reduction
S-CEM	Semi-continuous emission monitor
SDA	Spray dryer absorber
SGLP	Synthetic groundwater leaching procedure
STM	Sorbent trap method
TCLP	Toxicity characteristic leaching procedure
TR	Transformer-Rectifier

APPENDIX A:

Independence Test Plans

APPENDIX A1: Entergy Independence Test Plan—September 15, 2005

DOE NATIONAL ENERGY TECHNOLOGY LABORATORY MERCURY FIELD EVALUATION

Evaluation of TOXECON II™ Sorbent Injection for Mercury Control at Entergy's Independence Steam Electric Station

Revision 1 dated September 15, 2005 to Test Plan dated July 25, 2005

For:
Entergy
DOE NETL
EPRI

By:
ADA Environmental Solutions, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120

August 31, 2005

Test Plan Entergy Independence Plant

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Test Plan Revision

During Baseline testing per the original Test Plan, the plant reported that electrical field 7 of ESP B was down, isolated to an apparent ash build up on the field, probably caused by a rapper motor failure. Field 7 is the outlet field on the test side of ESP B, see Figure 3. Since TOXECON II™ is an injection technology involving mid-ESP sorbent injection, the loss of the outlet field, normally not of significant import to sorbent testing, would impact quality data collection. As a result of this failure, it was determined to run a shortened series of Parametric tests and delay further testing until repairs could be effected late in September.

Project Objectives

The objective of testing at Entergy's Independence Steam Electric Station (ISES) is to determine the cost and effects of sorbent injection using EPRI's TOXECON II™ process for control of mercury in stack emissions.

The benefit of the TOXECON II™ process, shown in Figure 1, *TOXECON II™ Process Diagram*, is that the ESP collects the majority of ash before the injection of the mercury control sorbent into the flue gas stream. With TOXECON II™ , the sorbent injection is between the fields of an existing electrostatic precipitator (ESP), generally after the first two fields, and the ash handling system segregates the untreated ash from the treated sorbent/ash mixture. This allows the ash collected in the ESP fields upstream of sorbent injection to be sold for use in concrete.

This evaluation will test one-eighth of the 842 MW flue gas stream from Unit 2.

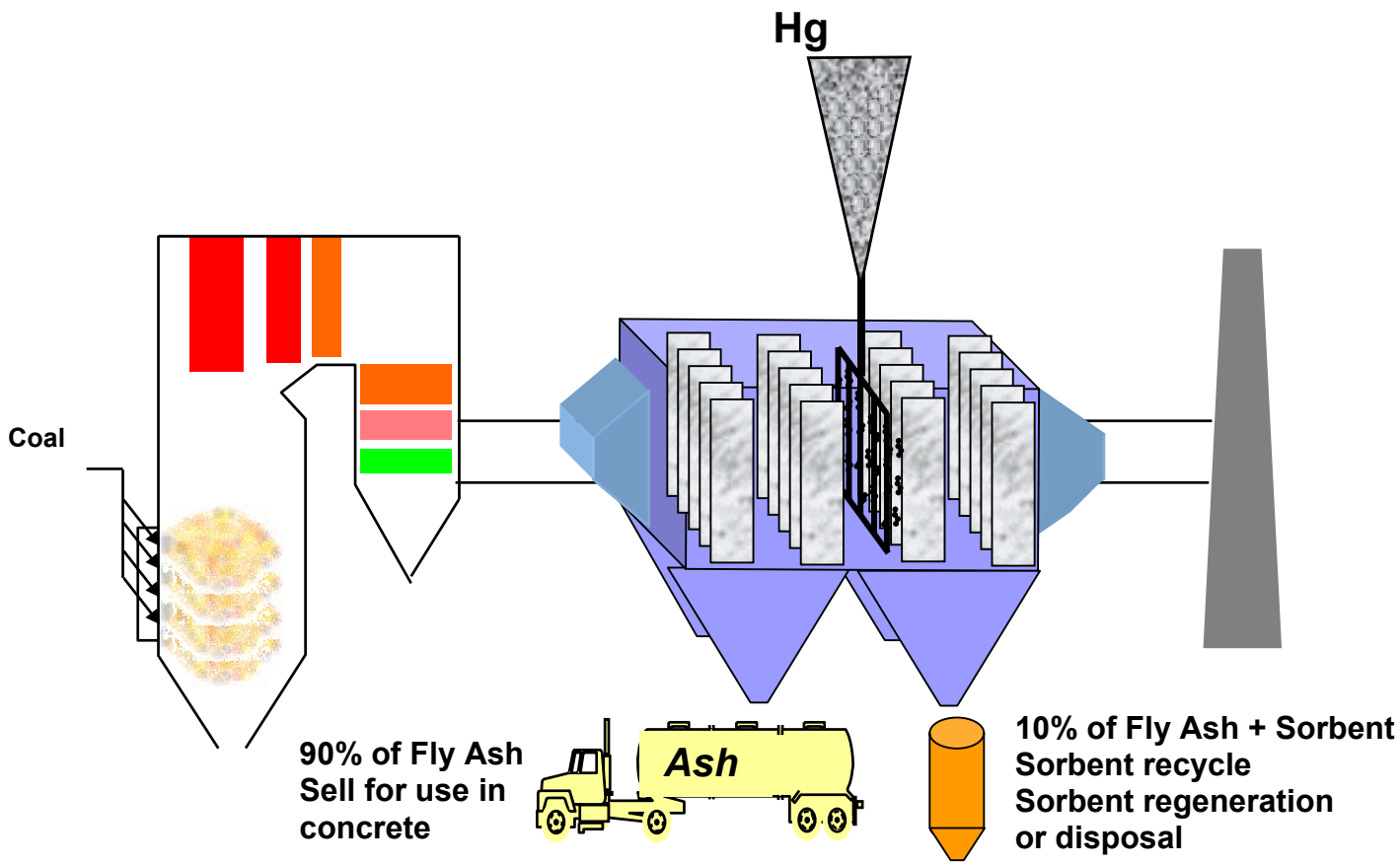


Figure 1. TOXECON II™ Process Diagram.

Project Overview

The Entergy Independence test program is part of a four-site program funded by the Department of Energy's National Energy Technology Laboratory (DOE/NETL) and industry partners to obtain the necessary information to assess the feasibility and costs of controlling mercury from coal-fired utility plants using either high temperature sorbents or EPRI's TOXECON II™ process. Table 1*, Host Sites Participating in the Sorbent Injection Demonstration Project*, shows the host sites for this program's testing. Testing at these four host sites will allow documentation of sorbent performance on the following configurations:

Table 1. Host Sites Participating in the Sorbent Injection Demonstration Project.

	Coal / Options	APC	Capacity (MW) / Test Portion	Current Hg Removal (%)
Entergy's **Independence Station Unit 2**	PRB	Cold-Side ESP	842/106	10-20%
MidAmerican's **Louisa Station Unit 1**	PRB	Hot-Side ESP	700/350	<10% (Estimated)
MidAmerican's **Council Bluffs Station Unit 2**	PRB	Hot-Side ESP	88/88	<10% (Estimated)
AEP's **Gavin Station Unit 1 or 2**	Bit	Cold-Side ESP / FGD	1,200/200	0% ESP, 70%+ in FGD

The test program selected Independence Unit 2 as one of the test sites because it has a large four-field ESP (SCA = 542 ft^2/kacfm) and fires PRB coal. This combination will allow an evaluation of the TOXECON II™ process in two configurations:

- Sorbent injection between the second and third ESP fields with an effective SCA of approximately 270 ft^2/kacfm to collect the sorbent.
- Sorbent injection between the third and fourth ESP fields with an effective SCA of approximately 135 ft^2/kacfm to collect the sorbent.

Host Site Description

The Independence Steam Electric Station is located in Independence County, Arkansas. Unit 2 is an 842-MW (gross) pulverized coal, electric generating unit with Lungstrum regenerative air preheaters that burns PRB coal. Table 2*, Independence Key Operating Parameters*, shows the key operating parameters for Independence Unit 2.

Table 2. Independence Key Operating Parameters.

Unit	2
Size (MW)	842
Test Portion (MWe)	106
Coal	PRB
Heating Value (as received)	8,700
Sulfur (% by weight)	0.32
Chlorine (%)	~0.01
Mercury (µg/g)	0.04
Particulate Control	Cold-Side ESP SCA = 542 ft^2/kacfm
Sulfur Control	Compliance Coal
Air Pre-Heater	Regenerative
Ash Reuse	Sold

Independence Unit 2 is equipped with four ESPs in a piggyback configuration, with two boxes on top and two boxes on the bottom, operating in parallel for particulate removal. Figure 2, *Sketch of West Half of the ESP at Independence Unit 2*, shows a sketch of one-half of the Unit 2 flue gas path. The figure shows two injection locations.

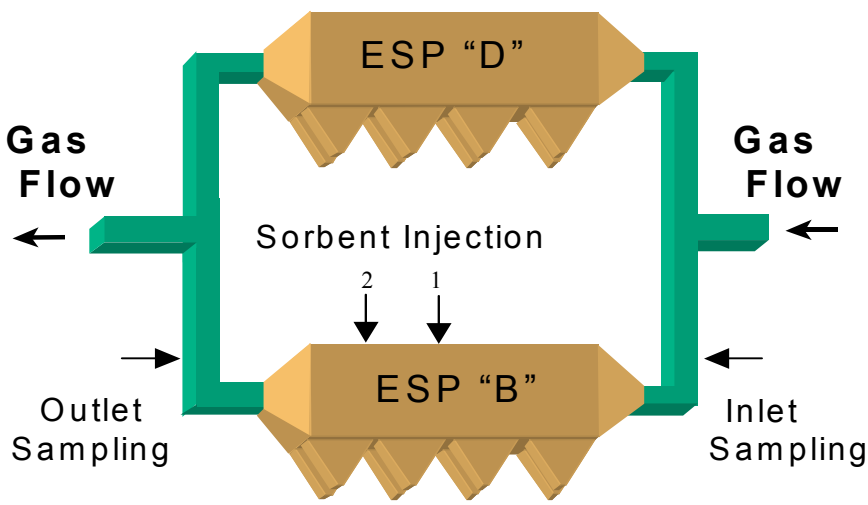


Figure 2. Sketch of West Half (Elevation View) of the ESP at Independence Unit 2.

Each ESP has eight electrical fields: four front to back and two side to side, and 16 hoppers: four front to back and four side to side. See Figure 3, *ESP Electrical Field and Ash Hopper Configuration*.

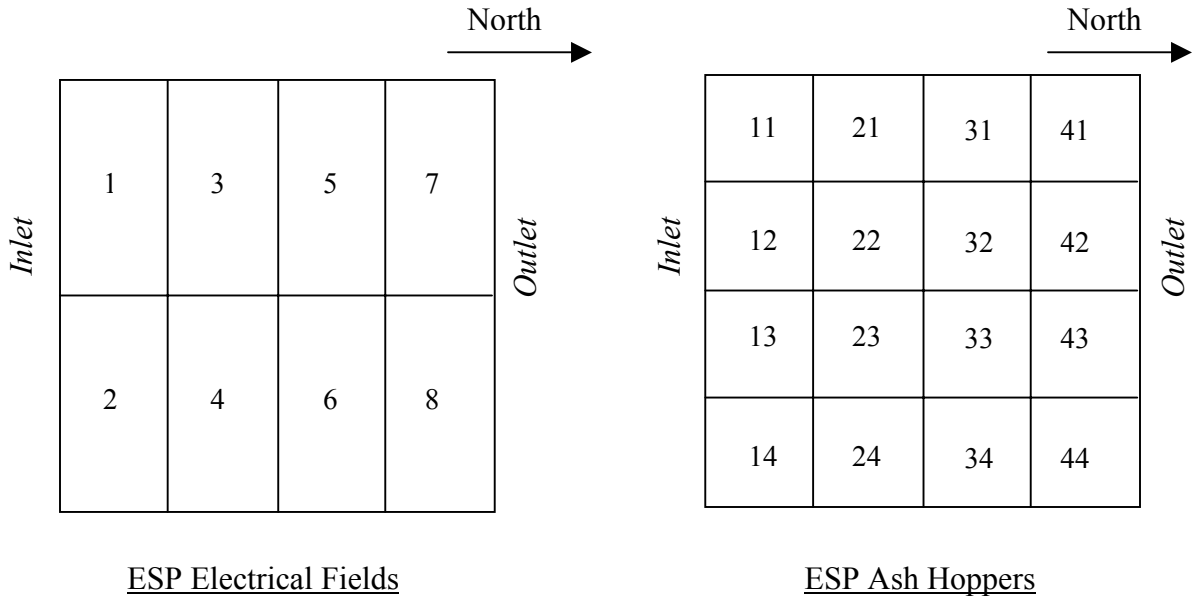


Figure 3: ESP Electrical Field and Ash Hopper Configuration.

The test program will inject sorbent between the ESP fields on one-eighth of the 842 MW flue gas stream. The first injection location is between precipitator electrical fields 3 and 5, and the second is between precipitator electrical fields 5 and 7. The test side of ESP B is designated as "test" side, the control side is "control" side, with the same numbering configuration.

General Technical Approach

The test program activities for each test site consist of the eleven tasks shown in Table 3, *Site-Specific Tasks.* These tasks provide the outline for the test plan.

Table 3. Site-Specific Tasks.

Task	Description
1.	Site Coordination, Kickoff Meeting, Test Plan, and QA/QC Plan
2.	Design and Install Site-Specific Equipment
3.	Field-Tests – Sorbent Selection
4.	Field-Tests – Baseline Tests
5.	Field-Tests – Parametric Tests
6.	Field-Tests – Long-Term Tests
7.	Data Analysis
8.	Sample Evaluation
9.	Site Report
10.	Technology Transfer
11.	Management and Reporting

Following are the task descriptions for the Entergy Independence testing:

Task 1. Site Coordination, Kickoff Meeting, Test Plan, and QA/QC Plan

Efforts within this task include planning the site-specific tests with Entergy, the Independence Power Plant, DOE/NETL, and the contributing team members. ADA-ES met with Entergy and Independence plant personnel on November 10, 2004, to discuss the overall scope of the program, the potential impact on plant equipment and operation, and identify potential equipment and port locations. ADA-ES conducted additional communications with Entergy to discuss the host site agreements and team member cost-sharing arrangements. ADA-ES and Entergy will finalize these efforts during this task. Other efforts include identifying any permit requirements, developing a quality assurance/quality control plan, developing a site specific installation document, finalizing the site-specific scope for each of the team members, and putting subcontracts in place for manual (Ontario Hydro, Particulate, etc.) sampling services.

Test Plan

This document is the Test Plan for the project testing at Entergy's Independence Station.

QA/QC Plan

ADA-ES personnel and subcontractors will be performing the various sampling and analytical functions required to evaluate the effectiveness of the mercury controls. All testing personnel will be required to adhere to written QA/QC procedures. QA/QC procedures will be prepared as part of separate detailed QA/QC plan that will be submitted

for approvals ahead of Long Term testing dates by Entergy/Independence and DOE. The plans will include the necessary QA/QC activities that are required to assure the validity of collected data. At a minimum, the QA/QC Plan will include a description of the test methods to be used: instrument/equipment testing; maintenance and inspection procedures; instrument calibration and frequency; inspection/acceptance requirements for supplies and consumables; procedures for checking data reduction and validation; and sample handling and chain of custody requirements. Standard methodologies and procedures have been established for all the methods to be used in the testing, therefore any new or unproven techniques will be noted as such when presenting information to the project.

Initial Sorbent Selection

A key component of the test planning process for these evaluations is identifying potential sorbents for testing. The test program anticipates the full-scale evaluation of two different sorbents. NORIT Americas' DARCO Hg, a lignite-derived activated carbon is considered the benchmark for these tests because of its wide use in previous and ongoing DOE and EPRI sponsored testing. Potential alternate sorbents include those that may achieve higher mercury removal than DARCO Hg or sorbents that are equally as effective but lower cost. For example, halogenated sorbents such as those tested at Holcomb, Meramec, and Laramie River Station under the DOE/NETL Phase II program (DE-FC26-03NT41986) have demonstrated improved effectiveness on low-rank and high PRB blend sites.

Task 2. Design and Install Site-Specific Equipment

Site-specific equipment includes the sorbent distribution header and sorbent injection grid installed between the ESP fields. ADA-ES engineers worked with plant personnel to design four injection grids and were on-site during installation activities. The installation contractor installed two sets of injection grids in the west half of the Unit 2B ESP; one set of two grids between precipitator fields B3 and B5 and the other set between precipitator fields B5 and B7.

Additional site support from the Independence plant includes installation of required platforms and scaffolding, supplying compressed air and electrical power, wiring plant signals including boiler load to the silo control panel, and balance of plant engineering. Table 4, *Scopes of Work for Sorbent Injection System*, presents a representative split of responsibilities on key equipment and activities between ADA-ES and the host plant.

Table 4. Scopes of Work for Sorbent Injection System.

ADA-ES	Host Site
Injection Silo and Feeder, delivered and erected on Entergy's foundation.	Injection Silo and Feeder Foundation and power
Conveying Hose (400 ft)	Injection Manifolds and Grids
PLC Controls	Test ports
Hg and Particulate SCEMs	Access platforms
Office Trailers (2)	Installation labor, other than silo erection
Coordination of Sorbent Ordering and Delivery	Compressed air
	Electrical power
	Signal Wiring / Telephones / Power
	Collection of Coal and Ash Samples
	PI System Information Trend Database
	PI Data Collection
	EMO Testing Unit Load Coordination
	Coordinate Test Program Technical Needs from Entergy

Entergy will supply and install the foundation for the silo and injection skid. ADA-ES engineers have provided the silo foundation design requirements to Entergy.

ADA-ES will oversee installation and system checkout of the overall sorbent injection system equipment and will be responsible for general maintenance of the systems during testing. At least one engineer or technician who is solely dedicated to the operation of the equipment will be on-site or on-call for all tests. The actual equipment installation, not including preparation tasks, is estimated to take three weeks. This includes time for checkout and troubleshooting. ADA-ES will also install the mercury monitors.

Independence will be responsible for all permitting and any regulatory variance requirements. ADA-ES can assist by providing information to or meeting with regulatory agencies as required.

The site-specific equipment for this test includes the following:

Sorbent Injection System

The sorbent injection system (Figure 4, *Carbon Injection Storage Silo and Feeder Trains Installed at Sunflower Electric's Holcomb Station*, shows a system installed at Sunflower Electric's Holcomb Station) consists of a bulk-storage silo and twin blower/feeder trains. The unit is approximately 50 feet high and 10 feet in diameter with an empty weight of 10 tons. The silo will hold 20 tons of sorbent. The injection blowers and feeders set underneath the storage silo.

Figure 4: Carbon Injection Storage Silo and Feeder Trains Installed at Sunflower Electric's Holcomb Station.

Pneumatic trucks deliver and unload the powdered activated carbon (PAC) sorbent into the silo, which is equipped with a bin vent bag filter. The sorbent feeds from the bottom of the storage silo through a rotary valve, into a small surge hopper (one for each feeder train), and then into the feed system.

The sorbent injection system for this testing has two delivery trains. Each train includes a variable speed screw feeder to meter the sorbent into a blower-driven eductor that then transports the sorbent (dilute phase) to the injection point. A regenerative blower on each

delivery train provides the conveying air. A flexible hose carries the sorbent from the feeders to distribution headers that feed the injection grids.

It was decided to run Parametric testing using a portable Porta-PAC, leased from Norit, to expedite sorbent changes. This would allow the optimum amount of flexibility during Parametric testing to respond to on-site testing findings.

The Independence ESP has two sets of two injection grids. Each grid consists of eight injection lances connected by a common header located within the ESP. Each delivery train will feed one header/grid assembly. The single feed connection to each grid manifold runs through the ESP support insulator enclosure and then into the precipitator. The conveying hose connects to the injection manifold connection located on the outside of the insulator enclosure.

A PLC system controls the system operation. The sorbent injection system allows controlling the sorbent feed rate either manually through an HMI interface in the control trailer, or automatically through a load following signal from the plant such as unit MW load or flue gas flowrate.

Mercury Monitoring System

The test program will use at least two mercury monitoring systems to provide real-time feedback of the mercury levels in the flue gas during baseline and sorbent injection testing. The monitoring systems consists of a sample extraction and conditioning system and the analyzer system, connected with a heated sample transport umbilical bundle. The ADA-ES analyzers consist of a cold vapor atomic absorption spectrometer (CVAAS) coupled with a gold amalgamation system (Au-CVAAS). Figure 5, *Sketch of Mercury Measurement System*, shows a sketch of the system.

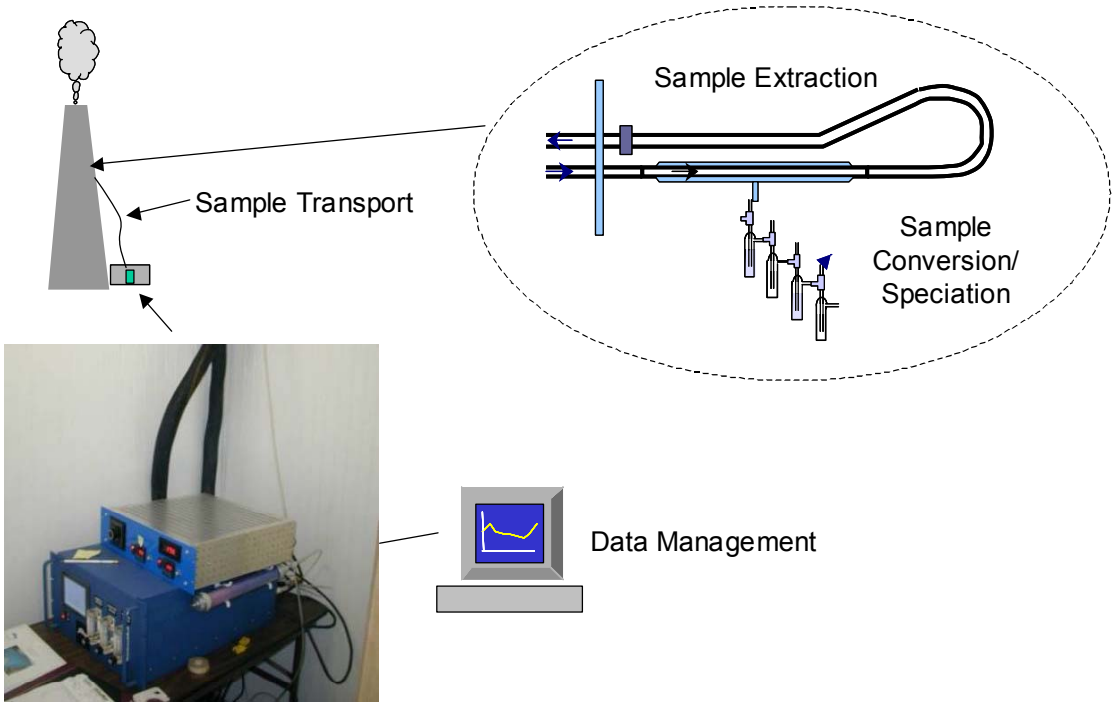


Figure 5: Sketch of Mercury Measurement System.

The figure shows an inertial separation probe. This probe separates the particulate matter from the sample with minimal sampling artifacts from fly ash or injected sorbent.

The system uses vapor-phase elemental mercury for analyzer calibration.

The monitoring system measures both *total* vapor-phase mercury and *elemental* vapor-phase mercury. The system determines *total* vapor-phase mercury concentrations by chemically reducing all of the oxidized mercury to the elemental form near the extraction location. To measure *elemental* mercury, the system removes the oxidized mercury from the sample gas while allowing elemental mercury to pass through without alteration. The oxidized mercury is then the difference between the *total* mercury measurement and the *elemental* mercury measurement.

Particulate Monitor

The test program will use particulate monitors to characterize the ESP outlet flue gas particulate emissions during baseline testing and sorbent injection. The particulate emissions data will help quantify the effects of injecting sorbent on ESP collection efficiency.

The test program will use two different particulate monitors. These include:

- TEOM 7000, Thermo Electron. The TEOM Series 7000 Source Particulate Monitor is an in-situ device that provides a direct measurement of the particulate matter (PM)

concentration in a flue gas stream. The mass transducer with its collection filter is inside of the duct or stack, and provides results in real time. The Series 7000 monitor performs its filter-based mass measurement using an industrially-hardened tapered element oscillating microbalance. This system has received conditional test method approval for USEPA Methods 17 and 5 (front half) and meets all of the requirements of the new American Society of Testing and Materials (ASTM) Standard Test Method D6831-02. The design of this instrument is for short-term unattended operation and thus it requires pulling the probe from the duct every few days to change the filter element. By changing the position of the extraction probe location in the duct, the system can measure the particulate concentration at various locations inside of the duct, thus allowing an evaluation of particulate stratification.

- CPM 5000, BHA Group (GE). The CPM 5000 series is an across-the-stack optical measurement device that measures particle flow with a beam of visible light through which the particles travel. When dust particles pass between the transmitter and receiver, the momentary blockage of light by the particles causes the receiver to see a modulating signal from the transmitter. The amplitude of the signal modulation increases with increasing dust concentration. The signal modulation is proportional to dust concentration. CPMs are sensitive to particle size distribution and particle characteristics. In addition, CPMs do not measure mass and therefore must be calibrated using EPA Method 5 or 17. While the system cannot measure the particulates at a single point, it does measure the particulates crossing the light path, so the measured particulates are a representation of the dust loading across the duct.

Task 3. Field-Tests – Sorbent Selection

The test program participants will select the sorbents for Independence based upon results from other sites similar to Independence Unit 2 (e.g., similar sulfur and halogen concentrations in the flue gas, similar operating temperature). The test program will test DARCO Hg as the benchmark sorbent for comparison and test DARCO Hg-LH as the second sorbent based on its potential to more economically remove mercury at Independence.

Recent testing of these two sorbents at AmerenUE's Meramec Station (DOE Contract DE-FC26-03NT41986) gave the following results (Meramec fires PRB coal and has a 320 ft^2/kacfm SCA cold-side ESP):

DARCO Hg is a non-chemically treated activated carbon Texas-Lignite coal derived sorbent, and has a bulk density of 25-30 lbs/ft^3. Results from Meramec testing with DARCO Hg demonstrated an upper limit of not more than 80% mercury removal which is similar to results from other cold-side ESP sites burning low-rank coals (PRB and North Dakota lignite). While halogen species, such as HCl, appear to enhance the performance of activated carbon, halogen concentrations are relatively low in low-rank coals. It appears that activated carbon injection rates of 3 to 10 lb/MMacf are sufficient to absorb the available halogens so that further increases in injection rates do not increase mercury removal.

DARCO Hg-LH is a brominated activated carbon. Results from Meramec testing with an injection concentration of 0.6 lb/MMacf show the total mercury removal was 78%. This increased to 97% removal at 3.2 lb/MMacf. The maximum mercury removal based on the change in the ESP outlet mercury concentration due to DARCO Hg-LH injection was 91% at 3.2 lb/MMacf. These data, shown in Figure 6, *Parametric Test Results for DARCO Hg and DARCO Hg-LH*, clearly demonstrate that using halogenated activated carbon can enhance mercury removal.

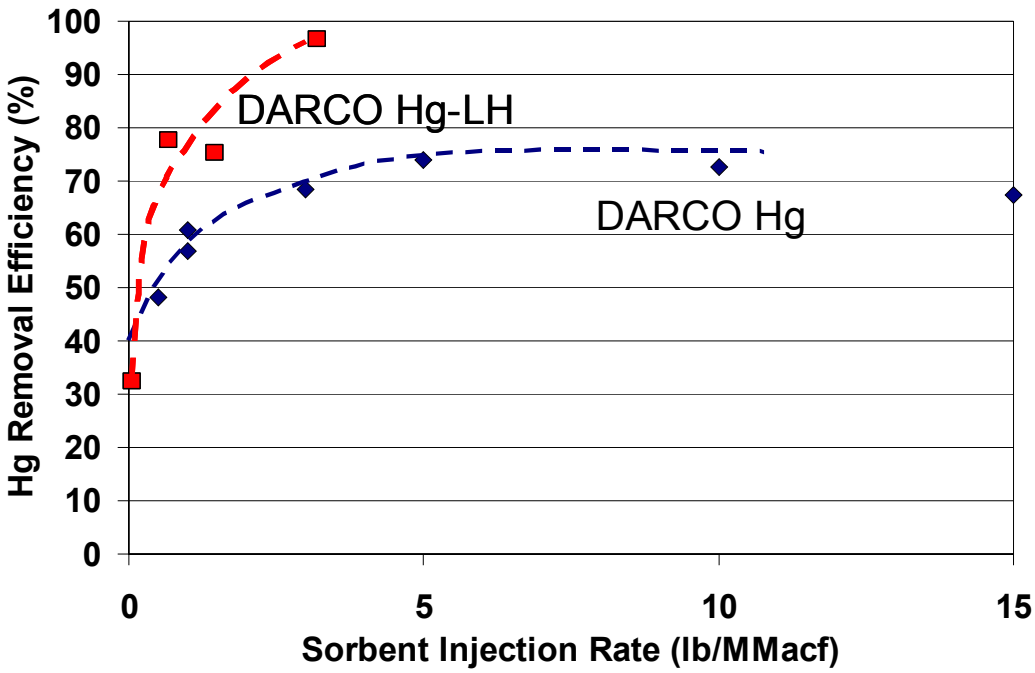


Figure 6: Parametric Test Results for DARCO Hg and DARCO Hg-LH.

Reducing the sorbent usage requirements is an important consideration for a TOXECON II™ configuration because of the small SCA available to collect the material. Data from Meramec indicates that using a halogenated sorbent may result in much higher mercury removal at lower injection concentrations.

Testing with these two sorbents will give a correlation between the mercury removal using the full ESP available collection area (such as at Meramec) and using only a part of the ESP available collection area (such as with the TOXECON II™ configuration at Independence).

Two additional sorbents will be tested to evaluate particulate pass through for the ESP fields. The first additional sorbent is Darco Hg E-10 which is a classified version of the Darco Hg, meaning the small fines are removed from the sorbent. Darco Hg E-11 is another version of Darco Hg with a larger mean particle size. Both these sorbents will be tested when injecting between ESP fields 5 and 7 to evaluate particulate pass through.

Task 4, 5, and 6.

Tasks 4, 5, and 6 are the actual field testing efforts to collect data to quantify the mercury removal. Table 5*, Full-Scale Test Sequence During August*, below, outlines the testing performed to date. Table 6, Scheduled Full Scale Test Sequence, outlines the testing scheduled for the remainder of the program. Table 7, *Completed Test Matrix for Baseline and Parametric Test Series*, details the testing that has occurred. Table 8, *Scheduled Test Matrix,* details the testing scheduled to occur. See the description of project Tasks 4, 5, and 6 below for further detail of the scope of each of these tasks.

Table 5. Full-Scale Test Sequence During August.

Test Description	Test Week	Parameters/Comments	Boiler Load
Baseline	Week 1 Aug 15 – Aug 21	Day 1 – Baseline Day 2 – Baseline Day 3 – ASTM M6784-02, M26a, M5 Day 4 – ASTM M6784-02, M26a, M5 Day 5 – Baseline Day 6, 7 – Baseline	Full Load 10AM-10PM
Parametric testing DARCO Hg	Week 2 Aug 22 – Aug 25	Day 1 – DARCO Hg: 3, 6 lb/MMacf, Location 1[a] Day 2 – DARCO Hg-LH: 1, 3, 6 lb/MMacf, Location 1 Day 3 – DARCO Hg E-10: 3, 6 lb/MMacf, Location 1 Day 4 – DARCO Hg E-11: 3, 6 lb/MMacf, Location 1 (Monitor particulate emissions and ESP electrical conditions during all tests)	Full Load 10AM-10PM
Test Delay			

[a] Location 1 is between fields 3 and 5
[b] Location 2 is between fields 5 and 7

Table 6: Scheduled Full Scale Test Sequence

Test Description	Test Week	Parameters/Comments	Boiler Load
Baseline Sept 27, – Sept 30	Week 3	Day 1 – Equipment Set Up Day 2 – Baseline Day 3 – Baseline Day 4 – Baseline (Monitor particulate emissions and ESP electrical conditions during all tests)	Full Load 48hr Full Load run requested during Baseline
Parametric testing Oct 1 - Oct 2	Week 3	Day 5 – DARCO Hg E-10: 3, 6 lb/MMacf, Location 2[b] Day 6 – DARCO Hg E-11: 3, 6 lb/MMacf, Location 2 (Monitor particulate emissions and ESP electrical conditions during all tests)	Full Load 10AM-10PM
Parametric testing Oct 3 – Oct 8	Week 4	Day 1 – DARCO Hg: 1, 3 lb/MMacf, Location 2 Day 2 – DARCO Hg: 6, 8 lb/MMacf, Location 2 Day 3 – DARCO Hg-LH: 0.5, 1 lb/MMacf, Location 2 Day 4 – DARCO Hg-LH: 3, 6 lb/MMacf, Location 2 Day 5 – PAC TBD[c]: TBD, Location 1[a] and 2 Day 6 – PAC TBD: TBD , Location 1 or 2, Dual (Monitor particulate emissions and ESP electrical conditions during all tests)	Full Load 10AM-10PM
Long-term tests Oct 10 - Nov 10	Weeks 5-9	Operate at consistent injection concentration 24 hours a day, 30 days while load following. Conduct ASTM M6784-02 weeks 2,3,4; M26A, and, M5 tests during week 3. Sorbent is Darco Hg-LH and concentration TBD based on testing results. Location (1 and/or 2) TBD	Full Load only during Ontario Hydro
Ash Recycle Nov 14 – Nov 17	Week 10	Day 1 – 4: Recycle Ash collected during Long Term at concentrations TBD	Full Load 10AM – 10PM

Table 7: Completed Test Matrix for Baseline and Parametric Test Series

August	Testing Day	PRB	PRB w/ Blend	Set Up	Baseline	Parametric	Darco Hg mid field	Darco Hg Back field	Darco Hg-LH mid field	Darco Hg-LH back field	Darco E10	Darco E11	Dual Field Injection	ADA Traverse	SCEM	STM inlet	STM Outlet	OH	Method 5	Method 26A	CPM 5000	TEOM7000
1	**1**	**X**		**x**																		
2	**2**	**X**		**x**																		
3	**3**	**X**		**x**										**x**								
4	**4**	**X**		**x**										**x**								
5	**5**	**X**		**x**										**x**	**x**						**x**	**x**
8	**6**	**X**		**x**											**x**						**x**	**x**
9	**7**	**X**		**x**											**x**	**2**	**2**				**x**	**x**
10	**8**	**X**		**x**											**x**		**1**				**x**	**x**
11	**9**	**X**		**x**											**x**		**1**				**x**	**x**
12	**10**	**X**		**x**											**x**						**x**	**x**
15	**11**	**X**			**x**										**x**						**x**	**x**
16	**12**	**X**			**x**										**x**		**2**	**x**	**x**	**x**	**x**	**x**
17	**13**	**X**			**x**										**x**		**2**	**x**	**x**	**x**	**x**	**x**
18	**14**	**X**			**x**										**x**		**2**	**x**	**x**	**x**	**x**	**x**
19	**15**	**X**			**x**										**x**						**x**	**x**
22	**16**	**X**				**x**	**3,6**								**x**						**x**	**x**
23	**17**	**X**				**x**			**1,3,6**						**x**						**x**	**x**
24	**18**	**X**				**x**					**3,6**		**x**		**x**						**x**	**x**
25	**19**	**X**				**x**						**3,6**			**x**		**3**	**3**			**x**	**x**
September	**Comment**	Coal	Coal Blend		Full Load 1000-2200	Full Load 1000-2200	Injection Rate lb/MMacf				Mid field only	Mid Field Only		Determine Sample Ports		2=dual sample, 1=single sample						

Table 8: Scheduled Test Matrix

Testing Day	PRB	Set Up	Baseline	Parametric	Long Term	Darco Hg mid field	Darco Hg Back field	Darco Hg-LH mid field	Darco Hg-LH back field	Darco E10	Darco E11	Dual Field Injection	Ash Recycle	SCEM	STM inlet - outlet	OH	CPM 5000 / TEOM 7000
19	X	x															
20	X		x											x	2,2		x
21	X		x											x			x
22	X		x											x	3,3		x
23	X			x						3,6				x			x
24	X			x							3.6			x			x
25	X			x			1,3							x			x
26	X			x			6,8							x			x
27	X			x					0.5,1					x	2,2		x
28	X			x					3,6					x			x
29	X			x				4	4					x			x
30	X			x				4	(4)			4		x			x
31	X													x			x
32	X				x				TBD					x			x
33	X				x				TBD					x			x
34	X				x				TBD					x	2,2		x
35	X				x				TBD					x			x
36	X				x				TBD					x			x
37	X				x				TBD					x			x
38	X				x				TBD					x			x
39	X				x				TBD					x			x
40	X				x				TBD					x	0,2	x	x
41	X				x				TBD					x	2,2	x	x
42	X				x				TBD					x			x
43	X				x				TBD					x			x
44	X				x				TBD					x			x
45	X				x				TBD					x			x
46	X				x				TBD					x			x
47	X				x				TBD					x	0,2	x	x
48	X				x				TBD					x	2,2	x	x
49	X				x				TBD					x			x
50	X				x				TBD					x			x
51	X				x				TBD					x			x
52	X				x				TBD					x			x
53	X				x				TBD					x			x
54	X				x				TBD					x	0,2	x	x
55	X				x				TBD					x	2,2	x	x
56	X				x				TBD					x			x
57	X				x				TBD					x			x
58	X				x				TBD					x			x
59	X				x				TBD					x			x

60	**X**				**x**				**TBD**					**x**			**x**
61	**X**				**x**				**TBD**					**x**			**x**
62	**X**												**x**	**x**	**2,2**		**x**
63	**X**												**x**	**x**			**x**
64	**X**												**x**	**x**			**x**
Comment	Coal		Full Load 1000-2200	Full Load 1000-2200	Injection Rate lb/MMacf				Back field only	Back Field Only		Determine Sample Ports			2=dual sample, 1=single sample	Week 3 LT: Method 5,26A	

Task 4. Field-Tests – Baseline Tests

Baseline testing (no sorbent injection) will commenced shortly after installation of the PAC injection and testing equipment and will continue during further testing. During the baseline testing series, the test program will perform mercury measurements at the inlet and outlet of the "B" ESP and will use these data to characterize native mercury capture across the ESP without sorbent injection. The Unit will operate at conditions expected during the Parametric tests. Normally, this includes holding the boiler load constant at full-load and operating the ESP equipment under standard full-load conditions. During this Task, the test program performed ASTM M6784-02 (mercury), M26A (HCl and HF), and particulate (EPA Method 5 or 17) measurements in conjunction with performing continuous mercury measurements using the mercury monitors and particulate measurements using the particulate monitors.

An evaluation will be made during this test series to install a third mercury monitor probe on the ESP outlet control side to monitor mercury levels without sorbent injection on a real time basis.

The test program will include installing two continuous particulate monitors at the outlet of the ESP to monitor the impact of sorbent injection on ESP particulate performance.

Task 5. Field-Tests – Parametric Tests

The test program will conduct two weeks of parametric tests following baseline testing, as shown in Table 5 and Table 6. During the continuing series of Parametric testing, the test program will evaluate the performance of the benchmark sorbent, DARCO Hg, at four injection concentrations and two injection locations. Continuing testing, the test program will evaluate a brominated activated carbon sorbent, DARCO Hg-LH, at similar test conditions as DARCO Hg. In addition, two enhanced Darco Hg sorbents, E-10 and E-11, will be evaluated to correlate particulate pass through against the benchmark Darco Hg.

The goal of the parametric test sequence is to develop a relationship between sorbent injection concentration and mercury removal efficiencies across the ESP. The test program will develop a correlation between sorbent injection concentration and ESP operation (power, spark rate, etc., and particulate emissions from the ESP) during this task.

One of the key ways to reduce the cost of a sorbent-based mercury control technology is to recycle the sorbent. Injecting PAC in a once through mode uses only a small fraction of activated carbon's sorption capacity. In a TOXECON II™ configuration, we expect the sorbent/fly ash mixture collected in the downstream ESP fields to be high in the sorbent fraction (i.e., near 50% compared to a very low sorbent fraction of 1%–2% where the sorbent injection is ahead of the entire ESP).

The test program will collect samples of the ash/sorbent mixture from downstream of sorbent injection and analyze them for sorbent fraction. It will then assess the viability of re-

injecting this material as-is into the ESP and the impacts this will have on the injection system operation, ESP operation, and mercury emission levels.

During sorbent injection testing, the plant ash handling system will route the ash from the hoppers downstream of the sorbent injection fields to the alternate ash silo (31, 32 and 41, 42, or 41, 42). If it is possible to re-inject this material, the test program will allocate one day of testing during the parametric test sequence to re-inject the material from the alternate ash silo.

The test program will conduct the parametric tests at plant full-load operating conditions. The test program will perform mercury measurements with the mercury monitors and particulate measurements with the continuous particulate monitors during the parametric tests.

Upon completion of the parametric testing, the test team (Entergy, ADA-ES, DOE, EPRI) will review the parametric testing results to determine the optimum long-term testing sorbents and conditions.

Task 6. Field-Tests – Long-Term Tests

The test program will conduct the long-term testing at the "optimum" settings as determined in the parametric tests and approved by both DOE and Entergy/Independence. It is the intent of DOE that these settings represent the most cost-effective condition for mercury removal. The goal of this task is to obtain sufficient data on mercury removal efficiency and determine the effects of PAC injection on the ESP operations, effects on byproducts, and impacts to the balance of plant equipment over a four-week period to assess viability of the process and determine the process economics.

During the long-term test period, the test program will conduct ASTM M6784-02 (Ontario Hydro) speciated mercury measurements during three distinct periods. Other tests include EPA M26A (if DARCO Hg-LH is the long-term test sorbent), and M5 or M17 particulate measurements at the inlet and outlet of the pollution control device.

This task is the single most important step in gaining acceptance from the utility industry as to the practical implementation of mercury removal technologies on coal-fired power plants using the TOXECON II™ process.

Task 7. Data Analysis

The goal of the data collection and analysis for this program is to measure the effect of sorbent injection on mercury control and the impact on the existing ESP. The test program will characterize mercury levels and plant operation with and without sorbent injection and use the results from the long-term evaluation to identify effects that may not be immediately obvious during the actual testing.

Task 8. Sample Evaluation

The test program will collect coal and combustion byproduct samples throughout the testing period. The program will analyze selected samples to better characterize mercury removal performance and factors that may influence this performance. Coal analyses will include ultimate and proximate analyses, as well as mercury and chlorine content. The ash analysis will include mercury and other possible tests such as alkalinity, size distribution, chlorine, fluorine, and metals such as selenium and arsenic.

Ash testing will also include standard leaching test methods such as the Toxicity Characteristic Leaching Procedure (TCLP, SW846-1311) and synthetic groundwater leaching procedure (SGLP). If the long-term tests use a chemically treated sorbent, the team will use SGLP to analyze for leaching of the chemical used in the treatment process.

Previous results from other programs have shown that the ash byproducts mixed with activated carbon are highly stable. However, it is important to continue evaluating these byproducts for each condition using well-established and documented techniques, and new techniques designed to perform even more robust analyses of the byproducts.

DOE has a test program planned to evaluate the stability of mercury on coal combustion byproducts. The test program will provide ash samples to the DOE contractor for analysis. The program will also collect and archive additional ash for other tests, including EPA, DOE, and EPRI requested tests, and independent DOE and Entergy approved companies.

The test program requires a sample and data management process for tracking a large quantity of samples from various process streams during the testing efforts. ADA-ES has developed a Sample and Data Management System (SDMS) that will store test data from the evaluation. The SDMS data can be used to generate reports, track sample history, and input results from laboratory analyses.

For data control and security, the system limits full access to the project manager and site manager at ADA-ES and the sample manager. Operators collecting samples will upload information to the database and print sample labels and Chain-of-Custody forms. ADA-ES will include testing results with regularly issued reports to the test team.

Task 9. Site Report

The test program will prepare a site report documenting measurements, test procedures, analyses, and results obtained in Tasks 3, 4, and 5. This report is a stand-alone document providing a comprehensive review of the testing. The test program will submit this report to the host utility. The report will also include a section on the initial economics for full-scale permanent commercial implementation of the control scheme, based upon results from long-term testing.

The test program will also assess the viability of re-injecting the collected sorbent/ash mixture from the ESP hoppers into the ESP, and impacts this will have on injection system operation, ESP operation and potential emission increases. The report will include and economic analysis identifying potential cost savings.

Based on input from the plant, the report will address modifications to existing plant equipment and develop a work scope document for the TOXECON II™ process. This may include modifications to the particulate collector, ash handling system, compressed air supply, electric power capacity, other plant auxiliary equipment, utilities, and other balance of plant engineering requirements.

Finally, the test program will develop a budget level cost estimate to implement the TOXECON II™ control technology. This will include capital cost estimates for mercury control process equipment as well as projected annual operating costs. Where possible, the report will include order-of-magnitude estimates for plant modifications and balance of plant items.

Task 10. Technology Transfer

The ultimate goal of technology transfer efforts is to make the program testing results available to the public as quickly, comprehensively and accurately as possible. To accomplish this goal, the program will make presentations at selected conferences, with DOE approval, to increase exposure of the test results and receive comments on the applicability of the technology to the industry.

Transferring the information generated during this program to the coal-fired utility industry is an important part of the program. Dr. Durham, who has led the technology transfer activities during the DOE Phase I and II programs, will lead this important activity. Technology transfer activities in the previous testing programs included participating in DOE/NETL-sponsored meetings, EPA Hg MACT Stakeholder meetings, presentations at more than 50 events or companies, hosting a project Web site for project team members and for presentation of project information, and publication of more than 100 technical papers.

ADA-ES will work with DOE/NETL to determine and support efforts for key meetings, presentations and publications. ADA-ES will also establish a Web site for the project and participants. ADA-ES has done this on other NETL projects with excellent results.

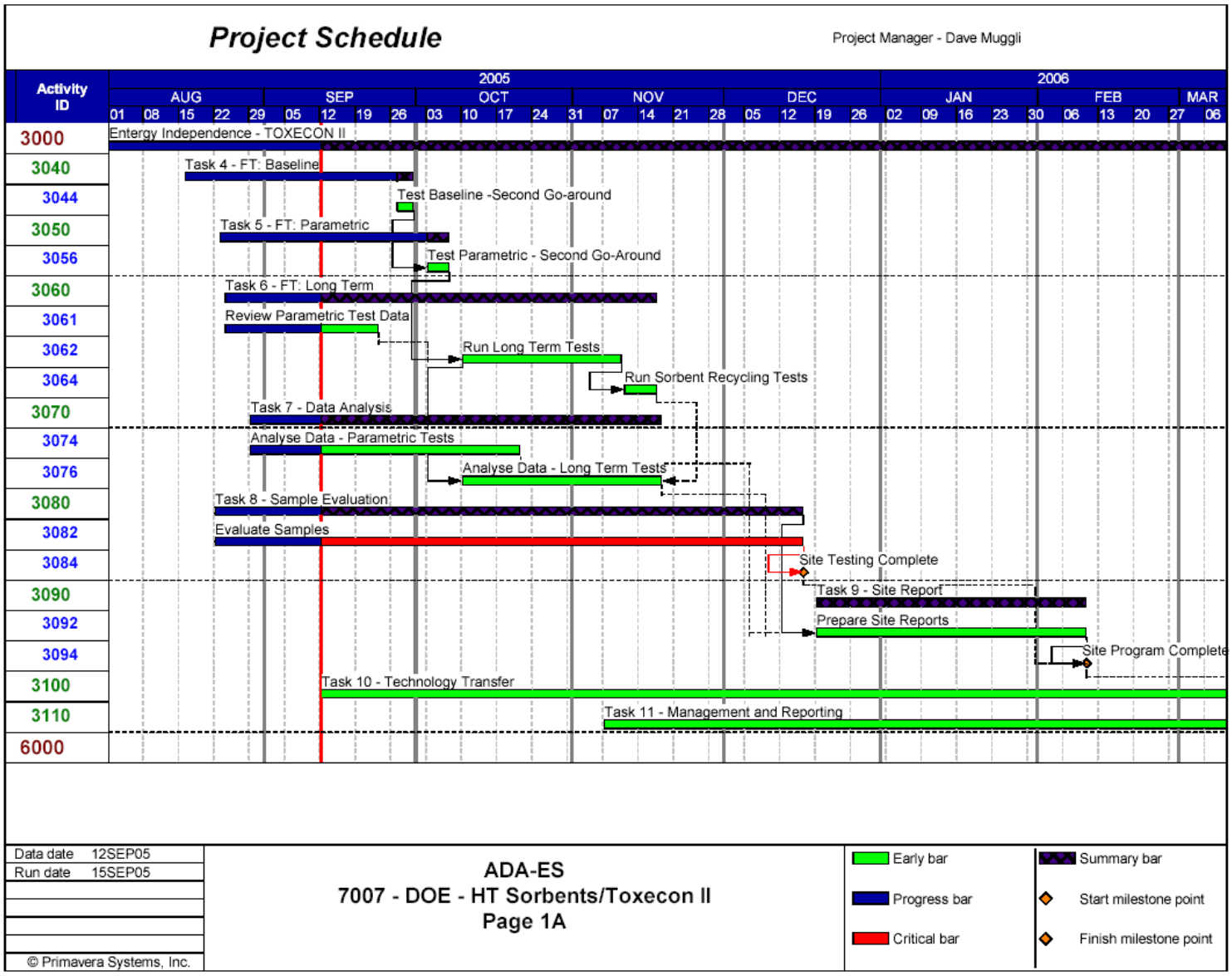
Task 11. Management and Reporting

This task includes the overall program management, and preparation of financial and administrative reports. This task will also include periodic meetings with DOE to discuss progress and obtain overall direction of the program from the DOE project manager.

Schedule

The current schedule for activities at Independence Station is shown in Figure 7.

Figure 7: Current Schedule for the Independence Test Program.



Key Personnel

Key personnel for the Independence tests are identified in Table 9.

Table 9. Key Project Personnel for Independence Mercury Field Evaluation.

Name	Company	Role	Phone #	E-Mail
Andrew O'Palko	DOE/NETL	Project Manager	304-285-4715	andrew.opalko@netl.doe.gov
Richard Roberts	Entergy	Entergy Technical Support	501-688-7068	rrobert@entergy.com
Dave Muggli	ADA-ES	Program Manager	303-339-8853	davem@adaes.com
Tom Campbell	ADA-ES	Site Project Manager	303-339-8864	tomc@adaes.com
Cody Wilson	ADA-ES	Site Project Engineer	303-339-8860	codyw@adaes.com
Mike Rees	Entergy	Superintendent	870-698-4573	mrees@entergy.com
Jerry Amrhein	ADA-ES	Hg Monitors	303-339-8841	jerrya@adaes.com
Steve Coker	Entergy	Sr. Engineer	870-698-4521	Scoker1@entergy.com
Kellee Cook	Entergy	Environmental Specialist	870-698-4517	Kcook2@entergy.con
Joe Hantz	Entergy	Fossil Environmental Support	281-297-3319	jhantz@entergy.com
Cam Martin	ADA-ES	Equipment Design	303-339-8849	camm@adaes.com
Richard Schlager	ADA-ES	Contracts	303-339-8855	Richards@adaes.com
Connie Senior	Reaction Engineering	Coal and Byproduct Issues	801-364-6925 ext 37	senior@reaction-eng.com
Michael Durham	ADA-ES	Technical Expert	303-734-1727	miked@adaes.com
Jean Bustard	ADA-ES	Technical Expert	303-734-1727	jeanb@adaes.com
Ramsay Chang	EPRI	Technical Expert	650-855-2535	rchang@epri.com

APPENDIX A2: Follow-On Test Plan—February 23, 2006

ELECTRIC POWER RESEARCH INSTITIUTE MERCURY FIELD EVALUATION

Evaluation of TOXECON II™ Sorbent Injection for Mercury Control at Entergy's Independence Steam Electric Station

Follow-On Test Plan dated February 23, 2006

For:
Entergy
EPRI

By:
ADA Environmental Solutions, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120

February 23, 2006

Follow-on Test Plan for Entergy Independence Station
February 23, 2006

Based on discussions during the team conference call on Tuesday, February 21, 2006, the following topics were of interest or discussed during the course of the call:

1. Sorbent Injection in front of the ESP using currently available ADA-ES equipment and existing ports and access
2. Mass Emission testing to quantify any changes in mass emissions from TOXECON II™ – three runs of M17 tests at each test condition:
    a. Baseline (no sorbent injection),
    b. TOXECON II™ at 10lb/MMacf injection concentration,
    c. Pre-ESP injection at 10lb/MMacf injection concentration
3. CFD Modeling of the ESP, Injection System
4. If possible, increase LOI to observe influence on Hg removal rates
5. If possible, vary excess O_2 levels at low loads to observe influence on Hg removal rates
6. Test smaller particle size sorbent to observe influence on Hg removal rates (note – previous tests with smaller particle size sorbent has caused significant feeding problems using both the silo and Porta-Pacs)
7. Measure air flow within the test side of ESP B to assist in the accuracy of the CFD modeling
8. Investigate bringing a pilot wet scrubber on site to analyze speciation and removal effects
9. Creating an economic standard calculation to estimate the cost effectiveness of sorbent injection vs. baghouse prices

Given the current ACI inventory and available budget, ADA-ES is recommending the following tests be conducted in the next few weeks:

Sunday	Monday	Tuesday	Wed	Thursday	Friday	Saturday
Feb 26	27 Travel to site	28 System Start-up (analyzers, injection system, etc), no Injection	Mar 1 System Start-up, no injection M-17 Full Load	2 TOX-II injection @ 10 lb/MMacf	3 TOX-II injection @ 10lb/MMacf M17 Full Load	4 Shift Injection to in front of ESP @ 1lb/MMacf
Mar 5 Pre-ESP Injection @3lb/MMacf	6 Pre-ESP Injection @6lb/MMacf	7 Pre-ESP Injection @10lb/MMacf M17 Full Load	8 Shift to Dual TOX-II Injection (F5/F7) @6lb/MMacf Increase LOI	9 Dual TOX-II Injection @ 6lb/MMacf Decrease O2	10 Dual TOX-II Injection @ 6lb/MMacf ACI OFF use up PAC	11 System Shutdown

Upon completion of the above tests, ADA-ES will demobilize the site to the extent necessary to secure it for several months until the possible startup for a follow-up testing program. Also, ADA-ES will compile the information from the program for distribution to EPRI and the project team members.

Concurrent with the above test program, ADA-ES will pursue modeling of the existing injection grid to evaluate its possible impact on Hg removal with the TOXECON II process. Following this effort, ADA-ES can pursue installing an alternate design if the project budget can support it. Another potential activity is to perform an internal ESP flow profile measurement if the opportunity arises to help validate the ESP internal flow profile and the CFD modeling.

Due to budget limitations, the current planned efforts do not include the following:

- Testing with varying PAC particle size to observe the influence on Hg removal rates
- Bringing a pilot wet scrubber on site to analyze speciation and removal effects

APPENDIX A3: Independence Test Plan—December 29, 2006

DOE NATIONAL ENERGY TECHNOLOGY LABORATORY MERCURY FIELD EVALUATION

Evaluation of TOXECON II ™ Sorbent Injection for Mercury Control at Entergy's Independence Steam Electric Station

Test Plan

Prepared for:
Entergy
DOE NETL
EPRI

Prepared by:
ADA Environmental Solutions, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120

December 29, 2006

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Project Objectives

The objective of testing at Entergy's Independence Steam Electric Station (ISES) is to determine the cost and effects of sorbent injection using EPRI's TOXECON II ™ for mercury control. During this phase of testing, an evaluation of a redesigned injection grid and delivery system will be evaluated to determine if improved mercury removal at lower cost can be achieved compared to Independence results from 2005-2006. This evaluation will be conducted on 1/16th of the 842 MW, Unit 2 flue gas stream.

Project Overview

This test is part of an overall program funded by the Department of Energy's National Energy Technology Laboratory (DOE/NETL) and industry partners to obtain the necessary information to assess the feasibility and costs of controlling mercury from coal-fired utility plants using either high temperature sorbents or EPRI's TOXECON II™ process. Host sites of this program are shown in Table 1. These host sites reflect a combination of coals and existing air pollution control configurations.

Table 1. Host Sites Participating in the Sorbent Injection Demonstration Project

	Coal / Options	**APC**	**Capacity (MW) / Test Portion**	**Current Hg Removal (%)**
Entergy's **Independence Station Unit 2**	PRB	Cold-Side ESP	842/53	10-20%
MidAmerican's **Louisa Station Unit 1**	PRB	Hot-Side ESP	700/350	<10%
MidAmerican's **Council Bluffs Station Unit 2**	PRB	Hot-Side ESP	88/88	<10% (Estimated)

Previous mercury control evaluations at ISES Unit 2 indicated that, although significant mercury control could be achieved by using the TOXECON II™ design, the sorbent concentration required was higher than expected. Through EPRI funding, the original lance design was modeled and results confirmed significant sorbent mal-distribution. Lances have been redesigned to improve the sorbent distribution. A lance grid was installed at Independence in December 2006 to treat 1/16th of the Unit 2 flue gas flow. This test plan describes tests planed to characterize the performance of the re-designed lances.

Host Site Description

The Independence Steam Electric Station is located in Independence County, Arkansas near the town of Newark.

Unit 2 is an 842-MW (gross) pulverized coal, electric generating unit with Lungstrum regenerative air preheaters that burns PRB coal. Key operating parameters for Unit 2 are included in Table 2.

Table 2. Independence Key Operating Parameters.

Unit	2
Size (MW)	842
Test Portion (MWe)	106
Flue Gas Flow acfm	3,200,000
Coal	PRB
Heating Value (as received)	8,700
Sulfur (% by weight)	0.32
Chlorine (%)	~0.01
Mercury (μg/g)	0.04
Particulate Control	Cold-Side ESP SCA = 542 ft^2/kacfm
Sulfur Control	Compliance Coal
Air Pre-Heater	Regenerative
Ash Reuse	Sold

Independence Unit 2 is equipped with four ESPs in a piggyback configuration, with two boxes on top and two boxes on the bottom, operating in parallel for particulate removal. A sketch of one-half of the Unit 2 flue gas path showing two injection locations that were utilized during the previous testing is presented in Figure 1. For the objectives of this test period only the injection location identified as “1” will be utilized.

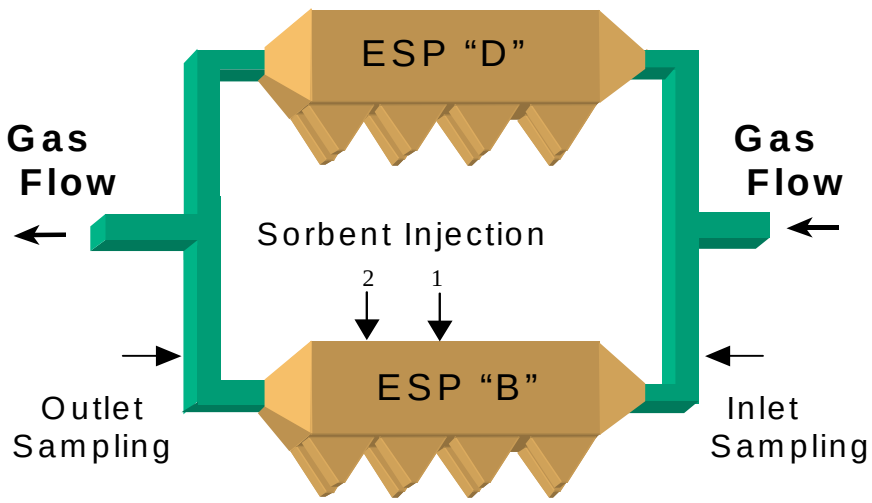


Figure 1. Sketch of West Half (Elevation View) of the ESP at Independence Unit 2.

Each ESP has eight TR sets configured as shown in Figure 3. TR sets 1, 3, 5 and 7. Injection lances are installed upstream of electrical field 5. The ash collection hopper designations are shown to the right in Figure 2. Eight injection lances are installed upstream of hoppers 31 and 41.

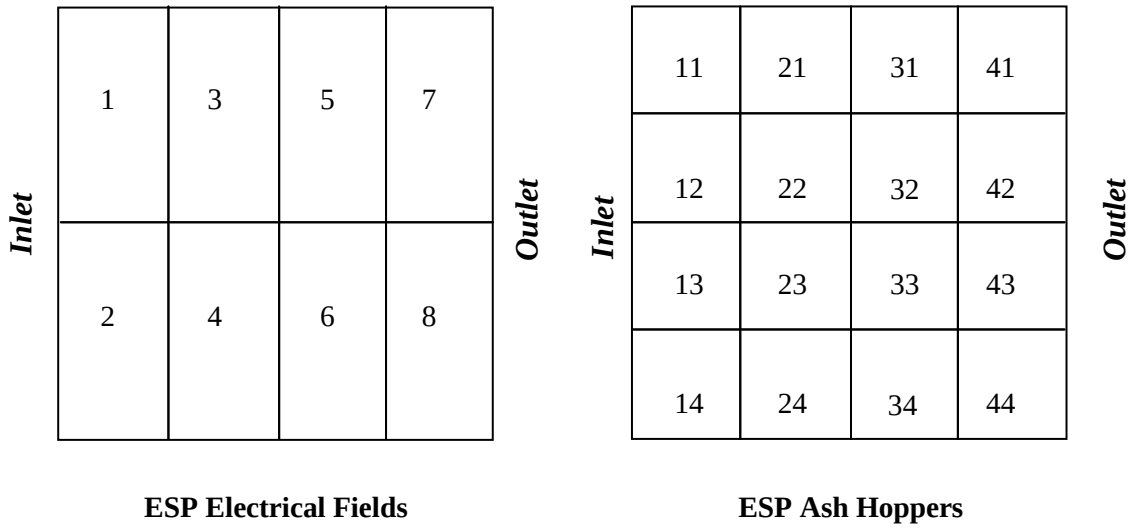


Figure 2: ESP Electrical Field and Ash Hopper Configuration.

Two mercury Semi-Continuous Emissions Monitors (SCEMs) will be used during the test period. Extraction locations will be upstream and downstream of the treated ESP. The downstream location will be in-line with the injection lances to assure representative outlet measurements.

Field Testing

Field-testing is planned in three phases: baseline, parametric, and long-term testing. These are described below. Additional tasks associated with each testing phase are sample and data collection, sample and data analysis, economic analysis of the technology based upon the test results, and reporting. These tasks are described in separate sections.

Baseline Testing

The baseline test period is split. One day of baseline testing (no sorbent injection) is scheduled prior to parametric testing, after the SCEMs are brought on-line, to assure all measurement equipment is in good working order and to characterize native mercury capture across the ESP. Unit operation will be set to include conditions expected during the parametric tests. Manual testing will include modified Appendix K, Sorbent Trap Method (STM), mercury measurements. An extended baseline test period is scheduled before the long-term carbon injection test. During this baseline testing, Method 5/202 particulate/condensable tests will be conducted at the stack to establish and characterize baseline particulate emissions for the entire unit. Particulate testing at the stack will include one six hour test each day for five consecutive days. Extended tests at the stack are scheduled to minimize run-to-run variations often observed for shorter sampling runs. During these tests, two Electrostatic Precipitator (ESP) conditions will be explored: the first during the one day Baseline period with normal ESP operating conditions - the Precipitator Optimization System (POS) controlling ESP power levels; and the second during the longer Baseline period with the transformer rectifier (TR) set B-5 and B-7 at 100% operating power. The TR set power levels are defined at 100% for prevention of back corona, not maximum output. The ESP rapping frequency will be set to once every four hours, standard operating conditions for the plant. The plant will shift the soot blowing system into the P-4 control scheme to minimize variation in soot blowing artifacts during Method 5/202 testing. STMs will also be conducted during the extended baseline test. Continuous mercury measurements will be made with the SCEMs installed upstream and downstream of the ESP and in line with the injection grid.

Parametric Testing

A new regenerative blower for the carbon injection system has been delivered to ISES and will be installed prior to parametric testing. Following initial baseline testing, 4-days of parametric testing are planned as shown in the test matrix (Table 3). The test matrix was designed to evaluate the effectiveness of the new sorbent injection grid, to determine the optimal carrier air flow for the current grid design, and characterize mercury removal as a function of injection concentration at high and low boiler load. During parametric tests, the ESP rapping frequency will be set to once every four hours, standard operating procedure for the plant. The target ESP operation for TR sets B-5 was 100% and B-7 was 50%. STMs will be conducted during one test condition. Continuous mercury measurements will be made with the SCEMs installed upstream and downstream of the ESP.

After parametric testing is completed, the project team will evaluate the data collected to determine the optimum long-term testing conditions.

Long-Term Testing (Extended 30-day test)

An "extended" 30-day continuous injection test will be conducted at the "optimum" settings as determined in the parametric tests and approved by DOE, EPRI, and Entergy/Independence. It is the intent of DOE that these settings represent the most cost effective condition for mercury removal. The goal of this task is to obtain operational data on removal efficiency over an extended period to indicate the effects on the particulate control device, effects on byproducts (ash), and impacts to the balance of plant equipment to begin to evaluate the viability of the process and determine the process economics.

During this period, Method 5/202 particulate/condensable tests will be conducted to characterize particulate emissions during carbon injection. Since only one $1/16^{th}$ of the flue gas is being treated with carbon, two test locations will be utilized to maximize the analysis. To correlate with Baseline testing, two days of tests will be conducted at the stack to determine overall impacts on the plant. The Method 5/202 particulate sampling will then be moved to the ESP outlet for 5 days. Three simultaneous 6-hour Method 5/202 samples will be collected per day for five days: one upstream of the test-side ESP, one downstream of the test side of the ESP downstream of the injection point, and one downstream of the control side of the ESP. The purpose of extended particulate sampling runs is to minimize run-to-run variations often encountered during shorter sampling runs. During M5/202 testing, CPM measurements will be taken across the outlet of the test-side ESP and the control-side ESP.

During the particulate testing, the ESP outlet field rapping frequency will be established at 4 hours for the days of stack testing and one day of ESP outlet testing. The outlet field rap cycle will then be changed to once per hour. The test side outlet TR set power levels will be in manual at 100%. Based on results during testing, TR set B-7 may be shifted to 50% power levels. During these M5/202 test sequences, the soot blowing schedule will conform to the P-4 scheme to allow data correlation with Baseline measurements. STMs will also be conducted during this phase of testing. Continuous mercury measurements will be made with the SCEMs installed upstream and downstream of the ESP.

Table 3. Proposed Test Matrix for Independence Unit 2

Test Description	Date	Test Day	Test Dur. (hrs)	Inj. Conc. (lb/MMacf)	Blower Setting	Boiler Load	Special
Blower and SCEM checkout	Jan 10 - 14, 2007	0		NA	OFF	Any	
Baseline	Mon 1/15/07	1	24	0	OFF	Any	STM
Parametric	Tue 1/16/07	2	3	1	Model	Full[1]	
			2	1	Model -	Full[1]	
			2	1	Model +	Full[1]	
			8	1	Best (A)	Low[1]	
	Wed 1/17/07	3	3	1	A	Full[1]	
			3 +	3	A	Full[1]	STM
			8	3	A	Low[1]	
	Thu 1/18/07	4	3	3	A	Full[1]	
			3+	6	A	Full[1]	
			8	6	A	Low[1]	
	Fri 1/19/07	Contingency					
	1/20/07 – 1/28/07	*Break to review data. Move forward with Long-Term if >80% removal at ≤ 3 lb/Macf*					
Baseline	1/29/07 – 2/1/07	BL 1-5	5 days	0	OFF	Full[1] for PM	PM
Long-Term Week 1	2/2/07 – 2/9/07	LT 1-7	7 days	TBD	A	Full[1] for STMs	STM
Long-Term Week 2	2/10/07 – 2/16/07	LT 8-14	7 days	TBD	A	Full[1] for PM	PM
Long-Term Week 3	2/17/07 – 2/23/07	LT 15-21	7 days	TBD	A	Full[1] for STMs	STM
Long-Term Week 4	2/24/07 – 3/4/07	LT 22-30	9 days	TBD	A		

Notes:

1. For parametric and long term tests noted, place ESP in 1 hour rap cycle. Field 5 TR sets to manual full power (100%). Field 7 TR sets to manual 100%.
2. Full Load = 842MW ± 5%
3. Sorbent injection will be stopped if the ESP spark rate or Unit 2 opacity exceeds levels determined by plant personnel at beginning of test week.

Sample and Data Collection

During every test day, the ADA-ES Site Manager will be on site or on call. The ADA-ES Site Manager will manage coordination on site between all ADA-ES activities and the plant staff. Plant staff will be collecting coal and ash samples and providing unit operating data for use in evaluating the mercury program results. Samples and data that will be collected during testing are summarized in Table 4.

Table 4. Samples and Data Collection during Independence Testing

Parameter Sample/signal/test	Baseline	Parametric	Long-Term
Coal daily composite*	Yes	Yes	Yes
Fly ash daily hopper samples: **	Yes	No	Yes
Unit operating data: boiler load, ESP operation, CEMS Data, etc. (listed separately in Table 5)	Yes	Yes	Yes
Mercury (total) monitors at ESP inlet and ESP outlet – SCEMs	Yes	Yes	Yes
Mercury (total) STM at inlet/outlet	Yes(1 set)	Yes(1 set)	Yes(1 set)
Particulate, M5/202	Yes	No	Yes
Sorbent Injection Rate, lb/min	No	Yes	Yes

*** Coal Sampling**

Coal sampling will be collected and will represent the coal as an "as burnt" sample that can be correlated to the operating conditions and data taken during the test program. All samples will be collected in labeled 1-Liter containers provided by ADA-ES. One sample will be collected each day. ADA-ES personnel will take custody of the samples and composite them on site for shipment and analysis.

**** Fly Ash Sampling**

Ash will be collected from two test hoppers (31 and 41) and two control hoppers (34 and 44). The hoppers should be emptied at about 1200 hours. Ash sampling will then occur at approximately 1100 hours. The schedule for hopper bypass is at 1200, all hoppers in bypass will be emptied. Hoppers 3-1, 3-2, 3-4 and 4-1, 4-2, and 4-4 will then be placed in bypass until the next day. Hopper 2-1 and 2-2 will be isolated at 0800 until 1200 to allow sufficient ash to collect.

Operations personnel or ADA-ES personnel will collect each ½-1L fly ash sample in a separate, labeled 1-L containers (provided by ADA-ES). Three, 5-gallon buckets of ash from the baseline testing and Long-Term will also be collected for DOE.

Plant Operating Data

The ADA-ES Site Manager will work closely with plant operators to monitor key plant operating parameters in real-time during testing. In addition, ADA-ES requests unit-operating data in electronic form on a fifteen-minute average basis. The list of requested plant data is provided in Table 5. If possible, it is useful if plant-operating data can be provided daily. If at any time the performance of the existing pollution control equipment or outlet emissions exceed acceptable operating limits, testing will be halted. Acceptable limits will be discussed and agreed upon prior to beginning injection.

Table 5. Unit operating parameters requested for 15- minute logging during Independence 2 Sorbent Injection Testing.

Parameter	**Unit(s)**
Load	MW, gross and net
Heat Rate	Btu/MW-hr
ID Fan	Amps
Boiler O_2	%, wet
Duct O_2	%, wet
Mill Fuel Flow	klb/hr
Boiler Air Flow	%
Main Steam Flow	klb/hr
AH Differential Pressure	in H_20
AH Gas Temperatures	F
AH Air Temperatures	F
SOFA position	%
CCOFA position	%
SO_3 Injection Rate	%, lb/hr
Sulfur burner DT	F
Main sootblower header steam flow	klb/hr
Ambient T	F
Barometric P	in Hg
Stack T, Flow, Velocity	F, lb/hr, ft/s
NO_x	ppm, lb/MMBtu
SO_2	ppm, lb/MMBtu
CO_2	%, wet
Opacity	%, 6-minute
TR Primary	V, A
TR Secondary	kV, mA
TR Spark Rate	spark/min

Miscellaneous notes daily:

- Equipment out of service, failures or upsets, note time and remedy
- Fuel type fired and source (train or coal pile)
- Soot-blowing or water cannon schedule

Sample and Data Analysis

Data collection and analysis for this program is designed to measure the effect of sorbent injection on mercury control and the impact on the existing pollution control equipment. The mercury levels and plant operation will be characterized with and without sorbent injection and the long-term evaluation to identify effects that may not be immediate.

Select coal and ash samples will be chosen by the test team for analysis. Ultimate and proximate analyses will be performed and mercury, chlorine, and sulfur levels will be determined for the coal samples. The ash will be analyzed for mercury. Leaching tests will be conducted to determine if the mercury is stable on the ash. Ash samples will also be sent to DOE for additional analyses on a separate program.

Site Report and Technology Transfer

A site report will be prepared documenting measurements, test procedures, analyses, and results. This report is intended to be a stand-alone document providing a comprehensive review of the tests and results. The report will include details from testing throughout this DOE program (2005 – 2007).

Design and Economics of TOXECON II

One aspect of the site report is an economic analysis. After completion of field testing and analysis of the data, the requirements and costs for full-scale permanent commercial implementation of the selected mercury control technology will be determined.

The ADA-ES program team will meet with the host utility plant and engineering personnel to develop plant-specific design criteria. Process equipment will be sized and designed based on test results and the plant-specific requirements (reagent storage capacity, plant arrangement, retrofit issues, winterization, controls interface, etc.). A conceptual design document will be developed. Sorbent type and sources will be evaluated to determine the most cost-effective reagent(s) for the site.

Modifications to existing plant equipment will be determined and a work scope document will be developed based on input from the plant. This may include modifications to the particulate collector, ash handling system, compressed air supply, electric power capacity, other plant auxiliary equipment, utilities, and other balance of plant engineering requirements.

Finally, a budget cost estimate will be developed to implement the control technology. This will include capital cost estimates for mercury control process equipment as well as projected annual operating costs. When possible, order-of-magnitude estimates will be included for plant modifications and balance of plant items.

Schedule

The tentative schedule for site activities at Independence Power Plant is include in the test matrix. A draft of the comprehensive report will be issued within 8 weeks of completing site activities.

Key Personnel

Key personnel for testing at Labadie Plant are identified below in Table 6.

Table 6. Key Project Personnel for Independence Plant Mercury Field Evaluation

Name	Company	Role	Phone #	E-Mail
Andrew O'Palko	DOE/NETL	Project Manager	304-285-4715	andrew.opalko@netl.doe.gov
Richard Roberts	Entergy	Entergy Technical Support	501-688-7068	rrobert@entergy.com
Sharon Sjostrom	ADA-ES	ADA-ES Project Manager	303-339-8856	sharons@adaes.com 303-919-8538
Brian Donnelly	ADA-ES	ADA-ES Site Manager	303-339-8865	briand@adaes.com 303-921-8153
Tom Campbell	ADA-ES	Senior Project Engineer	303-339-8864	tomc@adaes.com 303-981-7287
David Graham	ADA-ES	Senior Project Engineer	303-339-8845	davidd@adaes.com 303-520-9058
Todd Bradberry*	Entergy	Engineer	870-698-4581	BBRADBE@entergy.com
Steve Coker	Entergy	Sr. Engineer	870-698-4521	Scoker1@entergy.com
Kellee Fletcher	Entergy	Environmental Specialist	870-698-4517	Kfletch@entergy.con
Joe Hantz	Entergy	Fossil Env. Support	281-297-3319	jhantz@entergy.com
Connie Senior	Reaction Engineering	Coal and Byproduct Issues	801-364-6925 ext 37	senior@reaction-eng.com
Ramsay Chang	EPRI	Technical Expert	650-855-2535	rchang@epri.com

* Shipping to Independence will be coordinated through Todd Bradberry.

APPENDIX A4: Extended Test Matrix

Date	Day	Sorbent Injection	SCEM Online	Field 5 Injection	Field 7 Injection	Opacity Testing	Removal % Testing	Sorbent Screening	Porta-PAC: Alt Sorbent
15-Nov	Tuesday								
16-Nov	Wednesday	x	x	x					
17-Nov	Thursday	x	x	x		x			
18-Nov	Friday	x	x	x		x			
19-Nov	Saturday	x	x	x					
20-Nov	Sunday	x	x	x					
21-Nov	Monday	x	x	x					
22-Nov	Tuesday	x		x					
23-Nov	Wednesday	x		x					
24-Nov	Thursday	x		x					
25-Nov	Friday	x		x					
26-Nov	Saturday	x		x					
27-Nov	Sunday	x		x					
28-Nov	Monday	x		x					
29-Nov	Tuesday	x	x	x		x	x	x	
30-Nov	Wednesday	x	x	x		x	x	x	
1-Dec	Thursday	x	x		x	x	x	x	
2-Dec	Friday	x	x		x	x	x	x	
3-Dec	Saturday	x	x		x		x		
4-Dec	Sunday	x	x		x		x		
5-Dec	Monday	x	x		x	x	x		
6-Dec	Tuesday	x	x		x	x	x		
7-Dec	Wednesday	x	x	x	x	x	x		
8-Dec	Thursday	x	x	x		x	x		
9-Dec	Friday	x	x	x		x	x		
10-Dec	Saturday	x	x	x					
11-Dec	Sunday	x	x	x					
12-Dec	Monday	x	x	x					
13-Dec	Tuesday	x	x	x					
14-Dec	Wednesday	x	x	x					
15-Dec	Thursday	x	x	x					
16-Dec	Friday	x	x	x					
17-Dec	Saturday	x	x	x					
18-Dec	Sunday	x	x	x					
19-Dec	Monday	x	x	x					
20-Dec	Tuesday	x	x	x					
21-Dec	Wednesday	x	x	x					
22-Dec	Thursday	x		x					
23-Dec	Friday	x		x					
24-Dec	Saturday	x		x					
25-Dec	Sunday	x		x					
26-Dec	Monday	x		x					
27-Dec	Tuesday	x		x					
28-Dec	Wednesday	x		x					
29-Dec	Thursday	x		x					
30-Dec	Friday	x		x					
31-Dec	Saturday	x		x					
1-Jan	Sunday	x		x					
2-Jan	Monday	x		x					

3-Jan	Tuesday	x	x	x				
4-Jan	Wednesday	x	x	x				
5-Jan	Thursday	x	x	x				
6-Jan	Friday	x	x	x				
7-Jan	Saturday	x	x	x				
8-Jan	Sunday	x	x	x				
9-Jan	Monday	x	x	x	x	x		
10-Jan	Tuesday	x	x	x	x	x		
11-Jan	Wednesday	x	x	x	x	x		
12-Jan	Thursday	x	x	x	x	x		
13-Jan	Friday	x	x	x	x	x		
14-Jan	Saturday	x	x	x				
15-Jan	Sunday	x	x	x				
16-Jan	Monday	x	x	x		x		
17-Jan	Tuesday	x	x	x		x		x
18-Jan	Wednesday	x	x	x		x		x
19-Jan	Thursday	x	x	x		x		x
20-Jan	Friday	x	x	x		x		
21-Jan	Saturday	x	x	x				
22-Jan	Sunday	x	x	x				
23-Jan	Monday	x	x	x		x		
24-Jan	Tuesday	x	x	x		x		x
25-Jan	Wednesday	x	x	x		x		x
26-Jan	Thursday	x	x	x		x		x
27-Jan	Friday	x	x	x		x		
28-Jan	Saturday	x	x	x				
29-Jan	Sunday	x	x	x				
30-Jan	Monday	x	x	x				
31-Jan	Tuesday							

APPENDIX B:

Equipment Descriptions

Mercury Monitors

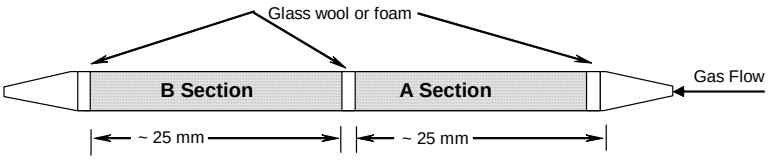
Vapor-Phase Mercury Emissions Using Sorbent Trap Method (STM)

This non-isokinetic test method samples flue gas while minimizing particulate capture, and provides total vapor-phase mercury emissions. The dry sorbent trap method was proposed in the Utility Mercury Reduction Rule (FR January 30, 2004) as a draft EPA test method, *Method 324 Determination of Vapor Phase Flue Gas Mercury Emissions from Stationary Sources Using Dry Sorbent Trap Sampling.* The method was proposed in the Utility Mercury Reduction Rule either for application as a reference method test, or for continuous compliance measurement for mercury. ADA-ES has used the method in the field since the early 1990s, and conducted the validation testing for Method 324, in which it compared favorably with the Ontario Hydro Method. The procedures used during the Independence tests were consistent with the procedures used during validation testing of the new Method.

In the Clean Air Mercury Rule (CAMR) signed by the EPA Administrator on March 15, 2005, the proposed Method 324 was revised and renamed as 40 CFR Part 75 Appendix K. The revised and renamed method will be an option for some sources for continuous compliance measurements for mercury. The method described in Appendix K has many rigorous quality control requirements that are in excess of what is necessary for the Big Brown tests. However, the principles of the method described in 40 CFR Part 75 Appendix K will be applied in this test program and will be referred to as the sorbent trap method (STM). The detailed procedures to be followed are summarized here.

This mercury measurement method extracts a known volume of flue gas from a duct through a dry sorbent trap (containing a specially treated form of activated carbon) as a single-point sample, with a nominal flow rate of about 400 cc/min at the gas meter. The dry sorbent trap, which is in the flue gas stream during testing, represents the entire mercury sample. Each trap is recovered in the field and shipped to a specialized lab such as Frontier GeoSciences, Inc. for analysis. Each trap is acid leached and the resulting leachate is analyzed for mercury using cold vapor atomic fluorescence spectrometry. Samples can be collected over time periods ranging from less than an hour to weeks in duration. The test result provides a time-averaged total vapor-phase mercury measurement of the flue gas stream.

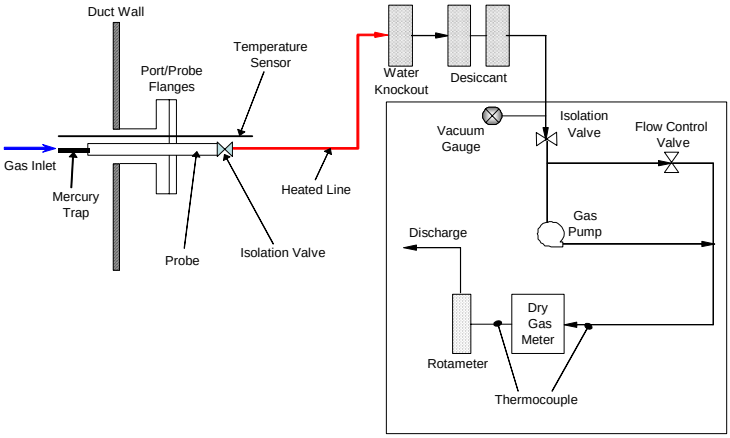
STM sampling collects paired samples as a quality control measure. The analysis results of the paired sample trains are compared and are typically in agreement within 5–20% relative percent difference (RPD) or about 1 lb/TBtu. Another built-in quality assurance



measure is achieved through the analysis of two trap sections in series. Each trap has two separate mercury sorbent sections, as shown in the figure below, and the "B" section is analyzed to evaluate whether any mercury breakthrough occurred. Low B section mercury, in conjunction with a field blank trap, is used to confirm overall sample handling quality.

The sample train is fairly simple, as shown below. Major components are a dry sorbent trap mounted directly on the end of a probe (usually heated), a moisture knockout outside the duct, and a sampling console that controls the sampling rate and meters the flue gas, as well as recording data in a data logger. Key temperatures, sampling volume, and barometric pressure are recorded on field sampling data sheets and/or by a data logger for each sample run.

The STM directly measures mercury concentration in units of $\mu g/dNm^3$. Using stack gas flow rate and gaseous data from the plant's CEMS and coal Ultimate Analysis (or EPA Method 19 F-Factors if Ultimate Analysis is unavailable), results can be calculated and reported in lb/TBtu.



Sampling Console

APPENDIX C:

Field Test Logs

APPENDIX C1: Independence Test Log—November 15, 2005

Entergy Independence Unit 2
DOE TOXECON™ II Mercury Control Evaluation

8/14/05
0800 – EZ, TC, BD on site.
0900 – Calibrate system.
1000 – Begin work on TEOM system. Set up but unable to install in duct, bendable probe will not bend down due to obstruction.
Test hopper sample system, take 5 gal sample for Lynn Birkett, DOE.
1800 – Depart site.

8/15/05
0800 – EZ on site for system calibration.
0830 – TC, BD on site.
0930 – After calibrating system, begin Baseline data collection.
1000 – Plant is at full load.
1100 – Begin sample routine.
1900 – Release plant to load follow.

8/16/05
0800 – EZ on site for system calibration.
0855 – Plant begins to raise load, stabilizes at 1000.
0930 – CL, TC, BH on site for testing.
1000 – METCO on site. Waiting on scaffolding additions.
1030 – Remove TEOM probe per METCO request. Modified TEOM bearing mount to allow operation in duct. Unable to test in duct.
1400 – Scaffolders come on site to modify scaffolding set up for METCO. Complete at 1700. METCO will wait until tomorrow for testing.
1930 – Release plant to load follow.

8/17/05
0800 – EZ on site for system calibration
0830 – CL on site to assist with off loading Porta-PAC and 14 supersacks of Hg, Hg-LH, E-10 and E-11.
0925 – Plant begins raising load to 840 MW. Completes at 1010.
0945 – BH and TC on site for start of testing for the day
1000 – Coal sample from north conveyor
1230 – Started 1st run of Ontario Hydro. Perform 324.
1300 – Talk with Mike Rees. Field 7 (outlet field on test side of ESP) is down and has been down for at least a week. Initial report is a hard ground but testing finds it comes up to power but loses power due to spark rate, runs about one hour. Isolate problem to rappers not functioning on field 7. Bring rappers on line but improvement is limited. Inform team, schedule meeting for Thursday.

1700 – Complete run 1 of Ontario Hydro. Test was long and slow, METCO thinks data will be good.
1845 – Start run 2 of Ontario Hydro. Perform 324 test.
2130 – Finish run 2 of Ontario Hydro.
2200 – Release plant to load follow.

8/18/05
1000 – CW, TC, EZ, CL, BH onsite.
1046 – After reviewing the ESP data for the past couple months, it was determined that field 7 has been out of operation since July 20. The plant is working to restore this field so that parametric testing can continue as planned.
1100 – Started 3rd run of source testing (OH, M5, M26a).
1140 – Reset CPM5000 for stack test calibration.
1415 – Complete 3rd run of Ontario Hydro.
1445 – Completed CPM5000 stack test calibration. Test side window value was .76%, control side window value is .81%.
1500 – Discussion of inlet and outlet Hg data on SCEM analyzers continues. Inlet numbers appear to run higher at low loads and as load is increased, off gas through the first several hours of testing. Then outlet continues to decline until lower than inlet. Need to do some data averaging to get a grip on data and ensure analyzers are working properly.
1600 – Set up TEOM7000 and power up.
1700 – Change RSView program.
1715 – Release plant to load follow.
1739 – Change RSLogix
1745 – Depart.

8/19/05
0800 – EZ, BH onsite. Chiller condensate pump at outlet sample port has quit, analyzer (EMC2) has taken on water.
0930 – TC, CW onsite.
1000 – Collected coal sample from north conveyor.
1300 – EMC2 has been overhauled, new gold, new detector tube, one of the solenoid valves replaced, sample lines flushed with HnO3 and water. Pump on chiller has been reconditioned and is working properly.
1600 – Complete ash sampling, Hoppers 4-2 and 3-2 are empty, no sample collected. Sampled hoppers 2-2, 1-2 & 1-3.
1630 – Started FAS.
1730 – Stopped FAS.
1800 – Stopped working.

8/20/05
0800 – EZ, BH, and CW onsite.
0810 – EMC2's computer locked up over night. The analyzer will not reboot. Working on downloading the collected data since yesterday afternoon until when the analyzer froze up. After that the analyzer hard drive will be formatted and the control files reloaded.
0912 – Collected coal sample.

0939 – Tested the Porta-PAC motor rotation and feeder operation. The system is working fine.
0950 – EMC-2 is back online and sampling. Deletion of the data files on the analyzer hard drive solved problem.
1025 – Conducted TEOM 6 point velocity traverse.
1115 – Started TEOM continuous test.
1500 – Stopped TEOM continuous test.
1549 – EMC analyzers are working great. Inlet Hg concentration is greater than that outlet. This is not what we have been seeing the past couple days at this time.

8/21/05
0830 – EZ, BH, and CW onsite.
0845 – EMC2 Hg analyzer froze up over night again. It appears this happened at around 1740. Removed all files from the analyzer computer and re-installed software. Data files were downloaded to the analyzer computer.
1045 – Started TEOM continuous particulate run at ESP outlet.
1130 – Started FAS at ESP inlet.
1230 – Stopped FAS
1230 – Inlet and outlet analyzers are finally operating. Outlet was flooded at one point.
1320 – Continue to struggle with Hg analyzers. The outlet calibration is drifting quickly. Currently the outlet is reading higher than the inlet by 2 ug/dNm.
1410 – Recalibrated the outlet Hg analyzer. This made the outlet Hg concentration decrease below the inlet Hg concentration by 1 ug/dNm.
1425 – Stopped TEOM continuous particulate run at ESP outlet.

8/22/05
0800 – EZ, BH onsite
0825 – CW Onsite
0830 – Inlet and outlet Hg analyzers are working fine. Outlet concentration is currently higher than the inlet by 0.5 ug/dNm.
1100 – Calibrated Porta-PAC. New maximum feedrate at 2000 rpm is 760.
1120 – Started DARCO Hg injection at 3 lbs/MMacf (78 lbs/hr) in front of field 5.
1140 – Inlet Hg is stable at 7.8 ug/dNm. Outlet just before sorbent injection started was at 9.2 ug/dNm. After started sorbent injection, the outlet Hg dropped to 3.3 ug/dNm, representing about a 60% incremental decrease in Hg emissions. Removal from inlet to outlet is 58%. Outlet analyzer was still higher than the inlet analyzer by 1 ug/dNm at the start of sorbent injection.
1220 – Inlet Hg T = 6.94 (7.56) ug/Nm3; Outlet Hg T = 2.34 (2.62) ug/Nm3.
1431 – Collected FAS sample from ESP inlet.
1510 – Increased ACI to 5 lbs/MMacf (156 lbs/MMacf) in front of field 5. Outlet Hg is stable at 1.7 ug/dNm prior to increasing sorbent feedrate.
1642 – Collected ash samples. Samples from row three are very dark from row 3 hoppers.
1751 – Stopped ACI injection.
1800 – Noticed increase in outlet particulate as measured by CPM5000 on test side during sorbent injection. Step changes observed at both injection rate changes.
1900 – Left Site

8/23/05
0800 – CL, BH, CW onsite
0930 – Loaded super sack of DARCO Hg-LH onto the Porta-PAC
1100 – Calibrated Porta-PAC feeder. New maximum feedrate is 875 lbs/hr.
1130 – The outlet analyzer is reading 5.6 ug/dNm total Hg with less than 1 ug/dNm being elemental. Inlet is reading 6.5 ug/dNm total and 5.5 ug/dNm elemental. Either a lot of the Hg is being oxidized across the ESP or something is wrong with the elemental sample train on the outlet.
1226 – Started ACI at 26 lbs/hr in front of field 5.
1325 – After starting DARCO Hg-LH sorbent injection, outlet Hg concentration has decreased from approximately 6.5 ug/dNm to 2.7 ug/dNM.
1430 – DCM on site
1525 – Collected ESP hopper ash samples.
1545 – Collected FAS sample.
1629 – Increased DARCO Hg-LH injection rate to 78 lbs/hr in front of field 5.
1721 – Ran TEOM particulate monitor during 78 lbs/hr injection rate.
1929 – Increase DARCO Hg-LH injection rate to 156 lbs/hr in front of field 5.
2000 – Ran TEOM particulate monitor during 156 lbs/hr rate.
2010 – No noticeable increase in outlet particulate emissions as measured by CPM5000.
2227 – Increased DARCO Hg-LH injection rate to 200 lbs/hr in front of field 5.

8/24/05
0800 – CL, BH, CW, DCM onsite
1000 – Loaded super sack of DARCO e-10 onto Porta-PAC.
1020 – Changed "B" factor in CPM calibration equation from 1.0 to 20.0 for both CPMs
1120 – Started TEOM particulate monitor.
1138 – Calibrated Porta-PAC with DARCO e-10 sorbent. New maximum feedrate at 2000 rpm is 760 lbs/hr.
1228 – Started DARCO E10 sorbent injection at 78 lbs/hr in front of field 5.
1530 – Collected ESP hopper ash samples.
1542 – Started FAS at ESP inlet.
1547 – Increased DARCO E10 injection rate to 156 lbs/hr in front of field 5.
1440 – Ran STMs at the ESP inlet and outlet.
1920 – Stopped TEOM particulate monitor.
1943 – Stopped DARCO E10 injection.
2030 – Left Site

8/25/05
0800 – CL, BH, CW, DCM onsite
1000 – Sample North Coal Conveyor
1025 – Started TEOM at ESP outlet.
1045 – Calibrated Porta-PAC with DARCO E-11. New Maximum feedrate at 2000 rpm is 800 lbs/hr.
1104 – Started DARCO E11 injection at 78 lbs/hr in front of field 5.
1210 – Started STM tests at ESP inlet. This will be a port traverse at both locations.
1553 – Finished 4th sorbent trap at ESP inlet and outlet

1613 – Increased DARCO E11 injection rate to 156 lbs/hr.
2001 – Stopped sorbent injection.
2200 – Left site.

9/7/05
Travel Denver, CO to Newark, AR.
1500 – TC & BH arrive on site. Set up and leak checked the TEOM and downloaded CPM data. TEOM and CPM do not appear to work off same computer.
1800 – Depart site.

9/8/05
0800 – Arrive on site.
0930 – TEOM acting up. Get it working properly at 12 pm.
1100 – Begin injecting Hg-LH at 3 lb/MMacf in front of field 5 with plant at full load at 1015.
1500 – Increase injection rate to 6 lb/MMacf. Two spikes in CPM and TEOM data during this period. Looks like it was related to rapping, but unable to determine source exactly.
1900 – Injection stops when super-sack depletes. Gather data.
2000 – Depart site.

9/9/05
0830 – Arrive on site.
0900 – Load DARCO Hg on Porta-PAC
0930 – Change filter on TEOM and start test
1025 – Calibrate Porta-PAC for 76 and 156 pph, start feeding DARCO Hg at 3 lb/MMacf in front of field 5 with plant at full load.
1430 – Increase injection rate to 6 lb/MMacf.
1550 – First low hopper alarm.
1640 – Shut off DE rappers fields 5 and 7. CE rappers on odd side do not energize. Operator manually turned on CE 2, 3, and 4 and all three turn on.
1655 – Second low hopper alarm. Bag is not dropping correctly. Don't think we are losing sorbent flow yet.
1825 – Sorbent out.
1830 – Manually rap field 7 (DE 7, 8)
1831 – Manually rap field 5 (DE 5, 6)
1835 – Finish rapping DE.
1835:45 – Rap CE 4.
1837:00 – CE 4 off, rap CE 3.
18:39:08 – CE 3 off, rap CE 2.
18:40:00 – CE 2 off. Opacity spiked at 58 instantaneous, hit 31 6-min. Each rap cycle above caused a spike. CE 3 and field 5 (DE 5, 6) the highest.
1846:38 – CE 1 on.
1847:00 – CE 1 off. Spiked to 25.
1930 – Began shutting down all equipment.
2030 – Departed.

9/27/05
0800 – TC, JA, BH onsite
setup

9/28/05
0800 – TC, JA, BH onsite
baseline testing

9/29/05
0800 – TC, JA, BH onsite
baseline testing

9/30/05
0800 – TC, JA, BH onsite
0930 – CW onsite
1345 – Started FAS at ESP inlet.
1430 – Stopped FAS at ESP inlet.
1358 – Spent the morning installing the probe in the control side outlet duct. Analyzers have been operating fine. The outlet is reading just a bit higher than the inlet.
1530 – Collected ash samples.
1700 – Conducted staggered outlet traverse STMs. Used ports 4 and 10 at depths of 32" and 64". These depths account for the port length of 21"
1854 – Hooked up control side 3 outlet duct probe to outlet analyzer. Can't get the values to match. There appears to be an intermittent leak in the probe. Load is fluctuating. Will work on the problem tomorrow.
1900 – Left Site.

10/1/05
0800 – CW, JA, BH, CS onsite
0830 – Inlet and outlet analyzers are working fine. The control side outlet sampling train didn't stabilize over night. O2 data confirms there is a leak of some sort. Will work on the problem this morning
0845 – Prepared STM and FAS equipment for testing this afternoon. Performed various maintenance tasks.
1030 – Calibrated Porta-PAC with DARCO E10. New maximum feedrate at 200 rpm is 760 lbs/hr.
1047 – Unit is at full load.
1132 – Inlet Hg is at 9 ug/dNm, Outlet is at 10 ug/dNm.
1148 – Started DARCO E10 injection between fields 5 and 7 at 78 lbs/hr (3 lbs/MMacf) in front of field 7.
1400 – Started FAS at ESP inlet.
1456 – Increased DARCO E10 injection rate to 156 lbs/hr (6 lbs/MMacf).
1600 – Collect fly ash samples from B11, B12, B13, & B33. No ash is available in B42.
1934 – Stopped DARCO E10 injection.
2000 – Left site.

10/2/05
0800 – CW, JA, BH, CS onsite
0815 – Loaded super sack of DARCO E11 on Porta-PAC.
0817 – Noticed some particulate spikes from DARCO E10 injection yester day at 6 lbs/MMacf. This decreased as the night went on.
0900 – Analyzers are working well. Inlet and outlet control side mercury concentrations are essentially equal. The outlet test side is about 1 ug/dNm lower than the control side. The test side filter was blown back to eliminate any possible sorbent buildup on the filter.
1010 – Calibrated Porta-PAC. New maximum feedrate is 900 lbs/hr at 2000 rpm.
1208 – Inlet Hg @ about 7.1 ug/dNm, outlet Hg @ about 7.5 ug/dNm. Start DARCO E-11 @ about 78 lbs/hr (3 lbs/MMacf) in front of field 7.
1238 – Started FAS at ESP inlet.
1508 – Increased DARCO E10 injection rate to 156 lbs/hr (5 lbs/MMacf).
1605 – Collected ash from B12, B13 & B31. No ash available in B41.
1940 – Stopped DARCO E11 sorbent injection.
2000 – Left site.

10/3/05
0800 – CW, JA, BH, CS onsite
9015 – Loaded super sack of DARCO Hg on Porta-PAC.
1010 – Calibrated Porta-PAC. New maximum feedrate is 815 lbs/hr at 2000 rpm.
1140 – Started DARCO Hg sorbent injection upstream of field 7 at 26 lbs/hr (1 lb/MMacf)
1145 – Started FAS at ESP inlet.
1450 – Increased DARCO Hg injection to 78 lbs/hr (3 lbs/MMacf)
1530 – Collected ash samples.
1843 – Stopped DARCO Hg injection
1900 – Left Site

10/4/05
0800 – CW, CL, BH, CS onsite
1124 – Changed Porta-PAC maximum feedrate to 780 at 2000 rpm.
1317 – Start DARCO Hg sorbent injection upstream of field 7 at 156 lbs/hr (6 lb/MMacf).
1330 – Started FAS at ESP Inlet
1540 – Collected Ash Samples
1703 – Increased DARCO Hg injection rate to 208 lbs/hr (8 lbs/MMacf).
2137 – Stopped DARCO Hg inject
2138 – Left Site

10/5/05
0730 – BH & CS on site.
0800 – CW onsite
0815 worked on supplying compressed air to the silo. The air supply pressure is 40 psig static.
0820 – The high level switch on the silo is still alarming. The signal fuse is blown. Will work on the problem later today.
0830 – CL onsite

0900 – Started loading the silo with DARCO Hg-LH sorbent.
1304 – Started DARCO Hg-LH sorbent injection at 13 lbs/hr (0.5 lbs/MMacf).
1615 – Increased DARCO Hg-LH injection rate to 26 lbs/hr (1.0 lbs/MMacf).
1830 – CL, BH, CS left site
1916 – Stopped DARCO HG injection
1920 – CW left site.

10/6/05
0730 – BH & CS on site.
0800 – TC and CL on site.
0830 – Talked with Mike Rees, power to Porta-PAC to be disconnected this morning. Will have forklift support for Porta-PAC shipment tomorrow.
0900 – Optimization system (POS) has been turned off since 0800, 10/5. Plant is beginning to point blame on system for opacity as opposed to rapping cycles. Will have to monitor to see if that is the case.
0920 – CL changed out speed switch from Porta-PAC to silo and that fixed the problem with #2 feeder train being unable to inject PAC controllable.
0930 – Talked with Mike Rees about end of long term and ash recycle. Plant is ready to support loading silo with ash. Plant will continue to use ash with the ash handlers monitoring ash quality with the carbon injected on 1/8 of the flue gas stream.
1027 – Lost silo power when disconnecting Porta-PAC system. Reestablished new program in PLC to prevent loss of system.
1030 – CL isolated loss of air pressure to bad union fitting on silo vent filter, off to repair.
1312 – Calibrated skid feeder (train # 1). CP 20 = 734. Start injecting DARCO HG-LH @ 78 lbs/hr (3 lbs/MMacf).
1608 – Increased PAC concentration to 6 lb/MMacf for Hg-LH. PAC rate at 156 lb/hr.
1650 –Collected ash from hopper B12, B13, B22, B23, B32, B33, no ash available from hoppers B42 or B43.
1932 – Stopped PAC injection.

10/7/05
0700 - BH & CS on site.
0800 – CL and TC on site.
0805 – Porta-PAC shipment out scheduled for next Thursday. Plant ran at 530 MW through the night.
0920 – Changed out filter on test outlet Hg probe, no significant change in Hg levels. O2 cell on inlet appears to be reading high.
1000 – Snurf control side outlet filter. Wash out and results slowly recover through the day.
1030 – Inlet gold positioning fails. Recover at 1300.
1511 – Begin injecting on rear grid at 78 lb/hr (3 lb/MMacf)
1636 – Stop injecting on rear grid with outlet HgT at 2.99 ug/m3. Check calibration of feeder, injecting at 77.7 lb/hr (expected 78 lb/hr) – close enough.
1653 – Begin injecting at 78 lb/hr (3 lb/MMacf) on middle grid.
1930 Load has dropped to 625 MW. Ended carbon test and notified control room.

10/8/05
0800 – CS, CL, and TC on site.
0900 – Inlet Hg(T) sample line crystallized in chiller, other Hg(O) line OK. Clean out and repair, calibrate.
1236 – Begin injecting Hg-LH at 3 lb/MMacf, 39 lb/hr per field.
1604 – Shift to 52 lb/hr front field, 26 lb/hr rear field injection.
1824 – Secure injection.

10/9/05
0800 – CS, CL on site.
0900 – Calibrate analyzers downloaded data

10/10/05
0800 – CS, CL, and TC arrived on site.
0830 – Began calibrating analyzers. Data from previous day looks like it takes about 18 hrs and full load for the inlet and outlet Hg(T) numbers to match up.
1548 – Commence long term testing at 4 lb/MMacf concentration (104 lb/hr max flow rate).
1700 – No ash samples today as hoppers not isolated.
1800 – Hg(T) outlet slowly coming down to expected range.
2200 – Load decrease begins, sorbent appears to be following load.
2230 – Sorbent injection trending down with load.

10/11/05
0800 – CL and EZ on site.
0815 – TC on site.
0820 – Sorbent injection is running slightly higher than expected, 54 lb/hr at 400 MW (expected injection rate is 48 lb/hr).
1600 – All equipment appears to be running well. Mike Rees has called about opacity. BHAs are agreeing with plant equipment that opacity is spiking. TEOM is down hard.
1800 – TC & EZ leave site

10/12/05
0800 – SM and EZ on site.
0810 – TC on site.
0830 – Walk down equipment, all appears to be operating correctly. Recalculate injection rate, system is working fine.
1400 – Changed field 7 rapping duration from 140 to 70 seconds. 6 min opacity following rapping has reduced from roughly 20% to less than 10%.

10/13/05
0800 – SM and EZ on site.
0810 – TC and CW onsite.
0955 – Plant technician is working on the opacity monitor. Readings are not reliable at this time.
1015 – Worked on replacing the silo pressure switch.

1330 – Calibrated train 1 feeder. CP-20 was set at 734 lbs/hr at 2000 rpm. This value was left the same.
1315 – Started FAS at ESP inlet.
1349 – Collected a few ash samples.
1549 – Collected ash samples.
1700 – Leave site.

10/14/05
0800 – SM and EZ on site.
0845 – CW onsite.
0955 – Notice some small problems with analyzer operations. Will be performing minor maintenance. See analyzer logbook for details.
1700 – Left site

10/15/05
0900 – CW onsite
1000 – EZ and SM onsite.
1200 – Performed analyzer maintenance. See logbook for details.
1741 – Performed more analyzer maintenance. Mercury data is spikey and elevated at the outlet.
1742 – Left site.

10/16/05
0900 – EZ and SM onsite
1200 – CW onsite
1600 – Increased ACI to 5.0 lbs/MMacf.
1614 – After evaluating the analyzer operation and performing several trouble shooting and diagnostic tests, still cannot determine the cause of the spikey data or the elevated outlet mercury levels.
1615 – Left site

10/17/05
0800 – CW and SM onsite.
1021 – Worked on some more outlet analyzer maintenance. See analyzer log for details.
1123 – Analyzer maintenance seems to have fixed the spikey data. Outlet analyzer is currently reading 2.4 and rising due to load ramp.
1330 – Field 7 rapping schedule was changed to rap every to hours.
1700 – JA onsite
1835 – After switching the sample lines between the two analyzers, there was no change in the mercury concentrations. This indicates both analyzers are operating properly. Overboard calibrations on EMC 2 also agree. The Increase in Hg concentration observed after 10/14 at noon can only be explained by properly blowing back the filters every day. Prior to this time, the blowback procedure was not done at high enough pressures.
1900 – Left site.

10/18/05
0800 – CW, JA, and SM onsite.
1128 – Analyzers are still operating well. Today OH runs will be completed. STMs will also be collected.
1200 – Started first OH run.
1320 – Started STM at ESP outlet
1700 – Started Second OH run.
1707 – Started STM at ESP outlet
1708 – Started FAS at ESP outlet.
1830 – Left site.

10/19/05
0800 – CW, JA, and SM onsite.
1128 – EMC 2 (outlet) froze up during data download. Working on restoring operation.
1230 – Started 3rd run of OH testing.
1345 – Started STMs at the ESP inlet
1440 – Started FAS at ESP inlet.
1530 – Complete FAS.
1630 – Complete 3rd run of OH testing. Depart site.

10/20/05
0800 – TC, JA, SM and CW on site.
1000 – CW departs after turn over.
1005 – EMC-2 continues to have problems, desorb file corrupted again. Restore operation at 1020 without desorb data
1030 – EMC back in operation. Most of the data recovered.
1300 – Continuing to have removal problems, attaining 80% with 5 lb/MMacf Hg-LH is proving elusive. All indications are analyzers are functioning correctly. Could be an issue with a plugged grid or potentially a different carbon (most of the parametrics performed with supersacks, long term done with silo)
1600 – Talk with office and decide to swap from rear to front grid to verify removal and potential grid blockage.
1700 - Depart site at 5 pm.

10/21/05
0800 – TC, JA, and SM arrive on site.
0846 – Swap to front grid injection, load holding steady at 390-400 MW. Complete swap at 0850. HgT outlet levels fall from 1.9 to 1.3. Will monitor this afternoon for follow through.
1000 – Analyzers OK. Talk with office. Continue to monitor situation with Hg removal rates.
1300 – Talk with Steve Coker, plant, to discuss rapping cycle. Steve wants to keep cycle for rear grid at 2 hrs. Will discuss with Mike Rees on Tuesday concerning decreasing back to 1 hr to verify no impact on Hg removal.
1500 – Traverse outlet test side with 4 STM traps.
1900 – Depart site.

10/22/05
0800 – TC, JA, SM on site.
1000 – Analyzers OK.
1200 – Check equipment, no problems with delivery.
1830 – Depart site.

10/23/05
0800 – JA, TC and SM on site.
0830 – Calibrate and download data.
1200 – Lose feed in #1 train. Try to start #2 sorbent, but won't start. #2 blower breaker tripped, reset and started blower. Lost feed on #1 due to individual hopper legs isolating flow with 6k lbs of sorbent left. Fix after 1 5 min off-line.
1400 – Depart site.
1900 – Arrive site to check equipment.
2000 – Depart, all equipment functioning OK.

10/24/05
0830 – Carbon arrived and the starting weight was 4360.
0945 – Finished with the carbon loading with a weight of 39330.
1110 – Stopped feeding carbon, calibrated silo. Injection was running low by a small factor. Changed CP-20 to 655 from 734.

SP	Wght	Time
120	3.48	120
60	1.76	120

Changed CP-20 to 650

120	4.14	120

Changed CP-20 to 655.
1130 – Began injecting carbon.
1352 – Stopped carbon injection to shift to rear field.
1354 – Began carbon injection on rear field but it had a leak on a hose. Restarted on front field at 1400.
1403 – Changed SP in PLC to 655 since it is controlling.
1500 – Began rear field injection.
1600 – Conference call.
1700 – Continue to have problems with the STM boxes: leaks, unable to communicate, etc.
2021 – Finished STM on outlet with rear field on line.
2022 – Shifted to front grid injection.
2030 – Departed site.

10/25/05
0730 – Arrived on site. TC, JA, CL, SM
0930 – Calibrated analyzers. Performed overboards on inlet, check within 10%. Mercury calibrator use is questionable since have not succeeded in lab tests. Will begin testing on Thursday after OH runs.
1300 – Release OH crew to begin testing.
1330 – Begin run 1 of OH testing, begin BHA tuning at 1345

1545 – OH run 1 complete.
1705 – OH run 2 started.
1930 – OH run 2 complete.
2000 – Departed.

10/26/05
0730 – CL, BH on site.
0800 – TC on site.
0945 – Calibrate analyzers, blow back.
1230 – Commence run 3 of the OH. Start STMs at ESP inlet
1250 – Run CPM stack test at ESP outlet
1530 – Collect ash samples
1700 – Ran overboards on EMC 1 and 2
1800 – Left site

10/27/05
0730 – CL, BH, CW on site.
0945 – Calibrate analyzers, blow back.
1400 – Started FAS
1509 – Collect ash samples.
1630 – Left Site

10/28/05
0730 – CL, BH, on site.
0800 – CW onsite
0920 – Calibrate analyzers, blow back.
1008 – Started FAS
1201 – Removal efficiencies while injecting on the back grid (10/18 through 10/20) the removal efficiency was about 57.6%. When the new sorbent was delivered on 10/24 the mercury removal increased to 74.3% (10/22 – 10/23). After moving to the front injection grid (10/22). The removal efficiency remained the same at 73% (10/27 – 10/28).
1430 – Collected Ash samples.
1626 – Left site

10/29/05
0830 – CL, BH, & CW on site.
1747 – Worked with the Cavkit all day on the inlet and outlet analyzers. Results are described in detail in the analyzer logbook.
1802 – Left site.

10/30/05
0830 – CL, BH, & CW on site.
1038 – Increased ACI injection rate from 5.0 lbs/MMacf to 8.0 lbs/MMacf. This will be short. 3-hour test to see if Hg removal can be increased by increasing the sorbent injection rate. Prior to increasing the injection rate, the average inlet Hg concentration was

7.36 ug/dNm while the outlet concentration was 3.16 ug/dNm, representing 56% Hg removal. Boiler load is currently 740 MW and stable.
1402 – After injecting sorbent at 8.0 lbs/MMacf for a little over 3 hours, there was no noticeable increase in Hg removal. The inlet mercury concentration was at 7.12 ug/dNm while the outlet concentration was 3.23 ug/dNm, representing a removal efficiency of 55%. Decreased sorbent injection rate to 5.0 lbs/MMacf. Boiler load during the test varied between 800 and 719 MW.
1524 – Worked with the cavkit on the control side outlet throughout the day.
1530 – Left site.

10/30/05
0803 – CL, BH, & CW on site.
1326 – Spent the morning working on the analyzers. The outlet analyzer had some moisture in it due to the chiller being overloaded with flush water. The analyzer and hotline were cleaned and place back in service. The inlet analyzer gold was changed.
1327 – ColoWyo coal will be fired today. It is expected that the coal will begin hitting the boiler around 1230.
1200 – Started FAS.
1504 – Collected ash samples.
1538 – Inlet is now at 2.5 ug/dNm and the outlet is at 0.8 ug/dNm, representing a 66% removal rate.
1600 – Left site

11/01/05
0800 – CL, BH, on site.
0810 – CW and CS onsite.
0900 – Everything is working fine. The inlet Hg concentration is about 3.0 ug/dNm while the outlet is 0.08 ug/dNm.
0901 – CL left iste.
1039 – Isolated ESP hoppers to collect ash samples later today.
1330 – Started first OH run.
1331 – Started FAS and STM at ESP inlet.
1620 – Started second round of Ontario Hydros
1640 – Unit load has dropped. Control thought we were done testing for the day.
1748 – Second OH run aborted due to load variance.
1800 – Left site.

11/02/05
0750 – CS, BH, and CW on site.
1400 – Started FAS at ESP inlet
1415 – Started OH run.
1445 – Collected ESP hopper ash samples.
1640 – Completed OH run.
1710 – Left site.

11/03/05
0650 – CS, BH, on site and ready to work.
1538 – Site meeting.
1548 – Left site.

11/04/05
0730 – CS & BH on site and ready to work.
0800 – TC on site.
1015 – Return full power to ESP B electrical fields 5 and 7. Opacity immediately decreases.
1627 – Stop injection to calibrate.
1645 – Start injection at 3 lb/MMacf. Calibration: 120 lb/hr feedrate – 2 min – 4.05 lbs: OK
1730 – Left site.

11/05/05
0720 – CS & BH on site and ready to work.
0820 – TC on site.
17:30 – Left site

11/06/05
0730 – CS & BH on site and ready to work.
0825 – TC on site. Train 1 has had two hopper fill alarms but still putting ACI in. Silo wt at 4500 lbs, will need to switch legs here shortly.
1630 – Left Site

11/07/05
0750 – CS & BH on site and ready to work.
0815 – TC on site. Feeder 1 tripped at 0520 due to low hopper level. Calibrated and began feeding on Train 2 at 0845. Cal: 120 lb/hr feedrate (manual) – 2 min – 3.87 lbs.
0930 – Informed by Mike Rees that ColoWyo is on the conveyor belts and will be fed for some period of time – until Wednesday.
1305 – Turn off ESP B electrical field 5.
1450 – Refill silo with recycle ash without blowing it up to 17,600 lbs.
1713 – Increase injection rate to 5 lb/MMacf.
17:35- CS & BH leaving site
1845 – Reenergize electrical field 5.
1850 – West (Test) CPM is not functioning correctly.
1900 – TC departs site.

11/08/05
0730 – CS & BH on site and ready to work.
0800 – TC on site. Shifted injection to Train 1 and sampled Train 2.
0900 – Test side BHA back on line. Needed to be reset for some reason. Will continue to monitor.
1327 – Shifted to Train 2 and sampled Train 1.
1511 – Shifted to Train 1. Feeders off-on train #2. Leaking oil from Train 2 rotary gearbox. T/S and find that gear box fill cap is plastic and the threads are worn. Valve was running for

an 1.5 hr, gear box got hot, oil expanded and ran out through cap which cannot maintain a tight seal. All other components appear to be working OK. Will check to see why hopper would not fill. Train 1 seems to be feeding OK.

11/09/05

0720 – CS on site and ready to work. SM on site.
0815 – TC on site. Lost opacity and all CEMs inputs into computer yesterday at 10 am.
1000 – Shift to Train 2 feed after filling hopper. Had to mechanically agitate silo. Began calibrating Train 1:
Run 1: 120 lb/hr designated feedrate – 2 min – 9.45 lbs = 283 lb/hr.
Change Feedrate SP to 755 from 655
Run 2: 60 lb/hr – 2 min – 4.23 lb = 126 lb/hr
Change Feedrate SP to 855 from 755
Run 3: 60 lb/hr – 2 min – 3.67 lb = 110 lb/hr
Will assume feedrate is doubled using this sorbent combination.
1145 – System back on line. Feeding at 1 lb/hr on Train 2. PLC faulted twice, Train 1 will not come up to discharge pressure.
1200 – Regain CEMs data.
1201 – Ash recycle is full in (now feeding from) at the silo.
1330 – All TEOM gear down except for box.
1615 – T/S train 1 discharge motive pressure. Blown gasket. Tighten to increase discharge pressure to 7.5 psig. Lost sorbent feed at 1630 temporarily.
1715 – Depart.

11/10/05

0740 – SM, EZ, TC on site.
0830 – Shift to Train 1 feeding at 1 lb/MMacf (0.5 lb/MMacf indicated).
Train 2 calibration: 15 lb/hr feedrate SP – 5 min – 2.04 lb = 24.5 lb/hr. Both sides holding at twice indicated feedrate.
1000 – Train 1 had a bridge problem, had to bang on silo to release sorbent into the hopper. Looks like ash-sorbent compacts much more readily than carbon by itself. Density may be an issue there.
1000 – TC left site.
1030 – Replaced outlet test side probe.
1120 – Started FAS.
1300 – Completed FAS.
1330 – Trends in Total Hg concentrations seem to be consistent with coal changes (to ColoWyo on 11/7 and back to PRB on 11/10). Outlet measurements seem to be increasing very slowly to 4.5 ug/Nm3 (40% removal). Increase not believed to be related to probe change. Need to wait and be sure it is stabilized for proper study.
1530 – Removal rate continued to decrease to 16%.
1632 – Increased injection rate to 2.0 lbs/MMacf.

11/11/05
0800 – SM, EZ, CW on site.
0916 – Switched operating trains on the silo. Had some trouble starting the blower. The breaker keeps tripping in and out.
1130 – Started FAS
1315 – Collected ESP hopper samples.
1423 – Eductor suction pressure is getting lower and lower as the day goes on. Blower pressure is also increasing. Could be due to some plugging. At the start of train 2 injection, the blower pressure was 9 psi. Now the pressure is 10 psi. The eductor suction valve is slowly being closed to ensure eductor suction pressure. Need to keep a close eye on blower performance.
1450 – Switched to train 1. Collected sample from train 2.

11/12/05
0830 – SM, EZ, CW on site.
0831 – Skid experienced some hopper fill malfunctions last night. Fixed itself.
0840 – Increased ACI to 4 lb/MMacf.
1015 – Switched train 1 and 2. Collected sorbent sample from train 1. Train 2 eductor suction pressure is 2" H2O wile the blower discharge pressure is 10.25 psi. Watch this today to see if eductor is plugging.
1041 – Starting ESP outlet staggered STM traverse.
1234 – Started FAS.
1350 – Stopped FAS.
1400 – Completed last STM run at ESP outlet.
1450 - Train 2 eductor suction pressure is 2" H2O wile the blower discharge pressure is 10.25 psi.
1450 – Left site

11/13/05
0830 – SM, EZ, CW on site.
0831 – Train 2 tripped off on low eductor suction pressure at 1730 on 11/11. Will investigate.
1121 – There is very little suction on the eductor suction port. After comparing the filed 7 grid to the field 5 grid, it appears that the filed 5 grid is plugged. After looking at the sorbent trend it appears the skid started and stopped for about an hour as the eductor suction increased and decreased. The grid was pulsed with compressed air and also sucked on using an eductor. Some of the grid has been cleared up.
1124 – Restarted injection on grid five at 6.0 lbs/MMacf. The eductor suction pressure has been adjusted to 2.0 in H2O while the blower discharge pressure is 11.0 psi. These values will be watched throughout the day.
1400 – Measuring inlet and outlet total Hg on EMC 1.
1423 – After throttling down the eductor port, still continuing to have eductor suction pressure alarms. Stopped train 2 feeder.
1608 – Left site.

11/14/05
0800 – SM, EZ, CW on site.
1000 – SM dismantled the outlet control assemblies.
1340 – Started emptying silo into the ESP inlet. Both trains are operating. Feeding at approximately 600 lbs/hr. Train 1 is running at 225 lbs/hr while train 2 is operating at 375 lbs/hr due to the blower leak on train 1.
1600 – Started to reassemble probe, taken from the outlet control and shortened the probe length to 48". This was placed in the port next to the outlet test probe.
1800 – Completed building the probe and assembly.
1815 – Installed two probes on the test side outlet duct. On probe is into the duct 50", the other probe is into the duct 26 inches. The total duct depth is 76 inches.
2341 – Finished unloading and loading silo
2359 – Left site.

11/15/05
0800 – SM, EZ, CW on site
0815 – Vacuumed injection grids using a sucker truck. There is some indication that the grids were cleared up because the vacuum would decrease during the process. Each grid was sucked for 10 minutes. There is also more suction observed on the injection grids.
0930 – SM left site for airport.
1108 – Fixed test side CPM 5000. The controller needed to be reconfigured.
1334 – The vacuum truck seems to have cleared the front grid up somewhat. Suction on the rear grid and front grid are essentially equal. When connecting the hoses to train 1, the eductor suction pressure without the blower running is 1" H2O for both trains. When comparing the suction upstairs, all four grids have about the same suction.
1335 – Filled train 2 hopper with sorbent. This is 100% DARCO Hg-LH. Train 1 hopper may still contain some recycle material. Will need to calibrate both trains after the sorbent has defluidized.

APPENDIX C2: EPRI Extended Test Log—March 11, 2006

EPRI Extended Testing Log

11/16/05
0730 – CW and CS on site. Install plugs for measuring system pressures.
1645 – TC on site.
1730 – Talk to operators. Begin to prepare system for start up.
1839 – Begin injecting from Train 2 on Field 5 grid at 4 lb/MMacf with Hg-LH. ESP B fields 5 and 7 running at full power, unit running at 840 MW. Initial inspection seems to be everything OK.
1915 – Depart site.

11/17/05
0730 – CS on site.
0810 – TC on site. Injection working fine.
0850 – T/R B-5 turned off.
1146 – Calibrate train 1:
1.7# – 60 lb/min – 2 min – 735 SP
3.5# – 120 lb/min – 2 min – 735 SP
4.1# – 90 lb/min – 2 min – 700 SP
1149 – Turn off train 2 and start train 1 feeding from silo.
Check calibration on train 2:
2.5# - 90 lb/min – 2 min – 735 SP
Injection concentration was running 18% low. So injection concentration of 4 lb/MMacf was actually 3.25 lb/MMacf. Need to check against silo weight usage rate.
Since about 9 am, chiller on inlet froze and CS has been working to repair.
1500 – Analyzer fully functional again.

11/18/05
0730 – CS on site.
0815 – TC on site.
0830 – Plant load is at 800+MW and inlet HgT running at 3.6ug/m3. CS beginning to find out cause of problem. Outlet is running at 2.7 ug/m3, with 4 lb/MMacf injection, should be a good number or close to it.
0855 – Increase injection rate to 5 lb/MMacf on Train 1. ESP T/R set B-5 still off line.
0930 – Looking at analyzer data, the inlet is reading significantly low for load. Isolate cause to the “A” channel isolation valves scrubbing. CS to clean.
1300 – Everything appears to be running correctly.
1600 – Change out a Balston filter and add another impinger to inlet train. Still getting some scrubbing on the inlet.
1900 – Depart site, data looking OK.

11/19/05
0730 – CS on site. Equipment running well.
0830 – TC on site. Update ftp site.
0915 – T/R set B-5 back on line.
1120 – Switched to both channels on outlet

1400 – Duct tape patch covering newly tapped holes came off on far lance. Smelled carbon and found small pile of carbon. Repatched hole.
18:00 – CS left site

11/20/05
0730 – CS on site. Analyzers running well.
0930 – Test side CPM reading zero. Rebooted and started back up.
1730 – CS left site

11/21/05
0730 – CS on site. Analyzers running well.
1058 – updated FTP
1135 – Switched Channel A on the analyzer to the Outlet.
1325 – Switched back to Inlet, analyzers correlate well.
1455 – Stopped sampling, began shutdown procedures
1616 – Stopped carbon injection. Notified that plant has tube leak and will be shutting down as well.

11/28/05
TC and CL travel to site.
1545 – TC on site. Bump start all silo equipment, walk down site.
1730 – Depart site.

11/29/05
0730 – CL on site. Begin assembling the analyzer.
0745 – TC on site. Prep silo for start up. Talk to Mike Rees, ID fan for A-C ESP is down, unit 2 limited in power.
1500 – Analyzer on line.
1648 – Begin injecting at 6 lb/MMacf. Plant is only running on one ID fan, so air flow is high for indicated power. Removal rates should be low. Prior to sorbent start, Pressure at the grid is (-)3.5" w.c. for both injection posts on grid between field 3 and 5.
1800 – Departed site.

11/30/05
0745 – TC and CL on site. Analyzers running fine.
1008 – Increase indicated injection rate to 10 lb/MMacf.
1425 – Shift to Train 2 injection. Check calibration.
Train 1 – 2 min – 150 lb/hr – 5.07 lbs
Train 2 – 2 min – 150 lb/hr – 4.84 lbs
1452 – Tripped Train 2 on high blower discharge pressure. Reset and restarted, looks OK.
1520 – Lowered B-7 power to 50%.
1715 – Departed site.

12/1/05
0745 – TC and CL on site. With B-7 off for the night, no apparent problems with opacity. Overall opacity levels did rise slightly, from below 5% to above 5%.
1047 – Increased injection rate to 12 lb/MMacf (430 MW=190 lb/hr). Pressures at injection grid penetration at (-)0.5 in (W) and (-)0.2 in(E) w.c.
1615 – Departed site.

12/2/05
0745 – CL on site.
0830 – TC on site. Inlet drain line leaking. Repairs underway.
0953 – Increased indicated injection concentration to 15 lb/MMacf. (237 lb/hr)
15:30 – Plant is installing ID fan motor
16:47 – Reduced injection to 5 lb/M

12/3/05
0730 – CVL on site. ID fan has been installed and load is ramping up. It appears from the opacity trace that the fan was put into service around midnight.
1340 – Unit went to 744 MW for an hour or so and then back down to 370 MW.
1400 – Unit holding ~ 400 MW. Injection rate is 5 lb/M (78 lb/hr). Removal is 70%.

12/4/05
0730 – CL on site. Unit is ramping up to full load. Injection rate remains at 5 lb/M. Injecting 113 lb/hr.
1030 – Unit load back down to 375 MW. Injecting 78 lb/hr.

12/5/05
0645 – CL on site. Unit is ramping up in load. Injection rate remains at 5 lb/M.
7:00 – Problems on inlet and outlet sample trains.
0830 – Load of carbon onsite to unload
0915 – Begin unloading carbon
0930 – Working on sample problems
11:20 – Carbon fill complete. Analyzer is still off line.
14:00 – Leaving site. Lots of problems remain (see lab notebook). Chad to come in later.
17:00 – Chad arrived on site to fix equipment.
18:15 – After thorough assessment determined that it is not possible to get either inlet or outlet operational. Partially covered both locations with tarp.

12/6/05
0900 – Low pressure alarm activated. Airline to skid improperly connected. Reconnected to dry air line. Valve also left open on line behind fill line.
0730 – Arrived on site Injection rate remains at 5 lb/M.
1915 – Leaving site

12/7/05
0720 – Arrived on site. Steve arrived to assist Chad in fixing everything. Injection rate remains at 5 lb/M.

12/8/05
0730 – Arrived on site. Injection rate remains at 5 lb/M.

12/9/05
0730 – CS Arrived on site. Injection rate remains at 5 lb/M.
1500 – Increasing injection rate to 6 lb/M

12/10/05
0730 – Arrived on site. Injection rate remains at 6 lb/M.
1403 – Increased injection rate to 7 lb/M

12/11/05
0800 – Arrived on site
1150 – Noticed that test side CPM is not responding. Will cycle power after lunch.
1300 – Cycled power on CPM, no change
16:26 – Increased injection rate to 8 lb/M
17:08 – After discussing Hg levels w/ Tom C. Decided to decrease injection rate to 5 lb/M

12/12/05
0745 – CS, PB and SM on site
1430 – Brignac, Sapp use scale in plant Chem Lab to mix sorbents for high load SSD testing
1600 – CS leaves site
1730 – PB, SM leave site

12/13/05
0715 – PB and SM on site
0800 – ACI rate at 5#/MMacf. Per Todd Blackberry Unit can't hold full load for very long this AM. Will get us 5 hours at full load this PM for STM tests.
0830 – Move outlet probe equipment to access sample port for STM traverse, standby for full load notification. Received notice will have full load from 6–10 PM tonight.
1100 – Pressures at injection grid penetration at (-)2.0 in (W) and (-)3.0 in(E) w.c., but at low load 369 MW.
1330 – Upload to FTP. Modrak prepares sample tubes for SSD
1800 – Start STM traverse; 3 different ports, two depths at each port.
2000 – Pressures at injection grid penetration at (-)4.0 in (W) and (-)4.50 in(E) w.c., but at high load 875 MW
2200 – Finish STM traverse; pulled ~ 25 liters through each trap.
2215 – PB and SM leave site

12/14/05
0500 – SM on site. Plant starts ramp to full load. Today plant will hold full load from 6 – 10 AM, and then again, from 6 – 10 PM.
0530 – PB on site
0600 – ACI rate at 5#/MMacf. Plant at full load. Modrak starts 1st SSD

0800 – Todd Blackberry calls to let us know plant will be switching to ColoWyo fuel, sometime early this afternoon. Todd was informed that high load from 6 – 10 PM today was not required.
1000 – Sorbent screening tests complete. Plant comes off load.
1200 – SM leaves site to travel home.
1400 – Traps from high load STM traverse packaged for shipment to Frontier. Original run sheets placed in folder in ADA trailer.
1500 – Resend daily data to FTP site. Site was full earlier today.
1600 – PB leaves site

12/15/05
0800 – PB on site. Plant ramping down from full load. ACI remains at 5#/MMacf.
0900 – Hg numbers very low on inlet and outlet. Plant must be burning ColoWyo.
1000 – Upload to FTP. Pack and ship SSD samples to ADA via UPS.
1400 – 18600# in Silo
1600 – Talk to Tom C
1620 – Restart test side BHA. Low value indicates rescaling necessary
1700 – PB leave site

12/16/05
0800 – PB on site. Plant ramping down from full load. ACI remains at 5#/MMacf.
0900 – Hg beginning to climb back up, indicating ColoWyo coal has worked its way through the system.
0930- EMC-2 Locks up on data download. Replace with EMC-1. Last HgT on EMC-2 screen was `7 inlet, 3 outlet (corr)@ low load.
1200 – Enter new "B" coefficient (value=20) into test-side BHA panel. Now matches control side.
1700 – Left site

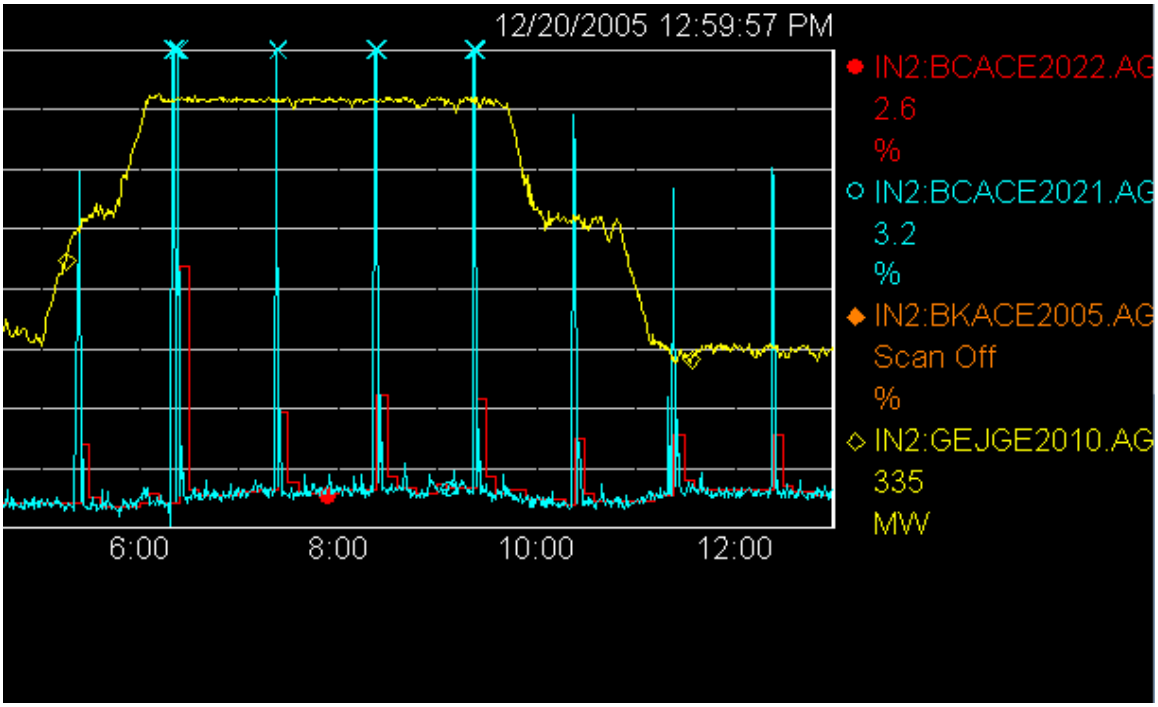
12/17/05
0730 – PB on site. Plant ramping down from full load. ACI remains at 5#/MMacf.
0830 – Hg ~10+ inlet, 4+ outlet. EMC-1, definitely back in PRB
0900 – Had to stop and start CPM test side due to Temperature fault.
1000 – Couldn't create plant data sheets for missing days 11/21 – 11/27. All cells "no good data available". PI data files may not hold that far back. Tom to check on this.
1249 – ACI to 8#/MMacf. Unit at low load; no opacity spikes
1630 – 13700# left in SILO, still running 8#/MMacf
1700 – left site

12/18/05
0730 – PB on site. Plant ramping up to full load. ACI remains at 8#/MMacf. Opacity is acceptable.
0830 –Cycle power on test side CPM to clear temperature fault. Spend much of the day, leak checking analyzers, impingers because 02 on "A" is high. Sometime during that process, the inlet Hg readings started coming in lower than expected, so am thinking about installing a clean sintered filter tomorrow AM. When blowing back the filter witnessed wet brown ash

coming out calibration port. It's a little slow doing all this by yourself, but hope to be ready for test of ACI into field 7.
1800 - left site

12/19/05
0730 – PB on site. 836 MW. ACI remains at 8#/MMacf. Opacity is acceptable,
0830 – Start changing sintered filter on inlet probe
0930 – Talk to Todd Blackberry about injecting into Field 7 this PM. He said he would talk to Steve Coker about doubling the rapper frequency and disabling POS system. So far 8#/MMacf has not shown any negative effects to the ESP.
0945 – Continue trying to change filter. Had some thread galling issues, the elevator was locked out, or out of service, and other minor things so finished at 1130
1130 – First two scans on inlet 8.9 and 8.7 corr, were 3.2 before changing filter. Still at low load, 380 MW. outlet still okay.
1430 – Stop train 2. Reconfigure hoses for two trains into unit 7 (was 112#/hr for 8/MMacf 360 MW, single train). Baseline dP injection lances both -4 "wc
1500 – Inlet Hg climbing, now 11.5 corr, analyzer calibration very good.
1519 – Both trains running at 3#/mmacf each (44#/hr each) Train#1: 8 psi blower, 1" eductor vac, 123 rpm@44#, Train 2; 10 psi blower, 1.5" eductor vac, 120 rpm@44
1630 – Restart BHA. Work on outlet probe. HgTin 11.25, HgTout 2.4
1800 – Upload data
1830 – Leave site

12/20/05
0730 – PB on site. 838 MW. ACI remains at 3#/MMacf/train. Train 1 hopper is empty this AM. Train 1 injection stopped at 1240 AM, therefore we got 9 hrs and 20 minutes at the 6# rate into field 7, before we lost Train 1. Agitated the pants leg and rotary valve, but still no flow. Also back seal on train2 rotary valve is blowing carbon when operating. Opacity is acceptable. 6 min avg spikes to 10 when rapping.
1020 – Both trains now feeding. The carbon finally began to flow after agitation. This kind of maintenance procedure would not be desirable in a commercial system.
1050 – 5000 lbs left in Silo.
1120 – (-) 4" east injection grid, -5" west injection, 10.8 HgTin corr, 3.80 corr out
1243 – ACI to 8#/MMacf



1420 – Outlet showing unusual spiking

<u>12/20/05</u>
0730 – Arrived onsite. Plant at full load. Injection at 8#/MMacf
0800 – B1 (outlet SnCL2 impinger) is dry this AM. Pump lost suction because 13 ga tygon got loose in ¼" PFA tube in the Stannous jug sometime over night. Since everything was flowing when I left site yesterday, I don't think yesterday afternoons spiky data could be attributed to this.
0810 – Refilled Stannous impinger, replaced feed tubing
0837 – Train 2 hopper empty. So injection down to 4 #/MMacf
0920 – Stopped Train 1. Carbon Injection now 0.
1140 – Stop analyzer, download data.

<u>1/18/06</u>
0730 – CS, CL on site
0800 – Plant coming off-line until Friday. Going to fix lance problem today and tomorrow.
0900 – Received carbon shipment from Norit
12:30 – The plan for getting the work done in the ESP is as follows

The ESP should be cool enough to enter by ~15:00 The crew will install the scaffolding and cut out the bottom 2/3 of the lances. The super sucker will arrive at 5:00 in the morning to get the grid sucked out

Tomorrow TC will be on-site tomorrow to supervise the new lance installation.
1630-Left site

1/19/06
0700 – CS, TC on site. The ESP was not ready to enter by 17:00. Plant pushed off work until today to give the ESP more time to flush out.
0900 – Plant team enters ESP, cuts off field 5 injection grid lower lance section. Most lances fully plugged above the ¾ to ½ in transition point.
1200 – Finish rodding out lances. Lances which are end of horizontal distribution tube on each grid furthest from door still appear to have plug problems. But may be caused by carbon in the horizontal distribution leg. Unable to clear. Good enough for testing.
1400 – Inspect field 7 grid after field 5 grid welded back together. Some lances probably plugged above lower transition, most are clean to bottom.

1/20/06
0700 – CS Arrived on site. Plant not generating any MW yet. Seem to be firing up boiler by heavy opacity problems
1430 – Plant started to produce MW, stopped venting stream
1630 – Plant at 269 MW. Talked to control room. Since there is no call for load they are going to step it up and down all night and into tomorrow most likely.

1/23/2006
07:30 – CS arrived on site.
12:20 – Started carbon injection at 1.5#/MMacf on both trains

1/24/06
0715 – CS and CL on site
1347 – Train 2 level alarm on site activated feed rate at zero.
14:00 – 16:00 – Problems with the silo feed. Train 2 hopper did not fill. Carbon may have hung up in the pant leg. Beat on the pant leg with the rotary valve in manual until the hopper was filled. While working on train 2, train 1 blower tripped on low motive air. When blower 1 was restarted the pressure was only 5 psi (8-10 being normal). Fiddled with the plastic pressure relief valve among other things and got the pressure up to 6 psi. Reset the lower trip point to 5 psi and restarted the train. (Checked blower 1's pressure against blower 2's pressure gauge and it was 5 psi) Attempted to restart train 2 but the blower would not start. Fearing problems with the controller or RS view, restarted the computer and cycled the skid power. The problem did not go away. Found the breaker inside the control panel for blower 2 tripped. Reset the breaker and started train 2. Blower tripped off again on low motive air. This time the problem was that the pressure was slightly over the high set point (10 psi). Raised the high set point to 11 psi and restarted the train.

At this time blower 1 is operating at 6 psi and blower 2 is at 10 psi. No explanation as to why things fell apart the way they did.

16:10 – Increased injection rate to 3.0 #/MMacf on both trains.

1/25/06
0725 – CS, BH on site
Train 2 stopped feeding in middle of night. Alarm sounded at 11:47 PM
I changed the settings on the test BHA per Dave's instructions. Set 4-20 ma loop to trailer to 250 mg/m3. (CVL)
1800 – BH left site. CVL will be starting STM sampling at ESP inlet, ports 4, 7, &10.

1/26/06
0710 – BH on site. CVL on site early to start STM sampling at ESP outlet, ports 4, 7, & 10.
1015 – Plant informed us that they had to drop load. We will have to finish port # 4 at high load tonight between 1800 – 2200 hrs.
1830 – Load at 743 MW. Start sampling at Port # 4 (ESP outlet).
2000 – End STM Test.

1/27/06
0730 – BH & CVL on site. Ship STM boxes to Conesville.
0800 – CL left site.
Plant had been running at high load (~800 MW) this morning from about 0600 to 1000, then dropped load to about 250 MW most of the day. Hg removal has been fairly high (~80%) during this period.
1630 – Left site.

1/28/06
0730 – BH on site.
1200 – Changed out SnCl2 impingers and cleaned out sample line between last impinger and chiller (both inlet and outlet). During this time (~0930 to ~1030 hrs) plant switched to ColoWyo coal.
1530 – Finish transferring data.
1600 – Left Site

1/29/06
0800 – BH on site.
1200 – EMC computer had locked up over night. I hooked up hyper terminal to diagnose the fault. The diag2 file was corrupt, deleted file and calibrated analyzer.
1302 – Train 12 hopper fill malfunction alarm on silo, train 2 @ 0 PPH. Started carbon flow through silo cone, into hopper with a few smacks of a hammer. Acknowledged the alarm.
1315 – Current feed rate = 59 PPH train #2, 56 PPH train #1. Boiler load at 571 MW.
1500 – Left site

1/30/06
0700 - BH on site. Silo seemed to run well all night, no alarms.
1215 – SnCl2 drain line @ ESP outlet ruptured overnight. Changed out all tubing at ESP in and out and leak checked. No leaks detected.
EMC running well, not seeing a lot of change in Hg at ESP outlet. ESP inlet Hg seems to follow the load fairly well.
1300 – Silo mid-level alert alarm. Currently at 20,310 lbs (18% full)?
1630 – Left site.

1/31/06
0700 – BH on site. Silo running well, no alarms overnight. Currently feeding at ~77 lbs/hr (train #1 & #2), plant at 800 MW.
1215 – EMC computer locked up this morning just before calibration. Found 2 bad files, diag1 & desorbc. Deleted both files. EMC is running well for the time being.

2/01/06
0730 – CS and BH onsite. Train 2 hopper fill alarm sounded at ~5:30. Fixed at 7:45
0753 - Trian #2 fill alarmed again. Had to hammer on cone to free up carbon flow.

2/02/06
0730 – CS arrived on site. Carbon getting low, estimate about 5 days worth.
18:00 – Leaving site. Just watched the control room ramp from 575-850 MW in 15 min…wow.

2/03/06
0730 – CS arrived on site. Switched from EMC2 to EMC1.

2/04/06
0730 – CS arrived on site. Nothing noteworthy, things just ran smooth

2/05/06
07:30 – CS on site. Hg levels really low, but trending nicely. Checked w/ control room switched to ColoWyo at ~4 am hit the boiler at ~8 am. Train 2 malfunction alarm sounded at 13:15. Agitated to see if that works.

2/06/06
07:05 – Arrived on site. Train 2 fill malfunction alarm sounded at 6:57.
13:00 – Increase injection to 8#/MMacf

2/07/06
07:15 – Arrived on site
15:00 – Noticed that there is carbon coming out of the rotary valve. Travis is ordering new bushings.
% removal about 80%

2/08/06
0730 – CS & BH on site.
1100 – Did overboard calibrations on inlet and outlet, both were well within the 20 % range.
1200 – Fixed the leak on train # 1 rotary valve by tightening the packing gland. I believe the packing will still need to be replaced at some point.
1400 – The d.p. at ESP inlet (across probe) still high (~130” H2O). Replace filter.
1700 – The entire ESP inlet sample equipment has been cleaned/replaced. D.P. now at ~30” H2O.
1800 – Left site.

2/09/06
0715 – BH on site. Train #1 has a "Eductor Suction Pressure Low" alarm. Train #2's pressures are 6.5 PSIG (blower discharge) & -1.0" H2O @ eductor, train # 1's pressures are 10.5 PSIG (blower discharge) & -1.5" H2O. The first alarm was at 1:45 AM and the second was at 5:40 AM. Current feed rate on train # 1 is 102 lbs/hr.
0740 – Boiler load currently at ~885 MW and steady since ~0620.
0900 – Boiler load down to ~450 MW
1430 – Eductor pressure alarm has alarmed several more times today. Closed down gate valve at eductor to increase pressure to -2.5" H2O.
1640 – Train # 1 Eductor Pressure low again. A large cloud of carbon could be seen coming from the screw outlet. Will shutdown train #1 as per Travis S. and Dave M. I am also stopping Train # 2. Will switch hoses so that train # 2 will feed the center of the ESP, closest to where we are sampling.
1650 – Train # 2 on, feeding center of ESP field 5, rate currently @ 71 lbs/hr (4 lbs/MMacf).
1706 – Carbon feed off. Carbon is leaking around fitting where it enters the ESP.
1830 – Disassembled the blower outlet (silencer?) on train # 1. It appears that there is a gasket missing that was causing the leak?
1845 – Will let EMCs run overnight with no carbon injection.

2/10/06
0715 – BH on site.
1000 – Removed silencer on blower # 1, one of the bolts is seized, the alignment pins are broken and there was no gasket.
1015 – Lowered pressure to solenoids on silo cones to 60 psi and 30 psi as per Travis S.
1035 – Carbon on through train # 1 @ 4 lbs/MMacf to centermost field five injection port. There was a loose pipe fitting that was causing the leak observed yesterday, after fixing that, no leak can be seen.
1130 – Plan to operate train 2 @ 4 lbs/MMacf until blower on train 1 is fixed. I discussed possible solutions with Cody W. We are going to try sealing the silencer back up with some sort of epoxy/silicone depending on what material can be found locally.
1510 – Train # 2 alarming at low eductor pressure now.
Carbon feed off, need to re-pressurize air system after pressurizing bag filter on silo.
1600 – Re- Zeroed the eductor photohelic, it was reading ~ + 2" H2O. Carbon on @ 4 lbs/MMacf trough train # 2, photohelic reading -2" H2O. The blower discharge pressure is at ~10 PSIG.
1640 – Carbon seems to be feeding well, but with the troubles experienced lately, will shut carbon off overnight just to be safe.
1700 – Left site.

2/11/06
0730 – BH on site. Train # 2 on @ 4 lbs/MMacf to field 5. Boiler load at ~560 MW. Blower discharge pressure @ ~ 10 PSIG, eductor vacuum @ ~ -3" H2O, draft control valve at eductor is 100% open.
1430 – Train #1 on at 4 lbs/macf. Drilled and taped the bad bolt on blower discharge. Was able to find new bolts locally. Blower discharge pressure @ 9.5 PSIG, eductor draft @ -1" H2O with control valve open 100%.
1630 – Silo trains running well. EMC's indicating ~ 80 % Hg removal. Leave site.

2/12/06

0800 – BH on site. Both trains are still running. There were two hopper fill malfunction alarms over night, both sides. The interruption must have been very brief because there was no feed interruption.
1030 – EMC running well, ran diagnostics, the desorb curve had gotten low (~1100 mv) overnight, but seemed to recover (~1500 mv) after blow back and calibration.
1100 – Downloaded data to ftp, trains running well, no alarms.
1130 – Left site.

2/13/06
0730 – BH on site. There were two train # 2 fill malfunction alarms early this morning (~0600). Neither caused a feed interruption. The test side BHA is not functioning properly. Will investigate.
1010 – BHA on line. The settings file was changed unintentionally during a data download attempt the other day. The settings have been restored.
1430 – The silo vent filter pulse valves are operational. The pulse valves may have been plugged with something that was causing them to stick open or simply frozen. I let the pulse valves cycle for a few minutes before turning on air pressure, not sure if this makes a difference or not.
1530 – Upload data to ftp.
1630 – Left site.

2/14/06
0700 – BH on site.
1100 – Have had Silo vent filter pulse air on all morning to clear filters out (hopefully). Turned off @ ~ 1100 hrs.
1430 – Upload data to ftp.
1600 – A package needs to be delivered to UPS for shipment to Dickerson. Leave site.

2/15/06
0700 – BH on site.
1500 – Upload data to ftp.
1530 – EZ on site.
1715 – BH and EZ leave site.

2/16/06
0807 – EZ on site.
1630 – EZ left site.

2/17/06
0820 – EZ on site.
1030 – Turned on the silo vent filter pulse valves in anticipation of a carbon delivery this afternoon. Waited a few minutes and then turned on the compressed air.
1100 – Turned off silo vent filters and compressed air. Alarm for low air pressure would repeat after alarm reset until I turned them off.

1230 – Notified that the sorbent truck might not arrive until 1700-1800.
1630 – Uploading data files to the FTP.
1730 – Carbon sorbent shipment arrives. Activate silo vent filter but keep getting alarms for low compressed air pressure. Then start getting alarms for high silo DP. Started at approx. 6800 lbs.
1835 – Done. Put in just about 35000 lbs, maybe just a little less but I called it off after it looked like it was just blowing around instead of going into the silo near the end of the refill (weight was not changing). Silo weight is now 40310 lbs. Stopped the silo vent filter thing.
1845 – I'm gone.

2/18/06
0837 – EZ on site.
EZ do some EMC stuff. Try to coordinate with the plant to increase the injection concentration to 10 lb/MMacf at a high load. Plant dropped load from 850 MW to 600 MW at 1000. Never went back to high load. Will try to coordinate tomorrow, if possible.
1500 – EZ leave site.

2/19/06
0815 – EZ on site. There were a few Train 2 Hopper Fill alarms at 1900 and 0200. Checked the trending log and noticed no decrease in sorbent injection.
0830-1215 – Both inlet and outlet analyzer chemicals froze in multiple locations yesterday evening and overnight. The analyzers finally started sampling a little after 1200. Removal was approx 78% (O2 corrected). That has been normal. Also looks like the plant has not increased to full load (> 750 MW) all day so far.
1730 – Upload data to the FTP site. EZ leave site.

2/20/06
0810 – EZ on site. Check out analyzers. EMC was flooded, hotline was full of chemical, two probes sucked in their impinger contents. Spent all day working on that, details in the analyzer log.
2045 – Analyzers are working again. No data download today because there's nothing to see. EZ leaving site.

2/21/06
0811 – EZ on site. Analyzers look okay. Removal is at 75% at high load 880 MW but there was some minor scrubbing at the inlet.
1100 – Internal project conference call.
1350 – Analyzer check OK.
1400 – External project conference call.
1415 – Upload data to FTP.
1600 – Analyzer check out OK.
1607 – Shut off Rotary Valves and Feeders of Train 1 and Train 2.
1615 – Shut off Blowers of Train 1 and Train 2. 26,350 lbs of Hg-LH in the silo.
1645 – EZ left site.

2/22/06
0845 – EZ on site. EMC looks good. Clean up site. Put EMC into safe idle mode for the 5-day break in testing.
1730 – EZ left site.

2/28/2005
0700 – CS and Kevin Fisher from Apogee on site
0800 – KF went to orientation

3/1/2006
0700 – arrived on site
10:04 – started first M17 test
15:05 – finished M17 test

3/2/2006
07:00 – arrived on site
08:45 – Plant switched to ColoWyo at ~22:00 last night. Contacted control room and found out that they won't switch back until late tomorrow evening or night.
13:00 – Starting injection at 10#/MMacf 5#/train
Train 2 fill malfunction alarm sounding every 10 minutes or so. Rapped on pantleg and it still sounds.
Turns out it is not the fill malfunction as I thought. It is a feeder malfunction. The feed screw motor is malfunctioning. Will look at it tomorrow. Turned of Train 2, increased train 1 injection to 10#/MMacf

3/3/2006
07:00 – arrived on site
11:00 – Started M17 test
15:35 – Finished M17 test
15:45 – Stopped carbon injection. Started to investigate the feeder problems on train 2
17:05 – Stopped problem test injection and hooked both trains back into the configuration we had yesterday. With train 2 going to the side away from the probes. If it trips over night we will still see removal.

3/4/2006
07:30 – Arrived on site. Last night train 2 tripped off at 7:11 pm. Will investigate further. Plant is still burning ColoWyo. Control room said PRB should hit the boiler later today or tonight.
10:09 – Train 2 feeder tripped again. Measured the DC output and analog in signals very noisy compared to T1. RPM fluctuating by ~15 on T2. Switched both trains to manual and set feed rate to 108#/hr. Measured voltage DC output signal and analog in and out signal now very stable.
11:54 – Dropped injection rate to 5#/MMacf until plant starts firing PRB.
17:00 – Contacted control room. PRB "should hit the boiler in ~3 hours increase injection back to 10#/MMacf

3/5/2006
07:30 – Arrived on site
13:00 – shut down carbon injection –
13:25 – hooked train 1 to pre-ESP system set injection rate to 1#/MMacf

3/6/2005
07:00 – arrived on site
10:10 – Removal rate appears steady ~73%. going to increase injection rate to 3#/MMacf
13:33 – Removal rate at 86% and rising
17:15 – Rough check of injection weight ~85%
17:25 – Increased injection to 6#/MMacf

3/7/2006
07:00 – Arrived on site Ian Clark and DM on site
07:36 – Increased injection to 10# acf. Removal rate held at 86% last night.
~09:45 – Started M17
~14:30 – Finished the M17 tests
14:29 – Stopped carbon injection, contacted control room to inform them the test was completed.

3/8/2006
07:00 – Arrived on site Ina Clark and DM on site
07:40 – Started injection in fields 5 and 7 at 3#/MMacf/side(6# total). Train 1 is going to the analyzer side. Train 2 is going to the right.
7:30 – Analyzer problems overnight – repairing.
8:25 – Analyzer repaired and calibrated, up and running.
11:30 – Train 2 started to act up again. Switched to manual 65#/hr
11:47 – Ian Clark and DM off site.
18:45 – Finished collected fly ash samples from the from row. Hopper B12 had hardly any ash in it. Checked with the control room they were running the O2 at –0.8%. No noticeable change in fly ash color.

3/9/2006
6:45 – Arrived on site
12:00 – Low load, low O2 test started O2 at 2.4% normal 3.2%= -0.8
noticed stack opacity is spiking at Field 7 raps. Also noticed that the train 2 feeder problem is happening as the cpm's see the field 7 rap at ~30 minutes after the hour.
16:06 – Collected samples from B-11 and B-12 Contacted control room to tell then that we are through testing at low O2 and load.
17:30 – Switched to field 5 from train 1 injecting 6#/MMacf. Going to watch the stack opacity to make sure it is going down.
19:20 – Changed configuration, hooked train 1 to analyzer side and train 2 to right side. Both set to 3#/MMacf

3/10/2006
06:30 – Arrived on site, Stack opacity back to normal
07:25 – Increased carbon injection rate to 12#/MMacf to empty silo. It's a carbon blowout!
17:15 – Shut down skid

APPENDIX C3: Independence Log Sheet—March 8, 2007

Independence Log Sheet

Thursday, January 11, 2007

- 0700 arrived on site (set up day 1)
- Observed that only one 4-inch PAC transfer line had been run and they used 4 of the 7 50 ft lengths of hose. This left only 3 for the next run I ordered more hose through Collin back in Denver. Also ordered a couple of more fittings for this hose. It my get here tomorrow or Monday at the latest.
- All the Contecos were delivered on site yesterday
- The plant hauled up all the equipment to the test area. (Slow start but worked very hard to get it competed.
- Hooked up the "Y" and the check valve to the new blower. Removed the old eductors and put together the new ones.
- Ran the Hot lines and sank the probes into the duct. Plugged in the EMC analyzer and have it just powered up.
- Filled all the chemical jugs with water
- Made a deficiency punch list for a run to Home Depot and Wal-Mart
- The plant did not have all of our equipment delivered to the trailer so it took some work to try and find it. At the end of the day it looks like everything that we had ordered was delivered and accounted for.
- Postponed a site meeting with Todd as the schedule for testing has not changed.
- The Load Request has been denied for the test period. There is cold weather coming this way and they expect to require full load around the clock next week.
- The Carbon was on site when we arrived this AM . Unfortunately it came in super-sacks and not bulk. The shipment was returned and bulk arranged for. The Carbon is expected to be here either tomorrow (Friday) or on Monday AM.
- Expected activities for tomorrow
    - Finish hooking up the new compressor to the new eductors and the splitters to the lances.
    - Run the blower to make sure that it does not trip after it runs for a while.
    - Hook up the electrical inter link or some other method to get the feeders to operate while the new blower is supplying the eductors.
    - Hook up most if not all the EMC equipment and start testing.
    - Build shelters around the probe equipment to prevent freezing.
- Left site at 18:30

Friday, January 12, 2007

- 0700 went shopping for materials to complete the setup Arrived on site (set up day 2). 0830
- Hooked up all the hoses and eductors on the skid
- Put together one of the 2 distribution headers the highest consumable next to carbon is Teflon Tape

- Put together approx ¾ of both the inlet and outlet test equipment. The outlet had problems with the filter heater. It had worked in Denver but decided that it wanted to short out once it got here.
- 18:30 off site

Saturday, January 13, 2007

- On site 0700 (set up day 3)(picked up a few more items from Home Depot)
- Got Inlet completely set-up by noon.
- Performed Leak check, calibrated and began sampling at 16:15
- Noticed a leak(O2 = 17%) once sampling checked probe and found loose port cap. O2 now at 6% and Hg corrected at ~6
- Brandon still having problems at outlet with heater. Got heater fixed just before we left. Had a short on the concave side somewhere. Used glass tape to cover it.
- 1900 left site for the day

Sunday, January 14, 2007

- 0700 on site (set up day 4)
- The inlet filter heater stayed hot all night.
- O830 started sampling at the inlet again after a calibration and a check out of the system
- Put together the remainder of the Outlet sampling equipment
- 1000 Inlet sampling. There is approx 1 ug removal across the ESP.
- Hooked up all the lances to the distribution headers.
- Each lance line was tapped for pressure measurements
- Hooked up the new blower discharge pressure to the silo motive air pressure gages and switches
- Tried to connect to the silo with the new computer – no luck so far. We may have to run the system on manual
- Turned on the air to silo – good pressure
- Removed the PAC drop tube on each silo feeder and taped them off in preparation for the carbon delivery tomorrow at 7 AM
- Still needing one more section of 4-inch hose to complete the PAC delivery system. This hopefully will be delivered on Monday AM.
- Checked out both STM boxes in preparation for tomorrows testing.
- 1630 left site

Monday, January 15, 2007

- 0630 floated into work (baseline day) to greet the carbon delivery
- Elevator out of service great way to start the day
- Rotary valves seized. One chain broken took couple of hours to get working.
- Ran dual STMs at in inlet and outlet.
- Attempted to collect hopper samples. Only able to collect hopper B11 even though Hoppers had been isolated for several hours
- Skid computer seems to be missing a RS Key. This is being sent out here tomorrow.
- Blower will not operate. Settings seen to not be configured properly.

- Analyzer working well. Seeing believable numbers compared to previous testing.
- Data looks a little spikey even with a side arm feed attached to flush out SnCl2 impinger tube at both locations
- Blower operational. Cleared fault # 2021 with parameter 1608, needed to be set to "not sel".
- Downloaded EMC data
- 2030 left site

Tuesday, January 16, 2007

- 0700, day 6 begins (Parametric day 1), crew becoming weary, coffee pot non-operational
- Calibrate blower (target 11" h20 at ESP inlet), feed screws and EMC
- Blower settings: 22 amps, 30 hz, 75% of maximum, 4.4 psi at blower discharge.
- Recalibrate Silo screw as per Tom C.?
- Outlet probe thermocouple shot, replaced. Having difficulty keeping chemicals flowing due to extreme cold.
- Start carbon injection at 1 lb/MMacf (20 lbs/hr per feeder) @~1238 hrs (each M-Drive set at 40).
- Feeding manually due to no communication between computer and PLC. This requires a person to manually turn on star valve every 5 – 10 minutes.
- Carbon feeders backing up into the eductors, feed off.
- The CP20 was not set properly, the carbon was trying to feed at too high a rate.
- CP20's set to 800 each, start feed at target rate of 40 lbs/hr total at 1325 hrs!

Train 1

Set Pt	seconds	lbs	lb/ hr	
100	120	2.92	87.6	
500	60	7.94	476.4	
1000	30	5.88	705.6	
2000	15	2.40	576.0	40
	CP 20 =	800.21		

Train 2

Set Pt	seconds	lbs	lb/ hr	
100	120	3.30	99.0	
500	60	8.08	484.8	
1000	30	5.96	715.2	
2000	15	2.42	580.8	40.5
	CP 20 =	809.54		

- The silo calibration looks to be very 1:1 like in the lower ranges and falls away from this ratio at the higher settings.
- Silo load cells have indicated ~70 lb difference in the last ~hour or so, the scale read ~5620 @ 1425 hrs and 5550 @ 1525 hrs suggesting a total feed rate of ~ 70 lbs/hr. M-drive currently set @ 40 each train, we have been feeding at ~ 2 lbs/MMacf.
- Silo load cells indicating ~5502 lbs @ 1625, it was @ 5550 1 hour ago, suggesting a total feed rate of ~ 48 lbs/hr

- Have been feeding at current rate for 3 hours, increase blower, target 15” h2o at ESP inlet.
- 1630 hrs: Blower settings: 26.8 amps, 35.5 Hz, 88.7% of maximum, 4.8 psi at blower discharge.
- Silo scale reading 5450 lbs at 1725 hrs. 52 lbs/hr.
- Mercury removal same as at lower blower setting (~80%). Lower blower settings target ~8” h2o at ESP inlet
- 1730 hrs: Blower settings: 19.6 amps, 26.7 Hz, 66.8% of maximum, 3.7 psi at blower discharge. Lowered the blower pressures as we did not see any change in Hg removal when we had raised the pressures. Removal still remains at approx 80%
- 18:33 Shut down carbon feed after 1-hour test run. Did not observe any Hg removal. Hg removal was approx 76-80 % across the ESP. Left the blower running at the lower rate all night to keep the system warm and to keep the lances clean.
- 18:30: Chad and Brandon checking out the monitoring equipment for the night and downloading the analyzer data.
- Off site 19:30

Wednesday, January 17, 2007

- 0700 – Day 8 (Parametric testing day 2). Working to establish communication to PLC (need 30 foot serial cable and a serial card for the pc)
- Checked the feed rate before starting the set pt of 40 on the M-Drive with a CP of 800 actually fed at a rate of 29 lbs/hr which is equivalent to 1.5 lbs/MMacf injection concentration.
- The inlet Hg was reading approx 7 ug and the outlet was reading 5 ug this was more baseline removal than we have recently seen so we speculated that the filter may have been contaminated with carbon from yesterday’s injection. After talking with Sharon, Brandon changed out the filter and the mercury readings remained the same.
- We wanted to start injection but the plant began to have operations problems with load swinging from 850 to 650 which showed up in the mercury analyzers as being very unstable. Decided to hold off injection until the unit stabilizes.
- Unit has not stabilized; evidently dispatch has been adjusting the power as required.
- Re-packed the gold in the EMC analyzer, inlet =~ 9 ug Hg, outlet = ~6 ug Hg.
- 1900 left site.

Thursday, January 18, 2007

- Start day 9 @ 0700 hrs.
- 0730 Checked all the analyzer equipment
- 0800 Calibrated the EMC
- 0902 Started Carbon injection at 1l b/MMacf or 20 lbs/hr on each feeder. M-drive CP values Train -1 = 700 Train - = 735 Blower at 30 Hz 21.2 amps and 4.1 PSI at the blower discharge. The outlet Hg had dropped after calibration which does not make a lot of sense because both inlet and outlet are on the same analyzer.
- 0900 setting up to run STMs

- 11:58 increased PAC feed rate to 3 lbs/MMacf. The transport air conditions remain the same as the 1 lb/MMacf injection concentration. Feeders are handling this rate very well.
- 12:00 Chad and Brandon started STMs at the inlet and outlet locations.
- 15:00 increase PAC feed rate to 6 lbs/MMacf (120 lbs/hr each feeder)
- Increase blower power to achieve ~11" h20 at ESP inlet lances. Blower settings: 23.3 amps, 33.0 Hz, 82.6% of maximum, 3.5 psi at blower discharge.
- 1555 hrs – control room called, they have to make some changes and it will affect load.
- 1700 – Load unaffected thus far, continue at 6 lbs/MMacf
- PAC is occasionally "lightly wafting" out of the end of the screw at the tee, have to shut screw off momentarily to wait to clear
- Hg removal just before we reduced injection rate was Inlet 9.03 Outlet .25 ug which represents 96.5% removal.
- 1702 – Decrease feed rate to 3 lbs/MMacf (60 lbs/hr per feeder) Blower settings: 23.3 amps, 33.0 Hz, 82.6% of maximum, 3.5 psi at blower discharge.
- Shut off Carbon injection at 1800 hrs. Downloaded EMC data, Plant data and loaded to ftp site
- 1830 hrs left site for the day.

Friday, January 19, 2007

- Started day at 0630 hrs
- Shut down everything in preparation for leaving the site.
- Chad will be the main contact for how and what the site requires to get running again.

Tuesday, January 23, 2007

- MAD arrived on site at 16:00 hrs
- Was able use hand carried laptop to see Silo PLC. Found that SLC battery is dead.
- Unable to clear fault.
- Departed site at 18:30

Wednesday, January 24, 2007

- CL and MAD arrived on site at 0730 hrs.
- Cleared fault on silo SLC.
- New battery ordered. Expect to have onsite Thursday
- Loaded RSLOGIX program onto SLC once fault cleared. Upon loading program communication silo. Had to establish communications via DH+ and change a setting in the software.
- Made changes to RSVIEW to allow connection to silo.
- Able to connect and control silo with RSVIEW
- Noticed potential clogging in lines or lances upon system startup. Was able to leave blower operating for a while and clear the lines.
- Breaker on blower #2 found to be tripping. Changed trip setting from 40 to 120A.
- Unable to connect to SLC w/ serial cable. Called Rockwell support no luck. Will call again Thursday and hope for better help.

- Analyzers up and measuring Hg at inlet and outlet. Will leave them up over night.
- Departed site at 19:30.

Thursday, January 25, 2007

- CL and MAD arrived on site at 0700 hrs.
- Began injecting carbon @ 1200. Load cells @ 4580.
- Stopped injection @ 14:20 due to persistent puffing problems. Attempted blowing out lances with HP air.
- Determined problems are resulting from restrictions in grid design (roughly 50% drop in cross sectional area).
- Communications problems with serial cable due to cable. Temp cable replaced with another temporary cable.
- Departed site at 19:00

Friday, January 26, 2007

- CL, MAD and JA on site at 0700 hrs.
- Began injecting carbon @ 1 lb/MMacf at 0930. Load cells @ 4480 lbs. Blower discharge @ 2.5 psi, Blower frequency, 30.0 Hz, 22.3 amps. Pressure at header 11.0 to 11.5 in H2O.
- Was able to get BHA CPM operational. Cleaned lenses on monitors.
- Changed injection rate to 3 lb/MMacf @ 1330. Silo load cells @ 4428 lbs. Blower settings unchanged.
- Plant started dropping load at 1400.
- Due to decreasing / varying load conditions skid placed in load following at 14:30
- Injection rate changed to 6 lb/MMacf at 1530. Blower settings unchanged.
- 1545 Changed blower settings to 26.2 Hz, 20.2 amps, blower discharge at 2.25 psi. Discharge header pressure @ 11 psi
- Unable to maintain injection rate on Train #2 (feeds side that the shack is over). Had to decrease feedrate on train #2 to 30 lbs/hr to prevent puffing problems. Train #1 remained in load following.
- Turned off injection system @ 18:30. Train #2 was able to maintain 30 lbs/hr without problems for the duration of this test. Train #1 was able to maintain up to 60 lbs/ hr during duration of this test without puffing issues.
- Noticed load ramping back up around 1700.
- Unable to get air flow readings due to hot wire anemometer getting fouled with carbon. BD will order new unit will for delivery early next week.
- Departed site at 2030.

Saturday, January 27, 2007

- JA on site at 07:00.
- Found Marty's ring at wash basin
- Cleaned up trailer.
- 19:30 Todd informed me that Boiler will be off line from 10:00 to 19:00 and that ASA will be on site at 15:00 tomorrow.
- Calibrated analyzers, downloaded data, shut down analyzers.

- Cleaned old impingers and installed new ones for next test.
- Copied EMC data to ftp site.
- 13:30 leave site.

Sunday, January 28, 2007

- JA on site at 09:30.
- Filled 3x5 gal DI containers at large green tanks.
- Worked on ASA Hardin Report.
- Printed new EMC Cal Sheets for Test Shack
- 14:00 ASA on site.
- 17:00 Sent Hardin Baseline data to Sharon.
- 17:30 Leave Site.

Monday, January 29, 2007

- JA on site at 07:00.
- Sent timesheet to Becky.
- Requested Unit 2 Isolate ESP Hoppers 1-2, 2-2, 1-3, 2-3, 1-4, 2-4.
- 08:30 Start first M5/202.
- 08:37 Blow back filter, Start up/Cal analyzers.
- 09:00 Analyzers on line, reading 6.5 Inlet and 6.0 ug/dscm Outlet.
- 13:30 Collected ash samples from 1-1, 1-2, 2-2. There was no ash in the back two fields and the sample port on 2-1 was plugged. I requested that the plant leave the back two fields isolated overnight.
- 14:50 Grabbed coal sample.
- Hg In = 6.0 and Hg Out = 6.0 ug/dscm.
- 15:38 End First M5/202.
- Post cal analyzers.
- Downloaded data to ftp site-CPM/EMC/Plant. Could not figure out how to do Skid Data
- 18:30 Gone (11.5 hrs)

Tuesday, January 30, 2007

- JA on site at 06:15.
- Requested Unit 2 Isolate ESP Hoppers 1-2, 2-2, 1-3, 2-3, 1-4, 2-4.
- 06:45 Start Second M5/202.
- 7:00 Found that fitting where impingers connect to probe filter at Outlet had melted and sealed the opening. Got old melted tubing out, but noticed someone had jammed other tubing into the gap between the filter and filter housing. Hope this doesn't affect reading. Replaced and did cal. Shortly after the tubing melted again. Reduced temperature from 400 to 350F. Noticed that temperature was swinging wildly. Removed TC from where it was installed and installed it into a filter port. Changed set point to 300F. Upon hooking up the impingers, the excess fluid flooded the chiller and some went into the heated hose. Luckily, the liquid did not make it past the Balston filter. Flushed hose with water, blew dry.
- Received battery for skid controller and 2 x 2.5 ml syringes and 6 x needles.

- Called Chad. Was able to get mouse working on skid computer by rebooting. Downloaded skid files and put on FTP site.
- 13:00 Collected coal sample. Tried to collect ash but all eight hoppers had strong vacuum and no ash. Todd said he would leave back two rows isolated tonight since they are done burning the ColoWyo coal.
- 13:36 End Second M5/202.
- Post cal analyzers.
- Downloaded data to ftp site-CPM/EMC/Plant.
- 15:15 Gone

Wednesday, January 31, 2007

- JA on site at 06:00.
- Back two fields of ESP Hoppers should have been isolated all night. Later, Todd informed me that these hoppers were not left isolated but will be tonight.
- 06:42 Start Third M5/202.
- 07:00 Outlet: Found another melted fitting at probe filter. Further investigation showed that the TC extension had a bad connection at the male end. When a new extension was used, the temp was above 450°F. Cut off the sealed male end and replaced it on the old extension.
- 8:45 Made new $SnCl_2$ and NaOH. Emptied waste. Calibrated.
- 13:20 End Third M5/202.
- 14:00 Collected coal sample. Got ash from, 1-1, 2-1, 1-2, 2-2.
- Post cal analyzers.
- Downloaded data to ftp site-CPM/EMC/Plant.
- 16:00 Gone (9 hrs) + 2 for Hardin at hotel.

Thursday, February 1, 2007

- JA on site at 06:00. Huge, historical, monstrous, news breaking, snowstorm last night (at least ¼") that brought Littlerock and surrounding communities to a complete standstill. Took me 1.5 hrs to drive 15 miles to hotel.
- Back two fields of ESP Hoppers should have been isolated all night.
- 07:05 Start Fourth M5/202.
- 07:00 Outlet: Everything running well, no melted fitting today!
- Hg In = 7.2 and Hg Out = 6.8 ug/dNcm. Calibrated. Emptied waste.
- All parts arrived to change splitter hoses from 1" to 1.5". Flour working on it.
- New anemometer probes arrived, but upon reading directions, it is obvious that this cannot be used in a dusty environment. Brandon is checking on more robust flow meter. Installed new microprocessor chip that came with new probe.
- 12:15 Found analyzer stuck on start-up screen. Turns out Flour tripped the transformer at about 11:30 and did not reset all breakers. Found the umbilical, kitty pad and probe heater off at the Outlet. Reset breakers.
- Hg In = 8.2 and Hg Out = 8.0 ug/dNcm.
- 13:00 Even with back fields off all night, only got ash from, 1-1, 2-1, 1-2, 2-2.
- 13:30 Collected coal sample.
- 13:42 End Fourth M5/202.

- Post cal analyzers. Blow back filters.
- Downloaded data to ftp site-CPM/EMC/Plant.
- 16:00 Gone

Friday, February 2, 2007

- JA on site at 06:00.
- Back two fields of ESP Hoppers should have been isolated all night.
- 07:00 Start Fifth M5/202.
- 07:10 All was well with EMC.
- Calibrated. Hg In = 8.2 and Hg Out = 8.1 ug/dNcm.
- 10:00 Activated carbon truck filled silo.
- 12:45 Collected coal sample.
- 13:00 Collected a little ash from, 2-3 and a full bottle from 1-3. All other hoppers were empty.
- Notified Unit 2 CR that they could return to normal operation on the ESP.
- 13:36 End Fifth and final M5/202.
- Post cal analyzers. Blow back filters. Shut down EMC system until Sunday.
- Downloaded data to ftp site-CPM/EMC/Plant.
- 15:00 Gone

Sunday, February 4, 2007

- JA on site at 10:00. Super Bowl Sunday!
- Installed new impingers, repositioned peristaltic pump tubing, blow back filters, calibrated.
- 13:30 Gone

Monday, February 5, 2007

- BH, CS & JA on site @ 0715
- Calibrated analyzers
- Noticed load on silo computer differs from pi system silo reads 844 pi reads 806
- Ran calibrations @ 500, 250 and 100 on M-Drive, all settings are ~ 14% low, lowered the CP20 value by ~ 14% each feeder. Spot checked each feeder, train # 1 OK, train number two still low, decrease CP20:
- Train # 1 CP20=610
- Train # 2 CP20=575
- Silo wt =43537 (@~1200 hrs)
- ~1300 start carbon
- ~1301 mouse on silo computer locked up, reboot computer
- ~1315 carbon on manually @ ~ 30lbs/hr
- 1326 switch to auto mode (RSView)
- Blower: 30.6 Hz, 19.6 Amps
- 15:49 – shut off feeders

- 1945 – Finish blowing out every injection lance we could reach (20 total), many of them were plugged or partially plugged. Keep blower going overnight but did not restart carbon. Going home now. (12.5 hrs)

Tuesday, February 6, 2007

- CS, BH on site.
- Finish blowing out four remaining PAC lances.
- 09:30 - 43680 lb in silo
- ~1030 – start injection @ 2 lbs/MMacf
- 10:33 silo wt = 43640
- 11:03 silo wt = 43869
- making carbon as we remove mercury
- 11:20 – Increase percent open on vent valve at blower discharge to decrease pressure at PAC injection manifold. (~16" H2O to ~12" H2O)
- 11:56 – 43820
- 12:28 – 43863
- 13:30 – 43869 – Checking for loose/bad wires on load cells and junction box
- Found some moisture in the load cell wire junction box, seems to be OK now – Reset totalizer 13:45 hrs
- 44056 @ 13:47
- 43999 @ 14:00
- Have installed ¼" pressure taps on all 24 injection lances, doing a traverse now
- 17:00 – Carbon feed off. It is thought by many that one or both manifolds are still partly plugged. Silo weight = 43965
- installed pressure taps on all 24 lance hoses. Pressure on west side (edge) 12" h2o, pressure on east side (center of ESP) =10" h2o
- check east manifold for clogs- none found
- blowing back all lances with 1" high pressure line. Will check pressures to see if both sides are equal pressure
- 18:45 restarted feeders still at 2#/MMacf
- silo weight =43953 @18:49
- 1945 - Leave

Wednesday, February 7, 2007

- BH & CS on site.
- 07:30 Silo weight = 43720, no alarms overnight
- 10:30 - stopped feeders to work on eductors on train 1 – no noticeable difference
- 10:30 silo wt = 43100
- 11:30 - adjusted pressures on train 2 to 11"
- 13:50 – increased blower rate to 4#/MMacf unit at full load
- 14:34 – silo wt = 43400 gaining wt again
- 17:39 – Feed off to check feeder calibration
- 18:02 – Carbon feed on
- Train # 1 = 40.8 lbs/hr

- Train # 2 = 40.2 lbs/hr
- 1900 – Leave

Thursday, February 8, 2007

- BH & CS on site.
- Silo running well, a few low suction pressure alarms on train # 1
- Average Hg removal = 86.5% since feeding @ 4#/MMacf
- 1015 – Increase carbon to 5#/MMacf
- checked injection rate at 60 lb/hr= 6#/MMacf @ full load
    - Train 1 = 60.0#/hr
    - Train 2 = 61.2#/hr
- 1435 – Increased carbon to 6#/MMacf
- 1540 – Increase blower pressure to manifolds
- 1840 – Left Site

Friday, February 9, 2007

- BH & CS on site.
- Plant switched to ColoWyo coal @ ~2000 – 2030 hrs last night
- 0930 – ColoWyo coal expected to run out any time now
- Over night the inlet SNCl2 feed stopped dropping the level to near zero. Got it back on line and noticed there must have been a coal change as well.
- 10:50 Carbon on train one was interrupted briefly.
- 13:15 Carbon on train one was interrupted briefly.
- Readjust blower pressure to achieve 11" h2o at PAC injection points, (was ~10")
- Started set up for STM testing.
- 1845 – Left Site

Saturday, February 10, 2007

- BH & CS on site.
- ~07:30 Carbon is "puffing" out of both feed screw trains. Feed off.
- Pressure now higher on East side train 2
- 1040 – Blew out all 24 injection lances with high pressure air, two may have been plugged (1B & 1C)
- 1042 – Start carbon @ 5#/MMacf
- 16:36 – Stopped carbon feeder on both trains
- 19:23 – Start carbon @ 5#/MMacf

Sunday, February 11, 2007

- Arrived on site to find carbon puffing again on train two east side
- Checked pressures upstairs and pressures are ~ 9 on east side and 8 on west
- Went upstairs to find mercury levels very low again. Called control room and found they started burning ColoWyo at ~18:30 last night and rat-holed this morning at 8:40. Should see north antelope in ~4hrs.
- Stopped carbon feed at 09:51

- Switched Train 1 line (west) with Train 2 line(east). The east side had been higher pressure. The east side still has higher pressures. Blew out lances on east side now both pressures are approx equal. Both sides are approx 12 w/o carbon.
- Started carbon at 15:50 @ 5#/MMacf.

Monday, February 12, 2007

- 6:30 - TC, EZ on site
- 7:15 Talk with Gary Goldblum of ASA. He will be beginning M-5 test in the stack as soon as he gets up there. Talked with Todd Bradberry of ISES. Load will be running until approx 2-3 pm. ColoWyo trains not scheduled to return for several days. So should see good Hg numbers for testing.
- No immediate evidence of puffing but Train 2 has minimal negative suction pressure. Silo weight changed 1100 lb over 12 hrs. Slightly lower loads for part of the 12 hrs but appears to indicate little or no free flow conditions.
- 10:15 First puff of the day. Stopped of its own accord.
- 11:58 Second puff. And stopped 15 seconds later.
- 14:05 Secure M-5 testing – Complete. Inform control room we are off load requirements.
- 14:47 Two puffs.
- 15:05 Both trains puffing slightly. Load is down at 630 MW
- 15:09 Secure both feeders. Still some back pressure on the system as continue to bleed carbon slightly. Dies off. Load continues to drop. Shut bleed off valve and system back pressure pushes carbon out of hose. Open bleed off valve entirely and slight leakage that dissipates. Go up and blow out hoses – 4 plugged lances.
- 16:17 Start feeding carbon at desired rate. Load is now 797 MW.
- Silo and EMC appear to be running fine.
- 17:05 Depart site.

Tuesday, February 13, 2007

- 0630 – TC, EZ on site. Unit not yet at load. Waiting for load stabilization prior to testing.
- 0645 – ASA checks in. Will wait for call from us.
- 0710 Load stabilizes at 880 MW. Talk to ASA, testing will start at 0810.
- Talk with Todd Bradberry. He has isolated all rows in ESP B except row 1. All rows will be blown down at 1200. Row 2 will be isolated every day at 0800. Row 3 and 4 will be isolated except at 1200. Soot blowing will run during this week for M-5 testing in the P4 mode, similar to baseline conditions. Monday's testing had a different configuration for soot blowing. ESP is operating with POS in normal load following mode.
- Check lances at 0800. 4 lances were plugged. Banging on lances had pressure to lances again.
- Train 1 did puff this morning at lower load. Based on alarms, puffed twice through the night. Does not appear to directly correlate to upswings on load. Both puffs occurred during load increases but not all load increases result in an alarm condition. Further monitoring will be needed.

- 0831 Began closing bleed off valve. Ate some carbon. Cannot get above 2 psi discharge pressure without beginning to backpressure system. Brian reports used to run at 5 psi blower discharge pressure. Lances cannot be fully open. Further mechanical agitation will be needed.
- Computer locked up. Rebooted. Now the RSView display is not showing the correct colors, but everything appears to be running correctly.
- The train 1 hopper had problems filling for some reason. Air is really moist, wonder if problems due to humidity in system, both carbon and electronics.
- Took ash samples. Will be done at 1447 with M-5 testing. Ash samples came from hoppers 1-1, 1-2, 2-1, 2-2, 3-1. Nothing from hoppers in row 4 and hopper 3-4. Plant isolated row 3 and 4 at 0930 and will keep isolated until 12pm tomorrow. Only reason we got something from 3-1 is a rap cycle on the carbon. Good timing.
- Check lances. Injection pressure upstream of manifold now at 5in. 2 plugged lances. Tap on all lances and 2 plugged lances clear.
- Talk with AA and reschedule M5 testing to occur at control and test side of outlet duct on ESP B. This is a change from previous test location which occurred at stack.
- 1730 Depart site.

Wednesday, February 14, 2007

- 0645 TC, EZ on site. Begin daily routine.
- 0800 Talk with Don Young at plant concerning rescheduling of plant load for Sat-Mon. Last weekend unit was loaded up so Don thinks there should not be an issue. Todd Bradberry is gone for the week, departed Wed noon, so Don is the contact through end of day Thursday. Friday and the weekend we are on our own.
- Silo has puffed once this morning. No work done on clearing lances.
- Something new learned every day. When some of the RSView colors are not working but the data on the screen (numbers, etc.) are updating, the daily file is not being updated. Data for silo not captured from 0830-13 Feb to 1030-14 Feb. Program rebooted at 1030.
- 1145 Sampled ash: 1-2, 2-2, 3-1. All other back hoppers empty.
- 1400 Rapped on all the lances and took pressures. 4 lances plugged. – cleared after rapping.
- 1430 Blew out all lances with high pressure air.
- The high pressure air seems to work better as the pressure upstream of the manifold dropped by 1-1.5 in (from 7 to 5.5 in) and did not change while rapping the lances. This would seem to indicate that the lances cleaned out better during high pressure cleaning than rapping. It could also indicate that we have lost some lances since the manifold pressure is dropping and removal rates are decreasing. However, we have been unable to increase air supply, so maybe that is not the case. Could just be gradual build up of carbon in the system or ash on the lance exterior at the holes which is causing increased back pressure and therefore lower flows, less penetration, etc.
- 1730 Downloading CPM data
- 1840 Depart site

Thursday, February 15, 2007

- 0630 TC, EZ on site. Unable to confirm availability of load for weekend.
- 0700 Talk with Gary Goldblum, ASA, about testing sequence. Decision is made to use 2 9 ft probes on control and test sides to do a comparison. Initial set up was a 9 ft on test side and 5 ft on control side but Gary thinks he has equipment to use two 9 ft probes. ASA also having a problem with icing. Temperature will remain below freezing for much of the day, so could be a continuous issue.
- 0830 Appears we may have a heater problem on the inlet probe. Will continue to investigate. Pulled cover off probe and heater started working. This is not the same heater that had problems previously. Should get a spare on site if/when it fails.
- 1000 ASA continues to have problems with freezing lines, waiting start of testing today.
- 1100 ASA begins sampling for the day.
- 1140 Sampled ash: 3-1. All other back hoppers empty.
- 1625 RSView computer locked up again. Second time today.
- 1632 Secured feed system
- 1638 Identified problem with inlet heater. EZ found a loose wire. There is a spare heater on site. Will replace in the morning.
- 1815 Replaced eductors and started blowers.
- 1820 Start injection. Looks OK.
- 1835 Depart

Friday, February 16, 2007

- 0645 EZ, TC on site. Silo is back pressuring and causing a cloud. Looking at alarms, appears to have started at approximately 0615.
- 0657 Secure feeders. Bang on lances. Injection pressures after clearing all lances is 11” east, 14 in west. This is original pressures for lance design. Adjust air flow down slightly. #2 Train is still back pressuring slightly. Will clean out after Method 5 testing.
- 0745 Begin feeders on Train #1. Train #2 is back pressuring still when feeding.
- 0755 Start Train #2 at 1 lb/MMacf, begin to walk up to 5 lb/MMacf.
- Eductors are definitely driving negative now, too low a flow and eductor will not pull enough negative, below approx 2 psi at eductor inlet.
- 0805 At 5 lb/MMacf.
- Shift from 4 hr rap to ½ rap appears to have eliminated spikes. ASA is struggling to get Method 5 underway.
- 1015 So much for the new eductor. Train #2 had a spit up. Secured feeding on Train #2. Will check pressures upstairs to see if I can lower manifold pressure.
- 1051 Started Train #2 after blowing it out. Still running a significantly higher pressure upstream of the manifold. Cleared out two potential blocked lances – 1A and 4C. This back pressure is translating into less negative and therefore more likely to blow back. I do not suspect free flow conditions, just back pressure conditions.
- 1107 Train #2 off again.
- 1405 Train 1 puffs. Back on line again.
- 1435 Train 1 off for back pressure

- 1540 Cleaned out injection lances with high pressure air. Have negative on both trains. Will continue to run with just air blowing through lances.
- 1559 Started carbon injection at 2.0 lb/MMacf on both trains.
- 1645 Lower injection concentration to 2.5 lb/MMacf for the night. That way if it upchucks, we'll only have to clean half the mess.
- 1700 Depart.

Saturday, February 17, 2007

- 0645 EZ, TC on site. Several alarms through the night but no big pile of carbon on the deck. Increase injection rate to 5 lb/MMacf.
- 0730 ASA begin Method 5/202.
- 0750 Stopped Train #2. The wind is blowing so hard it is messing with the little negative available. Will clean out train #2 and restart.
- 0910 Train #2 cleaned out.
- 0943 Lowered injection concentration and started Train #2. Will slowly bring up system. Still very windy out.
- 1005 Train #2 off again. Cannot hold it in the wind.
- 1139 Sample hoppers. Hopper 3-1 is only good sample. A smidgen out of 3-4 and nothing from 4-1, 4-4.
- 1345 ASA done with Method 5 tests for the day.
- Train #2 off line for rest of day.
- Run through STM procedures, begin STM traps in Method 5 port at 1830.
- EMC had a hard day. Taken apart and cleaned through the day.
- 1930 TC departs site
- 2100 EZ departs site after completion of STM traps.

Sunday, February 18, 2007

- 0645 EZ, TC on site. Train #1 online. Several low pressure alarms through the night indicated continued puffing. Train #2 offline. Walk down lances – 7A and 7B are plugged as usual. Doesn't take much tapping to clear lines. For some reason Unit 1 is off-line. Not many people around so doesn't appear to be a scheduled outage.
- 0715 ASA commences Method 5/202.
- Cannot find the data sheet for the skid and blower that we have been updating. Lost the last week of data. EZ found it by crashing Excel
- 1325 ASA completes Method 5/202.
- 1327 Plant begin shifting load around.
- Begin cleaning up and preparing for turn over.
- Depart site at 1700.

Monday, February 19, 2007

- 0645 EZ, TC, BD, CL on site. Train #1 online. Several low pressure alarms through the night. Train #1 still running. Train #2 down.
- Tried to clear out the lances with HP air on the west part of the ESP. Could not do this with the existing Poly tubing as it was getting to soft due to the heat. Copper tubing was decided against because of it being too good of a conductor in case the

lances had come apart. Ordered appropriate PFA tubing from Denver to do this. It should arrive tomorrow.

- At about 3 pm noticed the carbon feed to train 1 had stopped. Somehow the blower running signal stopped. It took a few tries before the PLC would allow me to control
- 1500 hrs Charles noticed that the outlet impingers had turned to crystals in the NaOH. Charles found that the chemical pump had been turned off. Suspect it ran this way all the previous night.
- 1530 hrs the EMC decided to freeze up. Charles had to use the hyperlink to delete the files and restart the system
- I was playing with the blower and the lance system after ASA had completed the testing. I had the eductor pressure up to 8 PSI with no puffing but the back pressure upstairs pegged the magnahelic.
- 1830 hrs left site

Tuesday, February 20, 2007

- Brian and Charles on site until the 27th.
- On site 0700 hrs
- Shut down carbon feed to train 1 to bang on lances and to reposition some of the hoses from the splitter to the lances
- 0720 Charles doing a cal on the analyzers found a high cell pressure on the outlet analyzer suspect that some crystals from yesterday have plugged the system. Charles continues to investigate and to start to prepare for moving the probe to a new port.
- Ran train 1 eductor at 4.5 psi (eductor inlet pressure) all night there was only a small point in the night around 11 pm that the eductor pressure showed a low alarm signal. There was no mess on the ground in the morning so it appeared that the alarms were brief and corrected quickly.
- 0850 started PAC feed to train-1 again. Plant at low load since we had come in 633 MW
- 1100 took ash samples - also took a coal sample
- Moved the outlet probe two ports East or port #4 from the western most port this is the port that ASA had been testing in.
- Both analyzers running but developing some high cell pressures. Suspect a plugged chiller ran some water to it and it improved somewhat. Will investigate more tomorrow.
- 1600 Left site for the day 10 hrs

Wednesday, February 21, 2007

- Arrived on site 0715
- Carbon had been puffing for quite some time last night so there was quite a mess this AM. Plant on low load.
- Shut down PAC feed from 0730 to 0900 banged on lances took some pressure reading. The east duct had a pressure of 14 inch at the inlet to the splitter and all the lances varied between 12.5 and 13 inches (east grid only).
- 0900 restarted injection of PAC to the east grid. Could only run at 2.5 inch H20 on the inlet pressure to the eductor.

- 10:00 Shut down PAC injection to clean the lances
- We had notice that the analyzer was still having high cell pressures and in fact the sample flow was severely reduced. Charles found that the gold had been compacted to a point that it would no longer allow a flow. Replace and repositioned the gold. This solved the flow problem at the analyzer but the chillers still severely restricted the flow. It looks as though the chiller caused the problem in the first place which caused a huge draw against the gold. Charles working on unplugging the chiller at both the inlet and outlet. Suspect some hydroxide crystals forming to cause this problem
- Cleaned out all the lances with the 3/8-inch PFA tubing 60 ft in length and HP air. All the lances were cleaned to the bottom. Most had plugging up to 4 ft from the bottom of the lances. I do not think that putting HP air to the lance will clear anything that is in the bottom of the lances. This may be effective in clearing the exposed holes. Based on this observation on the extent of the plugging I concluded that we were only using about ½ the holes in each lance. Prior to shutting the injection system down we were running at approx 2 PSI eductor inlet pressure approx 0 on the eductor suction the pressure on the splitter was 14 inches of H2O and the pressure on the lances ranged from 12.8 to 13 inches. This sort of confirms my thought that half the holes were plugged.
- After the lances were cleaned I again took the opportunity to reposition some of the hoses from the splitter to the lances in an attempt to make the flow a little easier.
- Restarted the transport air to the east injection grid. It was more than obvious that the lance restrictions had been removed. I could have run the eductor motive pressure to 12 inches and still had lots of eductor suction to play with. What I did settle on was an eductor pressure of 7 PSI and an eductor suction of 0.5 inches. The pressure on the distribution was too high to measure and so was the pressure on the lances.
- Installed data recorder on the control side CPM
- My way of thinking on this system is that we have to target the desired air flow instead of the back pressure because of the need to maintain enough flow to transport the PAC to the lances. If the pressure at each nozzle is too high the plume will penetrate further in. If this is how we have to run the system then all we have to do is change the angle of the nozzle to allow for this difference in plume penetration.
- 17:50 started PAC injection at 2 lbs/MMacf to see how the system would handle running at these conditions. I nervously left it at this rate over night.
- 18:40 left site

Thursday, February 22, 2007

- 0715 sped into the plant to see if we had produced a cloud of PAC to equal the plume of steam coming from the stack
- Found the system in exactly the state we left it in.7 PSI eductor inlet pressure .5 inches eductor vacuum. There were no skid alarms all night.
- Checked out the entire system . The Hg removal was:

  Inlet 10.02
  Outlet 2.06
  Removal 74.21 at 2 lbs/MMacf
- 0745 increased injection concentration from 2 lbs/MMacf to 3 lbs/MMacf.

- 0900 Charles went to download the EMC data and found that the analyzer had locked up again. Charles will unhook the impingers and reset the computer. We suspect that there are corrupt sectors on the hard drive that will continue to plague us. It may come down to doing a “fix disk” dos command to repair this but we will loose everything on the hard drive. The “A” drive floppy will not read so this again is causing more problems. Charles swapped out the computer from the spare analyzer. We will try to get the data from this computer when we have sufficient time.
- 1130 tried to get ash samples but there were none to be had..
- 16:30 the inlet analyzer started to read 21% O2 found a few things wrong with the system once we started to investigate. It leak checked OK so we assumed it was the filter. Found a nylon cap on one of the filter ports and the filter connection to the inertial filter loop was very loose. This did not solve the problem Sharon suggested that it may be the blower. She was right. – again.
- Changed out the blower on the inlet probe an the union fittings were not the same on each blower. I did not know that we had different connections.
- Once the blower was changed we were getting very low Hg readings at both the inlet and outlet. Called the control room and found that they were burning ColoWyo coal. The expected to continue to burn this coal for another 4 to 5 hrs.
- 1930 left site.

Friday, February 23, 2007

- 0715 on site
- 0715 found the blower had tripped out at 0530 hrs Lost Power to the welding outlet. Contacted the maintenance supervisor for repairs and he indicated that it would take a while as the entire plant is having a safety meeting. While I was waiting on the electrician I inspected the blower and found that the air intake filter had collapsed. This was most likely the problem– I remove the filter and blew it clean with HP air. There was a super-sack worth of carbon in it. The filter number is 810475 (universal) or 2358 (Napa). Blew out the entire blower containment box.
- 0715 found that the EMC analyzer was not sampling at the outlet location all night. Charles was positive that a check to see if both channels were operating last night was the last thing he had done.
- 0830 Charles found that the inlet analyzer filter heater had tripped off. The plug was covering the GFI trip button so it actually looked like it was not tripped.
- 0920 electrician restored power and I restarted the blower.
- 0940 started carbon feed at 1 lb/MMacf blower and eductor conditions are:

  Eductor inlet pressure 7.2 PSI
  Eductor suction -0.2 inches
  34.4 Hz
  39.2 amps
  86.1 %
- 0950 increased PAC feed to 3 lbs/MMacf the blower and eductor conditions are:

  Eductor inlet pressure 7.2 PSI
  Eductor suction -0.2 inches
  34.4 Hz
  39.0 amps
  86.1 %

- 10:30 Hg removal rate at approx 65%
- 13:30 increased Pack injection concentration to 5 lbs/MMacf the blower and eductor conditions are:

  Eductor inlet pressure 6.9 PSI
  Eductor suction -0.2 inches
  34.3Hz
  37.9 amps
  85.8 %
- After one hr at this increase carbon injection rate the Hg removal is unchanged.
- 13:45 tried to take ash samples could not get any from the last two rows. All the hoppers were drawing very strong vacuums. Coal sample taken.
- Purchased a new floppy and disks to try to recover the data on the EMC computer This did not work. Something on this EMC computer is not letting it communicate.
- 17:15 Hg removal is approx. 74% at 5#/MMacf
- 18:45 left site (11.5 hrs)

Saturday, February 24, 2007

- On site 0700
- Noticed that the injection grid had a few alarms of low eductor suction for a 2 minute period last night at approx 9:12 pm The system looks just like we left it the previous night.
- 07:30 the Hg removal is 81% at a injection concentration of 5 lbs/MMacf ant the load at 700 MW
- The EMC's were primed for disaster. (This means that every thing looked good for now.)
- Charles calibrating and downloading data.
- Hg removal was 81% MW =700
- The weather was terrible so we took some time to cover the electrical transformers upstairs. This proved to be a good move once the wind changed direction
- 10:00 Shut off PAC Feed to take flow measurements
- Picked up new blower air filter.
- Was able to get 2 complete sets of flow measurements before the wind and rain changed direction. The rain was pouring directly down on the silo and blower area making it impossible to work with the hot wire.
- 1510 Tried to restart PAC feed on train 1 but the M-drive control was going crazy found that the door on the Silo cabinet was not tight and rain must have gotten in.
- I switched the lines for the PAC feed to train 2 and used this side to feed the east grid. This worked. I also installed an air line into the skid cabinet to bleed dry air into the system. After about an hour of this the Train-1 m-drive decided to start working again.
- 16:10 PAC feed on train 2 stable and we plant to leave the feed on to the East grid on train-2 all night. Decided to watch this for a while before leaving site.
- 17:30 left site

Sunday, February 25, 2007

- 07:15 On site
- 0715 found this computer locked up. Had to do a hard boot and unfortunately we lost some of the log entries from yesterday. I had written some of them down on paper and gave the best description as to yesterday series of events that I could recall. This document was scheduled to be saved every 5 minutes but it appears that the save feature was not doing this at this interval. I changed the save to every one min. tested this and it appears it does not save.
- Injection grid ran without an alarm all night.
- 0800 Hg removal at 78% @ 5 lb/MMacf MW = 750
- Blower settings are:
  34.7 Hz
  37.2 amps
  86.7 % power
  Eductor inlet Pressure 6.7 PSI
  Eductor suction -0.3 inches H2o
- 11:15 shutting down PAC injection to install the old eductor to the new blower system and the old 2.5-inch line. Modified all the components to accommodate this change.
- Tried to get ash samples from Hoppers 31, 34, 41, 44 and could not get any. I have had these hoppers isolated for days.
- The current Hg removal rate is 74% MW = 890
- 15:49 Started PAC injection at 5#/MMacf on the old eductor with the new blower.
- 17:30 left site for the day.

Monday February 26, 2007

- 0715 BD CL arrived on site.
- Found the PAC injection system down. The alarms indicated that it went down about 730 last night. Found that the breaker had tripped for the blower
- 0735 PAC system up and running again.
- 0745 found that the EMC vacuum pump had stopped overnight. This in turn caused the chemicals to snurfed from that moment on.
- Cleaned both inlet and outlet probe filters
- 14:10 Started sampling on the outlet
- 14:30 Started sampling at the inlet location
- 15:00 Hg removal at 84% at 5#/MMacf
- 15:30 got an ash sample from only one hopper in the third row. Hopper 33 all the rest were empty. Took a Coal sample
- 15:30 calibrated the analyzer and downloaded data.
- 17:30 hrs left site 10.5 hrs

Tuesday February 27, 2007

- 0720 BH CS BD CL all on site.
- Both inlet and outlet Hg readings are low so the plant is probably burning ColoWyo coal.

- Attempt to collect ash from 3-1, 3-4, 4-1 & 4-4. Hoppers have been isolated all morning, no sample obtained. The plant needs to put those two rows back into service as they may be changing coal soon. Did collect a sample from hopper 3-3 just for fun.
- Shipping 1L ash samples and coal back to Denver
- Have 6 5 gallon buckets of ash
    - 3 from silo #2 that contains North Antelope ash w/o carbon
    - 3 from silo #1 that contains North Antelope ash w/ carbon. The samples contain ash from the test and control side from field 3 and 4. So ~50% of the ash in the bucket is from the control side.

Wednesday February 28, 2007

- 09:48 – Stopped feeder to take a quick grab sample to check the feeder calibration
    - 2 checks averaged 46 lb/hr
- Started carbon back up at 10:04
- Hg removal across the ESP was ~ 76 % upon arrival this morning. This after ~24 hours of feeding carbon at 5 #/MMacf in the current eductor/lance configuration (train #1 via the old eductor to the new blower system and the old 2.5 inch line).
- Hg removal was as high as 84% when this configuration was initially started.
- Chad is currently analyzing the rest of the data from this time frame to determine if the lower removal rate has been a steady decrease, or if the initial 84% removal rate was just a high reading.
- The pressure of the blower outlet has decreased (to ~ 8.5" H2O) since yesterday, increase blower setting slightly. Current settings:

  37 Hz
  46.8 amps
  79.9 % power
  Blower outlet pressure = 9 psig
  Eductor inlet Pressure 9 PSI
  Eductor suction -0.5 inches H2O

  Yesterday @ 1600 hrs:
  31 Hz
  46 amps
  77 % power
  Blower outlet pressure = 10 psig
  Eductor inlet Pressure 9 PSI
  Eductor suction -0.5 inches H2o
- The decrease in the blower outlet pressure could be an indication that there is no restriction in the PAC line or lance grid, the blower outlet bypass valve is and has been completely closed for some time now. The pressure at the injection lances have all been a consistent 8 to 9 inches of water since yesterday.
- Blew out all 12 injection lances, have not yet observed any change in removal.
- Row 3 and 4 ash hoppers have been isolated all day.

- 1510 - Attempt to collect ash from 3-1, 3-4, 4-1 & 4-4. Hoppers have been isolated all morning, no sample obtained. The plant needs to put those two rows back into service as they may be changing coal soon. Did collect a sample from hopper 3-3 just for fun.
- Blew out all 12 injection laces with high pressure air, most seemed to have solids built up in the lance(1-6 ft). The pressure at the lance inlet now down to ~ 2 to 3 inches of water. This suggests that the carbon is probably only dribbling into the duct which would account for the 70% removal we are seeing.
- 1814 – carbon off to clear out any carbon build up within the line. Depart site.

Thursday March 1, 2007

- 0720, BH & CS on site. The log computer locked up this morning, had to re-enter the last bit of log entries from yesterday.

Current Conditions:

32 Hz
45.8 amps
79.9 % power
Blower outlet pressure 8 psig
Eductor inlet Pressure 9 PSI
Eductor suction -1.8 inches H2O

- 08:30 checked pressures on lances. All still at 2-3”h20. Rodded out lance 5C , which had the most amount of carbon in it last night. It was clear. Also checked the line to 7A to check for clog, none found
- 09:00 – Switched to 4” line on East side. Opened up bleed valve and hooked the hose to Train 2(near cabinet).

Current Conditions:

32 Hz
41.9 amps
79.9 % power
Blower outlet pressure 7.5 psig
Eductor inlet Pressure 8 PSI
Eductor suction -0.8 inches H2O
East manifold pressure = ~ 34” H2O

- 1015 – Start carbon on train # 2 to East manifold at 2.5 lbs/MMacf (~26 lbs/hr).
- 1025 – Increase carbon to 5 lbs/MMacf (~26 lbs/hr).

Current Conditions:

32 Hz
41.9 amps
79.9 % power
Blower outlet pressure 7 psig
Eductor inlet pressure 7.5 PSI
Eductor suction inches -1 H2O
East manifold pressure = ~”H2O

- 1300 – Hg removal not getting any better than ~ 75 %. Switch EMC probe back to the west by one port (was in the fourth from the west, now it is in the third from the west).
- As of this morning, ash hoppers 3-1, 3-2, 3-4, 4-1, 4-2, 4-4 have all been bypassed since sometime last night.
- 1450 – Was able to collect a good ash sample from ash hopper # 3-1! That was the only one though.

  Note: Hoppers 3-3, 3-4, 4-3 and 4-4 were all "in service" after the sample was obtained. Evidently the operators are not able to maintain the hopper configurations they say they can.
- 1530 – Finish reinstalling the 4" feed line with the small eductor on train # 1. Currently it is hooked to the west manifold; the lances are being cleared of any residual carbon. (Carbon is <u>not on</u> to the west manifold, (train # 1)). Carbon feed to east manifold was temporarily interrupted due to low eductor pressure on train # 2.
- Continue carbon to east manifold (train #2) at 5 lbs/MMacf (50 lbs/hr).
- 1720 – start carbon on train # 1 to west manifold at 5 lbs/MMacf (50 lbs/hr).
  32 Hz
  38 amps
  79.9 % power
  Blower outlet pressure 7 psig
  Eductor inlet pressure 7.5 PSI
  Eductor suction inches -1" H2O
  East manifold pressure = ~"31 H2O
  West manifold = ~34" H2O
- 1830 – Continue feeding both trains @ 5 lbs/MMacf. Leave site.

Friday March 2, 2007

- 0715 CS & BH arrive on site. Silo still feeding 50 lbs/hr on each feeder, no alarms, no lakes of carbon on the ground!
- Everything is operating great at the moment %removal appears to be around 90%
- 11:39 - Changed injection rate to 3#/MMacf
- 1500 – Collect ash sample from hoppers 3-1 & 3-4. Ash hoppers 3-1, 3-2, 3-4, 4-1, 4-2, & 4-4 have all been isolated for several hours, 3-4, 4-1, & 4-4 had no ash.
- 1730 – Have installed a vibrator on 3C with a timer. Leaving now.

Saturday March 3, 2007

- 0830 – BH & CS on site after picking up some supplies from town.
- Hg removal still between 85 and 90 % (89.4% 18 hours) overnight at 3 lbs/MMacf.
- Ran STM at ESP inlet and outlet (one hour at inlet, two at outlet). Neither STM box created a data file! Recorded DGM m3 at start and stop of test.
- 1400 – Collect coal sample from north conveyor.
- 1500 – Collect ash sample from hoppers 3-1 & 3-4. Ash hoppers 3-1, 3-2, 3-4, 4-1, 4-2, & 4-4 have all been isolated for several hours, 3-4, 4-1, & 4-4 had no ash.
- 16:40 - Discharge Pressure up to 8.5 at 889 MW lowered down to 7.0
- 1700 – Leave site

Sunday March 4, 2007

- 0800 – Here again. Continue feeding at 3 lbs/MMacf. Plant switched to ColoWyo coal sometime during the night, mercury levels very low. Plant indicated that they would run out at 14:00
- Changed out Sncl2 impingers, rinsed crystals out of NaOH impingers.
- Cannot get either STM box to create data files on the compact flash cards.
- Precip operator is evacuating all ash hoppers this morning, then he will isolate them again, we will attempt to collect ash samples this afternoon.
- Blew out all injection ports (with the exception of a select few). No significant build up could be noticed except maybe the last 1 to 2 feet of the lance had some solids built up.
- No ash sample was obtained.
- 1530 leave site.

Monday March 5, 2007

- 0715 BH & CS on site. Carbon is still feeding at 3 lbs/MMacf (30 lbs/hour per side), silo level @ 0% full, load cells indicate 6100 lbs left in silo.
- 1000 – Start STM at inlet and outlet.
- 17:25 Decreased injection rate to 1.5 lb/MMacf
- 1830 leave site.

Tuesday March 6, 2007

- 0730 – BH & CS on site.
- Train # 2 tripped off at ~ 0407 hrs due to a feeder malfunction alarm. Cannot determine what caused this at this point. Reset alarm and started feeder.

Current Blower/Skid conditions:

- Power setting – 79.9%
- Hertz – 32
- Amps – 40
- Blower discharge pressure – 8 psi
- Train 1 suction - -1.4” H2O
- Train 1 pressure – 7 psi
- Train 1 feed rate – 15 lbs/hr
- Train 2 suction - -1.5: H2O
- Train 2 pressure – 8 psi
- Train 2 feed rate – 15 lbs/hr
- Additionally, there were two separate hopper fill malfunction alarms on train 2 overnight, probably due to the low silo level.
- 1010 – Another Feeder malfunction alarm has stopped the train 2 feeder. Reset
- 10:30 – Unit at low load(~650) feeder # 2 having constant problems
- 10:40 - due to skid problems increased injection rate back to 3.0
- 15:09 - Decreased the injection rate to 2 #/MMacf
- 16:44 – turned off carbon to check velocities at 610 mw
- 1815 - Turned on carbon @ 2 lbs/MMacf
- 1845 – Leave site.

Wednesday March 7, 2007

- 0715 – BH & CS on site
- 7:32 – Turned off feeders to take another crack at the velocities
- 8:39 – restarted feeders at 2 #/MMacf
- Ambient temperature around 75F notice % removal slipping despite constant feed and full load
- 1730 – Leave site.

Thursday March 8, 2007

- 07:00 – Turned off carbon feeders
- closed knife valves on silo
- Kept blower running
- Going to post the data, will update further once back in Denver if needed

APPENDIX D:

Source Testing

APPENDIX D1: Source Testing—August 15–18, 2005

METCO ENVIRONMENTAL
P.O. Box 598
Addison, TX 75001
(972) 931-7127

SOURCE EMISSIONS SURVEY
OF
ARKANSAS POWER & LIGHT COMPANY
INDEPENDENCE STEAM
ELECTRIC STATION
UNIT NUMBER 2 ESP INLET
AND OUTLET DUCTS
NEWARK, ARKANSAS
FOR
ADA-ES

AUGUST 2005

FILE NUMBER 05-233REV

" I certify that I have personally checked and am familiar with the information submitted herein, and based on my inquiries of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate, and complete. "

_____

James R. Monfries
Senior Quality Assurance Manager

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A. Location of Sampling Points
B. Source Emissions Calculations
C. Calibration Data
D. Field Testing Data
E. Analytical Data
F. Chain of Custody
G. Resumes of Test Personnel

SOURCE EMISSIONS SURVEY
ARKANSAS POWER & LIGHT COMPANY
INDEPENDENCE STEAM ELECTRIC STATION
UNIT NUMBER 2 ESP INLET AND OUTLET DUCTS
NEWARK, ARKANSAS
FOR
ADA-ES
FILE NUMBER 05-233

INTRODUCTION

METCO Environmental, P.O. Box 598, Addison, Texas, conducted a source emissions survey of Arkansas Power & Light Company, Independence Steam Electric Station, located in Newark, Arkansas, for ADA-ES, on August 15, 16, 17, and 18, 2005. The purpose of these tests was to determine the concentrations of particulate matter, hydrogen chloride, hydrogen bromide, hydrogen fluoride, and mercury at the Unit Number 2 ESP Inlet and Outlet Ducts.

The sampling was performed by the following METCO personnel: Steve Bornsen - Project Supervisor, Jason Brown, Rodney Malone, Ben Goebel, Ben Weber, Dustin Simpson, Doug Ware, Jason Sellers, and Joshua Orr.

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 17, and 26A; and the Ontario Hydro Method, Revised July 7, 1999 (ASTM D-6785-02).

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Run Number	Particulate Matter Emissions (gr/dscf*)	(lbs/hr)	(lbs/mmBtu)
1	1.7794	3,916.47	3.352
2	1.5092	3,259.65	2.918
3	1.8450	4,199.78	3.346
Average	1.7112	3,791.97	3.205

Run Number	Hydrogen Chloride Emissions (dry ppm)	(lbs/hr)	(lbs/mmBtu)	Hydrogen Fluoride Emissions (dry ppm	(lbs/hr)	(lbs/mmBtu)	Hydrogen Bromide Emissions (dry ppm)	(lbs/hr)	(lbs/mmBtu)
1	0.36	0.522	4.46E-04	0.94	0.754	6.45E-04	0.01	0.044	3.80E-05
2	0.34	0.494	4.42E-04	0.70	0.551	4.93E-04	N.D.	N.D.	N.D.
3	0.47	0.705	5.61E-04	0.86	0.715	5.69E-04	0.01	0.032	2.51E-05
Average	0.39	0.574	4.83E-04	0.83	0.673	5.69E-04	< 0.01	< 0.025	< 2.10E-05

Unit Number 2 ESP Outlet Duct

Run Number	Particulate Matter Emissions (gr/dscf*)	(lbs/hr)	(lbs/mmBtu)
1	0.0102	22.10	0.021
2	0.0123	23.45	0.025
3	0.0126	26.60	0.027
Average	0.0117	24.05	0.024

Run Number	Hydrogen Chloride Emissions (dry ppm)	(lbs/hr)	(lbs/mmBtu)	Hydrogen Fluoride Emissions (dry ppm	(lbs/hr)	(lbs/mmBtu)	Hydrogen Bromide Emissions (dry ppm)	(lbs/hr)	(lbs/mmBtu)
1	0.44	0.626	6.07E-04	1.85	1.459	1.42E-03	0.02	0.054	5.29E-05
2	0.38	0.480	5.08E-04	1.10	0.761	8.05E-04	N.D.	N.D.	N.D.
3	0.49	0.690	6.99E-04	1.63	1.251	1.27E-03	0.01	0.046	4.67E-05
Average	0.44	0.599	6.05E-04	1.53	1.157	1.17E-03	< 0.01	< 0.033	< 3.32E-05

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)
N.D. – None detected.

METCO ENVIRONMENTAL

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Run Number	Particle Bound Mercury Emissions (µg/m³)	Particle Bound Mercury Emissions (lbs/trillion Btu)	Oxidized Mercury Emissions (µg/m³)	Oxidized Mercury Emissions (lbs/trillion Btu)	Elemental Mercury Emissions (µg/m³)	Elemental Mercury Emissions (lbs/trillion Btu)	Total Mercury Mercury Emissions (µg/m³)	Total Mercury Mercury Emissions (lbs/trillion Btu)
1	0.328	0.270	7.950	6.546	5.016	4.130	13.294	10.946
2	0.365	0.308	2.315	1.957	5.652	4.777	8.332	7.042
3	0.359	0.284	1.964	1.557	5.010	3.971	7.333	5.812
Average	0.351	0.287	4.076	3.353	5.226	4.293	9.653	7.933

Unit Number 2 ESP Outlet Duct

Run Number	Particle Bound Mercury Emissions (µg/m³)	Particle Bound Mercury Emissions (lbs/trillion Btu)	Oxidized Mercury Emissions (µg/m³)	Oxidized Mercury Emissions (lbs/trillion Btu)	Elemental Mercury Emissions (µg/m³)	Elemental Mercury Emissions (lbs/trillion Btu)	Total Mercury Mercury Emissions (µg/m³)	Total Mercury Mercury Emissions (lbs/trillion Btu)
1	< 0.013	< 0.012	4.160	3.820	3.729	3.424	< 7.902	< 7.256
2	0.052	0.046	3.327	2.928	4.204	3.701	7.583	6.675
3	0.094	0.087	2.037	1.898	4.266	3.974	6.397	5.959
Average	< 0.053	< 0.048	3.175	2.882	4.066	3.700	< 7.294	< 6.630

MECO ENVIRONMENTAL

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

EPA Method 17 Particulate Matter

Run Number	1	2	3
Date	08/17/05	08/17/05	08/18/05
Time	1103-1616	1803-2052	1100-1348
Duct Flow Rate - ACFM	455,232	443,763	465,525
Duct Flow Rate - DSCFM*	256,821	252,027	265,609
% Water Vapor - % Vol.	12.50	11.37	11.81
% CO_2 - % Vol.	14.8	14.6	14.0
% O_2 - % Vol.	5.4	5.8	4.8
% Excess Air @ Sampling Point	34.3	37.9	28.7
Stack Temperature - °F	329	331	323
Stack Pressure - "Hg	28.72	28.62	28.60
Percent Isokinetic	96.6	98.4	98.2
Volume Dry Gas Sampled - DSCF*	55.094	55.078	57.964
Particulate Matter Emissions Nozzle & Thimble Catch grains/dscf*	1.7794	1.5092	1.8450
grains/cf @ Stack Conditions	1.0003	0.8542	1.0490
lbs/hr	3,916.47	3,259.65	4,199.78
lbs/mmBtu	3.352	2.918	3.346

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

EPA Method 26A

Run Number	1	2	3
Hydrogen Chloride - µg	846.1	815.4	1,162.8
Hydrogen Chloride Concentrations – dry ppm	0.36	0.34	0.47
Hydrogen Chloride Concentrations – lbs/hr	0.522	0.494	0.705
Hydrogen Chloride Concentrations – lbs/mmBtu	4.46E-04	4.42E-04	5.62E-04
Hydrogen Fluoride - µg	1,223.0	910.1	1,178.9
Hydrogen Fluoride Concentrations – dry ppm	0.94	0.70	0.86
Hydrogen Fluoride Concentrations – lbs/hr	0.754	0.551	0.715
Hydrogen Fluoride Concentrations – lbs/mmBtu	6.45E-04	4.93E-04	5.69E-04
Hydrogen Bromide - µg	72.0	N.D.	52.0
Hydrogen Bromide Concentrations – dry ppm	0.01	N.D.	0.01
Hydrogen Bromide Concentrations – lbs/hr	0.044	N.D.	0.032
Hydrogen Bromide Concentrations – lbs/mmBtu	3.80E-05	N.D.	2.51E-05

N.D. – None detected.

Note: Chorine and Bromine were not detected in the samples.

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Date	08/17/05	08/17/05	08/18/05
Time	1110-1527	1816-2105	1110-1350
Duct Flow Rate - ACFM	448,864	445,585	437,601
Duct Flow Rate - DSCFM*	256,671	253,438	248,598
% Water Vapor - % Vol.	12.36	12.38	12.64
% CO_2 - % Vol.	14.8	14.6	14.0
% O_2 - % Vol.	5.4	5.8	4.8
% Excess Air @ Sampling Point	34.3	37.9	28.7
Stack Temperature - °F	320	321	319
Stack Pressure - "Hg	28.73	28.62	28.60
Percent Isokinetic	95.1	103.2	101.6
Volume Dry Gas Sampled - DSCF*	55.967	58.109	56.112

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Particle Bound Mercury - µg	0.52	0.60	0.57
Particle Bound Mercury Emissions - µg/m^{3*}	0.328	0.365	0.359
Particle Bound Mercury Emissions - lbs/trillion Btu	0.270	0.308	0.284
Oxidized Mercury - µg	12.60	3.81	3.12
Oxidized Mercury Emissions - µg/m^{3*}	7.950	2.315	1.964
Oxidized Mercury Emissions - lbs/trillion Btu	6.546	1.957	1.557
Elemental Mercury - µg	7.95	9.30	7.96
Elemental Mercury Emissions - µg/m^{3*}	5.016	5.652	5.010
Elemental Mercury Emissions - lbs/trillion Btu	4.130	4.777	3.971
Total Mercury Emissions - µg/m^{3*}	13.294	8.332	7.333
Total Mercury Emissions - lbs/trillion Btu	10.946	7.042	5.812

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

EPA Method 17 Particulate Matter

Run Number	1	2	3
Date	08/17/05	08/17/05	08/18/05
Time	1101-1514	1802-2048	1100-1350
Duct Flow Rate - ACFM	427,845	387,599	425,892
Duct Flow Rate - DSCFM*	252,709	222,254	245,498
% Water Vapor - % Vol.	11.85	11.23	12.15
% CO_2 - % Vol.	12.8	13.6	13.2
% O_2 - % Vol.	7.0	6.4	7.2
% Excess Air @ Sampling Point	49.1	43.2	51.8
Stack Temperature - °F	298	324	312
Stack Pressure - "Hg	28.68	28.59	28.60
Percent Isokinetic	97.4	97.4	95.3
Volume Dry Gas Sampled - DSCF*	71.536	62.928	67.971
Particulate Matter Emissions Nozzle & Thimble Catch grains/dscf*	0.0102	0.0123	0.0126
grains/cf @ Stack Conditions	0.0060	0.0070	0.0073
lbs/hr	22.10	23.45	26.60
lbs/mmBtu	0.021	0.025	0.027

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

EPA Method 26A

Run Number	1	2	3
Hydrogen Chloride - µg	1,339.4	1,027.6	1,444.2
Hydrogen Chloride Emissions – dry ppm	0.44	0.38	0.49
Hydrogen Chloride Emissions – lbs/hr	0.626	0.480	0.690
Hydrogen Chloride Emissions – lbs/mmBtu	6.07E-04	5.08E-04	6.99E-04
Hydrogen Fluoride - µg	3,122.5	1,629.6	2,617.3
Hydrogen Fluoride Emissions – dry ppm	1.85	1.10	1.63
Hydrogen Fluoride Emissions – lbs/hr	1.459	0.761	1.251
Hydrogen Fluoride Emissions – lbs/mmBtu	1.42E-03	8.05E-04	1.27E-03
Hydrogen Bromide - µg	116.6	N.D.	96.4
Hydrogen Bromide Emissions – dry ppm	0.02	N.D.	0.01
Hydrogen Bromide Emissions – lbs/hr	0.054	N.D.	0.046
Hydrogen Bromide Emissions – lbs/mmBtu	5.29E-05	N.D.	4.67E-05

N.D. – None detected.

Note: Chorine and Bromine were not detected in the samples.

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Date	0817/05	08/17/05	08/18/05
Time	1110-1443	1812-2108	1120-1403
Duct Flow Rate - ACFM	431,045	445,572	437,962
Duct Flow Rate - DSCFM*	246,156	242,361	243,978
% Water Vapor - % Vol.	11.74	13.75	13.13
% CO_2 - % Vol.	12.8	13.6	13.2
% O_2 - % Vol.	7.0	6.4	7.2
% Excess Air @ Sampling Point	49.1	43.2	51.8
Stack Temperature - °F	325	343	330
Stack Pressure - "Hg	28.68	28.59	28.60
Percent Isokinetic	99.2	96.0	95.8
Volume Dry Gas Sampled - DSCF*	53.223	67.614	67.961

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Particle Bound Mercury - µg	< 0.02	0.10	0.18
Particle Bound Mercury Emissions - µg/m^{3*}	< 0.013	0.052	0.094
Particle Bound Mercury Emissions - lbs/trillion Btu	< 0.012	0.046	0.087
Oxidized Mercury - µg	6.27	6.37	3.92
Oxidized Mercury Emissions - µg/m^{3*}	4.160	3.327	2.037
Oxidized Mercury Emissions - lbs/trillion Btu	3.820	2.928	1.898
Elemental Mercury - µg	5.62	8.05	8.21
Elemental Mercury Emissions - µg/m^{3*}	3.729	4.204	4.266
Elemental Mercury Emissions - lbs/trillion Btu	3.424	3.701	3.974
Total Mercury Emissions - µg/m^{3*}	< 7.902	7.583	6.397
Total Mercury Emissions - lbs/trillion Btu	< 7.256	6.675	5.959

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

DISCUSSION OF RESULTS

Unit Number 2 ESP Inlet Duct

The three tests for particulate matter, hydrogen chloride, hydrogen bromide, and hydrogen fluoride appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 5.1 percent of the mean value. The measured flow rates (Q_s) for the tests were within 2.9 percent of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 3.4 percent.

The calculated emissions (pounds per million Btu) of particulate matter for the three tests showed a range of -9.0 percent to +4.6 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of hydrogen chloride for the three tests showed a range of -8.6 percent to +16.3 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of hydrogen fluoride for the three tests showed a range of -13.4 percent to +13.4 percent variation from the mean value.

The concentrations of hydrogen bromide for one of the three tests were below the minimum detectable limit of the method.

The three tests for speciated mercury appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters

calculated from the field data were in close agreement. The moisture percentages for the three tests were within 1.4 percent of the mean value. The measured flow rates (Q_s) for the tests were within 1.7 percent of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 4.9 percent.

The calculated emissions (pounds per trillion Btu) of total mercury for the three tests showed a range of -26.7 percent to +38.0 percent variation from the mean value.

Unit Number 2 ESP Outlet Duct

The three tests for particulate matter, hydrogen chloride, hydrogen bromide, and hydrogen fluoride appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 4.4 percent of the mean value. The measured flow rates (Q_s) for the tests were within 7.5 percent of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 4.7 percent.

The calculated emissions (pounds per million Btu) of particulate matter for the three tests showed a range of -13.7 percent to +11.0 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of hydrogen chloride for the three tests showed a range of -16.0 percent to +15.6 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of hydrogen fluoride for the three tests showed a range of -30.9 percent to +21.9 percent variation from the mean value.

The concentrations of hydrogen bromide for one of the three tests were below the minimum detectable limit of the method.

The three tests for speciated mercury appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 8.8 percent of the mean value. The measured flow rates (Q_s) for the tests were within 0.8 percent of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 4.2 percent.

The calculated emissions (pounds per trillion Btu) of total mercury for the three tests showed a range of -10.1 percent to +9.4 percent variation from the mean value.

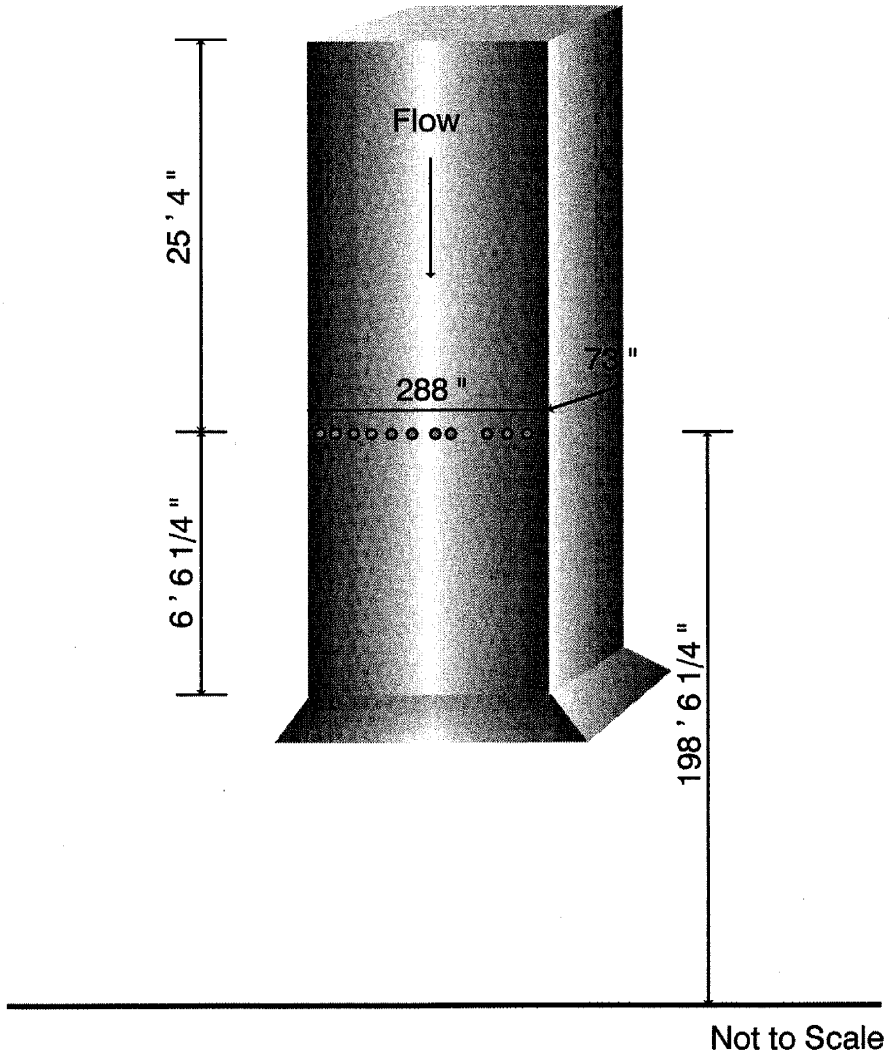
DESCRIPTION OF SAMPLING LOCATIONS

The sampling location on the Unit Number 2 ESP Inlet Duct is 198 feet 6 1/4 inches above the ground. The sampling ports are located 25 feet 4 inches (2.61 equivalent duct diameters) downstream from a bend in the duct and 6 feet 6 1/4 inches (0.67 equivalent duct diameters) upstream from an expansion in the duct.

The sampling location on the Unit Number 2 ESP Outlet Duct is approximately 200 feet above the ground. The sampling ports are located 6 feet 11 inches (0.71 equivalent duct diameters) downstream from a constriction in the duct and 3 feet 2 inches (0.33 equivalent duct diameters) upstream from a bend in the duct.

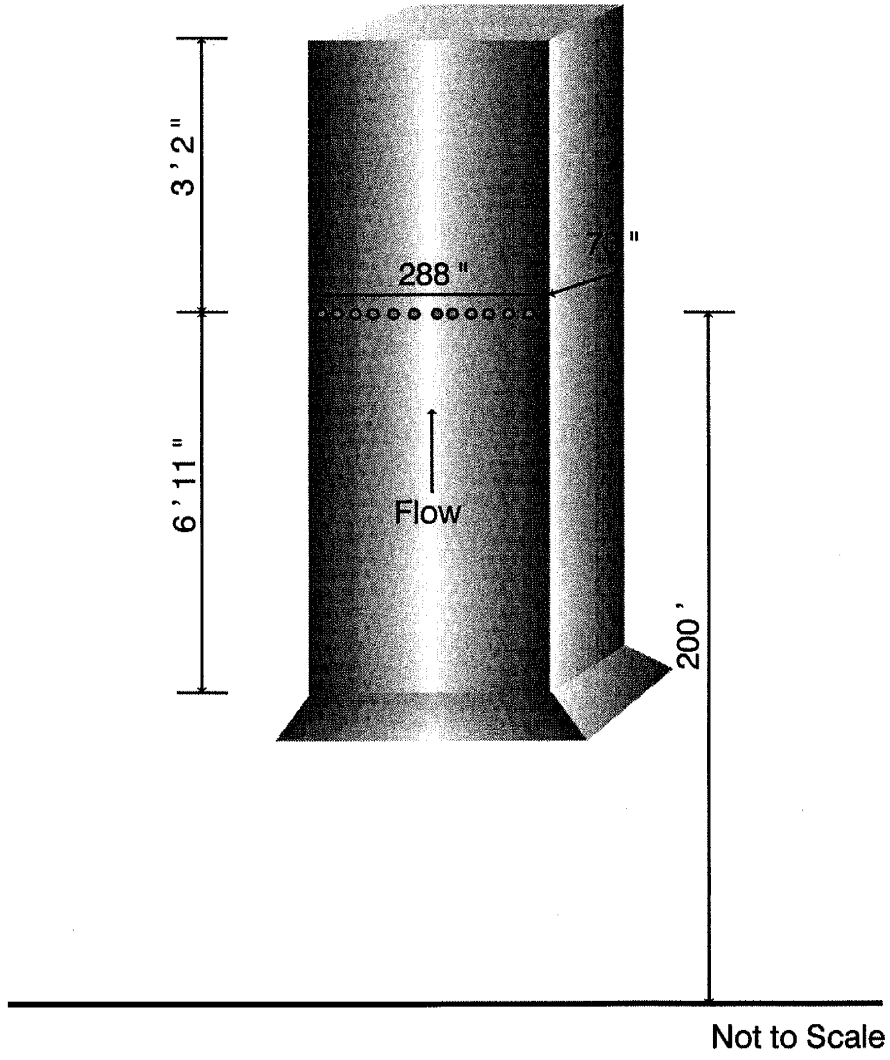
SAMPLING LOCATION

Unit Number 2 ESP Inlet Duct



SAMPLING LOCATION

Unit Number 2 ESP Outlet Duct



Not to Scale

SAMPLING AND ANALYTICAL PROCEDURES

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 17, and 26A; and the Ontario Hydro Method, Revised July 7, 1999 (ASTM D-6785-02).

A preliminary velocity traverse was made at eight of the eleven ports on the Unit Number 2 ESP Inlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. All traverse points were checked for cyclonic flow and the average angle of flow was equal to 4.8 degrees. Alternate procedures would be required if the angle of flow was greater than 20 degrees. Four traverse points were sampled from each of the eight ports for a total of thirty-two traverse points.

A preliminary velocity traverse was made at six of the twelve ports on the Unit Number 2 ESP Outlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. All traverse points were checked for cyclonic flow and the average angle of flow was equal to 5.2 degrees. Alternate procedures would be required if the angle of flow was greater than 20 degrees. Four traverse points were sampled from each of the eight ports for a total of thirty-two traverse points.

The sampling trains were leak-checked at the nozzle at 15 inches of mercury vacuum before each test, and again after each test at the highest vacuum reading recorded during the test. This was done to predetermine the possibility of a diluted sample.

The pitot tube lines were checked for leaks before and after each test under both a vacuum and a pressure. The lines were also checked for clearance and the manometer was zeroed before each test.

An integrated orsat sample was collected and analyzed according to EPA Method 3B during each test.

Particulate Matter/Halogens

Triplicate samples for particulate matter, hydrogen chloride, hydrogen bromide, and hydrogen fluoride were collected from each source. The samples were taken according to EPA Methods 1, 2, 3B, 4, 17, and 26A. For each run, samples of four-minute duration were taken isokinetically at each of the thirty-two traverse points for a total sampling time of 128 minutes. Reagent blanks were submitted.

The " front-half " of the sampling train contained the following components:

Quartz Nozzle
In-Stack Quartz Fiber Thimble and Filter in a Glass Assembly
Heated Glass Probe @ 248°F ± 25°F

The " back-half " of the sampling train contained the following components:

Impinger Number	Contents	Amount	Parameter Collected
1	0.1N Sulfuric Acid	100 ml	Halogens
2	0.1N Sulfuric Acid	100 ml	Halogens
3	Empty	----	Halogens and Moisture
4	0.1N Sodium Hydroxide	100 ml	Halogens
5	0.1N Sodium Hydroxide	100 ml	Halogens
6	Silica Gel	200 g	Moisture

Particulate matter emissions were calculated from gravimetric analysis of the "front-half" collections.

The halogen samples were analyzed by ion chromatography.

Speciated Mercury

Triplicate samples for speciated mercury were collected from each source. The samples were taken according to EPA Methods 1, 2, 3B, 4, 5, and 17; and the Ontario Hydro Method, Revised July 7, 1999. For Run Number 1 on the Inlet Duct, samples of four-minute duration were taken isokinetically at twenty-eight traverse points for a total sampling time of 96 minutes. For all other runs, samples of four-minute duration were taken isokinetically at each of the thirty-two traverse points for a total sampling time of 128 minutes. Blank train samples and reagent blanks were submitted.

The " front-half " of the sampling train contained the following components:

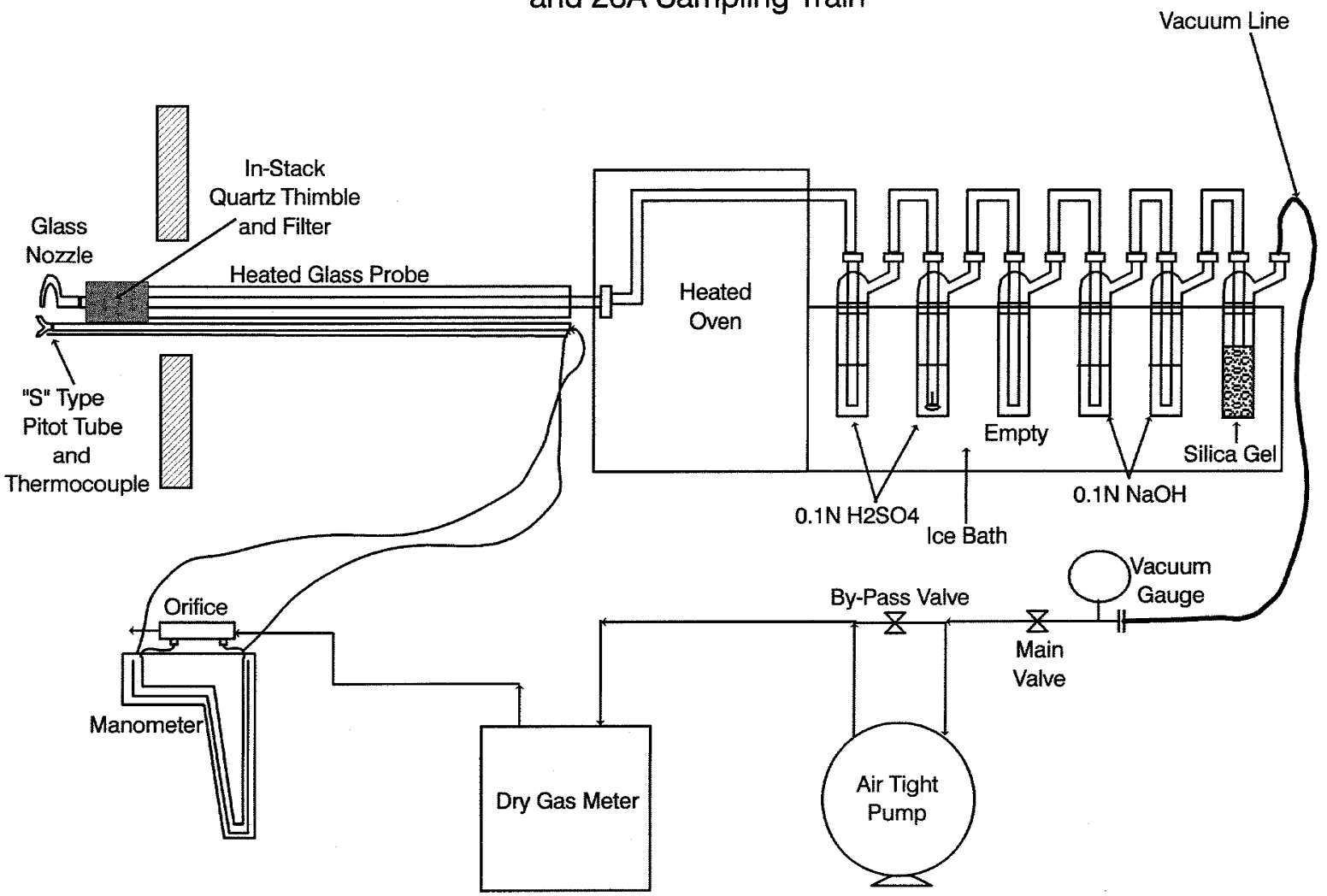
Quartz Nozzle
In-Stack Quartz Fiber Thimble and Filter in a Glass Assembly
Heated Glass Probe @ 248°F ± 25°F

The " back-half " of the sampling train contained the following components:

Impinger Number	Contents	Amount	Parameter Collected
1	1 mol/L KCl	100 ml	Oxidized Mercury
2	1 mol/L KCl	100 ml	Oxidized Mercury
3	1 mol/L KCl	100 ml	Oxidized Mercury
4	5% HNO_3 and 10% H_2O_2	100 ml	Elemental Mercury
5	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
6	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
7	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
8	Silica Gel	200 g	Moisture

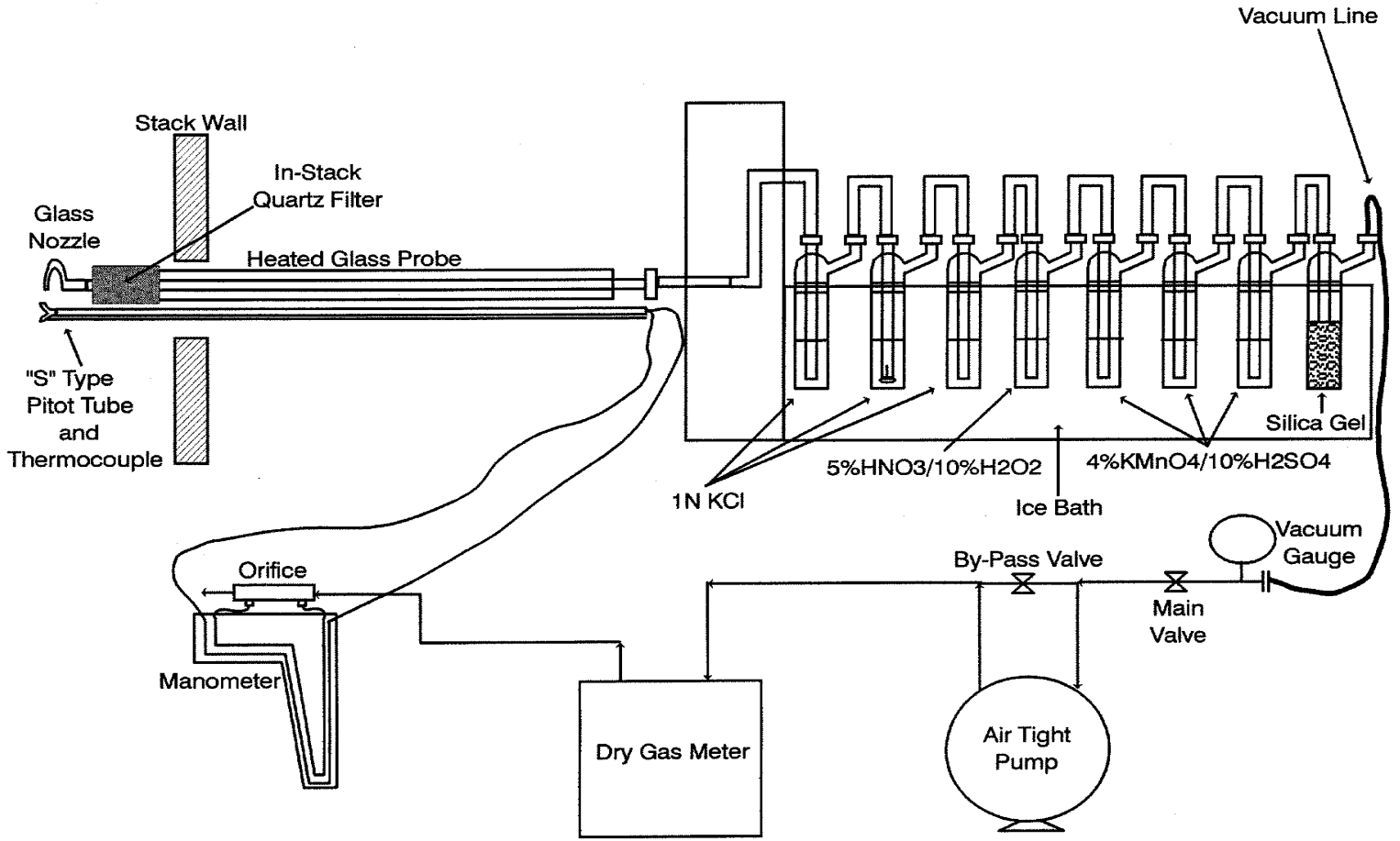
The mercury samples were analyzed by cold vapor atomic absorption spectroscopy.

Schematic Diagram of the EPA Combined Methods 17 and 26A Sampling Train



METCO ENVIRONMENTAL

Schematic Diagram of the Ontario Hydro Method Sampling Train



ENVIRONMENTAL

DESCRIPTION OF TESTS

Personnel from METCO Environmental arrived at the plant at 3:00 p.m. on Monday, August 15, 2005. After meeting with plant personnel and attending a brief safety orientation, the equipment was moved onto the Unit Number 2 ESP Inlet and Outlet Ducts. The equipment was secured for the night and all work was completed at 7:00 p.m.

On Tuesday, August 16, work began at 7:45 a.m. The equipment was prepared for testing. The preliminary data was collected. Testing was delayed until the scaffolding was completed. The equipment was secured for the night and all work was completed at 7:15 p.m.

On Wednesday, August 17, work began at 9:00 a.m. The equipment was prepared for testing. The first set of tests for particulate matter, hydrogen chloride, hydrogen fluoride, and hydrogen bromide began at 11:01 a.m. Testing continued until completion of the second set of tests at 8:52 p.m. The first set of tests for speciated mercury began at 11:10 a.m. Testing continued until completion of the second set of tests at 9:08 p.m. The samples were recovered. The equipment was secured for the night and all work was completed at 11:00 p.m.

On Thursday, August 18, work began at 9:15 a.m. The equipment was prepared for testing. The third set of tests for particulate matter, hydrogen chloride, hydrogen fluoride, and hydrogen bromide began at 11:00 a.m. and was completed at 1:50 p.m. The third set of tests for speciated mercury began at 11:10 a.m. and was completed at 2:03 p.m.

The equipment was moved off of the sampling locations and loaded into the sampling van. The samples were recovered and transported to METCO Environmental's laboratory in Dallas, Texas, for analysis and evaluation.

Operations at Arkansas Power & Light Company, Independence Steam Electric Station, Unit Number 2 ESP Inlet and Outlet Ducts, located in Newark, Arkansas, for ADA-ES, were completed at 5:00 pm. on Thursday, August 18, 2005.

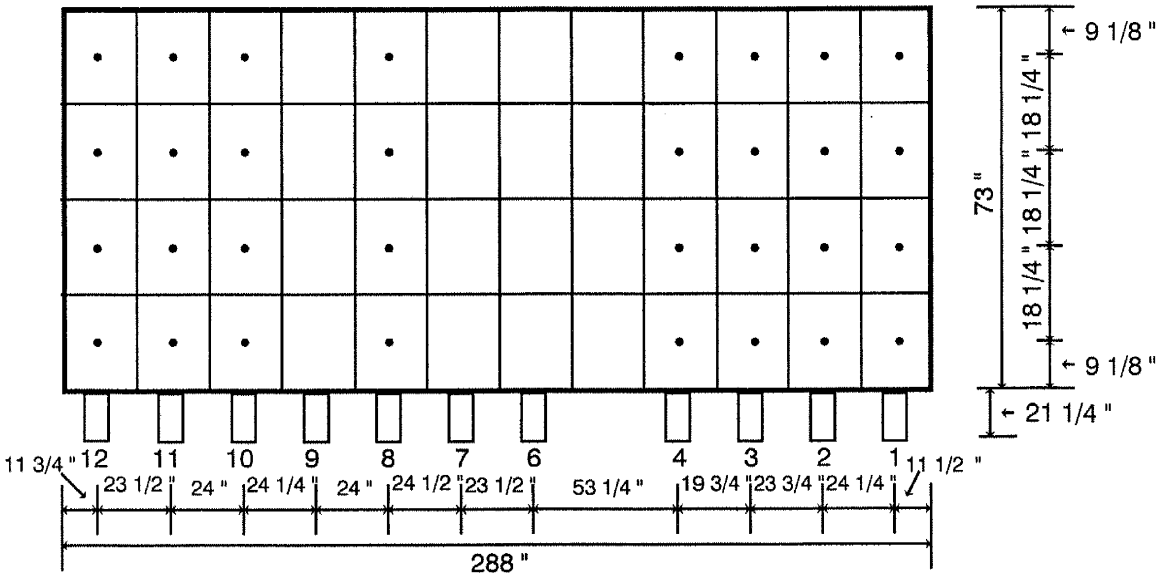
APPENDICES

A. Location of Sampling Points
B. Source Emissions Calculations
C. Calibration Data
D. Field Testing Data
E. Analytical Data
F. Chain of Custody
G. Resumes of Test Personnel

APPENDIX A

Location of Sampling Points
Unit Number 2 ESP Inlet Duct

The sampling ports are located 25 feet 4 inches (2.61 equivalent duct diameters) downstream from a bend in the duct and 6 feet 6 1/4 inches (0.67 equivalent duct diameters) upstream from an expansion in the duct. The locations of the sampling points were calculated as follows:



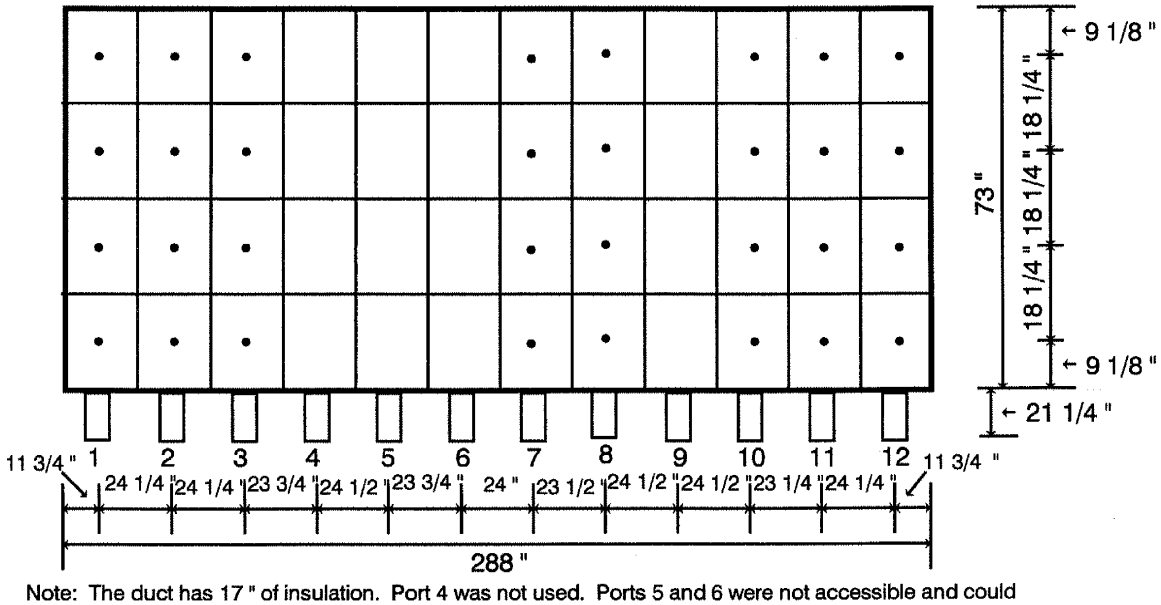
Note: The duct has 17 " of insulation. Port 5 does not exist. Ports 6 and 7 are not part of the gas stream and were not included in the calculation of the area. The width of where Ports 6 and 7 are located is 5 ' 5 ". This leaves a width of 18 ' 7 " on which the area was calculated. A plant monitor probe is located in Port 9.

Not to Scale

APPENDIX A

Location of Sampling Points
Unit Number 2 ESP Outlet Duct

The sampling ports are located 6 feet 11 inches (0.71 equivalent duct diameters) downstream from a constriction in the duct and 3 feet 2 inches (0.33 equivalent duct diameters) upstream from a bend in the duct. The locations of the sampling points were calculated as follows:



Note: The duct has 17 " of insulation. Port 4 was not used. Ports 5 and 6 were not accessible and could not be sampled. A plant monitor probe is located in Port 9.

Not to Scale

APPENDIX B

Nomenclature and Equations
for
Calculation of Source Emissions

NOMENCLATURE FOR PARTICULATE CALCULATIONS

Symbol	English Units	Metric Units	Description
A_s	$in.^2$	m^2	Stack Area
C_{an}	gr/dscf*	g/dscm*	Particulate - probe, cyclone, and filter
C_{ao}	gr/dscf*	g/dscm*	Particulate - total
C_{at}	gr/CF @ stack conditions	g/m^3	Particulate - probe, cyclone, and filter
C_{au}	gr/CF @ stack conditions	g/m^3	Particulate - total
C_{aw}	lbs/hr	kg/hr	Particulate - probe, cyclone, and filter
C_{ax}	lbs/hr	kg/hr	Particulate - total
C_p			Pitot Tube Calibration Factor
D_n	in.	m	Sampling Nozzle Diameter
%EA			Percent Excess Air at sampling point
g	32.174 ft/sec^2		Acceleration of Gravity
%I			Percent Isokinetic
%M			Percent Moisture in the stack gas by volume
M_d			Mole fraction of dry gas

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

Symbol	English Units	Metric Units	Description
m_f	mg	mg	Particulate - probe, cyclone, and filter
M_{water}	18 lb/lb-mole		Molecular Weight of water
m_t	mg	mg	Particulate - total
MW	lb/lb-mole	g/g-mole	Molecular Weight of stack gas
MW_{air}	28.96 lb/ lb-mole		Molecular Weight of air
MW_d	lb/lb-mole	g/g-mole	Molecular Weight of dry stack gas
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H_2O	mm H_2O	Orifice Pressure drop
P_s	"Hg Absolute	mm Hg	Stack Pressure
ΔP	"H_2O	mm H_2O	Velocity Head of stack gas
P_{std}	29.92 "Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m^3/hr	Stack Gas Volume at actual stack conditions
Q_s	DSCFM*	dscm/hr*	Stack Gas Volume at 29.92 "Hg, 528°R, dry
R	21.83 "Hg-ft^3/lb-mole°R		Universal Gas Constant
T_m	°F	°C	Average Gas Meter Temperature

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

Symbol	English Units	Metric Units	Description
T_t	min	min	Net time of test
T_s	°F	°C	Stack Temperature
T_{std}	528°R	293°K	Standard Temperature
V_m	ft^3	m^3	Volume of dry gas sampled @ meter conditions
Vm_{std}	dscf*	dscm*	Volume of dry gas sampled @ standard conditions
V_s	fpm	m/sec	Stack velocity @ stack conditions
V_w	ml	ml	Total water collected in impingers and silica gel
Vw_{gas}	scf*	scm*	Volume of water vapor collected @ standard conditions
ρ_{air}	0.0752 lbs/ft^3		Density of Air
ρ_{water}	1 g/ml		Density of Water
ρ_{man}	62.32 lbs/ft^3		Density of Manometer Oil

Standard Conditions: 29.92 "Hg, 68°F (760 mm Hg, 20°C)

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

METCO ENVIRONMENTAL

EXAMPLE CALCULATIONS

1. Volume of dry gas sampled at standard conditions. *

$$Vm_{std} = Vm \left(\frac{T_{std}}{T_m + 460} \right) \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}} \right]$$

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = dscf$$

$$Vm_{std} = dscf \times 0.028317 = dscm$$

2. Volume of water vapor collected at standard conditions. *

$$Vw_{gas} = \frac{(V_w - gms\ SO_2 - gms\ H_2S)\ \rho_{water}\ R\ T_{std}}{P_{std}\ M_{water}\ 453.6}$$

$$Vw_{gas} = 0.0472\ (V_w - gms\ SO_2 - gms\ H_2S) = scf$$

$$Vw_{gas} = scf \times 0.028317 = scm$$

3. Percent moisture in stack gas.

$$\%M = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \%$$

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

4. Mole fraction of dry gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average molecular weight of dry stack gas.

$$MW_d = \left[\%CO_2 \times \frac{44}{100}\right] + \left[\%O_2 \times \frac{32}{100}\right] + \left[\%N_2 \times \frac{28}{100}\right] + \left[\%CO \times \frac{28}{100}\right] = lb/lb\text{-}mole$$

$$= g/g\text{-}mole$$

6. Molecular weight of stack gas.

$$MW = MW_d \times M_d + 18\,(1 - M_d) = \frac{lb}{lb\text{-}mole} = g/g\text{-}mole$$

7 Percent excess air at sampling point.

$$\%EA = \frac{100\,[\%O_2 - (0.5\,\%CO)]}{0.265\,(\%N_2) - [\%O_2 - (0.5\,\%CO)]}$$

8. Stack Pressure.

$$P_s = P_b + \frac{Stack\ Pressure\ "H_2O}{13.6} = "Hg\ Absolute$$

$$P_s = "Hg\ Abs. \times 25.4 = mm\ Hg$$

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

9. Stack velocity at stack conditions.

$$V_s = C_p\, 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460) \times \Delta P}{12 \times \rho_{air} \times P_s \times MW \times T_{std}} \right]^{1/2}$$

$$V_s = 5{,}123.8\, C_p \left[\frac{(T_s + 460)}{P_s \times MW} \right]^{1/2} \sqrt{\Delta P}\ \text{average} = \text{fpm}$$

$$V_s = \text{fpm} \times 0.00508 = \text{m/sec}$$

10. Dry stack gas volume at standard conditions. *

$$Q_s = \frac{1}{144} V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

$$Q_s = \frac{0.123\, V_s \times A_s \times M_d \times P_s}{T_s + 460} = DSCFM$$

$$Q_s = DSCFM \times 1.6990 = dscm/hr$$

11. Actual stack gas volume at stack conditions.

$$Q_a = \frac{V_s \times A_s}{144} = ACFM$$

$$Q_a = ACFM \times 1.6990 = m^3/hr$$

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

12. Percent Isokinetic.

$$\%I = \frac{Vm_{std} \times (T_s + 460) \times P_{std} \times 100 \times 144\ in^2/ft^2}{M_d \times T_{std} \times P_s \times T_t \times V_s (\frac{\pi \times D_n^2}{4})}$$

$$\%I = \frac{1039 \times Vm_{std} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s \times D_n^2}$$

13. Particulate – probe, cyclone, and filter.

$$C_{an} = \frac{m_f}{Vm_{std}} \times \frac{1\ gr}{64.8\ mg}$$

$$C_{an} = 0.0154 \times \frac{m_f}{Vm_{std}} = gr/dscf\ *$$

$$C_{an} = gr/dscf \times 2.290 = g/dscm\ *$$

14. Particulate total.

$$C_{ao} = 0.0154 \times \frac{m_t}{Vm_{std}} = gr/dscf\ *$$

$$C_{ao} = gr/dscf \times 2.290 = g/dscm\ *$$

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

15. Particulate – probe, cyclone, and filter at stack conditions.

$$C_{at} = C_{an} \times \frac{P_s}{P_{std}} \times \frac{(T_{std})}{(T_s + 460)} \times M_d$$

$$C_{at} = \frac{17.65 \times C_{an} \times P_s \times M_d}{T_s + 460} = gr/CF$$

$$C_{at} = gr/CF \times 2.290 = gr/m^3$$

16. Particulate – total, at stack conditions.

$$C_{au} = \frac{17.65 \times C_{ao} \times P_s \times M_d}{T_s + 460} = gr/CF$$

$$C_{au} = gr/CF \times 2.290 = gr/m^3$$

17. Particulate – probe, cyclone, and filter.

$$C_{aw} = C_{an} \times Q_s \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ lb}}{7000 \text{ gr}}$$

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = lbs/hr$$

$$C_{aw} = lbs/hr \times 0.4536 = kg/hr$$

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

18. Particulate – total.

$C_{ax} = 0.00857 \times C_{ao} \times Q_s = lbs/hr$

$C_{ax} = lbs/hr \times 0.4536 = kg/hr$

EXAMPLE CALCULATIONS

$$\text{lbs/hr} = \frac{\text{mg}}{Vm_{std}} \times 2.205 \times 10^{-6}\ \text{lbs/mg} \times \text{DSCFM*} \times 60\ \text{min/hr}$$

Vm_{std} = Volume of dry gas sampled (dscf*)
DSCFM* = Stack Flow Rate

$$\text{ppm} = \frac{\text{mg}}{Vm_{std}\ (m^3)} \times \frac{24.04}{MW}$$

24.04 = Ideal Gas Constant liters/g-mole
Vm_{std} = Volume of dry gas sampled (m^3*)
MW = Molecular Weight

Compound	Molecular Weight
Hydrogen Fluoride	20.01
Hydrogen Chloride	36.45
Hydrogen Bromide	80.92

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

EXAMPLE CALCULATIONS

$$\text{lbs/trillion Btu} = \frac{\text{lbs/dscf*} \times F_d \text{ factor} \times 20.9\%O_2}{20.9\%O_2 - \%O_2 \text{ measured}}$$

F_d = Oxygen based F factor

Fuel	F_d factor
Bituminous Coal	9.780×10^9 dscf*/trillion Btu

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

EXAMPLE CALCULATIONS

$$\text{lbs/million Btu} = \frac{\text{gr/dscf} \times \frac{1\ \text{lb}}{7{,}000\ \text{gr}} \times F_d\ \text{factor} \times 20.9\%O_2}{20.9\%O_2 - \%O_2\ \text{measured}}$$

$$\text{lbs/million Btu} = \frac{\text{lbs/dscf*} \times F_d\ \text{factor} \times 20.9\%O_2}{20.9\%O_2 - \%O_2\ \text{measured}}$$

F_d = Oxygen based F factor

Fuel	F_d Factor
Bituminous Coal	9,780 dscf*/million Btu

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-233
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT - METHODS 17 & 26A

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
DATE			08/17/05	08/17/05	08/18/05
BEGIN TIME			1103	1803	1100
END TIME			1616	2052	1348
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.76	29.66	29.67
		(mm Hg)	(756.00)	(753.00)	(754.00)
P(m)	ORIFICE PRESSURE DROP	"H2O	0.544	0.553	0.620
		(mm H2O)	(13.800)	(14.000)	(15.700)
	DGM CALIBRATION FACTOR		0.997	0.997	0.997
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	57.402	58.628	61.779
	@ METER CONDITIONS	(m^3)	(1.625)	(1.660)	(1.749)
	LEAK CHECK VOLUME	ft.^3	3.328	3.387	5.895
T(m)	AVERAGE GAS METER	DEG.F	88	98	99
	TEMPERATURE	(DEG.C)	(31)	(37)	(37)
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	55.094	55.078	57.964
	@ STANDARD CONDITIONS*	(DSCM)	(1.560)	(1.560)	(1.641)
V(w)	TOTAL WATER COLLECTED, IMPINGERS & SILICA GEL	ml	166.8	149.7	164.4
V(w[gas])	VOLUME WATER VAPOR	SCF	7.873	7.066	7.760
	COLLECTED @ STANDARD	(SCM)	(0.223)	(0.200)	(0.220)
	CONDITIONS*				
%M	MOISTURE IN STACK GAS BY VOLUME	%	12.50	11.37	11.81
Md	MOL FRACTION OF DRY GAS		0.8750	0.8863	0.8819
Tt	NET TIME OF TEST	MINUTES	128	128	128

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-233
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT - METHODS 17 & 26A

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
CO2		%	14.8	14.6	14.0
O2		%	5.4	5.8	4.8
CO		%	0.0	0.0	0.0
N2		%	79.8	79.6	81.2
%EA	EXCESS AIR @ SAMPLING POINT	%	34.3	37.9	28.7
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE	30.58	30.57	30.43
		(g/g-MOLE)	(30.58)	(30.57)	(30.43)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE	29.01	29.14	28.96
		(g/g-MOLE)	(29.01)	(29.14)	(28.96)
Cp	PITOT TUBE CALIBRATION		0.806	0.806	0.808
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O	1.032	0.977	1.063
		(mm H20)	(26.200)	(24.800)	(27.000)
DELTA P ^(1/2)		"H2O	1.002	0.976	1.023
Ts	STACK TEMPERATURE	DEG. F	329	331	323
		(DEG. C)	(165)	(166)	(162)
Ps	STACK PRESSURE	"Hg Abs.	28.72	28.62	28.60
		(mm Hg)	(729.00)	(727.00)	(726.00)
		"H20	-14.10	-14.10	-14.50
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM	4,027	3,925	4,118
		(m/SEC.)	(20)	(20)	(21)
As	STACK AREA	(SQ.INCHES)	16,279	16,279	16,279
		(SQ.METERS)	(11)	(11)	(11)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM	256,821	252,027	265,609
		(DSCM/HR)	(436,339)	(428,194)	(451,270)
	WET STACK GAS VOLUME @ STANDARD CONDITIONS*	WSCFH	17,610,583	17,061,514	18,070,688
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM	455,232	443,763	465,525
		(m^3/HR)	(773,439)	(753,953)	(790,927)
Dn	SAMPLING NOZZLE DIAM.	IN.	0.190	0.190	0.190
		(m)	(0.005)	(0.005)	(0.005)
%I	PERCENT ISOKINETIC	%	96.6	98.4	98.2

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-233
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT - METHODS 17 & 26A

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
Mf	PARTICULATE - PROBE, CYCLONE AND FILTER	mg	6,366.0	5,397.6	6,944.5
Mt	PARTICULATE - TOTAL	mg	----	----	----
Can	PARTICULATE - PROBE, CYCLONE AND FILTER	gr/DSCF* (g/DSCM)	1.7794 (4.0749)	1.5092 (3.4560)	1.8450 (4.2251)
Cao	PARTICULATE - TOTAL	gr/DSCF* (g/DSCM)	---- ----	---- ----	---- ----
Cat	PARTIC.-PROBE, CYCLONE AND FILTER @ STACK COND.	gr/CF (g/m3)	1.0003 (2.2907)	0.8542 (1.9561)	1.0490 (2.4022)
Cau	PARTICULATE - TOTAL @ STACK CONDITIONS	gr/CF (g/m3)	---- ----	---- ----	---- ----
Caw	PARTICULATE - PROBE, CYCLONE AND FILTER	LBS/HR (Kg/HR)	3,916.47 (1,776.51)	3,259.65 (1,478.58)	4,199.78 (1,905.02)
Cax	PARTICULATE - TOTAL	LBS/HR (Kg/HR)	---- ----	---- ----	---- ----

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-233
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT - ONTARIO HYDRO

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
DATE			08/17/05	08/17/05	08/18/05
BEGIN TIME			1110	1816	1110
END TIME			1527	2105	1350
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.77	29.66	29.67
		(mm Hg)	(756.00)	(753.00)	(754.00)
P(m)	ORIFICE PRESSURE DROP	"H2O	0.642	0.785	0.724
		(mm H2O)	(16.300)	(19.900)	(18.400)
	DGM CALIBRATION FACTOR		1.008	1.008	1.008
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	57.746	61.043	59.148
	@ METER CONDITIONS	(m^3)	(1.635)	(1.729)	(1.675)
	LEAK CHECK VOLUME	ft.^3	1.422	3.036	2.005
T(m)	AVERAGE GAS METER	DEG.F	83	91	93
	TEMPERATURE	(DEG.C)	(28)	(33)	(34)
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	55.967	58.109	56.112
	@ STANDARD CONDITIONS*	(DSCM)	(1.585)	(1.645)	(1.589)
V(w)	TOTAL WATER COLLECTED,	ml	167.2	173.9	172.0
	IMPINGERS & SILICA GEL				
V(w[gas])	VOLUME WATER VAPOR	SCF	7.892	8.208	8.118
	COLLECTED @ STANDARD	(SCM)	(0.223)	(0.232)	(0.230)
	CONDITIONS*				
%M	MOISTURE IN STACK GAS	%	12.36	12.38	12.64
	BY VOLUME				
Md	MOL FRACTION OF DRY GAS		0.8764	0.8762	0.8736
Tt	NET TIME OF TEST	MINUTES	128	128	128

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-233
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT - ONTARIO HYDRO

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
CO2		%	14.8	14.6	14.0
O2		%	5.4	5.8	4.8
CO		%	0.0	0.0	0.0
N2		%	79.8	79.6	81.2
%EA	EXCESS AIR @ SAMPLING POINT	%	34.3	37.9	28.7
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.58 (30.58)	30.57 (30.57)	30.43 (30.43)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	29.03 (29.03)	29.01 (29.01)	28.86 (28.86)
Cp	PITOT TUBE CALIBRATION		0.816	0.816	0.816
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.983 (25.000)	0.966 (24.500)	0.937 (23.800)
DELTA P ^(1/2)		"H2O	0.982	0.972	0.953
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	320 (160)	321 (161)	319 (159)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	28.73 (730.00) -14.10	28.62 (727.00) -14.10	28.60 (726.00) -14.50
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	3,971 (20)	3,942 (20)	3,871 (20)
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	16,279 (11)	16,279 (11)	16,279 (11)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS* WET STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR) WSCFH	256,671 (436,084) 17,572,182	253,438 (430,591) 17,354,805	248,598 (422,368) 17,074,038
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	448,864 (762,620)	445,585 (757,049)	437,601 (743,484)
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.193 (0.005)	0.190 (0.005)	0.190 (0.005)
%I	PERCENT ISOKINETIC	%	95.1	103.2	101.6

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-233
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT - METHODS 17 & 26A

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
DATE			08/17/05	08/17/05	08/18/05
BEGIN TIME			1101	1802	1100
END TIME			1514	2048	1350
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.77	29.66	29.67
		(mm Hg)	(756.00)	(753.00)	(754.00)
P(m)	ORIFICE PRESSURE DROP	"H2O	1.095	0.873	1.068
		(mm H2O)	(27.800)	(22.200)	(27.100)
	DGM CALIBRATION FACTOR		1.019	1.019	1.019
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	74.542	66.930	72.235
	@ METER CONDITIONS	(m^3)	(2.111)	(1.895)	(2.045)
	LEAK CHECK VOLUME	ft.^3	1.957	1.596	1.498
T(m)	AVERAGE GAS METER	DEG.F	89	98	98
	TEMPERATURE	(DEG.C)	(32)	(37)	(37)
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	71.536	62.928	67.971
	@ STANDARD CONDITIONS*	(DSCM)	(2.026)	(1.782)	(1.925)
V(w)	TOTAL WATER COLLECTED,	ml	203.7	168.7	199.1
	IMPINGERS & SILICA GEL				
V(w[gas])	VOLUME WATER VAPOR	SCF	9.615	7.963	9.398
	COLLECTED @ STANDARD	(SCM)	(0.272)	(0.225)	(0.266)
	CONDITIONS*				
%M	MOISTURE IN STACK GAS	%	11.85	11.23	12.15
	BY VOLUME				
Md	MOL FRACTION OF DRY GAS		0.8815	0.8877	0.8785
Tt	NET TIME OF TEST	MINUTES	128	128	128

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-233
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT - METHODS 17 & 26A

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
CO2		%	12.8	13.6	13.2
O2		%	7.0	6.4	7.2
CO		%	0.0	0.0	0.0
N2		%	80.2	80.0	79.6
%EA	EXCESS AIR @ SAMPLING POINT	%	49.1	43.2	51.8
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.33 (30.33)	30.43 (30.43)	30.40 (30.40)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	28.87 (28.87)	29.04 (29.04)	28.89 (28.89)
Cp	PITOT TUBE CALIBRATION		0.797	0.797	0.797
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.584 (14.800)	0.463 (11.800)	0.568 (14.400)
DELTA P ^(1/2)		"H2O	0.750	0.669	0.739
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	298 (148)	324 (162)	312 (156)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	28.68 (728.00) -14.80	28.59 (726.00) -14.50	28.60 (726.00) -14.50
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	2,930 (15)	2,655 (13)	2,917 (15)
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	21,024 (14)	21,024 (14)	21,024 (14)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS* WET STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR) WSCFH	252,709 (429,353) 17,200,839	222,254 (377,610) 15,022,237	245,498 (417,101) 16,767,080
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	427,845 (726,909)	387,599 (658,531)	425,892 (723,591)
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.247 (0.006)	0.247 (0.006)	0.247 (0.006)
%I	PERCENT ISOKINETIC	%	97.4	97.4	95.3

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-233
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT - METHODS 17 & 26A

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
Mf	PARTICULATE - PROBE, CYCLONE AND FILTER	mg	47.4	50.3	55.8
Mt	PARTICULATE - TOTAL	mg	----	----	----
Can	PARTICULATE - PROBE, CYCLONE AND FILTER	gr/DSCF*	0.0102	0.0123	0.0126
		(g/DSCM)	(0.0234)	(0.0282)	(0.0290)
Cao	PARTICULATE - TOTAL	gr/DSCF*	----	----	----
		(g/DSCM)	----	----	----
Cat	PARTIC.-PROBE, CYCLONE AND FILTER @ STACK COND.	gr/CF	0.0060	0.0070	0.0073
		(g/m3)	(0.0137)	(0.0160)	(0.0167)
Cau	PARTICULATE - TOTAL @ STACK CONDITIONS	gr/CF	----	----	----
		(g/m3)	----	----	----
Caw	PARTICULATE - PROBE, CYCLONE AND FILTER	LBS/HR	22.10	23.45	26.60
		(Kg/HR)	(10.02)	(10.64)	(12.07)
Cax	PARTICULATE - TOTAL	LBS/HR	----	----	----
		(Kg/HR)	----	----	----

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-233
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT - ONTARIO HYDRO

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
DATE			08/17/05	08/17/05	08/18/05
BEGIN TIME			1110	1812	1120
END TIME			1443	2108	1403
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.77	29.66	29.67
		(mm Hg)	(756.00)	(753.00)	(754.00)
P(m)	ORIFICE PRESSURE DROP	"H2O	0.939	0.977	1.029
		(mm H2O)	(23.900)	(24.800)	(26.100)
	DGM CALIBRATION FACTOR		0.999	0.999	0.999
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	55.380	72.282	72.749
	@ METER CONDITIONS	(m^3)	(1.568)	(2.047)	(2.060)
	LEAK CHECK VOLUME	ft.^3	4.833	8.558	8.679
T(m)	AVERAGE GAS METER	DEG.F	88	101	102
	TEMPERATURE	(DEG.C)	(31)	(38)	(39)
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	53.223	67.614	67.961
	@ STANDARD CONDITIONS*	(DSCM)	(1.507)	(1.915)	(1.924)
V(w)	TOTAL WATER COLLECTED, IMPINGERS & SILICA GEL	ml	150.0	228.3	217.6
V(w[gas])	VOLUME WATER VAPOR	SCF	7.080	10.776	10.271
	COLLECTED @ STANDARD	(SCM)	(0.200)	(0.305)	(0.291)
	CONDITIONS*				
%M	MOISTURE IN STACK GAS BY VOLUME	%	11.74	13.75	13.13
Md	MOL FRACTION OF DRY GAS		0.8826	0.8625	0.8687
Tt	NET TIME OF TEST	MINUTES	96	128	128

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-233
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT - ONTARIO HYDRO

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
CO2		%	12.8	13.6	13.2
O2		%	7.0	6.4	7.2
CO		%	0.0	0.0	0.0
N2		%	80.2	80.0	79.6
%EA	EXCESS AIR @ SAMPLING POINT	%	49.1	43.2	51.8
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.33 (30.33)	30.43 (30.43)	30.40 (30.40)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	28.88 (28.88)	28.72 (28.72)	28.77 (28.77)
Cp	PITOT TUBE CALIBRATION		0.802	0.802	0.802
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.557 (14.100)	0.578 (14.700)	0.570 (14.500)
DELTA P ^(1/2)		"H2O	0.738	0.751	0.745
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	325 (163)	343 (173)	330 (166)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	28.68 (728.00) -14.80	28.59 (726.00) -14.50	28.60 (726.00) -14.50
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	2,952 (15)	3,052 (16)	3,000 (15)
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	21,024 (14)	21,024 (14)	21,024 (14)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS* WET STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR) WSCFH	246,156 (418,219) 16,733,923	242,361 (411,771) 16,859,896	243,978 (414,519) 16,851,249
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	431,045 (732,345)	445,572 (757,027)	437,962 (744,097)
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.247 (0.006)	0.247 (0.006)	0.247 (0.006)
%I	PERCENT ISOKINETIC	%	99.2	96.0	95.8

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

APPENDIX C

Calibration Data

Equipment	Calibration Factor	Calibration Date
Pitot Tube #28-12-2	0.805	07/18/05
Pitot Tube #53-5-1 (low side)	0.806	07/21/05
Pitot Tube #53-5-2 (low side)	0.797	07/21/05
Pitot Tube #54-5-1 (low side)	0.816	06/23/05
Pitot Tube #54-5-2	0.802	06/23/05
Pitot Tube #54-10-1	0.806	06/23/05
Pitot Tube #54-12-1	0.808	07/05/05
Probe Tip #05-233-1	0.247	08/16/05
Probe Tip #05-233-3	0.247	08/16/05
Probe Tip #05-233-4	0.193	08/16/05
Probe Tip #05-233-5	0.190	08/16/05
Probe Tip #05-233-7	0.190	08/16/05
Dry Gas Meter #28-2	1.019	07/07/05
Stack Unit Orifice #28-2		07/08/05
Digital Temperature Indicator #28-2		07/07/05
Dry Gas Meter #28-3	1.008	06/24/05
Stack Unit Orifice #28-3		07/07/05
Digital Temperature Indicator #28-3		06/24/05
Dry Gas Meter #53-1	0.997	07/01/05
Stack Unit Orifice #53-1		07/05/05
Digital Temperature Indicator #53-1		07/01/05

APPENDIX C

Calibration Data

Equipment	Calibration Factor	Calibration Date
Dry Gas Meter #53-2	0.999	07/12/05
Stack Unit Orifice #53-2		07/12/05
Digital Temperature Indicator #53-2		07/12/05
Barometer #53-3		07/08/05

PITOT TUBE CALIBRATION

Date: 7/18/05 Time: 1500

Pitot No.: 28-12-2 T_s: 75 °F

Pitot Dimensions: 12' x 3/8" C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	$\sqrt{\text{Standard Average}}$	High	$\sqrt{\text{High}}$	Cal. Factor	Low	$\sqrt{\text{Low}}$	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.33	0.574	0.808	0.33	0.574	0.808
20	40	0.34	0.34	0.583	0.52	0.721	0.801	0.52	0.721	0.801
28	50	0.54	0.54	0.735	0.83	0.911	0.799	0.83	0.911	0.799
35	60	0.80	0.80	0.894	1.20	1.095	0.808	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.50	1.225	0.808	1.50	1.225	0.808
50	80	1.30	1.30	1.140	2.00	1.414	0.798	2.00	1.414	0.798
62	90	1.60	1.60	1.265	2.40	1.549	0.808	2.40	1.549	0.808
28	50	0.54	0.54	0.735	0.83	0.911	0.799	0.83	0.911	0.799
28	50	0.54	0.54	0.735	0.83	0.911	0.799	0.83	0.911	0.799
Average							0.805			0.805

Summary of Results:

Normal high side calibration factor 0.805

variation + 0.37 %

variation - 0.87 %

Normal low side calibration factor 0.805

variation + 0.37 %

variation - 0.87 %

Calibrator: [signature]

Checked By: [signature]

PITOT TUBE CALIBRATION

Date: 7-21-05

Time: 0945

Pitot No.: 53-5-1

T_s: 75 °F

Pitot Dimensions: 5" X 1/4"

C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.33	0.574	0.808	0.34	0.583	0.796
20	40	0.34	0.34	0.583	0.51	0.714	0.808	0.51	0.714	0.808
28	50	0.54	0.54	0.735	0.80	0.894	0.813	0.80	0.894	0.813
35	60	0.80	0.80	0.894	1.20	1.095	0.808	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.50	1.225	0.808	1.50	1.225	0.808
50	80	1.30	1.30	1.140	2.00	1.414	0.798	2.00	1.414	0.798
62	90	1.60	1.60	1.265	2.40	1.549	0.808	2.40	1.549	0.808
28	50	0.54	0.54	0.735	0.80	0.894	0.813	0.80	0.894	0.813
28	50	0.54	0.54	0.735	0.80	0.894	0.813	0.80	0.894	0.813
Average							0.807			0.806

Summary of Results:

Normal high side calibration factor 0.807 ✓

variation + 0.74% ✓

variation - 1.12% ✓

Normal low side calibration factor 0.806 ✓

variation + 0.87% ✓

variation - 1.24% ✓

Calibrator: [signature]

Checked By: JASON BRANN

PITOT TUBE CALIBRATION

Date: 7-21-05 Time: 0820

Pitot No.: 53-5-2 T_s: 75 °F

Pitot Dimensions: 5' X 1/4" C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.34	0.583	0.796	0.34	0.583	0.796
20	40	0.34	0.34	0.583	0.51	0.714	0.808	0.51	0.714	0.808
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.83	0.911	0.799
35	60	0.80	0.80	0.894	1.25	1.118	0.792	1.25	1.118	0.792
41	70	1.00	1.00	1.000	1.55	1.245	0.795	1.55	1.245	0.795
50	80	1.30	1.30	1.140	2.00	1.414	0.798	2.05	1.432	0.788
62	90	1.60	1.60	1.265	2.45	1.565	0.800	2.50	1.581	0.792
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.83	0.911	0.799
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.83	0.911	0.799
Average							0.800			0.797

Summary of Results:

Normal high side calibration factor 0.800 ✓

variation + 1.00 ✓

variation - 1.00 ✓

Normal low side calibration factor 0.797 ✓

variation + 1.38 ✓

variation - 1.13 ✓

Calibrator: [signature]

Checked By: Jason Brown

PITOT TUBE CALIBRATION

Date: 23 June 2005 Time: 1500

Pitot No.: 54-5-1 T_s: 78 °F

Pitot Dimensions: 5' x 1/4" C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.33	0.574	0.808	0.32	0.566	0.821
20	40	0.34	0.34	0.583	0.50	0.707	0.816	0.50	0.707	0.816
28	50	0.54	0.54	0.735	0.80	0.894	0.813	0.80	0.894	0.813
35	60	0.80	0.80	0.894	1.20	1.095	0.808	1.15	1.072	0.826
41	70	1.00	1.00	1.000	1.50	1.225	0.808	1.45	1.204	0.822
50	80	1.30	1.30	1.140	1.95	1.396	0.808	1.90	1.396	0.808
62	90	1.60	1.60	1.265	2.35	1.533	0.817	2.35	1.533	0.817
28	50	0.54	0.54	0.735	0.80	0.894	0.813	0.80	0.894	0.813
28	50	0.54	0.54	0.735	0.80	0.894	0.813	0.80	0.894	0.813
Average							0.811			0.816

Summary of Results:

Normal high side calibration factor 0.811

variation + 0.74%

variation - 0.37%

Normal low side calibration factor 0.816

variation + 1.23%

variation - 0.98%

Calibrator: Ned Shappley

Checked By: Jason Brown

PITOT TUBE CALIBRATION

Date: 23 June 2005 Time: 1430

Pitot No.: 54-5-2 T_s: 77 °F

Pitot Dimensions: 5' X 1/4" C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.33	0574	0.808	0.33	0.574	0.808
20	40	0.34	0.34	0.583	0.52	0.721	0.801	0.51	0.714	0.808
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.82	0.906	0.803
35	60	0.80	0.80	0.894	1.25	1.118	0.792	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.55	1.245	0.795	1.55	1.245	0.795
50	80	1.30	1.30	1.140	1.95	1.396	0.808	1.95	1.396	0.808
62	90	1.60	1.60	1.265	2.45	1.565	0.800	2.40	1.549	0.808
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.82	0.906	0.803
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.82	0.906	0.803
Average							0.802			0.806

Summary of Results:

Normal high side calibration factor 0.802

variation + 0.75%

variation - 1.25%

Normal low side calibration factor 0.806

variation + 0.25%

variation - 1.36%

Calibrator: Ned Shappley

Checked By: JASON BROWN

PITOT TUBE CALIBRATION

Date: 23 June 2005 Time: 1400

Pitot No.: 54-10-1 T_s: 77 °F

Pitot Dimensions: 10' X 3/8" C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	$\sqrt{\text{Standard Average}}$	High	$\sqrt{\text{High}}$	Cal. Factor	Low	$\sqrt{\text{Low}}$	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.33	0.574	0.808	0.33	0.574	0.808
20	40	0.34	0.34	0.583	0.51	0.714	0.808	0.51	0.714	0.808
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
35	60	0.80	0.80	0.894	1.20	1.095	0.808	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.55	1.245	0.795	1.55	1.245	0.795
50	80	1.30	1.30	1.140	1.95	1.396	0.808	1.95	1.396	0.808
62	90	1.60	1.60	1.265	2.40	1.549	0.808	2.40	1.549	0.808
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
Average							0.806			0.806

Summary of Results:

Normal high side calibration factor 0.806

variation + 0.25 %

variation - 1.36 %

Normal low side calibration factor 0.806

variation + 0.25 %

variation - 1.36 %

Calibrator: Ned Shappley

Checked By: Jason Brown

PITOT TUBE CALIBRATION

Date: 7/5/05

Time: 0930

Pitot No.: 54-17-1

T_s: 77 °F

Pitot Dimensions: 12 x 3/8"

C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.33	0.574	0.808	0.33	0.574	0.808
20	40	0.34	0.34	0.583	0.51	0.714	0.808	0.51	0.714	0.808
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.80	0.894	0.813
35	60	0.80	0.80	0.894	1.20	1.095	0.808	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.50	1.225	0.808	1.50	1.225	0.808
50	80	1.30	1.30	1.140	1.95	1.396	0.808	1.90	1.378	0.819
62	90	1.60	1.60	1.265	2.40	1.549	0.808	2.45	1.565	0.800
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.80	0.894	0.813
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.80	0.894	0.813
Average										

Summary of Results:

Normal high side calibration factor 0.808 ✓

variation + 0.00%

variation - 0.00%

Normal low side calibration factor 0.809 ✓

variation + 1.24%

variation - 1.11%

Calibrator: Ned Shappley

Checked By: Jason Brown

METCO ENVIRONMENTAL

NOZZLE CALIBRATION

Nozzle Set No. 05-233 TASK 1

Date 8-16-05 Calibrator: Malone

	05-233 - 1	05-233-2	05-233-3	05-233-4	05-233-5	05-233-6
Reading 1	0.247	0.246	0.246	0.193	0.190	0.190
Reading 2	0.247	0.245	0.247	0.193	0.190	0.190
Reading 3	0.246	0.247	0.246	0.193	0.191	0.191
Reading 4	0.247	0.245	0.247	0.194	0.189	0.190
Reading 5	0.246	0.245	0.247	0.194	0.190	0.190
Reading 6	0.248	0.245	0.247	0.193	0.190	0.189
Reading 7	0.248	0.247	0.246	0.193	0.190	0.191
Reading 8	0.247	0.246	0.247	0.194	0.190	0.190
Reading 9	0.247	0.246	0.247	0.192	0.190	0.190
Reading 10	0.247	0.246	0.247	0.193	0.190	0.190
Average	0.247	0.246	0.247	0.193	0.190	0.190

	05-233-7	05-233-8	9	10	11	12
Reading 1	0.190	0.245				
Reading 2	0.190	0.248				
Reading 3	0.191	0.247				
Reading 4	0.189	0.247				
Reading 5	0.191	0.246				
Reading 6	0.189	0.248				
Reading 7	0.190	0.247				
Reading 8	0.190	0.247				
Reading 9	0.190	0.246				
Reading 10	0.190	0.247				
Average	0.190	0.247				

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 28-2

Date: 7/7/05

ΔH ("H_2O)	C_{DG}
0.5	1.020
1.0	1.011
1.5	1.035
2.0	1.028
3.0	1.010
4.0	1.012
Average	1.019

Variation: + 1.57%

- 0.88%

Calibrator: Ned Shappley

Checked By:

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28.2 Calibrator: Ned Shappley

Date: 7/7/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.5" H_2O P_b: 29.37 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)								Dry Gas Meter							
	Time	Meter Reading		Temp.		P_m		Meter Reading		Temp. In		Temp. Out		P_m	
End	1508	6.820	cf	75	°F	-0.5	"H_2O	500.430	cf	81	°F	73	°F	0.50	"H_2O
Start	1452	0.000	cf	75	°F	-0.5	"H_2O	493.718	cf	76	°F	73	°F	0.50	"H_2O
Avg.		6.820	cf	75	°F	-0.5	"H_2O	6.712	cf	76		°F		0.50	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 6.820 \left[\frac{29.37 + \frac{-0.5}{13.6}}{75 + 460} \right] \times 1.004 \quad (C_f) = 6.626 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 6.712 \left[\frac{29.37 + \frac{0.50}{13.6}}{76 + 460} \right] = 6.499 \text{ dcsf}$$

$$C_{DG} = \frac{6.626}{6.499} = \boxed{1.020}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28.2 Calibrator: Ned Shappley

Date: 7/7/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.0" H_2O P_b: 29.37 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)								Dry Gas Meter							
	Time	Meter Reading		Temp.		P_m		Meter Reading		Temp. In		Temp. Out		P_m	
End	1528	8.195	cf	75	°F	-0.90	"H_2O	508.793	cf	85	°F	74	°F	1.0	"H_2O
Start	1514	0.000	cf	75	°F	-0.90	"H_2O	500.600	cf	78	°F	73	°F	1.0	"H_2O
Avg.		8.195	cf	75	°F	-0.90	"H_2O	8.143	cf	78		°F		1.0	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 8.195 \left[\frac{29.37 + \frac{-0.90}{13.6}}{75 + 460}\right] \times 1.004 \ (C_f) = 7.954 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 8.143 \left[\frac{29.37 + \frac{1.0}{13.6}}{78 + 460}\right] = 7.866 \text{ dcsf}$$

$$C_{DG} = \frac{7.954}{7.866} = \boxed{1.011}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28-3 Calibrator: Ned Shappley

Date: 7/7/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.5" H_2O P_b: 29.37 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)								Dry Gas Meter							
	Time	Meter Reading		Temp.		P_m		Meter Reading		Temp. In		Temp. Out		P_m	
End	1552	12.485	cf	75	°F	-1.30	"H_2O	521.019	cf	88	°F	75	°F	1.50	"H_2O
Start	1535	0.000	cf	75	°F	-1.30	"H_2O	508.875	cf	81	°F	74	°F	1.50	"H_2O
Avg.		12.485	cf	75	°F	-1.30	"H_2O	12.144	cf	80		°F		1.50	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 12.485 \left[\frac{29.37 + \frac{-1.30}{13.6}}{75 + 460} \right] \times 1.004 \quad (C_p) = 12.106 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 12.144 \left[\frac{29.37 + \frac{1.50}{13.6}}{80 + 460} \right] = 11.702 \text{ dcsf}$$

$$C_{DG} = \frac{12.106}{11.702} = \boxed{1.035}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28-3 Calibrator: Ned Shappley

Date: 7/7/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 20" H_2O P_b: 29.37 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)							Dry Gas Meter						
	Time	Meter Reading		Temp.		P_m		Meter Reading		Temp. In		Temp. Out		P_m	
End	1614	14.500	cf	75	°F	-1.800	"H_2O	535.823	cf	92	°F	76	°F	2.0	"H_2O
Start	1555	0.000	cf	75	°F	-1.800	"H_2O	521.607	cf	86	°F	75	°F	2.0	"H_2O
Avg.		14.500	cf	75	°F	-1.800	"H_2O	14.216	cf	82			°F	2.0	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 14.500 \left[\frac{29.37 + \frac{-1.80}{13.6}}{75 + 460}\right] \times 1.004 \quad (C_p) = 14.042 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 14.216 \left[\frac{29.37 + \frac{2.0}{13.6}}{82 + 460}\right] = 13.665 \text{ dcsf}$$

$$C_{DG} = \frac{14.042}{13.665} = \boxed{1.028}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28-2 Calibrator: Ned Shappley

Date: 7/7/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.0" H_2O P_b: 29.37 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)								Dry Gas Meter							
	Time	Meter Reading		Temp.		P_m		Meter Reading		Temp. In		Temp. Out		P_m	
End	1635	14.100	cf	75	°F	-2.7	"H_2O	550.089	cf	92	°F	78	°F	3.0	"H_2O
Start	1618	0.000	cf	75	°F	-2.7	"H_2O	536.071	cf	87	°F	76	°F	3.0	"H_2O
Avg.		14.100	cf	75	°F	-2.7	"H_2O	14.018	cf	83			°F	3.0	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 14.100 \left[\frac{29.37 + \frac{-2.7}{13.6}}{75 + 460}\right] \times 1.004 \quad (C_f) = 13.624 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 14.018 \left[\frac{29.37 + \frac{3.0}{13.6}}{83 + 460}\right] = 13.483 \text{ dcsf}$$

$$C_{DG} = \frac{13.624}{13.483} = \boxed{1.010}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28-2 Calibrator: Ned Shappley

Date: 7-7-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.0 P_b: 29.37 "Hg

Control Module Vacuum: 5.0 "Hg

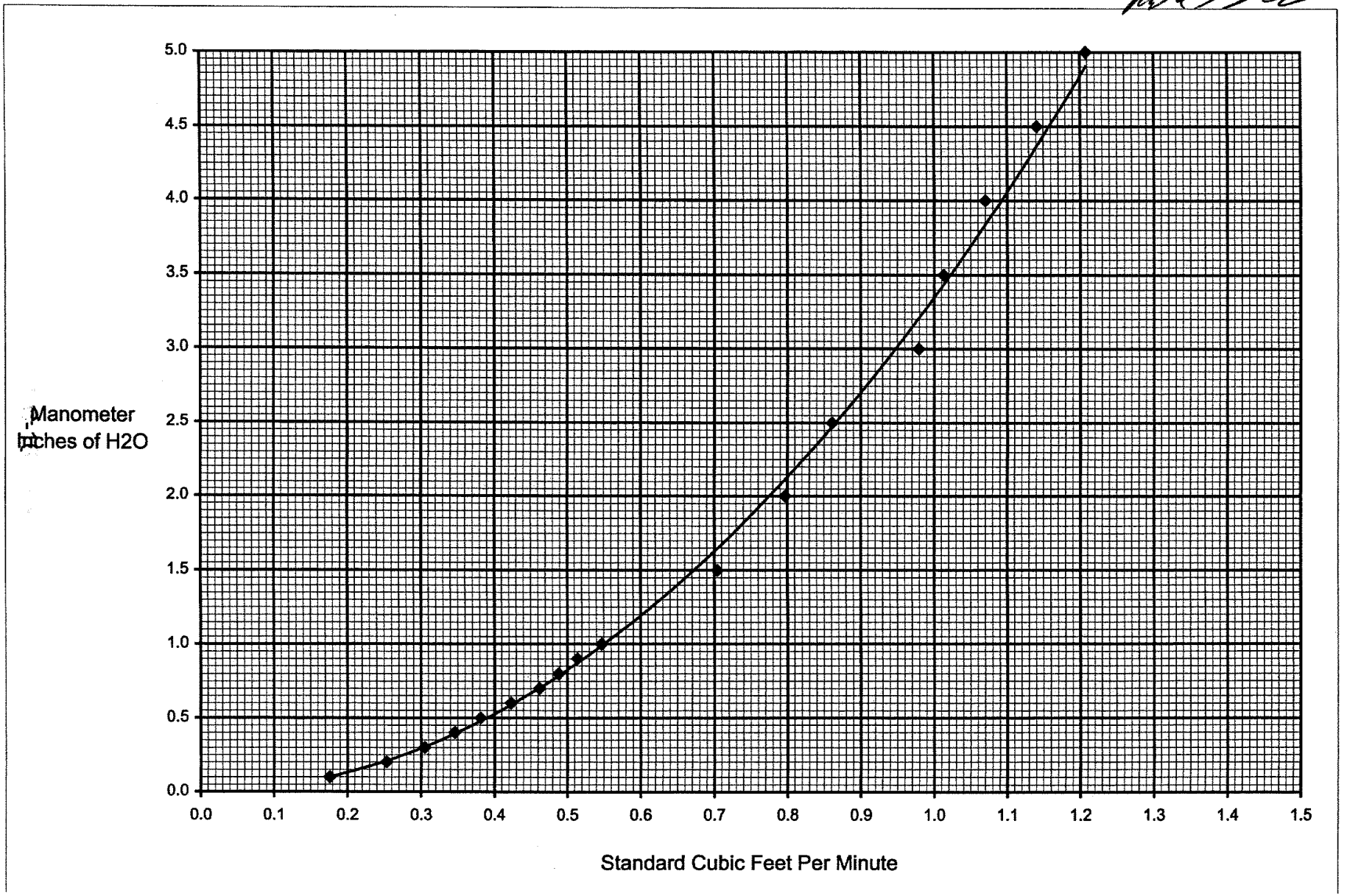
	Wet Test Meter (No. 4)							Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m		Meter Reading		Temp. In		Temp. Out		P_m	
End	1650	12.130	cf	75	°F	-3.80	"H_2O	562.306	cf	92	°F	79	°F	4.0	"H_2O
Start	1640	0.000	cf	75	°F	-3.80	"H_2O	550.302	cf	88	°F	77	°F	4.0	"H_2O
Avg.		12.130	cf	75	°F	-3.80	"H_2O	12.004	cf	84	°F	4.0			"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 12.130 \left[\frac{29.37 + \frac{-3.80}{13.6}}{75 + 460}\right] \times 1.004 \quad (C_f) = 11.688 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 12.004 \left[\frac{29.37 + \frac{-4.0}{13.6}}{84 + 460}\right] = 11.553 \text{ dcsf}$$

$$C_{DG} = \frac{11.688}{11.553} = \boxed{1.012}$$

STACK UNIT ORIFICE NO: **28-2** DATE: **07/08/05** CALIBRATED BY: **Ned Shappley** CHECKED BY:



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 28-2

CALIBRATION DATA

DATE: 7/7/05

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	1415	74	74
Ice Bath	1421	32	33
Boiling Water	1424	211	210
Oven	1450	250	251
Oven	1442	300	301
Oven	1431	350	351
Oven	1436	375	376

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. 01

Calibrator Ned Shappley

Checked By: [signature]

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 28-3

Date: 6-24-2005

ΔH ("H_2O)	C_{DG}
0.5	1.015
1.0	1.028
1.5	1.010
2.0	1.007
3.0	0.999
4.0	0.989
Average	1.008

Variation: + 1.98%

- 1.88%

Calibrator: Doug Waie

Checked By: Neal Shappley

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28-3

Calibrator: [signature] & Doug Ware

Date: 6/24/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.5 "H_2O

P_b: 29.41 "Hg

Control Module Vacuum: 5 "Hg

	Wet Test Meter (No. 3)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m		Meter Reading	Temp. In	Temp. Out	P_m
End	1029	5.085 cf	77 °F	-1.1	"H_2O	31.534 cf	80 °F	80 °F	0.50 "H_2O
Start	1016	0.000 cf	77 °F	-1.1	"H_2O	26.531 cf	80 °F	80 °F	0.50 "H_2O
Avg.	13	5.085 cf	77 °F	-1.1	"H_2O	5.003 cf	80 °F		0.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.085 \left[\frac{29.41 - \frac{1.1}{13.6}}{77 + 460}\right] \times .997\,(C_p) = 4.887 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.003 \left[\frac{29.41 + \frac{.50}{13.6}}{80 + 460}\right] = 4.815 \text{ dcsf}$$

$$C_{DG} = \frac{4.887}{4.815} = \boxed{1.015}$$

MITECO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28-3 Calibrator: Doug Ware

Date: 6/24/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.0 "H_2O P_b: 29.41 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1100	6.248 cf	77 °F	-1.7 "H_2O	41.551 cf	84 °F	78 °F	1.00 "H_2O
Start	1046	0.000 cf	77 °F	-1.7 "H_2O	35.499 cf	81 °F	78 °F	1.00 "H_2O
Avg.	14	6.248 cf	77 °F	-1.7 "H_2O	6.052 cf	80 °F		1.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 6.248 \left[\frac{29.41 + \frac{-1.7}{13.6}}{77 + 460} \right] \times .997\ (C_p) = 5.996 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 6.052 \left[\frac{29.41 + \frac{1.00}{13.6}}{80 + 460} \right] = 5.832 \text{ dcsf}$$

$$C_{DG} = \frac{5.996}{5.832} = \boxed{1.028}$$

MITECO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28.3 Calibrator: Doug Ware

Date: 6/24/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.5 "H_2O P_b: 29.41 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m		Meter Reading	Temp. In	Temp. Out	P_m
End	1121	11.251 cf	77 °F	-2.30 "H_2O		54.001 cf	88 °F	78 °F	1.50 "H_2O
Start	1104	0.000 cf	77 °F	-2.30 "H_2O		42.922 cf	81 °F	77 °F	1.50 "H_2O
Avg.	17	11.251 cf	77 °F	-2.30 "H_2O		11.079 cf	81 °F		1.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.251 \left[\frac{29.41 + \frac{-2.30}{13.6}}{77 + 460}\right] \times .997 \ (C_i) = 10.781 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.079 \left[\frac{29.41 + \frac{1.50}{13.6}}{81 + 460}\right] = 10.670 \text{ dcsf}$$

$$C_{DG} = \frac{10.781}{10.670} = \boxed{1.010}$$

MITECO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28-3 Calibrator: Doug Ware

Date: 6/24/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2.0 "H_2O P_b: 29.41 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1143	11.151 cf	77 °F	-2.90 "H_2O	65.879 cf	85 °F	79 °F	2.00 "H_2O
Start	1128	0.000 cf	77 °F	-2.90 "H_2O	54.877 cf	84 °F	78 °F	2.00 "H_2O
Avg.		11.151 cf	77 °F	-2.90 "H_2O	cf		°F	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.151 \left[\frac{29.41 + \frac{-2.90}{13.6}}{77 + 460}\right] \times .997\ (C_p) = 10.669 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.002 \left[\frac{29.41 + \frac{2.00}{13.6}}{82 + 460}\right] = 10.590 \text{ dcsf}$$

$$C_{DG} = \frac{10.669}{10.590} = \boxed{1.007}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28-3 Calibrator: Doug Ware

Date: 6/24/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.0" H2O

P_b: 29.41 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)					Dry Gas Meter				
	Time	Meter Reading	Temp.		P_m	Meter Reading	Temp. In		Temp. Out	P_m
End	1525	11.221 cf	77	°F	-4.2 "H_2O	105.946 cf	81	°F	75 °F	3.0 "H_2O
Start	1511	0.000 cf	77	°F	-4.2 "H_2O	94.945 cf	75	°F	75 °F	3.0 "H_2O
Avg.		11.221 cf	77	°F	-4.2 "H_2O	11.001 cf	77		°F	3.0 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.221 \left[\frac{29.41 + \frac{-4.2}{13.6}}{77 + 460}\right] \times .997\ (C_f) = 10.701 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.001 \left[\frac{29.41 + \frac{3.0}{13.6}}{77 + 460}\right] = 10.714 \text{ dcsf}$$

$$C_{DG} = \frac{10.701}{10.714} = \boxed{0.999}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 28-3 Calibrator: Doug Ware

Date: 6/24/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.0" H2O P_b: 29.41 "Hg

Control Module Vacuum: 5.0 "Hg

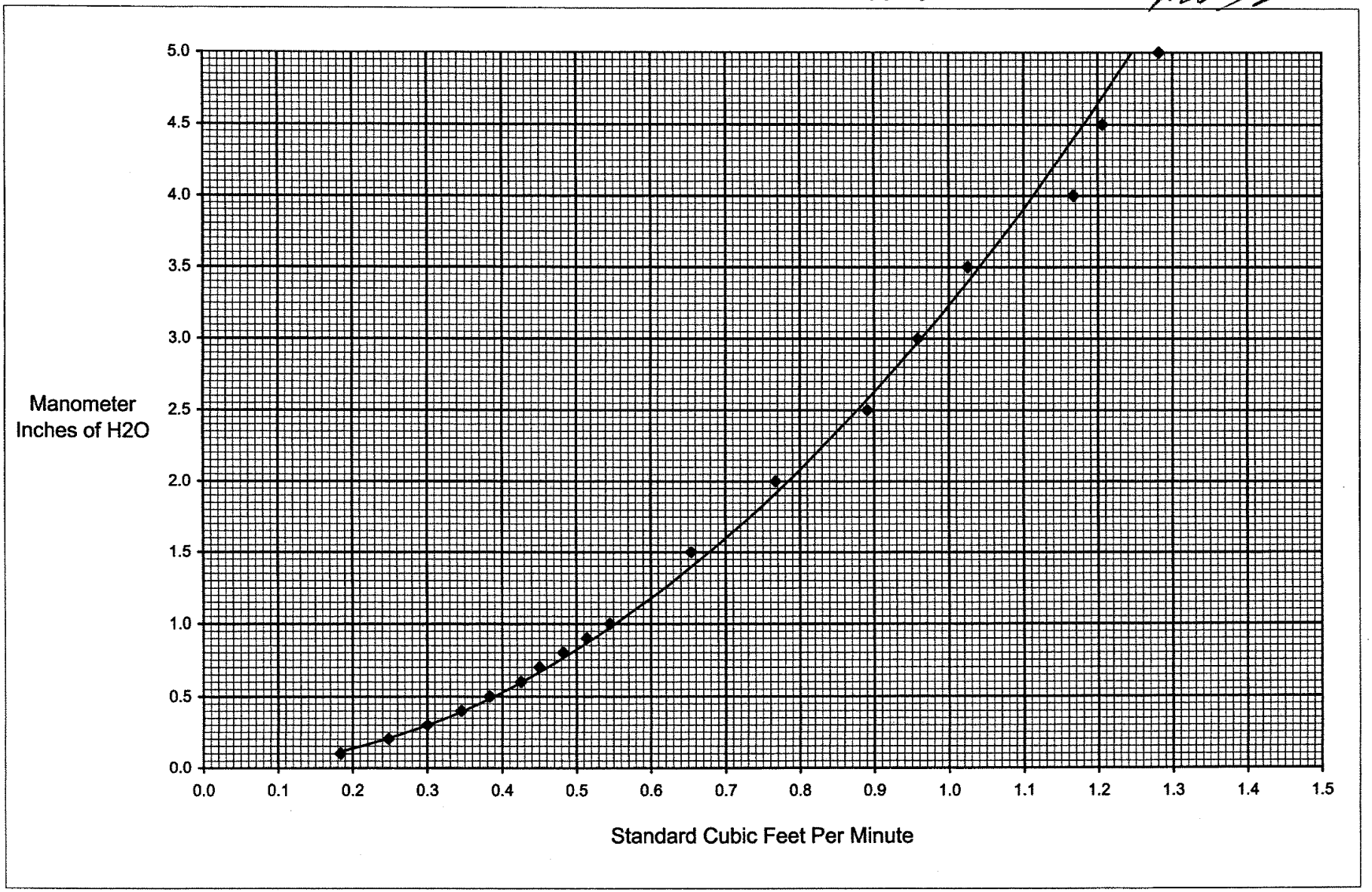
Wet Test Meter (No. 3)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1339	15.197 cf	77 °F	-6.0 "H_2O	93.544 cf	87 °F	77 °F	4.0 "H_2O
Start	1327	0.000 cf	77 °F	-6.0 "H_2O	78.527 cf	78 °F	76 °F	4.0 "H_2O
Avg.	12	15.197 cf	77 °F	-6.0 "H_2O	15.017 cf	80 °F		4.0 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 15.197 \left[\frac{29.41 + \frac{-6.0}{13.6}}{77 + 460}\right] \times .997 \ (C_p) = 14.426 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 15.017 \left[\frac{29.41 + \frac{4.0}{13.6}}{80 + 460}\right] = 14.580 \text{ dcsf}$$

$$C_{DG} = \frac{14.427}{14.580} = \boxed{0.989}$$

STACK UNIT ORIFICE NO: **28-3** DATE: **07/07/05** CALIBRATED BY: **Ned Shappley** CHECKED BY:



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 28-3

CALIBRATION DATA

DATE: 6-24-2005

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	847	72	70
Ice Bath	845	31	32
Boiling Water	859	211	209
Oven	917	253	250
Oven	939	300	300
Oven	955	351	350
Oven	1004	375	375

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. D.1

Calibrator Doug Ware

Checked By: Mark Glier

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 53-1

Date: 07-01-05

ΔH ("H_2O)	C_{DG}
0.5	0.983
1.0	0.990
1.5	0.998
2.0	0.996
3.0	1.010
4.0	1.007
Average	0.997

Variation: + 1.30%

- 1.40 %

Calibrator: [signature]

Checked By: Steve Bourisel

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 53-1

Calibrator: Mitchell Stuckert

Date: 07-01-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.5

P_b: 29.29 "Hg

Control Module Vacuum: 5 "Hg

	Wet Test Meter (No. 3)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	11:40	5.173 cf	75 °F	1.50 "H_2O	121.858 cf	77 °F	77 °F	0.50 "H_2O
Start	0:00	0.000 cf	75 °F	1.50 "H_2O	116.588 cf	75 °F	74 °F	0.50 "H_2O
Avg.	11:40	5.173 cf	75 °F	1.50 "H_2O	5.270 cf	76 °F		0.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.173 \left[\frac{29.29 + \frac{1.500}{13.6}}{75 + 460}\right] \times 0.997 (C_f) = 5.002 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.270 \left[\frac{29.29 + \frac{0.500}{13.6}}{76 + 460}\right] = 5.089 \text{ dcsf}$$

$$C_{DG} = \frac{5.002}{5.089} = \boxed{0.983}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 53-1 Calibrator: [signature]

Date: 07-01-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.0 P_b: 29.27 "Hg

Control Module Vacuum: 5 "Hg

	Wet Test Meter (No. 3)					Dry Gas Meter				
	Time	Meter Reading	Temp.	P_m		Meter Reading	Temp. In	Temp. Out	P_m	
End	8:35	5.210 cf	75 °F	2.0	"H_2O	128.228 cf	80 °F	77 °F	1.00	"H_2O
Start	0:00	0.000 cf	75 °F	2.0	"H_2O	122.933 cf	78 °F	77 °F	1.00	"H_2O
Avg.	8:35	5.218 cf	75 °F	2.0	"H_2O	5.295 cf	78 °F		1.00	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.218 \left[\frac{29.29 + \frac{2.00}{13.6}}{75 + 460}\right] \times 0.997 \ (C_p) = 5.052 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.295 \left[\frac{29.29 + \frac{1.00}{13.6}}{78 + 460}\right] = 5.101 \text{ dcsf}$$

$$C_{DG} = \frac{5.052}{5.101} = \boxed{0.990}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 537

Calibrator: [signature]

Date: 07-01-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.5

P_b: 29.29 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)							Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out	P_m
End	14:04	10.161	cf	76	°F	2.20 "H_2O	139.031	cf	84	°F	79 °F	1.50 "H_2O
Start	0:00	0.000	cf	76	°F	2.20 "H_2O	128.784	cf	79	°F	76 °F	1.50 "H_2O
Avg.	14:04	10.161	cf	76	°F	2.20 "H_2O	10.247	cf	80	°F		"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.161 \left[\frac{29.29 + \frac{2.200}{13.6}}{76 + 460}\right] \times 0.997\ (C_p) = 9.825 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.247 \left[\frac{29.29 + \frac{1.500}{13.6}}{80 + 460}\right] = 9.847 \text{ dcsf}$$

$$C_{DG} = \frac{9.825}{9.847} = \boxed{0.998}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 53-1 Calibrator: [signature]

Date: 07-01-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2.0 P_b: 29.29 "Hg

Control Module Vacuum: 5 "Hg

	Wet Test Meter (No. 3)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	12:25	10.397 cf	77 °F	3.30 "H_2O	150.218 cf	89 °F	80 °F	2.00 "H_2O
Start	0:00	0.002 cf	77 °F	3.30 "H_2O	139.667 cf	84 °F	78 °F	2.00 "H_2O
Avg.	12:25	10.341 cf	77 °F	3.30 "H_2O	10.551 cf	83 °F		2.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.341 \left[\frac{29.29 + \frac{3.30}{13.6}}{77 + 460}\right] \times 0.997 (C_p) = 10.056 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.551 \left[\frac{29.29 + \frac{2.00}{13.6}}{83 + 460}\right] = 10.096 \text{ dcsf}$$

$$C_{DG} = \frac{10.056}{10.096} = \boxed{\cancel{0.40}\ 0.996}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 53-1 Calibrator: [signature]

Date: 07-01-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.0 P_b: 29.29 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End		9.608 cf	77 °F	4.50 "H_2O	161.533 cf	98 °F	79 °F	3.00 "H_2O
Start	0:00	0.000 cf	77 °F	4.50 "H_2O	151.869 cf	88 °F	78 °F	3.00 "H_2O
Avg.		9.608 cf	77 °F	4.50 "H_2O	9.664 cf	85 °F		3.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 9.608 \left[\frac{29.29 + \frac{4.500}{13.6}}{77 + 460}\right] \times 0.997 (C_f) = 9.326 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 9.664 \left[\frac{29.29 + \frac{3.000}{13.6}}{85 + 460}\right] = 9.236 \text{ dcsf}$$

$$C_{DG} = \frac{9.326}{9.236} = \boxed{1.010}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 53-1 Calibrator: [signature]

Date: 07-01-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.0 P_b: 29.29 "Hg

Control Module Vacuum: 5 "Hg

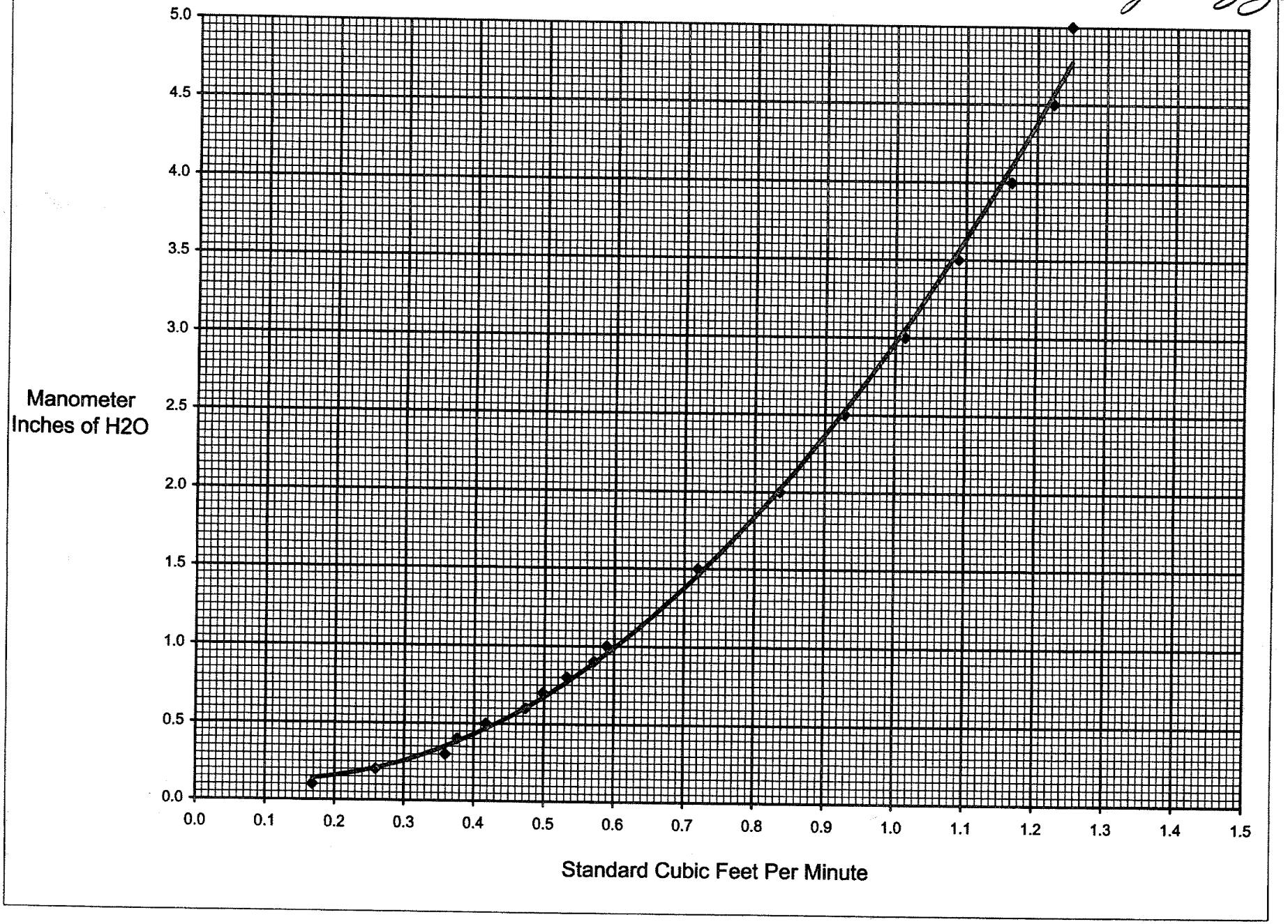
	Wet Test Meter (No. 3)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	8:45	10.440 cf	77 °F	6.00 "H_2O	172.397 cf	79 °F	78 °F	4.00 "H_2O
Start	0:00	0.000 cf	77 °F	6.00 "H_2O	162.993 cf	77 °F	77 °F	4.00 "H_2O
Avg.	8:45	10.440 cf	77 °F	6.00 "H_2O	10.404 cf	78 °F		"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.440 \left[\frac{29.29 + \frac{6.000}{13.6}}{77 + 460}\right] \times 0.997\ (C_f) = 10.171 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.404 \left[\frac{29.29 + \frac{4.000}{13.6}}{78 + 460}\right] = 10.098 \text{ dcsf}$$

$$C_{DG} = \frac{10.171}{10.098} = \boxed{1.007}$$

Orifice# 53-1 Calibrated By: Mitchell Stuckert Date 7-5-05 Checked By: [illegible]



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 53-1

CALIBRATION DATA

DATE: 07-01-05

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	9:02	76	76
Ice Bath	9:05	32	32
Boiling Water	9:08	212	213
Oven	9:12	251	253
Oven	9:29	372	373
Oven	9:38	353	352
Oven	9:49	306	305

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. D-1

Calibrator [signature]

Checked By: STEVE BORENSEN

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 53-2

Date: 12 July 2005

ΔH ("H_2O)	C_{DG}
0.5	1.008
1.0	1.003
1.5	0.997
2.0	0.997
3.0	0.993
4.0	0.995
Average	0.999

Variation: + 0.95%

- 0.50%

Calibrator: Phil Rowland

Checked By: Ned Shappley

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 53-2 Calibrator: Phil Rowland

Date: 12 July 2006

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.50 P_b: 29.38 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	0906	5.020 cf	77 °F	-0.60 "H_2O	378.249 cf	90 °F	81 °F	0.50 "H_2O
Start	0854	0.000 cf	77 °F	-0.60 "H_2O	373.188 cf	88 °F	81 °F	0.50 "H_2O
Avg.		5.020 cf	77 °F	-0.60 "H_2O	5.061 cf	85 °F		0.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.020 \left[\frac{29.38 + \frac{-0.60}{13.6}}{77 + 460} \right] \times 1.004\ (C_p) = 4.860 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.061 \left[\frac{29.38 + \frac{0.50}{13.6}}{85 + 460} \right] = 4.821 \text{ dcsf}$$

$$C_{DG} = \frac{4.860}{4.821} = \boxed{1.008}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 53-2

Calibrator: Phil Rowland

Date: 12 July 2005

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.00

P_b: 29.38 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)					Dry Gas Meter				
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	0920	5.020 cf	77 °F	-1.00 "H_2O	384.972 cf	90 °F	81 °F	1.00 "H_2O
Start	0912	0.000 cf	77 °F	-1.00 "H_2O	379.896 cf	89 °F	81 °F	1.00 "H_2O
Avg.		5.020 cf	77 °F	-1.00 "H_2O	5.076 cf	85 °F		1.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.020 \left[\frac{29.38 + \frac{-1.00}{13.6}}{77 + 460} \right] \times 1.004 (C_f) = 4.855 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.076 \left[\frac{29.38 + \frac{1.00}{13.6}}{85 + 460} \right] = 4.842 \text{ dcsf}$$

$$C_{DG} = \frac{4.855}{4.842} = \boxed{1.003}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 53-2

Calibrator: Phil Rowland

Date: 12 July 2005

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.50

P_b: 29.38 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	0940	10.095 cf	77 °F	-1.35 "H_2O	396.550 cf	95 °F	82 °F	1.50 "H_2O
Start	0926	0.000 cf	77 °F	-1.30 "H_2O	386.271 cf	90 °F	81 °F	1.50 "H_2O
Avg.		10.095 cf	77 °F	-1.33 "H_2O	10.279 cf	87 °F		1.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.095 \left[\frac{29.38 + \frac{-1.33}{13.6}}{77 + 460} \right] \times 1.004\ (C_f) = 9.755 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.279 \left[\frac{29.38 + \frac{1.50}{13.6}}{87 + 460} \right] = 9.781 \text{ dcsf}$$

$$C_{DG} = \frac{9.755}{9.781} = \boxed{0.997}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 53-2 Calibrator: Phil Rowland

Date: 12 July 2005

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2.00 P_b: 29.38 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	0958	10.100 cf	77 °F	-1.70 "H_2O	407.408 cf	100 °F	82 °F	2.00 "H_2O
Start	0946	0.000 cf	77 °F	-1.65 "H_2O	397.101 cf	92 °F	82 °F	2.00 "H_2O
Avg.		10.100 cf	77 °F	-1.68 "H_2O	10.307 cf	89 °F		2.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.100 \left[\frac{29.38 + \frac{-1.68}{13.6}}{77 + 460}\right] \times 1.004\ (C_f) = 9.751 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.307 \left[\frac{29.38 + \frac{2.00}{13.6}}{89 + 460}\right] = 9.784 \text{ dcsf}$$

$$C_{DG} = \frac{9.751}{9.784} = \boxed{0.997}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 53-2 Calibrator: Phil Rowland

Date: 12 July 2005

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.00 P_b: 29.38 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1011	10.100 cf	77 °F	-2.45 "H_2O	418.711 cf	100 °F	83 °F	3.00 "H_2O
Start	1001	0.000 cf	77 °F	-2.40 "H_2O	408.379 cf	97 °F	82 °F	3.00 "H_2O
Avg.		10.100 cf	77 °F	-2.43 "H_2O	10.332 cf	91 °F		3.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.100 \left[\frac{29.38 + \frac{-2.43}{13.6}}{77 + 460}\right] \times 1.004\ (C_p) = 9.733 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.332 \left[\frac{29.38 + \frac{3.00}{13.6}}{91 + 460}\right] = 9.797 \text{ dcsf}$$

$$C_{DG} = \frac{9.733}{9.797} = \boxed{0.993}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 53-2

Calibrator: Phil Rowland

Date: 12 July 2005

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.00

P_b: 29.38 "Hg

Control Module Vacuum: 5.0 "Hg

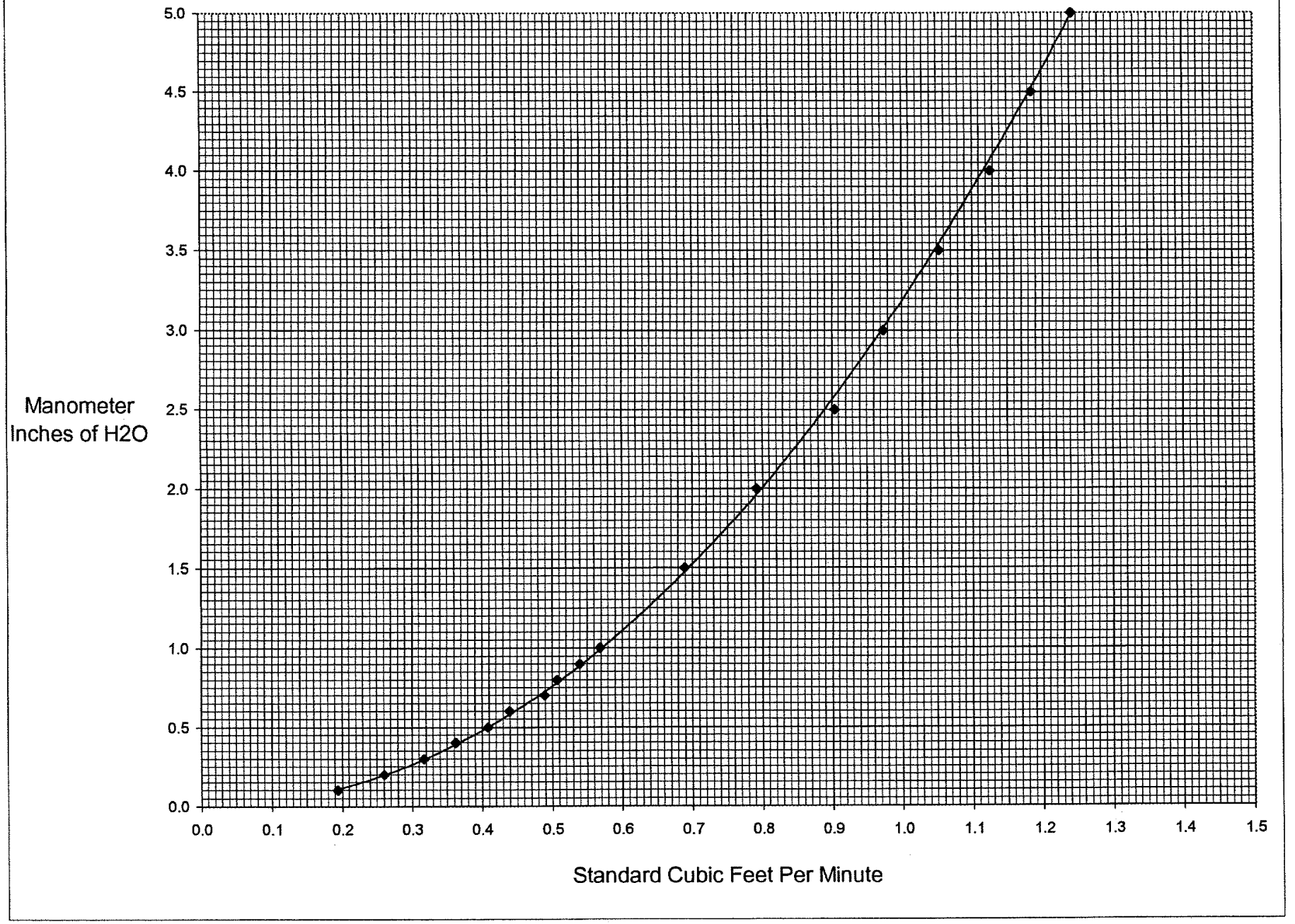
	Wet Test Meter (No. 4)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1025	10.115 cf	77 °F	-3.20 "H_2O	430.333 cf	107 °F	85 °F	4.00 "H_2O
Start	1016	0.000 cf	77 °F	-3.10 "H_2O	419.988 cf	98 °F	84 °F	4.00 "H_2O
Avg.		10.115 cf	77 °F	-3.15 "H_2O	10.345 cf	94 °F		4.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.115 \left[\frac{29.38 + \frac{-3.15}{13.6}}{77 + 460}\right] \times 1.004\ (C_p) = 9.729 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.345 \left[\frac{29.38 + \frac{4.00}{13.6}}{94 + 460}\right] = 9.780 \text{ dcsf}$$

$$C_{DG} = \frac{9.729}{9.780} = \boxed{0.995}$$

7/12/05 cal: Philip Rowland ✓ed: Ned Shappley 53-2



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 53-2

CALIBRATION DATA

DATE: 12 July 2005

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	0820	80	78
Ice Bath	0825	33	33
Boiling Water	0827	212	212
Oven	0840	250	250
Oven	0842	298	300
Oven	0844	348	350
Oven	0845	372	375

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. D-1

Calibrator Phil Rowland

Checked By: Ned Shappley

METCO ENVIRONMENTAL

VMGS1

BAROMETER CALIBRATION

Barometer No. 53-3

Date: 163 07/08/05
Time: 1632

Barometric Pressure @ Addison Airport @ 719 ft.	=	29.97
	-	0.719
Absolute Pressure @ Addison Airport	=	29.251
	+	0.083
Absolute Pressure @ METCO @ 636 ft.	=	29.334
Barometer Reading	=	29.33
Variation	=	0.004
Barometer Adjusted?		Yes ____ No ✓
Barometer Reading (after adjustment)	=	

Signature of Calibrator

APPENDIX D

Field Testing Data

METCO ENVIRONMENTAL

Job Number: 05-233 TASK 1 ✓ | 17&126A Field Data | Ambient Temp. °F: 88°
Job Name: ADA-ES ✓ | Assumed Moisture %: 12
Run Number: 1 ✓ | Read and record at the start of each test point. | Probe Length: 5'
Unit: Unit 2 ESP Inlet Ducts | C Factor: 0.485 to reference.
Date: 8-17-05 ✓ | Purge to: — | Initial Leak @ 15.0 "Hg = 0.000 cfm ✓
Operator: Simpson/Ware/Bornsen | Purge time: — | Final Leak @ 6.0 "Hg = 0.000 cfm ✓
Sample box No. 51-2 | Meter Box No. 53-1 ✓ | Pitot Leak Check Initial ✓ Final ✓ ✓

Point	1103 Clock Time	532.979 Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	~~1103~~	~~532.607~~	1.05	0.51	0.51	3.0	338	285	274	50	84	82	Pb=29.78
3	1107	534.98	1.10	0.53	0.53	3.0	338	273	272	50	83	83	Ps= ~~-14.1~~
2	1111	536.78	1.20	0.58	0.58	3.0	339	279	279	51	85	83	-14.9
1	1115	538.74	1.20	0.58	0.58	3.0	341	279	280	50	84	82	
End	1119	540.431	—	—	—	—	—	—	—	—	—	—	vol = .492 ✓
11-4	1120	540.923	1.05	0.51	0.51	3.0	338	278	277	48	84	84	
3	1124	542.82	0.94	0.46	0.46	3.0	339	285	282	52	86	83	
2	1128	544.43	0.89	0.43	0.43	3.0	341	279	277	53	87	83	
1	1132	546.09	0.81	0.39	0.39	3.0	339	283	276	53	86	82	
End	1136	547.545	—	—	—	—	—	—	—	—	—	—	vol = 0.400 ✓
10-4	1136	547.945	0.94	0.46	0.46	3.0	342	270	281	57	86	85	
3	1200	549.84	1.10	0.53	0.53	3.0	342	279	280	55	86	85	
2	1204	551.63	0.94	0.46	0.46	3.0	342	274	285	51	86	85	
1	1208	553.49	0.94	0.46	0.46	3.0	338	283	284	53	87	85	
End	1212	554.812	—	—	—	—	—	—	—	—	—	—	vol = 0.528 ✓
8-4	1236	555.340	0.57	0.28	0.28	2.0	331	279	287	55	85	84	
3	1240	556.81	0.42	0.20	0.20	2.0	331	270	280	55	85	85	
2	1244	557.96	0.27	0.13	0.13	2.0	332	276	276	52	85	86	

Pitot Tube Calibration Factor C_p 0.806 ✓ two side | Pitot Tube No. 53-5-1 ✓ | Barometer No. 53-3 ✓ | Probe Tip No. 05-233-7 ✓
Volume Collected V_m ~~57.256~~ ft^3 57.402 ✓ | Baro. Press. P_b 29.76 ✓ "Hg | Total Volume of Leak Checks After Start: ~~3.475~~ ft^3 3.398 ✓
Water Collected V_w 166.8 ✓ ml | Probe Tip Dia. D_n 0.190 ✓ in. | V_m = Dry Gas Meter Calibration Factor ~~57.428~~ 57.575 x 0.997 ✓
Time of Test T_t 128 ✓ min. | % CO_2 14.8 ✓ | % CO 0.0 ✓
Stack Pressure P_s -14.00 ✓ "H_2O | % O_2 5.4 ✓ | % N_2 79.8 ✓ | {Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}
Area Stack A_s ~~21,024~~ 16,279 ✓ in^2

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Impinger Box No. 51.2

Impinger 1	Final Weight	878.0		Impinger 1	140.7
	Initial Weight	737.3			
	Increase			Impinger 2	14.1
Impinger 2	Final Weight	769.7		Impinger 3	1.7
	Initial Weight	755.6			
	Increase			Impinger 4	0.3
Impinger 3	Final Weight	638.0	V_w =	Impinger 5	1.7
	Initial Weight	636.3	g SO_2 = -		
	Increase		V_w =	Impinger 6	8.3
Impinger 4	Final Weight	744.3		Impinger 7	
	Initial Weight	744.0			
	Increase			Total	166.8 ✓ = V_w
Impinger 5	Final Weight	736.7	P_b = 29.76 ✓	$\%CO_2$ =	14.8 ✓
	Initial Weight	735.0	V_m = ~~57.256~~ 57.402 ✓	$\%O_2$ =	5.4 ✓
	Increase		V_w = 166.8 ✓	%CO =	0.0 ✓
			P_m = 0.544 ✓	$\%N_2$ =	79.8 ✓
Impinger 6	Final Weight	919.6	Avg ΔP = 1.032 ✓	A_s =	~~21.024~~ 16.279 ✓
	Initial Weight	911.3		D_n =	0.190 ✓
	Increase		Avg$\sqrt{\Delta P}$ = 1.002 ✓	T_t =	128 ✓
			C_p = 0.866 ✓		
Impinger 7	Final Weight		P_s = -14.1 ✓ "H_2O	28.72 ✓ "Hg	
	Initial Weight		T_m = ~~90~~ 88 ✓ °F	~~550~~ 548 ✓ °R	
	Increase		T_s = 329 ✓ °F	789 ✓ °R	

Water Weight Gain

Moisture Content: %M = ~~12.57~~ 12.50 ✓ M_d = ~~0.8743~~ 0.8750 ✓ MW_d = 30.584 ✓ MW = ~~29.00~~ 29.01 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{57.256}\ 57.402 \left[\frac{29.76 + \frac{0.544}{13.6}}{\cancel{90}\ 88 + 460}\right] = \cancel{54.754}\ 55.094\ \text{sft}^3 \quad \cancel{0.428}\ 0.430\ \text{scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 166.8 ✓ = 7.873 ✓ sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{7.873 ✓}{55.094 ✓ \cancel{54.754} + 7.873 ✓}$ x 100 = ~~12.57~~ 12.50 ✓ %

V_s = 5123.8 x 0.866 ✓ 789 ✓ x 1.002 ✓ = ~~4028~~ 4027 ✓ fpm

ACFM: ~~585024~~ 455232 ✓

SCFM: ~~331496~~ 256821 ✓

%I = 1,039 x ~~54.754~~ 55.094 ✓ x 789 ✓ / 128 ✓ x ~~0.8743~~ 0.8750 ✓ x ~~4028~~ 4027 ✓ x 28.72 ✓ x ~~29.00~~ 29.01 ✓ x (0.190 ✓)^2 = ~~96.0~~ 96.6 ✓ %

%EA: 34.3 ✓

Run Number 1 ✓ M5/26A FIELD DATA

Unit Unit 2 ES Inlet Duct ✓

Date 8-17-05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
A-1	1248	558.84	0.30	0.15	0.15	2.0	333	279	275	60	86	85	leak ✓ @ 6.0 = 0.000
End	1252	559.862	—	—	—	—	—	—	—	—	—	—	VOl = 0.410 ✓
4-4	1330	560.272	1.10	0.61	0.61	3.0	325	274	253	68	88	87	Pb = 29.75
3	1413	562.21	1.25	0.70	0.70	4.0	324	282	254	64	89	89	Ps = -14.0
2	1417	564.22	1.25	0.70	0.70	4.0	327	280	256	55	91	89	Cf = 0.557
1	1421	566.29	1.10	0.61	0.61	4.0	327	270	256	54	92	89	
End	1425	568.215	—	—	—	—	—	—	—	—	—	—	vol = 0.539 ✓
3-4	1426	568.754	1.10	0.61	0.61	4.0	324	276	257	51	92	89	
3	1430	570.71	1.10	0.61	0.61	4.0	322	266	254	52	93	89	
2	1434	572.78	1.20	0.67	0.67	4.0	325	275	261	54	93	90	
1	1438	574.82	1.10	0.61	0.61	4.0	306	282	262	54	95	90	
End	1442	576.584	—	—	—	—	—	—	—	—	—	—	vol = 0.539 ✓
2-4	1443	577.123	1.20	0.67	0.67	4.0	323	279	262	49	95	89	
3	1447	579.10	1.10	0.61	0.61	4.0	321	283	262	49	96	91	
2	1451	581.06	1.00	0.56	0.56	4.0	322	280	267	50	96	91	
1	1455	583.01	1.10	0.61	0.61	4.0	322	277	267	52	97	92	
End	1459	584.895	—	—	—	—	—	—	—	—	—	—	vol = 0.420 ✓
1-4	1600	585.315	1.40	0.78	0.78	5.0	308	281	268	50	96	92	
3	1604	587.26	1.50	0.83	0.83	5.0	310	270	264	51	97	92	
2	1608	589.34	1.50	0.83	0.83	5.0	310	279	268	53	97	92	
1	1612	591.45	1.30	0.73	0.73	5.0	311	281	269	53	98	93	
End	1616	593.882	—	—	—	—	—	—	—	—	—	—	

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METCO ENVIRONMENTAL

Job Number: 05-233-TASK1 ✓ | M17126A Field Data | Ambient Temp. °F: 92

Job Name: ADA-ES ✓ | Assumed Moisture %: 12%

Run Number: 2 ✓ | Read and record at the start of each test point. | Probe Length: 5'

Unit: ESP Inlet ~~Exhaust~~ Duct ✓ | C Factor: 0.557 to reference.

Date: 8-17-05 ✓ | Purge to: – | Initial Leak @ 15.0 "Hg = 0.000 cfm ✓

Operator: Simpson / Orr / Bonser | Purge time: – | Final Leak @ 8.0 "Hg = 0.000 cfm ✓

Sample box No. 51-1 | Meter Box No. 53-1 ✓ | Pitot Leak Check Initial ✓ Final ✓ ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1803	594.533	1.20	0.67	0.67	4.5	325	280	262	58	97	97	Pb = 29.66
3	1807	596.72	1.40	0.78	0.78	5.0	327	274	269	55	97	96	Ps = -14.1
2	1811	598.86	1.30	0.72	0.72	5.0	326	274	270	56	97	96	
1	1815	600.91	1.10	0.61	0.61	4.0	327	275	268	54	97	96	
End	1819	603.146	–	–	–	–	–	–	–	–	–	–	vol = 0.501 ✓
2-4	1820	603.647	1.10	0.61	0.61	4.0	327	273	277	53	98	97	
3	1824	605.71	1.00	0.56	0.56	4.0	326	277	279	55	99	97	
2	1828	607.68	1.00	0.56	0.56	4.0	325	275	280	54	100	97	
1	1832	609.32	0.95	0.53	0.53	4.0	329	276	284	56	100	97	
End	1836	611.053	–	–	–	–	–	–	–	–	–	–	vol = 0.489 ✓
3-4	1837	611.542	1.00	0.56	0.56	4.0	326	273	280	56	100	98	
3	1841	613.31	1.10	0.61	0.61	4.0	328	271	280	58	100	98	
2	1845	615.37	1.10	0.61	0.61	4.0	329	277	279	58	100	98	
1	1849	617.41	1.10	0.61	0.61	4.0	328	274	280	59	100	98	
End	1853	619.173	–	–	–	–	–	–	–	–	–	–	vol = 0.529 ✓
4-4	1854	619.702	1.10	0.61	0.61	5.0	329	274	279	59	100	98	
3	1858	621.53	1.20	0.67	0.67	5.0	329	277	283	59	100	98	
2	1902	623.47	1.20	0.67	0.67	5.0	332	289	282	59	100	98	

Pitot Tube Calibration Factor C_p: 0.806 ✓ low side | Pitot Tube No.: 53-5-1 ✓ | Barometer No.: 53-3 ✓ | Probe Tip No.: 05-233-7 ✓

Volume Collected V_m: ~~58.396~~ ft^3 58.628 ✓ | Baro. Press. P_b: 29.66 ✓ "Hg | Total Volume of Leak Checks After Start: ~~3.679~~ ft^3 3.387 ✓

Water Collected V_w: 149.7 ✓ ml | Probe Tip Dia. D_n: 0.190 ✓ in. | V_m = Dry Gas Meter Calibration Factor: ~~58.572~~ X 0.997 ✓ 58.804 ✓

Time of Test T_t: 128 ✓ min. ✓ | % CO_2: 14.6 ✓ | % CO: 0.0 ✓

Stack Pressure P_s: ~~29.66~~ -14.1 "H_2O | % O_2: 5.8 ✓ | % N_2: 79.6 ✓ | {Dry Gas Meter Reading – ft^3 – (T_t – min. X Leak Rate – cfm)}

Area Stack A_s: ~~21,024~~ ✓ in^2 16,279

VERSION 1
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Impinger Box No. 51-1

Impinger 1	Final Weight	863.5		Impinger 1	125.5
	Initial Weight	738.0		Impinger 2	15.9
	Increase	125.5		Impinger 3	3.3
Impinger 2	Final Weight	730.4		Impinger 4	2.3
	Initial Weight	714.5		Impinger 5	0.0
	Increase	15.9		Impinger 6	2.7
Impinger 3	Final Weight	657.5		Impinger 7	
	Initial Weight	654.2		Total	149.7 ✓ = V_w
	Increase	3.3			
Impinger 4	Final Weight	739.9			
	Initial Weight	737.6			
	Increase	2.3			
Impinger 5	Final Weight	732.5			
	Initial Weight	732.5			
	Increase	0.0			
Impinger 6	Final Weight	920.3			
	Initial Weight	917.6			
	Increase	2.7			
Impinger 7	Final Weight				
	Initial Weight				
	Increase				

Water Weight Gain

V_w =
g SO_2 = -
V_w =

P_b =	29.66 ✓	$\%CO_2$ =	14.6 ✓
V_m =	~~58.396~~ 58.628 ✓	$\%O_2$ =	5.8 ✓
V_w =	149.7 ✓	%CO =	0.0 ✓
P_m =	0.553 ✓	$\%N_2$ =	79.6 ✓
Avg ΔP =	0.977 ✓	A_s =	~~24.62~~ 18.219 ✓
		D_n =	0.190 ✓
Avg$\sqrt{\Delta P}$ =	0.976 ✓	T_t =	128 ✓
C_p =	0.806 ✓		
P_s =	14.1 ✓ "H_2O		28.62 "Hg
T_m =	98 ✓ °F		558 ✓ °R
T_s =	331 ✓ °F		791 ✓ °R

Moisture Content: %M = ~~11.41~~ 11.37 ✓ M_d = ~~0.8859~~ 0.8863 ✓ MW_d = 30.568 ✓ MW = ~~29.13~~ 29.14 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{58.396}\ 58.628 \left[\frac{29.66 + \frac{0.553}{13.6}}{98 + 460}\right] = \cancel{54.860}\ 55.078 \text{ sft}^3 = \cancel{0.429}\ 0.430 \text{ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 149.7 ✓ = 7.066 ✓ sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{7.066}{\cancel{54.860}\ 55.078 + 7.066}$ x 100 = ~~11.41~~ 11.37 ✓ %

V_s = 5123.8 x $\sqrt{\frac{791}{28.62 \times \cancel{29.13}\ 29.14}}$ x 0.806 ✓ x 0.976 ✓ = ~~3926~~ 3925 ✓ fpm

%I = $\frac{1{,}039 \times \cancel{54.860}\ 55.078 \times 791}{128 \times 28.62 \times \cancel{0.8859}\ 0.8863 \times \cancel{3926}\ 3925 \times (0.190)^2}$ = ~~98.0~~ 98.4 ✓ %

ACFM: ~~573209~~ 443763 ✓

SCFM: ~~325423~~ 252,027 ✓

%EA: 37.9 ✓

Run Number 2 M17/26A FIELD DATA

Unit Esp Inlet Exhaust Duct

Date 8-17-05

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-1	1906	625.498	1.00	0.56	0.56	4.0	332	276	279	60	100	99	
End	1910	627.493	—	—	—	—	—	—	—	—	—	—	vol = 0.351 ✓
8-4	1930	627.844	0.63	0.37	0.37	3.0	326	282	280	67	101	99	ΔFactor to = 0.583
3	1934	629.52	0.45	0.26	0.26	3.0	330	283	281	66	98	98	
2	1938	630.90	0.26	0.12	0.12	2.0	340	286	281	46	98	98	
1	1942	631.82	0.31	0.18	0.18	2.0	339	287	280	63	97	98	
End	1946	632.903	—	—	—	—	—	—	—	—	—	—	vol = 0.518 ✓
10-4	2002	633.421	1.10	0.64	0.64	4.0	330	291	283	51	98	97	
3	2006	635.17	1.00	0.58	0.58	5.0	328	279	282	52	97	97	
2	2010	637.27	0.90	0.52	0.52	3.0	331	274	283	52	97	97	
1	2014	639.00	0.61	0.36	0.36	3.0	322	281	280	52	98	97	
End	2018	640.617	—	—	—	—	—	—	—	—	—	—	vol = 0.419 ✓
11-4	2019	641.036	0.90	0.52	0.52	4.0	334	266	278	53	98	97	
3	2023	642.773	0.94	0.55	0.55	4.0	333	258	282	54	99	97	
2	2027	644.52	0.90	0.52	0.52	4.0	336	261	283	55	99	97	
1	2031	646.38	0.80	0.47	0.47	4.0	338	268	280	54	99	97	
End	2035	648.007	—	—	—	—	—	—	—	—	—	—	vol = 0.580 ✓
12-4	2036	648.587	1.10	0.64	0.64	6.0	341	268	282	55	100	97	
3	2040	650.70	1.10	0.64	0.64	6.0	341	270	280	55	100	97	
2	2044	652.37	1.20	0.70	0.70	6.0	340	270	280	55	102	97	
1	2048	654.12	1.20	0.70	0.70	6.0	342	270	281	55	102	97	
End	2052	654.724	—	—	—	—	—	—	—	—	—	—	

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METCO ENVIRONMENTAL

Job Number: 05-233-TASK 1 ✓ | 17126 A Field Data | Ambient Temp. °F: 90°
Job Name: ADA-ES ✓ | Assumed Moisture %: 12%
Run Number: 3 ✓ | Read and record at the start of each test point. | Probe Length: 10'
Unit: Esp Inlet Duct ✓ | C Factor: 0.583 to reference.
Date: 8-18-05 ✓ | Purge to: — | Initial Leak @ 15.0 "Hg = 0.000 cfm ✓
Operator: Simpson, Ware, Bomsen | Purge time: — | Final Leak @ 8.0 "Hg = 0.000 cfm ✓
Sample box No. 51-1 Meter Box No. 53-1 ✓ | Pitot Leak Check Initial ✓ Final ✓ ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1100	673.294	1.20	0.70	0.70	4.5	~~309~~ 328	258	269	61	92	92	Pb = 29.67
3	1104	675.38	1.20	0.70	0.70	4.5	340	259	273	55	93	92	Ps = -14.5
2	1108	677.40	1.30	0.76	0.76	5.0	333	257	271	55	95	92	
1	1112	679.47	1.30	0.76	0.76	5.0	324	262	277	54	96	92	
End	1116	681.574	—	—	—	—	—	—	—	—	—	—	vol = 0.857 ✓
11-4	1118	682.431	1.20	0.70	0.70	5.0	320	263	278	54	97	93	
3	1122	684.49	1.10	0.64	0.64	5.0	339	260	279	54	98	93	
2	1126	686.38	1.10	0.64	0.64	5.0	353	261	280	54	98	93	
1	1130	688.21	0.85	0.50	0.50	4.0	329	268	281	54	100	93	
End	1134	690.021	—	—	—	—	—	—	—	—	—	—	vol = 0.725 ✓
10-4	1136	690.746	1.20	0.70	0.70	5.0	330	256	278	54	100	94	
3	1140	692.71	1.20	0.70	0.70	5.0	340	257	277	54	100	95	
2	1144	694.73	0.85	0.50	0.50	4.0	325	261	274	55	101	95	
1	1148	696.65	0.85	0.50	0.50	4.0	320	263	273	56	102	96	Leak ✓ @ 8.0 = 0.000
End	1152	698.333	—	—	—	—	—	—	—	—	—	—	vol = 1.463 ✓
8-4	1209	699.796	0.90	0.47	0.47	4.0	318	251	257	62	100	98	
3	1213	701.49	0.69	0.40	0.40	4.0	334	261	274	60	100	98	
2	1217	703.60	0.50	0.29	0.29	3.0	323	258	287	62	100	98	

Pitot Tube Calibration Factor C_p: 0.808 ✓
Volume Collected V_m: ~~62.268~~ ft^3 61.779 ✓
Water Collected V_w: 164.4 ✓ ml
Time of Test T_t: 128 ✓ min.
Stack Pressure P_s: -14.5 ✓ "H_2O

Pitot Tube No.: 54-12-1 ✓ ✓
Baro. Press. P_b: 29.67 "Hg
Probe Tip Dia. D_n: 0.190 ✓ in.
% CO_2: 14.0 ✓ % CO: 0.0 ✓
% O_2: 4.8 ✓ % N_2: 81.2 ✓
Area Stack A_s: ~~21,024~~ ✓ in^2
16279

Barometer No.: 53-3 ✓ Probe Tip No.: 5-233-7 ✓
Total Volume of Leak Checks After Start: — ft^3 5.895 ✓
V_m = Dry Gas Meter Calibration Factor ~~62.455~~ x 0.997 ✓
61.965 ✓
{Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

VERSION 1
22 OCTOBER 2002

Inlet

Impinger Box No. 51-1

Impinger 1	Final Weight	880.4
	Initial Weight	743.5
	Increase	137.1
Impinger 2	Final Weight	734.0
	Initial Weight	716.6
	Increase	17.4
Impinger 3	Final Weight	655.2
	Initial Weight	653.2
	Increase	2.0
Impinger 4	Final Weight	740.2
	Initial Weight	738.4
	Increase	1.4
Impinger 5	Final Weight	737.4
	Initial Weight	736.0
	Increase	1.4
Impinger 6	Final Weight	925.0
	Initial Weight	920.1
	Increase	4.9
Impinger 7	Final Weight	
	Initial Weight	
	Increase	

Water Weight Gain

Impinger 1	137.1
Impinger 2	17.4
Impinger 3	2.0
Impinger 4	1.6
Impinger 5	1.4
Impinger 6	4.9
Impinger 7	
Total	164.4 ✓ = V_w

V_w =
g SO_2 = - —
V_w =

P_b = 29.67 ✓
V_m = ~~62.268~~ 61.779 ✓
V_w = 164.4 ✓
P_m = ~~0.600~~ 0.6030 ✓
Avg ΔP = 1.063 ✓
Avg $\sqrt{\Delta P}$ = 1.023 ✓
C_p = 0.808 ✓
P_s = -14.5 ✓ "H_2O
T_m = ~~48~~ 99 ✓ °F
T_s = 323 ✓ °F

%CO_2 = 14.0 ✓
%O_2 = 4.8 ✓
%CO = ~~0.0~~ ✓
%N_2 = 81.2 ✓
A_s = ~~21,024~~ ✓ 16279
D_n = 0.190 ✓
T_t = 128 ✓

28.60 ✓ "Hg
~~558~~ 559 ✓ °R
783 ✓ °R

Moisture Content: %M = ~~11.71~~ 11.81 ✓ M_d = ~~0.8829~~ 0.8819 ✓ MW_d = 30.432 ✓ MW = ~~28.98~~ 28.96 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{62.268}\ 61.779 \left[\frac{29.67 + \frac{\cancel{0.600}\ 0.6030}{13.6}}{\cancel{98}\ 99 + 460}\right] = \cancel{58.525}\ 57.964\ \text{sft}^3 = \cancel{0.457}\ 0.453\ \text{scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 164.4 ✓ = 7.760 ✓ sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{7.760 ✓}{\cancel{58.525}\ 57.964 + 7.760}$ x 100 = ~~11.71~~ 11.81 ✓ %

V_s = 5123.8 x 0.808 ✓ $\sqrt{\frac{783 ✓}{28.60 \times \cancel{28.98}\ 28.96 ✓}}$ x 1.023 ✓ = ~~4116~~ 4118 ✓ fpm

%I = $\frac{1,039 \times 783 ✓ \times \cancel{58.525}\ 57.964 ✓}{\cancel{4116}\ 4118 ✓ \times \cancel{0.8829}\ 0.8819 ✓ \times 28.60 ✓ \times 128 ✓ \times (0.190)^2 ✓}$ = ~~99.1~~ 98.2 ✓ %

ACFM: ~~601,008~~ 465,525 ✓

SCFM: ~~343,251~~ 265,609 ✓

%EA: 28.7%

VERSION 1
22 OCTOBER 2002

Run Number 3

Unit ESP Inlet Duct

Date 8-18-05

17/26A FIELD DATA

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
8-1	1221	704.33	0.47	0.28	0.28	3.0	308	260	280	64	101	99	
End	1225	705.651	—	—	—	—	—	—	—	—	—	—	vol = 0.493
4-4	1237	706.144	1.00	0.58	0.58	5.0	318	254	289	47	100	99	Pb = 29.67
3	1241	708.02	1.30	0.76	0.76	6.0	327	254	285	56	102	100	Ps = -14.5
2	1245	709.98	1.30	0.76	0.76	6.0	315	259	285	51	102	100	
1	1249	712.27	1.10	0.64	0.64	5.0	307	261	282	52	102	101	
End	1253	714.264	—	—	—	—	—	—	—	—	—	—	vol = 0.734
3-4	1255	714.998	1.00	0.58	0.58	5.0	310	254	280	47	103	101	
3	1259	716.93	1.10	0.64	0.64	6.0	330	255	279	47	104	100	
2	1303	718.80	1.10	0.64	0.64	6.0	324	255	276	47	104	101	
1	1307	720.81	0.70	0.41	0.41	5.0	326	257	279	47	103	101	
End	1311	722.476	—	—	—	—	—	—	—	—	—	—	vol = 0.772
2-4	1313	723.248	0.80	0.47	0.47	5.0	314	256	279	47	104	101	
3	1317	725.12	1.10	0.64	0.64	5.0	315	256	277	47	104	101	
2	1321	726.998	1.10	0.64	0.64	5.0	316	258	277	48	105	102	
1	1325	728.96	1.20	0.70	0.70	5.0	310	251	279	47	105	102	
End	1329	730.834	—	—	—	—	—	—	—	—	—	—	vol = 0.851
1-4	1331	731.687	1.30	0.76	0.76	6.0	317	252	277	48	106	102	
3	1335	733.95	1.50	0.87	0.87	6.0	324	255	277	48	106	102	
2	1339	736.18	1.50	0.87	0.87	6.0	322	256	278	48	106	102	
1	1343	738.32	1.10	0.64	0.64	6.0	311	258	274	49	106	102	
End	1348	741.154	—	—	—	—	—	—	—	—	—	—	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-233 task 1 ✓
Job Name: ADA-ES ✓
Run Number: 1 ✓
Unit: Unit 2 ESP Inlet ✓
Date: 8/17/05 ✓
Operator: malone/ Orr /Bornsen
Sample box No. 51-1 Meter Box No. 28-3 ✓

D-HYDRO ~~Meth 17~~ Field Data

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓ ✓

Ambient Temp. °F 85
Assumed Moisture % 12
Probe Length 5'
C Factor ~~0.489~~ 0.812 to reference.
Initial Leak @ 15.0 "Hg = 0.001 cfm ✓
Final Leak @ 7.0 "Hg = 0.007 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1110	116.969	1.20	0.59	0.59	3.0	305	267	271	80	80	78	Pb: 29.78
3	1114	119.00	1.20	0.59	0.59	3.0	310	272	271	67	80	78	Ps: -14.1
2	1118	120.70	1.20	0.59	0.59	3.0	311	262	270	66	81	79	
1	1122	122.40	1.20	0.59	0.59	3.0	311	260	272	65	81	79	
END	1126	123.805	–	–	–	–	–	–	–	–	–	–	vol: 0.492 ✓
2-4	1127	124.297	1.10	0.53	0.53	3.0	310	257	268	67	82	79	
3	1131	125.956	1.00	0.49	0.49	3.0	312	252	266	67	82	79	
2	1135	127.46	0.97	0.47	0.47	3.0	312	256	264	66	82	80	
1	1139	128.87	0.92	0.45	0.45	3.0	307	268	266	68	83	80	
END	1143	130.431	–	–	–	–	–	–	–	–	–	–	
3-4	1230	130.431	1.00	0.49	0.49	3.0	305	262	257	65	80	80	
3	1234	132.00	1.00	0.49	0.49	3.0	312	271	258	66	80	80	
2	1238	133.86	1.00	0.49	0.49	3.0	312	263	259	66	81	80	
1	1242	135.07	0.68	0.33	0.33	3.0	293	267	264	66	81	80	
END	1246	136.295	–	–	–	–	–	–	–	–	–	–	
4-4	1247	136.681	1.20	0.59	0.59	3.0	313	263	259	67	82	80	Vol. 0.386
3	1251	138.40	1.30	0.64	0.64	3.0	318	258	257	68	83	81	Ps: -14.0
2	1255	140.20	1.30	0.64	0.64	3.0	322	264	260	68	83	81	Pb: 29.75

Pitot Tube Calibration Factor C_p 0.816 ✓ low side
Volume Collected V_m ~~58.135~~ ft^3 57.746 ✓
Water Collected V_w ~~166.2~~ 167.2 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.1 ✓ "H_2O

Pitot Tube No. 54-5-1 ✓
Baro. Press. P_b 29.77 ✓ "Hg
Probe Tip Dia. D_n 0.193 ✓ in.
% CO_2 14.8 ✓ % CO 0.0 ✓
% O_2 5.4 ✓ % N_2 79.8 ✓
Area Stack A_s ~~21.024~~ 16.279 in^2

Barometer No. 53-3 ✓ Probe Tip No. 05-233-4 ✓
Total Volume of Leak Checks After Start: ~~1.036~~ ft^3 1.422
V_m = Dry Gas Meter Calibration Factor 1.008 ✓ x ~~57.674~~ 57.288 ✓
{Dry Gas Meter Reading – ft^3 – (T_t – min. X Leak Rate – cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 51-1

Impinger 1	Final Weight	853.5		Impinger 1	129.2
	Initial Weight	729.3			
	Increase	129.2		Impinger 2	17.9
Impinger 2	Final Weight	743.0		Impinger 3	1.9
	Initial Weight	725.1			
	Increase	17.9		Impinger 4	1.0
Impinger 3	Final Weight	654.3	V_w =	Impinger 5	1.2
	Initial Weight	652.4	g SO_2 =		
	Increase	1.9	V_w = 993.0 F	Impinger 6	-0.2
Impinger 4	Final Weight	733.0	Imp. 8 977.0 / 16.0	Impinger 7	0.2
	Initial Weight	732.0		Imp. 8	16.0
	Increase	1.0		Total	~~166.2~~ 167.2 = V_w
Impinger 5	Final Weight	738.0	P_b = 29.77	$\%CO_2$ =	14.8
	Initial Weight	736.8	V_m = ~~58.135~~ 57.746	$\%O_2$ =	5.4
	Increase	1.2	V_w = ~~166.2~~ 167.2	%CO =	0.0
			P_m = 0.642	$\%N_2$ =	79.8
Impinger 6	Final Weight	716.0	Avg ΔP = 0.983	A_s =	~~21.024~~ 16.279
	Initial Weight	716.2		D_n =	0.193
	Increase	-0.2	Avg$\sqrt{\Delta P}$ = 0.982	T_t =	128
			C_p = 0.816		
Impinger 7	Final Weight	648.2	P_s = -14.1 "H_2O	28.73	"Hg
	Initial Weight	648.0	T_m = 83 °F	543	°R
	Increase	0.2	T_s = 320 °F	780	°R

Water Weight Gain

Moisture Content: %M = ~~12.22~~ 12.36 M_d = ~~0.8778~~ 0.8764 MW_d = 30.584 MW = ~~29.05~~ 29.03

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{58.135}\ 57.746 \left[\frac{29.77 + \frac{0.642}{13.6}}{83 + 460}\right] = \cancel{56.292}\ 55.967\ \text{sft}^3 = \cancel{0.440}\ 0.431\ \text{scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x ~~166.2~~ 167.2 = ~~7.845~~ 7.892 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{\cancel{7.845}\ 7.892}{\cancel{56.292}\ 55.967 + \cancel{7.845}\ 7.892}$ x 100 = ~~12.22~~ 12.36 %

V_s = 5123.8 x 0.816 $\sqrt{\frac{780}{28.73 \times \cancel{29.05}\ 29.03}}$ x 0.982 = ~~3969~~ 3971 fpm

ACFM: ~~579500~~ 448,864

SCFM: ~~331847~~ 256,677

%I = $\frac{1{,}039 \times 780 \times \cancel{56.292}\ 55.967}{128 \times 28.73 \times \cancel{0.8778}\ 0.8764 \times \cancel{3969}\ 3971 \times (0.193)^2}$ = ~~95.6~~ 95.1 %

%EA: 34.3

Run Number 1 ✓ D-HYDRO FIELD DATA

Unit Unit 2 ESP Inlet ✓

Date 8/17/05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-1	1259	141.85	1.10	0.53	0.53	3.0	323	265	261	68	83	81	
END	1303	143.567	–	–	–	–	–	–	–	–	–	–	leak ✓ 6.0 good @ 0.004
8-4	1324	143.786	0.60	0.52	0.52	3.0	333	264	259	67	83	82	Vol: 0.219 ✓
3	1328	144.70	0.60	0.52	0.52	3.0	333	264	262	65	83	82	*cf : 0.857
2	1332	146.80	0.30	0.26	0.26	3.0	333	266	262	66	84	82	
1	1336	148.00	0.45	0.39	0.39	3.0	327	267	261	67	85	82	*
END	1340	149.680	–	–	–	–	–	–	–	–	–	–	Vol: 0.325 ✓
10-4	1341	150.005	1.00	0.86	0.86	3.5	330	268	266	68	86	82	
3	1345	152.20	0.92	0.79	0.79	3.5	332	269	262	67	86	82	
2	1349	153.90	~~0.95~~ 0.93 @ ~~0.69~~ 0.80		0.80	3.5	331	267	261	67	86	83	ΔP : 0.93 ΔH : 0.80
1	1353	155.80	0.70	0.60	0.60	3.5	320	270	263	68	87	83	
END	1357	157.809	–	–	–	–	–	–	–	–	–	–	
11-4	1444	157.809	1.00	0.86	0.86	3.5	321	253	259	70	86	85	
3	1448	160.10	1.00	0.86	0.86	3.5	330	263	260	66	87	85	
2	1452	162.23	0.97	0.83	0.83	3.5	331	266	260	67	87	85	
1	1456	164.50	0.92	0.79	0.79	3.5	330	272	261	65	88	86	
END	1500	166.305	–	–	–	–	–	–	–	–	–	–	
12-4	1511	166.305	1.00	0.86	0.86	3.5	326	260	258	64	88	86	
3	1515	168.60	1.10	0.90	0.90	3.5	333	270	259	66	88	86	
2	1519	170.60	1.30	1.12	1.10	3.5	334	272	260	64	90	86	
1	1523	172.95	1.30	1.12	1.10	3.5	334	271	261	65	90	86	
END	1527	175.679	–	–	–	–	–	–	–	–	–	–	

Version 1

METCO ENVIRONMENTAL

Job Number: 05-233 task 1 ✓
Job Name: ADA-ES ✓
Run Number: 2 ✓
Unit: Unit 2 ESP Inlet ✓
Date: 8/17/05 ✓
Operator: Malone/Orr/Borner
Sample box No. 51-3 Meter Box No. 28-3 ✓

D-HYDRO ~~Meth 17~~ Field Data

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓ ✓

Ambient Temp. °F 95
Assumed Moisture % 12
Probe Length 5'
C Factor 0.812 to reference.
Initial Leak @ 16.0 "Hg = 0.002 cfm ✓
Final Leak @ 23.0 "Hg = 0.000 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1816	176.878	1.10	0.89	0.89	4.0	330	251	272	80	90	90	Pb: 29.66
3	1820	179.20	1.10	0.89	0.89	4.0	336	261	269	67	91	90	Ps: -14.1
2	1824	181.75	1.30	1.06	1.10	4.0	337	258	274	67	91	90	
1	1828	184.05	1.10	0.89	0.89	4.0	333	261	270	66	92	91	
END	1832	185.859	–	–	–	–	–	–	–	–	–	–	vol: 0.631 ✓
11-4	1833	186.490	1.10	0.89	0.89	4.0	329	273	271	66	92	90	
3	1837	188.21	1.10	0.89	0.89	4.0	334	259	273	65	92	90	
2	1841	190.70	0.98	0.80	0.80	4.0	333	255	270	65	92	90	
1	1845	192.63	0.86	0.70	0.70	4.0	326	261	270	65	91	90	
END	1849	194.460	–	–	–	–	–	–	–	–	–	–	vol: 0.590 ✓
10-4	1850	195.050	1.00	0.81	0.81	4.0	330	256	268	68	91	90	
3	1854	197.40	0.86	0.70	0.70	4.0	328	262	272	67	91	90	
2	1858	198.90	0.86	0.70	0.70	4.0	328	263	271	67	91	90	
1	1902	200.57	0.55	0.45	0.45	3.5	317	270	273	67	91	90	
END	1906	202.105	–	–	–	–	–	–	–	–	–	–	vol: 0.553 ✓
9-4	1907	202.658	0.40	0.32	0.32	3.0	326	256	262	68	91	90	
3	1911	203.80	0.48	0.39	0.39	3.5	331	249	256	66	91	90	
2	1915	205.30	0.48	0.39	0.39	3.5	330	256	255	67	91	90	

Pitot Tube Calibration Factor C_p 0.816 ✓ low side.
Volume Collected V_m ~~61.773~~ ft^3 61.043
Water Collected V_w 173.9 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.1 ✓ "H_2O

Pitot Tube No. 54-5-1 ✓
Baro. Press. P_b 29.66 ✓ "Hg
Probe Tip Dia. D_n ~~0.190~~ 0.190 in. ✓
% CO_2 14.6 ✓ % CO 0.0 ✓
% O_2 5.8 ✓ % N_2 79.6 ✓
Area Stack A_s ~~21.027~~ ✓ in^2
16.279

Barometer No. 53-3 ✓ Probe Tip No. 05-233-5 ✓
Total Volume of Leak Checks After Start: ~~2.077~~ ft^3 ~~2.312~~ 3.036
V_m = Dry Gas Meter Calibration Factor 1.008 ✓ x ~~61.283~~ 60.569 ✓

{Dry Gas Meter Reading – ft^3 – (T_t – min. X Leak Rate – cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 51-3

Impinger 1	Final Weight	873.2		Impinger 1	132.1
	Initial Weight	741.1			
	Increase			Impinger 2	19.0
Impinger 2	Final Weight	754.1		Impinger 3	3.6
	Initial Weight	735.1			
	Increase			Impinger 4	2.2
Impinger 3	Final Weight	745.2	V_w =	Impinger 5	0.0
	Initial Weight	741.6	g SO_2 =		
	Increase		V_w =	Impinger 6	-0.7
Impinger 4	Final Weight	629.4	Imp8 955.6 F / 973.0 I	Impinger 7	0.3
	Initial Weight	627.2		Imp8	17.4
	Increase			Total	173.9 = V_w
Impinger 5	Final Weight	746.8	P_b = 29.66	$\%CO_2$ = 14.6	
	Initial Weight	746.8	V_m = ~~61.773~~ 61.043	$\%O_2$ = 5.8	
	Increase		V_w = 173.9	%CO = 0.0	
			P_m = 0.785	$\%N_2$ = 79.6	
Impinger 6	Final Weight	733.1	Avg ΔP = 0.966	A_s = ~~21.024~~ 16.279	
	Initial Weight	733.8		D_n = ~~21.024~~ 0.190	
	Increase		Avg$\sqrt{\Delta P}$ = 0.972	T_t = 128	
			C_p = 0.816		
Impinger 7	Final Weight	748.3	P_s = -14.1 "H_2O	28.62 "Hg	
	Initial Weight	748.0	T_m = 91 °F	551 °R	
	Increase		T_s = 321 °F	781 °R	

Moisture Content: %M = ~~12.25~~ 12.38 M_d = ~~0.8775~~ 0.8762 MW_d = 30.568 MW = ~~29.03~~ 29.01

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{61.773}\ 61.043 \left[\frac{29.66 + \frac{0.785}{13.6}}{91 + 460}\right] = \frac{\cancel{58.804}\ 58.109\ \text{sft}^3}{\cancel{0.459}\ 0.454\ \text{scfm}}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 173.9 = 8,208 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{8,208}{8,208 + \cancel{58.804}\ 58.109}$ x 100 = ~~12.25~~ 12.38 %

V_s = 5123.8 x 0.816 $\sqrt{\frac{781}{28.62 \times \cancel{29.03}\ 29.01}}$ x 0.972 = ~~3940~~ 3942 fpm

ACFM: ~~575,266~~ 445,585

SCFM: ~~327,629~~ 253,438

%I = $\frac{1,039 \times 781 \times \cancel{58.804}\ 58.109}{128 \times 28.62 \times \cancel{3940}\ 3942 \times \cancel{0.8775}\ 0.8762 \times (0.190)^2}$ = ~~104.4~~ 103.2 %

%EA: 37.9

VERSION 1
22 OCTOBER 2002

Run Number 2

Unit Unit 2 ESP Inlet

Date 8/17/05

D-HYDRO Meth 17 FIELD DATA

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
8-1	1919	206.30	0.30	0.24	0.24	3.0	326	264	256	68	91	90	
END	1923	207.577	—	—	—	—	—	—	—	—	—	—	Pb: 29.66
4-4	1955	207.577	1.20	0.97	0.97	5.0	311	272	263	68	89	90	Ps: -14.1
3	1959	209.78	1.20	0.97	0.97	6.0	313	260	268	67	89	90	
2	2003	211.87	1.20	0.97	0.97	6.0	313	253	268	64	90	90	
1	2007	213.80	1.10	0.89	0.89	6.5	303	258	266	64	90	90	
END	2011	215.650	—	—	—	—	—	—	—	—	—	—	vol. 0.462
3-4	2012	216.112	0.94	0.76	0.76	8.0	313	250	269	65	91	90	
3	2016	217.74	0.94	0.76	0.76	8.5	313	260	267	65	91	90	
2	2020	219.50	1.00	0.81	0.81	12.0	314	263	267	65	92	90	
1	2024	221.35	0.94	0.76	0.76	14.0	311	267	267	65	92	90	
END	2028	223.201	—	—	—	—	—	—	—	—	—	—	vol. .262
2-4	2029	223.463	1.10	0.89	0.89	16.0	315	273	268	67	92	90	
3	2033	225.43	1.10	0.89	0.89	20.0	314	271	270	64	92	90	
2	2037	227.33	0.94	0.76	0.76	20.0	314	271	270	64	92	90	pump off @ 2040
1	2044	229.00	0.88	0.72	0.72	4.0	310	278	271	67	90	90	228.220
END	2048	231.312	—	—	—	—	—	—	—	—	—	—	pump on @ 2042
1-4	2049	231.580	1.30	1.06	1.10	4.0	311	264	272	68	92	93	228.490
3	2053	234.18	1.10	0.89	0.89	4.0	316	263	274	68	93	90	
2	2057	236.08	1.20	0.97	0.97	4.0	316	263	272	67	93	90	vol: 0.270
1	2101	238.30	1.20	0.97	0.97	4.0	305	261	271	66	93	90	vol: 0.268
END	2105	240.473	—	—	—	—	—	—	—	—	—	—	

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METCO ENVIRONMENTAL

Job Number: 05-233 task 1 ✓
Job Name: ADA-ES ✓
Run Number: 3 ✓
Unit: Unit 2 ESP Inlet ✓
Date: 8/18/05 ✓
Operator: Malone/Ware/Bornsen
Sample box No. 51-3 Meter Box No. 28-3 ✓

0-HYDRO ~~LMT~~ Field Data

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓ ✓

Ambient Temp. °F 90
Assumed Moisture % 12
Probe Length 5'
C Factor 0.772 to reference.
Initial Leak @ 16.0 "Hg = 0.000 cfm ✓
Final Leak @ 14.0 "Hg = 0.000 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1110	241.213	1.20	0.93	0.93	4.0	315	274	273	80	88	87	Pb 29.67
3	1114	243.40	1.40	1.08	1.10	4.0	316	263	271	67	89	87	Ps: -14.5
2	1118	245.70	1.20	0.93	0.93	4.0	314	264	274	65	90	87	
1	1122	248.00	1.20	0.93	0.93	4.0	302	262	265	65	91	87	
END	1126	249.781	–	–	–	–	–	–	–	–	–	–	vol: 0.490 ✓
2-4	1127	250.271	1.10	0.85	0.85	4.0	306	256	260	64	92	88	
3	1131	252.70	1.00	0.77	0.77	4.0	316	256	255	66	93	88	
2	1135	254.40	1.00	0.77	0.77	4.0	318	261	251	66	93	88	
1	1139	256.00	0.95	0.73	0.73	4.0	302	272	252	67	93	88	
END	1143	258.021	–	–	–	–	–	–	–	–	–	–	vol: 0.466 ✓
3-4	1144	258.487	1.00	0.77	0.77	4.0	308	252	251	67	94	89	
3	1148	260.50	1.00	0.77	0.77	4.0	317	267	258	67	94	89	
2	1152	262.75	0.76	0.59	0.59	4.0	296	271	270	68	94	89	
1	1156	264.40	0.50	0.39	0.39	4.0	294	267	273	68	94	90	
END	1200	265.443	–	–	–	–	–	–	–	–	–	–	
4-4	1212	265.443	1.00	0.77	0.77	4.0	312	253	274	71	93	90	
3	1216	267.00	1.20	0.93	0.93	4.0	319	266	276	65	94	90	
2	1220	269.31	1.20	0.93	0.93	4.0	317	273	273	62	94	91	

Pitot Tube Calibration Factor C_p 0.816 ✓ Nowside
Volume Collected V_m 59.148 ✓ ft^3
Water Collected V_w 172.0 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -3.45 ✓ "H_2O

Pitot Tube No. 54-5-1 ✓
Baro. Press. P_b 29.67 ✓ "Hg
Probe Tip Dia. D_n 0.190 ✓ in.
% CO_2 14.0 ✓ % CO 0.0 ✓
% O_2 4.8 ✓ % N_2 81.2 ✓
Area Stack A_s ~~21.021~~ ✓ in^2
16.279

Barometer No. 53-3 ✓ Probe Tip No. 05-233-45 ✓
Total Volume of Leak Checks After Start: 2.005 ✓ ft^3
V_m = Dry Gas Meter Calibration Factor 1.008 ✓ x 58.679 ✓

{Dry Gas Meter Reading – ft^3 – (T_t ___ min. X Leak Rate ___ cfm)}

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Impinger Box No. S1-3

			Water Weight Gain		
Impinger 1	Final Weight	858.9		Impinger 1	122.3
	Initial Weight	736.6			
	Increase			Impinger 2	22.0
Impinger 2	Final Weight	763.5		Impinger 3	3.9
	Initial Weight	741.5			
	Increase			Impinger 4	2.7
			V_w =		
Impinger 3	Final Weight	745.6	g SO_2 = -	Impinger 5	-0.1
	Initial Weight	741.7	V_w =		
	Increase			Impinger 6	0.1
			Imp. 8 990.7 / 972.4		
Impinger 4	Final Weight	633.3		Impinger 7	2.8
	Initial Weight	630.6		Imp 8	18.3
	Increase			Total	172.0 = V_w
Impinger 5	Final Weight	741.9	P_b = 29.67	$\%CO_2$ =	14.0
	Initial Weight	742.0	V_m = 59.148	$\%O_2$ =	4.8
	Increase		V_w = 172.0	%CO =	0.0
			P_m = 0.724	$\%N_2$ =	81.2
Impinger 6	Final Weight	738.1	Avg ΔP = 0.937	A_s =	~~21024~~ 16,279
	Initial Weight	738.0		D_n =	0.190
	Increase		Avg$\sqrt{\Delta P}$ = 0.953	T_t =	128
			C_p = 0.816		
Impinger 7	Final Weight	748.8	P_s = -14.5 "H_2O		28.60 "Hg
	Initial Weight	746.0	T_m = 93 °F		553 °R
	Increase		T_s = 319 °F		779 °R

Moisture Content: %M = 12.64 M_d = 0.8736 MW_d = 30.432 MW = 28.86

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 59.148 \left[\frac{29.67 + \frac{0.724}{13.6}}{93 + 460}\right] = \frac{56.112\ sft^3}{0.438\ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 172.0 = 8.118 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{8.118}{56.112 + 8.118}$ x 100 = 12.64 %

V_s = 5123.8 x 0.816 $\sqrt{\frac{779}{28.60 \times 28.86}}$ x 0.953 = 3871 fpm

%I = $\frac{1{,}039 \times 779 \times 56.112}{128 \times 28.60 \times 3871 \times 0.8736 \times (0.190)^2}$ = 121.6 %

ACFM: ~~566,152~~ 437,601

SCFM: ~~321,059~~ 248,598

%EA: 28.7

Run Number 3 ✓ O-HYDRO / M17 FIELD DATA

Unit Unit 2 ESP Inlet ✓

Date 8/18/05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-1	1224	271.20	1.10	0.85	0.85	7.0	305	282	273	62	95	91	vol: 0.287 ✓
END	1228	273.295	—	—	—	—	—	—	—	—	—	—	Pb: 29.67
8-4	1242	273.582	0.42	0.32	0.32	7.0	327	260	266	66	93	92	Ps: -14.5
3	1246	274.87	0.46	0.36	0.36	9.0	330	261	263	67	94	92	
2	1250	275.99	0.25	0.19	0.19	10.0	327	269	264	67	94	92	
1	1254	276.87	0.25	0.19	0.19	11.0	317	274	263	68	94	92	
END	1258	278.135	—	—	—	—	—	—	—	—	—	—	
10-4	1300	278.135	1.10	0.85	0.85	4.0	328	264	263	60	94	92	
3	1304	280.20	1.10	0.85	0.85	4.0	335	262	263	61	95	93	
2	1308	282.15	0.90	0.69	0.69	4.0	330	259	265	62	96	93	
1	1312	283.95	0.60	0.46	0.46	3.5	325	259	263	63	97	93	
END	1316	285.750	—	—	—	—	—	—	—	—	—	—	vol: 0.332 ✓
11-4	1317	286.082	1.00	0.77	0.77	4.0	329	267	267	65	97	93	
3	1321	288.15	1.00	0.77	0.77	4.0	334	267	266	66	98	94	
2	1325	290.05	0.95	0.73	0.73	4.0	332	261	266	62	98	94	
1	1329	292.50	0.95	0.73	0.73	4.0	322	268	268	62	98	94	
END	1333	293.750	—	—	—	—	—	—	—	—	—	—	vol: 0.430 ✓
12-4	1334	294.180	1.00	0.77	0.77	4.0	325	267	266	61	98	94	
3	1338	296.26	1.10	0.85	0.85	4.0	333	264	261	61	99	95	
2	1342	298.10	1.10	0.85	0.85	4.5	336	263	262	62	99	95	
1	1346	300.05	1.00	0.77	0.77	4.5	336	264	265	62	99	95	
END	1350	301.897	—	—	—	—	—	—	—	—	—	—	

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METCO ENVIRONMENTAL

Job Number: 05-233 ✓
Job Name: ADA ES ✓
Run Number: 1 TASK 1 ✓
Unit: ESP outlet Unit 2 ✓
Date: 8/17/05 ✓
Operator: Goebel / Webber / Borenson
Sample box No. 51-3 Meter Box No. 28-2 ✓

11B/26A Field Data

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓ ✓

Ambient Temp. °F 80
Assumed Moisture % 13
Probe Length 5 lbs 7'
C Factor 10-75.3 to reference.
Initial Leak @ 15.0 "Hg = 0.005 cfm ✓
Final Leak @ 10.0 "Hg = 0.005 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	port	Remarks
4	1104	623.351	0.75	1.40	1.40	3.0	286	271	258	59	83	81	1	
3	1105	626.17	0.59	1.10	1.10	3.0	290	264	266	54	84	80		
2	1109	628.09	0.54	1.00	1.00	3.0	286	253	263	53	85	80		
1	1113	630.31	0.21	0.39	0.39	2.5	200	254	268	53	87	80		
End	1117	632.619	–	–	–	–	–	–	–	–	–	–	–	
4	1118	632.619	0.82	1.55	1.55	4.5	301	267	258	56	89	81	2	P_b = 29.78
3	1122	634.21	0.81	1.55	1.55	4.5	305	268	257	53	91	81		P_s = -14.9 "H_2O
2	1126	636.77	0.84	1.55	1.55	4.5	300	267	251	52	94	81		
1	1130	639.39	0.54	1.00	1.00	4.0	289	266	266	52	95	81		
End	1134	642.358	–	–	–	–	–	–	–	–	–	–		
4	1158	642.358	0.58	1.10	1.10	4.0	280	269	264	63	86	82	3	
3	1202	644.43	0.49	0.93	0.93	4.0	307	266	254	57	85	82		
2	1206	646.43	0.60	1.15	1.15	4.0	300	260	268	55	85	82		
1	1210	648.70	0.36	0.68	0.68	4.0	258	249	265	55	86	82		
End	1214	650.830	–	–	–	–	–	–	–	–	–	–		
4	1236	650.830	0.32	0.66	0.60	4.0	310	270	266	64	82	80	7	
3	1240	653.00	0.40	0.75	0.75	4.0	314	269	262	58	82	80	7	
2	1244	654.90	0.46	0.86	0.86	4.0	310	265	266	56	83	81		

Pitot Tube Calibration Factor C_p 0.797 ✓ lowside
Volume Collected V_m 74.542 ✓ ft^3
Water Collected V_w 203.7 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.8 ✓ "H_2O

Pitot Tube No. 53-5-2 ✓
Baro. Press. P_b 29.77 ✓ "Hg
Probe Tip Dia. D_n 0.247 ✓ in.
% CO_2 12.8 ✓ % CO 0.0 ✓
% O_2 7.0 ✓ % N_2 80.2 ✓
Area Stack A_s 21024 ✓ in^2

Barometer No. 53-3 ✓ Probe Tip No. 05-233-3 ✓
Total Volume of Leak Checks After Start: 1.957 ✓ ft^3
V_m = Dry Gas Meter Calibration Factor 1.019 ✓ X 73.152 ✓

(Dry Gas Meter Reading ✓ ft^3 – (T_t – min. X Leak Rate – cfm)]

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Impinger Box No. 51.3

Impinger 1	Final Weight	827.7		Impinger 1	173.3
	Initial Weight	654.4			
	Increase			Impinger 2	28.0
Impinger 2	Final Weight	673.3		Impinger 3	3.9
	Initial Weight	653.3			
	Increase			Impinger 4	0.1
			V_w =		
Impinger 3	Final Weight	646.7	g SO_2 = -	Impinger 5	0.1
	Initial Weight	642.8	V_w =		
	Increase			Impinger 6	6.3
Impinger 4	Final Weight	734.5		Impinger 7	
	Initial Weight	734.4			
	Increase			Total	203.7 = V_w

Water Weight Gain

Impinger 5	Final Weight	716.2	P_b =	29.77	%CO_2 =	12.8
	Initial Weight	716.1	V_m =	74.542	%O_2 =	7.0
	Increase		V_w =	203.7	%CO =	0.0
			P_m =	1.095	%N_2 =	80.2
Impinger 6	Final Weight	1004.7	Avg ΔP =	0.584	A_s =	21024
	Initial Weight	998.4			D_n =	0.247
	Increase		Avg$\sqrt{\Delta P}$ =	0.750	T_t =	128
			C_p =	0.797		28.68
Impinger 7	Final Weight		P_s =	-14.8 "H_2O	~~28.65~~	"Hg
	Initial Weight		T_m =	89 °F	549	°R
	Increase		T_s =	298 °F	758	°R

Moisture Content: %M = 11.85 M_d = 0.8815 MW_d = 30.328 MW = 28.87

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 74.542 \left[\frac{29.77 + \frac{1.095}{13.6}}{89 + 460}\right] = \frac{71.536\ \text{sft}^3}{0.559\ \text{scfm}}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 203.7 = 9.615 sft³

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{9.615}{9.615 + 71.536}$ x 100 = 11.85 %

V_s = 5123.8 x 0.797 $\sqrt{\frac{758}{28.65 \times 28.87}}$ x 0.750 = ~~2932~~ 2930 fpm

%I = $\frac{1{,}039 \times 71.536 \times 758}{0.8815 \times 28.65 \times 2932 \times 128 \times (0.247)^2}$ = 97.4 %

ACFM: ~~428069~~ 427,845

SCFM: ~~252,617~~ 252,709

%EA: 49.1

Run Number 1 178/26A FIELD DATA

Unit ESP outlet Unit 2

Date 8/17/05

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	port Remarks
1	1248	656.82	0.15	0.28	0.28	3.0	260	255	257	55	85	81	7
End	1252	658.693	—	—	—	—	—	—	—	—	—	—	
4	1407	660.650	0.56	1.05	1.05	3.5	281	270	260	63	87	85	10 1k Ω 10.0
3	1411	662.94	0.57	1.10	1.10	3.5	321	266	262	55	91	85	0.005
2	1415	664.01	0.79	1.45	1.45	4.0	320	260	270	56	93	85	vol = 1.957
1	1419	667.52	0.60	1.18	1.10	4.0	280	266	265	54	95	85	Pb 28.75
End	1423	670.166	—	—	—	—	—	—	—	—	—	—	Ps -14.7
4	1424	670.166	0.58	1.10	1.10	4.0	316	265	262	58	97	86	10
3	1428	672.12	0.60	1.10	1.10	4.0	322	267	255	56	98	86	
2	1432	674.31	0.80	1.50	1.50	4.0	328	263	263	55	100	86	
1	1436	676.80	0.67	1.25	1.25	4.0	386	261	262	53	102	87	
End	1440	679.42	—	—	—	—	—						
4	1441	679.42	0.90	1.70	1.70	4.5	308	256	261	55	103	88	11
3	1445	682.01	0.86	1.60	1.60	4.5	328	252	263	53	105	88	
2	1449	685.97	0.83	1.55	1.55	4.5	323	254	266	53	105	88	
1	1453	687.54	0.38	0.72	0.72	3.5	300	261	262	53	105	89	
End	1457	689.553	—	—	—	—	—	—	—	—	—	—	
4	1458	689.553	0.77	1.45	1.45	4.0	306	273	252	56	104	89	12
3	1502	692.29	0.79	1.50	1.50	4.5	326	265	256	53	106	89	
2	1506	694.88	0.26	0.49	0.49	3.5	308	265	270	51	107	90	
1	1510	696.62	0.26	0.49	0.49	3.5	288	266	268	52	105	90	
End	1514	698.460	—	—	—	—	—	—	—	—	—	—	

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METCO ENVIRONMENTAL

Job Number 05-233 ✓ | 178/26A Field Data | Ambient Temp. °F 88

Job Name ADA ES ✓ | Assumed Moisture % 13

Run Number 2 ✓ | Read and record at the start of each test point. | Probe Length 7'

Unit ESP Outlet Unit 2 ✓ | C Factor 10-75.3 to reference.

Date 8/17/05 ✓ | Purge to: — | Initial Leak @ 15.5 "Hg = 0.005 cfm ✓

Operator Goebel/Webber/Borensen | Purge time: — | Final Leak @ 10.0 "Hg = 0.010 cfm ✓

Sample box No. 54-2 Meter Box No. 28-2 ✓ | Pitot Leak Check Initial ✓ Final ✓ ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	port	Remarks
4	0602	699.385	0.55	1.05	1.05	4.5	331	252	250	63	94	94	12	run time
3	0606	701.31	0.72	1.35	1.35	5.0	342	250	251	56	95	95		1802-2048
2	0610	703.51	0.26	0.49	0.49	4.0	342	251	251	52	97	94		
1	0614	705.39	0.21	0.40	0.40	3.5	323	256	251	53	97	94		
End	0618	706.845	—	—	—	—	—	—	—	—	—	—		
4	0619	706.845	0.36	0.68	0.68	4.0	332	252	252	54	98	94	11	Pb = 29.66
3	0623	708.88	0.53	1.00	1.00	4.5	340	254	253	52	99	94		
2	0627	710.86	0.37	0.70	0.70	4.5	334	266	252	50	102	94		
1	0631	712.82	0.49	0.92	0.92	4.5	306	268	260	51	103	95		
End	0635	714.981	—	—	—	—	—	—	—	—	—	—		
4	0636	714.981	0.76	1.45	1.45	5.5	338	259	262	51	104	95	10	
3	0640	717.53	0.49	0.92	0.92	4.5	339	257	263	50	106	95		
2	0644	719.80	0.53	1.00	1.00	4.5	338	257	257	51	105	95		
1	0648	721.90	0.45	0.85	0.85	4.5	330	255	254	51	106	95		lk ✓ @ 11.0
End	0652	724.114	—	—	—	—	—	—	—	—	—	—		0.005
4	0701	725.240	0.35	0.66	0.66	4.5	331	258	251	62	102	95	7	vol 1.126 ✓
3	0705	727.18	0.41	0.77	0.77	4.5	333	250	260	59	102	95		
2	0709	729.10	0.40	0.76	0.76	4.5	327	248	258	59	103	95		

Pitot Tube Calibration Factor C_p 0.797 looks.ok ✓ | Pitot Tube No. 53-5-2 ✓ | Barometer No. 53-3 ✓ | Probe Tip No. 05-233-3 ✓

Volume Collected V_m 66.930 ✓ ft^3 | Baro. Press. P_b 29.66 ✓ "Hg | Total Volume of Leak Checks After Start: 1.596 ✓ ft^3

Water Collected V_w 168.7 ✓ ml | Probe Tip Dia. D_n ~~0.5~~ 0.247 ✓ in. | V_m = Dry Gas Meter Calibration Factor 1.019 ✓ X 65.682 ✓

Time of Test T_t 128 ✓ min. | % CO_2 13.6 ✓ | % CO 0.0 ✓

Stack Pressure P_s -14.5 ✓ "H_2O | % O_2 6.4 ✓ | % N_2 80.0 ✓ | {Dry Gas Meter Reading ___ ft^3 – (T_t ___ min. X Leak Rate ___ cfm)}

Area Stack A_s 21024 ✓ in^2

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Impinger Box No. 54.2

Water Weight Gain

Impinger 1	Final Weight	879.5		Impinger 1	132.5
	Initial Weight	747.0			
	Increase	132.5		Impinger 2	15.8
Impinger 2	Final Weight	763.8		Impinger 3	3.5
	Initial Weight	748.0			
	Increase	15.8		Impinger 4	3.1
			V_w =		
Impinger 3	Final Weight	548.9	g SO_2 = -	Impinger 5	1.4
	Initial Weight	545.4	V_w =		
	Increase	3.5		Impinger 6	12.4
Impinger 4	Final Weight	734.1		Impinger 7	
	Initial Weight	731.0			
	Increase	3.1		Total	168.7 ✓ = V_w
Impinger 5	Final Weight	746.8	P_b = 29.66 ✓	$\%CO_2$ =	13.6 ✓
	Initial Weight	745.4	V_m = 66.930 ✓	$\%O_2$ =	6.4 ✓
	Increase	1.4	V_w = 168.7 ✓	%CO =	0.0 ✓
			P_m = ~~0.4467~~ 0.873 ✓	$\%N_2$ =	80.0 ✓
Impinger 6	Final Weight	1000.5	Avg ΔP = 0.463 ✓	A_s =	21024
	Initial Weight	988.1		D_n =	0.247
	Increase	12.4	Avg$\sqrt{\Delta P}$ = 0.669 ✓	T_1 =	128
			C_p = 0.797 ✓		
Impinger 7	Final Weight		P_s = -14.5 ✓ "H_2O	28.59 ✓	"Hg
	Initial Weight		T_m = 98 ✓ °F	558 ✓	°R
	Increase		T_s = 324 ✓ °F	784 ✓	°R

Moisture Content: %M = ~~11.24~~ 11.23 ✓ M_d = ~~0.8876~~ 0.8877 ✓ MW_d = 30.432 ✓ MW = ~~29.03~~ 29.04 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 66.930 \left[\frac{29.66 + \frac{0.873}{13.6}}{98 + 460}\right] = \frac{62.928}{\cancel{62.864}}\ sft^3 = \frac{0.492}{\cancel{0.491}}\ scfm$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 168.7 ✓ = 7.963 ✓ sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{7.963}{62.928 + 7.963}$ ✓ x 100 = ~~11.24~~ 11.23 ✓ %

V_s = 5123.8 x 0.797 ✓ $\sqrt{\frac{784}{29.03 \times 28.59}}$ ✓ x 0.669 ✓ = 2655 ✓ fpm

ACFM: ~~387,665~~ 387,599 ✓

SCFM: ~~222,229~~ 222,254 ✓

%I = $\frac{1,039 \times 62.928 \times 29.04 \times 784}{28.59 \times 2655 \times 0.8877 \times 128 \times (0.247)^2}$ = ~~97.3~~ 97.4 ✓ %

%EA: 43.2 ✓

Run Number 2 ✓ 5/26A FIELD DATA

Unit ESP outlet Unit 2 ✓

Date 8/17/05 ✓

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	Stack Temp °F	Probe Temp °F	~~Oven~~ Line Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
			ΔP_s		P_m		T_s				T_m		
1	0713	731.04	0.21	0.39	0.39	~~0.39~~ 4.0	298	252	256	56	104	95	7
End	0717	732.959	—	—	—	—	—	—	—	—	—	—	
4	0728	732.959	0.50	0.95	0.95	4.5	330	270	252	66	99	95	8 ps = -14.5
3	0732	734.65	0.55	1.05	1.05	4.5	334	268	253	59	100	95	
2	0736	736.73	0.41	0.77	0.77	4.5	337	266	252	55	101	95	
1	0740	738.69	0.22	0.42	0.42	4.0	300	266	251	53	102	95	1k ✓ @ 11.0
End	0744	740.471	—	—	—	—	—	—	—	—	—	—	= 0.005
4	0758	740.941	0.65	1.20	1.20	5.0	321	252	284	58	98	95	3 Pb = 29.66
3	0802	742.95	0.49	0.92	0.92	5.0	322	270	270	51	99	95	ps = -14.5
2	0806	745.105	0.51	0.96	0.96	5.0	320	265	271	50	101	95	vol = 0.470 ✓
1	0810	747.36	0.21	0.40	0.40	4.0	305	258	264	51	102	95	
End	0814	748.800	—	—	—	—	—	—	—	—	—	—	
4	0815	748.800	0.48	0.91	0.91	4.5	316	256	253	53	100	95	2
3	0819	751.05	0.71	1.30	1.30	5.5	320	256	251	50	101	95	
2	0823	753.41	0.77	1.45	1.45	5.5	319	270	252	51	104	95	
1	0827	755.99	0.62	1.20	1.20	5.5	314	271	253	51	106	95	
End	0831	758.770	—	—	—	—	—	—	—	—	—	—	
4	0832	758.770	0.35	0.66	0.66	3.5	309	257	252	56	104	95	1
3	0836	760.47	0.54	1.00	1.00	5.0	314	257	265	54	104	95	
2	0840	762.49	0.54	1.00	1.00	5.0	315	257	262	55	106	95	
1	0844	764.49	0.19	0.36	0.36	3.5	299	249	260	56	105	95	
End	0848	766.663	—	—	—	—	—	—	—	—	—	—	

20 pts

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number 05-233 ✓ 17/264 Field Data
Job Name ADA ES ✓
Run Number 3 ✓
Unit Unit 2 ESP outlet Duct ✓
Date 8/18/05 ✓
Operator Goebel / Webber / Bowman
Sample box No. S4-2 Meter Box No. 28-2 ✓

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 90
Assumed Moisture % 12
Probe Length 7'
C Factor 10 → 5.3 to reference.
Initial Leak @ 15.5 "Hg = 0.005 cfm ✓
Final Leak @ 9.0 "Hg = 0.010 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Port	Remarks
4	1100	767.464	0.19	0.36	0.36	3.0	291	249	268	46	88	86	1	Pb = 29.67
3	1104	769.12	0.19	0.36	0.36	3.0	302	251	268	46	88	86		Ps = -14.5
2	1108	770.76	0.19	0.36	0.36	3.0	304	250	260	48	90	86		
1	1112	772.18	0.19	0.36	0.36	3.0	304	252	257	48	91	88		lk ✓ @ 15.0
End	1116	773.480	—	—	—	—	—	—	—	—	—	—		= 0.005
4	1131	773.916	0.46	0.86	0.86	5.0	297	256	254	61	93	89	2	vol = 0.436 ✓
3	1135	775.12	0.86	1.60	1.60	6.0	314	251	263	55	95	89		
2	1139	778.15	0.85	1.60	1.60	6.0	313	261	267	53	98	89		
1	1143	780.91	0.66	1.25	1.25	6.0	235	249	268	54	100	90		
End	1147	783.641	—	—	—	—	—	—	—	—	—	—		
4	1148	783.641	0.81	1.55	1.55	6.0	304	258	259	55	102	90	3	
3	1152	786.34	~~0.65~~ 0.65	~~1.05~~ 1.20	~~1.05~~ 1.20	5.5	313	261	252	56	104	91		
2	1156	788.83	0.67	1.25	1.25	5.5	312	266	254	56	105	92		
1	1200	791.19	0.59	1.10	1.10	5.5	258	260	263	59	105	92		lk ✓ @ 11.0
End	1204	793.91	—	—	—	—	—	—	—	—	—	—		= 0.005
4	1210	794.800	0.43	0.81	0.81	5.0	306	252	256	64	102	93	7	vol = 0.898 ✓
3	1214	796.89	0.51	0.96	0.96	5.0	530	255	254	63	103	93		
2	1218	798.85	0.52	0.98	0.98	5.0	329	257	250	63	104	93		

Pitot Tube Calibration Factor C_p 0.797 ✓ low 5.3a
Volume Collected V_m 72.235 ✓ ft^3
Water Collected V_w 199.1 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.5 ✓ "H_2O

Pitot Tube No. S3-S-2 ✓
Baro. Press. P_b 29.67 ✓ "Hg
Probe Tip Dia. D_n 0.247 ✓ in.
% CO_2 13.2 ✓ % CO 0.0 ✓
% O_2 7.2 ✓ % N_2 79.6 ✓
Area Stack A_s 21024 ✓ in^2

Barometer No. S3-3 ✓ Probe Tip No. 05-233-3 ✓
Total Volume of Leak Checks After Start: 1.498 ✓ ft^3
V_m = Dry Gas Meter Calibration Factor 1.019 ✓ X 70.888 ✓

{Dry Gas Meter Reading ___ ft^3 – (T_t ___ min. X Leak Rate ___ cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 54-2

Impinger 1	Final Weight	898.7		Water Weight Gain	
	Initial Weight	745.7		Impinger 1	153.0
	Increase			Impinger 2	20.3
Impinger 2	Final Weight	768.9		Impinger 3	4.7
	Initial Weight	748.6			
	Increase			Impinger 4	2.0
			V_w =		
Impinger 3	Final Weight	548.2	g SO_2 = -	Impinger 5	2.4
	Initial Weight	543.5	V_w =		
	Increase			Impinger 6	16.7
Impinger 4	Final Weight	729.4		Impinger 7	
	Initial Weight	727.4			
	Increase			Total	199.1 ✓ = V_w
Impinger 5	Final Weight	740.7	P_b = 29.67 ✓	$\%CO_2$ =	13.2 ✓
	Initial Weight	738.3	V_m = 72.235 ✓	$\%O_2$ =	7.2 ✓
	Increase		V_w = 199.1 ✓	%CO =	0.0 ✓
			P_m = 1.068 ✓	$\%N_2$ =	79.6 ✓
Impinger 6	Final Weight	1016.9	Avg ΔP = 0.568 ✓	A_s =	21024 ✓
	Initial Weight	1000.2		D_n =	0.247 ✓
	Increase		Avg$\sqrt{\Delta P}$ = 0.739 ✓	T_t =	128 ✓
			C_p = 0.797 ✓		
Impinger 7	Final Weight		P_s = -14.5 ✓ "H_2O	28.60 ✓	"Hg
	Initial Weight		T_m = 98 ✓ °F	558 ✓	°R
	Increase		T_s = 512 ✓ °F	772 ✓	°R

Moisture Content: %M = 12.15 ✓ M_d = 0.8785 ✓ MW_d = 30.400 ✓ MW = 28.89 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 72.235 \left[\frac{29.67 + \frac{1.068}{13.6}}{98 + 460}\right] = \frac{67.971}{0.531}\ \text{sft}^3 \ \text{scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 199.1 ✓ = 9.398 ✓ sft^3

$$\%\ \text{Moisture} = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{9.398}{9.398 + 67.971} \times 100 = 12.15\ \%$$

$$V_s = 5123.8 \times 0.797 \sqrt{\frac{772}{28.60 \times 28.89}} \times 0.739 = 2917\ \text{fpm}$$

ACFM: 425,892 ✓

SCFM: 245,498 ✓

$$\%I = \frac{1{,}039 \times 67.971 \times 772}{28.60 \times 0.8785 \times 2917 \times 128 \times (0.247)^2} = 95.3\ \%$$

%EA: 51.8 ✓

Run Number 3 ✓ 17/264 **FIELD DATA**

Unit Unit 2 ESP outlet Duct ✓

Date 8/18/05 ✓

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual (P_m)	Pump Vacuum "Hg Gauge	Stack Temp °F (T_s)	Probe Temp °F	~~Oven~~ Line Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet (T_m)	Dry Gas Temp °F Outlet	port Remarks
1	1222	801.018	0.41	0.76	0.76	5.0	302	251	255	63	102	94	7
End	1226	802.42	—	—	—	—	—	—	—	—	—	—	
4	1227	802.42	0.50	0.95	0.95	5.0	327	260	259	65	103	94	8
3	1231	804.64	0.60	1.10	1.10	5.0	332	254	254	52	103	95	
2	1235	805.80	0.45	0.85	0.85	5.0	331	255	254	49	104	95	
1	1239	807.87	0.51	0.96	0.96	5.0	320	257	252	47	105	95	Hk ✓ @ 8.0
End	1243	810.425	—	—	—	—	—	—	—	—	—	—	= 0.000
4	1300	810.597	0.72	1.35	1.35	5.5	300	270	264	59	99	96	10 vol = 0.172 ✓
3	1304	813.02	0.62	1.20	1.20	5.5	339	258	261	52	100	96	Pb 29.67
2	1308	815.50	0.78	1.50	1.50	6.0	334	251	254	51	103	96	Ps = -14.5
1	1312	818.07	0.75	1.40	1.40	6.0	313	252	251	51	104	96	
End	1316	820.531	—	—	—	—	—	—	—	—	—	—	
4	1317	820.531	0.50	0.95	0.95	5.0	316	268	258	55	105	97	11
3	1321	822.93	0.67	1.25	1.25	5.5	339	261	265	56	106	97	
2	1325	825.51	0.91	1.70	1.70	6.5	335	252	268	56	108	97	
1	1329	828.11	0.88	1.65	1.65	6.5	313	268	269	56	109	97	
End	1333	830.945	—	—	—	—	—	—	—	—	—	—	
4	1334	830.945	0.37	0.70	0.70	5.0	311	269	270	61	108	97	12
3	1338	833.08	0.71	1.35	1.35	6.5	304	261	263	61	109	98	
2	1342	835.45	0.61	1.15	1.15	6.0	335	258	258	60	111	98	
1	1346	837.88	0.40	0.75	0.75	5.0	319	270	252	61	111	98	
End	1350	839.850	—	—	—	—	—	—	—	—	—	—	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number 05-233 ✓ ONTARIO HYDRO METHOD 11 Field Data

Job Name ADA ES ✓

Run Number 1 TASK 1 ✓

Unit UNIT 2 ESP OUTLET ✓

Date 8-17-05 ✓

Operator BROWN/SELLERS/BORNSEN ✓

Sample box No. 51-2 Meter Box No. 53-2

Read and record at the start of each test point.

Purge to: —

Purge time: —

Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 85

Assumed Moisture % 12

Probe Length 7'

C Factor 10 → 17 ΔH to reference.

Initial Leak @ 15.5 "Hg = 0.004 cfm ✓

Final Leak @ 0.0 "Hg = 0.000 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔPs "Pitot" "H2O	Orifice ΔH "H2O Desired	Pm Orifice ΔH "H2O Actual	Pump Vacuum "Hg Gauge	Ts Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Tm Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1110	506.676	0.62	1.05	1.05	3.0	321	251	276	67	85	83	
12-3	1114	509.39	0.30	0.51	0.51	3.0	320	269	276	64	86	83	Pb 29.78 "Hg
12-2	1118	511.14	0.36	0.60	0.60	3.0	320	275	276	64	86	83	Pump off 1123 513.20
12-1	1122	513.00	0.30	0.51	0.51	3.0	321	276	276	64	86	83	Pump ON 1137 513.50
END	1126	515.822	~~0.85~~	~~1.45~~	—	—	—	—	—	—			Ps -14.9 "H2O
11-4	1145	515.822	~~1.45~~	~~0.~~	1.45	5.0	324	279	278	70	88	85	Δvol = 0.293 ✓
11-3	1149	518.48	0.80	1.35	1.35	5.0	326	278	283	66	92	85	
11-2	1153	521.29	0.70	1.50	1.50	5.0	328	280	283	68	94	86	
11-1	1157	524.03	0.72	1.20	1.20	5.0	330	274	285	65	95	85	
END	1201	527.135	—	—	—	—	—	—	—	—	—	—	leak ✓ 10"; 0.006
10-4	1228	527.620	0.50	0.84	0.84	4.5	328	289	285	71	84	84	Δvol = 0.485 ✓
10-3	1232	530.51	0.50	0.84	0.84	4.5	328	280	284	65	85	84	
10-2	1236	532.26	0.62	1.05	1.05	5.0	329	282	284	63	86	84	
10-1	1240	534.61	0.55	0.92	0.92	5.0	321	274	281	60	89	84	
END	1244	536.772	—	—	—	—	—	—	—	—	—	—	leak ✓ 10; 0.007
10-4	1245	537.311	~~0.84~~ 0.50	0.84	0.84	4.5	327	271	278	61	89	84	Δvol = 0.539 ✓
10-3	1249	539.44	0.51	0.85	0.85	4.5	327	270	276	60	92	84	Pb 29.75 "Hg
10-2	1253	541.51	0.62	1.05	1.05	5.0	330	270	275	59	94	84	Ps -14.7 "H2O

Pitot Tube Calibration Factor C_p 0.802 ✓

Volume Collected V_m ~~55.438~~ ft³ 55.380 ✓

Water Collected V_w 150 ✓ ml

Time of Test T_t ~~120~~ 96 ✓ min.

Stack Pressure P_s -14.8 ✓ "H_2O

Pitot Tube No. S4-5-2 ✓

Baro. Press. P_b 29.77 ✓ "Hg

Probe Tip Dia. D_n 0.247 ✓ in.

% CO_2 12.8 ✓ % CO 0.0 ✓

% O_2 7.0 ✓ % N_2 80.2 ✓

Area Stack A_s 21024 ✓ in²

Barometer No. 53-3 ✓ Probe Tip No. 05-233-1 ✓

Total Volume of Leak Checks After Start: 4.833 ✓ ft³ 55.435 ✓

V_m = Dry Gas Meter Calibration Factor 0.999 ✓ X ~~56.494~~ JB

{Dry Gas Meter Reading — ft³ – (T_t — min. X Leak Rate — cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 51.2

Impinger 1	Final Weight	835.0		Impinger 1	114.5
	Initial Weight	720.5			
	Increase	114.5		Impinger 2	18.8
Impinger 2	Final Weight	647.8		Impinger 3	3.4
	Initial Weight	629.0			
	Increase	18.8		Impinger 4	2.0
Impinger 3	Final Weight	711.6		Impinger 5	0.0
	Initial Weight	708.2			
	Increase	3.4		Impinger 6	1.0
Impinger 4	Final Weight	727.2		Impinger 7	0.0
	Initial Weight	725.2		Imp. 8	10.3
	Increase	2.0		Total	150.0 = V_w
Impinger 5	Final Weight	749.0			
	Initial Weight	749.0			
	Increase	0.0			
Impinger 6	Final Weight	741.2			
	Initial Weight	740.2			
	Increase	1.0			
Impinger 7	Final Weight	738.0			
	Initial Weight	738.0			
	Increase	0.0			

Water Weight Gain

V_w =

g SO_2 = -

V_w =

1028.3 F

Imp. 8 1018.0 I

10.3

P_b =	29.77	$\%CO_2$ =	12.8
V_m =	~~56.438~~ 55.380	$\%O_2$ =	7.0
V_w =	150.0	%CO =	0.0
P_m =	0.939	$\%N_2$ =	80.2
Avg ΔP =	0.557	A_s =	21024
		D_n =	0.247
Avg$\sqrt{\Delta P}$ =	0.738	T_t =	96
C_p =	0.802		
P_s =	-14.8 "H_2O		28.68 "Hg
T_m =	88 °F		548 °R
T_s =	~~313~~ 385 °F		~~773~~ 785 °R

Moisture Content: %M = ~~11.55~~ 11.74 M_d = ~~0.8845~~ 0.8826 MW_d = 30.328 MW = 28.88

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \text{~~56.438~~ 55.380} \left[\frac{29.77 + \frac{0.939}{13.6}}{88 + 460}\right] = \text{~~51.240~~ 53.223 sft}^3 = \text{~~0.505~~ 0.554 scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 150.0 = 7.080 sft^3

$$\% \text{ Moisture} = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{7.080}{\text{~~51.240~~ 53.223} + 7.080} \times 100 = \text{~~11.55~~ 11.74}\ \%$$

V_s = 5123.8 x 0.802 x ~~773~~ 785 x 0.738 = ~~2932~~ 2952 fpm

28.68 x 28.88

$$\%I = \frac{1{,}039 \times \text{~~51.240~~ 53.223} \times \text{~~773~~ 785}}{96 \times 28.68 \times \text{~~0.8845~~ 0.8826} \times \text{~~2932~~ 2952} \times (0.247)^2} = \text{~~98.4~~ 99.2}\ \%$$

ACFM: ~~427738~~ 431,045

SCFM: ~~248114~~ 246,156

%EA: 49.1

VERSION 1
22 OCTOBER 2002

Run Number 1 TASK 1 ✓ 0-H FIELD DATA

Unit UNIT 2 ESP OUTLET ✓

Date 8-17-05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
10-1	1257	543.82	0.62	1.05	1.05	5.0	330	270	275	58	94	85	
END	1301	546.400	—	—	—	—	—	—	—	—	—	—	Δvol 1.059 ✓
7-4	1321	547.459	0.36	0.60	0.60	4.0	335	277	282	70	91	86	
3	1325	549.61	0.36	0.60	0.60	4.0	336	276	281	67	93	87	
2	1329	551.32	0.46	0.78	0.78	4.0	336	276	281	67	93	87	
1	1333	553.51	0.46	0.78	0.78	4.0	310	276	284	64	94	87	
END	1337	555.294	—	—	—	—	—	—	—	—	—	—	leak ✓ 10; 0.008
3-4	1427	557.757	0.56	0.95	0.95	4.5	318	249	254	68	93	90	Δvol = 2.457 ✓
3-3	1431	560.06	0.48	0.82	0.82	4.5	319	254	256	64	94	90	
3-2	1435	562.21	0.70	1.20	1.20	5.0	318	259	251	63	98	91	
3-1	1439	564.61	0.72	1.20	1.20	5.0	317	258	254	62	100	91	
END	1443	566.944	—	—	—	—	—	—	—	—	—	—	
2-4													

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-233 ✓
Job Name: ADA-ES ✓
Run Number: 2 TASK 1 ✓
Unit: UNIT 2 ESP OUTLET ✓
Date: 8-17-05 ✓
Operator: BROWN/WEBER/BORNSEN
Sample box No. 76 Meter Box No. 53-2 ✓

ONTARIO HYDRO ~~Method 17~~ Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓ ✓

Ambient Temp. °F 88
Assumed Moisture % 12
Probe Length 7'
C Factor 10→17 ΔH to reference.
Initial Leak @ 15.5 "Hg = 0.006 cfm ✓
Final Leak @ 11.0 "Hg = 0.004 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔPs "Pitot" "H₂O	Orifice ΔH "H₂O Desired	Pm Orifice ΔH "H₂O Actual	Pump Vacuum "Hg Gauge	Ts Stack Temp °F	Probe Temp °F	LINE ~~Oven~~ Temp °F	Effluent Temp °F	Tm Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1812	570.340	0.30	0.50	0.50	5.0	332	278	279	69	97	96	Pb 29.66
3	1816	572.13	0.55	0.92	0.92	5.5	346	276	271	64	98	96	Ps -14.5
2	1820	574.49	0.55	0.92	0.92	6.0	352	274	274	63	100	96	
1	1824	576.62	0.32	0.54	0.54	5.0	341	271	279	60	101	96	
END	1828	578.491	—	—	—	—	—	—	—	—	—	—	Δvol = 0.860 ✓
2-4	1830	579.351	0.50	0.85	0.85	6.0	336	271	278	65	100	96	
3	1834	581.45	0.85	1.45	1.45	8.0	342	270	278	63	101	96	
2	1838	584.49	0.85	1.45	1.45	8.0	340	271	279	61	101	97	
1	1842	586.93	0.68	1.15	1.15	7.0	346	270	277	60	101	97	
END	1846	589.401	—	—	—	—	—	—	—	—	—	—	leak ✓ 11.5" 0.006
3-4	1849	590.090	0.72	1.20	1.20	7.0	361	268	271	66	106	97	Δvol = 0.689 ✓
3	1853	592.52	0.65	1.10	1.10	7.0	360	269	266	65	107	96	
2	1857	594.99	0.44	0.74	0.74	5.5	362	272	268	61	107	96	
1	1901	597.02	0.72	1.20	1.20	7.0	359	273	269	60	108	97	
END	1905	599.441	—	—	—	—	—	—	—	—	—	—	leak ✓ 11.5 0.006
1-4	1926	600.901	0.36	0.62	0.62	5.0	371	278	280	69	102	97	leak ✓ 12.0 0.006
3	1930	603.11	0.32	0.54	0.54	5.0	374	271	281	61	102	97	Δvol = 1.460 ✓
2	1934	604.52	0.36	0.62	0.62	5.0	365	270	281	60	102	97	

Pitot Tube Calibration Factor C_p 0.802 ✓
Volume Collected V_m 72.282 ✓ ft^3
Water Collected V_w 228.3 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.5 ✓ "H_2O

Pitot Tube No. 54-5-2 ✓
Baro. Press. P_b 29.66 ✓ "Hg
Probe Tip Dia. D_n 0.247 ✓ in.
% CO_2 13.6 ✓ % CO 0 ✓
% O_2 6.4 ✓ % N_2 80.0 ✓
Area Stack A_s 21024 ✓ in^2

Barometer No. 53-3 ✓ Probe Tip No. 05-233-1 ✓
Total Volume of Leak Checks After Start: 8.558 ft^3 ✓
V_m = Dry Gas Meter Calibration Factor 0.999 ✓ x 72.354 ✓

{Dry Gas Meter Reading ____ ft^3 – (T_t ____ min. X Leak Rate ____ cfm)}

VERSION 1
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Impinger Box No. 76

Impinger 1	Final Weight	921.5		Impinger 1	179.9
	Initial Weight	741.6			
	Increase			Impinger 2	22.0
Impinger 2	Final Weight	758.0		Impinger 3	3.2
	Initial Weight	736.0			
	Increase			Impinger 4	4.3
			V_w =		
Impinger 3	Final Weight	744.0	g SO_2 = -	Impinger 5	2.3
	Initial Weight	740.8	V_w =		
	Increase			Impinger 6	0.4
Impinger 4	Final Weight	725.0	Imp 8 F 1015.2 I 1029.5	Impinger 7	1.9
	Initial Weight	720.7		Imp 8	14.3
	Increase			Total	228.3 = V_w

Impinger 5	Final Weight	737.9	P_b =	29.66	%CO_2 =	13.6	
	Initial Weight	735.6	V_m =	72.282	%O_2 =	6.4	
	Increase		V_w =	228.3	%CO =	0.0	
			P_m =	0.977	%N_2 =	80.0	
Impinger 6	Final Weight	623.2	Avg ΔP =	0.578	A_s =	21024	
	Initial Weight	622.8			D_n =	0.247	
	Increase		Avg$\sqrt{\Delta P}$ =	0.751	T_t =	128	
			C_p =	0.802			
Impinger 7	Final Weight	744.0	P_s =	-14.5 H_2O		28.59	"Hg
	Initial Weight	742.1	T_m =	101 °F		561	°R
	Increase		T_s =	343 °F		803	°R

Moisture Content: %M = 13.75 M_d = 0.8625 MW_d = 30.432 MW = 28.72

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 72.282 \left[\frac{29.66 + \frac{0.977}{13.6}}{101 + 460}\right] = \frac{67.614\ sft^3}{0.528\ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 228.3 = 10.776 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{10.776}{10.776 + 67.614}$ x 100 = 13.75 %

V_s = 5123.8 x 0.802 $\sqrt{\frac{803}{28.59 \times 28.72}}$ x 0.751 = 30.52 fpm

ACFM: 44,572

SCFM: 242,361

%I = $\frac{1{,}039 \times 803 \times 67.614}{0.8625 \times 30.52 \times 28.59 \times 128 \times (0.247)^2}$ = 96.0 %

%EA: 43.2

Run Number 2 TASK 1 ✓ O-HYDRO **FIELD DATA**

Unit UNIT 2 ESP OUTLET ✓

Date 8-17-05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	LINE ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
T-1	1938	606.33	0.44	0.74	0.74	5.5	343	278	280	60	102	97	
END	1942	608.284	—	—	—	—	—	—	—	—	—	—	leak ✓ 11.5" 0.004
T-4	1956	609.371	0.36	0.62	0.62	5.0	307	279	276	69	100	97	leak ✓ 12" 0.004
3	2000	611.34	0.36	0.62	0.62	5.0	320	278	273	68	101	97	Pb 29.66 "Hg
2	2004	613.11	0.40	0.68	0.68	5.5	368	269	276	64	102	97	Ps -14.5 "H_2O
1	2008	614.97	0.45	0.75	0.75	5.5	363	271	272	61	103	97	Δvol = 1.087 ✓
END	2012	617.011	—	—	—	—	—	—	—	—	—	—	Δvol = 2.070 ✓
10-4	2016	619.081	0.55	0.95	0.95	6.0	327	259	266	68	104	97	
3	2020	621.39	0.74	1.25	1.25	7.0	333	267	272	64	107	97	
2	2024	623.82	0.90	1.50	1.50	7.5	336	272	266	63	109	97	
1	2028	626.49	0.85	1.45	1.45	7.5	338	271	271	61	109	98	
END	2032	629.411	—	—	—	—	—	—	—	—	—	—	
11-4	2034	630.550	0.50	0.85	0.85	6.0	339	267	271	67	110	97	Δvol = 1.139 ✓
3	2038	632.69	0.74	1.25	1.25	7.0	347	269	271	61	110	97	
2	2042	635.41	0.74	1.25	1.25	7.0	341	275	276	60	112	98	
1	2046	637.84	0.80	1.35	1.35	7.5	345	271	272	60	111	98	
END	2050	640.571	—	—	—	—	—	—	—	—	—	—	Δvol = 1.253 ✓
12-4	2052	641.824	0.56	0.95	0.95	6.5	323	270	278	64	108	98	
3	2056	644.11	0.82	1.35	1.35	7.5	329	270	279	61	109	98	
2	2100	646.82	0.56	0.95	0.95	6.5	333	270	279	60	109	98	
1	2104	648.91	0.56	0.95	0.95	6.5	330	272	274	61	109	98	
END	2108	651.252	—	—	—	—	—	—	—	—	—	—	

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METCO ENVIRONMENTAL

Job Number 05-233 ✓
Job Name ADA-ES ✓
Run Number 3 TASK 1 ✓
Unit UNIT 2 ESP OUTLET ✓
Date 8-18-05 ✓
Operator BROWN/SELLERS/BORNSEN
Sample box No. 76 Meter Box No. 53-2 ✓

0-HYDRO / M17 Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓ ✓

Ambient Temp. °F 90
Assumed Moisture % 12
Probe Length 7'
C Factor 10-7 18ΔH to reference.
Initial Leak @ 15.0 "Hg = 0.005 cfm ✓
Final Leak @ 10.0 "Hg = 0.007 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	LINE ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1120	655.220	0.26	0.42	0.42	4.5	326	249	251	66	94	92	Pb 29.67 "Hg
3	1124	657.03	0.80	1.45	1.45	6.5	328	256	249	62	95	92	Ps -14.5
2	1128	659.34	0.44	0.80	0.80	5.5	325	252	249	59	97	92	
1	1132	661.38	0.44	0.80	0.80	5.5	326	253	252	58	97	92	
END	1136	663.441	—	—	—	—	—	—	—	—	—	—	ΔVol = 0.520 ✓
11-4	1137	663.961	0.40	0.72	0.72	5.0	328	251	261	55	100	93	
3	1141	665.97	0.56	1.00	1.00	5.5	330	251	264	55	101	93	
2	1145	668.29	0.90	1.60	1.60	7.0	335	258	268	55	104	93	
1	1149	671.01	0.90	1.60	1.60	7.0	327	261	270	55	104	94	
END	1153	673.833	—	—	—	—	—	—	—	—	—	—	leak ✓ 10; 0.004
8-4	1158	675.832	0.50	0.90	0.90	6.0	327	250	253	59	104	95	ΔVol = 1.999 ✓
3	1202	678.09	0.55	1.00	1.00	6.0	328	251	253	57	106	96	
2	1206	680.27	0.55	1.00	1.00	6.0	330	251	253	57	106	96	
1	1210	682.62	0.50	0.90	0.90	6.0	334	258	254	58	107	97	
END	1214	684.861	—	—	—	—	—	—	—	—	—	—	leak ✓ 11; 0.007
10-4	1220	687.080	0.83	1.50	1.50	7.0	333	256	250	57	107	97	ΔVol = 2.219 ✓
3	1224	689.79	0.85	1.55	1.55	7.0	334	256	252	57	107	97	
2	1228	692.49	0.61	1.15	1.15	6.0	337	261	248	58	109	98	

Pitot Tube Calibration Factor C_p 0.802 ✓
Volume Collected V_m 72.749 ✓ ft^3
Water Collected V_w 217.6 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.5 ✓ "H_2O

Pitot Tube No. 54-5-2 ✓
Baro. Press. P_b 29.67 ✓ "Hg
Probe Tip Dia. D_n 0.247 ✓ in.
% CO_2 13.2 ✓ % CO 0.0 ✓
% O_2 7.2 ✓ % N_2 79.6 ✓
Area Stack A_s 21024 ✓ in^2

Barometer No. 53-3 ✓ Probe Tip No. 05-233-1 ✓
Total Volume of Leak Checks After Start: 8.679 ✓ ft^3
V_m = Dry Gas Meter Calibration Factor 0.999 ✓ x 72.822 ✓

{Dry Gas Meter Reading ___ ft^3 – (T_t ___ min. X Leak Rate ___ cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 76

Impinger 1	Final Weight	914.6		Impinger 1	174.8
	Initial Weight	739.8			
	Increase			Impinger 2	23.1
Impinger 2	Final Weight	763.9		Impinger 3	3.9
	Initial Weight	740.8			
	Increase			Impinger 4	2.6
Impinger 3	Final Weight	746.2	V_w =	Impinger 5	-0.1
	Initial Weight	742.3	g SO_2 = -		
	Increase		V_w =	Impinger 6	-0.8
Impinger 4	Final Weight	722.7	Imp. 8 1042.7 / 1028.6	Impinger 7	0.0
	Initial Weight	720.1		Imp 8	14.1
	Increase			Total	217.6 = V_w
Impinger 5	Final Weight	747.1	P_b = 29.67	$\%CO_2$ =	13.2
	Initial Weight	747.2	V_m = 72.749	$\%O_2$ =	7.2
	Increase		V_w = 217.6	%CO =	0.0
			P_m = 1.029	$\%N_2$ =	79.6
Impinger 6	Final Weight	741.0	Avg ΔP = 0.570	A_s =	21024
	Initial Weight	741.8		D_n =	0.247
	Increase		Avg$\sqrt{\Delta P}$ = 0.745	T_t =	128
			C_p = 0.802		
Impinger 7	Final Weight	623.5	P_s = -14.5 H_2O		28.60 "Hg
	Initial Weight	623.5	T_m = 102 °F		562 °R
	Increase		T_s = 330 °F		790 °R

Water Weight Gain

Moisture Content: %M = 13.13 M_d = 0.8687 MW_d = 30.400 MW = 28.77

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 72.749 \left[\frac{29.67 + \frac{1.029}{13.6}}{102 + 460}\right] = 67.961\ sft^3 = 0.531\ scfm$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 217.6 = 10.271 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{10.271}{10.271 + 67.961}$ x 100 = 13.13 %

V_s = 5123.8 x $\sqrt{\frac{0.802 \times 790}{28.60 \times 28.77}}$ x 0.745 = 3000 fpm

%I = $\frac{1.039 \times 67.961 \times 790}{0.8687 \times 3000 \times 28.60 \times 128 \times (0.247)^2}$ = 95.8 %

ACFM: 437962

SCFM: 243978

%EA: 51.8

Run Number 3 ✓ O-HYDRO M.17 **FIELD DATA**

Unit UNIT 2 ESP OUTLET ✓

Date 8-18-05 ✓

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual (P_m)	Pump Vacuum "Hg Gauge	Stack Temp °F (T_s)	Probe Temp °F	~~Oven~~ LINE Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet (T_m)	Dry Gas Temp °F Outlet	Remarks
10-1	1232	695.16	0.60	1.10	1.10	6.0	338	~~338~~ 264	251	57	109	99	
END	1236	697.511	—	—	—	—	—	—	—	—	—	—	leak ✓ 11"; 0.009
1-4	1255	699.491	0.34	0.62	0.62	5.0	336	272	248	68	108	99	Δvol = 1.98 ✓
3	1259	701.43	0.44	0.80	0.80	5.5	337	268	249	66	100	100	Pb 29.67"Hg
2	1303	703.41	0.52	0.94	0.94	5.5	341	261	251	64	104	100	Ps -14.5
1	1307	705.69	0.48	0.86	0.86	5.5	337	258	254	64	106	100	
END	1311	707.829	—	—	—	—	—	—	—	—	—	—	
3-4	1313	708.411	0.80	1.45	1.45	7.0	352	267	266	61	107	99	Δvol = 0.582 ✓
3	1317	711.13	0.52	0.94	0.94	6.0	358	263	270	62	109	99	
2	1321	713.49	0.74	1.35	1.35	6.5	330	260	264	62	109	100	
1	1325	716.05	0.76	1.40	1.40	7.0	327	259	260	59	109	101	
END	1329	718.600	—	—	—	—	—	—	—	—	—	—	
2-4	1330	719.311	0.33	0.60	0.60	5.0	318	253	254	62	110	101	Δvol = 0.711 ✓
3	1334	721.19	0.35	0.62	0.62	5.0	320	254	254	60	110	101	
2	1338	722.97	0.46	0.82	0.82	5.5	325	253	250	60	110	101	
1	1342	725.02	0.90	1.60	1.60	7.0	324	252	250	60	110	101	
END	1346	727.521	—	—	—	—	—	—	—	—	—	—	Δvol = 0.1601 ✓
1-4	1347	728.189	0.25	0.45	0.45	4.5	314	250	249	61	110	101	
3	1351	729.79	0.60	1.10	1.10	6.0	321	252	249	60	110	101	
2	1355	732.132	0.60	1.10	1.10	6.0	322	253	249	60	110	101	
1	1359	734.71	0.44	0.80	0.80	5.5	323	254	250	60	110	101	
END	1403	736.721	—	—	—	—	—	—	—	—	—	—	

Version 1
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PRELIMINARY VELOCITY TRAVERSE DATA
AND
SAMPLING LOCATION DATA

Job Number 05-233 TASK 1

Job Name ADAES

Stack Height 198' ft.

Sampling Location Inlet Duct Unit #2

Sampling Port Height Above Ground 198' ~~6 1/4"~~ ft.

Date 8-16-05 Time 1030

	Port A	Port B	Port C	Port D	Average
Port & Inside Diameter (in.)	94 1/4" on	All {A,B,C,D,G,I,J,K}			94 1/4"
Port & Wall Thickness (in.)	21 1/4" on	All (A,B,C,D,G,I,J,K)			21 1/4"
Inside Stack Diameter (in.)	73" on	All (A,B,C,D,G,I,J,K)			73" x 288"

Sampling Ports are 6 ft. 6 1/4 in. (0.67 stack diameters) ~~downstream~~ upstream from disturbance (inlet, constriction, bend, expansion) 2.61

Sampling Ports are 25 ft. 4 in. (2.60 stack diameters) ~~upstream~~ downstream from disturbance (outlet, constriction, bend, expansion)

Point Number	Percent Diameter	Distance from Ref. Point (decimal in.)	Distance from Ref. Point (fractional in.)	Port A ΔP/T_s/α (Right to Left)	Port B ΔP/T_s/α	Port C ΔP/T_s/α	Port D ΔP/T_s/α
1	–	9.125	9 1/8"	1.301309+5	1.2013101+10	1.1013111+5	1.4513121+8
2	–	27.375	27 3/8	1.401307+7	1.1013101+5	1.2513101 0	1.4013111+10
3	–	45.625	45 5/8	1.451308+5	1.2013101+3	1.3013091+7	1.4015111+4
4	–	63.875	63 7/8	1.301309+6	1.301308+4	1.2513081+6	1.2513081+3
5				/ /	/ /	/ /	/ /
6				Port G	Port I	Port J	Port K
1	–	9.125	9 1/8	0.3513011-11	1.0013271-5	0.8513361-5	1.4013321 0
2	–	27.375	27 3/8	0.6013221-10	1.1013361 0	0.9513301-3	1.3513311 0
3	–	45.625	45 5/8	0.7113211-6	1.2013261+5	1.2013301-2	1.4013291-1
4	–	63.875	63 7/8	0.7513191-7	1.2513241+4	1.3013281-4	1.2513261-3
11				/ /	/ /	/ /	/ /
12				/ /	/ /	/ /	/ /
13				/ /	/ /	/ /	/ /
14				/ /	/ /	/ /	/ /
15				/ /	/ /	/ /	/ /
16				/ /	/ /	/ /	/ /
17				/ /	/ /	/ /	/ /
18				/ /	/ /	/ /	/ /
19	* Port G was odd compared to			/ /	/ /	/ /	/ /
20	rest of ports			/ /	/ /	/ /	/ /
21				/ /	/ /	/ /	/ /
22				/ /	/ /	/ /	/ /
23				/ /	/ /	/ /	/ /
24				/ /	/ /	/ /	/ /

Pitot Tube No. 28-12-2

C_p = 0.805

P_b = 29.76 "Hg

P_s = -14.2 "H_2O 28.72 "Hg

A_s = 21,024 in.²

Average ΔP 1.166

Average $\Delta P^{1/2}$ 1.071

Average T_s 317 °F

Average α 4.81 degrees

VERSION 1
22 OCTOBER 200

PRELIMINARY VELOCITY TRAVERSE DATA
AND
SAMPLING LOCATION DATA

Job Number 05-233

Job Name ADA

OUTLET

Sampling Location ESP OUTLET UNIT 2

Stack Height 198 ft.

Sampling Port Height Above Ground 198 ft.

192+6

Date 8/15/05 Time 1100

	Port A	Port B	Port C	Port D	Average
Port & Inside Diameter (in.)					~~94~~ 95
Port & Wall Thickness (in.)					22
Inside Stack Diameter (in.)					~~72~~ 73 x 288"

Sampling Ports are 6 ft. 11 in. (~~0.77~~ 0.72 0.71 stack diameters) downstream from disturbance (inlet, constriction, bend, expansion)

Sampling Ports are 3 ft. 2 in. (~~0.33~~ 0.33 stack diameters) upstream from disturbance (outlet, constriction, bend, expansion)

De = ~~116.5~~ ~~115.2~~ 116.5

Point Number	Percent Diameter	Distance from Ref. Point (decimal in.)	Distance from Ref. Point (fractional in.)	Port A 1 ΔP/T_s/α	Port B 2 ΔP/T_s/α	Port C 3 ΔP/T_s/α	Port D 4 ΔP/T_s/α
1		~~12.167~~	~~12 3/16~~	/ /	/ /	/ /	/ /
2		~~36.5~~	~~36 1/2~~	/ /	/ /	/ /	/ /
3		~~60.833~~	~~60 13/16~~	/ /	/ /	/ /	/ /
4				/ /	/ /	/ /	/ /
5				/ /	/ /	/ /	/ /
6				/ /	/ /	/ /	/ /
7				/ /	/ /	/ /	/ /
8				/ /	/ /	/ /	/ /
9				/ /	/ /	/ /	/ /
10				K 12 /	K 11 /	K 18 /	10 /
11		~~9.125~~	1	0.30 / 315 / -3°	0.90 / 323 -2	0.25 / 317 / 2	/ /
12		~~27.375~~	2	0.36 / 321 / -3°	0.95 / 323 / -5	0.47 / 319 / 5	/ /
13		~~45.625~~	3	0.84 / 321 / -5°	0.74 / 319 / -8	0.56 / 315 / 5	/ /
14		~~63.875~~	4	0.30 / 321 / -5°	0.38 / 316 / -10	0.50 / 312 / 5	/ /
15				/ /	/ /	/ /	/ /
16				/ /	/ /	/ /	/ /
17				/ /	/ /	/ /	/ /
18				/ /	/ /	/ /	/ /
19				/ /	/ /	/ /	/ /
20				1 / /	2 / /	3 / /	4 / /
21		9.125 ✓	9 1/8 ✓	0.17 / 279 2°	0.75 / 283 / -3°	/ /	0.56 / 305 / 2°
22		27.375 ✓	27 3/8 ✓	0.61 / 295 / 2°	0.89 / 307 / -2°	/ /	0.52 / 309 / 5°
23		45.625 ✓	45 5/8 ✓	0.50 / 293 / 2°	0.74 / 307 / -5°	/ /	0.70 / 306 / 10°
24		63.875 ✓	63 7/8 ✓	0.11 / 283 / 5°	0.58 / 298 / -17°	/ /	0.68 / 296 / 12°

Pitot Tube No. 54-10-1 ✓

C_p = 0.806 ✓

P_b = 29.74 "Hg

P_s = -14.9 "H_2O ~~28.66~~ "Hg

A_s = 21024 ✓ in.^{2} ✓

Average ΔP 0.557 ✓

Average $\Delta P^{1/2}$ 0.727 ✓

Average T_x 308 ✓ °F 768

Average α ~~0.46~~ 5.2 ✓ degrees

VERSION 1
22 OCTOBER 2002

APPENDIX E

Analytical Data

METCO Environmental

Particulate Analysis Summary

Job Number 05 - 233 Task1

Job Name ADA - ES

Location Newark, Oh.

Date Analysis Completed 8-29-05

Unit Tested #2 ESP Inlet

Run No.	1	2	3		
Particulate on Thimble Filter (mg)	4,577.7	4,548.6	6,278.1		
Particulate in Front Wash (mg)*	1788.3	849.0	666.4		
MF (mg)	6,366.0	5,397.6	6,944.5		
Particulate in Impinger #1 (mg)					
MT (mg)					

M. Ganter
Analyst

* Less Acetone Residue

METCO Environmental

Particulate Analysis EPA Method ~~5~~ 17

Front Wash

Job Number 05-233 task1 Location Newark, OH.

Job Name ADA-ES Unit Tested #2 ESP Inlet

Desiccator Time In	1635 8/24				
Desiccator Time Out	1315 8/25	815 8/26			

Run No. 1	Volume (ml) 335				
Final Weight (g)	127.3258	127.3262	✓		
Initial Weight (g)	125.5358	125.5351			
Particulate Weight (g)	1.7907	1.7911			

1.7731

Particulate Average (mg) 1790.9
Less Acetone Blank (mg) 2.6
Total Particulate (mg) 1788.3 ✓

Run No. 2	Volume (ml) 168				
Final Weight (g)	122.0104	122.0108	✓		
Initial Weight (g)	121.1603	121.1603			
Particulate Weight (g)	0.8501	0.8505			

Particulate Average (mg) 850.3
Less Acetone Blank (mg) 1.3
Total Particulate (mg) 849.0 ✓

Run No. 3	Volume (ml) 163				
Final Weight (g)	174.8958	174.8957	✓		
Initial Weight (g)	174.2281	174.2281			
Particulate Weight (g)	0.6677	0.6676			

Particulate Average (mg) 667.7
Less Acetone Blank (mg) 1.3
Total Particulate (mg) 666.4 ✓

Acetone Blank	Volume (ml)				
Final Weight (g)					
Initial Weight (g)					
Difference (g)					

Mettler AE240

Average (mg) _____
* mg/l _____

* Note: If greater than 7.9 mg/l, use 7.9 mg/l.

Analyst

METCO Environmental

Particulate Analysis EPA Method ~~5~~/17

Stack ~~Filters~~ thimbles

Job Number 05-233 TSKI

Job Name ADA-ES

Location Newark, Oh.

Unit Tested #2 ESP Inlet

Desiccator Time In	8/23 1430				
Desiccator Time Out	8/24 1620	8/30 8/26			

Run No. 1	Filter No. Q 376				
Filter & Particulate + Tare Weight (g)	7.6833	7.6820	✓		
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) 7.6827

Initial Filter Weight (g) 3.1050

Total Particulate (mg) 4,577.7 ✓

Run No. 2	Filter No. Q 388				
Filter & Particulate + Tare Weight (g)	7.6477	7.6471	✓		
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) 7.6474

Initial Filter Weight (g) 3.0988

Total Particulate (mg) 4,548.6 ✓

Run No. 3	Filter No. Q 389				
Filter & Particulate + Tare Weight (g)	9.3482	9.3472	✓		
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) 9.3477

Initial Filter Weight (g) 3.0696

Total Particulate (mg) 6278.1 ✓

Run No. _____	Filter No. _____				
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Mettler AE240

Filter & Particulate Average (g) _____

Initial Filter Weight (g) _____

Total Particulate (mg) _____

MJ

Analyst

METCO Environmental

Particulate Analysis Summary

Job Number 05-233 Task1

Date Analysis Completed 8-29-05

Job Name ADA-ES

Unit Tested # 2 ESP Outlet

Location Newark, Ar.

Run No.	1	2	3		
Particulate on ~~Filter~~ thimble (mg)	22.3	46.3	50.7		
Particulate in Front Wash (mg)*	25.1	4.0	5.1		
MF (mg)	47.4	50.3	55.8		
Particulate in Impinger #1 (mg)					
MT (mg)					

M. Gaster
Analyst

* Less Acetone Residue

METCO Environmental

Particulate Analysis EPA Method ~~5~~ 17

Front Wash

Job Number 05-233 task 1 Location Newark, Oh.

Job Name ADA - ES Unit Tested #2 ESP Outlet

Desiccator Time In	900 8/24				
Desiccator Time Out	1350 8/24	1540 8/25			

Run No. 1	Volume (ml) 95				
Final Weight (g)	120.8240	120.8243	✓		
Initial Weight (g)	120.7983	120.7983			
Particulate Weight (g)	0.0257	0.0260			

Particulate Average (mg) 25.9
Less Acetone Blank (mg) 0.8
Total Particulate (mg) 25.1 ✓

Run No. 2	Volume (ml) 58				
Final Weight (g)	139.0173	139.0172 ✓			
Initial Weight (g)	139.0128	139.0128			
Particulate Weight (g)	0.0045	0.0044			

Particulate Average (mg) 4.5
Less Acetone Blank (mg) 0.5
Total Particulate (mg) 4.0 ✓

Run No. 3	Volume (ml) 95				
Final Weight (g)	168.6031	168.6036 ✓			
Initial Weight (g)	168.5975	168.5975			
Particulate Weight (g)	0.0056	0.0061			

Particulate Average (mg) 5.9
Less Acetone Blank (mg) 0.8
Total Particulate (mg) 5.1 ✓

Acetone Blank ✓	Volume (ml) 192				
Final Weight (g)	172.2511	172.2513 ✓			
Initial Weight (g)	172.2468	172.2468			
Difference (g)	0.0043	0.0045			

Mettler AE240

Average (mg) 4.4
* mg/l 22.9 ✓

* Note: If greater than 7.9 mg/l, use 7.9 mg/l.

Analyst

METCO Environmental

Particulate Analysis EPA Method ~~5~~ 17
Thimbles
Stack Filters

Job Number 05-233 Tsk1 Location Newark, Ar.

Job Name ADA-ES Unit Tested #2 ESP Outlet

Desiccator Time In	8/23 1430				
Desiccator Time Out	8/24 1625	850 8/26			

Run No. 1	Filter No. Q 392				
Filter & Particulate + Tare Weight (g)	2.9731	2.9731	✓		
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) 2.9731
Initial Filter Weight (g) 2.9508
Total Particulate (mg) 22.3 ✓

Run No. 2	Filter No. Q 398				
Filter & Particulate + Tare Weight (g)	3.1841	3.1836	✓		
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) 3.1839
Initial Filter Weight (g) 3.1376
Total Particulate (mg) 46.3 ✓

Run No. 3	Filter No. Q 391				
Filter & Particulate + Tare Weight (g)	3.1403	3.1394	3.1390 ✓		
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) 3.1392
Initial Filter Weight (g) 3.0885
Total Particulate (mg) 50.7 ✓

Run No. Blank	Filter No. Q 382				
Filter & Particulate + Tare Weight (g)	3.0980	3.0980			
Tare Weight (g)					
Filter & Particulate (g)					

Mettler AE240

Filter & Particulate Average (g) 3.0980
Initial Filter Weight (g) 3.0960
Total Particulate (mg) 2.0 ✓

MB
Analyst

METCO ENVIRONMENTAL

LABORATORY QUALITY ASSURANCE DATA

BALANCE ID Mettler AE240

DATE & TIME		100g STD	1.0g STD	0.5g STD	ANALYST	REMARKS
8/26/05 0815	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
8/29/05 0910	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
8/30/05 0815	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
8/31/05 0758	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
815 9-1-05	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
845 9/2/05	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
9/5/05 830	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
9/6/05 845	Actual (g)	99.9999	1.0000	0.5000	MK	
	Difference (mg)	-0.1	0	0		
	Actual (g)					
	Difference (mg)					
	Actual (g)					
	Difference (mg)					
	Actual (g)					
	Difference (mg)					
	Actual (g)					
	Difference (mg)					

METCO ENVIRONMENTAL

LABORATORY QUALITY ASSURANCE DATA

BALANCE ID Mettler AE240

DATE & TIME		100g STD	1.0g STD	0.5g STD	ANALYST	REMARKS
8/8/05	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
8/9/05 1015	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
8/11/05 0935	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
8/12/05 1010	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
8/15/05 0908	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
1130 8/16/05	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
945 8/17/05	Actual (g)	100.0000	1.0000	0.5000	MK	tech came to service WBG1 + WDC-2
	Difference (mg)	0	0	0		
1410 8/18/05	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
830 8/19/05	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
835 8/22/05	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
8/23/05 920	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
950 8/24/05	Actual (g)	100.0000	1.0000	0.5000	MK	
	Difference (mg)	0	0	0		
8/25 1330		100.0000	1.0000	0.5000	MK	
		0	0	0		

05-233 task 1
ADA-ES
Newark, Ohio

9-6-05
#2 ESP Inlet

Run	Imp	Vol	Dilu	ppm F	ppm F	ppm Avg	% RD	ppm Cl	ppm Cl	ppm avg.	% RD	ppm Br	ppm Br	ppm avg.	% RD	Total ug HF	Total ug HCl	Total ug HBr	Total ug Cl_2*	Total ug Br_2*
1	1-3	416	1	2.797	2.789	2.793	0.3	1.968	1.988	1.978	1.0	0.172	0.170	0.171	1.2	1,223.040	846.060	72.026	–	–
	4,5	256	2	–	–	–		ND	ND	ND	–	ND	ND	ND	–				ND	ND
									Run 1 total ug							1,223.0	846.1	72.0	ND	ND
2	1-3	456	1	1.906	1.886	1.896	1.1	1.714	1.764	1.739	2.9	ND	ND	ND	–	910.080	815.353	ND	–	–
	4,5	298	2	–	–			ND	ND	ND	–	ND	ND	ND	–				ND	ND
									Run 2 total ug							910.1	815.4	ND	ND	ND
3	1-3	465	1	2.399	2.418	2.4085	0.8	2.438	2.426	2.432	0.5	0.109	0.112	0.1105	2.7	1,178.897	1,162.781	52.026	–	–
	4,5	268	2	–	–			ND	ND	ND	–	ND	ND	ND	–				ND	ND
									Run 3 total ug							1,178.9	1,162.8	52.0	ND	ND

SPIKE	ppm F	ppm F	% RD	ppm Cl	ppm Cl	% RD	ppm Br	ppm Br	% RD	% Recovery F		% Recovery Cl		% Recovery Br	
RI I 4,5 @ 2x+1 ppm	–	–		1.055	1.051	0.4	1.008	0.986	2.2	–	–	105.5	105.1	100.8	98.6
RI I 1-3 @ 2x+1.25 ppm	2.448	2.460	0.5	2.375	2.400	1.0	1.301	1.302	0.1	99.5	100.5	92.7	94.7	99.7	99.7

* Initial pH: Run 1 Imp 4+5, 7.5 Run 2 Imp 4+5, 7 Run 3 Imp 4+5, 6 The pH's were adjusted to basic and then sodium thiosulfate added.

05-233 Task1
ADA-ES
Newark, Ar-Ond

9-6-05
2 ESP Outlet

Run	Imp	Vol	Dilu	ppm F	ppm F	ppm AVG.	% RD	ppm Cl	ppm Cl	ppm Avg.	% RD	ppm Br	ppm Br	ppm avg.	% RD	Total ug HF	Total ug HCl	Total ug HBr	Total ug Cl_2*	Total ug Br_2*
1	1-3	467	1	6.402	6.302	6.352	1.6	2.815	2.764	2.7895	1.8	0.246	0.247	0.2465	0.4	3,122.509	1,339.444	116.556		
	4,5	240	2	–	–			ND	ND	ND	–	ND	ND	ND	–				ND	ND
										Run 1 total ug						3,122.5	1,339.4	116.6	ND	ND
2	1-3	428	1	3.554	3.680	3.617	3.5	2.404	2.266	2.335	5.9	ND	ND	ND	–	1,629.554	1,027.571	ND		
	4,5	260	2	–	–			ND	ND	ND	–	ND	ND	ND	–				ND	ND
										Run 2 total ug						1,629.6	1,027.6	ND	ND	ND
3	1-3	475	1	5.232	5.237	5.2345	0.1	2.946	2.968	2.957	0.7	0.201	0.200	0.2005	0.5	2617.250	1,444.196	96.429		
	4,5	260	2	–	–			ND	ND	ND	–	ND	ND	ND	–				ND	ND
										Run 3 total ug						2617.3	1,444.2	96.4	ND	ND

Spike	ppm F	ppm F	% RD	ppm Cl	ppm Cl	% RD	ppm Br	ppm Br	% RD	% Recovery F	% Recovery Cl	% Recovery Br
R2I-3@2x+1ppm	2.876	2.894	0.6	2.125	2.156	1.4	1.042	1.060	1.7	106.8	95.8	104.2
										108.6	98.9	106.0
R2I4,5@2x+1ppm	–	–		1.080	1.007	7.0	0.979	1.024	4.5	–	108.0	97.9
										–	100.7	102.4

* Initial pH's Run 1 Imp 4+5, pH 12-14 Run 2 Imp 4+5, pH 7 Run 3 Imp 4+5, pH 5-4
The pH's were adjusted to basic, if needed, and then sodium thiosulfate added.

METCO ENVIRONMENTAL

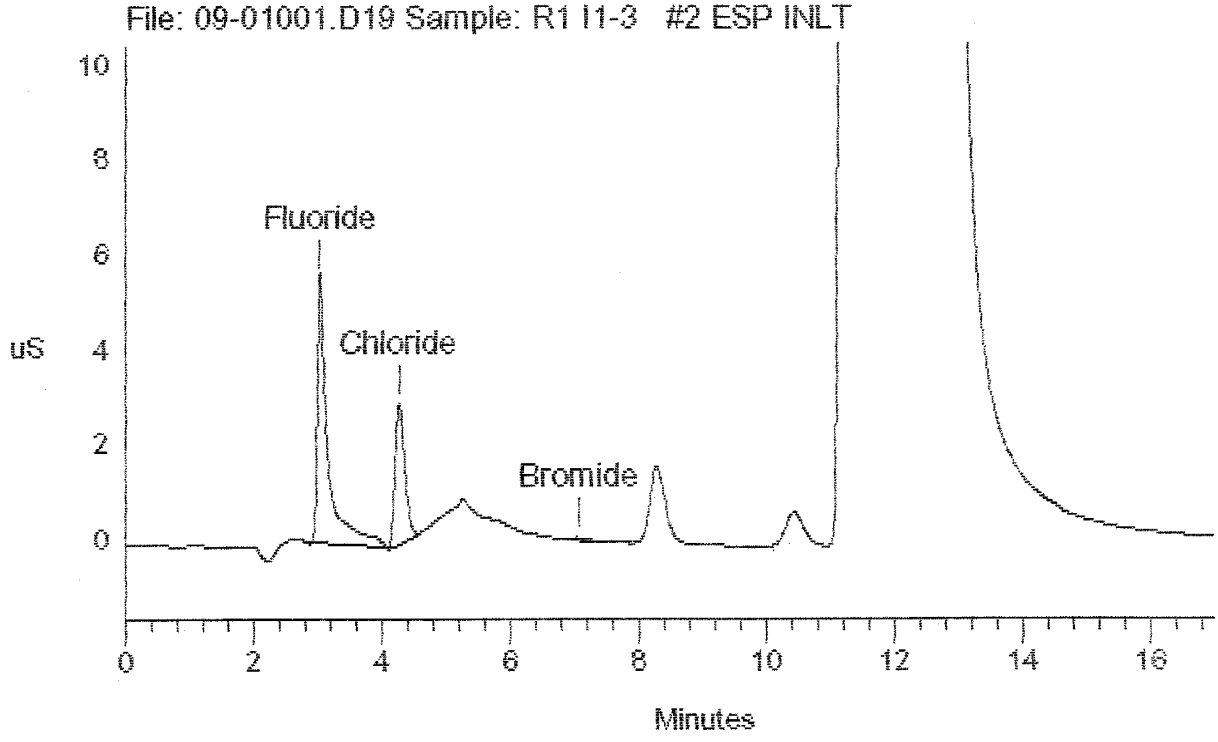
Data Reprocessed On 09/05/2005 13:29:50

```
================================================================================
| Sample Name: R1 I1-3   #2 ESP INLT          Date: 09/01/2005 16:15:51        |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D19                         |
| Method     : C:\DX\METHOD\HF2.MET                                            |
| ACI Address: 1  System: 1  Inject#: 19                   Detector:CDM-2      |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                 |
================================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.03	Fluoride	66480774	5576580	2.797
4.27	Chloride	30172865	2927083	1.968
7.07	Bromide	512380	45296	0.172
	Totals	97166019	8548959	4.938



METCO ENVIRONMENTAL

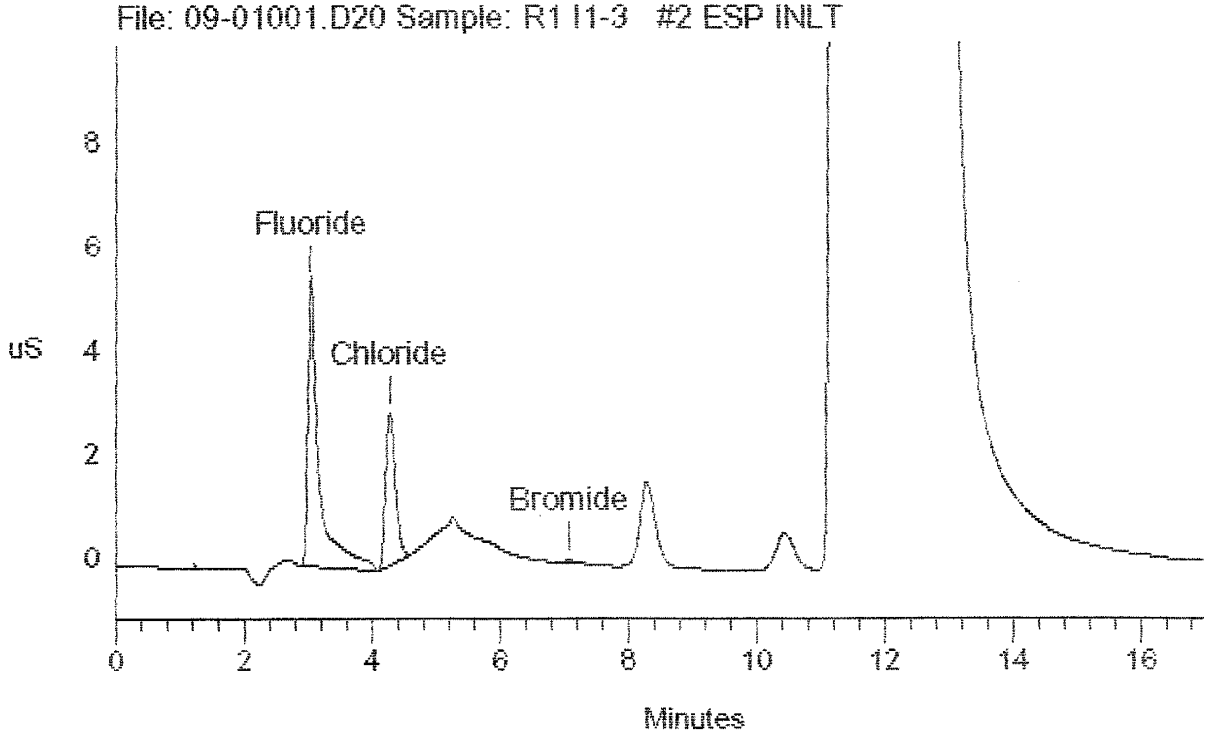
Data Reprocessed On 09/05/2005 13:30:02

```
==============================================================================
| Sample Name: R1 I1-3   #2 ESP INLT          Date: 09/01/2005 16:34:12      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D20                       |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 20                  Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.03	Fluoride	66260861	5446909	2.789
4.27	Chloride	30496820	2917776	1.988
7.09	Bromide	499336	44549	0.170
	Totals	97257017	8409233	4.948



METCO ENVIRONMENTAL

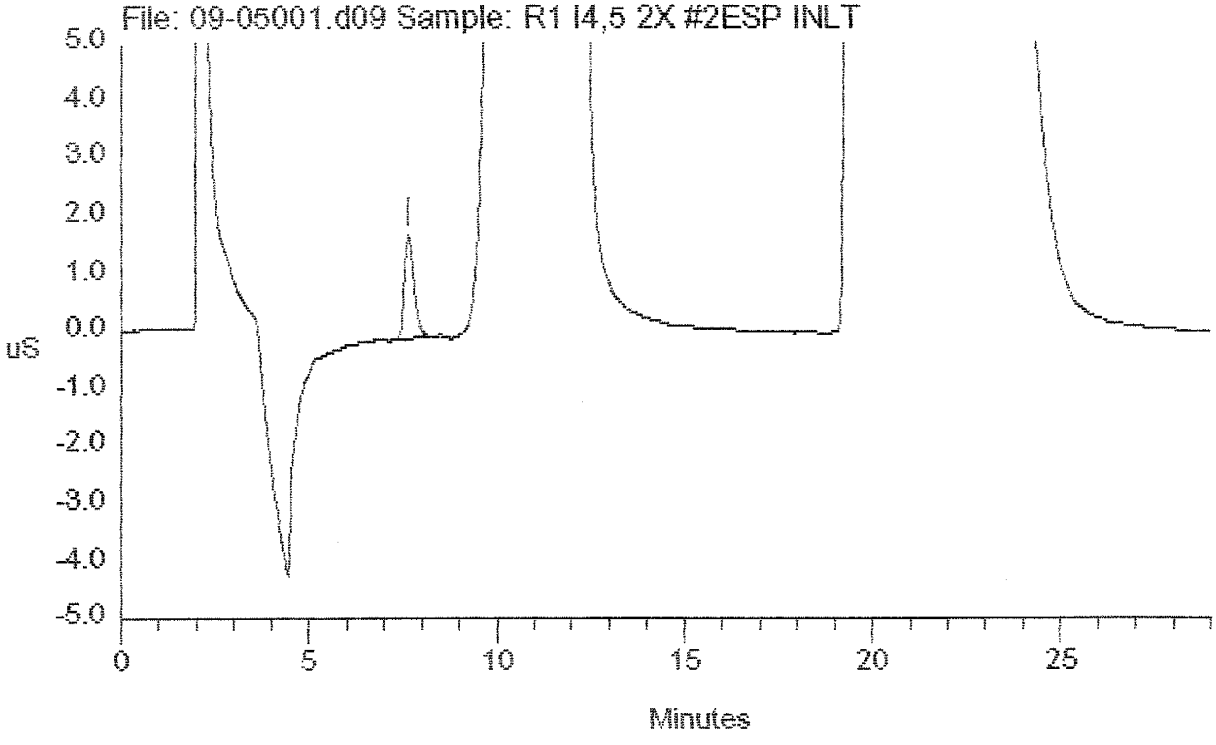
Data Reprocessed On 09/06/2005 07:15:52

Sample Name: R1 I4,5 2X #2ESP INLT	Date: 09/05/2005 13:42:22
Data File : C:\DX\DATA\ANIONS\05-233T1\09-05001.d09	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 9	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	29.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

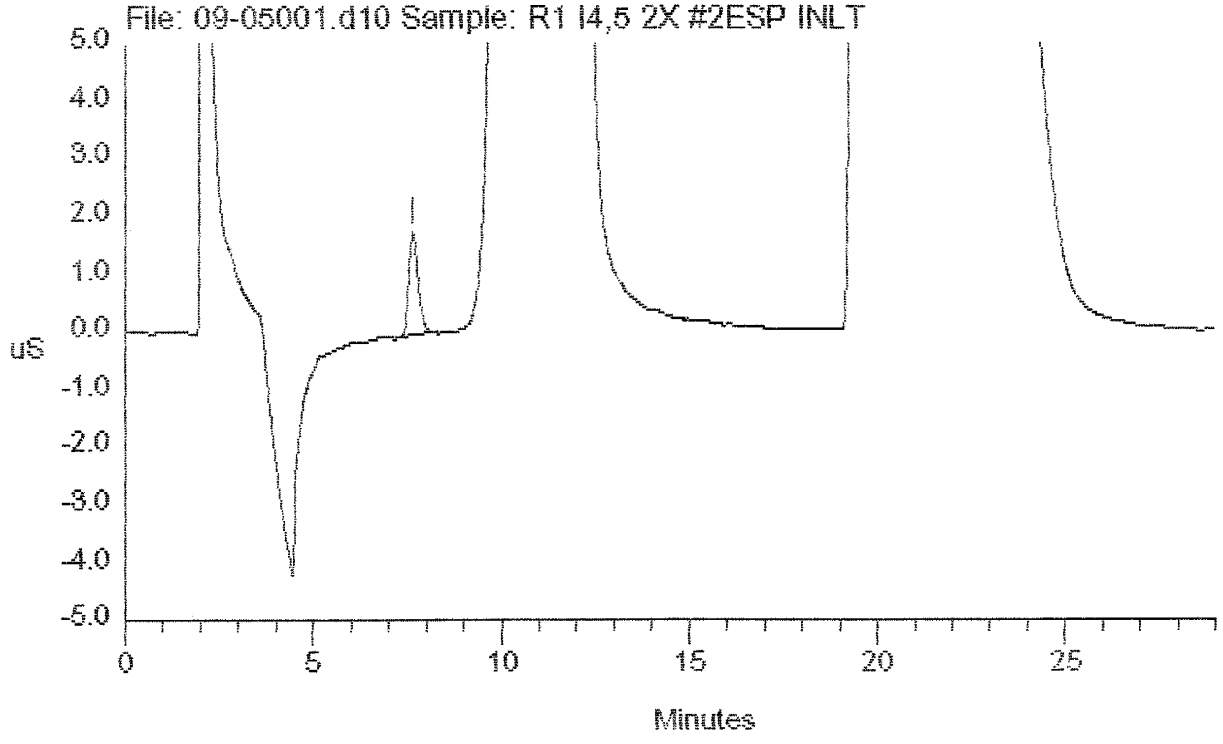
Data Reprocessed On 09/06/2005 07:15:53

```
==============================================================================
| Sample Name: R1 I4,5 2X #2ESP INLT          Date: 09/05/2005 14:12:41       |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-05001.d10                        |
| Method     : C:\DX\METHOD\HCLLO2.MET                                        |
| ACI Address: 1  System: 1  Inject#: 10                  Detector:CDM-2      |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                  |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	29.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

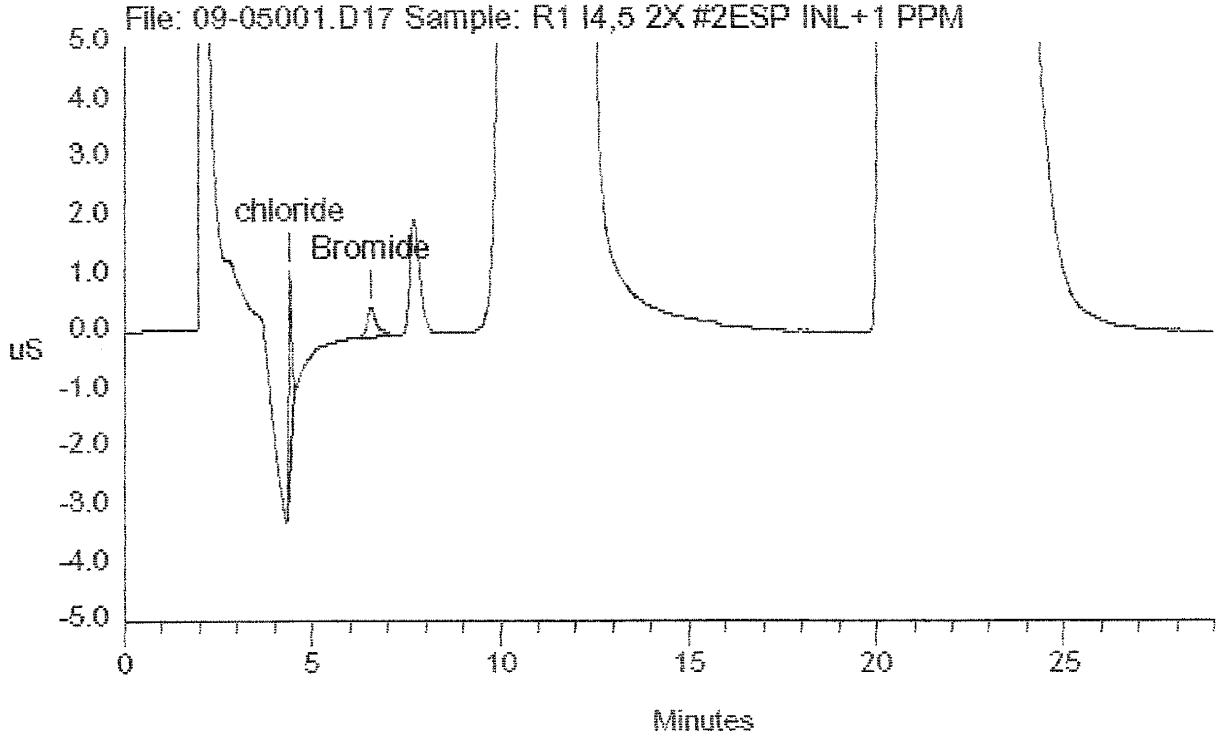
Data Reprocessed On 09/06/2005 07:08:46

```
==============================================================================
| Sample Name: R1 I4,5 2X #2ESP INL+1 PPM     Date: 09/05/2005 17:45:11        |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-05001.D17                        |
| Method     : C:\DX\METHOD\HCLLO2.MET                                        |
| ACI Address: 1  System: 1  Inject#: 17                  Detector:CDM-2      |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                  |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.40	chloride	18916246	3474537	1.055
6.57	Bromide	8503950	487116	1.008
	Totals	27420196	3961653	2.063



METCO ENVIRONMENTAL

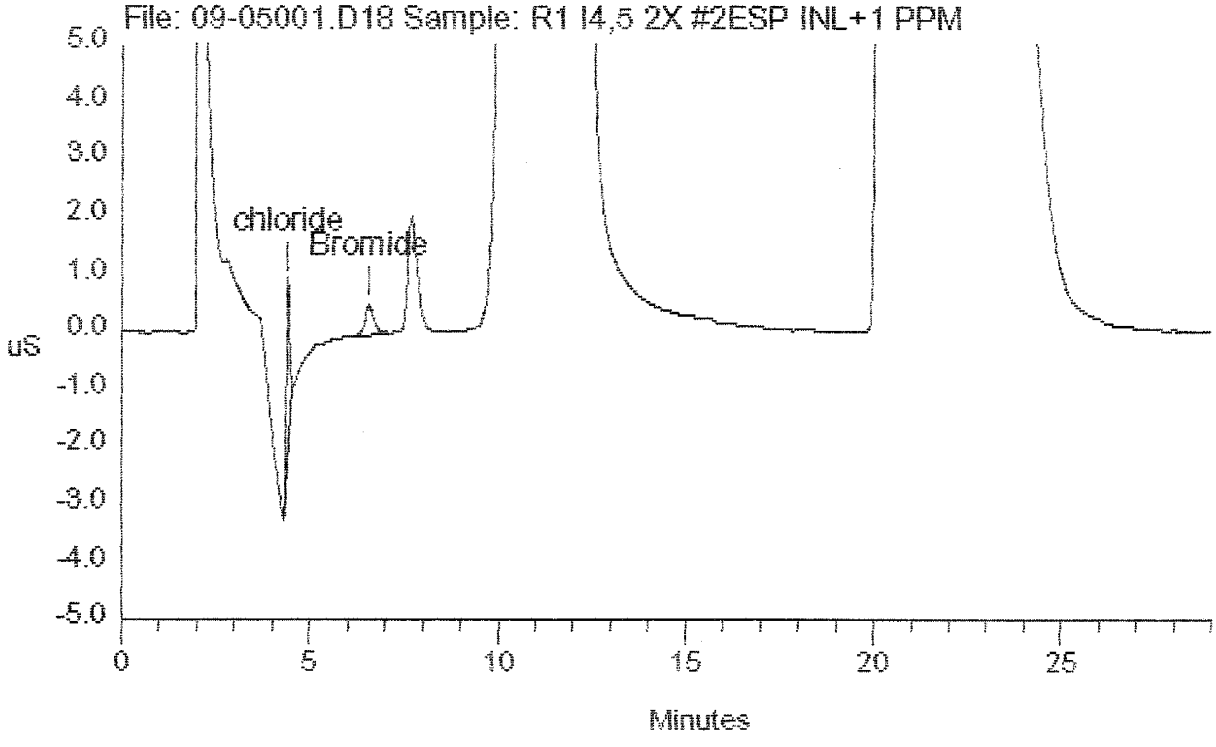
Data Reprocessed On 09/06/2005 07:17:27

Sample Name: R1 I4,5 2X #2ESP INL+1 PPM	Date: 09/05/2005 18:15:32
Data File : C:\DX\DATA\ANIONS\05-233T1\09-05001.D18	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 18	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.40	chloride	18824228	3296963	1.051
6.57	Bromide	8317144	505389	0.986
	Totals	27141372	3802352	2.037



METCO ENVIRONMENTAL

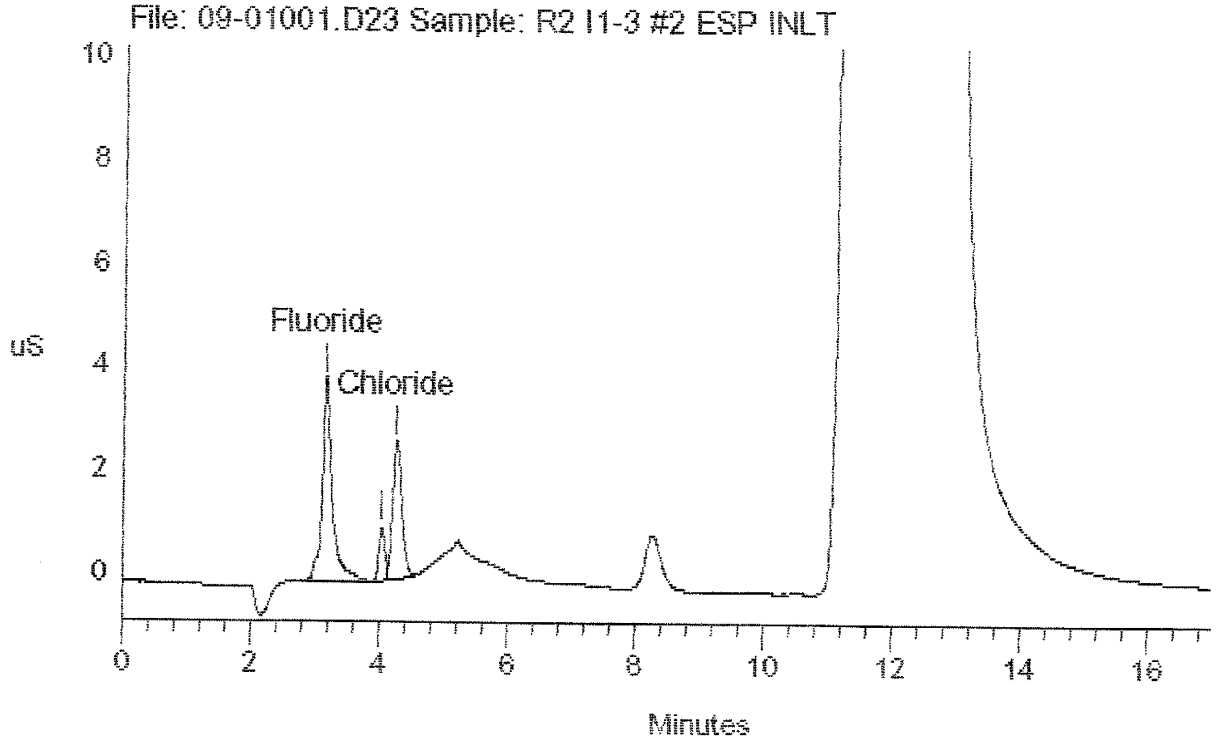
Data Reprocessed On 09/05/2005 13:30:20

Sample Name: R2 I1-3 #2 ESP INLT	Date: 09/01/2005 17:29:15
Data File : C:\DX\DATA\ANIONS\05-233T1\09-01001.D23	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 23	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.15	Fluoride	42292658	3848808	1.906
4.25	Chloride	25957776	2606227	1.714
	Totals	68250434	6455035	3.620



METCO ENVIRONMENTAL

Data Reprocessed On 09/05/2005 13:30:31

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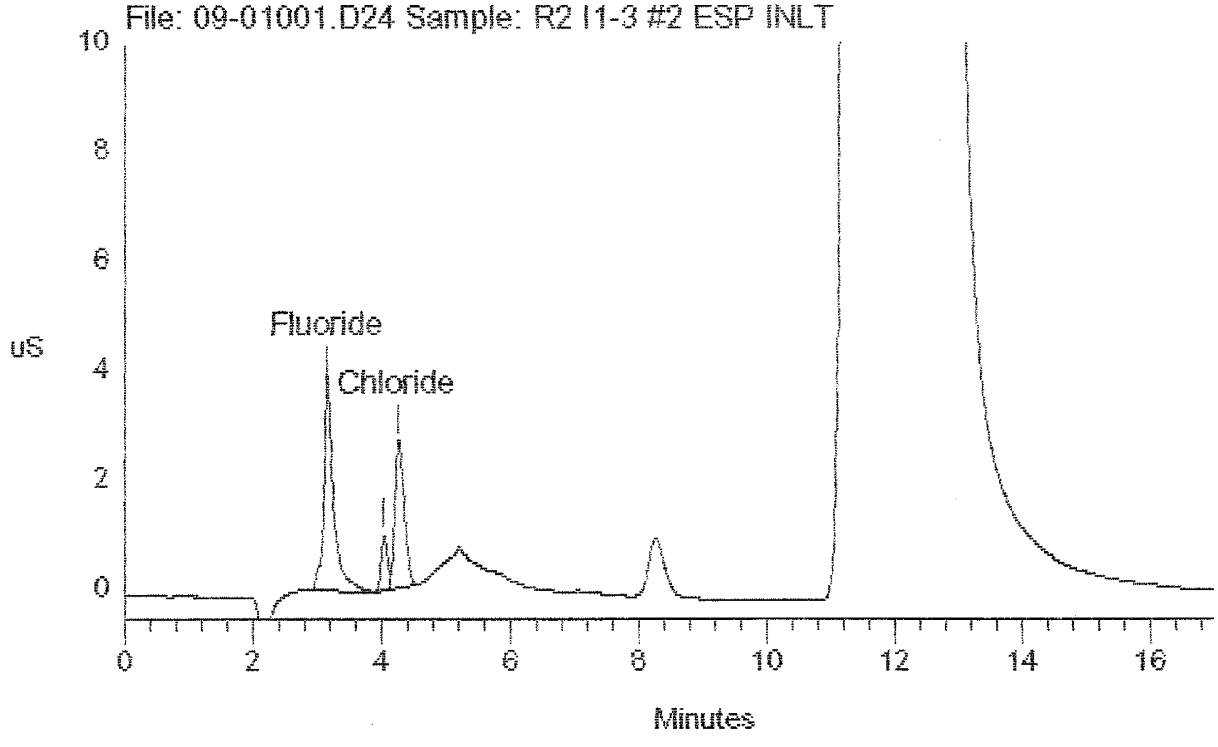
==============================================================================
| Sample Name: R2 I1-3 #2 ESP INLT            Date: 09/01/2005 17:47:36      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D24                       |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 24                  Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.15	Fluoride	41752040	3776800	1.886
4.25	Chloride	26784264	2627955	1.764
	Totals	68536304	6404755	3.650



METCO ENVIRONMENTAL

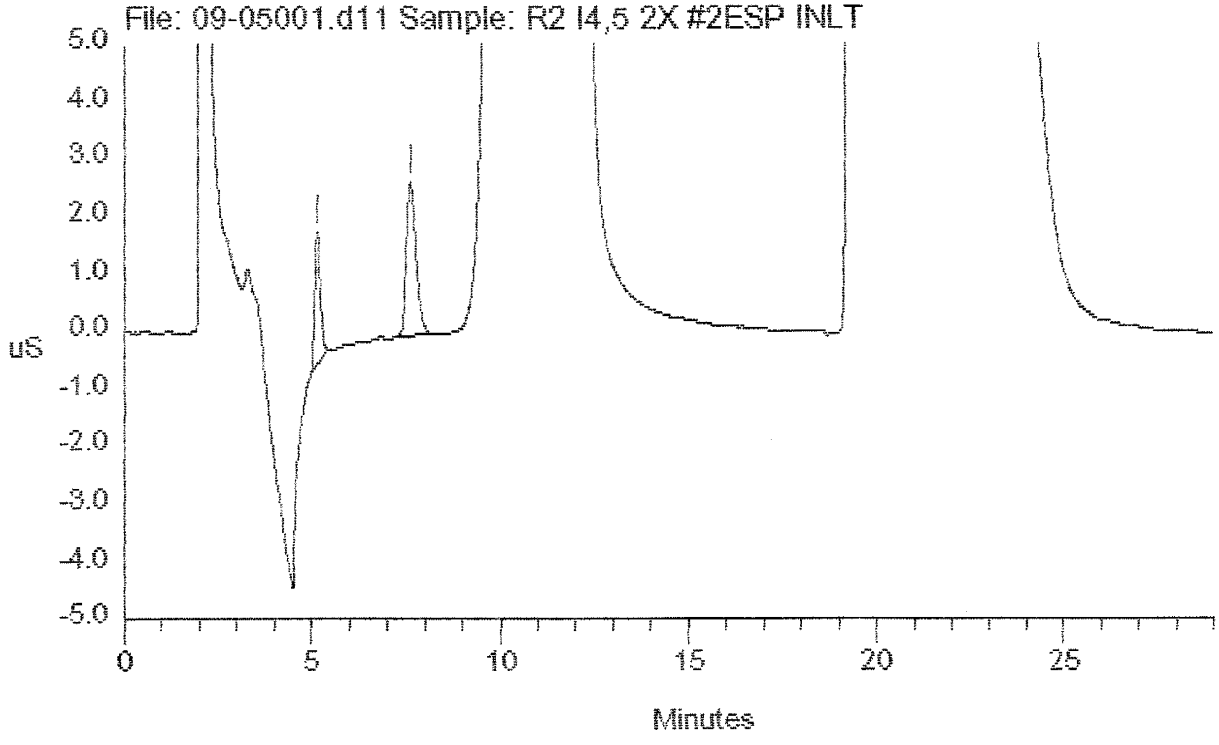
Data Reprocessed On 09/06/2005 07:15:54

Sample Name: R2 I4,5 2X #2ESP INLT	Date: 09/05/2005 14:43:02
Data File : C:\DX\DATA\ANIONS\05-233T1\09-05001.d11	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 11	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

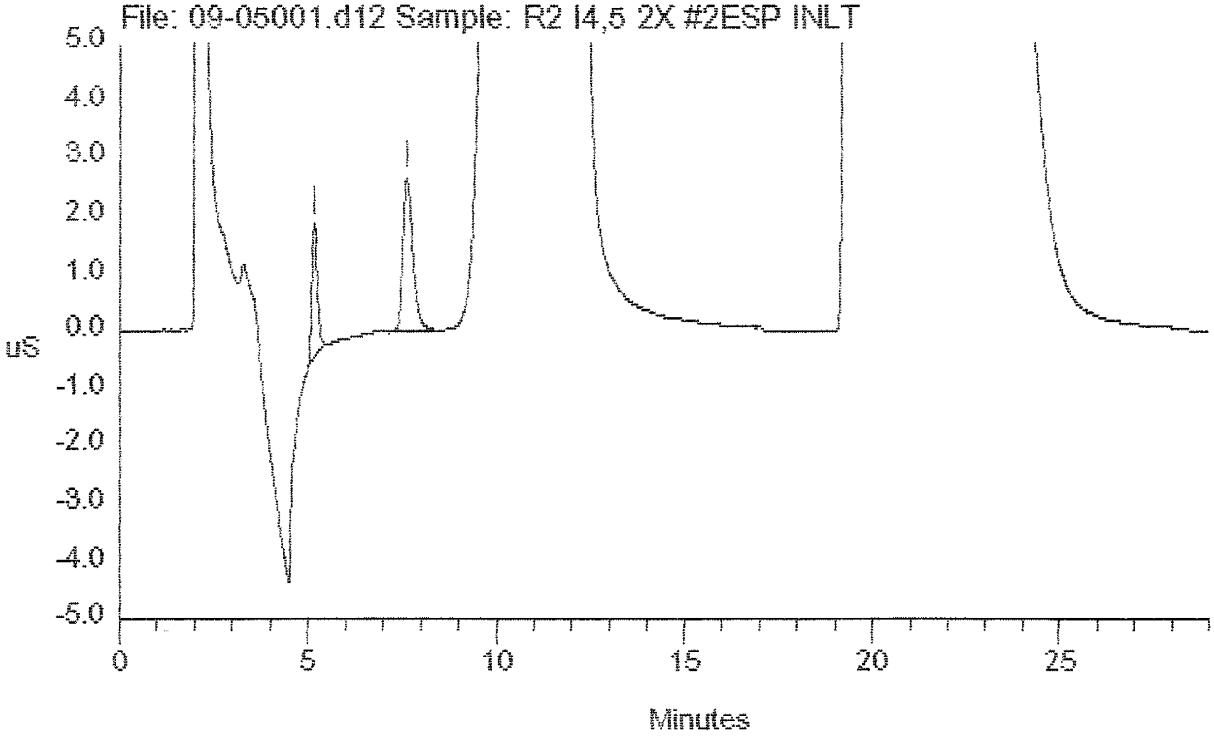
Data Reprocessed On 09/06/2005 07:15:55

```
==============================================================================
| Sample Name: R2 I4,5 2X #2ESP INLT          Date: 09/05/2005 15:13:26      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-05001.d12                       |
| Method     : C:\DX\METHOD\HCLLO2.MET                                       |
| ACI Address: 1  System: 1  Inject#: 12                  Detector:CDM-2     |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                 |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

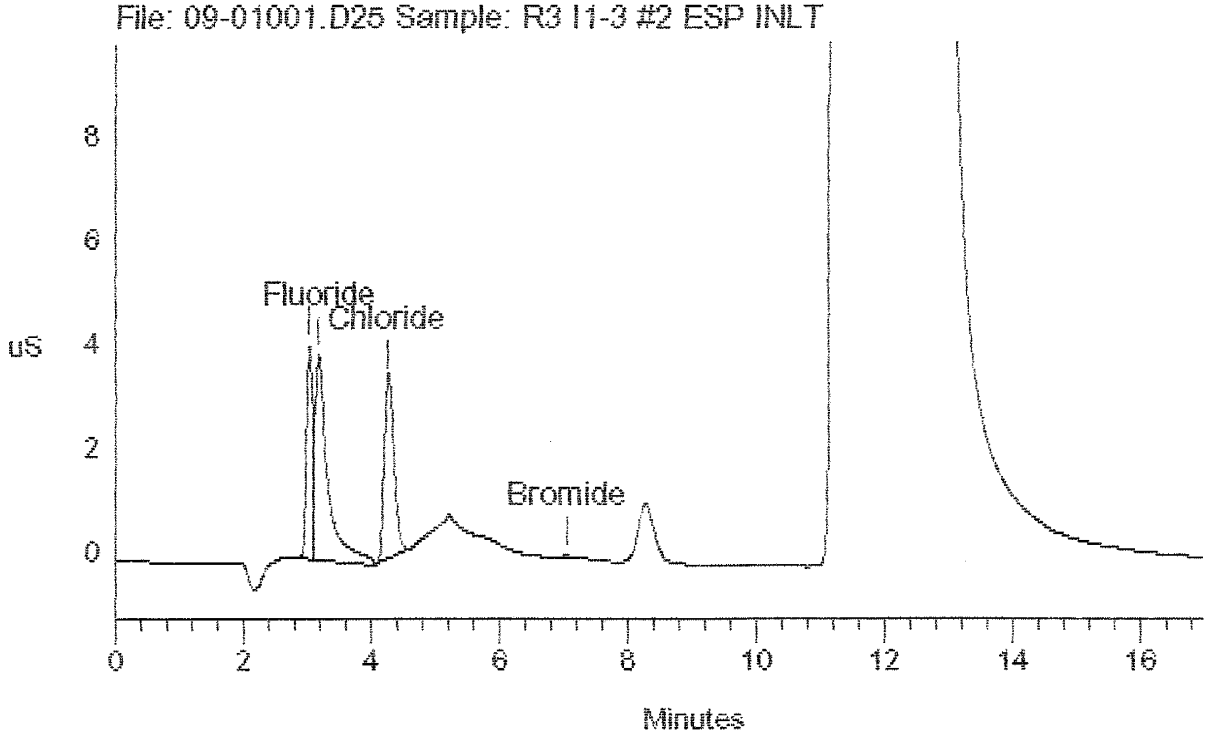
Data Reprocessed On 09/05/2005 13:30:48

Sample Name: R3 I1-3 #2 ESP INLT	Date: 09/01/2005 18:05:57
Data File : C:\DX\DATA\ANIONS\05-233T1\09-01001.D25	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 25	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.18	Fluoride	54694900	3905494	2.399
4.25	Chloride	35648538	3457500	2.438
7.04	Bromide	496920	40766	0.109
	Totals	90840358	7403760	4.945



METCO ENVIRONMENTAL

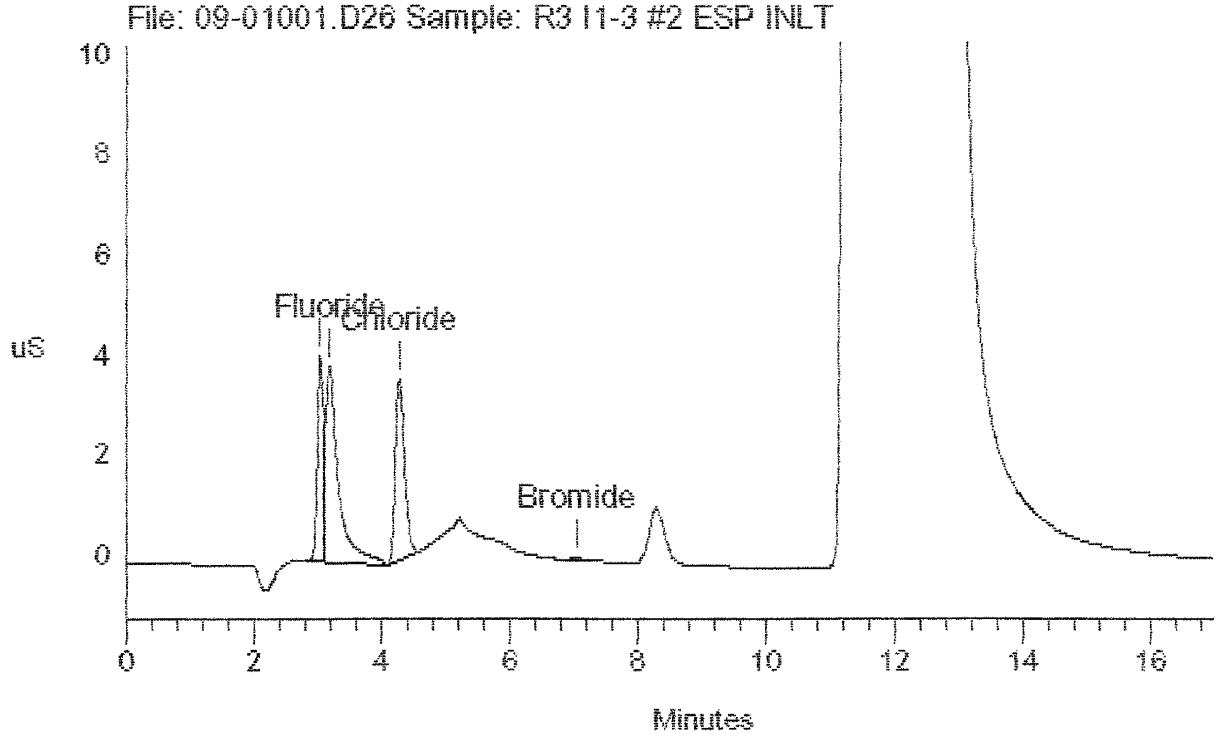
Data Reprocessed On 09/05/2005 13:31:00

Sample Name: R3 I1-3 #2 ESP INLT	Date: 09/01/2005 18:24:18
Data File : C:\DX\DATA\ANIONS\05-233T1\09-01001.D26	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 26	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	16.99	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.18	Fluoride	55188453	3901825	2.418
4.27	Chloride	35465302	3600663	2.426
7.04	Bromide	522020	44716	0.112
	Totals	91175775	7547204	4.957



METCO ENVIRONMENTAL

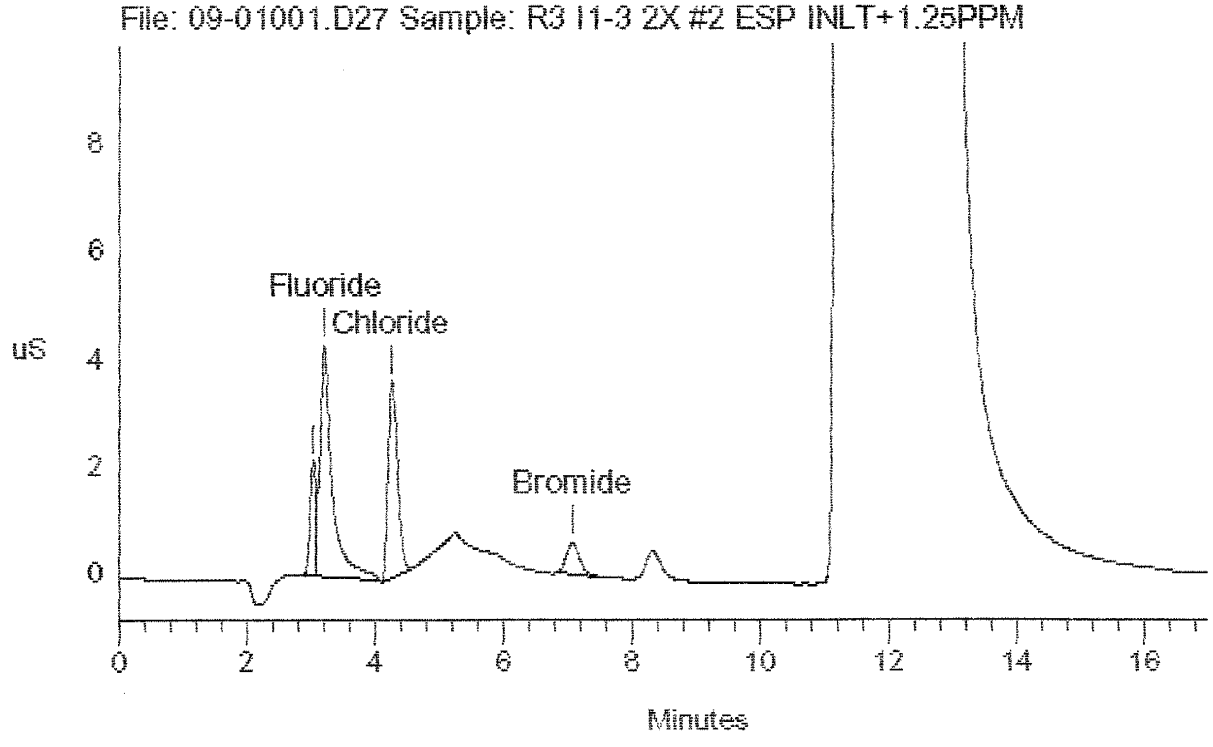
Data Reprocessed On 09/05/2005 13:31:15

```
==============================================================================
| Sample Name: R3 I1-3 2X #2 ESP INLT+1.25PPM Date: 09/01/2005 18:42:39      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D27                       |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 27                  Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.20	Fluoride	57009939	4293374	2.448
4.25	Chloride	36923892	3644407	2.375
7.07	Bromide	8867952	596651	1.301
	Totals	102801783	8534433	6.125



METCO ENVIRONMENTAL

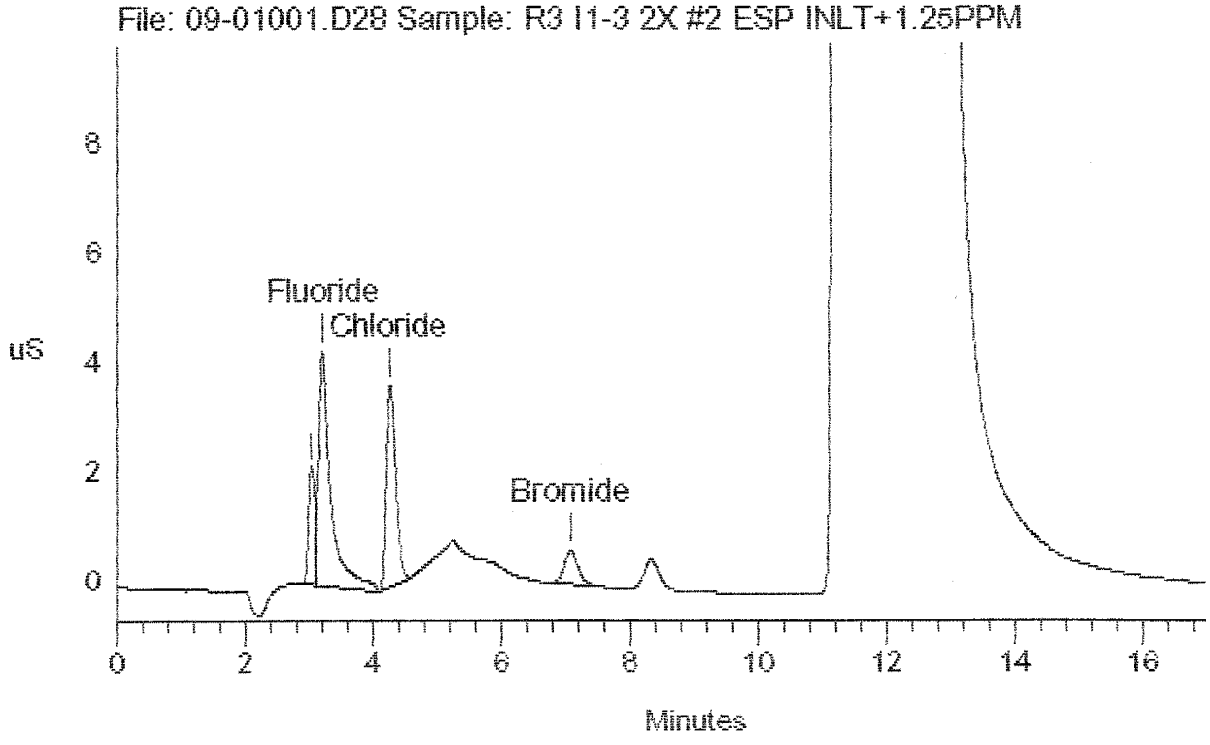
Data Reprocessed On 09/05/2005 13:31:27

```
==============================================================================
| Sample Name: R3 I1-3 2X #2 ESP INLT+1.25PPM Date: 09/01/2005 19:01:00      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D28                      |
| Method     : C:\DX\METHOD\HF2.MET                                         |
| ACI Address: 1  System: 1  Inject#: 28                  Detector:CDM-2     |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.20	Fluoride	57320690	4265958	2.460
4.25	Chloride	37329258	3668500	2.400
7.07	Bromide	8872360	599249	1.302
	Totals	103522308	8533707	6.161



METCO ENVIRONMENTAL

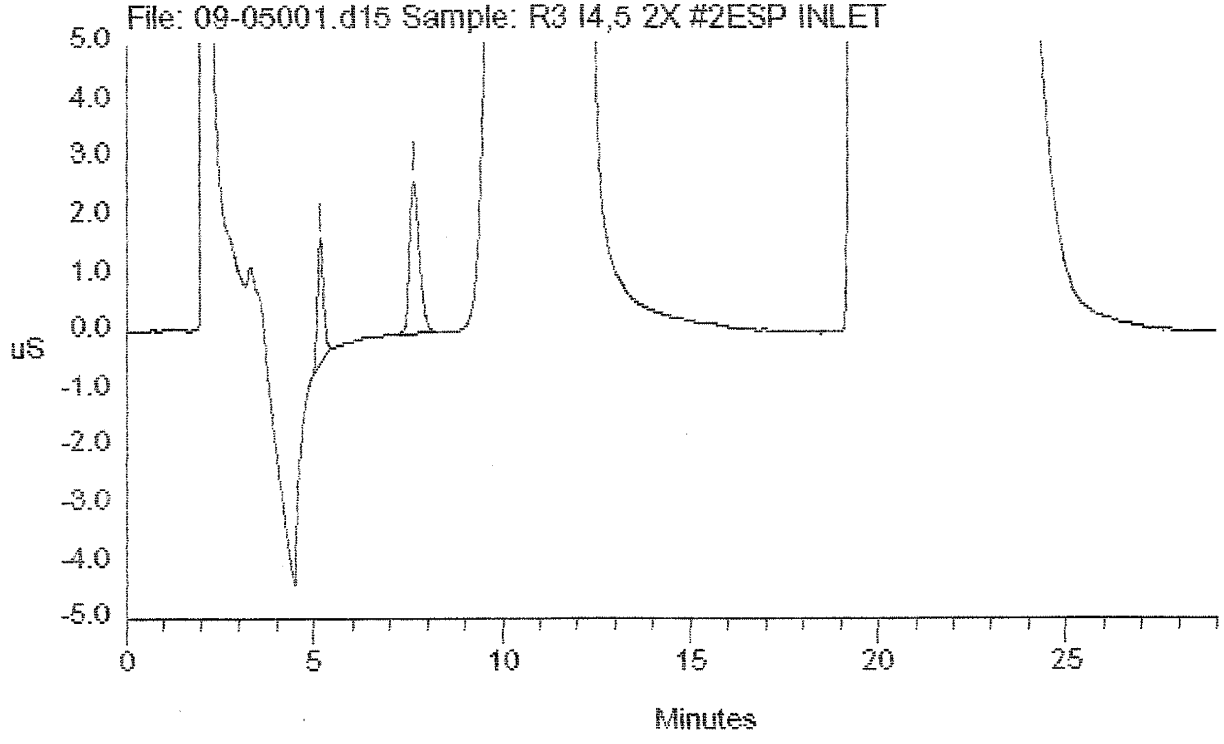
Data Reprocessed On 09/06/2005 07:15:56

```
==============================================================================
| Sample Name: R3 I4,5 2X #2ESP INLET          Date: 09/05/2005 16:44:29      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-05001.d15                       |
| Method     : C:\DX\METHOD\HCLLO2.MET                                       |
| ACI Address: 1  System: 1  Inject#: 15                  Detector:CDM-2     |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                 |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	29.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

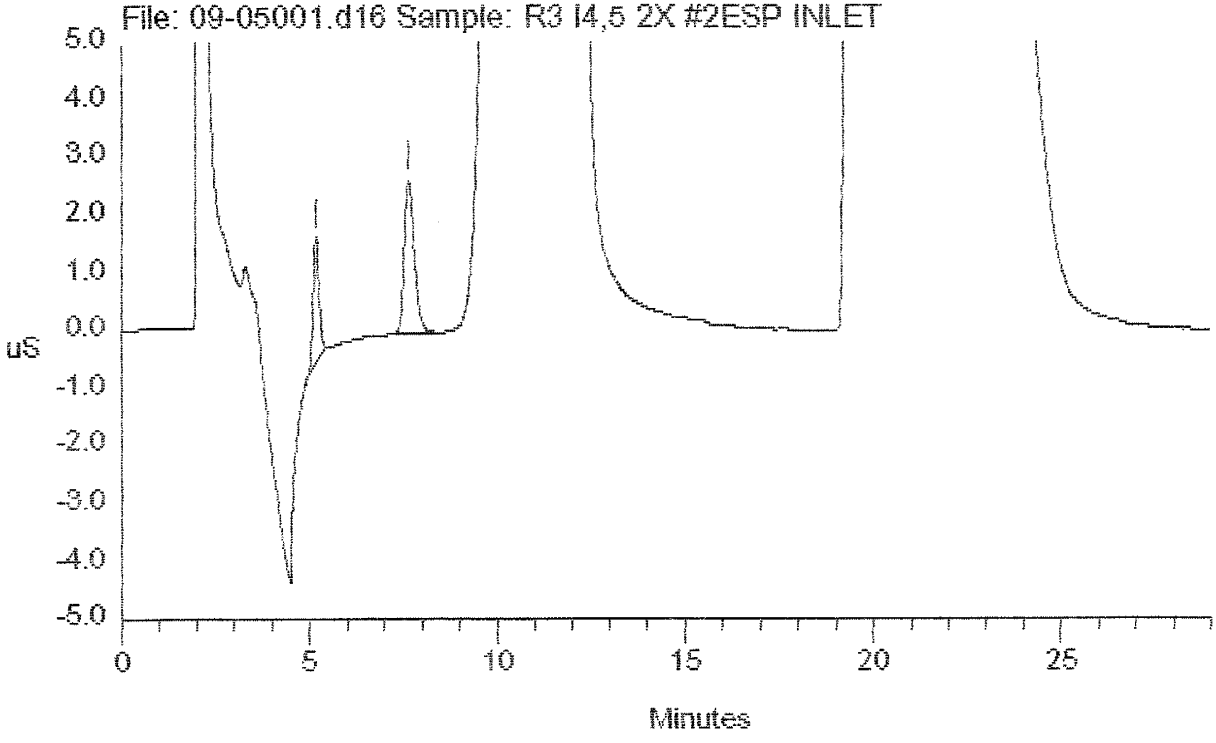
Data Reprocessed On 09/06/2005 07:15:57

Sample Name: R3 I4,5 2X #2ESP INLET	Date: 09/05/2005 17:14:50
Data File : C:\DX\DATA\ANIONS\05-233T1\09-05001.d16	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 16	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	29.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

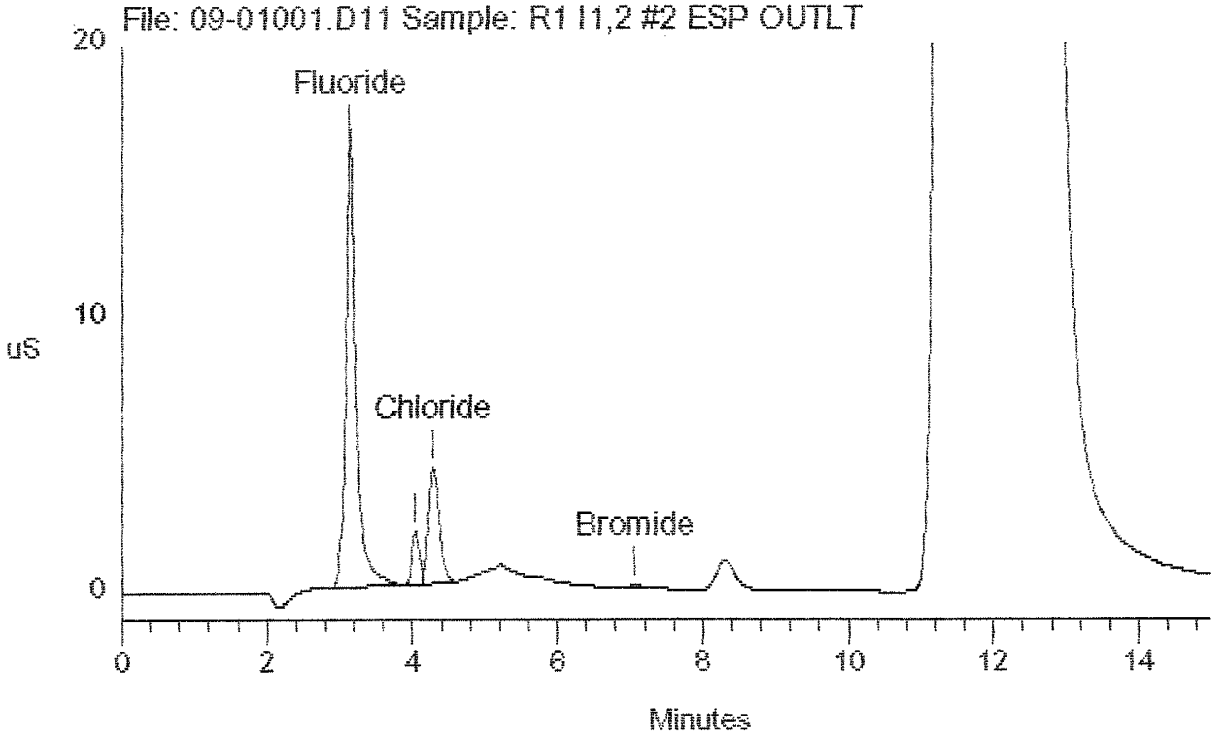
Data Reprocessed On 09/05/2005 12:28:29

```
================================================================================
| Sample Name: R1 I1,2 #2 ESP OUTLT          Date: 09/01/2005 13:08:26          |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D11                          |
| Method     : C:\DX\METHOD\HF2.MET                                             |
| ACI Address: 1  System: 1  Inject#: 11                  Detector:CDM-2        |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                   |
================================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	4500	5Hz	0.00	15.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.13	Fluoride	164236000	16183250	6.402
4.28	Chloride	44211046	4194760	2.815
7.07	Bromide	1061940	80232	0.246
	Totals	209508986	20458242	9.462



METCO ENVIRONMENTAL

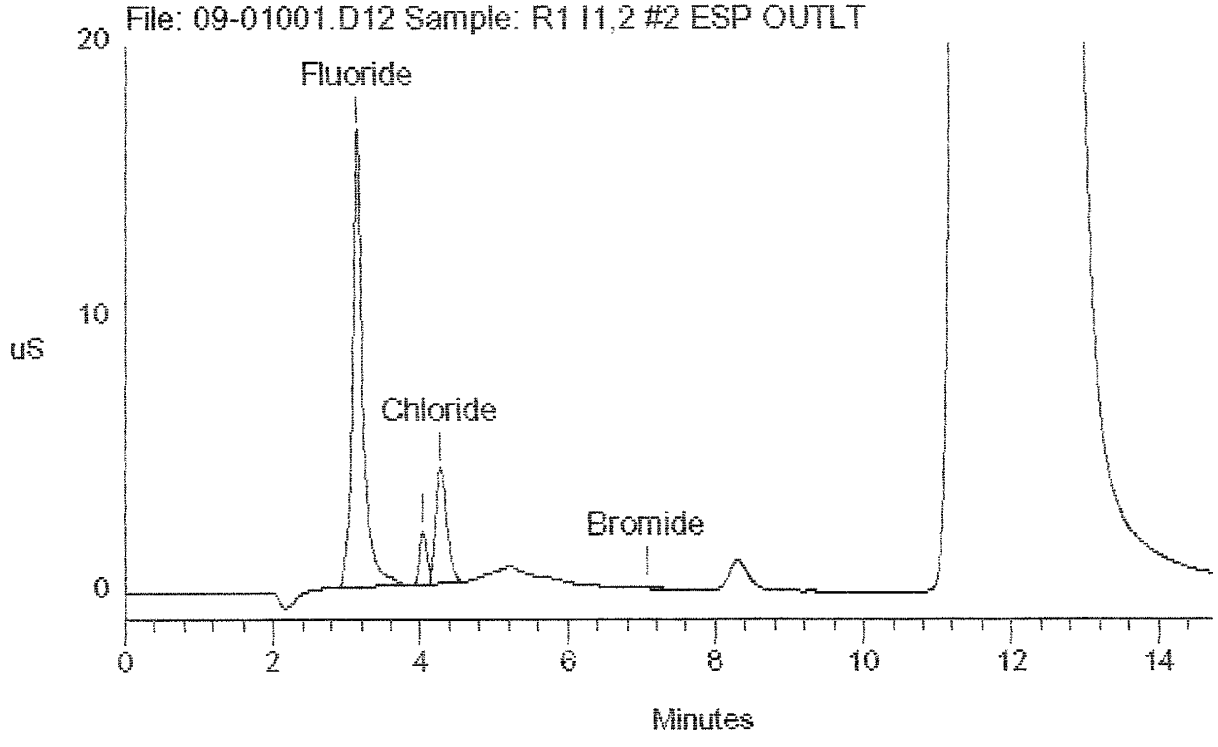
Data Reprocessed On 09/05/2005 12:28:40

```
================================================================================
| Sample Name: R1 I1,2 #2 ESP OUTLT          Date: 09/01/2005 13:45:14          |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D12                          |
| Method     : C:\DX\METHOD\HF2.MET                                             |
| ACI Address: 1  System: 1  Inject#: 12                  Detector:CDM-2        |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                   |
================================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	4425	5Hz	0.00	14.75		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.13	Fluoride	161525100	16559800	6.302
4.27	Chloride	43364129	4133290	2.764
7.07	Bromide	1070160	77146	0.247
	Totals	205959389	20770236	9.313



METCO ENVIRONMENTAL

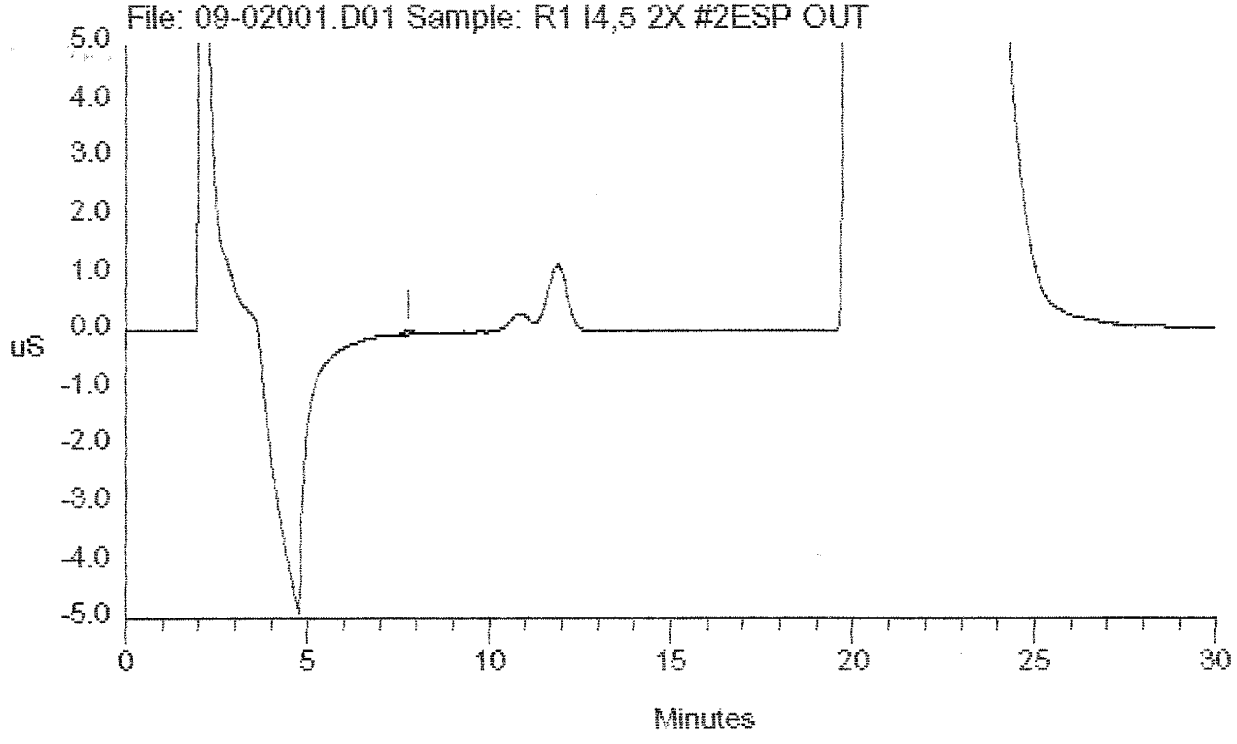
Data Reprocessed On 09/05/2005 13:34:49

```
==============================================================================
| Sample Name: R1 I4,5 2X #2ESP OUT          Date: 09/02/2005 09:19:09        |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-02001.D01                        |
| Method     : C:\DX\METHOD\HCLLO2.MET                                        |
| ACI Address: 1  System: 1  Inject#: 1                   Detector:CDM-2      |
| Analyst    :                Column: AS14,4mm, STD 1-12-01                   |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	9000	5Hz	0.00	30.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

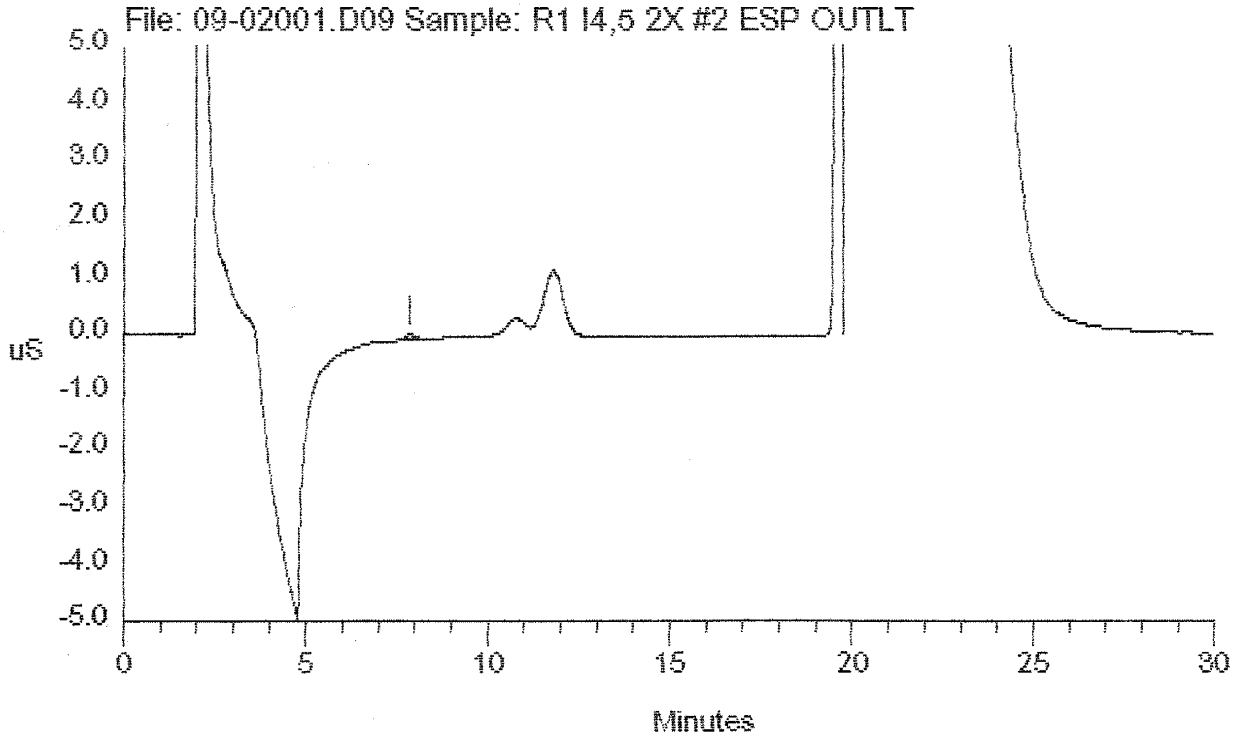
Data Reprocessed On 09/05/2005 13:35:01

Sample Name: R1 I4,5 2X #2 ESP OUTLT	Date: 09/02/2005 13:39:22
Data File : C:\DX\DATA\ANIONS\05-233T1\09-02001.D09	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 9	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	9000	5Hz	0.00	30.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

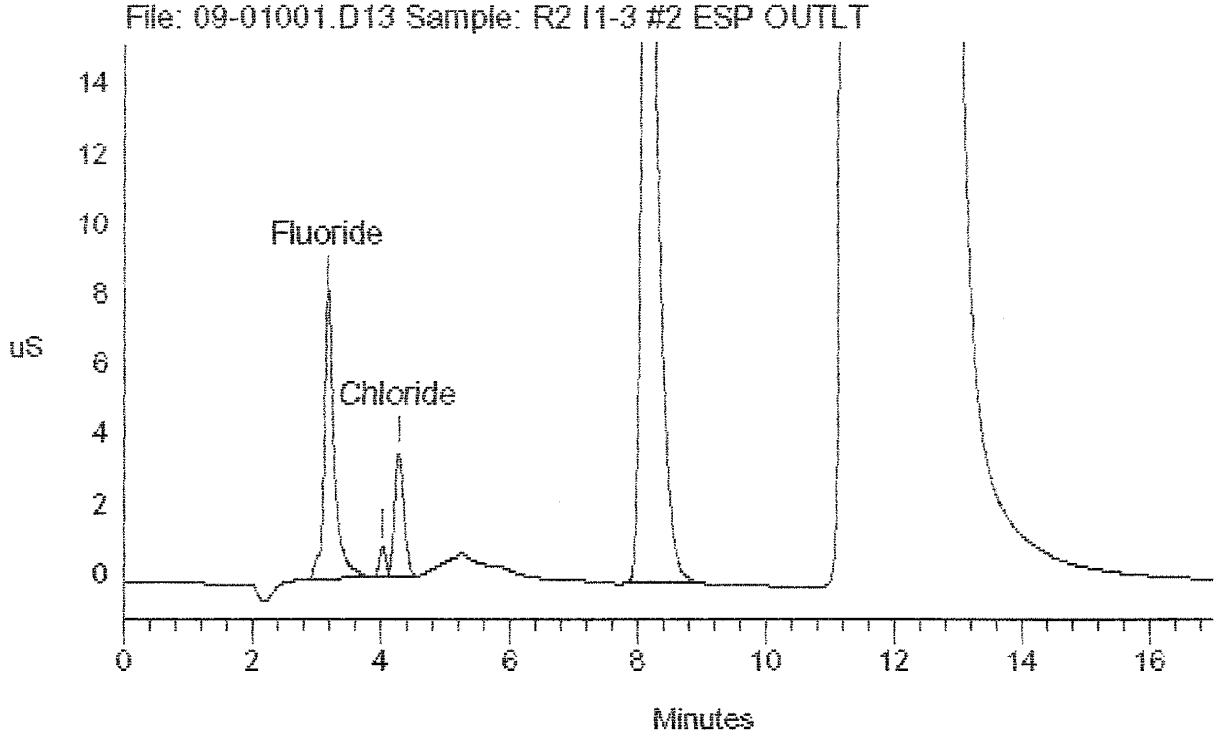
Data Reprocessed On 09/05/2005 13:28:41

```
==============================================================================
| Sample Name: R2 I1-3 #2 ESP OUTLT          Date: 09/01/2005 14:04:44       |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D13                       |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 13                  Detector:CDM-2     |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.17	Fluoride	89153656	8144713	3.554
4.27	Chloride	34852830	3523845	2.404
	Totals	124006486	11668557	5.958



METCO ENVIRONMENTAL

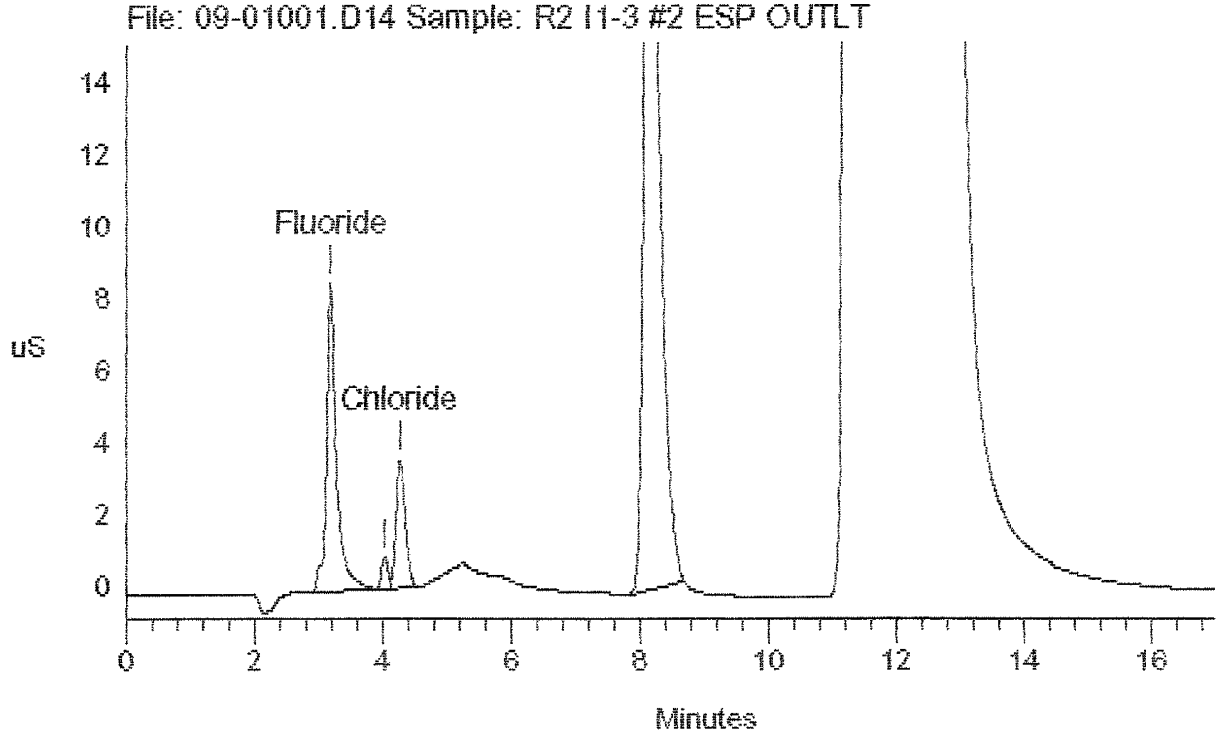
Data Reprocessed On 09/05/2005 13:28:51

```
==============================================================================
| Sample Name: R2 I1-3 #2 ESP OUTLT          Date: 09/01/2005 14:23:05        |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D14                        |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 14                  Detector:CDM-2      |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                 |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.18	Fluoride	90407622	8508186	3.680
4.27	Chloride	35108109	3531294	2.266
	Totals	125515731	12039480	5.945



METCO ENVIRONMENTAL

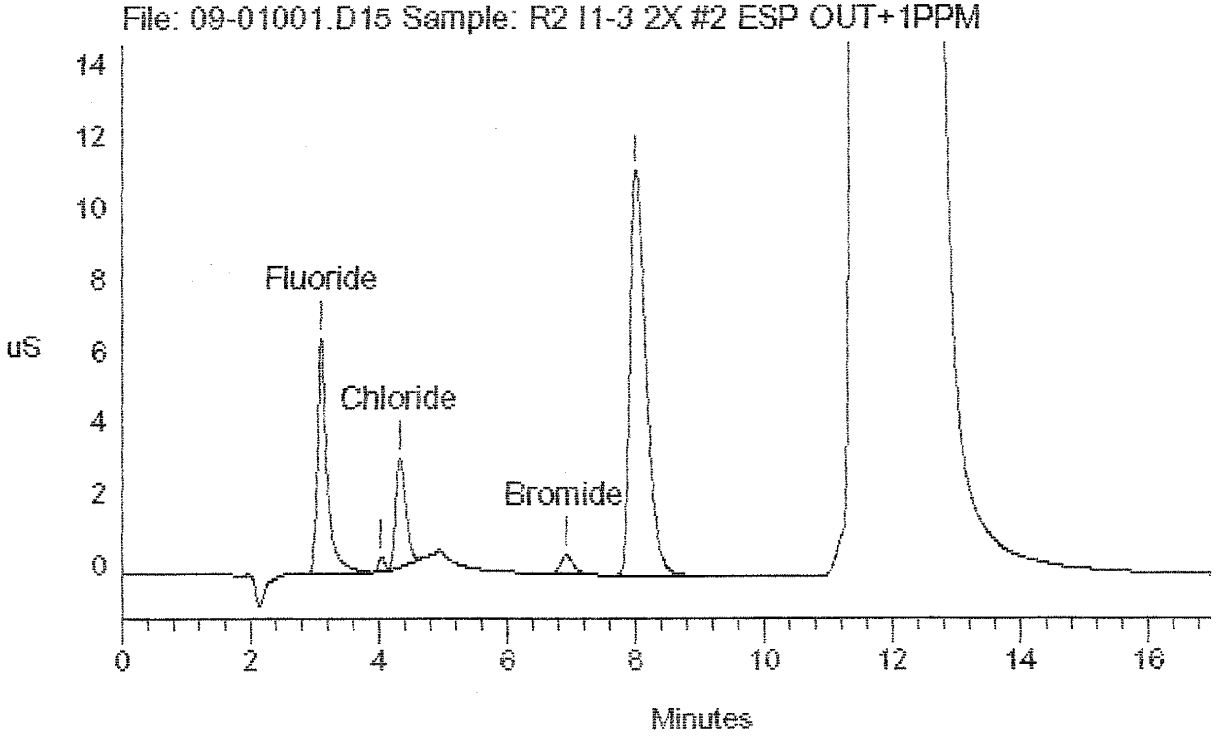
Data Reprocessed On 09/05/2005 13:29:05

```
==============================================================================
| Sample Name: R2 I1-3 2X #2 ESP OUT+1PPM     Date: 09/01/2005 14:41:26        |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D15                        |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 15                  Detector:CDM-2      |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                 |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.10	Fluoride	68604412	6571801	2.876
4.32	Chloride	32776387	2977669	2.125
6.92	Bromide	6947440	523008	1.042
	Totals	108328239	10072477	6.043



METCO ENVIRONMENTAL

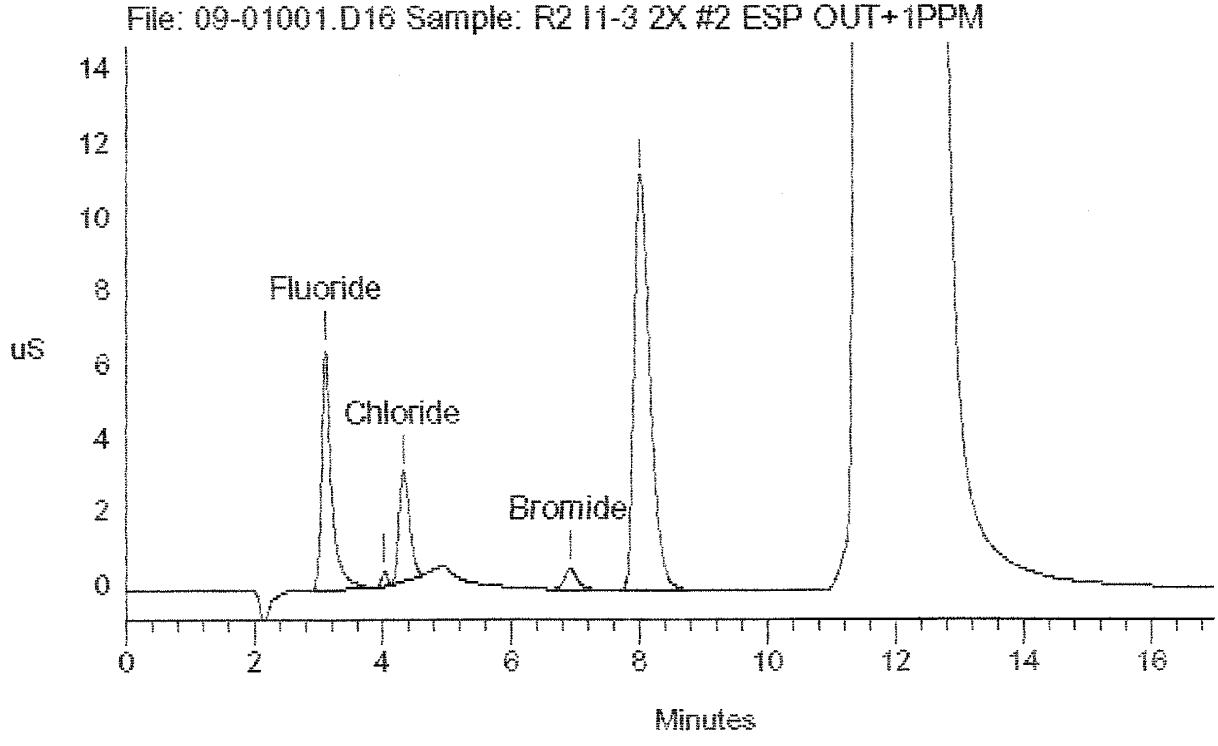
Data Reprocessed On 09/05/2005 13:29:18

```
==============================================================================
| Sample Name: R2 I1-3 2X #2 ESP OUT+1PPM     Date: 09/01/2005 14:59:47      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D16                      |
| Method     : C:\DX\METHOD\HF2.MET                                         |
| ACI Address: 1  System: 1  Inject#: 16                  Detector:CDM-2    |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05              |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.10	Fluoride	69110576	6526973	2.894
4.32	Chloride	33282500	2956451	2.156
6.92	Bromide	7081514	532355	1.060
	Totals	109474590	10015780	6.110



METCO ENVIRONMENTAL

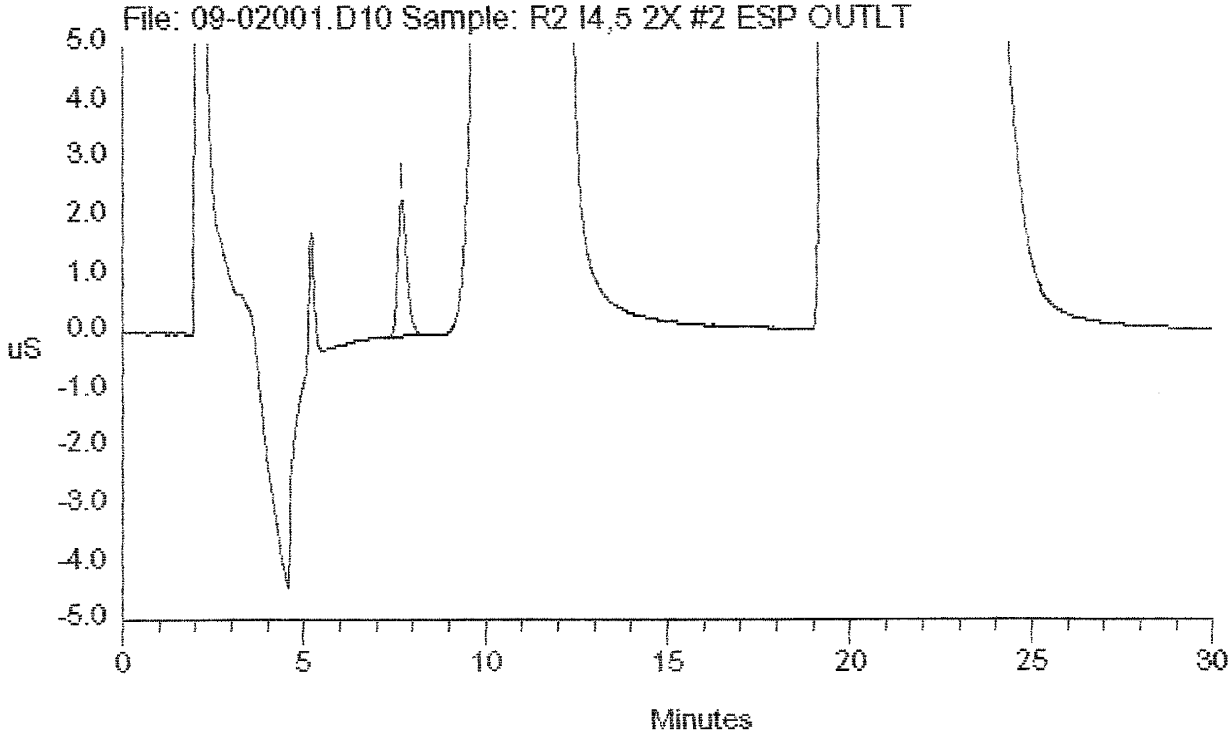
Data Reprocessed On 09/05/2005 13:35:26

Sample Name: R2 I4,5 2X #2 ESP OUTLT	Date: 09/02/2005 14:10:41
Data File : C:\DX\DATA\ANIONS\05-233T1\09-02001.D10	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 10	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	9000	5Hz	0.00	30.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

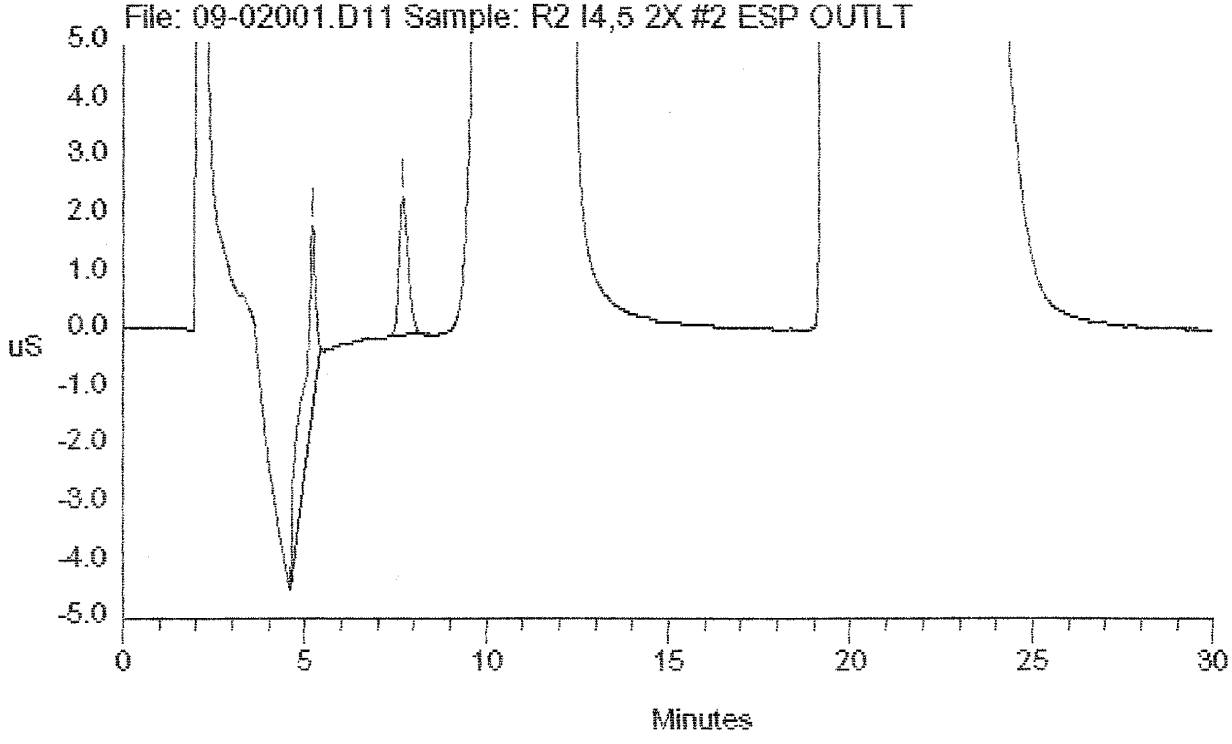
Data Reprocessed On 09/05/2005 13:36:02

```
==============================================================================
| Sample Name: R2 I4,5 2X #2 ESP OUTLT        Date: 09/02/2005 14:42:05      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-02001.D11                       |
| Method     : C:\DX\METHOD\HCLLO2.MET                                       |
| ACI Address: 1  System: 1  Inject#: 11                  Detector:CDM-2     |
| Analyst    :                Column: AS14,4mm, STD 1-12-01                  |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	9000	5Hz	0.00	30.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

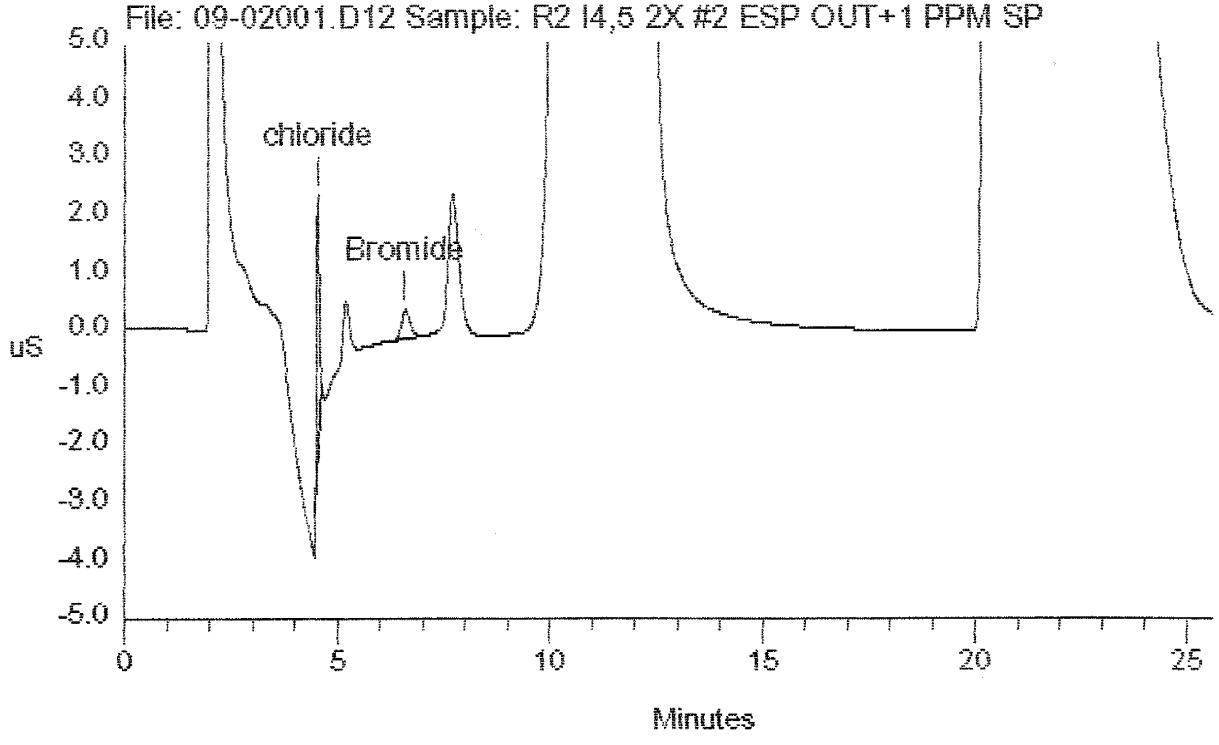
Data Reprocessed On 09/05/2005 13:36:20

```
==============================================================================
| Sample Name: R2 I4,5 2X #2 ESP OUT+1 PPM SP Date: 09/02/2005 15:09:11      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-02001.D12                      |
| Method     : C:\DX\METHOD\HCLLO2.MET                                      |
| ACI Address: 1  System: 1  Inject#: 12                  Detector:CDM-2     |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	7696	5Hz	0.00	25.65		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.55	chloride	19411962	4779920	1.080
6.58	Bromide	7346202	500713	0.979
	Totals	26758164	5280632	2.058



METCO ENVIRONMENTAL

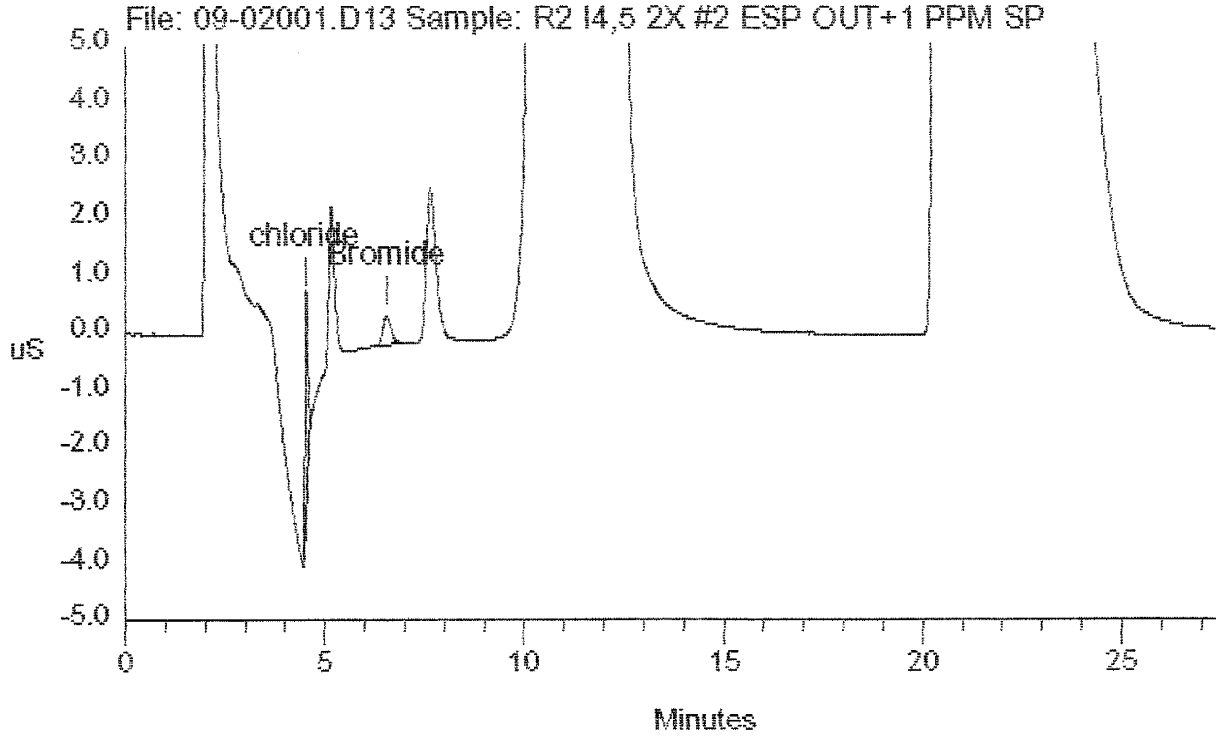
Data Reprocessed On 09/05/2005 13:36:31

```
==============================================================================
| Sample Name: R2 I4,5 2X #2 ESP OUT+1 PPM SP Date: 09/02/2005 15:38:01      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-02001.D13                      |
| Method     : C:\DX\METHOD\HCLLO2.MET                                      |
| ACI Address: 1  System: 1  Inject#: 13                  Detector:CDM-2     |
| Analyst    :                Column: AS14,4mm, STD 1-12-01                 |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8217	5Hz	0.00	27.39		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.52	chloride	17906028	3783980	1.007
6.55	Bromide	7689450	518244	1.024
	Totals	25595478	4302224	2.031



METCO ENVIRONMENTAL

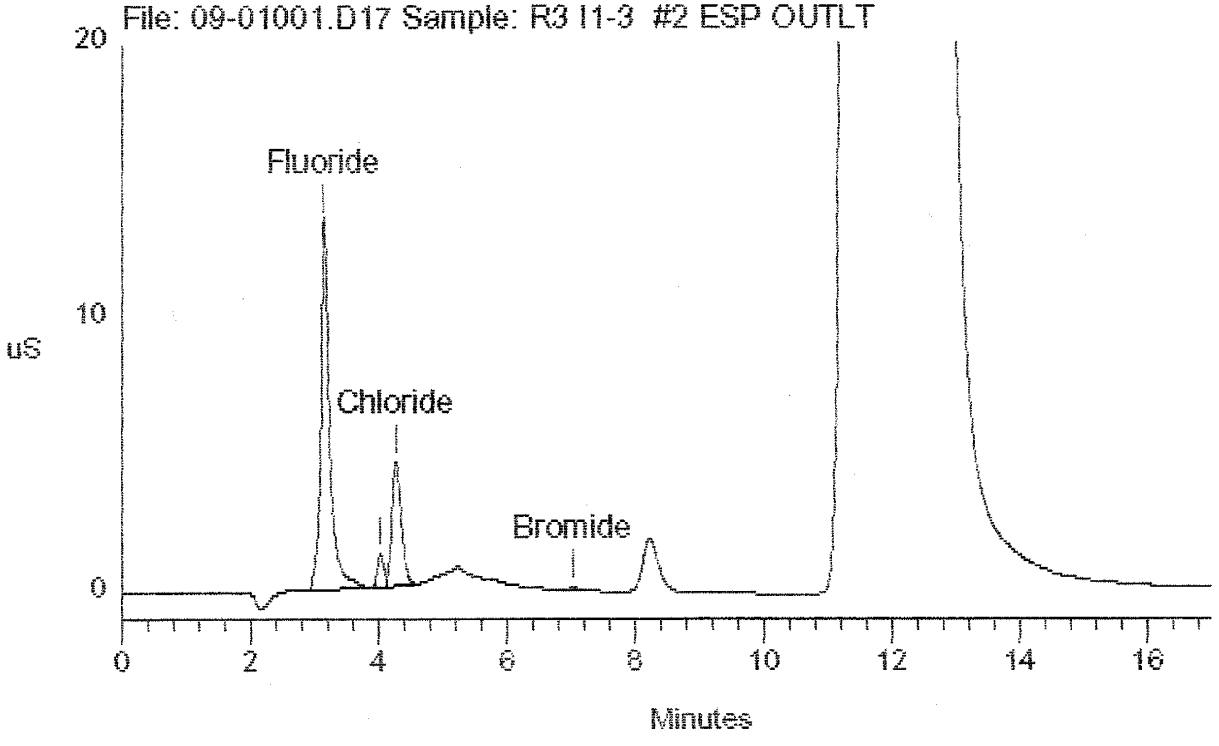
Data Reprocessed On 09/05/2005 13:29:28

```
==============================================================================
| Sample Name: R3 I1-3  #2 ESP OUTLT          Date: 09/01/2005 15:18:08      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D17                       |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 17                  Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	5100	5Hz	0.00	17.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.13	Fluoride	132517754	13318783	5.232
4.27	Chloride	46382946	4502692	2.946
7.02	Bromide	726418	59102	0.201
	Totals	179627118	17880577	8.379



METCO ENVIRONMENTAL

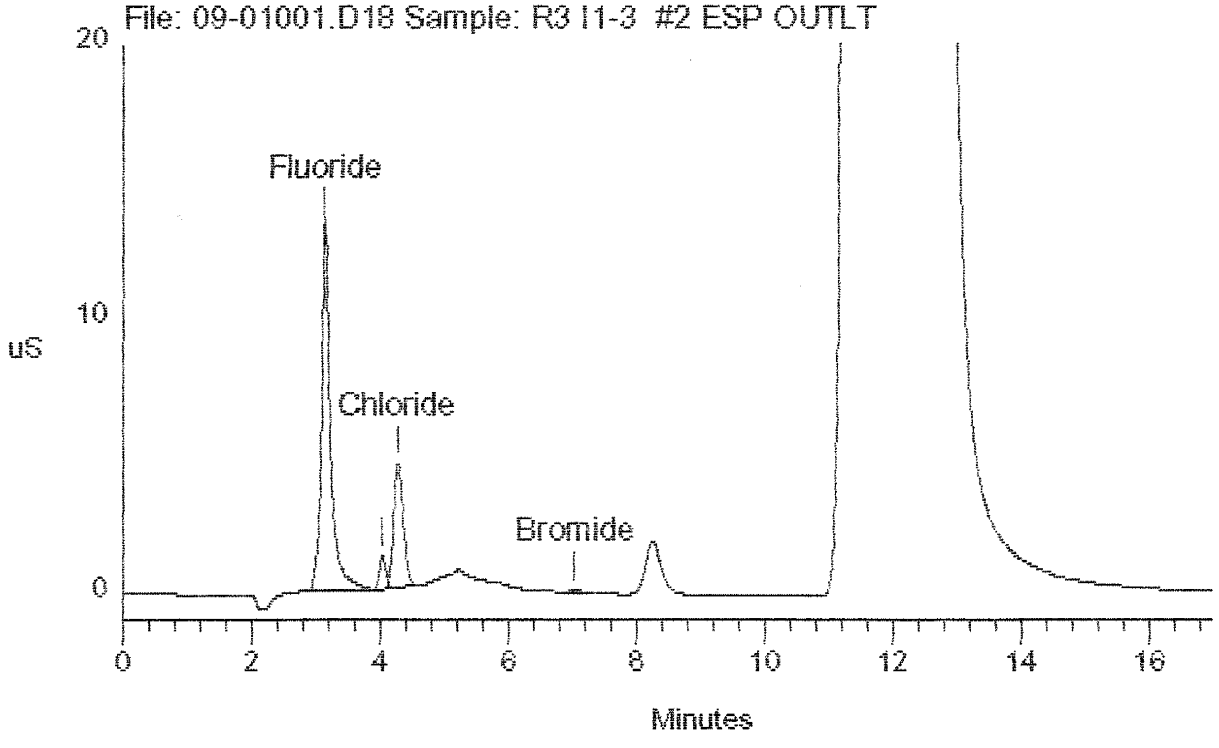
Data Reprocessed On 09/05/2005 13:29:38

```
==============================================================================
| Sample Name: R3 I1-3  #2 ESP OUTLT          Date: 09/01/2005 15:36:27      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D18                       |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 18                  Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.13	Fluoride	132647336	13282185	5.237
4.27	Chloride	46752708	4487341	2.968
7.03	Bromide	717624	60249	0.200
	Totals	180117668	17829775	8.405



METCO ENVIRONMENTAL

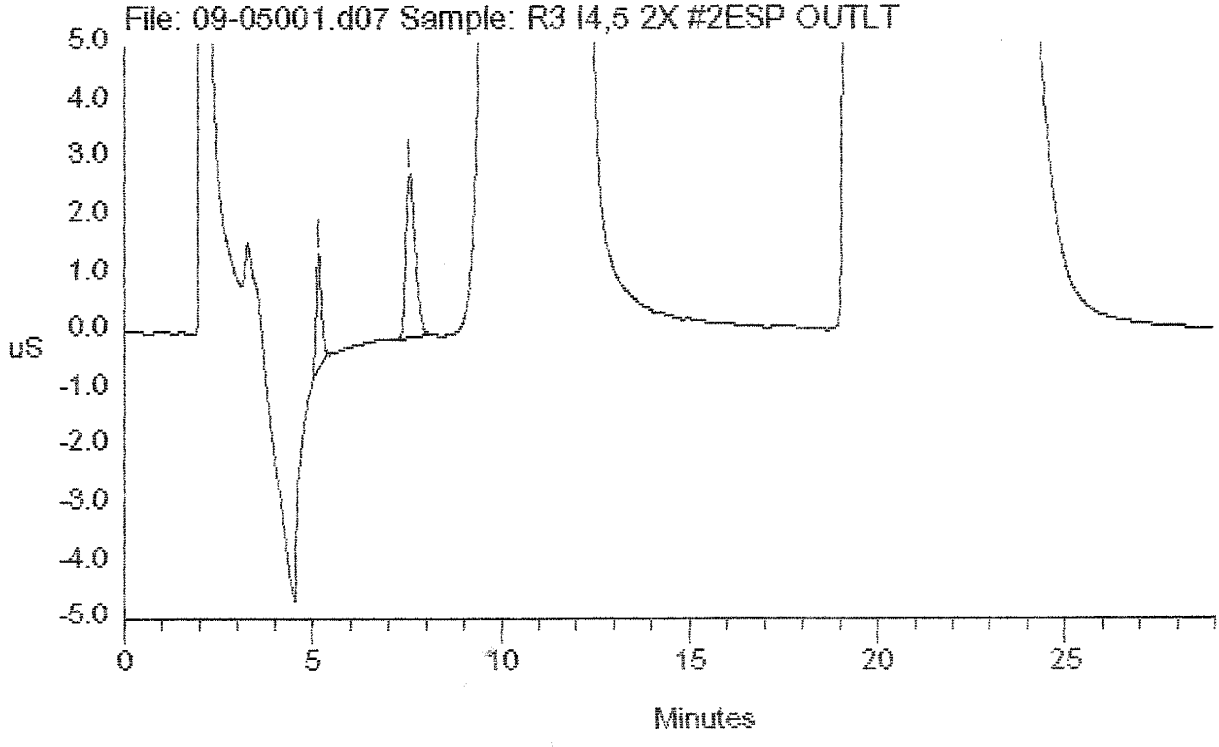
Data Reprocessed On 09/06/2005 07:15:50

```
==============================================================================
| Sample Name: R3 I4,5 2X #2ESP OUTLT          Date: 09/05/2005 12:41:41      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-05001.d07                        |
| Method     : C:\DX\METHOD\HCLLO2.MET                                        |
| ACI Address: 1  System: 1  Inject#: 7                    Detector:CDM-2     |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                  |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	29.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

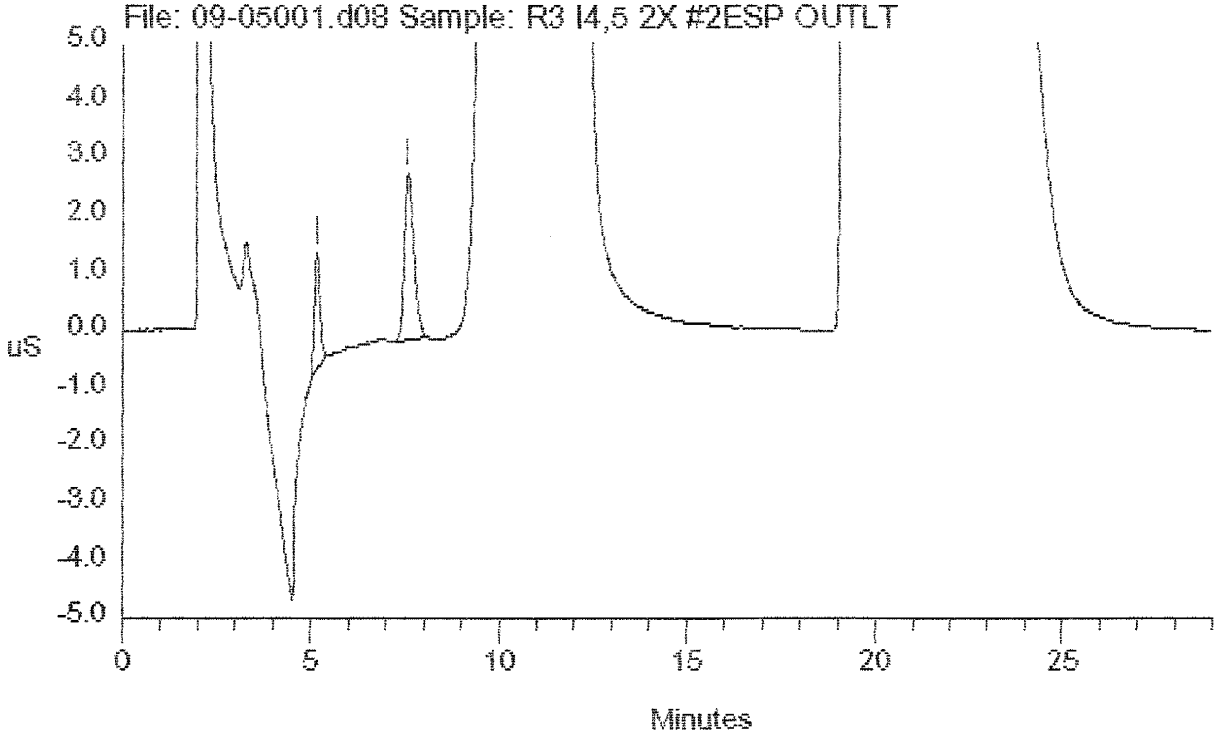
Data Reprocessed On 09/06/2005 07:15:51

```
================================================================================
| Sample Name: R3 I4,5 2X #2ESP OUTLT          Date: 09/05/2005 13:12:02        |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-05001.d08                          |
| Method     : C:\DX\METHOD\HCLLO2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 8                    Detector:CDM-2       |
| Analyst    :                  Column: AS14,4mm, STD 1-12-01                   |
================================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

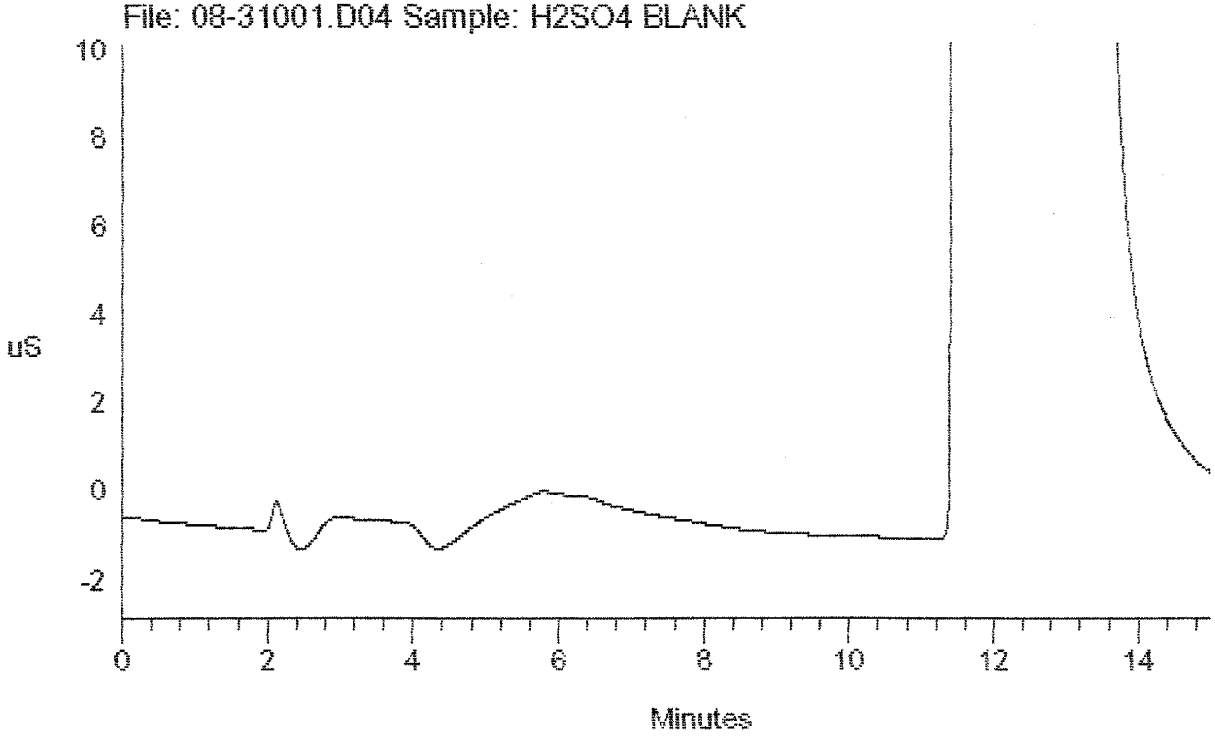
Data Reprocessed On 09/05/2005 12:18:13

```
==============================================================================
| Sample Name: H2SO4 BLANK                    Date: 08/31/2005 14:56:31       |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\08-31001.D04                        |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 4                   Detector:CDM-2      |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	4500	5Hz	0.00	15.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

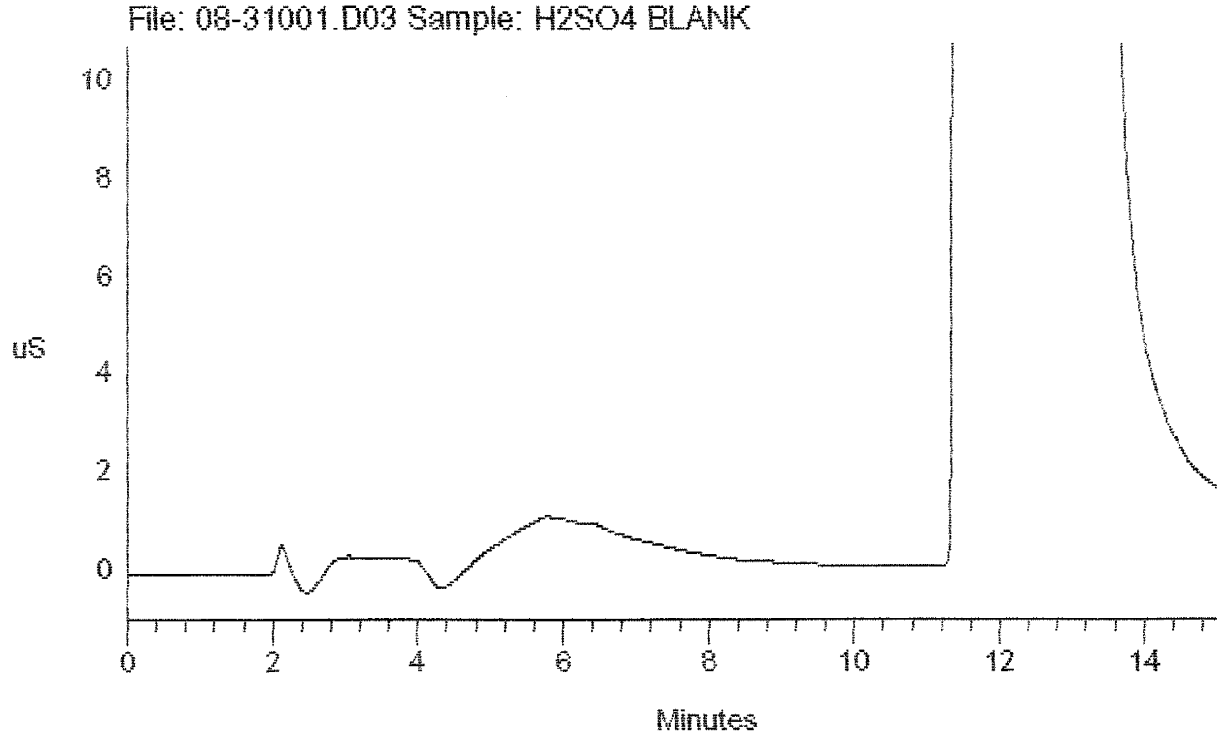
Data Reprocessed On 09/05/2005 12:18:01

```
==============================================================================
| Sample Name: H2SO4 BLANK                    Date: 08/31/2005 14:40:09       |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\08-31001.D03                        |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 3                   Detector:CDM-2      |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	4500	5Hz	0.00	15.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

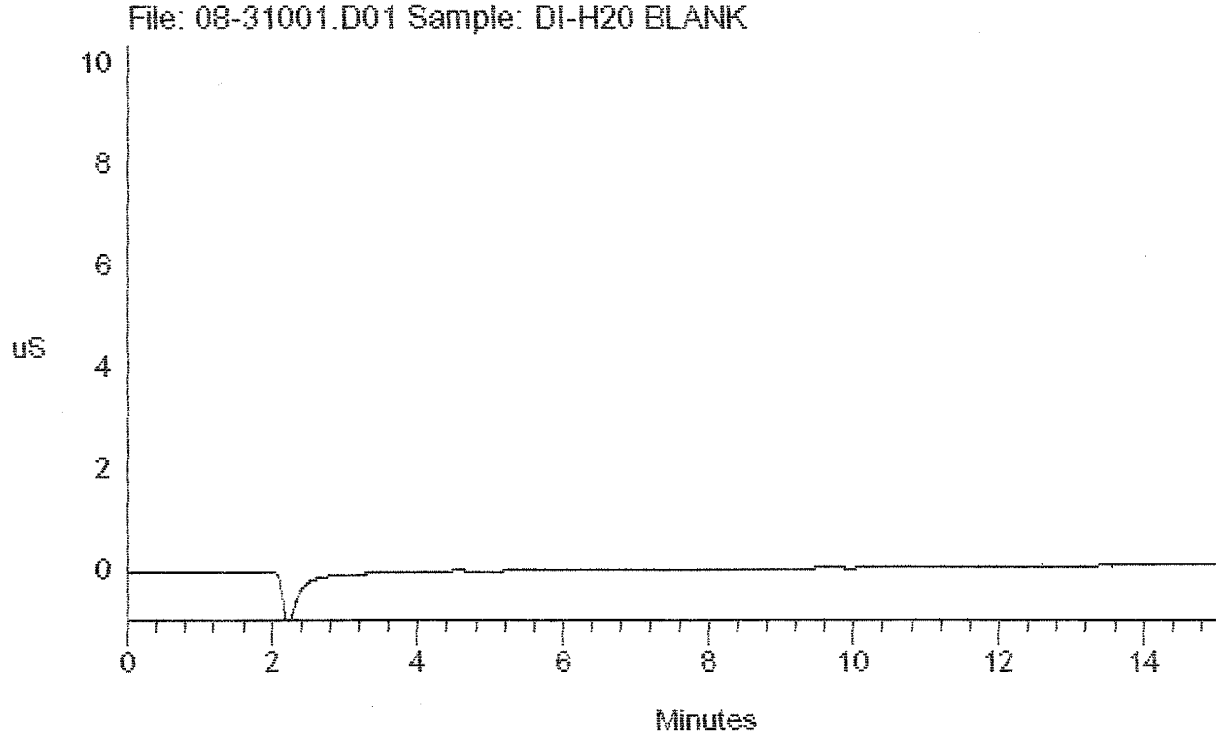
Data Reprocessed On 09/05/2005 12:17:35

```
==============================================================================
| Sample Name: DI-H20 BLANK                    Date: 08/31/2005 14:07:25      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\08-31001.D01                        |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 1                    Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	4500	5Hz	0.00	15.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

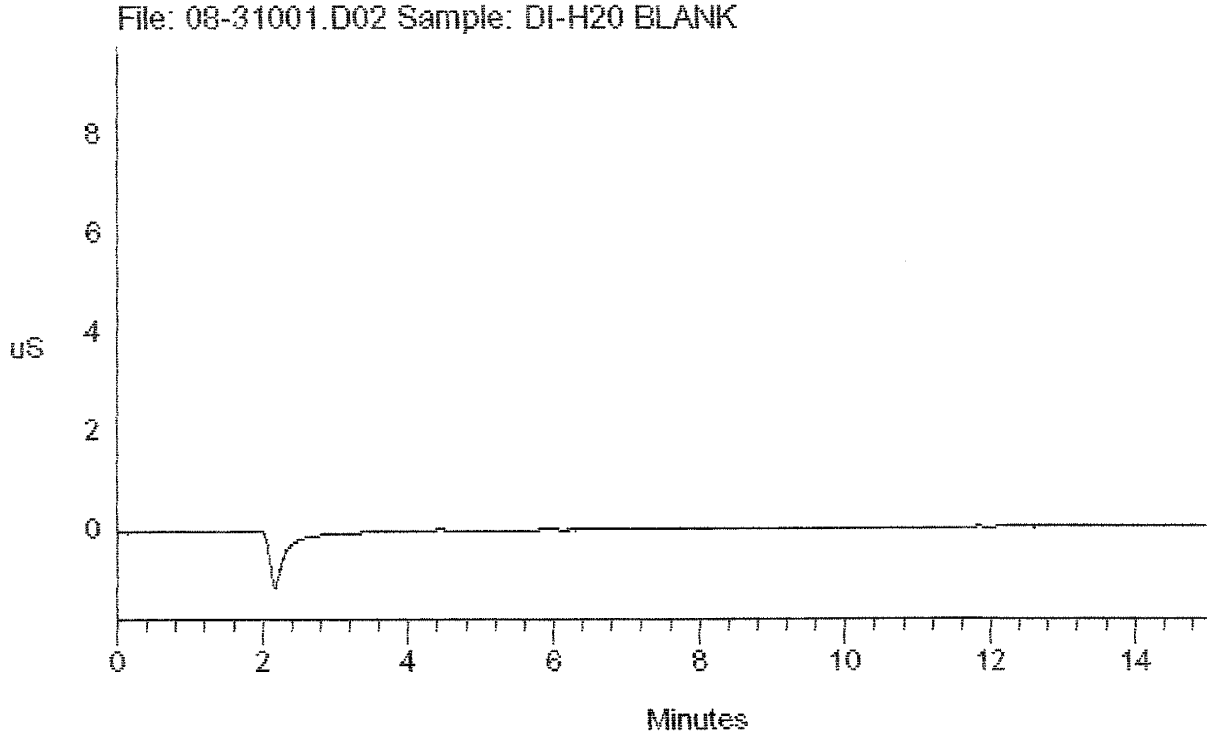
Data Reprocessed On 09/05/2005 12:17:48

Sample Name: DI-H20 BLANK	Date: 08/31/2005 14:23:47
Data File : C:\DX\DATA\ANIONS\05-233T1\08-31001.D02	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 2	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	4500	5Hz	0.00	15.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

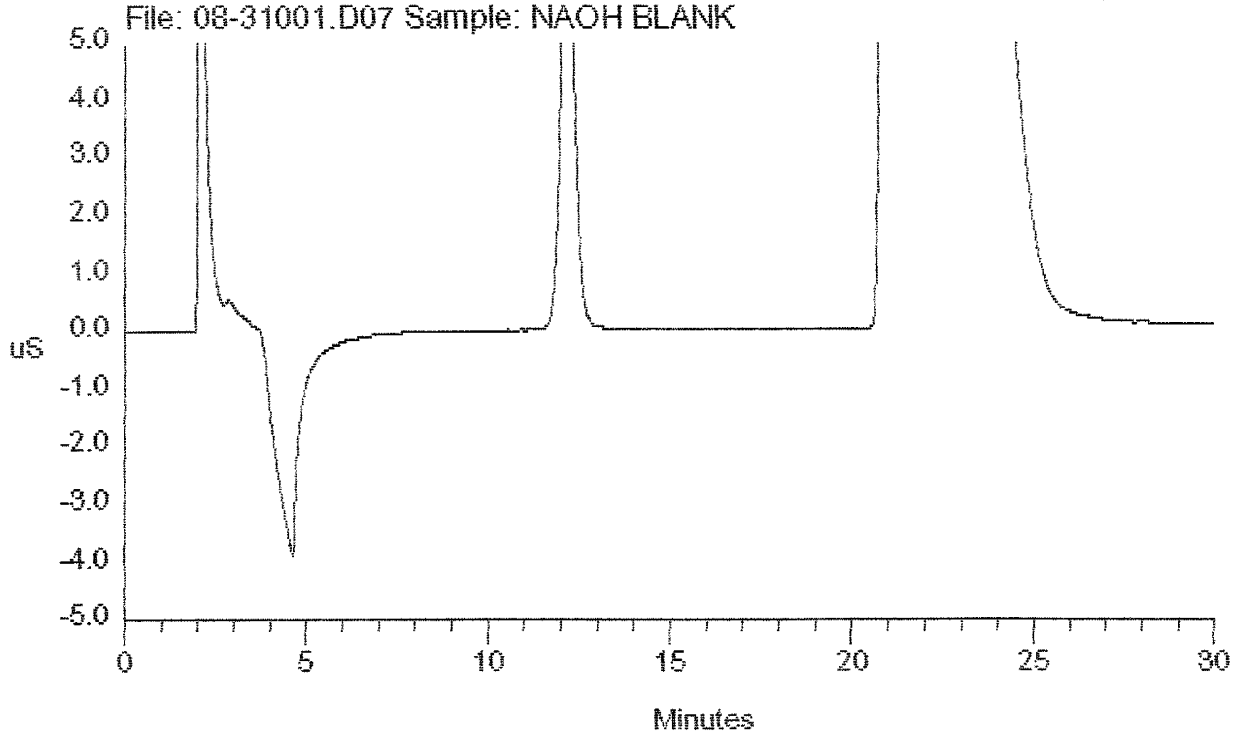
Data Reprocessed On 09/05/2005 12:18:46

Sample Name: NAOH BLANK	Date: 08/31/2005 16:30:57
Data File : C:\DX\DATA\ANIONS\05-233T1\08-31001.D07	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 7	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	9000	5Hz	0.00	30.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

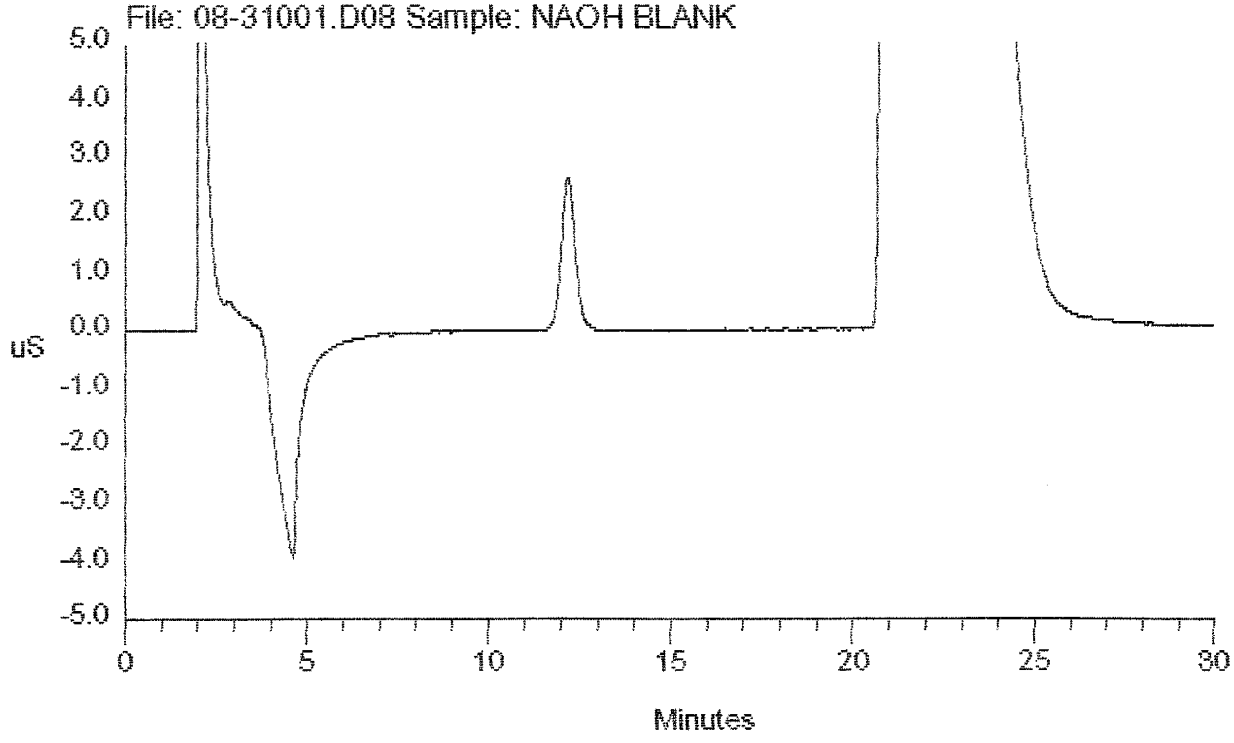
Data Reprocessed On 09/05/2005 12:18:56

Sample Name: NAOH BLANK	Date: 08/31/2005 17:02:21
Data File : C:\DX\DATA\ANIONS\05-233T1\08-31001.D08	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 8	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	9000	5Hz	0.00	30.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

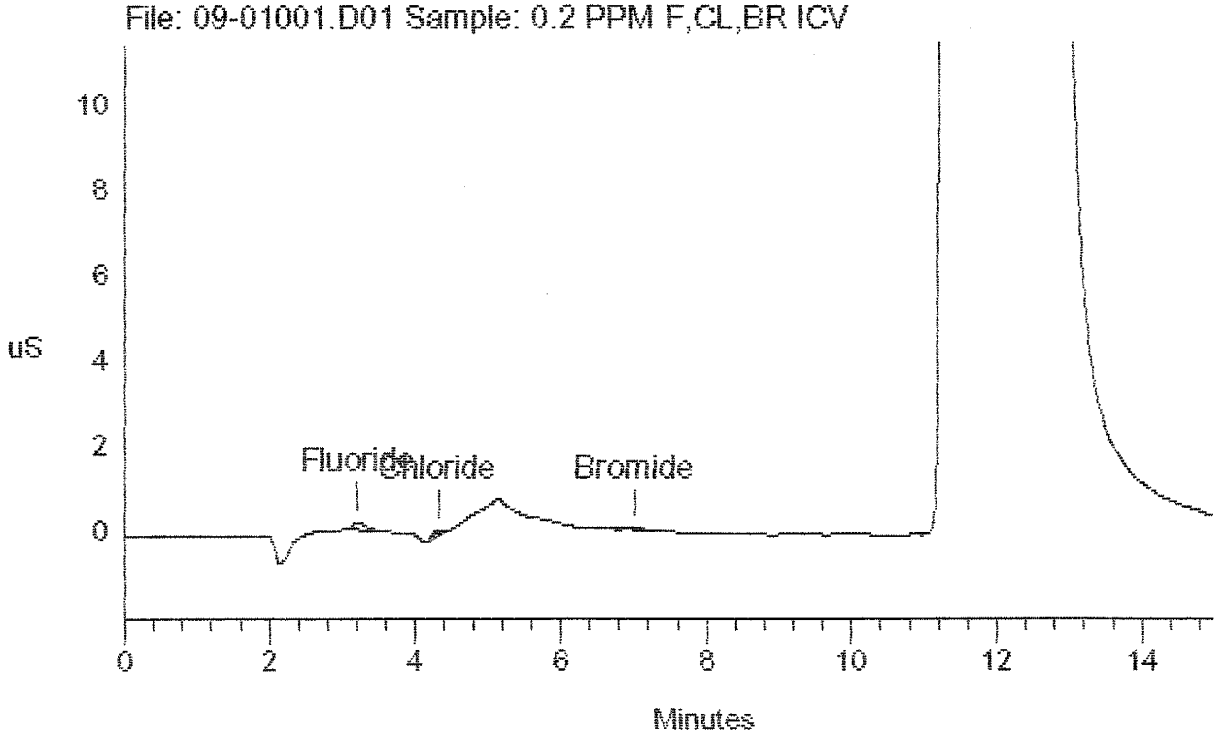
Data Reprocessed On 09/05/2005 12:20:55

Sample Name: 0.2 PPM F,CL,BR ICV	Date: 09/01/2005 07:19:17
Data File : C:\DX\DATA\ANIONS\05-233T1\09-01001.D01	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 1	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	4500	5Hz	0.00	15.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.20	Fluoride	1811820	165097	0.212
4.32	Chloride	794540	104839	0.199
7.02	Bromide	1021780	73200	0.186
	Totals	3628140	343136	0.598



METCO ENVIRONMENTAL

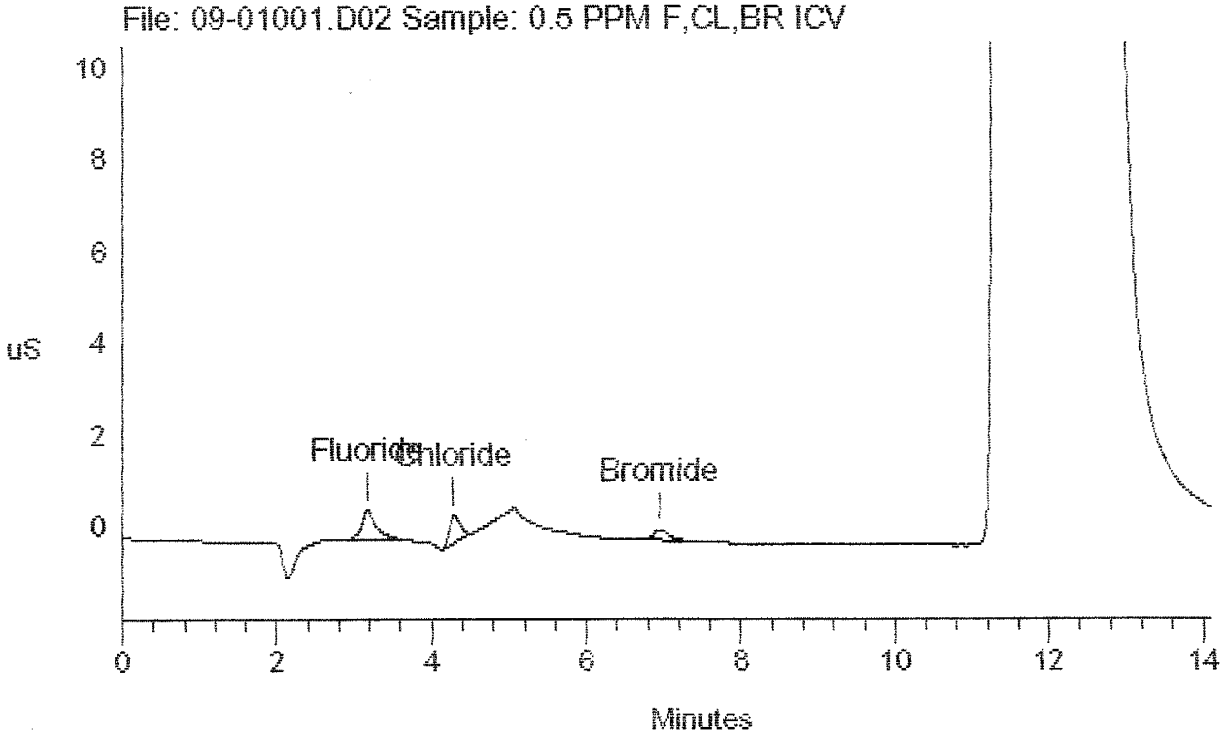
Data Reprocessed On 09/05/2005 12:21:22

Sample Name: 0.5 PPM F,CL,BR ICV	Date: 09/01/2005 07:34:51
Data File : C:\DX\DATA\ANIONS\05-233T1\09-01001.D02	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 2	Detector:CDM-2
Analyst :	Column: AS14-,4mm, STARTED 2-05

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	4234	5Hz	0.00	14.11	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.17	Fluoride	9088270	648599	0.501
4.28	Chloride	5771679	580489	0.506
6.95	Bromide	3197546	229196	0.505
	Totals	18057495	1458285	1.513



METCO ENVIRONMENTAL

Data Reprocessed On 09/05/2005 12:22:15

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==============================================================================
| Sample Name: 1 PPM F,CL,BR ICV              Date: 09/01/2005 07:58:59      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D03                       |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 3                   Detector:CDM-2     |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```
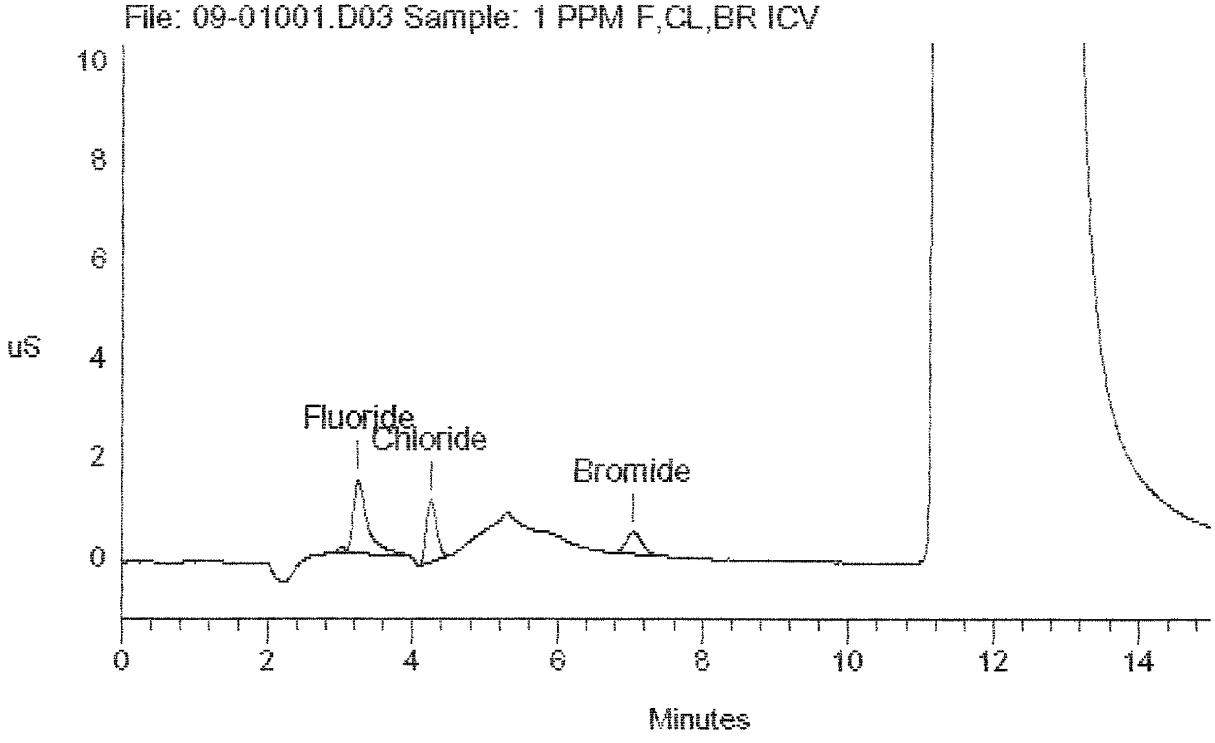

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	4500	5Hz	0.00	15.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.25	Fluoride	21431740	1505199	0.992
4.25	Chloride	12370170	1256129	0.929
7.03	Bromide	6514520	430168	0.993
	Totals	40316430	3191495	2.914



METCO ENVIRONMENTAL

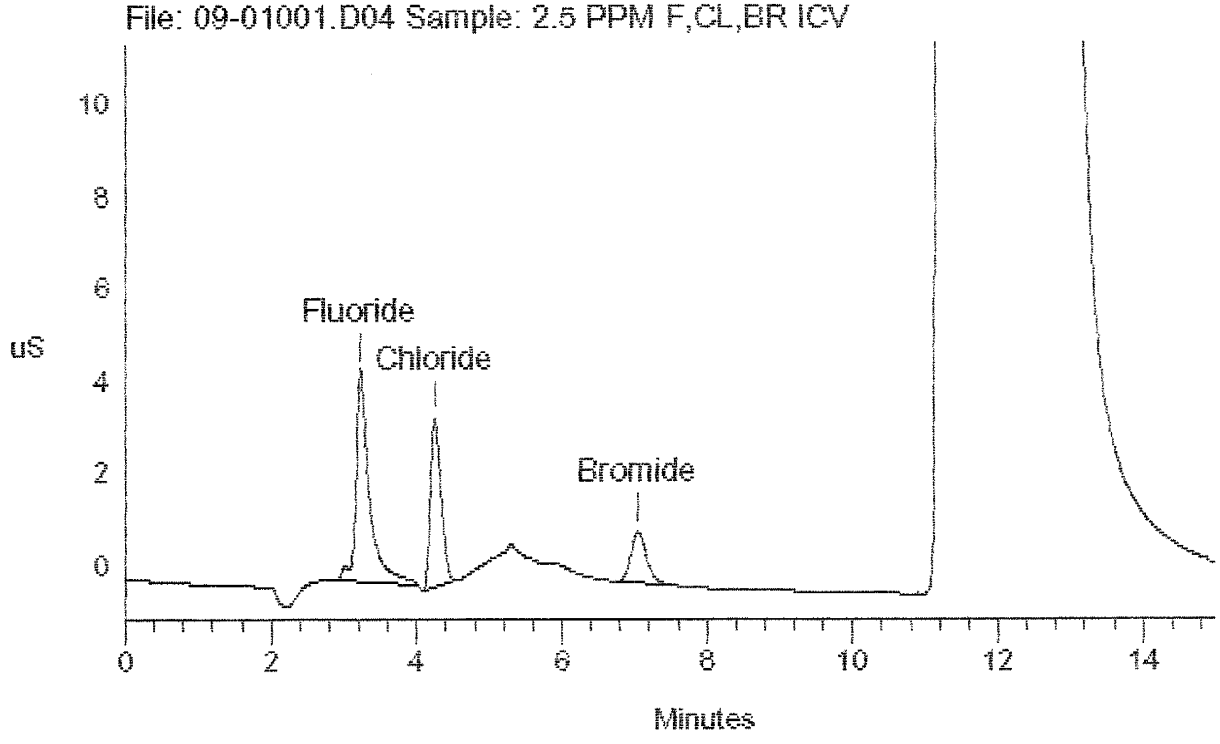
Data Reprocessed On 09/05/2005 12:22:29

```
==============================================================================
| Sample Name: 2.5 PPM F,CL,BR ICV            Date: 09/01/2005 08:15:21      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D04                       |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 4                   Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	4500	5Hz	0.00	15.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.22	Fluoride	59703622	4557843	2.512
4.25	Chloride	36809754	3656223	2.496
7.03	Bromide	16885876	1101026	2.517
	Totals	113399252	9315093	7.525



METCO ENVIRONMENTAL

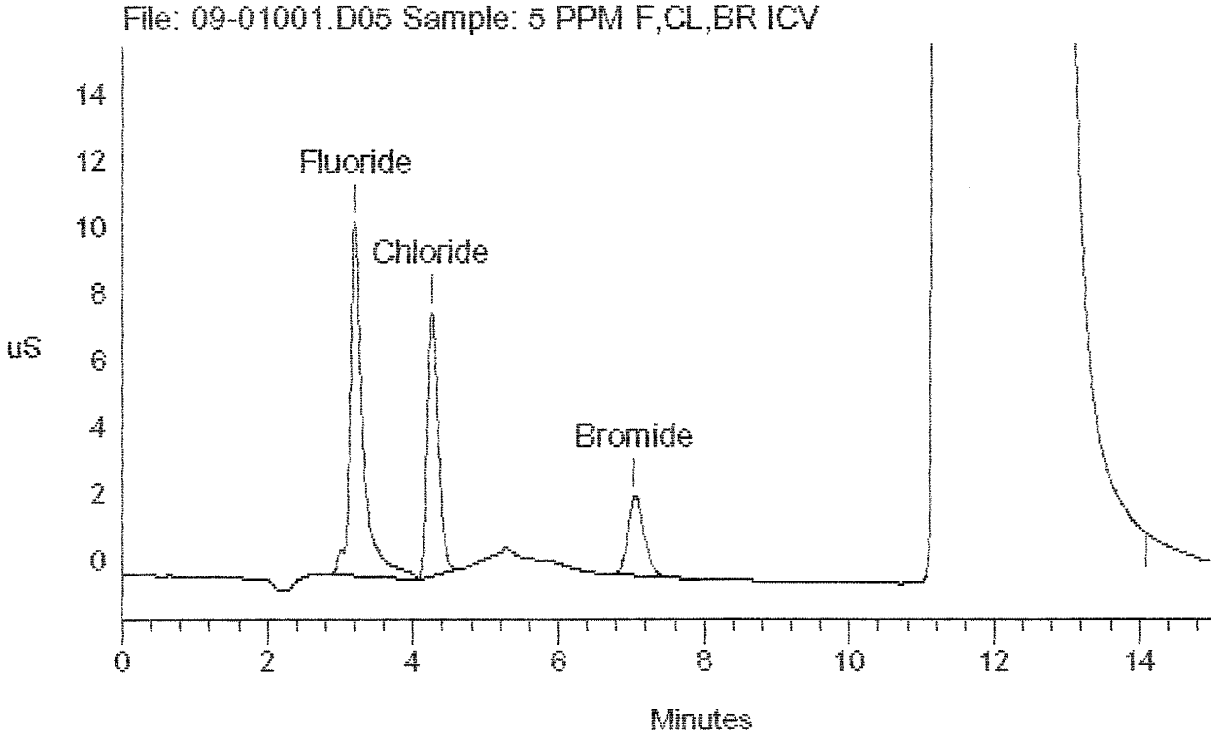
Data Reprocessed On 09/05/2005 12:22:49

Sample Name: 5 PPM F,CL,BR ICV	Date: 09/01/2005 08:31:45
Data File : C:\DX\DATA\ANIONS\05-233T1\09-01001.D05	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 5	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	4500	5Hz	0.00	15.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.20	Fluoride	126382110	10561089	5.006
4.25	Chloride	81806458	7860471	5.081
7.05	Bromide	37278548	2374910	5.140
	Totals	245467116	20796469	15.227



METCO ENVIRONMENTAL

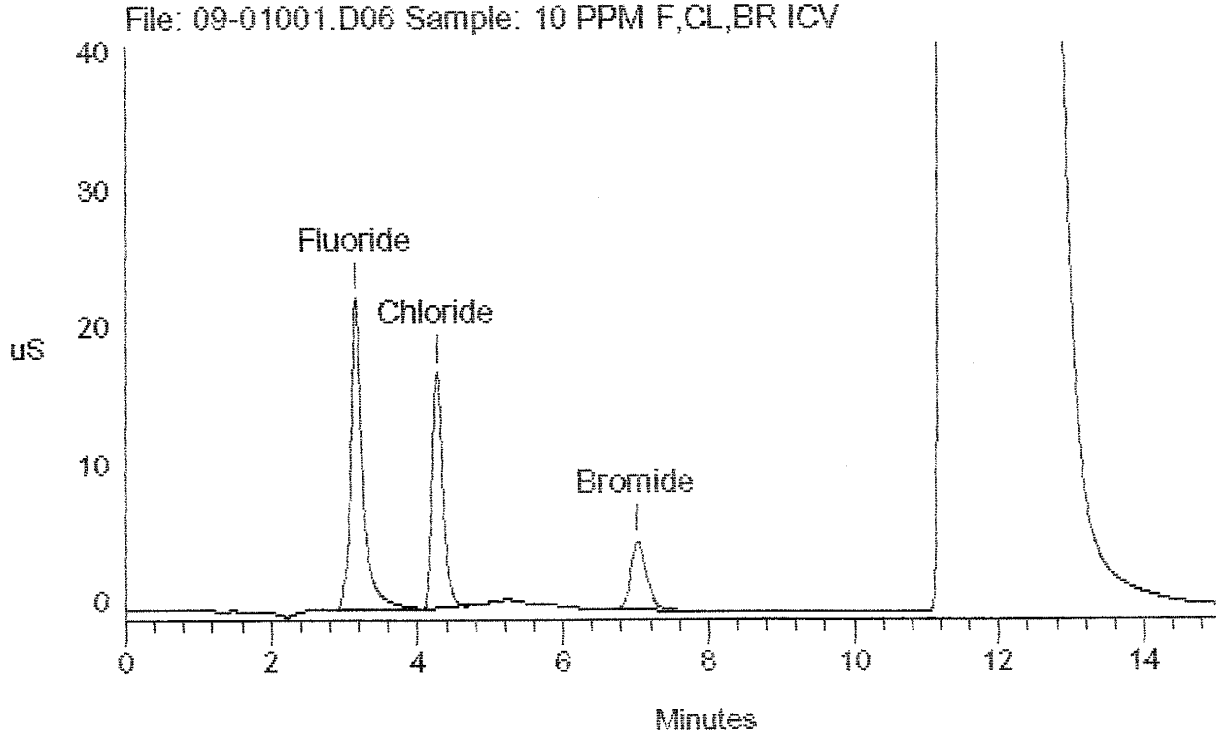
Data Reprocessed On 09/05/2005 12:23:08

```
==============================================================================
| Sample Name: 10 PPM F,CL,BR ICV              Date: 09/01/2005 10:48:09      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D06                        |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 6                    Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	4500	5Hz	0.00	15.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.15	Fluoride	264574992	22646775	9.719
4.27	Chloride	180986534	17249622	9.811
7.02	Bromide	75697876	4990356	9.709
	Totals	521259402	44886753	29.239



METCO ENVIRONMENTAL

Data Reprocessed On 09/05/2005 12:23:41

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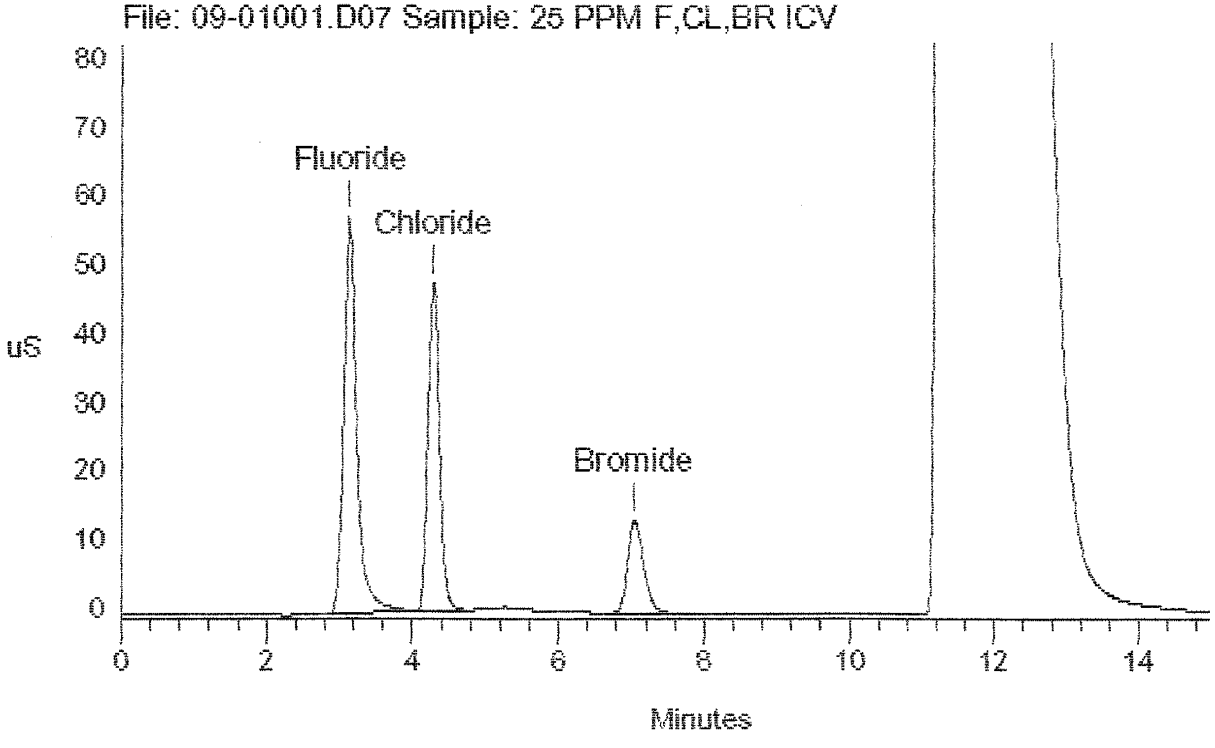
==============================================================================
| Sample Name: 25 PPM F,CL,BR ICV              Date: 09/01/2005 11:04:33      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D07                        |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 7                    Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	4500	5Hz	0.00	15.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.13	Fluoride	712968582	57482647	25.069
4.28	Chloride	525455692	47688270	25.141
7.03	Bromide	205503722	13489498	24.810
	Totals	1443927996	118660415	75.020



METCO ENVIRONMENTAL

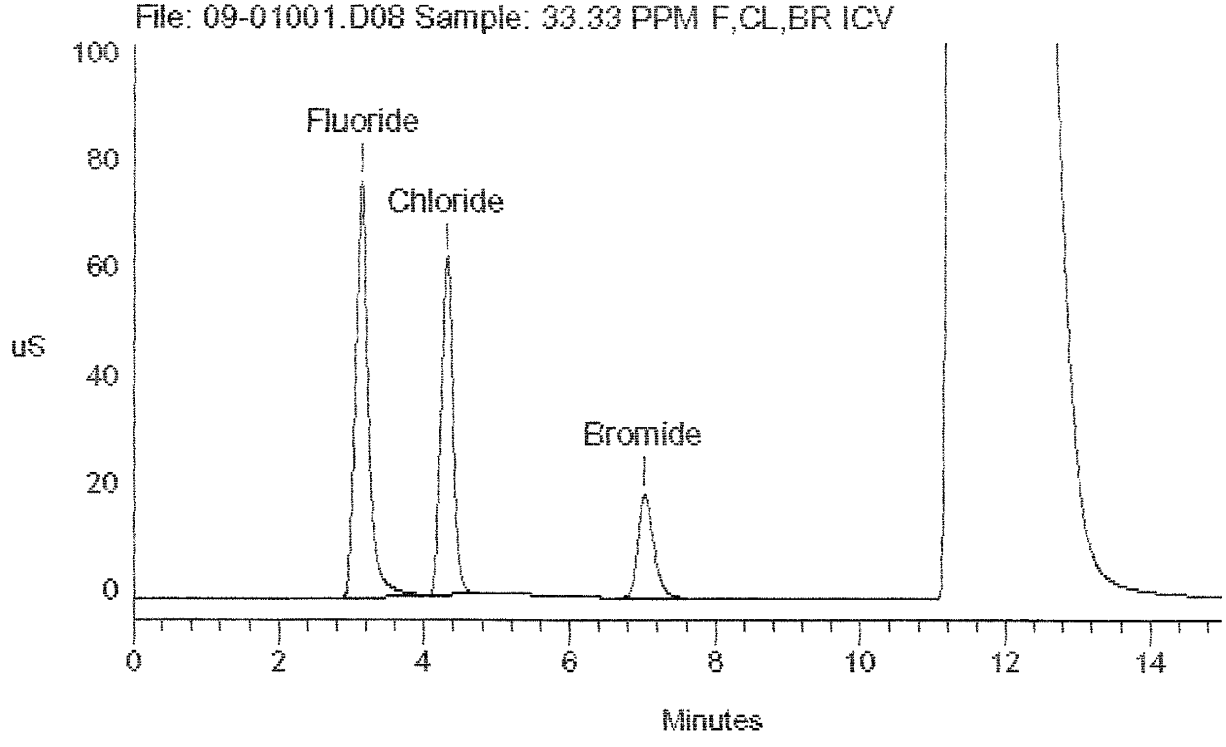
Data Reprocessed On 09/05/2005 12:24:01

```
==============================================================================
| Sample Name: 33.33 PPM F,CL,BR ICV          Date: 09/01/2005 11:20:55      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D08                       |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 8                   Detector:CDM-2     |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	4500	5Hz	0.00	15.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.13	Fluoride	957362261	77051565	33.499
4.30	Chloride	716190091	61980649	33.980
7.02	Bromide	282196140	19135261	33.888
	Totals	1955748492	158167475	101.367



METCO ENVIRONMENTAL

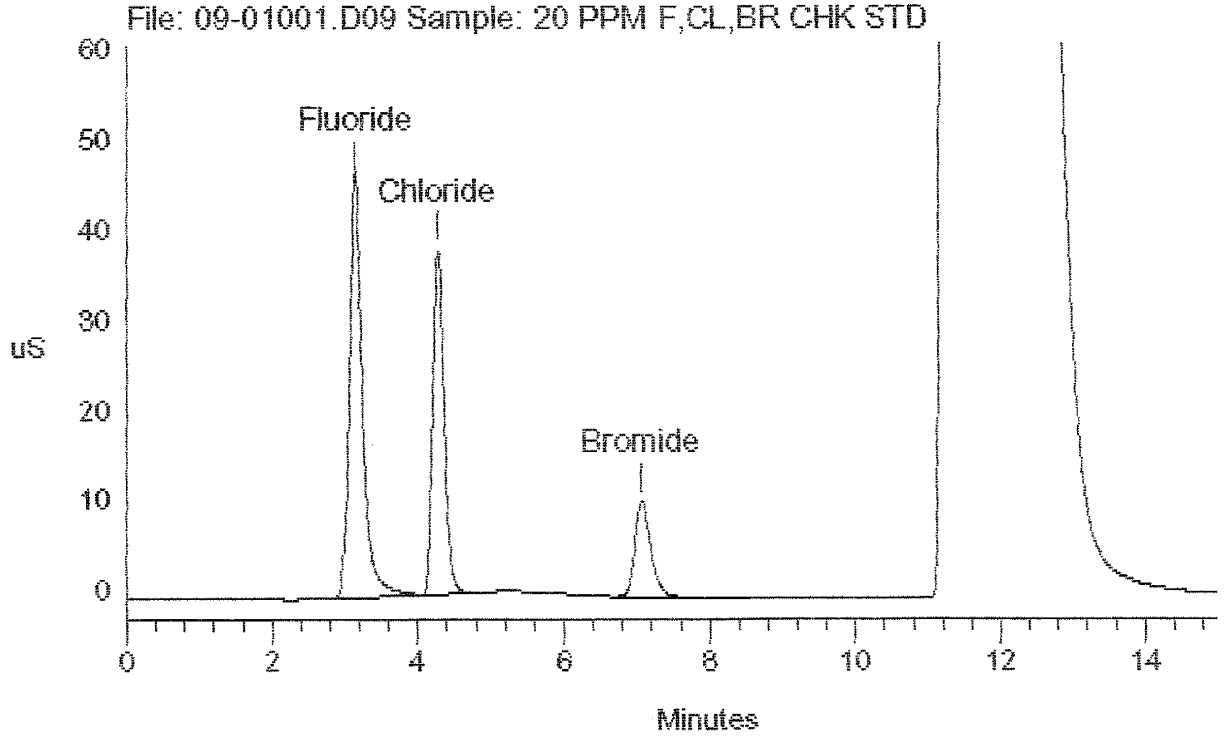
Data Reprocessed On 09/05/2005 12:24:19

Sample Name: 20 PPM F,CL,BR CHK STD	Date: 09/01/2005 11:37:17
Data File : C:\DX\DATA\ANIONS\05-233T1\09-01001.D09	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 9	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	4500	5Hz	0.00	15.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.13	Fluoride	575996527	46178528	20.345
4.28	Chloride	412804461	38270425	19.920
7.07	Bromide	162300890	10625780	19.696
	Totals	1151101878	95074734	59.961



METCO ENVIRONMENTAL

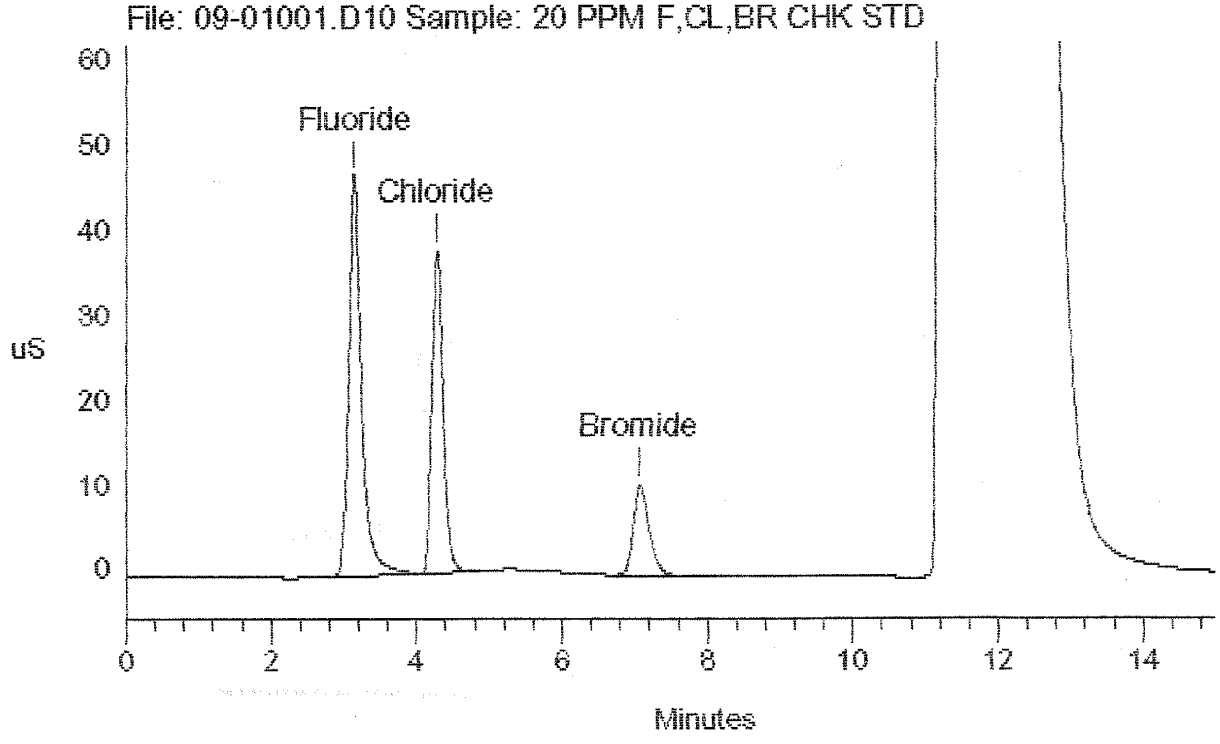
Data Reprocessed On 09/05/2005 12:24:34

Sample Name: 20 PPM F,CL,BR CHK STD	Date: 09/01/2005 11:53:39
Data File : C:\DX\DATA\ANIONS\05-233T1\09-01001.D10	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 10	Detector:CDM-2
Analyst :	Column: AS14-,4mm, STARTED 2-05

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	4500	5Hz	0.00	15.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.13	Fluoride	573626618	46784314	20.264
4.28	Chloride	411375822	38083590	19.854
7.07	Bromide	160947480	10595515	19.536
	Totals	1145949920	95463420	59.653



METCO ENVIRONMENTAL

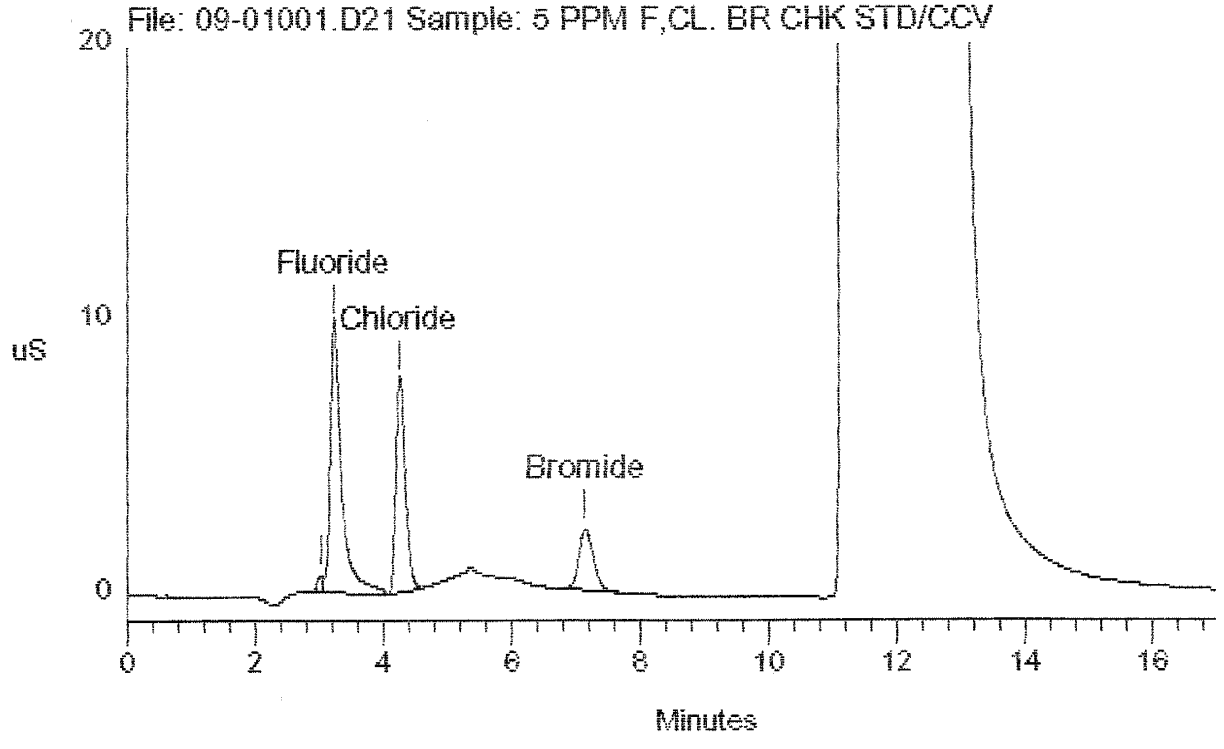
Data Reprocessed On 09/05/2005 12:24:52

```
==============================================================================
| Sample Name: 5 PPM F,CL. BR CHK STD/CCV     Date: 09/01/2005 16:52:33      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D21                      |
| Method     : C:\DX\METHOD\HF2.MET                                         |
| ACI Address: 1  System: 1  Inject#: 21                  Detector:CDM-2    |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05              |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.22	Fluoride	123846032	9834879	4.912
4.25	Chloride	81261166	7813798	5.048
7.13	Bromide	36634908	2273526	5.053
	Totals	241742106	19922204	15.014



METCO ENVIRONMENTAL

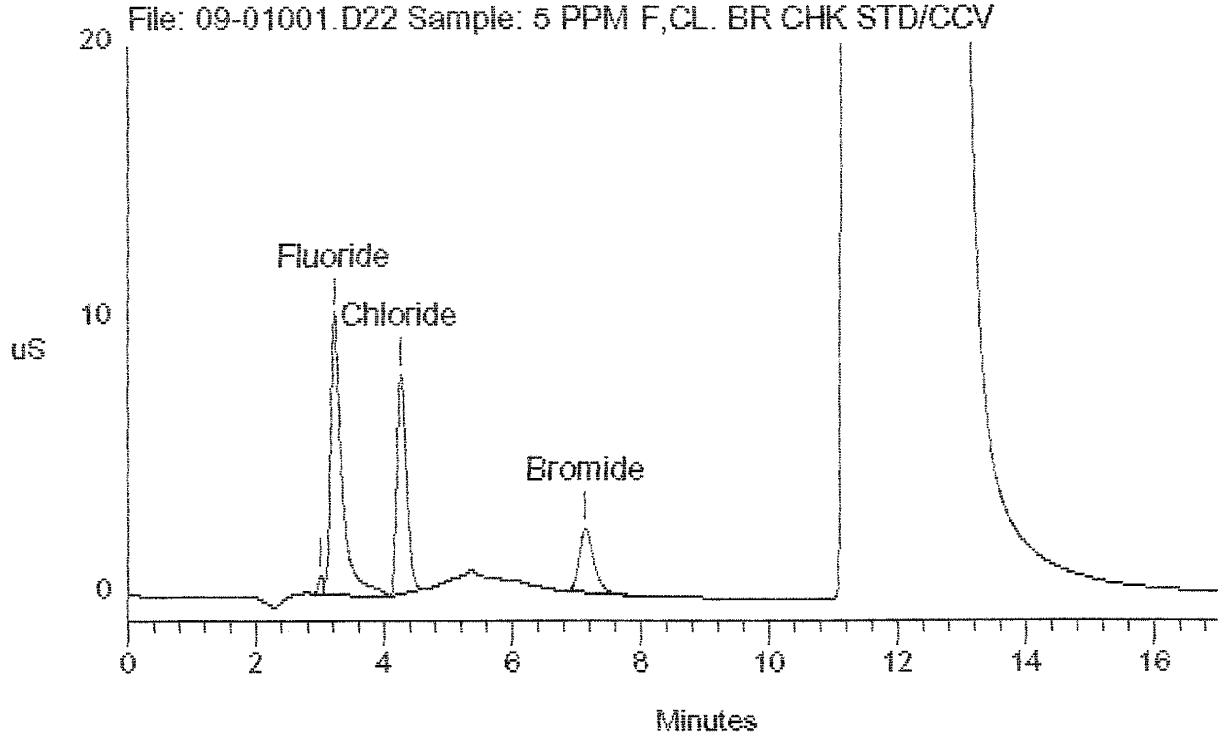
Data Reprocessed On 09/05/2005 12:25:02

```
==============================================================================
| Sample Name: 5 PPM F,CL. BR CHK STD/CCV     Date: 09/01/2005 17:10:54      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D22                       |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 22                  Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	5100	5Hz	0.00	17.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.22	Fluoride	124061193	10121201	4.920
4.25	Chloride	82463492	7921773	5.121
7.13	Bromide	36816293	2298487	5.078
	Totals	243340978	20341462	15.119



METCO ENVIRONMENTAL

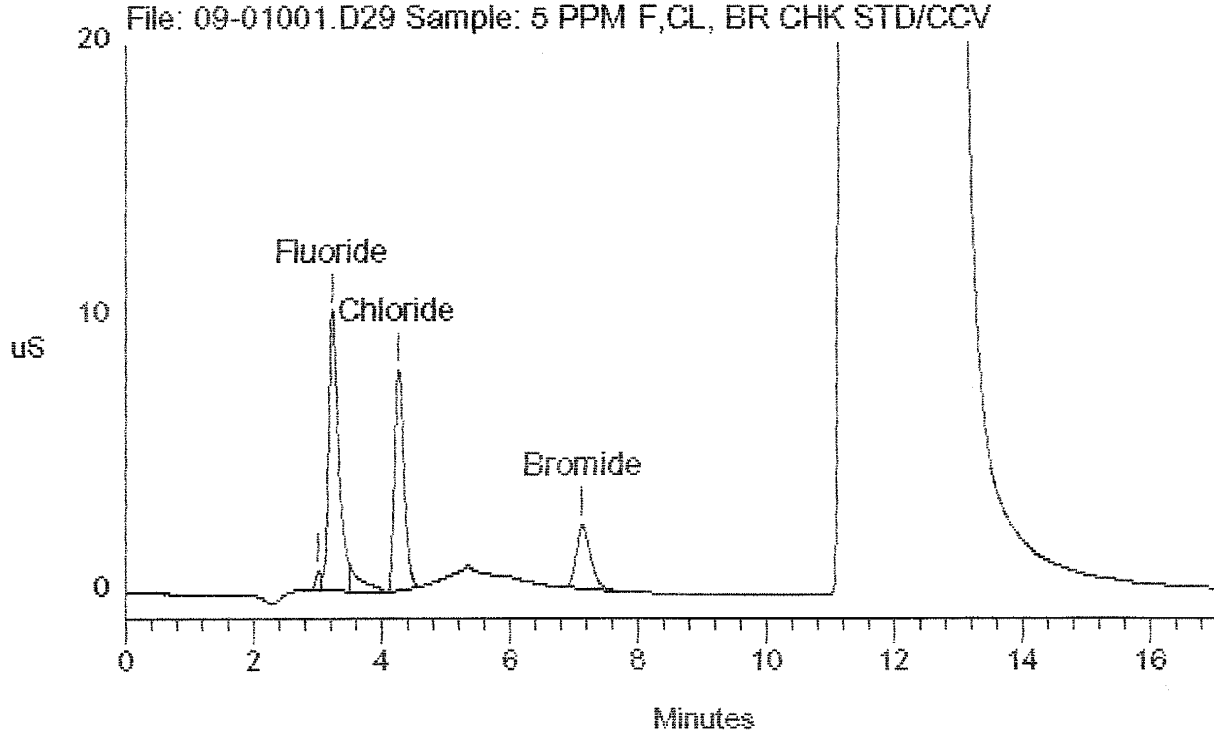
Data Reprocessed On 09/05/2005 12:25:17

Sample Name: 5 PPM F,CL, BR CHK STD/CCV	Date: 09/01/2005 19:19:21
Data File : C:\DX\DATA\ANIONS\05-233T1\09-01001.D29	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 29	Detector:CDM-2
Analyst :	Column: AS14-,4mm, STARTED 2-05

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.22	Fluoride	124367276	10165672	4.932
4.25	Chloride	82898466	7979989	5.147
7.13	Bromide	36447108	2292357	5.028
	Totals	243712850	20438018	15.106



METCO ENVIRONMENTAL

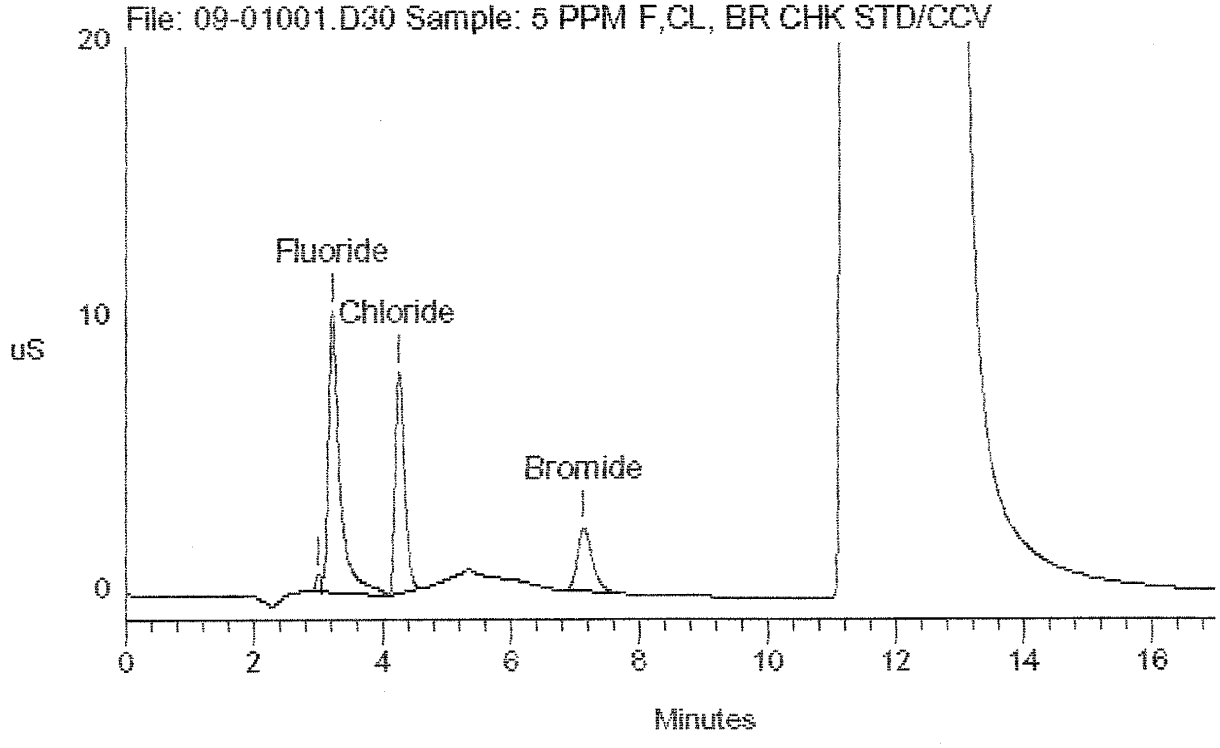
Data Reprocessed On 09/05/2005 12:25:27

```
==============================================================================
| Sample Name: 5 PPM F,CL, BR CHK STD/CCV     Date: 09/01/2005 19:37:42        |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-01001.D30                         |
| Method     : C:\DX\METHOD\HF2.MET                                            |
| ACI Address: 1  System: 1  Inject#: 30                  Detector:CDM-2       |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                 |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	5100	5Hz	0.00	17.00		2000

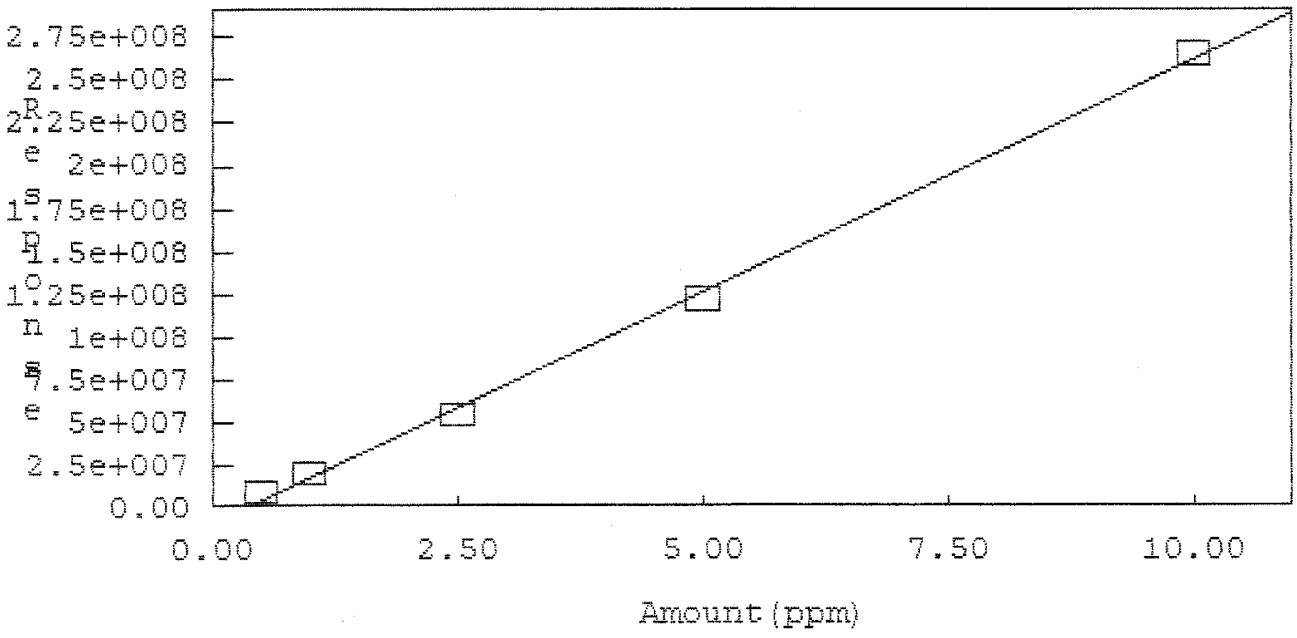
********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.22	Fluoride	124866253	10300897	4.950
4.25	Chloride	82892956	8039390	5.146
7.13	Bromide	36758548	2301569	5.070
	Totals	244517757	20641855	15.166



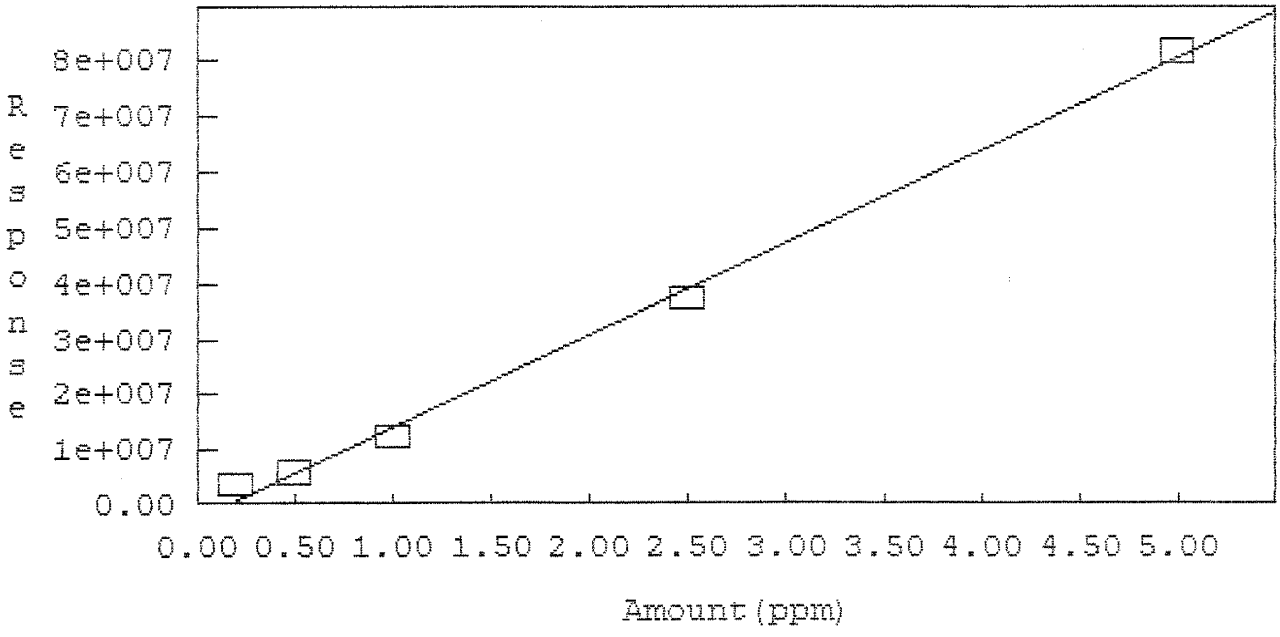
Method: HF2.MET - Last Updated: 13:21 on Thu, 01 Sep 2005

Component: Fluoride
Fit Type: Linear
r^2 = 0.998285
Amt = Resp * 3.687e-008 + 0.3464
Resp = Amt * 2.712e+007 + -9.395e+006
Standardization: External
Calibration: Area



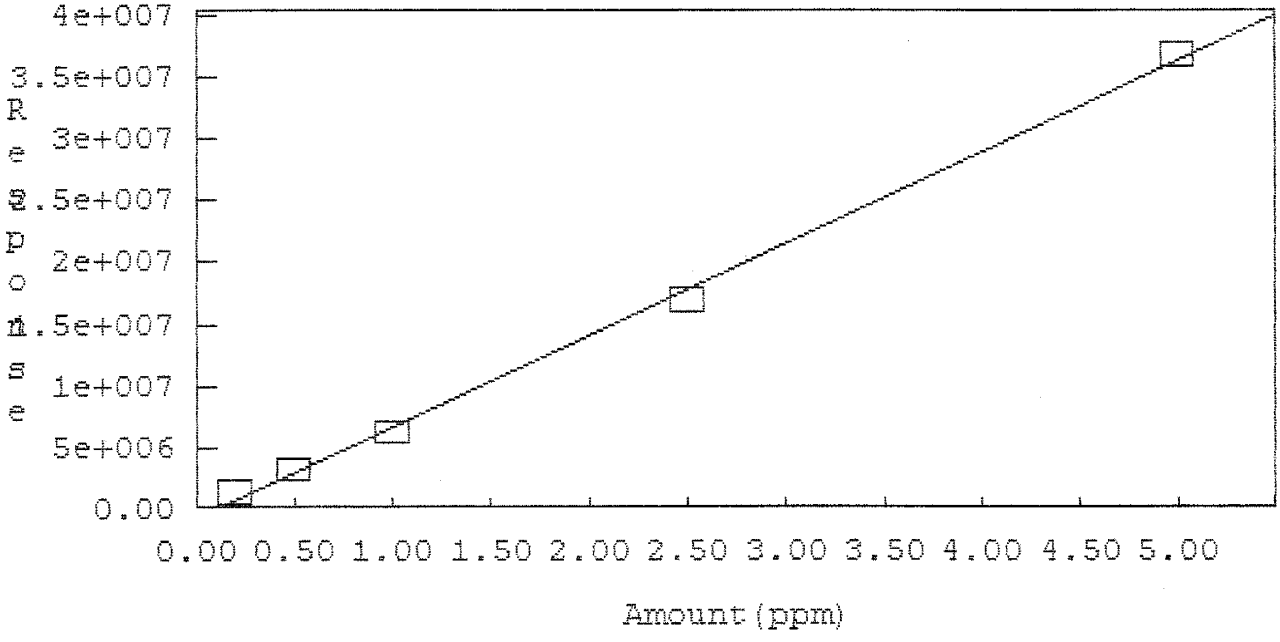
Method: HF2.MET - Last Updated: 13:21 on Thu, 01 Sep 2005

Component: Chloride
Fit Type: Linear
r^2 = 0.996424
Amt = Resp * 6.028e-008 + 0.1495
Resp = Amt * 1.659e+007 + -2.48e+006
Standardization: External
Calibration: Area



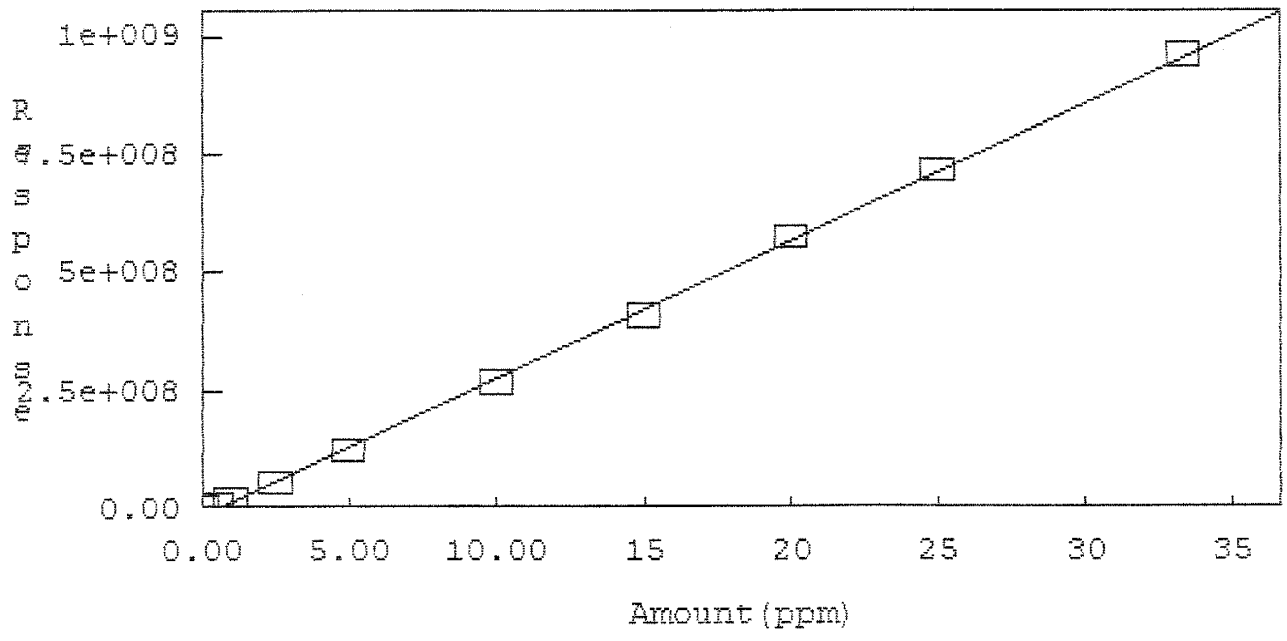
Method: HF2.MET - Last Updated: 13:21 on Thu, 01 Sep 2005

Component: Bromide
Fit Type: Linear
r^2 = 0.998225
Amt = Resp * 1.351e-007 + 0.1028
Resp = Amt * 7.4e+006 + -7.607e+005
Standardization: External
Calibration: Area



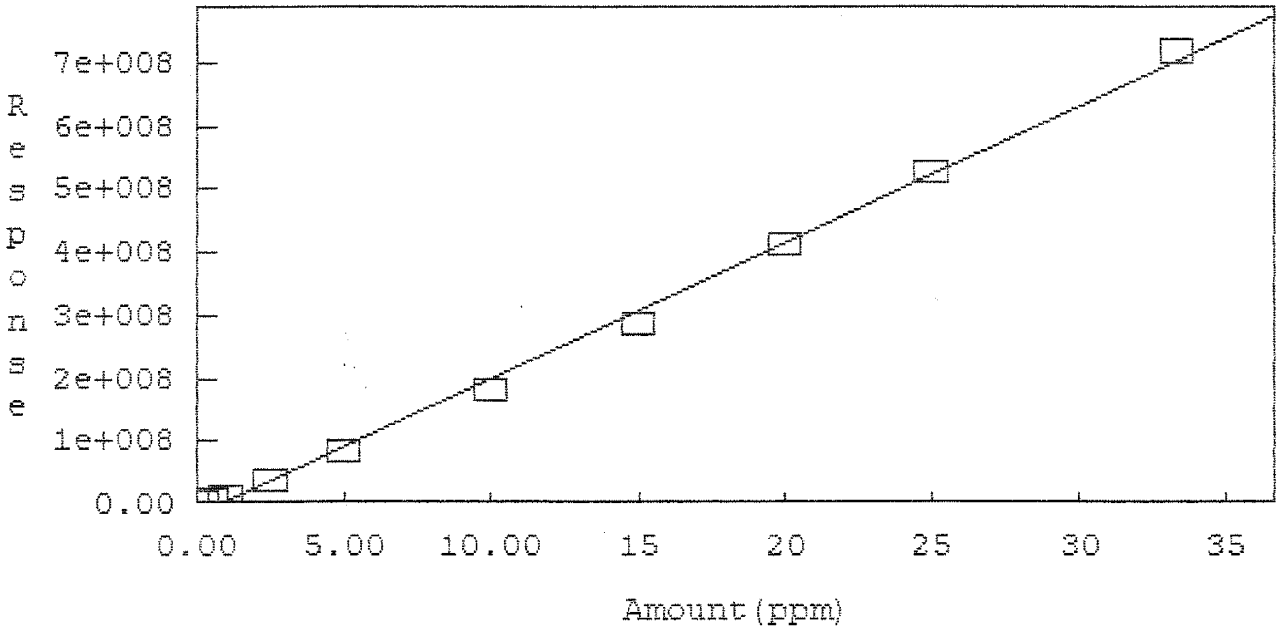
Method: HF2.MET - Last Updated: 13:21 on Thu, 01 Sep 2005

Component: Fluoride
Fit Type: Linear
r^2 = 0.999183
Amt = Resp * 3.449e-008 + 0.4789
Resp = Amt * 2.899e+007 + -1.388e+007
Standardization: External
Calibration: Area



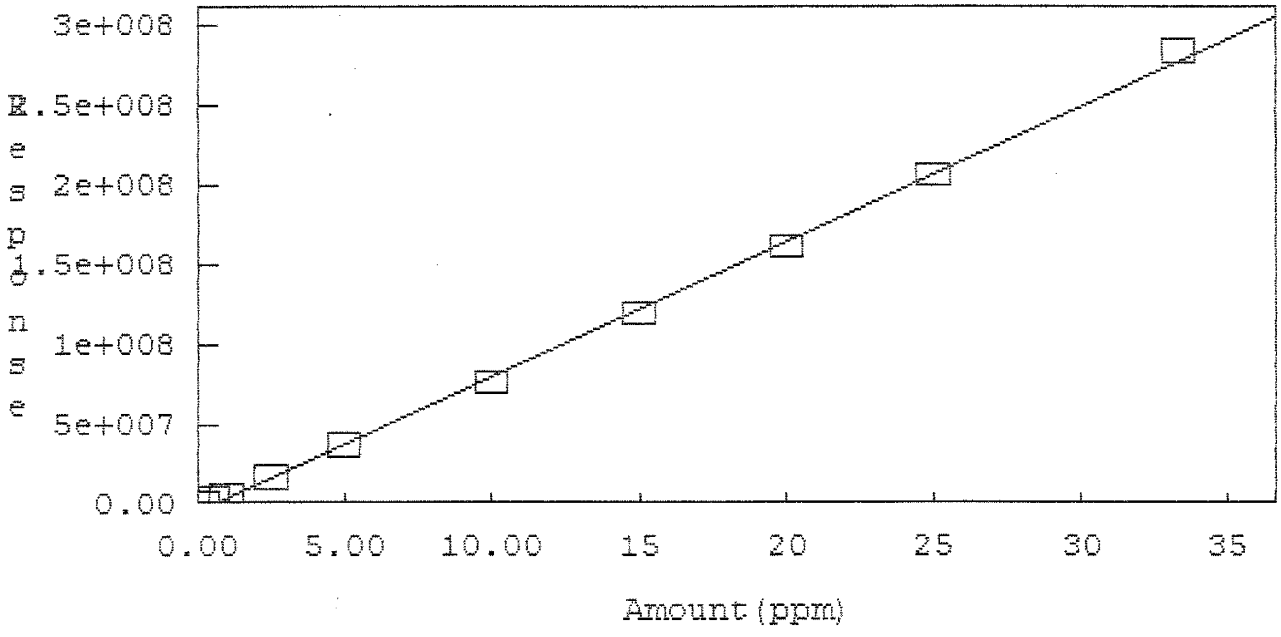
Method: HF2.MET - Last Updated: 13:21 on Thu, 01 Sep 2005

Component: Chloride
Fit Type: Linear
r^2 = 0.997256
Amt = Resp * 4.634e-008 + 0.7891
Resp = Amt * 2.158e+007 + -1.703e+007
Standardization: External
Calibration: Area



Method: HF2.MET - Last Updated: 13:21 on Thu, 01 Sep 2005

Component: Bromide
Fit Type: Linear
r^2 = 0.998733
Amt = Resp * 1.184e-007 + 0.484
Resp = Amt * 8.448e+006 + -4.088e+006
Standardization: External
Calibration: Area



METCO ENVIRONMENTAL

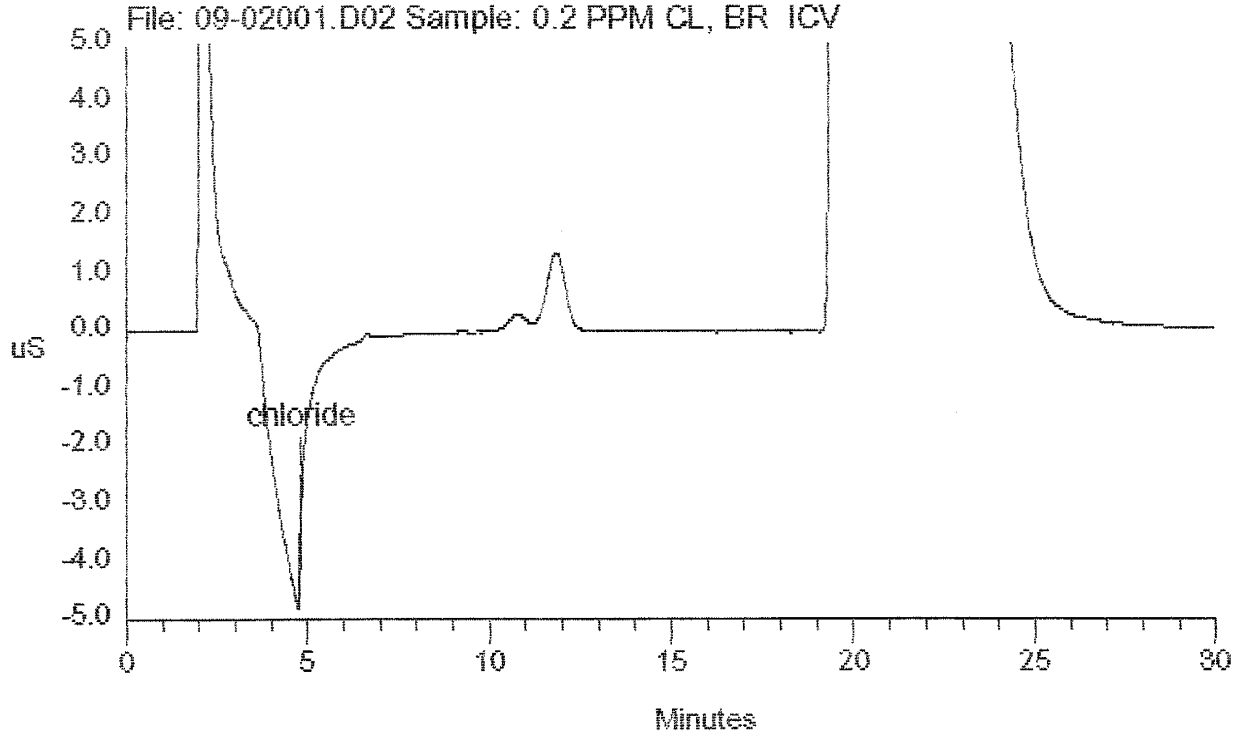
Data Reprocessed On 09/05/2005 13:37:34

```
==============================================================================
| Sample Name: 0.2 PPM CL, BR  ICV            Date: 09/02/2005 09:59:37      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-02001.D02                       |
| Method     : C:\DX\METHOD\HCLLO2.MET                                       |
| ACI Address: 1  System: 1  Inject#: 2                   Detector:CDM-2     |
| Analyst    :                Column: AS14,4mm, STD 1-12-01                  |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	9000	5Hz	0.00	30.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.81	chloride	4123200	1099714	0.207
	Totals	4123200	1099714	0.207



METCO ENVIRONMENTAL

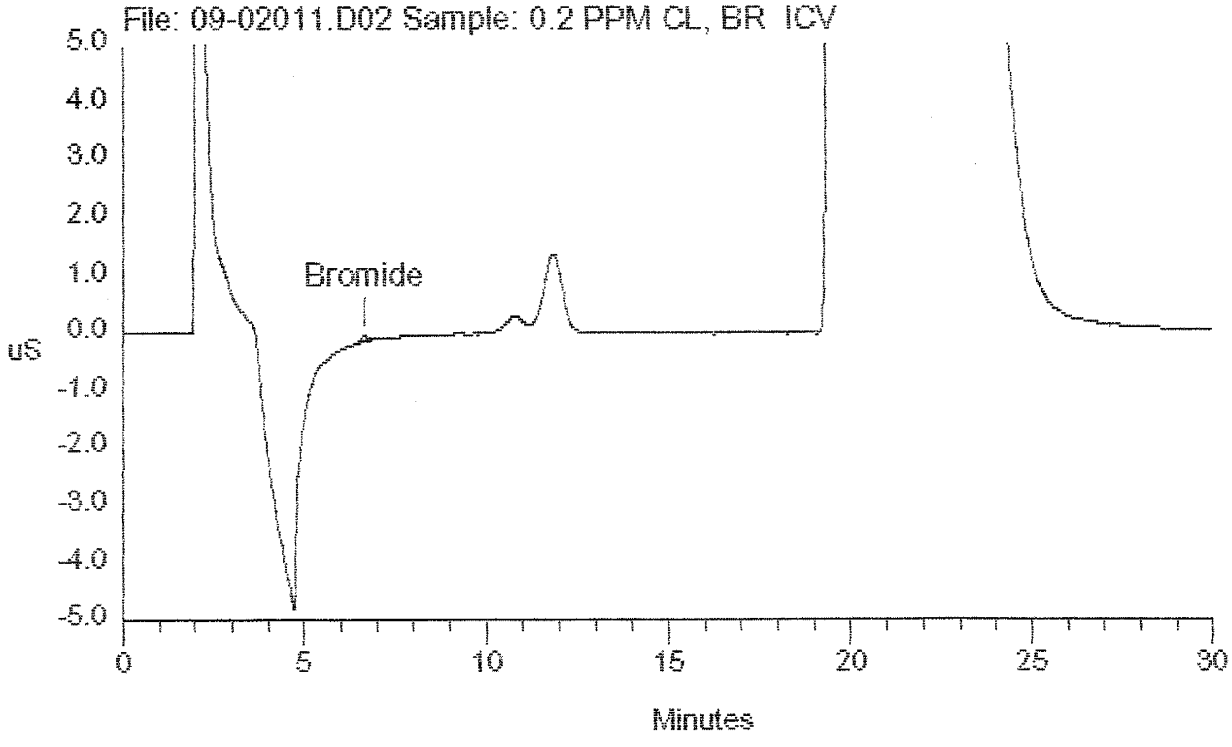
Data Reprocessed On 09/05/2005 13:37:52

Sample Name: 0.2 PPM CL, BR ICV	Date: 09/02/2005 09:59:37
Data File : C:\DX\DATA\ANIONS\05-233T1\09-02011.D02	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 2	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	9000	5Hz	0.00	30.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
6.65	Bromide	1505636	116319	0.198
	Totals	1505636	116319	0.198



METCO ENVIRONMENTAL

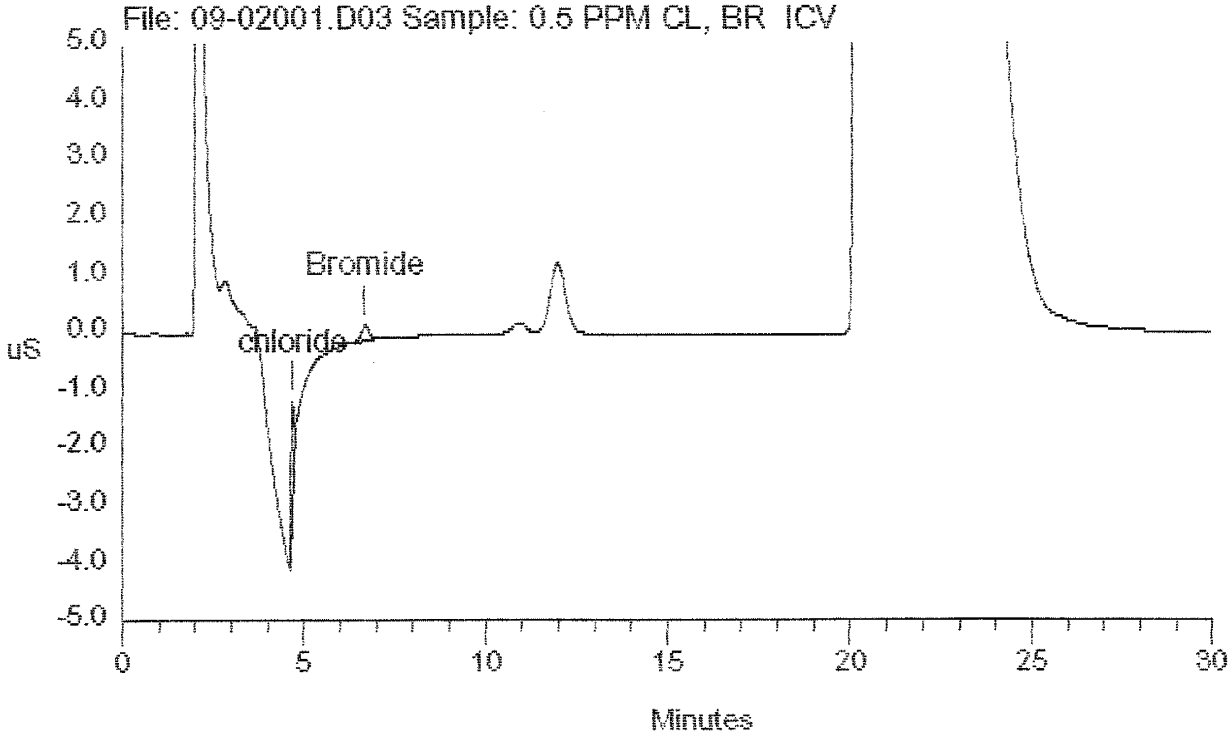
Data Reprocessed On 09/05/2005 13:38:05

```
================================================================================
| Sample Name: 0.5 PPM CL, BR  ICV            Date: 09/02/2005 10:31:01        |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-02001.D03                         |
| Method     : C:\DX\METHOD\HCLLO2.MET                                         |
| ACI Address: 1  System: 1  Inject#: 3                    Detector:CDM-2      |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                   |
================================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	9000	5Hz	0.00	30.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.68	chloride	7017600	1688316	0.482
6.68	Bromide	3692984	270359	0.500
	Totals	10710584	1958675	0.982



METCO ENVIRONMENTAL

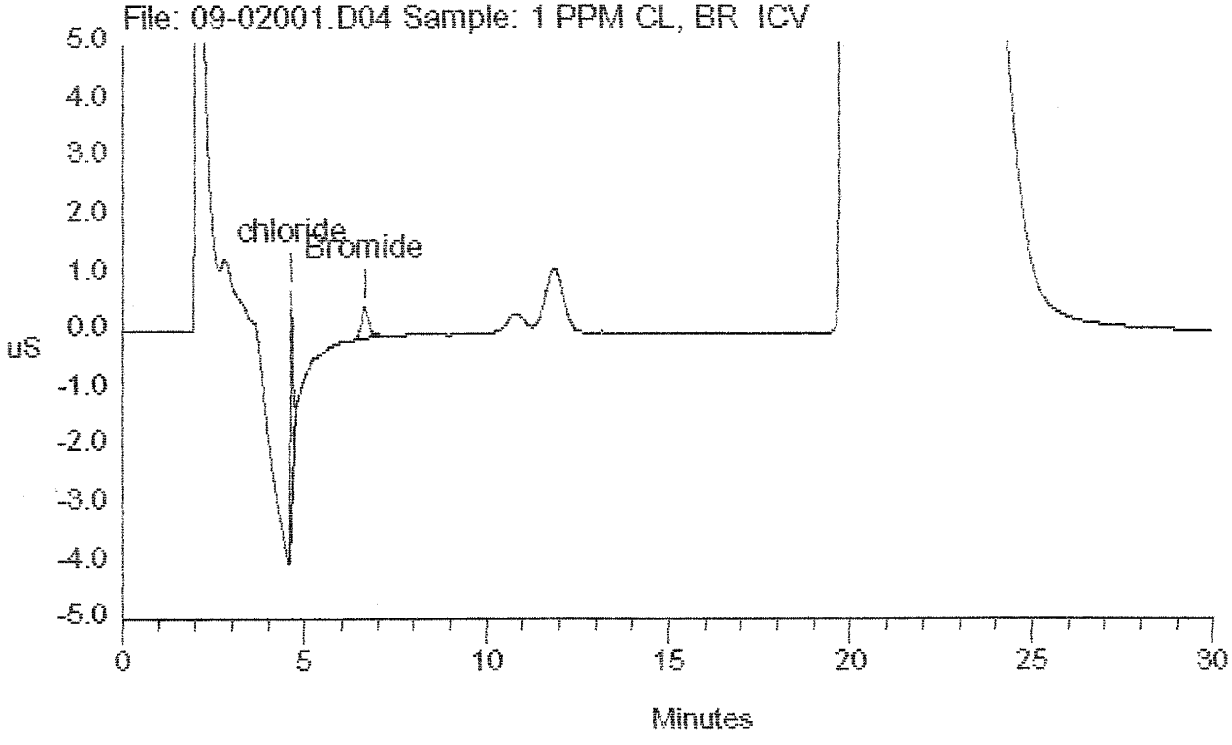
Data Reprocessed On 09/05/2005 13:38:17

Sample Name: 1 PPM CL, BR ICV	Date: 09/02/2005 11:02:25
Data File : C:\DX\DATA\ANIONS\05-233T1\09-02001.D04	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 4	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	9000	5Hz	0.00	30.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	chloride	18272256	3891600	1.025
6.64	Bromide	7991812	533339	1.063
	Totals	26264068	4424939	2.088



METCO ENVIRONMENTAL

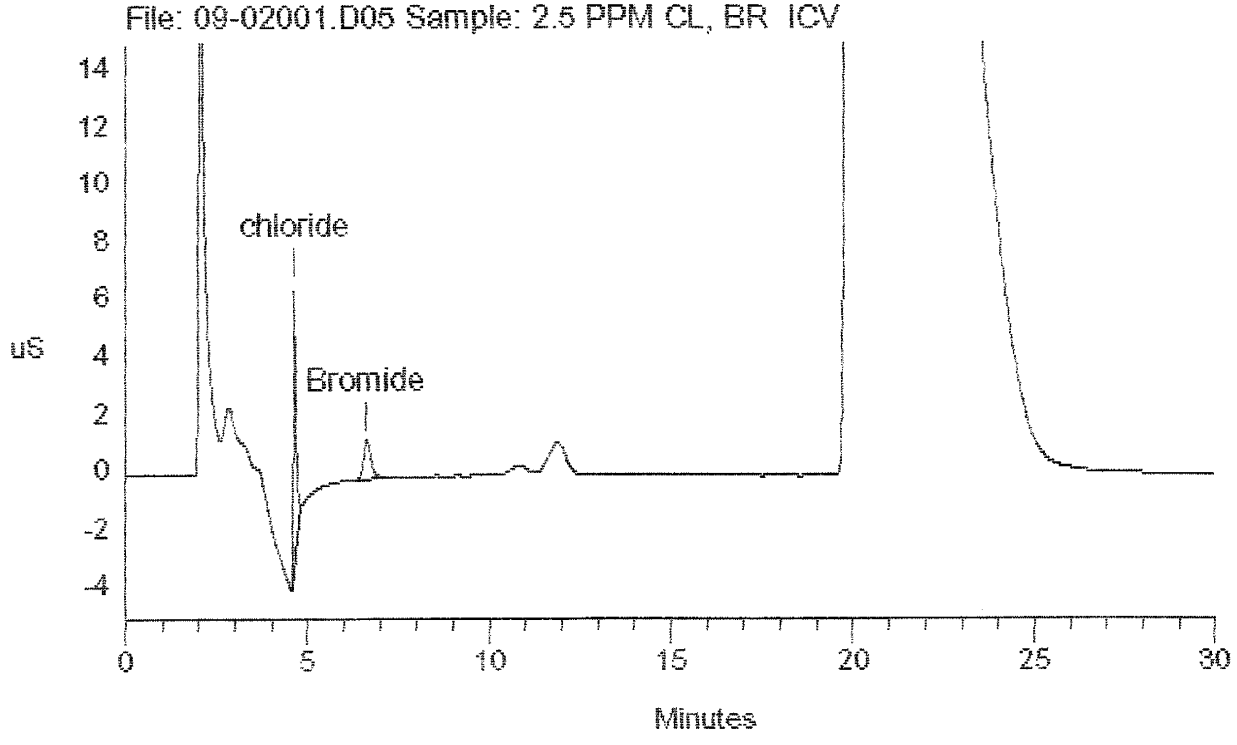
Data Reprocessed On 09/05/2005 13:38:30

```
==============================================================================
| Sample Name: 2.5 PPM CL, BR  ICV            Date: 09/02/2005 11:33:49      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-02001.D05                       |
| Method     : C:\DX\METHOD\HCLLO2.MET                                       |
| ACI Address: 1  System: 1  Inject#: 5                   Detector:CDM-2     |
| Analyst    :                Column: AS14,4mm, STD 1-12-01                  |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	9000	5Hz	0.00	30.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	chloride	49050142	9833297	2.508
6.63	Bromide	18931648	1306519	2.497
	Totals	67981790	11139817	5.005



METCO ENVIRONMENTAL

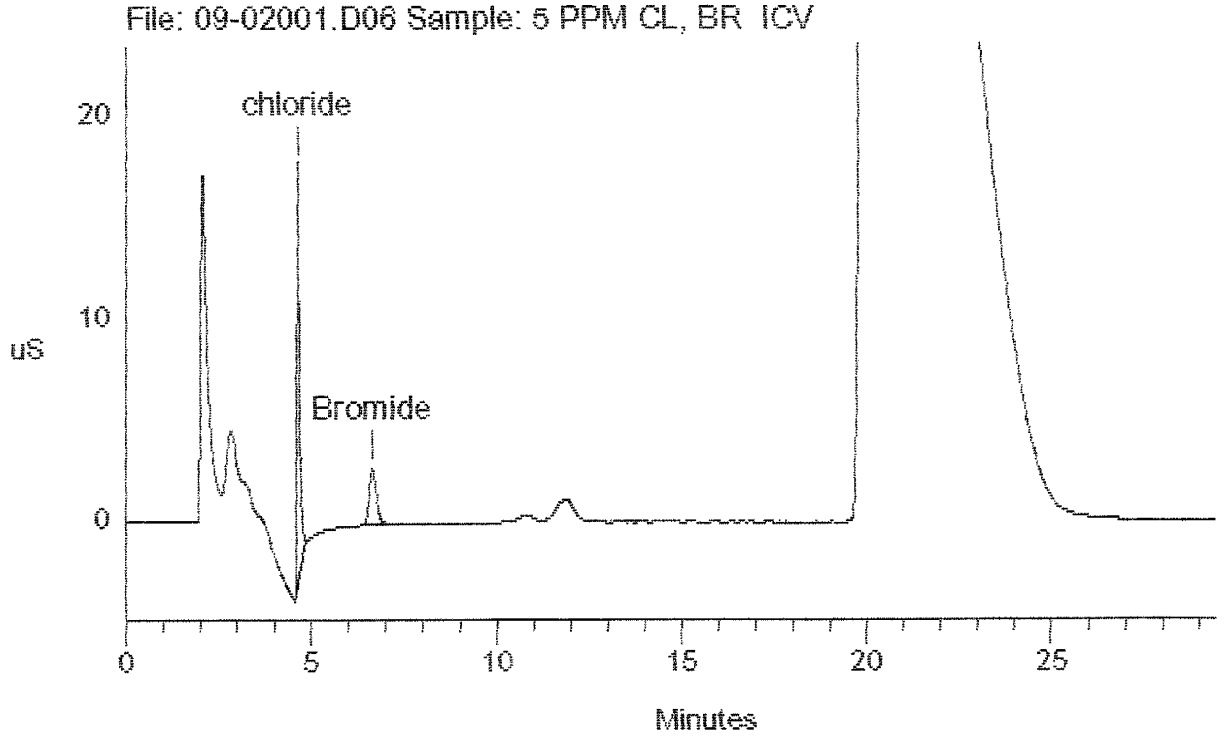
Data Reprocessed On 09/05/2005 13:38:48

```
================================================================================
| Sample Name: 5 PPM CL, BR  ICV                Date: 09/02/2005 12:05:09      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-02001.D06                         |
| Method     : C:\DX\METHOD\HCLLO2.MET                                         |
| ACI Address: 1  System: 1  Inject#: 6                    Detector:CDM-2      |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                   |
================================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	9000	5Hz	0.00	29.49		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	chloride	105555800	21007851	5.080
6.63	Bromide	38163759	2732378	5.020
	Totals	143719559	23740229	10.100



METCO ENVIRONMENTAL

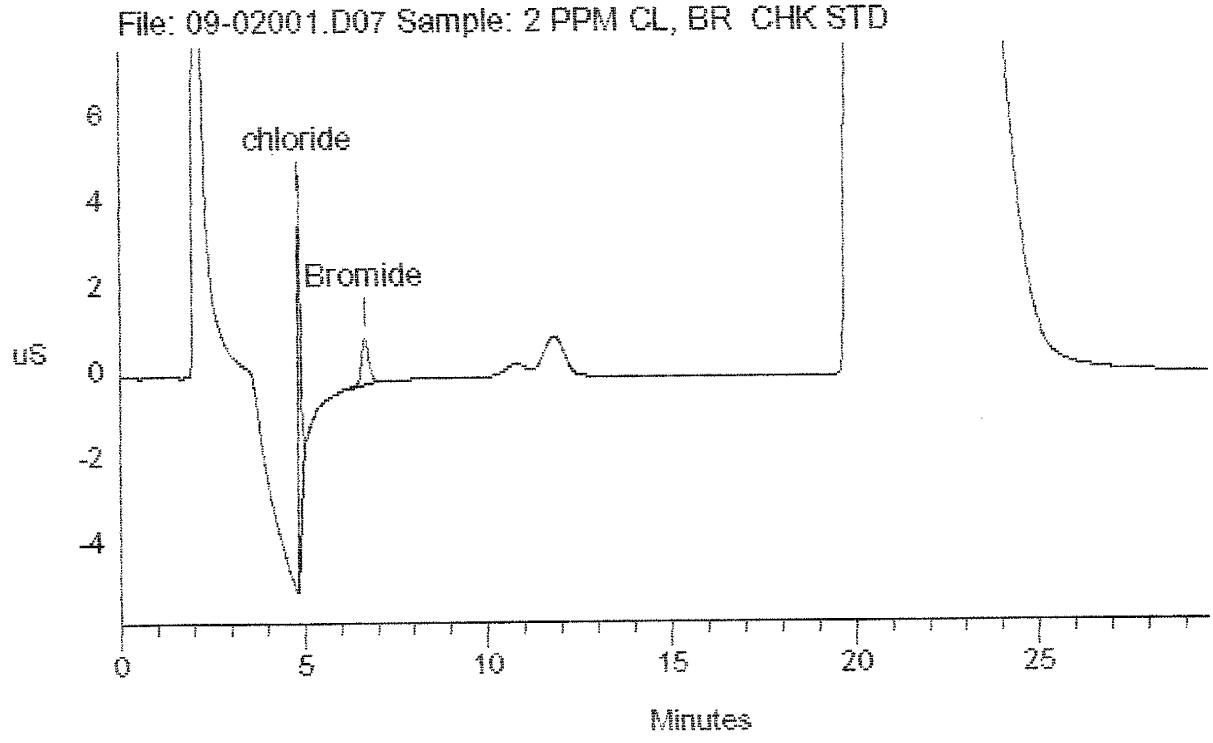
Data Reprocessed On 09/05/2005 13:39:06

Sample Name: 2 PPM CL, BR CHK STD	Date: 09/02/2005 12:36:32
Data File : C:\DX\DATA\ANIONS\05-233T1\09-02001.D07	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 7	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	9000	5Hz	0.00	29.65		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.87	chloride	39478052	8415651	2.047
6.67	Bromide	15074002	1110731	1.991
	Totals	54552054	9526382	4.038



METCO ENVIRONMENTAL

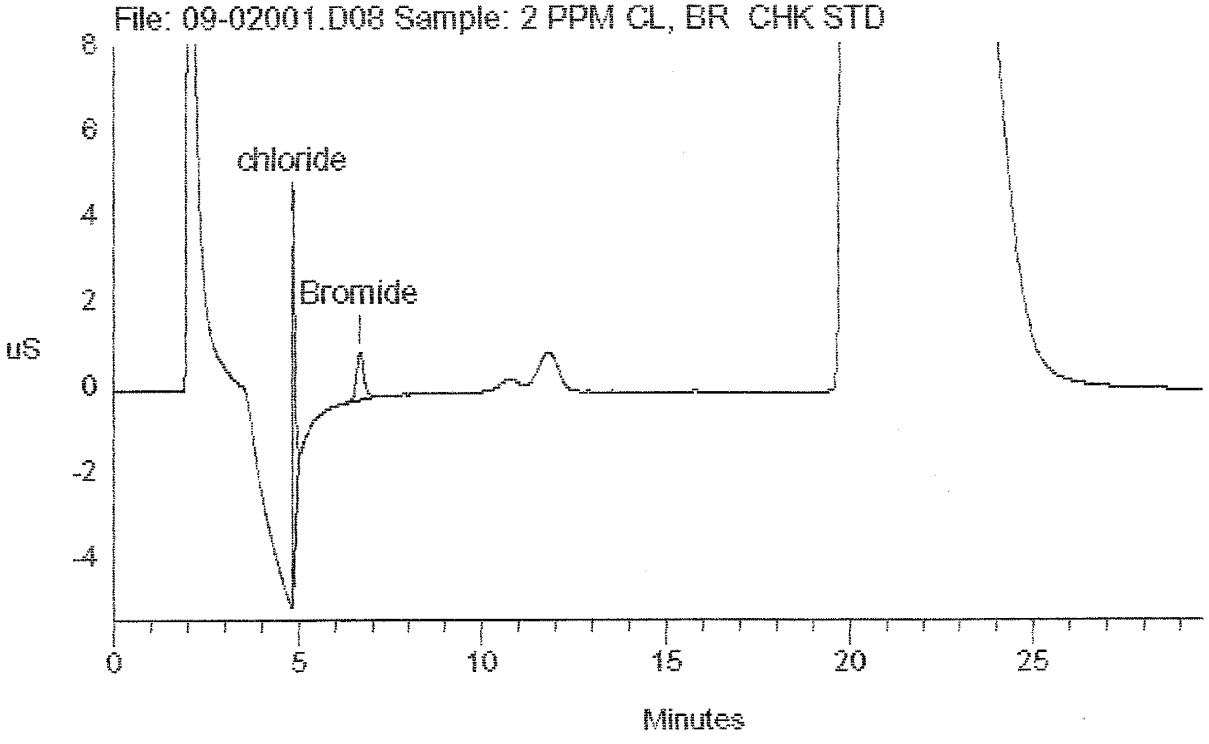
Data Reprocessed On 09/05/2005 13:39:22

Sample Name: 2 PPM CL, BR CHK STD	Date: 09/02/2005 13:08:01
Data File : C:\DX\DATA\ANIONS\05-233T1\09-02001.D08	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 8	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8999	5Hz	0.00	29.65		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.87	chloride	39451012	8334635	2.045
6.67	Bromide	15157784	1105826	2.002
	Totals	54608796	9440460	4.048



METCO ENVIRONMENTAL

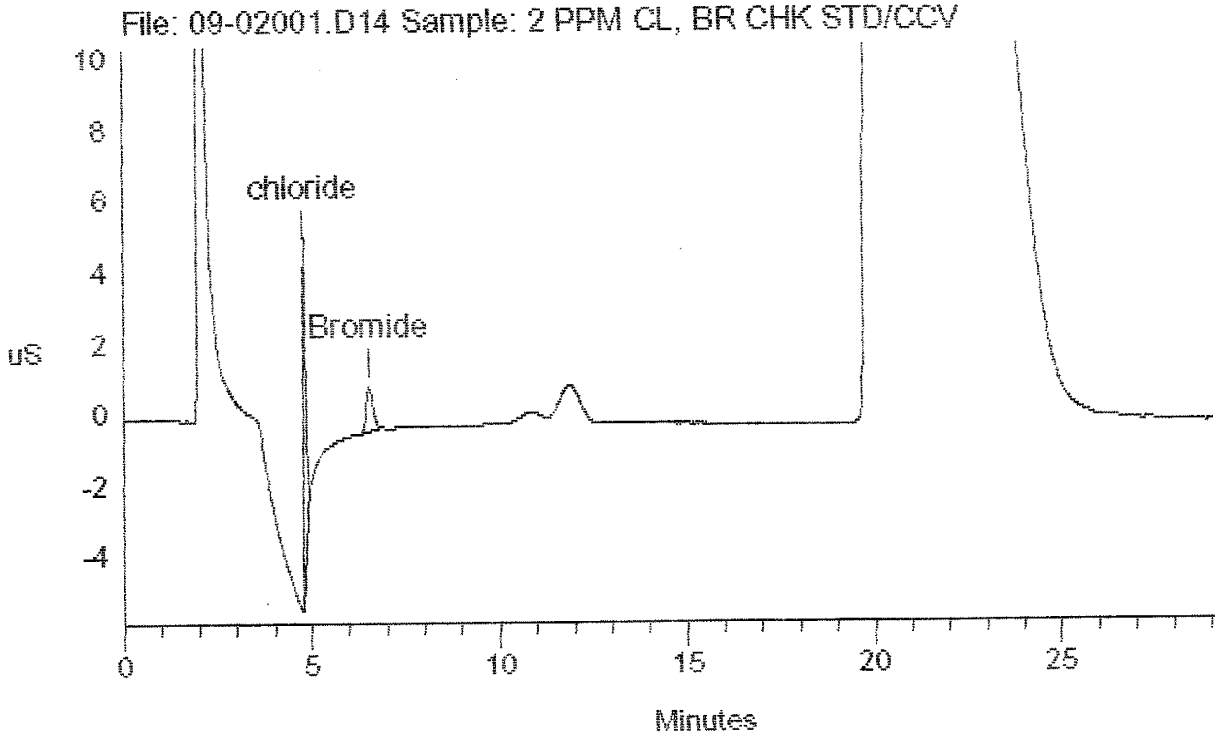
Data Reprocessed On 09/05/2005 13:36:47

Sample Name: 2 PPM CL, BR CHK STD/CCV	Date: 09/02/2005 16:08:36
Data File : C:\DX\DATA\ANIONS\05-233T1\09-02001.D14	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 14	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8729	5Hz	0.00	29.10	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.82	chloride	38873868	9335963	2.018
6.55	Bromide	15764062	1230843	2.082
	Totals	54637930	10566806	4.100



METCO ENVIRONMENTAL

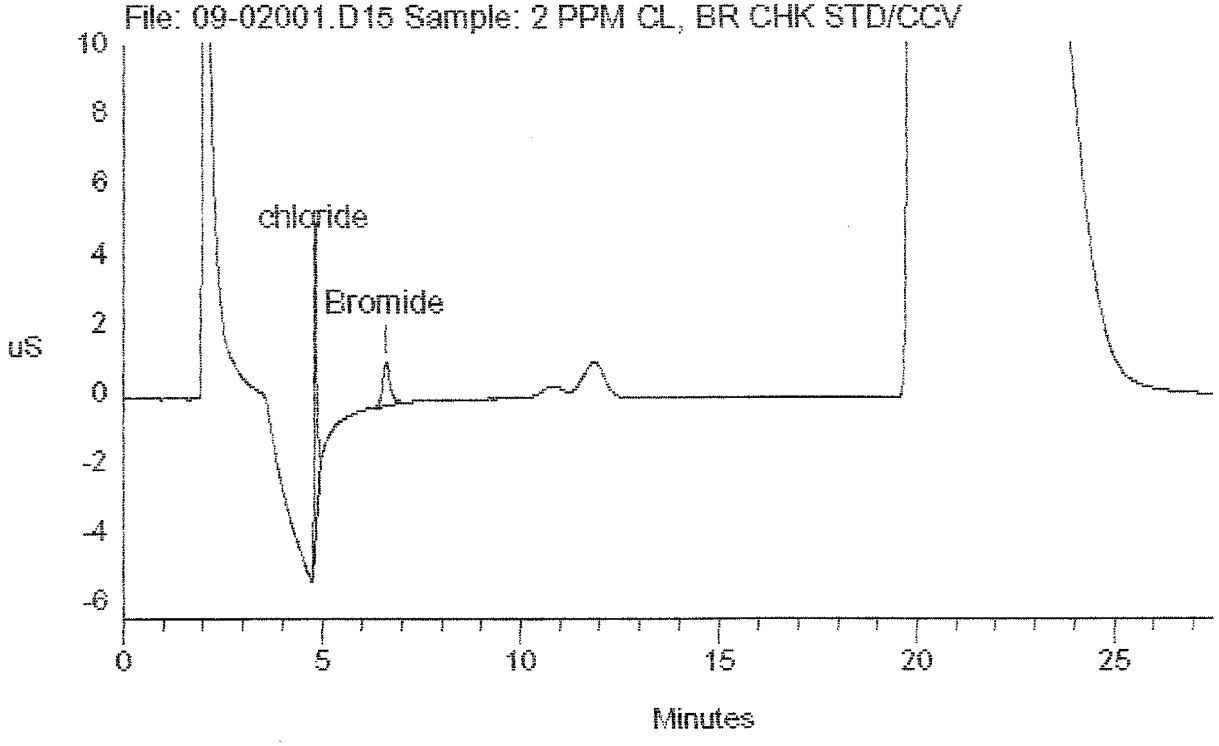
Data Reprocessed On 09/05/2005 13:37:05

Sample Name: 2 PPM CL, BR CHK STD/CCV	Date: 09/02/2005 16:38:58
Data File : C:\DX\DATA\ANIONS\05-233T1\09-02001.D15	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 15	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	27.53		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.82	chloride	39771578	7997818	2.061
6.60	Bromide	15599360	1208072	2.060
	Totals	55370938	9205891	4.121



METCO ENVIRONMENTAL

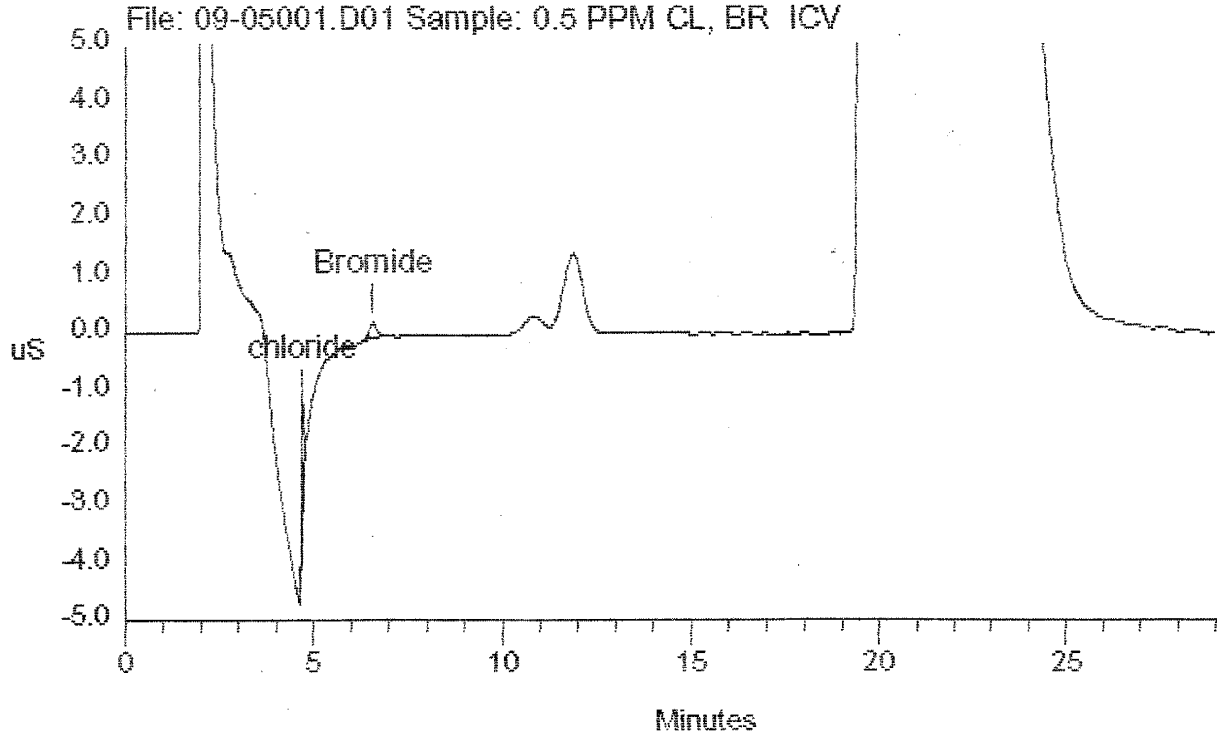
Data Reprocessed On 09/05/2005 13:40:36

```
==============================================================================
| Sample Name: 0.5 PPM CL, BR  ICV            Date: 09/05/2005 09:39:35      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-05001.D01                       |
| Method     : C:\DX\METHOD\HCLLO2.MET                                       |
| ACI Address: 1  System: 1  Inject#: 1                   Detector:CDM-2     |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                 |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.70	chloride	7320000	2163500	0.497
6.58	Bromide	3700651	278290	0.501
	Totals	11020651	2441790	0.998



METCO ENVIRONMENTAL

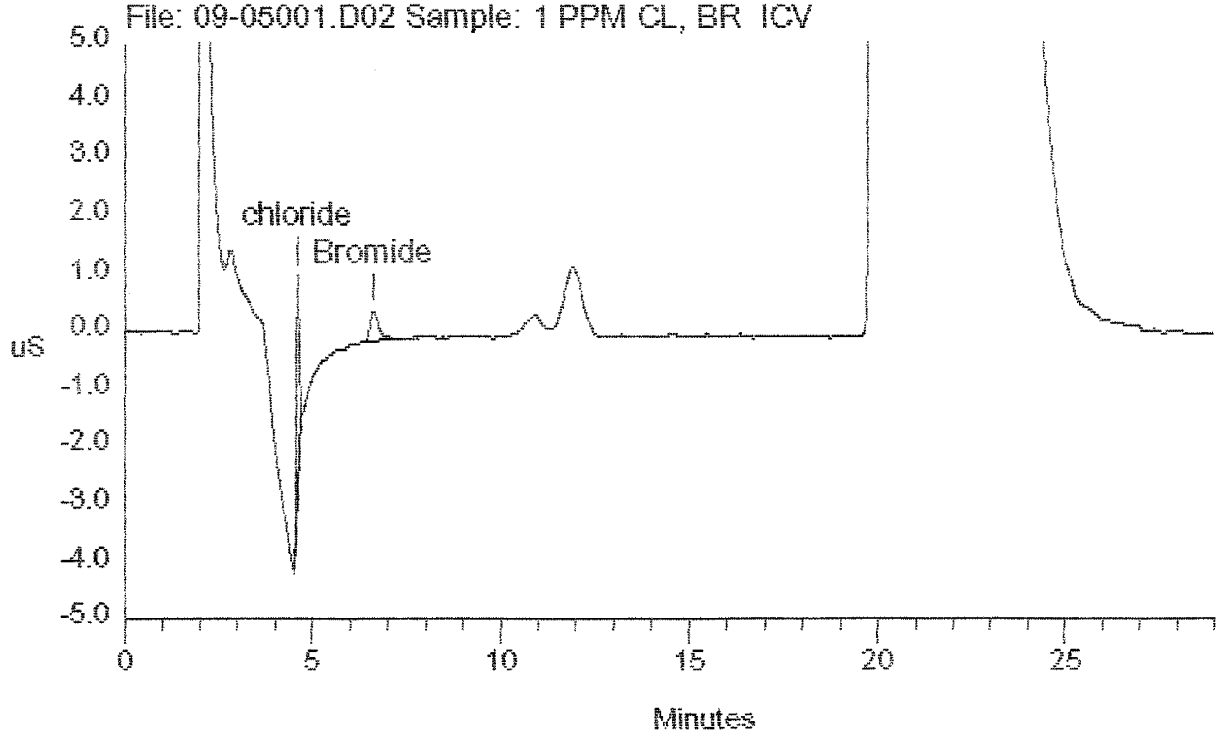
Data Reprocessed On 09/05/2005 13:40:47

Sample Name: 1 PPM CL, BR ICV	Date: 09/05/2005 10:09:57
Data File : C:\DX\DATA\ANIONS\05-233T1\09-05001.D02	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 2	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.60	chloride	19258910	4143218	1.056
6.60	Bromide	8139026	516815	0.986
	Totals	27397936	4660032	2.042



METCO ENVIRONMENTAL

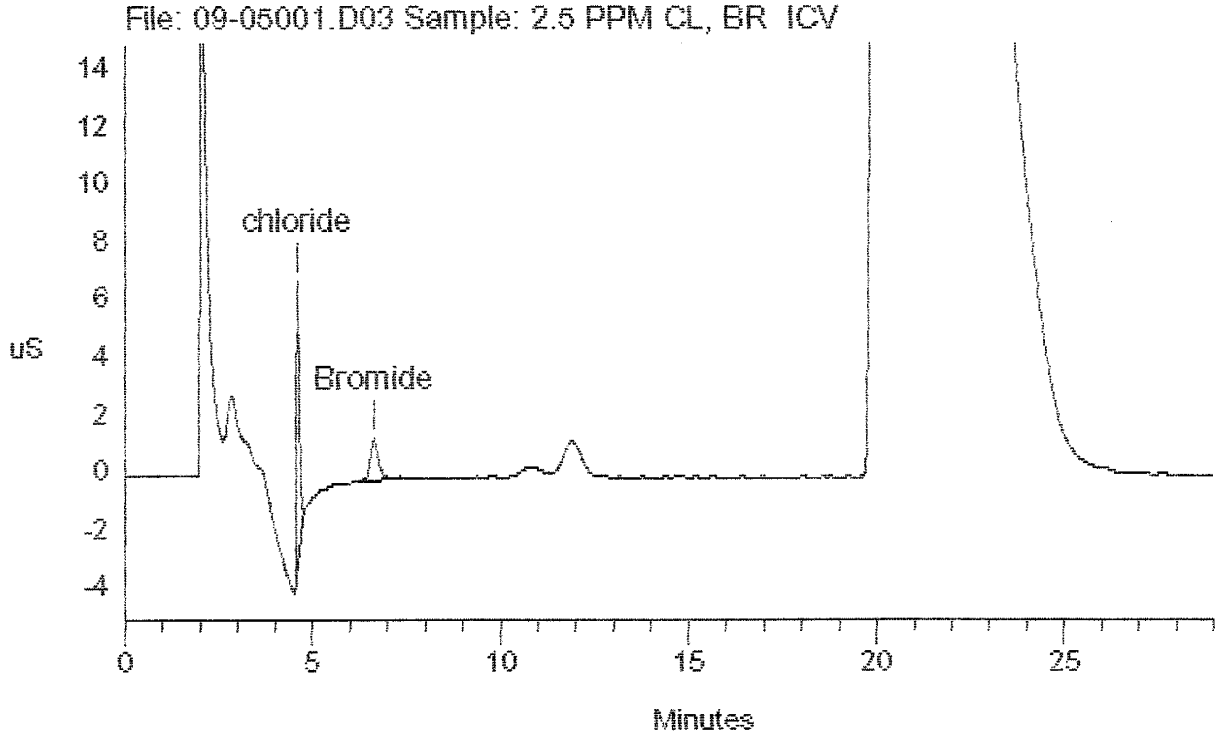
Data Reprocessed On 09/05/2005 13:41:04

```
==============================================================================
¦ Sample Name: 2.5 PPM CL, BR  ICV            Date: 09/05/2005 10:40:18      ¦
¦ Data File  : C:\DX\DATA\ANIONS\05-233T1\09-05001.D03                       ¦
¦ Method     : C:\DX\METHOD\HCLLO2.MET                                       ¦
¦ ACI Address: 1  System: 1  Inject#: 3                   Detector:CDM-2     ¦
¦ Analyst    :                Column: AS14,4mm, STD 1-12-01                 ¦
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	29.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.60	chloride	50308270	10071529	2.569
6.63	Bromide	21331132	1417551	2.504
	Totals	71639402	11489080	5.073



METCO ENVIRONMENTAL

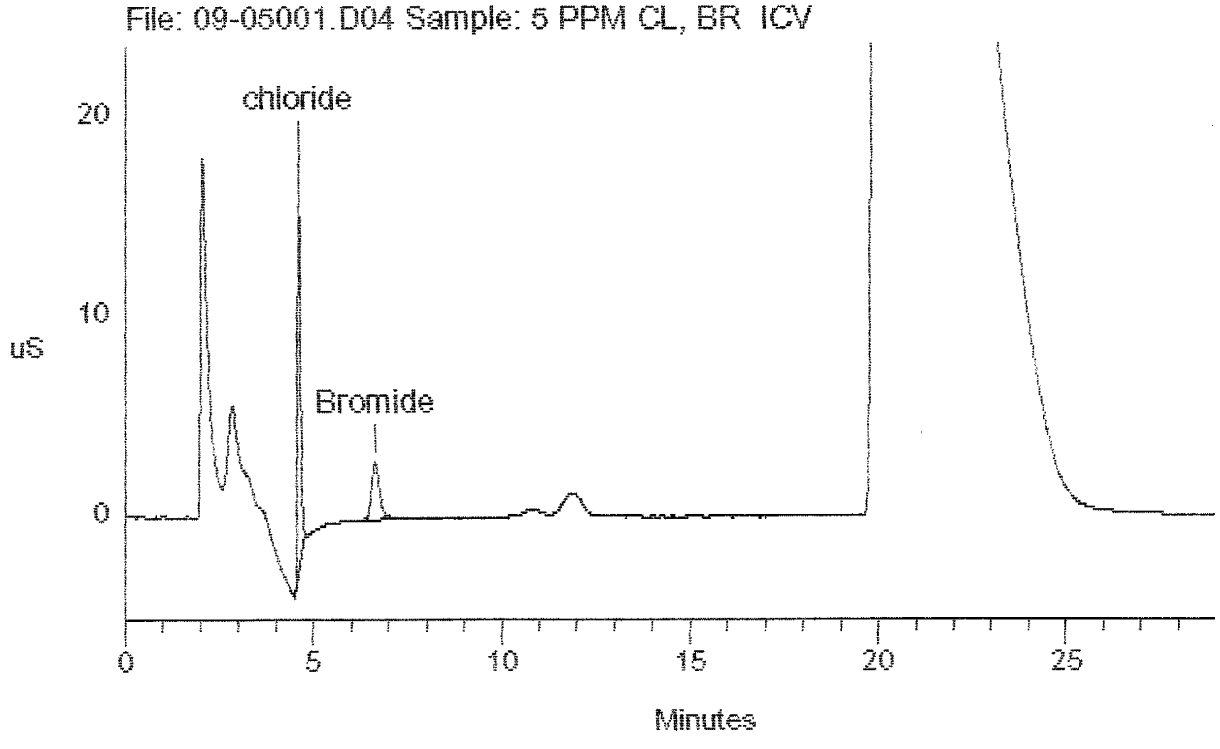
Data Reprocessed On 09/05/2005 13:41:24

```
==============================================================================
| Sample Name: 5 PPM CL, BR  ICV                Date: 09/05/2005 11:10:39     |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-05001.D04                        |
| Method     : C:\DX\METHOD\HCLLO2.MET                                        |
| ACI Address: 1  System: 1  Inject#: 4                     Detector:CDM-2    |
| Analyst    :                  Column: AS14,4mm, STD 1-12-01                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	28.99	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.60	chloride	105110262	21112794	5.060
6.63	Bromide	42130460	2865988	5.053
	Totals	147240722	23978782	10.113



METCO ENVIRONMENTAL

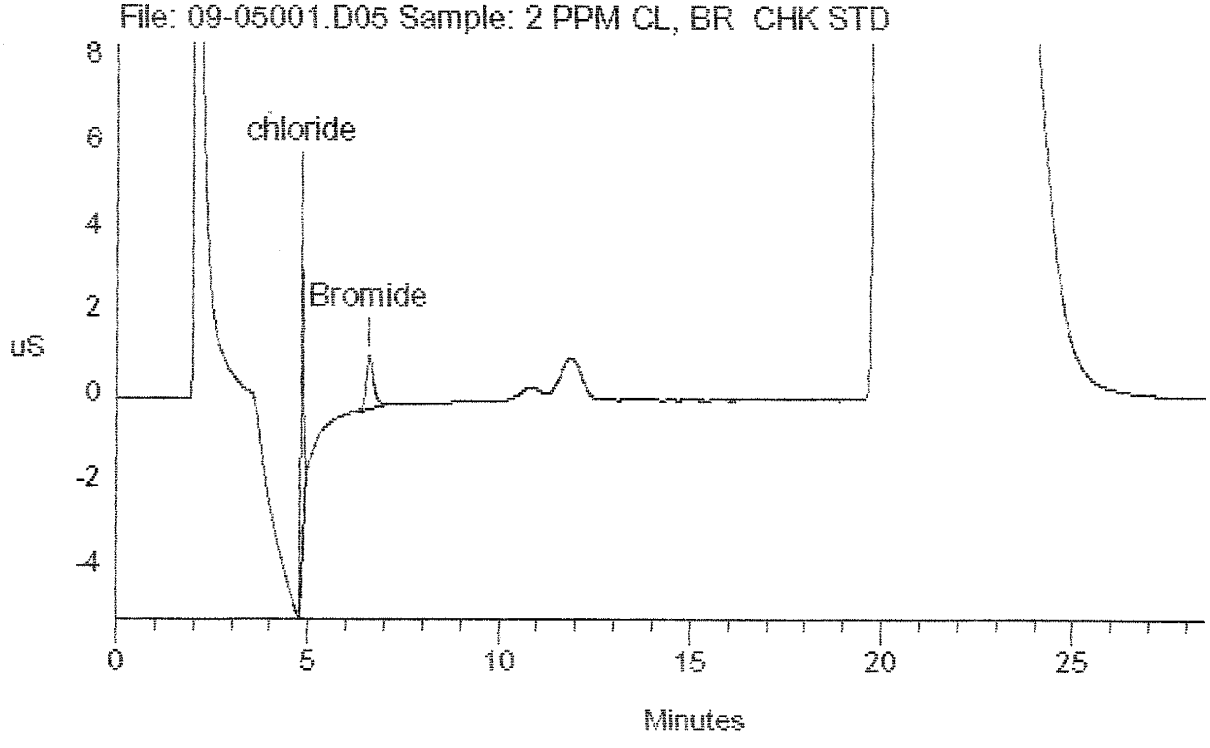
Data Reprocessed On 09/05/2005 13:41:40

Sample Name: 2 PPM CL, BR CHK STD	Date: 09/05/2005 11:41:00
Data File : C:\DX\DATA\ANIONS\05-233T1\09-05001.D05	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 5	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	28.50		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.82	chloride	39360130	9236926	2.003
6.60	Bromide	17023426	1233145	1.996
	Totals	56383556	10470071	3.999



METCO ENVIRONMENTAL

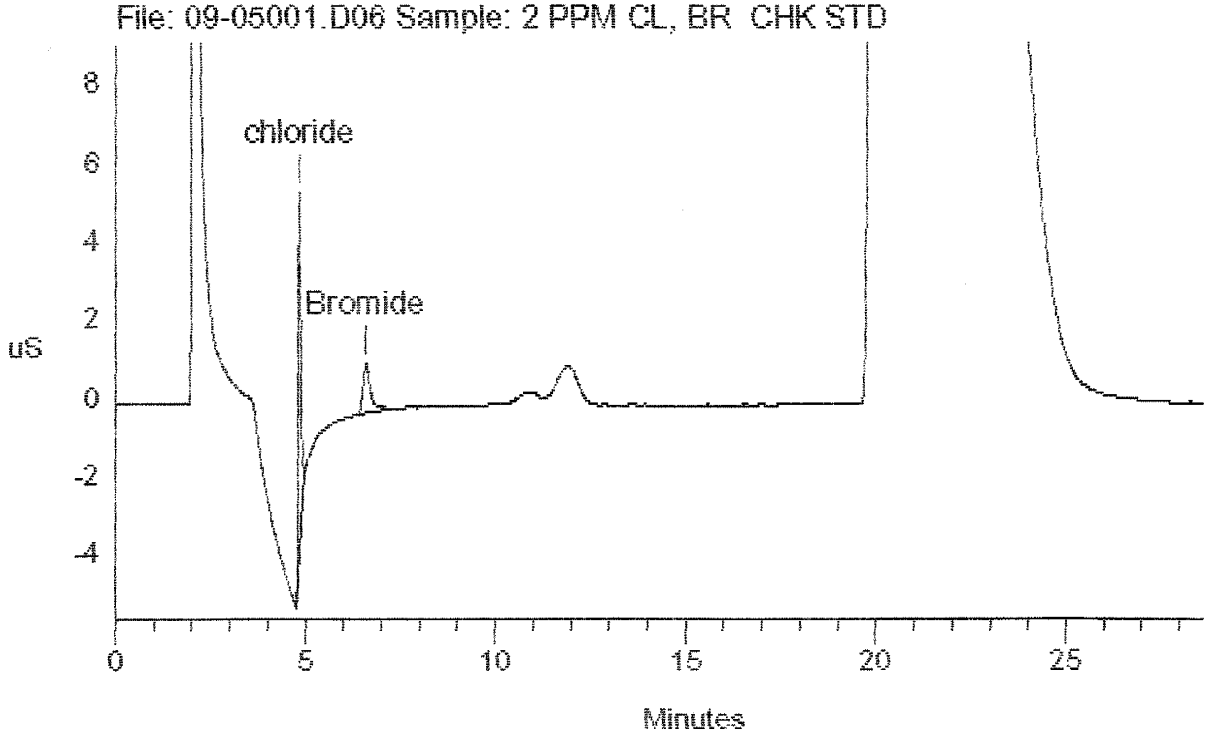
Data Reprocessed On 09/05/2005 13:41:56

```
==============================================================================
| Sample Name: 2 PPM CL, BR  CHK STD          Date: 09/05/2005 12:11:19      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\09-05001.D06                       |
| Method     : C:\DX\METHOD\HCLLO2.MET                                       |
| ACI Address: 1  System: 1  Inject#: 6                   Detector:CDM-2     |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                 |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	28.67		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.83	chloride	39852730	9641636	2.026
6.58	Bromide	17750934	1222702	2.080
	Totals	57603664	10864339	4.106



METCO ENVIRONMENTAL

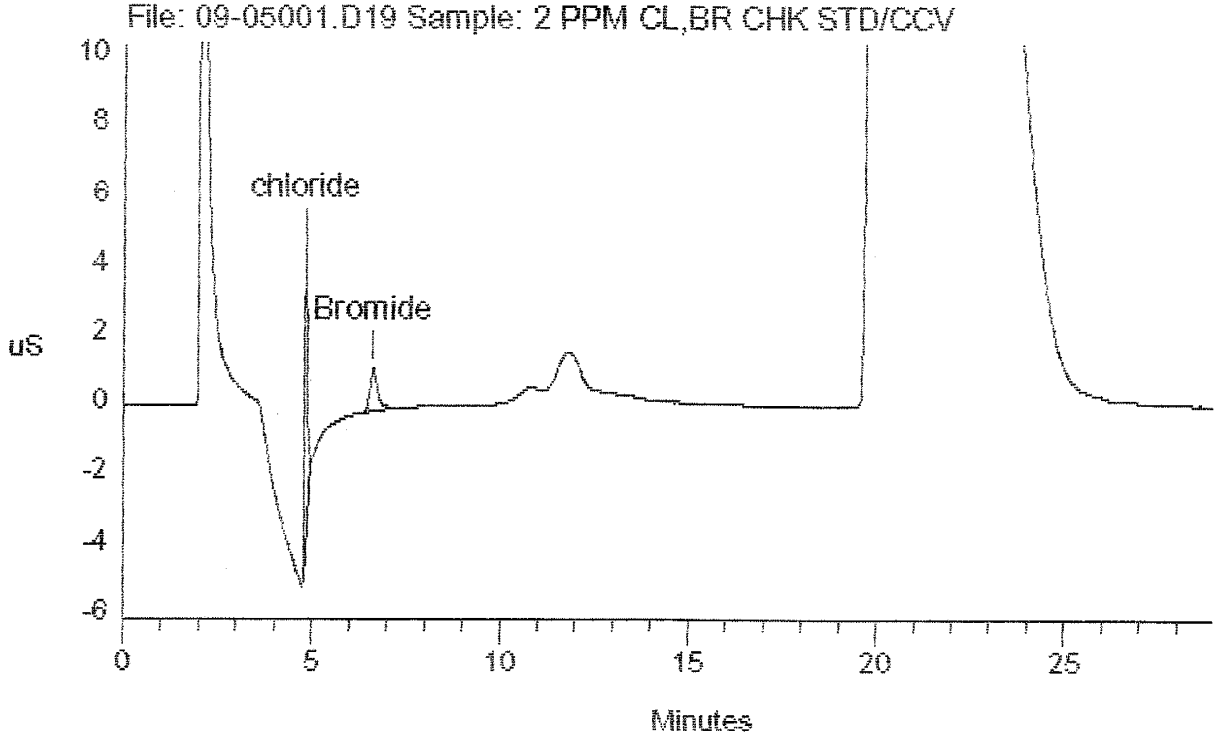
Data Reprocessed On 09/06/2005 07:17:50

Sample Name: 2 PPM CL,BR CHK STD/CCV	Date: 09/05/2005 18:45:54
Data File : C:\DX\DATA\ANIONS\05-233T1\09-05001.D19	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 19	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	28.99	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.80	chloride	41388190	8849158	2.097
6.62	Bromide	17083977	1197124	2.003
	Totals	58472167	10046282	4.100



METCO ENVIRONMENTAL

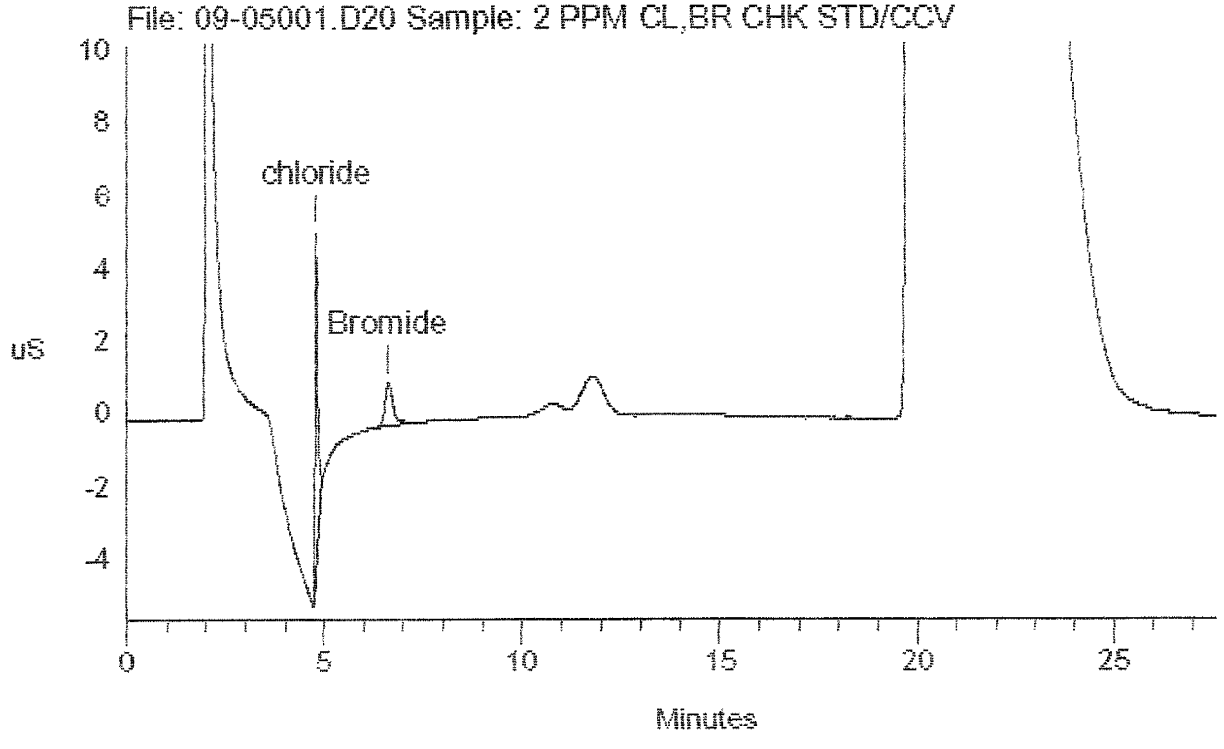
Data Reprocessed On 09/06/2005 07:18:05

Sample Name: 2 PPM CL,BR CHK STD/CCV	Date: 09/05/2005 19:16:15
Data File : C:\DX\DATA\ANIONS\05-233T1\09-05001.D20	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 20	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	27.61		2000

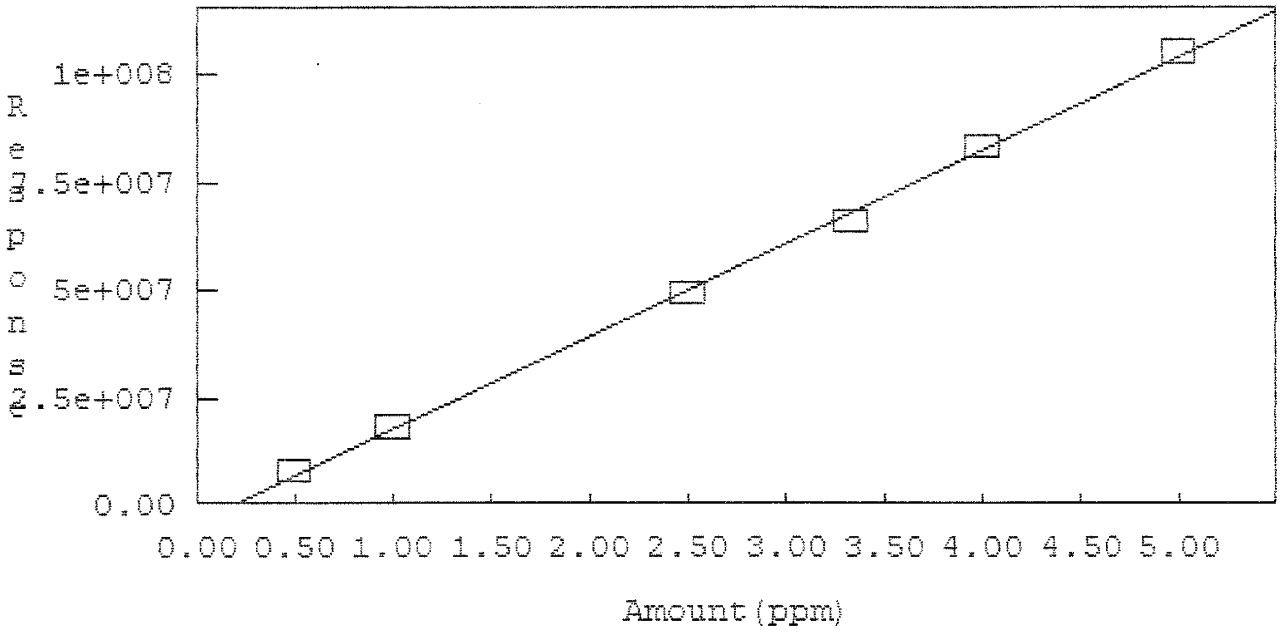
********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.80	chloride	40671966	9328772	2.064
6.62	Bromide	17140840	1185122	2.009
	Totals	57812806	10513893	4.073



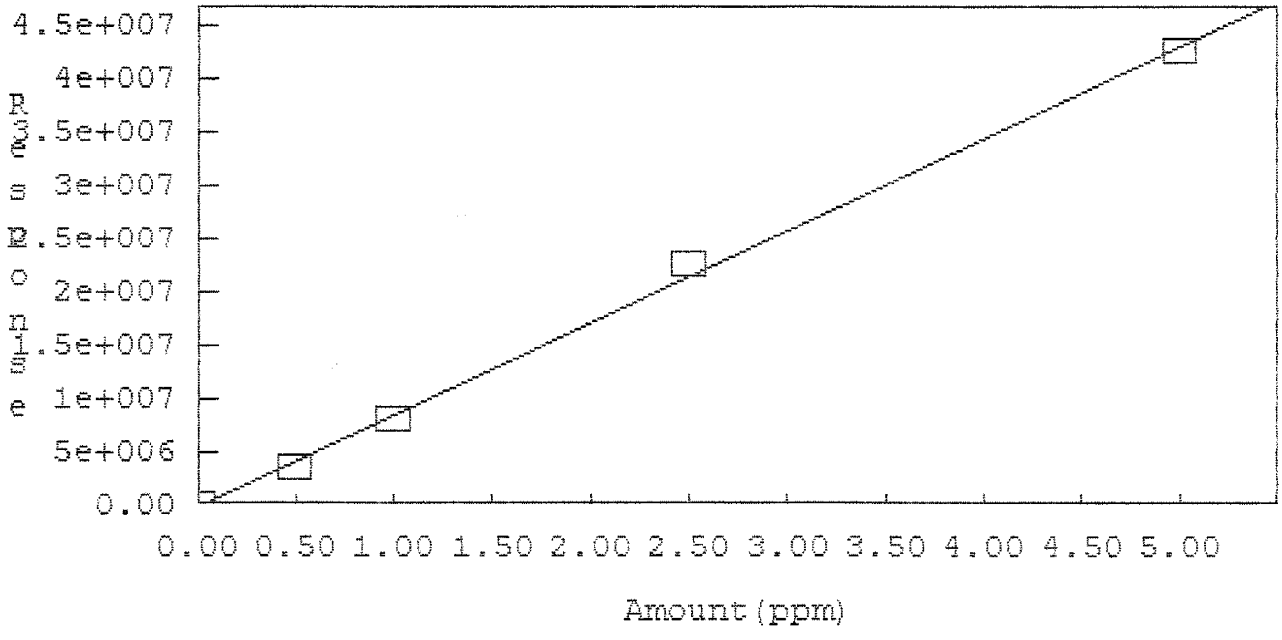
Method: HCLLO2.MET - Last Updated: 11:50 on Mon, 05 Sep 2005

Component: chloride
Fit Type: Linear
r^2 = 0.998999
Amt = Resp * 4.637e-008 + 0.178
Resp = Amt * 2.156e+007 + -3.838e+006
Standardization: External
Calibration: Area



Method: HCLLO2.MET - Last Updated: 11:50 on Mon, 05 Sep 2005

Component: Bromide
Fit Type: Linear
r^2 = 0.998482
Amt = Resp * 1.16e-007 + 0.0218
Resp = Amt * 8.624e+006 + -1.88e+005
Standardization: External
Calibration: Area



RICCA CHEMICAL COMPANY

PO Box 13090 Arlington, TX 76094 | http://www.riccachemical.com | 1-888-GO-RICCA | customerservice@riccachemical.com

Fluoride Standard, 1 mL = 1 mg F-, 1000 ppm F-

Lot Number: 1411654 Product Number: 3173 Expiration Date: MAY 2006 Manufacture Date:11/30/2004

The certified value reported is the prepared value based upon the method of preparation of the material. The uncertainty in the prepared value is based upon the volumetric method of preparation.

Contains:

Name	CAS#	Grade
Sodium Fluoride, NaF	7681-49-4	High Purity
Water, Deionized, H2O	7732-18-5	ACS, ASTM D 1193 (Type I), EP, USP

Test Name	Assay Method	Specification	Result
Appearance	Clarity, Color, Odor	Clear, colorless, odorless	Passed Test
Certified Concentration	Based on accurate volumetric preparation	1000 ± 5 ppm F-	1000 ppm F-

Specification	Reference	Method Number
Fluoride Solution, Stock (1.00 mL = 1.00 mg F)	ASTM	D 5996
Fluoride Calibration Stock Solution (1,000 mg/L F-)	EPA (SW-846)	9214
Fluoride Stock Solution (1.00 mL = 1.00 mg F-)	EPA (SW-846)	9056
Fluoride Stock Solution (1.00 mL = 1.00 mg F?)	ASTM	D 4327
Stock Solution, 1.0 mL = 1.0 mg F	EPA	340.3
Fluoride Solution, Stock (1.00 mL = 1.00 mg F)	ASTM	D 5542
Fluoride Stock Standard Solution (1 mg of F in 1 mL)	ACS	

Volumetric glassware complies with Class A tolerance requirements of ASTM E 288 and NIST Circular 434; it is calibrated before first use and recalibrated regularly in accordance with ASTM E 542 and NIST Procedure NBSIR 74-461. Balances are calibrated regularly with weights certified traceable to the NIST national mass standard. Thermometers and temperature probes are calibrated before first use and recalibrated regularly with a thermometer traceable to NIST standards. All products are prepared according to master documents that assure manufacture according to validated methods. Batch records document raw material traceability and production and testing history for each lot manufactured.

Shelf Life (unopened container):

Part Number	Shelf Life
3173-4	18 months
3173-32	18 months
3173-16	18 months

Recommended Storage: 15°C - 30°C (59°F - 86°F)

Joan Lutkenhaus

Joan Lutkenhaus
Director of Quality Assurance and Regulatory Affairs

This Certificate of Analysis is designed to comply with ISO Guide 31 "Reference Materials – Contents of Certificates and Labels." To determine manufacturing site using lot number, visit www.riccachemical.com/AboutUs/lot.pdf.

Version: 1

RICCA CHEMICAL COMPANY

PO Box 13090 Arlington, TX 76094 | http://www.riccachemical.com | 1-888-GO-RICCA | customerservice@riccachemical.com

Chloride Standard, 1 mL = 1 mg Cl-, 1000 ppm Cl- (0.0282 Normal)

Lot Number: 1412008 Product Number: 1955 Expiration Date: MAY 2006 Manufacture Date:12/1/2004

Contains:

Name	CAS#	Grade
Sodium Chloride, NaCl	7647-14-5	ACS
Water, Deionized, H2O	7732-18-5	ACS, ASTM D 1193 (Type I), EP, USP

Test Name	Assay Method	Specification	Result
Appearance	Clarity, Color, Odor	Clear, colorless, odorless	Passed Test
Assay at 20°C (traceable to NIST SRM 999)	Titrimetric vs. Silver Nitrate (Potassium Chromate Indicator)	1000 ± 1 ppm Cl	999 ppm Cl

Specification	Reference	Method Number
Chloride Solution, Stock (1.00 mL = 1.00 mg Cl)	ASTM	D 5996
Chloride Calibration Stock Solution (1,000 mg/L Cl-)	EPA (SW-846)	9212
Chloride Stock Solution (1.00 mL = 1.00 mg Cl-)	EPA (SW-846)	9056
Chloride solution (1000 ppm)	TAPPI	T 699 om-87
Chloride solution (1000 ppm)	TAPPI	T 700 om-93
Chloride Stock Solution (1.00 mL = 1.00 mg Cl-)	ASTM	D 4327
Sodium Chloride, NaCl, stock standard solution	EPA (SW-846)	9057
Sodium Chloride Calibration Standard (1 µg Cl-/µL)	EPA (SW-846)	9021
Sodium Chloride Calibration Standard (1 µg Cl-/µL)	EPA (SW-846)	9023
Sodium Chloride Solution, 1 mL = 1 mg Cl-	ASTM	D 4458
Chloride Solution, Stock (1000 mg/L)	ASTM	D 512 C
Chloride Solution Stock (1.00 mL = 1.00 mg chloride)	ASTM	D 5542
Standard Chloride Solution, 1000 mg/L	APHA	4110 B
Stock Chloride Solution	APHA	4500-Cl- E

Volumetric glassware complies with Class A tolerance requirements of ASTM E 288 and NIST Circular 434; it is calibrated before first use and recalibrated regularly in accordance with ASTM E 542 and NIST Procedure NBSIR 74-461. Balances are calibrated regularly with weights certified traceable to the NIST national mass standard. Thermometers and temperature probes are calibrated before first use and recalibrated regularly with a thermometer traceable to NIST standards. All products are prepared according to master documents that assure manufacture according to validated methods. Batch records document raw material traceability and production and testing history for each lot manufactured.

Shelf Life (unopened container):

Part Number	Shelf Life
1955-4	18 months
1955-8	18 months
1955-16	18 months

Recommended Storage: 15°C - 30°C (59°F - 86°F)

Version: 1

Joan Lutkenhaus
Director of Quality Assurance and Regulatory Affairs

This Certificate of Analysis is designed to comply with ISO Guide 31 "Reference Materials -- Contents of Certificates and Labels." To determine manufacturing site using lot number, visit www.riccachemical.com/AboutUs/lot.pdf.

Version: 1

RICCA CHEMICAL COMPANY

PO Box 13090 Arlington, TX 76094 | http://www.riccachemical.com | 1-888-GO-RICCA | customerservice@riccachemical.com

Bromide Standard, 1 mL = 1 mg Br-, 1000 ppm Br-

Lot Number: 1508179 Product Number: 1180 Expiration Date: JAN 2007 Manufacture Date:8/5/2005

The certified value reported is the prepared value based upon the method of preparation of the material. The uncertainty in the prepared value is based upon the volumetric method of preparation.

Contains:

Name	CAS#	Grade
Sodium Bromide, NaBr	7647-15-6	High Purity
Water, Deionized, H2O	7732-18-5	ACS, ASTM D 1193 (Type I), EP, USP

Test Name	Assay Method	Specification	Result
Appearance	Clarity, Color, Odor	Clear, colorless, odorless	Passed Test
Certified Concentration	Based on accurate volumetric preparation	1000 ± 5 ppm Br	1000 ppm Br

Specification	Reference	Method Number
Bromide Solution, Standard (1 mL = 1 mg Br-)	ASTM	D 3869 D
Bromide Stock Solution (1.00 mL = 1.00 mg Br-)	EPA (SW-846)	9056
Bromide Stock Solution (1.00 mL = 1.00 mg Br?)	ASTM	D 4327
Sodium Bromide Standard Solution, 1000 mg/L	ASTM	D 1246
Standard Bromide Solution, 1000 mg/L	APHA	4110 B

Volumetric glassware complies with Class A tolerance requirements of ASTM E 288 and NIST Circular 434; it is calibrated before first use and recalibrated regularly in accordance with ASTM E 542 and NIST Procedure NBSIR 74-461. Balances are calibrated regularly with weights certified traceable to the NIST national mass standard. Thermometers and temperature probes are calibrated before first use and recalibrated regularly with a thermometer traceable to NIST standards. All products are prepared according to master documents that assure manufacture according to validated methods. Batch records document raw material traceability and production and testing history for each lot manufactured.

Shelf Life (unopened container):

Part Number	Shelf Life
1180-4	18 months
1180-8	18 months
1180-16	18 months

Recommended Storage: 15°C - 30°C (59°F - 86°F)

Joan Lutkenhaus

Joan Lutkenhaus
Director of Quality Assurance and Regulatory Affairs

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Version: 1

METCO ENVIRONMENTAL

Data Reprocessed On 09/05/2005 12:17:09

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==============================================================================
| Sample Name: LAB WATER BLANK                Date: 08/29/2005 10:04:38      |
| Data File  : C:\DX\DATA\ANIONS\05-233T1\08-29001.D02                       |
| Method     : C:\DX\METHOD\HCL2.MET                                         |
| ACI Address: 1  System: 1  Inject#: 2                   Detector:CDM-2     |
| Analyst    :     .          Column: AS14,4mm, STD 2-21-05                  |
==============================================================================
```
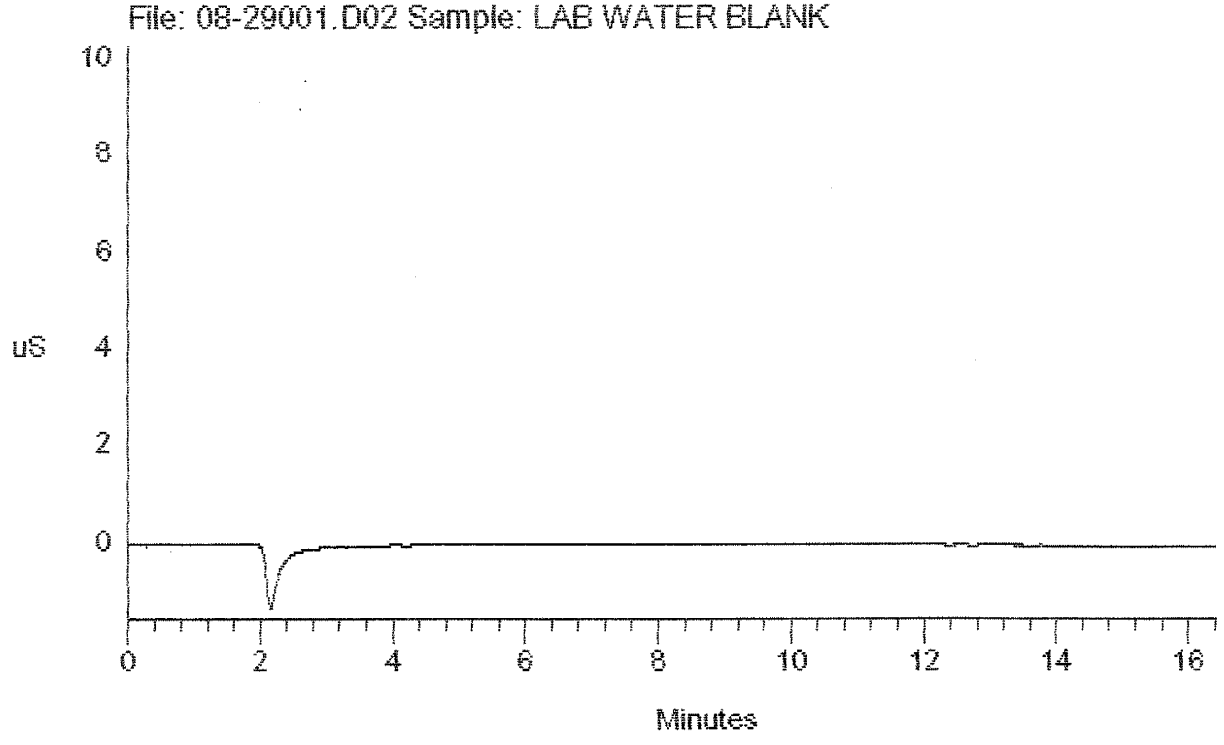

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	4930	5Hz	0.00	16.43		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

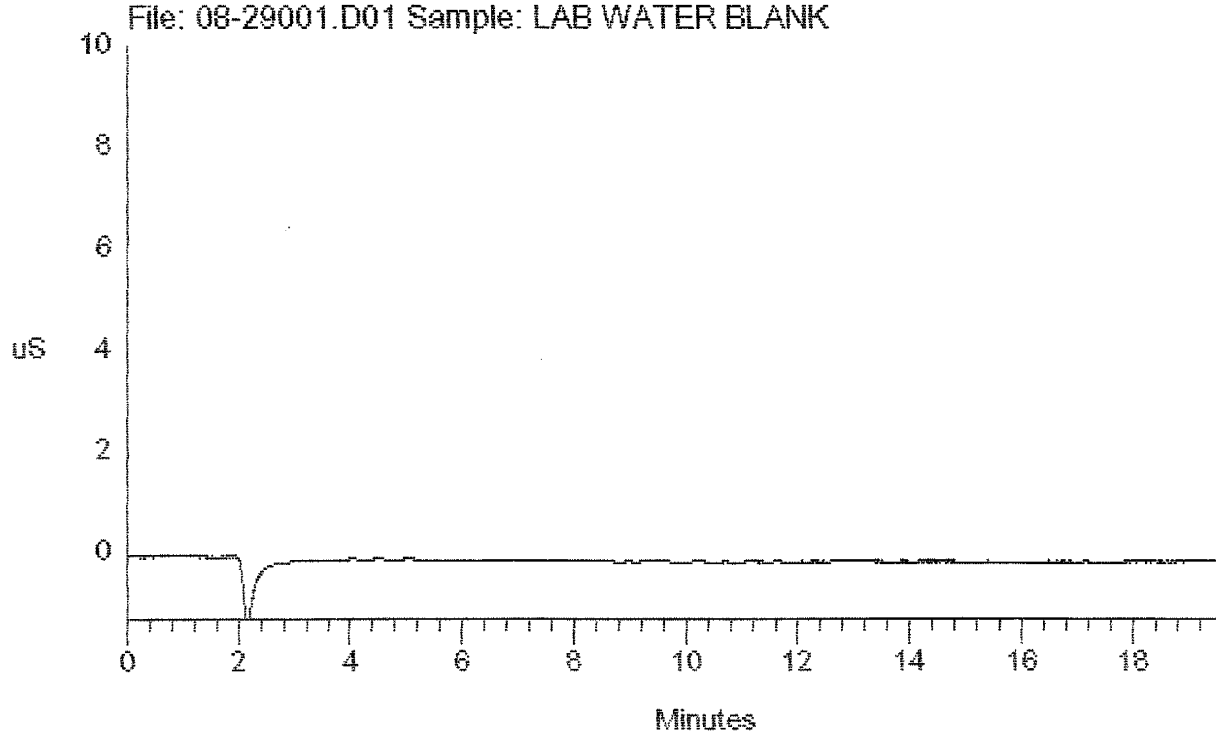
Data Reprocessed On 09/05/2005 12:17:22

Sample Name: LAB WATER BLANK	Date: 08/29/2005 09:34:26
Data File : C:\DX\DATA\ANIONS\05-233T1\08-29001.D01	
Method : C:\DX\METHOD\HCL2.MET	
ACI Address: 1 System: 1 Inject#: 1	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 2-21-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	5850	5Hz	0.00	19.50		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



Data Analysis Technologies, Inc.
7715 Corporate Blvd.
Plain City, OH 43064
NELAP/LELAP Certification 03027

Sample Analysis Certificate

Client:	Metco Environmental	Date:	9/15/05
Address:	3226 Commander Drive	DAT Project #:	0805035
	Carrollton, TX 75006	Sample Date:	8/17-19/05
		Date Received:	8/25/05
		Date Analyzed:	9/13/05
		Analyst:	DE

Attn: Mike Hutcherson
Your Project: 05-233 Tank 1
Sampled By: S.B. / R.M.

Analysis: Mercury
Method: Ontario Hydro

Results: See attached summary tables.

QC: Met criteria for the method.

Reviewed and approved for release by: _____ Date: 9/15/05
President *DAT* Inc.

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Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 0805035
Client: Metco Environmental
Site: ADA-ES

Prep Date: 9/12/05
Analysis Date: 9/13/05

Client ID	DAT ID	*MDL*	Hg Total ug	Q
Inlet Run 1				
Filter/Cont 2	0805035- 1,2	*0.02*	0.52	
Cont. 3b	0805035- 3ab	*0.03*	12.6	
Cont. 4	0805035- 4	*0.32*	ND	
Cont. 5	0805035- 5	*0.09*	7.95	
Inlet Run 2				
Filter/Cont 2	0805035- 6,7	*0.02*	0.60	
Cont. 3b	0805035- 8ab	*0.04*	3.81	
Cont. 4	0805035- 9	*0.25*	0.26	
Cont. 5	0805035- 10	*0.09*	9.04	
Inlet Run 3				
Filter/Cont 2	0805035- 11,12	*0.02*	0.57	
Cont. 3b	0805035- 13ab	*0.05*	3.12	
Cont. 4	0805035- 14	*0.25*	ND	
Cont. 5	0805035- 15	*0.08*	7.96	
Run 1-5c/5b Solids	0805035- 18 dup	*0.04*	2000.00	

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 0805035
Client: Metco Environmental
Site: ADA-ES

Prep Date: 9/12/05
Analysis Date: 9/13/05

Client ID	DAT ID	*MDL*	Hg Total ug	Q	Dup Result Total ug
Outlet Run 1					
Filter/Cont 2	0805035- 16,17	*0.02*	ND		
Cont. 3b	0805035- 18ab	*0.03*	6.27		
Cont. 4	0805035- 19	*0.32*	ND		
Cont. 5	0805035- 20	*0.09*	5.62		
Outlet Run 2					
Filter/Cont 2	0805035- 21,22	*0.02*	0.10		
Cont. 3b	0805035- 23ab	*0.04*	6.37		
Cont. 4	0805035- 24	*0.25*	ND		
Cont. 5	0805035- 25	*0.09*	8.05		
Outlet Run 3					
Filter/Cont 2	0805035- 26,27	*0.02*	0.18		
Cont. 3b	0805035- 28ab	*0.05*	3.92		
Cont. 4	0805035- 29	*0.25*	ND		
Cont. 5	0805035- 30	*0.08*	8.21		8.24
Cont. 5	0805035- 30 Dup	*0.08*	8.24		

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 0805035
Client: Metco Environmental
Site: ADA-ES

Prep Date: 9/12/05
Analysis Date: 9/13/05

Client ID	DAT ID	*MDL*	Hg Total ug	Q
Blank Train				
Filter/Cont 2	0805035- 31,32	*0.02*	ND	
Cont. 3a	0805035- 33	*0.09*	ND	
Cont. 3b	0805035- 34	*0.46*	ND	
Cont. 4	0805035- 35	*0.03*	ND	
Reagent Blanks				
Cont. 7,12	0805035- 36,41	*0.02*	ND	
Cont. 8	0805035- 37	*0.09*	ND	
Cont. 9	0805035- 38	*0.46*	ND	
Cont. 10	0805035- 39	*0.03*	ND	
Cont. 11	0805035- 40	*0.08*	ND	

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 0805035
Client: Metco Environmental
Site: ADA-ES

Prep Date: 9/12/05
Analysis Date: 9/13/05

Thimble/Filter ID	DAT ID	Weight g
Inlet Run 1	0805035-1	4.8172
Inlet Run 2	0805035-6	6.7537
Inlet Run 3	0805035-11	7.5470
Outlet Run 1	0805035-16	3.2145
Outlet Run 2	0805035-21	3.1903
Outlet Run 3	0805035-26	3.1491
Blank Train	0805035-31	2.9452
Reagent Blank Cont. 12	0805035-41	3.1271

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 0805035
Client: Metco Environmental
Site: ADA-ES

Prep Date: 9/12/05
Analysis Date: 9/13/05

QC Summary		Hg ug/L	% Rec	%RPD
Front Method Blank	0805035-MB Front	0.05 ND		
Back Method Blank	0805035-MB Back	0.05 ND		
Laboratory Spike	0805035-LS Front	14.5	145	
Laboratory Spike	0805035-LS Back	11.4	114	
Matrix Spike	0805035-5 MS	9.80	98	
	0805035-5 MSD	10.11	101	3.1
Matrix Spike	0805035-13b MS	11.29	113	
	0805035-13b MSD	11.39	114	0.9
Duplicate Results	0805035-30	8.21		
	0805035-30	8.24		0.4

ND = Not detected at the detection limit shown.

DOCUMENTATION

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 task 1
Job Name: ADA-ES
Location: Newark, AR MD
Unit: Unit 2 ESP Inlet Duct

Project Manager: S. Bowden
Project Supervisor: S. Bowden

Method: OH ASTM D6784-02

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3		~~PM~~ Hg	Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Cont 1 Filter	8-17-05	1640	1									✓	[illegible]	
Run 1 Cont 2 Front Half Rinse		1635	1									✓	[illegible]	
Run 1 Cont 3 Backhalf Rinse + Imp 1,2,3		1835	2	KCl solution	300ml							✓	[illegible]	
Run 1 Cont 4 Imp 4		1841	1	HNO_3 / H_2O_2	100ml							✓	[illegible]	
Run 1 Cont 5 Imp. 5,6,7		1849	1	Acid $KMnO_4$	300ml							✓	[illegible]	
Run 2 Cont 1 Filter	8-17-05	2125	1									✓	[illegible]	
Run 2 Cont Front Half Rinse		2130	1									✓	[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Shipped Via: Fed Ex [illegible]	Date: 8/23/05	Time: 0910
Samples Received at Laboratory by: [illegible]	Date: 8/25/05	Time: 1210
Samples Analyzed by:	Date:	Time:
Samples Analyzed by:	Date:	Time:
Data Checked by:	Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 task 1
Job Name: ADA-ES
Location: Newark, AR - SND
Unit: Unit 2 ESP Inlet Duct

Project Manager: S. Bonner
Project Supervisor: S. Bonner
Method: 0#

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3		Hg	Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Cont 3 Backhalf & Imp 1,2,3	8-17-05	2215	2	KCl	300ml							✓	[illegible]	
Run 2 Cont 4 Imp. 4		2210	1	HNO_3 / H_2O_2	100ml							✓	[illegible]	
Run 2 Cont 5 Imp. 5,6,7		2206	1	Acid $KMnO_4$	300ml							✓	[illegible]	
Run 3 Cont 1 Filter	8-18-05	1435	1									✓	[illegible]	
Run 3 Cont 2 Front wash		1438	1									✓	[illegible]	
Run 3 Cont. 3 Backhalf & Imp. 1,2,3		1506	2	KCl	300ml							✓	[illegible]	
Run 3 Cont. 4 Imp. 4		150[illegible]	1	HNO_3 / H_2O_2	100ml							✓	[illegible]	

Samples Received for Transport/Shipment by:	[illegible]	Date:	8-18-05	Time: 1700
Samples Received for Transport/Shipment by:		Date:		Time:
Samples Received for Transport/Shipment by:		Date:		Time:
Samples Shipped Via:	Fed Ex [illegible]	Date:	8/23/05	Time: 0910
Samples Received at Laboratory by:	[illegible]	Date:	8/25/05	Time: 1210
Samples Analyzed by:		Date:		Time:
Samples Analyzed by:		Date:		Time:
Data Checked by:		Date:		Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 Task 1
Job Name: ADA-ES
Location: Newark, AR - IND
Unit: Unit 2 ESP Inlet Duct

Project Manager: S. Bonner
Project Supervisor: S. Bonner
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3		Hg	Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 Cont. 5 Impg. 5,6,7	8.18.05	1507	1	Acid KMnO4	300ml							✓	[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Shipped Via: FedEx - [illegible]	Date: 8/23/05	Time: 0910
Samples Received at Laboratory by: [illegible]	Date: 8/23/05	Time: 1210
Samples Analyzed by:	Date:	Time:
Samples Analyzed by:	Date:	Time:
Data Checked by:	Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 Task 1
Job Name: ADA-ES
Location: Newark, AR - IND
Unit: Unit 2 ~~SCR~~ ESP Outlet Duct

Project Manager: S. Bornsen
Project Supervisor: S. Bornsen

Method: OH ASTM D 6784-02

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3		Hg	Recovered by	REMARKS (Specific Compounds/Methods)
~~Cont~~ Run 1 Cont 1 Filter	8-17-05	1620	1									✓	[illegible]	
Run 1 Cont 2 Front Half Rinse		1625	1									✓	[illegible]	
Run 1 Cont 3 Back Half Rinsed Imp 1,2,3		1904	2	KCl solution	300ml							✓	[illegible]	
Run 1 Cont 4 Imp. 4		1908	1	HNO_3/H_2O_2	100ml							✓	[illegible]	
Run 1 Cont 5 Imp 5,6,7		1918	1	Acid $KMnO_4$	300ml							✓	[illegible]	
Run 2 Cont 1 Filter	8-17-05	2145	1									✓	[illegible]	
Run 2 Cont 2 Front Half Rinse		2151	1									✓	[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 8-18-05	Time: 1700	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via: Fed Ex [illegible]	Date: 8/23/05	Time: 0910	
Samples Received at Laboratory by: [illegible]	Date: 8/25/05	Time: 1210	
Samples Analyzed by:	Date:	Time:	
Samples Analyzed by:	Date:	Time:	
Data Checked by:	Date:	Time:	

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 (Task 1)
Job Name: ADA-ES
Location: Newark, AR - IND
Unit: Unit 2 ESP Outlet Duct

Project Manager: S. Bensen
Project Supervisor: S. Donnan
Method: ~~[illegible]~~ OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3		Hg	Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Cont 3 Backhalf + Imp 1,2,3	8-17-05	2237	2	KCl	300ml							✓	R. Malone	
Run 2 Cont 4 Imp 4		2220	1	HNO_3/H_2O_2	100ml							✓	R. Malone	
Run 2 Cont 5 Imp 5,6,7		2226	1	Acid $KMnO_4$	300ml							✓	R. Malone	
Run 3 Cont. 1 Filter	8-18-05	1533	1									✓	R. Malone	
Run 3 Cont. 2 Frontheat		1536	1									✓	R. Malone	
Run 3 Cont. 3 Backhalf + Imp 1,2,3		1521	2	KCl	300ml							✓	[illegible]	
Run 3 Cont 4 Imp. 4		1513	1	H_2O_2/HNO_3	100ml							✓	[illegible]	

Samples Received for Transport/Shipment by:	[illegible]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	FedEx	Date: 8/23/05	Time: 0910
Samples Received at Laboratory by:	[illegible]	Date: 8/25/05	Time: 1210
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 Jankl
Job Name: ADA-ES
Location: Norwalk, Ark - Ind
Unit: Unit 2 ESP Outlet Duct

Project Manager: S. Bonzer
Project Supervisor: S. Bonzer

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	Mercury		Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 Cont 5 Imp 5,6,7	8/18/05	1522	1	KMNO4	300ml						✓		R. Mehner	

Samples Received for Transport/Shipment by:	[signature]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Fed Ex [signature]	Date: 8/23/05	Time: 0910
Samples Received at Laboratory by:	[signature]	Date: 8/25/05	Time: 1210
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 task 1
Job Name: ADA-ES
Location: Newark, AR - IND
Unit: Unit 2 ESP Inlet/Outlet Duct

Project Manager: S. Borgen
Project Supervisor: S. Borgen

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3		Hg	Recovered by	REMARKS (Specific Compounds/Methods)
Blank Train cont 1 Filter	8/18/05	1532	1									✓	R. Malone	
Blank Train cont. 2 Frontha lf Rinse		1535	1									✓	R. Malone	
Blank Train cont. 3 Backhalf Rinse Imp. 1,2,3		1554	1	KCL	300 mL							✓	R. Malone	
Blank Train cont. 4 Imp. 4		1549	1	5% HNO_3/10% H_2O_2	100 mL							✓	R. Malone	
Blank Train cont 5 Imp. 5,6,7		1546	1	Kmno4	300 mL							✓	R. Malone	

Samples Received for Transport/Shipment by:	[signature]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Fed Ex	Date: 8/23/05	Time: 0910
Samples Received at Laboratory by:	[signature]	Date: 8/25/05	Time: 1210
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 (task 1)
Job Name: AQA - ES
Location: Newark, AR - IND
Unit: Unit 2 ESP Inlet/Outlet Duct

Project Manager: S. Bunger
Project Supervisor: S. Bunger
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3		Hg	Recovered by	REMARKS (Specific Compounds/Methods)
RB Cont. 7 0.1N HNO3 Blank	8/18/05	1255	1									✓	[illegible]	
RB Cont. 8 1N KCl Blank		1258	1									✓	[illegible]	
RB Cont. 9 5% HNO3/10% H2O2 Blank		1300	1									✓	[illegible]	
RB Cont. 10 Acid KMnO4 Blank		1302	1									✓	[illegible]	
RB Cont. 11 10% Hydroxylamine Blank		1601	1									✓	R. [illegible]	
RB Cont. 12 Filter Blank		1304	1									✓	[illegible]	

Samples Received for Transport/Shipment by:	[illegible]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	FedEx [illegible]	Date: 8/23/05	Time: 0910
Samples Received at Laboratory by:	[illegible]	Date: 8/25/05	Time: 1210
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

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10 MARCH 2003

DAT Labs Inc.
Sample Receipt Report

Client: Metro Environmental

Custodian Initial: RB Date: 8/25/05

The client has been contacted.

_____ Yes _____ No

Upon receipt of samples, check if any of the following discrepancies have been noted.

	Discrepancy Type	*Specify applicable client ID or "all"*
	COC and samples do not match	
	No unique sample identifications	
	Samples received outside of the required temp criteria. **Receipt Temp:** ambient	
	No preservation type was noted	
	No date of collection stated	
	No time of collection stated	
	The sample collector was not named	
	Sample containers were not appropriate	
	Sample labels were destroyed or unreadable	
	Samples were received outside of holding time	
	There was not enough sample to perform the requested analysis.	
	Samples showed sign of damage or contamination.	
	Aqueous samples for volatile analysis: Headspace? Y N If Y (es), details:	
	Sample pH acidic basic neutral Please describe any outliers or nonconformances below.	

Details: _____

Sample pH for nonvolatile aqueous samples and presence or absence of headspace (Y or N) for aqueous samples shall be recorded at time of sample log-in.
Under no circumstances shall VOA vials be opened at time of sample receipt.

Other Discrepancies:

Sample ID	**Discrepancy**

☒ ***Upon receipt, the samples met all of DAT's acceptance criteria.*** ***DAT Project #*** 0805035

FRMSRR081501

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064.

Project Number: 0805035

1 of 3

Date Received:	8/25/2005	**Carrier:**	FedEx
Client Name:	Metco Environmental	**Analysis:**	Mercury/Ontario Hydro
Tracking number:	602557619599	**Package Temp:**	ambient
Custody Seals ?:	No	**COC:**	☑ check if COC from client

Sample Information

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
Inlet Run 1 Filter	0805035-1	8/17/2005	filter	glass jar	
Inlet Run 1 Cont. 2	0805035-2	8/17/2005	0.1N HNO3	amber jar	
Inlet Run 1 Cont. 3	0805035-3a/b	8/17/2005	KCl	amber jar	
Inlet Run 1 Cont. 4	0805035-4	8/17/2005	HNO3/H2O2	amber jar	
Inlet Run 1 Cont. 5	0805035-5	8/17/2005	KMnO4	amber jar	
Inlet Run 2 Filter	0805035-6	8/17/2005	filter	glass jar	
Inlet Run 2 Cont. 2	0805035-7	8/17/2005	0.1N HNO3	amber jar	
Inlet Run 2 Cont. 3	0805035-8a/b	8/17/2005	KCl	amber jar	
Inlet Run 2 Cont. 4	0805035-9	8/17/2005	HNO3/H2O2	amber jar	
Inlet Run 2 Cont. 5	0805035-10	8/17/2005	KMnO4	amber jar	
Inlet Run 3 Filter	0805035-11	8/18/2005	filter	glass jar	

Laboratory Receiving Initials

0805035
8/25/2005 12:40:53 PM

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064.

Project Number: 0805035

2 of 3

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
Inlet Run 3 Cont. 2	0805035-12	8/18/2005	0.1N HNO3	amber jar	
Inlet Run 3 Cont. 3	0805035-13a/b	8/18/2005	KCl	amber jar	
Inlet Run 3 Cont. 4	0805035-14	8/18/2005	HNO3/H2O2	amber jar	
Inlet Run 3 Cont. 5	0805035-15	8/18/2005	KMnO4	amber jar	
Outlet Run 1 Filter	0805035-16	8/17/2005	filter	glass jar	
Outlet Run 1 Cont. 2	0805035-17	8/17/2005	0.1N HNO3	amber jar	
Outlet Run 1 Cont. 3	0805035-18a/b	8/17/2005	KCl	amber jar	
Outlet Run 1 Cont. 4	0805035-19	8/17/2005	HNO3/H2O2	amber jar	
Outlet Run 1 Cont. 5	0805035-20	8/17/2005	KMnO4	amber jar	
Outlet Run 2 Filter	0805035-21	8/17/2005	filter	glass jar	
Outlet Run 2 Cont. 2	0805035-22	8/17/2005	0.1N HNO3	amber jar	
Outlet Run 2 Cont. 3	0805035-23a/b	8/17/2005	KCl	amber jar	
Outlet Run 2 Cont. 4	0805035-24	8/17/2005	HNO3/H2O2	amber jar	
Outlet Run 2 Cont. 5	0805035-25	8/17/2005	KMnO4	amber jar	
Outlet Run 3 Filter	0805035-26	8/18/2005	filter	glass jar	
Outlet Run 3 Cont. 2	0805035-27	8/18/2005	0.1N HNO3	amber jar	
Outlet Run 3 Cont. 3	0805035-28a/b	8/18/2005	KCl	amber jar	

KAS

Laboratory Receiving Initials

0805035

8/25/2005 12:40:53 PM

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064.

Project Number: 0805035

3 of 3

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
Outlet Run 3 Cont. 4	0805035-29	8/18/2005	HNO3/H2O2	amber jar	
Outlet Run 3 Cont. 5	0805035-30	8/18/2005	KMnO4	amber jar	
Blank Train Filter	0805035-31	8/18/2005	filter	glass jar	
Blank Train Cont. 2	0805035-32	8/18/2005	0.1N HNO3	amber jar	
Blank Train Cont. 3	0805035-33	8/18/2005	KCl	amber jar	
Blank Train Cont. 4	0805035-34	8/18/2005	HNO3/H2O2	amber jar	
Blank Train Cont. 5	0805035-35	8/18/2005	KMnO4	amber jar	
Reagent Blank Cont. 7	0805035-36	8/18/2005	0.1N HNO3	amber jar	
Reagent Blank Cont. 8	0805035-37	8/18/2005	KCl	amber jar	
Reagent Blank Cont. 9	0805035-38	8/18/2005	HNO3/H2O2	amber jar	
Reagent Blank Cont. 10	0805035-39	8/18/2005	KMnO4	amber jar	
Reagent Blank Cont. 11	0805035-40	8/18/2005	hydroxylamine	amber jar	
Reagent Blank Cont. 12	0805035-41	8/18/2005	filter	glass jar	

Laboratory Receiving Initials

0805035

8/25/2005 12:40:53 PM

APPENDIX F

Chain of Custody

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 task 1
Job Name: ADA-ES
Location: Newark, ARL - IND
Unit: Unit 2 ESP Inlet Duct

Project Manager: S. Bowersen
Project Supervisor: S. Bowersen

Method: 17/26A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter	8-17-05	1617	1			✓							[illegible]	HCl, HBr, HF, Cl_2, Br
Run 1 Acetone Frontwash		1623	1			✓							[illegible]	
Run 1 Imp 1,2,3, Backhalf		1954	1	0.1N H_2SO_4	200ml		✓						[illegible]	
Run 1 Imp 4,5		2000	1	0.1N NaOH	200ml			✓					[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 8-18-05	Time: 1700	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via:	Date:	Time:	
Samples Received at Laboratory by: [illegible]	Date: 8/23/05	Time: 0900	
Samples Analyzed by: M. Banter	Date: 9/6/05	Time: 1100	
Samples Analyzed by:	Date:	Time:	
Data Checked by: [illegible]	Date: 09/07/05	Time: 1500	

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 Task 1
Job Name: ADA-ES
Location: Newark AR - Ind
Unit: Unit 2 ESP ~~Inlet~~ Duct Inlet

Project Manager: S. Borensen
Project Supervisor: S. Borensen
Method: 17/26A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Filter	8/17/05	2200	1			✓							[illegible]	HCl, HBr, HF, Cl_2, Br
Run 2 Acetone Frontwash		2205	1			✓							[illegible]	
Run 2 Imp 1,2,3		2150	1	0.1N H_2SO_4	200mL		✓						[illegible]	
Run 2 Imp 4,5		2155	1	0.1N NaOH	200mL			✓					[illegible]	
Run 3 Filter	8-17-05	1426	1			✓							[illegible]	
Run 3 Acetone Frontwash		1428	1			✓							[illegible]	
Run 3 Imp 1,2,3		1900	1	0.1N H_2SO_4	200ml		✓						[illegible]	
Run 3 Imp 4,5		1505	1	0.1N NaOH	200ml			✓					[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 8-18-05	Time: 1700	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via:	Date:	Time:	
Samples Received at Laboratory by: [illegible]	Date: 8/23/05	Time: 0900	
Samples Analyzed by: M. Danter	Date: 9/6/05	Time: 1100	
Samples Analyzed by:	Date:	Time:	
Data Checked by: [illegible]	Date: 09/07/05	Time: 1500	

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10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 task 1
Job Name: ADA-ES
Location: Newark, AR WD
Unit: Unit 2 ESP Inlet Duct

Project Manager: S. Bowersen
Project Supervisor: S. Bowersen

Method: OH ASTM D6784-02

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3		Part Hg	Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Cont 1 Filter	8-17-05	1640	1									✓	[illegible]	
Run 1 Cont 2 Front Half Rinse		1635	1									✓	[illegible]	
Run 1 Cont 3 Back Half Rinse & Imp 1,2,3		1835	2	KCl solution	300ml							✓	[illegible]	
Run 1 Cont 4 Imp 4		1841	1	HNO_3 / H_2O_2	100ml							✓	[illegible]	
Run 1 Cont 5 Imp. 5,6,7		1849	1	Acid $KMnO_4$	300ml							✓	[illegible]	
Run 2 Cont 1 Filter	8-17-05	2125	1									✓	[illegible]	
Run 2 Cont Front Half Rinse		2130	1									✓	[illegible]	

Samples Received for Transport/Shipment by:	[illegible]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Fed Ex [illegible]	Date: 8/23/05	Time: 0910
Samples Received at Laboratory by:	[illegible]	Date: 8/25/05	Time: 1210
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:	[illegible]	Date: 09/19/05	Time: 1530

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10 MARCH 2003

METCO Environmental

CHAIN OF CUSTODY RECORD

Job No.: 05-233 task 1
Job Name: ADA-ES
Location: Newark, OH - SND
Unit: Unit 2 ESP Inlet Duct

Project Manager: S. Bonner
Project Supervisor: S. Bonner
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3		Hg	Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Cont 3 Backhalf & Imp 1,2,3	8-17-05	2215	2	KCl	300ml							✓	[illegible]	
Run 2 Cont 4 Imp. 4		2210	1	HNO_3/H_2O_2	100ml							✓	[illegible]	
Run 2 Cont 5 Imp. 5,6,7		2206	1	Acid $KMnO_4$	300ml							✓	[illegible]	
Run 3 Cont 1 Filter	8-18-05	1435	1									✓	[illegible]	
Run 3 Cont 2 Frontwash		1438	1									✓	[illegible]	
Run 3 Cont. 3 Backhalf & Imp. 1,2,3		1906	2	KCl	300ml							✓	[illegible]	
Run 3 Cont. 4 Imp. 4		1500	1	HNO_3/H_2O_2	100ml							✓	[illegible]	

Samples Received for Transport/Shipment by: [signature]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Shipped Via: Fed Ex [signature]	Date: 8/23/05	Time: 0910
Samples Received at Laboratory by: [signature]	Date: 8/25/05	Time: 1210
Samples Analyzed by:	Date:	Time:
Samples Analyzed by:	Date:	Time:
Data Checked by: [signature]	Date: 09/19/05	Time: 1500

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METCO Environmental

CHAIN OF CUSTODY RECORD

Job No.: 05-233 Task 1
Job Name: ADA-ES
Location: Newark, AR - IND
Unit: Unit 2 ESP Inlet Duct

Project Manager: S. Bonner
Project Supervisor: S. Bonner

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3		Hg	Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 Cont. 5 Impg. 5,6,7	8-18-05	1507	1	Acid KMnO4	300ml							✓	[illegible]	

Samples Received for Transport/Shipment by:	[illegible]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Fed Ex - [illegible]	Date: 8/23/05	Time: 0910
Samples Received at Laboratory by:	[illegible]	Date: 8/25/05	Time: 1210
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:	[illegible]	Date: 09/19/05	Time: 1500

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CHAIN OF CUSTODY RECORD

Job No.: 05-233 Task 1
Job Name: ADA-ES
Location: Newark, AR - JMP
Unit: Unit 2 ESP X Outlet Duct

Project Manager: S. Borensen
Project Supervisor: S. Borensen
Method: 17/26 A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 F. filter	8-17-05	1604	1			✓							[illegible]	HCl, HBr, HF Cl2, Br
Run 1 Acetone Frontwash		1610	1			✓							[illegible]	
Run 1 Imp. 1,2,3 Duckhalf		1942	1	0.1N H2SO4	200ml		✓						[illegible]	
Run 1 Imp 4,5		1944	1	0.1N NaOH	200ml			✓					[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 8-18-05	Time: 1700	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via:	Date:	Time:	
Samples Received at Laboratory by: [illegible]	Date: 8/23/05	Time: 0900	
Samples Analyzed by: M. Santer	Date: 9/6/05	Time: 1400	
Samples Analyzed by:	Date:	Time:	
Data Checked by: [illegible]	Date: 09/08/05	Time: 1500	

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CHAIN OF CUSTODY RECORD

Job No.: 05-233 TASK 1
Job Name: ADA-ES
Location: Newark AR - IND
Unit: Unit 2 ESP ~~Inlet~~ Outlet Duct

Project Manager: S. Bornsen
Project Supervisor: S. Bornsen

Method: 17/26A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Filter	8-17-05	2205	1			✓							[signature]	HCl, HBr, HF, Cl_2, Br
Run 2 Acetone Frontwash	↓	2210	1			✓							[signature]	
Run 2 Imp 1,2,3 Backhalf		2140	1	0.1N H_2SO_4	200mL		✓						[signature]	
Run 2 Imp 4,5	↓	2145	1	0.1N NaOH	200mL		✓	✓					[signature]	
Run 3 Filter	8-18-05	1419	1			✓							[signature]	
Run 3 Acetone Frontwash		1421	1			✓							[signature]	
Run 3 Imp. 1,2,3		1520	1	0.1N H_2SO_4	200mL		✓						[signature]	
Run 3 Imp. 4,5		1525	1	0.1N NaOH	200mL			✓					[signature]	

Samples Received for Transport/Shipment by: [signature]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Shipped Via:	Date:	Time:
Samples Received at Laboratory by: [signature]	Date: 8/23/05	Time: 0900
Samples Analyzed by: M. Dantes	Date: 9-6-05	Time: 1400
Samples Analyzed by:	Date:	Time:
Data Checked by: [signature]	Date: 09/07/05	Time: 1500

VERSION 2
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METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-233 - TASK 1
Job Name: ADA-ES
Location: Newark AR - Ind
Unit: Unit 2 ESP Ducts

Project Manager: Steve Bornsen
Project Supervisor: Steve Bornsen

Method: 17/26 A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
RB - Filter	8-18-05	1504	1			✓							[illegible]	HCl, HBr, HF Cl2, Br
RB - ~~HDCE~~ DI H2O		1507	1		200mL	✓	✓	✓					[illegible]	
RB - Acetone		1510	1		200mL	✓							[illegible]	
RB - 0.1N NaOH		1512	1		200mL			✓					[illegible]	
RB - 0.1N H2SO4	✓	1515	1		200mL		✓						[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 8-18-05	Time: 1700	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via:	Date:	Time:	
Samples Received at Laboratory by: [illegible]	Date: 8/23/05	Time: 0900	
Samples Analyzed by: M. Ganter	Date: 9/6/05	Time: 1400	
Samples Analyzed by:	Date:	Time:	
Data Checked by: JMM	Date: 09/07/05	Time: 1500	

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CHAIN OF CUSTODY RECORD

Page 1 of 3

Job No.: 05-233 Task 1
Job Name: ADA-ES
Location: Newark, OH - Ind
Unit: Unit 2 SCR Outlet Duct

Project Manager: S. Bonnacker
Project Supervisor: S. Bonnacker

Method: OH ASTM D 6784-02

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3		Hg	Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Cont 1 Filter	8-17-05	1620	1									✓	[illegible]	
Run 1 Cont 2 Front Half Rinse		1625	1									✓	[illegible]	
Run 1 Cont 3 Back Half Rinse Imp 1,2,3		1904	2	KCl solution	300ml							✓	[illegible]	
Run 1 Cont 4 Imp. 4		1908	1	HNO_3/H_2O_2	100ml							✓	[illegible]	
Run 1 Cont 5 Imp 5,6,7		1918	1	Acid KMnO4	300ml							✓	[illegible]	
Run 2 Cont 1 Filter	8-17-05	2145	1									✓	[illegible]	
Run 2 Cont 2 Front Half Rinse		2151	1									✓	[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 8-18-05	Time: 1700	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via: Fed Ex [illegible]	Date: 8/23/05	Time: 0910	
Samples Received at Laboratory by: [illegible]	Date: 8/25/05	Time: 1210	
Samples Analyzed by:	Date:	Time:	
Samples Analyzed by:	Date:	Time:	
Data Checked by: JRM	Date: 09/15/05	Time: JRM	

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METCO Environmental ®

CHAIN OF CUSTODY RECORD

Job No.: 05-233 Task 1
Job Name: ADA-ES
Location: Newark, AR - IND
Unit: Unit 2 ESP Outlet Duct

Project Manager: S. Benson
Project Supervisor: S. Dover
Method: ~~EPA~~ OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3		Hg	Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Cont 3 Backhalf + Imp 1,2,3	8-17-05	2237	2	KCl	300ml							✓	R. Malone	
Run 2 Cont 4 Imp 4		2220	1	HNO_3/H_2O_2	100ml							✓	R. Malone	
Run 2 Cont 5 Imp 5,6,7		2226	1	Acid $KMnO_4$	300ml							✓	R. Malone	
Run 3 Cont. 1 Filter	8-18-05	1533	1									✓	R. Malone	
Run 3 Cont. 2 Frontheat		1536	1									✓	R. Malone	
Run 3 Cont. 3 Backhalf + Imp 1,2,3		1521	2	KCl	300ml							✓	[illegible]	
Run 3 Cont 4 Imp. 4		1513	1	H_2O_2/HNO_3	100ml							✓	[illegible]	

Samples Received for Transport/Shipment by:	[illegible]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	FedEx [illegible]	Date: 8/23/05	Time: 0910
Samples Received at Laboratory by:	K. [illegible]	Date: 8/26/05	Time: 1240
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:	[illegible]	Date: 09/19/05	Time: 1530

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CHAIN OF CUSTODY RECORD

Job No.: 05-233 Jackl
Job Name: ADA-ES
Location: Norwalk, Ark - Ind
Unit: Unit 2 ESP Outlet Duct

Project Manager: S. Bonzer
Project Supervisor: S. Bonzer
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Mercury		Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 Cont 5 Imp 5,6,7	8/18/05	1522	1	KMnO4	300ml						✓		R. Mehra	

SAMPLE ANALYSIS REQUIRED

		Time
Samples Received for Transport/Shipment by:	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Shipped Via: Fed Ex	Date: 8/23/05	Time: 0910
Samples Received at Laboratory by:	Date: 8/25/05	Time: 1210
Samples Analyzed by:	Date:	Time:
Samples Analyzed by:	Date:	Time:
Data Checked by:	Date: 09/15/05	Time: 1330

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CHAIN OF CUSTODY RECORD

Job No.: 05-233 task 1
Job Name: ADA-ES
Location: Newark, AR - IND
Unit: Unit 2 ESP Inlet/Outlet Duct

Project Manager: S. Bergen
Project Supervisor: S. Bergen

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3		OH	Recovered by	REMARKS (Specific Compounds/Methods)
Blank Train cont 1 Filter	8/18/05	1532	1									✓	R. Melvin	
Blank Train cont. 2 Fronthalf Rinse		1535	1									✓	R. Melvin	
Blank Train cont. 3 Backhalf Rinse Imp. 1,2,3		1554	1	KCL	300mL							✓	R. Melvin	
Blank Train cont. 4 Imp. 4		1549	1	5% HNO_3/10% H_2O_2	100mL							✓	R. Melvin	
Blank Train cont 5 Imp. 5,6,7		1546	1	KMnO4	300mL							✓	R. Melvin	

Samples Received for Transport/Shipment by:	[signature]	Date: 8-18-05	Time: 1700
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	FedEx	Date: 8/23/05	Time: 0950
Samples Received at Laboratory by:	[signature]	Date: 8/25/05	Time: 1210
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:	[signature]	Date: 09/19/05	Time: 1530

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10 MARCH 2003

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CHAIN OF CUSTODY RECORD

Job No.: 05-233 (Task 1)
Job Name: ADA-ES
Location: Newark, AR - IND
Unit: Unit 2 ESP Inlet/Outlet Dust

Project Manager: S. Bunger
Project Supervisor: S. Bunger
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3		Hg	Recovered by	REMARKS (Specific Compounds/Methods)
RB Cart. 7 0.1N HNO_3 Blank	8.18.05	1255	1									✓	[illegible]	
RB Cart. 8 1N KCl Blank		1258	1									✓	[illegible]	
RB Cart. 9 5% HNO_3/10% H_2O_2 Blank		1300	1									✓	[illegible]	
RB Cart. 10 Acid $KMnO_4$ Blank		1302	1									✓	[illegible]	
RB Cart. 11 10% Hydroxylamine Blank		1601	1									✓	[illegible]	
RB Cart. 12 Filter Blank		1304	1									✓	[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 8-18-05	Time: 1700	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via: FedEx [illegible]	Date: 8/23/05	Time: 0910	
Samples Received at Laboratory by: [illegible]	Date: 8/25/05	Time: 1210	
Samples Analyzed by:	Date:	Time:	
Samples Analyzed by:	Date:	Time:	
Data Checked by: [illegible]	Date: 09/19/05	Time: 1530	

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APPENDIX G

Resumes of Test Personnel

ROBERT M. PATTERSON; President

Education	B. S. 1983, Central Michigan University; Mt. Pleasant, Michigan, in Geology and Earth Science-Meteorology.
Professional Training Courses	Attended a two-day short course, "Performing and Observing Source Sampling" in Dallas, Texas. Attended a one-day short course on basic supervision. Attended a four-week management course presented by the American Management Association, 1991-1992.
Certification	Certified Visible Emissions Evaluator Certified Cabot Full-Face Respirator Fit Tester
Professional Memberships	Source Evaluation Society American Management Association
Technical Experience	Participated in the sampling of over 1,000 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 1986-present. Over nineteen years experience with EPA and Texas Air Control Board methods of sampling - both stationary sources and ambient air. CFR, Title 40, Chapter I, Part 60, EPA Methods 1 through 25, and 101 through 110. Performance Specifications 1 through 5. CFR, Title 40, Chapter I, Part 50, Appendix A through F. "Sampling Procedures Manual, Texas Air Control Board, January 1983." Parts 1-1 through 14-6, Appendix B through Appendix M. Experienced with sampling Method 0010, Modified Method 5 Sampling Train; Method 0030, Volatile Organic Sampling Train; and various EPA and "Site Specific" multiple metal and acid gas sampling trains.

(continued)

PATTERSON, Rob (cont'd)

Technical Experience (cont'd)

Over twenty one years experience with EPA and Texas Air Control Board methods of analysis of both stationary and ambient air samples. Particulate matter, SO_3, SO_2, H_2SO_4, NO_x, CO, CO_2, O_2, H_2S, F, TRS, HCl, Cl_2, NH_3, VOC, C_1-C_7, and other organics. Both laboratory and on-site analyses were performed.

Experienced in the sampling and analysis of commercial calibration gas cylinders for sulfur dioxide, oxides of nitrogen, carbon dioxide, oxygen, carbon monoxide, and C_1-C_7 hydrocarbons.

Thoroughly trained in the operation and routine maintenance of the following:

- MSA LIRA Model 202S Infrared Analyzer
- Analytical Instrument Development, Inc. Model 340A Calibration System
- Shimadzu GC-Mini 2 Gas Chromatograph
- Thermo Environmental Model 10AR Oxides of Nitrogen Analyzer
- Thermo Oxygen Analyzer
- Teledyne Model 326 Oxygen Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer
- Thermo Environmental Model 40 Sulfur Dioxide Analyzer
- Ratfisch Model RS 100 Total Hydrocarbon Analyzer
- Western Research Model 721AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- Ratfisch Model RS 55 Total Hydrocarbon Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer

JAMES R. MONFRIES; Senior Quality Assurance Manager

Education	B. S. 1975, University of Texas at Arlington; Arlington, Texas, in Biology with a minor in Chemistry. Graduate work at the University of Texas at Dallas in the Environmental Science Department.
Professional Training Courses	Attended a two-day short course, "Performing and Observing Source Sampling" in Dallas, Texas, July 1976.
Certification	Certified Visible Emissions Evaluator
Professional Memberships	Air and Waste Management Association Source Evaluation Society - Past President
Technical Experience	Participated in the sampling of over 700 sources, serving in the supervisory capacity on over 500 sources. Many of the sources were sampled simultaneously using more than one sampling train at several points in the flue gas stream, 1976-present. Has also supervised several ambient air monitoring studies, including a permanent five-station high volume air sampling network in South Texas, a permanent four-station high volume air sampling network in Pennsylvania, and a permanent seven-station sulfur dioxide sampling network in East Texas. Was Quality Assurance Manager for several ambient air monitoring studies; including a four-station high volume air sampling network for TSP and PM10 in Midlothian, Texas; a single-station high volume air sampling network for PM10 in South Texas; a two-station high volume air sampling network for TSP in Wichita Falls, Texas; and a four-station continuous air sampling network for TSP and PM10 in Jewett, Texas using Thermo Andersen FH 62 C14 Beta Gauge Dust Monitors.

(continued)

MONFRIES, James (cont'd)

Twenty years experience with EPA and Texas Commission on Environmental Quality methods of analysis of both source and ambient air samples for particulates, SO_2, SO_3,, H_2SO_4, H_2S, HCl, Cl_2, NO_x, Hydrocarbons, and TRS.

Experienced in the analysis of commercial calibration gas cylinders for sulfur dioxide and oxides of nitrogen.

Experienced with VOST and Modified Method 5 Sampling Procedures.

Thoroughly trained in the operation and routine maintenance of the following:

- Lear Siegler, Inc. SM800 Stack Gas Monitor
- Du Pont Model 460/1 Photometric Analyzer System
- Lear Siegler, Inc. SM1000 Ambient SO_2 Monitor
- Calibrated Instruments Ultragas SO_2 Monitor
- Meloy 285E SO_2 Analyzer
- Meloy SA-700 Fluorescent SO_2 Analyzer
- MSA LIRA Model 202S Infrared Analyzer
- Analytical Instrument Development, Inc. Model 340A Calibration System
- Shimadzu GC-Mini 2 Gas Chromatograph
- Thermo Environmental Model 10S NO_x Analyzer
- Thermo Oxygen Analyzer
- Teledyne Model 326 Oxygen Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer
- Thermo Environmental Model 40 Sulfur Dioxide Analyzer
- Ratfisch Model RS 103 Total Hydrocarbon Analyzer
- Western Research Model 721AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- Ratfisch Model RS 55 Total Hydrocarbon Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer
- Thermo Andersen Model FH 62 C14 Dust Monitor

STEVEN J. BORNSEN; Project Supervisor II

Education	B. S. in Geology, 1995; University of Texas at Arlington; Arlington, Texas.
Professional Training Courses	Attended 40-hour Occupational & Environmental Training Program on Hazardous Materials (CFR 1910.120); Dallas, Texas, January 1996. Attended a two-day short course, "Performing and Observing Source Sampling," Dallas, Texas; September 1996.
Certifications	Certified Visible Emissions Evaluator HAZMAT certified Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 200 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 1995-present. Experienced with Modified Method 5 Sampling Train (Method 0010). Experienced with VOST sampling procedure (Method 0030). Experienced with calibration techniques for all field testing equipment. Experienced with various multiple metal and acid gas sampling trains. Experienced with particle size and PM_{10} sampling procedures.

(continued)

BORNSEN, Steve (cont'd)

Technical Experience (cont'd)

Experienced with on-site gravimetric particulate matter analysis.

Has performed on-site SO_2 analysis and H_2S fuel gas analysis.

Thoroughly trained in the operation and routine maintenance of the following:

- Thermo Environmental Model 10S and 42C Oxides of Nitrogen Analyzers
- Teledyne Model 326 Oxygen Analyzer
- Western Research Model 721 AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer

JASON BROWN; Project Supervisor II

Education	B. S. in Zoology, 1995; University of Oklahoma, Norman, Oklahoma.
Professional Training Courses	Attended 40-hour Hazardous Waste Operations and Emergency Response in accordance with 29 CFR 1910.120, Dallas, Texas in January 2000. Attended 8-hour HAZWOPER refresher course from 2001 to the present. Attended a two-day short course, "Performing and Observing Source Sampling" in Dallas, Texas – August 1999. Attended 10-hour OSHA training.
Certifications	Certified Visible Emissions Evaluator HAZMAT certified Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 200 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 1999-present. Experienced with Modified Method 5 Sampling Train (Method 0010). Experienced with VOST sampling procedure (Method 0030). Experienced with calibration techniques for all field-testing equipment. Experienced with various multiple metal and acid gas sampling trains.

(continued)

BROWN, Jason (cont'd)

Technical Experience (cont'd)

Has performed on-site SO_2 analysis and H_2S fuel gas analysis.

Thoroughly trained in the operation and routine maintenance of the following:

- Thermo Environmental Model 10S and 42C Oxides of Nitrogen Analyzers
- Teledyne Model 326 Oxygen Analyzer
- Western Research Model 721 AT Sulfur Dioxide Analyzer.
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer

RODNEY MALONE; Project Supervisor II

Education	B. S. Forestry, December 2000; Stephen F. Austin State University; Nacogdoches, Texas.
Certifications	HAZMAT certified Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 200 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2001-present. Experienced with Modified Method 5 Sampling Train (Method 0010). Experienced with VOST Sampling Procedures (Method 0030). Experienced with calibration techniques for all field testing equipment. Experienced with various multiple metal and acid gas sampling trains. Has performed on-site SO_2 analysis and H_2S fuel gas analysis. Thoroughly trained in the operation and routine maintenance of the following: • Thermo Environmental Model 10S, 42C, and 42CHL Oxides of Nitrogen Analyzers • Teledyne Model 326 Oxygen Analyzer • Horiba Model PIR 2000 Carbon Dioxide Analyzer

(continued)

MALONE, Rodney (cont'd)

Technical Experience (cont'd)

Operation and routine maintenance (cont'd)

- Thermo Environmental Model 48 Carbon Monoxide Analyzer.
- Western Research Model 721M Sulfur Dioxide Analyzer
- J.U.M. VE-7 Hydrocarbon Analyzer
- Shimadzu Gas Chromatograph 14 and 17a

BEN GOEBEL; Project Supervisor I

Education	B. S. Environmental Biology, December 1999; Michigan State University; Lansing, Michigan.
Certifications	HAZMAT certified Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 150 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2002-present.

DUSTIN J. SIMPSON; Environmental Scientist I

Education	B. S. in Environmental Science, August 2004; Stephen F. Austin State University, Nacogdoches, Texas.
Certifications	Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2004-present.

JASON SELLERS; Environmental Scientist I

Education	B. S. Wildlife and Fisheries Sciences, May 2004; Texas A&M University, College Station, Texas.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

DOUGLAS WARE; Environmental Scientist I

Education	B. S. Criminal Justice, December 10, 2004; Sam Houston State University, Huntsville, Texas.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

JOSHUA ORR; Environmental Scientist I

Education	B. S. Environmental Studies, Summer 2002; Southwest Texas State University; San Marcos, Texas.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

BEN WEBER.; Environmental Scientist I

Education	B. A. Biology; January 2005; Buffalo State College, Buffalo, New York.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

APPENDIX D2: Source Testing—October 17–19, 2005

METCO ENVIRONMENTAL
P.O. Box 598
Addison, TX 75001
(972) 931-7127

SOURCE EMISSIONS SURVEY
OF
ARKANSAS POWER & LIGHT COMPANY
INDEPENDENCE STEAM
ELECTRIC STATION
UNIT NUMBER 2 ESP INLET
AND OUTLET DUCTS
NEWARK, ARKANSAS
FOR
ADA-ES

OCTOBER 2005

FILE NUMBER 05-234REV

" I certify that I have personally checked and am familiar with the information submitted herein, and based on my inquiries of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate, and complete. "

_____

James R. Monfries
Senior Quality Assurance Manager

METCO ENVIRONMENTAL

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A. Location of Sampling Points
B. Source Emissions Calculations
C. Calibration Data
D. Field Testing Data
E. Analytical Data
F. Chain of Custody
G. Resumes of Test Personnel

SOURCE EMISSIONS SURVEY
ARKANSAS POWER & LIGHT COMPANY
INDEPENDENCE STEAM ELECTRIC STATION
UNIT NUMBER 2 ESP INLET AND OUTLET DUCTS
NEWARK, ARKANSAS
FOR
ADA-ES
FILE NUMBER 05-234

INTRODUCTION

METCO Environmental, P.O. Box 598, Addison, Texas, conducted a source emissions survey of Arkansas Power & Light Company, Independence Steam Electric Station, located in Newark, Arkansas, for ADA-ES, on October 17, 18, and 19, 2005. The purpose of these tests was to determine the concentrations of speciated mercury at the Unit Number 2 ESP Inlet and Outlet Ducts.

The sampling was performed by the following METCO personnel: Steve Bornsen - Project Supervisor, Rodney Malone, Joshua Orr, and Dustin Dodson.

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 5, and 17; and the Ontario Hydro Method, Revised July 7, 1999 (ASTM D-6784-02).

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Run Number	Particle Bound Mercury Emissions (µg/m^3)	Particle Bound Mercury Emissions (lbs/trillion Btu)	Oxidized Mercury Emissions (µg/m^3)	Oxidized Mercury Emissions (lbs/trillion Btu)	Elemental Mercury Emissions (µg/m^3)	Elemental Mercury Emissions (lbs/trillion Btu)	Total Mercury Mercury Emissions (µg/m^3)	Total Mercury Mercury Emissions (lbs/trillion Btu)
1	1.093	0.900	1.826	1.504	7.082	5.831	10.001	8.235
2	0.045	0.038	2.743	2.288	5.532	4.615	8.320	6.941
3	0.049	0.037	1.162	0.945	5.757	4.680	6.965	5.662
Average	0.395	0.325	1.910	1.579	6.124	5.042	8.429	6.946

Unit Number 2 ESP Outlet Duct

Run Number	Particle Bound Mercury Emissions (µg/m^3)	Particle Bound Mercury Emissions (lbs/trillion Btu)	Oxidized Mercury Emissions (µg/m^3)	Oxidized Mercury Emissions (lbs/trillion Btu)	Elemental Mercury Emissions (µg/m^3)	Elemental Mercury Emissions (lbs/trillion Btu)	Total Mercury Mercury Emissions (µg/m^3)	Total Mercury Mercury Emissions (lbs/trillion Btu)
1	1.939	1.807	1.726	1.608	0.785	0.731	4.450	4.146
2	1.468	1.348	0.466	0.428	0.937	0.860	2.871	2.636
3	3.772	3.415	0.342	0.310	0.751	0.680	4.865	4.405
Average	2.393	2.190	0.845	0.782	0.824	0.757	4.062	3.729

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SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Date	10/18/05	10/18/05	10/19/05
Time	1207-1509	1705-1926	1249-1459
Duct Flow Rate - ACFM	414,222	427,204	432,501
Duct Flow Rate - DSCFM*	236,067	242,924	243,608
% Water Vapor - % Vol.	11.38	10.91	11.57
% CO_2 - % Vol.	14.4	14.4	14.4
% O_2 - % Vol.	5.4	5.6	5.2
% Excess Air @ Sampling Point	34.1	35.9	32.3
Stack Temperature - °F	323	327	332
Stack Pressure - "Hg	28.43	28.36	28.48
Percent Isokinetic	99.2	101.6	100.0
Volume Dry Gas Sampled - DSCF*	52.010	54.836	54.099

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Particle Bound Mercury - µg	1.61	0.07	0.07
Particle Bound Mercury Emissions - µg/m^{3*}	1.093	0.045	0.046
Particle Bound Mercury Emissions - lbs/trillion Btu	0.900	0.038	0.037
Oxidized Mercury - µg	2.69	4.26	1.78
Oxidized Mercury Emissions - µg/m^{3*}	1.826	2.743	1.162
Oxidized Mercury Emissions - lbs/trillion Btu	1.504	2.288	0.945
Elemental Mercury - µg	10.43	8.59	8.82
Elemental Mercury Emissions - µg/m^{3*}	7.082	5.532	5.757
Elemental Mercury Emissions - lbs/trillion Btu	5.831	4.615	4.680
Total Mercury Emissions - µg/m^{3*}	10.001	8.320	6.965
Total Mercury Emissions - lbs/trillion Btu	8.235	6.941	5.662

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Date	10/18/05	10/18/05	10/19/05
Time	1204-1535	1705-1931	1248-1507
Duct Flow Rate - ACFM	415,842	441,634	442,555
Duct Flow Rate - DSCFM*	233,093	241,869	242,010
% Water Vapor - % Vol.	13.26	14.45	14.82
% CO_2 - % Vol.	13.6	13.4	13.4
% O_2 - % Vol.	7.2	7.0	6.8
% Excess Air @ Sampling Point	52.2	49.7	47.4
Stack Temperature - °F	323	328	329
Stack Pressure - "Hg	28.57	28.48	28.60
Percent Isokinetic	91.0	92.4	97.7
Volume Dry Gas Sampled - DSCF*	61.187	64.459	68.149

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Particle Bound Mercury - µg	3.36	2.68	7.28
Particle Bound Mercury Emissions - µg/m^{3*}	1.939	1.468	3.772
Particle Bound Mercury Emissions - lbs/trillion Btu	1.807	1.348	3.415
Oxidized Mercury - µg	2.99	0.85	0.66
Oxidized Mercury Emissions - µg/m^{3*}	1.726	0.466	0.342
Oxidized Mercury Emissions - lbs/trillion Btu	1.608	0.428	0.310
Elemental Mercury - µg	1.36	1.71	1.45
Elemental Mercury Emissions - µg/m^{3*}	0.785	0.937	0.751
Elemental Mercury Emissions - lbs/trillion Btu	0.731	0.860	0.680
Total Mercury Emissions - µg/m^{3*}	4.450	2.871	4.865
Total Mercury Emissions - lbs/trillion Btu	4.146	2.636	4.405

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

DISCUSSION OF RESULTS

Unit Number 2 ESP Inlet Duct

The three tests for speciated mercury appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 3.3 percent of the mean value. The measured flow rates (Q_s) for the tests were within 2.0 percent of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 1.6 percent.

The calculated emissions (pounds per trillion Btu) of total mercury for the three tests showed a range of -18.5 percent to +18.6 percent variation from the mean value.

Unit Number 2 ESP Outlet Duct

The three tests for speciated mercury appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 6.5 percent of the mean value. The measured flow rates (Q_s) for the tests were within 2.5 percent of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 9.0 percent.

The calculated emissions (pounds per trillion Btu) of total mercury for the three tests showed a range of -29.3 percent to +18.1 percent variation from the mean value.

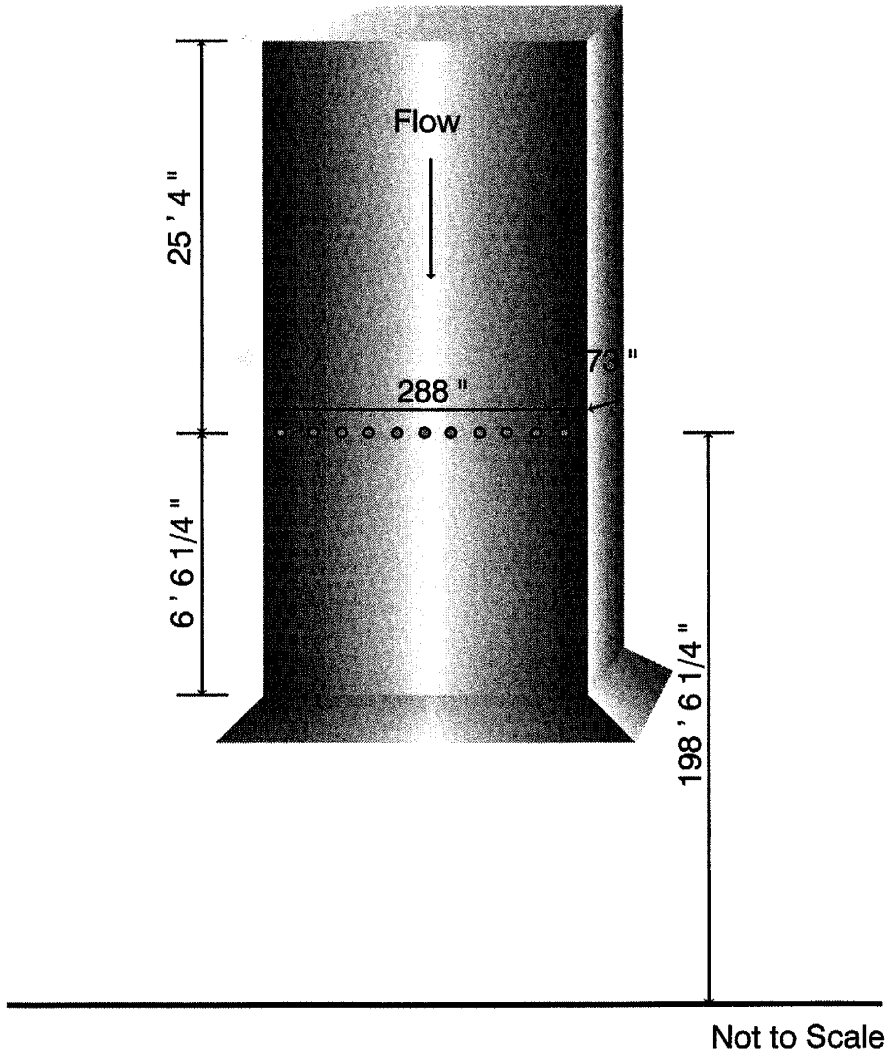
DESCRIPTION OF SAMPLING LOCATIONS

The sampling location on the Unit Number 2 ESP Inlet Duct is 198 feet 6 1/4 inches above the ground. The sampling ports are located 25 feet 4 inches (2.61 equivalent duct diameters) downstream from a bend in the duct and 6 feet 6 1/4 inches (0.67 equivalent duct diameters) upstream from an expansion in the duct.

The sampling location on the Unit Number 2 ESP Outlet Duct is approximately 200 feet above the ground. The sampling ports are located 6 feet 11 inches (0.71 equivalent duct diameters) downstream from a constriction in the duct and 3 feet 2 inches (0.33 equivalent duct diameters) upstream from a bend in the duct.

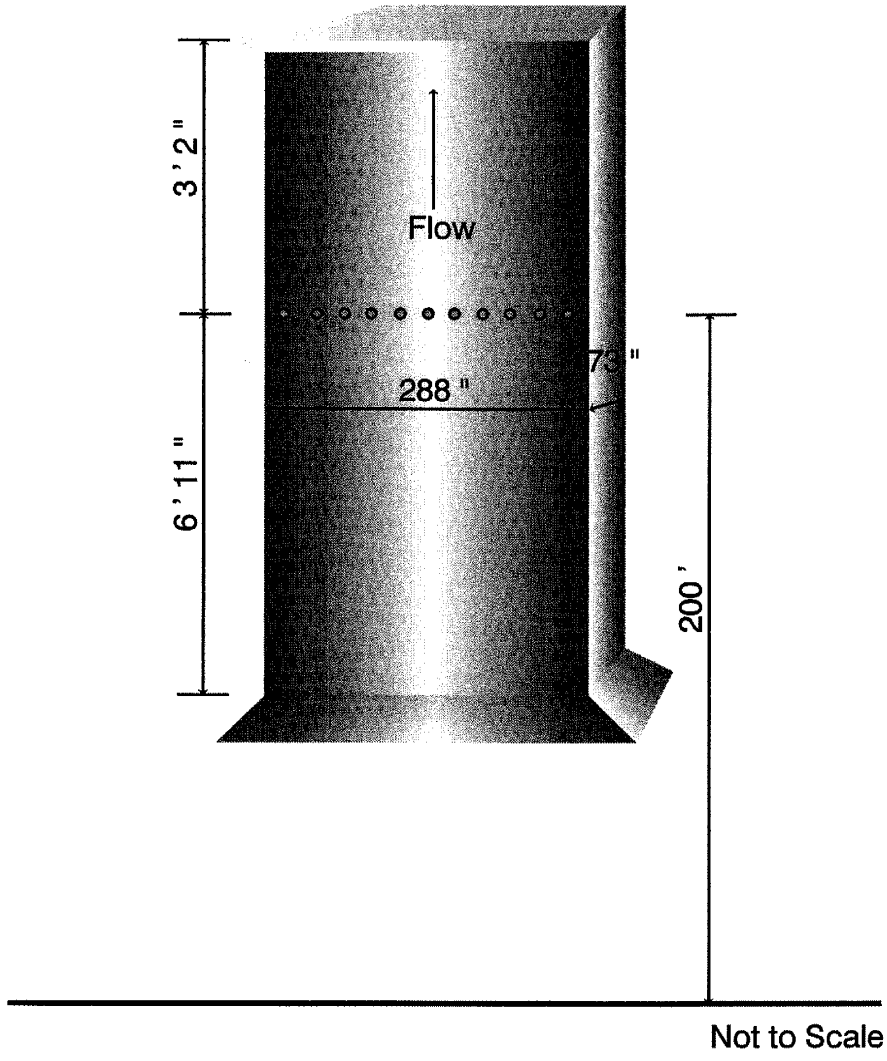
SAMPLING LOCATION

Unit Number 2 ESP Inlet Duct



SAMPLING LOCATION

Unit Number 2 ESP Outlet Duct



SAMPLING AND ANALYTICAL PROCEDURES

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 5, and 17; and the Ontario Hydro Method, Revised July 7, 1999 (ASTM D-6784-02).

A preliminary velocity traverse was made at eight of the eleven ports on the Unit Number 2 ESP Inlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. Several traverse points were checked for cyclonic flow and none was found to be present. Four traverse points were sampled from each of the eight ports for a total of thirty-two traverse points.

A preliminary velocity traverse was made at eight of the twelve ports on the Unit Number 2 ESP Outlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. Several traverse points were checked for cyclonic flow and none was found to be present. Four traverse points were sampled from each of the eight ports for a total of thirty-two traverse points.

The sampling trains were leak-checked at the nozzle at 15 inches of mercury vacuum before each test, and again after each test at the highest vacuum reading recorded during the test. This was done to predetermine the possibility of a diluted sample.

The pitot tube lines were checked for leaks before and after each test under both a vacuum and a pressure. The lines were also checked for clearance and the manometer was zeroed before each test.

An integrated orsat sample was collected and analyzed according to EPA Method 3B during each test.

Speciated Mercury

Triplicate samples for speciated mercury were collected from each source. The samples were taken according to EPA Methods 1, 2, 3B, 4, 5, and 17; and the Ontario Hydro Method, Revised July 7, 1999. For each run, samples of four-minute duration were taken isokinetically at each of the thirty-two traverse points for a total sampling time of 128 minutes. Blank train samples and reagent blanks were submitted.

The " front-half " of the sampling train contained the following components:

Glass Nozzle
In-Stack Glass Thimble and Filter in a Glass Assembly
Heated Glass Probe @ 248°F ± 25°F
Heated Teflon Sample Line @ 248°F ± 25°F*

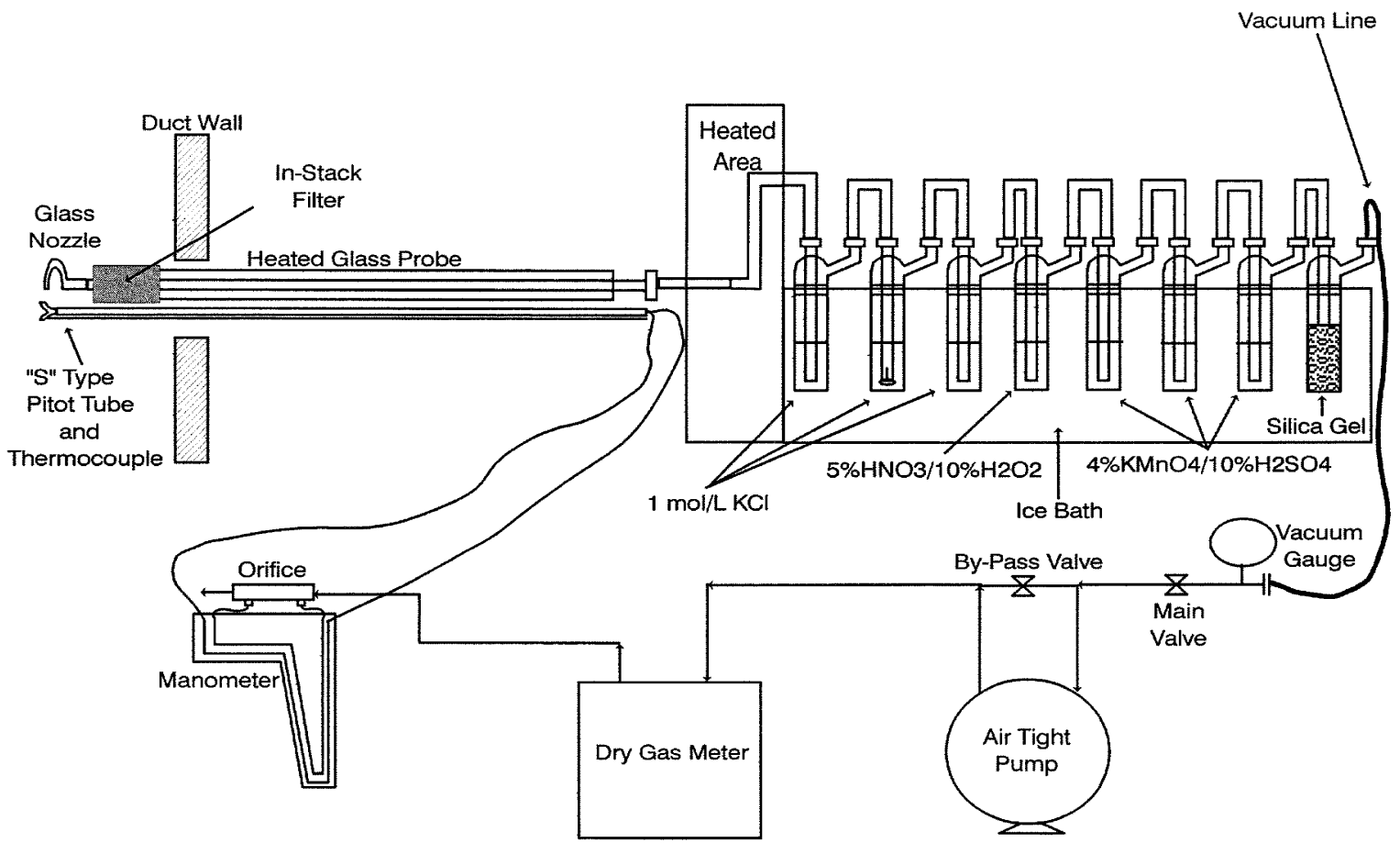
* Only used on the Outlet Duct.

The " back-half " of the sampling train contained the following components:

Impinger Number	Contents	Amount	Parameter Collected
1	1 mol/L KCl	100 ml	Oxidized Mercury
2	1 mol/L KCl	100 ml	Oxidized Mercury
3	1 mol/L KCl	100 ml	Oxidized Mercury
4	5% HNO_3 and 10% H_2O_2	100 ml	Elemental Mercury
5	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
6	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
7	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
8	Silica Gel	200 g	Moisture

The mercury samples were analyzed by cold vapor atomic absorption spectroscopy.

Schematic Diagram of the Ontario Hydro Method Sampling Train used on the Inlet Duct



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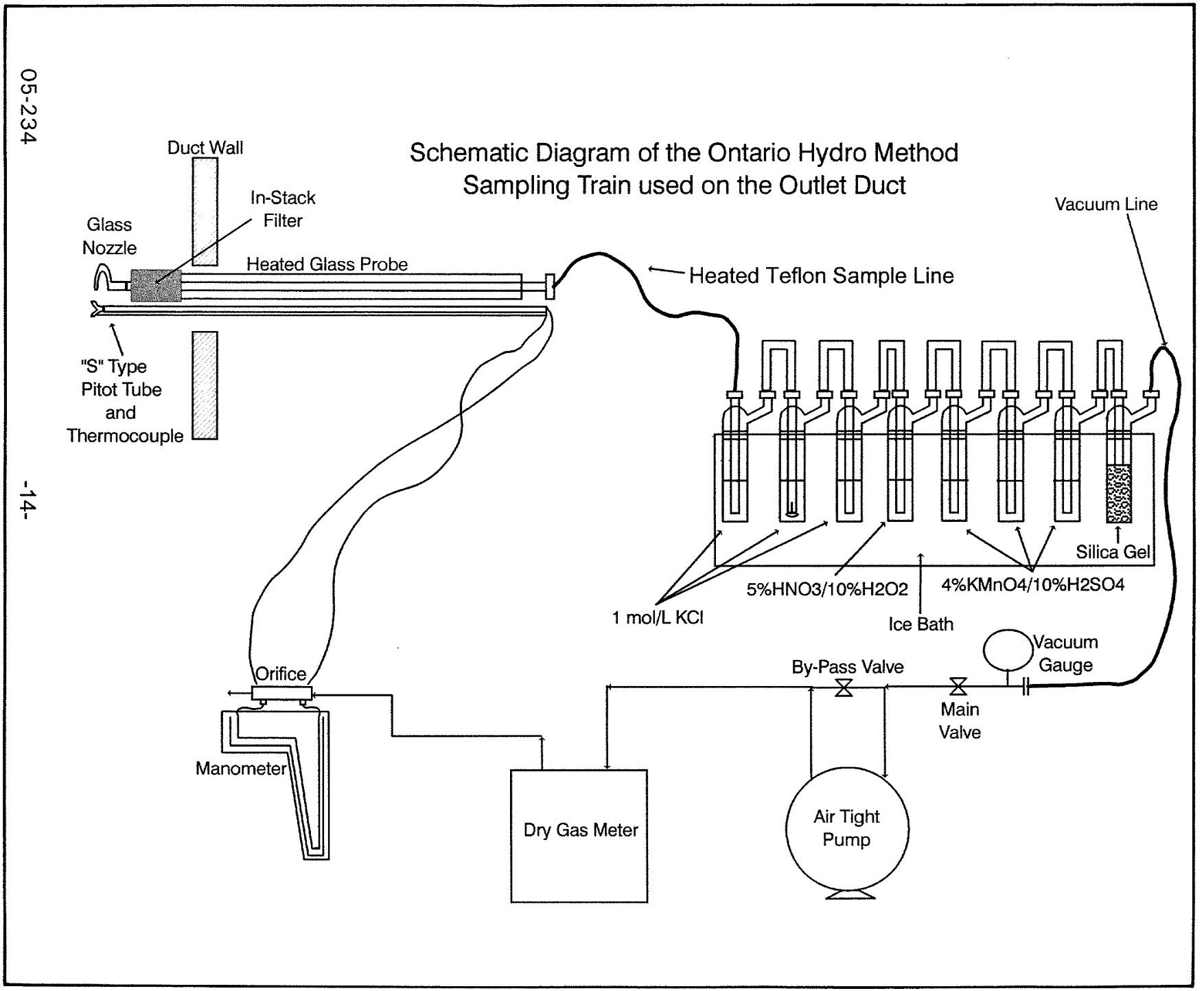

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DESCRIPTION OF TESTS

Personnel from METCO Environmental arrived at the plant at 2:15 p.m. on Monday, October 17, 2005. After meeting with plant personnel and attending a brief safety orientation, the equipment was moved onto the Unit Number 2 ESP Inlet and Outlet Ducts. The equipment was secured for the night and all work was completed at 5:15 p.m.

On Tuesday, October 18, work began at 9:00 a.m. The equipment was prepared for testing. The first set of tests for speciated mercury began at 12:04 p.m. Testing continued until completion of the second set of tests at 7:31 p.m. The samples were recovered. The equipment was secured for the night and all work was completed at 9:00 p.m.

On Wednesday, October 19, work began at 8:30 a.m. The equipment was prepared for testing. The third set of tests for speciated mercury began at 12:48 p.m. and was completed at 3:07 p.m.

The equipment was moved off of the sampling locations and loaded into the sampling van. The samples were recovered and transported to METCO Environmental's laboratory in Dallas, Texas, for analysis and evaluation.

Operations at Arkansas Power & Light Company, Independence Steam Electric Station, Unit Number 2 ESP Inlet and Outlet Ducts, located in Newark, Arkansas, for ADA-ES, were completed at 4:15 pm. on Wednesday, October 19, 2005.

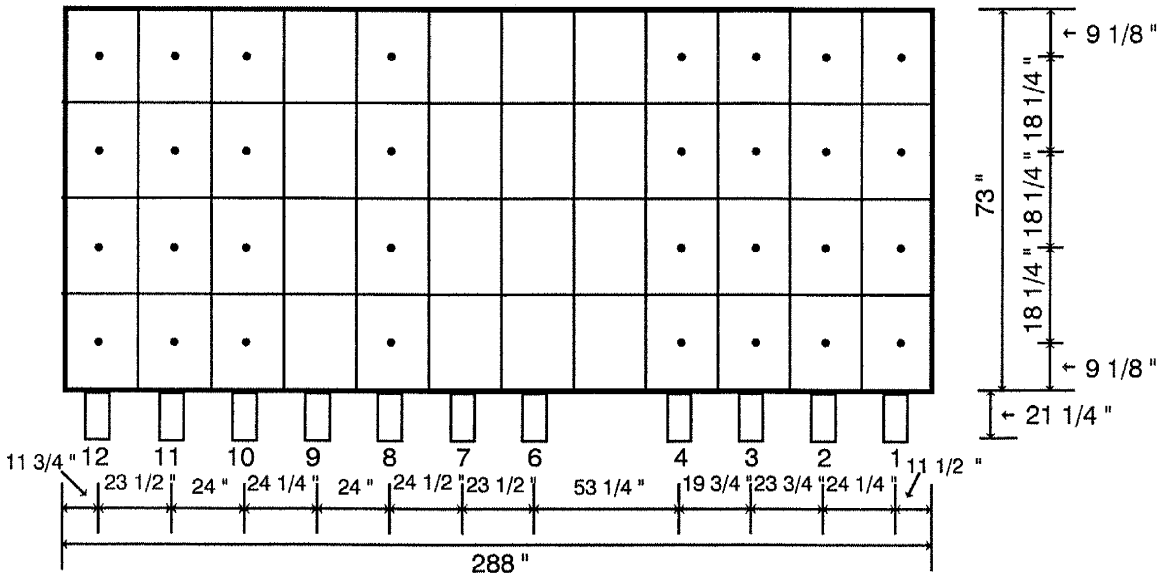
APPENDICES

A. Location of Sampling Points
B. Source Emissions Calculations
C. Calibration Data
D. Field Testing Data
E. Analytical Data
F. Chain of Custody
G. Resumes of Test Personnel

APPENDIX A

Location of Sampling Points
Unit Number 2 ESP Inlet Duct

The sampling ports are located 25 feet 4 inches (2.61 equivalent duct diameters) downstream from a bend in the duct and 6 feet 6 1/4 inches (0.67 equivalent duct diameters) upstream from an expansion in the duct. The locations of the sampling points were calculated as follows:



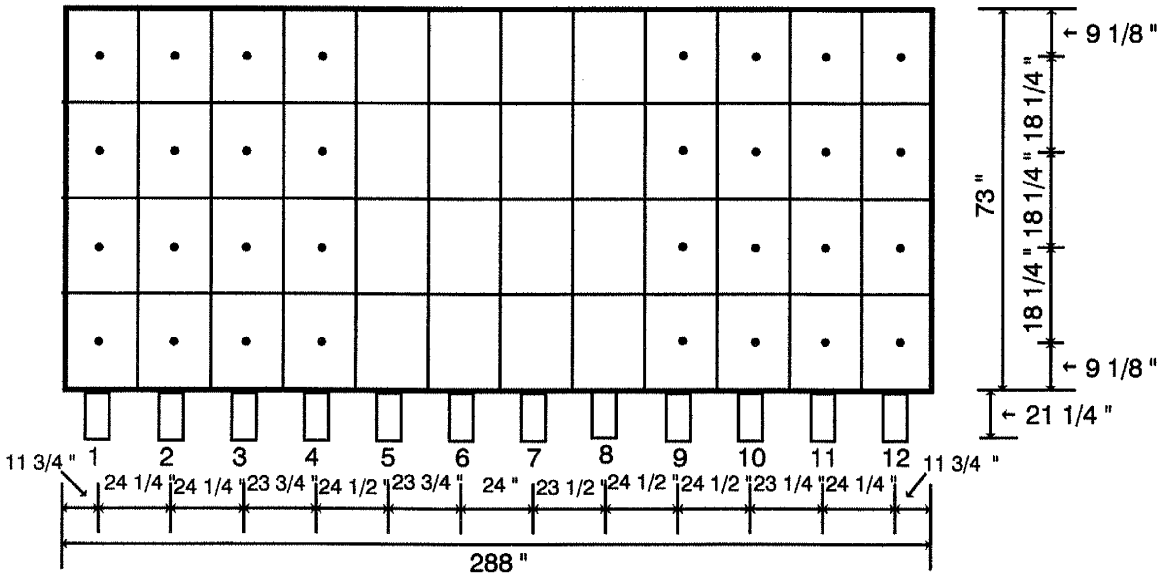
Note: The duct has 17 " of insulation. Port 5 does not exist. Ports 6 and 7 are not part of the gas stream and were not included in the calculation of the area. The width of where Ports 6 and 7 are located is 5 ' 5 ". This leaves a width of 18 ' 7 " on which the area was calculated. A plant monitor probe is located in Port 9.

Not to Scale

APPENDIX A

Location of Sampling Points
Unit Number 2 ESP Outlet Duct

The sampling ports are located 6 feet 11 inches (0.71 equivalent duct diameters) downstream from a constriction in the duct and 3 feet 2 inches (0.33 equivalent duct diameters) upstream from a bend in the duct. The locations of the sampling points were calculated as follows:



Note: The duct has 17 " of insulation. Ports 5 and 6 were not accessible and could not be sampled.

Not to Scale

APPENDIX B

Nomenclature and Equations
for
Calculation of Source Emissions

NOMENCLATURE FOR PARTICULATE CALCULATIONS

Symbol	English Units	Metric Units	Description
A_s	in.^{2}	m^2	Stack Area
C_{an}	gr/dscf*	g/dscm*	Particulate - probe, cyclone, and filter
C_{ao}	gr/dscf*	g/dscm*	Particulate - total
C_{at}	gr/CF @ stack conditions	g/m^3	Particulate - probe, cyclone, and filter
C_{au}	gr/CF @ stack conditions	g/m^3	Particulate - total
C_{aw}	lbs/hr	kg/hr	Particulate - probe, cyclone, and filter
C_{ax}	lbs/hr	kg/hr	Particulate - total
C_p			Pitot Tube Calibration Factor
D_n	in.	m	Sampling Nozzle Diameter
%EA			Percent Excess Air at sampling point
g	32.174 ft/sec^2		Acceleration of Gravity
%I			Percent Isokinetic
%M			Percent Moisture in the stack gas by volume
M_d			Mole fraction of dry gas

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

Symbol	English Units	Metric Units	Description
m_f	mg	mg	Particulate - probe, cyclone, and filter
M_{water}	18 lb/lb-mole		Molecular Weight of water
m_t	mg	mg	Particulate - total
MW	lb/lb-mole	g/g-mole	Molecular Weight of stack gas
MW_{air}	28.96 lb/ lb-mole		Molecular Weight of air
MW_d	lb/lb-mole	g/g-mole	Molecular Weight of dry stack gas
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H_2O	mm H_2O	Orifice Pressure drop
P_s	"Hg Absolute	mm Hg	Stack Pressure
ΔP	"H_2O	mm H_2O	Velocity Head of stack gas
P_{std}	29.92 "Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m^3/hr	Stack Gas Volume at actual stack conditions
Q_s	DSCFM*	dscm/hr*	Stack Gas Volume at 29.92 "Hg, 528°R, dry
R	21.83 "Hg-ft^3/lb-mole°R		Universal Gas Constant
T_m	°F	°C	Average Gas Meter Temperature

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

Symbol	English Units	Metric Units	Description
T_t	min	min	Net time of test
T_s	°F	°C	Stack Temperature
T_{std}	528°R	293°K	Standard Temperature
V_m	ft^3	m^3	Volume of dry gas sampled @ meter conditions
Vm_{std}	dscf*	dscm*	Volume of dry gas sampled @ standard conditions
V_s	fpm	m/sec	Stack velocity @ stack conditions
V_w	ml	ml	Total water collected in impingers and silica gel
Vw_{gas}	scf*	scm*	Volume of water vapor collected @ standard conditions
ρ_{air}	0.0752 lbs/ft^3		Density of Air
ρ_{water}	1 g/ml		Density of Water
ρ_{man}	62.32 lbs/ft^3		Density of Manometer Oil

Standard Conditions: 29.92 "Hg, 68°F (760 mm Hg, 20°C)

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

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EXAMPLE CALCULATIONS

1. Volume of dry gas sampled at standard conditions. *

$$Vm_{std} = Vm \left(\frac{T_{std}}{T_m + 460} \right) \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}} \right]$$

$$Vm_{std} = 17.65\, Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = dscf$$

$$Vm_{std} = dscf \ x\ 0.028317 = dscm$$

2. Volume of water vapor collected at standard conditions. *

$$Vw_{gas} = \frac{(V_w - gms\ SO_2 - gms\ H_2S)\ \rho_{water}\ R\ T_{std}}{P_{std}\ M_{water}\ 453.6}$$

$$Vw_{gas} = 0.0472\,(V_w - gms\ SO_2 - gms\ H_2S) = scf$$

$$Vw_{gas} = scf\ x\ 0.028317 = scm$$

3. Percent moisture in stack gas.

$$\%M = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}\ x\ 100 = \%$$

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

4. Mole fraction of dry gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average molecular weight of dry stack gas.

$$MW_d = \left[\%CO_2 \times \frac{44}{100}\right] + \left[\%O_2 \times \frac{32}{100}\right] + \left[\%N_2 \times \frac{28}{100}\right] + \left[\%CO \times \frac{28}{100}\right] = lb/lb\text{-}mole$$

$$= g/g\text{-}mole$$

6. Molecular weight of stack gas.

$$MW = MW_d \times M_d + 18\,(1 - M_d) = \frac{lb}{lb\text{-}mole} = g/g\text{-}mole$$

7. Percent excess air at sampling point.

$$\%EA = \frac{100\,[\%O_2 - (0.5\,\%CO)]}{0.265\,(\%N_2) - [\%O_2 - (0.5\,\%CO)]}$$

8. Stack Pressure.

$$P_s = P_b + \frac{Stack\ Pressure\ "H_2O}{13.6} = "Hg\ Absolute$$

$$P_s = "Hg\ Abs. \times 25.4 = mm\ Hg$$

9. Stack velocity at stack conditions.

$$V_s = C_p\, 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460)}{12 \times \rho_{air} \times P_s \times MW \times T_{std}} \right]^{1/2} \times \sqrt{\Delta P}\ average$$

$$V_s = 5{,}123.8\, C_p \left[\frac{(T_s + 460)}{P_s \times MW} \right]^{1/2} \sqrt{\Delta P}\ average = fpm$$

$$V_s = fpm \times 0.00508 = m/sec$$

10. Dry stack gas volume at standard conditions. *

$$Q_s = \frac{1}{144} V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

$$Q_s = \frac{0.123\, V_s \times A_s \times M_d \times P_s}{T_s + 460} = DSCFM$$

$$Q_s = DSCFM \times 1.6990 = dscm/hr$$

11. Actual stack gas volume at stack conditions.

$$Q_a = \frac{V_s \times A_s}{144} = ACFM$$

$$Q_a = ACFM \times 1.6990 = m^3/hr$$

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

12. Percent Isokinetic.

$$\%I = \frac{Vm_{std} \times (T_s + 460) \times P_{std} \times 100 \times 144\ in^2/ft^2}{M_d \times T_{std} \times P_s \times T_t \times V_s (\frac{\pi \times D_n^2}{4})}$$

$$\%I = \frac{1039 \times Vm_{std} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s \times D_n^2}$$

EXAMPLE CALCULATIONS

$$\text{lbs/trillion Btu} = \frac{\text{lbs/dscf*} \times F_d \text{ factor} \times 20.9\%O_2}{20.9\%O_2 - \%O_2 \text{ measured}}$$

F_d = Oxygen based F factor

Fuel	F_d factor
Bituminous Coal	9.780×10^9 dscf*/trillion Btu

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-234
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
DATE			10/18/05	10/18/05	10/19/05
BEGIN TIME			1207	1705	1249
END TIME			1509	1926	1459
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.62	29.54	29.66
		(mm Hg)	(752.00)	(750.00)	(753.00)
P(m)	ORIFICE PRESSURE DROP	"H2O	0.600	0.639	0.648
		(mm H2O)	(15.200)	(16.200)	(16.500)
	DGM CALIBRATION FACTOR		1.008	1.008	1.008
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	54.238	58.489	57.159
	@ METER CONDITIONS	(m^3)	(1.536)	(1.656)	(1.619)
	LEAK CHECK VOLUME	ft.^3	0.000	0.000	0.000
T(m)	AVERAGE GAS METER	DEG.F	86	97	94
	TEMPERATURE	(DEG.C)	(30)	(36)	(34)
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	52.010	54.836	54.099
	@ STANDARD CONDITIONS*	(DSCM)	(1.473)	(1.553)	(1.532)
V(w)	TOTAL WATER COLLECTED, IMPINGERS & SILICA GEL	ml	141.5	142.3	150.0
V(w[gas])	VOLUME WATER VAPOR	SCF	6.679	6.717	7.080
	COLLECTED @ STANDARD	(SCM)	(0.189)	(0.190)	(0.200)
	CONDITIONS*				
%M	MOISTURE IN STACK GAS BY VOLUME	%	11.38	10.91	11.57
Md	MOL FRACTION OF DRY GAS		0.8862	0.8909	0.8843
Tt	NET TIME OF TEST	MINUTES	128	128	128

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

METCO ENVIRONMENTAL

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-234
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
CO2		%	14.4	14.4	14.4
O2		%	5.4	5.6	5.2
CO		%	0.0	0.0	0.0
N2		%	80.2	80.0	80.4
%EA	EXCESS AIR @ SAMPLING POINT	%	34.1	35.9	32.3
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.52 (30.52)	30.53 (30.53)	30.51 (30.51)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	29.10 (29.10)	29.16 (29.16)	29.06 (29.06)
Cp	PITOT TUBE CALIBRATION		0.806	0.806	0.806
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.875 (22.200)	0.931 (23.600)	0.942 (23.900)
DELTA P ^(1/2)		"H2O	0.912	0.938	0.947
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	323 (162)	327 (164)	332 (167)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	28.43 (722.00) -16.20	28.36 (720.00) -16.00	28.48 (723.00) -16.00
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	3,664 (19)	3,779 (19)	3,826 (19)
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	16,279 (11)	16,279 (11)	16,279 (11)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS* WET STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR) WSCFH	236,067 (401,078) 15,982,871	242,924 (412,728) 16,360,355	243,608 (413,890) 16,528,870
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	414,222 (703,763)	427,204 (725,820)	432,501 (734,819)
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.190 (0.005)	0.190 (0.005)	0.190 (0.005)
%I	PERCENT ISOKINETIC	%	99.2	101.6	100.0

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-234
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
DATE			10/18/05	10/18/05	10/19/05
BEGIN TIME			1204	1705	1248
END TIME			1535	1931	1507
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.62	29.54	29.66
		(mm Hg)	(752.00)	(750.00)	(753.00)
P(m)	ORIFICE PRESSURE DROP	"H2O	0.804	0.895	1.008
		(mm H2O)	(20.400)	(22.700)	(25.600)
	DGM CALIBRATION FACTOR		0.991	0.991	0.991
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	63.893	68.339	71.940
	@ METER CONDITIONS	(m^3)	(1.809)	(1.935)	(2.037)
	LEAK CHECK VOLUME	ft.^3	12.272	0.000	0.000
T(m)	AVERAGE GAS METER	DEG.F	87	94	94
	TEMPERATURE	(DEG.C)	(31)	(34)	(34)
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	61.187	64.459	68.149
	@ STANDARD CONDITIONS*	(DSCM)	(1.733)	(1.825)	(1.930)
V(w)	TOTAL WATER COLLECTED,	ml	198.2	230.6	251.3
	IMPINGERS & SILICA GEL				
V(w[gas])	VOLUME WATER VAPOR	SCF	9.355	10.884	11.861
	COLLECTED @ STANDARD	(SCM)	(0.265)	(0.308)	(0.336)
	CONDITIONS*				
%M	MOISTURE IN STACK GAS	%	13.26	14.45	14.82
	BY VOLUME				
Md	MOL FRACTION OF DRY GAS		0.8674	0.8555	0.8518
Tt	NET TIME OF TEST	MINUTES	128	128	128

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-234
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
CO2		%	13.6	13.4	13.4
O2		%	7.2	7.0	6.8
CO		%	0.0	0.0	0.0
N2		%	79.2	79.6	79.8
%EA	EXCESS AIR @ SAMPLING POINT	%	52.2	49.7	47.4
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.46 (30.46)	30.42 (30.42)	30.42 (30.42)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	28.81 (28.81)	28.63 (28.63)	28.58 (28.58)
Cp	PITOT TUBE CALIBRATION		0.805	0.805	0.805
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.519 (13.200)	0.576 (14.600)	0.574 (14.600)
DELTA P ^(1/2)		"H2O	0.708	0.746	0.748
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	323 (162)	328 (164)	329 (165)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	28.57 (726.00) -14.30	28.48 (723.00) -14.40	28.60 (726.00) -14.40
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	2,848 (14)	3,025 (15)	3,031 (15)
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	21,024 (14)	21,024 (14)	21,024 (14)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS* WET STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR) WSCFH	233,093 (396,025) 16,123,565	241,869 (410,935) 16,963,343	242,010 (411,175) 17,046,959
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	415,842 (706,516)	441,634 (750,336)	442,555 (751,901)
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.246 (0.006)	0.246 (0.006)	0.246 (0.006)
%I	PERCENT ISOKINETIC	%	91.0	92.4	97.7

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

APPENDIX C

Calibration Data

Equipment	Calibration Factor	Calibration Date
Pitot Tube #31-5-1 (low side)	0.806	10/12/05
Pitot Tube #31-5-3	0.805	10/14/05
Probe Tip #05-233-2	0.246	08/16/05
Probe Tip #05-233-7	0.190	08/16/05
Dry Gas Meter #27-3	0.991	08/12/05
Stack Unit Orifice #27-3		08/12/05
Digital Temperature Indicator #27-3		08/12/05
Dry Gas Meter #31-1	1.008	10/03/05
Stack Unit Orifice #31-1		10/04/05
Digital Temperature Indicator #31-1		10/03/05
Barometer #31-1		06/21/05

PITOT TUBE CALIBRATION

Date: 10-12-05

Pitot No.: 31-5-1

Pitot Dimensions: 5' x 1/4"

Time: 1430

T_s: 75 °F

C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.33	0.575	0.808	0.33	0.575	0.808
20	40	0.34	0.34	0.583	0.52	0.721	0.801	0.52	0.721	0.801
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.81	0.900	0.808
35	60	0.80	0.80	0.894	1.25	1.118	0.792	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.55	1.245	0.795	1.50	1.225	0.808
50	80	1.30	1.30	1.140	2.00	1.414	0.798	2.00	1.414	0.798
62	90	1.60	1.60	1.265	2.45	1.565	0.800	2.40	1.549	0.808
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.82	0.906	0.803
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.82	0.906	0.803
Average							0.801 ✓			0.806 ✓

Summary of Results:

Normal high side calibration factor 0.801 ✓

variation + 0.87 ✓

variation - 1.12 ✓

Normal low side calibration factor 0.806 ✓

variation + 0.25 ✓

variation - 0.99 ✓

Calibrator: JOSH ORR / DEKE BRUMMETT

Checked By: JASON BROWN

PITOT TUBE CALIBRATION

Date: 10-14-05

Time: 0955

Pitot No.: 31-5-3

T_s: 75 °F

Pitot Dimensions: 5' x 1/4"

C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.34	0.583	0.796	0.34	0.583	0.796
20	40	0.34	0.34	0.583	0.51	0.714	0.808	0.51	0.714	0.808
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
35	60	0.80	0.80	0.894	1.20	1.095	0.808	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.50	1.225	0.808	1.50	1.225	0.808
50	80	1.30	1.30	1.140	2.00	1.414	0.798	1.95	1.396	0.808
62	90	1.60	1.60	1.265	2.40	1.549	0.808	2.40	1.549	0.808
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.82	0.906	0.803
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
Average							0.805			0.807

Summary of Results:

Normal high side calibration factor 0.805

variation + 0.37

variation - 1.12

Normal low side calibration factor 0.807

variation + 0.12

variation - 1.36

Calibrator: JOSH ORR / DEXE BRUMMETT

Checked By: JASON BROWN

VERSION 1
22 OCTOBER 2002

MITECO ENVIRONMENTAL

NOZZLE CALIBRATION

Nozzle Set No. 05-233TASK1

Date 8-16-05 Calibrator: Malone

	05-233-1	05-233-2	05-233-3	05-233-4	05-233-5	05-233-6
Reading 1	0.247	0.246	0.246	0.193	0.190	0.190
Reading 2	0.247	0.245	0.247	0.193	0.190	0.190
Reading 3	0.246	0.247	0.246	0.193	0.191	0.191
Reading 4	0.247	0.245	0.247	0.194	0.189	0.190
Reading 5	0.246	0.245	0.247	0.194	0.190	0.190
Reading 6	0.248	0.245	0.247	0.193	0.190	0.189
Reading 7	0.248	0.247	0.246	0.193	0.190	0.191
Reading 8	0.247	0.246	0.247	0.194	0.190	0.190
Reading 9	0.247	0.246	0.247	0.192	0.190	0.190
Reading 10	0.247	0.246	0.247	0.193	0.190	0.190
Average	0.247	0.246	0.247	0.193	0.190	0.190

	05-233-7	05-233-8	9	10	11	12
Reading 1	0.190	0.245				
Reading 2	0.190	0.248				
Reading 3	0.191	0.247				
Reading 4	0.189	0.247				
Reading 5	0.191	0.246				
Reading 6	0.189	0.248				
Reading 7	0.190	0.247				
Reading 8	0.190	0.247				
Reading 9	0.190	0.246				
Reading 10	0.190	0.247				
Average	0.190	0.247				

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 273

Date: 8/12/05

ΔH ("H_2O)	C_{DG}
0.5	0.979
1.0	0.989
1.5	1.008
2.0	0.990
3.0	0.988
4.0	0.989
Average	0.991

Variation: + 1.72%

- 1.21%

Calibrator: Ned Shappley

Checked By:

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27-3

Calibrator: Ned Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.5 H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)						Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out		P_m
End	1128	5.170	cf	75	°F	-0.4	844.539	cf	70	°F	69	°F	0.5 "H_2O
Start	1116	0.000	cf	75	°F	-0.4	839.300	cf	70	°F	71	°F	0.5 "H_2O
Avg.		5.170	cf	75	°F	-0.4	5.239	cf	70		°F		0.5 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.170 \left[\frac{29.40 + \frac{-0.4}{13.6}}{75 + 460}\right] \times 1.004 \quad (C_f) = 5.039 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.239 \left[\frac{29.40 + \frac{0.5}{13.6}}{70 + 460}\right] = 5.136 \text{ dcsf}$$

$$C_{DG} = \frac{5.039}{5.136} = \boxed{0.979}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27-3

Calibrator: Ned Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.0" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)

	Time	Meter Reading		Temp.		P_m	
End	1141	5.300	cf	74	°F	-0.4	"H_2O
Start	1131	0.000	cf	74	°F	-0.4	"H_2O
Avg.		5.300	cf	74	°F	-0.40	"H_2O

Dry Gas Meter

Meter Reading		Temp. In		Temp. Out		P_m	
850.231	cf	71	°F	73	°F	1.00	"H_2O
844.900	cf	69	°F	71	°F	1.00	"H_2O
5.331	cf	71			°F	1.00	"H_2O

$$Wet\ Test\ Meter\ Vm_{std} = 17.65 \times 5.300 \left[\frac{29.40 + \frac{-0.4}{13.6}}{74 + 460}\right] \times 1.004 \quad (C_i) = 5.166 \text{ dcsf}$$

$$Dry\ Gas\ Meter\ Vm_{std} = 17.65 \times 5.331 \left[\frac{29.40 + \frac{1.00}{13.6}}{71 + 460}\right] = 5.223 \text{ dcsf}$$

$$C_{DG} = \frac{5.166}{5.223} = \boxed{0.989}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27-3

Calibrator: Ned Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.5" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)

	Time	Meter Reading	Temp.	P_m
End	1158	10.325 cf	74 °F	-1.3 "H_2O
Start	1142	0.000 cf	74 °F	-1.3 "H_2O
Avg.		10.325 cf	74 °F	-1.3 "H_2O

Dry Gas Meter

	Meter Reading	Temp. In	Temp. Out	P_m
End	860.610 cf	78 °F	72 °F	1.5 "H_2O
Start	850.398 cf	71 °F	73 °F	1.5 "H_2O
Avg.	10.212 cf	74 °F		1.5 "H_2O

$$Wet\ Test\ Meter\ Vm_{std} = 17.65 \times 10.325 \left[\frac{29.40 + \frac{-1.3}{13.6}}{74 + 460} \right] \times 1.004 \quad (C_f) = 10.091 \ dcsf$$

$$Dry\ Gas\ Meter\ Vm_{std} = 17.65 \times 10.212 \left[\frac{29.40 + \frac{1.5}{13.6}}{74 + 460} \right] = 9.961 \ dcsf$$

$$C_{DG} = \frac{10.091}{9.961} = \boxed{1.008}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27-3

Date: 8/12/05

Calibrator: Ned Shappley

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 20" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)

	Time	Meter Reading		Temp.		P_m	
End	1416	10.240	cf	74	°F	-1.5	"H_2O
Start	1400	0.000	cf	74	°F	-1.5	"H_2O
Avg.		10.240	cf	74	°F	-1.5	"H_2O

Dry Gas Meter

	Meter Reading		Temp. In		Temp. Out		P_m	
End	911.712	cf	87	°F	73	°F	2.0	"H_2O
Start	901.343	cf	80	°F	73	°F	2.00	"H_2O
Avg.	10.369	cf	78			°F	2.0	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.240 \left[\frac{29.40 + \frac{-1.5}{13.6}}{74 + 460}\right] \times 1.04 \quad (C_f) = 9.953 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.369 \left[\frac{29.40 + \frac{2.0}{13.6}}{78 + 460}\right] = 10.051 \text{ dcsf}$$

$$C_{DG} = \frac{9.953}{10.051} = \boxed{0.990}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27.3

Calibrator: Dad Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.0" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)

	Time	Meter Reading	Temp.	P_m
End	1332	14.780 cf	74 °F	-2.30 "H_2O
Start	1319	0.000 cf	74 °F	-2.30 "H_2O
Avg.		14.780 cf	74 °F	-2.30 "H_2O

Dry Gas Meter

	Meter Reading	Temp. In	Temp. Out	P_m
End	890.387 cf	92 °F	73 °F	3.00 "H_2O
Start	875.402 cf	82 °F	73 °F	3.00 "H_2O
Avg.	14.985 cf	80 °F		3.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 14.780 \left[\frac{29.40 + \frac{-2.30}{13.6}}{74 + 460}\right] \times 1.004 \quad (C_f) = 14.337 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 14.985 \left[\frac{29.40 + \frac{3.0}{13.6}}{80 + 460}\right] = 14.508 \text{ dcsf}$$

$$C_{DG} = \frac{14.337}{14.508} = \boxed{0.988}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 273

Date: 8/12/05

Calibrator: Ned Shappley

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.0

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 9)

	Time	Meter Reading		Temp.		P_m	
End	1343	10.050	cf	74	°F	-3.2	"H_2O
Start	1335	0.000	cf	74	°F	-3.2	"H_2O
Avg.		10.050	cf	74	°F	-3.2	"H_2O

Dry Gas Meter

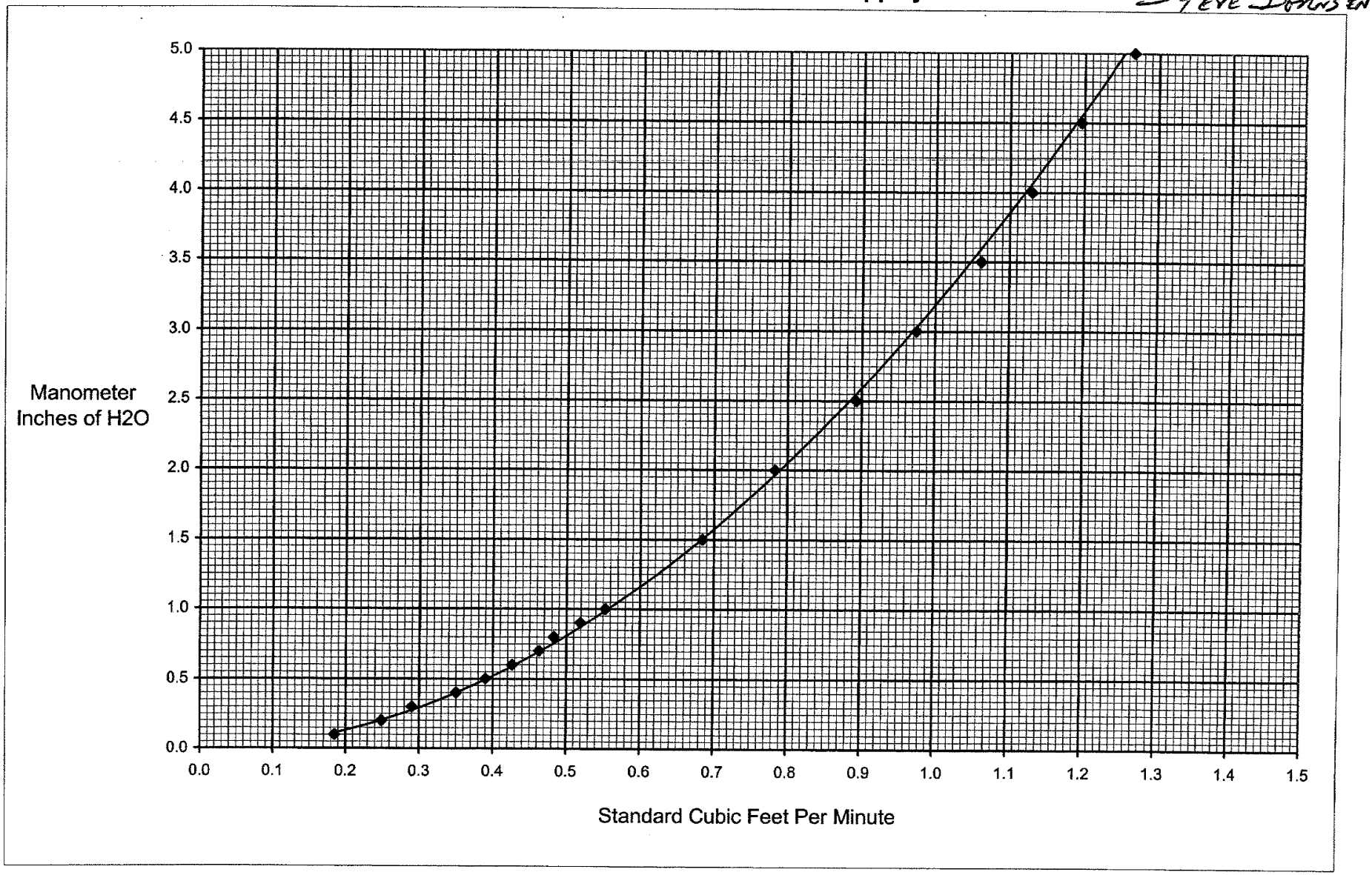
	Meter Reading		Temp. In		Temp. Out		P_m	
End	901.097	cf	95	°F	73	°F	4.0	"H_2O
Start	890.910	cf	90	°F	72	°F	4.0	"H_2O
Avg.	10.187	cf	83	°F			4.0	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.050 \left[\frac{29.40 + \frac{-3.2}{13.6}}{74 + 460} \right] \times 1.004 \quad (C_p) = 9.727 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.187 \left[\frac{29.40 + \frac{4.0}{13.6}}{83 + 460} \right] = 9.832 \text{ dcsf}$$

$$C_{DG} = \frac{9.727}{9.832} = \boxed{0.989}$$

STACK UNIT ORIFICE NO: **27-3** DATE: **08/12/05** CALIBRATED BY: **Ned Shappley** CHECKED BY: Steve Downsen



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 27-3

CALIBRATION DATA

DATE: 8/12/05

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	1000	77	76
Ice Bath	1001	32	32
Boiling Water	1006	211	210
Oven	1020	247	248
Oven	1035	300	301
Oven	1042	350	349
Oven	1047	382	380

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. D1

Calibrator Ned Shappley

Checked By: Mark Glier

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 31-1

Date: 3 Oct 2005

ΔH ("H_2O)	C_{DG}
0.5	1.009
1.0	1.009
1.5	1.008
2.0	1.006
3.0	1.008
4.0	1.007
Average	1.008 ✓

Variation: + 0.10% ✓

- 0.20% ✓

Calibrator: Phil Rowland

Checked By: Steve Boonsen

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.50

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1445	11.000 cf	75 °F	−0.55 "H_2O	260.949 cf	86 °F	78 °F	0.50 "H_2O
Start	1410	0.000 cf	75 °F	−0.60 "H_2O	249.885 cf	83 °F	79 °F	0.50 "H_2O
Avg.	35	11.000 cf	75 °F	−0.58 "H_2O	11.064 cf	82 °F		0.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-0.58}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.762 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.064 \left[\frac{29.58 + \frac{0.50}{13.6}}{82 + 460}\right] = 10.671 \text{ dcsf}$$

$$C_{DG} = \frac{10.762}{10.671} = \boxed{1.009 \checkmark}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)						Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out		P_m
End	1515	11.000	cf	75	°F	-0.90 "H_2O	273.477	cf	91	°F	80	°F	1.00 "H_2O
Start	1455	0.000	cf	75	°F	-0.85 "H_2O	262.399	cf	85	°F	78	°F	1.00 "H_2O
Avg.	20	11.000	cf	75	°F	-0.88 "H_2O	11.078	cf	84	°F			1.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-0.88}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.754 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.078 \left[\frac{29.58 + \frac{1.00}{13.6}}{84 + 460}\right] = 10.658 \text{ dcsf}$$

$$C_{DG} = \frac{10.754}{10.658} = \boxed{1.009 \checkmark}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 30 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.50

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)							Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out		P_m
End	1540	11.020	cf	75	°F	-1.20 "H_2O	286.256	cf	94	°F	80	°F	1.50 "H_2O
Start	1520	0.000	cf	75	°F	-1.20 "H_2O	275.128	cf	89	°F	80	°F	1.50 "H_2O
Avg.	20	11.020	cf	75	°F	-1.20 "H_2O	11.128	cf	86	°F			1.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.020 \left[\frac{29.58 + \frac{-1.20}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.765 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.128 \left[\frac{29.58 + \frac{1.50}{13.6}}{86 + 460}\right] = 10.680 \text{ dcsf}$$

$$C_{DG} = \frac{10.765}{10.680} = \boxed{1.008}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)							Dry Gas Meter					
	Time	Meter Reading	Temp.		P_m		Meter Reading	Temp. In		Temp. Out		P_m
End	1555	11.000	cf	75	°F	-1.50 "H_2O	298.634	cf	95	°F	80	°F 2.00 "H_2O
Start	1545	0.000	cf	75	°F	-1.50 "H_2O	287.532	cf	90	°F	80	°F 2.00 "H_2O
Avg.	10	11.000	cf	75	°F	-1.50 "H_2O	11.102	cf	86	°F		2.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-1.50}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.737 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.102 \left[\frac{29.58 + \frac{2.00}{13.6}}{86 + 460}\right] = 10.669 \text{ dcsf}$$

$$C_{DG} = \frac{10.737}{10.669} = \boxed{1.006 \checkmark}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)						Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out	P_m
End	1615	11.000	cf	75	°F	-2.25 "H_2O	310.766	cf	99	°F	81 °F	3.00 "H_2O
Start	1605	0.000	cf	75	°F	-2.20 "H_2O	299.689	cf	92	°F	81 °F	3.00 "H_2O
Avg.	10	11.000	cf	75	°F	-2.23 "H_2O	11.077	cf	88		°F	3.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-2.23}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.718 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.077 \left[\frac{29.58 + \frac{3.00}{13.6}}{88 + 460}\right] = 10.632 \text{ dcsf}$$

$$C_{DG} = \frac{10.718}{10.632} = \boxed{1.008}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Calibrator: Phil Rowland

Date: 3 Oct 2005

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

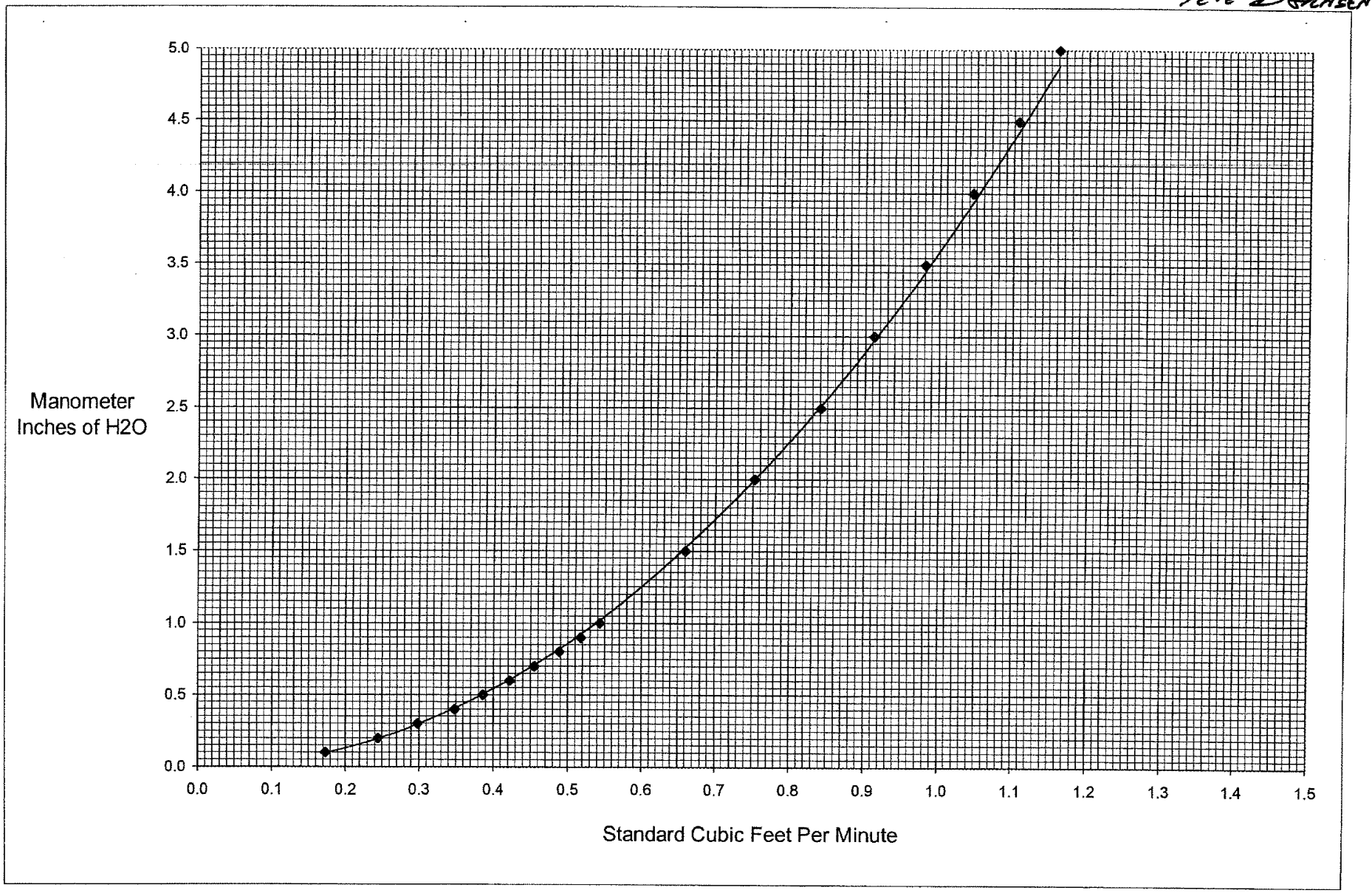
	Wet Test Meter (No. 4)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1630	11,000 cf	75 °F	-3.00 "H_2O	323,057 cf	100 °F	82 °F	4.00 "H_2O
Start	1620	0.000 cf	75 °F	-2.90 "H_2O	311,999 cf	94 °F	81 °F	4.00 "H_2O
Avg.	10	11,000 cf	75 °F	-2.95 "H_2O	11,058 cf	89 °F		4.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11{,}000 \left[\frac{29.58 + \frac{-2.95}{13.6}}{75 + 460}\right] \times 1.004 \ (C_f) = 10{,}698 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11{,}058 \left[\frac{29.58 + \frac{4.00}{13.6}}{89 + 460}\right] = 10{,}620 \text{ dcsf}$$

$$C_{DG} = \frac{10.698}{10.620} = \boxed{1.007 \ \checkmark}$$

STACK UNIT ORIFICE NO: **31-1** DATE: **10/04/05** CALIBRATED BY: **Phillip Rowland** CHECKED BY: Steve Borchsen



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 31-1

CALIBRATION DATA

DATE: 3 Oct 2005

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	1306	76	75
Ice Bath	1307	34	34
Boiling Water	1309	213	211
Oven	1325	376	375
Oven	1332	352	350
Oven	1339	301	300
Oven	1346	251	250

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. D-1

Calibrator Phil Rowland

Checked By: Steve Bronsen

METCO ENVIRONMENTAL

JMLS4

BAROMETER CALIBRATION

Barometer No. 31-1

Date: 6/21/05

Time: 1015

Barometric Pressure @ Addison Airport @ 719 ft.	=	30.09
	-	0.719
Absolute Pressure @ Addison Airport	=	29.371
	+	0.083
Absolute Pressure @ METCO @ 636 ft.	=	29.454
Barometer Reading	=	29.500
Variation	=	-0.046
Barometer Adjusted?	Yes ✓	No ____
Barometer Reading (after adjustment)	=	29.45

Signature of Calibrator

APPENDIX D

Field Testing Data

METCO ENVIRONMENTAL

1.05 0.72

Job Number 05-234 task 2 ✓
Job Name ADA-ES ✓
Run Number 1 - task 2 ✓
Unit ESP Inlet Duct ✓
Date 10-18-05 ✓
Operator Bonnsen ORR ✓
Sample box No. 79 Meter Box No. 31-1 ✓

OH Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 79
Assumed Moisture % 15.0
Probe Length 5'
C Factor 1.0 → 7.0 to reference.
Initial Leak @ 15.0 "Hg = 0.000 cfm
Final Leak @ 12.0 "Hg = 0.004 cfm

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1207	397.825	1.30	0.88	0.88	8.0	319	249	250	74	82	80	
3	1211	399.90	1.30	0.88	0.88	8.0	319	251	253	66	84	80	
2	1215	401.89	1.25	0.85	0.85	8.0 ~~12.0~~	318	257	259	66	86	81	
1	1219	404.12	1.20	0.80	0.80	8.0 ~~12.5~~	315	257	262	60	88	81	
—	1223	409.295	—	—	—	—	—	—	—	—	—	—	
2-4	1223	405.295	1.05	0.73	0.73	7.0	315	274	274	59	90	82	
3	1227	407.37	1.05	0.73	0.73	7.0	317	272	271	59	90	82	
2	1231	409.90	0.93	0.65	0.65	7.0	317	271	269	58	88	83	
1	1235	411.32	0.61	0.42	0.42	5.0	316	270	267	58	87	83	
—	1239	412.770	—	—	—	—	—	—	—	—	—	—	
3-4	1239	412.770	1.10	0.75	0.75	7.5	318	251	272	62	84	84	
3	1243	414.61	1.10	0.75	0.75	7.5	315	253	270	58	85	84	
2	1247	416.48	1.00	0.70	0.70	7.5	316	252	269	58	85	84	
1	1251	418.34	0.42	0.27	0.27	3.5	308	252	269	64	87	81	
—	1255	419.792	—	—	—	—	—	—	—	—	—	—	
4-4	1255	419.792	1.10	0.75	0.75	7.0	321	254	271	63	87	81	
3	1259	421.48	1.00	0.70	0.70	7.0	321	252	270	60	88	82	
2	1303	424.21	1.00	0.70	0.70	7.0	320	254	269	60	88	82	

Pitot Tube Calibration Factor C_p 0.80 ✓ low
Volume Collected V_m 54.238 ✓ ft^3
Water Collected V_w 141.5 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -16.2 ✓ "H_2O

Pitot Tube No. 31-5-1 ✓
Baro. Press. P_b 29.62 ✓ "Hg
Probe Tip Dia. D_n ~~0.194~~ 0.19 ✓ in.
% CO_2 14.4 ✓ % CO 0.0 ✓
% O_2 5.4 ✓ % N_2 80.2 ✓
Area Stack A_s ~~21024~~ ✓ 16279 ✓ in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-233-7 ✓
Total Volume of Leak Checks After Start: — ft^3
V_m = Dry Gas Meter Calibration Factor 1.008 ✓ X 53.808

{Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

VERSION 1
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Impinger Box No. 79

Impinger 1	Final Weight	816.2 ~~855.0~~	**Water Weight Gain**	Impinger 1	79.8
	Initial Weight	736.4	Imp. 8 987.0		
	Increase		976.2	Impinger 2	28.7
Impinger 2	Final Weight	746.8		Impinger 3	7.8
	Initial Weight	718.1			
	Increase			Impinger 4	3.3
			V_w =		
Impinger 3	Final Weight	750.7	g SO_2 = -	Impinger 5	1.6
	Initial Weight	742.9	V_w =		
	Increase			Impinger 6	7.4
Impinger 4	Final Weight	718.6		Impinger 7	2.1
	Initial Weight	715.3		Impinger 8	10.8
	Increase			Total	141.5 ✓ = V_w

Impinger 5	Final Weight	758.7	P_b =	29.62 ✓	%CO_2 =	14.4 ✓	
	Initial Weight	757.1	V_m =	54.238 ✓	%O_2 =	5.4 ✓	
	Increase		V_w =	141.5 ✓	%CO =	0.0 ✓	
			P_m =	0.600 ✓	%N_2 =	80.2 ✓	
Impinger 6	Final Weight	676.4	Avg ΔP =	0.875 ✓	A_s =	~~21.024~~ ✓	16.279 ✓
	Initial Weight	669.0			D_n =	~~0.194~~	0.190
	Increase		Avg$\sqrt{\Delta P}$ =	0.912 ✓	T_t =	128 ✓	
			C_p =	0.806 ✓			
Impinger 7	Final Weight	642.6	P_s =	-16.2 ✓ "H_2O		28.43 ✓	"Hg
	Initial Weight	640.5	T_m =	86 ✓ °F		546 ✓	°R
	Increase		T_s =	323 ✓ °F		783 ✓	°R

Moisture Content: %M = 11.38 ✓ M_d = 0.8862 ✓ MW_d = 30.520 ✓ MW = 29.10 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 54.238 \left[\frac{29.62 + \frac{0.600}{13.6}}{86 + 460}\right] = \frac{52.010}{0.406} \begin{matrix} \checkmark\ sft^3 \\ \checkmark\ scfm \end{matrix}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 141.5 = 6.679 ✓ sft^3

$$\%\ Moisture = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{6.679}{52.010 + 6.679} \times 100 = 11.38\ \checkmark\ \%$$

$$V_s = 5123.8 \times 0.806 \sqrt{\frac{783}{28.43 \times 29.10}} \times 0.912 = 3664\ \checkmark\ fpm$$

$$\%I = \frac{1{,}039 \times 52.010 \times 783}{128 \times 28.43 \times 3664 \times 0.8862 \times (\cancel{0.194}\ 0.190)^2} = \frac{95.1}{99.2} \begin{matrix} \% \\ \checkmark \end{matrix}$$

ACFM: ~~534959~~ 414,222 ✓

SCFM: ~~304876~~ 236,067 ✓

%EA: 34.1 ✓

Run Number 1 OH FIELD DATA

Unit ESP Inlet Duct

Date 10-18-05

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-1	1307	424.94	0.86	0.58	0.58	7.0	315	255	262	60	90	84	
-	1311	426.950	-	-	-	-	-	-	-	-	-	-	
8-~~X~~4	1327	426.950	0.25	0.16	0.16	3.0	317	257	262	65	85	84	
~~X~~3	1331	427.91	0.25	0.16	0.16	3.0	319	254	257	64	85	84	
~~X~~2	1335	428.87	0.12	0.08	0.08	3.0	320	257	256	64	85	84	
~~X~~1	1339	429.63	0.20	0.12	0.12	3.0	322	256	254	62	85	84	
-	1343	430.495	-	-	-	-	-	-	-	-	-	-	
10-4	~~1421~~ ~~430.495~~	430.495	0.77	0.55	0.55	5.0	332	254	269	72	87	86	
3	1425	432.38	0.78	0.56	0.56	5.0 ~~8.0~~	330	254	267	65	87	86	
2	1429	434.00	0.70	0.48	0.48	6.0	325	253	266	62	88	86	
1	1433	435.74	0.50	0.34	0.34	5.0	318	254	264	63	90	86	
-	1437	436.960	-	-	-	-	-	-	-	-	-	-	
11-4	1437	436.960	1.10	0.75	0.75	8.0	330	256	260	65	92	87	
3	1441	438.71	1.10	0.75	0.75	8.0	337	256	260	62	93	87	
2	1445	440.60	0.96	0.66	0.66	7.0	332	255	262	62	93	87	
1	1449	442.50	0.80	0.56	0.56	7.0	330	255	261	62	94	88	
-	1453	444.100	-	-	-	-	-	-	-	-	-	-	
12-4	1453	444.100	1.10	0.75	0.75	8.0	338	257	258	66	95	87	
3	1457	445.96	1.10	0.75	0.75	8.0	338	256	258	65	95	89	
2	1501	447.83	1.00	0.70	0.70	8.0	338	255	257	64	96	89	
1	1505	449.73	1.00	0.70	0.70	8.0	337	254	255	64	96	89	
-	1509	451.633	-	-	-	-	-	-	-	-	-	-	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-234 - task 2
Job Name: ADA. ES
Run Number: 2 - task 2
Unit: UNIT 2 ESP INLET DUCT
Date: 10-18-05
Operator: BORNSEN / OCR
Sample box No. 55-3 Meter Box No. 31-1

Field Data: OK

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 92
Assumed Moisture % 15
Probe Length 5'
C Factor 10 → 20 to reference.
Initial Leak @ 15.0 "Hg = 0.000 cfm
Final Leak @ 19.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1705	452.030	1.30	0.90	0.90	7.0	323	267	253	72	95	95	
3	1709	454.31	1.30	0.90	0.90	7.0	323	271	258	61	95	95	
2	1713	456.52	1.40	0.95	0.95	7.5	323	251	278	66	96	94	
1	1717	458.79	1.25	0.85	0.85	7.0	323	249	278	67	96	94	
–	1721	460.775	–	–	–	–	–	–	–	–	–	–	
2-4	1723	460.775	1.10	0.75	0.75	7.5	325	250	287	65	98	96	
3	1727	463.65	1.00	0.70	0.70	7.0	323	251	288	68	98	96	
2	1731	465.64	0.95	0.65	0.65	6.5	322	248	292	67	99	95	
1	1735	467.46	0.85	0.58	0.58	6.0	321	251	290	65	99	95	
3-4	1739	469.215	–	–	–	–	–	–	–	–	–	–	
3-4	1740	469.215	1.15	0.80	0.80	7.0	320	248	285	68	96	95	
3	1744	471.62	1.15	0.80	0.80	7.0	318	263	284	68	100	95	
2	1748	473.61	1.05	0.70	0.70	7.0	319	259	283	64	101	96	
1	1752	475.56	0.70	0.49	0.49	6.0	318	259	272	66	102	96	
–	1756	477.411	–	–	–	–	–	–	–	–	–	–	
4-4	1757	477.471	1.30	0.90	0.90	7.5	319	254	274	66	102	96	
3	1801	479.05	1.30	0.90	0.90	7.5	319	252	272	68	102	96	
2	1805	481.79	1.30	0.90	0.90	7.5	319	255	265	67	103	95	

Pitot Tube Calibration Factor C_p 0.85 low
Volume Collected V_m 58.489 ft³
Water Collected V_w 142.3 ml
Time of Test T_t 128 min.
Stack Pressure P_s -16.0 "H_2O

Pitot Tube No. 31-5-1
Baro. Press. P_b 29.54 "Hg
Probe Tip Dia. D_n ~~0.494~~ 0.99 in.
% CO_2 14.4 % CO 0.0
% O_2 5.6 % N_2 80.0
Area Stack A_s ~~21,020~~ 16,279 in²

Barometer No. 31-1 Probe Tip No. 05-233-7
Total Volume of Leak Checks After Start: – ft³
V_m = Dry Gas Meter Calibration Factor 1.008 x 58.025

{Dry Gas Meter Reading – ft³ – (T_t – min. X Leak Rate – cfm)}

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Impinger Box No. 51-3

Impinger 1	Final Weight	855.0		Impinger 1	111.4
	Initial Weight	743.6			
	Increase		Impinger 8 Final 993.4 Initial 982.4	Impinger 2	17.6
Impinger 2	Final Weight	654.0		Impinger 3	0.4
	Initial Weight	636.4			
	Increase			Impinger 4	1.2
Impinger 3	Final Weight	709.7	V_w = g SO_2 = — V_w =	Impinger 5	0.5
	Initial Weight	709.3			
	Increase			Impinger 6	−0.1
Impinger 4	Final Weight	747.4		Impinger 7	0.3
	Initial Weight	746.2		Imp 8	11.0
	Increase			Total	142.3 = V_w
Impinger 5	Final Weight	659.6	P_b = 29.54	$\%CO_2$ =	14.4
	Initial Weight	659.1	V_m = ~~142.3~~ 58.489	$\%O_2$ =	5.6
	Increase		V_w = 142.3	%CO =	0.0
			P_m = 0.639	$\%N_2$ =	80.0
Impinger 6	Final Weight	744.1	Avg ΔP = 0.931	A_s =	~~21024~~ 16,279
	Initial Weight	744.2		D_n =	~~0.194~~ 0.190
	Increase		Avg$\sqrt{\Delta P}$ = 0.938	T_t =	128
			C_p = ~~0.80~~ 0.806		
Impinger 7	Final Weight	722.0	P_s = −16.0 "H_2O	28.36	"Hg
	Initial Weight	721.7	T_m = ~~96~~ 97 °F	~~556~~ 557	°R
	Increase		T_s = 327 °F	787	°R

Water Weight Gain

Moisture Content: %M = ~~10.89~~ 10.91 M_d = ~~0.8911~~ 0.8909 MW_d = 30.528 MW = 29.16

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 58.489 \left[\frac{29.54 + \frac{0.639}{13.6}}{96 + 460}\right] = \frac{54.836 \text{ ~~54.934~~ sft}^3}{0.428 \text{ ~~0.429~~ scfm}}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 142.3 = 6.717 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{6.717}{6.717 + 54.934}$ x 100 = ~~10.89~~ 10.91 %

V_s = 5123.8 x 0.806 $\sqrt{\frac{787}{28.36 \times 29.16}}$ x 0.938 = ~~3756~~ 3779 fpm

%I = $\frac{1{,}039 \times 787 \times 54.934}{128 \times 28.36 \times 3756 \times 0.8911 \times (0.194)^2}$ = ~~98.2~~ 101.6 %

ACFM: ~~551726~~ ~~548303~~ 427,204

SCFM: ~~311892~~ ~~313802~~ 242,924

%EA: 35.9

Run Number 2 OH **FIELD DATA**

Unit Unit 2 ESP Inlet Duct

Date 10-18-05

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1	1809	483.91	1.00	0.70	0.70	7.5	321	250	265	66	103	96	
—	1813	485.850	—	—	—	—	—	—	—	—	—	—	
8-4	1816	487.195	0.20	0.13	0.13	3.5	332	263	264	68	102	97	
3	1820	488.13	0.20	0.13	0.13	3.5	333	259	261	68	102	97	
2	1824	488.97	0.07	0.04	0.04	2.5	332	256	263	68	101	98	
1	1828	489.56	0.23	0.15	0.15	3.0	327	256	263	68	100	98	
—	1832	490.335	—	—	—	—	—	—	—	—	—	—	
10-4	1835	490.335	0.70	0.49	0.49	6.5	338	270	262	68	99	95	
3	1839	492.99	0.70	0.49	0.49	6.5	339	255	258	68	99	97	
2	1843	494.53	0.86	0.54	0.54	6.5	339	254	262	68	98	96	
1	1847	496.12	0.58	0.40	0.40	6.0	331	249	260	68	98	96	
—	1851	497.645	—	—	—	—	—	—	—	—	—	—	
11-4	1853	497.645	1.10	0.75	0.75	8.0	330	248	263	68	97	97	
3	1857	499.84	1.10	0.75	0.75	8.0	331	248	263	67	98	97	
2	1901	501.29	0.96	0.66	0.66	7.0	332	248	263	68	97	97	
1	1905	502.71	0.80	0.56	0.56	7.0	330	250	262	68	95	96	
—	1909	504.115	—	—	—	—	—	—	—	—	—	—	
12-4	1910	504.115	1.10	0.75	0.75	8.0	338	249	261	68	97	96	
3	1914	505.89	1.10	0.75	0.75	8.0	337	248	260	68	96	96	
2	1918	507.28	1.00	0.70	0.70	8.0	337	249	261	68	96	95	
1	1922	508.67	1.00	0.70	0.70	8.0	337	248	262	68	96	95	
—	1926	510.055	—	—	—	—	—	—	—	—	—	—	

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METCO ENVIRONMENTAL

Job Number: 05-234 task 2 ✓
Job Name: ADA - ES ✓
Run Number: 3 ✓
Unit: ESP Inlet Duct ✓
Date: 10-19-05 ✓
Operator: Bowerson / Orr ✓
Sample box No. 79 Meter Box No. 31-1 ✓

OH Field Data

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 92
Assumed Moisture % 15
Probe Length 5'
C Factor 10 → 70 to reference.
Initial Leak @ 15.0 "Hg = 0.000 cfm
Final Leak @ 18.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1249	510.800	1.10	0.75	0.75	9.0	343	276	273	64	91	89	
3	1253	513.20	1.10	0.75	0.75	9.0	341	265	273	60	91	89	
2	1257	515.13	1.00	0.70	0.70	9.0	342	264	263	60	91	90	
1	1301	517.08	1.00	0.70	0.70	9.0	343	264	268	61	93	90	
–	1305	518.951	–	–	–	–	–	–	–	–	–	–	
11-4	1305	518.951	1.00	0.70	0.70	8.0	341	257	260	62	93	90	
3	1309	520.69	1.00	0.70	0.70	9.0	339	259	257	63	95	91	
2	1313	522.57	0.85	0.58	0.58	8.5	338	265	257	64	96	91	
1	1317	524.33	0.75	0.50	0.50	8.0	339	268	257	64	95	91	
–	1321	526.015	–	–	–	–	–	–	–	–	–	–	
10-4	1321	526.015	0.80	0.56	0.56	8.0	339	274	253	64	96	91	
3	1325	527.68	0.85	0.58	0.54	8.0	339	274	254	64	96	92	
2	1329	529.37	0.80	0.56	0.56	8.0	338	276	253	65	97	92	
1	1333	531.19	0.50	0.32	0.32	6.0	338	276	253	65	97	92	
–	1337	532.592	–	–	–	–	–	–	–	–	–	–	
9-4	1337	532.592	0.30	0.20	0.20	5.0	333	275	249	65	96	92	
3	1341	533.72	0.30	0.20	0.20	5.0	334	275	251	65	96	92	
2	1345	534.78	0.10	0.06	0.06	3.0	334	284	252	65	94	93	

Pitot Tube Calibration Factor C_p 0.806 low ✓
Volume Collected V_m 56.989 ft^3 57.159 ✓
Water Collected V_w 150.0 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -16.0 ✓ "H_2O

Pitot Tube No. 31-5-1 ✓
Baro. Press. P_b 29.66 ✓ "Hg
Probe Tip Dia. D_n 0.144 0.190 ✓ in.
% CO_2 14.4 ✓ % CO 0.0 ✓
% O_2 5.6 ✓ % N_2 80.4 ✓
Area Stack A_s ~~21024~~ ✓ 16279 in^2

Barometer No. 347 ✓ Probe Tip No. 05-233-1 ✓
Total Volume of Leak Checks After Start: – ft^3
V_m = Dry Gas Meter Calibration Factor 1.004 ✓ x 56.705

{Dry Gas Meter Reading – ft^3 – (T_t – min. X Leak Rate – cfm)}

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Impinger Box No. 79

			Water Weight Gain		
Impinger 1	Final Weight	854.9	Imp. 8 1002.4	Impinger 1	112.7
	Initial Weight	742.2	986.4	Impinger 2	17.3
	Increase	112.7	16.0	Impinger 3	2.6
Impinger 2	Final Weight	735.8		Impinger 4	1.9
	Initial Weight	718.5			
	Increase	17.3	V_w =	Impinger 5	1.3
Impinger 3	Final Weight	743.8	g SO_2 = - —	Impinger 6	-2.6
	Initial Weight	741.2	V_w =		
	Increase	2.6		Impinger 7	0.8
Impinger 4	Final Weight	718.3		Imp. 8	16.0
	Initial Weight	716.4		Total	150.0 ✓ = V_w
	Increase	1.9			

Impinger 5	Final Weight	767.1	P_b =	29.66 ✓	%CO_2 =	14.4 ✓
	Initial Weight	765.8	V_m =	~~56.989~~ 57.159 ✓	%O_2 =	5.2 ✓
	Increase	1.3	V_w =	150.0 ✓	%CO =	0.0 ✓
			P_m =	0.648 ✓	%N_2 =	80.4 ✓
Impinger 6	Final Weight	685.0	Avg ΔP =	0.942 ✓	A_s =	~~21024~~ ✓ 16279
	Initial Weight	687.6			D_n =	~~0.194~~ 0.190 ✓
	Increase	-2.6	Avg$\sqrt{\Delta P}$ =	0.947 ✓	T_t =	128 ✓
			C_p =	0.806 ✓		
Impinger 7	Final Weight	647.4	P_s =	-16.0 ✓ "H_2O	28.48 ✓	"Hg
	Initial Weight	646.6	T_m =	94 ✓ °F	554 ✓	°R
	Increase	0.8	T_s =	332 ✓ °F	792 ✓	°R

Moisture Content: %M = ~~11.60~~ 11.57 ✓ M_d = ~~0.8840~~ 0.8843 ✓ MW_d = 30.512 ✓ MW = 29.06 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{56.989}\ 57.159 \left[\frac{29.66 + \frac{0.648}{13.6}}{94 + 460}\right] = \cancel{53.938}\ 54.099 \text{ ft}^3 = \cancel{0.421}\ 0.423 \text{ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 150.0 = 7.080 ✓ sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{7.080}{\cancel{53.938}\ 54.099 + 7.080}$ x 100 = ~~11.60~~ 11.57 ✓ %

V_s = 5123.8 x 0.806 $\sqrt{\frac{792}{28.48 \times 29.06}}$ x 0.947 = 3826 ✓ fpm

%I = $\frac{1{,}039 \times \cancel{53.938}\ 54.099 \times 792}{128 \times 28.48 \times \cancel{0.8840}\ 0.8843 \times 3826 \times (\cancel{0.194}\ 0.190)^2}$ = ~~95.6~~ 100.0 ✓ %

ACFM: ~~558566~~ 432,501 ✓

SCFM: ~~314509~~ 243,608 ✓

%EA: 32.3 ✓

Run Number 3 — 014 — FIELD DATA

Unit ESP Inlet Duct

Date 10-19-05

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1	1349	535.44	0.25	0.170	0.170	3.5	332	280	253	65	~~65~~ 95	93	
–	1353	536.270	–	–	–	–	–	–	–	–	–	–	
4-4	1355	536.699	1.30	0.90	0.90	11.0	321	265	253	65	96	92	
3	1359	538.82	1.30	0.90	0.90	11.0	321	259	249	65	95	93	
2	1403	540.99	1.30	0.90	0.90	11.5	321	257	250	66	97	93	
1	1407	542.62	1.10	0.75	0.75	11.0	321	255	252	66	99	93	
–	1411	544.895	–	–	–	–	–	–	–	–	–	–	
3-4	1411	544.895	1.10	0.75	0.75	10.0	322	250	254	66	98	93	
3	1415	546.75	1.10	0.75	0.75	10.0	323	250	255	66	98	93	
2	1419	548.63	1.10	0.75	0.75	10.0	323	250	252	67	98	93	
1	1423	550.51	0.60	~~0.50~~ 0.50	~~0.50~~ 0.50	8.0	323	258	257	67	98	94	
–	1427	552.000	–	–	–	–	–	–	–	–	–	–	
2-4	1427	552.000	1.10	0.75	0.75	10.0	325	258	258	68	99	94	
3	1431	553.77	1.10	0.75	0.75	10.0	326	261	255	68	99	94	
2	1435	555.62	1.00	0.70	0.70	10.5	327	263	258	68	99	93	
1	1439	557.56	0.85	0.60	0.60	10.0	329	262	256	67	99	94	
–	1443	559.255	–	–	–	–	–	–	–	–	–	–	
1-4	1443	559.255	1.40	0.95	0.95	13.0	329	260	257	66	99	95	
3	1447	561.24	1.40	0.95	0.95	13.0	329	258	256	66	99	95	
2	1451	563.31	1.40	0.95	0.95	14.0	329	266	257	67	99	97	
1	1455	565.48	1.30	0.90	0.90	14.0	329	267	257	67	100	95	
–	1459	567.505	–	–	–	–	–	–	–	–	–	–	
4													
3													
2													
1													
–			–	–	–	–	–	–	–	–	–	–	

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METCO ENVIRONMENTAL

Job Number: 05-234 task 2 ✓
Job Name: ADA-ES ✓
Run Number: 1 - task 2 ✓
Unit: ESP Outlet Duct ✓
Date: 10-18-05 ✓
Operator: Malone | Dodson | Bomsen
Sample box No. 76 Meter Box No. 27-3 ✓

OH Field Data

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 85
Assumed Moisture % 13
Probe Length 5'
C Factor ΔH 0.90 → ΔP 0.57 to reference.
Initial Leak @ 15.0 "Hg = 0.010 cfm
Final Leak @ 13.0 "Hg = 0.008 cfm

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated Line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1204	989.789	0.63	0.97	0.97	10.0	333	248	269	68	79	79	Integrated Orsat
3	1208	991.80	0.25	0.38	0.38	6.0	328	250	268	64	79	80	
2	1212	993.70	0.40	0.62	0.62	6.0	333	252	266	61	79	80	
1	1216	995.45	0.44	0.70	0.70	6.0	310	270	262	61	79	83	
END	1220	997.495	–	–	–	–	–	–	–	–	–	–	vol: 0.909
11-4	1225	998.404	0.41	0.62	0.62	6.0	332	250	253	65	79	82	
3	1229	1000.50	0.58	0.90	0.90	8.5	331	253	260	57	80	84	
2	1233	1002.40	0.87	1.35	1.35	11.0	333	270	253	52	84	85	
1	1237	1004.80	0.82	1.25	1.25	10.0	332	271	256	53	85	86	
END	1241	1007.451	–	–	–	–	–	–	–	–	–	–	vol: 0.669
10-4	1246	1008.120	0.77	1.20	1.20	10.0	332	259	253	54	84	86	
3	1250	1010.50	0.54	0.84	0.84	7.5	331	249	260	55	87	87	
2	1254	1012.30	0.67	1.05	1.05	9.0	332	253	266	53	87	86	
1	1258	1015.00	0.40	0.62	0.62	6.0	330	269	267	54	84	84	
END	1302	1016.572	–	–	–	–	–	–	–	–	–	–	vol: 0.378
9-4	1305	1016.950	0.52	0.80	0.80	7.5	329	264	251	53	84	84	
3	1308	1018.70	0.50	0.76	0.76	7.0	329	257	253	55	84	84	pump off 1309
2	1317	1020.54	0.40	0.62	0.62	6.0	331	266	251	55	84	84	pump on 1313

Pitot Tube Calibration Factor C_p 0.805 ✓
Volume Collected V_m ~~63.90~~ 63.88 ft^3 ✓
Water Collected V_w 198.2 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s –14.3 ✓ "H_2O

Pitot Tube No. 31-5-3 ✓
Baro. Press. P_b 29.62 ✓ "Hg
Probe Tip Dia. D_n 0.246 ✓ in.
% CO_2 13.6 ✓ % CO 0.0 ✓
% O_2 7.2 ✓ % N_2 79.2 ✓
Area Stack A_s 210.24 ✓ in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-233-2 ✓
Total Volume of Leak Checks After Start: ~~[illegible]~~ ft^3 e 12.272
V_m = Dry Gas Meter Calibration Factor 0.991 ✓ x 64.473

{Dry Gas Meter Reading ____ ft^3 – (T_t ____ min. X Leak Rate ____ cfm)}

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Impinger Box No. 76

Impinger 1	Final Weight	893.7		Impinger 1	~~194.5~~
	Initial Weight	749.2			
	Increase	144.5		Impinger 2	33.4
Impinger 2	Final Weight	705.0		Impinger 3	7.9
	Initial Weight	671.6			
	Increase	33.4		Impinger 4	3.9
Impinger 3	Final Weight	753.9		Impinger 5	0.7
	Initial Weight	746.0			
	Increase	7.9		Impinger 6	0.2
Impinger 4	Final Weight	718.0		Impinger 7	0.1
	Initial Weight	714.1		Imp. 8	7.5
	Increase	3.9		Total	198.2 ✓ = V_w
Impinger 5	Final Weight	632.7			
	Initial Weight	632.0			
	Increase	0.7			
Impinger 6	Final Weight	744.6			
	Initial Weight	744.4			
	Increase	0.2			
Impinger 7	Final Weight	670.1			
	Initial Weight	670.0			
	Increase	0.1			

Water Weight Gain

8 1008.3
1000.8
7.5

V_w =
g SO_2 = -
V_w =

P_b =	29.62 ✓		$\%CO_2$ =	13.6 ✓
V_m =	~~62.901~~ 63.893 ✓		$\%O_2$ =	7.2 ✓
V_w =	198.2 ✓		%CO =	0.0 ✓
P_m =	0.804 ✓		$\%N_2$ =	79.2 ✓
Avg ΔP =	0.519 ✓		A_s =	21024 ✓
			D_n =	0.246 ✓
Avg$\sqrt{\Delta P}$ =	0.708 ✓		T_t =	128 ✓
C_p =	0.805 ✓			
P_s =	-14.3 ✓	"H_2O	28.57 ✓	"Hg
T_m =	87 ✓ ~~88~~	°F	548 547 ✓	°R
T_s =	323 ✓	°F	783 ✓	°R

Moisture Content: %M = ~~13.46~~ 13.26 ✓ ~~13.28~~ ~~13.28~~ M_d = ~~0.8654~~ 0.8674 ✓ ~~0.8677~~ MW_d = 30.464 ✓ MW = ~~28.79~~ 28.81 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{61.901}\ 63.893 \left[\frac{29.62 + \frac{0.804}{13.6}}{\cancel{88}\ 87 + 460}\right] = \cancel{60.127}\ 61.187 \text{ ✓ } \cancel{61.076} \text{ sft}^3 \quad \cancel{0.490}\ 0.477\ 0.478 \text{ ✓ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 198.2 = 9.355 ✓ sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{9.355}{61.187\ \cancel{61.076} + 9.355}$ x 100 = ~~13.46~~ 13.26 ✓ ~~13.28~~ %

V_s = 5123.8 x 0.805 $\sqrt{\frac{783}{28.57 \times \cancel{28.79}\ 28.81}}$ x 0.708 = 2848 ✓ fpm

%I = $\frac{1{,}039 \times 783 \times \cancel{60.127}\ 61.187\ \cancel{61.076}}{128 \times 28.57 \times \cancel{2849}\ 2848 \times \cancel{0.8654}\ 0.8674\ \cancel{0.8677} \times (0.246)^2}$ = ~~90.9~~ 91.0 ✓ %

ACFM: ~~415986~~ 415842 ✓
233,093 ✓
SCFM: ~~232637~~ 233012

%EA: 52.2

Run Number 1 task-2 OH FIELD DATA

Unit ESP Outlet Duct

Date 10-18-05

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated Line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-1	1321	1022.556	0.31	0.48	0.48	5.5	321	270	268	52	87	86	
END	1325	1024.979	—	—	—	—	—	—	—	—	—	—	vol: 10.316
4-4	1418	1035.295	0.69	1.10	1.10	5.5	317	266	249	67	87	88	1418 start time
3	1422	1037.00	0.40	0.62	0.62	5.0	318	258	253	62	90	88	
2	1426	1039.00	0.28	0.44	0.44	5.0	318	267	252	63	91	90	
1	1430	1040.30	0.24	0.38	0.38	3.5	318	264	254	62	91	91	
END	1434	1041.650	—	—	—	—	—	—	—	—	—	—	
3-4	1442	1041.650	0.60	0.94	0.94	5.0	314	250	260	67	91	91	
3	1446	1044.05	0.52	0.80	0.80	5.0	316	249	262	66	91	92	
2	1450	1046.17	0.65	1.00	1.00	5.0	316	253	264	64	91	92	
1	1454	1048.80	0.60	0.94	0.94	5.5	315	254	263	63	91	92	
END	1458	1050.660	—	—	—	—	—	—	—	—	—	—	
2-4	1500	1050.660	0.55	0.85	0.85	4.5	316	270	249	68	92	92	
3	1504	1052.56	0.72	1.10	1.10	6.0	317	254	255	66	93	92	
2	1508	1055.05	0.80	1.25	1.25	6.5	316	259	258	66	93	92	
1	1512	1057.50	0.60	0.94	0.94	6.0	314	260	262	66	93	92	
END	1516	1059.789	—	—	—	—	—	—	—	—	—	—	
1-4	1519	1059.789	0.20	0.31	0.31	4.5	318	253	252	66	94	93	
3	1523	1061.03	0.47	0.74	0.74	5.5	318	255	254	64	94	93	
2	1527	1063.00	0.55	0.85	0.85	6.0	320	254	258	63	94	93	
1	1531	1065.20	0.22	0.32	0.32	4.0	318	256	260	65	94	93	
END	1535	1066.534	—	—	—	—	—	—	—	—	—	—	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-233 task2 ✓
Job Name: ADA - ES ✓
Run Number: 2 - task 2 ✓
Unit: SP outlet Duct ✓
Date: 10-18-05 ✓
Operator: Malone / Dodson / Barnsey ✓
Sample box No. HG-4 Meter Box No. 27-3 ✓

OH Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 95
Assumed Moisture % 12
Probe Length 5'
C Factor ΔH 10 - ΔP 6.5 to reference.
Initial Leak @ 15.0 "Hg = 0.007 cfm
Final Leak @ 10.0 "Hg = 0.002 cfm

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1705	67.520	0.20	0.31	0.31	4.0	316	272	252	77	90	92	Integrated Orsat
3	1709	69.00	0.36	0.56	0.56	4.5	320	250	249	65	93	93	
2	1713	70.75	0.46	0.71	0.71	5.0	319	258	250	64	94	94	
1	1717	72.54	0.25	0.39	0.39	4.0	318	263	250	66	94	94	
END	1721	73.922	—	—	—	—	—	—	—	—	—	—	
2-4	1722	73922	0.67	1.05	1.05	6.0	318	270	255	66	96	96	
3	1726	75.98	0.90	1.40	1.40	7.0	~~326~~ 326	269	257	66	98	96	TS: 326
2	1730	78.75	0.80	1.25	1.25	7.0	327	269	258	65	98	96	
1	1734	81.60	0.54	0.85	0.85	5.0	328	265	255	59	98	96	
END	1738	83.662	—	—	—	—	—	—	—	—	—	—	
3-4	1739	83.662	0.76	1.20	1.20	6.5	324	254	261	61	98	97	
3	1743	86.20	0.50	0.77	0.77	5.0	324	255	263	57	100	98	
2	1747	88.10	0.76	1.20	1.20	6.5	321	257	261	57	101	97	
1	1751	90.60	0.50	0.77	0.77	5.0	319	259	260	59	102	98	
END	1755	92.729	—	—	—	—	—	—	—	—	—	—	
4-4	1759	92.729	0.80	1.25	1.25	6.5	323	261	265	64	99	98	
3	1803	95.23	0.60	0.92	0.92	6.5	325	260	266	64	101	98	
2	1807	97.95	0.55	0.85	0.85	5.0	324	262	268	62	101	97	

Pitot Tube Calibration Factor C_p 0.805 ✓
Volume Collected V_m 68.339 ✓ ft^3
Water Collected V_w 230.6 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.4 ✓ "H_2O

Pitot Tube No. 31-5-3 ✓
Baro. Press. P_b 29.54 ✓ "Hg
Probe Tip Dia. D_n 0.246 ✓ in.
% CO_2 13.4 ✓ % CO 0.0 ✓
% O_2 7.0 ✓ % N_2 79.6 ✓
Area Stack A_s 21024 ✓ in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-233-2 ✓
Total Volume of Leak Checks After Start: — ft^3
V_m = Dry Gas Meter Calibration Factor 0.991 ✓ x 68.960

{Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

VERSION 1
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Impinger Box No. HG-4

Impinger 1	Final Weight	859.4		Impinger 1	192.1
	Initial Weight	667.3		Impinger 2	22.1
	Increase	192.1		Impinger 3	3.1
Impinger 2	Final Weight	765.5		Impinger 4	1.2
	Initial Weight	743.4		Impinger 5	0.4
	Increase	22.1		Impinger 6	0.2
Impinger 3	Final Weight	674.4		Impinger 7	-1.0
	Initial Weight	671.3		Imp 8	12.5
	Increase	3.1		Total	230.6 = V_w
Impinger 4	Final Weight	671.5			
	Initial Weight	670.3			
	Increase	1.2			
Impinger 5	Final Weight	752.0			
	Initial Weight	751.6			
	Increase	0.4			
Impinger 6	Final Weight	715.4			
	Initial Weight	715.2			
	Increase	0.2			
Impinger 7	Final Weight	749.0			
	Initial Weight	750.0			
	Increase	-1.0			

Water Weight Gain

Imp 8: 1007.4 − 1004.9

V_w =

g SO_2 = -

V_w =

P_b =	29.54		%CO_2 =	13.6
V_m =	68.339		%O_2 =	7.0
V_w =	230.6		%CO =	0.0
P_m =	0.895		%N_2 =	79.46
Avg ΔP =	~~0.746~~ 0.576		A_s =	21024
			D_n =	0.246
Avg$\sqrt{\Delta P}$ =	~~0.576~~ 0.746		T_1 =	128
C_p =	0.805			
P_s =	-14.4	"H_2O	28.48	"Hg
T_m =	~~72~~ 94	°F	~~552~~ 554	°R
T_s =	328	°F	788	°R

Moisture Content: %M = ~~14.40~~ 14.45 M_d = ~~0.8560~~ 0.8555 MW_d = ~~30.456~~ 30.424 MW = ~~28.66~~ 28.63

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 68.339 \left[\frac{29.54 + \frac{0.895}{13.6}}{\cancel{72}\ 94 + 460}\right] = \cancel{64.692}\ 64.459\ \text{sft}^3 \quad \cancel{0.505}\ 0.504\ \text{scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 230.6 = 10.884 sft³

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{10.884}{\cancel{64.692}\ 64.459 + 10.884}$ x 100 = ~~14.40~~ 14.45 %

V_s = 5123.8 x 0.805 $\sqrt{\frac{788}{28.48 \times \cancel{28.66}\ 28.63}}$ x $\frac{\cancel{0.576}}{0.746}$ = ~~2334~~ 3,025 fpm

%I = $\frac{1{,}039 \times \cancel{64.692}\ 64.459 \times 788}{128 \times 28.48 \times \cancel{2334}\ \cancel{3023}\ 3025 \times \cancel{0.8560}\ 0.8555 \times (0.246)^2}$ = ~~92.8~~ 92.4 %

ACFM: ~~340815~~ 441,634 ~~441402~~

SCFM: ~~186128~~ 241,869 ~~241851~~

%EA: ~~49.9~~ 49.7

Run Number 2 - task2 OH FIELD DATA

Unit ESP Outlet Duct

Date 10-18-05

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated Line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-1	1811	100.00	0.30	0.46	0.46	4.0	320	262	263	62	101	97	
END	1815	101.488	—	—	—	—	—	—	—	—	—	—	
9-4	1822	101.488	0.65	1.00	~~1.00~~ 1.00	6.0	325	264	268	63	97	94	
3	1826	103.52	0.57	0.89	0.89	6.0	334	265	269	63	98	94	
2	1830	105.90	0.43	0.66	0.66	6.0	332	267	269	62	97	90	
1	1834	107.70	0.37	0.56	0.56	6.0	330	255	268	60	97	89	
END	1838	109.439	—	—	—	—	—	—	—	—	—	—	
10-4	1840	109.439	0.88	1.40	1.40	7.0	331	255	269	62	95	86	
3	1844	112.55	0.65	1.00	1.00	7.0	334	254	270	60	96	84	
2	1848	114.95	0.77	1.20	1.20	7.0	336	255	271	60	96	84	
1	1852	117.09	0.56	0.88	0.88	6.0	336	257	266	60	96	83	
END	1856	119.500	—	—	—	—	—	—	—	—	—	—	
11-4	1858	119.500	0.43	0.66	0.66	6.0	340	258	267	61	96	83	
3	1902	121.60	0.77	1.20	1.20	7.0	339	250	267	62	95	83	
2	1906	123.90	0.96	1.50	1.50	8.0	338	249	267	61	95	83	
1	1910	126.50	0.66	1.00	1.00	7.0	339	251	269	60	95	83	
END	1914	129.109	—	—	—	—	—	—	—	—	—	—	
12-4	1915	129.109	0.37	0.56	0.56	4.0	338	264	264	63	94	82	
3	1919	130.67	0.77	1.20	1.20	7.0	336	265	266	62	94	83	
2	1923	133.10	0.40	0.60	0.60	5.0	336	267	263	61	95	83	
1	1927	135.10	0.25	0.38	0.38	4.0	332	266	262	60	95	83	
END	1931	136.480	—	—	—	—	—	—	—	—	—	—	

Version 1
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METCO ENVIRONMENTAL

Job Number: 05-234 - task 2 ✓
Job Name: ADA-ES ✓
Run Number: 3 - task 2 ✓
Unit: ESP Outlet Duct ✓
Date: 10-19-05 ✓
Operator: Malone / Dodson / Bornsen
Sample box No. 76 Meter Box No. 27-3 ✓

OH Field Data

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 89
Assumed Moisture % 13
Probe Length 5'
C Factor ΔH10 → ΔP 5.7 to reference.
Initial Leak @ 15.0 "Hg = 0.005 cfm
Final Leak @ 12.0 "Hg = 0.005 cfm

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	~~Oven~~ Heated Line Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1248	137.594	0.50	0.88	0.88	5.0	338	269	261	56	87	92	Integrated Orsat
3	1252	139.55	0.63	1.10	1.10	6.0	339	250	258	55	88	93	
2	1256	142.00	0.37	0.65	0.65	4.5	340	264	249	56	90	94	
1	1300	143.90	0.15	0.26	0.26	3.5	326	265	250	56	90	94	
END	1304	145.055	–	–	–	–	–	–	–	–	–	–	
11-4	1305	145.055	0.48	0.84	0.84	5.0	338	264	252	57	91	95	
3	1309	147.10	~~0.48~~ 0.70	~~0.84~~ 1.20	~~0.84~~ 1.20	5.0	338	265	253	57	93	96	ΔP 0.70 Pm 1.20
2	1313	149.80	0.90	1.60	1.60	7.5	338	270	255	56	94	96	
1	1317	152.47	0.60	1.05	1.05	6.0	338	265	257	55	97	96	
END	1321	154.835	–	–	–	–	–	–	–	–	–	–	
10-4	1323	154.835	0.80	1.40	1.40	7.0	335	262	250	59	96	95	
3	1327	157.50	0.47	0.83	0.83	5.0	337	261	251	57	97	94	
2	1331	159.80	0.80	1.40	1.40	7.0	338	260	252	56	98	93	
1	1335	162.55	0.53	0.93	0.93	6.0	339	259	253	56	98	93	
END	1339	164.725	–	–	–	–	–	–	–	–	–	–	
9-4	1340	164.725	0.57	1.00	1.00	6.0	334	257	254	60	96	91	
3	1344	167.00	0.52	0.91	0.91	5.5	335	251	253	60	96	91	
2	1348	169.30	0.47	0.83	0.83	5.0	337	252	253	61	97	90	

Pitot Tube Calibration Factor C_p 0.805 ✓
Volume Collected V_m 71.940 ✓ ft^3
Water Collected V_w 251.3 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.4 ✓ "H_2O

Pitot Tube No. 31-5-3 ✓
Baro. Press. P_b 29.66 ✓ "Hg
Probe Tip Dia. D_n 0.246 ✓ in.
% CO_2 13.4 ✓ % CO 0.0 ✓
% O_2 6.8 ✓ % N_2 79.8 ✓
Area Stack A_s 210.24 ✓ in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-233-2 ✓
Total Volume of Leak Checks After Start: – ft^3
V_m = Dry Gas Meter Calibration Factor 0.991 ✓ x 72.593

{Dry Gas Meter Reading – ft^3 – (T_t – min. X Leak Rate – cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 76

Impinger 1	Final Weight	952.2		Impinger 1	200.0
	Initial Weight	752.2		Impinger 2	22.2
	Increase	200.0		Impinger 3	4.7
Impinger 2	Final Weight	697.4		Impinger 4	3.1
	Initial Weight	675.2		Impinger 5	0.9
	Increase	22.2		Impinger 6	0.9
Impinger 3	Final Weight	751.6		Impinger 7	3.1
	Initial Weight	746.9		Imp. 8	16.4
	Increase	4.7		Total	251.3 ✓ = V_w
Impinger 4	Final Weight	704.0			
	Initial Weight	700.9			
	Increase	3.1			
Impinger 5	Final Weight	647.0			
	Initial Weight	646.1			
	Increase	0.9			
Impinger 6	Final Weight	740.9			
	Initial Weight	740.6			
	Increase	0.9			
Impinger 7	Final Weight	684.3			
	Initial Weight	681.2			
	Increase	3.1			

Water Weight Gain

Imp. 8 1024.4
1008.0
16.4

V_w =
g SO_2 = - -
V_w =

P_b =	29.66 ✓	$\%CO_2$ =	13.4 ✓
V_m =	71.940 ✓	$\%O_2$ =	6.8 ✓
V_w =	251.3 ✓	%CO =	0.0 ✓
P_m =	1.008 ✓	$\%N_2$ =	79.8 ✓
Avg ΔP =	0.574 ✓	A_s =	21024 ✓
		D_n =	0.246 ✓
Avg$\sqrt{\Delta P}$ =	0.748 ✓	T_t =	128 ✓
C_p =	0.805 ✓		
P_s =	-14.4 ✓ "H_2O		28.60 ✓ "Hg
T_m =	94 ✓ °F		554 ✓ °R
T_s =	329 ✓ °F		789 ✓ °R

Moisture Content: %M = 14.82 ✓ M_d = 0.8518 ✓ MW_d = 30.416 ✓ MW = 28.58 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 71.940 \left[\frac{29.66 + \frac{1.008}{13.6}}{94 + 460}\right] = 68.149\ ✓\ sft^3 = 0.532\ ✓\ scfm$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 251.3 = 11.861 ✓ sft^3

$$\%\ Moisture = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{11.861}{68.149 + 11.861} \times 100 = 14.82\ ✓\ \%$$

$$V_s = 5123.8 \times 0.805 \sqrt{\frac{789}{28.60 \times 28.58}} \times 0.748 = 3031\ ✓\ fpm$$

ACFM: 442555 ✓

SCFM: 242010 ✓

$$\%I = \frac{1{,}039 \times 789 \times 68.149}{128 \times 28.60 \times 3031 \times 0.8518 \times (0.246)^2} = 97.7\ ✓\ \%$$

%EA: 47.4 ✓

Run Number 3 - task 2 OH FIELD DATA

Unit ESP Outlet Duct

Date 10-19-05

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated Line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
9-1	1352	171.40	0.44	0.77	0.77	5.0	333	266	253	62	97	90	
END	1356	173.514	—	—	—	—	—	—	—	—	—	—	
4-4	1359	173.514	0.73	1.30	1.30	6.5	324	269	250	64	94	87	
3	1403	176.40	0.63	1.10	1.10	6.0	324	268	251	65	95	88	
2	1407	178.35	0.54	0.95	0.95	6.0	324	267	255	66	96	89	
1	1411	180.75	0.39	0.68	0.68	4.5	322	263	257	63	97	91	
END	1415	182.691	—	—	—	—	—	—	—	—	—	—	
3-4	1416	182.691	0.70	1.20	1.20	6.5	321	262	256	64	96	91	
3	1420	184.96	0.47	0.83	0.83	5.5	324	260	248	60	97	92	
2	1424	187.15	0.67	1.20	1.20	6.5	322	261	248	60	97	92	
1	1428	189.40	0.55	0.96	0.96	6.0	321	261	250	60	98	93	
END	1432	191.489	—	—	—	—	—	—	—	—	—	—	
2-4	1433	191.489	0.65	1.15	1.15	6.5	321	262	251	63	97	91	
3	1437	194.00	0.84	1.50	1.50	7.5	324	255	248	57	99	90	
2	1441	196.80	0.92	1.60	1.60	8.0	325	255	249	56	100	89	
1	1445	199.85	0.65	1.15	1.15	6.5	321	256	252	57	100	89	
END	1449	202.434	—	—	—	—	—	—	—	—	—	—	
1-4	1451	202.434	0.24	0.42	0.42	3.5	319	251	252	61	97	89	
3	1455	203.85	0.57	1.00	1.00	5.5	322	253	253	60	97	89	
2	1459	206.00	0.38	0.67	0.67	4.5	321	254	254	60	97	89	
1	1503	207.95	0.50	0.88	0.88	5.0	320	256	255	61	97	89	
END	1507	210.187	—	—	—	—	—	—	—	—	—	—	1507 end

Version 1
22 OCTOBER 2002

APPENDIX E

Analytical Data

Data Analysis Technologies, Inc.
7715 Corporate Blvd.
Plain City, OH 43064
NELAP/LELAP Certification 03027

Sample Analysis Certificate

Client:	Metco Environmental	Date:	11/4/05
Address:	3226 Commander Drive Carrollton, TX 75006	DAT Project #:	1005038
		Sample Date:	10/18-19/05
		Date Received:	10/21/05
		Date Analyzed:	11/02/05
		Analyst:	DE

Attn: Steve Bornsen
Your Project: 05-234 ADA-ES
Sampled By: S.B.

Analysis: Mercury
Method: Ontario Hydro

Results: See attached summary tables.

QC: Met criteria for the method.

Reviewed and approved for release by: _____ Date: 11/4/05
President *DAT* Inc.

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Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1005038
Client: Metco Environmental
Site: ADA-ES

Prep Date: 11/1/05
Analysis Date: 11/2/05

Client ID	DAT ID	MDL	Hg Total ug	Q	Dup Result Total ug
Inlet Run 1					
Filter/Cont 2	1005038-1,2	0.02	1.61		
Cont. 3 KCl ox	1005038-3a	0.03	0.08		
Cont. 3	1005038-3b	0.09	2.61		
Cont. 4 el Hg	1005038-4	0.30	1.29		
Cont. 5	1005038-5	0.09	9.14		
Inlet Run 2					
Filter/Cont 2	1005038-6,7	0.02	0.07		
Cont. 3 KCl ox	1005038-8a	0.03	1.77		
Cont. 3	1005038-8b	0.08	2.49		
Cont. 4 el Hg	1005038-9	0.29	ND		
Cont. 5	1005038-10	0.08	8.59		
Inlet Run 3					
Filter/Cont 2	1005038-11,12	0.02	0.07		
Cont. 3 KCl ox	1005038-13a	0.08	1.74		
Cont. 3	1005038-13b	0.04	0.04		
Cont. 4 el Hg	1005038-14	0.29	0.35		
Cont. 5	1005038-15	0.09	8.47		

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1005038
Client: Metco Environmental
Site: ADA-ES

Prep Date: 11/1/05
Analysis Date: 11/2/05

Client ID	DAT ID	MDL	Hg Total ug	Q	Dup Result Total ug
Outlet Run 1					
Filter/Cont 2	1005038- 16,17	0.02	3.36		
Cont. 3	1005038- 18a	0.07	2.94		
Cont. 3	1005038- 18b	0.03	0.05		
Cont. 4	1005038- 19	0.30	0.54		
Cont. 5	1005038- 20	0.07	0.82		
Outlet Run 2					
Filter/Cont 2	1005038- 21,22	0.02	2.68		
Cont. 3	1005038- 23a	0.04	0.34		
Cont. 3	1005038- 23b	0.08	0.51		
Cont. 4	1005038- 24	0.28	ND		
Cont. 5	1005038- 25	0.09	1.71		
Outlet Run 3					
Filter/Cont 2	1005038- 26,27	0.02	7.28		
Cont. 3	1005038- 28a	0.10	0.61		
Cont. 3	1005038- 28b	0.04	0.05		
Cont. 4	1005038- 29	0.30	ND		
Cont. 5	1005038- 30	0.09	0.73		0.72
Cont. 5	1005038- 30 Dup	0.09	0.72		

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1005038
Client: Metco Environmental
Site: ADA-ES

Prep Date: 11/1/05
Analysis Date: 11/2/05

Client ID	DAT ID	MDL	Hg Total ug	Q	Dup Result Total ug
Blank Train					
Filter/Cont 2	1005038-31,32	0.02	ND		
Cont. 3a	1005038-33	0.08	ND		
Cont. 3b	1005038-34	0.30	ND		
Cont. 4	1005038-35	0.08	ND		
Reagent Blanks					
Cont. 7,12	1005038-36,41	0.02	ND		
Cont. 8	1005038-37	0.01	ND		
Cont. 9	1005038-38	0.10	ND		
Cont. 10	1005038-39	0.01	ND		
Cont. 11	1005038-40	0.08	ND		

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1005038
Client: Metco Environmental
Site: ADA-ES

Prep Date: 11/1/05
Analysis Date: 11/2/05

QC Summary		Hg ug/L	% Rec	%RPD
Front Method Blank	1005038-MB Front	0.05 ND		
Back Method Blank	1005038-MB Back	0.00 ND		
Laboratory Spike	1005038-LS Front	14.2	142	
Laboratory Spike	1005038-LS Back	10.0	100	
Matrix Spike	1005038-5 MS	9.25	93	
	1005038-5 MSD	9.41	94	1.7
Matrix Spike	1005038-14 MS	10.68	107	
	1005038-14 MSD	10.75	108	0.7
Matrix Spike	1005038-23a MS	9.21	92	
	1005038-23a MSD	9.32	93	1.2
Duplicate Results	1005038-30	0.41		
	1005038-30 D	0.41		1.4

ND = Not detected at the detection limit shown.

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1005038
Client: Metco Environmental
Site: ADA-ES

Prep Date: 11/1/05
Analysis Date: 11/2/05

Thimble/Filter ID	DAT ID	Weight g
Inlet Run 1	1005038-1	0.5248
Inlet Run 2	1005038-6	0.5205
Inlet Run 3	1005038-11	0.5390
Outlet Run 1	1005038-16	0.5175
Outlet Run 2	1005038-21	0.4965
Outlet Run 3	1005038-26	0.5607
Blank Train	1005038-31	0.5463
Reagent Blank Cont. 12	1005038-41	0.5329

DOCUMENTATION

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064.

Project Number: 1005038

1 of 3

Date Received: 10/21/2005
Client Name: Metco Environmental
Tracking number: 602557620309
Custody Seals ?: No

Carrier: FedEx
Analysis: Mercury (Hg)/Ontario Hy
Package Temp: ambient
COC: ☑ check if COC from client

Sample Information

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
Inlet Run 1 Cont. 1	1005038-1	10/18/2005	Air (filter)	glass jar	
Inlet Run 1 Cont. 2	1005038-2	10/18/2005	front wash	amber jar	
Inlet Run 1 Cont. 3	1005038-3a/b	10/18/2005	KCl	amber jar	
Inlet Run 1 Cont. 4	1005038-4	10/18/2005	HNO3/H2O2	amber jar	
Inlet Run 1 Cont. 5	1005038-5	10/18/2005	KMnO4	amber jar	
Inlet Run 2 Cont. 1	1005038-6	10/18/2005	Air (filter)	glass jar	
Inlet Run 2 Cont. 2	1005038-7	10/18/2005	front wash	amber jar	
Inlet Run 2 Cont. 3	1005038-8a/b	10/18/2005	KCl	amber jar	
Inlet Run 2 Cont. 4	1005038-9	10/18/2005	HNO3/H2O2	amber jar	
Inlet Run 2 Cont. 5	1005038-10	10/18/2005	KMnO4	amber jar	
Inlet Run 3 Cont. 1	1005038-11	10/18/2005	Air (filter)	glass jar	

KDS

Laboratory Receiving Initials

1005038
10/21/2005 12:06:21 PM

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064.

Project Number: 1005038

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
Inlet Run 3 Cont. 2	1005038-12	10/18/2005	front wash	amber jar	
Inlet Run 3 Cont. 3	1005038-13a/b	10/18/2005	KCl	amber jar	
Inlet Run 3 Cont. 4	1005038-14	10/18/2005	HNO3/H2O2	amber jar	
Inlet Run 3 Cont. 5	1005038-15	10/18/2005	KMnO4	amber jar	
Outlet Run 1 Cont. 1	1005038-16	10/18/2005	Air (filter)	glass jar	
Outlet Run 1 Cont. 2	1005038-17	10/18/2005	front wash	amber jar	
Outlet Run 1 Cont. 3	1005038-18a/b	10/18/2005	KCl	amber jar	
Outlet Run 1 Cont. 4	1005038-19	10/18/2005	HNO3/H2O2	amber jar	
Outlet Run 1 Cont. 4	1005038-20	10/18/2005	KMnO4	amber jar	
Outlet Run 2 Cont. 1	1005038-21	10/18/2005	Air (filter)	glass jar	
Outlet Run 2 Cont. 2	1005038-22	10/18/2005	front wash	amber jar	
Outlet Run 2 Cont. 3	1005038-23a/b	10/18/2005	KCl	amber jar	
Outlet Run 2 Cont. 4	1005038-24	10/18/2005	HNO3/H2O2	amber jar	
Outlet Run 2 Cont. 4	1005038-25	10/18/2005	KMnO4	amber jar	
Outlet Run 3 Cont. 1	1005038-26	10/18/2005	Air (filter)	glass jar	
Outlet Run 3 Cont. 2	1005038-27	10/18/2005	front wash	amber jar	

Laboratory Receiving Initials

1005038
10/21/2005 12:06:21 PM

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064.

Project Number: 1005038

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
Outlet Run 3 Cont. 3	1005038-28a/b	10/18/2005	KCl	amber jar	
Outlet Run 3 Cont. 4	1005038-29	10/18/2005	HNO3/H2O2	amber jar	
Outlet Run 3 Cont. 4	1005038-30	10/18/2005	KMnO4	amber jar	
Blank Train Filter Cont. 1	1005038-31	10/19/2005	Air (filter)	glass jar	
Blank Train Cont. 2	1005038-32	10/19/2005	front wash	amber jar	
Blank Train Cont. 3	1005038-33	10/19/2005	KCl	amber jar	
Blank Train Cont. 4	1005038-34	10/19/2005	HNO3/H2O2	amber jar	
Blank Train Cont. 5	1005038-35	10/19/2005	KMnO4	amber jar	
0.1N HNO3 Blank Cont. 7	1005038-36	10/19/2005	HNO3	amber jar	
KCl Blank Cont. 8	1005038-37	10/19/2005	KCl	amber jar	
5% HNO3/H2O2 Blank Cont. 9	1005038-38	10/19/2005	HNO3/H2O2	amber jar	
KMnO4 Blank Cont. 10	1005038-39	10/19/2005	KMnO4	amber jar	
Hydroxylamine Blank Cont. 11	1005038-40	10/19/2005	hydrox.amine	amber jar	
Filter Blank Cont. 12	1005038-41	10/19/2005	Air (filter)	glass jar	

Laboratory Receiving Initials

1005038

10/21/2005 12:06:21 PM

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05.234
Job Name: ADA-ES
Location: Newark, OH
Unit: IGES #2 ESP Inlet Duct

Project Manager: S. Bonnesen
Project Supervisor: S. Bonnesen
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec. H2S		Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter Cont. 1	10-18-05	1610	1								✓		[illegible]	
Run 1 Frontwash Cont. 2		1615	1								✓		[illegible]	
Run 1 Imp. 1,2,3 Cont. 3		2028	2	KCl	300ml						✓		[illegible]	
Run 1 Imp. 4 Cont. 4		2024	1	HNO3/H2O2	100ml						✓		[illegible]	
Run 1 Imp. 5,6,7 Cont. 5		2024	1	KMnO4	300ml						✓		[illegible]	
Run 2 Filter Cont. 1	10-18-05	2010	1								✓		[illegible]	
Run 2 Frontwash Cont. 2		2015	1								✓		[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 10-19-05	Time: 1600
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Shipped Via: [illegible] — FedEx	Date: 10-20-05	Time: 1520
Samples Received at Laboratory by: [illegible]	Date: 10-21-05	Time: 11:30
Samples Analyzed by:	Date:	Time:
Samples Analyzed by:	Date:	Time:
Data Checked by:	Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental

CHAIN OF CUSTODY RECORD

Job No.: 05-224
Job Name: ADA-ES
Location: NEWARK, AR
Unit: ISES #2 ESP INLET DUCT

Project Manager: S. BOWEN
Project Supervisor: S. BOWEN

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Stge OH		Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Imp. 1,2,3 Cont. 3	10-18-05	2050	2	KCl	300 ml						✓		[illegible]	
Run 2 Imp. 4 Cont. 4		2050	1	HNO_3/H_2O_2	100 ml						✓		[illegible]	
Run 2 Imp. 5,6,7 Cont. 5		2050	1	$KMnO_4$	300 ml						✓		[illegible]	
Run 3 Filter Cont. 1	10-19-05	1537	1								✓		[illegible]	
Run 3 Flowmeter Cont. 2		1540	1								✓		[illegible]	
Run 3 Imp. 1,2,3 Cont. 3		1550	2	KCl	300 ml						✓		[illegible]	
Run 3 Imp. 4 Cont. 4		1554	1	HNO_3/H_2O_2	100 ml						✓		[illegible]	

		Date:	Time:
Samples Received for Transport/Shipment by:	[illegible]	10-19-05	1610
Samples Received for Transport/Shipment by:			
Samples Received for Transport/Shipment by:			
Samples Shipped Via:	[illegible] — Fed Ex	10-20-05	1520
Samples Received at Laboratory by:	[illegible]	10-21-05	11:30
Samples Analyzed by:			
Samples Analyzed by:			
Date Checked by:			

VERSION 2
10 MARCH 2003

CHAIN OF CUSTODY RECORD

Job No.: 05.234
Job Name: AAA-ES
Location: Newark, AR
Unit: Units #2 ESP Inlet Duct

Project Manager: S. Borchsen
Project Supervisor: S. Borchsen

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	RO Filter		Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 Impr. 3,5,7 Cont. 5	10.19.05	1554	1	KMnO4	200ml						✓		[signature]	

SAMPLE ANALYSIS REQUIRED

Samples Received for Transport/Shipment by: [signature] Date: 10-19-05 Time: 1600
Samples Received for Transport/Shipment by: Date: Time:
Samples Received for Transport/Shipment by: Date: Time:
Samples Shipped Via: [signature] Fed Ex Date: 10-20-05 Time: 1500
Samples Received at Laboratory by: [signature] Date: 10-21-05 Time: 11:30
Samples Analyzed by: Date: Time:
Samples Analyzed by: Date: Time:
Data Checked by: Date: Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-234
Job Name: ADA-ES
Location: NEWARK, AR
Unit: 1SG4½ ESP OUTLET DUCT

Project Manager: S. Bonasch
Project Supervisor: S. Bonasch

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec. OH	Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter Cont. 1	10-18-05	1615	1								✓	S. Bonasch	
Run 1 Frontwash Cont. 2		1618	1								✓	S. Bonasch	
Run 1 Imp. 1,2,3 Cont. 3		2040	2	KCl	300ml						✓	S. Bonasch	
Run 1 Imp. 4 Cont. 4		2040	1	HNO_3/H_2O_2	100ml						✓	S. Bonasch	
Run 1 Imp. 5,6,7 Cont. 5		2040	1	$KMnO_4$	300ml						✓	S. Bonasch	
Run 2 Filter Cont. 1	10-19-05	2000	1								✓	S. Bonasch	
Run 2 Frontwash Cont. 2		2005	1										

Samples Received for Transport/Shipment by: S. Bonasch — Date: 10-19-05 — Time: 1600
Samples Received for Transport/Shipment by: — Date: — Time:
Samples Received for Transport/Shipment by: — Date: — Time:
Samples Shipped Via: S. Bonasch — Date: 10-20-05 — Time: 1500
Samples Received at Laboratory by: [illegible] — Date: 10-21-05 — Time: 11:20
Samples Analyzed by: — Date: — Time:
Samples Analyzed by: — Date: — Time:
Data Checked by: — Date: — Time:

VERSION 2

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-234
Job Name: ADA-ES
Location: Newark, AR Outlet
Unit: IPES #2 ESP ~~Inlet~~ Duct

Project Manager: S. Bonasch
Project Supervisor: S. Bonasch
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Pb		Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Imp. 1,2,3 Cont. 3	10-18-05	2045	2	KCl	300 ml						✓		[illegible]	
Run 2 Imp. 4 Cont. 4		2045	1	HNO_3/H_2O_2	100 ml						✓		[illegible]	
Run 2 Imp. 5,6,7 Cont. 5		2045	1	$KMnO_4$	300 ml						✓		[illegible]	
Run 3 Filter Cont. 1	10-19-05	1531	1								✓		[illegible]	
Run 3 Front Wash Cont. 2		1534	1								✓		[illegible]	
Run 3 Imp. 1,2,3 Cont. 3		1539	2	KCl	300 ml						✓		[illegible]	
Run 3 Imp. 4 Cont. 4		1541	1	HNO_3/H_2O_2	100 ml						✓		[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 10-19-05	Time: 1600
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Shipped Via: [illegible] FedEX	Date: 10-20-05	Time: 1520
Samples Received at Laboratory by: [illegible]	Date: 11-21-05	Time: 11:30
Samples Analyzed by:	Date:	Time:
Samples Analyzed by:	Date:	Time:
Data Checked by:	Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-234
Job Name: ADA-E3
Location: NEWARK, NJ
Unit: ISB #2 EA Mercury Data

Project Manager: S. Bonnell
Project Supervisor: S. Bonnell

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	OH Stc		Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 Imp. 5,6,7 Cont. 5	10-19-05	1600	1	XAnal	300						✓		[illegible]	

Samples Received for Transport/Shipment by: [illegible] Date: 10-19-05 Time: 1600
Samples Received for Transport/Shipment by: Date: Time:
Samples Received for Transport/Shipment by: Date: Time:
Samples Shipped Via: [illegible] Date: 10.20.05 Time: 1500
Samples Received at Laboratory by: [illegible] Date: 10-21-05 Time: 11:30
Samples Analyzed by: Date: Time:
Samples Analyzed by: Date: Time:
Data Checked by: Date: Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-224
Job Name: ADA-ES
Location: Newark, AR
Unit: Igs #2 ESP Inlet/Outlet Duct

Project Manager: S. Bonnell
Project Supervisor: S. Bonnell

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	Filter #		Recovered by	REMARKS (Specific Compounds/Methods)
BLANK TRAIN FILTER CONT. 1	10-19-05	1310	1								✓		[illegible]	
BLANK TRAIN FRONTHALF# CONT. 2		1313	1								✓		[illegible]	
BLANK TRAIN IMP. 1,2,3 CONT. 3		1323	1	KCl	300ml						✓		[illegible]	
BLANK TRAIN IMP. 4 CONT. 4		1317	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
BLANK TRAIN IMP. 5,6,7 CONT. 5		1321	1	RAwt	300ml						✓		[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 10-19-05	Time: 1600	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via: [illegible]	Date: 10-20-05	Time: 1520	
Samples Received at Laboratory by: [illegible]	Date: 10-21-05	Time: 11:30	
Samples Analyzed by:	Date:	Time:	
Samples Analyzed by:	Date:	Time:	
Data Checked by:	Date:	Time:	

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Page 1 of 1

Job No.: 05-234
Job Name: ADA-ES
Location: NEWARK, AR
Unit: ISES #2 ESP INLET/OUTLET DUCT

Project Manager: S. Bonnell
Project Supervisor: S. Bonnell

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Hg		Recovered by	REMARKS (Specific Compounds/Methods)
0.1 N HNO_3 BLANK CONT. 7	10-19-05	1030	1								✓		[illegible]	
1N HCl BLANK CONT. 8		1032	1								✓		[illegible]	
5% HNO_3/10% H_2O_2 Peroxide BLANK CONT. 9		1035	1								✓		[illegible]	
ACID KMnO4 BLANK CONT. 10		1037	1								✓		[illegible]	
HYDROXYLAMINE SOLUTION BLANK CONT. 11		1040	1								✓		[illegible]	
FILTER BLANK CONT. 12		1017	1								✓		[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 10-19-05	Time: 1600	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via: [illegible] FedEx	Date: 10-20-05	Time: 1520	
Samples Received at Laboratory by: [illegible]	Date: 10-21-05	Time: 11:30	
Samples Analyzed by:	Date:	Time:	
Samples Analyzed by:	Date:	Time:	
Data Checked by:	Date:	Time:	

VERSION 2
10 MARCH 2003

DAT Labs Inc.
Sample Receipt Report

Client: Mejco Env.

Custodian Initial: KKS Date: 10-21-05

The client has been contacted. ____ Yes ____ No

Upon receipt of samples, check if any of the following discrepancies have been noted.

	Discrepancy Type	Specify applicable client ID or "all"
	COC and samples do not match	
	No unique sample identifications	
	Samples received outside of the required temp criteria. **Receipt Temp:** Ambient	
	No preservation type was noted	
	~~No date of collection stated~~	
	No time of collection stated	
	The sample collector was not named	
	Sample containers were not appropriate	
	Sample labels were destroyed or unreadable	
	Samples were received outside of holding time	
	There was not enough sample to perform the requested analysis.	
	Samples showed sign of damage or contamination.	
	Aqueous samples for volatile analysis: Headspace? Y N If Y (es), details:	
	Sample pH acidic basic neutral Please describe any outliers or nonconformances below.	

Details: _____

Sample pH for nonvolatile aqueous samples and presence or absence of headspace (Y or N) for aqueous samples shall be recorded at time of sample log-in.
Under no circumstances shall VOA vials be opened at time of sample receipt.

Other Discrepancies:

Sample ID	Discrepancy

☒ ***Upon receipt, the samples met all of DAT's acceptance criteria.*** ***DAT Project #*** 1005038

FRMSRR081501

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

(Provide at least three copies to the airline.)

Shipper
Robert Peel
Metco Environmental
3226 Commander Drive
CARROLLTON TX 75006 US

Air Waybill No. 60255762030 9 NZ CMHA

Page 1 of 1 Pages

Shipper's Reference Number (optional)

FedEx Express

Consignee
Ron Mitchum
DAT. Inc.
7715 Corporate
Plain City OH 43064 US

Two completed and signed copies of this Declaration must be handed to the operator

WARNING

Failure to comply with all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.

TRANSPORT DETAILS

This shipment is within the limitations prescribed for: *(delete non applicable)*

PASSENGER AND CARGO AIRCRAFT | CARGO AIRCRAFT ONLY

Airport of Departure: CARROLLTON

Airport of Destination: Plain City NZCMH

Shipment type: *(delete non applicable)* NON-RADIOACTIVE | RADIOACTIVE

NATURE AND QUANTITY OF DANGEROUS GOODS

UN Number or Identification Number, Proper Shipping name, Class or Division, Packing Group (if required), and all other required information

Corrosive liquid, n.o.s. (NITRIC ACID / SULPHURIC ACID)	8	UN1760	II	1 WOODEN CRATE X 10.50 L	812

Additional Handling Information

I declare that all of the applicable air transport requirements have been met.

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable International and National Governmental Regulations. I declare that all of the applicable air transport requirements have been met.

Name/Title of Signatory: ROBERT PEEL SHIPPER

Place and Date: DALLAS 10/20/2005

Signature *(see warning above)* Robert Peel

Emergency Telephone Number: 8002553924

FOR RADIOACTIVE MATERIAL SHIPMENT ACCEPTABLE FOR PASSENGER AIRCRAFT, THE SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN OR INCIDENT TO RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.

APPENDIX F

Chain of Custody

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05.234
Job Name: ADA-ES
Location: Newark, Ark
Unit: ISES #2 ESP Inlet Duct

Project Manager: S. Bokinsen
Project Supervisor: S. Bokinsen

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	Spec. H2S		Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter Cont. 1	10-18-05	1610	1								✓		[illegible]	
Run 1 Frontwash Cont. 2		1615	1								✓		[illegible]	
Run 1 Imp. 1,2,3 Cont. 3		2028	2	KCl	300ml						✓		[illegible]	
Run 1 Imp. 4 Cont. 4		2024	1	HNO3/H2O2	100ml						✓		[illegible]	
Run 1 Imp. 5,6,7 Cont. 5		2034	1	KMnO4	200ml						✓		[illegible]	
Run 2 Filter Cont. 1	10-18-05	2010	1								✓		[illegible]	
Run 2 Frontwash Cont. 2		2015	1								✓		[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 10-19-05	Time: 1600	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via: [illegible] — FedEx	Date: 10-20-05	Time: 1520	
Samples Received at Laboratory by: [illegible]	Date: 10-21-05	Time: 11:30	
Samples Analyzed by:	Date:	Time:	
Samples Analyzed by:	Date:	Time:	
Data Checked by: [illegible]	Date: ~~10~~ 11/08/05	Time: 1515	

VERSION 2
10 MARCH 2003

METCO Environmental ®

CHAIN OF CUSTODY RECORD

Job No.: 05-234
Job Name: ADA-ES
Location: Newark, AR
Unit: IGES #2 ESP Inlet Duct

Project Manager: S. Bowden
Project Supervisor: S. Bowden

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	He Strip		Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Imp. 1,2,3 Cont. 3	10-18-05	2050	2	KCl	300 ml						✓		[illegible]	
Run 2 Imp. 4 Cont. 4		2050	1	HNO_3/H_2O_2	100 ml						✓		[illegible]	
Run 2 Imp. 5,6,7 Cont. 5		2050	1	$KMnO_4$	300 ml						✓		[illegible]	
Run 3 Filter Cont. 1	10-19-05	1537	1								✓		[illegible]	
Run 3 Front wash Cont. 2		1540	1								✓		[illegible]	
Run 3 Imp. 1,2,3 Cont. 3		1550	2	KCl	300 ml						✓		[illegible]	
Run 3 Imp. 4 Cont. 4		1554	1	HNO_3/H_2O_2	100 ml						✓		[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 10-19-05	Time: 1610
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Shipped Via: [illegible] — Fed Ex	Date: 10-20-05	Time: 1520
Samples Received at Laboratory by: [illegible]	Date: 10-21-05	Time: 11:30
Samples Analyzed by:	Date:	Time:
Samples Analyzed by:	Date:	Time:
Data Checked by: [illegible]	Date: 11/08/05	Time: 1515

VERSION 2
10 MARCH 2003

CHAIN OF CUSTODY RECORD

Job No.: 05.234
Job Name: AAA-ES
Location: Newark, AR
Unit: Units 1 & 2 ESP Inlet Duct

Project Manager: S. Barnes
Project Supervisor: S. Barnes

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	RO Filter		Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 Impr. 5,6,7 Cont. 5	10.19.05	1554	1	KMnO4	300ml						✓		[signature]	

Samples Received for Transport/Shipment by: [signature] Date: 10-19-05 Time: 1600
Samples Received for Transport/Shipment by: Date: Time:
Samples Received for Transport/Shipment by: Date: Time:
Samples Shipped Via: [signature] — Fed Ex Date: 10-20-05 Time: 1500
Samples Received at Laboratory by: [signature] Date: 10-21-05 Time: 11:30
Samples Analyzed by: Date: Time:
Samples Analyzed by: Date: Time:
Data Checked by: [signature] Date: 11/08/05 Time: 1515

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-234
Job Name: ADA-ES
Location: NEWARK, AR
Unit: 1&2 ESP OUTLET DUCT

Project Manager: S. Bonsen
Project Supervisor: S. Bonsen

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec. OH	Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter Cont. 1	10-18-05	1615	1								✓	[illegible]	
Run 1 Frontwash Cont. 2		1618	1								✓	[illegible]	
Run 1 Imp. 1,2,3 Cont. 3		2040	2	KCl	300ml						✓	[illegible]	
Run 1 Imp. 4 Cont. 4		2040	1	HNO_3/H_2O_2	100ml						✓	[illegible]	
Run 1 Imp. 5,6,7 Cont. 5		2040	1	$KMnO_4$	300ml						✓	[illegible]	
Run 2 Filter Cont. 1	10-19-05	2000	1								✓	[illegible]	
Run 2 Frontwash Cont. 2		2005	1										

Samples Received for Transport/Shipment by: [illegible]	Date: 10-19-05	Time: 1600
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Shipped Via: [illegible]	Date: 10-20-05	Time: 1500
Samples Received at Laboratory by: [illegible]	Date: 10-21-05	Time: 11:30
Samples Analyzed by:	Date:	Time:
Samples Analyzed by:	Date:	Time:
Data Checked by: [illegible]	Date: 11/08/05	Time: 1515

VERSION 2

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CHAIN OF CUSTODY RECORD

Job No.: 05-234
Job Name: ADA-ES
Location: Newark, AR Outlet
Unit: 1&2 ESP ~~Inlet~~ Duct

Project Manager: S. Johnsen
Project Supervisor: S. Johnsen
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Hg 29		Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Imp. 1,2,3 Cont. 3	10-18-05	2045	2	KCl	300 ml						✓		[illegible]	
Run 2 Imp. 4 Cont. 4		2045	1	HNO_3/H_2O_2	100 ml						✓		[illegible]	
Run 2 Imp. 5,6,7 Cont. 5		2045	1	$KMnO_4$	300 ml						✓		[illegible]	
Run 3 Filter Cont. 1	10-19-05	1531	1								✓		[illegible]	
Run 3 Frontwash Cont. 2		1534	1								✓		[illegible]	
Run 3 Imp. 1,2,3 Cont. 3		1539	2	KCl	300 ml						✓		[illegible]	
Run 3 Imp. 4 Cont. 4		1541	1	HNO_3/H_2O_2	100 ml						✓		[illegible]	

		Date:	Time:
Samples Received for Transport/Shipment by:	[illegible]	10-19-05	1600
Samples Received for Transport/Shipment by:			
Samples Received for Transport/Shipment by:			
Samples Shipped Via:	[illegible] FedEx	10-20-05	1520
Samples Received at Laboratory by:	[illegible]	11-21-05	11:30
Samples Analyzed by:			
Samples Analyzed by:			
Date Checked by:	[illegible]	11/08/05	1515

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METCO Environmental

CHAIN OF CUSTODY RECORD

Job No.: 05-234
Job Name: ADA-03
Location: NEWARK, NJ
Unit: ISB #2 EB Hooper Dock

Project Manager: S. Bonasera
Project Supervisor: S. Bonasera

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	OH Sfc		Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 Imp. 5,6,7 Cont. 5	10-19-05	1600	1	XAD-2	300						✓		[signature]	

Samples Received for Transport/Shipment by: [signature] Date: 10-19-05 Time: 1600
Samples Received for Transport/Shipment by: Date: Time:
Samples Received for Transport/Shipment by: Date: Time:
Samples Shipped Via: [signature] Date: 10-20-05 Time: 1500
Samples Received at Laboratory by: [signature] Date: 10-21-05 Time: 11:20
Samples Analyzed by: Date: Time:
Samples Analyzed by: Date: Time:
Data Checked by: [signature] Date: 11/08/05 Time: 1515

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10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

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Job No.: 05-234
Job Name: ADA-ES
Location: Newark, OH
Unit: Iss #2 ESP Inlet/Outlet Duct

Project Manager: S. Bonnell
Project Supervisor: S. Bonnell

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	Hg		Received by	REMARKS (Specific Compounds/Methods)
BLANK TRAIN FILTER CONT. 1	10-19-05	1310	1								✓		[illegible]	
BLANK TRAIN FRONTHALF CONT. 2		1313	1								✓		[illegible]	
BLANK TRAIN IMP. 1,2,3 CONT. 3		1323	1	KCl	300ml						✓		[illegible]	
BLANK TRAIN IMP. 4 CONT. 4		1317	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
BLANK TRAIN IMP. 5,6,7 CONT. 5		1321	1	KMnO4	300ml						✓		[illegible]	

Samples Received for Transport/Shipment by:	[illegible]	Date: 10-19-05	Time: 1600
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	[illegible]	Date: 10-20-05	Time: 1520
Samples Received at Laboratory by:	[illegible]	Date: 10-21-05	Time: 11:30
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:	[illegible]	Date: 11/08/05	Time: 1515

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-234
Job Name: ADA-ES
Location: Newark, AR
Unit: ISES #2 ESP Inlet/Outlet Duct

Project Manager: S. Bonnell
Project Supervisor: S. Bonnell

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	Spec. Gr.		Recovered by	REMARKS (Specific Compounds/Methods)
0.1 N HNO_3 Blank Cont. 7	10-19-05	1030	1								✓		[illegible]	
1N KCl Blank Cont. 8		1032	1								✓		[illegible]	
5% HNO_3/H_2O_2 Rinse Blank Cont. 9		1035	1								✓		[illegible]	
Acid $KMnO_4$ Blank Cont. 10		1037	1								✓		[illegible]	
Hydroxylamine Solution Blank Cont. 11		1040	1								✓		[illegible]	
Filter Blank Cont. 12		1017	1								✓		[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 10-19-05	Time: 1600	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via: [illegible] Fedex	Date: 10-20-05	Time: 1520	
Samples Received at Laboratory by: [illegible]	Date: 10-21-05	Time: 11:30	
Samples Analyzed by:	Date:	Time:	
Samples Analyzed by:	Date:	Time:	
Data Checked by: [illegible]	Date: 11/08/05	Time: 1515	

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10 MARCH 2003

APPENDIX G

Resumes of Test Personnel

ROBERT M. PATTERSON; President

Education	B. S. 1983, Central Michigan University; Mt. Pleasant, Michigan, in Geology and Earth Science-Meteorology.
Professional Training Courses	Attended a two-day short course, "Performing and Observing Source Sampling" in Dallas, Texas. Attended a one-day short course on basic supervision. Attended a four-week management course presented by the American Management Association, 1991-1992.
Certification	Certified Visible Emissions Evaluator Certified Cabot Full-Face Respirator Fit Tester
Professional Memberships	Source Evaluation Society American Management Association
Technical Experience	Participated in the sampling of over 1,000 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 1986-present. Over nineteen years experience with EPA and Texas Air Control Board methods of sampling - both stationary sources and ambient air. CFR, Title 40, Chapter I, Part 60, EPA Methods 1 through 25, and 101 through 110. Performance Specifications 1 through 5. CFR, Title 40, Chapter I, Part 50, Appendix A through F. "Sampling Procedures Manual, Texas Air Control Board, January 1983." Parts 1-1 through 14-6, Appendix B through Appendix M. Experienced with sampling Method 0010, Modified Method 5 Sampling Train; Method 0030, Volatile Organic Sampling Train; and various EPA and "Site Specific" multiple metal and acid gas sampling trains.

(continued)

PATTERSON, Rob (cont'd)

Technical Experience (cont'd)

Over twenty one years experience with EPA and Texas Air Control Board methods of analysis of both stationary and ambient air samples. Particulate matter, SO_3, SO_2, H_2SO_4, NO_x, CO, CO_2, O_2, H_2S, F, TRS, HCl, Cl_2, NH_3, VOC, C_1-C_7, and other organics. Both laboratory and on-site analyses were performed.

Experienced in the sampling and analysis of commercial calibration gas cylinders for sulfur dioxide, oxides of nitrogen, carbon dioxide, oxygen, carbon monoxide, and C_1-C_7 hydrocarbons.

Thoroughly trained in the operation and routine maintenance of the following:

- MSA LIRA Model 202S Infrared Analyzer
- Analytical Instrument Development, Inc. Model 340A Calibration System
- Shimadzu GC-Mini 2 Gas Chromatograph
- Thermo Environmental Model 10AR Oxides of Nitrogen Analyzer
- Thermo Oxygen Analyzer
- Teledyne Model 326 Oxygen Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer
- Thermo Environmental Model 40 Sulfur Dioxide Analyzer
- Ratfisch Model RS 100 Total Hydrocarbon Analyzer
- Western Research Model 721AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- Ratfisch Model RS 55 Total Hydrocarbon Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer

JAMES R. MONFRIES; Senior Quality Assurance Manager

Education	B. S. 1975, University of Texas at Arlington; Arlington, Texas, in Biology with a minor in Chemistry. Graduate work at the University of Texas at Dallas in the Environmental Science Department.
Professional Training Courses	Attended a two-day short course, "Performing and Observing Source Sampling" in Dallas, Texas, July 1976.
Certification	Certified Visible Emissions Evaluator
Professional Memberships	Air and Waste Management Association Source Evaluation Society - Past President
Technical Experience	Participated in the sampling of over 700 sources, serving in the supervisory capacity on over 500 sources. Many of the sources were sampled simultaneously using more than one sampling train at several points in the flue gas stream, 1976-present. Has also supervised several ambient air monitoring studies, including a permanent five-station high volume air sampling network in South Texas, a permanent four-station high volume air sampling network in Pennsylvania, and a permanent seven-station sulfur dioxide sampling network in East Texas. Was Quality Assurance Manager for several ambient air monitoring studies; including a four-station high volume air sampling network for TSP and PM10 in Midlothian, Texas; a single-station high volume air sampling network for PM10 in South Texas; a two-station high volume air sampling network for TSP in Wichita Falls, Texas; and a four-station continuous air sampling network for TSP and PM10 in Jewett, Texas using Thermo Andersen FH 62 C14 Beta Gauge Dust Monitors.

(continued)

MONFRIES, James (cont'd)

Twenty years experience with EPA and Texas Commission on Environmental Quality methods of analysis of both source and ambient air samples for particulates, SO_2, SO_3, H_2SO_4, H_2S, HCl, Cl_2, NO_x, Hydrocarbons, and TRS.

Experienced in the analysis of commercial calibration gas cylinders for sulfur dioxide and oxides of nitrogen.

Experienced with VOST and Modified Method 5 Sampling Procedures.

Thoroughly trained in the operation and routine maintenance of the following:

- Lear Siegler, Inc. SM800 Stack Gas Monitor
- Du Pont Model 460/1 Photometric Analyzer System
- Lear Siegler, Inc. SM1000 Ambient SO_2 Monitor
- Calibrated Instruments Ultragas SO_2 Monitor
- Meloy 285E SO_2 Analyzer
- Meloy SA-700 Fluorescent SO_2 Analyzer
- MSA LIRA Model 202S Infrared Analyzer
- Analytical Instrument Development, Inc. Model 340A Calibration System
- Shimadzu GC-Mini 2 Gas Chromatograph
- Thermo Environmental Model 10S NO_x Analyzer
- Thermo Oxygen Analyzer
- Teledyne Model 326 Oxygen Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer
- Thermo Environmental Model 40 Sulfur Dioxide Analyzer
- Ratfisch Model RS 103 Total Hydrocarbon Analyzer
- Western Research Model 721AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- Ratfisch Model RS 55 Total Hydrocarbon Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer
- Thermo Andersen Model FH 62 C14 Dust Monitor

STEVEN J. BORNSEN; Utilities Associate

Education	B. S. in Geology, 1995; University of Texas at Arlington; Arlington, Texas.
Professional Training Courses	Attended 40-hour Occupational & Environmental Training Program on Hazardous Materials (CFR 1910.120); Dallas, Texas, January 1996. Attended a two-day short course, "Performing and Observing Source Sampling," Dallas, Texas; September 1996.
Certifications	Certified Visible Emissions Evaluator HAZMAT certified Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 400 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 1995-present. Experienced with Modified Method 5 Sampling Train (Method 0010). Experienced with VOST sampling procedure (Method 0030). Experienced with calibration techniques for all field testing equipment. Experienced with various multiple metal and acid gas sampling trains. Experienced with particle size and PM_{10} sampling procedures.

(continued)

BORNSEN, Steve (cont'd)

Technical Experience (cont'd)

Experienced with on-site gravimetric particulate matter analysis.

Has performed on-site SO_2 analysis and H_2S fuel gas analysis.

Thoroughly trained in the operation and routine maintenance of the following:

- Thermo Environmental Model 10S and 42C Oxides of Nitrogen Analyzers
- Teledyne Model 326 Oxygen Analyzer
- Western Research Model 721 AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer

RODNEY MALONE; Project Supervisor II

Education	B. S. Forestry, December 2000; Stephen F. Austin State University; Nacogdoches, Texas.
Certifications	HAZMAT certified Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 200 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2001-present. Experienced with Modified Method 5 Sampling Train (Method 0010). Experienced with VOST Sampling Procedures (Method 0030). Experienced with calibration techniques for all field testing equipment. Experienced with various multiple metal and acid gas sampling trains. Has performed on-site SO_2 analysis and H_2S fuel gas analysis. Thoroughly trained in the operation and routine maintenance of the following: • Thermo Environmental Model 10S, 42C, and 42CHL Oxides of Nitrogen Analyzers • Teledyne Model 326 Oxygen Analyzer • Horiba Model PIR 2000 Carbon Dioxide Analyzer

(continued)

MALONE, Rodney (cont'd)

Technical Experience (cont'd)

Operation and routine maintenance (cont'd)

- Thermo Environmental Model 48 Carbon Monoxide Analyzer.
- Western Research Model 721M Sulfur Dioxide Analyzer
- J.U.M. VE-7 Hydrocarbon Analyzer
- Shimadzu Gas Chromatograph 14 and 17a

JOSHUA ORR; Environmental Scientist I

Education	B. S. Environmental Studies, Summer 2002; Southwest Texas State University; San Marcos, Texas.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

DUSTIN DODSON; Environmental Scientist I

Education	B. S. Industrial Engineering, May 2005; Northwestern State University; Natchitoches, Louisiana.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

APPENDIX D3: Source Testing—October 24–26, 2005

METCO ENVIRONMENTAL
P.O. Box 598
Addison, TX 75001
(972) 931-7127

SOURCE EMISSIONS SURVEY
OF
ARKANSAS POWER & LIGHT COMPANY
INDEPENDENCE STEAM
ELECTRIC STATION
UNIT NUMBER 2 ESP INLET
AND OUTLET DUCTS
NEWARK, ARKANSAS
FOR
ADA-ES

OCTOBER 2005

FILE NUMBER 05-235

" I certify that I have personally checked and am familiar with the information submitted herein, and based on my inquiries of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate, and complete. "

_____

James R. Monfries
Senior Quality Assurance Manager

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SUMMARY OF RESULTS	2
DISCUSSION OF RESULTS	12
DESCRIPTION OF SAMPLING LOCATIONS	15
SAMPLING AND ANALYTICAL PROCEDURES	18
DESCRIPTION OF TESTS	25
APPENDICES	27

A. Location of Sampling Points
B. Source Emissions Calculations
C. Calibration Data
D. Field Testing Data
E. Analytical Data
F. Chain of Custody
G. Resumes of Test Personnel

SOURCE EMISSIONS SURVEY
ARKANSAS POWER & LIGHT COMPANY
INDEPENDENCE STEAM ELECTRIC STATION
UNIT NUMBER 2 ESP INLET AND OUTLET DUCTS
NEWARK, ARKANSAS
FOR
ADA-ES
FILE NUMBER 05-235

INTRODUCTION

METCO Environmental, P.O. Box 598, Addison, Texas, conducted a source emissions survey of Arkansas Power & Light Company, Independence Steam Electric Station, located in Newark, Arkansas, for ADA-ES, on October 24, 25, and 26, 2005. The purpose of these tests was to determine the concentrations of particulate matter, hydrogen chloride, hydrogen bromide, hydrogen fluoride, chlorine, and bromine, and speciated mercury at the Unit Number 2 ESP Inlet and Outlet Ducts.

The sampling was performed by the following METCO personnel: Steve Bornsen - Project Supervisor, Rodney Malone, Eric Stone, John Cutaia, Joshua Orr, Dustin Dodson, Jason Sellers, Chris Poshek, and Doug Ware.

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 17, and 26A; and the Ontario Hydro Method, Revised July 7, 1999 (ASTM D-6785-02).

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Run Number	Particulate Matter Emissions (gr/dscf*)	(lbs/hr)	(lbs/mmBtu)	Chlorine Concentrations (dry ppm	(lbs/hr)	(lbs/mmBtu)	Bromine Concentrations (dry ppm)	(lbs/hr)	(lbs/mmBtu)
1	2.0140	4,219.74	3.608	0.02	0.059	5.08E-05	0.01	0.043	3.66E-05
2	2.5276	5,333.79	4.528	0.02	0.068	5.77E-05	0.01	0.072	6.11E-05
3	2.0712	4,322.90	3.665	0.01	0.039	3.32E-05	0.01	0.060	5.07E-05
Average	2.2043	4,625.48	3.934	0.02	0.055	4.72E-05	0.01	0.058	4.95E-05

Run Number	Hydrogen Chloride Concentrations (dry ppm)	(lbs/hr)	(lbs/mmBtu)	Hydrogen Fluoride Concentrations (dry ppm	(lbs/hr)	(lbs/mmBtu)	Hydrogen Bromide Concentrations (dry ppm)	(lbs/hr)	(lbs/mmBtu)
1	0.48	0.673	5.75E-04	1.37	1.048	8.96E-04	0.02	0.055	4.67E-05
2	0.47	0.659	5.59E-04	2.01	1.543	1.31E-03	0.02	0.059	4.99E-05
3	0.46	0.635	5.38E-04	1.48	1.120	9.50E-04	0.02	0.055	4.66E-05
Average	0.47	0.656	5.57E-04	1.62	1.237	1.05E-03	0.02	0.056	4.77E-05

Unit Number 2 ESP Outlet Duct

Run Number	Particulate Matter Emissions (gr/dscf*)	(lbs/hr)	(lbs/mmBtu)	Chlorine Emissions (dry ppm	(lbs/hr)	(lbs/mmBtu)	Bromine Emissions (dry ppm)	(lbs/hr)	(lbs/mmBtu)
1	0.0044	9.85	0.008	0.01	0.042	3.40E-05	N.D.	N.D.	N.D.
2	0.0060	13.66	0.011	0.02	0.057	4.56E-05	N.D.	N.D.	N.D.
3	0.0044	10.12	0.008	0.02	0.045	3.57E-05	N.D.	N.D.	N.D.
Average	0.0049	11.21	0.009	0.02	0.048	3.84E-05	N.D.	N.D.	N.D.

Run Number	Hydrogen Chloride Emissions (dry ppm)	(lbs/hr)	(lbs/mmBtu)	Hydrogen Fluoride Emissions (dry ppm	(lbs/hr)	(lbs/mmBtu)	Hydrogen Bromide Emissions (dry ppm)	(lbs/hr)	(lbs/mmBtu)
1	0.48	0.711	5.80E-04	1.35	1.091	8.91E-04	0.65	2.109	1.72E-03
2	0.52	0.778	6.21E-04	1.80	1.489	1.19E-03	0.70	2.328	1.86E-03
3	0.47	0.722	5.70E-04	1.60	1.335	1.06E-03	0.70	2.371	1.87E-03
Average	0.49	0.737	5.90E-04	1.58	1.497	1.05E-03	0.68	2.269	1.82E-03

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

N.D. – None detected.

METCO ENVIRONMENTAL

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Run Number	Particle Bound Mercury Emissions ($\mu g/m^3$)	Particle Bound Mercury Emissions (lbs/trillion Btu)	Oxidized Mercury Emissions ($\mu g/m^3$)	Oxidized Mercury Emissions (lbs/trillion Btu)	Elemental Mercury Emissions ($\mu g/m^3$)	Elemental Mercury Emissions (lbs/trillion Btu)	Total Mercury Mercury Emissions ($\mu g/m^3$)	Total Mercury Mercury Emissions (lbs/trillion Btu)
1	0.125	0.098	2.175	1.703	4.481	3.508	6.781	5.309
2	0.091	0.072	2.787	2.182	3.237	2.535	6.115	4.789
3	0.043	0.033	1.323	1.023	4.718	3.650	6.084	4.706
Average	0.086	0.068	2.095	1.636	4.145	3.231	6.327	4.935

Unit Number 2 ESP Outlet Duct

Run Number	Particle Bound Mercury Emissions ($\mu g/m^3$)	Particle Bound Mercury Emissions (lbs/trillion Btu)	Oxidized Mercury Emissions ($\mu g/m^3$)	Oxidized Mercury Emissions (lbs/trillion Btu)	Elemental Mercury Emissions ($\mu g/m^3$)	Elemental Mercury Emissions (lbs/trillion Btu)	Total Mercury Mercury Emissions ($\mu g/m^3$)	Total Mercury Mercury Emissions (lbs/trillion Btu)
1	1.639	1.299	0.058	0.046	0.241	0.191	1.938	1.536
2	1.144	0.918	0.255	0.205	0.442	0.355	1.841	1.478
3	1.841	1.460	0.274	0.217	0.391	0.310	2.506	1.987
Average	1.541	1.226	0.196	0.156	0.358	0.285	2.095	1.667

METCO ENVIRONMENTAL

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

EPA Method 17 Particulate Matter

Run Number	1	2	3
Date	10/25/05	10/25/05	10/26/05
Time	1345-1610	1724-1939	1251-1506
Duct Flow Rate - ACFM	415,113	415,616	409,896
Duct Flow Rate - DSCFM*	244,478	246,223	243,539
% Water Vapor - % Vol.	11.40	10.59	11.00
% CO_2 - % Vol.	14.6	14.4	14.6
% O_2 - % Vol.	4.6	4.6	4.4
% Excess Air @ Sampling Point	27.4	27.3	25.8
Stack Temperature - °F	309	310	306
Stack Pressure - "Hg	28.86	28.81	28.87
Percent Isokinetic	95.3	97.9	101.0
Volume Dry Gas Sampled - DSCF*	51.730	53.521	54.620
Particulate Matter Emissions Nozzle & Thimble Catch grains/dscf*	2.0140	2.5276	2.0712
grains/cf @ Stack Conditions	1.1820	1.4924	1.2262
lbs/hr	4,219.74	5,333.79	4,322.90
lbs/mmBtu	3.608	4.528	3.665

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

EPA Method 26A

Run Number	1	2	3
Hydrogen Chloride - µg	1,076.2	1,082.7	1,075.8
Hydrogen Chloride Concentrations – dry ppm	0.48	0.47	0.46
Hydrogen Chloride Concentrations – lbs/hr	0.673	0.659	0.635
Hydrogen Chloride Concentrations – lbs/mmBtu	5.75E-04	5.59E-04	5.38E-04
Hydrogen Fluoride - µg	1,676.6	2,535.1	1,899.0
Hydrogen Fluoride Concentrations – dry ppm	1.37	2.01	1.48
Hydrogen Fluoride Concentrations – lbs/hr	1.048	1.543	1.120
Hydrogen Fluoride Concentrations – lbs/mmBtu	8.96E-04	1.31E-03	9.50E-04
Hydrogen Bromide - µg	87.3	96.6	93.1
Hydrogen Bromide Concentrations – dry ppm	0.02	0.02	0.02
Hydrogen Bromide Concentrations – lbs/hr	0.055	0.059	0.055
Hydrogen Bromide Concentrations – lbs/mmBtu	4.67E-05	4.99E-05	4.66E-05
Chlorine - µg	95.1	111.7	66.3
Chlorine Concentrations – dry ppm	0.02	0.02	0.01
Chlorine Concentrations – lbs/hr	0.059	0.068	0.039
Chlorine Concentrations – lbs/mmBtu	5.08E-05	5.77E-05	3.32E-05
Bromine - µg	68.4	118.3	101.4
Bromine Concentrations – dry ppm	0.01	0.01	0.01
Bromine Concentrations – lbs/hr	0.043	0.072	0.060
Bromine Concentrations – lbs/mmBtu	3.66E-05	6.11E-05	5.07E-05

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Date	10/25/05	10/25/05	10/26/05
Time	1321-1547	1643-1851	1230-1440
Duct Flow Rate - ACFM	412,630	414,142	403,221
Duct Flow Rate - DSCFM*	242,656	241,590	237,034
% Water Vapor - % Vol.	10.84	11.05	10.91
% CO_2 - % Vol.	14.6	14.4	14.6
% O_2 - % Vol.	4.6	4.6	4.4
% Excess Air @ Sampling Point	27.4	27.3	25.8
Stack Temperature - °F	315	318	315
Stack Pressure - "Hg	28.86	28.81	28.87
Percent Isokinetic	99.4	93.5	93.8
Volume Dry Gas Sampled - DSCF*	53.592	50.179	49.398

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Particle Bound Mercury - µg	0.19	0.13	0.06
Particle Bound Mercury Emissions - µg/m^{3*}	0.125	0.091	0.043
Particle Bound Mercury Emissions - lbs/trillion Btu	0.098	0.072	0.033
Oxidized Mercury - µg	3.30	3.96	1.85
Oxidized Mercury Emissions - µg/m^{3*}	2.175	2.787	1.323
Oxidized Mercury Emissions - lbs/trillion Btu	1.703	2.182	1.023
Elemental Mercury - µg	6.80	4.60	6.60
Elemental Mercury Emissions - µg/m^{3*}	4.481	3.237	4.718
Elemental Mercury Emissions - lbs/trillion Btu	3.508	2.535	3.650
Total Mercury Emissions - µg/m^{3*}	6.781	6.115	6.084
Total Mercury Emissions - lbs/trillion Btu	5.309	4.789	4.706

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

EPA Method 17 Particulate Matter

Run Number	1	2	3
Date	10/25/05	10/25/05	10/26/05
Time	1342-1610	1723-1948	1249-1511
Duct Flow Rate - ACFM	460,212	448,912	452,747
Duct Flow Rate - DSCFM*	259,222	264,831	267,647
% Water Vapor - % Vol.	14.81	11.79	10.51
% CO_2 - % Vol.	14.2	14.2	14.2
% O_2 - % Vol.	4.8	4.8	4.8
% Excess Air @ Sampling Point	28.8	28.8	28.8
Stack Temperature - °F	312	302	313
Stack Pressure - "Hg	28.82	28.77	28.83
Percent Isokinetic	97.3	93.7	90.7
Volume Dry Gas Sampled - DSCF*	73.307	72.139	70.541
Particulate Matter Emissions Nozzle & Thimble Catch grains/dscf*	0.0044	0.0060	0.0044
grains/cf @ Stack Conditions	0.0025	0.0035	0.0026
lbs/hr	9.85	13.66	10.12
lbs/mmBtu	0.008	0.011	0.008

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

EPA Method 26A

Run Number	1	2	3
Hydrogen Chloride - µg	1,519.6	1,601.3	1,437.8
Hydrogen Chloride Emissions – dry ppm	0.48	0.52	0.47
Hydrogen Chloride Emissions – lbs/hr	0.711	0.778	0.722
Hydrogen Chloride Emissions – lbs/mmBtu	5.80E-04	6.21E-04	5.70E-04
Hydrogen Fluoride - µg	2,332.8	3,066.5	2,658.9
Hydrogen Fluoride Emissions – dry ppm	1.35	1.80	1.60
Hydrogen Fluoride Emissions – lbs/hr	1.091	1.489	1.335
Hydrogen Fluoride Emissions – lbs/mmBtu	8.91E-04	1.19E-03	1.06E-03
Hydrogen Bromide - µg	4,508.2	4,792.8	4,723.2
Hydrogen Bromide Emissions – dry ppm	0.65	0.70	0.70
Hydrogen Bromide Emissions – lbs/hr	2.109	2.328	2.371
Hydrogen Bromide Emissions – lbs/mmBtu	1.72E-03	1.86E-03	1.87E-03
Chlorine - µg	89.1	117.6	90.0
Chlorine Emissions – dry ppm	0.01	0.02	0.02
Chlorine Emissions – lbs/hr	0.042	0.057	0.045
Chlorine Emissions – lbs/mmBtu	3.40E-05	4.56E-05	3.57E-05
Bromine - µg	N.D.	N.D.	N.D.
Bromine Emissions – dry ppm	N.D.	N.D.	N.D.
Bromine Emissions – lbs/hr	N.D.	N.D.	N.D.
Bromine Emissions – lbs/mmBtu	N.D.	N.D.	N.D.

N.D. – None detected.

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Date	10/25/05	10/25/05	10/26/05
Time	1322-1544	1645-1912	1230-1451
Duct Flow Rate - ACFM	446,246	437,606	428,275
Duct Flow Rate - DSCFM*	261,317	251,642	251,520
% Water Vapor - % Vol.	10.85	12.76	11.20
% CO_2 - % Vol.	14.2	14.0	14.2
% O_2 - % Vol.	4.8	5.0	4.8
% Excess Air @ Sampling Point	28.8	30.4	28.8
Stack Temperature - °F	317	313	312
Stack Pressure - "Hg	28.82	28.77	28.83
Percent Isokinetic	97.2	99.2	99.7
Volume Dry Gas Sampled - DSCF*	73.251	71.947	72.304

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

Ontario Hydro Mercury

Run Number	1	2	3
Particle Bound Mercury - µg	3.40	2.33	3.77
Particle Bound Mercury Emissions - µg/m^{3*}	1.639	1.144	1.841
Particle Bound Mercury Emissions - lbs/trillion Btu	1.299	0.918	1.460
Oxidized Mercury - µg	0.12	0.52	0.56
Oxidized Mercury Emissions - µg/m^{3*}	0.058	0.255	0.274
Oxidized Mercury Emissions - lbs/trillion Btu	0.046	0.205	0.217
Elemental Mercury - µg	0.50	0.90	0.80
Elemental Mercury Emissions - µg/m^{3*}	0.241	0.442	0.391
Elemental Mercury Emissions - lbs/trillion Btu	0.191	0.355	0.310
Total Mercury Emissions - µg/m^{3*}	1.938	1.841	2.506
Total Mercury Emissions - lbs/trillion Btu	1.536	1.478	1.987

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

DISCUSSION OF RESULTS

Unit Number 2 ESP Inlet Duct

The three tests for particulate matter, hydrogen chloride, hydrogen bromide, hydrogen fluoride, chlorine, and bromine appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 3.7 percent of the mean value. The measured flow rates (Q_s) for the tests were within 0.6 percent of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 4.7 percent.

The calculated emissions (pounds per million Btu) of particulate matter for the three tests showed a range of -8.3 percent to +15.1 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of hydrogen chloride for the three tests showed a range of -3.5 percent to +3.2 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of hydrogen fluoride for the three tests showed a range of -14.8 percent to +24.5 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of hydrogen bromide for the three tests showed a range of -2.4 percent to +4.5 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of chlorine for the three tests showed a range of -29.7 percent to +22.2 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of bromine for the three tests showed a range of -26.0 percent to +23.5 percent variation from the mean value.

The three tests for speciated mercury appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 1.1 percent of the mean value. The measured flow rates (Q_s) for the tests were within 1.4 percent of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 6.5 percent.

The calculated emissions (pounds per trillion Btu) of total mercury for the three tests showed a range of -4.6 percent to +7.6 percent variation from the mean value.

Unit Number 2 ESP Outlet Duct

The three tests for particulate matter, hydrogen chloride, hydrogen bromide, hydrogen fluoride, chlorine, and bromine appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 19.7 percent of the mean value. The measured flow rates (Q_s) for the tests were within 1.8 percent of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 9.3 percent.

The calculated emissions (pounds per million Btu) of particulate matter for the three tests showed a range of -11.1 percent to +22.2 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of hydrogen chloride for the three tests showed a range of -3.4 percent to +5.2 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of hydrogen fluoride for the three tests showed a range of -14.9 percent to +13.7 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of hydrogen bromide for the three tests showed a range of -5.3 percent to +2.9 percent variation from the mean value.

The calculated emissions (pounds per million Btu) of chlorine for the three tests showed a range of -11.5 percent to +18.6 percent variation from the mean value.

The concentrations of bromine for the three tests were below the minimum detectable limit of the method.

The three tests for speciated mercury appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 10.0 percent of the mean value. The measured flow rates (Q_s) for the tests were within 2.5 percent of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 2.8 percent.

The calculated emissions (pounds per trillion Btu) of total mercury for the three tests showed a range of -11.3 percent to +19.2 percent variation from the mean value.

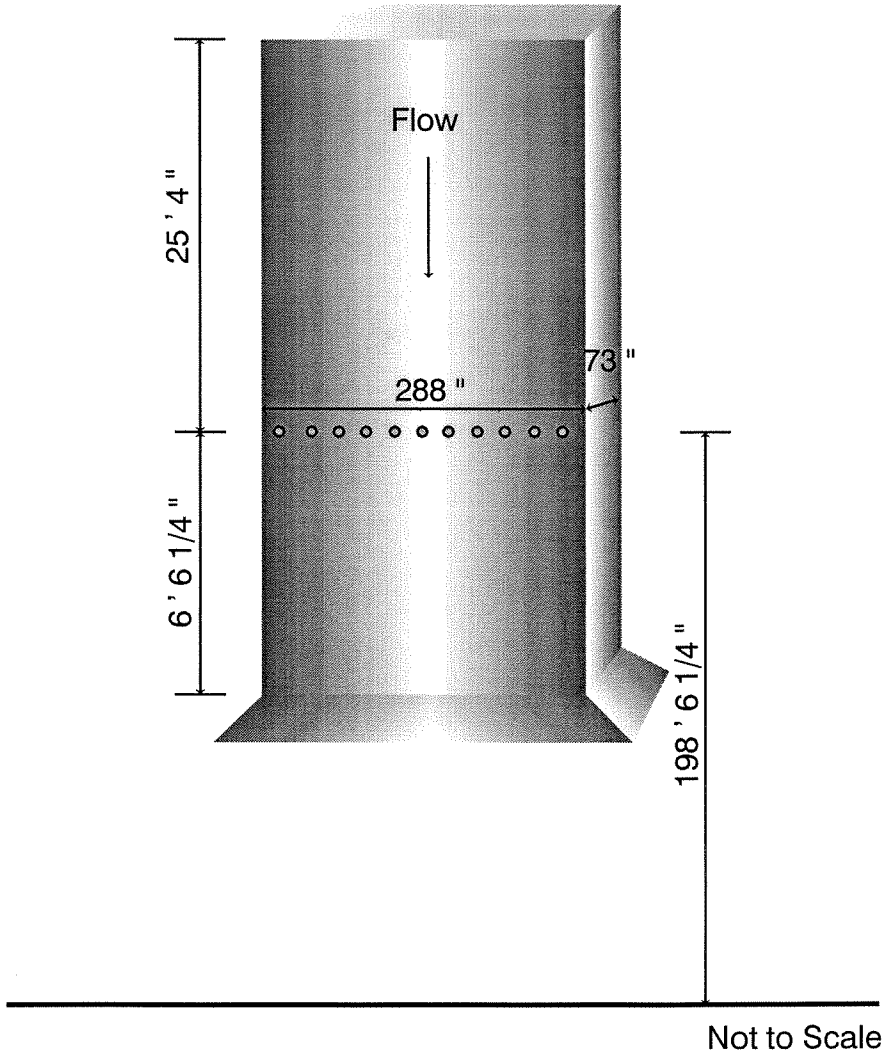
DESCRIPTION OF SAMPLING LOCATIONS

The sampling location on the Unit Number 2 ESP Inlet Duct is 198 feet 6 1/4 inches above the ground. The sampling ports are located 25 feet 4 inches (2.61 equivalent duct diameters) downstream from a bend in the duct and 6 feet 6 1/4 inches (0.67 equivalent duct diameters) upstream from an expansion in the duct.

The sampling location on the Unit Number 2 ESP Outlet Duct is approximately 200 feet above the ground. The sampling ports are located 6 feet 11 inches (0.71 equivalent duct diameters) downstream from a constriction in the duct and 3 feet 2 inches (0.33 equivalent duct diameters) upstream from a bend in the duct.

SAMPLING LOCATION

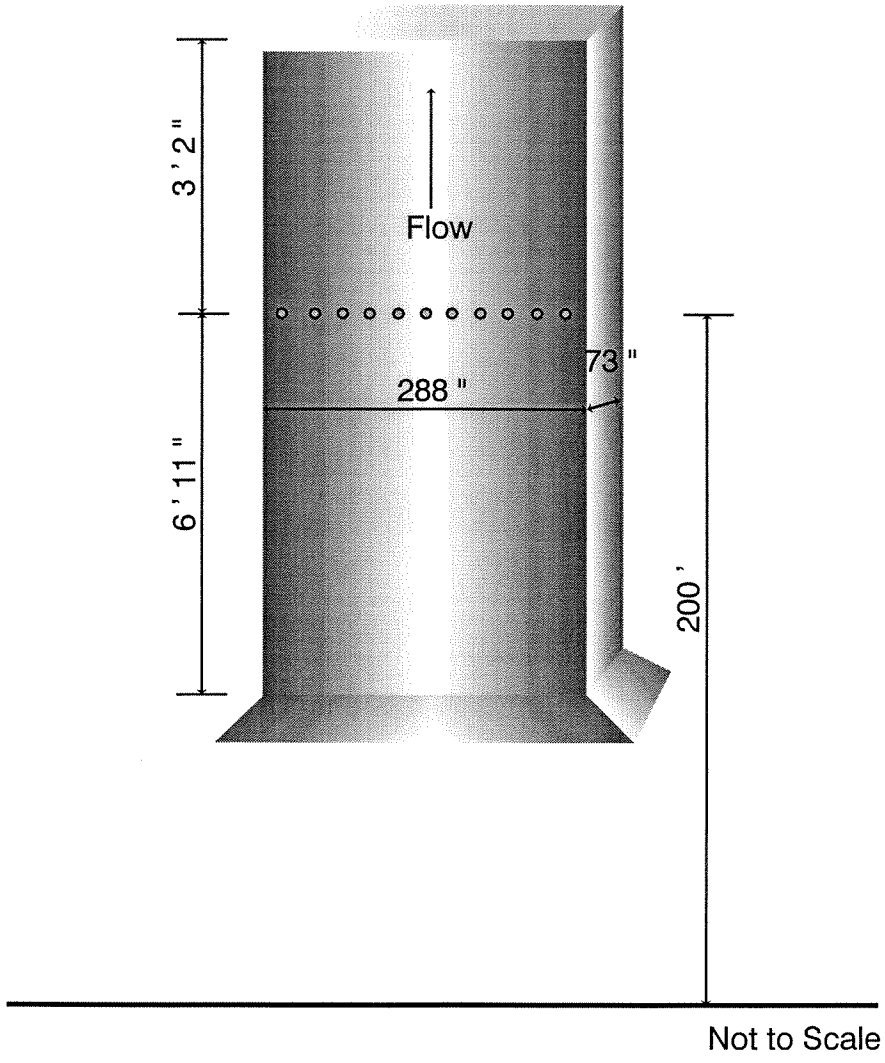
Unit Number 2 ESP Inlet Duct



Not to Scale

SAMPLING LOCATION

Unit Number 2 ESP Outlet Duct



Not to Scale

SAMPLING AND ANALYTICAL PROCEDURES

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 17, and 26A; and the Ontario Hydro Method, Revised July 7, 1999 (ASTM D-6785-02).

A preliminary velocity traverse was made at eight of the eleven ports on the Unit Number 2 ESP Inlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. Several traverse points were checked for cyclonic flow and none was found to be present. Four traverse points were sampled from each of the eight ports for a total of thirty-two traverse points.

A preliminary velocity traverse was made at eight of the twelve ports on the Unit Number 2 ESP Outlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. Several traverse points were checked for cyclonic flow and none was found to be present. Four traverse points were sampled from each of the eight ports for a total of thirty-two traverse points.

The sampling trains were leak-checked at the nozzle before each test, and again after each test at the highest vacuum reading recorded during the test. This was done to predetermine the possibility of a diluted sample.

The pitot tube lines were checked for leaks before and after each test under both a vacuum and a pressure. The lines were also checked for clearance and the manometer was zeroed before each test.

An integrated orsat sample was collected and analyzed according to EPA Method 3B during each test.

Particulate Matter/Halogens

Triplicate samples for particulate matter, hydrogen chloride, hydrogen bromide, hydrogen fluoride, chlorine, and bromine were collected from each source. The samples were taken according to EPA Methods 1, 2, 3B, 4, 17, and 26A. For each run, samples of four-minute duration were taken isokinetically at each of the thirty-two traverse points for a total sampling time of 128 minutes. Reagent blanks were submitted.

The " front-half " of the sampling train contained the following components:

Glass Nozzle
In-Stack Quartz Fiber Thimble and Filter in a Glass Assembly
Heated Glass Probe @ 248°F ± 25°F
Heated Teflon Sample Line @ 248°F ± 25°F*

* Only used on the outlet duct.

The " back-half " of the sampling train contained the following components:

Impinger Number	Contents	Amount	Parameter Collected
1	0.1N Sulfuric Acid	100 ml	Halides
2	0.1N Sulfuric Acid	100 ml	Halides
3	Empty	----	Halides and Moisture
4	0.1N Sodium Hydroxide	100 ml	Halogens
5	0.1N Sodium Hydroxide	100 ml	Halogens
6	Silica Gel	200 g	Moisture

Particulate matter emissions were calculated from gravimetric analysis of the "front-half" collections.

The halide and halogen samples were analyzed by ion chromatography.

Speciated Mercury

Triplicate samples for speciated mercury were collected from each source. The samples were taken according to EPA Methods 1, 2, 3B, 4, 5, and 17; and the Ontario Hydro Method, Revised July 7, 1999. For each run, samples of four-minute duration were taken isokinetically at each of the thirty-two traverse points for a total sampling time of 128 minutes. Blank train samples and reagent blanks were submitted.

The " front-half " of the sampling train contained the following components:

Glass Nozzle
In-Stack Quartz Fiber Thimble and Filter in a Glass Assembly
Heated Glass Probe @ 248°F ± 25°F
Heated Teflon Sample Line @ 248°F ± 25°F*

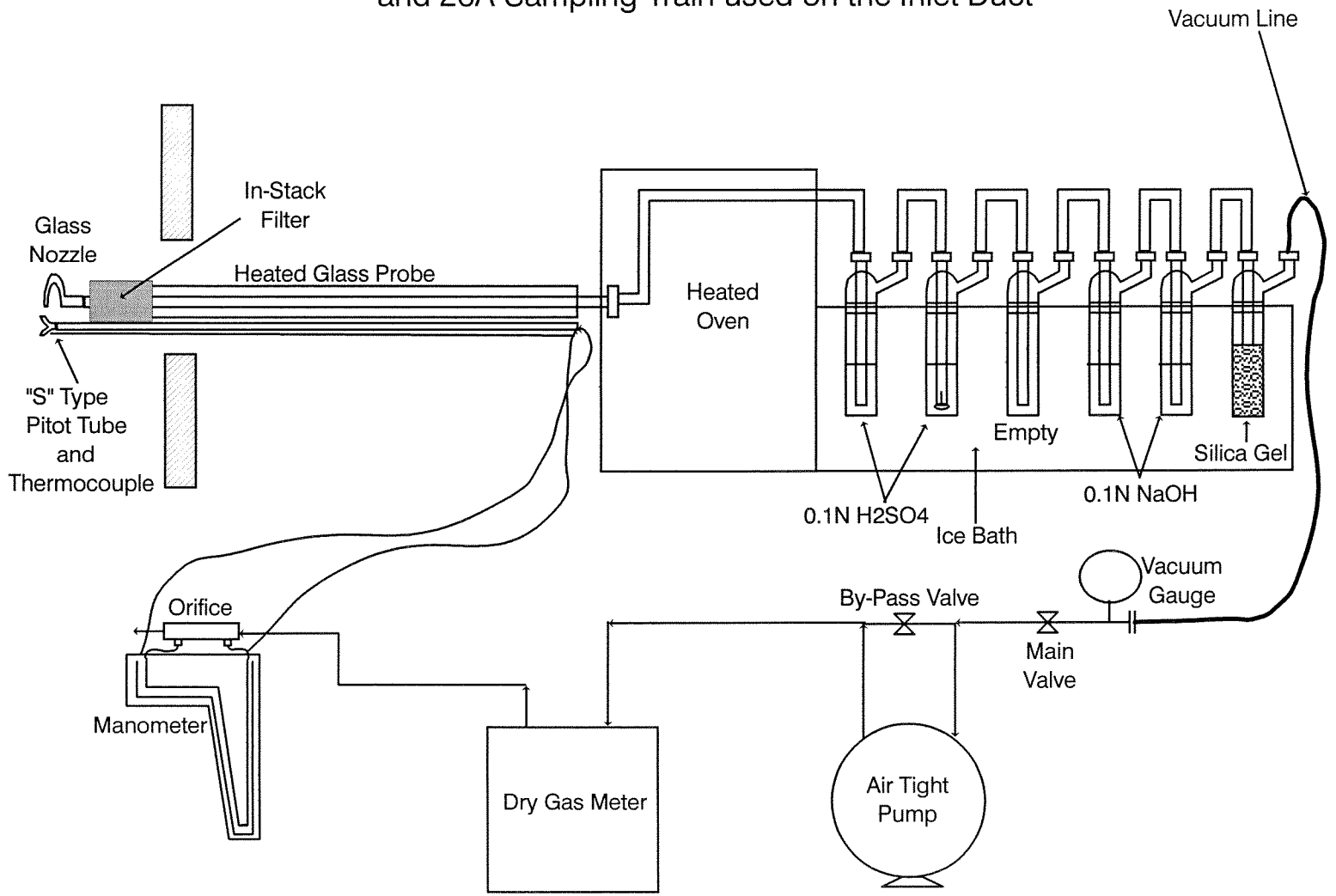
* Only used on the outlet duct.

The " back-half " of the sampling train contained the following components:

Impinger Number	Contents	Amount	Parameter Collected
1	1 mol/L KCl	100 ml	Oxidized Mercury
2	1 mol/L KCl	100 ml	Oxidized Mercury
3	1 mol/L KCl	100 ml	Oxidized Mercury
4	5% HNO_3 and 10% H_2O_2	100 ml	Elemental Mercury
5	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
6	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
7	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
8	Silica Gel	200 g	Moisture

The mercury samples were analyzed by cold vapor atomic absorption spectroscopy.

Schematic Diagram of the EPA Combined Methods 17 and 26A Sampling Train used on the Inlet Duct



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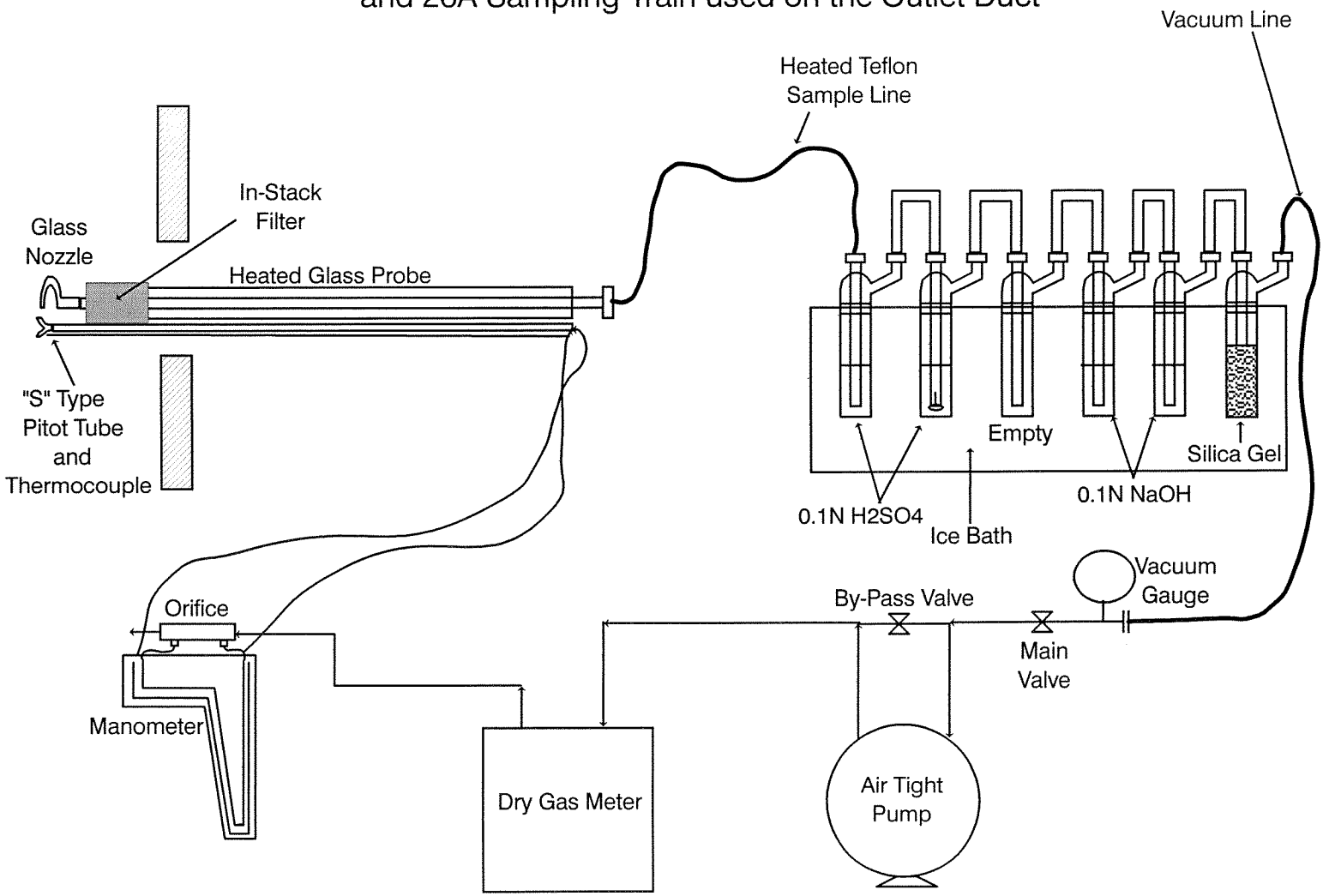
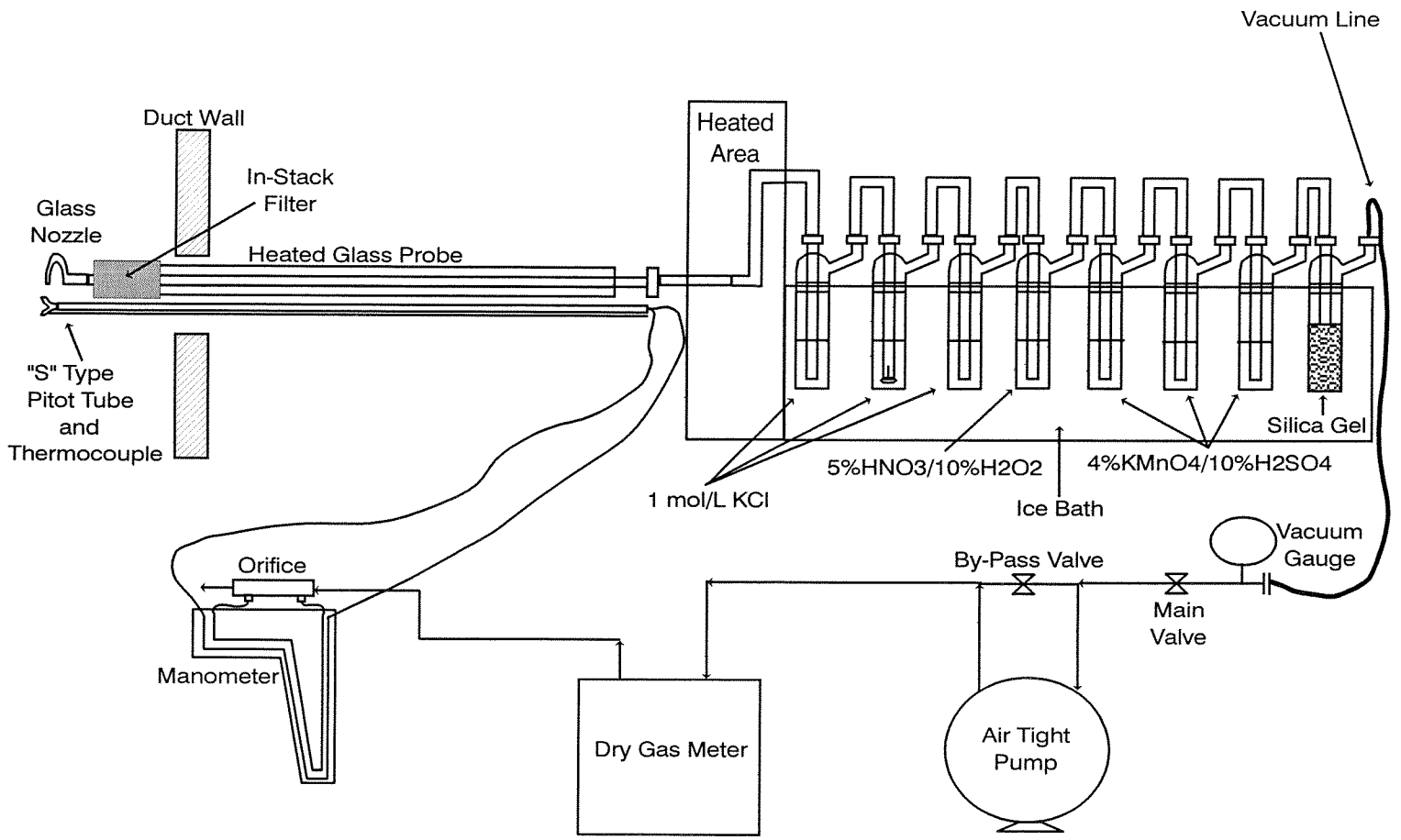
Schematic Diagram of the EPA Combined Methods 17 and 26A Sampling Train used on the Outlet Duct

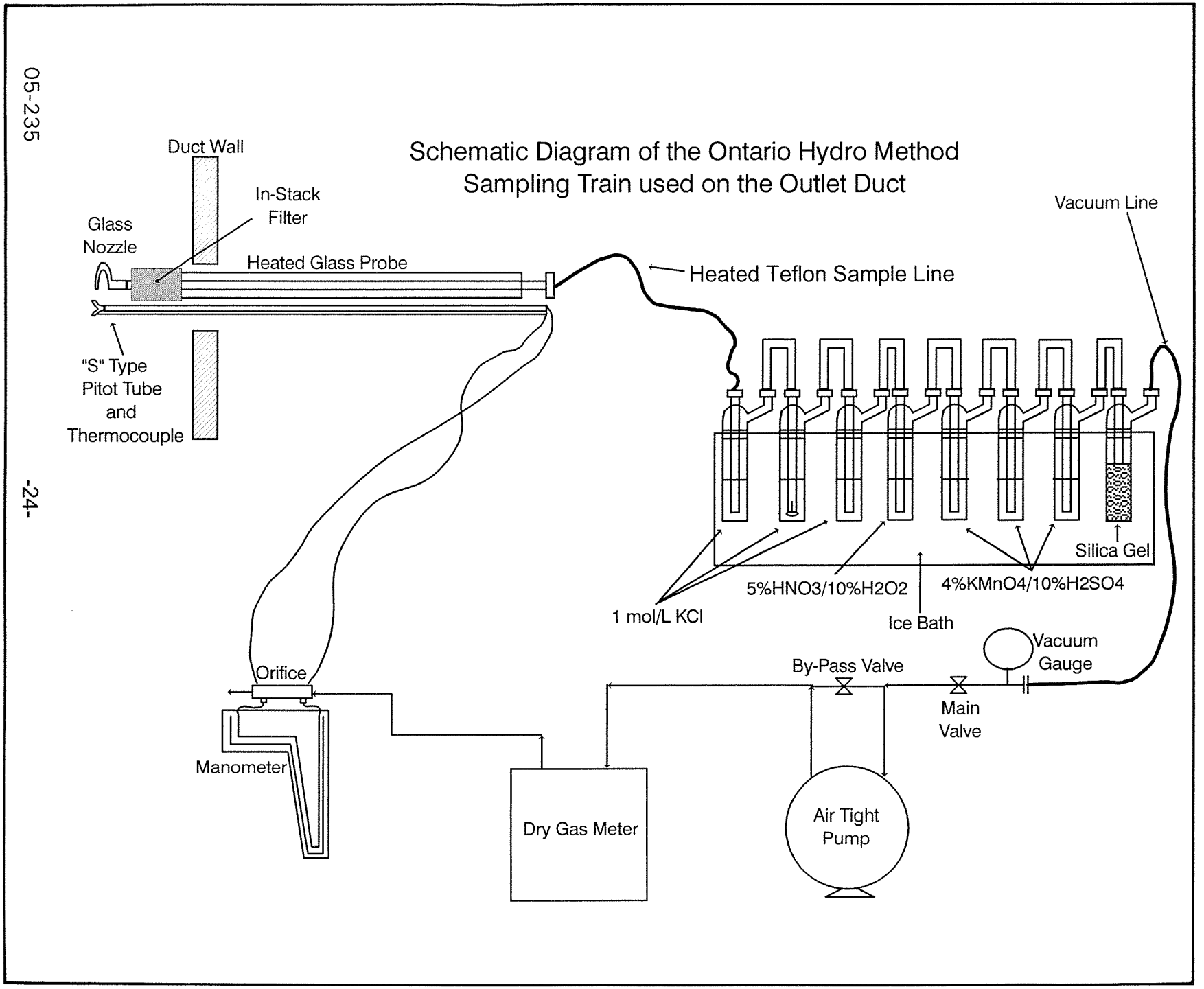


METCO ENVIRONMENTAL

Schematic Diagram of the Ontario Hydro Method Sampling Train used on the Inlet Duct



METCO ENVIRONMENTAL



METCO ENVIRONMENTAL

DESCRIPTION OF TESTS

Personnel from METCO Environmental arrived at the plant at 2:00 p.m. on Monday, October 24, 2005. After meeting with plant personnel and attending a brief safety orientation, the equipment was moved onto the Unit Number 2 ESP Inlet and Outlet Ducts. The equipment was secured for the night and all work was completed at 5:15 p.m.

On Tuesday, October 25, work began at 9:45 a.m. The equipment was prepared for testing. The first set of tests for speciated mercury began at 1:21 p.m. Testing continued until completion of the second set of tests at 7:12 p.m. The first set of tests for particulate matter, hydrogen chloride, hydrogen fluoride, hydrogen bromide, chlorine, and bromine began at 1:42 p.m. Testing continued until completion of the second set of tests at 7:48 p.m. The samples were recovered. The equipment was secured for the night and all work was completed at 8:15 p.m.

On Wednesday, October 26, work began at 9:45 a.m. The equipment was prepared for testing. The third set of tests for particulate matter, hydrogen chloride, hydrogen fluoride, hydrogen bromide, chlorine, and bromine began at 12:49 p.m. and was completed at 3:11 p.m. The third set of tests for speciated mercury began at 12:30 p.m. and was completed at 2:51 p.m.

The equipment was moved off of the sampling locations and loaded into the sampling van. The samples were recovered and transported to METCO Environmental's laboratory in Dallas, Texas, for analysis and evaluation.

Operations at Arkansas Power & Light Company, Independence Steam Electric Station, Unit Number 2 ESP Inlet and Outlet Ducts, located in Newark, Arkansas, for ADA-ES, were completed at 4:15 p.m. on Wednesday, October 26, 2005.

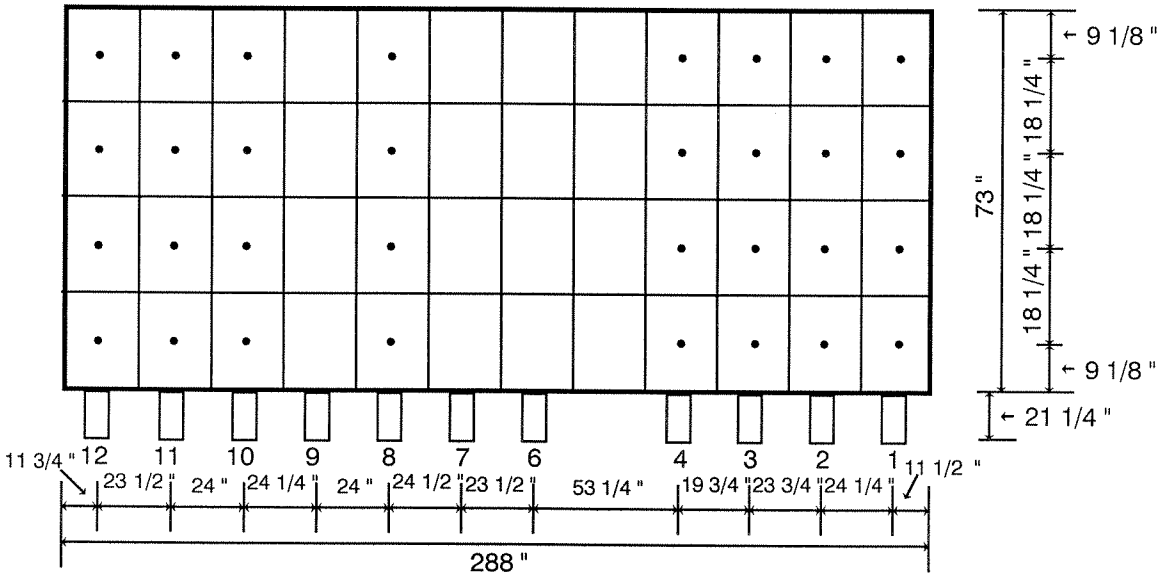
APPENDICES

A. Location of Sampling Points
B. Source Emissions Calculations
C. Calibration Data
D. Field Testing Data
E. Analytical Data
F. Chain of Custody
G. Resumes of Test Personnel

APPENDIX A

Location of Sampling Points
Unit Number 2 ESP Inlet Duct

The sampling ports are located 25 feet 4 inches (2.61 equivalent duct diameters) downstream from a bend in the duct and 6 feet 6 1/4 inches (0.67 equivalent duct diameters) upstream from an expansion in the duct. The locations of the sampling points were calculated as follows:



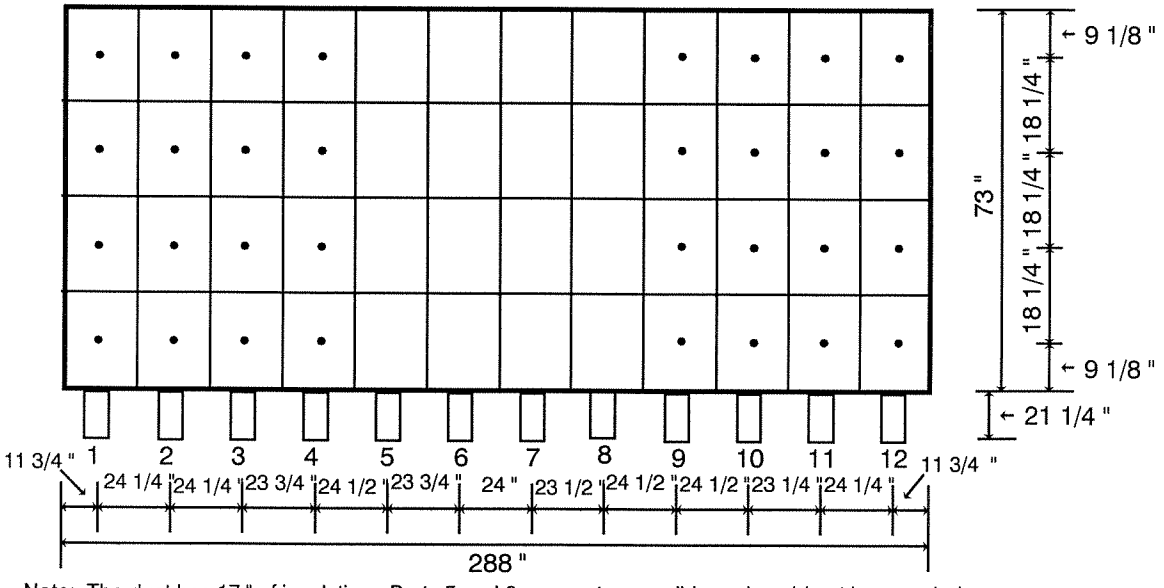
Note: The duct has 17 " of insulation. Port 5 does not exist. Ports 6 and 7 are not part of the gas stream and were not included in the calculation of the area. The width of where Ports 6 and 7 are located is 5 ' 5 ". This leaves a width of 18 ' 7 " on which the area was calculated. A plant monitor probe is located in Port 9.

Not to Scale

APPENDIX A

Location of Sampling Points
Unit Number 2 ESP Outlet Duct

The sampling ports are located 6 feet 11 inches (0.71 equivalent duct diameters) downstream from a constriction in the duct and 3 feet 2 inches (0.33 equivalent duct diameters) upstream from a bend in the duct. The locations of the sampling points were calculated as follows:



Note: The duct has 17 " of insulation. Ports 5 and 6 were not accessible and could not be sampled.

Not to Scale

APPENDIX B

Nomenclature and Equations
for
Calculation of Source Emissions

NOMENCLATURE FOR PARTICULATE CALCULATIONS

Symbol	English Units	Metric Units	Description
A_s	$in.^2$	m^2	Stack Area
C_{an}	gr/dscf*	g/dscm*	Particulate - probe, cyclone, and filter
C_{ao}	gr/dscf*	g/dscm*	Particulate - total
C_{at}	gr/CF @ stack conditions	g/m^3	Particulate - probe, cyclone, and filter
C_{au}	gr/CF @ stack conditions	g/m^3	Particulate - total
C_{aw}	lbs/hr	kg/hr	Particulate - probe, cyclone, and filter
C_{ax}	lbs/hr	kg/hr	Particulate - total
C_p			Pitot Tube Calibration Factor
D_n	in.	m	Sampling Nozzle Diameter
%EA			Percent Excess Air at sampling point
g	32.174 ft/sec^2		Acceleration of Gravity
%I			Percent Isokinetic
%M			Percent Moisture in the stack gas by volume
M_d			Mole fraction of dry gas

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

Symbol	English Units	Metric Units	Description
m_f	mg	mg	Particulate - probe, cyclone, and filter
M_{water}	18 lb/lb-mole		Molecular Weight of water
m_t	mg	mg	Particulate - total
MW	lb/lb-mole	g/g-mole	Molecular Weight of stack gas
MW_{air}	28.96 lb/ lb-mole		Molecular Weight of air
MW_d	lb/lb-mole	g/g-mole	Molecular Weight of dry stack gas
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H_2O	mm H_2O	Orifice Pressure drop
P_s	"Hg Absolute	mm Hg	Stack Pressure
ΔP	"H_2O	mm H_2O	Velocity Head of stack gas
P_{std}	29.92 "Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m^3/hr	Stack Gas Volume at actual stack conditions
Q_s	DSCFM*	dscm/hr*	Stack Gas Volume at 29.92 "Hg, 528°R, dry
R	21.83 "Hg-ft^3/lb-mole°R		Universal Gas Constant
T_m	°F	°C	Average Gas Meter Temperature

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

Symbol	English Units	Metric Units	Description
T_t	min	min	Net time of test
T_s	°F	°C	Stack Temperature
T_{std}	528°R	293°K	Standard Temperature
V_m	ft^3	m^3	Volume of dry gas sampled @ meter conditions
Vm_{std}	dscf*	dscm*	Volume of dry gas sampled @ standard conditions
V_s	fpm	m/sec	Stack velocity @ stack conditions
V_w	ml	ml	Total water collected in impingers and silica gel
Vw_{gas}	scf*	scm*	Volume of water vapor collected @ standard conditions
ρ_{air}	0.0752 lbs/ft^3		Density of Air
ρ_{water}	1 g/ml		Density of Water
ρ_{man}	62.32 lbs/ft^3		Density of Manometer Oil

Standard Conditions: 29.92 "Hg, 68°F (760 mm Hg, 20°C)

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

EXAMPLE CALCULATIONS

1. Volume of dry gas sampled at standard conditions. *

$$Vm_{std} = Vm \left(\frac{T_{std}}{T_m + 460} \right) \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}} \right]$$

$$Vm_{std} = 17.65\, Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = dscf$$

$$Vm_{std} = dscf \ x\ 0.028317 = dscm$$

2. Volume of water vapor collected at standard conditions. *

$$Vw_{gas} = \frac{(V_w - gms\ SO_2 - gms\ H_2S)\ \rho_{water}\ R\ T_{std}}{P_{std}\ M_{water}\ 453.6}$$

$$Vw_{gas} = 0.0472\ (V_w - gms\ SO_2 - gms\ H_2S) = scf$$

$$Vw_{gas} = scf\ x\ 0.028317 = scm$$

3. Percent moisture in stack gas.

$$\%M = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}\ x\ 100 = \%$$

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

4. Mole fraction of dry gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average molecular weight of dry stack gas.

$$MW_d = \left[\%CO_2 \times \frac{44}{100}\right] + \left[\%O_2 \times \frac{32}{100}\right] + \left[\%N_2 \times \frac{28}{100}\right] + \left[\%CO \times \frac{28}{100}\right] = lb/lb\text{-}mole$$

$$= g/g\text{-}mole$$

6. Molecular weight of stack gas.

$$MW = MW_d \times M_d + 18\,(1 - M_d) = \frac{lb}{lb\text{-}mole} = g/g\text{-}mole$$

7. Percent excess air at sampling point.

$$\%EA = \frac{100\,[\%O_2 - (0.5\,\%CO)]}{0.265\,(\%N_2) - [\%O_2 - (0.5\,\%CO)]}$$

8. Stack Pressure.

$$P_s = P_b + \frac{Stack\ Pressure\ "H_2O}{13.6} = "Hg\ Absolute$$

$$P_s = "Hg\ Abs. \times 25.4 = mm\ Hg$$

9. Stack velocity at stack conditions.

$$V_s = C_p\, 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460)}{12 \times \rho_{air} \times P_s \times MW \times T_{std}} \right]^{1/2} \times \sqrt{\Delta P}\ average$$

$$V_s = 5{,}123.8\, C_p \left[\frac{(T_s + 460)}{P_s \times MW} \right]^{1/2} \sqrt{\Delta P}\ average = fpm$$

$$V_s = fpm \times 0.00508 = m/sec$$

10. Dry stack gas volume at standard conditions. *

$$Q_s = \frac{1}{144} V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

$$Q_s = \frac{0.123\, V_s \times A_s \times M_d \times P_s}{T_s + 460} = DSCFM$$

$$Q_s = DSCFM \times 1.6990 = dscm/hr$$

11. Actual stack gas volume at stack conditions.

$$Q_a = \frac{V_s \times A_s}{144} = ACFM$$

$$Q_a = ACFM \times 1.6990 = m^3/hr$$

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

12. Percent Isokinetic.

$$\%I = \frac{Vm_{std} \times (T_s + 460) \times P_{std} \times 100 \times 144\ in^2/ft^2}{M_d \times T_{std} \times P_s \times T_t \times V_s (\frac{\pi \times D_n^2}{4})}$$

$$\%I = \frac{1039 \times Vm_{std} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s \times D_n^2}$$

13. Particulate – probe, cyclone, and filter.

$$C_{an} = \frac{m_f}{Vm_{std}} \times \frac{1\ gr}{64.8\ mg}$$

$$C_{an} = 0.0154 \times \frac{m_f}{Vm_{std}} = gr/dscf\ *$$

$$C_{an} = gr/dscf \times 2.290 = g/dscm\ *$$

14. Particulate total.

$$C_{ao} = 0.0154 \times \frac{m_t}{Vm_{std}} = gr/dscf\ *$$

$$C_{ao} = gr/dscf \times 2.290 = g/dscm\ *$$

* 29.92 " Hg, 68° F (760 mm Hg, 20° C)

15. Particulate – probe, cyclone, and filter at stack conditions.

$$C_{at} = C_{an} \times \frac{P_s}{P_{std}} \times \frac{(T_{std})}{(T_s + 460)} \times M_d$$

$$C_{at} = \frac{17.65 \times C_{an} \times P_s \times M_d}{T_s + 460} = gr/CF$$

$$C_{at} = gr/CF \times 2.290 = gr/m^3$$

16. Particulate – total, at stack conditions.

$$C_{au} = \frac{17.65 \times C_{ao} \times P_s \times M_d}{T_s + 460} = gr/CF$$

$$C_{au} = gr/CF \times 2.290 = gr/m^3$$

17. Particulate – probe, cyclone, and filter.

$$C_{aw} = C_{an} \times Q_s \times \frac{60\ min}{1\ hr} \times \frac{1\ lb}{7000\ gr}$$

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = lbs/hr$$

$$C_{aw} = lbs/hr \times 0.4536 = kg/hr$$

18. Particulate – total.

$C_{ax} = 0.00857 \times C_{ao} \times Q_s = lbs/hr$

$C_{ax} = lbs/hr \times 0.4536 = kg/hr$

EXAMPLE CALCULATIONS

$$\text{lbs/hr} = \frac{\text{mg}}{Vm_{std}} \times 2.205 \times 10^{-6}\ \text{lbs/mg} \times \text{DSCFM*} \times 60\ \text{min/hr}$$

Vm_{std} = Volume of dry gas sampled (dscf*)
DSCFM* = Stack Flow Rate

$$\text{ppm} = \frac{\text{mg}}{Vm_{std}\ (m^3)} \times \frac{24.04}{MW}$$

24.04 = Ideal Gas Constant liters/g-mole
Vm_{std} = Volume of dry gas sampled (m^3*)
MW = Molecular Weight

Compound	Molecular Weight
Hydrogen Fluoride	20.01
Hydrogen Chloride	36.45
Hydrogen Bromide	80.92
Chlorine	70.90
Bromine	159.82

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

EXAMPLE CALCULATIONS

$$\text{lbs/trillion Btu} = \frac{\text{lbs/dscf*} \times F_d \text{ factor} \times 20.9\%O_2}{20.9\%O_2 - \%O_2 \text{ measured}}$$

F_d = Oxygen based F factor

Fuel	F_d factor
Bituminous Coal	9.780×10^9 dscf*/trillion Btu

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

EXAMPLE CALCULATIONS

$$\text{lbs/million Btu} = \frac{\text{gr/dscf} \times \frac{1\ \text{lb}}{7{,}000\ \text{gr}} \times F_d\ \text{factor} \times 20.9\%O_2}{20.9\%O_2 - \%O_2\ \text{measured}}$$

$$\text{lbs/million Btu} = \frac{\text{lbs/dscf*} \times F_d\ \text{factor} \times 20.9\%O_2}{20.9\%O_2 - \%O_2\ \text{measured}}$$

F_d = Oxygen based F factor

Fuel	F_d Factor
Bituminous Coal	9,780 dscf*/million Btu

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-235
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT - METHODS 5 & 26A

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
DATE			10/25/05	10/25/05	10/26/05
BEGIN TIME			1345	1724	1251
END TIME			1610	1939	1506
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.89	29.84	29.90
		(mm Hg)	(759.00)	(758.00)	(759.00)
P(m)	ORIFICE PRESSURE DROP	"H2O	0.541	0.548	0.579
		(mm H2O)	(13.700)	(13.900)	(14.700)
	DGM CALIBRATION FACTOR		1.006	1.006	1.006
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	50.138	52.365	54.156
	@ METER CONDITIONS	(m^3)	(1.420)	(1.483)	(1.534)
	LEAK CHECK VOLUME	ft.^3	2.485	0.000	0.000
T(m)	AVERAGE GAS METER	DEG.F	52	56	64
	TEMPERATURE	(DEG.C)	(11)	(13)	(18)
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	51.730	53.521	54.620
	@ STANDARD CONDITIONS*	(DSCM)	(1.465)	(1.516)	(1.547)
V(w)	TOTAL WATER COLLECTED, IMPINGERS & SILICA GEL	ml	141.0	134.3	143.0
V(w[gas])	VOLUME WATER VAPOR	SCF	6.655	6.339	6.750
	COLLECTED @ STANDARD	(SCM)	(0.188)	(0.180)	(0.191)
	CONDITIONS*				
%M	MOISTURE IN STACK GAS BY VOLUME	%	11.40	10.59	11.00
Md	MOL FRACTION OF DRY GAS		0.8860	0.8941	0.8900
Tt	NET TIME OF TEST	MINUTES	128	128	128

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-235
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT - METHODS 5 & 26A

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
CO2		%	14.6	14.4	14.6
O2		%	4.6	4.6	4.4
CO		%	0.0	0.0	0.0
N2		%	80.8	81.0	81.0
%EA	EXCESS AIR @ SAMPLING POINT	%	27.4	27.3	25.8
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.52 (30.52)	30.49 (30.49)	30.51 (30.51)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	29.09 (29.09)	29.17 (29.17)	29.14 (29.14)
Cp	PITOT TUBE CALIBRATION		0.800	0.800	0.800
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.921 (23.400)	0.930 (23.600)	0.903 (22.900)
DELTA P ^(1/2)		"H2O	0.936	0.937	0.927
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	309 (154)	310 (154)	306 (152)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	28.86 (733.00) -14.00	28.81 (732.00) -14.00	28.87 (733.00) -14.00
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	3,672 (19)	3,676 (19)	3,626 (18)
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	16,279 (11)	16,279 (11)	16,279 (11)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS* WET STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR) WSCFH	244,478 (415,368) 16,556,072	246,233 (418,350) 16,523,856	243,539 (413,773) 16,418,360
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	415,113 (705,277)	415,616 (706,132)	409,896 (696,413)
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.190 (0.005)	0.190 (0.005)	0.190 (0.005)
%I	PERCENT ISOKINETIC	%	95.3	97.9	101.0

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-235
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT - METHODS 5 & 26A

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
Mf	PARTICULATE - PROBE, CYCLONE AND FILTER	mg	6,765.3	8,784.4	7,346.1
Mt	PARTICULATE - TOTAL	mg	----	----	----
Can	PARTICULATE - PROBE, CYCLONE AND FILTER	gr/DSCF*	2.0140	2.5276	2.0712
		(g/DSCM)	(4.6121)	(5.7882)	(4.7431)
Cao	PARTICULATE - TOTAL	gr/DSCF*	----	----	----
		(g/DSCM)	----	----	----
Cat	PARTIC.-PROBE, CYCLONE AND FILTER @ STACK COND.	gr/CF	1.1820	1.4924	1.2262
		(g/m3)	(2.7068)	(3.4176)	(2.8080)
Cau	PARTICULATE - TOTAL @ STACK CONDITIONS	gr/CF	----	----	----
		(g/m3)	----	----	----
Caw	PARTICULATE - PROBE, CYCLONE AND FILTER	LBS/HR	4,219.74	5,333.79	4,322.90
		(Kg/HR)	(1,914.08)	(2,419.41)	(1,960.87)
Cax	PARTICULATE - TOTAL	LBS/HR	----	----	----
		(Kg/HR)	----	----	----

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-235
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT - OH

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
DATE			10/25/05	10/25/05	10/26/05
BEGIN TIME			1321	1643	1230
END TIME			1547	1851	1440
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.89	29.84	29.90
		(mm Hg)	(759.00)	(758.00)	(759.00)
P(m)	ORIFICE PRESSURE DROP	"H2O	0.551	0.571	0.563
		(mm H2O)	(14.000)	(14.500)	(14.300)
	DGM CALIBRATION FACTOR		1.008	1.008	1.008
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	52.347	49.473	49.261
	@ METER CONDITIONS	(m^3)	(1.482)	(1.401)	(1.395)
	LEAK CHECK VOLUME	ft.^3	3.958	0.000	0.660
T(m)	AVERAGE GAS METER	DEG.F	56	60	67
	TEMPERATURE	(DEG.C)	(13)	(16)	(19)
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	53.592	50.179	49.398
	@ STANDARD CONDITIONS*	(DSCM)	(1.518)	(1.421)	(1.399)
V(w)	TOTAL WATER COLLECTED,	ml	138.0	132.1	128.1
	IMPINGERS & SILICA GEL				
V(w[gas])	VOLUME WATER VAPOR	SCF	6.514	6.235	6.046
	COLLECTED @ STANDARD	(SCM)	(0.184)	(0.177)	(0.171)
	CONDITIONS*				
%M	MOISTURE IN STACK GAS	%	10.84	11.05	10.91
	BY VOLUME				
Md	MOL FRACTION OF DRY GAS		0.8916	0.8895	0.8909
Tt	NET TIME OF TEST	MINUTES	128	128	128

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-235
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT - OH

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
CO2		%	14.6	14.4	14.6
O2		%	4.6	4.6	4.4
CO		%	0.0	0.0	0.0
N2		%	80.8	81.0	81.0
%EA	EXCESS AIR @ SAMPLING POINT	%	27.4	27.3	25.8
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.52 (30.52)	30.49 (30.49)	30.51 (30.51)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	29.16 (29.16)	29.11 (29.11)	29.15 (29.15)
Cp	PITOT TUBE CALIBRATION		0.806	0.806	0.806
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.891 (22.600)	0.904 (23.000)	0.846 (21.500)
DELTA P ^(1/2)		"H2O	0.921	0.921	0.900
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	315 (157)	318 (159)	315 (157)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	28.86 (733.00) -14.00	28.81 (732.00) -14.00	28.87 (733.00) -14.00
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	3,650 (19)	3,663 (19)	3,567 (18)
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	16,279 (11)	16,279 (11)	16,279 (11)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS* WET STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR) WSCFH	242,656 (412,273) 16,329,475	241,590 (410,461) 16,296,121	237,034 (402,721) 15,963,677
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	412,630 (701,058)	414,142 (703,627)	403,221 (685,072)
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.190 (0.005)	0.190 (0.005)	0.190 (0.005)
%I	PERCENT ISOKINETIC	%	99.4	93.5	93.8

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-235
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT - METHODS 5/26A

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
DATE			10/25/05	10/25/05	10/26/05
BEGIN TIME			1342	1723	1249
END TIME			1610	1948	1511
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.89	29.84	29.90
		(mm Hg)	(759.00)	(758.00)	(759.00)
P(m)	ORIFICE PRESSURE DROP	"H2O	1.128	1.105	1.100
		(mm H2O)	(28.700)	(28.100)	(27.900)
	DGM CALIBRATION FACTOR		1.013	1.013	1.013
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	71.087	70.485	69.320
	@ METER CONDITIONS	(m^3)	(2.013)	(1.996)	(1.963)
	LEAK CHECK VOLUME	ft.^3	0.000	0.000	0.000
T(m)	AVERAGE GAS METER	DEG.F	53	56	60
	TEMPERATURE	(DEG.C)	(12)	(13)	(16)
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	73.307	72.139	70.541
	@ STANDARD CONDITIONS*	(DSCM)	(2.076)	(2.043)	(1.998)
V(w)	TOTAL WATER COLLECTED, IMPINGERS & SILICA GEL	ml	270.1	204.3	175.6
V(w[gas])	VOLUME WATER VAPOR	SCF	12.749	9.643	8.288
	COLLECTED @ STANDARD	(SCM)	(0.361)	(0.273)	(0.235)
	CONDITIONS*				
%M	MOISTURE IN STACK GAS BY VOLUME	%	14.81	11.79	10.51
Md	MOL FRACTION OF DRY GAS		0.8519	0.8821	0.8949
Tt	NET TIME OF TEST	MINUTES	128	128	128

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-235
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT - METHODS 5/26A

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
CO2		%	14.2	14.2	14.2
O2		%	4.8	4.8	4.8
CO		%	0.0	0.0	0.0
N2		%	81.0	81.0	81.0
%EA	EXCESS AIR @ SAMPLING POINT	%	28.8	28.8	28.8
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.46 (30.46)	30.46 (30.46)	30.46 (30.46)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	28.62 (28.62)	28.99 (28.99)	29.15 (29.15)
Cp	PITOT TUBE CALIBRATION		0.808	0.808	0.808
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.632 (16.100)	0.617 (15.700)	0.623 (15.800)
DELTA P ^(1/2)		"H2O	0.787	0.777	0.781
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	312 (156)	302 (150)	313 (156)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	28.82 (732.00) -14.50	28.77 (731.00) -14.50	28.83 (732.00) -14.50
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	3,152 (16)	3,075 (16)	3,101 (16)
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	21,024 (14)	21,024 (14)	21,024 (14)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS* WET STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR) WSCFH	259,222 (440,418) 18,257,213	264,831 (449,948) 18,013,672	267,647 (454,732) 17,944,821
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	460,212 (781,900)	448,912 (762,701)	452,747 (769,217)
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.247 (0.006)	0.247 (0.006)	0.247 (0.006)
%I	PERCENT ISOKINETIC	%	97.3	93.7	90.7

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-235
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT - METHODS 5/26A

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
Mf	PARTICULATE - PROBE, CYCLONE AND FILTER	mg	21.1	28.2	20.2
Mt	PARTICULATE - TOTAL	mg	----	----	----
Can	PARTICULATE - PROBE, CYCLONE AND FILTER	gr/DSCF* (g/DSCM)	0.0044 (0.0101)	0.0060 (0.0138)	0.0044 (0.0101)
Cao	PARTICULATE - TOTAL	gr/DSCF* (g/DSCM)	---- ----	---- ----	---- ----
Cat	PARTIC.-PROBE, CYCLONE AND FILTER @ STACK COND.	gr/CF (g/m3)	0.0025 (0.0057)	0.0035 (0.0080)	0.0026 (0.0060)
Cau	PARTICULATE - TOTAL @ STACK CONDITIONS	gr/CF (g/m3)	---- ----	---- ----	---- ----
Caw	PARTICULATE - PROBE, CYCLONE AND FILTER	LBS/HR (Kg/HR)	9.85 (4.47)	13.66 (6.20)	10.12 (4.59)
Cax	PARTICULATE - TOTAL	LBS/HR (Kg/HR)	---- ----	---- ----	---- ----

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-235
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT - OH

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
DATE			10/25/05	10/25/05	10/26/05
BEGIN TIME			1322	1645	1230
END TIME			1544	1912	1451
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.89	29.84	29.90
		(mm Hg)	(759.00)	(758.00)	(759.00)
P(m)	ORIFICE PRESSURE DROP	"H2O	1.088	1.054	1.084
		(mm H2O)	(27.600)	(26.800)	(27.500)
	DGM CALIBRATION FACTOR		0.991	0.991	0.991
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	71.178	70.306	71.738
	@ METER CONDITIONS	(m^3)	(2.016)	(1.991)	(2.031)
	LEAK CHECK VOLUME	ft.^3	0.000	0.000	0.000
T(m)	AVERAGE GAS METER	DEG.F	54	56	65
	TEMPERATURE	(DEG.C)	(12)	(13)	(18)
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	73.251	71.947	72.304
	@ STANDARD CONDITIONS*	(DSCM)	(2.074)	(2.037)	(2.047)
V(w)	TOTAL WATER COLLECTED,	ml	188.9	223.0	193.3
	IMPINGERS & SILICA GEL				
V(w[gas])	VOLUME WATER VAPOR	SCF	8.916	10.526	9.124
	COLLECTED @ STANDARD	(SCM)	(0.252)	(0.298)	(0.258)
	CONDITIONS*				
%M	MOISTURE IN STACK GAS	%	10.85	12.76	11.20
	BY VOLUME				
Md	MOL FRACTION OF DRY GAS		0.8915	0.8724	0.8880
Tt	NET TIME OF TEST	MINUTES	128	128	128

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-235
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT - OH

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
CO2		%	14.2	14.0	14.2
O2		%	4.8	5.0	4.8
CO		%	0.0	0.0	0.0
N2		%	81.0	81.0	81.0
%EA	EXCESS AIR @ SAMPLING POINT	%	28.8	30.4	28.8
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.46 (30.46)	30.44 (30.44)	30.46 (30.46)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	29.11 (29.11)	28.85 (28.85)	29.07 (29.07)
Cp	PITOT TUBE CALIBRATION		0.805	0.805	0.805
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.603 (15.300)	0.581 (14.800)	0.564 (14.300)
DELTA P ^(1/2)		"H2O	0.770	0.753	0.741
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	317 (158)	313 (156)	312 (156)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	28.82 (732.00) -14.50	28.77 (731.00) -14.50	28.83 (732.00) -14.50
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	3,056 (16)	2,997 (15)	2,933 (15)
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	21,024 (14)	21,024 (14)	21,024 (14)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS* WET STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR) WSCFH	261,317 (443,978) 17,587,235	251,642 (427,540) 17,306,878	251,520 (427,332) 16,994,595
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	446,246 (758,172)	437,606 (743,493)	428,275 (727,639)
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.246 (0.006)	0.246 (0.006)	0.246 (0.006)
%I	PERCENT ISOKINETIC	%	97.2	99.2	99.7

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

APPENDIX C

Calibration Data

Equipment	Calibration Factor	Calibration Date
Pitot Tube #31-5-1 (low side)	0.806	10/12/05
Pitot Tube #31-5-3	0.805	10/14/05
Pitot Tube #49-5-2	0.808	09/29/05
Pitot Tube #49-5-3 (low side)	0.800	09/29/05
Probe Tip #05-233-2	0.246	08/16/05
Probe Tip #05-233-5	0.190	08/16/05
Probe Tip #05-233-7	0.190	08/16/05
Probe Tip #05-233-8	0.247	08/16/05
Dry Gas Meter #27-3	0.991	08/12/05
Stack Unit Orifice #27-3		08/12/05
Digital Temperature Indicator #27-3		08/12/05
Dry Gas Meter #31-1	1.008	10/03/05
Stack Unit Orifice #31-1		10/04/05
Digital Temperature Indicator #31-1		10/03/05
Dry Gas Meter #49-1	1.013	09/29/05
Stack Unit Orifice #49-1		09/29/05
Digital Temperature Indicator #49-1		09/29/05

APPENDIX C

Calibration Data

Equipment	Calibration Factor	Calibration Date
Dry Gas Meter #49-3	1.006	09/16/05
Stack Unit Orifice #49-3		09/19/05
Digital Temperature Indicator #49-3		09/16/05
Barometer #31-1		10/12/05

PITOT TUBE CALIBRATION

Date: 10-12-05

Time: 1430

Pitot No.: 31-5-1

T_s: 75 °F

Pitot Dimensions: 5' x 1/4"

C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.33	0.575	0.808	0.33	0.575	0.808
20	40	0.34	0.34	0.583	0.52	0.721	0.801	0.52	0.721	0.801
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.81	0.900	0.808
35	60	0.80	0.80	0.894	1.25	1.118	0.792	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.55	1.245	0.795	1.50	1.225	0.808
50	80	1.30	1.30	1.140	2.00	1.414	0.798	2.00	1.414	0.798
62	90	1.60	1.60	1.265	2.45	1.565	0.800	2.40	1.549	0.808
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.82	0.906	0.803
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.82	0.906	0.803
Average							0.801			0.806

Summary of Results:

Normal high side calibration factor 0.801

variation + 0.87

variation - 1.12

Normal low side calibration factor 0.806

variation + 0.25

variation - 0.99

Calibrator: JOSH ORR / DEKE BRUMMETT

Checked By: JASON BROWN

VERSION 1
22 OCTOBER 2002

PITOT TUBE CALIBRATION

Date: 10-14-05

Time: 0955

Pitot No.: 31-S-3

T_s: 75 °F

Pitot Dimensions: 5' x 1/4"

C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.34	0.583	0.796	0.34	0.583	0.796
20	40	0.34	0.34	0.583	0.51	0.714	0.808	0.51	0.714	0.808
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
35	60	0.80	0.80	0.894	1.20	1.095	0.808	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.50	1.225	0.808	1.50	1.225	0.808
50	80	1.30	1.30	1.140	2.00	1.414	0.798	1.95	1.396	0.808
62	90	1.60	1.60	1.265	2.40	1.549	0.808	2.40	1.549	0.808
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.82	0.906	0.803
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
Average							0.805 ✓			0.807 ✓

Summary of Results:

Normal high side calibration factor 0.805 ✓

variation + 0.37 ✓

variation - 1.12 ✓

Normal low side calibration factor 0.807 ✓

variation + 0.12 ✓

variation - 1.36 ✓

Calibrator: JOSH ORR / DEXE BRUMMETT

Checked By: JASON BROWN

PITOT TUBE CALIBRATION

Date: 29 September 2005

Pitot No.: 49-5-2

Pitot Dimensions: 5' x 1/4"

Time: 1515

T_s: 75 °F

C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.314	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.33	0.574	0.808	0.33	0.574	0.808
20	40	0.34	0.34	0.583	0.50	0.707	0.816	0.50	0.707	0.816
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.81	0.900	0.808
35	60	0.80	0.80	0.894	1.20	1.095	0.808	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.50	1.225	0.808	1.50	1.225	0.808
50	80	1.30	1.30	1.140	1.95	1.396	0.808	1.95	1.396	0.808
62	90	1.60	1.60	1.265	2.40	1.549	0.808	2.35	1.533	0.817
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.81	0.900	0.808
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.81	0.900	0.808
Average							0.808 ✓			0.810 ✓

Summary of Results:

Normal high side calibration factor 0.808

variation + 0.99 ✓ %

variation - 0.62 ✓ %

Normal low side calibration factor 0.810

variation + 0.86 ✓ %

variation - 0.25 ✓ %

Calibrator: [signature]

Checked By: Shane Lee

PITOT TUBE CALIBRATION

Date: 29 September 2005

Pitot No.: 49-5-3

Pitot Dimensions: 5' x 1/4"

Time: 1330

T_s: 75 °F

C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.34	0.583	0.796	0.34	0.583	0.796
20	40	0.34	0.34	0.583	0.52	0.721	0.801	0.52	0.721	0.801
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.81	0.900	0.808
35	60	0.80	0.80	0.894	1.25	1.118	0.792	1.25	1.118	0.792
41	70	1.00	1.00	1.000	1.55	1.245	0.795	1.55	1.245	0.795
50	80	1.30	1.30	1.140	2.00	1.414	0.798	2.00	1.414	0.798
62	90	1.60	1.60	1.265	2.45	1.565	0.800	2.45	1.565	0.800
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.82	0.906	0.803
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.82	0.906	0.803
Average							0.799			0.800

Summary of Results:

Normal high side calibration factor 0.799

variation + 1.13 %

variation - 0.88 %

Normal low side calibration factor 0.800

variation + 1.00 %

variation - 1.00 %

Calibrator: [signature]

Checked By: Shane Lee

NOZZLE CALIBRATION

Nozzle Set No. 05-233 TASK 1

Date 8-16-05 Calibrator: Malone

	05-233-1	05-233-2	05-233-3	05-233-4	05-233-5	05-233-6
Reading 1	0.247	0.246	0.246	0.193	0.190	0.190
Reading 2	0.247	0.245	0.247	0.193	0.190	0.190
Reading 3	0.246	0.247	0.246	0.193	0.191	0.191
Reading 4	0.247	0.245	0.247	0.194	0.189	0.190
Reading 5	0.246	0.245	0.247	0.194	0.190	0.190
Reading 6	0.248	0.245	0.247	0.193	0.190	0.189
Reading 7	0.246	0.247	0.246	0.193	0.190	0.191
Reading 8	0.247	0.246	0.247	0.194	0.190	0.190
Reading 9	0.247	0.246	0.247	0.192	0.190	0.190
Reading 10	0.247	0.246	0.247	0.193	0.190	0.190
Average	0.247	0.246	0.247	0.193	0.190	0.190

	05-233-7	05-233-8	9	10	11	12
Reading 1	0.190	0.245				
Reading 2	0.190	0.248				
Reading 3	0.191	0.247				
Reading 4	0.189	0.247				
Reading 5	0.191	0.246				
Reading 6	0.189	0.248				
Reading 7	0.190	0.247				
Reading 8	0.190	0.247				
Reading 9	0.190	0.246				
Reading 10	0.190	0.247				
Average	0.190	0.247				

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 27-3

Date: 8/12/05

ΔH ("H_2O)	C_{DG}
0.5	0.979
1.0	0.989
1.5	1.008
2.0	0.990
3.0	0.988
4.0	0.989
Average	0.991

Variation: + 1.72%

- 1.21%

Calibrator: Ned Shappley

Checked By:

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27-3

Date: 8/12/05

Calibrator: Ved Shappley

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.5 H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)

	Time	Meter Reading		Temp.		P_m	
End	1128	5.170	cf	75	°F	-0.4	"H_2O
Start	1116	0.000	cf	75	°F	-0.4	"H_2O
Avg.		5.170	cf	75	°F	-0.4	"H_2O

Dry Gas Meter

	Meter Reading		Temp. In		Temp. Out		P_m	
	844.539	cf	70	°F	69	°F	0.5	"H_2O
	839.300	cf	70	°F	71	°F	0.5	"H_2O
	5.239	cf	70			°F	0.5	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.170 \left[\frac{29.40 + \frac{-0.4}{13.6}}{75 + 460} \right] \times 1.004 \quad (C_p) = 5.029 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.239 \left[\frac{29.40 + \frac{0.5}{13.6}}{70 + 460} \right] = 5.136 \text{ dcsf}$$

$$C_{DG} = \frac{5.029}{5.136} = \boxed{0.979}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27-3

Calibrator: Ned Sheppley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.0" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)

	Time	Meter Reading		Temp.		P_m	
End	1141	5.300	cf	74	°F	-0.4	"H_2O
Start	1131	0.000	cf	74	°F	-0.4	"H_2O
Avg.		5.300	cf	74	°F	-0.40	"H_2O

Dry Gas Meter

	Meter Reading		Temp. In		Temp. Out		P_m	
End	850.231	cf	71	°F	73	°F	1.00	"H_2O
Start	844.900	cf	69	°F	71	°F	1.00	"H_2O
Avg.	5.331	cf	71	°F			1.00	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.300 \left[\frac{29.40 + \frac{-0.4}{13.6}}{74 + 460}\right] \times 1.004 \quad (C_f) = 5.166 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.331 \left[\frac{29.40 + \frac{1.00}{13.6}}{71 + 460}\right] = 5.223 \text{ dcsf}$$

$$C_{DG} = \frac{5.166}{5.223} = \boxed{0.989}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27-3

Date: 8/12/05

Calibrator: Neal Shappley

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.5" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)						Dry Gas Meter					
	Time	Meter Reading	Temp.		P_m		Meter Reading	Temp. In		Temp. Out		P_m
End	1158	10.325 cf	74	°F	-1.3	"H_2O	860.610 cf	78	°F	72	°F	1.5 "H_2O
Start	1142	0.000 cf	74	°F	-1.3	"H_2O	850.398 cf	71	°F	73	°F	1.5 "H_2O
Avg.		10.325 cf	74	°F	-1.3	"H_2O	10.212 cf	74			°F	1.5 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.325 \left[\frac{29.40 + \frac{-1.3}{13.6}}{74 + 460} \right] \times 1.004 \quad (C_f) = 10.041 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.212 \left[\frac{29.40 + \frac{1.5}{13.6}}{74 + 460} \right] = 9.961 \text{ dcsf}$$

$$C_{DG} = \frac{10.041}{9.961} = \boxed{1.008}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27-3

Calibrator: Ned Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 20" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)								Dry Gas Meter						
	Time	Meter Reading		Temp.		P_m		Meter Reading		Temp. In		Temp. Out		P_m	
End	1416	10.240	cf	74	°F	-1.5	"H_2O	911.712	cf	87	°F	73	°F	2.0	"H_2O
Start	1400	0.000	cf	74	°F	-1.5	"H_2O	901.343	cf	80	°F	73	°F	2.00	"H_2O
Avg.		10.240	cf	74	°F	-1.5	"H_2O	10.369	cf	78			°F	2.0	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.240 \left[\frac{29.40 + \frac{-1.5}{13.6}}{74 + 460} \right] \times 1.009 \quad (C_f) = 9.153 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.369 \left[\frac{29.40 + \frac{2.0}{13.6}}{78 + 460} \right] = 10.051 \text{ dcsf}$$

$$C_{DG} = \frac{9.953}{10.051} = \boxed{0.990}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 273

Calibrator: Dad Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.0" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)

	Time	Meter Reading	Temp.	P_m
End	1332	14.780 cf	74 °F	-2.30 "H_2O
Start	1319	0.000 cf	74 °F	-2.30 "H_2O
Avg.		14.780 cf	74 °F	-2.30 "H_2O

Dry Gas Meter

	Meter Reading	Temp. In	Temp. Out	P_m
End	890.387 cf	92 °F	73 °F	3.00 "H_2O
Start	875.402 cf	82 °F	73 °F	3.00 "H_2O
Avg.	14.985 cf	80 °F		3.00 "H_2O

$$Wet\ Test\ Meter\ Vm_{std} = 17.65 \times 14.780 \left[\frac{29.40 + \frac{-2.30}{13.6}}{74 + 460} \right] \times 1.004 \quad (C_f) = 14.337\ dcsf$$

$$Dry\ Gas\ Meter\ Vm_{std} = 17.65 \times 14.985 \left[\frac{29.40 + \frac{3.0}{13.6}}{80 + 460} \right] = 14.508\ dcsf$$

$$C_{DG} = \frac{14.337}{14.508} = \boxed{0.988}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 273

Calibrator: Ned Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.0

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)

	Time	Meter Reading		Temp.		P_m	
End	1343	10.050	cf	74	°F	-3.2	"H_2O
Start	1335	0.000	cf	74	°F	-3.2	"H_2O
Avg.		10.050	cf	74	°F	-3.2	"H_2O

Dry Gas Meter

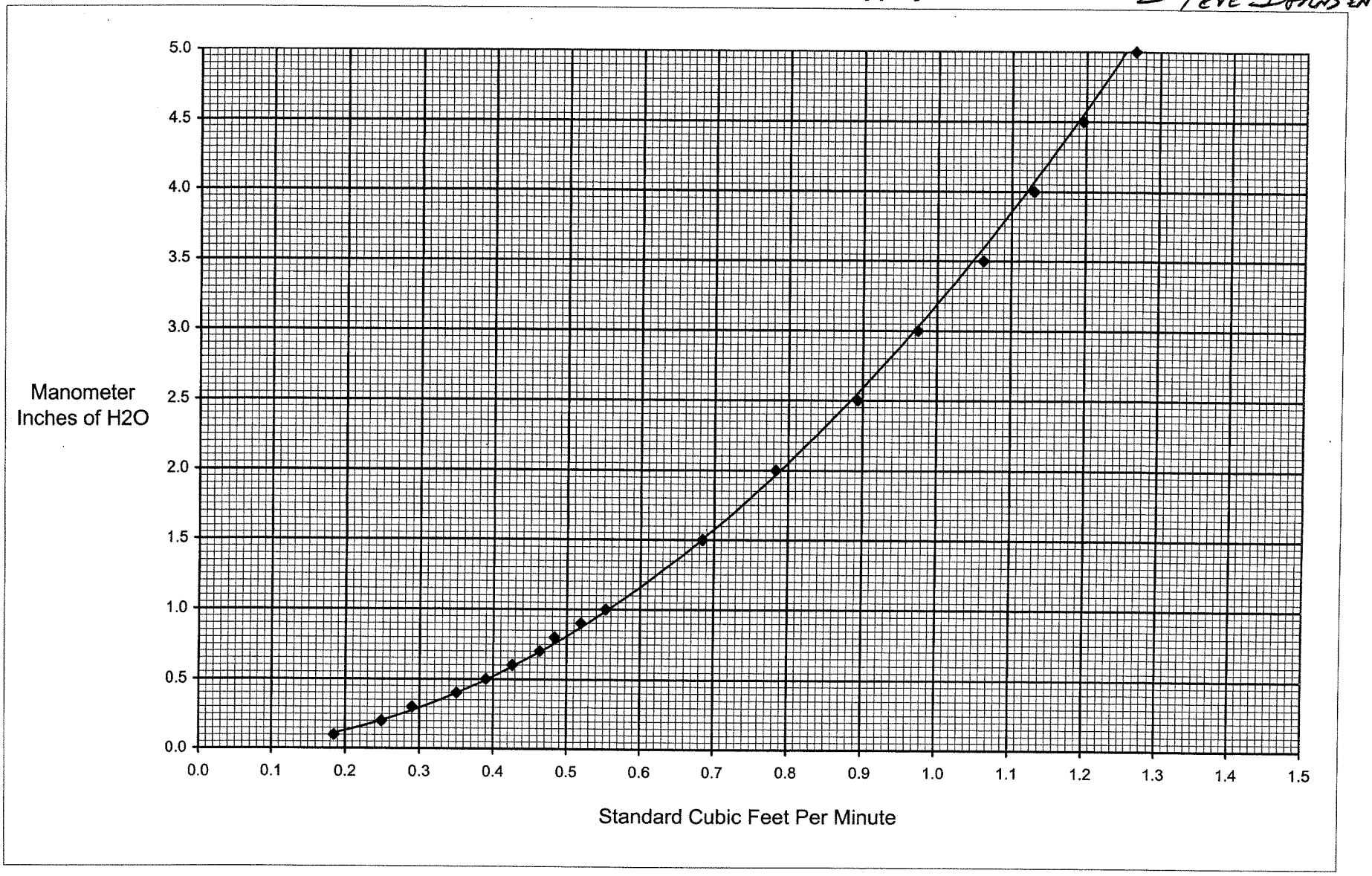
Meter Reading		Temp. In		Temp. Out		P_m	
101.097	cf	95	°F	73	°F	4.0	"H_2O
890.910	cf	90	°F	72	°F	4.0	"H_2O
10.187	cf	83			°F	4.0	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.050 \left[\frac{29.40 + \frac{-3.2}{13.6}}{74 + 460} \right] \times 1.004 \quad (C_f) = 9.727 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.187 \left[\frac{29.40 + \frac{4.0}{13.6}}{83 + 460} \right] = 9.832 \text{ dcsf}$$

$$C_{DG} = \frac{9.727}{9.832} = \boxed{0.989}$$

STACK UNIT ORIFICE NO: **27-3** DATE: **08/12/05** CALIBRATED BY: **Ned Shappley** CHECKED BY: Steve Johnsen



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 27-3

CALIBRATION DATA

DATE: 8/12/05

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	1000	77	76
Ice Bath	1001	32	32
Boiling Water	1006	211	210
Oven	1020	247	248
Oven	1035	300	301
Oven	1042	350	349
Oven	1047	382	380

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. D1

Calibrator Ned Shappley

Checked By: Mark Glier

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 31-1

Date: 3 Oct 2005

ΔH ("H_2O)	C_{DG}
0.5	1.009
1.0	1.009
1.5	1.008
2.0	1.006
3.0	1.008
4.0	1.007
Average	1.008 ✓

Variation: + 0.10% ✓

- 0.20% ✓

Calibrator: Phil Rowland

Checked By: Steve Boansen

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.50

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m		Meter Reading	Temp. In	Temp. Out	P_m
End	1445	11.000 cf	75 °F	−0.55	"H_2O	260.949 cf	86 °F	78 °F	0.50 "H_2O
Start	1410	0.000 cf	75 °F	−0.60	"H_2O	249.885 cf	83 °F	79 °F	0.50 "H_2O
Avg.	35	11.000 cf	75 °F	−0.58	"H_2O	11.064 cf	82 °F		0.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-0.58}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.762 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.064 \left[\frac{29.58 + \frac{0.50}{13.6}}{82 + 460}\right] = 10.671 \text{ dcsf}$$

$$C_{DG} = \frac{10.762}{10.671} = \boxed{1.009 \checkmark}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)						Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out		P_m
End	1515	11.000	cf	75	°F	-0.90 "H_2O	273.477	cf	91	°F	80	°F	1.00 "H_2O
Start	1455	0.000	cf	75	°F	-0.85 "H_2O	262.399	cf	85	°F	78	°F	1.00 "H_2O
Avg.	20	11.000	cf	75	°F	-0.88 "H_2O	11.078	cf	84	°F			1.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-0.88}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.754 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.078 \left[\frac{29.58 + \frac{1.00}{13.6}}{84 + 460}\right] = 10.658 \text{ dcsf}$$

$$C_{DG} = \frac{10.754}{10.658} = \boxed{1.009 \checkmark}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 30 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.50

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1540	11.020 cf	75 °F	-1.20 "H_2O	286.256 cf	94 °F	80 °F	1.50 "H_2O
Start	1520	0.000 cf	75 °F	-1.20 "H_2O	275.128 cf	89 °F	80 °F	1.50 "H_2O
Avg.	20	11.020 cf	75 °F	-1.20 "H_2O	11.128 cf	86 °F		1.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.020 \left[\frac{29.58 + \frac{-1.20}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.765 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.128 \left[\frac{29.58 + \frac{1.50}{13.6}}{86 + 460}\right] = 10.680 \text{ dcsf}$$

$$C_{DG} = \frac{10.765}{10.680} = \boxed{1.008}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)							Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out		P_m
End	1555	11.000	cf	75	°F	-1.50 "H_2O	298.634	cf	95	°F	80	°F	2.00 "H_2O
Start	1545	0.000	cf	75	°F	-1.50 "H_2O	287.532	cf	90	°F	80	°F	2.00 "H_2O
Avg.	10	11.000	cf	75	°F	-1.50 "H_2O	11.102	cf	86	°F			2.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-1.50}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.737 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.102 \left[\frac{29.58 + \frac{2.00}{13.6}}{86 + 460}\right] = 10.669 \text{ dcsf}$$

$$C_{DG} = \frac{10.737}{10.669} = \boxed{1.006 \checkmark}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)						Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out	P_m
End	1615	11.000	cf	75	°F	-2.25 "H_2O	310.766	cf	99	°F	81 °F	3.00 "H_2O
Start	1605	0.000	cf	75	°F	-2.20 "H_2O	299.689	cf	92	°F	81 °F	3.00 "H_2O
Avg.	10	11.000	cf	75	°F	-2.23 "H_2O	11.077	cf	88		°F	3.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-2.23}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.718 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.077 \left[\frac{29.58 + \frac{3.00}{13.6}}{88 + 460}\right] = 10.632 \text{ dcsf}$$

$$C_{DG} = \frac{10.718}{10.632} = \boxed{1.008}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

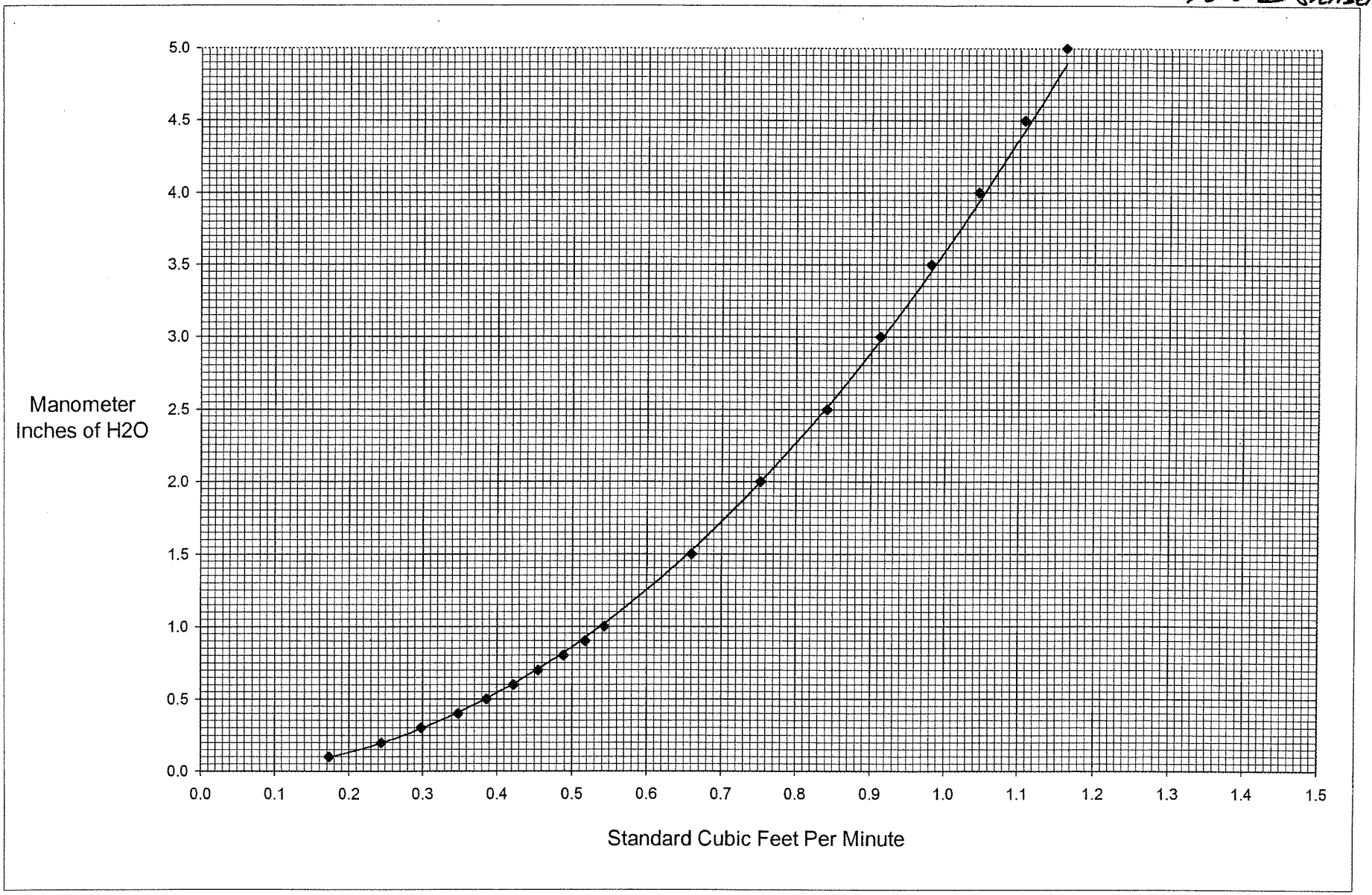
	Wet Test Meter (No. 4)						Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out	P_m
End	1630	11,000	cf	75	°F	-3.00 "H_2O	323,057	cf	100	°F	82 °F	4.00 "H_2O
Start	1620	0.000	cf	75	°F	-2.90 "H_2O	311,999	cf	94	°F	81 °F	4.00 "H_2O
Avg.	10	11,000	cf	75	°F	-2.95 "H_2O	11.058	cf	89		°F	4.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11{,}000 \left[\frac{29.58 + \frac{-2.95}{13.6}}{75 + 460}\right] \times 1.004 \ (C_t) = 10{,}698 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.058 \left[\frac{29.58 + \frac{4.00}{13.6}}{89 + 460}\right] = 10.620 \text{ dcsf}$$

$$C_{DG} = \frac{10.698}{10.620} = \boxed{1.007 \ \checkmark}$$

STACK UNIT ORIFICE NO: **31-1** DATE: **10/04/05** CALIBRATED BY: **Phillip Rowland** CHECKED BY: Steve Bonsen



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 31-1

CALIBRATION DATA

DATE: 3 Oct 2005

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	1306	76	75
Ice Bath	1307	34	34
Boiling Water	1309	213	211
Oven	1325	376	375
Oven	1332	352	350
Oven	1339	301	300
Oven	1346	251	250

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. D-1

Calibrator Phil Roland

Checked By: Steve Bronsen

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 49-1

Date: 9-29-05

ΔH ("H_2O)	C_{DG}
0.5	1.028
1.0	1.017
1.5	1.006
2.0	1.013
3.0	1.002
4.0	1.009
Average	1.013 ✓

Variation: + 1.48 % ✓

- 1.09 % ✓

Calibrator: Rodney Malone

Checked By: [illegible]

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-1

Date: 9-29-05

Calibrator: Rodney Malone

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.50" H_2O

P_b: 29.60 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)						Dry Gas Meter				
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In	Temp. Out	P_m
End	1019	5.180	cf	76	°F	-1.90 "H_2O	421.223	cf	76 °F	78 °F	0.50 "H_2O
Start	1005	0.000	cf	76	°F	-1.90 "H_2O	416.219	cf	76 °F	79 °F	0.50 "H_2O
Avg.		5.180	cf	76	°F	-1.90 "H_2O	5.004	cf	77 °F		0.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.180 \left[\frac{29.60 + \frac{-1.90}{13.6}}{76 + 460}\right] \times 0.997\ (C_f) = 5.010 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.004 \left[\frac{29.60 + \frac{0.50}{13.6}}{77 + 460}\right] = 4.874 \text{ dcsf}$$

$$C_{DG} = \frac{5.010}{4.874} = \boxed{1.028}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-1

Date: 9.29-05

Calibrator: Rodney Malone

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.00" H_2O

P_b: 29.60 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)

	Time	Meter Reading	Temp.	P_m
End	1041	8.210 cf	76 °F	-2.50 "H_2O
Start	1027	0.000 cf	76 °F	-2.50 "H_2O
Avg.		8.210 cf	76 °F	-2.50 "H_2O

Dry Gas Meter

	Meter Reading	Temp. In	Temp. Out	P_m
End	429.710 cf	77 °F	85 °F	1.00 "H_2O
Start	421.690 cf	76 °F	78 °F	1.00 "H_2O
Avg.	8.020 cf	79 °F		1.00 "H_2O

$$Wet\ Test\ Meter\ Vm_{std} = 17.65 \times 8.210 \left[\frac{29.60 + \frac{-2.50}{13.6}}{76 + 460}\right] \times 0.997\ (C_f) = 7.929\ dcsf$$

$$Dry\ Gas\ Meter\ Vm_{std} = 17.65 \times 8.020 \left[\frac{29.60 + \frac{1.00}{13.6}}{79 + 460}\right] = 7.793\ dcsf$$

$$C_{DG} = \frac{7.929}{7.793} = \boxed{1.017}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-1

Calibrator: Rodney Malone

Date: 9-29-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.50" H_2O

P_b: 29.60 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)						Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out		P_m
End	1120	11.370	cf	76	°F	-3.00 "H_2O	441.235	cf	87	°F	78	°F	1.50 "H_2O
Start	1105	0.000	cf	76	°F	-3.00 "H_2O	430.008	cf	79	°F	77	°F	1.50 "H_2O
Avg.		11.370	cf	76	°F	-3.00 "H_2O	11.227	cf	80	°F			1.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.370 \left[\frac{29.60 + \frac{-3.00}{13.6}}{76 + 460}\right] \times 0.997 \ (C_f) = 10.967 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.227 \left[\frac{29.60 + \frac{1.50}{13.6}}{80 + 460}\right] = 10.902 \text{ dcsf}$$

$$C_{DG} = \frac{10.967}{10.902} = \boxed{1.006}$$

✓

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-1

Date: 9-29-05

Calibrator: Rodney Malone

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2.00" H_2O

P_b: 29.60 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)						Dry Gas Meter				
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In	Temp. Out	P_m
End	1145	12.870	cf	76	°F	-3.50 "H_2O	454.022	cf	89 °F	80 °F	2.00 "H_2O
Start	1130	0.000	cf	76	°F	-3.50 "H_2O	441.385	cf	82 °F	78 °F	2.00 "H_2O
Avg.		12.870	cf	76	°F	-3.50 "H_2O	12.637	cf	82	°F	2.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 12.870 \left[\frac{29.60 + \frac{-3.50}{13.6}}{76 + 460}\right] \times 0.997\ (C_f) = 12.398 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 12.637 \left[\frac{29.60 + \frac{2.00}{13.6}}{82 + 460}\right] = 12.241 \text{ dcsf}$$

$$C_{DG} = \frac{12.398}{12.241} = \boxed{1.013}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-1

Date: 9-29-05

Calibrator: Rodney Malone

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.00" H_2O

P_b: 29.60 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)							Dry Gas Meter				
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In	Temp. Out	P_m
End	1327	10.620	cf	76	°F	-4.50 "H_2O	464.763	cf	83 °F	78 °F	3.00 "H_2O
Start	1315	0.000	cf	76	°F	-4.50 "H_2O	454.335	cf	78 °F	77 °F	3.00 "H_2O
Avg.		10.620	cf	76	°F	-4.50 "H_2O	10.428	cf	79	°F	3.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.620 \left[\frac{29.60 + \frac{-4.50}{13.6}}{76 + 460}\right] \times 0.997\ (C_f) = 10.205 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.428 \left[\frac{29.60 + \frac{3.00}{13.6}}{79 + 460}\right] = 10.183 \text{ dcsf}$$

$$C_{DG} = \frac{10.205}{10.183} = \boxed{1.002}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-1

Date: 9-29-05

Calibrator: Rodney Malone

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.00" H_2O

P_b: 29.60 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)

	Time	Meter Reading	Temp.	P_m
End	1350	19,050 cf	76 °F	-5.50 "H_2O
Start	1330	0.000 cf	76 °F	-5.50 "H_2O
Avg.		19,050 cf	76 °F	-5.50 "H_2O

Dry Gas Meter

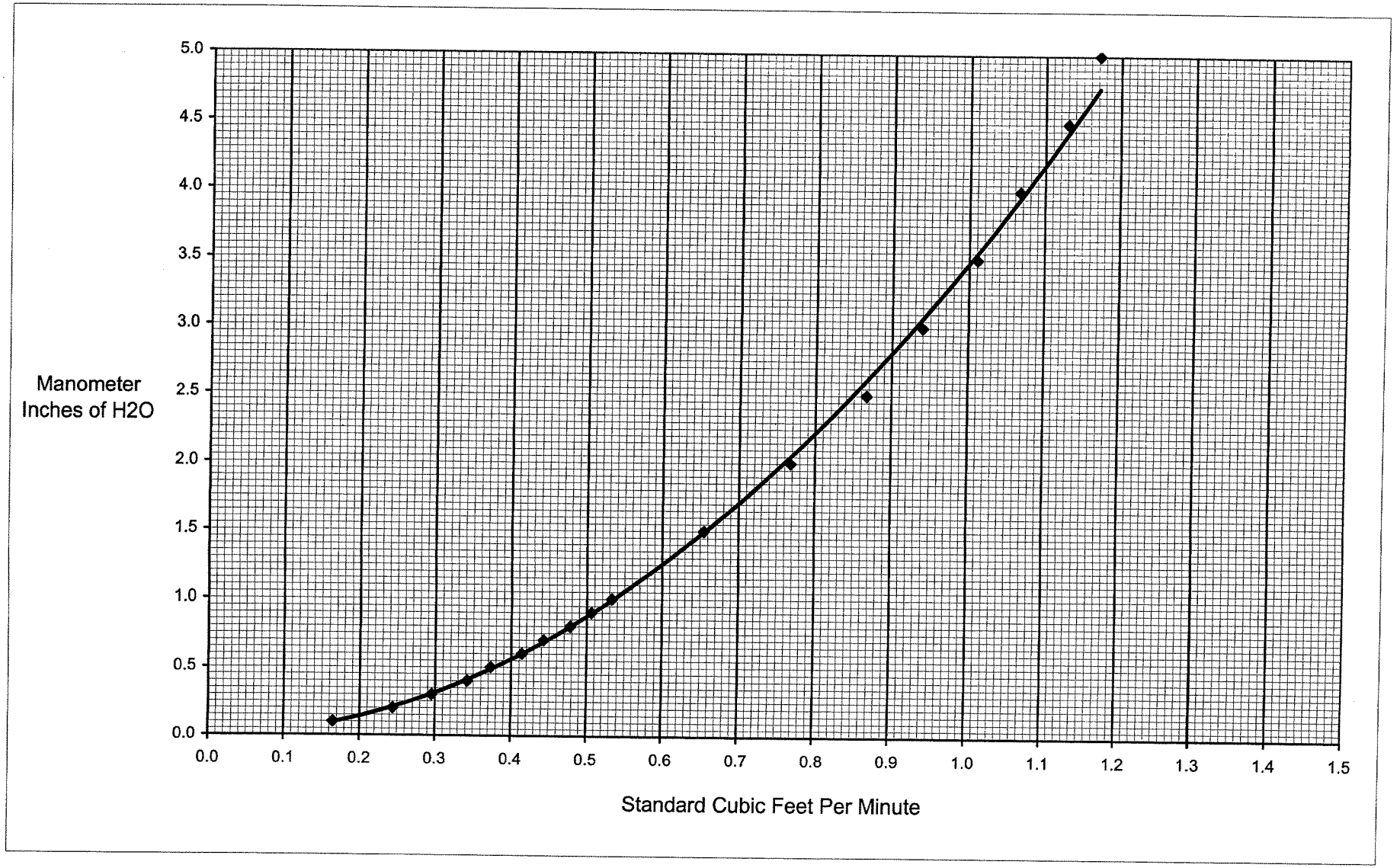
	Meter Reading	Temp. In	Temp. Out	P_m
End	483.680 cf	94 °F	78 °F	4.00 "H_2O
Start	465.085 cf	80 °F	77 °F	4.00 "H_2O
Avg.	18.595 cf	82 °F		4.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 19.050 \left[\frac{29.60 + \frac{-5.50}{13.6}}{76 + 460}\right] \times 0.997 \quad (C_f) = 18.259 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 18.595 \left[\frac{29.60 + \frac{4.00}{13.6}}{82 + 460}\right] = 18.102 \text{ dcsf}$$

$$C_{DG} = \frac{18.259}{18.102} = \boxed{1.009}$$

STACK UNIT ORIFICE NO: ***49-1*** DATE: **09/29/05** CALIBRATED BY: **Rodney Malone** CHECKED BY: Shane Lee



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 49-1

CALIBRATION DATA

DATE: 9-29-05

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	0925	76	76
Ice Bath	0932	35	35
Boiling Water	0946	214	215
Oven	0953	250	250
Oven	0957	300	302
Oven	0959	350	351
Oven	1002	375	374

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. D-I

Calibrator Rodney Malone

Checked By: [signature]

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 49-3

Date: 9-16-05

ΔH ("H_2O)	C_{DG}
0.5	1.013
1.0	1.005
1.5	1.005
2.0	1.003
3.0	1.004
4.0	1.003
Average	1.006

Variation: + 0.70%

- 0.30%

Calibrator: Rodney Malone

Checked By: [illegible]

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-3

Calibrator: R. Malone

Date: 9-16-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.50"

P_b: 29.43 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)						Dry Gas Meter				
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In	Temp. Out	P_m
End	0012	5.315	cf	77	°F	-1.40 "H_2O	672.072	cf	77 °F	76 °F	0.50 "H_2O
Start	0000	0.000	cf	77	°F	-1.40 "H_2O	666.864	cf	77 °F	76 °F	0.50 "H_2O
Avg.		5.315	cf	77	°F	-1.40 "H_2O	5.208	cf	77	°F	0.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.315 \left[\frac{29.43 + \frac{-1.40}{13.6}}{77 + 460}\right] \times 0.997 \quad (C_f) = 5.108 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.208 \left[\frac{29.43 + \frac{0.50}{13.6}}{77 + 460}\right] = 5.044 \text{ dcsf}$$

$$C_{DG} = \frac{5.108}{5.044} = \boxed{1.013}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-3

Calibrator: R. Malone

Date: 9-16-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.00"

P_b: 29.43 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m		Meter Reading	Temp. In	Temp. Out	P_m
End	0012	5.270 cf	77 °F	-2.00	"H_2O	677.464 cf	81 °F	76 °F	1.00 "H_2O
Start	0000	0.000 cf	77 °F	-2.00	"H_2O	672.265 cf	77 °F	76 °F	1.00 "H_2O
Avg.		5.270 cf	77 °F	-2.00	"H_2O	5.199 cf	78 °F		1.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.270 \left[\frac{29.43 + \frac{-2.00}{13.6}}{77 + 460}\right] \times 0.997 \ (C_f) = 5.057 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.199 \left[\frac{29.43 + \frac{1.00}{13.6}}{78 + 460}\right] = 5.032 \text{ dcsf}$$

$$C_{DG} = \frac{5.057}{5.032} = \boxed{1.005}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-3

Calibrator: R. Malone

Date: 9-16-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.50"

P_b: 29.43 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)							Dry Gas Meter				
	Time	Meter Reading	Temp.		P_m		Meter Reading	Temp. In	Temp. Out	P_m	
End	0015	11.800	cf	77 °F	-2.70	"H_2O	689.416	cf	87 °F	77 °F	1.50 "H_2O
Start	0000	0.000	cf	77 °F	-2.70	"H_2O	677.768	cf	80 °F	76 °F	1.50 "H_2O
Avg.		11.800	cf	77 °F	-2.70	"H_2O	11.648	cf	80 °F		1.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.800 \left[\frac{29.43 + \frac{-2.70}{13.6}}{77 + 460}\right] \times 0.997\ (C_p) = 11.303 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.648 \left[\frac{29.43 + \frac{1.50}{13.6}}{80 + 460}\right] = 11.246 \text{ dcsf}$$

$$C_{DG} = \frac{11.303}{11.246} = \boxed{1.005}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-3

Calibrator: R. Malone

Date: 9-16-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2.00"

P_b: 29.43 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)							Dry Gas Meter				
	Time	Meter Reading	Temp.		P_m		Meter Reading	Temp. In		Temp. Out	P_m
End	0015	10,325	cf	77 °F	-3.50	"H_2O	699.869	cf	92 °F	78 °F	2.00 "H_2O
Start	0000	0.000	cf	77 °F	-3.50	"H_2O	689.689	cf	86 °F	78 °F	2.00 "H_2O
Avg.		10.325	cf	77 °F	-3.50	"H_2O	10.180	cf	84 °F		2.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.325 \left[\frac{29.43 + \frac{-3.50}{13.6}}{77 + 460}\right] \times 0.997(C_f) = 9.870 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.180 \left[\frac{29.43 + \frac{2.00}{13.6}}{80 + 460}\right] = 9.841 \text{ dcsf}$$

$$C_{DG} = \frac{9.870}{9.841} = \boxed{1.003}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-3

Calibrator: R. Malone

Date: 9-16-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.00"

P_b: 29.43 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	0015	10.390 cf	77 °F	-4.70 "H_2O	710.394 cf	93 °F	79 °F	3.00 "H_2O
Start	0000	0.000 cf	77 °F	-4.70 "H_2O	700.119 cf	89 °F	78 °F	3.00 "H_2O
Avg.		10.390 cf	77 °F	-4.70 "H_2O	10.275 cf	85 °F		3.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.390 \left[\frac{29.43 + \frac{-4.70}{13.6}}{77 + 460}\right] \times 0.997\ (C_p) = 9.902 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.275 \left[\frac{29.43 + \frac{3.00}{13.6}}{85 + 460}\right] = 9.867 \text{ dcsf}$$

$$C_{DG} = \frac{9.902}{9.867} = \boxed{1.004}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 49-3

Calibrator: R. Molina

Date: 9-16-05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.00"

P_b: 29.43 "Hg

Control Module Vacuum: 5.0 "Hg

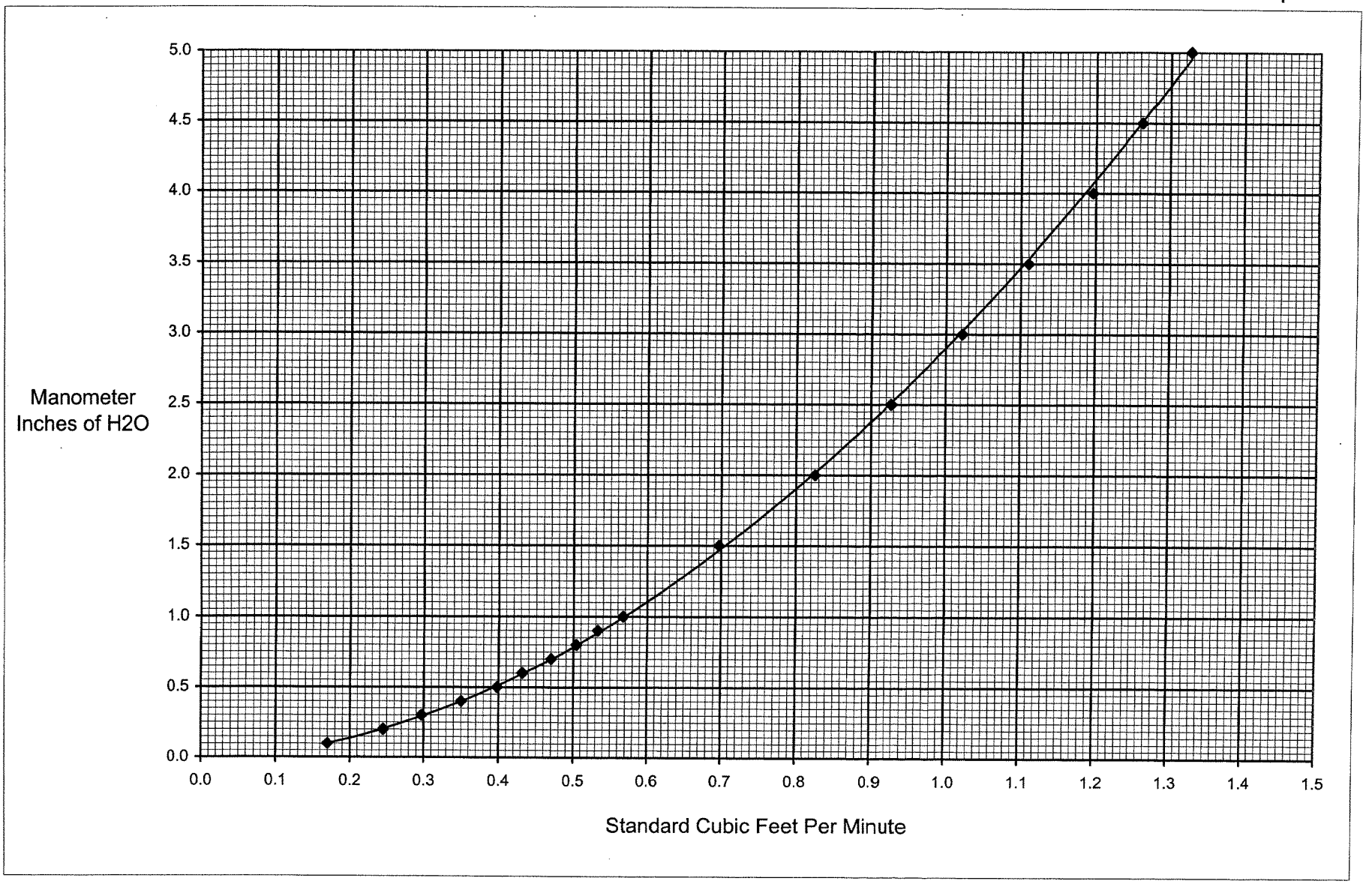
Wet Test Meter (No. 3)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	0012	10.370 cf	77 °F	-6.00 "H_2O	720.998 cf	97 °F	87 °F	4.00 "H_2O
Start	0000	0.000 cf	77 °F	-6.00 "H_2O	710.740 cf	92 °F	79 °F	4.00 "H_2O
Avg.		10.370 cf	77 °F	-6.00 "H_2O	10.238 cf	87 °F		4.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.370 \left[\frac{29.43 + \frac{-6.00}{13.6}}{77 + 460}\right] \times 0.997\ (C_p) = 9.851 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.238 \left[\frac{29.43 + \frac{4.00}{13.6}}{87 + 460}\right] = 9.819 \text{ dcsf}$$

$$C_{DG} = \frac{9.851}{9.819} = \boxed{1.003}$$

STACK UNIT ORIFICE NO: **49-3** DATE: **09/19/05** CALIBRATED BY: **John Cutaia** CHECKED BY: Dustin Simpson



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 49-3

CALIBRATION DATA

DATE: 9-16-05

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	1530	79	79
Ice Bath	1535	32	32
Boiling Water	1549	211	212
Oven	1600	250	251
Oven	1603	300	302
Oven	1607	350	352
Oven	1610	375	378

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. D-1

Calibrator Rodney [illegible]

Checked By: [illegible]

METCO ENVIRONMENTAL

JMGSt

BAROMETER CALIBRATION

Barometer No. 31-1

Date: 10-12-05

Time: 1410

Barometric Pressure @ Addison Airport @ 719 ft.	=	30.05
	-	0.719
Absolute Pressure @ Addison Airport	=	29.331
	+	0.083
Absolute Pressure @ METCO @ 636 ft.	=	29.414
Barometer Reading	=	29.42
Variation	=	0.006
Barometer Adjusted?		Yes ____ No ✓
Barometer Reading (after adjustment)	=	

Steve Bornsen
Signature of Calibrator

APPENDIX D

Field Testing Data

METCO ENVIRONMENTAL

Job Number: 05-235 ✓
Job Name: ADA-ES ✓
Run Number: 1
Unit: Unit 2 ESP Inlet Duct ✓
Date: 10/25/05 ✓
Operator: Sellers/Poshek/Bonsen
Sample box No. 49-1 Meter Box No. 49-3 ✓

PM/HCL Field Data

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓ ✓

Ambient Temp. °F 45
Assumed Moisture % 14
Probe Length 5'
C Factor 10 → ~~8~~ 5.8 to reference.
Initial Leak @ 15 "Hg = 0.000 cfm ✓
Final Leak @ 19 "Hg = 0.000 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1345	895.614	1.40	0.80	0.80	5.0	307	272	256	59	48	48	
3	1349	899.615	1.50	0.85	0.85	5.0	308	268	269	49	49	48	
2	1353	899.72	1.40	0.80	0.80	5.0	307	243	273	46	50	49	
1	1356	901.31	0.90	0.50	0.50	4.5	316	223	273	46	51	49	
End	1359	902.391	–	–	–	–	–	–	–	–	–	–	
2-4	1400	902.814	0.95	0.55	0.55	5.0	307	250	273	46	51	49	Δ=0.423 ✓
3	1404	904.41	1.10	0.65	0.65	5.0	309	265	272	46	51	49	
2	1408	906.13	1.00	0.60	0.60	5.0	290	266	267	45	52	49	
1	1412	907.85	0.80	0.45	0.45	5.0	305	262	263	46	52	49	
End	1416	909.324	–	–	–	–	–	–	–	–	–	–	
3-4	1418	909.820	0.90	0.50	0.50	5.0	308	247	256	46	52	49	Δ=0.501 ✓
3	1422	911.39	1.10	0.85	0.85	6.0	306	256	262	45	53	50	
2	1426	913.42	1.00	0.60	0.60	5.5	305	252	266	45	53	50	
1	1430	915.08	0.60	0.35	0.35	5.0	305	263	267	46	53	50	
End	1434	916.612	–	–	–	–	–	–	–	–	–	–	
4-4	1437	917.570	1.20	0.70	0.70	6.0	307	231	261	46	54	50	Δ=0.958 ✓
3	1441	919.25	1.20	0.70	0.70	6.0	310	246	261	46	54	50	
2	1445	921.13	1.20	0.70	0.70	6.0	308	260	268	46	54	50	

Pitot Tube Calibration Factor C_p LOW-0.800 ✓
Volume Collected V_m ~~50.645~~ 50.138 ft^3 ✓
Water Collected V_w 141.0 ml
Time of Test T_t 128 min.
Stack Pressure P_s -14.0 "H_2O

Pitot Tube No. 49-5-3 ✓
Baro. Press. P_b 29.59 ✓ "Hg
Probe Tip Dia. D_n 0.190 ✓ in.
% CO_2 14.6 % CO 0.0
% O_2 4.6 % N_2 80.8
Area Stack A_s ~~21024~~ ✓ 16279 in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-235-5 ✓
Total Volume of Leak Checks After Start: ~~1.981~~ 2.485 ft^3 ✓
V_m = Dry Gas Meter Calibration Factor ~~52.329~~ / ~~50.343~~ 49.839 ✓ x 1.006 ✓
{Dry Gas Meter Reading ____ ft^3 – (T_t ____ min. X Leak Rate ____ cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 49-1

Impinger 1	Final Weight	820.6		Impinger 1	74.8
	Initial Weight	745.8		Impinger 2	38.5
	Increase			Impinger 3	8.0
Impinger 2	Final Weight	797.6		Impinger 4	4.7
	Initial Weight	759.1		Impinger 5	2.3
	Increase			Impinger 6	12.7
Impinger 3	Final Weight	644.7		Impinger 7	
	Initial Weight	636.7		Total	141.0 = V_w
	Increase				
Impinger 4	Final Weight	760.1			
	Initial Weight	755.4			
	Increase				
Impinger 5	Final Weight	749.1			
	Initial Weight	746.8			
	Increase				
Impinger 6	Final Weight	875.4			
	Initial Weight	862.7			
	Increase				
Impinger 7	Final Weight				
	Initial Weight				
	Increase				

Water Weight Gain

V_w =

g SO_2 = -

V_w =

P_b =	29.89		%CO_2 =	14.6	
V_m =	~~50.645~~ 50.138		%O_2 =	4.6	
V_w =	141.0		%CO =	0.0	
P_m =	~~0.550~~ 0.541		%N_2 =	80.8	
Avg ΔP =	0.921		A_s =	~~21.024~~ 16.279	
			D_n =	0.190	
Avg$\sqrt{\Delta P}$ =	0.936		T_t =	128	
C_p =	0.800				
P_s =	-14.8	"H_2O		28.82	"Hg
T_m =	52	°F		512	°R
T_s =	309	°F		769	°R

Moisture Content: %M = ~~11.30~~ 11.40 M_d = ~~0.8870~~ 0.8860 MW_d = ~~30.440~~ 30.52 MW = 29.08

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{50.645}\ 50.138 \left[\frac{29.89 + \frac{\cancel{0.550}\ 0.541}{13.6}}{52 + 460}\right] = \cancel{52.256}\ 51.730\ \text{sft}^3 = \cancel{0.408}\ 0.404\ \text{scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 141.0 = 6.655 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{6.655}{51.730 + 6.655}$ x 100 = ~~11.30~~ 11.40 %

V_s = 5123.8 x 0.800 $\sqrt{\frac{769}{28.82 \times 29.08}}$ x 0.936 = 3678 fpm

%I = $\frac{1{,}039 \times 769 \times \cancel{52.256}\ 51.730}{128 \times 28.82 \times 0.8870 \times 3678 \times (0.190)^2}$ = ~~96.1~~ 95.3 %

ACFM: ~~537036~~ 415,113

SCFM: ~~316172~~ 244,478

%EA: ~~27.6~~ 27.4

VERSION 1
22 OCTOBER 2002

Run Number 1 PM/HCL FIELD DATA

Unit Unit 2 ESP Inlet Duct

Date 10/25/05

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-1	1449	923.01	0.90	0.50	0.50	6.0	297	272	268	47	55	50	
End	1453	924.563	—	—	—	—	—	—	—	—	—	—	
8 4	1501	924.563	0.18	0.10	0.10	3.0	304	257	248	48	54	52	Δ=0.000
3	1505	925.14	0.25	0.15	0.15	3.5	317	240	249	50	53	51	
2	1509	925.98	0.15	0.10	0.10	3.0	315	257	254	49	53	51	
1	1513	926.71	0.15	0.10	0.10	3.0	260	270	261	49	53	51	
END	1517	927.416	—	—	—	—	—	—	—	—	—	—	
10-4	1518	927.655	0.90	0.50	0.50	5.0	311	249	268	46	53	51	Δ=0.179 ✓
3	1522	929.18	0.85	0.50	0.50	5.0	317	253	270	46	53	51	
2	1526	930.81	0.85	0.50	0.50	5.5	317	256	268	46	54	51	
1	1530	932.39	0.90	0.55	0.55	6.0	308	258	266	46	54	52	
End	1534	933.971	—	—	—	—	—	—	—	—	—	—	
11-4	1535	934.395	0.95	0.55	0.55	6.0	313	273	258	48	55	52	Δ=0.424 ✓
3	1539	936.08	0.90	0.50	0.50	6.0	320	260	262	49	56	52	
2	1543	937.62	0.90	0.50	0.50	6.0	320	250	262	50	56	52	
1	1547	939.23	0.85	0.50	0.50	6.0	320	261	264	52	56	52	
End	1551	940.755	—	—	—	—	—	—	—	—	—	—	
12-4	1554	940.753	1.10	0.65	0.65	6.5	322	251	264	52	56	53	Δ=0.000
3	1558	942.61	1.10	0.65	0.65	6.5	321	264	263	53	56	53	
2	1602	944.33	1.20	0.70	0.70	7.0	312	272	264	55	56	52	
1	1606	946.15	1.10	0.65	0.65	7.0	322	250	267	56	57	53	
END	1610	947.938	—	—	—	—	—	—	—	—	—	—	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-235 ✓
Job Name: ADA-ES ✓
Run Number: 2 ✓
Unit: Unit 2 ESP Inlet Duct ✓
Date: 10/25/05 ✓
Operator: Sellers/Poshek/Bonsen
Sample box No. 31-3 Meter Box No. 49-3 ✓

PM/HCL Field Data

Read and record at the start of each test point.

Purge to: =
Purge time: —
Pitot Leak Check Initial ✓ Final ✓ ✓

Ambient Temp. °F 52
Assumed Moisture % 14
Probe Length 5'
C Factor 10 → 5.8 to reference.
Initial Leak @ 15 "Hg = 0.000 cfm ✓
Final Leak @ 18 "Hg = 0.000 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1724	948.397	1.20	0.70	0.70	9.0	325	244	259	50	53	53	
3	1728	950.39	1.20	0.70	0.70	9.0	324	259	267	47	53	53	
2	1732	952.23	1.30	0.75	0.75	9.0	323	271	272	44	54	53	
1	1736	954.28	1.00	0.60	0.60	8.5	323	253	266	44	54	53	
End	1740	955.955	—	—	—	—	—	—	—	—	—	—	
11-4	1741	955.955	1.10	0.65	0.65	8.0	320	242	259	44	55	53	
3	1745	957.81	1.00	0.60	0.60	8.0	322	271	255	43	55	53	
2	1749	959.35	0.95	0.55	0.55	8.0	323	267	253	44	56	53	
1	1753	960.98	0.70	0.40	0.40	7.0	323	260	256	44	56	53	
End	1757	962.451	—	—	—	—	—	—	—	—	—	—	
10-4	1758	962.451	0.90	0.50	0.50	7.5	316	260	271	46	58	54	
3	1802	964.14	0.85	0.50	0.50	8.0	322	256	272	46	58	54	
2	1806	966.01	0.80	0.45	0.45	7.5	319	260	263	46	58	54	
1	1810	967.12	0.60	0.35	0.35	7.0	322	262	262	47	58	54	
End	1814	968.445	—	—	—	—	—	—	—	—	—	—	
8-4	1815	968.445	0.20	0.15	0.15	4.5	302	260	251	47	58	54	
3	1819	969.23	0.20	0.15	0.15	4.5	319	256	251	47	57	54	
2	1823	970.04	0.15	0.10	0.10	4.5	315	253	257	48	57	54	

Pitot Tube Calibration Factor C_p 0.800 ✓ Low
Volume Collected V_m 52.365 ✓ ft^3
Water Collected V_w 134.3 ✓ ml
Time of Test T_t 124 ✓ min.
Stack Pressure P_s -14.0 ✓ "H_2O

Pitot Tube No. 49-5-3 ✓
Baro. Press. P_b 29.84 ✓ "Hg
Probe Tip Dia. D_n 0.190 ✓ in.
% CO_2 14.4 ✓ % CO 0.0 ✓
% O_2 4.6 ✓ % N_2 81.0 ✓
Area Stack A_s ~~21024~~ ✓ in^2
16279 ✓

Barometer No. 31-1 ✓ Probe Tip No. 05-233-5 ✓
Total Volume of Leak Checks After Start: — ft^3
V_m = Dry Gas Meter Calibration Factor 52.053 ✓ x 1.006 ✓

{Dry Gas Meter Reading ____ ft^3 – (T_t ____ min. X Leak Rate ____ cfm)}

VERSION 1
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Impinger Box No. 31-3

Impinger 1	Final Weight	713.7		Impinger 1	90.9
	Initial Weight	622.8		Impinger 2	18.9
	Increase			Impinger 3	3.0
Impinger 2	Final Weight	757.5		Impinger 4	2.0
	Initial Weight	738.6		Impinger 5	0.7
	Increase			Impinger 6	18.8
Impinger 3	Final Weight	641.9		Impinger 7	
	Initial Weight	638.9		Total	134.3 = V_w
	Increase				
Impinger 4	Final Weight	665.6			
	Initial Weight	663.6			
	Increase				
Impinger 5	Final Weight	665.5			
	Initial Weight	664.8			
	Increase				
Impinger 6	Final Weight	980.2			
	Initial Weight	961.4			
	Increase				
Impinger 7	Final Weight				
	Initial Weight				
	Increase				

Water Weight Gain

V_w =

g SO_2 = -

V_w =

P_b =	29.84		$\%CO_2$ =	14.4
V_m =	52.365		$\%O_2$ =	4.6
V_w =	134.3		%CO =	0.0
P_m =	0.548		$\%N_2$ =	81.0
Avg ΔP =	0.930		A_s =	~~21024~~ 16,279
			D_n =	0.190
Avg$\sqrt{\Delta P}$ =	0.937		T_t =	128
C_p =	0.800			
P_s =	-14.0	"H_2O	28.81	"Hg
T_m =	56	°F	516	°R
T_s =	310	°F	770	°R

Moisture Content: %M = 10.59 M_d = 0.8941 MW_d = 30.488 MW = 29.17

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 52.365 \left[\frac{29.84 + \frac{0.548}{13.6}}{56 + 460}\right] = 53.521\ sft^3 = 0.418\ scfm$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 134.3 = 6.339 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{6.339}{53.521 + 6.339}$ x 100 = 10.59 %

V_s = 5123.8 x 0.800 $\sqrt{\frac{770}{28.81 \times 29.17}}$ x 0.937 = 3677 fpm

%I = $\frac{1{,}039 \times 770 \times 53.521}{128 \times 28.81 \times 0.8941 \times 3677 \times (0.190)^2}$ = 97.8 %

ACFM: ~~536853~~ 415,616

SCFM: ~~318092~~ 246,233

%EA: 27.3

Run Number 2 ✓ PM/HCL FIELD DATA

Unit Unit 2 ESP Inlet Duct ✓

Date 10/25/05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
8-1	1827	970.84	0.15	0.10	0.10	4.5	301	251	261	48	57	54	
End	1831	971.681	—	—	—	—	—	—	—	—	—	—	
4-4	1832	971.681	1.20	0.70	0.70	~~38~~ 9.0	~~30~~	250	262	48	57	54	
3	1836	973.33	1.20	0.70	0.70	9.5	309	251	264	49	57	54	
2	1840	974.93	0.90	0.50	0.50	9.0	311	263	267	50	58	54	
1	1844	976.61	0.60	0.35	0.35	7.0	300	278	270	52	58	54	
End	1848	977.852	—	—	—	—	—	—	—	—	—	—	
3-4	1849	977.852	~~0.6~~ 1.10	0.65	0.65	8.5	303	278	267	52	58	54	
3	1853	979.24	1.10	0.65	0.65	9.5	305	271	267	53	58	55	
2	1857	981.05	1.00	0.60	0.60	10.0	305	252	268	55	60	55	
1	1901	982.91	0.70	0.40	0.40	9.0	290	247	266	57	60	55	
END	1905	984.465	—	—	—	—	—	—	—	—	—	—	
2-4	1906	984.465	1.10	0.65	0.65	10.0	297	244	263	58	60	55	
3	1910	986.45	1.10	0.65	0.65	10.5	301	262	265	60	60	55	
2	1914	988.28	1.10	0.65	0.65	11.0	299	271	270	60	59	55	
1	1918	990.14	0.80	0.45	0.45	10.5	295	258	266	63	60	55	
END	1922	991.852	—	—	—	—	—	—	—	—	—	—	
1-4	1923	991.852	~~0.90~~ 1.50	0.90	0.90	13.5	300	225	252	66	59	56	
3	1927	993.86	1.60	0.95	0.95	14.5	301	235	250	66	59	56	
2	1931	996.12	1.50	0.90	0.90	15.5	302	254	248	65	59	55	
1	1935	998.31	0.95	0.60	0.60	15.0	296	262	248	65	59	55	
END	1939	100.450	—	—	—	—	—	—	—	—	—	—	

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METCO ENVIRONMENTAL

Job Number: 05-235 ✓
Job Name: ADA-ES ✓
Run Number: 3 ✓
Unit: Unit 2 ESP Inlet Duct ✓
Date: 10/26/05 ✓
Operator: Sellers / Poshek / Bonsper
Sample box No. 49-1 Meter Box No. 49-3 ✓

PM/HCL Field Data

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F ~~48~~ 55
Assumed Moisture % 14
Probe Length 5'
C Factor 10 → 5.8 to reference.
Initial Leak @ 15 "Hg = 0.000 cfm ✓
Final Leak @ 12 "Hg = 0.000 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1251	1.186	1.30	0.85	0.85	6.5	~~278~~	231	260	41	58	57	
3	1255	3.29	1.30	0.85	0.85	6.0	303	237	263	42	58	57	
2	1259	5.33	1.30	0.85	0.85	6.5	302	249	267	41	59	57	
1	1303	7.34	1.10	0.70	0.70	6.0	292	271	268	41	60	57	
End	1307	9.211	–	–	–	–	–	–	–	–	–	–	
2-4	1308	9.211	1.10	0.70	0.70	6.0	298	250	267	42	61	57	
3	1312	11.01	1.10	0.70	0.70	6.0	301	257	266	43	62	58	
2	1316	13.10	1.00	0.65	0.65	6.0	300	254	263	44	63	58	
1	1320	14.63	0.70	0.45	0.45	5.5	288	256	261	44	64	59	
End	1324	16.011	–	–	–	–	–	–	–	–	–	–	
3-4	1325	16.011	1.10	0.70	0.70	6.0	296	243	261	44	64	59	
3	1329	17.87	1.10	0.70	0.70	6.5	302	253	261	44	65	59	
2	1333	19.73	1.00	0.65	0.65	6.5	303	260	258	44	66	59	
1	1337	21.55	0.70	0.45	0.45	6.0	270	259	259	45	67	60	
End	1341	23.015	–	–	–	–	–	–	–	–	–	–	
4-4	1342	23.015	1.20	0.75	0.75	6.5	301	254	253	46	67	60	
3	1346	24.93	1.20	0.75	0.75	6.5	306	250	258	47	68	61	
2	1350	26.89	1.20	0.75	0.75	7.0	305	259	258	49	69	61	

Pitot Tube Calibration Factor C_p 0.800 Low ✓
Volume Collected V_m 54.156 ✓ ft^3
Water Collected V_w 143 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.0 ✓ "H_2O

Pitot Tube No. 49-5-3 ✓
Baro. Press. P_b 29.90 ✓ "Hg
Probe Tip Dia. D_n 0.190 ✓ in. ✓
% CO_2 14.6 ✓ % CO 0.0
% O_2 4.4 ✓ % N_2 81.0 ✓
Area Stack A_s ~~21024~~ ✓ in^2
16279

Barometer No. 31-1 ✓ Probe Tip No. 05-233-5 ✓
Total Volume of Leak Checks After Start: – ft^3
V_m = Dry Gas Meter Calibration Factor 53.833 x 1.006 ✓

{Dry Gas Meter Reading – ft^3 – (T_t – min. X Leak Rate – cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 49-1

Impinger 1	Final Weight	841.5		Impinger 1	98.7
	Initial Weight	742.8			
	Increase			Impinger 2	20.6
Impinger 2	Final Weight	778.0		Impinger 3	3.6
	Initial Weight	757.4			
	Increase			Impinger 4	1.9
			V_w =		
Impinger 3	Final Weight	641.7	g SO_2 = —	Impinger 5	~~12.8~~ 30 0.4
	Initial Weight	638.1	V_w =		
	Increase			Impinger 6	17.8
Impinger 4	Final Weight	789.2		Impinger 7	
	Initial Weight	757.3			
	Increase			Total	143 = V_w
Impinger 5	Final Weight	745.7	P_b = 29.90	$\%CO_2$ =	14.6
	Initial Weight	745.3	V_m = 54.156	$\%O_2$ =	4.4
	Increase		V_w = 143	%CO =	0.0
			P_m = 0.579	$\%N_2$ =	81.0
Impinger 6	Final Weight	893.0	Avg ΔP = 0.903	A_s = ~~2.0274~~ 1.0279	
	Initial Weight	875.2		D_n =	0.190
	Increase		Avg$\sqrt{\Delta P}$ = 0.927	T_t =	128
			C_p = 0.800		
Impinger 7	Final Weight		P_s = -1.40 "H_2O	28.87 "Hg	
	Initial Weight		T_m = 64 °F	524 °R	
	Increase		T_s = 306 °F	766 °R	

Moisture Content: %M = ~~11.042~~ 00 M_d = ~~0.4892~~ 8900 MW_d = 30.512 MW = ~~9.236~~ 80 29.13

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 54.156 \left[\frac{29.90 + \frac{0.579}{13.6}}{64 + 460}\right] = \frac{54.620\ \text{sft}^3}{0.4287\ \text{scfm}}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 143 = 6.750 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{6.750}{6.750 + 54.620}$ x 100 = ~~11.042~~ 00 %

V_s = 5123.8 x 0.800 $\sqrt{\frac{766}{28.87 \times 29.13}}$ x 0.927 = 3626 fpm

%I = $\frac{1{,}039 \times 54.620 \times 766}{28.87 \times 8900 \times 128 \times 3626 \times (0.190)^2}$ = ~~56.417~~ 101.066 %

ACFM: ~~409,896~~ 409,896 ~~529,463~~

SCFM: ~~240,587~~ 243,539. 25.81

%EA: ~~0.0388~~

Run Number 3 PM/HCL FIELD DATA

Unit Unit 2 ESP Inlet Duct

Date 10/26/05

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-1	1354	28.83	0.90	0.60	0.60	6.5	292	258	259	51	69	61	
END	1358	30.565	–	–	–	–	–	–	–	–	–	–	
8-4	1359	30.565	0.20	0.13	0.13	4.0	303	262	259	52	69	62	
3	1403	31.49	0.20	0.13	0.13	4.0	317	265	258	52	68	62	
2	1407	32.29	0.19	0.12	0.12	4.0	317	260	258	53	68	62	
1	1411	33.11	0.25	0.16	0.16	4.5	289	266	260	54	67	62	
END	1415	33.555	–	–	–	–	–	–	–	–	–	–	
10-4	1416	33.555	0.80	0.50	0.50	6.0	316	253	258	54	67	63	
3	1420	35.54	0.80	0.50	0.50	6.0	321	261	260	56	67	63	
2	1424	37.12	0.80	0.50	0.50	6.5	322	266	262	57	68	63	
1	1428	38.69	0.60	0.40	0.40	6.0	306	269	262	58	69	63	
END	1432	40.095	–	–	–	–	–	–	–	–	–	–	
11-4	1433	40.095	0.90	0.60	0.60	6.5	316	264	261	60	69	63	
3	1437	41.87	0.95	0.60	0.60	7.0	322	267	262	61	69	63	
2	1441	43.63	0.85	0.55	0.55	7.0	322	271	263	64	69	64	
1	1445	45.31	0.45	0.30	0.30	6.5	306	265	265	65	70	64	
END	1449	46.944	–	–	–	–	–	–	–	–	–	–	
12-4	1450	46.944	1.10	0.70	0.70	8.0	320	257	263	66	70	64	
3	1454	49.16	1.10	0.70	0.70	8.0	322	256	263	66	70	64	
2	1458	51.02	1.30	0.85	0.85	9.0	323	250	260	67	71	64	
1	1502	53.08	1.10	0.70	0.70	8.5	323	230	258	67	71	65	
END	1506	55.019	–	–	–	–	–	–	–	–	–	–	

Version 1
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METCO ENVIRONMENTAL

Job Number 05-235 ✓ | DH Field Data | Ambient Temp. °F 55°

Job Name ADA-ES ✓ | Assumed Moisture % 14

Run Number 1 ✓ | Read and record at the start of each test point. | Probe Length 5ft

Unit Unit 2 ESP Inlet Duct ✓ | C Factor 1 - 0.62 to reference.

Date 10-25-05 ✓ | Purge to: — | Initial Leak @ 15 "Hg = 0.000 cfm ✓

Operator Orr, Posteck, Bomsen | Purge time: — | Final Leak @ 18 "Hg = 0.000 cfm ✓

Sample box No. 51-3 Meter Box No. 31-1 ✓ | Pitot Leak Check Initial ✓ Final ✓ ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1321	569.009	1.30	0.75	0.75	7.5	308	273	255	52	52	52	
3	1325	570.92	1.30	0.75	0.75	7.0	308	261	256	51	53	52	
2	1329	572.73	1.30	0.75	0.75	7.0	307	250	257	52	53	52	
1	1333	574.79	1.10	0.70	0.70	7.0	305	252	256	52	55	53	
2-4	1337	576.355	—	—	—	—	—	—	—	—	—	—	
2-4	1337	576.355	1.10	0.70	0.70	7.0	305	248	260	52	55	53	
3	1341	578.13	1.10	0.70	0.70	7.0	306	248	259	54	56	51	
2	1345	580.00	1.05	0.65	0.65	7.0	308	254	262	53	56	55	
1	1349	581.63	0.85	0.54	0.54	6.0	309	257	258	53	58	53	
—	1353	583.195	—	—	—	—	—	—	—	—	—	—	
3-4	1353	583.195	1.10	0.70	0.70	6.5	310	263	262	54	58	51	
3	1357	584.86	1.10	0.70	0.70	6.5	309	258	263	55	59	53	
2	1401	586.61	1.00	0.65	0.65	6.5	306	254	264	53	59	53	
1	1405	588.39	0.55	0.34	0.34	5.5	306	254	264	51	58	54	
—	1409	590.282	—	—	—	—	—	—	—	—	—	—	
4-4	1409	590.282	1.20	0.70	0.70	7.5	306	262	259	50	58	53	
3	1413	591.62	1.20	0.70	0.70	7.5	306	262	262	50	58	54	
2	1417	593.44	1.20	0.70	0.70	7.5	306	263	264	50	59	56	

Pitot Tube Calibration Factor C_p .806 ✓ LOW | Pitot Tube No. 31-5-1 ✓ | Barometer No. 31-1 ✓ | Probe Tip No. D5-233-7 ✓

Volume Collected V_m 52.347 ✓ ft^3 | Baro. Press. P_b 29.89 ✓ "Hg | Total Volume of Leak Checks After Start: 3.958 ✓ ft^3

Water Collected V_w 138.0 ✓ ml | Probe Tip Dia. D_n 0.190 ✓ in. | V_m = Dry Gas Meter Calibration Factor 1.009 ✓ X 51.932 ✓

Time of Test T_t 129 ✓ min. | % CO_2 14.6 ✓ | % CO 0.0 ✓

Stack Pressure P_s -14.0 ✓ "H_2O | % O_2 4.6 ✓ | % N_2 80.8 ✓ | {Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

Area Stack A_s ~~21,024~~ ✓ in^2
16,279

VERSION 1
22 OCTOBER 2002

Impinger Box No. 51-3

Impinger 1	Final Weight	836.6		Impinger 1	90.8
	Initial Weight	~~745.8~~			
	Increase	745.8	Impinger 8 1007.2 / 993.4	Impinger 2	20.7
Impinger 2	Final Weight	655.8		Impinger 3	3.7
	Initial Weight	635.1			
	Increase			Impinger 4	2.6
			V_w = —		
Impinger 3	Final Weight	711.8	g SO_2 = -	Impinger 5	0.5
	Initial Weight	708.1	V_w =		
	Increase			Impinger 6	-0.3
Impinger 4	Final Weight	747.8		Impinger 7	6.2
	Initial Weight	745.2		Impinger 8	13.8
	Increase			Total	~~135.8~~ 138.0 = V_w
Impinger 5	Final Weight	665.2	P_b = 29.89	$\%CO_2$ =	14.6
	Initial Weight	664.7	V_m = 52.347	$\%O_2$ =	4.6
	Increase		V_w = 138	%CO =	0.0
			P_m = ~~0.549~~ 0.551	$\%N_2$ =	80.8
Impinger 6	Final Weight	739.3	Avg ΔP = ~~0.891~~ ~~0.858~~ 0.891	A_s =	~~21024~~ 16,279
	Initial Weight	739.6		D_n =	0.190
	Increase		Avg$\sqrt{\Delta P}$ = ~~0.901~~ 0.931	T_i =	128
			C_p = 0.806		
Impinger 7	Final Weight	720.6	P_s = ~~-14~~ -14.0 "H_2O	28.86	"Hg
	Initial Weight	714.4	T_m = 56 °F	516	°R
	Increase		T_s = ~~305.813~~ ~~306~~ 315 °F	~~766~~ 775	°R

Water Weight Gain

Moisture Content: %M = 10.84 M_d = .8916 MW_d = 30.520 MW = 29.16

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 52.347 \left[\frac{29.89 + \frac{0.551}{13.6}}{56 + 460}\right] = \frac{53.592\ sft^3}{0.419\ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 138 = 6.514 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{6.514}{53.592 + 6.514}$ x 100 = 10.84 %

V_s = 5123.8 x 0.806 $\sqrt{\frac{\cancel{766}\ 775}{28.86 \times 29.16}}$ x $\frac{\cancel{0.901}\ 0.931}{}$ = ~~3550~~ 3650 fpm

%I = $\frac{1{,}039 \times \cancel{766}\ 775 \times 53.592}{128 \times 28.86 \times .8916 \times \cancel{3550}\ 3650 \times (.190)^2}$ = ~~101.0~~ 99.4 %

ACFM: ~~578295~~ 412,630

SCFM: ~~308380~~ 242,656

%EA: 27.4

Run Number 1 ✓ 04 FIELD DATA

Unit Unit ESP Inlet Duct ✓

Date 10-25-05 ✓

			ΔP_s		P_m		T_s				T_m		
Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1	1421	595.39	1.00	0.65	0.65	7.5	308	265	267	51	59	54	
–	1425	596.635	–	–	–	–	–	–	–	–	–	–	
9-4	1443	600.593	0.25	0.15	0.15	4.0	321	278	268	48	56	52	
3	1447	601.76	0.25	0.15	0.15	4.0	321	280	267	50	57	55	V=3.858
2	1451	602.99	0.25	0.15	0.15	4.0	321	271	265	51	57	56	
1	1455	603.81	0.15	0.09	0.09	3.5	318	267	272	50	57	55	
–	1459	604.795	–	–	–	–	–	–	–	–	–	–	
10-4	1459	604.795	0.55	0.34	0.34	5.0	325	265	272	51	58	56	
3	1503	606.16	0.70	0.44	0.44	5.5	323	264	274	50	59	56	
2	1507	607.69	0.70	0.44	0.44	5.5	322	261	277	50	59	57	
1	1511	609.27	0.50	0.30	0.30	5.5	321	259	275	50	59	56	
–	1515	610.675	–	–	–	–	–	–	–	–	–	–	
11-4	1515	610.675	1.00	0.65	0.65	7.5	322	263	273	51	58	55	
3	1519	612.32	1.00	0.65	0.65	7.5	321	267	267	53	58	55	
2	1523	614.18	0.85	0.54	0.54	7.5	321	263	267	51	58	55	
1	1527	615.87	0.65	0.40	0.40	~~6.5~~ 7.0	322	262	273	53	62	57	
–	1531	617.445	–	–	–	–	–	–	–	–	–	–	
12-4	1531	617.445	0.95	0.60	0.60	8.0	323	268	269	51	63	58	
3	1535	619.21	1.00	0.65	0.65	8.0	324	267	266	53	62	58	
2	1539	620.95	1.20	0.75	0.75	9.0	323	267	269	52	66	58	
1	1543	622.88	1.05	0.65	0.65	9.0	325	266	270	52	64	57	
–	1547	624.899	–	–	–	–	–	–	–	–	–	–	

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22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number 05-235 ✓ | 014 Field Data | Ambient Temp. °F 52

Job Name ADA-ES ✓ | Assumed Moisture % 14

Run Number 2 ✓ | Read and record at the start of each test point. | Probe Length 5ft

Unit Unit 2 ESP Inlet Duct ✓ | C Factor 1-0.62 to reference.

Date 10-25-05 ✓ | Purge to: — | Initial Leak @ 15.0 "Hg = 0.000 cfm ✓

Operator Orr, Postheck, Bornsen | Purge time: — | Final Leak @ 18.0 "Hg = 0.000 cfm ✓

Sample box No. 79 Meter Box No. 31-1 ✓ | Pitot Leak Check Initial ✓ Final ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1643	625.485	1.10	0.70	0.70	8.0	327	291	248	51	57	57	
3	1647	627.07	1.10	0.70	0.70	8.0	327	279	248	48	59	58	
2	1651	628.91	1.20	0.75	0.75	8.0	327	270	260	53	58	59	
1	1655	630.70	1.05	0.65	0.65	8.0	330	265	269	52	59	58	
—	1659	632.532	—	—	—	—	—	—	—	—	—	—	
11-4	1659	632.532	1.00	0.65	0.65	7.5	328	266	282	49	60	58	
3	1703	634.32	1.05	0.65	0.65	7.5	328	262	280	48	58	58	
2	1707	635.93	0.95	0.60	0.60	7.5	326	263	274	51	59	58	
1	1711	637.59	0.70	0.44	0.44	6.5	326	263	270	51	59	58	
—	1715	639.085	—	—	—	—	—	—	—	—	—	—	
10-4	1715	639.085	0.80	0.50	0.50	6.5	323	267	270	53	61	58	
3	1719	640.46	0.85	0.54	0.54	6.5	323	263	269	52	62	58	
2	1723	642.02	0.80	0.50	0.50	6.5	323	263	268	52	62	58	
1	1727	643.54	0.70	0.44	0.44	6.5	323	262	265	53	61	58	
—	1731	645.995	—	—	—	—	—	—	—	—	—	—	
8-4	1731	645.995	0.20	0.12	0.12	3.0	314	263	264	52	61	58	
3	1735	645.97	0.33	0.22	0.22	3.5	319	258	264	54	61	58	
2	1739	646.91	0.20	0.12	0.12	3.0	319	259	265	54	61	58	

Pitot Tube Calibration Factor C_p .806 ✓ low

Volume Collected V_m ~~49.08~~ 49.473 ft^3

Water Collected V_w 132.1 ✓ ml

Time of Test T_t 128 ✓ min.

Stack Pressure P_s -14.0 ✓ H_2O

Pitot Tube No. 31-5-1 ✓

Baro. Press. P_b 29.81 ✓ "Hg

Probe Tip Dia. D_n 0.190 ✓ in.

% CO_2 14.4 ✓ % CO 0.0 ✓

% O_2 4.6 ✓ % N_2 81.0 ✓

Area Stack A_s ~~21,024~~ ✓ in^2

16,279

Barometer No. 31-1 ✓ Probe Tip No. 05-233-7 ✓

Total Volume of Leak Checks After Start: — ft^3

V_m = Dry Gas Meter Calibration Factor 1.008 ✓ x 49.080 ✓

{Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

VERSION 1
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Impinger Box No. 79

Impinger 1	Final Weight	810.7		Impinger 1	75.2
	Initial Weight	735.5			
	Increase		955.6	Impinger 2	20.3
Impinger 2	Final Weight	729.6	Imp. 8 940.0	Impinger 3	4.6
	Initial Weight	709.3			
	Increase			Impinger 4	2
			V_w =		
Impinger 3	Final Weight	746.6	g SO_2 = - —	Impinger 5	0.3
	Initial Weight	742.0	V_w =		
	Increase			Impinger 6	12.2
Impinger 4	Final Weight	715.4		Impinger 7	1.9
	Initial Weight	713.4		Impinger 8	15.6
	Increase			Total	132.1 = V_w
Impinger 5	Final Weight	748.1	P_b = 29.84	$\%CO_2$ =	14.4
	Initial Weight	747.8	V_m = ~~49.084~~ 49.473	$\%O_2$ =	4.6
	Increase		V_w = 132.1	%CO =	0.0
			P_m = 0.571	$\%N_2$ =	81.0
Impinger 6	Final Weight	685.0	Avg ΔP = 0.904	A_s =	~~31024~~ 16,279
	Initial Weight	672.8		D_n =	0.190
	Increase		Avg$\sqrt{\Delta P}$ = 0.921	T_t =	128
			C_p = 0.806		
Impinger 7	Final Weight	633.0	P_s = -14.0 "H_2O	28.81	"Hg
	Initial Weight	631.1	T_m = 60 °F	520	°R
	Increase		T_s = 318 °F	778	°R

Moisture Content: %M = ~~11.06~~ 11.05 M_d = ~~0.8894~~ 0.8895 MW_d = 30.488 MW = 29.11

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{49.08}\ 49.413 \left[\frac{29.84 + \frac{0.571}{13.6}}{60 + 460}\right] = \cancel{50.128}\ 50.179\ sft^3 = \cancel{0.3928}\ 0.3928\ scfm$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 132.1 = 6.235 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{\cancel{132.1}\ 6.235}{\cancel{50.128}\ 50.179 + \cancel{132.1}\ 6.235}$ x 100 = ~~11.06~~ 11.05 %

V_s = 5123.8 x 0.806 $\sqrt{\frac{778}{28.81 \times 29.11}}$ x 0.921 = 3663 fpm

ACFM: ~~584856~~ 414,142

SCFM: ~~311974~~ 241,590

%I = $\frac{1,039 \times 778 \times \cancel{50.128}\ 50.179}{128 \times 28.81 \times \cancel{0.8894}\ 0.8895 \times 3663 \times (.190)^2}$ = ~~93.4~~ 93.5 %

%EA: 27.3

VERSION 1
22 OCTOBER 2002

Run Number 2 ✓ 04 FIELD DATA

Unit Unit 2 ESP Inlet Duct ✓

Date 10-25-05 ✓

.099

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1	1743	647.68	0.25	0.15	0.15	3.0	319	263	264	54	61	59	
–	1747	648.505	–	–	–	–	–	–	–	–	–	–	
4-4	1747	648.505	1.30	0.85	0.85	9.5	310	263	256	53	62	59	
3	1751	650.04	1.30	0.85	0.85	9.5	310	263	256	53	62	59	
2	1755	651.85	1.20	0.75	0.75	9.5	310	260	255	55	63	59	
1	1759	653.79	0.95	0.60	0.60	9.0	311	265	257	54	64	59	
–	1803	655.435	–	–	–	–	–	–	–	–	–	–	
3-4	1803	655.435	1.20	0.75	0.75	9.5	310	264	254	53	63	57	
3	1807	657.19	1.20	0.75	0.75	9.5	310	262	255	54	63	59	
2	1811	659.05	1.10	0.70	0.70	10.0	311	262	258	54	63	59	
1	1815	660.89	0.50	0.30	0.30	6.0	311	263	257	53	63	59	
–	1819	662.075	–	–	–	–	–	–	–	–	–	–	
2-4	1819	662.075	1.20	0.75	0.75	9.0	312	260	255	56	64	63	
3	1823	663.74	1.20	0.75	0.75	9.0	312	263	255	56	64	63	
2	1827	665.49	1.05	0.65	0.65	9.5	311	262	256	57	65	60	
1	1831	667.19	0.80	0.50	0.50	8.5	312	262	256	57	65	60	
–	1835	668.755	–	–	–	–	–	–	–	–	–	–	
1-4	1835	668.755	1.40	0.90	0.90	11.0	312	258	253	56	64	60	
3	1839	670.52	1.40	0.90	0.90	11.0	313	255	253	57	64	59	
2	1843	672.39	0.80	0.50	0.50	9.5	313	253	252	57	64	59	
1	1847	673.96	.05	.03	.03	2.5	312	253	252	57	64	59	0.05
–	1851	674.565	–	–	–	–	–	–	–	–	–	–	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number 05-235 ✓ | DH Field Data | Ambient Temp. °F 55

Job Name ADA-ES ✓ | Assumed Moisture % 14.0

Run Number 3 ✓ | Read and record at the start of each test point. | Probe Length 5 ft

Unit Unit 2 ESP Inlet Duct ✓ | C Factor 1 - 0.64 to reference.

Date 10-26-05 ✓ | Purge to: – | Initial Leak @ 15.0 "Hg = 0.000 cfm ✓

Operator Orr, Postek | Purge time: – | Final Leak @ 17.0 "Hg = 0.000 cfm ✓

Sample box No. 51-3 Meter Box No. 31-1 ✓ | Pitot Leak Check Initial ✓ Final ✓ ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1230	675.255	1.30	0.85	0.85	8.0	306	271	251	61	62	61	
3	1234	677.21	1.30	0.85	0.85	8.0	305	248	253	61	62	61	
2	1238	679.24	1.40	0.90	0.90	8.0	305	248	256	60	61	61	
1	1242	681.25	1.00	0.65	0.65	7.0	306	248	260	60	63	60	
–	1246	683.085	–	–	–	–	–	–	–	–	–	–	
2-4	1246	683.085	1.05	0.70	0.70	6.5	306	257	263	61	65	63	
3	1250	684.82	1.05	0.70	0.70	6.5	306	252	263	61	65	63	
2	1254	686.57	0.60	0.40	0.40	5.0	307	253	262	63	67	63	
1	1258	687.95	0.50	0.34	0.34	3.0	306	254	263	62	67	60	
–	1302	688.715	–	–	–	–	–	–	–	–	–	–	
3-4	1302	688.715	~~0.95~~ 1.00	0.65	0.65	6.5	305	266	265	65	65	62	
3	1306	689.94	1.00	0.65	0.65	6.5	306	260	266	64	69	62	
2	1310	691.68	0.95	0.64	0.64	6.5	305	254	267	65	68	63	
1	1314	693.36	0.60	0.40	0.40	5.0	305	259	263	66	68	62	
–	1318	694.705	–	–	–	–	–	–	–	–	–	–	
4-4	1318	694.705	1.05	0.70	0.70	7.0	305	255	263	65	69	63	
3	1322	696.34	1.05	0.70	0.70	7.5	305	255	263	65	69	63	
2	1326	698.18	1.20	0.80	0.80	8.0	306	251	266	66	72	64	

Pitot Tube Calibration Factor C_p 0.806 Low ✓

Volume Collected V_m ~~48.870~~ ft^3 49.261

Water Collected V_w 126.1 ✓ ml

Time of Test T_t 128 ✓ min.

Stack Pressure P_s -14.0 ✓ "H_2O

Pitot Tube No. 31-5-1 ✓

Baro. Press. P_b 29.90 ✓ "Hg

Probe Tip Dia. D_n 0.190 ✓ in.

% CO_2 14.6 ✓ % CO 0.0 ✓

% O_2 4.4 ✓ % N_2 81.0 ✓

Area Stack A_s ~~21024~~ ✓ in^2 16279.

Barometer No. 31-1 ✓ Probe Tip No. 05-235-7 ✓

Total Volume of Leak Checks After Start: 0.606 ✓ ft^3

V_m = Dry Gas Meter Calibration Factor 1.008 ✓ X 48.870 ✓

{Dry Gas Meter Reading ___ ft^3 – (T_t ___ min. X Leak Rate ___ cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 51-3

Impinger 1	Final Weight	821.2		Impinger 1	78.1
	Initial Weight	743.1	#8 1022.4 / 1006.9	Impinger 2	18.8
	Increase			Impinger 3	4.6
Impinger 2	Final Weight	654.6		Impinger 4	3.2
	Initial Weight	635.8			
	Increase		V_w =	Impinger 5	0.1
Impinger 3	Final Weight	714.0	g SO_2 = –	Impinger 6	6.8
	Initial Weight	709.4	V_w =		
	Increase			Impinger 7	1.0
Impinger 4	Final Weight	745.6		Imp 8	15.5
	Initial Weight	742.4		Total	128.1 ✓ = V_w
	Increase				

Water Weight Gain

Impinger 5	Final Weight	656.9	P_b =	29.90 ✓	$\%CO_2$ =	14.6 ✓
	Initial Weight	656.8	V_m =	~~48.870~~ 49.261 ✓	$\%O_2$ =	4.4 ✓
	Increase	0.1	V_w =	128.1 ✓	%CO =	0.0 ✓
			P_m =	~~0.560~~ 0.563	$\%N_2$ =	81.0 ✓
Impinger 6	Final Weight	739.3	Avg ΔP =	0.846 ✓	A_s =	~~21.024~~ ✓ 16.279 ✓
	Initial Weight	732.5			D_n =	0.190 ✓
	Increase		Avg$\sqrt{\Delta P}$ =	0.900 ✓	T_t =	128 ✓
			C_p =	0.806 ✓		
Impinger 7	Final Weight	711.1	P_s =	-14.0 ✓ "H_2O	28.87 ✓	"Hg
	Initial Weight	710.1	T_m =	67 ✓ °F	527 ✓	°R
	Increase	1.0	T_s =	315 ✓ °F	775 ✓	°R

Moisture Content: %M = ~~10.98~~ 10.91 ✓ M_d = ~~0.8902~~ 0.8909 ✓ MW_d = 30.512 ✓ MW = ~~27.16~~ ~~29.14~~ 29.15 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{48.870}\ 49.261 \left[\frac{29.90 + \frac{\cancel{0.560}\ 0.563}{13.6}}{67 + 460}\right] = \cancel{49.006}\ 49.398\ \text{sft}^3 \quad \cancel{0.383}\ 0.386\ \text{scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 128.1 ✓ = 6.046 ✓ sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{6.046}{\cancel{49.006}\ 49.398 + 6.046}$ x 100 = ~~10.98~~ 10.91 ✓ %

V_s = 5123.8 x 0.806 ✓ $\sqrt{\frac{775}{28.87 \times \cancel{29.14}\ 29.15}}$ ✓ x 0.900 ✓ = 3567 ✓ fpm

ACFM: ~~520841~~ 403,221 ✓

SCFM: ~~3530584~~ 237,034 ✓

%I = $\frac{1{,}039 \times 775 \times \cancel{49.006}\ 49.398}{128 \times 28.87 \times \cancel{0.8902}\ 0.8909 \times 3567 \times (.190)^2}$ = ~~43.2~~ 93.8 ✓ %

%EA: 25.8 ✓

Run Number 3 ✓ 04 FIELD DATA

Unit Unit 2 ESP Inlet Duct ✓

Date 10-26-05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1	1330	700.07	0.90	0.63	0.63	7.5	306	254	263	67	71	65	
–	1334	701.835	–	–	–	–	–	–	–	–	–	–	✓ 0.66
8-4	1336	702.495	0.25	0.17	0.17	3.0	318	257	262	59	71	65	
3	1340	703.31	0.30	0.19	0.19	3.0	319	257	263	59	71	65	
2	1344	704.17	0.20	0.13	0.13	3.0	320	251	262	56	69	65	
1	1348	704.93	0.25	0.17	0.17	3.0	324	255	264	57	69	65	
–	1352	705.765	–	–	–	–	–	–	–	–	–	–	
10-4	1352	705.765	0.75	0.50	0.50	6.0	325	264	262	58	69	65	
3	1356	707.09	0.75	0.50	0.50	6.0	325	250	263	56	70	66	
2	1400	708.58	0.80	0.54	0.54	6.5	325	252	263	56	70	66	
1	1404	710.12	0.48	0.32	0.32	5.0	325	253	264	57	70	66	
–	1408	711.395	–	–	–	–	–	–	–	–	–	–	
11-4	1408	711.395	0.95	0.64	0.64	7.5	327	258	266	55	72	67	
3	1412	713.46	0.95	0.64	0.64	7.5	326	258	265	55	72	67	
2	1416	714.69	0.80	0.54	0.54	7.5	328	253	268	57	73	67	
1	1420	716.31	0.75	0.50	0.50	7.0	327	255	268	56	73	67	
–	1424	717.895	–	–	–	–	–	–	–	–	–	–	
12-4	1424	717.895	1.00	0.67	0.67	8.0	327	262	271	60	73	66	
3	1428	719.57	1.00	0.67	0.67	8.0	327	262	271	60	73	66	
2	1432	721.37	1.20	0.80	0.80	10.0	328	262	268	60	73	66	
1	1436	723.25	0.70	0.48	0.48	7.5	328	262	269	60	75	69	
–	1440	724.795	–	–	–	–	–	–	–	–	–	–	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-235 task 3 ✓ | PM/HCL Field Data | Ambient Temp. °F: 47

Job Name: ADA-ES ✓ | Assumed Moisture %: 14

Run Number: 1 ✓ | Read and record at the start of each test point. | Probe Length: 5'

Unit: ESP Outlet Duct ✓ | C Factor: 10-5.6 to reference.

Date: 10/25/05 ✓ | Purge to: — | Initial Leak @ 15 "Hg = 0.000 cfm ✓

Operator: Ware / Dotson / Borenson | Purge time: — | Final Leak @ 15 "Hg = 0.000 cfm ✓

Sample box No. 49-3 | Meter Box No. 49-1 ✓ | Pitot Leak Check Initial ✓ Final ✓ ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	P_m Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated Line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1 4	1342	61.090	0.29	0.52	0.52	3.0	292	272	250	46	51	50	Pump off 1343 61.850
3	1348	62.69	0.55	1.00	1.00	4.0	292	254	250	45	51	50	Pump on 1345
2	1352	64.64	0.60	1.10	1.10	4.0	300	279	280	45	51	50	
1	1356	66.28	0.30	0.52	0.52	3.0	292	298	251	44	51	50	
End	1400	67.965	—	—	—	—	—	—	—	—	—	—	
2 4	1404	67.965	0.73	1.30	1.30	5.0	299	300	298	45	52	51	
3	1406	69.83	0.85	1.50	1.50	6.0	307	290	~~301~~ 290	45	52	51	
2	1410	72.37	0.92	1.60	1.60	6.0	304	301	270	46	52	51	
1	1414	75.23	0.70	1.15	1.10	5.0	298	298	265	48	52	51	
End	1418	77.590	—	—	—	—	—	—	—	—	—	—	
3 4	1420	77.590	0.50	0.90	0.90	4.0	302	300	265	48	52	51	
3	1424	79.45	0.51	0.90	0.90	4.0	309	295	255	51	53	51	
2	1428	81.74	0.67	1.20	1.20	5.0	308	300	259	51	53	51	
1	1432	84.24	0.67	1.20	1.20	5.0	308	290	257	50	53	51	
End	1436	86.230	—	—	—	—	—	—	—	—	—	—	
4 4	1438	86.230	0.77	1.40	1.40	5.0	309	296	252	54	53	51	
3	1442	88.42	0.68	1.20	1.20	5.0	312	305	256	54	54	52	
2	1446	90.93	0.55	0.95	0.95	4.0	312	291	256	56	54	52	

Pitot Tube Calibration Factor C_p 0.808 ✓

Volume Collected V_m 71.087 ✓ ft^3

Water Collected V_w 270.1 ✓ ml

Time of Test T_t 128 ✓ min.

Stack Pressure P_s -14.5 ✓ "H_2O

Pitot Tube No. 49-5-2 ✓

Baro. Press. P_b 29.89 ✓ "Hg

Probe Tip Dia. D_n 0.247 ✓ in.

% CO_2 14.2 ✓ % CO 0.0 ✓

% O_2 4.8 ✓ % N_2 81.0 ✓

Area Stack A_s 21024 ✓ in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-233-8 ✓

Total Volume of Leak Checks After Start: — ft^3 1.013 Su

V_m = Dry Gas Meter Calibration Factor 70.175 ✓ x ~~1.003~~.

{Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 49-3

Impinger 1	Final Weight	940.4		Impinger 1	199.5
	Initial Weight	740.9			
	Increase			Impinger 2	37.5
Impinger 2	Final Weight	794.1		Impinger 3	9.2
	Initial Weight	756.6			
	Increase			Impinger 4	5.3
			V_w =		
Impinger 3	Final Weight	649.5	g SO_2 = -	Impinger 5	-1.0
	Initial Weight	640.3	V_w =		
	Increase			Impinger 6	19.6
Impinger 4	Final Weight	753.7		Impinger 7	
	Initial Weight	748.4			
	Increase			Total	270.1 = V_w
Impinger 5	Final Weight	738.0	P_b = 29.89	$\%CO_2$ =	14.2
	Initial Weight	739.0	V_m = ~~70.175~~ 71.087	$\%O_2$ =	4.8
	Increase		V_w = 270.1	%CO =	0.0
			P_m = 1.128	$\%N_2$ =	81.0
Impinger 6	Final Weight	960.0	Avg ΔP = 0.632	A_s =	21024
	Initial Weight	940.4		D_n =	0.247
	Increase		Avg$\sqrt{\Delta P}$ = 0.787	T_t =	128
			C_p = 0.808		
Impinger 7	Final Weight		P_s = -14.5 "H_2O	28.82 "Hg	
	Initial Weight		T_m = 53 °F	513 °R	
	Increase		T_s = 312 °F	772 °R	

Water Weight Gain

Moisture Content: %M = 14.81 M_d = 0.8519 MW_d = 30.464 MW = 28.62

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{70.175}\ 71.087 \left[\frac{29.89 + \frac{1.128}{13.6}}{53 + 460}\right] = 73.307\ sft^3 = 0.573\ scfm$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 270.1 = 12.749 sft^3

$$\%\ Moisture = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{12.749}{73,313\ \cancel{73.307} + 12.749} \times 100 = 14.81\ \%$$

$$V_s = 5123.8 \times 0.808 \sqrt{\frac{772}{28.82 \times 28.62}} \times 0.787 = 3152\ fpm$$

ACFM: 460 212

SCFM: ~~258918~~ 259,226

$$\%I = \frac{1,039 \times 772 \times 73.307}{128 \times 28.82 \times 0.8519 \times 3152 \times (0.247)^2} = 97.3\ \%$$

%EA: ~~377.5~~ 28.8

VERSION 1
22 OCTOBER 2002

Run Number 1 ✓ 17/26 A FIELD DATA

Unit Esp outlet Duct ✓

Date 10/25/05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1	1450	93.16	0.55	0.95	0.95	4.0	310	274	260	57	54	52	
End	1454	94.900	—	—	—	—	—	—	—	—	—	—	
9 4	1458	94.90	0.60	1.10	1.10	5.0	321	290	254	56	54	52	
3	1502	97.85	0.62	1.20	1.20	5.0	322	305	265	56	54	52	
2	1506	99.45	0.48	0.85	0.85	4.0	324	300	267	55	54	52	
1	1510	101.65	0.53	0.92	0.92	4.0	330	304	267	55	54	52	
End	1514	103.268	—	—	—	—	—	—	—	—	—	—	
10 4	1517	103.268	0.85	1.50	1.50	6.0	320	267	268	55	54	52	
3	1521	105.75	0.66	1.20	1.20	5.0	320	275	267	55	54	53	
2	1525	108.14	0.75	1.40	1.40	6.0	321	290	269	56	54	53	
1	1529	110.52	0.67	1.20	1.20	5.0	321	299	272	57	55	53	
End	1534	113.555	~~0.72~~	~~1.30~~	~~1.30~~	~~5.0~~	~~320~~	~~295~~	~~278~~	~~58~~	~~55~~	~~53~~	
11 4	1536	113.555	0.72	1.30	1.30	5.0	320	295	278	58	55	53	
3	1540	115.57	0.76	1.40	1.40	6.0	321	289	281	60	55	53	
2	1544	118.52	0.76	1.40	1.40	6.0	321	284	282	60	55	53	
1	1548	120.67	0.69	1.20	1.20	5.0	322	283	283	60	55	53	
End	1552	123.070	—	—	—	—	—	—	—	—	—	—	
12-4	1554	123.070	0.75	1.40	1.40	6.0	298	270	282	60	55	54	
3	1558	125.63	0.83	1.50	1.50	6.0	323	267	281	61	55	54	
2	1602	128.07	0.45	0.80	0.80	4.0	323	268	281	61	55	54	
1	1606	129.65	0.25	0.40	0.40	2.0	320	274	282	61	55	54	
End	1610	131.265	—	—	—	—	—	—	—	—	—	—	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-235 task 3 ✓
Job Name: ADA-ES ✓
Run Number: 2 ✓
Unit: ESP Outlet Duct ✓
Date: 10/25/05 ✓
Operator: Ware / Dodge / Barnsen
Sample box No. 49-2 Meter Box No. 49-1 ✓

Pm / HCl Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓ ✓

Ambient Temp. °F 52
Assumed Moisture % 14%
Probe Length 5'
C Factor 5.6-10 to reference.
Initial Leak @ 14.0 "Hg = 0.000 cfm ✓
Final Leak @ 10.0 "Hg = 0.000 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1723	137.01	0.55	1.0	1.0	4.0	302	300	280	48	55	55	
3	1727	138.47	0.85	1.5	1.5	5.0	325	286	281	47	55	55	
2	1731	141.22	0.45	0.8	0.8	3.5	327	286	282	47	55	55	
1	1735	143.37	0.25	0.45	0.45	2.0	215	275	287	46	55	55	
End	1739	144.650	—	—	—	—	—	—	—	—	—	—	
11-4	1741	144.650	0.56	1.0	1.0	4	288	274	286	47	56	55	
3	1745	146.77	0.72	1.3	1.3	4.5	323	267	286	47	56	55	
2	1749	149.16	0.95	1.7	1.7	6.0	326	267	287	46	56	55	
1	1753	151.94	0.80	1.4	1.4	5.0	315	264	284	46	57	55	
End	1757	154.510	—	—	—	—	—	—	—	—	—	—	
10-4	1759	154.510	0.75	1.3	1.3	4.5	311	273	280	47	56	55	
3	1803	156.87	0.65	1.2	1.2	4.0	322	265	273	47	57	55	
2	1807	158.72	0.85	1.5	1.5	5.0	322	267	272	47	57	56	
1	1811	161.54	0.58	1.1	1.1	4.0	322	264	267	48	57	56	
End	1815	163.770	—	—	—	—	—	—	—	—	—	—	
9-4	1817	163.770	0.58	1.1	1.1	4.0	309	268	270	47	56	57	
3	1821	166.46	0.60	1.1	1.1	4.0	323	267	274	49	57	56	
2	1825	168.25	0.52	0.95	0.95	4.0	322	264	275	49	57	55	

Pitot Tube Calibration Factor C_p 0.808 ✓
Volume Collected V_m ~~70.485~~ ~~9.58~~ ft^3
Water Collected V_w 204.3 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.5 ✓ "H_2O

Pitot Tube No. 40-5-2 ✓
Baro. Press. P_b 29.84 ✓ "Hg
Probe Tip Dia. D_n 0.247 in.
% CO_2 ~~14.0~~ 14.2 % CO 0.0 ✓
% O_2 ~~5.0~~ 4.8 ✓ % N_2 81.0 ✓
Area Stack A_s 21024 ✓ in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-237-8 ✓
Total Volume of Leak Checks After Start: — ft^3
V_m = Dry Gas Meter Calibration Factor 69.580 X 1.013 ✓

{Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 49-3

Impinger 1	Final Weight	794.0		Water Weight Gain	
	Initial Weight	624.0		Impinger 1	170.0
	Increase	170.0		Impinger 2	22.3
Impinger 2	Final Weight	786.4		Impinger 3	7.6
	Initial Weight	764.1			
	Increase	22.3		Impinger 4	2.0
			V_w =		
Impinger 3	Final Weight	561.2	g SO_2 = -	Impinger 5	1.9
	Initial Weight	553.6	V_w =		
	Increase	7.6		Impinger 6	0.5
Impinger 4	Final Weight	746.0		Impinger 7	—
	Initial Weight	744.0			
	Increase	2.0		Total	204.3 = V_w
Impinger 5	Final Weight	733.9	P_b = 29.84	%CO_2 =	14.2
	Initial Weight	732.0	V_m = ~~69.58~~ 70.485	%O_2 =	4.8
	Increase	1.9	V_w = 204.3	%CO =	0.0
			P_m = 1.1053	%N_2 =	81.0
Impinger 6	Final Weight	953.4	Avg ΔP = 0.617 ~~0.875~~	A_s =	21024
	Initial Weight	952.9		D_n =	0.247
	Increase	0.5	Avg$\sqrt{\Delta P}$ = ~~0.7767~~ 0.777	T_t =	128
			C_p = 0.808		
Impinger 7	Final Weight		P_s = -14.5 "H_2O	28.77	"Hg
	Initial Weight		T_m = 56.39 °F	516.39	°R
	Increase		T_s = 302 °F	762.0	°R

Moisture Content: %M = 11.79 M_d = 0.8821 MW_d = 30.464 MW = 28.99

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{69.58}\ 70.485 \left[\frac{29.84 + \frac{1.1053}{13.6}}{56.39 + 460}\right] = \cancel{71.213}\ 72.139\ sft^3 = \cancel{0.556}\ 0.564\ scfm$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 204.3 = ~~34.75486~~ 9.643 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{\cancel{164.3}\ 9.643}{\cancel{71.213}\ 72.139 + \cancel{164.3}\ 9.643}$ x 100 = 11.79 %

V_s = 5123.8 x 0.808 $\sqrt{\frac{762}{28.99 \times 28.77}}$ x 0.777 = ~~3074.79~~ 3075 fpm

ACFM: 448912

SCFM: 264831

%I = $\frac{1{,}039 \times 72.139 \times 762}{128 \times 28.77 \times 0.8821 \times \cancel{3074.79}\ 3075 \times (0.247)^2}$ = 93.7 %

%EA: 28.8

VERSION 1
22 OCTOBER 2002

Run Number 2 ✓ Pm / HCL **FIELD DATA**

Unit Esp outlet Duct ✓

Date 10/25/05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated Line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1	1829	170.25	0.51	0.90	0.90	4.0	322	266	272	50	56	55	
End	1833	172.275	—	—	—	—	—	—	—	—	—	—	
4-4	1837	172.275	0.78	1.40	1.40	5.0	307	272	270	50	56	56	
3	1841	174.81	0.65	1.15	1.15	5.0	314	270	271	52	56	55	
2	1845	176.84	0.54	0.95	0.95	4.0	311	268	272	49	56	55	
1	1849	178.82	0.40	0.75	0.75	3.0	303	264	280	49	56	55	
End	1853	180.885	—	—	—	—	—	—	—	—	—	—	
3-4	1855	180.885	0.60	1.10	1.10	4.0	302	265	278	50	56	55	
3	1859	183.23	0.50	0.90	0.90	4.0	312	272	279	50	56	55	
2	1903	185.13	0.75	1.40	1.40	4.0	312	272	279	50	56	55	
1	1907	187.45	0.56	0.95	0.95	4.0	282	270	268	51	56	55	
End	1911	189.505	—	—	—	—	—	—	—	—	—	—	
2-4	1914	189.505	0.68	1.20	1.20	5.0	294	271	280	52	55	55	
3	1918	191.75	0.81	1.45	1.45	5.0	307	273	278	52	55	55	
2	1922	194.25	0.88	1.50	1.50	5.0	304	272	277	51	55	55	
1	1926	196.89	0.78	1.4	1.4	5.0	260	272	271	51	55	55	
End	1930	199.410	—	—	—	—	—	—	—	—	—	—	
1-4	1932	199.410	0.33	0.59	0.59	3.0	293	272	273	54	55	55	
3	1936	200.75	0.54	0.95	0.95	4.0	301	268	272	54	55	55	
2	1940	202.76	0.56	1.00	1.00	4.0	292	269	270	55	55	55	
1	1944	205.15	0.22	0.38	0.38	2.0	200	270	270	57	55	55	
End	1948	206.590	—	—	—	—	—	—	—	—	—	—	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-235 task3 ✓
Job Name: ADA-ES ✓
Run Number: 3 ✓
Unit: 2 ESP Outlet Duct ✓
Date: 10/26/05 ✓
Operator: Ware/Dodge/Bornsen
Sample box No. 49-3 Meter Box No. 49-1 ✓

PM/HCL Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓ ✓

Ambient Temp. °F 57
Assumed Moisture % 14%
Probe Length 5'
C Factor _____ to reference.
Initial Leak @ 14 "Hg = 0.000 cfm ✓
Final Leak @ 14 "Hg = 0.000 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated Line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1249	207.605	0.30	0.54	0.54	3.0	292	300	267	58	56	55	
3	1253	209.08	0.49	0.85	0.85	4.0	301	320	272	55	57	54	
2	1257	210.92	0.48	0.85	0.85	4.0	298	310	270	53	58	55	
1	1301	212.85	0.20	0.36	0.36	2.0	265	307	272	53	58	55	
End	1305	214.215	—	—	—	—	—	—	—	—	—	—	
2-4	1306	214.215	0.85	1.50	1.50	6.0	303	292	274	53	59	55	
3	1310	216.71	0.88	1.50	1.50	6.0	306	286	273	51	60	55	
2	1314	219.52	0.88	1.50	1.50	6.0	305	285	275	52	60	56	
1	1318	221.71	0.77	1.40	1.40	6.0	298	290	273	52	61	56	
End	1322	224.230	—	—	—	—	—	—	—	—	—	—	
3-4	1323	224.230	0.65	1.20	1.20	5.0	307	285	270	53	60	56	
3	1327	226.25	0.52	0.95	0.95	4.5	308	295	274	53	60	56	
2	1331	228.40	0.72	1.30	1.30	5.5	307	298	272	54	61	57	
1	1335	230.58	0.50	0.90	0.90	4.5	303	301	275	54	62	57	
End	1339	232.605	—	—	—	—	—	—	—	—	—	—	
4-4	1343	232.605	0.78	1.40	1.40	6.0	309	306	274	57	61	57	
3	1347	234.97	0.72	1.30	1.30	6.0	311	298	275	54	62	58	
2	1351	237.08	0.52	0.95	0.95	5.0	311	298	267	55	62	58	

Pitot Tube Calibration Factor C_p 0.808 ✓
Volume Collected V_m 69.320 ✓ ft^3
Water Collected V_w 175.6 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.5 ✓ "H_2O

Pitot Tube No. 49-S-2 ✓
Baro. Press. P_b ~~29.17~~ 29.90 "Hg
Probe Tip Dia. D_n 0.247 ✓ in.
% CO_2 14.2 ✓ % CO 0.0 ✓
% O_2 4.8 ✓ % N_2 81.0 ✓
Area Stack A_s 21024 ✓ in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-233-8 ✓
Total Volume of Leak Checks After Start: — ft^3
V_m = Dry Gas Meter Calibration Factor 68.430 ✓ x 1.013 ✓

{Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 49-3

Impinger 1	Final Weight	872.2		Impinger 1	131.0
	Initial Weight	741.2			
	Increase			Impinger 2	19.5
Impinger 2	Final Weight	775.5		Impinger 3	3.5
	Initial Weight	756.0			
	Increase			Impinger 4	~~4~~ 2.9
Impinger 3	Final Weight	645.2	V_w =	Impinger 5	0.4
	Initial Weight	641.7	g SO_2 = - —		
	Increase		V_w =	Impinger 6	18.3
Impinger 4	Final Weight	749.8		Impinger 7	
	Initial Weight	746.9			
	Increase			Total	175.6 ✓ = V_w
Impinger 5	Final Weight	737.2	P_b = 29.90 ✓	%CO_2 =	14.2 ✓
	Initial Weight	736.8	V_m = 69.320 ✓	%O_2 =	4.8 ✓
	Increase		V_w = 175.6 ✓	%CO =	0.0 ✓
			P_m = 1.100 ✓	%N_2 =	81.0 ✓
Impinger 6	Final Weight	978.1	Avg ΔP = 0.623 ✓	A_s =	~~0.247~~ 21024 ✓
	Initial Weight	959.8		D_n =	0.247 ✓
	Increase		Avg$\sqrt{\Delta P}$ = 0.781 ✓	T_t =	128 ✓
			C_p = 0.808 ✓		
Impinger 7	Final Weight		P_s = -14.5 ✓ "H_2O	28.83	"Hg
	Initial Weight		T_m = 60 ✓ °F	520 ✓	°R
	Increase		T_s = ~~312~~ 313 ✓ °F	~~772~~ 773 ✓	°R

Moisture Content: %M = 10.51 ✓ M_d = 0.8949 ✓ MW_d = 30.464 ✓ MW = 29.15 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 69.320 \left[\frac{29.90 + \frac{1.100}{13.6}}{60 + 460}\right] = \frac{70.541}{0.551}\ \text{sft}^3/\text{scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 175.6 ✓ = 8.288 ✓ sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{8.288}{70.541 + 8.288}$ x 100 = 10.51 ✓ %

V_s = 5123.8 x 0.808 ✓ $\sqrt{\frac{\cancel{772}\ 773}{28.83 \times 29.15}}$ x 0.781 ✓ = ~~3099~~ 3101 ✓ fpm

%I = $\frac{1{,}039 \times \cancel{772}\ 773 \times 70.541}{128 \times 28.83 \times 0.8949 \times \cancel{3099}\ 3101 \times (0.247)^2}$ = ~~90.6~~ 90.7 ✓ %

ACFM: ~~452454~~ 452,747 ✓

SCFM: ~~267821~~ 267,617

%EA: 28.8 ✓

Run Number 05-235 ✓ PM/HCL **FIELD DATA**

Unit 2 ESP Outlet Duct ✓

Date 10/26/05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1	1255	239.27	0.40	0.70	0.70	4.0	302	290	280	56	62	58	
End	1259	241.105	—	—	—	—	—	—	—	—	—	—	
9-4	1402	241.105	0.60	1.10	1.10	5.0	320	300	280	57	62	58	
3	1406	243.24	0.55	0.95	0.95	5.0	323	303	280	55	62	59	
2	1410	245.22	0.53	0.95	0.95	5.0	325	294	281	56	63	59	
1	1414	247.27	0.53	0.95	0.95	5.0	317	295	280	56	63	59	
End	1418	249.275	—	—	—	—	—	—	—	—	—	—	
10-4	1420	249.275	0.73	1.20	1.20	5.0	324	288	~~[illegible]~~ 280	56	63	59	
3	1424	251.51	0.62	1.10	1.10	5.0	326	292	280	55	64	59	
2	1428	253.95	0.78	1.40	1.40	7.0	326	291	285	56	65	60	
1	1432	256.32	0.62	1.10	1.10	5.0	327	291	285	57	65	60	
End	1436	258.420	—	—	—	—	—	—	—	—	—	—	
11-4	1437	258.420	0.56	0.95	0.95	4.5	326	294	284	59	65	60	
3	1441	260.43	0.70	1.20	1.20	5.0	326	287	280	59	65	60	
2	1445	262.42	0.95	1.70	1.70	8.0	327	289	282	60	65	61	
1	1449	265.12	0.55	0.95	0.95	5.0	328	284	283	60	65	61	
End	1453	267.285	—	—	—	—	—	—	—	—	—	—	
12-4	1455	267.285	0.70	1.20	1.20	5.0	325	293	284	62	65	61	
3	1459	269.62	0.86	1.50	1.50	7.0	326	291	296	63	65	61	
2	1503	272.05	0.55	0.95	0.95	5.0	328	291	294	63	65	61	
1	1507	274.27	0.45	0.80	0.80	4.0	228	291	294	60	65	61	
End	1511	276.035	—	—	—	—	—	—	—	—	—	—	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-235 ✓
Job Name: ADA - ES ✓
Run Number: 1 ~~outlet~~ ✓
Unit: 2 ESP Outlet Duct ✓
Date: 10/25/05 ✓
Operator: Cutaia / Dedge / Bernsen
Sample box No. 76 Meter Box No. 27-3 ✓

Ontario Hydro Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 50
Assumed Moisture % 14%
Probe Length 5'
C Factor 4Δ10 → ΔP 5.7 to reference.
Initial Leak @ 15.0 "Hg = 0.001 cfm ✓
Final Leak @ 6.5 "Hg = 0.002 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔPs "Pitot" "H₂O	Orifice ΔH "H₂O Desired	Pm Orifice ΔH "H₂O Actual	Pump Vacuum "Hg Gauge	Ts Stack Temp °F	Probe Temp °F	Heated Line ~~Oven~~ Temp °F	Effluent Temp °F	Tm Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1322	213.062	0.35	0.63	0.63	3.0	298	240	240	46	48	48	
1-3	1326	214.71	0.40	0.73	0.73	3.0	300	241	241	46	49	50	
1-2	1330	216.65	0.53	0.97	0.97	4.0	275	238	241	46	50	50	
1-1	1334	218.81	0.94	1.76	1.76	5.0	280	239	240	46	51	52	
2-4	1339	221.705	0.54	1.04	1.04	4.0	256	240	243	45	52	52	End 1338
2-3	1343	223.93	0.78	1.51	1.51	5.0	260	241	242	45	52	52	
2-2	1347	226.59	0.86	1.66	1.66	5.0	265	238	240	43	54	54	
2-1	1351	229.35	0.70	1.30	1.30	5.0	291	239	240	43	55	53	
3-4	1355	231.842	0.64	1.19	1.19	5.0	298	241	244	43	55	53	End 1355
3-2	1400	233.94	0.50	0.93	0.93	4.0	290	240	244	44	55	53	
3-3	1404	236.04	0.67	1.24	1.24	4.0	298	240	244	44	55	53	
3-1	1408	238.48	0.60	1.11	1.11	4.0	311	240	244	46	55	53	
4-4	1415	240.788	0.75	1.39	1.39	4.0	324	240	245	46	54	53	End 1412
4-3	1419	243.30	0.78	1.39	1.39	4.0	330	239	241	46	55	53	
4-2	1423	245.88	0.50	0.89	0.89	4.0	324	240	242	46	55	53	
4-1	1427	247.93	0.42	0.75	0.75	4.0	331	240	243	46	55	52	
End	1431	249.826	-	-	-	—	—	—	—	—	-	—	End 1431

Pitot Tube Calibration Factor C_p 0.805 ✓
Volume Collected V_m 71.178 ✓ ft^3
Water Collected V_w 188.9 ✓ ml
Time of Test T_t 198 ✓ min.
Stack Pressure P_s −14.5 ✓ "H_2O

Pitot Tube No. 3153 ✓
Baro. Press. P_b 29.89 ✓ "Hg
Probe Tip Dia. D_n ~~05-233-2~~ in. 0.246 ✓
% CO_2 ~~14.0~~ 14.2 % CO 0.0 ✓
% O_2 ~~5.0~~ 4.8 % N_2 ~~81.0~~ 81.0 ✓
Area Stack A_s 21024 ✓ in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-233-2 ✓
Total Volume of Leak Checks After Start: 0.000 ft^3
V_m = Dry Gas Meter Calibration Factor 71.824 ✓ X 0.991 ✓

{Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 76

Impinger 1	Final Weight	~~944.5~~ 892.0		Impinger 1	145.7
	Initial Weight	746.3			
	Increase	145.7		Impinger 2	20.1
Impinger 2	Final Weight	692.0	Imp. 8 962.4 / 979.0 / 16.6	Impinger 3	3.5
	Initial Weight	671.9			
	Increase	20.1		Impinger 4	2.7
Impinger 3	Final Weight	748.4	V_w =	Impinger 5	-0.1
	Initial Weight	744.9	g SO_2 = - —		
	Increase	3.5	V_w =	Impinger 6	0.4
Impinger 4	Final Weight	700.2		Impinger 7	0
	Initial Weight	697.5		#8	16.6
	Increase	2.7		Total	188.9 ✓ = V_w
Impinger 5	Final Weight	632.8	P_b = 29.89 ✓	$\%CO_2$ =	14.2 ✓
	Initial Weight	632.9	V_m = 71.178 ✓	$\%O_2$ =	4.8 ✓
	Increase	-0.1	V_w = 188.9 ✓	%CO =	0.0 ✓
			P_m = 1.088 ✓	$\%N_2$ =	81.0 ✓
Impinger 6	Final Weight	737.0	Avg ΔP = 0.603 ✓	A_n =	21024 ✓
	Initial Weight	736.6		D_n =	0.246 ✓
	Increase	0.4	Avg$\sqrt{\Delta P}$ = 0.770 ✓	T_t =	128 ✓
			C_p = 0.805 ✓		
Impinger 7	Final Weight	667.7	P_s = -14.5 ✓ H_2O	28.82 ✓	"Hg
	Initial Weight	667.7	T_m = 54 ✓ °F	514 ✓	°R
	Increase	0	T_s = 317 ✓ °F	777 ✓	°R

Water Weight Gain

Moisture Content: %M = 10.85 ✓ M_d = 0.8915 ✓ MW_d = 30.464 ✓ MW = 29.11 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 71.178 \left[\frac{29.89 + \frac{1.088}{13.6}}{54 + 460}\right] = \frac{73.251}{\cancel{73.251}} \text{ sft}^3 \text{ scfm}$$

0.572 ✓

$$Vw_{gas} = 0.0472 \times Vw = 0.0472 \times \frac{\cancel{73.251}\ 188.9}{} = \frac{\cancel{3.4574}\ 8.916}{} \text{ sft}^3$$

$$\%\ Moisture = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{\cancel{3.4574}\ 8.916}{73.251 + \cancel{3.4574}\ 8.916} \times 100 = 10.85\ \%$$

$$V_s = 5123.8 \times 0.805 \sqrt{\frac{777}{28.82 \times 29.11}} \times 0.770 = 3056 \text{ fpm}$$

$$\%I = \frac{1{,}039 \times 73.251 \times 777}{128 \times 0.8915 \times 28.82 \times 3056 \times (0.246)^2} = 97.2\ \%$$

ACFM: 446246

SCFM: 261317

%EA: 28.8

Run Number 1 ✓ Ontario Hydro FIELD DATA

Unit 2 ESP outlet Duct ✓

Date 10/25/05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
9-4	1435	249.82	0.61	1.10	1.10	4.0	315	240	239	46	54	55	
9-3	1439	252.11	0.54	0.97	0.97	4.0	317	238	241	46	55	54	
9-2	1443	254.27	0.45	0.80	0.80	4.0	321	238	242	46	56	52	
9-1	1447	256.22	~~0.74~~ 0.42	0.74	0.74	4.0	327	240	245	47	56	52	
End	1451	258.110	~~0.65~~	~~1.14~~	~~1.14~~	~~4.0~~	~~336~~	~~240~~	~~246~~	~~46~~	~~56~~	~~52~~	
10-4	1452	258.110	0.65	1.14	1.14	4.0	336	240	246	46	56	52	
10-3	1456	260.43	0.53	0.93	0.93	4.0	325	241	248	46	56	52	
10-2	1500	262.54	0.70	1.23	1.23	4.5	338	241	248	46	57	53	
10-1	1504	264.96	0.54	0.95	0.95	4.0	345	241	249	46	57	53	
End	1508	267.088	—	—	—	—	—	—	—	—	—	—	
11-4	1510	267.088	0.51	0.89	0.89	4.0	343	241	249	46	57	53	
11-3	1514	269.15	0.56	0.97	0.97	4.0	345	241	249	46	58	53	
11-2	1518	271.31	0.88	1.53	1.53	5.0	347	239	250	46	58	52	
11-1	1522	274.01	0.68	1.18	1.18	4.0	348	239	250	46	58	52	
End	1526	276.384	—	—	—	—	—	—	—	—	—	—	
12-4	1528	276.384	0.60	1.04	1.04	4.0	350	240	250	46	58	52	
12-3	1532	278.60	0.84	1.45	1.45	4.0	349	240	248	46	57	54	
12-2	1536	281.24	0.52	0.89	0.89	4.0	356	238	249	46	57	54	
12-1	1540	283.31	0.30	0.51	0.51	4.0	358	238	249	46	57	54	
End	1544	284.886											

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-235 ✓
Job Name: ADA-ES ✓
Run Number: 2 ✓
Unit: 2 ESP outlet Duct ✓
Date: 10/25/05 ✓
Operator: Cutaia / Dodge / Stone
Sample box No. ~~75~~ Meter Box No. 27-3 ✓

Ontario Hydro Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 52
Assumed Moisture % 14%
Probe Length 5'
C Factor 10 — 5.7 to reference.
Initial Leak @ 18.0 "Hg = 0.003 cfm ✓
Final Leak @ 10.0 "Hg = 0.001 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	Stack Temp °F	Probe Temp °F	~~Oven~~ Heated line Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
			ΔP_s		P_m		T_s				T_m		
12-4	1645	285.826	0.60	1.08	1.08	6.0	321	251	243	54	53	54	
12-3	1649	288.08	0.84	1.51	1.51	7.0	322	251	244	54	54	53	
12-2	1653	290.75	0.40	0.72	0.72	5.0	321	253	241	50	54	53	
12-1	1657	292.60	0.32	0.57	0.57	4.5	323	253	245	50	54	53	
End	1701	294.249	—	—	—	—	—	—	—	—	~~53~~	~~52~~	
11-4	1703	294.249	0.57	1.02	1.02	6.0	321	255	244	48	55	54	
11-3	1707	296.45	0.72	1.29	1.29	6.5	321	255	245	48	55	54	
11-2	1711	298.93	0.96	1.72	1.72	7.5	322	255	245	48	56	54	
11-1	1715	301.79	0.78	1.40	1.40	7.0	322	256	243	46	57	54	
End	1719	304.379	—	—	—	—	—	—	—	—	—	—	
10-4	1722	304.379	0.72	1.29	1.29	6.0	318	256	244	46	59	54	
10-3	1726	306.86	0.54	0.97	0.97	5.5	318	256	245	46	59	54	
10-2	1730	309.01	0.51	0.92	0.92	5.5	319	252	246	46	58	54	
10-1	1734	311.10	0.71	1.28	1.28	6.5	318	252	246	46	58	54	
End	1738	~~316.044~~	—	—	—	—	—	—	—	—	—	—	
		313.575											

Pitot Tube Calibration Factor C_p 0.805 ✓
Volume Collected V_m 70.306 ✓ ft^3
Water Collected V_w 223.0 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.5 ✓ "H_2O

Pitot Tube No. 3153 ✓
Baro. Press. P_b 29.84 ✓ "Hg
Probe Tip Dia. D_n 0.246 ✓ in.
% CO_2 14.0 ✓ % CO ~~0.0~~ ✓
% O_2 5.0 ✓ % N_2 81.0 ✓
Area Stack A_s 21024 ✓ in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-233-2 ✓
Total Volume of Leak Checks After Start: 0 ft^3
V_m = Dry Gas Meter Calibration Factor 70.944 ✓ x 0.991 ✓

{Dry Gas Meter Reading ____ ft^3 – (T_t ____ min. X Leak Rate ____ cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. HG4

			Water Weight Gain		
Impinger 1	Final Weight	852.5		Impinger 1	187.2
	Initial Weight	665.3			
	Increase		1031.4	Impinger 2	17.9
			Imp.8 1017.7		
Impinger 2	Final Weight	763.9		Impinger 3	2.6
	Initial Weight	746.0	—		
	Increase			Impinger 4	2.0
			V_w =		
Impinger 3	Final Weight	675.7	g SO_2 = - —	Impinger 5	-0.3
	Initial Weight	673.1	V_w =		
	Increase			Impinger 6	1.7
Impinger 4	Final Weight	673.7		Impinger 7	-1.8
	Initial Weight	671.7		Imp 8	13.7
	Increase			Total	223 ✓ = V_w
Impinger 5	Final Weight	750.2	P_b = 29.84 ✓	$\%CO_2$ =	14.0 ✓
	Initial Weight	750.5	V_m = 70.306 ✓	$\%O_2$ =	5.0 ✓
	Increase		V_w = 223 ✓	%CO =	0.0 ✓
			P_m = 1.054 ✓	$\%N_2$ =	81.0 ✓
Impinger 6	Final Weight	717.1	Avg ΔP = 0.581 ✓	A_s =	21024 ✓
	Initial Weight	715.4		D_n =	0.246 ✓
	Increase		Avg$\sqrt{\Delta P}$ = 0.753 ✓	T_t =	128 ✓
			C_p = 0.805 ✓		
Impinger 7	Final Weight	745.8	P_s = -14.5 ✓ "H_2O	28.77 ✓	"Hg
	Initial Weight	747.6	T_m = 56 ✓ °F	576 ✓	°R
	Increase		T_s = 313 ✓ °F	773 ✓	°R

Moisture Content: %M = ~~13.02~~ 12.76 ✓ M_d = ~~0.8698~~ 0.8724 ✓ MW_d = 30.440 ✓ MW = ~~28.92~~ 28.85

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 70.306 \left[\frac{29.84 + \frac{1.054}{13.6}}{56 + 460}\right] = 71.946 \text{ sft}^3 \quad 0.562 \text{ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 223 ✓ = 10.526 ✓ sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{10.526}{71.946 + 10.526}$ ✓ x 100 = ~~13.02~~ 12.76 ✓ %

V_s = 5123.8 x 0.805 ✓ $\sqrt{\frac{773}{28.77}}$ ✓ x 0.753 ✓ = ~~2999~~ 2,997 ✓ fpm

71.947 ~~71.946~~ ✓ ~~28.92~~ 28.85 ✓ 99.2 ✓

%I = $\frac{1{,}039 \times 70.306 \times 773}{28.77 \times 0.8698 \times 128 \times 2999 \times (0.246)^2}$ = ~~97.1~~ %

0.8724 ✓ 2997 ✓

ACFM: ~~437833~~ 437606 ✓

SCFM: ~~351,060~~ 251,642 ~~120533~~

%EA: ~~32.9~~ 30.4 ✓

Run Number 2 ✓ Ontario Hydro FIELD DATA

Unit 2 ESP outlet Duct ✓

Date 10/25/05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
9-4	1740	313.575	0.49	0.88	0.88	5.0	315	248	246	46	57	54	
9-3	1744	315.62	0.56	1.01	1.01	5.5	317	248	246	46	57	54	
9-2	1748	317.81	0.47	0.84	0.84	5.0	318	249	245	46	57	54	
9-1	1752	319.82	0.48	0.86	0.86	5.0	319	249	245	46	58	55	
End	1756	321.862	—	—	—	—	—	—	—	—	—	—	
4-4	1800	321.862	0.75	1.36	1.36	6.5	308	251	249	45	56	55	
4-3	1804	324.41	0.67	1.22	1.22	6.0	308	251	249	45	59	54	
4-2	1808	326.83	0.50	0.92	0.92	5.0	309	251	247	45	59	54	
4-1	1812	328.92	0.30	0.55	0.55	4.0	306	254	248	45	60	55	
End	1816	330.547	—	—	—	—	—	—	—	—	—	—	
3-4	1818	330.547	0.58	1.06	1.06	5.5	305	250	240	46	60	55	
3-3	1822	332.80	0.50	0.91	0.91	5.0	309	250	241	46	59	53	
3-2	1826	334.89	0.64	1.18	1.18	5.0	309	250	242	46	59	54	
3-1	1830	337.27	0.56	1.03	1.03	5.0	309	246	243	46	59	54	
End	1834	339.486	—	—	—	—	—	—	—	—	—	—	
2-4	1837	339.486	0.58	1.07	1.07	5.0	307	240	243	46	58	54	
2-3	1841	341.74	0.71	1.31	1.31	6.0	308	240	245	46	59	54	
2-2	1845	344.24	0.81	1.49	1.49	7.0	307	240	246	46	59	54	
2-1	1849	346.91	0.66	1.21	1.21	6.5	308	241	247	46	60	54	
End	1853	349.314	—	—	—	—	—	—	—	—	—	—	
1-4	1856	349.314	0.28	0.52	0.52	4.0	298	240	249	47	60	54	
1-3	1900	350.88	0.64	1.19	1.19	5.0	301	238	250	47	60	54	
1-2	1904	353.26	0.53	0.98	0.98	5.0	303	239	251	45	60	55	
1-1	1908	355.43	.20	0.37	0.37	5.0	304	241	253	45	61	55	
End	1912	356.770	—	—	—	—	—	—	—	—	—	—	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-235 ✓
Job Name: ADA-ES ✓
Run Number: 3 Esp Outlet Duct ✓
Unit: 2 ✓
Date: 10/26/05 ✓
Operator: Cutina / Dodge / Stone
Sample box No. 76 Meter Box No. 27-3 ✓

Ontario Hydro Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 60
Assumed Moisture % 14%
Probe Length 5'
C Factor 16-5.7 to reference.
Initial Leak @ 13.0 "Hg = 0.004 cfm ✓
Final Leak @ 9.0 "Hg = 0.001 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1230	359.294	0.21	0.41	0.41	3.0	292	260	244	56	56	56	
1-3	1234	360.68	0.41	0.79	0.79	4.0	293	260	244	56	56	56	
1-2	1238	362.62	0.55	1.07	1.07	5.0	296	258	244	51	57	56	
1-1	1242	364.87	0.17	0.33	0.33	2.0	296	258	245	51	58	57	
End	1246	366.132	—	—	—	—	—	—	—	—	—	—	
2-4	1248	366.132	0.63	1.22	1.22	5.0	299	254	244	51	60	59	
2-3	1252	368.54	0.78	1.51	1.51	6.0	300	253	244	50	60	59	
2-2	1256	371.23	0.80	1.55	1.55	6.0	301	253	246	50	61	60	
2-1	1300	373.96	0.62	1.21	1.21	5.0	298	254	246	50	65	64	
End	1304	376.379	—	—	—	—	—	—	—	—	—	—	
3-4	1305	376.379	0.58	1.13	1.13	5.0	305	250	246	47	66	64	
3-3	1309	378.71	0.48	0.93	0.93	5.0	306	242	249	47	67	63	
3-2	1313	380.84	0.63	1.22	1.22	5.0	306	243	249	47	68	63	
3-1	1317	383.27	0.49	0.95	0.95	4.5	304	244	250	47	70	63	
End	1321	385.429	—	—	—	—	—	—	—	—	—	—	

Pitot Tube Calibration Factor C_p 0.805 ✓
Volume Collected V_m 71.738 ✓ ft^3
Water Collected V_w 193.3 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.5 ✓ "H_2O

Pitot Tube No. 3153 ✓
Baro. Press. P_b 29.90 ✓ "Hg
Probe Tip Dia. D_n 0.246 ✓ in.
% CO_2 14.2 ✓ % CO 0.0 ✓
% O_2 4.8 ✓ % N_2 81.0 ✓
Area Stack A_s 21024 ✓ in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-233-2 ✓
Total Volume of Leak Checks After Start: — ft^3
V_m = Dry Gas Meter Calibration Factor 72.39 ✓ x 0.991 ✓

{Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

VERSION 1
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Impinger Box No. 76

Impinger 1	Final Weight	~~944.9~~ 896.8		Impinger 1	151.6
	Initial Weight	745.2			
	Increase		#8 992.0 / 978.7	Impinger 2	21.3
Impinger 2	Final Weight	694.2		Impinger 3	3.5
	Initial Weight	672.9			
	Increase			Impinger 4	2.8
Impinger 3	Final Weight	748.9	V_w =	Impinger 5	0
	Initial Weight	745.4	g SO_2 = —		
	Increase		V_w =	Impinger 6	-0.3
Impinger 4	Final Weight	701.6		Impinger 7	1.1
	Initial Weight	698.8		Imp 8	13.3
	Increase			Total	193.3 ✓ = V_w
Impinger 5	Final Weight	635.0	P_b = 29.90 ✓	$\%CO_2$ =	14.2 ✓
	Initial Weight	635.0	V_m = 71.738 ✓	$\%O_2$ =	4.8 ✓
	Increase	0	V_w = 193.3 ✓	%CO =	0.0 ✓
			P_m = 1.084 ✓	$\%N_2$ =	81.0 ✓
Impinger 6	Final Weight	735.9	Avg ΔP = 0.564 ✓	A_s =	21024 ✓
	Initial Weight	736.2		D_n =	0.246 ✓
	Increase		Avg$\sqrt{\Delta P}$ = 0.741 ✓	T_t =	128 ✓
			C_p = 0.805 ✓		
Impinger 7	Final Weight	668.2	P_s = -14.5 ✓ "H_2O	28.83 ✓	"Hg
	Initial Weight	667.1	T_m = 65 ✓ °F	525 ✓	°R
	Increase		T_s = 312 ✓ °F	772 ✓	°R

Moisture Content: %M = ~~11.28~~ 11.20 ✓ M_d = ~~0.8872~~ 0.8880 ✓ MW_d = 30.464 ✓ MW = ~~29.058~~ 29.07 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 71.738 \left[\frac{29.90 + \frac{1.084}{13.6}}{65 + 460}\right] = \frac{72.304}{0.565}\ \text{sft}^3/\text{scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 193.3 ✓ = 9.124 ✓ sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{9.124}{72.304 / \cancel{71.738} + 9.124}$ x 100 = ~~11.28~~ 11.20 ✓ %

V_s = 5123.8 x 0.805 ✓ $\sqrt{\frac{772}{28.83 \times \cancel{29.058}\ 29.07}}$ x 0.741 ✓ = ~~2934~~ 2933 ✓ fpm

%I = $\frac{1{,}039 \times \cancel{71.738}\ 72.304 \times 772}{28.83 \times \cancel{0.8872}\ 0.8880 \times 128 \times \cancel{2934}\ 2933 \times (0.246)^2}$ = ~~98.9~~ 99.7 ✓ %

ACFM: ~~428349~~ ~~428364~~ 428275 ✓

SCFM: ~~251379~~ ~~126430~~ 251,520 ✓

%EA: ~~0.0347~~ 28.8 ✓

Run Number 3 ✓ Ontario Hydro FIELD DATA

Unit 2 ESP outlet duct ✓

Date 10/26/05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-4	1324	385.429	0.69	1.33	1.33	5.5	305	248	253	46	67	63	
4-3	1328	387.97	0.58	1.13	1.13	5.0	306	246	253	46	69	63	
4-2	1332	390.30	0.50	0.97	0.97	5.0	308	244	252	46	69	63	
4-1	1336	392.47	0.35	0.66	0.66	4.0	308	243	251	46	70	63	
End	1340	394.264	—	—	—	—	—	—	—	—	—	—	
8-4	1343	394.264	0.59	1.13	1.13	5.0	315	244	250	48	67	64	
8-3	1347	396.60	0.55	1.05	1.05	5.0	319	244	250	48	67	64	
8-2	1351	398.86	0.49	0.93	0.93	5.0	322	246	251	47	68	65	
8-1	1355	400.99	0.48	0.92	0.92	5.0	321	246	251	47	68	65	
End	1359	403.104	—	—	—	—	—	—	—	—	—	—	
10-4	1400	403.104	0.74	1.41	1.41	6.0	320	255	249	46	69	64	
10-3	1404	405.72	0.56	1.07	1.07	5.0	321	256	248	46	70	65	
10-2	1408	408.00	0.68	1.29	1.29	6.0	323	256	248	46	72	65	
10-1	1412	410.51	0.58	1.11	1.11	6.0	324	254	248	45	72	65	
End	1416	412.839	—	—	—	—	—	—	—	—	—	—	
12-4	1418	412.839	0.52	0.99	0.99	5.0	321	253	246	45	71	63	
12-3	1422	415.03	0.63	1.20	1.20	5.0	320	254	240	45	72	62	
12-2	1426	417.44	0.90	1.72	1.72	7.0	323	254	240	46	73	64	
12-1	1430	420.34	0.80	1.53	1.53	6.5	324	255	238	46	73	64	
End	1434	423.077	—	—	—	—	—	—	—	—	—	—	
12-4	1435	423.077	0.61	1.17	1.17	5.0	324	254	240	46	74	65	
12-3	1439	425.46	0.77	1.47	1.47	6.0	325	254	241	46	75	65	
12-2	1443	428.15	0.40	0.77	0.77	4.5	326	253	240	46	76	65	
12-1	1447	430.09	0.27	0.51	0.51	4.5	326	255	240	47	76	66	
End	1451	431.684	—	—	—	—	—	—	—	—	—	—	

Version 1
22 OCTOBER 2002

APPENDIX E

Analytical Data

METCO Environmental

Particulate Analysis Summary

Job Number 05-235

Date Analysis Completed 11-2-05

Job Name ADA-ES

Unit Tested ESP # 2 Inlet

Location Newark, OH.

Run No.	1	2	3		
Particulate on Filter (mg) Thimble	5,543.0	7,777.6	6,917.8		
Particulate in Front Wash (mg)*	1,222.3	1,006.8	428.3		
MF (mg)	6,765.3	8,784.4	7,346.1		
Particulate in Impinger #1 (mg)					
MT (mg)					

M. Ganter
Analyst

* Less Acetone Residue

METCO Environmental

Particulate Analysis EPA Method 17

Thimbles and Backup Filters

Job Number 05-235 Location Newark, Ar

Job Name ADA-ES Unit Tested ESP #2 Inlet

Desiccator Time In	1030 10/28					
Desiccator Time Out	1645 10/31	1541 11/1				

Run No. 1	Thimble No. Q 435		Filter No.		
Thimble Final Weight (g)	8.5976	8.5976	✓		
Thimble Initial Weight (g)	3.0546	3.0546			
Particulate (g)	5.5430	5.5430			
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Initial Filter Weight (g) _____

Filter Particulate Average (mg) _____

Thimble Particulate Average (mg) 5,543.0

Total Particulate (mg) 5,543.0 ✓

Run No. 2	Thimble No. Q 404		Filter No.		
Thimble Final Weight (g)	10.9298	10.9284	✓ <1%		
Thimble Initial Weight (g)	3.1515	3.1515			
Particulate (g)	7.7783	7.7769			
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Initial Filter Weight (g) _____

Filter Particulate Average (mg) _____

Thimble Particulate Average (mg) 7,777.6

Total Particulate (mg) 7,777.6 ✓

Run No. 3	Thimble No. Q403		Filter No.		
Thimble Final Weight (g)	10.0197	10.0191	✓ <1%		
Thimble Initial Weight (g)	3.1016	3.1016			
Particulate (g)	6.9181	6.9175			
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Mettler AE240

Initial Filter Weight (g) _____

Filter Particulate Average (mg) _____

Thimble Particulate Weight (mg) 6,917.8

Total Particulate (mg) 6,917.8 ✓

MB

Analyst

METCO Environmental

Particulate Analysis EPA Method 5

Front Wash

Job Number 05-235 Location Newark, AR

Job Name ADA-ES Unit Tested ESP #2 Inlet

Desiccator Time In	805 10/31				
Desiccator Time Out	1330 10/31	1040 11/1			

Run No. 1	Volume (ml) 160				
Final Weight (g)	126.9947	126.9942	✓		
Initial Weight (g)	125.7715	125.7715			
Particulate Weight (g)	1.2232	1.2227			

Particulate Average (mg) 1,223.0

4.5 mg/l Less Acetone Blank (mg) 0.7

Total Particulate (mg) 1222.3 ✓

Run No. 2	Volume (ml) 168				
Final Weight (g)	150.6218	150.6222	✓		
Initial Weight (g)	149.6144	149.6144			
Particulate Weight (g)	1.0074	1.0078			

Particulate Average (mg) 1,007.6

Less Acetone Blank (mg) 0.8

Total Particulate (mg) 1,006.8 ✓

Run No. 3	Volume (ml) 119				
Final Weight (g)	171.8541	171.8535	✓		
Initial Weight (g)	171.4250	171.4250			
Particulate Weight (g)	0.4291	0.4285			

Particulate Average (mg) 428.8

Less Acetone Blank (mg) 0.5

Total Particulate (mg) 428.3 ✓

Acetone Blank	Volume (ml) _____				
Final Weight (g)					
Initial Weight (g)					
Difference (g)					

Mettler AE240

Average (mg) _____

4.5 mg/l * mg/l _____

* Note: If greater than 7.9 mg/l, use 7.9 mg/l.

Analyst

METCO Environmental

Particulate Analysis Summary

Job Number 05-235

Date Analysis Completed 11-2-05

Job Name ADA-ES

Unit Tested ESP #2 Outlet

Location Newark, Ar.

Run No.	1	2	3		
Particulate on Filter (mg) Thimble	18.5	22.3	15.3		
Particulate in Front Wash (mg)*	2.6	5.9	4.9		
MF (mg)	21.1	28.2	20.2		
Particulate in Impinger #1 (mg)					
MT (mg)					

M. Carter
Analyst

* Less Acetone Residue

METCO Environmental

Particulate Analysis EPA Method 17

Thimbles and Backup Filters

Job Number 05-235 Location Newark, Ar

Job Name ADA-ES Unit Tested ESP # 2 Outlet

Desiccator Time In	10/28 1030					
Desiccator Time Out	1640 10/31	1535 11/1				

Run No. 1	Thimble No. Q 430		Filter No.		
Thimble Final Weight (g)	3.0965	3.0964	✓		
Thimble Initial Weight (g)	3.0780	3.0780			
Particulate (g)	0.0185	0.0184			
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Initial Filter Weight (g) _____

Filter Particulate Average (mg) _____

Thimble Particulate Average (mg) 18.5

Total Particulate (mg) 18.5 ✓

Run No. 2	Thimble No. Q 402		Filter No.		
Thimble Final Weight (g)	3.0983	3.0981	✓		
Thimble Initial Weight (g)	3.0759	3.0759			
Particulate (g)	0.0224	0.0222			
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Initial Filter Weight (g) _____

Filter Particulate Average (mg) _____

Thimble Particulate Average (mg) 22.3

Total Particulate (mg) 22.3 ✓

Run No. 3	Thimble No. Q 416		Filter No.		
Thimble Final Weight (g)	3.1301	3.1299	✓		
Thimble Initial Weight (g)	3.1147	3.1147			
Particulate (g)	0.0154	0.0152			
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Mettler AE240

Initial Filter Weight (g) _____

Filter Particulate Average (mg) _____

Thimble Particulate Weight (mg) 15.3

Total Particulate (mg) 15.3 ✓

MH

Analyst

METCO Environmental

Particulate Analysis EPA Method 17

Thimbles and Backup Filters

Job Number 05-235 Location Newark, OH

Job Name ADA-ES Unit Tested ESP#2 In/Out

Desiccator Time In					
Desiccator Time Out	10/31	1540 11/1			

Run No. Blank	Thimble No. Ⓓ 421		Filter No.		
Thimble Final Weight (g)	3.2393	3.2391	✓		
Thimble Initial Weight (g)	3.2373	3.2373			
Particulate (g)	0.0020	0.0018			
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Initial Filter Weight (g) _____

Filter Particulate Average (mg) _____

Thimble Particulate Average (mg) 1.9

Total Particulate (mg) 1.9

Run No. _____	Thimble No. _____		Filter No. _____		
Thimble Final Weight (g)					
Thimble Initial Weight (g)					
Particulate (g)					
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Initial Filter Weight (g) _____

Filter Particulate Average (mg) _____

Thimble Particulate Average (mg) _____

Total Particulate (mg) _____

Run No. _____	Thimble No. _____		Filter No. _____		
Thimble Final Weight (g)					
Thimble Initial Weight (g)					
Particulate (g)					
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Mettler AE240

Initial Filter Weight (g) _____

Filter Particulate Average (mg) _____

Thimble Particulate Weight (mg) _____

Total Particulate (mg) _____

Analyst

METCO Environmental

Particulate Analysis EPA Method 5

Front Wash

Job Number 05-235 Location Newark, Ar

Job Name ADA-ES Unit Tested ESP # 2 Outlet

Desiccator Time In	805 10/31				
Desiccator Time Out	1049 10/31	935 11/1	1550 11/1		

Run No. 1	Volume (ml) 59				
Final Weight (g)	139.7013	139.7009	✓		
Initial Weight (g)	139.6982	139.6982			
Particulate Weight (g)	0.0031	0.0027			

Particulate Average (mg) 2.9
Less Acetone Blank (mg) 0.3
Total Particulate (mg) 2.6 ✓

Run No. 2	Volume (ml) 84				
Final Weight (g)	161.0226	161.0223	✓		
Initial Weight (g)	161.0162	161.0162			
Particulate Weight (g)	0.0064	0.0061			

Particulate Average (mg) 6.3
Less Acetone Blank (mg) 0.4
Total Particulate (mg) 5.9 ✓

Run No. 3	Volume (ml) 83				
Final Weight (g)	174.5736	174.5729	174.5731	✓	
Initial Weight (g)	174.5677	174.5677	174.5677		
Particulate Weight (g)	0.0059	0.0052	0.0054		

Particulate Average (mg) 5.3
Less Acetone Blank (mg) 0.4
Total Particulate (mg) 4.9 ✓

Acetone Blank	Volume (ml) 110				
Final Weight (g)	169.5281	169.5278	✓		
Initial Weight (g)	169.5275	169.5275			
Difference (g)	0.0006	0.0003			

Mettler AE240

Average (mg) 0.5
* mg/l 4.5 ✓

* Note: If greater than 7.9 mg/l, use 7.9 mg/l.

MH
Analyst

METCO ENVIRONMENTAL

LABORATORY QUALITY ASSURANCE DATA

BALANCE ID Mettler AE240

DATE & TIME		100g STD	1.0g STD	0.5g STD	ANALYST	REMARKS
10/20/05 1310	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0.0	0	0		
805 10/21/05	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0	0	0		
820 10/24/05	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0	0	0		
805 10/25/05	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0	0	0		
810 10/26	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0	0	0		
0915 10/27	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0	0	0		
830 10/28	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0	0	0		
1045 10/31	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0	0	0		
9/25 11/1	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0	0	0		
11/2/05 1015	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0	0	0		
920 11/3	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0	0	0		
11/4/05 0852	Actual (g)	100.0000	1.0000	0.5000	mk	
	Difference (mg)	0	0	0		
11/7/05 0855		100.0000	1.0000	0.5000	mk	
		0	0	0		

05-235
ADA-ES

11-7-05
#2 ESP Inlet

Halide Analysis

Run	Imp	Vol.	D.L.	ppm F	ppm F	Avg. ppm	% RD	ppm Cl	ppm Cl	Avg ppm	% RD	ppm Br	ppm Br	avg. ppm	% RD	Total ug HF	Total ug HCl	Total ug HBr	Total ug Cl2*	Total ug Br2
1	1-3	426	1	3.745	3.733	3.739	0.3	2.465	2.449	2.457	0.7	0.198	0.207	0.2025	4.4	1,676.6	1,076.2	87.3		
*	4,5	290	2	–	–	–	–	0.163	0.165	0.164	1.2	0.118	0.118	0.118	0	–	–	–	95.1	68.4
												RUN 1 total ugs				1,676.6	1,076.2	87.3	95.1	68.4
2	1-3	424	1	5.690	5.670	5.680	0.4	2.460	2.507	2.4835	1.9	0.219	0.231	0.225	5.3	2535.1	1,082.7	96.6		
*	4,5	313	2	–	–	–	–	0.179	0.178	0.1785	0.6	0.189	0.189	0.189	0	–	–	–	111.7	118.3
												RUN 2 total ug				2535.1	1,082.7	96.6	111.7	118.3
3	1-3	406	1	4.432	4.455	4.4435	0.5	2.589	2.565	2.577	0.9	0.222	0.231	0.2265	4.0	1899.0	1,075.8	93.1		
*	4,5	300	2	–	–	–	–	0.112	0.109	0.1105	2.7	0.170	0.168	0.169	1.2	–	–	–	66.3	101.4
												RUN 3 total ug				1,899.0	1,075.8	93.1	66.3	101.4

SPIKE	ppm F	ppm F	% RD	% Recov	% Recov	ppm Cl	ppm Cl	% RD	% Recov	% Recov	ppm Br	ppm Br	% RD	% Recov	% Recov
R3I1-3@2x+2.5ppm	4.699	4.673	0.6	99.1	98.1	3.876	3.902	0.7	103.5	104.5	2.609	2.602	0.3	99.8	99.6
R3I4,5@2x+1ppm						1.112	1.112	0	~~103.7~~ ~~100.7~~ ~~100.2~~	~~100.7~~ 100.2	1.168	1.168	0	99.9	99.9

* Initial pH of runs 1, 2, and 3 Imp. 4,5 were pH 6-7. The pH was adjusted to basic with NaOH before Sodium thiosulfate was added.

05235
ADA-ES

ESP #2 Outlet

Halide Analysis

RUN	Imp	Vol	DILN	ppm F	ppm F	Avg. ppm	% RD	ppm Cl	ppm Cl	avg. ppm	% RD	ppm Br	ppm Br	avg. Br	% RD	Total ug HF	Total ug HCl	Total HBr	Total ug Cl_2*	Total ug Br_2
1	1-3	486	1	4.596	4.524	4.560	1.6	2.981	3.101	3.041	3.9	9.109	9.214	9.1615	1.1	2332.8	1519.6	4508.2	–	–
	4,5	276	2	–	–	–	–	0.159	0.164	0.1615	3.1	ND	ND	ND	–	–	–	–	89.1	ND
												Run 1 total ug				2332.8	1519.6	4508.2	89.1	ND
2	1-3	485	1	6.004	6.009	6.0065	0.1	3.208	3.214	3.211	0.2	9.774	9.746	9.760	0.3	3066.5	1601.3	4792.8	–	–
*	4,5	297	2	–	–	–	–	0.198	0.198	0.198	0	ND	ND	ND	–	–	–	–	117.6	ND
												Run 2 total ug				3066.5	1601.3	4792.8	117.6	ND
3	1-3	478	1	5.282	5.287	5.2845	0.1	2.922	2.929	2.9255	0.2	9.772	9.746	9.759	0.3	2658.9	1437.8	4723.2		
	4,5	293	2	–	–	–	–	0.154	0.153	0.1535	0.7	ND	ND	ND	–	–	–		89.951	ND
												Run 3 total ug				2658.9	1437.8	4723.2	90.0	ND

SPIKE	ppm F	ppm F	% RD	% Recov.	% Rec	ppm Cl	ppm Cl	% RD	% Recov.	% Recov.	ppm Br	ppm Br	% RD	% Recov.	% Recov.
R3I1-3@2x+1.25ppm.	3.928	3.949	0.5	102.9	104.5	2.645	2.616	1.1	94.6	92.3	6.058	6.139	1.3	94.3	100.8
R3I4,5@2x+1ppm	–	–	–			1.141	1.146	0.4	98.8	99.3	1.055	1.033	2.1	105.5	103.3

* Initial pH of Run 2 Imp 4,5 was 6-7. The pH was adjusted to basic before adding sodium thiosulfate. Runs 1 and 3 had basic initial pH values.

METCO ENVIRONMENTAL

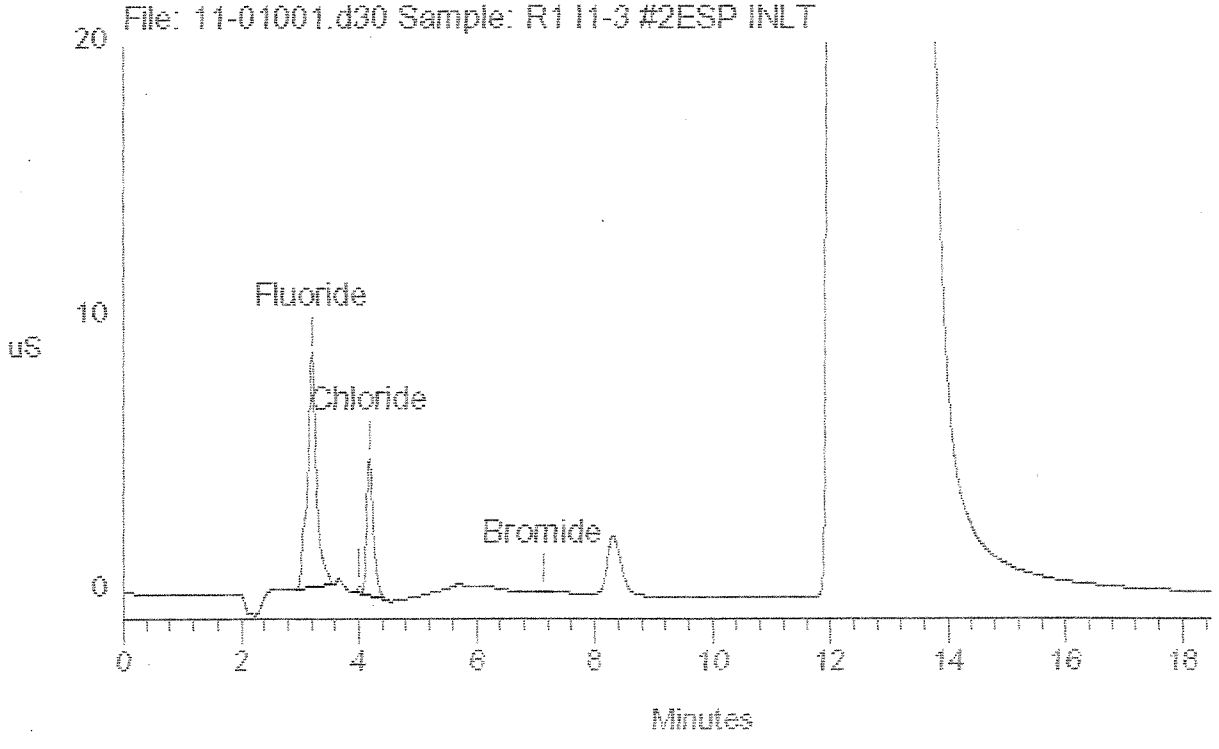
Data Reprocessed On 11/02/2005 15:41:50

Sample Name: R1 I1-3 #2ESP INLT	Date: 11/01/2005 20:38:04
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d30	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 30	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.20	Fluoride	92186895	8464560	3.745
4.18	Chloride	39882795	5029931	2.465
7.13	Bromide	417132	41688	0.198
	Totals	132486822	13536178	6.409



METCO ENVIRONMENTAL

Data Reprocessed On 11/02/2005 15:41:51

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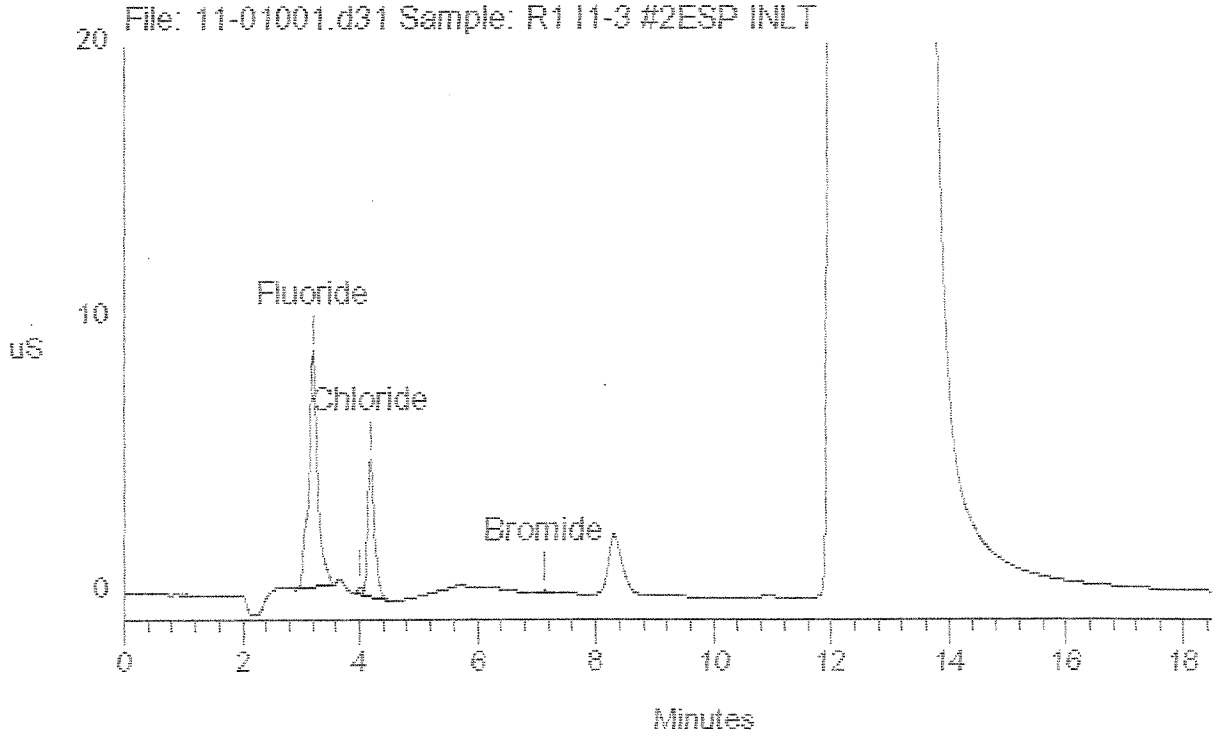
==============================================================================
| Sample Name: R1 I1-3 #2ESP INLT              Date: 11/01/2005 20:57:59      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d31                          |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 31                   Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.20	Fluoride	91850720	8522991	3.733
4.18	Chloride	39619393	4962816	2.449
7.13	Bromide	481750	48277	0.207
	Totals	131951863	13534083	6.389



METCO ENVIRONMENTAL

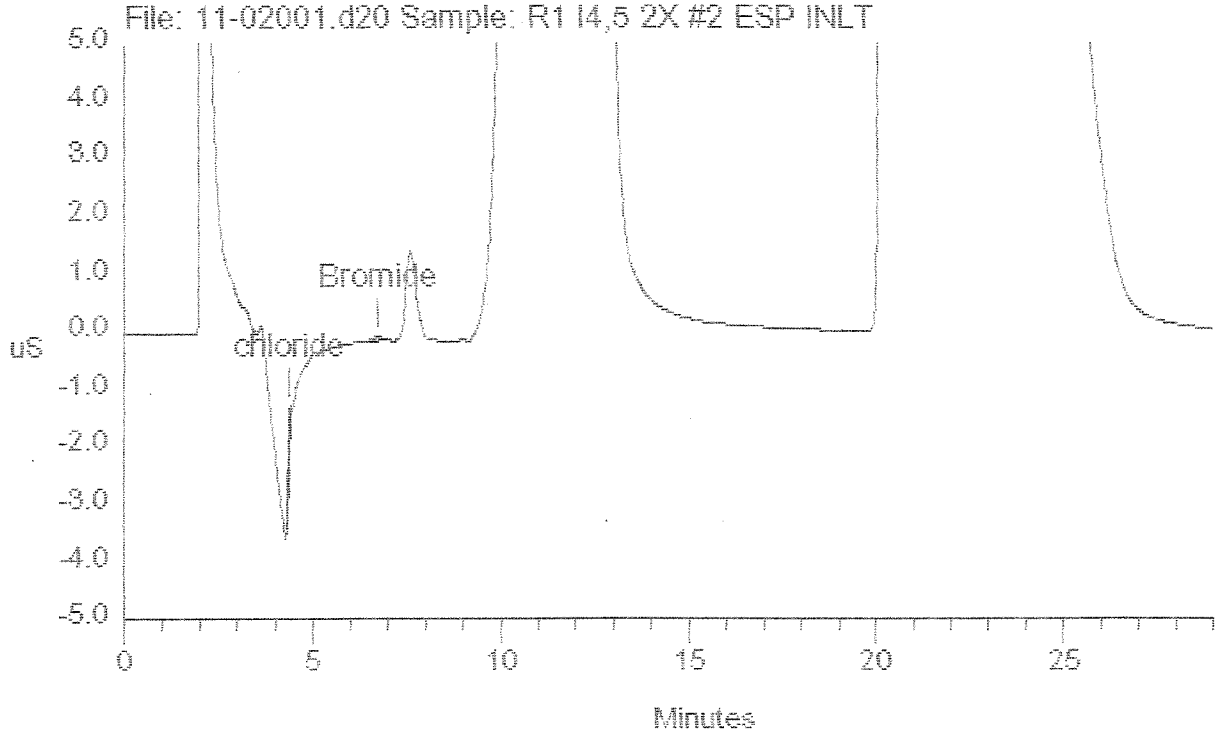
Data Reprocessed On 11/03/2005 09:20:37

Sample Name: R1 I4,5 2X #2 ESP INLT	Date: 11/02/2005 20:09:19
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d20	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 20	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.37	chloride	3846000	905200	0.163
6.73	Bromide	885920	56696	0.118
	Totals	4731920	961896	0.282



METCO ENVIRONMENTAL

Data Reprocessed On 11/03/2005 09:20:38

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==============================================================================
| Sample Name: R1 I4,5 2X #2 ESP INLT          Date: 11/02/2005 20:39:40      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-02001.d21                          |
| Method     : C:\DX\METHOD\HCLLO2.MET                                        |
| ACI Address: 1  System: 1  Inject#: 21                   Detector:CDM-2     |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                  |
==============================================================================
```
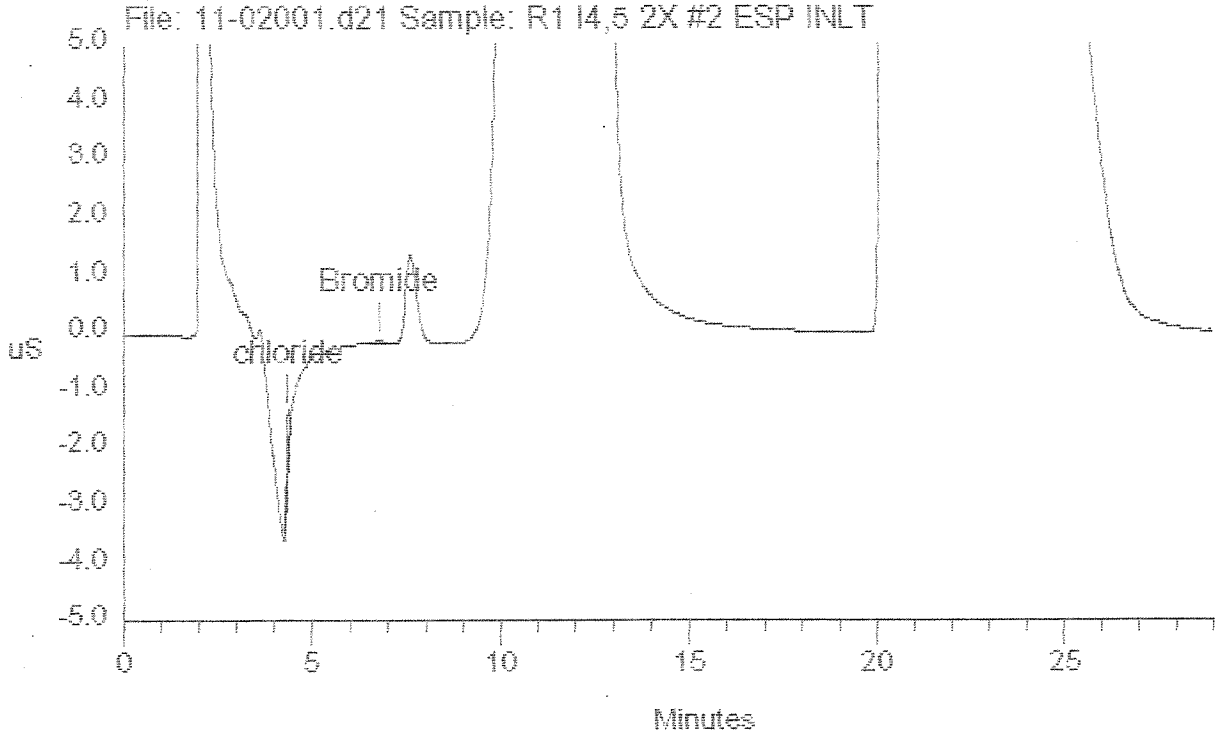

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.37	chloride	3876200	963556	0.165
6.77	Bromide	885380	52152	0.118
	Totals	4761580	1015707	0.283



METCO ENVIRONMENTAL

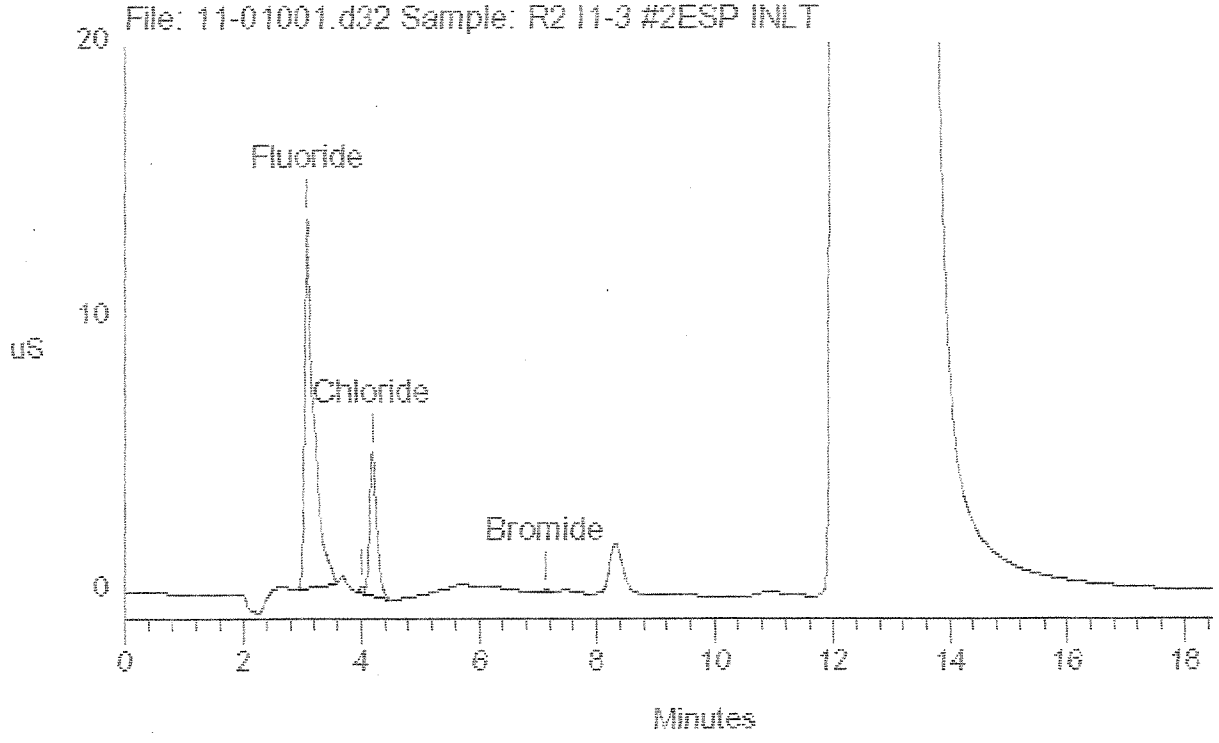
Data Reprocessed On 11/02/2005 15:41:52

Sample Name: R2 I1-3 #2ESP INLT	Date: 11/01/2005 21:17:54
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d32	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 32	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.08	Fluoride	146324560	13482826	5.690
4.18	Chloride	41784973	5244100	2.460
7.13	Bromide	406206	40631	0.219
	Totals	188515739	18767556	8.369



METCO ENVIRONMENTAL

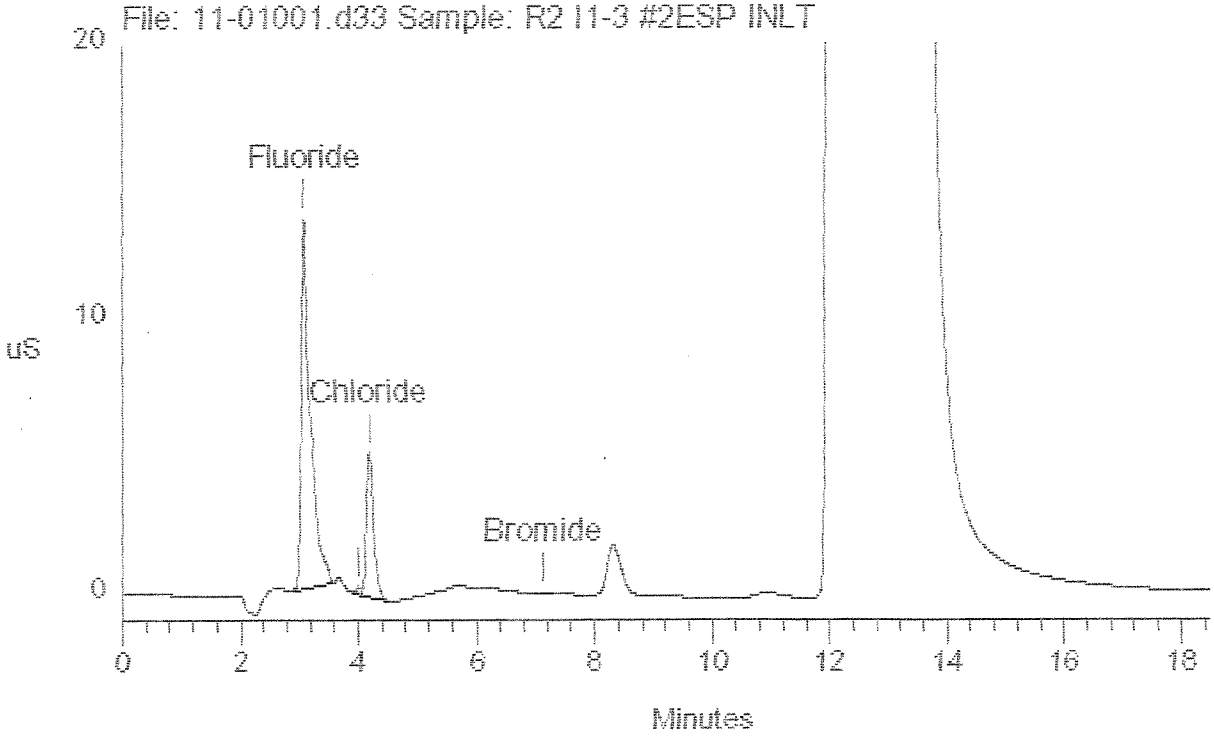
Data Reprocessed On 11/02/2005 15:41:55

```
==============================================================================
| Sample Name: R2 I1-3 #2ESP INLT              Date: 11/01/2005 21:37:43      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d33                          |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 33                   Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	5550	5Hz	0.00	18.50		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.08	Fluoride	145758200	13480487	5.670
4.18	Chloride	42666604	5256066	2.507
7.13	Bromide	497612	48400	0.231
	Totals	188922416	18784954	8.407



METCO ENVIRONMENTAL

Data Reprocessed On 11/03/2005 09:20:41

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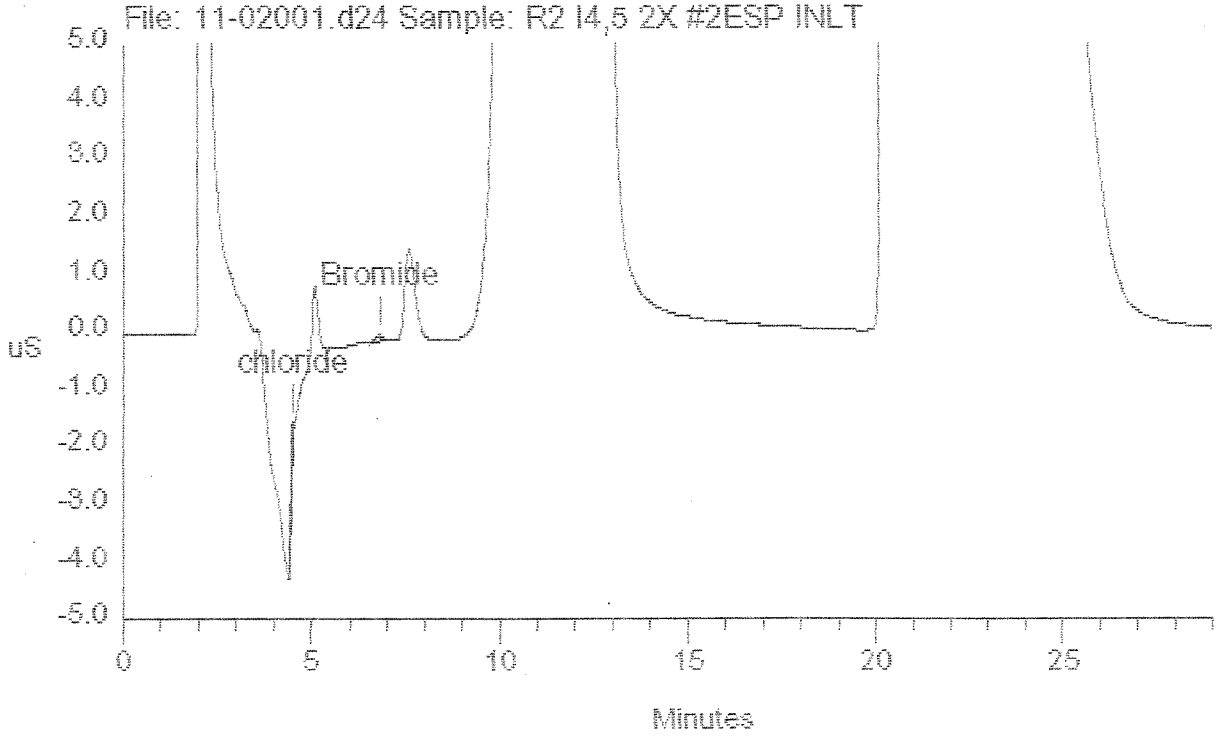
==============================================================================
| Sample Name: R2 I4,5 2X #2ESP INLT          Date: 11/02/2005 22:10:43      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-02001.d24                         |
| Method     : C:\DX\METHOD\HCLLO2.MET                                       |
| ACI Address: 1  System: 1  Inject#: 24                  Detector:CDM-2     |
| Analyst    :                Column: AS14,4mm, STD 1-12-01                  |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.50	chloride	4152000	956125	0.179
6.80	Bromide	1440044	97235	0.189
	Totals	5592044	1053360	0.368



METCO ENVIRONMENTAL

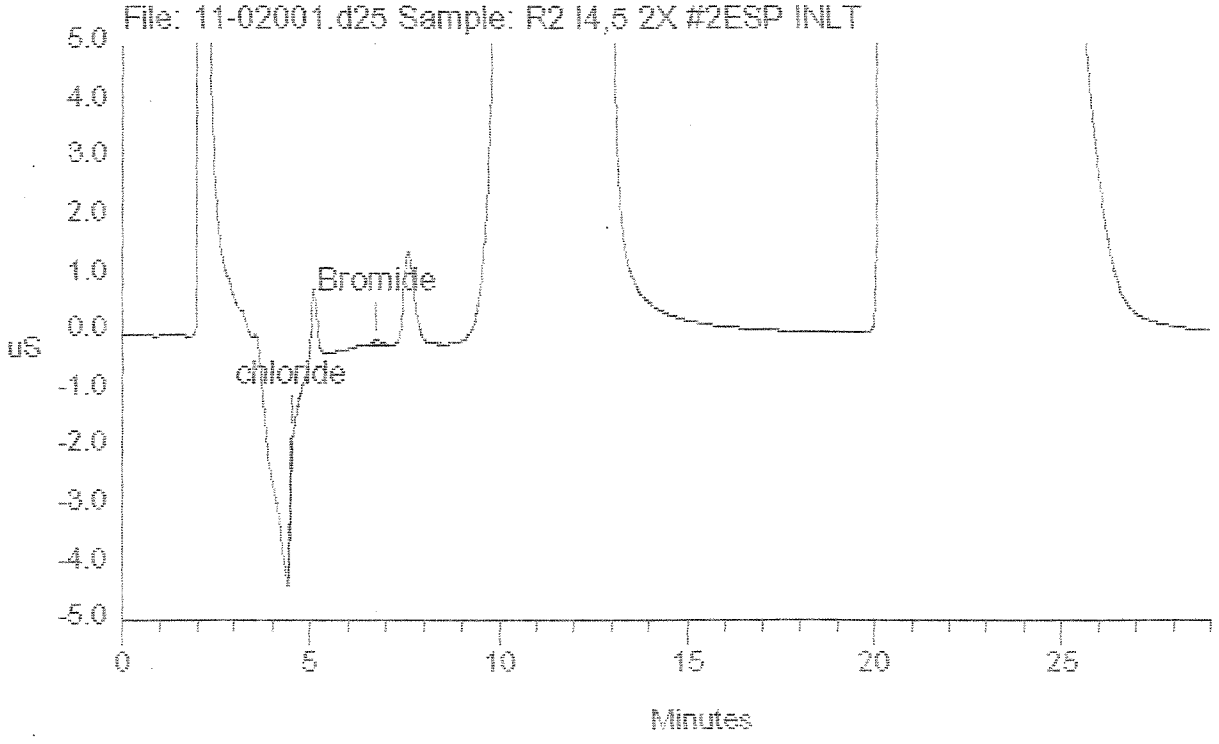
Data Reprocessed On 11/03/2005 09:20:42

Sample Name: R2 I4,5 2X #2ESP INLT	Date: 11/02/2005 22:41:04
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d25	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 25	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.50	chloride	4144400	997394	0.178
6.75	Bromide	1440260	83388	0.189
	Totals	5584660	1080782	0.367



METCO ENVIRONMENTAL

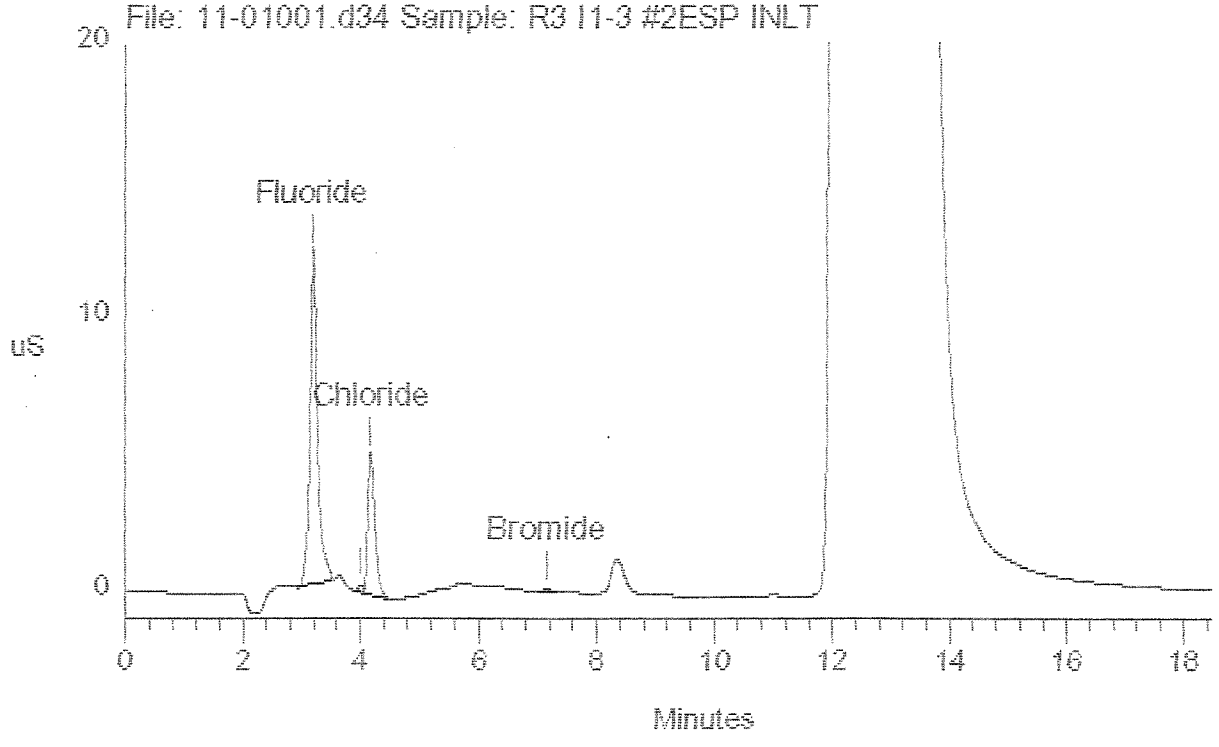
Data Reprocessed On 11/02/2005 15:41:56

Sample Name: R3 I1-3 #2ESP INLT	Date: 11/01/2005 21:57:38
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d34	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 34	Detector:CDM-2
Analyst :	Column: AS14-,4mm, STARTED 2-05

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.18	Fluoride	110815720	12071326	4.432
4.17	Chloride	41976383	5033477	2.589
7.15	Bromide	594624	55867	0.222
	Totals	153386727	17160670	7.243



METCO ENVIRONMENTAL

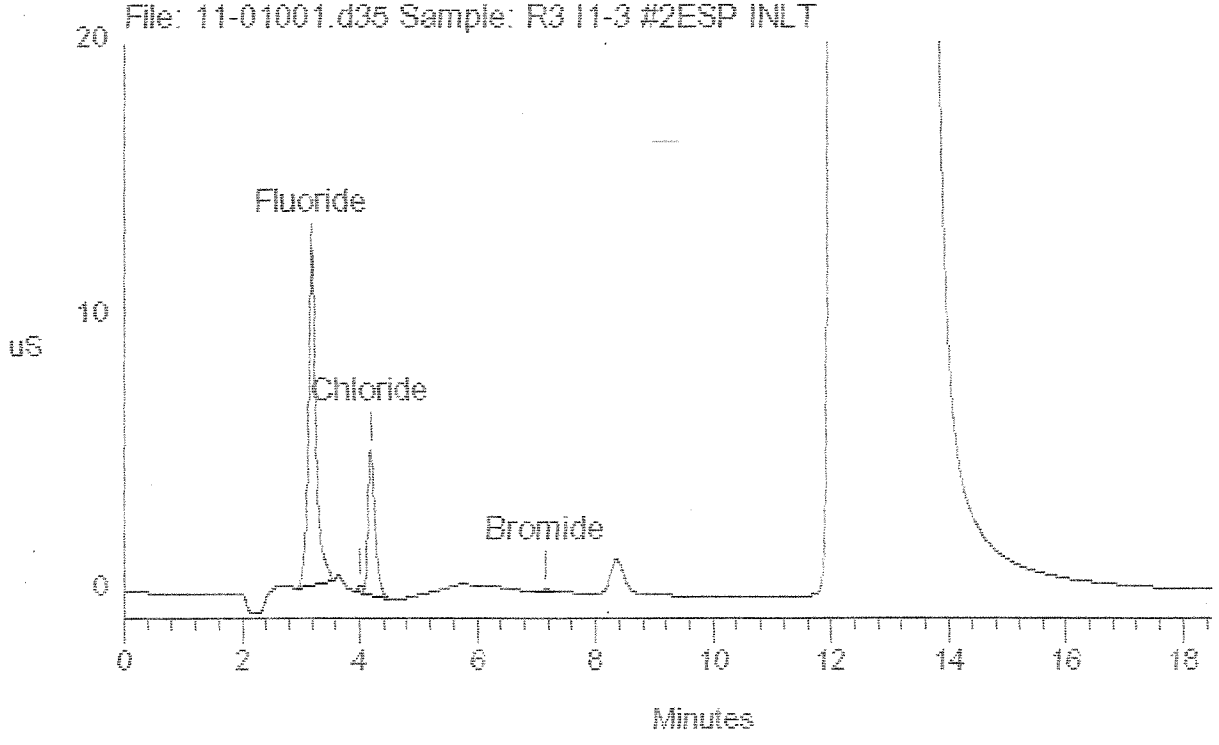
Data Reprocessed On 11/02/2005 15:41:57

Sample Name: R3 I1-3 #2ESP INLT	Date: 11/01/2005 22:17:33
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d35	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 35	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.18	Fluoride	111428940	11805555	4.455
4.18	Chloride	41578634	5242664	2.565
7.15	Bromide	659880	60605	0.231
	Totals	153667454	17108824	7.251



METCO ENVIRONMENTAL

Data Reprocessed On 11/02/2005 15:41:57

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==========================================================================
| Sample Name: R3 I1-3 2X #2ESP INLT+2.5 PPM  Date: 11/01/2005 22:37:27  |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d36                    |
| Method     : C:\DX\METHOD\HF2.MET                                     |
| ACI Address: 1  System: 1  Inject#: 36                Detector:CDM-2   |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05           |
==========================================================================
```
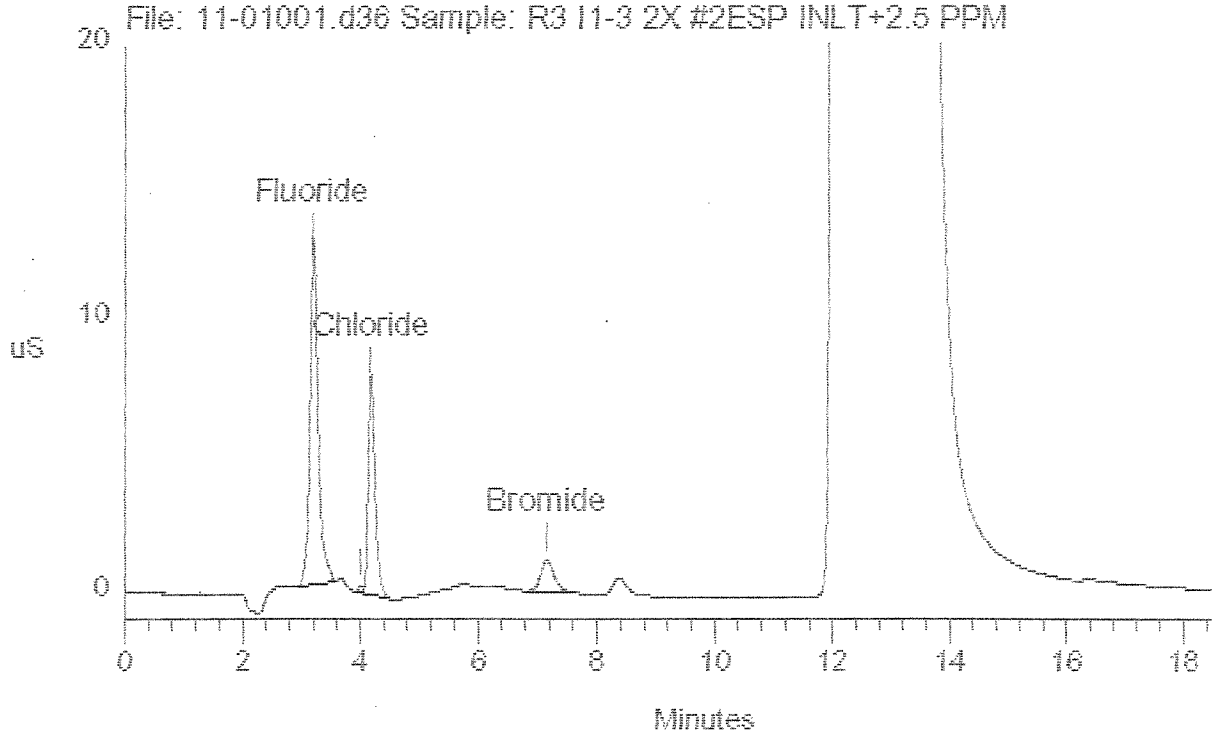

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	5550	5Hz	0.00	18.50		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.18	Fluoride	118054600	12189464	4.699
4.17	Chloride	63687918	7694873	3.876
7.15	Bromide	18593730	1178038	2.609
	Totals	200336248	21062376	11.184



METCO ENVIRONMENTAL

Data Reprocessed On 11/02/2005 15:41:58

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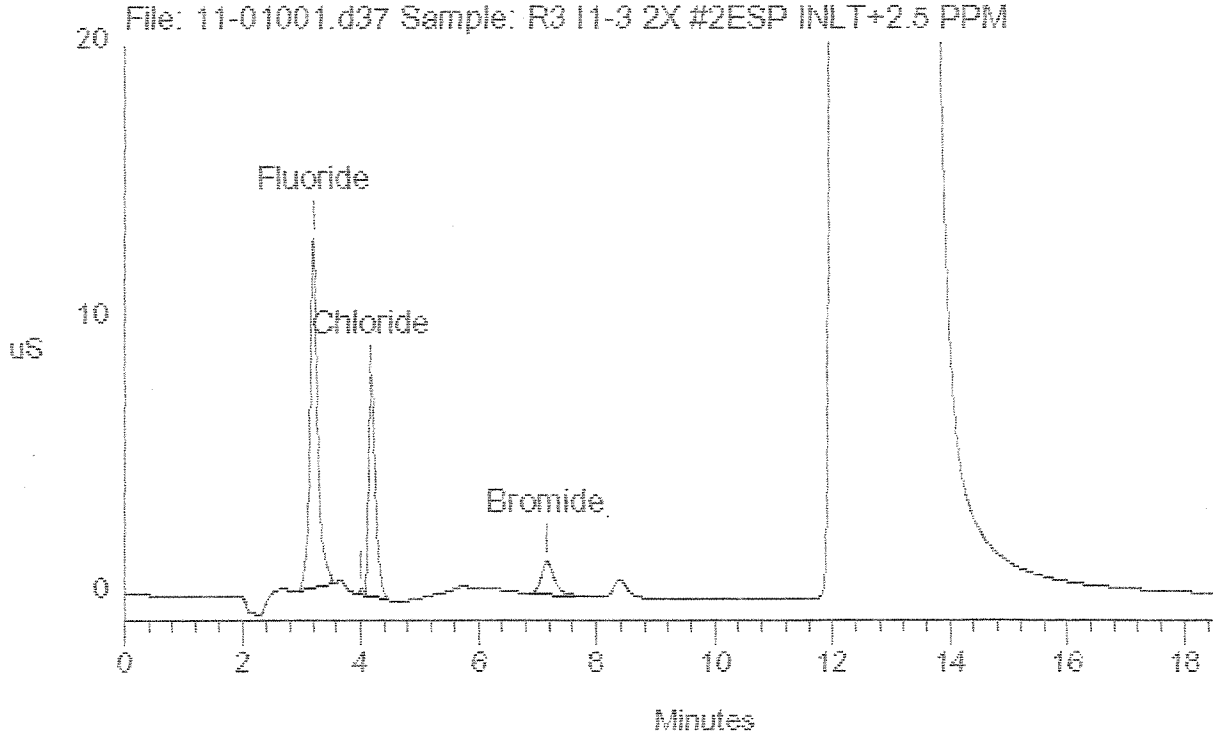
==============================================================================
| Sample Name: R3 I1-3 2X #2ESP INLT+2.5 PPM  Date: 11/01/2005 22:57:16      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d37                         |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 37                  Detector:CDM-2     |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.20	Fluoride	117348480	12702733	4.673
4.17	Chloride	64120656	7757081	3.902
7.15	Bromide	18545470	1193386	2.602
	Totals	200014606	21653199	11.177



METCO ENVIRONMENTAL

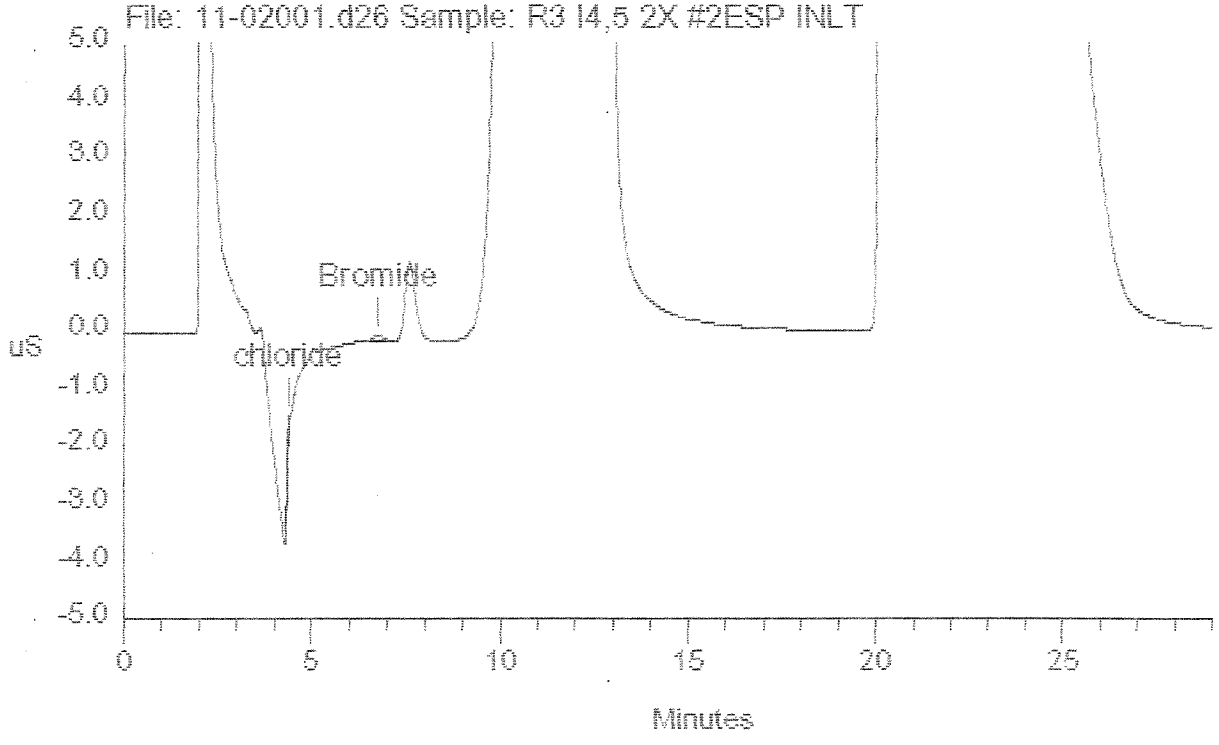
Data Reprocessed On 11/03/2005 09:20:43

Sample Name: R3 I4,5 2X #2ESP INLT	Date: 11/02/2005 23:11:25
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d26	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 26	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.39	chloride	2830400	534581	0.112
6.75	Bromide	1294234	82628	0.170
	Totals	4124634	617208	0.283



METCO ENVIRONMENTAL

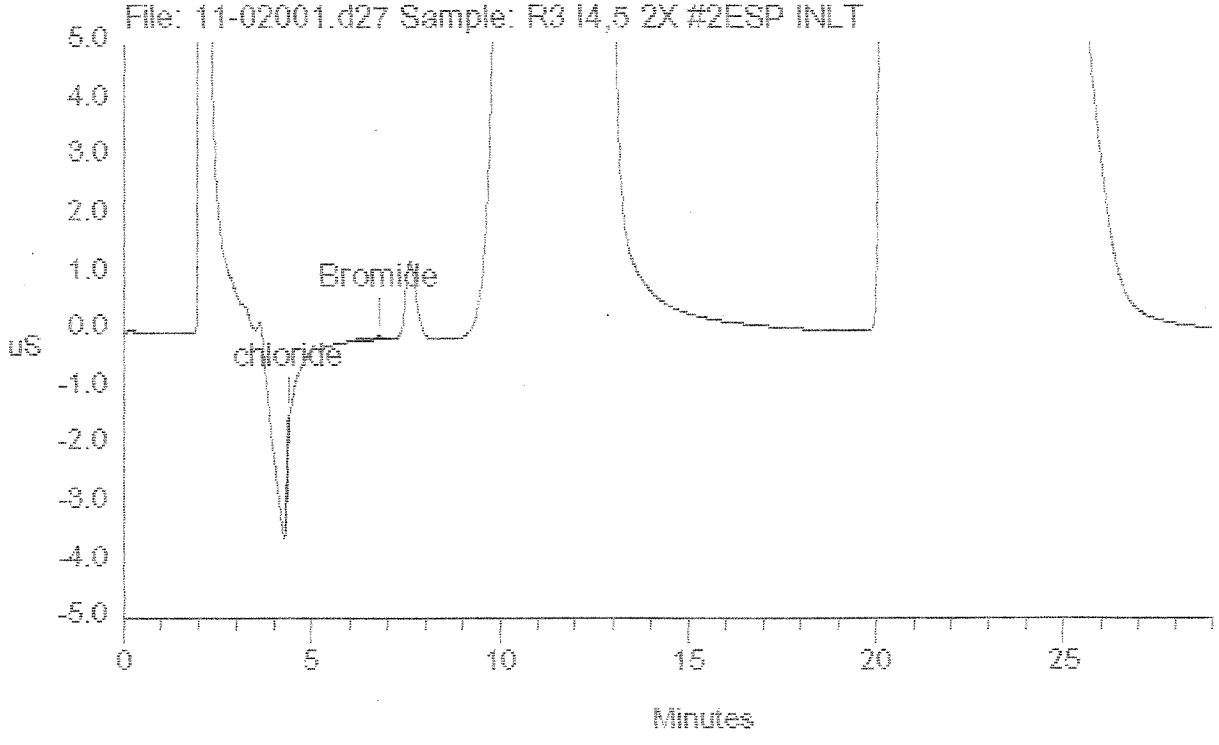
Data Reprocessed On 11/03/2005 09:20:44

Sample Name: R3 I4,5 2X #2ESP INLT	Date: 11/02/2005 23:41:46
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d27	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 27	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	29.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.39	chloride	2754600	354000	0.109
6.77	Bromide	1275440	46484	0.168
	Totals	4030040	400484	0.276



METCO ENVIRONMENTAL

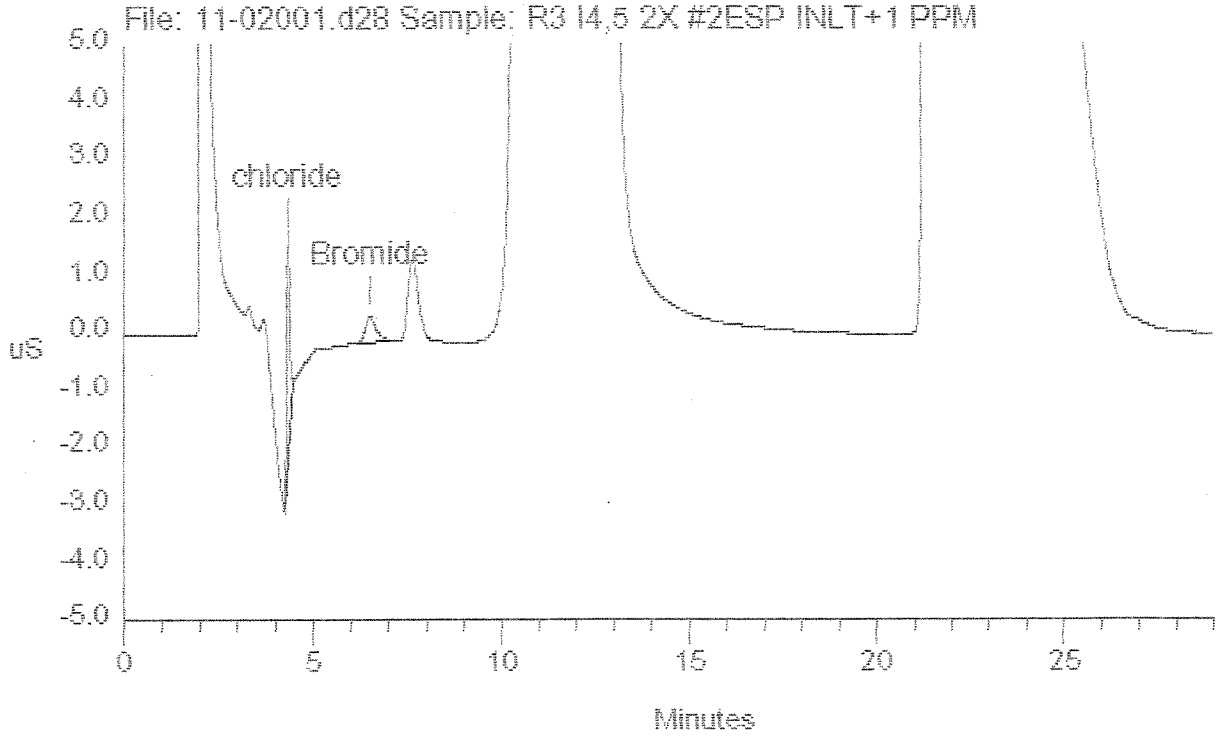
Data Reprocessed On 11/03/2005 09:20:45

Sample Name:	R3 I4,5 2X #2ESP INLT+1 PPM Date: 11/03/2005 00:12:07
Data File :	C:\DX\DATA\ANIONS\05-235\11-02001.d28
Method :	C:\DX\METHOD\HCLLO2.MET
ACI Address:	1 System: 1 Inject#: 28 Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.33	chloride	22721222	4038104	1.112
6.52	Bromide	9118542	471338	1.168
	Totals	31839764	4509443	2.279



METCO ENVIRONMENTAL

Data Reprocessed On 11/03/2005 09:20:46

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==============================================================================
| Sample Name: R3 I4,5 2X #2ESP INLT+1 PPM    Date: 11/03/2005 00:42:28       |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-02001.d29                          |
| Method     : C:\DX\METHOD\HCLLO2.MET                                        |
| ACI Address: 1  System: 1  Inject#: 29                  Detector:CDM-2      |
| Analyst    :                Column: AS14,4mm, STD 1-12-01                   |
==============================================================================
```
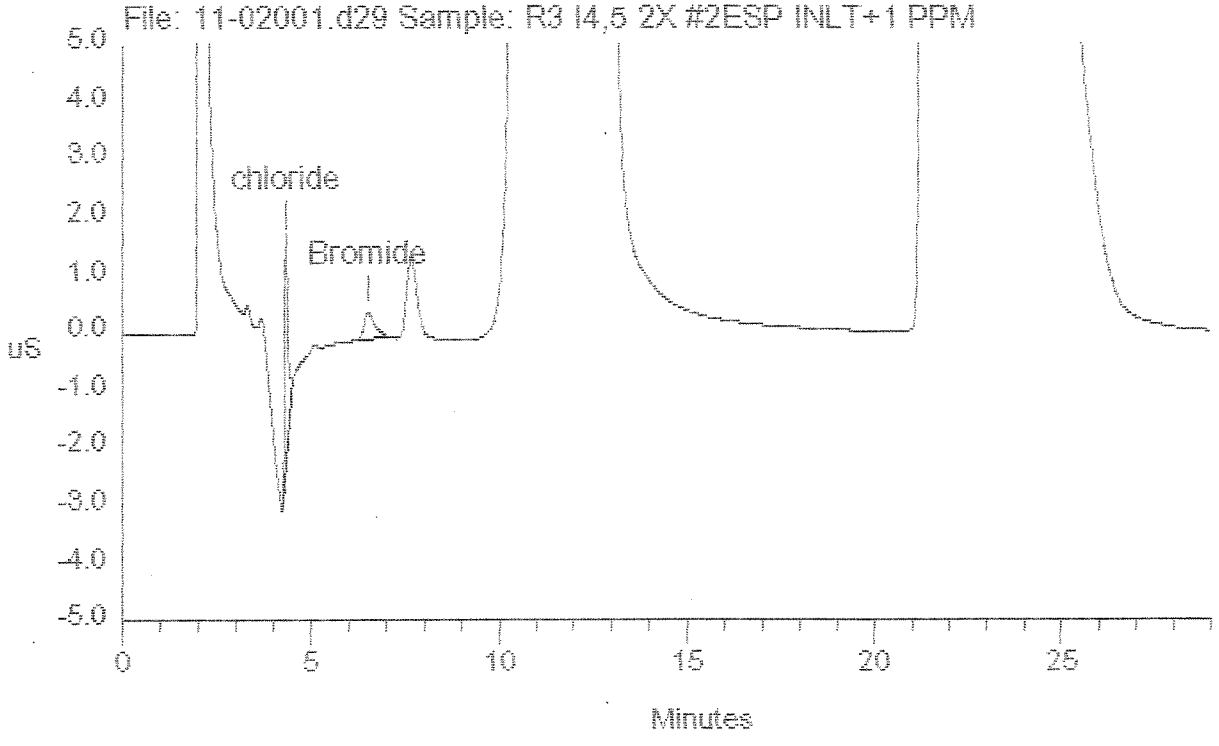

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.33	chloride	22728304	4010417	1.112
6.52	Bromide	9121098	456215	1.168
	Totals	31849402	4466631	2.280



METCO ENVIRONMENTAL

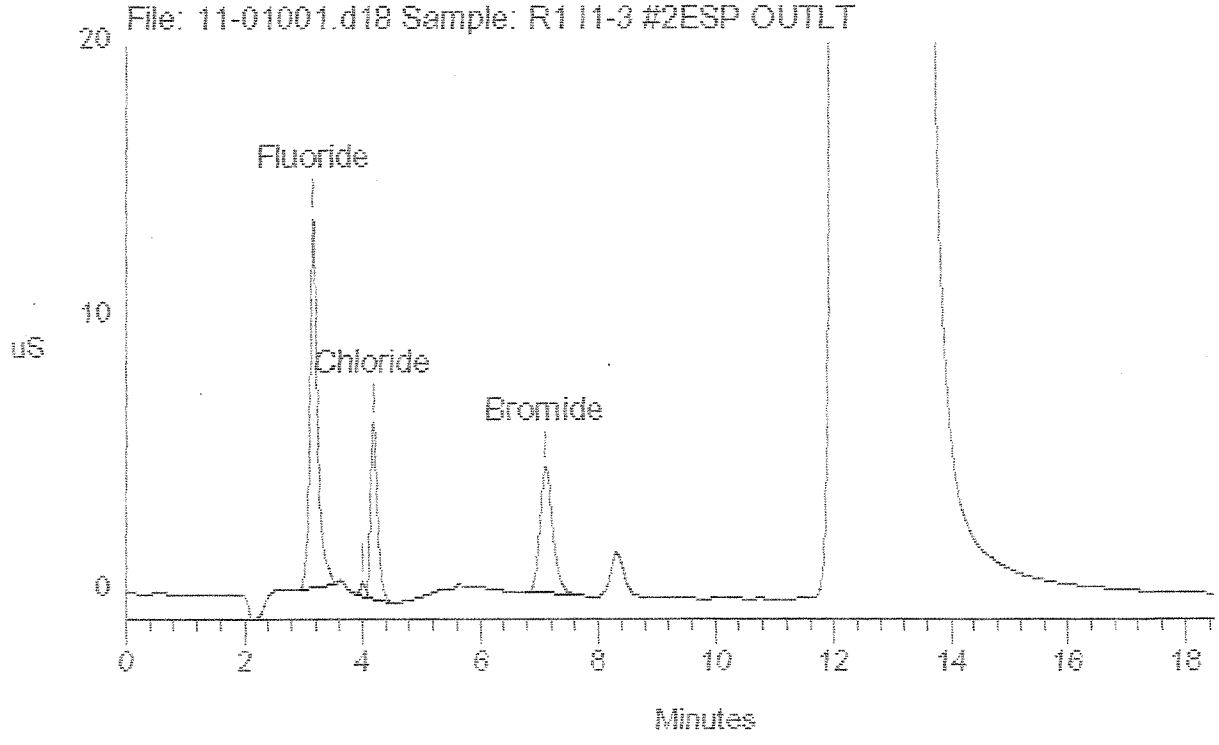
Data Reprocessed On 11/02/2005 15:41:36

Sample Name: R1 I1-3 #2ESP OUTLT	Date: 11/01/2005 16:39:31
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d18	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 18	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.17	Fluoride	116124652	13488901	4.596
4.18	Chloride	51654899	6447935	2.981
7.10	Bromide	68619014	4581012	9.109
	Totals	236398565	24517847	16.687



METCO ENVIRONMENTAL

Data Reprocessed On 11/02/2005 15:41:37

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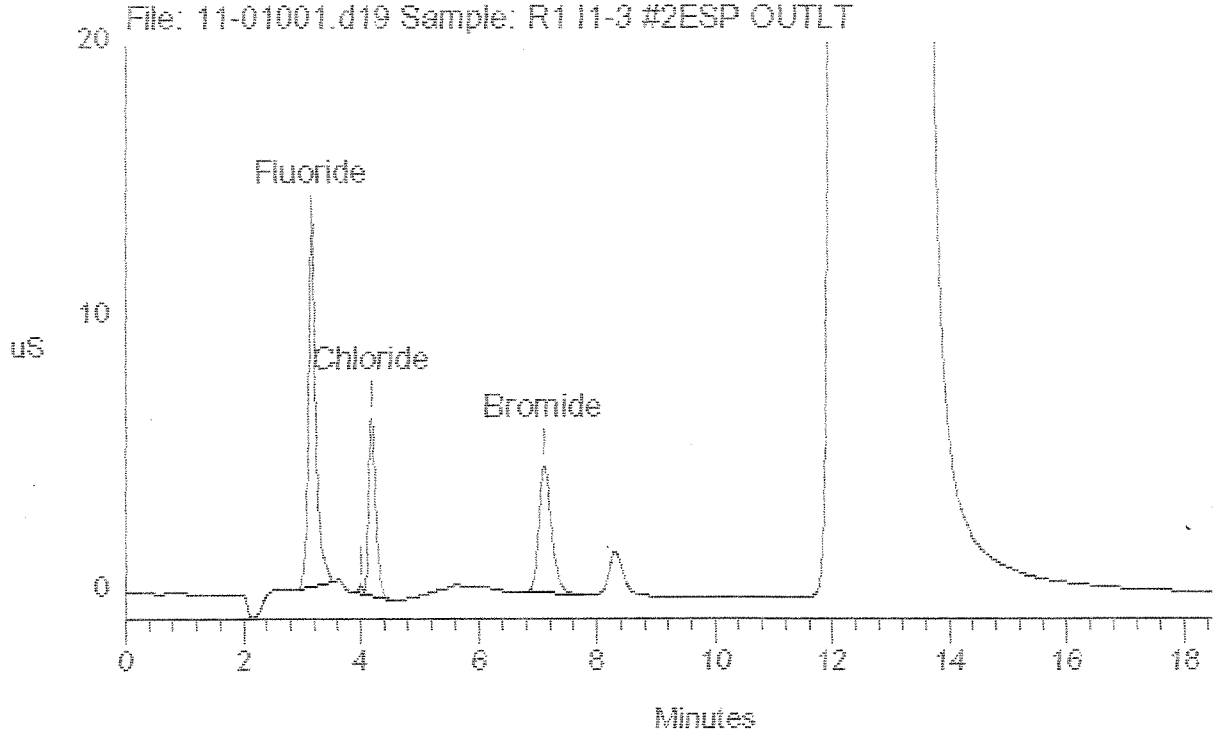
==============================================================================
| Sample Name: R1 I1-3 #2ESP OUTLT            Date: 11/01/2005 16:59:19      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d19                         |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 19                   Detector:CDM-2    |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.15	Fluoride	114134845	12906669	4.524
4.18	Chloride	53914374	6510999	3.101
7.10	Bromide	69423447	4667809	9.214
	Totals	237472666	24085477	16.839



METCO ENVIRONMENTAL

Data Reprocessed On 11/03/2005 13:17:48

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==============================================================================
| Sample Name: R1 I4,5 2X #2 ESP OUTLT        Date: 11/02/2005 16:36:51      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-02001.D13                         |
| Method     : C:\DX\METHOD\HCLLO2.MET                                       |
| ACI Address: 1  System: 1  Inject#: 13                  Detector:CDM-2     |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                 |
==============================================================================
```
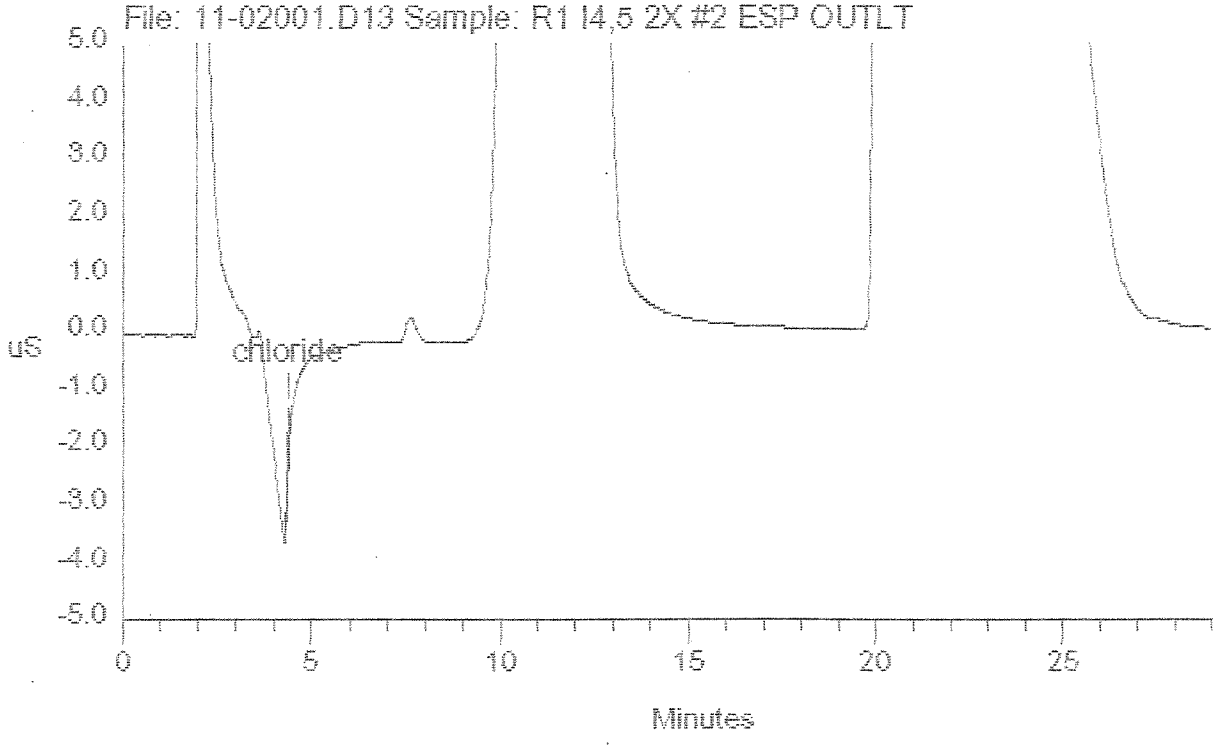

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.38	chloride	3758400	974706	0.159
	Totals	3758400	974706	0.159



METCO ENVIRONMENTAL

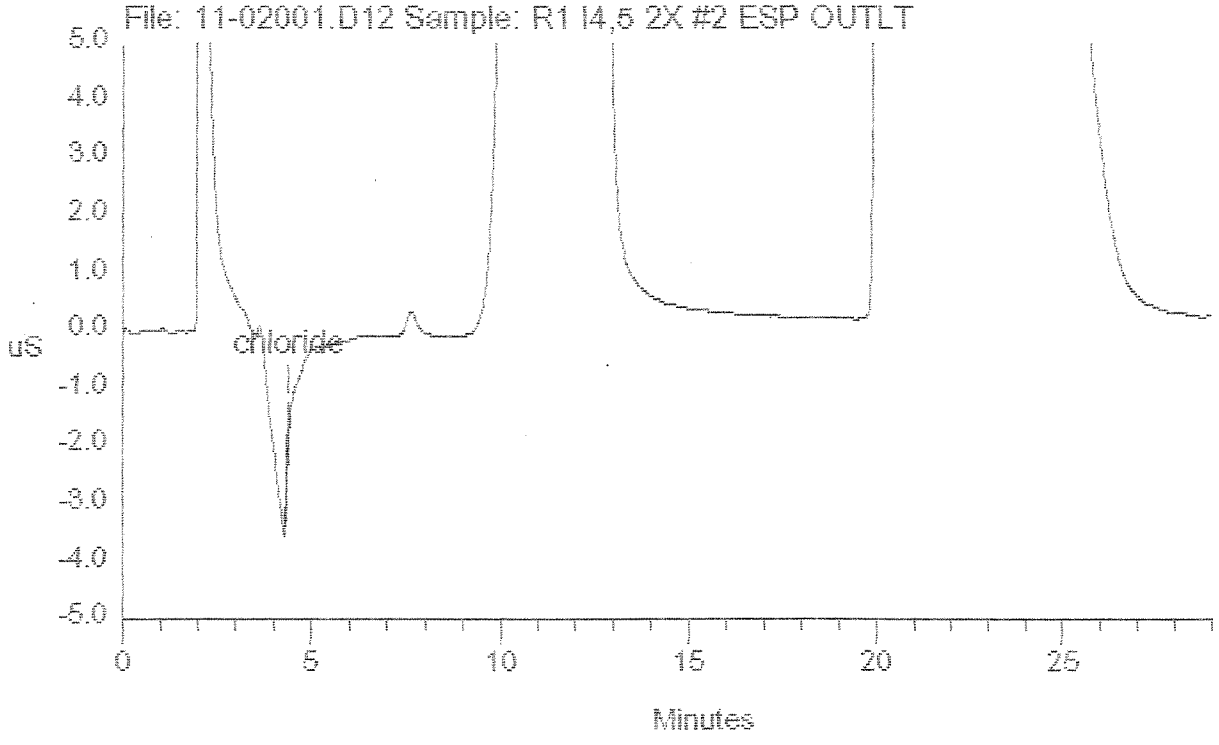
Data Reprocessed On 11/03/2005 13:18:00

Sample Name: R1 I4,5 2X #2 ESP OUTLT	Date: 11/02/2005 16:06:28
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.D12	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 12	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	29.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.40	chloride	3859600	792571	0.164
	Totals	3859600	792571	0.164



METCO ENVIRONMENTAL

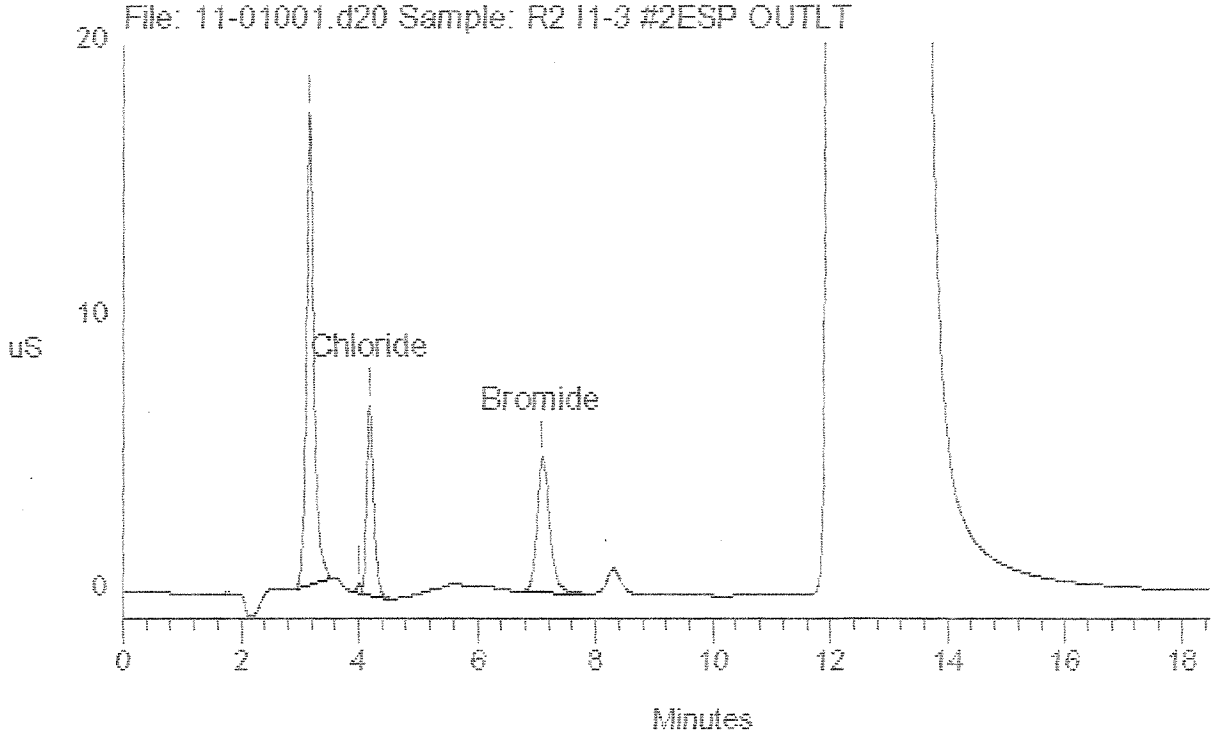
Data Reprocessed On 11/02/2005 15:41:38

Sample Name: R2 I1-3 #2ESP OUTLT	Date: 11/01/2005 17:19:14
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d20	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 20	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.17	Fluoride	154969340	17204982	6.004
4.18	Chloride	55939507	6858739	3.208
7.08	Bromide	73717834	4896624	9.774
	Totals	284626681	28960345	18.985



METCO ENVIRONMENTAL

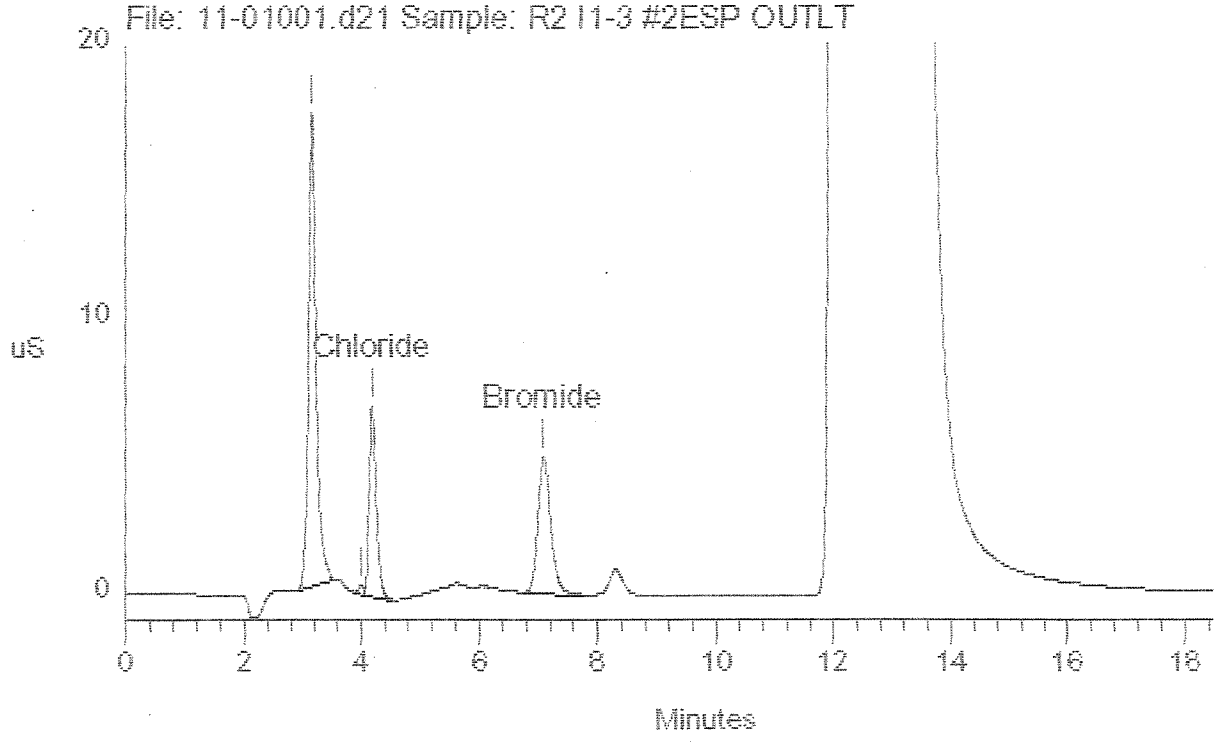
Data Reprocessed On 11/02/2005 15:41:41

Sample Name: R2 I1-3 #2ESP OUTLT	Date: 11/01/2005 17:39:09
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d21	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 21	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.17	Fluoride	155128880	17216554	6.009
4.18	Chloride	56055687	6897842	3.214
7.08	Bromide	73504310	4928169	9.746
	Totals	284688877	29042564	18.969



METCO ENVIRONMENTAL

Data Reprocessed On 11/03/2005 09:20:32

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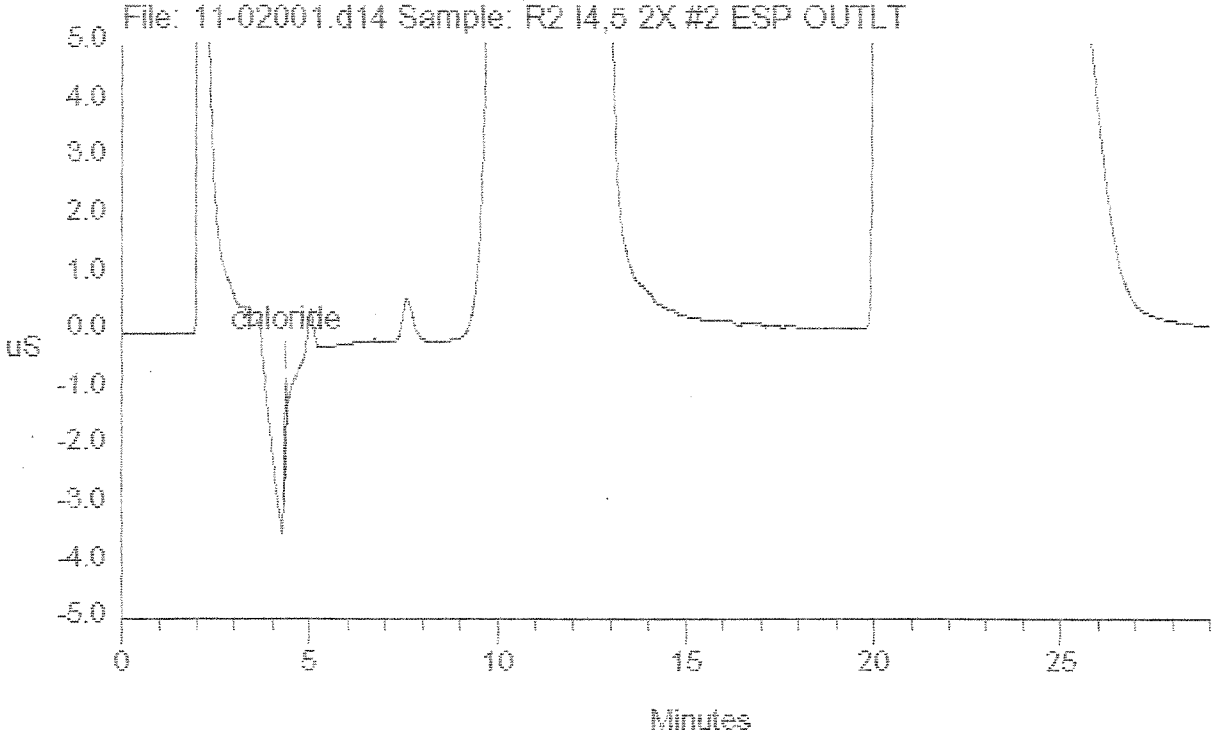
==============================================================================
| Sample Name: R2 I4,5 2X #2 ESP OUTLT        Date: 11/02/2005 17:07:12       |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-02001.d14                          |
| Method     : C:\DX\METHOD\HCLLO2.MET                                        |
| ACI Address: 1  System: 1  Inject#: 14                  Detector:CDM-2      |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                  |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.35	chloride	4537140	1179790	0.198
	Totals	4537140	1179790	0.198



METCO ENVIRONMENTAL

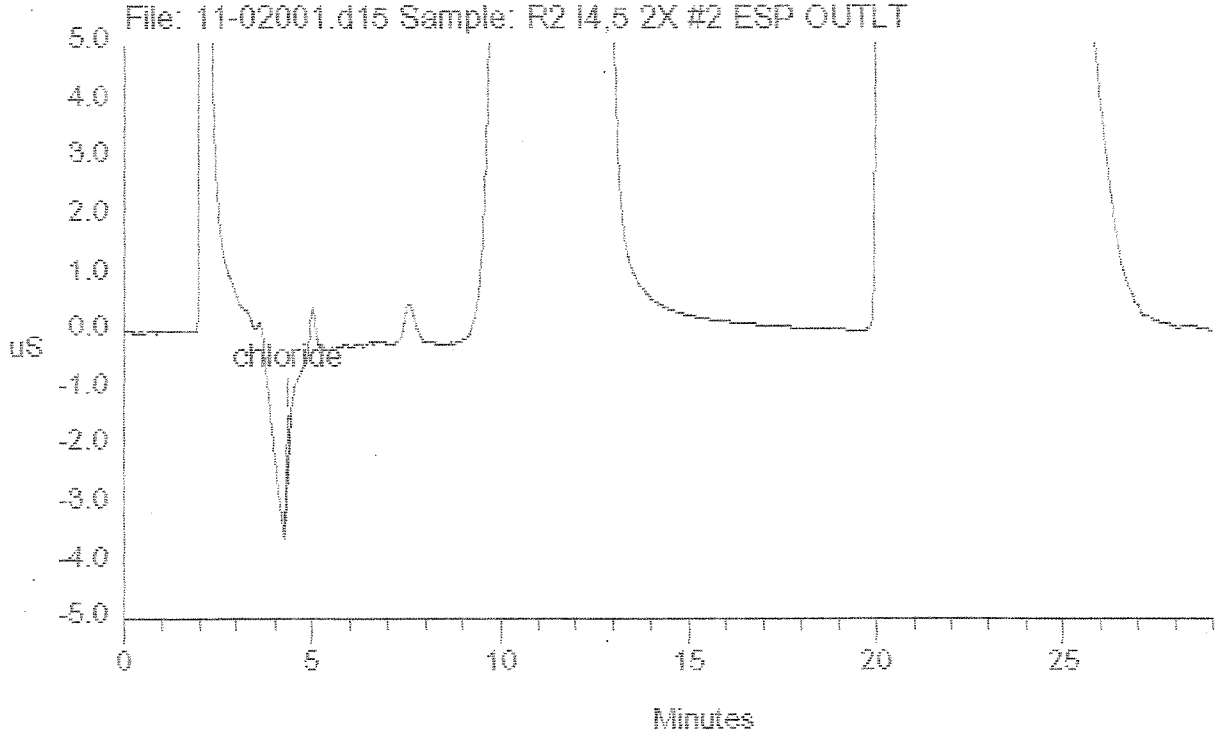
Data Reprocessed On 11/03/2005 09:20:33

Sample Name: R2 I4,5 2X #2 ESP OUTLT	Date: 11/02/2005 17:37:33
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d15	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 15	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.36	chloride	4526400	845628	0.198
	Totals	4526400	845628	0.198



METCO ENVIRONMENTAL

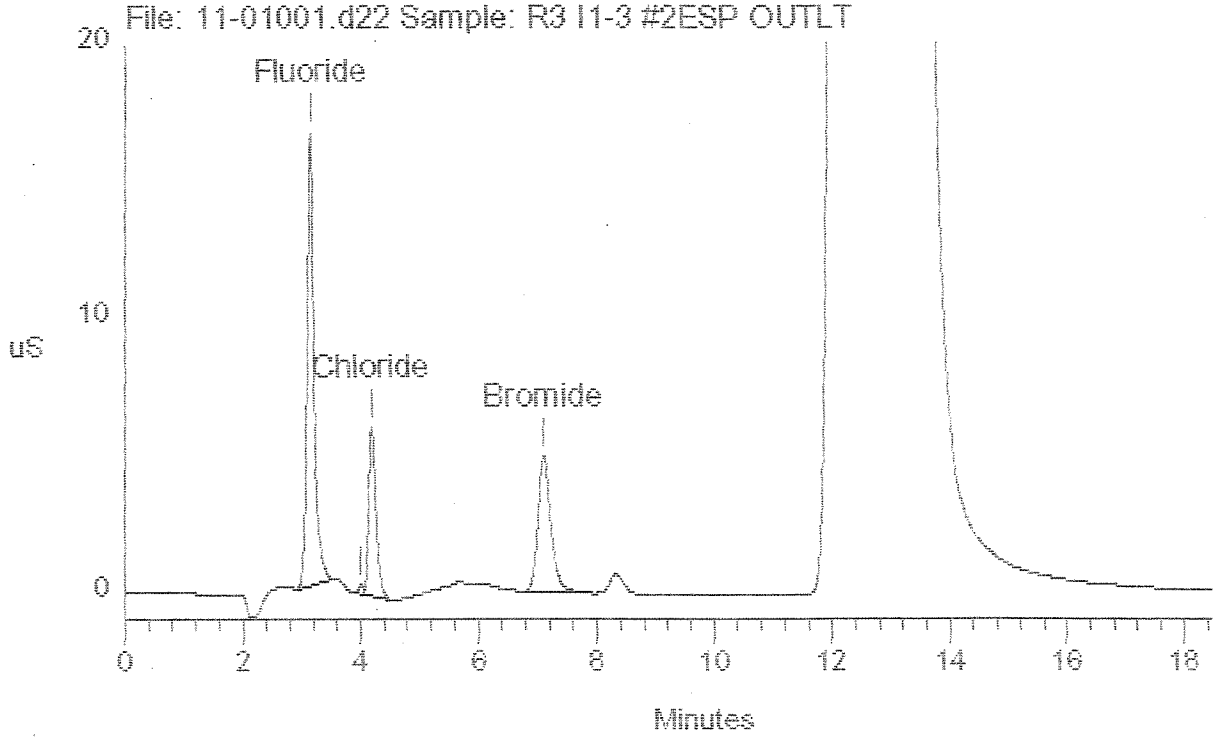
Data Reprocessed On 11/02/2005 15:41:42

Sample Name: R3 I1-3 #2ESP OUTLT	Date: 11/01/2005 17:59:04
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d22	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 22	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.15	Fluoride	135053300	16549167	5.282
4.18	Chloride	50533462	6116589	2.922
7.10	Bromide	73702826	4943878	9.772
	Totals	259289588	27609634	17.976



METCO ENVIRONMENTAL

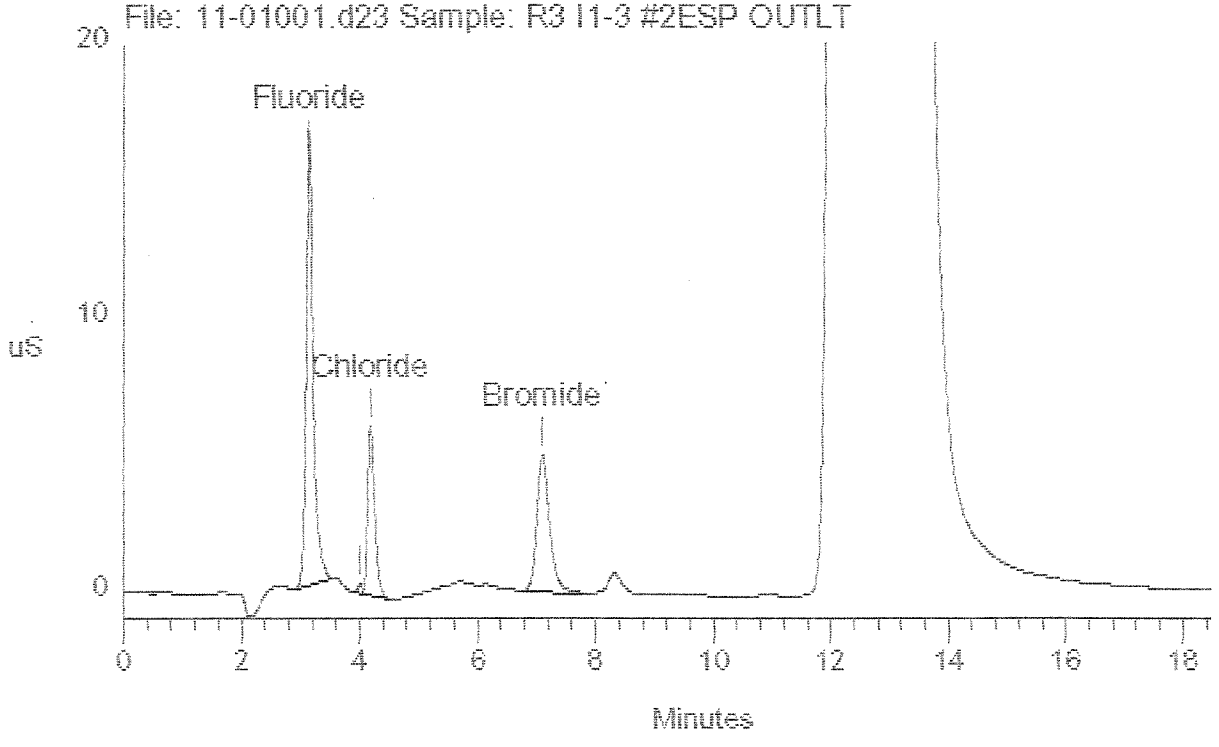
Data Reprocessed On 11/02/2005 15:41:43

Sample Name: R3 I1-3 #2ESP OUTLT	Date: 11/01/2005 18:18:53
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d23	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 23	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.13	Fluoride	135204360	15578008	5.287
4.18	Chloride	50668143	6119118	2.929
7.10	Bromide	73505048	4938097	9.746
	Totals	259377551	26635223	17.963



METCO ENVIRONMENTAL

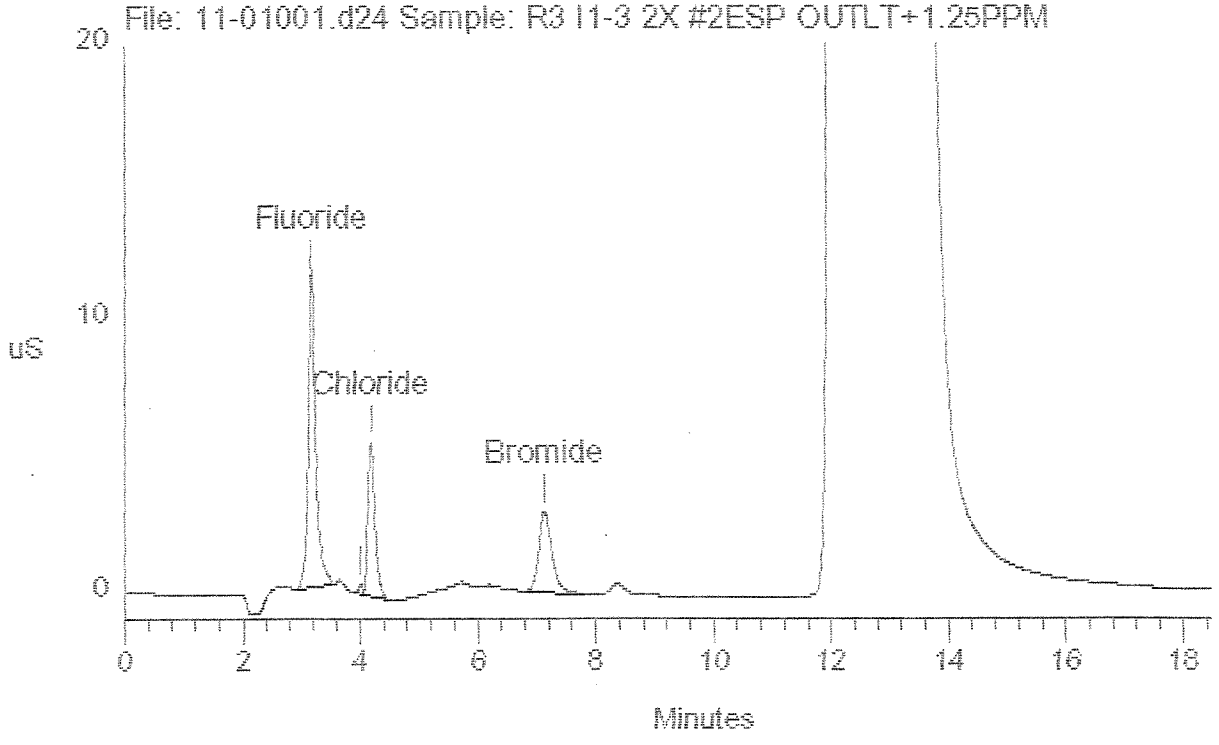
Data Reprocessed On 11/02/2005 15:41:44

```
==============================================================================
| Sample Name: R3 I1-3 2X #2ESP OUTLT+1.25PPM Date: 11/01/2005 18:38:47      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d24                         |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 24                  Detector:CDM-2     |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.17	Fluoride	97709100	11257275	3.928
4.18	Chloride	45287282	5624097	2.645
7.12	Bromide	45207980	2933614	6.058
	Totals	188204362	19814986	12.632



METCO ENVIRONMENTAL

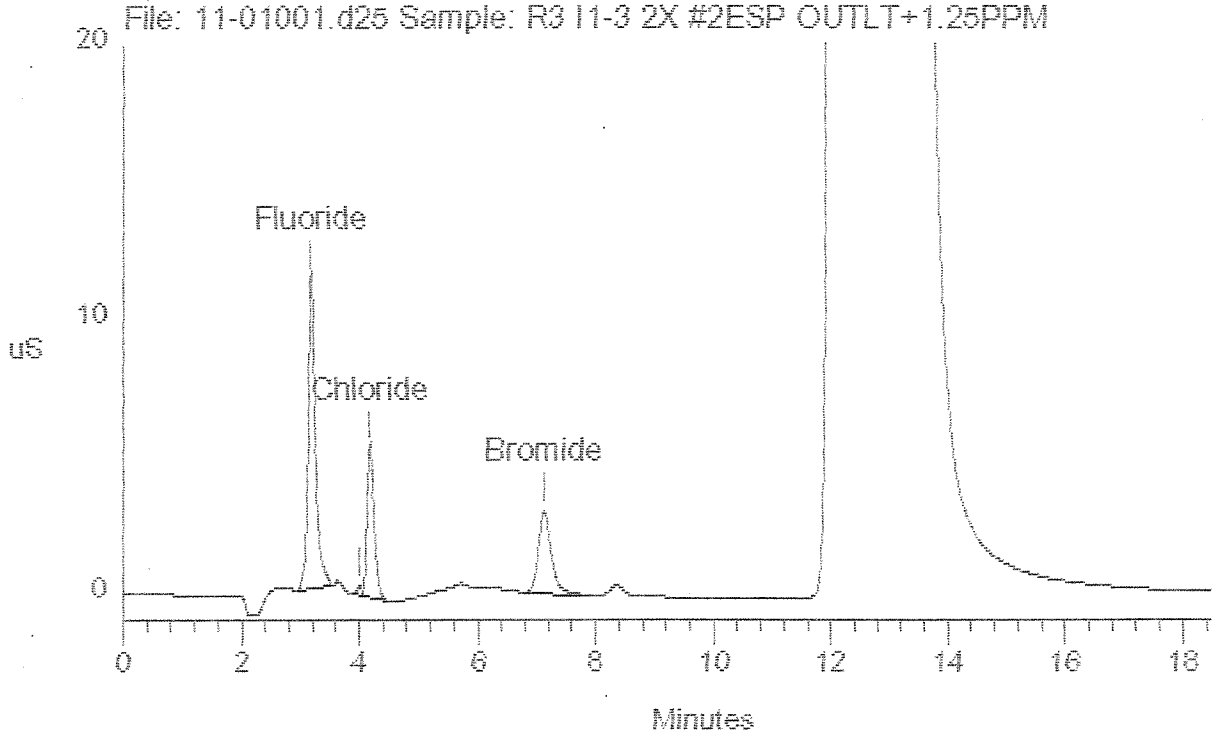
Data Reprocessed On 11/02/2005 15:41:44

```
==============================================================================
| Sample Name: R3 I1-3 2X #2ESP OUTLT+1.25PPM Date: 11/01/2005 18:58:36      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d25                         |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 25                  Detector:CDM-2      |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                 |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.17	Fluoride	98278800	11270722	3.949
4.17	Chloride	44737868	5404458	2.616
7.12	Bromide	45827498	2955123	6.139
	Totals	188844166	19630304	12.704



METCO ENVIRONMENTAL

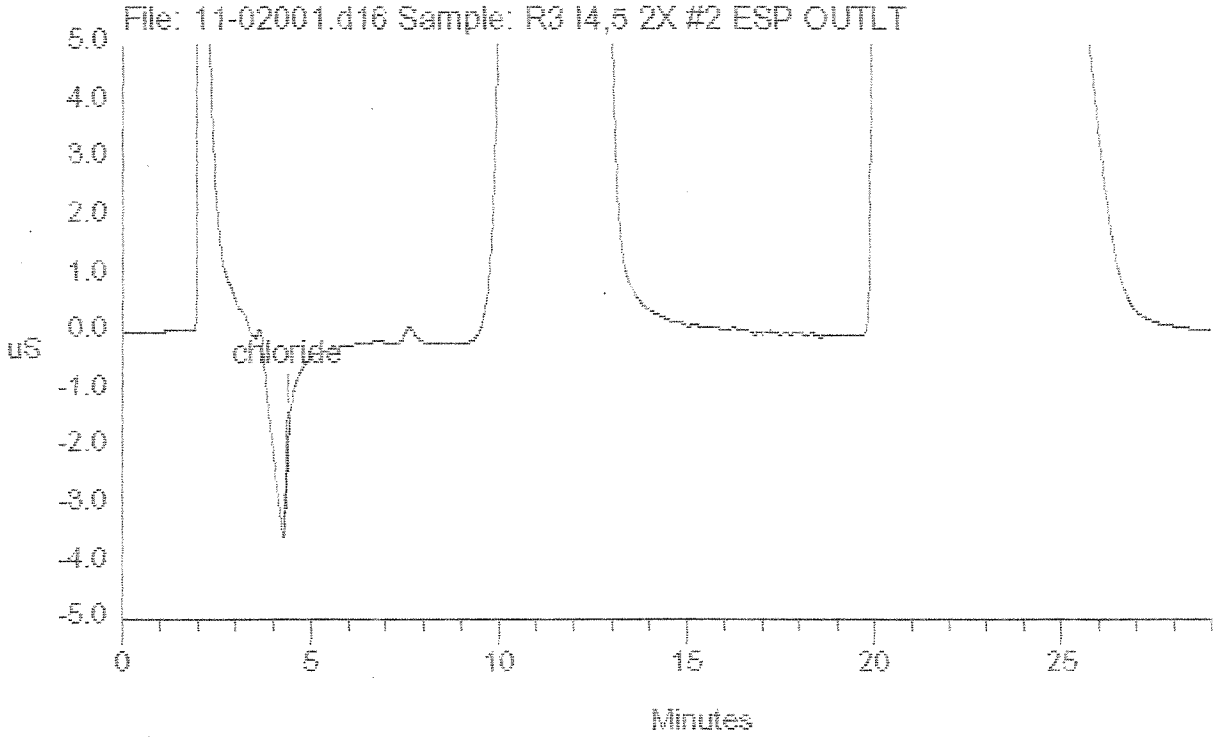
Data Reprocessed On 11/03/2005 09:20:34

```
==============================================================================
¦ Sample Name: R3 I4,5 2X #2 ESP OUTLT        Date: 11/02/2005 18:07:54      ¦
¦ Data File  : C:\DX\DATA\ANIONS\05-235\11-02001.d16                         ¦
¦ Method     : C:\DX\METHOD\HCLLO2.MET                                       ¦
¦ ACI Address: 1  System: 1  Inject#: 16                  Detector:CDM-2     ¦
¦ Analyst    :                 Column: AS14,4mm, STD 1-12-01                 ¦
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8700	5Hz	0.00	29.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.38	chloride	3664400	748324	0.154
	Totals	3664400	748324	0.154



METCO ENVIRONMENTAL

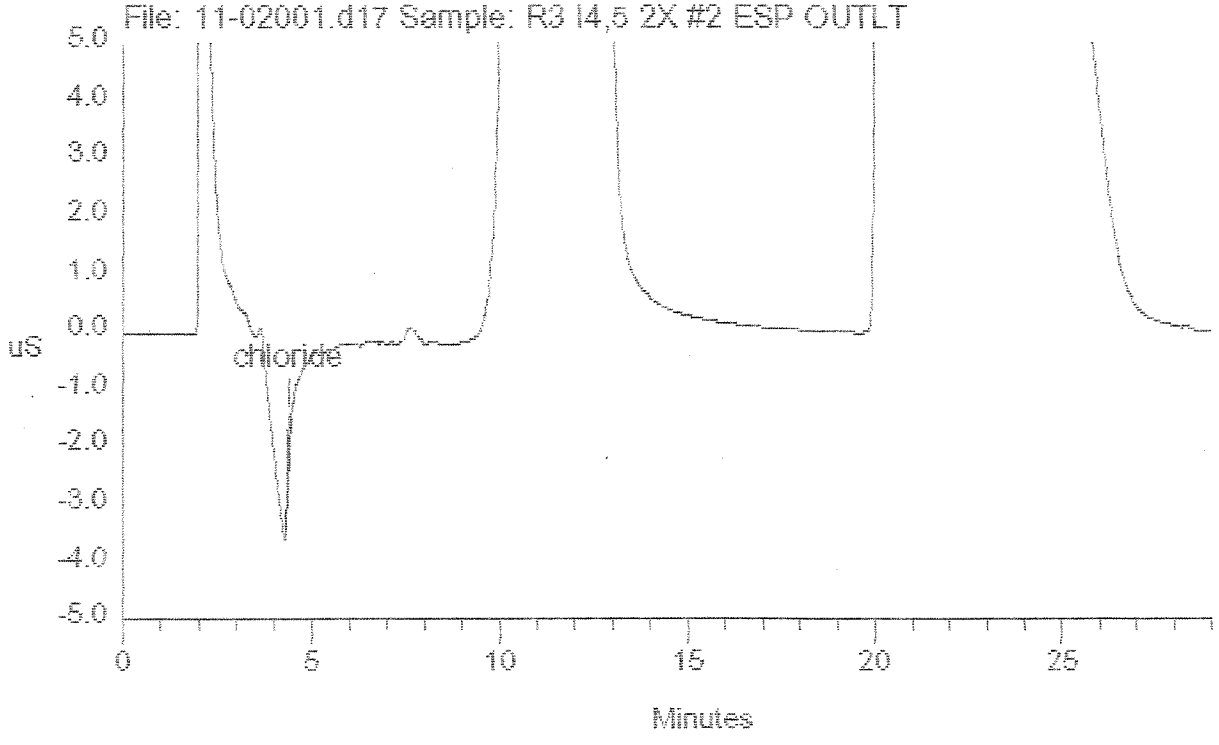
Data Reprocessed On 11/03/2005 09:20:35

Sample Name: R3 I4,5 2X #2 ESP OUTLT	Date: 11/02/2005 18:38:15
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d17	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 17	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.39	chloride	3630000	718324	0.153
	Totals	3630000	718324	0.153



METCO ENVIRONMENTAL

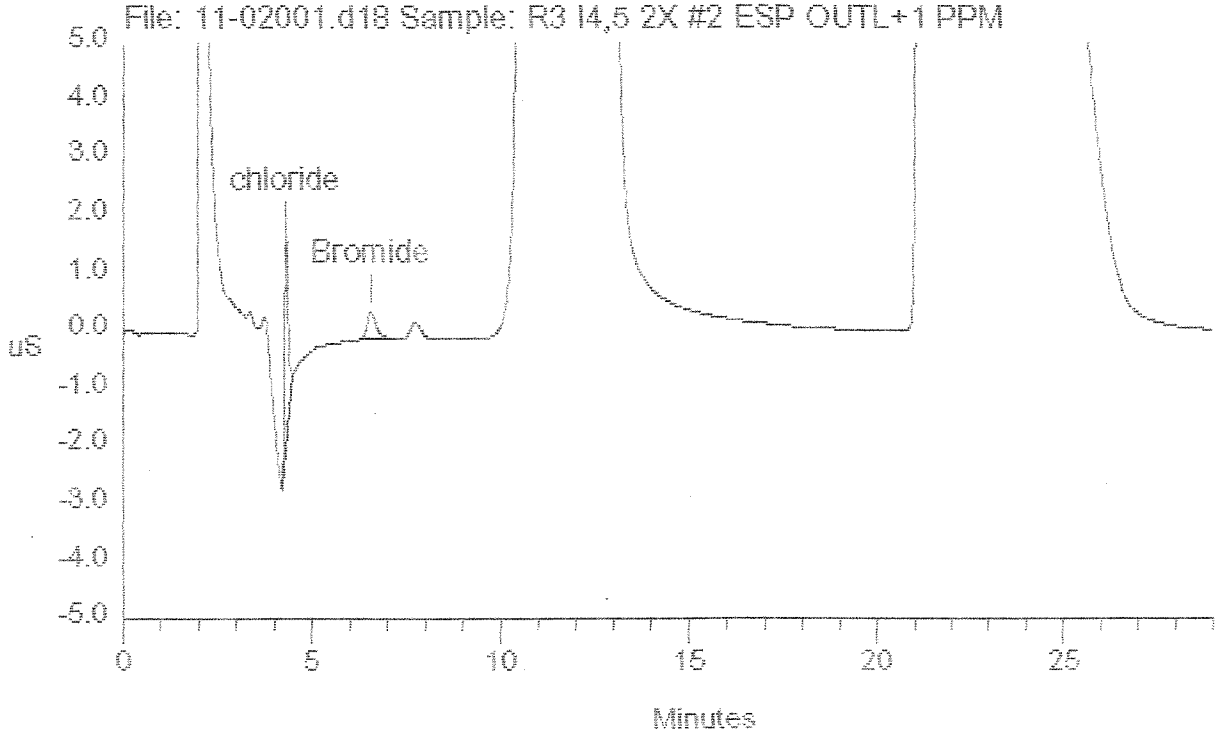
Data Reprocessed On 11/03/2005 09:20:36

```
==============================================================================
| Sample Name: R3 I4,5 2X #2 ESP OUTL+1 PPM   Date: 11/02/2005 19:08:37      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-02001.d18                        |
| Method     : C:\DX\METHOD\HCLLO2.MET                                      |
| ACI Address: 1  System: 1  Inject#: 18                  Detector:CDM-2     |
| Analyst    :                Column: AS14,4mm, STD 1-12-01                 |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.30	chloride	23301554	3745294	1.141
6.55	Bromide	8233916	472039	1.055
	Totals	31535470	4217333	2.196



METCO ENVIRONMENTAL

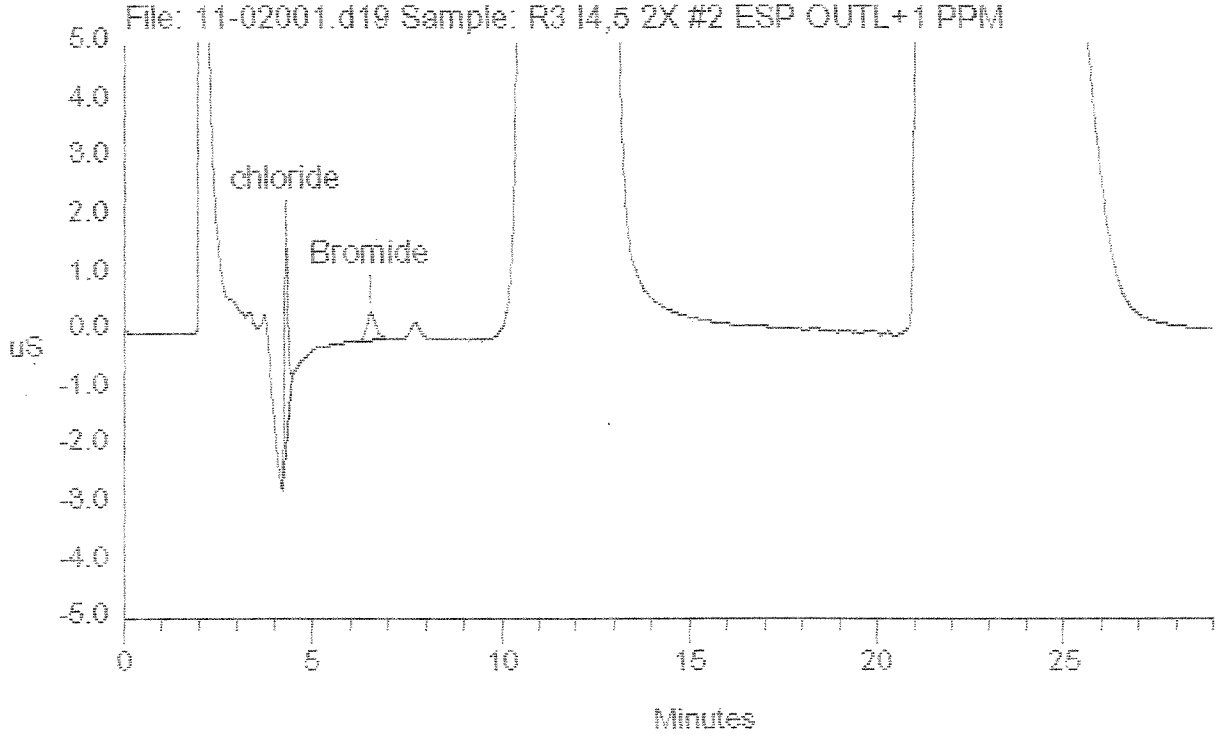
Data Reprocessed On 11/03/2005 09:20:37

Sample Name:	R3 I4,5 2X #2 ESP OUTL+1 PPM Date: 11/02/2005 19:38:58
Data File :	C:\DX\DATA\ANIONS\05-235\11-02001.d19
Method :	C:\DX\METHOD\HCLLO2.MET
ACI Address: 1 System: 1	Inject#: 19 Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.30	chloride	23404082	3734690	1.146
6.53	Bromide	8057306	473493	1.033
	Totals	31461388	4208183	2.178



METCO ENVIRONMENTAL

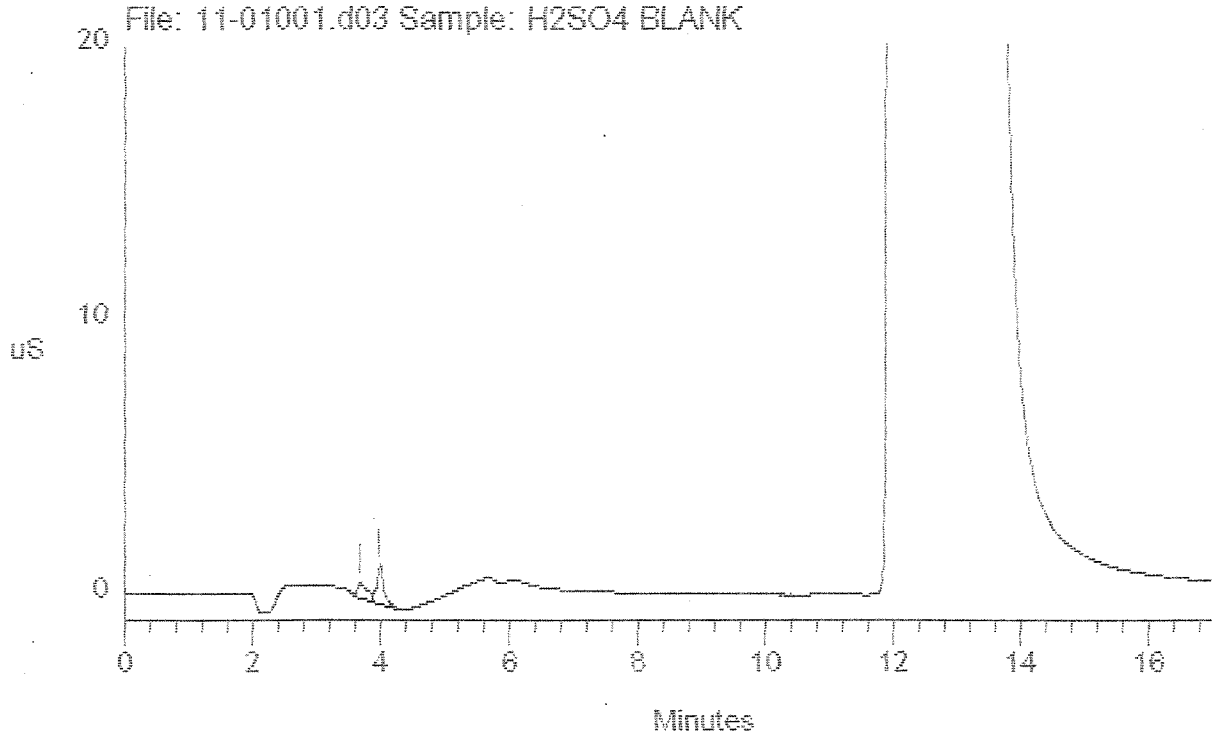
Data Reprocessed On 11/02/2005 15:41:18

Sample Name: H2SO4 BLANK	Date: 11/01/2005 11:25:16
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d03	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 3	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

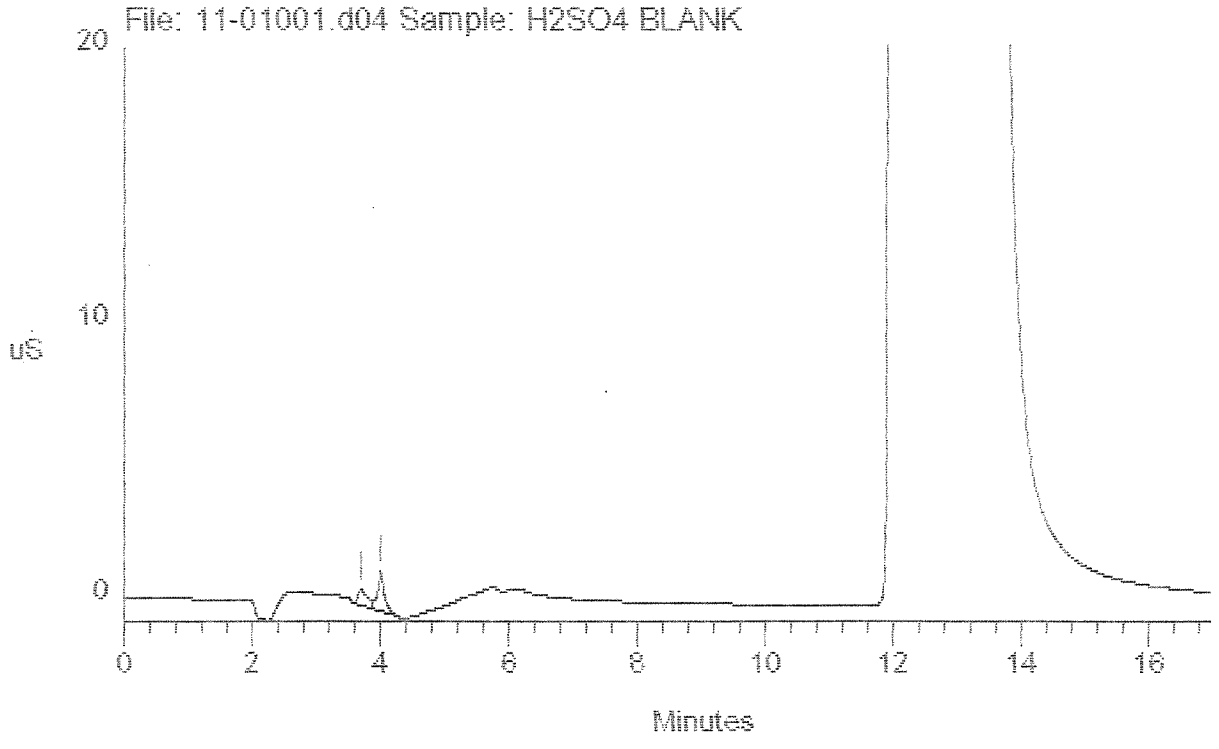
Data Reprocessed On 11/02/2005 15:41:21

Sample Name: H2SO4 BLANK	Date: 11/01/2005 11:43:37
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d04	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 4	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5100	5Hz	0.00	17.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

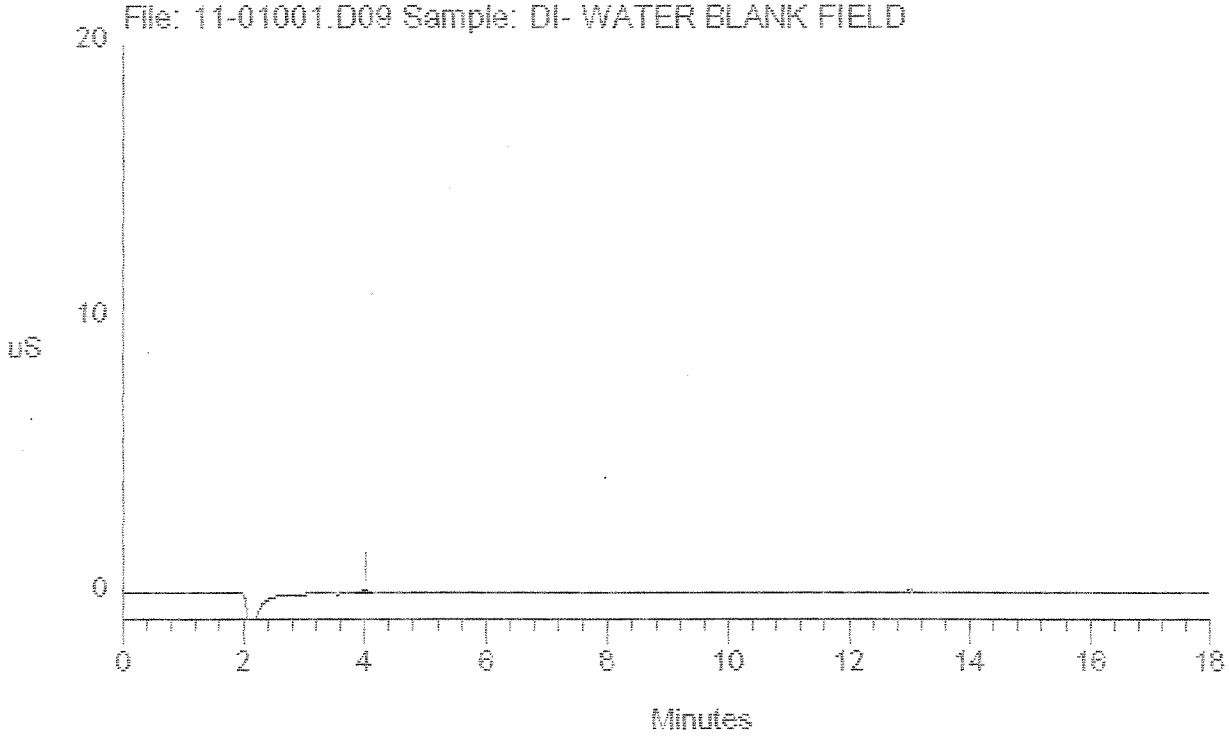
Data Reprocessed On 11/03/2005 11:38:14

Sample Name: DI- WATER BLANK FIELD	Date: 11/01/2005 13:39:07
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.D09	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 10	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	5400	5Hz	0.00	18.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

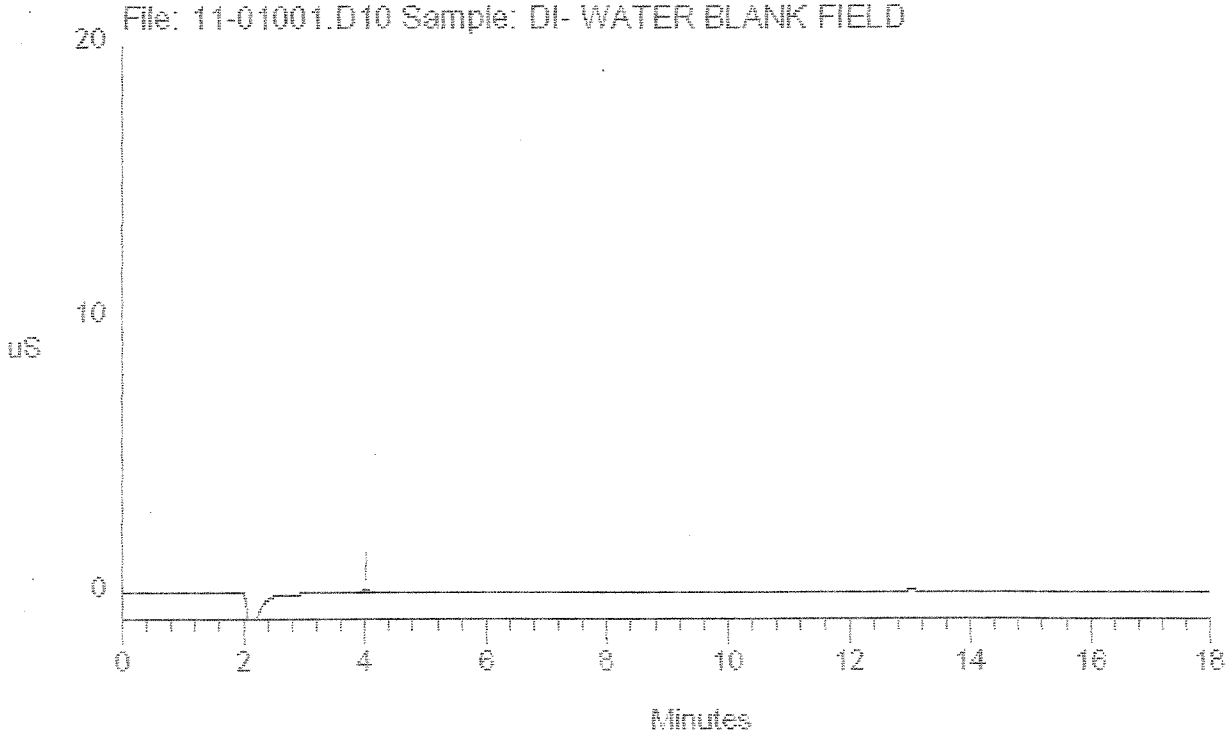
Data Reprocessed On 11/03/2005 11:38:25

Sample Name: DI- WATER BLANK FIELD	Date: 11/01/2005 14:01:28
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.D10	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 10	Detector:CDM-2
Analyst :	Column: AS14-,4mm, STARTED 2-05

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5400	5Hz	0.00	18.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

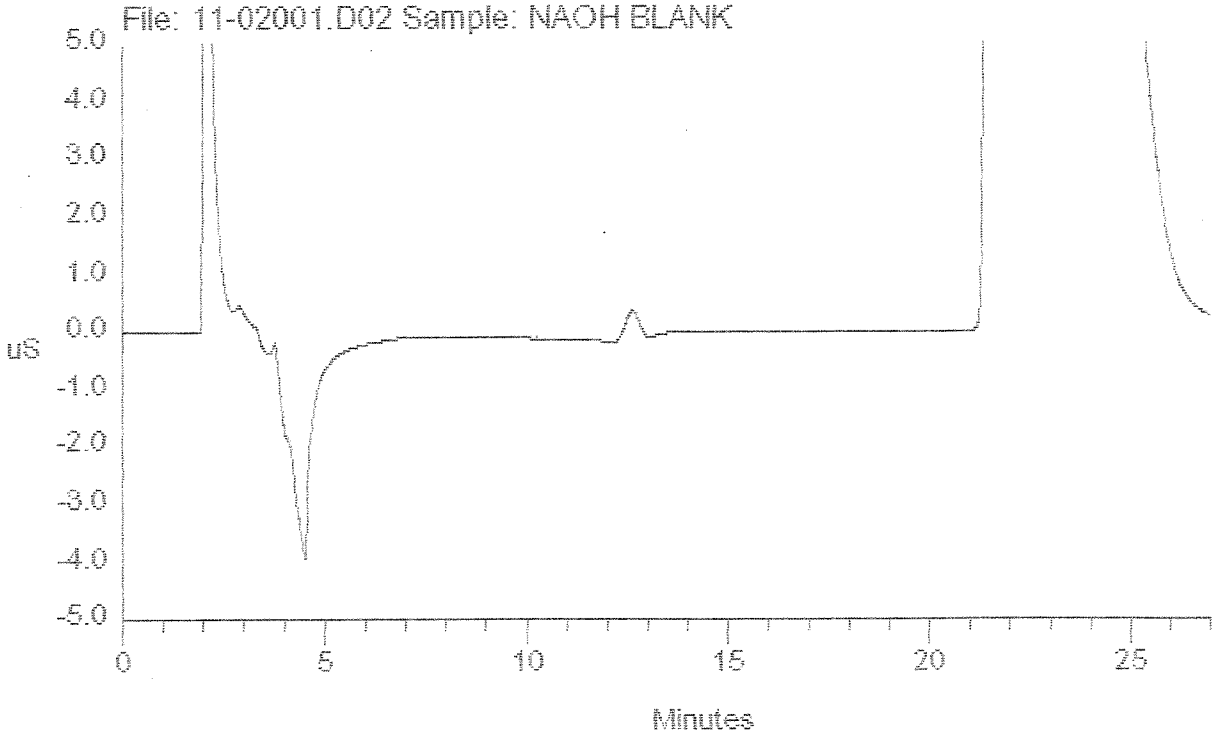
Data Reprocessed On 11/03/2005 11:43:36

Sample Name: NAOH BLANK	Date: 11/02/2005 11:02:53
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.D02	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 2	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	8112	5Hz	0.00	27.04		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

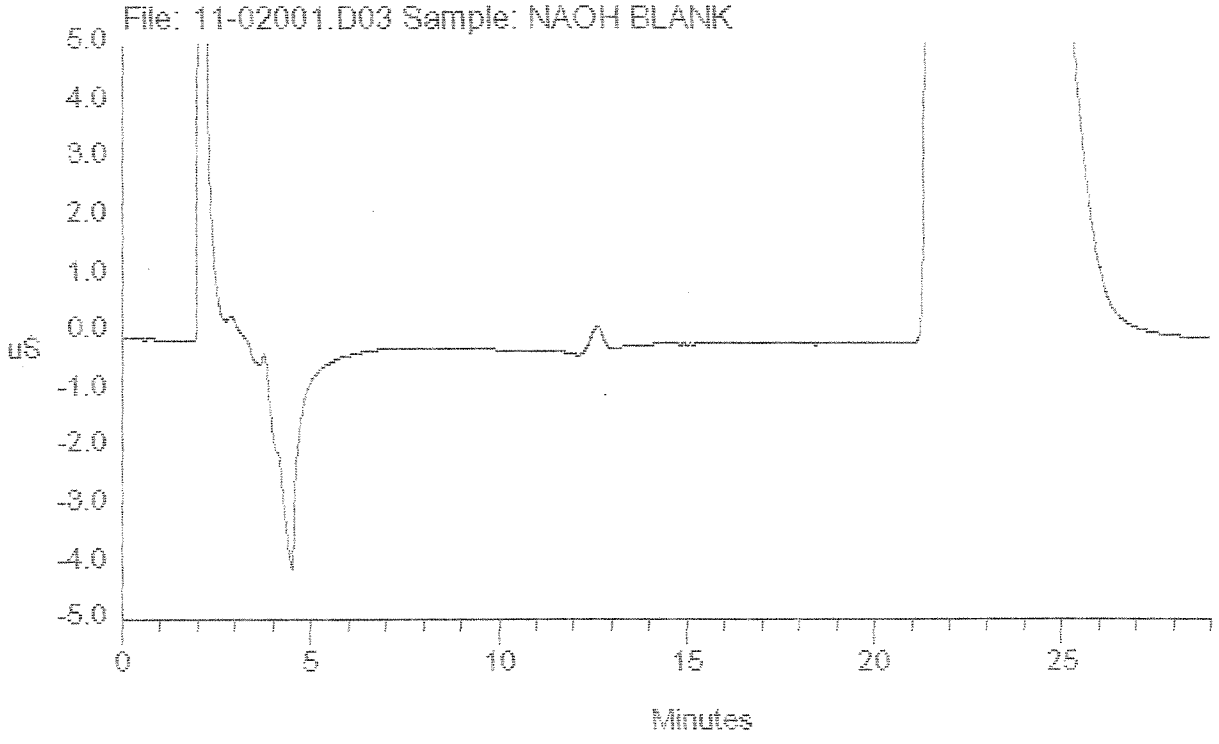
Data Reprocessed On 11/03/2005 11:43:45

Sample Name: NAOH BLANK	Date: 11/02/2005 11:33:14
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.D03	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 3	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

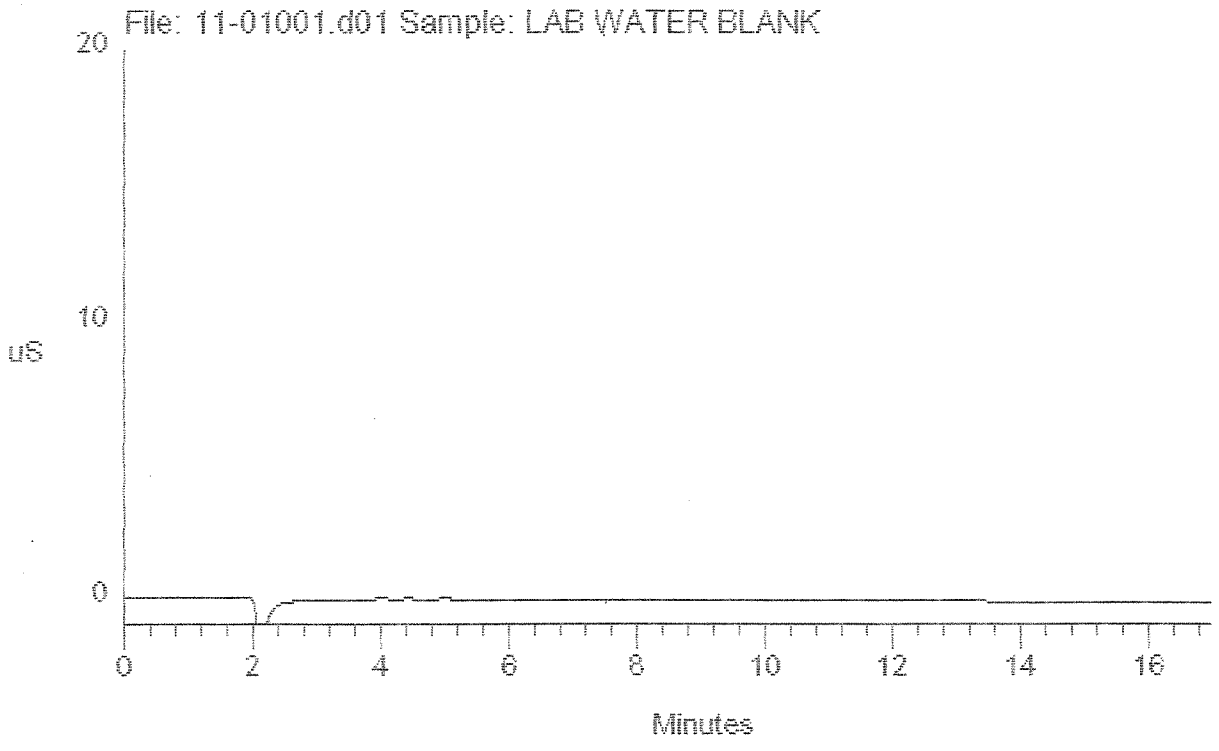
Data Reprocessed On 11/02/2005 15:41:17

```
==============================================================================
¦ Sample Name: LAB WATER BLANK                Date: 11/01/2005 10:48:34      ¦
¦ Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d01                         ¦
¦ Method     : C:\DX\METHOD\HF2.MET                                          ¦
¦ ACI Address: 1  System: 1  Inject#: 1                   Detector:CDM-2     ¦
¦ Analyst    :                Column: AS14-,4mm, STARTED 2-05                ¦
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	5100	5Hz	0.00	17.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

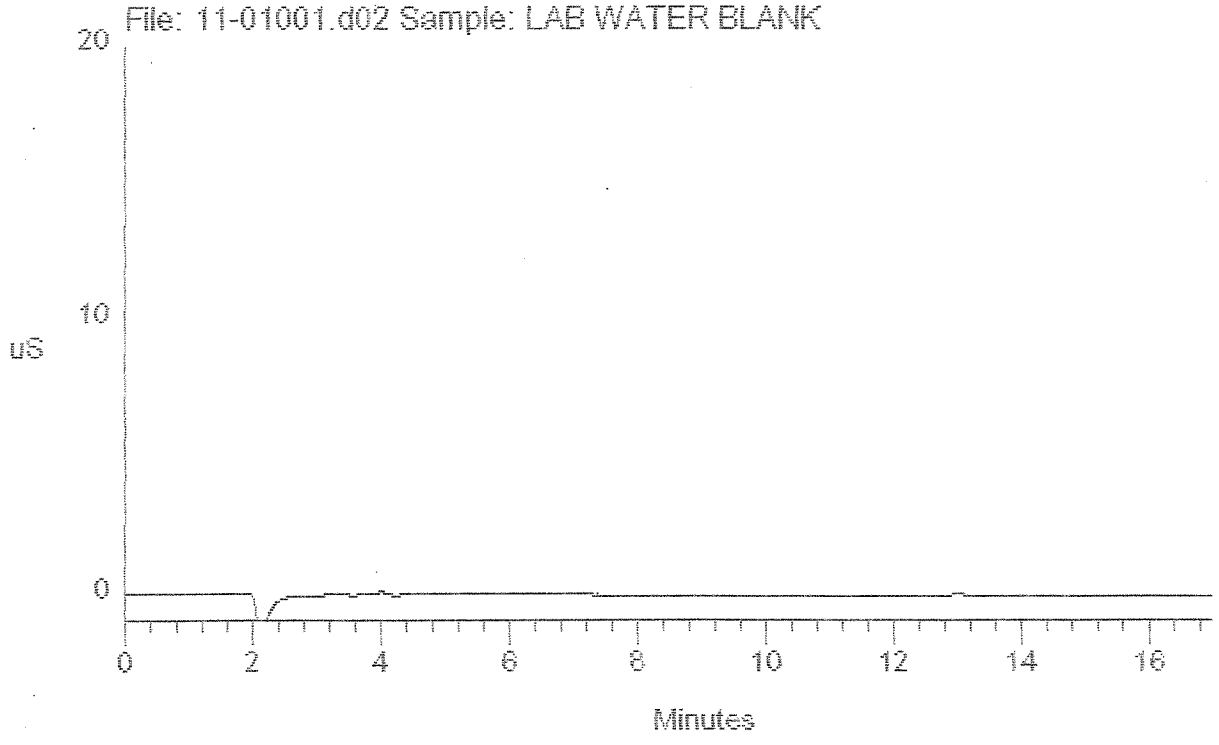
Data Reprocessed On 11/02/2005 15:41:18

```
==============================================================================
| Sample Name: LAB WATER BLANK                Date: 11/01/2005 11:06:55      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d02                         |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 2                   Detector:CDM-2     |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	5100	5Hz	0.00	17.00		2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

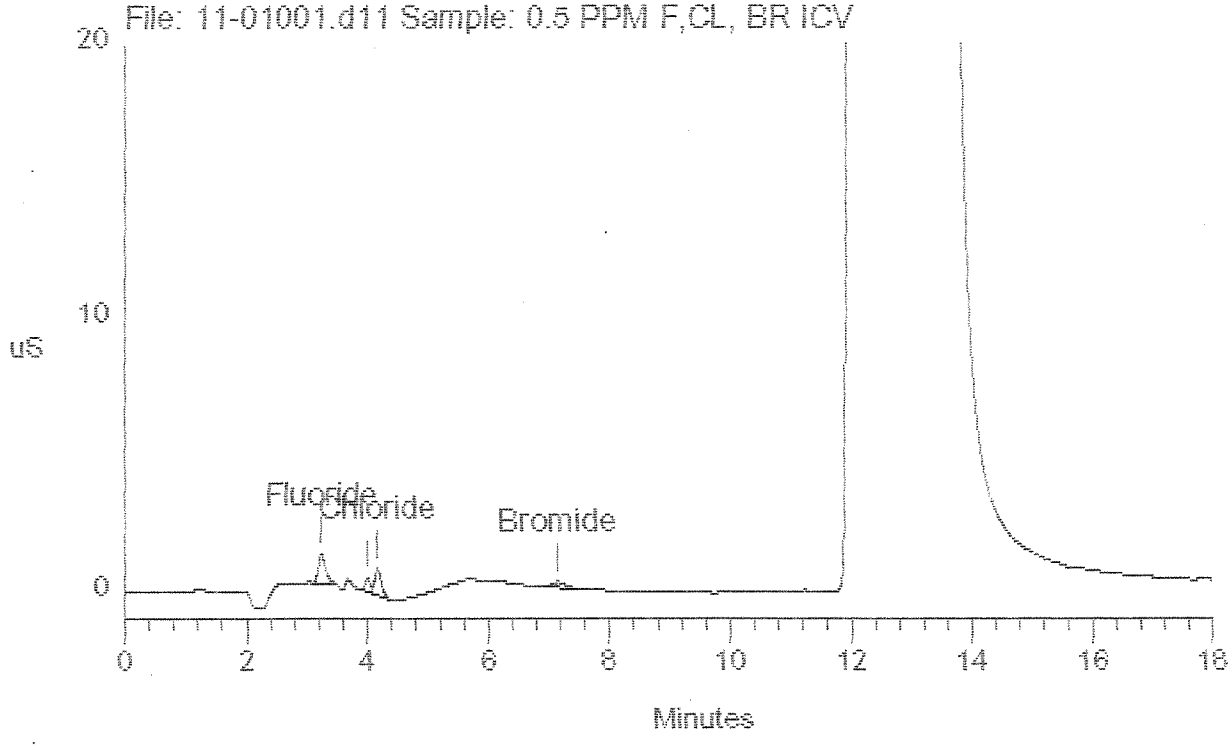
Data Reprocessed On 11/02/2005 15:41:28

```
==============================================================================
| Sample Name: 0.5 PPM F,CL, BR ICV          Date: 11/01/2005 14:20:52       |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d11                         |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 11                  Detector:CDM-2     |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5400	5Hz	0.00	18.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.23	Fluoride	8945420	1082204	0.515
4.17	Chloride	7353623	960820	0.504
7.15	Bromide	3182888	208112	0.526
	Totals	19481931	2251136	1.545



METCO ENVIRONMENTAL

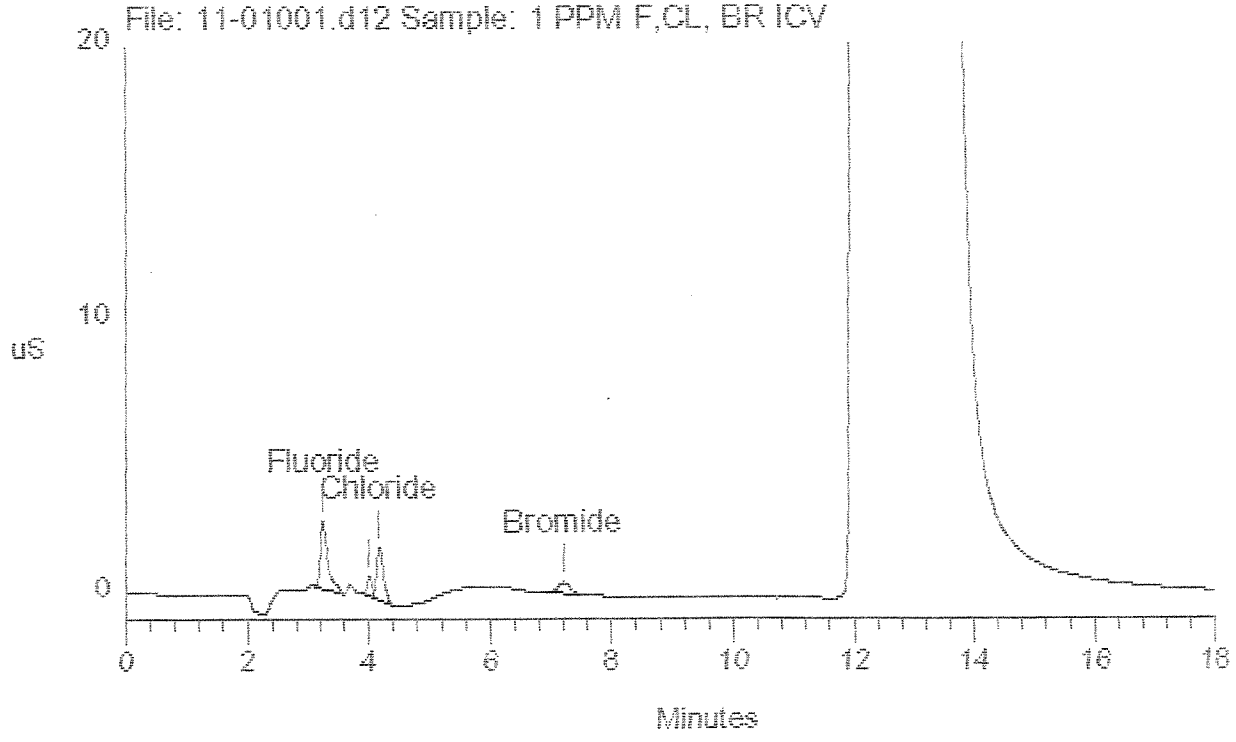
Data Reprocessed On 11/02/2005 15:41:29

Sample Name: 1 PPM F,CL, BR ICV	Date: 11/01/2005 14:40:17
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d12	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 12	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5400	5Hz	0.00	18.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.23	Fluoride	21130434	2397183	1.153
4.17	Chloride	15075175	1955836	1.051
7.20	Bromide	5703910	394135	0.909
	Totals	41909519	4747155	3.113



METCO ENVIRONMENTAL

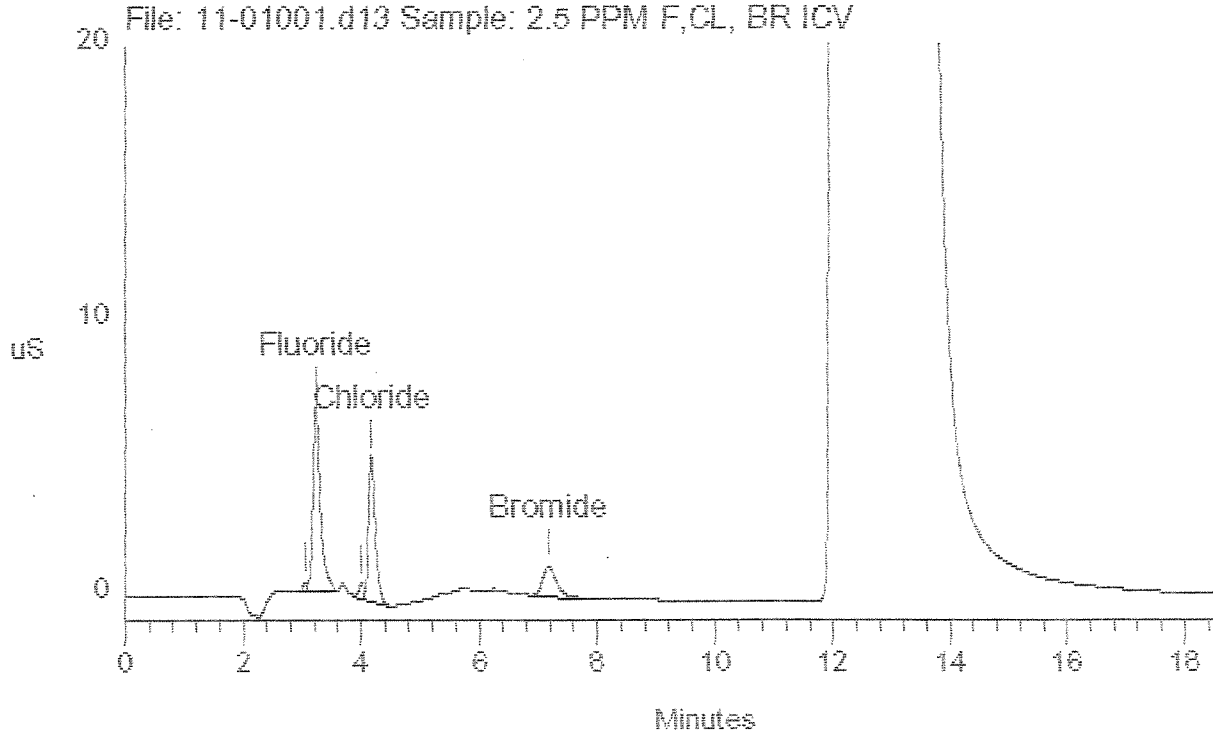
Data Reprocessed On 11/02/2005 15:41:30

```
==============================================================================
| Sample Name: 2.5 PPM F,CL, BR ICV          Date: 11/01/2005 15:00:12       |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d13                         |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 13                  Detector:CDM-2     |
| Analyst    :                Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.23	Fluoride	58566770	6822264	2.510
4.17	Chloride	40868684	5213546	2.412
7.17	Bromide	17829272	1101220	2.490
	Totals	117264726	13137030	7.412



METCO ENVIRONMENTAL

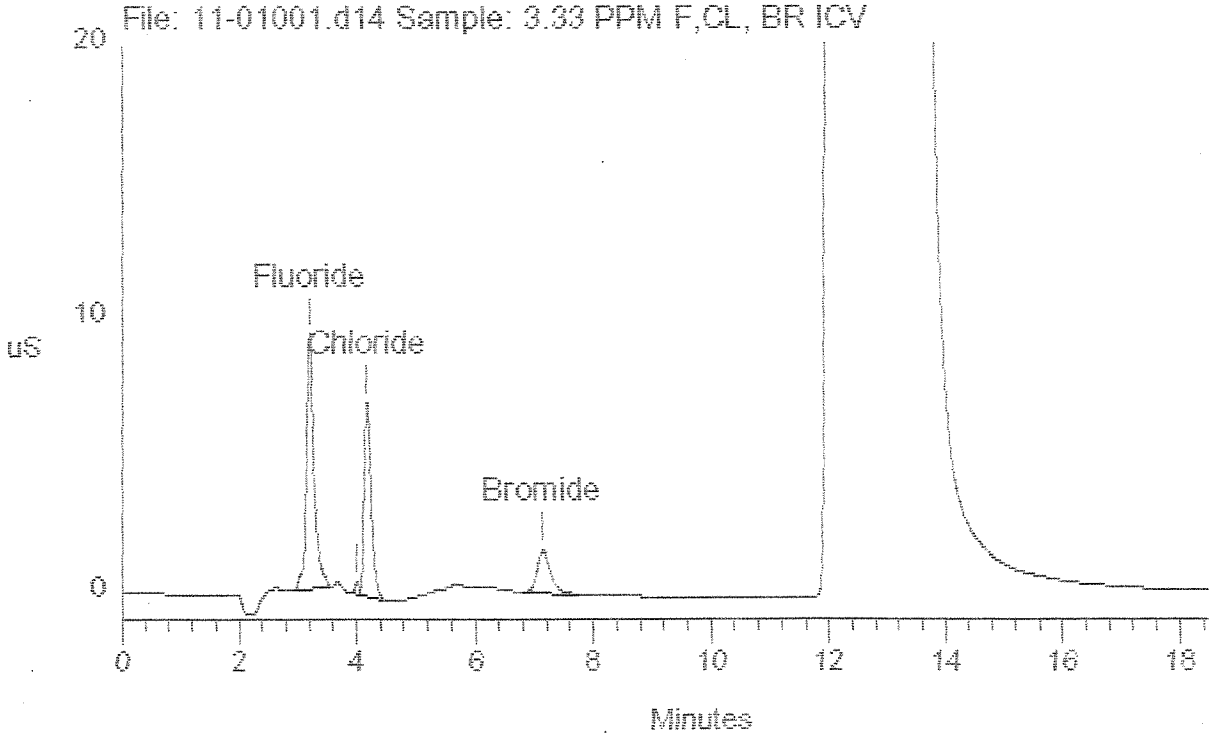
Data Reprocessed On 11/02/2005 15:41:33

Sample Name: 3.33 PPM F,CL, BR ICV	Date: 11/01/2005 15:20:06
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d14	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 14	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.20	Fluoride	81934240	9194220	3.357
4.17	Chloride	56774212	7025181	3.252
7.13	Bromide	24898427	1552000	3.411
	Totals	163606879	17771401	10.019



METCO ENVIRONMENTAL

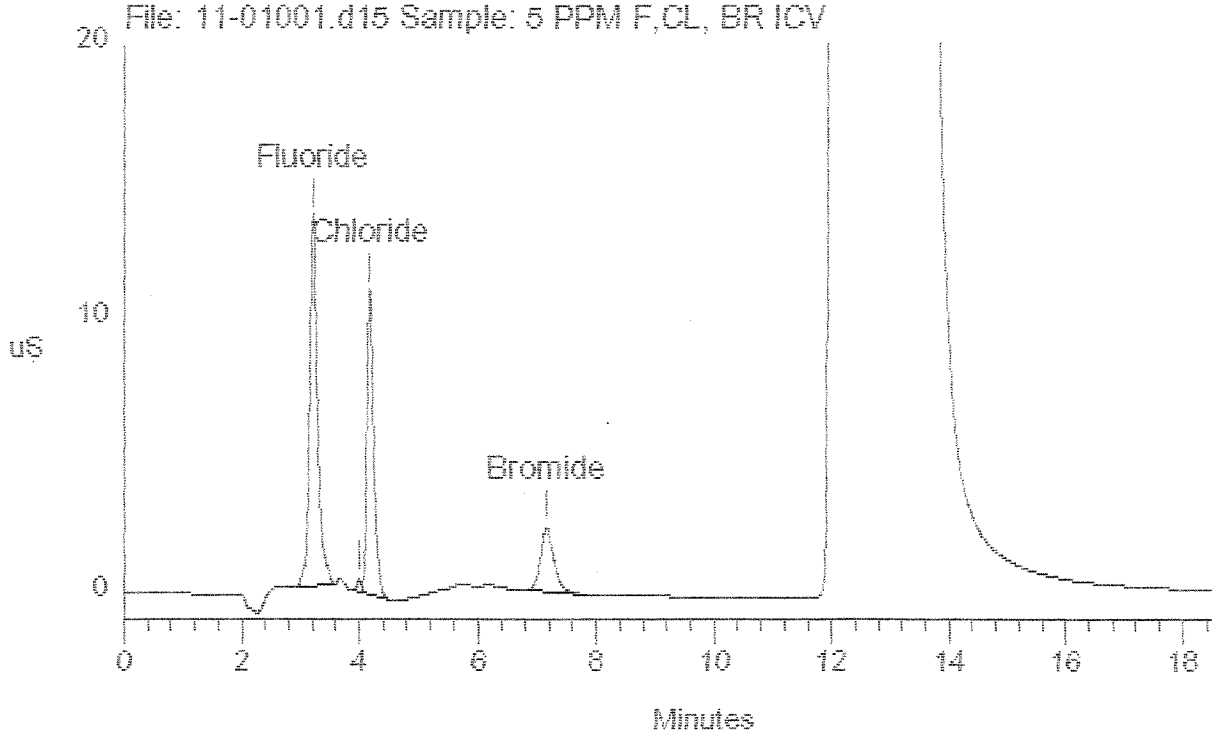
Data Reprocessed On 11/02/2005 15:41:33

Sample Name: 5 PPM F,CL, BR ICV	Date: 11/01/2005 15:39:56
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d15	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 15	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.20	Fluoride	125659020	13440073	4.941
4.17	Chloride	86191464	11087939	4.805
7.15	Bromide	37298467	2334898	5.027
	Totals	249148951	26862910	14.773



METCO ENVIRONMENTAL

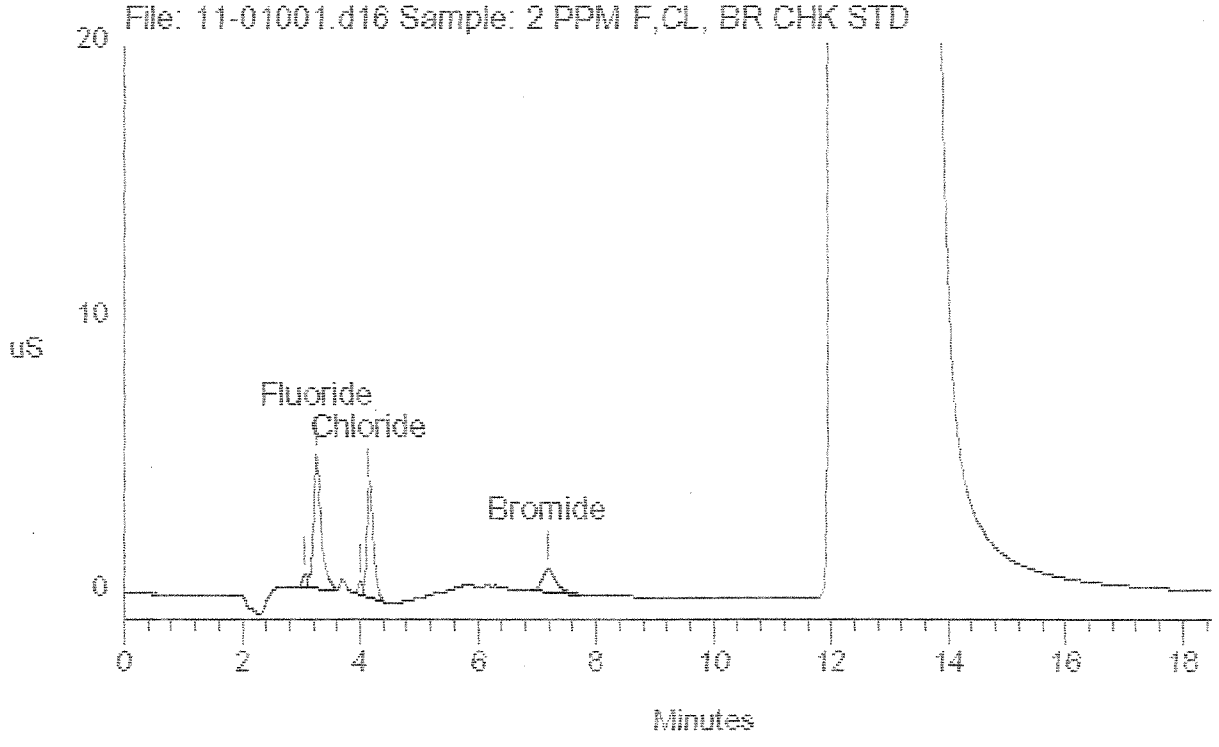
Data Reprocessed On 11/02/2005 15:41:34

```
==============================================================================
| Sample Name: 2 PPM F,CL, BR CHK STD          Date: 11/01/2005 15:59:51      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d16                          |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 16                   Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.25	Fluoride	43516124	4883027	1.964
4.15	Chloride	32173649	4009925	1.953
7.18	Bromide	14101554	861910	2.004
	Totals	89791328	9754862	5.921



METCO ENVIRONMENTAL

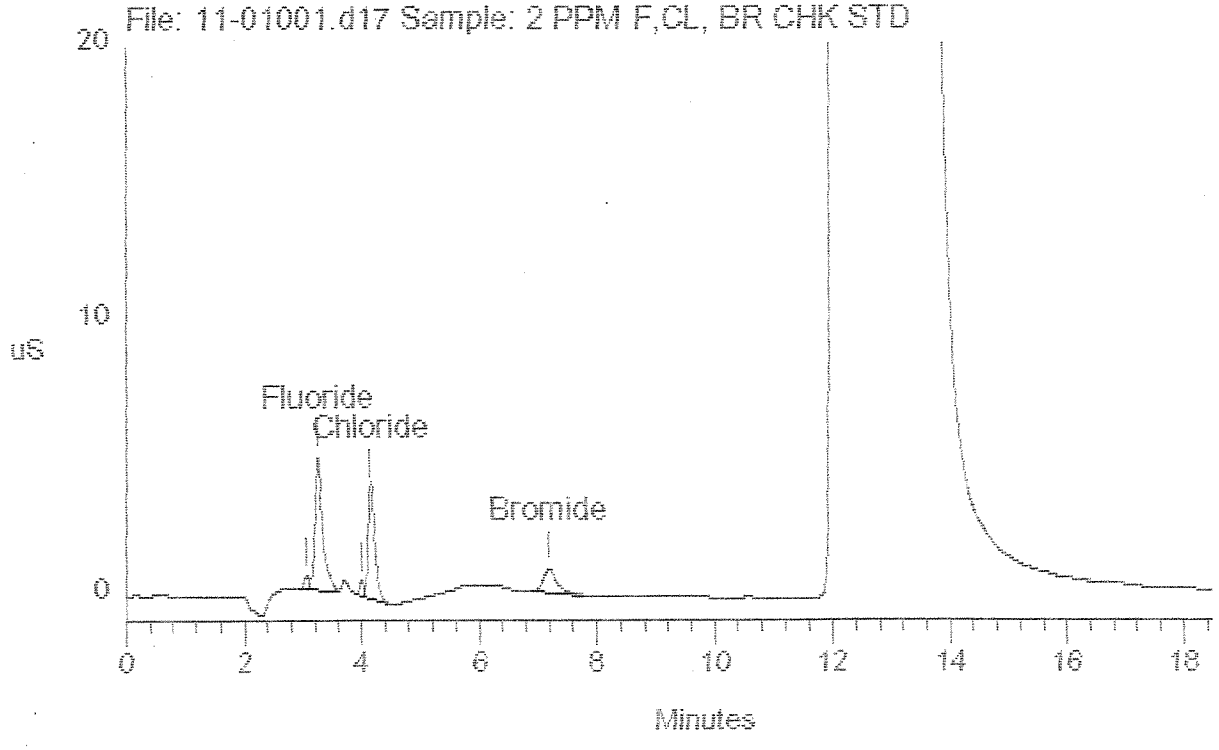
Data Reprocessed On 11/02/2005 15:41:35

```
==============================================================================
| Sample Name: 2 PPM F,CL, BR CHK STD          Date: 11/01/2005 16:19:42      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d17                          |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 17                   Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.25	Fluoride	42952595	4826502	1.944
4.15	Chloride	32487082	4043462	1.970
7.18	Bromide	14112040	865041	2.005
	Totals	89551716	9735004	5.919



METCO ENVIRONMENTAL

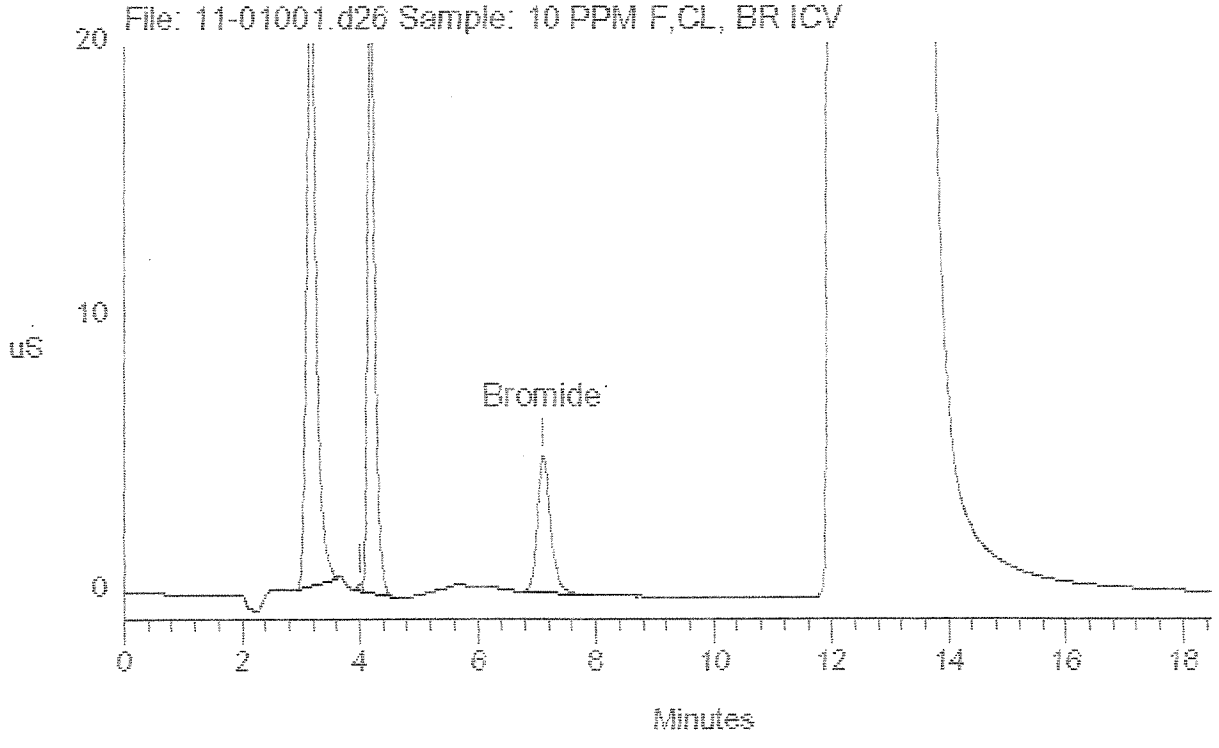
Data Reprocessed On 11/02/2005 15:41:45

```
==============================================================================
| Sample Name: 10 PPM F,CL, BR ICV            Date: 11/01/2005 19:18:31      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d26                         |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 26                  Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.17	Fluoride	262352736	24818958	9.895
4.18	Chloride	190034230	22472023	10.286
7.10	Bromide	76797583	4953774	10.175
	Totals	529184549	52244755	30.356



METCO ENVIRONMENTAL

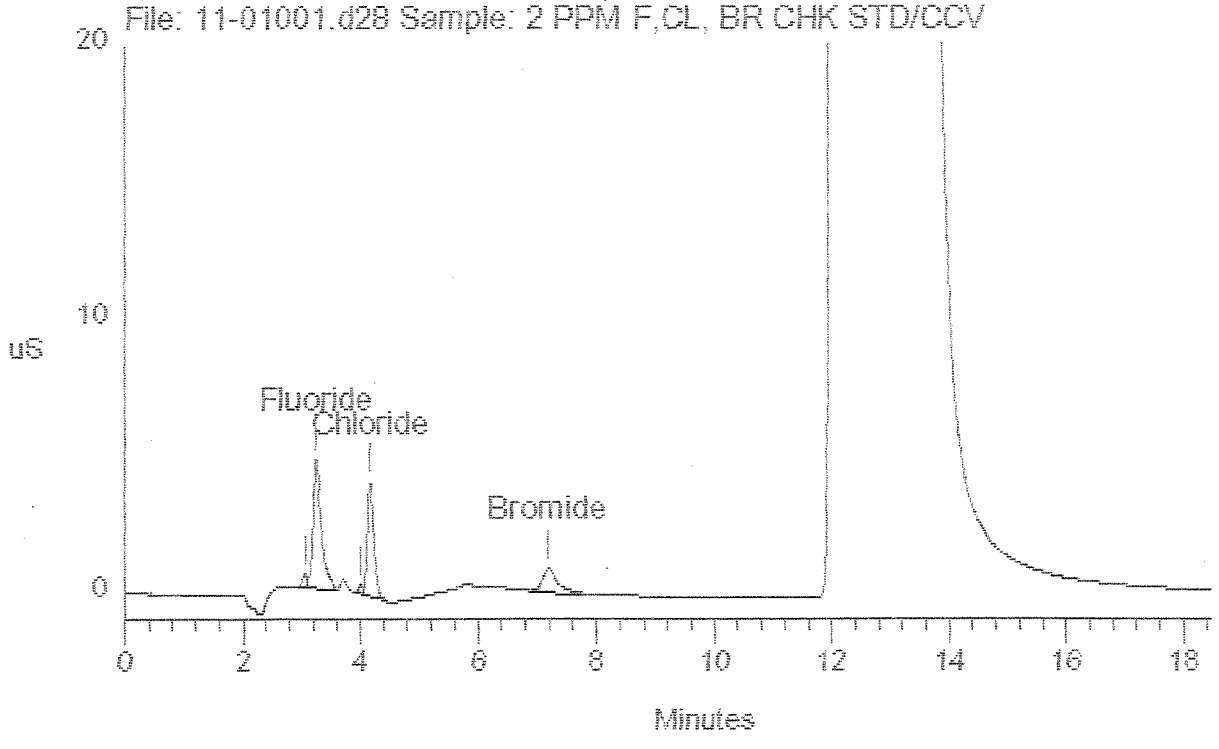
Data Reprocessed On 11/02/2005 15:41:49

```
==============================================================================
| Sample Name: 2 PPM F,CL, BR CHK STD/CCV     Date: 11/01/2005 19:58:21      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d28                         |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 28                  Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.25	Fluoride	42783003	4708095	1.938
4.17	Chloride	32394706	4172432	1.965
7.18	Bromide	14480660	848083	2.053
	Totals	89658369	9728610	5.956



METCO ENVIRONMENTAL

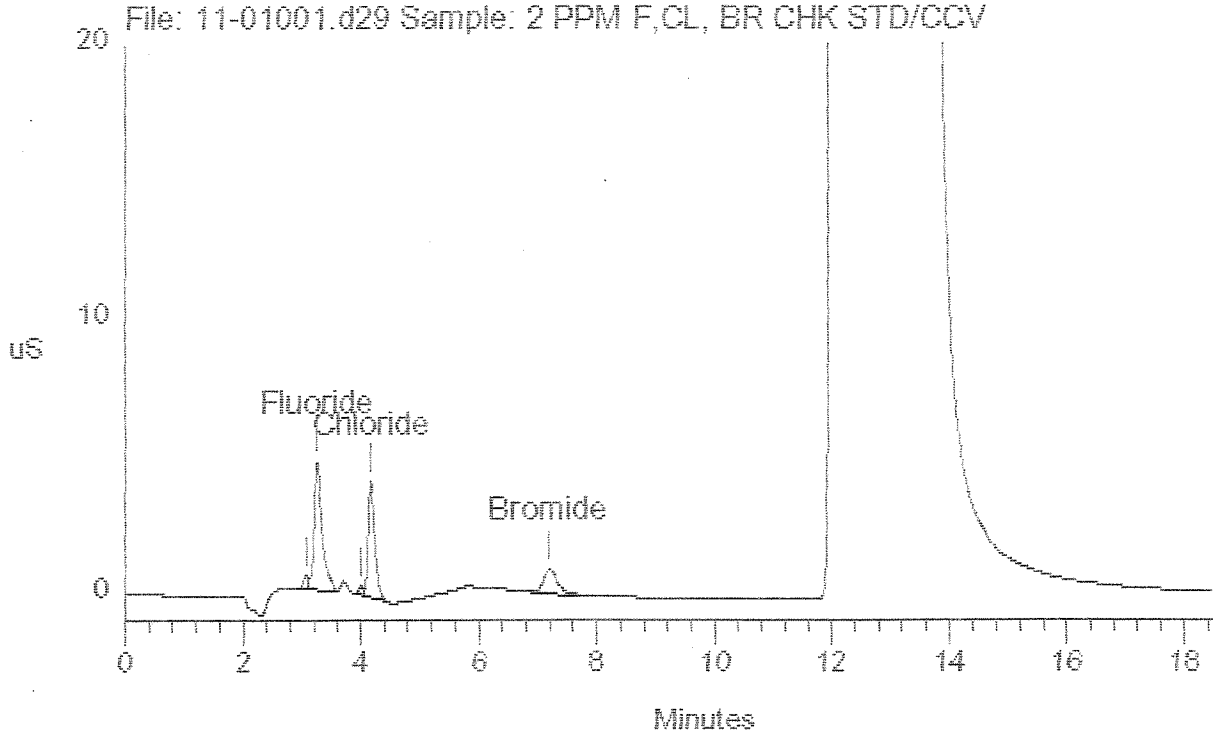
Data Reprocessed On 11/02/2005 15:41:50

Sample Name: 2 PPM F,CL, BR CHK STD/CCV	Date: 11/01/2005 20:18:09
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d29	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 29	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.25	Fluoride	42617332	4657415	1.932
4.17	Chloride	32509807	4169685	1.971
7.18	Bromide	14073689	857185	2.000
	Totals	89200828	9684285	5.903



METCO ENVIRONMENTAL

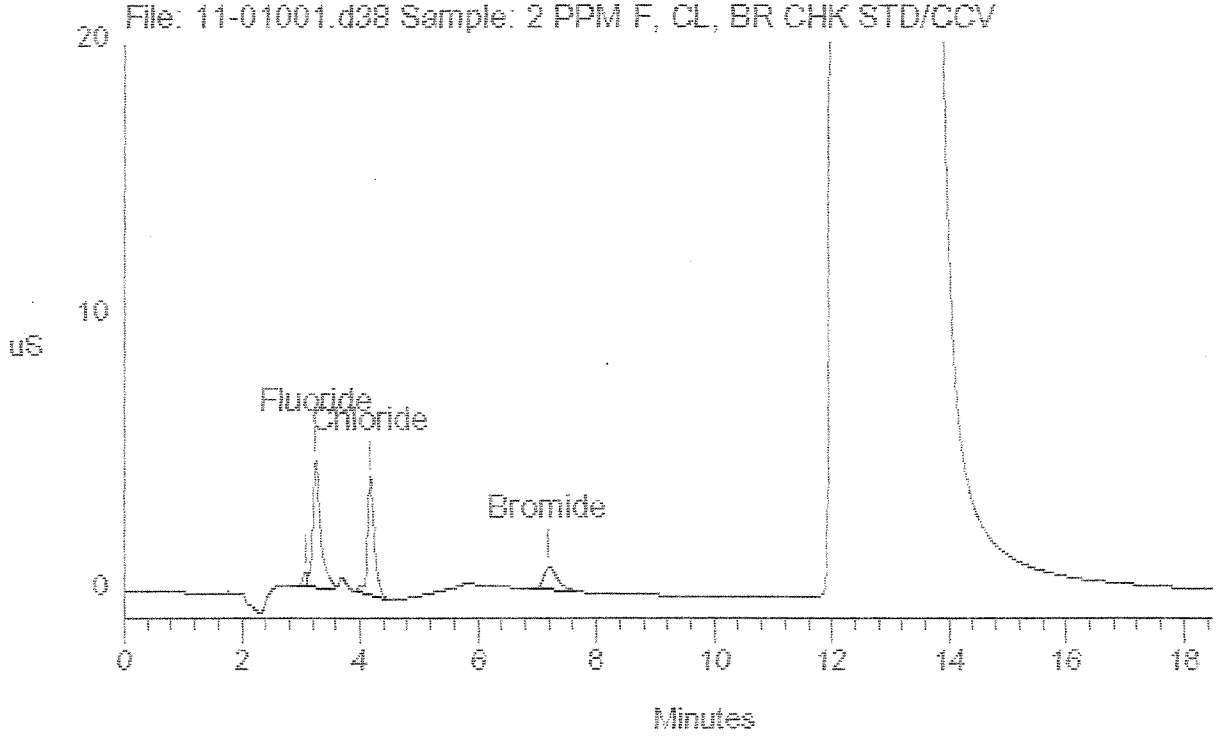
Data Reprocessed On 11/02/2005 15:42:00

Sample Name: 2 PPM F, CL, BR CHK STD/CCV	Date: 11/01/2005 23:17:11
Data File : C:\DX\DATA\ANIONS\05-235\11-01001.d38	
Method : C:\DX\METHOD\HF2.MET	
ACI Address: 1 System: 1 Inject#: 38	Detector:CDM-2
Analyst : Column: AS14-,4mm, STARTED 2-05	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.25	Fluoride	42107483	4565269	1.899
4.17	Chloride	34497122	4210679	2.146
7.18	Bromide	14119742	846163	2.015
	Totals	90724347	9622111	6.060



METCO ENVIRONMENTAL

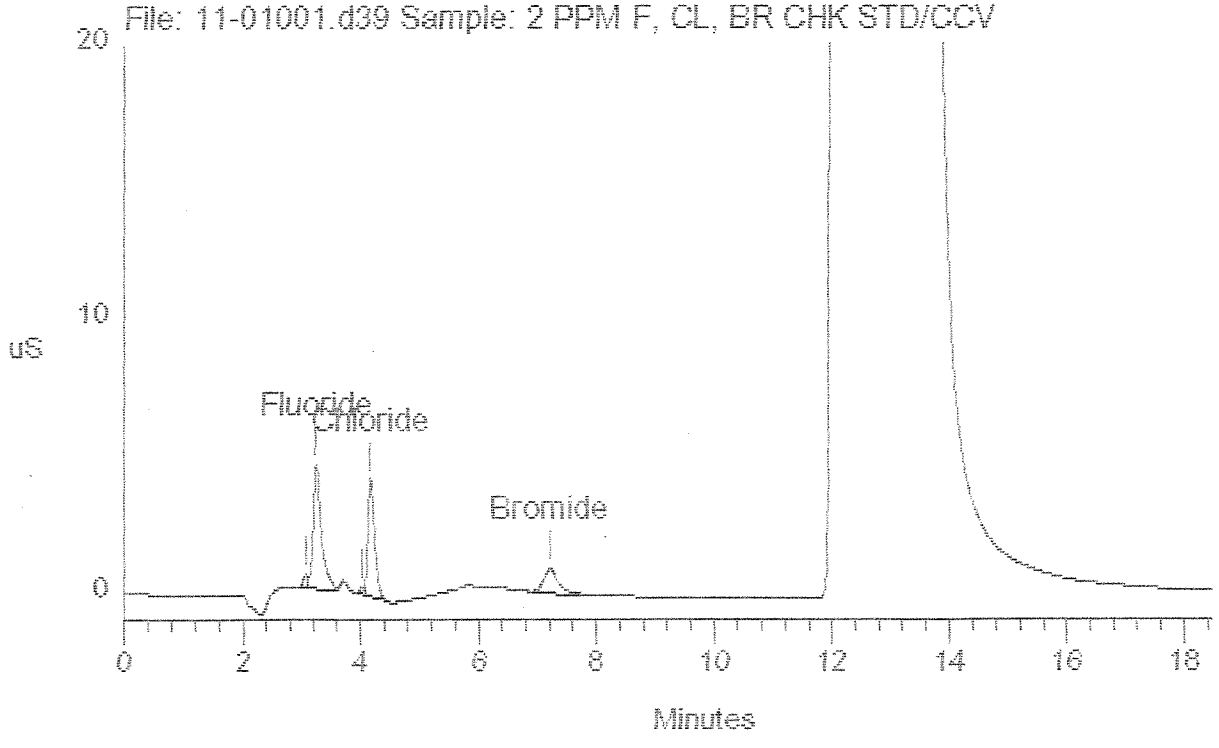
Data Reprocessed On 11/02/2005 15:42:02

```
==============================================================================
| Sample Name: 2 PPM F, CL, BR CHK STD/CCV    Date: 11/01/2005 23:37:06       |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d39                          |
| Method     : C:\DX\METHOD\HF2.MET                                           |
| ACI Address: 1  System: 1  Inject#: 39                   Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05                |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.25	Fluoride	42187540	4506556	1.902
4.17	Chloride	33492846	4184677	2.086
7.20	Bromide	13994306	858020	1.999
	Totals	89674692	9549253	5.987



METCO ENVIRONMENTAL

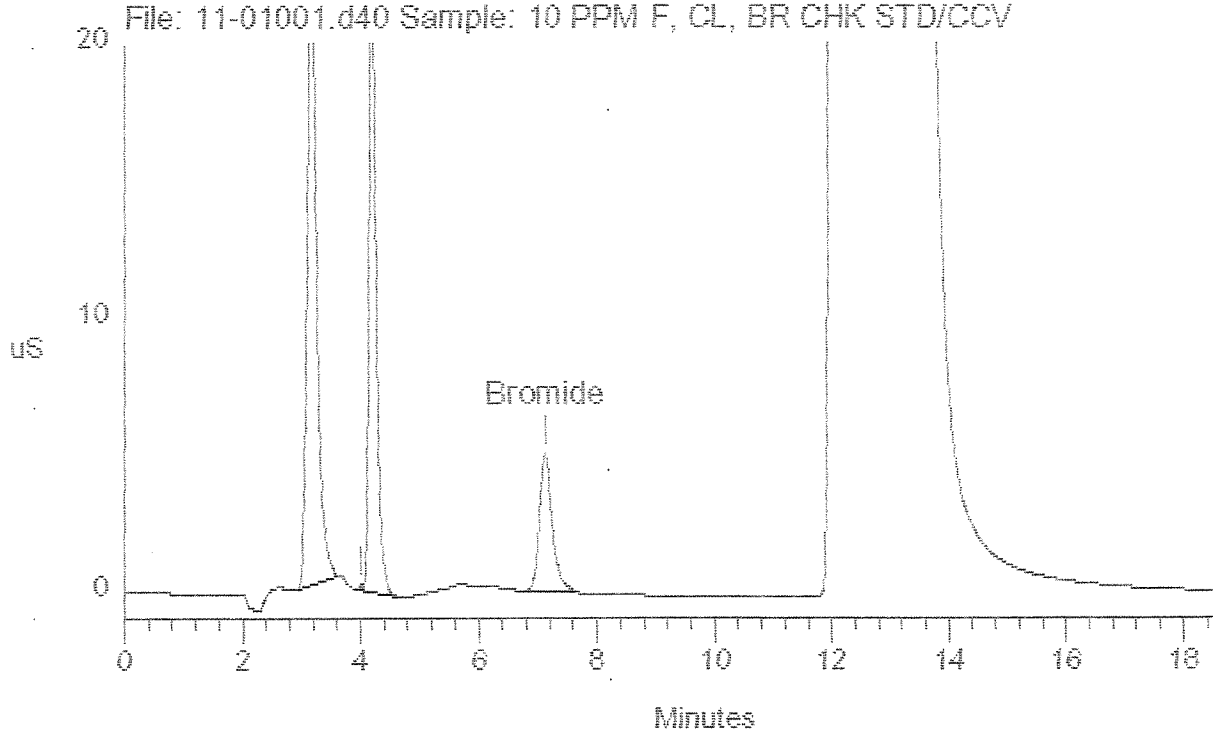
Data Reprocessed On 11/02/2005 15:42:03

```
==============================================================================
| Sample Name: 10 PPM F, CL, BR CHK STD/CCV   Date: 11/01/2005 23:57:01      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d40                         |
| Method     : C:\DX\METHOD\HF2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 40                  Detector:CDM-2     |
| Analyst    :                 Column: AS14-,4mm, STARTED 2-05               |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.17	Fluoride	261388224	24344841	9.860
4.20	Chloride	188130137	23123737	10.186
7.12	Bromide	77509262	5014580	10.268
	Totals	527027623	52483158	30.314



METCO ENVIRONMENTAL

Data Reprocessed On 11/02/2005 15:42:04

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==============================================================================
¦ Sample Name: 10 PPM F, CL, BR CHK STD/CCV   Date: 11/02/2005 00:16:56      ¦
¦ Data File  : C:\DX\DATA\ANIONS\05-235\11-01001.d41                         ¦
¦ Method     : C:\DX\METHOD\HF2.MET                                          ¦
¦ ACI Address: 1  System: 1  Inject#: 41                  Detector:CDM-2     ¦
¦ Analyst    :                Column: AS14-,4mm, STARTED 2-05                ¦
==============================================================================
```
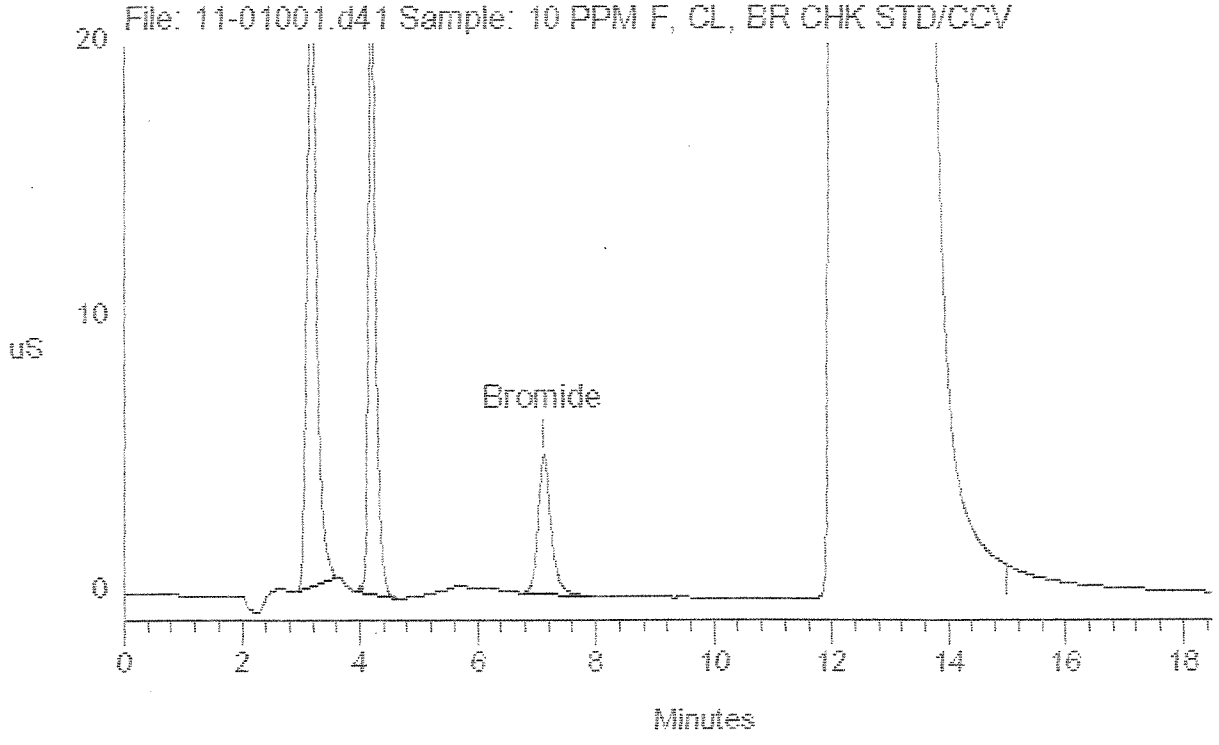

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5550	5Hz	0.00	18.50	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
3.17	Fluoride	262197740	24290357	9.889
4.18	Chloride	188872428	22161370	10.225
7.10	Bromide	77634056	4943337	10.284
	Totals	528704224	51395064	30.398



METCO ENVIRONMENTAL

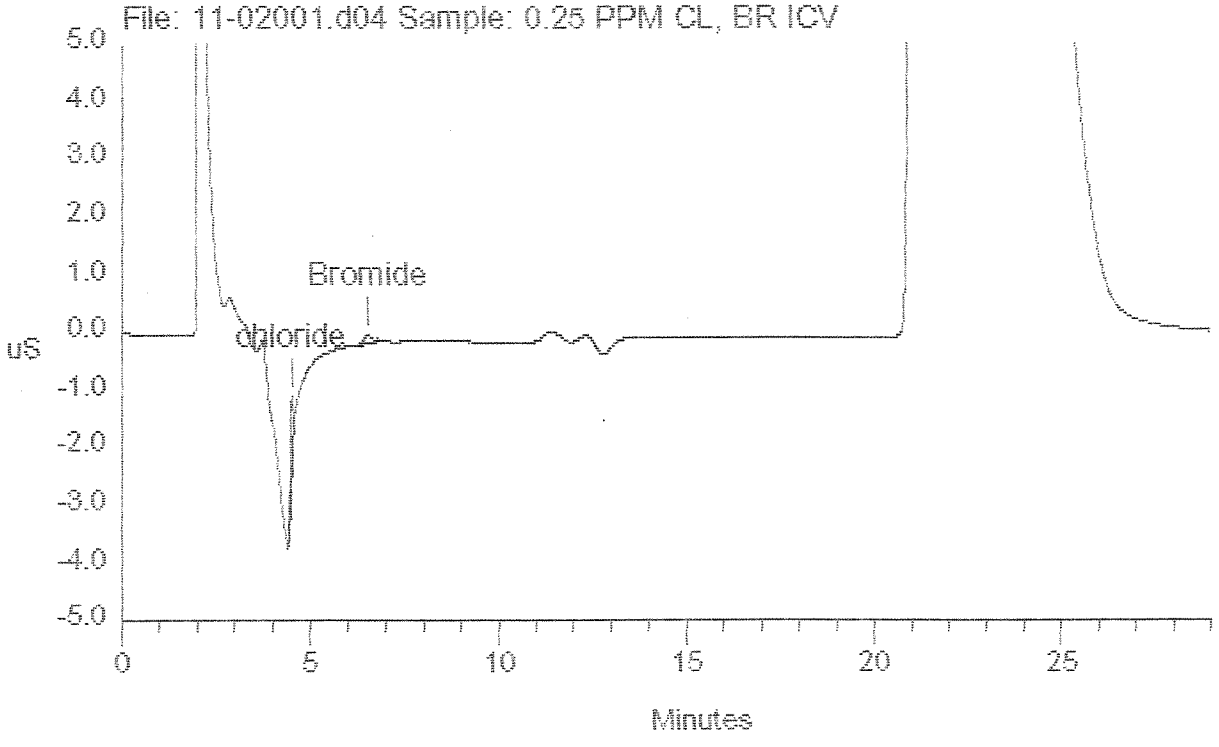
Data Reprocessed On 11/02/2005 15:42:10

Sample Name: 0.25 PPM CL, BR ICV	Date: 11/02/2005 12:03:36
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d04	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 4	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.50	chloride	5486600	1354750	0.246
6.53	Bromide	1898714	125830	0.247
	Totals	7385314	1480580	0.493



METCO ENVIRONMENTAL

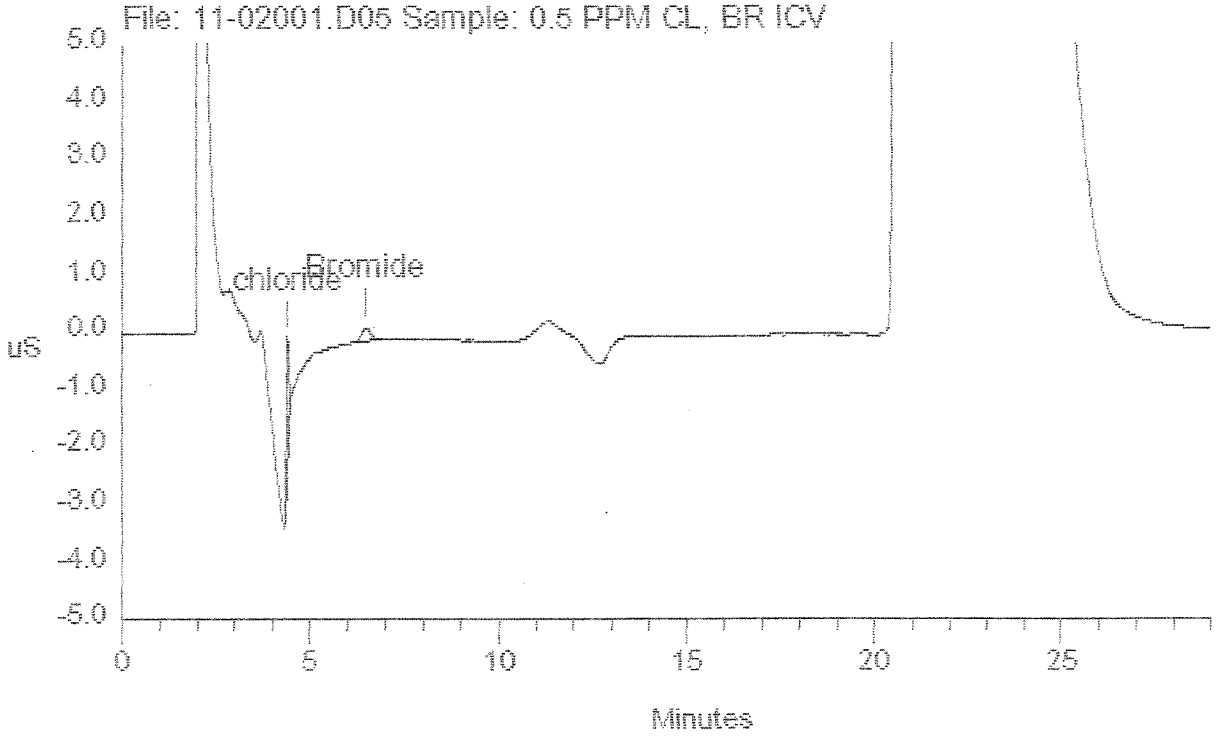
Data Reprocessed On 11/03/2005 13:47:42

Sample Name: 0.5 PPM CL, BR ICV	Date: 11/02/2005 12:33:57
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.D05	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 5	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.40	chloride	10536334	2324933	0.499
6.48	Bromide	4022416	249240	0.518
	Totals	14558750	2574173	1.018



METCO ENVIRONMENTAL

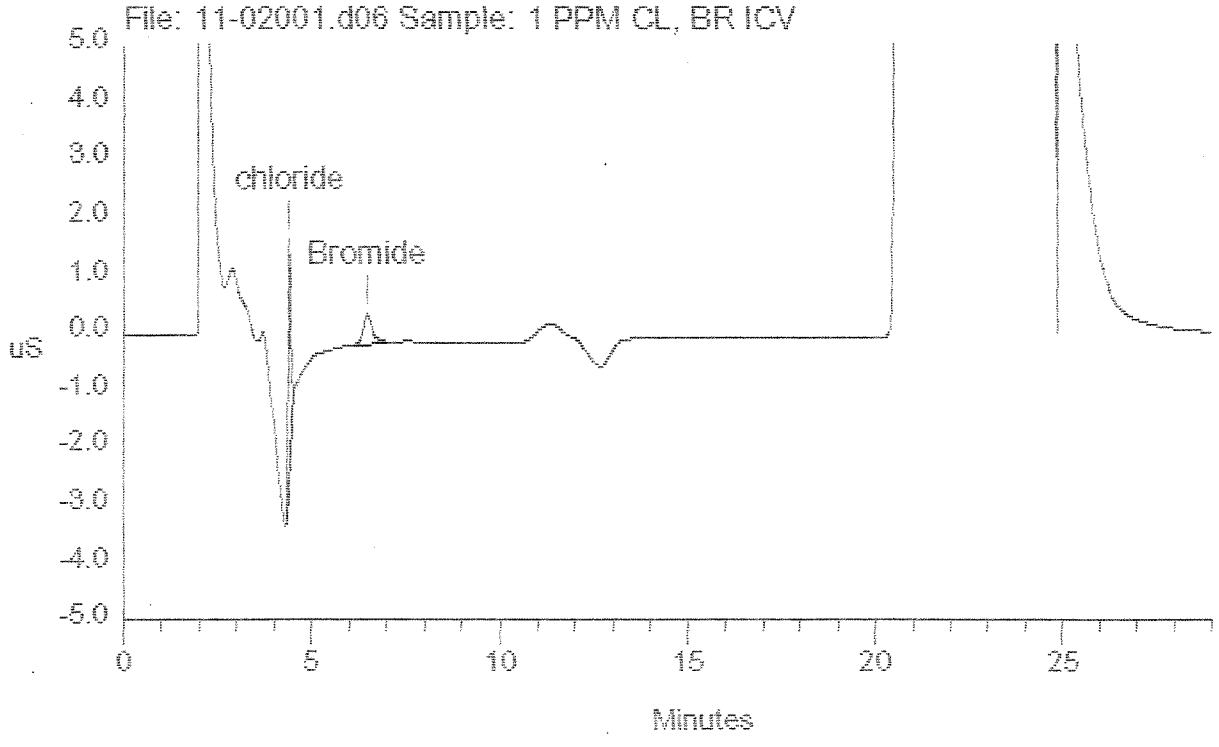
Data Reprocessed On 11/02/2005 15:42:12

Sample Name: 1 PPM CL, BR ICV	Date: 11/02/2005 13:04:18
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d06	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 6	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.40	chloride	20074164	4097537	0.979
6.47	Bromide	8542370	511108	1.094
	Totals	28616534	4608645	2.073



METCO ENVIRONMENTAL

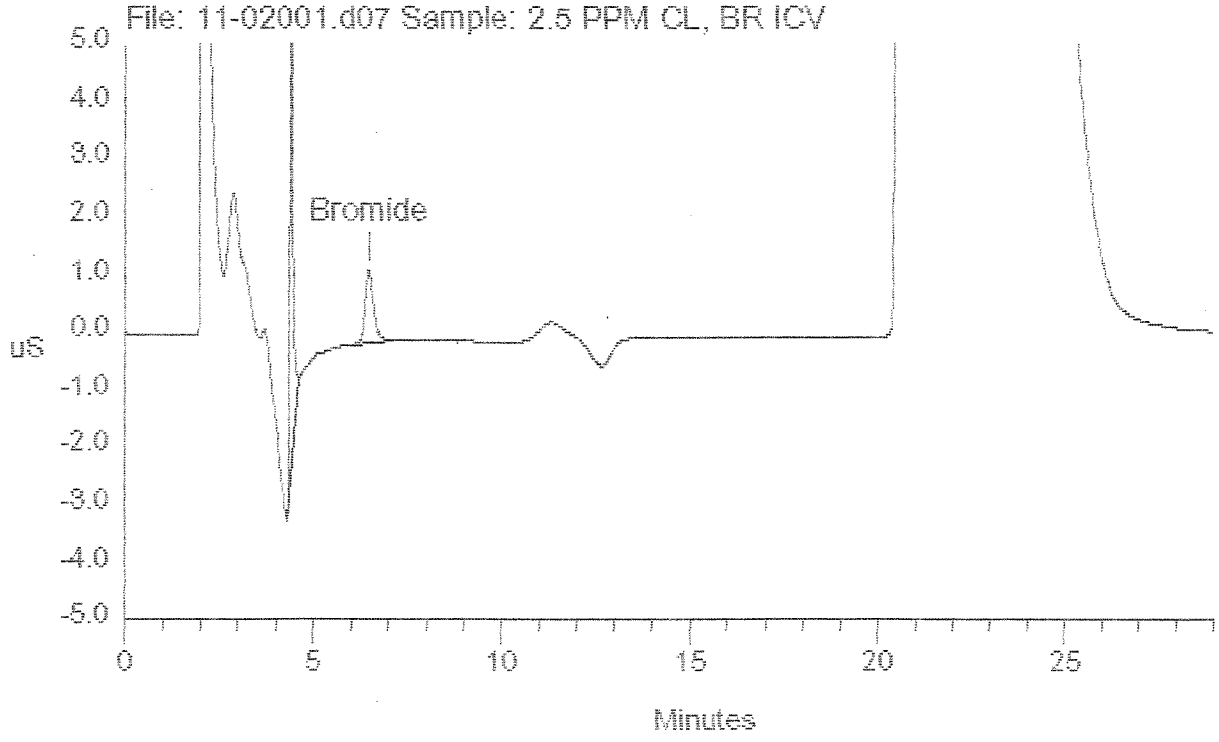
Data Reprocessed On 11/02/2005 15:42:13

Sample Name: 2.5 PPM CL, BR ICV	Date: 11/02/2005 13:34:38
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d07	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 7	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.38	chloride	50898964	8468266	2.527
6.47	Bromide	20350248	1267678	2.600
	Totals	71249212	9735944	5.127



METCO ENVIRONMENTAL

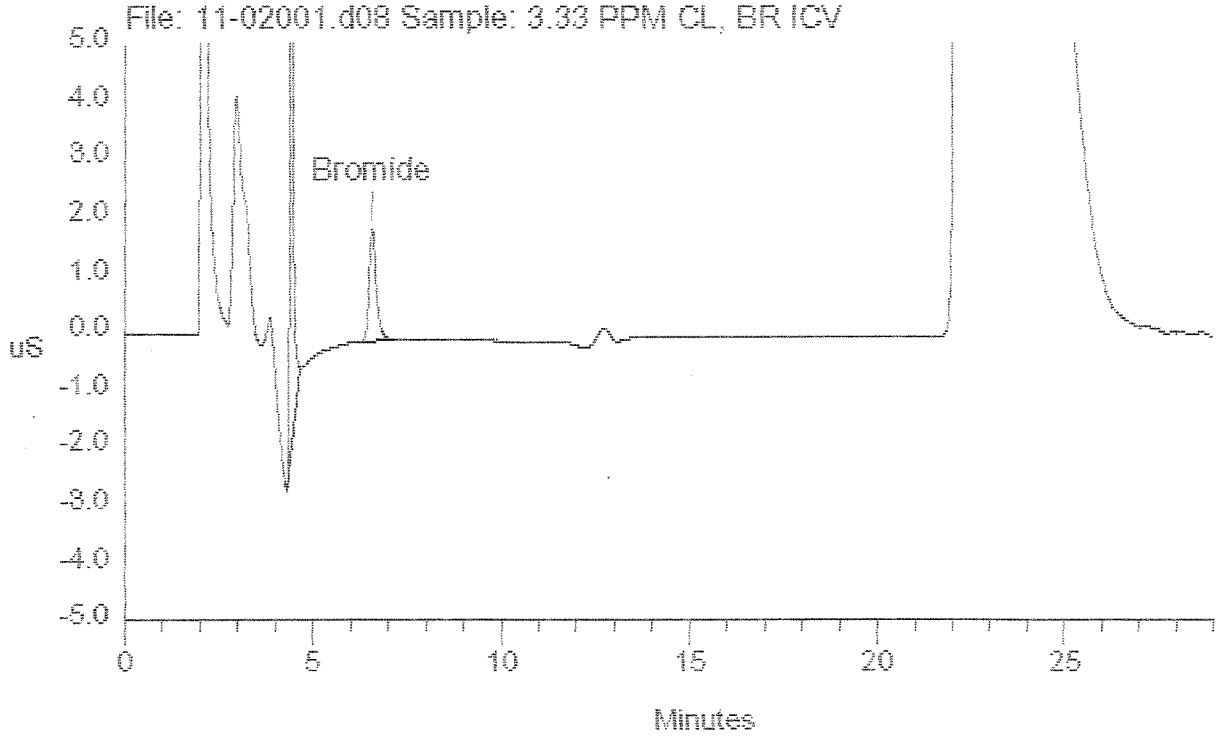
Data Reprocessed On 11/02/2005 15:42:14

Sample Name: 3.33 PPM CL, BR ICV	Date: 11/02/2005 14:04:59
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d08	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 8	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.42	chloride	65838730	10606666	3.277
6.57	Bromide	25637488	1911173	3.274
	Totals	91476218	12517839	6.552



METCO ENVIRONMENTAL

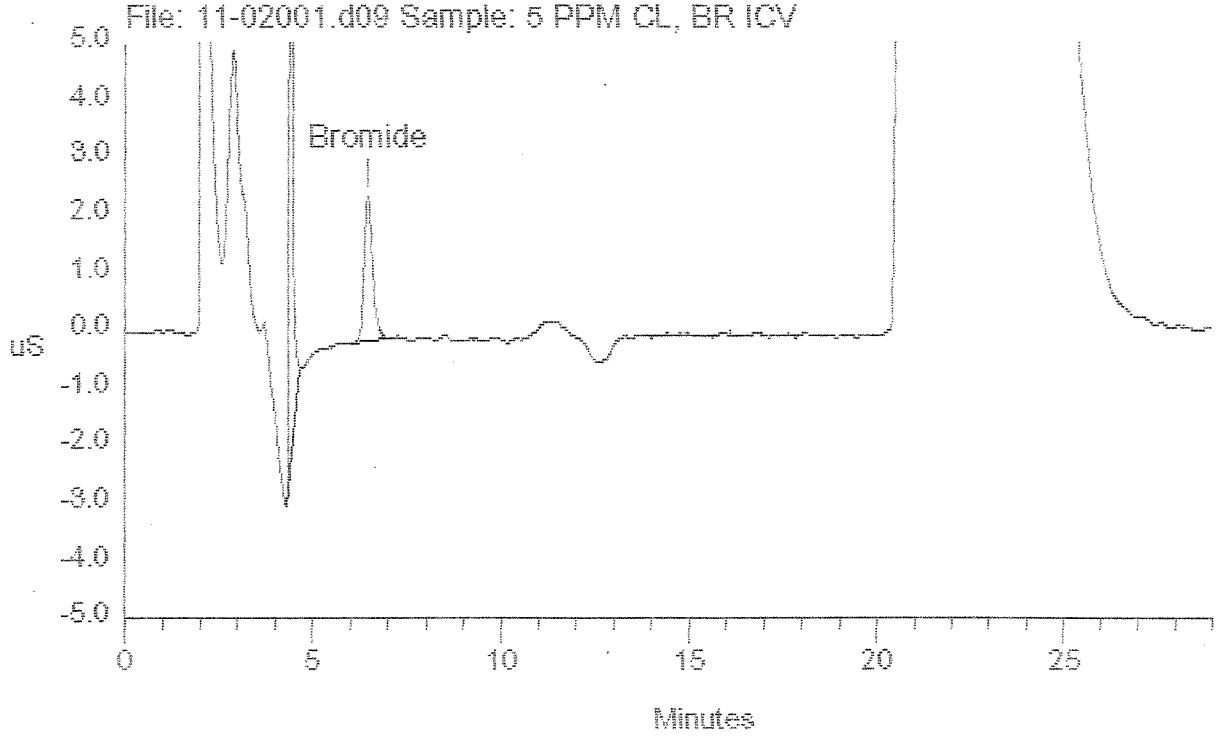
Data Reprocessed On 11/02/2005 15:42:17

Sample Name: 5 PPM CL, BR ICV	Date: 11/02/2005 14:35:20
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d09	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 9	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.40	chloride	100736508	19310212	5.030
6.47	Bromide	39492510	2513263	5.041
	Totals	140229018	21823476	10.071



METCO ENVIRONMENTAL

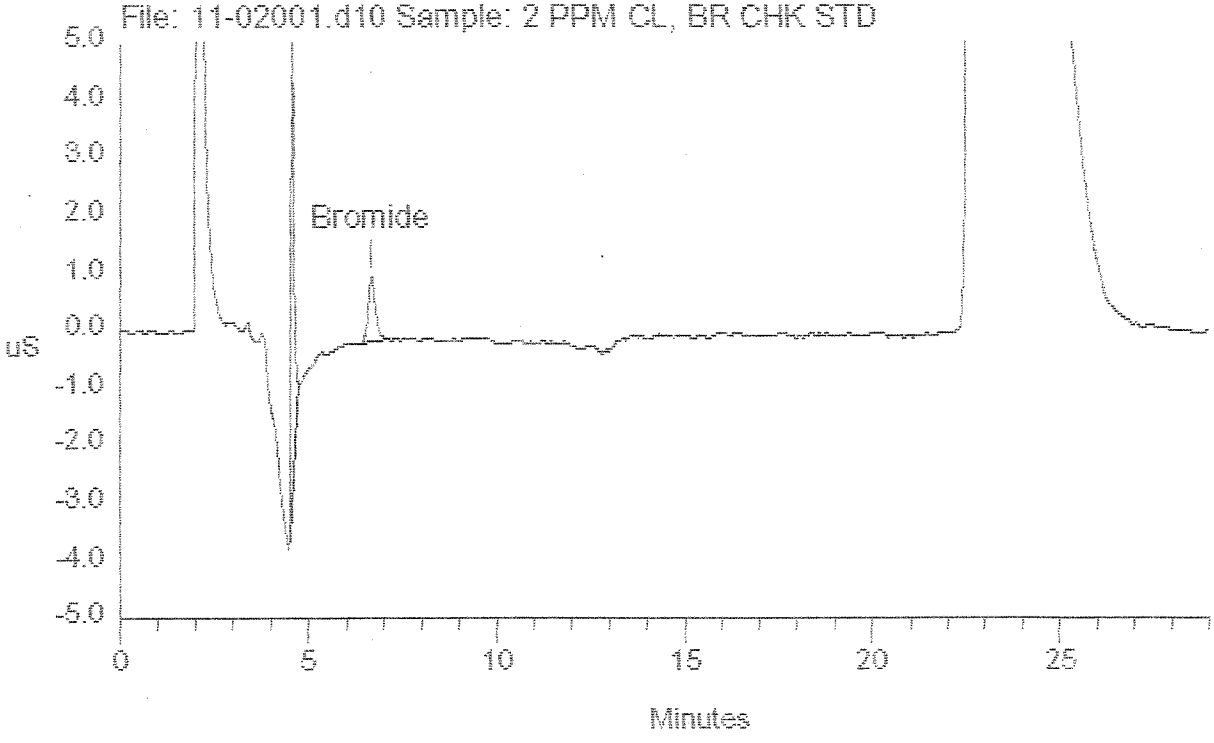
Data Reprocessed On 11/02/2005 15:42:18

Sample Name: 2 PPM CL, BR CHK STD	Date: 11/02/2005 15:05:43
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d10	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 10	Detector:CDM-2
Analyst :	Column: AS14,4mm, STD 1-12-01

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.57	chloride	40742970	8177676	2.017
6.65	Bromide	15599270	1120853	1.994
	Totals	56342240	9298529	4.011



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@EJL

METCO ENVIRONMENTAL

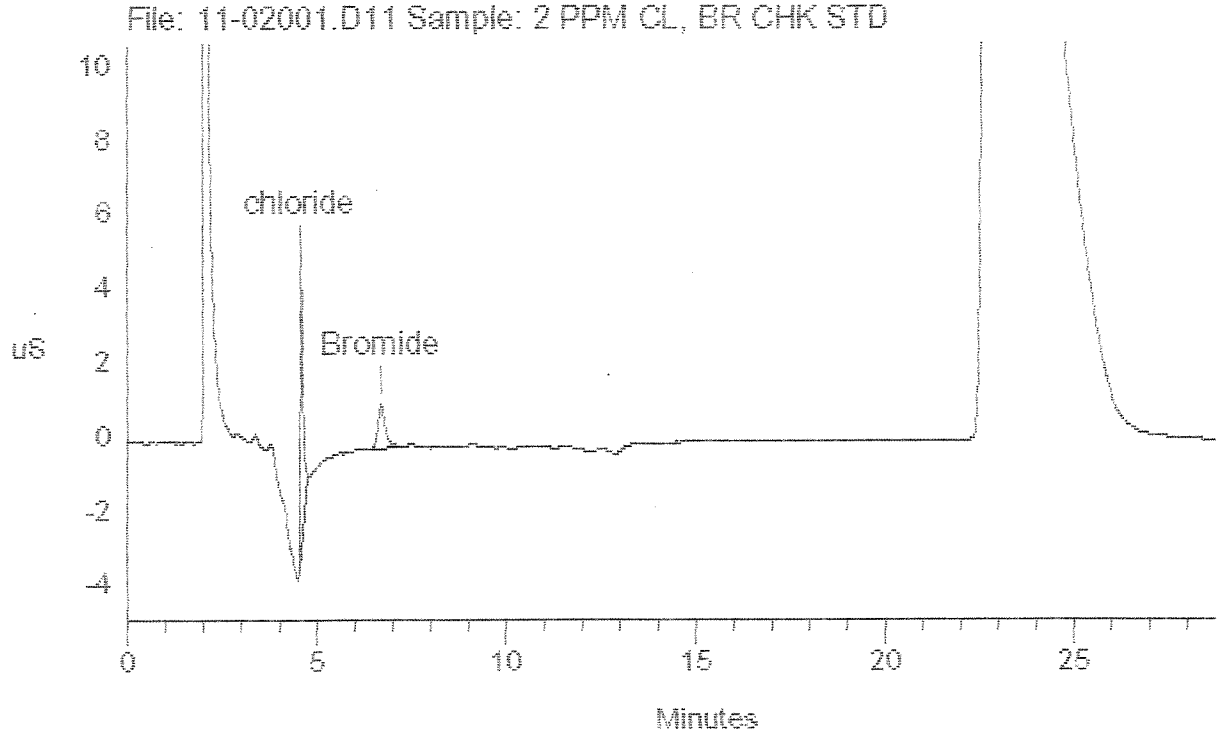
Data Reprocessed On 11/02/2005 16:02:06

Sample Name: 2 PPM CL, BR CHK STD	Date: 11/02/2005 15:36:07
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.D11	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 11	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	28.78	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.57	chloride	41641204	7714975	2.062
6.68	Bromide	16077992	1159670	2.055
	Totals	57719196	8874644	4.117



METCO ENVIRONMENTAL

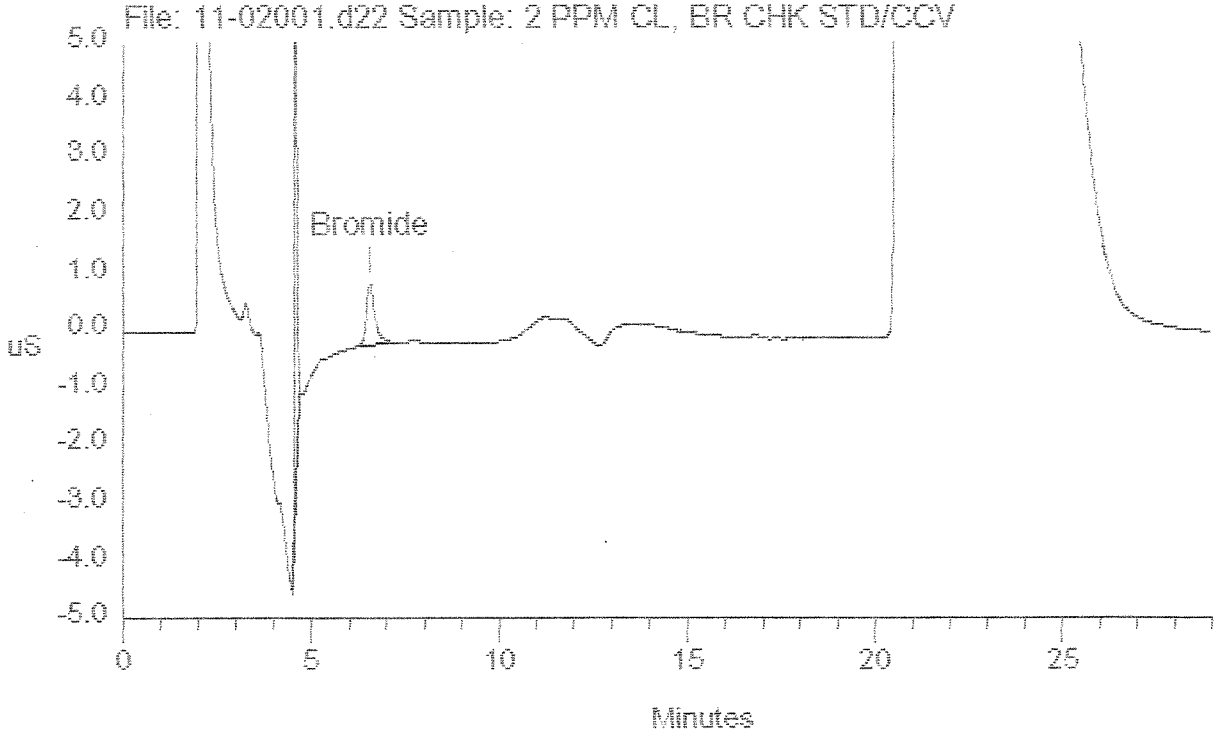
Data Reprocessed On 11/03/2005 09:20:40

```
================================================================================
| Sample Name: 2 PPM CL, BR CHK STD/CCV        Date: 11/02/2005 21:10:01        |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-02001.d22                            |
| Method     : C:\DX\METHOD\HCLLO2.MET                                          |
| ACI Address: 1  System: 1  Inject#: 22                   Detector:CDM-2       |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                    |
================================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.58	chloride	41452316	9118830	2.052
6.57	Bromide	16138100	1051852	2.063
	Totals	57590416	10170682	4.115



METCO ENVIRONMENTAL

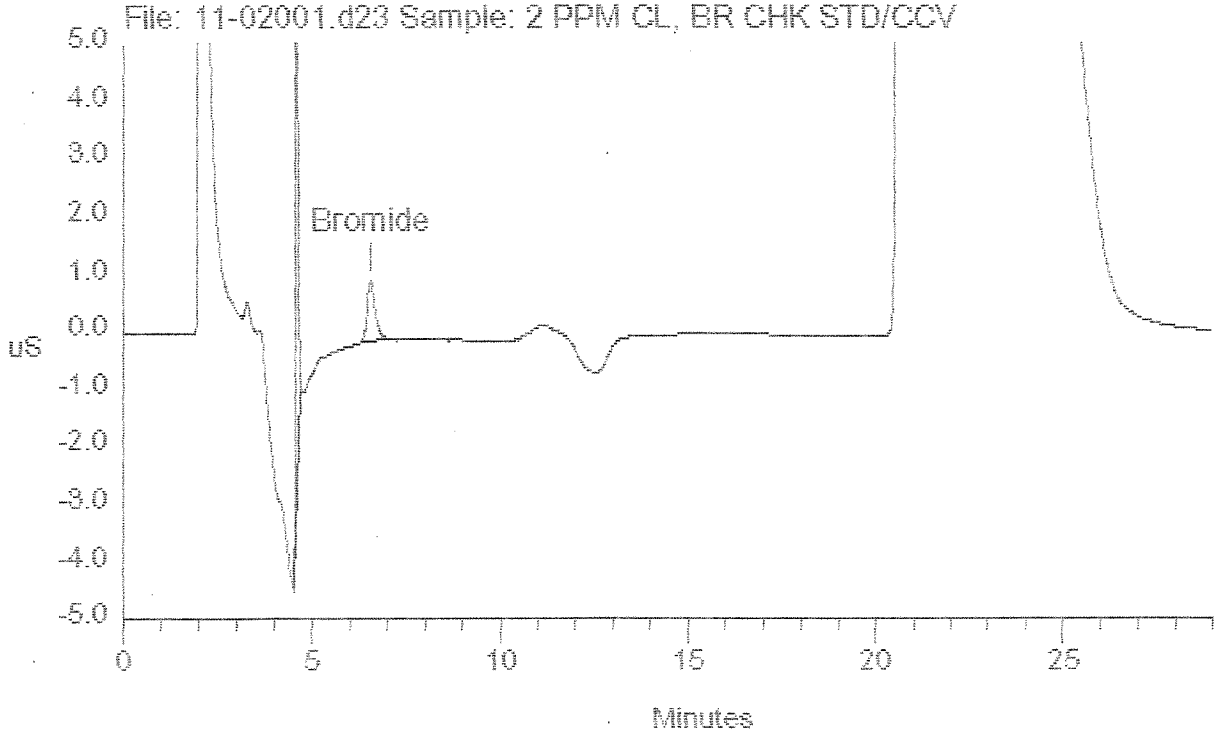
Data Reprocessed On 11/03/2005 09:20:40

```
==============================================================================
| Sample Name: 2 PPM CL, BR CHK STD/CCV        Date: 11/02/2005 21:40:22      |
| Data File  : C:\DX\DATA\ANIONS\05-235\11-02001.d23                          |
| Method     : C:\DX\METHOD\HCLLO2.MET                                        |
| ACI Address: 1  System: 1  Inject#: 23                  Detector:CDM-2      |
| Analyst    :                 Column: AS14,4mm, STD 1-12-01                  |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.58	chloride	41995370	8813462	2.080
6.55	Bromide	15915024	1048085	2.035
	Totals	57910394	9861546	4.114



METCO ENVIRONMENTAL

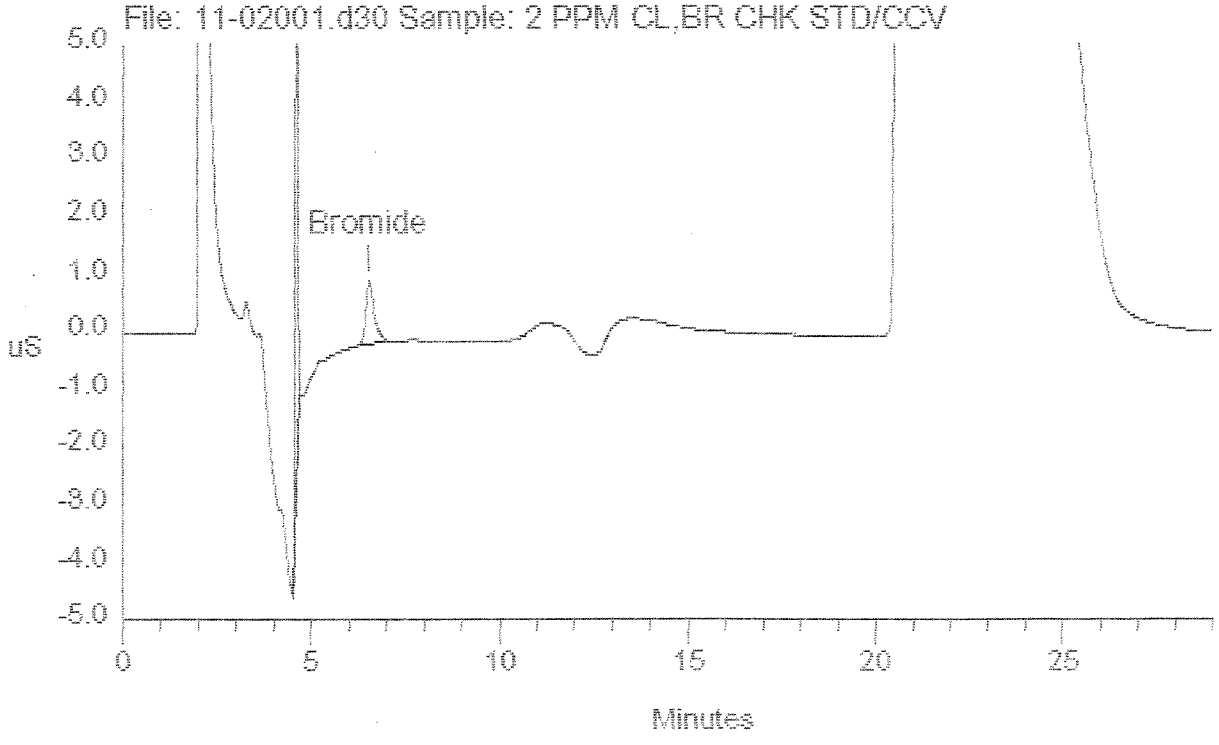
Data Reprocessed On 11/03/2005 09:20:47

Sample Name: 2 PPM CL,BR CHK STD/CCV	Date: 11/03/2005 01:12:49
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d30	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 30	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.60	chloride	41572714	10073500	2.058
6.53	Bromide	16043266	1060656	2.051
	Totals	57615980	11134156	4.109



METCO ENVIRONMENTAL

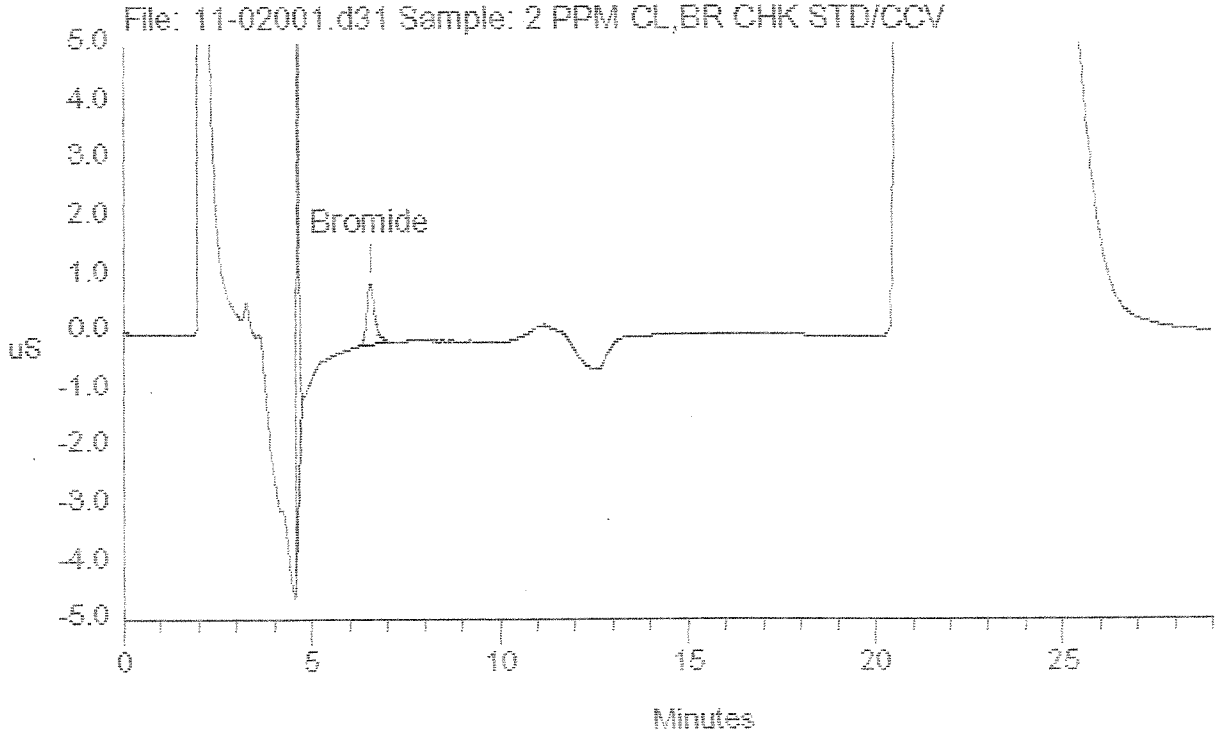
Data Reprocessed On 11/03/2005 09:20:48

Sample Name: 2 PPM CL,BR CHK STD/CCV	Date: 11/03/2005 01:43:10
Data File : C:\DX\DATA\ANIONS\05-235\11-02001.d31	
Method : C:\DX\METHOD\HCLLO2.MET	
ACI Address: 1 System: 1 Inject#: 31	Detector:CDM-2
Analyst : Column: AS14,4mm, STD 1-12-01	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8700	5Hz	0.00	29.00	2000

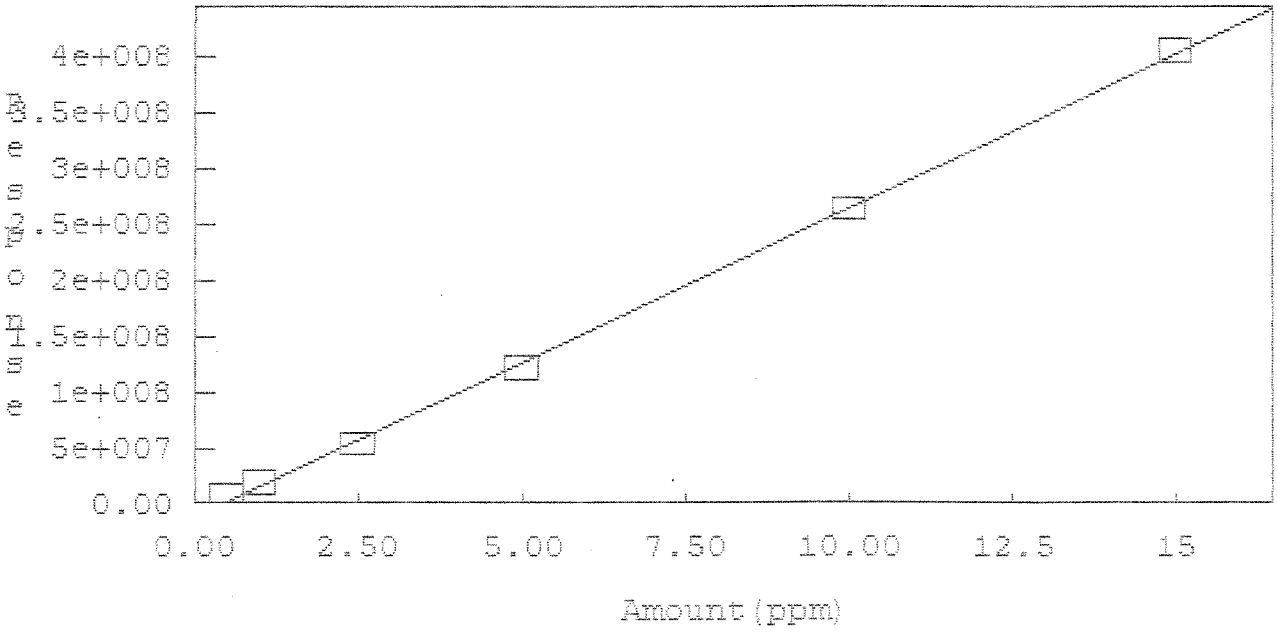
********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.60	chloride	42071438	8898566	2.083
6.55	Bromide	15959716	1073156	2.040
	Totals	58031154	9971722	4.124



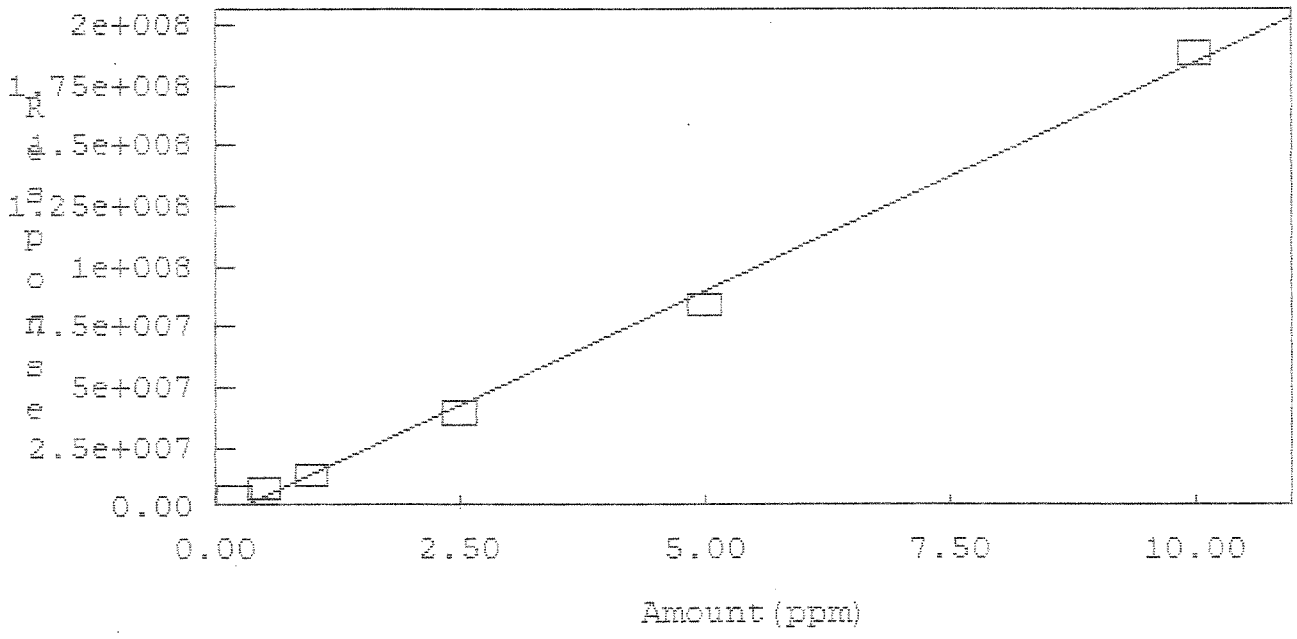
Method: HF2.MET - Last Updated: 09:39 on Wed, 02 Nov 2005

Component: Fluoride
Fit Type: Linear
r^2 = 0.999208
Amt = Resp * 3.624e-008 + 0.3874
Resp = Amt * 2.759e+007 + -1.069e+007
Standardization: External
Calibration: Area



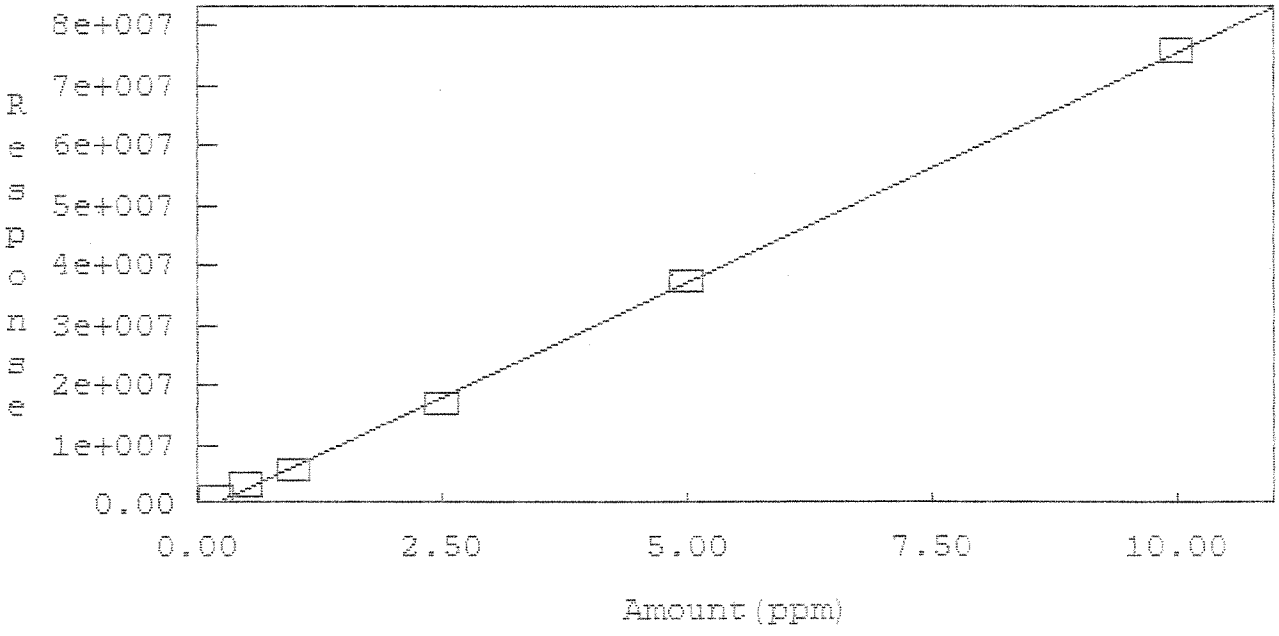
Method: HF2.MET - Last Updated: 09:39 on Wed, 02 Nov 2005

Component: Chloride
Fit Type: Linear
r^2 = 0.996144
Amt = Resp * 5.279e-008 + 0.2548
Resp = Amt * 1.894e+007 + -4.826e+006
Standardization: External
Calibration: Area



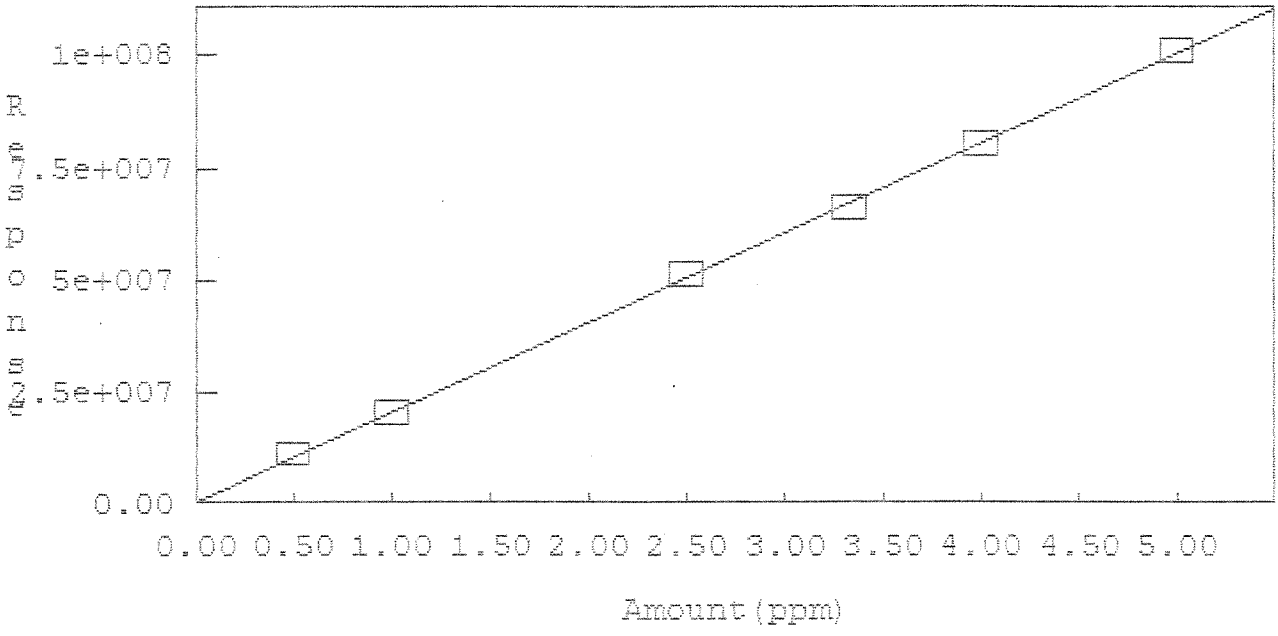
Method: HF2.MET - Last Updated: 09:39 on Wed, 02 Nov 2005

Component: Bromide
Fit Type: Linear
r^2 = 0.999078
Amt = Resp * 1.303e-007 + 0.1658
Resp = Amt * 7.673e+006 + -1.272e+006
Standardization: External
Calibration: Area



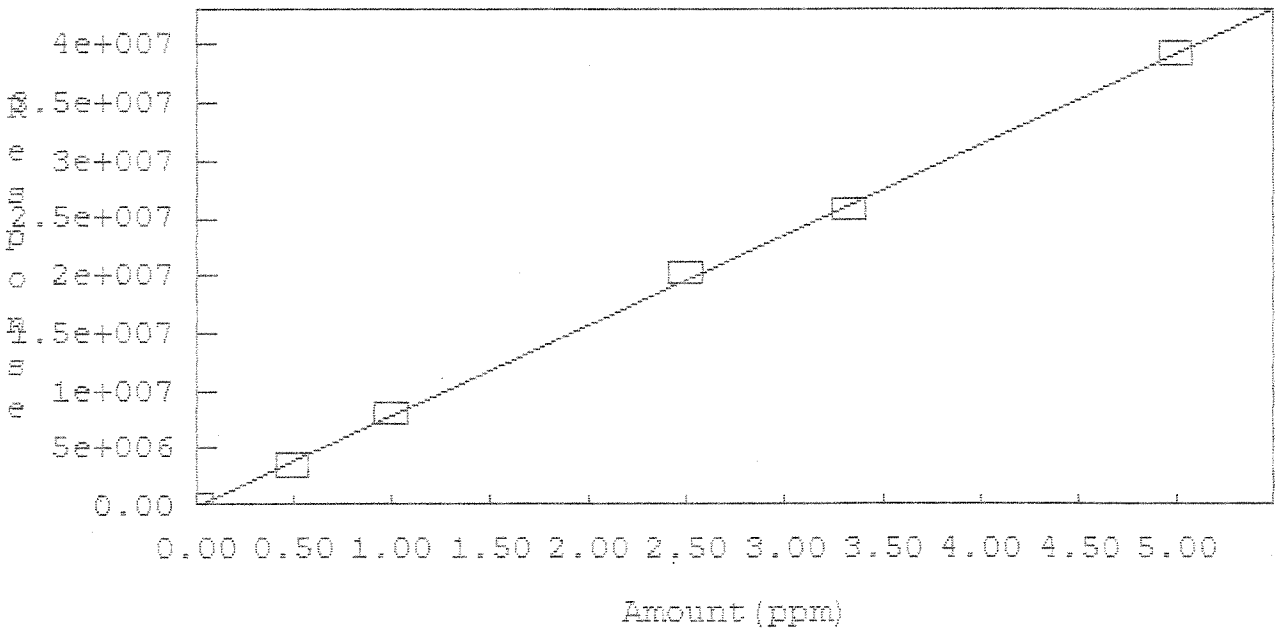
Method: HCLLO2.MET - Last Updated: 14:55 on Wed, 02 Nov 2005

Component: chloride
Fit Type: Linear
r^2 = 0.999627
Amt = Resp * 5.023e-008 + -0.02973
Resp = Amt * 1.991e+007 + 5.919e+005
Standardization: External
Calibration: Area



Method: HCLLO2.MET - Last Updated: 14:55 on Wed, 02 Nov 2005

Component: Bromide
Fit Type: Linear
r^2 = 0.999373
Amt = Resp * 1.275e-007 + 0.005233
Resp = Amt * 7.842e+006 + -4.104e+004
Standardization: External
Calibration: Area



RICCA CHEMICAL COMPANY

PO Box 13090 Arlington, TX 76094 | http://www.riccachemical.com | 1-888-GO-RICCA | customerservice@riccachemical.com

Fluoride Standard, 1 mL = 1 mg F-, 1000 ppm F-

Lot Number: 1411654 Product Number: 3173 Expiration Date: MAY 2006 Manufacture Date:11/30/2004

The certified value reported is the prepared value based upon the method of preparation of the material. The uncertainty in the prepared value is based upon the volumetric method of preparation.

Contains:

Name	CAS#	Grade
Sodium Fluoride, NaF	7681-49-4	High Purity
Water, Deionized, H2O	7732-18-5	ACS, ASTM D 1193 (Type I), EP, USP

Test Name	Assay Method	Specification	Result
Appearance	Clarity, Color, Odor	Clear, colorless, odorless	Passed Test
Certified Concentration	Based on accurate volumetric preparation	1000 ± 5 ppm F-	1000 ppm F-

Specification	Reference	Method Number
Fluoride Solution, Stock (1.00 mL = 1.00 mg F)	ASTM	D 5996
Fluoride Calibration Stock Solution (1,000 mg/L F-)	EPA (SW-846)	9214
Fluoride Stock Solution (1.00 mL = 1.00 mg F-)	EPA (SW-846)	9056
Fluoride Stock Solution (1.00 mL = 1.00 mg F?)	ASTM	D 4327
Stock Solution, 1.0 mL = 1.0 mg F	EPA	340.3
Fluoride Solution, Stock (1.00 mL = 1.00 mg F)	ASTM	D 5542
Fluoride Stock Standard Solution (1 mg of F in 1 mL)	ACS	

Volumetric glassware complies with Class A tolerance requirements of ASTM E 288 and NIST Circular 434; it is calibrated before first use and recalibrated regularly in accordance with ASTM E 542 and NIST Procedure NBSIR 74-461. Balances are calibrated regularly with weights certified traceable to the NIST national mass standard. Thermometers and temperature probes are calibrated before first use and recalibrated regularly with a thermometer traceable to NIST standards. All products are prepared according to master documents that assure manufacture according to validated methods. Batch records document raw material traceability and production and testing history for each lot manufactured.

Shelf Life (unopened container):

Part Number	Shelf Life
3173-4	18 months
3173-32	18 months
3173-16	18 months

Recommended Storage: 15°C - 30°C (59°F - 86°F)

Joan Lutkenhaus

Joan Lutkenhaus
Director of Quality Assurance and Regulatory Affairs

This Certificate of Analysis is designed to comply with ISO Guide 31 "Reference Materials -- Contents of Certificates and Labels." To determine manufacturing site using lot number, visit www.riccachemical.com/AboutUs/lot.pdf.

Version: 1

RICCA CHEMICAL COMPANY

PO Box 13090 Arlington, TX 76094 | http://www.riccachemical.com | 1-888-GO-RICCA | customerservice@riccachemical.com

Chloride Standard, 1 mL = 1 mg Cl-, 1000 ppm Cl- (0.0282 Normal)

Lot Number: 1412008 Product Number: 1955 Expiration Date: MAY 2006 Manufacture Date:12/1/2004

Contains:

Name	CAS#	Grade
Sodium Chloride, NaCl	7647-14-5	ACS
Water, Deionized, H2O	7732-18-5	ACS, ASTM D 1193 (Type I), EP, USP

Test Name	Assay Method	Specification	Result
Appearance	Clarity, Color, Odor	Clear, colorless, odorless	Passed Test
Assay at 20°C (traceable to NIST SRM 999)	Titrimetric vs. Silver Nitrate (Potassium Chromate Indicator)	1000 ± 1 ppm Cl	999 ppm Cl

Specification	Reference	Method Number
Chloride Solution, Stock (1.00 mL = 1.00 mg Cl)	ASTM	D 5996
Chloride Calibration Stock Solution (1,000 mg/L Cl-)	EPA (SW-846)	9212
Chloride Stock Solution (1.00 mL = 1.00 mg Cl-)	EPA (SW-846)	9056
Chloride solution (1000 ppm)	TAPPI	T 699 om-87
Chloride solution (1000 ppm)	TAPPI	T 700 om-93
Chloride Stock Solution (1.00 mL = 1.00 mg Cl-)	ASTM	D 4327
Sodium Chloride, NaCl, stock standard solution	EPA (SW-846)	9057
Sodium Chloride Calibration Standard (1 µg Cl-/µL)	EPA (SW-846)	9021
Sodium Chloride Calibration Standard (1 µg Cl-/µL)	EPA (SW-846)	9023
Sodium Chloride Solution, 1 mL = 1 mg Cl-	ASTM	D 4458
Chloride Solution, Stock (1000 mg/L)	ASTM	D 512 C
Chloride Solution Stock (1.00 mL = 1.00 mg chloride)	ASTM	D 5542
Standard Chloride Solution, 1000 mg/L	APHA	4110 B
Stock Chloride Solution	APHA	4500-Cl- E

Volumetric glassware complies with Class A tolerance requirements of ASTM E 288 and NIST Circular 434; it is calibrated before first use and recalibrated regularly in accordance with ASTM E 542 and NIST Procedure NBSIR 74-461. Balances are calibrated regularly with weights certified traceable to the NIST national mass standard. Thermometers and temperature probes are calibrated before first use and recalibrated regularly with a thermometer traceable to NIST standards. All products are prepared according to master documents that assure manufacture according to validated methods. Batch records document raw material traceability and production and testing history for each lot manufactured.

Shelf Life (unopened container):

Part Number	Shelf Life
1955-4	18 months
1955-8	18 months
1955-16	18 months

Recommended Storage: 15°C - 30°C (59°F - 86°F)

Version: 1

Joan Lutkenhaus
Director of Quality Assurance and Regulatory Affairs

This Certificate of Analysis is designed to comply with ISO Guide 31 "Reference Materials -- Contents of Certificates and Labels." To determine manufacturing site using lot number, visit www.riccachemical.com/AboutUs/lot.pdf.

Version: 1

RICCA CHEMICAL COMPANY

PO Box 13090 Arlington, TX 76094 | http://www.riccachemical.com | 1-888-GO-RICCA | customerservice@riccachemical.com

Bromide Standard, 1 mL = 1 mg Br-, 1000 ppm Br-

Lot Number: 1508179 Product Number: 1180 Expiration Date: JAN 2007 Manufacture Date:8/5/2005

The certified value reported is the prepared value based upon the method of preparation of the material. The uncertainty in the prepared value is based upon the volumetric method of preparation.

Contains:

Name	CAS#	Grade
Sodium Bromide, NaBr	7647-15-6	High Purity
Water, Deionized, H2O	7732-18-5	ACS, ASTM D 1193 (Type I), EP, USP

Test Name	Assay Method	Specification	Result
Appearance	Clarity, Color, Odor	Clear, colorless, odorless	Passed Test
Certified Concentration	Based on accurate volumetric preparation	1000 ± 5 ppm Br	1000 ppm Br

Specification	Reference	Method Number
Bromide Solution, Standard (1 mL = 1 mg Br-)	ASTM	D 3869 D
Bromide Stock Solution (1.00 mL = 1.00 mg Br-)	EPA (SW-846)	9056
Bromide Stock Solution (1.00 mL = 1.00 mg Br?)	ASTM	D 4327
Sodium Bromide Standard Solution, 1000 mg/L	ASTM	D 1246
Standard Bromide Solution, 1000 mg/L	APHA	4110 B

Volumetric glassware complies with Class A tolerance requirements of ASTM E 288 and NIST Circular 434; it is calibrated before first use and recalibrated regularly in accordance with ASTM E 542 and NIST Procedure NBSIR 74-461. Balances are calibrated regularly with weights certified traceable to the NIST national mass standard. Thermometers and temperature probes are calibrated before first use and recalibrated regularly with a thermometer traceable to NIST standards. All products are prepared according to master documents that assure manufacture according to validated methods. Batch records document raw material traceability and production and testing history for each lot manufactured.

Shelf Life (unopened container):

Part Number	Shelf Life
1180-4	18 months
1180-8	18 months
1180-16	18 months

Recommended Storage: 15°C - 30°C (59°F - 86°F)

Joan Lutkenhaus

Joan Lutkenhaus
Director of Quality Assurance and Regulatory Affairs

This Certificate of Analysis is designed to comply with ISO Guide 31 "Reference Materials -- Contents of Certificates and Labels." To determine manufacturing site using lot number, visit www.riccachemical.com/AboutUs/lot.pdf.

Version: 1

Data Analysis Technologies, Inc.
7715 Corporate Blvd.
Plain City, OH 43064
NELAP/LELAP Certification 03027

Sample Analysis Certificate

Client:	Metco Environmental	Date:	11/18/05
Address:	3226 Commander Drive	DAT Project #:	1105003
	Carrollton, TX 75006	Sample Date:	10/25-26/05
		Date Received:	11/01/05
		Date Analyzed:	11/17/05
		Analyst:	DE

Attn: Steve Bornsen
Your Project: 05-235 ADA-ES
Sampled By: S.B.

Analysis: Mercury
Method: Ontario Hydro

Results: See attached summary tables.

QC: Met all criteria for the method.

Reviewed and approved for release by: _____ Date: 11/18/05
President *DAT* Inc.

NELAP/LELAP Certification # 03027
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Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1105003
Client: Metco Environmental
Site: ADA-ES

Prep Date: 11/16/05
Analysis Date: 11/17/05

Client ID	DAT ID	*MDL*	Hg Total ug	Q	Dup Result Total ug
Blank Train					
Filter/Cont 2	1105003- 31,32	*0.02*	ND		
Cont. 3	1105003- 33	*0.08*	ND		
Cont. 4	1105003- 34	*0.26*	ND		
Cont. 5	1105003- 35	*0.07*	ND		
Reagent Blanks					
Cont. 7,12	1105003- 41,36	*0.02*	ND		
Cont. 8	1105003- 37	*0.01*	ND		
Cont. 9	1105003- 38	*0.10*	ND		
Cont. 10	1105003- 39	*0.01*	ND		
Cont. 11	1105003- 40	*0.02*	ND		

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1105003
Client: Metco Environmental
Site: ADA-ES

Prep Date: 11/16/05
Analysis Date: 11/17/05

Client ID	DAT ID	*MDL*	Hg Total ug	Q	Dup Result Total ug
Inlet Run 1					
Filter/Cont 2	1105003- 1,2	*0.02*	0.19		
Cont. 3a	1105003- 3a	*0.03*	ND		
Cont. 3b	1105003- 3b	*0.07*	3.30		
Cont. 4	1105003- 4	*0.24*	ND		
Cont. 5	1105003- 5	*0.07*	6.8		
Inlet Run 2					
Filter/Cont 2	1105003- 6,7	*0.02*	0.13		
Cont. 3a	1105003- 8a	*0.07*	3.96		
Cont. 3b	1105003- 8b	*0.02*	ND		
Cont. 4	1105003- 9	*0.30*	ND		
Cont. 5	1105003- 10	*0.07*	4.6		
Inlet Run 3					
Filter/Cont 2	1105003- 11,12	*0.02*	0.06		
Cont. 3a	1105003- 13a	*0.05*	0.43		
Cont. 3b	1105003- 13b	*0.04*	1.42		
Cont. 4	1105003- 14	*0.25*	ND		
Cont. 5	1105003- 15	*0.08*	6.6		

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1105003
Client: Metco Environmental
Site: ADA-ES

Prep Date: 11/16/05
Analysis Date: 11/17/05

Client ID	DAT ID	*MDL*	Hg Total ug	Q	Dup Result Total ug
Outlet Run 1					
Filter/Cont 2	1105003- 16,17	*0.02*	3.40		
Cont. 3a	1105003- 18a	*0.08*	0.12		
Cont. 3b	1105003- 18b	*0.03*	ND		
Cont. 4	1105003- 19	*0.26*	ND		
Cont. 5	1105003- 20	*0.08*	0.5		
Outlet Run 2					
Filter/Cont 2	1105003- 21,22	*0.02*	2.33		
Cont. 3a	1105003- 23a	*0.08*	0.52		
Cont. 3b	1105003- 23b	*0.04*	ND		
Cont. 4	1105003- 24	*0.26*	ND		
Cont. 5	1105003- 25	*0.08*	0.9		
Outlet Run 3					
Filter/Cont 2	1105003- 26,27	*0.02*	3.77		
Cont. 3a	1105003- 28a	*0.08*	0.56		
Cont. 3b	1105003- 28b	*0.05*	ND		ND
Cont. 4	1105003- 29	*0.28*	ND		
Cont. 5	1105003- 30	*0.08*	0.8		

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1105003
Client: Metco Environmental
Site: ADA-ES

Prep Date: 11/16/05
Analysis Date: 11/17/05

QC Summary		Hg ug/L	% Rec	%RPD
Front Method Blank	1105003-MB Front	0.05 ND		
Back Method Blank	1105003-MB Back	0.05 ND		
Laboratory Spike	1105003-LS Front	12.9	129	
Laboratory Spike	1105003-LS Back	10.8	108	
Matrix Spike	1105003-5 MS	9.83	98	
	1105003-5 MSD	9.43	94	4.2
Matrix Spike	1105003-13b MS	9.64	96	
	1105003-13b MSD	9.39	94	2.6
Matrix Spike	1105003-19 MS	10.5	105	
	1105003-19 MSD	10.3	103	1.9
Duplicate Results	1105003-29	0.05 ND		
	1105003-29 D	0.05 ND		

ND = Not detected at the detection limit shown.

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1105003
Client: Metco Environmental
Site: ADA-ES

Prep Date: 11/16/05
Analysis Date: 11/17/05

Thimble/Filter ID	DAT ID	Weight g
Inlet Run 1	1105003-1	0.5158
Inlet Run 2	1105003-6	0.5065
Inlet Run 3	1105003-11	0.5210
Outlet Run 1	1105003-16	0.5195
Outlet Run 2	1105003-21	0.5207
Outlet Run 3	1105003-26	0.5303
Blank Train	1105003-31	0.5617
Reagent Blank Cont. 12	1105003-41	0.5810

SAMPLE DATA

DAT Labs, Inc. Extraction Form

Project # 1105003

Sample: SOLIDS (LIQUID) AIR

Analysis: (Hg) ONTARIO-HYDRO

Prepared By: DE

Date: 11/15/05

Spike Witness:

Solvent Manufac:

Solvent Lot #

Extraction	Solvent	Volume mls	Reps
Soxhlet	Hexane		
Sep Funnel	Methanol		
Sonication	Methylene Chloride		
Cont. Ext	ACN		
Vial	Ethyl Acetate		
SPE Distill	IPA		
Other	Toluene		
No Extract	X Water		

X Other (Describe) DIGESTION W/ 7mL HF & 5mL HNO_3

SURROGATE ID	VOL mls / ul	CONC
SL-		
SL-		
SL-		

LS/MS ID	VOL mls / ul	CONC
SL-		
SL-		
SL-		

INT STD ID	VOL mls / ul	CONC
SL-		
SL-		
SL-		

COMMENTS

SAMPLE ID	ORIGINAL VOL ~~TOTAL SAMPLE AMNT~~	FINAL VOL ~~SAMPLE AMNT EXTRACTED~~	ALIQUOT VOL ~~TOTAL EXTRACT VOL~~ (ADD ALL REPS)	FINAL VOL ~~FINAL EXTRACT VOL~~ mls / ul	SURR INIT	SPK INIT	IS INIT
1105003-mbF		100	10	40mL			
-mbb		↓	40	↓			
-1sF			1				
-1sb			40				
-1(2)	360	100	10				
-3a	130	N/A	↓				
-3b	360	↓					
-4	120		1				
-5	370		10				
-6,(7)	340	100	↓				
-8a	340	N/A					
-8b	120	↓					
-9	150		1				
-10	370		10				

If extract was split for additional analyses, please note the aliquot volume for this analysis and at what point the extract was spiked.

ALIQUOT VOLUME: _____ mls ul (Circle one)

Extract was spiked: Before After the split. (Circle one)

Additional samples may be listed on the back of this page.

CORRON

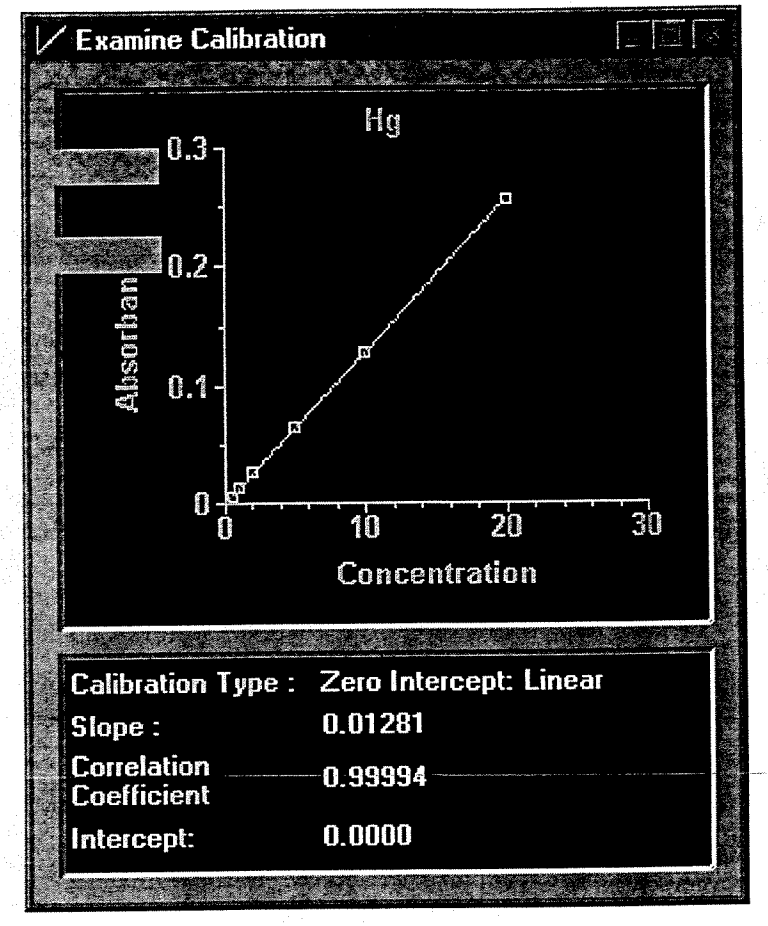
Project # 1105003 Continued from other side

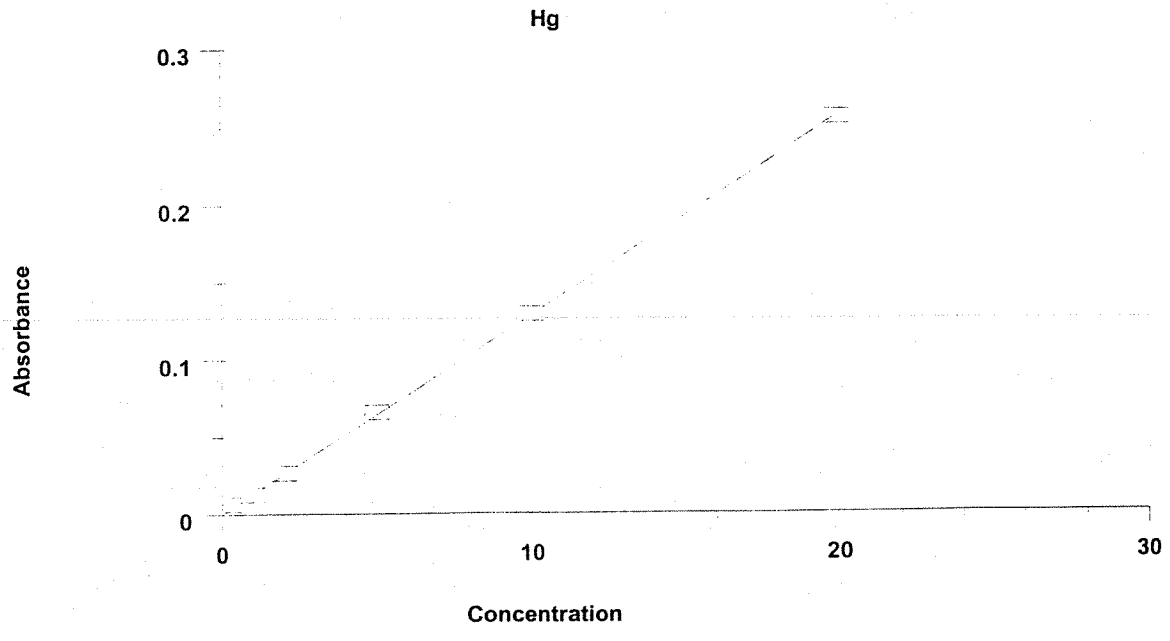
SAMPLE ID	ORIGINAL VOL ~~TOTAL SAMPLE AMNT~~	FINAL VOL ~~SAMPLE AMNT EXTRACTED~~	ALIQUOT VOL ~~TOTAL EXTRACT VOL~~ (ADD ALL REPS)	FINAL VOL. ~~FINAL EXTRACT VOL~~ mls / ul	SURR INIT	SPK INIT	IS INIT
1105003-1,12	330	100	10	40mL			
-13a	270	N/A					
-13b	220						
-14	125		1				
-15	385		10				
-16,17	180	100					
-18a	420	N/A					
-18b	170						
-19	130		1				
-20	DE 11/18/05 ~~190~~ 395		10				
-21,22	190	100					
-23a	385	N/A					
-23b	215						
-24	130		1				
-25	395		10				
-26,27	190	100					
-28a	390	N/A					
-28b	240						
-29	140		1				
-30	400		10				
-31,32	140	100					
-33	390	N/A					
-34	130		1				
-35	360		10				
-41,36	60	100					
-37	50	N/A					
-38	50		1				
-39	50		10				
-40	100						

Initial

fmgenext12601

004205


Examine Calibration
Hg
0.3
0.2
0.1
0
Absorban
0
10
20
30
Concentration
Calibration Type : Zero Intercept: Linear
Slope : 0.01281
Correlation Coefficient 0.99994
Intercept: 0.0000


Hg
0.3
0.2
0.1
0
Absorbance
0
10
20
30
Concentration

Sample Information File C:\AAUSER\SAMPINFO\1105003.SIF

Description : Metco Environmental
Batch ID : 1105003
Volume Units : L
Weight Units : µg
Analyst : de
Sample Volume : 0.50

AS Loc	Sample ID	Sample Weight	Sample Units	User Dilution	Remarks
9	1105003-mbf				
10	1105003-mbb				
11	1105003-lsf				
12	1105003-lsb				
13	1105003-1 2				
14	1105003-3a				
15	1105003-3b				
16	1105003-4				
17	1105003-5				
18	1105003-5ms				
19	1105003-5msd				
20	1105003-6 7				
21	1105003-8a				
22	1105003-8b				
23	1105003-9				
24	1105003-10				
25	1105003-11 12				
26	1105003-13a				
27	1105003-13b				
28	1105003-13b ms				
29	1105003-13b msd				
30	1105003-14				
31	1105003-15				
32	1105003-16 17				
33	1105003-18a				
34	1105003-18b				
35	1105003-19				
36	1105003-19 ms				
37	1105003-19 msd				
38	1105003-20				
39	1105003-21 22				
40	1105003-23a				
41	1105003-23b				
42	1105003-24				
43	1105003-25				
44	1105003-26 27				
45	1105003-28a				
46	1105003-28b				
47	1105003-29				
48	1105003-29d				
49	1105003-30				
50	1105003-31 32				
51	1105003-33				
52	1105003-34				
53	1105003-35				
54	1105003-41 36				
55	1105003-37				
56	1105003-38				
57	1105003-39				
58	1105003-40				
59	pql check				

Seq. No.	1	AS Loc:	8	Date:	11/17/05			
Sample ID:	Calib Blank							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg			0.0006	0.0029	62.4779	0.0006	4.1652	15:46:11
			0.0006	0.0033	62.4779	0.0006	4.1652	15:46:41
			0.0006	0.0038	62.4770	0.0006	4.1651	15:47:10
Auto-zero performed.								
Mean:			0.0006					
SD:			0.00003					
%RSD:			4.81					

Seq. No.	2	AS Loc:	1	Date:	11/17/05			
Sample ID:	ICAL 20							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg			0.2557	1.1591	62.4731	0.2563	4.1649	15:49:06
			0.2532	1.1533	62.4664	0.2538	4.1644	15:49:35
			0.2566	1.1524	62.4644	0.2572	4.1643	15:50:04
[Hg] Standard number 1 applied. [20.00]								
Correlation Coefficient: 1.00000		Slope: 0.01276						
Mean:			0.2552					
SD:			0.00174					
%RSD:			0.68					

Seq. No.	3	AS Loc:	2	Date:	11/17/05			
Sample ID:	ICAL 10							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg			0.1322	0.5918	62.4698	0.1328	4.1646	15:51:57
			0.1267	0.5823	62.4678	0.1273	4.1645	15:52:26
			0.1280	0.5878	62.4687	0.1286	4.1646	15:52:55
[Hg] Standard number 2 applied. [10.00]								
Correlation Coefficient: 0.99991		Slope: 0.01279						
Mean:			0.1290					
SD:			0.00286					
%RSD:			2.22					

Seq. No.	4	AS Loc:	3	Date:	11/17/05			
Sample ID:	ICAL 5.0							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg			0.0668	0.3000	62.4698	0.0674	4.1646	15:54:49
			0.0649	0.2980	62.4690	0.0655	4.1646	15:55:18
			0.0658	0.2977	62.4699	0.0664	4.1647	15:55:47
[Hg] Standard number 3 applied. [5.000]								
Correlation Coefficient: 0.99987		Slope: 0.01281						
Mean:			0.0659					
SD:			0.00096					
%RSD:			1.46					

Seq. No.	5	AS Loc:	4	Date:	11/17/05			
Sample ID:	ICAL 2.0							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg			0.0266	0.1230	62.4713	0.0272	4.1648	15:57:42
			0.0263	0.1202	62.4699	0.0269	4.1647	15:58:12
			0.0260	0.1223	62.4713	0.0266	4.1648	15:58:41
[Hg] Standard number 4 applied. [2.000]								

Correlation Coefficient: 0.99991 Slope: 0.01281

Mean:	0.0263
SD:	0.00028
%RSD:	1.08

Seq. No. 6 **AS Loc:** 5 **Date:** 11/17/05
Sample ID: ICAL 1.0

Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg			0.0125	0.0601	62.4735	0.0131	4.1649	16:00:37
			0.0125	0.0601	62.4719	0.0131	4.1648	16:01:07
			0.0127	0.0604	62.4724	0.0133	4.1648	16:01:37

[Hg] Standard number 5 applied. [1.000]
Correlation Coefficient: 0.99993 Slope: 0.01281

Mean:	0.0125
SD:	0.00009
%RSD:	0.72

Seq. No. 7 **AS Loc:** 6 **Date:** 11/17/05
Sample ID: ICAL 0.5

Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg			0.0063	0.0312	62.4685	0.0069	4.1646	16:03:34
			0.0062	0.0319	62.4696	0.0068	4.1646	16:04:03
			0.0063	0.0313	62.4690	0.0069	4.1646	16:04:32

[Hg] Standard number 6 applied. [0.5000]
Correlation Coefficient: 0.99994 Slope: 0.01281

Mean:	0.0063
SD:	0.00004
%RSD:	0.62

Seq. No. 8 **AS Loc:** 7 **Date:** 11/17/05
Sample ID: ICAL 0.2

Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg			0.0021	0.0119	62.4696	0.0027	4.1646	16:06:30
			0.0022	0.0132	62.4721	0.0028	4.1648	16:06:59
			0.0022	0.0133	62.4710	0.0028	4.1647	16:07:29

[Hg] Standard number 7 applied. [0.2000]
Correlation Coefficient: 0.99994 Slope: 0.01281

Mean:	0.0022
SD:	0.00009
%RSD:	4.15

Seq. No. 9 **AS Loc:** 106 **Date:** 11/17/05
Sample ID: ICV/CCV

Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	9.517µg/L	9.517µg/L	0.1219	0.5608	62.4782	0.1225	4.1652	16:12:55
	9.413µg/L	9.413µg/L	0.1206	0.5625	62.4770	0.1212	4.1651	16:13:24
	9.328µg/L	9.328µg/L	0.1195	0.5598	62.4779	0.1201	4.1652	16:13:53

QC value within specified limits.

Mean:	9.419µg/L	9.419µg/L	0.1206
SD:	0.0947µg/L	0.0947µg/L	0.00121
%RSD:	1.00		1.00

Seq. No.	10	AS Loc:	8	Date:	11/17/05			
Sample ID:	ICB/CCB							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0004µg/L	-0.0004µg/L	-0.0000	0.0031	62.4859	0.0006	4.1657	16:15:50
	-0.0020µg/L	-0.0020µg/L	-0.0000	0.0033	62.4870	0.0006	4.1658	16:16:20
	-0.0035µg/L	-0.0035µg/L	-0.0000	0.0025	62.4871	0.0006	4.1658	16:16:49
QC value within specified limits.								
Mean:	-0.0020µg/L	-0.0020µg/L	-0.0000					
SD:	0.0016µg/L	0.0016µg/L	0.00002					
%RSD:	78.89		78.89					

Seq. No.	11	AS Loc:	9	Date:	11/17/05			
Sample ID:	1105003-mbf							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0408µg/L	-0.0408µg/L	-0.0005	0.0002	62.4913	0.0001	4.1661	16:18:44
	-0.0438µg/L	-0.0438µg/L	-0.0006	0.0003	62.4919	0.0000	4.1661	16:19:14
	-0.0381µg/L	-0.0381µg/L	-0.0005	0.0010	62.4925	0.0001	4.1662	16:19:43
Mean:	-0.0409µg/L	-0.0409µg/L	-0.0005					
SD:	0.0028µg/L	0.0028µg/L	0.00004					
%RSD:	6.90		6.90					

Seq. No.	12	AS Loc:	10	Date:	11/17/05			
Sample ID:	1105003-mbb							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0431µg/L	-0.0431µg/L	-0.0006	0.0001	62.4894	0.0001	4.1660	16:21:35
	-0.0442µg/L	-0.0442µg/L	-0.0006	-0.0001	62.4905	0.0000	4.1660	16:22:04
	-0.0448µg/L	-0.0448µg/L	-0.0006	0.0000	62.4907	0.0000	4.1661	16:22:34
Mean:	-0.0440µg/L	-0.0440µg/L	-0.0006					
SD:	0.0008µg/L	0.0008µg/L	0.00001					
%RSD:	1.86		1.86					

Seq. No.	13	AS Loc:	11	Date:	11/17/05			
Sample ID:	1105003-lsf							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	12.95µg/L	12.95µg/L	0.1658	0.7591	62.4913	0.1664	4.1661	16:24:27
	12.95µg/L	12.95µg/L	0.1659	0.7597	62.4870	0.1665	4.1658	16:24:56
	12.93µg/L	12.93µg/L	0.1656	0.7567	62.4868	0.1662	4.1658	16:25:26
Mean:	12.94µg/L	12.94µg/L	0.1658					
SD:	0.0122µg/L	0.0122µg/L	0.00016					
%RSD:	0.09		0.09					

Seq. No.	14	AS Loc:	12	Date:	11/17/05			
Sample ID:	1105003-lsb							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	10.76µg/L	10.76µg/L	0.1378	0.6441	62.4893	0.1384	4.1659	16:27;21
	10.82µg/L	10.82µg/L	0.1385	0.6440	62.4859	0.1391	4.1657	16:27:50
	10.81µg/L	10.81µg/L	0.1384	0.6441	62.4847	0.1390	4.1657	16:28:19
Mean:	10.80µg/L	10.80µg/L	0.1383					
SD:	0.0307µg/L	0.0307µg/L	0.00039					
%RSD:	0.28		0.28					

Seq. No.	15	AS Loc:	13	Date:	11/17/05			
Sample ID:	1105003-1 2							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.4687µg/L	0.4687µg/L	0.0060	0.0303	62.4902	0.0066	4.1660	16:30:14
	0.4646µg/L	0.4646µg/L	0.0060	0.0296	62.4902	0.0066	4.1660	16:30:44
	0.4755µg/L	0.4755µg/L	0.0061	0.0309	62.4913	0.0067	4.1661	16:31:13
Mean:	0.4696µg/L	0.4696µg/L	0.0060					
SD:	0.0055µg/L	0.0055µg/L	0.00007					
%RSD:	1.17		1.17					

Seq. No.	16	AS Loc:	14	Date:	11/17/05			
Sample ID:	1105003-3a							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.0222µg/L	0.0222µg/L	0.0003	0.0048	62.4962	0.0009	4.1664	16:33:09
	0.0183µg/L	0.0183µg/L	0.0002	0.0044	62.4951	0.0008	4.1663	16:33:38
	0.0168µg/L	0.0168µg/L	0.0002	0.0041	62.4951	0.0008	4.1663	16:34:08
Mean:	0.0191µg/L	0.0191µg/L	0.0002					
SD:	0.0028µg/L	0.0028µg/L	0.00004					
%RSD:	14.45		14.45					

Seq. No.	17	AS Loc:	15	Date:	11/17/05			
Sample ID:	1105003-3b							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	2.279µg/L	2.279µg/L	0.0292	0.1401	62.4996	0.0298	4.1666	16:36:04
	2.296µg/L	2.296µg/L	0.0294	0.1403	62.4984	0.0300	4.1665	16:36:33
	2.308µg/L	2.308µg/L	0.0296	0.1401	62.4976	0.0302	4.1665	16:37:02
Mean:	2.294µg/L	2.294µg/L	0.0294					
SD:	0.0148µg/L	0.0148µg/L	0.00019					
%RSD:	0.64		0.64					

Seq. No.	18	AS Loc:	16	Date:	11/17/05			
Sample ID:	1105003-4							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0235µg/L	-0.0235µg/L	-0.0003	0.0017	62.5017	0.0003	4.1668	16:39:01
	-0.0308µg/L	-0.0308µg/L	-0.0004	0.0007	62.5028	0.0002	4.1668	16:39:30
	-0.0213µg/L	-0.0213µg/L	-0.0003	0.0017	62.5051	0.0003	4.1670	16:39:59
Mean:	-0.0252µg/L	-0.0252µg/L	-0.0003					
SD:	0.0050µg/L	0.0050µg/L	0.00006					
%RSD:	19.80		19.80					

Seq. No.	19	AS Loc:	17	Date:	11/17/05			
Sample ID:	1105003-5							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	4.574µg/L	4.574µg/L	0.0586	0.2766	62.5098	0.0592	4.1673	16:41:54
	4.626µg/L	4.626µg/L	0.0592	0.2781	62.5090	0.0598	4.1673	16:42:23
	4.566µg/L	4.566µg/L	0.0585	0.2765	62.5087	0.0591	4.1672	16:42:52
Mean:	4.588µg/L	4.588µg/L	0.0588					
SD:	0.0324µg/L	0.0324µg/L	0.00042					
%RSD:	0.71		0.71					

Seq. No.	20	AS Loc:	18	Date:	11/17/05			
Sample ID:	1105003-5ms							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	14.31µg/L	14.31µg/L	0.1833	0.8690	62.5147	0.1839	4.1677	16:44:44
	14.46µg/L	14.46µg/L	0.1851	0.8737	62.5119	0.1857	4.1674	16:45:13
	14.49µg/L	14.49µg/L	0.1855	0.8749	62.5090	0.1861	4.1673	16:45:42
Mean:	14.42µg/L	14.42µg/L	0.1846					
SD:	0.0943µg/L	0.0943µg/L	0.00121					
%RSD:	0.65		0.65					

Seq. No.	21	AS Loc:	106	Date:	11/17/05			
Sample ID:	ICV/CCV							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	9.714µg/L	9.714µg/L	0.1244	0.5703	62.5119	0.1250	4.1674	16:47:36
	9.704µg/L	9.704µg/L	0.1243	0.5784	62.5097	0.1249	4.1673	16:48:05
	9.740µg/L	9.740µg/L	0.1247	0.5786	62.5099	0.1253	4.1673	16:48:35
QC value within specified limits.								
Mean:	9.719µg/L	9.719µg/L	0.1245					
SD:	0.0185µg/L	0.0185µg/L	0.00024					
%RSD:	0.19		0.19					

Seq. No.	22	AS Loc:	8	Date:	11/17/05			
Sample ID:	ICB/CCB							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0080µg/L	-0.0080µg/L	-0.0001	0.0018	62.5108	0.0005	4.1674	16:50:32
	0.0021µg/L	0.0021µg/L	0.0000	0.0031	62.5121	0.0006	4.1675	16:51:01
	0.0054µg/L	0.0054µg/L	0.0001	0.0032	62.5111	0.0007	4.1674	16:51:31
QC value within specified limits.								
Mean:	-0.0002µg/L	-0.0002µg/L	-0.0000					
SD:	0.0070µg/L	0.0070µg/L	0.00009					
%RSD:	4038.83		4,038.83					

Seq. No.	23	AS Loc:	19	Date:	11/17/05			
Sample ID:	1105003-5msd							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	14.06µg/L	14.06µg/L	0.1801	0.8587	62.5133	0.1807	4.1675	16:53:26
	14.00µg/L	14.00µg/L	0.1793	0.8584	62.5088	0.1799	4.1672	16:53:55
	13.99µg/L	13.99µg/L	0.1792	0.8579	62.5067	0.1798	4.1671	16:54:24
Mean:	14.02µg/L	14.02µg/L	0.1795					
SD:	0.0373µg/L	0.0373µg/L	0.00048					
%RSD:	0.27		0.27					

Seq. No.	24	AS Loc:	20	Date:	11/17/05			
Sample ID:	1105003-6 7							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.3182µg/L	0.3182µg/L	0.0041	0.0210	62.5143	0.0047	4.1676	16:56:17
	0.3267µg/L	0.3267µg/L	0.0042	0.0218	62.5154	0.0048	4.1677	16:56:46
	0.3250µg/L	0.3250µg/L	0.0042	0.0217	62.5154	0.0048	4.1677	16:57:15
Mean:	0.3233µg/L	0.3233µg/L	0.0041					
SD:	0.0044µg/L	0.0044µg/L	0.00006					
%RSD:	1.38		1.38					

Seq. No.	25	AS Loc:	21	Date:	11/17/05			
Sample ID:	1105003-8a							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	2.917µg/L	2.917µg/L	0.0374	0.1800	62.5214	0.0380	4.1681	16:59:07
	2.917µg/L	2.917µg/L	0.0374	0.1796	62.5216	0.0380	4.1681	16:59:37
	2.909µg/L	2.909µg/L	0.0373	0.1793	62.5211	0.0379	4.1681	17:00:06
Mean:	2.915µg/L	2.915µg/L	0.0373					
SD:	0.0045µg/L	0.0045µg/L	0.00006					
%RSD:	0.15		0.15					

Seq. No.	26	AS Loc:	22	Date:	11/17/05			
Sample ID:	1105003-8b							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0042µg/L	-0.0042µg/L	-0.0001	0.0030	62.5237	0.0005	4.1682	17:01:59
	-0.0080µg/L	-0.0080µg/L	-0.0001	0.0021	62.5228	0.0005	4.1682	17:02:28
	-0.0036µg/L	-0.0036µg/L	-0.0000	0.0031	62.5250	0.0006	4.1683	17:02:58
Mean:	-0.0053µg/L	-0.0053µg/L	-0.0001					
SD:	0.0024µg/L	0.0024µg/L	0.00003					
%RSD:	45.05		45.05					

Seq. No.	27	AS Loc:	23	Date:	11/17/05			
Sample ID:	1105003-9							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.0093µg/L	0.0093µg/L	0.0001	0.0035	62.5259	0.0007	4.1684	17:04:52
	0.0096µg/L	0.0096µg/L	0.0001	0.0030	62.5259	0.0007	4.1684	17:05:21
	0.0156µg/L	0.0156µg/L	0.0002	0.0044	62.5268	0.0008	4.1684	17:05:50
Mean:	0.0115µg/L	0.0115µg/L	0.0001					
SD:	0.0035µg/L	0.0035µg/L	0.00005					
%RSD:	30.81		30.81					

Seq. No.	28	AS Loc:	24	Date:	11/17/05			
Sample ID:	1105003-10							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	3.126µg/L	3.126µg/L	0.0400	0.1932	62.5237	0.0406	4.1683	17:07:45
	3.108µg/L	3.108µg/L	0.0398	0.1911	62.5225	0.0404	4.1682	17:08:14
	3.152µg/L	3.152µg/L	0.0404	0.1933	62.5234	0.0410	4.1682	17:08:43
Mean:	3.128µg/L	3.128µg/L	0.0401					
SD:	0.0224µg/L	0.0224µg/L	0.00029					
%RSD:	0.72		0.72					

Seq. No.	29	AS Loc:	25	Date:	11/17/05			
Sample ID:	1105003-11 12							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.1390µg/L	0.1390µg/L	0.0018	0.0110	62.5216	0.0024	4.1681	17:10:38
	0.1417µg/L	0.1417µg/L	0.0018	0.0117	62.5216	0.0024	4.1681	17:11:07
	0.1485µg/L	0.1485µg/L	0.0019	0.0123	62.5214	0.0025	4.1681	17:11:36
Mean:	0.1431µg/L	0.1431µg/L	0.0018					
SD:	0.0049µg/L	0.0049µg/L	0.00006					
%RSD:	3.43		3.43					

Seq. No.	30	AS Loc:	26	Date:	11/17/05			
Sample ID:	1105003-13a							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.3860µg/L	0.3860µg/L	0.0049	0.0268	62.5170	0.0055	4.1678	17:13:31
	0.3937µg/L	0.3937µg/L	0.0050	0.0264	62.5166	0.0056	4.1678	17:14:01
	0.4068µg/L	0.4068µg/L	0.0052	0.0282	62.5188	0.0058	4.1679	17:14:30
Mean:	0.3955µg/L	0.3955µg/L	0.0051					
SD:	0.0105µg/L	0.0105µg/L	0.00013					
%RSD:	2.66		2.66					

Seq. No.	31	AS Loc:	27	Date:	11/17/05			
Sample ID:	1105003-13b							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	1.617µg/L	1.617µg/L	0.0207	0.1014	62.5159	0.0213	4.1677	17:16:26
	1.615µg/L	1.615µg/L	0.0207	0.1007	62.5145	0.0213	4.1676	17:16:55
	1.624µg/L	1.624µg/L	0.0208	0.1004	62.5154	0.0214	4.1677	17:17:24
Mean:	1.618µg/L	1.618µg/L	0.0207					
SD:	0.0045µg/L	0.0045µg/L	0.00006					
%RSD:	0.28		0.28					

Seq. No.	32	AS Loc:	28	Date:	11/17/05			
Sample ID:	1105003-13b ms							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	11.28µg/L	11.28µg/L	0.1445	0.6836	62.5156	0.1451	4.1677	17:19:21
	11.26µg/L	11.26µg/L	0.1442	0.6827	62.5119	0.1448	4.1675	17:19:50
	11.24µg/L	11.24µg/L	0.1439	0.6806	62.5119	0.1445	4.1674	17:20:19
Mean:	11.26µg/L	11.26µg/L	0.1442					
SD:	0.0216µg/L	0.0216µg/L	0.00028					
%RSD:	0.19		0.19					

Seq. No.	33	AS Loc:	106	Date:	11/17/05			
Sample ID:	ICV/CCV							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	9.459µg/L	9.459µg/L	0.1211	0.5719	62.5180	0.1217	4.1679	17:22:16
	9.400µg/L	9.400µg/L	0.1204	0.5700	62.5148	0.1210	4.1677	17:22:45
	9.344µg/L	9.344µg/L	0.1197	0.5675	62.5168	0.1203	4.1678	17:23:15
QC value within specified limits.								
Mean:	9.401µg/L	9.401µg/L	0.1204					
SD:	0.0575µg/L	0.0575µg/L	0.00074					
%RSD:	0.61		0.61					

Seq. No.	34	AS Loc:	8	Date:	11/17/05			
Sample ID:	ICB/CCB							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0029µg/L	-0.0029µg/L	-0.0000	0.0027	62.5182	0.0006	4.1679	17:25:13
	0.0055µg/L	0.0055µg/L	0.0001	0.0042	62.5182	0.0007	4.1679	17:25:42
	0.0037µg/L	0.0037µg/L	0.0000	0.0038	62.5166	0.0007	4.1678	17:26:11
QC value within specified limits.								
Mean:	0.0021µg/L	0.0021µg/L	0.0000					
SD:	0.0045µg/L	0.0045µg/L	0.00006					
%RSD:	209.96		209.96					

Seq. No.	35	AS Loc:	29	Date:	11/17/05			
Sample ID:	1105003-13b msd							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	10.97µg/L	10.97µg/L	0.1405	0.6721	62.5157	0.1411	4.1677	17:28:08
	11.01µg/L	11.01µg/L	0.1410	0.6705	62.5102	0.1416	4.1674	17:28:38
	11.06µg/L	11.06µg/L	0.1416	0.6743	62.5085	0.1422	4.1672	17:29:07
Mean:	11.01µg/L	11.01µg/L	0.1411					
SD:	0.0437µg/L	0.0437µg/L	0.00056					
%RSD:	0.40		0.40					

Seq. No.	36	AS Loc:	30	Date:	11/17/05			
Sample ID:	1105003-14							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0193µg/L	-0.0193µg/L	-0.0002	0.0016	62.5086	0.0004	4.1672	17:31:03
	-0.0117µg/L	-0.0117µg/L	-0.0001	0.0028	62.5087	0.0005	4.1672	17:31:33
	-0.0182µg/L	-0.0182µg/L	-0.0002	0.0019	62.5076	0.0004	4.1672	17:32:01
Mean:	-0.0164µg/L	-0.0164µg/L	-0.0002					
SD:	0.0041µg/L	0.0041µg/L	0.00005					
%RSD:	25.20		25.20					

Seq. No.	37	AS Loc:	31	Date:	11/17/05			
Sample ID:	1105003-15							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	4.262µg/L	4.262µg/L	0.0546	0.2616	62.5051	0.0552	4.1670	17:33:59
	4.265µg/L	4.265µg/L	0.0546	0.2606	62.5031	0.0552	4.1669	17:34:28
	4.290µg/L	4.290µg/L	0.0549	0.2609	62.5039	0.0555	4.1669	17:34:57
Mean:	4.272µg/L	4.272µg/L	0.0547					
SD:	0.0155µg/L	0.0155µg/L	0.00020					
%RSD:	0.36		0.36					

Seq. No.	38	AS Loc:	32	Date:	11/17/05			
Sample ID:	1105003-16 17							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	8.478µg/L	8.478µg/L	0.1086	0.5025	62.5028	0.1092	4.1668	17:36:52
	8.470µg/L	8.470µg/L	0.1085	0.5022	62.5005	0.1091	4.1667	17:37:21
	8.562µg/L	8.562µg/L	0.1097	0.5065	62.4993	0.1103	4.1666	17:37:50
Mean:	8.503µg/L	8.503µg/L	0.1089					
SD:	0.0509µg/L	0.0509µg/L	0.00065					
%RSD:	0.60		0.60					

Seq. No.	39	AS Loc:	33	Date:	11/17/05			
Sample ID:	1105003-18a							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.0721µg/L	0.0721µg/L	0.0009	0.0077	62.4993	0.0015	4.1666	17:39:40
	0.0736µg/L	0.0736µg/L	0.0009	0.0076	62.4985	0.0015	4.1666	17:40:09
	0.0729µg/L	0.0729µg/L	0.0009	0.0078	62.5005	0.0015	4.1667	17:40:38
Mean:	0.0729µg/L	0.0729µg/L	0.0009					
SD:	0.0008µg/L	0.0008µg/L	0.00001					
%RSD:	1.09		1.09					

Seq. No.	40	AS Loc:	34	Date:	11/17/05			
Sample ID:	1105003-18b							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.0065µg/L	0.0065µg/L	0.0001	0.0036	62.4996	0.0007	4.1666	17:42:29
	0.0049µg/L	0.0049µg/L	0.0001	0.0034	62.4995	0.0007	4.1666	17:42:58
	0.0084µg/L	0.0084µg/L	0.0001	0.0039	62.4994	0.0007	4.1666	17:43:27
Mean:	0.0066µg/L	0.0066µg/L	0.0001					
SD:	0.0017µg/L	0.0017µg/L	0.00002					
%RSD:	26.39		26.39					

Seq. No.	41	AS Loc:	35	Date:	11/17/05			
Sample ID:	1105003-19							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0426µg/L	-0.0426µg/L	-0.0005	0.0005	62.4976	0.0001	4.1665	17:45:20
	-0.0424µg/L	-0.0424µg/L	-0.0005	0.0006	62.4973	0.0001	4.1665	17:45:49
	-0.0401µg/L	-0.0401µg/L	-0.0005	0.0007	62.4976	0.0001	4.1665	17:46:18
Mean:	-0.0417µg/L	-0.0417µg/L	-0.0005					
SD:	0.0014µg/L	0.0014µg/L	0.00002					
%RSD:	3.31		3.31					

Seq. No.	42	AS Loc:	36	Date:	11/17/05			
Sample ID:	1105003-19 ms							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	10.52µg/L	10.52µg/L	0.1347	0.6338	62.4962	0.1353	4.1664	17:48:14
	10.44µg/L	10.44µg/L	0.1338	0.6305	62.4927	0.1344	4.1662	17:48:44
	10.50µg/L	10.50µg/L	0.1345	0.6308	62.4930	0.1351	4.1662	17:49:13
Mean:	10.49µg/L	10.49µg/L	0.1343					
SD:	0.0401µg/L	0.0401µg/L	0.00051					
%RSD:	0.38		0.38					

Seq. No.	43	AS Loc:	37	Date:	11/17/05			
Sample ID:	1105003-19 msd							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	10.19µg/L	10.19µg/L	0.1305	0.6140	62.4987	0.1311	4.1666	17:51:15
	10.31µg/L	10.31µg/L	0.1320	0.6172	62.4961	0.1327	4.1664	17:51:44
	10.28µg/L	10.28µg/L	0.1317	0.6149	62.4965	0.1323	4.1664	17:52:13
Mean:	10.26µg/L	10.26µg/L	0.1314					
SD:	0.0630µg/L	0.0630µg/L	0.00081					
%RSD:	0.61		0.61					

Seq. No.	44	AS Loc:	38	Date:	11/17/05			
Sample ID:	1105003-20							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.2874µg/L	0.2874µg/L	0.0037	0.0203	62.5019	0.0043	4.1668	17:54:06
	0.2886µg/L	0.2886µg/L	0.0037	0.0209	62.5010	0.0043	4.1667	17:54:35
	0.2884µg/L	0.2884µg/L	0.0037	0.0210	62.5018	0.0043	4.1668	17:55:04
Mean:	0.2882µg/L	0.2882µg/L	0.0037					
SD:	0.0007µg/L	0.0007µg/L	0.00001					
%RSD:	0.23		0.23					

Seq. No.	45	AS Loc:	106	Date:	11/17/05			
Sample ID:	ICV/CCV							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	9.483µg/L	9.483µg/L	0.1214	0.5748	62.4973	0.1221	4.1665	17:56:59
	9.594µg/L	9.594µg/L	0.1229	0.5779	62.4948	0.1235	4.1663	17:57:29
	9.620µg/L	9.620µg/L	0.1232	0.5780	62.4938	0.1238	4.1662	17:57:58
QC value within specified limits.								
Mean:	9.566µg/L	9.566µg/L	0.1225					
SD:	0.0730µg/L	0.0730µg/L	0.00093					
%RSD:	0.76		0.76					

Seq. No.	46	AS Loc:	8	Date:	11/17/05			
Sample ID:	ICB/CCB							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.0067µg/L	0.0067µg/L	0.0001	0.0032	62.4930	0.0007	4.1662	17:59:55
	0.0082µg/L	0.0082µg/L	0.0001	0.0035	62.4948	0.0007	4.1663	18:00:24
	0.0089µg/L	0.0089µg/L	0.0001	0.0038	62.4939	0.0007	4.1663	18:00:53
QC value within specified limits.								
Mean:	0.0079µg/L	0.0079µg/L	0.0001					
SD:	0.0011µg/L	0.0011µg/L	0.00001					
%RSD:	13.90		13.90					

Seq. No.	47	AS Loc:	39	Date:	11/17/05			
Sample ID:	1105003-21 22							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	5.819µg/L	5.819µg/L	0.0745	0.3414	62.4915	0.0751	4.1661	18:02:49
	5.846µg/L	5.846µg/L	0.0749	0.3431	62.4905	0.0755	4.1660	18:03:19
	5.815µg/L	5.815µg/L	0.0745	0.3423	62.4902	0.0751	4.1660	18:03:48
Mean:	5.826µg/L	5.826µg/L	0.0746					
SD:	0.0169µg/L	0.0169µg/L	0.00022					
%RSD:	0.29		0.29					

Seq. No.	48	AS Loc:	40	Date:	11/17/05			
Sample ID:	1105003-23a							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.3403µg/L	0.3403µg/L	0.0044	0.0235	62.4893	0.0050	4.1659	18:05:43
	0.3375µg/L	0.3375µg/L	0.0043	0.0231	62.4884	0.0049	4.1659	18:06:12
	0.3418µg/L	0.3418µg/L	0.0044	0.0236	62.4893	0.0050	4.1660	18:06:41
Mean:	0.3399µg/L	0.3399µg/L	0.0044					
SD:	0.0022µg/L	0.0022µg/L	0.00003					
%RSD:	0.64		0.64					

Seq. No.	49	AS Loc:	41	Date:	11/17/05			
Sample ID:	1105003-23b							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.0047µg/L	0.0047µg/L	0.0001	0.0035	62.4890	0.0007	4.1659	18:08:36
	0.0025µg/L	0.0025µg/L	0.0000	0.0035	62.4882	0.0006	4.1659	18:09:05
	0.0026µg/L	0.0026µg/L	0.0000	0.0032	62.4891	0.0006	4.1659	18:09:34
Mean:	0.0033µg/L	0.0033µg/L	0.0000					
SD:	0.0013µg/L	0.0013µg/L	0.00002					
%RSD:	38.55		38.55					

Seq. No.	50	AS Loc:	42	Date:	11/17/05			
Sample ID:	1105003-24							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0393µg/L	-0.0393µg/L	-0.0005	0.0009	62.4896	0.0001	4.1660	18:11:28
	-0.0438µg/L	-0.0438µg/L	-0.0006	0.0003	62.4882	0.0000	4.1659	18:11:58
	-0.0449µg/L	-0.0449µg/L	-0.0006	-0.0001	62.4884	0.0000	4.1659	18:12:27
Mean:	-0.0427µg/L	-0.0427µg/L	-0.0005					
SD:	0.0030µg/L	0.0030µg/L	0.00004					
%RSD:	6.98		6.98					

Seq. No.	51	AS Loc:	43	Date:	11/17/05			
Sample ID:	1105003-25							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.5350µg/L	0.5350µg/L	0.0069	0.0349	62.4881	0.0075	4.1659	18:14:22
	0.5446µg/L	0.5446µg/L	0.0070	0.0359	62.4885	0.0076	4.1659	18:14:51
	0.5473µg/L	0.5473µg/L	0.0070	0.0358	62.4881	0.0076	4.1659	18:15:21
Mean:	0.5423µg/L	0.5423µg/L	0.0069					
SD:	0.0065µg/L	0.0065µg/L	0.00008					
%RSD:	1.19		1.19					

Seq. No.	52	AS Loc:	44	Date:	11/17/05			
Sample ID:	1105003-26 27							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	9.526µg/L	9.526µg/L	0.1220	0.5597	62.4927	0.1226	4.1662	18:17:18
	9.413µg/L	9.413µg/L	0.1205	0.5564	62.4884	0.1211	4.1659	18:17:48
	9.364µg/L	9.364µg/L	0.1199	0.5522	62.4884	0.1205	4.1659	18:18:18
Mean:	9.434µg/L	9.434µg/L	0.1208					
SD:	0.0832µg/L	0.0832µg/L	0.00107					
%RSD:	0.88		0.88					

Seq. No.	53	AS Loc:	45	Date:	11/17/05			
Sample ID:	1105003-28a							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.3639µg/L	0.3639µg/L	0.0047	0.0256	62.4951	0.0053	4.1663	18:20:15
	0.3608µg/L	0.3608µg/L	0.0046	0.0252	62.4928	0.0052	4.1662	18:20:45
	0.3594µg/L	0.3594µg/L	0.0046	0.0251	62.4916	0.0052	4.1661	18:21:15
Mean:	0.3614µg/L	0.3614µg/L	0.0046					
SD:	0.0023µg/L	0.0023µg/L	0.00003					
%RSD:	0.63		0.63					

Seq. No.	54	AS Loc:	46	Date:	11/17/05			
Sample ID:	1105003-28b							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.0068µg/L	0.0068µg/L	0.0001	0.0039	62.4915	0.0007	4.1661	18:23:13
	0.0042µg/L	0.0042µg/L	0.0001	0.0035	62.4891	0.0007	4.1659	18:23:43
	0.0089µg/L	0.0089µg/L	0.0001	0.0042	62.4893	0.0007	4.1659	18:24:13
Mean:	0.0066µg/L	0.0066µg/L	0.0001					
SD:	0.0024µg/L	0.0024µg/L	0.00003					
%RSD:	35.76		35.76					

Seq. No.	55	AS Loc:	47	Date:	11/17/05			
Sample ID:	1105003-29							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0385µg/L	-0.0385µg/L	-0.0005	0.0008	62.4890	0.0001	4.1659	18:26:12
	-0.0371µg/L	-0.0371µg/L	-0.0005	0.0013	62.4870	0.0001	4.1658	18:26:42
	-0.0361µg/L	-0.0361µg/L	-0.0005	0.0014	62.4859	0.0001	4.1657	18:27:12
Mean:	-0.0372µg/L	-0.0372µg/L	-0.0005					
SD:	0.0012µg/L	0.0012µg/L	0.00002					
%RSD:	3.28		3.28					

Seq. No.	56	AS Loc:	48	Date:	11/17/05			
Sample ID:	1105003-29d							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0417µg/L	-0.0417µg/L	-0.0005	0.0005	62.4834	0.0001	4.1656	18:29:07
	-0.0429µg/L	-0.0429µg/L	-0.0005	0.0004	62.4824	0.0001	4.1655	18:29:37
	-0.0425µg/L	-0.0425µg/L	-0.0005	0.0005	62.4822	0.0001	4.1655	18:30:07
Mean:	-0.0424µg/L	-0.0424µg/L	-0.0005					
SD:	0.0006µg/L	0.0006µg/L	0.00001					
%RSD:	1.42		1.42					

Seq. No.	57	AS Loc:	106	Date:	11/17/05			
Sample ID:	ICV/CCV							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	9.680µg/L	9.680µg/L	0.1240	0.5849	62.4790	0.1246	4.1653	18:32:01
	9.776µg/L	9.776µg/L	0.1252	0.5852	62.4767	0.1258	4.1651	18:32:31
	9.780µg/L	9.780µg/L	0.1252	0.5891	62.4765	0.1259	4.1651	18:33:01
QC value within specified limits.								
Mean:	9.745µg/L	9.745µg/L	0.1248					
SD:	0.0565µg/L	0.0565µg/L	0.00072					
%RSD:	0.58		0.58					

Seq. No.	58	AS Loc:	8	Date:	11/17/05			
Sample ID:	ICB/CCB							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.0053µg/L	0.0053µg/L	0.0001	0.0032	62.4790	0.0007	4.1653	18:34:59
	0.0053µg/L	0.0053µg/L	0.0001	0.0031	62.4791	0.0007	4.1653	18:35:28
	0.0075µg/L	0.0075µg/L	0.0001	0.0036	62.4792	0.0007	4.1653	18:35:59
QC value within specified limits.								
Mean:	0.0060µg/L	0.0060µg/L	0.0001					
SD:	0.0013µg/L	0.0013µg/L	0.00002					
%RSD:	21.30		21.30					

Seq. No.	59	AS Loc:	49	Date:	11/17/05			
Sample ID:	1105003-30							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.5295µg/L	0.5295µg/L	0.0068	0.0354	62.4779	0.0074	4.1652	18:37:53
	0.5261µg/L	0.5261µg/L	0.0067	0.0351	62.4770	0.0073	4.1651	18:38:23
	0.5332µg/L	0.5332µg/L	0.0068	0.0352	62.4767	0.0074	4.1651	18:38:54
Mean:	0.5296µg/L	0.5296µg/L	0.0068					
SD:	0.0036µg/L	0.0036µg/L	0.00005					
%RSD:	0.67		0.67					

Seq. No.	60	AS Loc:	50	Date:	11/17/05			
Sample ID:	1105003-31 32							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0397µg/L	-0.0397µg/L	-0.0005	0.0009	62.4759	0.0001	4.1651	18:40:48
	-0.0391µg/L	-0.0391µg/L	-0.0005	0.0008	62.4755	0.0001	4.1650	18:41:17
	-0.0395µg/L	-0.0395µg/L	-0.0005	0.0007	62.4758	0.0001	4.1651	18:41:48
Mean:	-0.0394µg/L	-0.0394µg/L	-0.0005					
SD:	0.0003µg/L	0.0003µg/L	0.00000					
%RSD:	0.67		0.67					

Seq. No.	61	AS Loc:	51	Date:	11/17/05			
Sample ID:	1105003-33							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0431µg/L	-0.0431µg/L	-0.0006	0.0004	62.4742	0.0001	4.1649	18:43:41
	-0.0425µg/L	-0.0425µg/L	-0.0005	0.0005	62.4744	0.0001	4.1650	18:44:10
	-0.0409µg/L	-0.0409µg/L	-0.0005	0.0006	62.4742	0.0001	4.1649	18:44:41
Mean:	-0.0422µg/L	-0.0422µg/L	-0.0005					
SD:	0.0011µg/L	0.0011µg/L	0.00001					
%RSD:	2.71		2.71					

Seq. No.	62	AS Loc:	52	Date:	11/17/05			
Sample ID:	1105003-34							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0442µg/L	-0.0442µg/L	-0.0006	0.0002	62.4736	0.0000	4.1649	18:46:35
	-0.0410µg/L	-0.0410µg/L	-0.0005	0.0008	62.4742	0.0001	4.1649	18:47:05
	-0.0417µg/L	-0.0417µg/L	-0.0005	0.0006	62.4731	0.0001	4.1649	18:47:35
Mean:	-0.0423µg/L	-0.0423µg/L	-0.0005					
SD:	0.0017µg/L	0.0017µg/L	0.00002					
%RSD:	3.93		3.93					

Seq. No.	63	AS Loc:	53	Date:	11/17/05			
Sample ID:	1105003-35							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0352µg/L	-0.0352µg/L	-0.0005	0.0011	62.4708	0.0002	4.1647	18:49:28
	-0.0345µg/L	-0.0345µg/L	-0.0004	0.0010	62.4702	0.0002	4.1647	18:49:57
	-0.0330µg/L	-0.0330µg/L	-0.0004	0.0012	62.4698	0.0002	4.1647	18:50:28
Mean:	-0.0342µg/L	-0.0342µg/L	-0.0004					
SD:	0.0011µg/L	0.0011µg/L	0.00001					
%RSD:	3.33		3.33					

Seq. No.	64	AS Loc:	54	Date:	11/17/05			
Sample ID:	1105003-41 36							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0448µg/L	-0.0448µg/L	-0.0006	0.0002	62.4676	0.0000	4.1645	18:52:20
	-0.0381µg/L	-0.0381µg/L	-0.0005	0.0011	62.4676	0.0001	4.1645	18:52:50
	-0.0406µg/L	-0.0406µg/L	-0.0005	0.0005	62.4665	0.0001	4.1644	18:53:20
Mean:	-0.0412µg/L	-0.0412µg/L	-0.0005					
SD:	0.0034µg/L	0.0034µg/L	0.00004					
%RSD:	8.16		8.16					

Seq. No.	65	AS Loc:	55	Date:	11/17/05			
Sample ID:	1105003-37							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0354µg/L	-0.0354µg/L	-0.0005	0.0011	62.4619	0.0001	4.1641	18:55:15
	-0.0404µg/L	-0.0404µg/L	-0.0005	0.0005	62.4610	0.0001	4.1641	18:55:44
	-0.0382µg/L	-0.0382µg/L	-0.0005	0.0012	62.4607	0.0001	4.1641	18:56:14
Mean:	-0.0380µg/L	-0.0380µg/L	-0.0005					
SD:	0.0025µg/L	0.0025µg/L	0.00003					
%RSD:	6.54		6.54					

Seq. No.	66	AS Loc:	56	Date:	11/17/05			
Sample ID:	1105003-38							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0439µg/L	-0.0439µg/L	-0.0006	0.0001	62.4582	0.0000	4.1639	18:58:09
	-0.0449µg/L	-0.0449µg/L	-0.0006	0.0000	62.4576	0.0000	4.1639	18:58:39
	-0.0416µg/L	-0.0416µg/L	-0.0005	0.0004	62.4576	0.0001	4.1639	18:59:09
Mean:	-0.0435µg/L	-0.0435µg/L	-0.0006					
SD:	0.0017µg/L	0.0017µg/L	0.00002					
%RSD:	3.85		3.85					

Seq. No.	67	AS Loc:	57	Date:	11/17/05			
Sample ID:	1105003-39							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0299µg/L	-0.0299µg/L	-0.0004	0.0016	62.4561	0.0002	4.1637	19:01:04
	-0.0330µg/L	-0.0330µg/L	-0.0004	0.0010	62.4547	0.0002	4.1636	19:01:34
	-0.0311µg/L	-0.0311µg/L	-0.0004	0.0013	62.4541	0.0002	4.1636	19:02:04
Mean:	-0.0313µg/L	-0.0313µg/L	-0.0004					
SD:	0.0016µg/L	0.0016µg/L	0.00002					
%RSD:	5.06		5.06					

Seq. No.	68	AS Loc:	58	Date:	11/17/05			
Sample ID:	1105003-40							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0434µg/L	-0.0434µg/L	-0.0006	0.0000	62.4553	0.0000	4.1637	19:03:59
	-0.0438µg/L	-0.0438µg/L	-0.0006	-0.0001	62.4552	0.0000	4.1637	19:04:29
	-0.0425µg/L	-0.0425µg/L	-0.0005	0.0005	62.4550	0.0001	4.1637	19:04:59
Mean:	-0.0432µg/L	-0.0432µg/L	-0.0006					
SD:	0.0007µg/L	0.0007µg/L	0.00001					
%RSD:	1.59		1.59					

Seq. No.	69	AS Loc:	106	Date:	11/17/05			
Sample ID:	ICV/CCV							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	9.624µg/L	9.624µg/L	0.1232	0.5824	62.4561	0.1239	4.1637	19:06:54
	9.623µg/L	9.623µg/L	0.1232	0.5816	62.4518	0.1238	4.1635	19:07:24
	9.656µg/L	9.656µg/L	0.1237	0.5818	62.4518	0.1243	4.1635	19:07:54
QC value within specified limits.								
Mean:	9.634µg/L	9.634µg/L	0.1234					
SD:	0.0188µg/L	0.0188µg/L	0.00024					
%RSD:	0.20		0.20					

Seq. No.	70	AS Loc:	8	Date:	11/17/05			
Sample ID:	ICB/CCB							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	0.0058µg/L	0.0058µg/L	0.0001	0.0034	62.4516	0.0007	4.1634	19:09:52
	0.0084µg/L	0.0084µg/L	0.0001	0.0037	62.4516	0.0007	4.1634	19:10:22
	0.0062µg/L	0.0062µg/L	0.0001	0.0036	62.4515	0.0007	4.1634	19:10:52
QC value within specified limits.								
Mean:	0.0068µg/L	0.0068µg/L	0.0001					
SD:	0.0014µg/L	0.0014µg/L	0.00002					
%RSD:	20.80		20.80					

Seq. No.	71	AS Loc:	59	Date:	11/17/05			
Sample ID:	pql check							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	-0.0092µg/L	-0.0092µg/L	-0.0001	0.0030	62.4461	0.0005	4.1631	19:12:50
	-0.0122µg/L	-0.0122µg/L	-0.0002	0.0021	62.4455	0.0004	4.1630	19:13:20
	-0.0094µg/L	-0.0094µg/L	-0.0001	0.0027	62.4456	0.0005	4.1630	19:13:50
Mean:	-0.0103µg/L	-0.0103µg/L	-0.0001					
SD:	0.0017µg/L	0.0017µg/L	0.00002					
%RSD:	16.73		16.73					

Seq. No.	72	AS Loc:	106	Date:	11/17/05			
Sample ID:	ICV/CCV							
Elem	SampleConc	StndConc	Blank Corr Signal	Pk Area	BG Area	Pk Ht	BG Ht	Time
Hg	9.729µg/L	9.729µg/L	0.1246	0.5898	62.4424	0.1252	4.1628	19:15:47
	9.720µg/L	9.720µg/L	0.1245	0.5869	62.4379	0.1251	4.1625	19:16:17
	0.9990µg/L	0.9990µg/L	0.0128	0.0382	62.4369	0.0134	4.1625	19:16:47
QC failed, value less than lower limit for Hg.								
Alarm sounded, system waiting for operator action.								
Mean:	6.816	6.816	0.0873					
SD:	5.038	5.038	0.06452					
%RSD:	73.91		73.91					

DOCUMENTATION

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064

Project Number: 1105003

1 of 3

Date Received:	11/1/2005	**Carrier:**	FedEx
Client Name:	Metco Environmental	**Analysis:**	Mercury (Hg)/Ontario Hy
Tracking number:	602557620651	**Package Temp:**	ambient
Custody Seals ?:	No	**COC:**	☑ check if COC from client

Sample Information

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
Inlet Run 1 Filter Cont. 1	1105003-1	10/25/2005	Air (filter)	glass jar	
Inlet Run 1 F.W. Cont. 2	1105003-2	10/25/2005	HNO3	amber jar	
Inlet Run 1 Imp 1,2,3 Cont. 3	1105003-3a/b	10/25/2005	KCl	amber jar	
Inlet Run 1 Imp 4 Cont. 4	1105003-4	10/25/2005	HNO3/H2O2	amber jar	
Inlet Run 1 Imp 5,6,7 Cont. 5	1105003-5	10/25/2005	KMnO4	amber jar	
Inlet Run 2 Filter Cont. 1	1105003-6	10/26/2005	Air (filter)	glass jar	
Inlet Run 2 F.W. Cont. 2	1105003-7	10/26/2005	HNO3	amber jar	
Inlet Run 2 Imp 1,2,3 Cont. 3	1105003-8a/b	10/26/2005	KCl	amber jar	
Inlet Run 2 Imp 4 Cont. 4	1105003-9	10/26/2005	HNO3/H2O2	amber jar	
Inlet Run 2 Imp 5,6,7 Cont. 5	1105003-10	10/26/2005	KMnO4	amber jar	
Inlet Run 3 Filter Cont. 1	1105003-11	10/26/2005	Air (filter)	glass jar	

KDS

Laboratory Receiving Initials

1105003

11/1/2005 2:09:41 PM

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064

Project Number: 1105003

2 of 3

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
Inlet Run 3 F.W. Cont. 2	1105003-12	10/26/2005	HNO3	amber jar	
Inlet Run 3 Imp 1,2,3 Cont. 3	1105003-13a/b	10/26/2005	KCl	amber jar	
Inlet Run 3 Imp 4 Cont. 4	1105003-14	10/26/2005	HNO3/H2O2	amber jar	
Inlet Run 3 Imp 5,6,7 Cont. 5	1105003-15	10/26/2005	KMnO4	amber jar	
Outlet Run 1 Filter Cont. 1	1105003-16	10/25/2005	Air (filter)	glass jar	
Outlet Run 1 F.W. Cont. 2	1105003-17	10/25/2005	HNO3	amber jar	
Outlet Run 1 Imp 1,2,3 Cont. 3	1105003-18a/b	10/25/2005	KCl	amber jar	
Outlet Run 1 Imp 4 Cont. 4	1105003-19	10/25/2005	HNO3/H2O2	amber jar	
Outlet Run 1 Imp 5,6,7 Cont. 5	1105003-20	10/25/2005	KMnO4	amber jar	
Outlet Run 2 Filter Cont. 1	1105003-21	10/26/2005	Air (filter)	glass jar	
Outlet Run 2 F.W. Cont. 2	1105003-22	10/26/2005	HNO3	amber jar	
Outlet Run 2 Imp 1,2,3 Cont. 3	1105003-23a/b	10/26/2005	KCl	amber jar	
Outlet Run 2 Imp 4 Cont. 4	1105003-24	10/26/2005	HNO3/H2O2	amber jar	
Outlet Run 2 Imp 5,6,7 Cont. 5	1105003-25	10/26/2005	KMnO4	amber jar	
Outlet Run 3 Filter Cont. 1	1105003-26	10/26/2005	Air (filter)	glass jar	
Outlet Run 3 F.W. Cont. 2	1105003-27	10/26/2005	HNO3	amber jar	

KAS

Laboratory Receiving Initials

1105003

11/1/2005 2:09:41 PM

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064

Project Number: 1105003

3 of 3

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
Outlet Run 3 Imp 1,2,3 Cont. 3	1105003-28a/b	10/26/2005	KCl	amber jar	
Outlet Run 3 Imp 4 Cont. 4	1105003-29	10/26/2005	HNO3/H2O2	amber jar	
Outlet Run 3 Imp 5,6,7 Cont. 5	1105003-30	10/26/2005	KMnO4	amber jar	
BT Filter Cont. 1	1105003-31	10/26/2005	Air (filter)	glass jar	
BT F.W. Cont. 2	1105003-32	10/26/2005	HNO3	amber jar	
BT Imp 1,2,3 Cont. 3	1105003-33	10/26/2005	KCl	amber jar	
BT Imp 4 Cont. 4	1105003-34	10/26/2005	HNO3/H2O2	amber jar	
BT Imp 5,6,7 Cont. 5	1105003-35	10/26/2005	KMnO4	amber jar	
RB 0.1N HNO3 Cont. 7	1105003-36	10/26/2005	HNO3	amber jar	
RB 1N KCl Cont. 8	1105003-37	10/26/2005	KCl	amber jar	
RB HNO3/H2O2 Cont. 9	1105003-38	10/26/2005	HNO3/H2O2	amber jar	
RB KMnO4 Cont. 10	1105003-39	10/26/2005	KMnO4	amber jar	
RB Hydroxylamine Cont. 11	1105003-40	10/26/2005	hydrox.amine	amber jar	
RB Filter Cont. 12	1105003-41	10/26/2005	Air (filter)	glass jar	

KES

Laboratory Receiving Initials

1105003

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CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Hot Springs, AR
Unit: Unit #2 ESP Inlet Duct

Project Manager: S. Bonnen
Project Supervisor: S. Bonnen

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter Cont. 1	10-25-05	1610	1								✓		[illegible]	
Run 1 Frontwash Cont. 2		1610	1								✓		[illegible]	
Run 1 Imp. 1,2,3 Cont. 3		1750	2	KCl	300ml						✓		[illegible]	
Run 1 Imp. 4 Cont. 4		1750	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
Run 1 Imp. 5,6,7 Cont. 5		1750	1	$KMnO_4$	300ml						✓		[illegible]	
Run 2 Filter Cont. 1	10/26/05	1020	1								✓		[illegible]	
Run 2 Frontwash Cont. 2		1020	1								✓		[illegible]	

Samples Received for Transport/Shipment by:	R. Malone	Date:	10-26-05	Time: 1630
Samples Received for Transport/Shipment by:		Date:		Time:
Samples Received for Transport/Shipment by:		Date:		Time:
Samples Shipped Via:	Fed Ex [illegible]	Date:	10-28-05	Time: 1000
Samples Received at Laboratory by:	[illegible]	Date:	11-1-05	Time: 1:20
Samples Analyzed by:		Date:		Time:
Samples Analyzed by:		Date:		Time:
Data Checked by:		Date:		Time:

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10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit #2 ESP Inlet Duct

Project Manager: S. Bonner
Project Supervisor: S. Bonner

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	See Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Imp 1,2,3 Cont. 3	10/25/05	2010	2	KCl	300 ml						✓		[illegible]	
Run 2 Imp. 4 Cont. 4		2010	1	HNO_3/H_2O_2	100 ml						✓		[illegible]	
Run 2 Imp 5,6,7 Cont. 5		2010	1	$KMnO_4$	300 ml						✓		[illegible]	
Run 3 Filter Cont. 1	10/26/05	1530	1								✓		[illegible]	
Run 3 Frontnosl Cont. 2		1530	1								✓		[illegible]	
Run 3 Imp 1,2,3 Cont. 3		1610	2	KCl	300 ml						✓		[illegible]	
Run 3 Imp 4 Cont. 4		1610	1	HNO_3/H_2O_2	100 ml						✓		[illegible]	
Run 3 Imp 5,6,7 Cont. 5		1610	1	$KMnO_4$	300 ml						✓		[illegible]	

Samples Received for Transport/Shipment by:	R. Malone	Date: 10-26-05	Time: 1630
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Fed Ex - [illegible]	Date: 10-28-05	Time: 1010
Samples Received at Laboratory by:	[illegible]	Date: 11-1-05	Time: 1:20
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

VERSION 2
10 MARCH 2003

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CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 4 #2 ESP Outlet Duct

Project Manager: S. Bonner
Project Supervisor: S. Bonner

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec. Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter Cont. 1	10.25.05	1620	1								✓		[illegible]	
Run 1 Frontwash Cont. 2		1620	1								✓		[illegible]	
Run 1 Imp 1,2,3 Cont. 3		1725	2	KCl	300ml						✓		[illegible]	
Run 1 Imp. 4 Cont. 4		1725	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
Run 1 Imp. 5,6,7 Cont. 5		1725	1	$KMnO_4$	300ml						✓		[illegible]	
Run 2 Filter Cont. 1	10/26/05	1000	1								✓		[illegible]	
Run 2 Frontwash Cont. 2		1000	1								✓		[illegible]	

Samples Received for Transport/Shipment by:	R. Malone	Date:	10.26-05	Time: 1630
Samples Received for Transport/Shipment by:		Date:		Time:
Samples Received for Transport/Shipment by:		Date:		Time:
Samples Shipped Via:	FedEx [illegible]	Date:	10-28-05	Time: 1800
Samples Received at Laboratory by:	[illegible]	Date:	11-1-05	Time: 1:20
Samples Analyzed by:		Date:		Time:
Samples Analyzed by:		Date:		Time:
Data Checked by:		Date:		Time:

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CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit #2 ESP Outlet Duct

Project Manager: Steve Bonner
Project Supervisor: Steve Bonner

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Imp 1,2,7 Cont. 3	10/25/05	2000	2	KCl	300ml						✓		[illegible]	
Run 2 Imp 4 Cont. 4		2000	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
Run 2 Imp 5,6,7 Cont. 5		2000	1	$KMnO_4$	300ml						✓		[illegible]	
Run 3 Filter Cont. 1	10/26/05	1520	1								✓		[illegible]	
Run 3 Frontwash Cont. 2		1520	1								✓		[illegible]	
Run 3 Imp. 1,2,3 Cont. 3		1550	2	KCl	300ml						✓		[illegible]	
Run 3 Imp 4 Cont. 4		1550	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
Run 3 Imp 5,6,7 Cont. 5		1550	1	$KMnO_4$	300ml						✓		[illegible]	

Samples Received for Transport/Shipment by:	R. Malone	Date: 10-26-05	Time: 1630
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Fed Ex [illegible]	Date: 10-28-05	Time: 1000
Samples Received at Laboratory by:	[illegible]	Date: 11-1-05	Time: 1120
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

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10 MARCH 2003

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CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit #2 ESP Inlet/Outlet Duct

Project Manager: Steve Bonner
Project Supervisor: Steve Bonner

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	See Key		Recovered by	REMARKS (Specific Compounds/Methods)
Blank Train														
BT Filter Cont. 1	10-26-05	1300	1								✓		[illegible]	
BT Frontwash Cont. 2		1300	1								✓		[illegible]	
BT Imp 1,2,3 Cont. 3		1320	1	KCl	300ml						✓		[illegible]	
BT Imp. 4 Cont. 4		1320	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
BT Imp 5,6,7 Cont. 5		1320	1	KMnO4	300ml						✓		[illegible]	

Samples Received for Transport/Shipment by:	R. Malone	Date: 10-26-05	Time: 1630
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Fed Ex [illegible]	Date: 10-28-05	Time: 1000
Samples Received at Laboratory by:	[illegible]	Date: 11-1-05	Time: 1120
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

VERSION 2
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CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Norwood, MA
Unit: Unit #2 ESP Inlet/Outlet Duct

Project Manager: S. Bonner
Project Supervisor: S. Bonner
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	SRBC Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Reagent Blanks														
RB 0.1N HNO_3 Cont. 7	10-26-05	1030	1								✓		[illegible]	
RB 1N KCl Cont 8		1030	1								✓		[illegible]	
RB HNO_3/H_2O_2 Cont 9		1030	1								✓		[illegible]	
RB $KMnO_4$ Cont 10		1030	1								✓		[illegible]	
RB Hydroxalmine Cont 11		1030	1								✓		[illegible]	
RB Filter Cont 12		1030	1								✓		[illegible]	

Samples Received for Transport/Shipment by:	R. Malone	Date: 10-26-05	Time: 1630
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Fed Ex [illegible]	Date: 10-28-05	Time: 1000
Samples Received at Laboratory by:	[illegible]	Date: 11-1-05	Time: 1:20
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

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10 MARCH 2003

APPENDIX F

Chain of Custody

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CHAIN OF CUSTODY RECORD

Job No.: 05-235 task 3
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 Esp Inlet Duct

Project Manager: M. Hutcherson
Project Supervisor: S. Bornsen

Method: 17 ~~5~~/26 A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 cont. 1 Filter	10-25-05	1705	1			✓							R. Malone	HCl, HBr, HCl, HF, Br⁻, Cl⁻
Run 1 cont. 2 Acetone FW		1715	1			✓							R. Malone	
Run 1 cont. 3 Imp. 1, 2, 3		1737	1	0.1N H2SO4	200 mL		✓						R. Malone	
Run 1 cont. 4 Imp. 4, 5		1737	1	0.1N NaOH	200mL			✓					R. Malone	

Samples Received for Transport/Shipment by:	R. Malone	Date:	10-26-05	Time:	1630
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Shipped Via:	Metro – [illegible]	Date:	10-28-05	Time:	1000
Samples Received at Laboratory by:		Date:		Time:	
Samples Analyzed by:	M. Banter	Date:	11/7/05	Time:	1630
Samples Analyzed by:		Date:		Time:	
Data Checked by:	[illegible]	Date:	11/08/05	Time:	1030

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CHAIN OF CUSTODY RECORD

Job No.: 05-235 task 3
Job Name: ADA-ES
Location: Newark, AR
Unit: unit 2 Esp Inlet Duct

Project Manager: M. Hutcheson
Project Supervisor: S. Bornsen

Method: 17 ~~B~~/26 A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 cont. 1 Filter	10-25-05	1949	1			✓							R. Malone	HCl, HBr, HF, Cl⁻, Br⁻
Run 2 cont. 2 Acetone FW		1951	1			✓							R. Malone	
Run 2 cont. 3 Imp. 1, 2, 3		1959	1	0.1 N H_2SO_4	200 mL		✓						R. Malone	
Run 2 cont. 4 Imp. 4, 5		2003	1	0.1N NaOH	200 mL			✓					R. Malone	

Samples Received for Transport/Shipment by:	R. Malone	Date:	10-26-05	Time:	1630
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Shipped Via:	Metco	Date:	10-28-05	Time:	1000
Samples Received at Laboratory by:		Date:		Time:	
Samples Analyzed by:	M. Banter	Date:	11/7/05	Time:	1030
Samples Analyzed by:		Date:		Time:	
Data Checked by:	JRM	Date:	11/08/05	Time:	1030

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CHAIN OF CUSTODY RECORD

Job No.: 05-235 task 3
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 Esp Inlet Duct

Project Manager: M. Hutcherson
Project Supervisor: S. Bornsen

Method: 17/26A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 cont. 1 Filter	10-26-05	1510	1			✓							R. Malone	HCl, HBr, HF, Cl⁻, Br⁻
Run 3 cont. 2 Acetone FW		1515	1			✓							R. Malone	
Run 3 cont. 3 Imp. 1, 2, 3		1520	1	0.1N H_2SO_4	200 mL		✓						R. Malone	
Run 3 cont. 4 Imp. 4, 5		1525	1	0.1N NaOH	200 mL			✓					R. Malone	

Samples Received for Transport/Shipment by:	R. Malone	Date:	10-26-05	Time:	1630
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Shipped Via:	Metco	Date:	10-28-05	Time:	1400
Samples Received at Laboratory by:		Date:		Time:	
Samples Analyzed by:	M. Genter	Date:	11/7/05	Time:	1030
Samples Analyzed by:		Date:		Time:	
Data Checked by:		Date:	11/08/05	Time:	1030

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Utility Newark, AR
Unit: Unit #2 ESP Inlet Duct

Project Manager: S. Bornsen
Project Supervisor: S. Bornsen
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	SPEC Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter Cont. 1	10.25.05	1610	1								✓		[illegible]	
Run 1 Frontwash Cont. 2		1610	1								✓		[illegible]	
Run 1 Imp. 1,2,3 Cont. 3		1750	2	KCl	300ml						✓		[illegible]	
Run 1 Imp. 4 Cont. 4		1750	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
Run 1 Imp. 5,6,7 Cont. 5		1750	1	$KMnO_4$	300ml						✓		[illegible]	
Run 2 Filter Cont. 1	10/26/05	1020	1								✓		[illegible]	
Run 2 Frontwash Cont. 2		1020	1								✓		[illegible]	

Samples Received for Transport/Shipment by:	R. Malone	Date:	10-26-05	Time:	1630
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Shipped Via:	Fed Ex [illegible]	Date:	10-28-05	Time:	1000
Samples Received at Laboratory by:	[illegible]	Date:	11-1-05	Time:	1:20
Samples Analyzed by:		Date:		Time:	
Samples Analyzed by:		Date:		Time:	
Data Checked by:	[illegible]	Date:	11/30/05	Time:	1045

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: APA-ES
Location: Newark, AR
Unit: Unit #2 ESP Inlet Duct

Project Manager: S. Bonner
Project Supervisor: S. Bonner

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	See Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Imp 1,2,3 Cont. 3	12/25/05	2010	2	KCl	300ml						✓		[illegible]	
Run 2 Imp. 4 Cont. 4		2010	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
Run 2 Imp 5,6,7 Cont. 5		2010	1	$KMnO_4$	300ml						✓		[illegible]	
Run 3 Filter Cont. 1	12/26/05	1530	1								✓		[illegible]	
Run 3 Frontwash Cont. 2		1530	1								✓		[illegible]	
Run 3 Imp 1,2,3 Cont. 3		1610	2	KCl	300ml						✓		[illegible]	
Run 3 Imp 4 Cont. 4		1610	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
Run 3 Imp 5,6,7 Cont. 5		1610	1	$KMnO_4$	300ml						✓		[illegible]	

Samples Received for Transport/Shipment by:	R. Malone	Date: 12-26-05	Time: 1630
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Fed Ex - [illegible]	Date: 10-28-05	Time: 1010
Samples Received at Laboratory by:	[illegible]	Date: 11-1-05	Time: 1:20
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:	[illegible]	Date: 11/30/05	Time: 1045

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: DS-235 task 3
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Outlet Duct

Project Manager: M. Hutcherson
Project Supervisor: S. Bornsen

Method: 17 & 26A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 cont. 1 Filter	10-25-05	1700	1			✓							R. Malone	HCl, HBr, HF, Cl⁻, Br⁻
Run 1 cont. 2 Acetone FW		1715	1			✓							R. Malone	
Run 1 cont. 3 Imp. 1,2,3		1720	1	0.1N H_2SO_4	200ml		✓	✗					R. Malone	
Run 1 cont. 4 Imp. 4,5		1727	1	0.1N NaOH	200ml		✗	✓					R. Malone	

Samples Received for Transport/Shipment by:	R. Malone	Date: 10-26-05	Time: 1630
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Nitco	Date: 10-28-05	Time: 1000
Samples Received at Laboratory by:		Date:	Time:
Samples Analyzed by:	M. Baxter	Date: 11-7-05	Time: 0900
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date: 11/08/05	Time: 1045

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-235 task 3
Job Name: ADA-ES
Location: Newark, AR
Unit: unit 2 ESP outlet Duct

Project Manager: M. Hutchersen
Project Supervisor: S. Bornsen

Method: 17/26A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 cont. 1 Filter	10-25-05	1950	1			✓							R. Malone	HCl, HBr, HF, Cl⁻, Br⁻
Run 2 cont. 1 Acetone Fw		1955	1			✓							R. Malone	
Run 2 cont. 3 Imp. 1, 2, 3		2000	1	0.1N H_2SO_4	200mL		✓						R. Malone	
Run 2 cont. 4 Imp. 4, 5		2002	1	0.1N NaOH	200mL			✓					R. Malone	

Samples Received for Transport/Shipment by:	R. Malone	Date:	10-26-05	Time:	1630
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Shipped Via:	Metco — ST B.	Date:	10-28-05	Time:	1000
Samples Received at Laboratory by:		Date:		Time:	
Samples Analyzed by:	M. Santee	Date:	11/7/05	Time:	0900
Samples Analyzed by:		Date:		Time:	
Data Checked by:		Date:	11/08/05	Time:	1045

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-235 task 3
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP outlet Duct

Project Manager: M. Hutcherson
Project Supervisor: S. Bornsen

Method: 17 & 26A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 cont. 1 Filter	10-26-05	1520	1			✓							R. Melone	HCl, HBr, HF, Cl⁻, Br⁻
Run 3 cont. 2 Acetone FW		1525	1			✓							R. Melone	
Run 3 cont. 3 Imp. 1, 2, 3		1530	1	0.1 N H_2SO_4	200ml		✓						R. Melone	
Run 3 cont. 4 Imp. 4, 5		1535	1	0.1 N NaOH	200ml			✓					R. Melone	

Samples Received for Transport/Shipment by:	R. Melone	Date: 10-26-05	Time: 1630
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Metco – [illegible]	Date: 10-28-05	Time: 1000
Samples Received at Laboratory by:		Date:	Time:
Samples Analyzed by:	M. Gantz	Date: 11/7/05	Time: 0900
Samples Analyzed by:		Date:	Time:
Data Checked by:	[illegible]	Date: 11/08/05	Time: 1145

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 Esp Inlet/Outlet Duct

Project Manager: M. Hutcherson
Project Supervisor: S. Bornsen

Method: 17/26A

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3			Recovered by	REMARKS (Specific Compounds/Methods)
Cont. 5 Reagent Blank Acetone	10-26-05	1305	1			✓							R. Malone	
Cont. 6 R.B. Filter		1309	1			✓							R. Malone	
Cont 7 R.B. DI H_2O		1311	1			✓	✓	✓					R. Malone	
Cont 8 R.B. 0.1N H_2SO_4		1315	1	0.1N H_2SO_4	100ml		✓						R. Malone	
Cont. 9 R.B. 0.1N NaOH		1320	1	0.1N NaOH	100ml			✓					R. Malone	

Samples Received for Transport/Shipment by:	R. Malone	Date:	10-26-05	Time:	1630
Samples Received for Transport/Shipment by:	[signature]	Date:	~~10.26.05~~	Time:	—
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Shipped Via:	Metco — [signature]	Date:	10-28-05	Time:	1000
Samples Received at Laboratory by:		Date:		Time:	
Samples Analyzed by:	M. Gunter	Date:	11/7/05	Time:	1030
Samples Analyzed by:		Date:		Time:	
Data Checked by:	JM	Date:	11/08/05	Time:	1035

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit #2 ESP Outlet Duct

Project Manager: S. Bonner
Project Supervisor: S. Bonner

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec. Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter Cont. 1	10.25.05	1620	1								✓		[illegible]	
Run 1 Frontwash Cont. 2		1620	1								✓		[illegible]	
Run 1 Imp 1,2,3 Cont. 3		1725	2	KCl	300ml						✓		[illegible]	
Run 1 Imp. 4 Cont. 4		1725	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
Run 1 Imp. 5,6,7 Cont. 5		1725	1	$KMnO_4$	300ml						✓		[illegible]	
Run 2 Filter Cont. 1	10/26/05	1000	1								✓		[illegible]	
Run 2 Frontwash Cont. 2		1000	1								✓		[illegible]	

Samples Received for Transport/Shipment by:	R. Malone	Date:	10.26-05	Time:	1630
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Shipped Via:	FedEx [illegible]	Date:	10-28-05	Time:	1800
Samples Received at Laboratory by:	[illegible]	Date:	11-1-05	Time:	1:20
Samples Analyzed by:		Date:		Time:	
Samples Analyzed by:		Date:		Time:	
Data Checked by:	[illegible]	Date:	11/30/05	Time:	1045

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit #2 ESP Outlet Duct

Project Manager: Steve Bonner
Project Supervisor: Steve Bonner

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	See Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 2 Imp 1,2,7 Cont. 3	10/25/05	2000	2	KCl	300ml						✓		[illegible]	
Run 2 Imp 4 Cont. 4		2000	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
Run 2 Imp 5,6,7 Cont. 5		2000	1	$KMnO_4$	200ml						✓		[illegible]	
Run 3 Filter Cont. 1	10/26/05	1520	1								✓		[illegible]	
Run 3 Frontwash Cont. 2		1520	1								✓		[illegible]	
Run 3 Imp. 1,2,3 Cont. 3		1550	2	KCl	300ml						✓		[illegible]	
Run 3 Imp 4 Cont. 4		1550	1	HNO_3/H_2O_2	100ml						✓		[illegible]	
Run 3 Imp 5,6,7 Cont. 5		1550	1	$KMnO_4$	300ml						✓		[illegible]	

Samples Received for Transport/Shipment by: R. Melone	Date: 10-26-05	Time: 1630	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via: Fed Ex [illegible]	Date: 10-28-05	Time: 1000	
Samples Received at Laboratory by: [illegible]	Date: 11-1-05	Time: 1120	
Samples Analyzed by:	Date:	Time:	
Samples Analyzed by:	Date:	Time:	
Data Checked by: [illegible]	Date: 11/30/05	Time: 1045	

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit #2 ESP Inlet/Outlet Duct

Project Manager: Steve Benson
Project Supervisor: Steve Benson

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Blank Train														
BT Filter Cont. 1	10-26-05	1300	1								✓		Steve Benson	
BT Frontwash Cont. 2		1300	1								✓		Steve Benson	
BT Imp 1,2,3 Cont. 3		1320	1	KCl	300ml						✓		Steve Benson	
BT Imp. 4 Cont. 4		1320	1	HNO_3/H_2O_2	100ml						✓		Steve Benson	
BT Imp 5,6,7 Cont. 5		1320	1	$KMnO_4$	300ml						✓		Steve Benson	

Samples Received for Transport/Shipment by:	R. Malone	Date:	10-26-05	Time:	1630
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Shipped Via:	Fed Ex Steve Benson	Date:	10-28-05	Time:	1000
Samples Received at Laboratory by:	[illegible]	Date:	11-1-05	Time:	1120
Samples Analyzed by:		Date:		Time:	
Samples Analyzed by:		Date:		Time:	
Data Checked by:	[illegible]	Date:	11/30/05	Time:	1045

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-235
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit #2 ESP Inlet/Outlet Duct

Project Manager: S. Bonner
Project Supervisor: S. Bonner

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Reagent Blanks														
RB 0.1N HNO_3 Cont. 7	10-26-05	1030	1								✓		[illegible]	
RB 1N KCl Cont 8		1030	1								✓		[illegible]	
RB HNO_3/H_2O_2 Cont 9		1030	1								✓		[illegible]	
RB $KMnO_4$ Cont 10		1030	1								✓		[illegible]	
RB Hydroxalmine Cont 11		1030	1								✓		[illegible]	
RB Filter Cont 12		1030	1								✓		[illegible]	

Samples Received for Transport/Shipment by:	R. Malone	Date: 10-26-05	Time: 1630
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	Fed Ex [illegible]	Date: 10-28-05	Time: 1000
Samples Received at Laboratory by:	[illegible]	Date: 11-1-05	Time: 1120
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:	[illegible]	Date: 11/30/05	Time: 1045

VERSION 2
10 MARCH 2003

APPENDIX G

Resumes of Test Personnel

ROBERT M. PATTERSON; President

Education	B. S. 1983, Central Michigan University; Mt. Pleasant, Michigan, in Geology and Earth Science-Meteorology.
Professional Training Courses	Attended a two-day short course, "Performing and Observing Source Sampling" in Dallas, Texas. Attended a one-day short course on basic supervision. Attended a four-week management course presented by the American Management Association, 1991-1992.
Certification	Certified Visible Emissions Evaluator Certified Cabot Full-Face Respirator Fit Tester
Professional Memberships	Source Evaluation Society American Management Association
Technical Experience	Participated in the sampling of over 1,000 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 1986-present. Over nineteen years experience with EPA and Texas Air Control Board methods of sampling - both stationary sources and ambient air. CFR, Title 40, Chapter I, Part 60, EPA Methods 1 through 25, and 101 through 110. Performance Specifications 1 through 5. CFR, Title 40, Chapter I, Part 50, Appendix A through F. "Sampling Procedures Manual, Texas Air Control Board, January 1983." Parts 1-1 through 14-6, Appendix B through Appendix M. Experienced with sampling Method 0010, Modified Method 5 Sampling Train; Method 0030, Volatile Organic Sampling Train; and various EPA and "Site Specific" multiple metal and acid gas sampling trains.

(continued)

PATTERSON, Rob (cont'd)

Technical Experience (cont'd)

Over twenty one years experience with EPA and Texas Air Control Board methods of analysis of both stationary and ambient air samples. Particulate matter, SO_3, SO_2, H_2SO_4, NO_x, CO, CO_2, O_2, H_2S, F, TRS, HCl, Cl_2, NH_3, VOC, C_1-C_7, and other organics. Both laboratory and on-site analyses were performed.

Experienced in the sampling and analysis of commercial calibration gas cylinders for sulfur dioxide, oxides of nitrogen, carbon dioxide, oxygen, carbon monoxide, and C_1-C_7 hydrocarbons.

Thoroughly trained in the operation and routine maintenance of the following:

- MSA LIRA Model 202S Infrared Analyzer
- Analytical Instrument Development, Inc. Model 340A Calibration System
- Shimadzu GC-Mini 2 Gas Chromatograph
- Thermo Environmental Model 10AR Oxides of Nitrogen Analyzer
- Thermo Oxygen Analyzer
- Teledyne Model 326 Oxygen Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer
- Thermo Environmental Model 40 Sulfur Dioxide Analyzer
- Ratfisch Model RS 100 Total Hydrocarbon Analyzer
- Western Research Model 721AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- Ratfisch Model RS 55 Total Hydrocarbon Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer

JAMES R. MONFRIES; Senior Quality Assurance Manager

Education	B. S. 1975, University of Texas at Arlington; Arlington, Texas, in Biology with a minor in Chemistry. Graduate work at the University of Texas at Dallas in the Environmental Science Department.
Professional Training Courses	Attended a two-day short course, "Performing and Observing Source Sampling" in Dallas, Texas, July 1976.
Certification	Certified Visible Emissions Evaluator
Professional Memberships	Air and Waste Management Association Source Evaluation Society - Past President
Technical Experience	Participated in the sampling of over 700 sources, serving in the supervisory capacity on over 500 sources. Many of the sources were sampled simultaneously using more than one sampling train at several points in the flue gas stream, 1976-present. Has also supervised several ambient air monitoring studies, including a permanent five-station high volume air sampling network in South Texas, a permanent four-station high volume air sampling network in Pennsylvania, and a permanent seven-station sulfur dioxide sampling network in East Texas. Was Quality Assurance Manager for several ambient air monitoring studies; including a four-station high volume air sampling network for TSP and PM10 in Midlothian, Texas; a single-station high volume air sampling network for PM10 in South Texas; a two-station high volume air sampling network for TSP in Wichita Falls, Texas; and a four-station continuous air sampling network for TSP and PM10 in Jewett, Texas using Thermo Andersen FH 62 C14 Beta Gauge Dust Monitors.

(continued)

MONFRIES, James (cont'd)

Twenty years experience with EPA and Texas Commission on Environmental Quality methods of analysis of both source and ambient air samples for particulates, SO_2, SO_3,, H_2SO_4, H_2S, HCl, Cl_2, NO_x, Hydrocarbons, and TRS.

Experienced in the analysis of commercial calibration gas cylinders for sulfur dioxide and oxides of nitrogen.

Experienced with VOST and Modified Method 5 Sampling Procedures.

Thoroughly trained in the operation and routine maintenance of the following:

- Lear Siegler, Inc. SM800 Stack Gas Monitor
- Du Pont Model 460/1 Photometric Analyzer System
- Lear Siegler, Inc. SM1000 Ambient SO_2 Monitor
- Calibrated Instruments Ultragas SO_2 Monitor
- Meloy 285E SO_2 Analyzer
- Meloy SA-700 Fluorescent SO_2 Analyzer
- MSA LIRA Model 202S Infrared Analyzer
- Analytical Instrument Development, Inc. Model 340A Calibration System
- Shimadzu GC-Mini 2 Gas Chromatograph
- Thermo Environmental Model 10S NO_x Analyzer
- Thermo Oxygen Analyzer
- Teledyne Model 326 Oxygen Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer
- Thermo Environmental Model 40 Sulfur Dioxide Analyzer
- Ratfisch Model RS 103 Total Hydrocarbon Analyzer
- Western Research Model 721AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- Ratfisch Model RS 55 Total Hydrocarbon Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer
- Thermo Andersen Model FH 62 C14 Dust Monitor

STEVEN J. BORNSEN; Utilities Associate

Education	B. S. in Geology, 1995; University of Texas at Arlington; Arlington, Texas.
Professional Training Courses	Attended 40-hour Occupational & Environmental Training Program on Hazardous Materials (CFR 1910.120); Dallas, Texas, January 1996. Attended a two-day short course, "Performing and Observing Source Sampling," Dallas, Texas; September 1996.
Certifications	Certified Visible Emissions Evaluator HAZMAT certified Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 400 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 1995-present. Experienced with Modified Method 5 Sampling Train (Method 0010). Experienced with VOST sampling procedure (Method 0030). Experienced with calibration techniques for all field testing equipment. Experienced with various multiple metal and acid gas sampling trains. Experienced with particle size and PM_{10} sampling procedures.

(continued)

BORNSEN, Steve (cont'd)

Technical Experience (cont'd)

Experienced with on-site gravimetric particulate matter analysis.

Has performed on-site SO_2 analysis and H_2S fuel gas analysis.

Thoroughly trained in the operation and routine maintenance of the following:

- Thermo Environmental Model 10S and 42C Oxides of Nitrogen Analyzers
- Teledyne Model 326 Oxygen Analyzer
- Western Research Model 721 AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer

RODNEY MALONE; Project Supervisor II

Education	B. S. Forestry, December 2000; Stephen F. Austin State University; Nacogdoches, Texas.
Certifications	HAZMAT certified Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 200 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2001-present. Experienced with Modified Method 5 Sampling Train (Method 0010). Experienced with VOST Sampling Procedures (Method 0030). Experienced with calibration techniques for all field testing equipment. Experienced with various multiple metal and acid gas sampling trains. Has performed on-site SO_2 analysis and H_2S fuel gas analysis. Thoroughly trained in the operation and routine maintenance of the following: • Thermo Environmental Model 10S, 42C, and 42CHL Oxides of Nitrogen Analyzers • Teledyne Model 326 Oxygen Analyzer • Horiba Model PIR 2000 Carbon Dioxide Analyzer

(continued)

MALONE, Rodney (cont'd)

Technical Experience (cont'd)

Operation and routine maintenance (cont'd)

- Thermo Environmental Model 48 Carbon Monoxide Analyzer.
- Western Research Model 721M Sulfur Dioxide Analyzer
- J.U.M. VE-7 Hydrocarbon Analyzer
- Shimadzu Gas Chromatograph 14 and 17a

ERIC STONE; Environmental Scientist II

Education	B. S. Environmental Science, December 2004; Stephen F. Austin State University, Nacogdoches, Texas.
Technical Experience	Participated in the sampling of over 50 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

JOHN CUTAIA; Environnmental Scientist I

Education	Over ten (10) years of experience using Methods 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 24, 29, 201A. Analyzers used: Thermo 43A, 51, 48C, 42C, Servomex 1400, 1400C; Fuj. 3300, Horiba VIA-510, Western 721, Rosemont 951A
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

JOSHUA ORR; Environmental Scientist I

Education	B. S. Environmental Studies, Summer 2002; Southwest Texas State University; San Marcos, Texas.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

DUSTIN DODSON; Environmental Scientist I

Education	B. S. Industrial Engineering, May 2005; Northwestern State University; Natchitoches, Louisiana.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

JASON SELLERS; Environmental Scientist I

Education	B. S. Wildlife and Fisheries Sciences, May 2004; Texas A&M University, College Station, Texas.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

CHRISTOPHER POSHEK; Environmental Scientist I

Education	B. A. in Geography, May 2001 and B. A. in Economics, August 2003; Southern Illinois University, Carbondale, Illinois.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

DOUGLAS WARE; Environmental Scientist I

Education	B. S. Criminal Justice, December 10, 2004; Sam Houston State University, Huntsville, Texas.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

APPENDIX D4: Source Testing—November 1–2, 2005

METCO ENVIRONMENTAL
P.O. Box 598
Addison, TX 75001
(972) 931-7127

SOURCE EMISSIONS SURVEY
OF
ARKANSAS POWER & LIGHT COMPANY
INDEPENDENCE STEAM
ELECTRIC STATION
UNIT NUMBER 2 ESP INLET
AND OUTLET DUCTS
NEWARK, ARKANSAS
FOR
ADA-ES

NOVEMBER 2005

FILE NUMBER 05-236

" I certify that I have personally checked and am familiar with the information submitted herein, and based on my inquiries of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate, and complete. "

_____

James R. Monfries
Senior Quality Assurance Manager

METCO ENVIRONMENTAL

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SUMMARY OF RESULTS	2
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DESCRIPTION OF SAMPLING LOCATIONS	9
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A. Location of Sampling Points
B. Source Emissions Calculations
C. Calibration Data
D. Field Testing Data
E. Analytical Data
F. Chain of Custody
G. Resumes of Test Personnel

SOURCE EMISSIONS SURVEY
ARKANSAS POWER & LIGHT COMPANY
INDEPENDENCE STEAM ELECTRIC STATION
UNIT NUMBER 2 ESP INLET AND OUTLET DUCTS
NEWARK, ARKANSAS
FOR
ADA-ES
FILE NUMBER 05-236

INTRODUCTION

METCO Environmental, P.O. Box 598, Addison, Texas, conducted a source emissions survey of Arkansas Power & Light Company, Independence Steam Electric Station, located in Newark, Arkansas, for ADA-ES, on November 1 and 2, 2005. The purpose of these tests was to determine the concentrations of speciated mercury at the Unit Number 2 ESP Inlet and Outlet Ducts.

The sampling was performed by the following METCO personnel: Steve Bornsen - Project Supervisor, Dustin Simpson, Steve Trammell, Joshua Orr, and Dustin Dodson.

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 5, and 17; and the Ontario Hydro Method, Revised July 7, 1999 (ASTM D-6784-02).

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Run Number	Particle Bound Mercury Emissions (µg/m^3)	Particle Bound Mercury Emissions (lbs/trillion Btu)	Oxidized Mercury Emissions (µg/m^3)	Oxidized Mercury Emissions (lbs/trillion Btu)	Elemental Mercury Emissions (µg/m^3)	Elemental Mercury Emissions (lbs/trillion Btu)	Total Mercury Mercury Emissions (µg/m^3)	Total Mercury Mercury Emissions (lbs/trillion Btu)
1	< 0.013	< 0.010	0.152	0.122	0.989	0.794	< 1.154	< 0.926
3	0.015	0.014	0.398	0.371	1.186	1.105	1.599	1.490
Average	< 0.014	< 0.012	0.275	0.247	1.088	0.950	< 1.377	< 1.208

Unit Number 2 ESP Outlet Duct

Run Number	Particle Bound Mercury Emissions (µg/m^3)	Particle Bound Mercury Emissions (lbs/trillion Btu)	Oxidized Mercury Emissions (µg/m^3)	Oxidized Mercury Emissions (lbs/trillion Btu)	Elemental Mercury Emissions (µg/m^3)	Elemental Mercury Emissions (lbs/trillion Btu)	Total Mercury Mercury Emissions (µg/m^3)	Total Mercury Mercury Emissions (lbs/trillion Btu)
1	0.142	0.116	0.530	0.431	0.236	0.192	0.908	0.739
3	0.116	0.110	0.215	0.203	0.064	0.060	0.395	0.373
Average	0.129	0.113	0.373	0.317	0.150	0.126	0.652	0.556

Note: Run Number 2 was aborted due to unit operational problems.

METCO ENVIRONMENTAL

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Ontario Hydro Mercury

Run Number	1	3
Date	11/01/05	11/02/05
Time	1340-1603	1415-1636
Duct Flow Rate - ACFM	414,707	344,005
Duct Flow Rate - DSCFM*	247,619	213,006
% Water Vapor - % Vol.	8.55	6.93
% CO_2 - % Vol.	13.8	11.6
% O_2 - % Vol.	5.0	7.2
% Excess Air @ Sampling Point	30.3	50.3
Stack Temperature - °F	322	307
Stack Pressure - "Hg	28.83	28.81
Percent Isokinetic	101.3	99.4
Volume Dry Gas Sampled - DSCF*	55.706	47.042

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)
Note: Run Number 2 was aborted due to unit operational problems.

SUMMARY OF RESULTS

Unit Number 2 ESP Inlet Duct

Ontario Hydro Mercury

Run Number	1	3
Particle Bound Mercury - µg	< 0.02	0.02
Particle Bound Mercury Emissions - µg/m^{3*}	< 0.013	0.015
Particle Bound Mercury Emissions - lbs/trillion Btu	< 0.010	0.014
Oxidized Mercury - µg	0.24	0.53
Oxidized Mercury Emissions - µg/m^{3*}	0.152	0.398
Oxidized Mercury Emissions - lbs/trillion Btu	0.122	0.371
Elemental Mercury - µg	1.56	1.58
Elemental Mercury Emissions - µg/m^{3*}	0.989	1.186
Elemental Mercury Emissions - lbs/trillion Btu	0.794	1.105
Total Mercury Emissions - µg/m^{3*}	< 1.154	1.599
Total Mercury Emissions - lbs/trillion Btu	< 0.926	1.490

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)
Note: Run Number 2 was aborted due to unit operational problems.

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

Ontario Hydro Mercury

Run Number	1	3
Date	11/01/05	11/02/05
Time	1344-1610	1418-1640
Duct Flow Rate - ACFM	437,518	372,619
Duct Flow Rate - DSCFM*	258,122	230,337
% Water Vapor - % Vol.	8.85	7.20
% CO_2 - % Vol.	13.8	11.4
% O_2 - % Vol.	5.2	7.4
% Excess Air @ Sampling Point	32.0	52.4
Stack Temperature - °F	326	306
Stack Pressure - "Hg	28.72	28.81
Percent Isokinetic	96.7	91.5
Volume Dry Gas Sampled - DSCF*	71.932	60.733

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)
Note: Run Number 2 was aborted due to unit operational problems.

SUMMARY OF RESULTS

Unit Number 2 ESP Outlet Duct

Ontario Hydro Mercury

Run Number	1	3
Particle Bound Mercury - µg	0.29	0.20
Particle Bound Mercury Emissions - µg/m^{3*}	0.142	0.116
Particle Bound Mercury Emissions - lbs/trillion Btu	0.116	0.110
Oxidized Mercury - µg	1.08	0.37
Oxidized Mercury Emissions - µg/m^{3*}	0.530	0.215
Oxidized Mercury Emissions - lbs/trillion Btu	0.431	0.203
Elemental Mercury - µg	0.48	0.11
Elemental Mercury Emissions - µg/m^{3*}	0.236	0.064
Elemental Mercury Emissions - lbs/trillion Btu	0.192	0.060
Total Mercury Emissions - µg/m^{3*}	0.908	0.395
Total Mercury Emissions - lbs/trillion Btu	0.739	0.373

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)
Note: Run Number 2 was invalid due to unit operational problems.

DISCUSSION OF RESULTS

Run Number 2 was aborted due to unit operational problems.

Unit Number 2 ESP Inlet Duct

The two completed tests for speciated mercury appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the two completed tests were within 10.5 percent of the mean value. The measured flow rates (Q_s) for the tests were within 7.5 percent of the mean value. The rates of sampling for the two completed tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 1.3 percent.

The calculated emissions (pounds per trillion Btu) of total mercury for the two completed tests showed a range of -23.3 percent to +23.3 percent variation from the mean value.

Unit Number 2 ESP Outlet Duct

The two completed tests for speciated mercury appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the two completed tests were within 10.3 percent of the mean value. The measured flow rates (Q_s) for the tests were within 5.7 percent of the mean value. The rates of sampling for the two completed tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 8.5 percent.

The calculated emissions (pounds per trillion Btu) of total mercury for the two completed tests showed a range of -32.9 percent to +32.9 percent variation from the mean value.

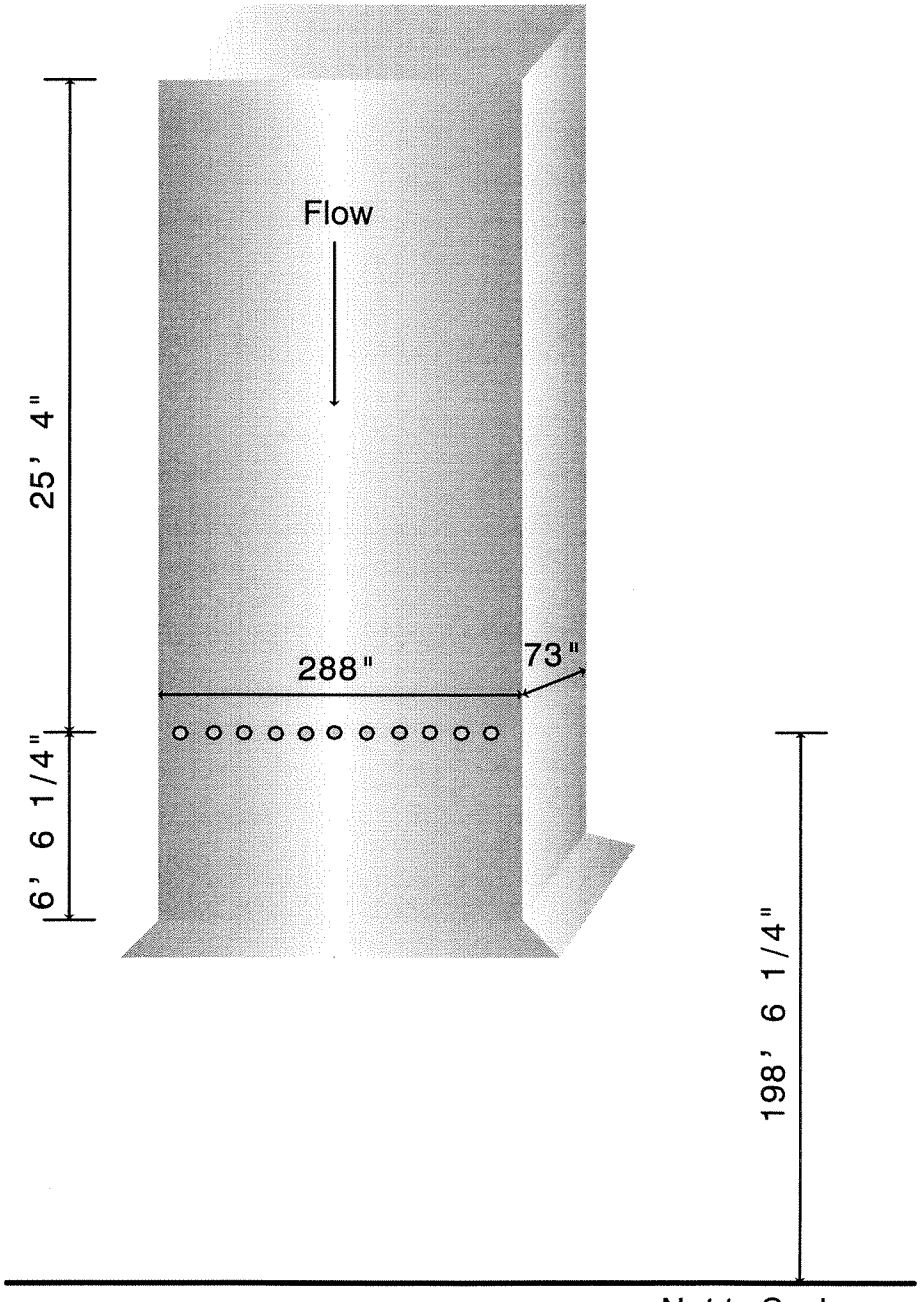
DESCRIPTION OF SAMPLING LOCATIONS

The sampling location on the Unit Number 2 ESP Inlet Duct is 198 feet 6 1/4 inches above the ground. The sampling ports are located 25 feet 4 inches (2.61 equivalent duct diameters) downstream from a bend in the duct and 6 feet 6 1/4 inches (0.67 equivalent duct diameters) upstream from an expansion in the duct.

The sampling location on the Unit Number 2 ESP Outlet Duct is approximately 200 feet above the ground. The sampling ports are located 6 feet 11 inches (0.71 equivalent duct diameters) downstream from a constriction in the duct and 3 feet 2 inches (0.33 equivalent duct diameters) upstream from a bend in the duct.

SAMPLING LOCATION

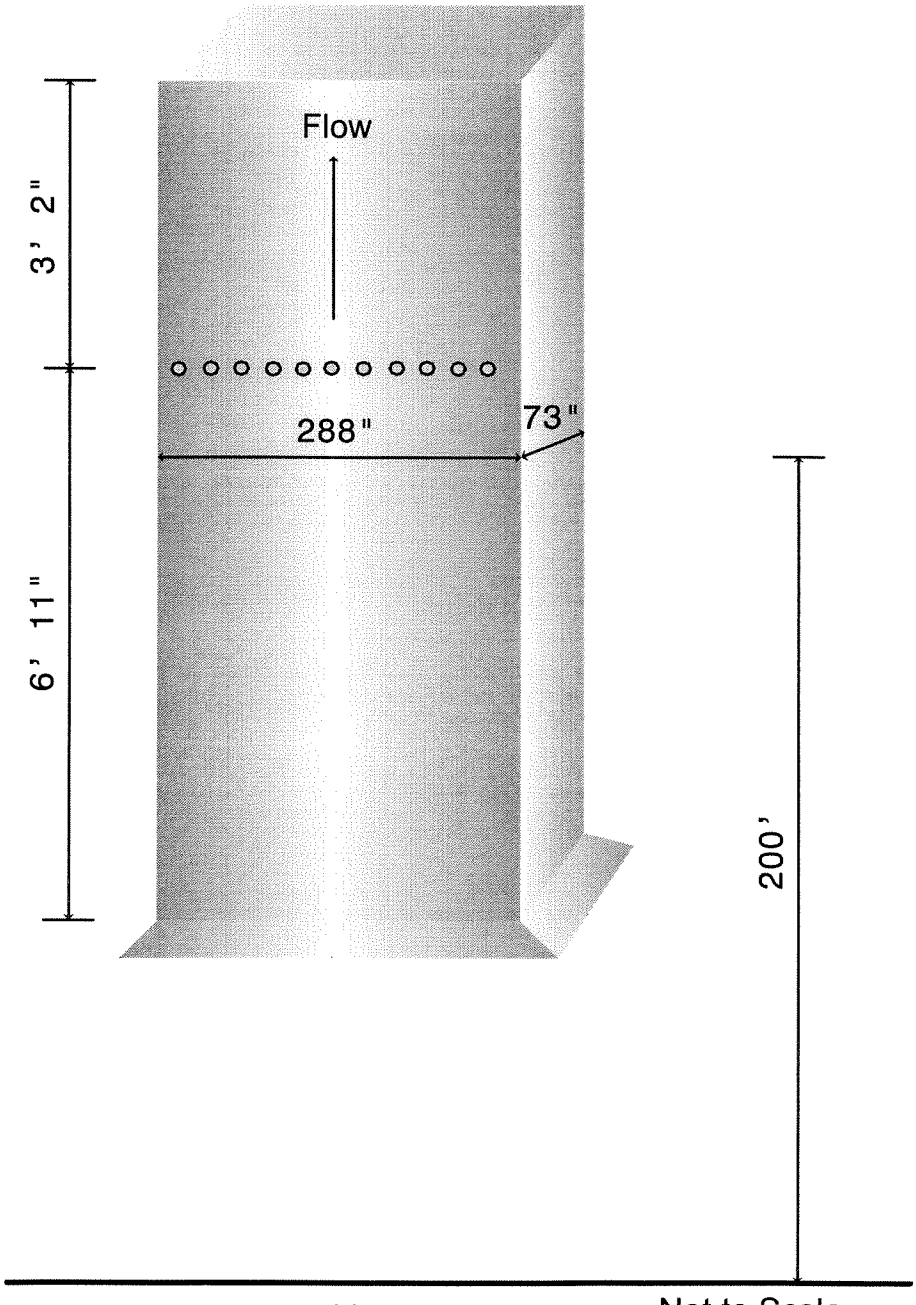
Unit Number 2 ESP Inlet Duct



Not to Scale

SAMPLING LOCATION

Unit Number 2 ESP Outlet Duct



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SAMPLING AND ANALYTICAL PROCEDURES

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 5, and 17; and the Ontario Hydro Method, Revised July 7, 1999 (ASTM D-6784-02).

A preliminary velocity traverse was made at eight of the eleven ports on the Unit Number 2 ESP Inlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. Several traverse points were checked for cyclonic flow and none was found to be present. Four traverse points were sampled from each of the eight ports for a total of thirty-two traverse points.

A preliminary velocity traverse was made at eight of the twelve ports on the Unit Number 2 ESP Outlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. Several traverse points were checked for cyclonic flow and none was found to be present. Four traverse points were sampled from each of the eight ports for a total of thirty-two traverse points.

The sampling trains were leak-checked at the nozzle at 15 inches of mercury vacuum before each test, and again after each test at the highest vacuum reading recorded during the test. This was done to predetermine the possibility of a diluted sample.

The pitot tube lines were checked for leaks before and after each test under both a vacuum and a pressure. The lines were also checked for clearance and the manometer was zeroed before each test.

An integrated orsat sample was collected and analyzed according to EPA Method 3B during each test.

Speciated Mercury

Duplicate samples for speciated mercury were collected from each source. The samples were taken according to EPA Methods 1, 2, 3B, 4, 5, and 17; and the Ontario Hydro Method, Revised July 7, 1999. For each run, samples of four-minute duration were taken isokinetically at each of the thirty-two traverse points for a total sampling time of 128 minutes. Blank train samples and reagent blanks were submitted.

The " front-half " of the sampling train contained the following components:

Quartz Nozzle
In-Stack Glass Thimble and Filter in a Glass Assembly
Heated Glass Probe @ 248°F ± 25°F
Heated Teflon Sample Line @ 248°F ± 25°F*

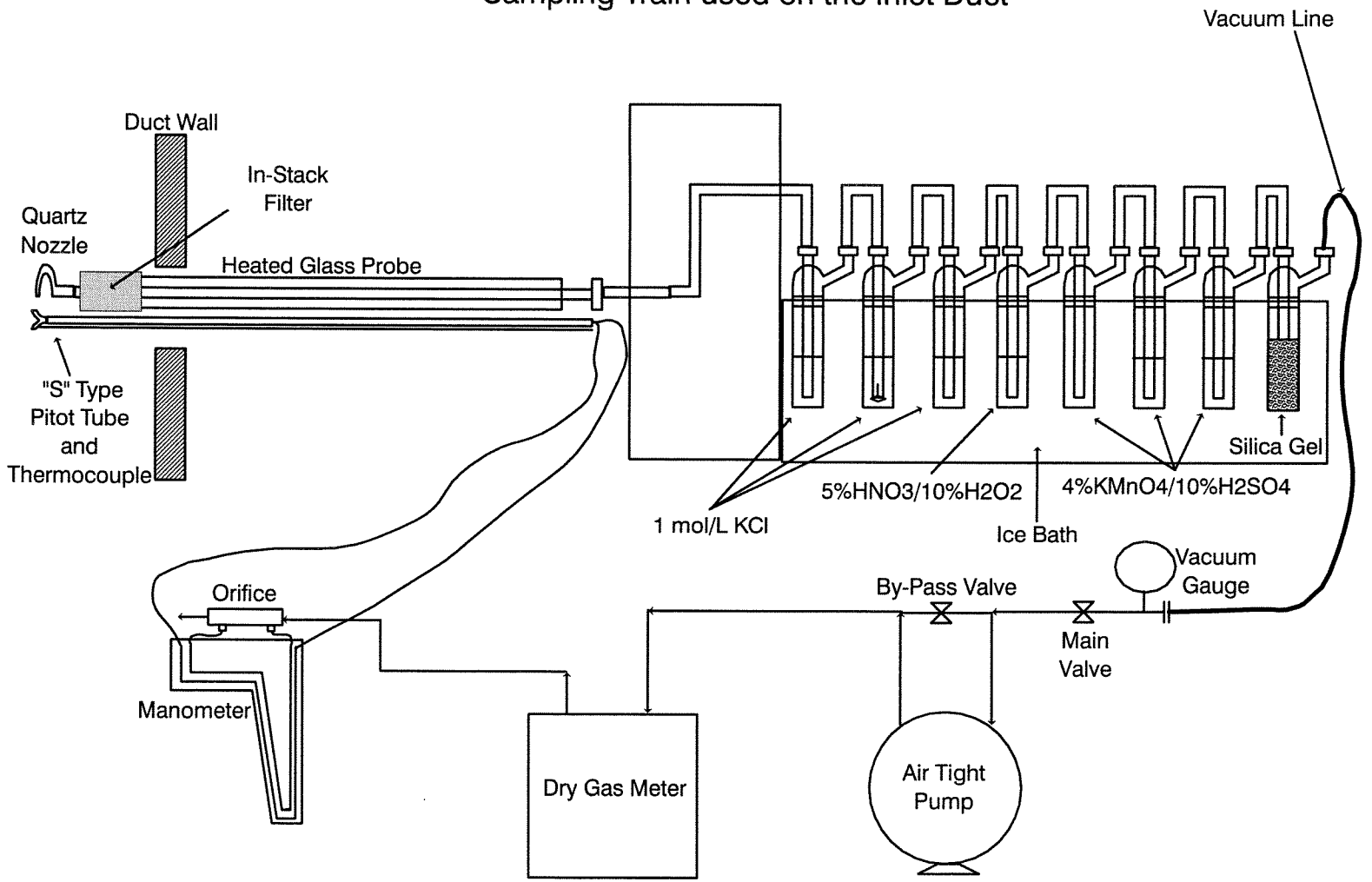
* Only used on the Outlet Duct.

The " back-half " of the sampling train contained the following components:

Impinger Number	Contents	Amount	Parameter Collected
1	1 mol/L KCl	100 ml	Oxidized Mercury
2	1 mol/L KCl	100 ml	Oxidized Mercury
3	1 mol/L KCl	100 ml	Oxidized Mercury
4	5% HNO_3 and 10% H_2O_2	100 ml	Elemental Mercury
5	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
6	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
7	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury
8	Silica Gel	200 g	Moisture

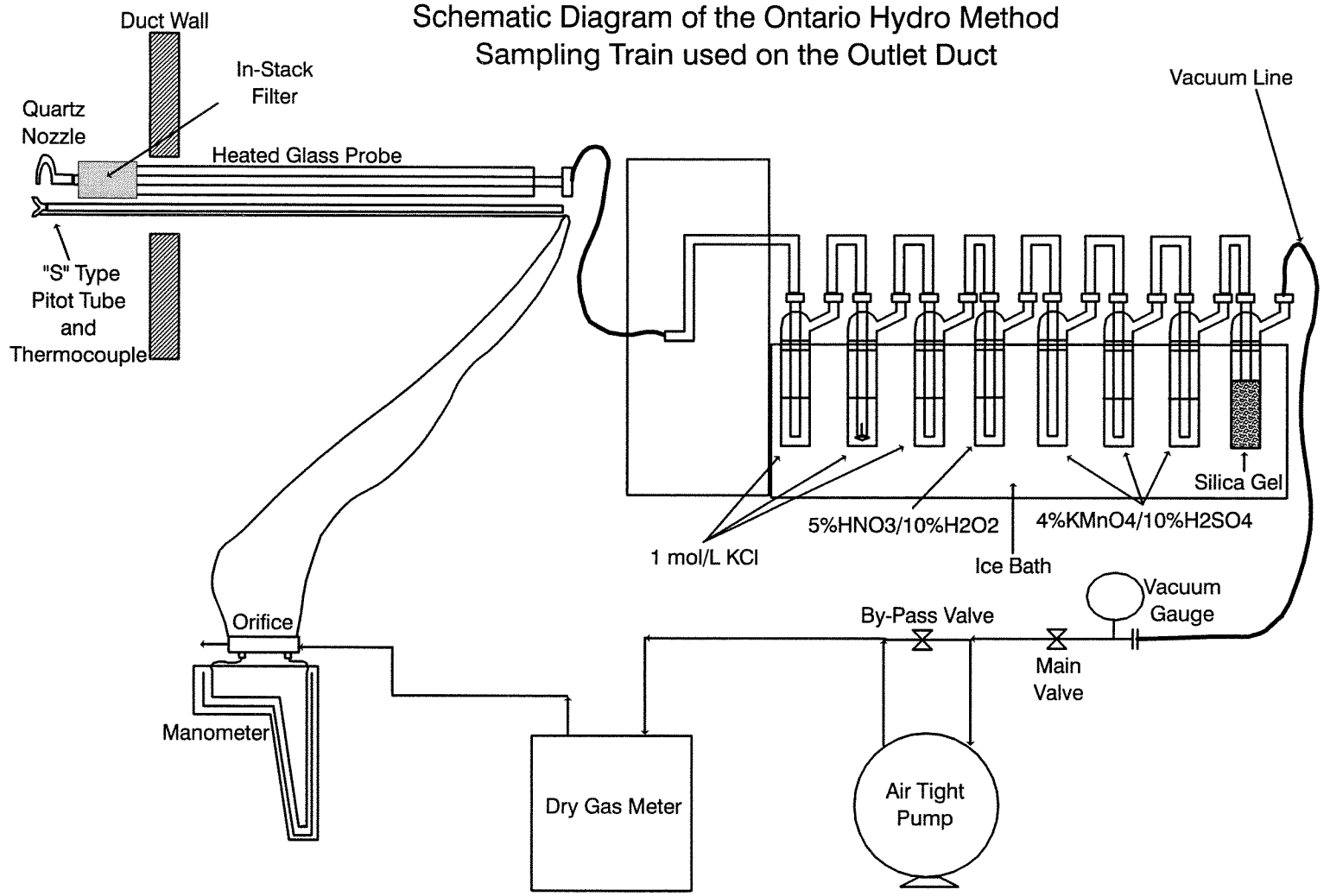
The mercury samples were analyzed by cold vapor atomic absorption spectroscopy.

Schematic Diagram of the Ontario Hydro Method Sampling Train used on the Inlet Duct



METCO ENVIRONMENTAL

Schematic Diagram of the Ontario Hydro Method Sampling Train used on the Outlet Duct



METCO ENVIRONMENTAL

DESCRIPTION OF TESTS

Personnel from METCO Environmental arrived at the plant at 8:45 a.m. on Tuesday, November 1, 2005. After meeting with plant personnel and attending a brief safety orientation, the equipment was moved onto the Unit Number 2 ESP Inlet and Outlet Ducts and prepared for testing. The first set of tests for speciated mercury began at 1:40 p.m. and was completed at 4:10 p.m. The second set of tests for speciated mercury began at 4:41p.m. and was aborted at 5:52 p.m. due to unit operational problems. The samples were recovered. The equipment was secured for the night and all work was completed at 6:30 p.m.

On Wednesday, November 2, work began at 10:45 a.m. The equipment was prepared for testing. The third set of tests for speciated mercury began at 2:15 p.m. and was completed at 4:40 p.m.

The equipment was moved off of the sampling locations and loaded into the sampling van. The samples were recovered and transported to METCO Environmental's laboratory in Dallas, Texas, for analysis and evaluation.

Operations at Arkansas Power & Light Company, Independence Steam Electric Station, Unit Number 2 ESP Inlet and Outlet Ducts, located in Newark, Arkansas, for ADA-ES, were completed at 7:15 p.m. on Wednesday, November 2, 2005.

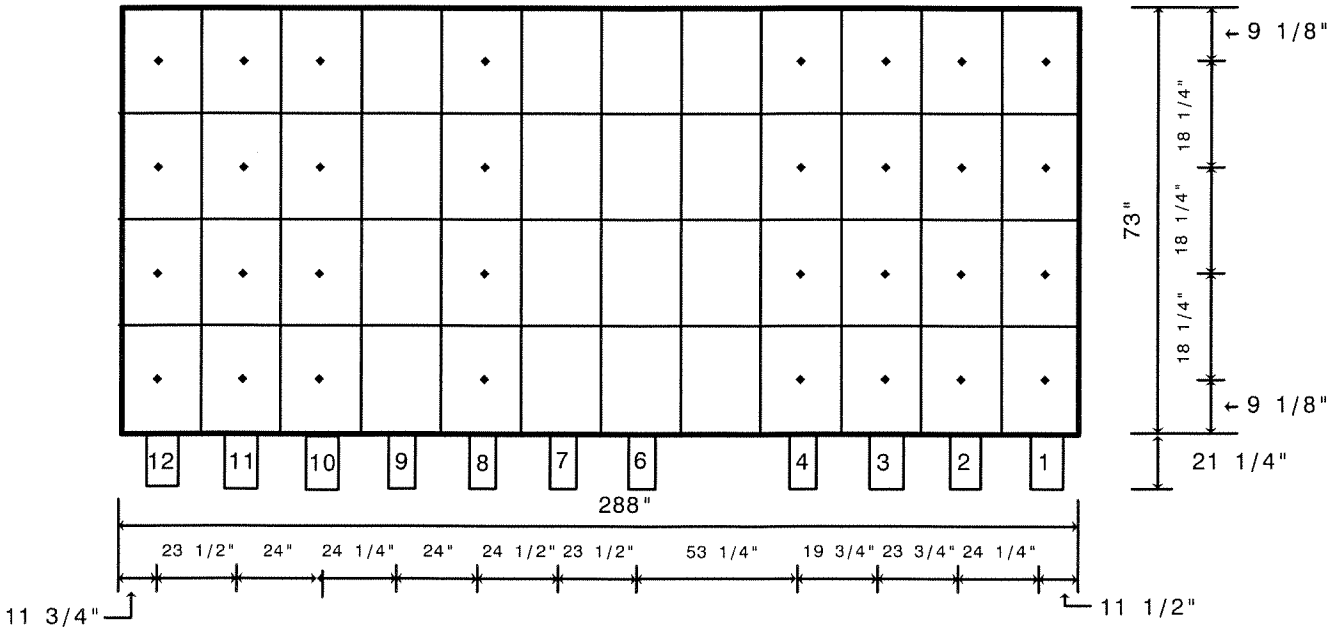
APPENDICES

A. Location of Sampling Points
B. Source Emissions Calculations
C. Calibration Data
D. Field Testing Data
E. Analytical Data
F. Chain of Custody
G. Resumes of Test Personnel

APPENDIX A

Location of Sampling Points
Unit Number 2 ESP Inlet Duct

The sampling ports are located 25 feet 4 inches (2.61 equivalent duct diameters) downstream from a bend in the duct and 6 feet 6 1/4 inches (0.67 equivalent duct diameters) upstream from an expansion in the duct. The locations of the sampling points were calculated as follows:



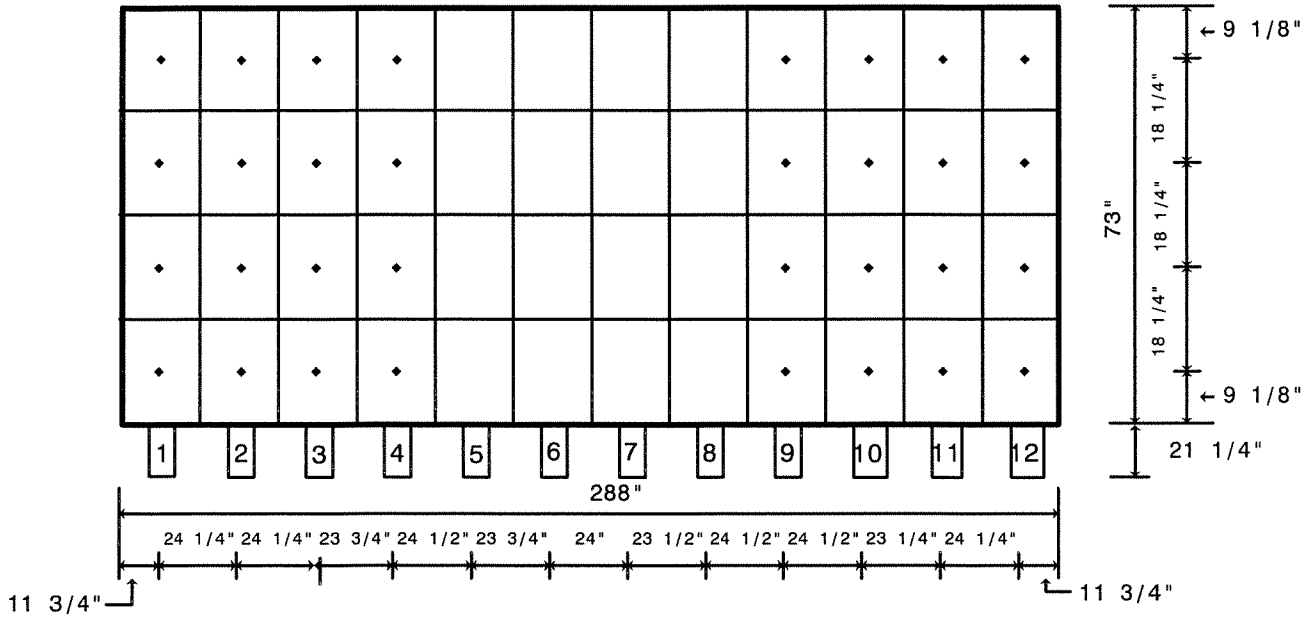
Note: The duct has 17 " of insulation. Port 5 does not exist. Ports 6 and 7 are not located in the gas stream and were not sampled. The width of where Ports 6 and 7 are located is 5' 5". This leaves a width of 18' 7" on which the area was calculated. A plant monitor probe is located in Port 9.

 Not to Scale

APPENDIX A

Location of Sampling Points
Unit Number 2 ESP Outlet Duct

The sampling ports are located 6 feet 11 inches (0.71 equivalent duct diameters) downstream from a constriction in the duct and 3 feet 2 inches (0.33 equivalent duct diameters) upstream from a bend in the duct. The locations of the sampling points were calculated as follows:



Note: The duct has 17 " of insulation. Ports 5 and 6 were not accessible and could not be sampled.

Not to Scale

APPENDIX B

Nomenclature and Equations
for
Calculation of Source Emissions

NOMENCLATURE FOR FLOW RATE AND MOISTURE CALCULATIONS

Symbol	English Units	Metric Units	Description
A_s	$in.^2$	m^2	Stack Area
C_p			Pitot Tube Calibration Factor
%EA			Percent Excess Air at sampling point
g	32.2 ft/sec^2		Acceleration of Gravity
%I			Percent Isokinetic
%M			Percent Moisture in the stack gas by volume
M_d			Mole fraction of dry gas
M_{water}	18 lb/lb-mole		Molecular Weight of water
MW	lb/lb-mole	g/g-mole	Molecular Weight of stack gas
MW_{air}	28.96 lb/ lb-mole		Molecular Weight of air
MW_d	lb/lb-mole	g/g-mole	Molecular Weight of dry stack gas
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H_2O	mm H_2O	Orifice Pressure drop

Symbol	English Units	Metric Units	Description
P_s	"Hg Absolute	mm Hg	Stack Pressure
ΔP	"H_2O	mm H_2O	Velocity Head of stack gas
P_{std}	29.92 "Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m^3/hr	Stack Gas Volume at actual stack conditions
Q_s	DSCFM*	dscm/hr*	Stack Gas Volume at 29.92 "Hg, 528°R, dry
R	21.83 "Hg-ft^3/lb-mole°R		Universal Gas Constant
T_m	°F	°C	Average Gas Meter Temperature
T_t	min	min	Net time of test
T_s	°F	°C	Stack Temperature
T_{std}	528°R	293°K	Standard Temperature
V_m	ft^3	m^3	Volume of dry gas sampled @ meter conditions
Vm_{std}	dscf*	dscm*	Volume of dry gas sampled @ standard conditions
V_s	fpm	m/sec	Stack velocity @ stack conditions
V_w	ml	ml	Total water collected in impingers and silica gel

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

Symbol	English Units	Metric Units	Description
Vw_{gas}	scf*	scm*	Volume of water vapor collected @ standard conditions
ρ_{air}	0.0752 lbs/ft^3		Density of Air
ρ_{water}	1 g/ml		Density of Water
ρ_{man}	62.32 lbs/ft^3		Density of Manometer Oil

Standard Conditions: 29.92 "Hg, 68°F (760 mm Hg, 20°C)

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

EXAMPLE CALCULATIONS

1. Volume of dry gas sampled at standard conditions. *

$$Vm_{std} = Vm \left(\frac{T_{std}}{T_m + 460} \right) \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}} \right]$$

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = dscf$$

$$Vm_{std} = dscf \times 0.028317 = dscm$$

2. Volume of water vapor collected at standard conditions. *

$$Vw_{gas} = \frac{(V_w - gms\ SO_2 - gms\ H_2S)\ \rho_{water}\ RT_{std}}{P_{std}\ M_{water}\ 453.6}$$

$$Vw_{gas} = 0.0472\ (V_w - gms\ SO_2 - gms\ H_2S) = scf$$

$$Vw_{gas} = scf \times 0.028317 = scm$$

3. Percent moisture in stack gas.

$$\%M = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \%$$

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

4. Mole fraction of dry gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average molecular weight of dry stack gas.

$$MW_d = \left[\%CO_2 \times \frac{44}{100}\right] + \left[\%O_2 \times \frac{32}{100}\right] + \left[\%N_2 \times \frac{28}{100}\right] + \left[\%CO \times \frac{28}{100}\right] = lb/lb\text{-}mole$$

$$= g/g\text{-}mole$$

6. Molecular weight of stack gas.

$$MW = MW_d \times M_d + 18\,(1 - M_d) = \frac{lb}{lb\text{-}mole} = g/g\text{-}mole$$

7 Percent excess air at sampling point.

$$\%EA = \frac{100\,[\%O_2 - (0.5\,\%CO)]}{0.265\,(\%N_2) - [\%O_2 - (0.5\,\%CO)]}$$

8. Stack Pressure.

$$P_s = P_b + \frac{Stack\ Pressure\ "H_2O}{13.6} = "Hg\ Absolute$$

$$P_s = "Hg\ Abs. \times 25.4 = mm\ Hg$$

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

9. Stack velocity at stack conditions.

$$V_s = C_p\, 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460) \times \Delta P}{12 \times \rho_{air} \times P_s \times MW \times T_{std}} \right]^{1/2}$$

$$V_s = 5{,}123.8\, C_p \left[\frac{(T_s + 460)}{P_s \times MW} \right]^{1/2} \sqrt{\Delta P}\ \text{average} = \text{fpm}$$

$$V_s = \text{fpm} \times 0.00508 = \text{m/sec}$$

10. Dry stack gas volume at standard conditions. *

$$Q_s = \frac{1}{144} V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

$$Q_s = \frac{0.123\, V_s \times A_s \times M_d \times P_s}{T_s + 460} = DSCFM$$

$$Q_s = DSCFM \times 1.6990 = dscm/hr$$

11. Actual stack gas volume at stack conditions.

$$Q_a = \frac{V_s \times A_s}{144} = ACFM$$

$$Q_a = ACFM \times 1.6990 = m^3/hr$$

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

12. Percent Isokinetic.

$$\%I = \frac{Vm_{std} \times (T_s + 460) \times P_{std} \times 100 \times 144\ in^2 / ft^2}{M_d \times T_{std} \times P_s \times T_t \times V_s \left(\frac{\pi \times D_n^2}{4}\right)}$$

$$\%I = \frac{1039 \times Vm_{std} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s \times D_n^2}$$

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

EXAMPLE CALCULATIONS

$$\text{lbs/trillion Btu} = \frac{\text{lbs/dscf*} \times F_d \text{ factor} \times 20.9\%O_2}{20.9\%O_2 - \%O_2 \text{ measured}}$$

F_d = Oxygen based F factor

Fuel	F_d factor
Bituminous Coal	9.780×10^9 dscf*/trillion Btu

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-236
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	3	
DATE			11/01/05	11/02/05	
BEGIN TIME			1340	1415	
END TIME			1603	1636	
P(b)	BAROMETRIC PRESSURE	"Hg Abs. (mm Hg)	29.90 (759.00)	29.88 (759.00)	
P(m)	ORIFICE PRESSURE DROP	"H2O (mm H2O)	0.583 (14.800)	0.431 (10.900)	
	DGM CALIBRATION FACTOR		1.008	1.008	
V(m)	VOLUME DRY GAS SAMPLED @ METER CONDITIONS LEAK CHECK VOLUME	ft.^3 (m^3) ft.^3	55.443 (1.570) 0.497	48.295 (1.368) 0.491	
T(m)	AVERAGE GAS METER TEMPERATURE	DEG.F (DEG.C)	66 (19)	82 (28)	
V(m[std])*	VOLUME DRY GAS SAMPLED @ STANDARD CONDITIONS*	DSCF (DSCM)	55.706 (1.577)	47.042 (1.332)	
V(w)	TOTAL WATER COLLECTED, IMPINGERS & SILICA GEL	ml	110.4	74.2	
V(w[gas])	VOLUME WATER VAPOR COLLECTED @ STANDARD CONDITIONS*	SCF (SCM)	5.211 (0.148)	3.502 (0.099)	
%M	MOISTURE IN STACK GAS BY VOLUME	%	8.55	6.93	
Md	MOL FRACTION OF DRY GAS		0.9145	0.9307	
Tt	NET TIME OF TEST	MINUTES	128	128	

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-236
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP INLET DUCT

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	3	
CO2		%	13.8	11.6	
O2		%	5.0	7.2	
CO		%	0.0	0.0	
N2		%	81.2	81.2	
%EA	EXCESS AIR @ SAMPLING POINT	%	30.3	50.3	
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.41 (30.41)	30.14 (30.14)	
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	29.35 (29.35)	29.30 (29.30)	
Cp	PITOT TUBE CALIBRATION		0.806	0.806	
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.895 (22.700)	0.632 (16.100)	
DELTA P ^(1/2)		"H2O	0.924	0.773	
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	322 (161)	307 (153)	
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	28.83 (732.00) -14.50	28.81 (732.00) -14.50	
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	3,668 (19)	3,043 (15)	
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	16,279 (11)	16,279 (11)	
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS* WET STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR) WSCFH	247,619 (420,705) 16,246,189	213,006 (361,897) 13,731,987	
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	414,707 (704,587)	344,005 (584,464)	
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.190 (0.005)	0.190 (0.005)	
%I	PERCENT ISOKINETIC	%	101.3	99.4	

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION SURVEY

JOB NUMBER: 05-236
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	3	
DATE			11/01/05	11/02/05	
BEGIN TIME			1344	1418	
END TIME			1610	1640	
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.82	29.88	
		(mm Hg)	(757.00)	(759.00)	
P(m)	ORIFICE PRESSURE DROP	"H2O	1.055	0.799	
		(mm H2O)	(26.800)	(20.300)	
	DGM CALIBRATION FACTOR		0.991	0.991	
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	71.429	61.949	
	@ METER CONDITIONS	(m^3)	(2.023)	(1.754)	
	LEAK CHECK VOLUME	ft.^3	0.000	0.000	
T(m)	AVERAGE GAS METER	DEG.F	64	79	
	TEMPERATURE	(DEG.C)	(18)	(26)	
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	71.932	60.733	
	@ STANDARD CONDITIONS*	(DSCM)	(2.037)	(1.720)	
V(w)	TOTAL WATER COLLECTED, IMPINGERS & SILICA GEL	ml	148.0	99.9	
V(w[gas])	VOLUME WATER VAPOR	SCF	6.986	4.715	
	COLLECTED @ STANDARD	(SCM)	(0.198)	(0.134)	
	CONDITIONS*				
%M	MOISTURE IN STACK GAS BY VOLUME	%	8.85	7.20	
Md	MOL FRACTION OF DRY GAS		0.9115	0.9280	
Tt	NET TIME OF TEST	MINUTES	128	128	

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 05-236
JOB NAME: ADA-ES
LOCATION: NEWARK, ARKANSAS
UNIT TESTED: UNIT NUMBER 2 ESP OUTLET DUCT

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	3	
CO2		%	13.8	11.4	
O2		%	5.2	7.4	
CO		%	0.0	0.0	
N2		%	81.0	81.2	
%EA	EXCESS AIR @ SAMPLING POINT	%	32.0	52.4	
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.42 (30.42)	30.12 (30.12)	
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	29.32 (29.32)	29.25 (29.25)	
Cp	PITOT TUBE CALIBRATION		0.805	0.805	
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.583 (14.800)	0.433 (11.000)	
DELTA P ^(1/2)		"H2O	0.752	0.649	
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	326 (163)	306 (152)	
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	28.72 (729.00) -15.00	28.81 (732.00) -14.50	
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	2,997 (15)	2,552 (13)	
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	21,024 (14)	21,024 (14)	
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS* WET STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR) WSCFH	258,122 (438,549) 16,991,026	230,337 (391,343) 14,892,478	
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	437,518 (743,343)	372,619 (633,080)	
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.246 (0.006)	0.246 (0.006)	
%I	PERCENT ISOKINETIC	%	96.7	91.5	

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

APPENDIX C

Calibration Data

Equipment	Calibration Factor	Calibration Date
Pitot Tube #31-5-1 (low side)	0.806	10/12/05
Pitot Tube #31-5-3	0.805	10/14/05
Probe Tip #05-233-2	0.246	08/16/05
Probe Tip #05-233-7	0.190	08/16/05
Dry Gas Meter #27-3	0.991	08/12/05
Stack Unit Orifice #27-3		08/12/05
Digital Temperature Indicator #27-3		08/12/05
Dry Gas Meter #31-1	1.008	10/03/05
Stack Unit Orifice #31-1		10/04/05
Digital Temperature Indicator #31-1		10/03/05
Barometer #31-1		10/12/05

PITOT TUBE CALIBRATION

Date: 10-12-05

Pitot No.: 31-5-1

Pitot Dimensions: 5' x 1/4"

Time: 1430

T_s: 75 °F

C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.33	0.575	0.808	0.33	0.575	0.808
20	40	0.34	0.34	0.583	0.52	0.721	0.801	0.52	0.721	0.801
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.81	0.900	0.808
35	60	0.80	0.80	0.894	1.25	1.118	0.792	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.55	1.245	0.795	1.50	1.225	0.808
50	80	1.30	1.30	1.140	2.00	1.414	0.798	2.00	1.414	0.798
62	90	1.60	1.60	1.265	2.45	1.565	0.800	2.40	1.549	0.808
28	50	0.54	0.54	0.735	0.82	0.906	0.803	0.82	0.906	0.803
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.82	0.906	0.803
Average							0.801 ✓			0.806 ✓

Summary of Results:

Normal high side calibration factor 0.801 ✓

variation + 0.87 ✓

variation - 1.12 ✓

Normal low side calibration factor 0.806 ✓

variation + 0.25 ✓

variation - 0.99 ✓

Calibrator: JOSH ORR / DEKE BRUMMETT

Checked By: JASON BROWN

PITOT TUBE CALIBRATION

Date: 10-14-05

Pitot No.: 31-5-3

Pitot Dimensions: 5' x 1/4"

Time: 0955

T_s: 75 °F

C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
7	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
14	30	0.22	0.22	0.469	0.34	0.583	0.796	0.34	0.583	0.796
20	40	0.34	0.34	0.583	0.51	0.714	0.808	0.51	0.714	0.808
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
35	60	0.80	0.80	0.894	1.20	1.095	0.808	1.20	1.095	0.808
41	70	1.00	1.00	1.000	1.50	1.225	0.808	1.50	1.225	0.808
50	80	1.30	1.30	1.140	2.00	1.414	0.798	1.95	1.396	0.808
62	90	1.60	1.60	1.265	2.40	1.549	0.808	2.40	1.549	0.808
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.82	0.906	0.803
28	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
Average							0.805 ✓			0.807 ✓

Summary of Results:

Normal high side calibration factor 0.805 ✓

variation + 0.37 ✓

variation - 1.12 ✓

Normal low side calibration factor 0.807 ✓

variation + 0.12 ✓

variation - 1.36 ✓

Calibrator: JOSH ORR / DEXE BRUMMETT

Checked By: Jason Brown

VERSION 1
22 OCTOBER 2002

MITECO ENVIRONMENTAL

NOZZLE CALIBRATION

Nozzle Set No. 05-233 TASK 1

Date 8-16-05 Calibrator: Malone

	05-233 - 1	05-233 - 2	05-233 - 3	05-233 - 4	05-233 - 5	05-233 - 6
Reading 1	0.247	0.246	0.246	0.193	0.190	0.190
Reading 2	0.247	0.245	0.247	0.193	0.190	0.190
Reading 3	0.246	0.247	0.246	0.193	0.191	0.191
Reading 4	0.247	0.245	0.247	0.194	0.189	0.190
Reading 5	0.246	0.245	0.247	0.194	0.190	0.190
Reading 6	0.248	0.245	0.247	0.193	0.190	0.189
Reading 7	0.248	0.247	0.246	0.193	0.190	0.191
Reading 8	0.247	0.246	0.247	0.194	0.190	0.190
Reading 9	0.247	0.246	0.247	0.192	0.190	0.190
Reading 10	0.247	0.246	0.247	0.193	0.190	0.190
Average	0.247	0.246	0.247	0.193	0.190	0.190

	05-233 - 7	05-233 - 8	9	10	11	12
Reading 1	0.190	0.245				
Reading 2	0.190	0.248				
Reading 3	0.191	0.247				
Reading 4	0.189	0.247				
Reading 5	0.191	0.246				
Reading 6	0.189	0.248				
Reading 7	0.190	0.247				
Reading 8	0.190	0.247				
Reading 9	0.190	0.246				
Reading 10	0.190	0.247				
Average	0.190	0.247				

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 27-3

Date: 8/12/05

ΔH ("H_2O)	C_{DG}
0.5	0.979
1.0	0.989
1.5	1.008
2.0	0.990
3.0	0.988
4.0	0.989
Average	0.991

Variation: + 1.72%

- 1.21%

Calibrator: Ned Shappley

Checked By:

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27-3

Calibrator: Red Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.5 H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)							Dry Gas Meter						
	Time	Meter Reading		Temp.		P_m		Meter Reading		Temp. In		Temp. Out		P_m	
End	1128	5.170	cf	75	°F	-0.4	"H_2O	844.539	cf	70	°F	69	°F	0.5	"H_2O
Start	1116	0.000	cf	75	°F	-0.4	"H_2O	839.300	cf	70	°F	71	°F	0.5	"H_2O
Avg.		5.170	cf	75	°F	-0.4	"H_2O	5.239	cf	70		°F		0.5	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.170 \left[\frac{29.40 + \frac{-0.4}{13.6}}{75 + 460} \right] \times 1.004 \quad (C_f) = 5.039 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.239 \left[\frac{29.40 + \frac{0.5}{13.6}}{70 + 460} \right] = 5.136 \text{ dcsf}$$

$$C_{DG} = \frac{5.039}{5.136} = \boxed{0.979}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27-3

Calibrator: Ned Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.0" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 4)

	Time	Meter Reading		Temp.		P_m	
End	1141	5.300	cf	74	°F	-0.4	"H_2O
Start	1131	0.000	cf	74	°F	-0.4	"H_2O
Avg.		5.300	cf	74	°F	-0.40	"H_2O

Dry Gas Meter

	Meter Reading		Temp. In		Temp. Out		P_m	
End	850.231	cf	71	°F	73	°F	1.00	"H_2O
Start	844.900	cf	69	°F	71	°F	1.00	"H_2O
Avg.	5.331	cf	71			°F	1.00	"H_2O

$$Wet\ Test\ Meter\ Vm_{std} = 17.65 \times 5.300 \left[\frac{29.40 + \frac{-0.4}{13.6}}{74 + 460}\right] \times 1.004 \quad (C_f) = 5.166 \ dcsf$$

$$Dry\ Gas\ Meter\ Vm_{std} = 17.65 \times 5.331 \left[\frac{29.40 + \frac{1.00}{13.6}}{71 + 460}\right] = 5.223 \ dcsf$$

$$C_{DG} = \frac{5.166}{5.223} = \boxed{0.989}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27-3

Calibrator: Neal Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.5" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)					Dry Gas Meter				
	Time	Meter Reading	Temp.		P_m	Meter Reading	Temp. In	Temp. Out	P_m	
End	1158	10.325 cf	74	°F	-1.3	"H_2O	860.010 cf	78 °F	72 °F	1.5 "H_2O
Start	1142	0.000 cf	74	°F	-1.3	"H_2O	850.398 cf	71 °F	73 °F	1.5 "H_2O
Avg.		10.325 cf	74	°F	-1.3	"H_2O	10.212 cf	74	°F	1.5 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.325 \left[\frac{29.40 + \frac{-1.3}{13.6}}{74 + 460} \right] \times 1.009 \quad (C_f) = 10.091 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.212 \left[\frac{29.40 + \frac{1.5}{13.6}}{74 + 460} \right] = 9.961 \text{ dcsf}$$

$$C_{DG} = \frac{10.091}{9.961} = \boxed{1.008}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 27.3

Calibrator: Ned Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 20" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)						Dry Gas Meter					
	Time	Meter Reading	Temp.		P_m		Meter Reading	Temp. In		Temp. Out		P_m	
End	1416	10.240	cf	74	°F	-1.5	"H_2O	911.712	cf	87	°F	73	°F	2.0	"H_2O
Start	1400	0.000	cf	74	°F	-1.5	"H_2O	901.343	cf	80	°F	73	°F	2.00	"H_2O
Avg.		10.240	cf	74	°F	-1.5	"H_2O	10.369	cf	78			°F	2.0	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.240 \left[\frac{29.40 + \frac{-1.5}{13.6}}{74 + 460} \right] \times 1.009 \quad (C_f) = 9.953 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.369 \left[\frac{29.40 + \frac{2.0}{13.6}}{78 + 460} \right] = 10.051 \text{ dcsf}$$

$$C_{DG} = \frac{9.953}{10.051} = \boxed{0.990}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 273

Calibrator: Dad Shappley

Date: 8/12/05

$$\textit{Calibration Factor } (C_{DG}) = \frac{\textit{Wet Test Meter } Vm_{std}}{\textit{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.0" H_2O

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)						Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out	P_m
End	1332	14.780	cf	74	°F	-2.30 "H_2O	890.387	cf	92	°F	73 °F	3.00 "H_2O
Start	1319	0.000	cf	74	°F	-2.30 "H_2O	875.402	cf	82	°F	73 °F	3.00 "H_2O
Avg.		14.780	cf	74	°F	-2.30 "H_2O	14.985	cf	80	°F		3.00 "H_2O

$$\textit{Wet Test Meter } Vm_{std} = 17.65 \times 14.780 \left[\frac{29.40 + \frac{-2.30}{13.6}}{74 + 460} \right] \times 1.004 \quad (C_p) = 14.337 \textit{ dcsf}$$

$$\textit{Dry Gas Meter } Vm_{std} = 17.65 \times 14.985 \left[\frac{29.40 + \frac{3.0}{13.6}}{80 + 460} \right] = 14.508 \textit{ dcsf}$$

$$C_{DG} = \frac{14.337}{14.508} = \boxed{0.988}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 273

Calibrator: Ned Shappley

Date: 8/12/05

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.0

P_b: 29.40 "Hg

Control Module Vacuum: 5.0 "Hg

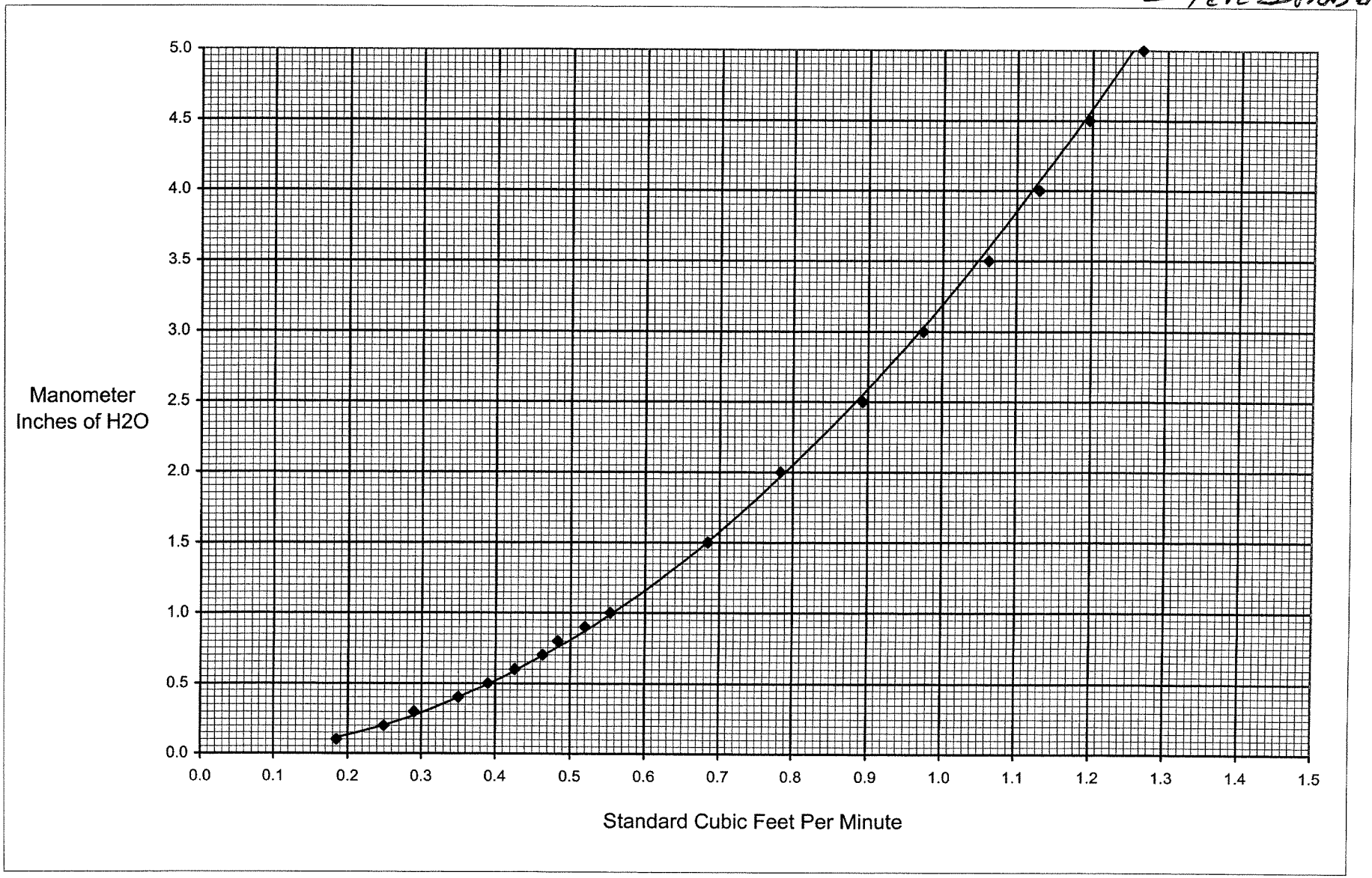
Wet Test Meter (No. 9)								Dry Gas Meter							
	Time	Meter Reading		Temp.		P_m		Meter Reading		Temp. In		Temp. Out		P_m	
End	1343	10.050	cf	74	°F	-3.2	"H_2O	901.097	cf	95	°F	73	°F	4.0	"H_2O
Start	1335	0.000	cf	74	°F	-3.2	"H_2O	890.910	cf	90	°F	72	°F	4.0	"H_2O
Avg.		10.050	cf	74	°F	-3.2	"H_2O	10.187	cf	83			°F	4.0	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.050 \left[\frac{29.40 + \frac{-3.2}{13.6}}{74 + 460} \right] \times 1.004 \quad (C_f) = 9.727 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.187 \left[\frac{29.40 + \frac{4.0}{13.6}}{83 + 460} \right] = 9.832 \text{ dcsf}$$

$$C_{DG} = \frac{9.727}{9.832} = \boxed{0.989}$$

STACK UNIT ORIFICE NO: **27-3** DATE: **08/12/05** CALIBRATED BY: **Ned Shappley** CHECKED BY: Steve Johnsen



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 27-3

CALIBRATION DATA

DATE: 8/12/05

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	1000	77	76
Ice Bath	1001	32	32
Boiling Water	1006	211	210
Oven	1020	247	248
Oven	1035	300	301
Oven	1042	350	349
Oven	1047	382	380

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. D1

Calibrator Ned Shappley

Checked By: Mark Glier

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter No.: 31-1

Date: 3 Oct 2005

ΔH ("H_2O)	C_{DG}
0.5	1.009
1.0	1.009
1.5	1.008
2.0	1.006
3.0	1.008
4.0	1.007
Average	1.008 ✓

Variation: + 0.10% ✓

- 0.20% ✓

Calibrator: Phil Rowland

Checked By: Steve Boonsen

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.50

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1445	11.000 cf	75 °F	−0.55 "H_2O	260.949 cf	86 °F	78 °F	0.50 "H_2O
Start	1410	0.000 cf	75 °F	−0.60 "H_2O	249.885 cf	83 °F	79 °F	0.50 "H_2O
Avg.	35	11.000 cf	75 °F	−0.58 "H_2O	11.064 cf	82 °F		0.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-0.58}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.762 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.064 \left[\frac{29.58 + \frac{0.50}{13.6}}{82 + 460}\right] = 10.671 \text{ dcsf}$$

$$C_{DG} = \frac{10.762}{10.671} = \boxed{1.009 \checkmark}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)					Dry Gas Meter				
	Time	Meter Reading	Temp.	P_m		Meter Reading	Temp. In	Temp. Out	P_m	
End	1515	11.000 cf	75 °F	-0.90	"H_2O	273.477 cf	91 °F	80 °F	1.00	"H_2O
Start	1455	0.000 cf	75 °F	-0.85	"H_2O	262.399 cf	85 °F	78 °F	1.00	"H_2O
Avg.	20	11.000 cf	75 °F	-0.88	"H_2O	11.078 cf	84 °F		1.00	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-0.88}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.754 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.078 \left[\frac{29.58 + \frac{1.00}{13.6}}{84 + 460}\right] = 10.658 \text{ dcsf}$$

$$C_{DG} = \frac{10.754}{10.658} = \boxed{1.009 \checkmark}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Calibrator: Phil Rowland

Date: 30 Oct 2005

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.50

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m		Meter Reading	Temp. In	Temp. Out	P_m
End	1540	11.020 cf	75 °F	-1.20	"H_2O	286.256 cf	94 °F	80 °F	1.50 "H_2O
Start	1520	0.000 cf	75 °F	-1.20	"H_2O	275.128 cf	89 °F	80 °F	1.50 "H_2O
Avg.	20	11.020 cf	75 °F	-1.20	"H_2O	11.128 cf	86 °F		1.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.020 \left[\frac{29.58 + \frac{-1.20}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.765 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.128 \left[\frac{29.58 + \frac{1.50}{13.6}}{86 + 460}\right] = 10.680 \text{ dcsf}$$

$$C_{DG} = \frac{10.765}{10.680} = \boxed{1.008}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Calibrator: Phil Rowland

Date: 3 Oct 2005

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)						Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out		P_m
End	1555	11.000	cf	75	°F	-1.50 "H_2O	298.634	cf	95	°F	80	°F	2.00 "H_2O
Start	1545	0.000	cf	75	°F	-1.50 "H_2O	287.532	cf	90	°F	80	°F	2.00 "H_2O
Avg.	10	11.000	cf	75	°F	-1.50 "H_2O	11.102	cf	86			°F	2.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-1.50}{13.6}}{75 + 460}\right] \times 1.004\ (C_p) = 10.737 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.102 \left[\frac{29.58 + \frac{2.00}{13.6}}{86 + 460}\right] = 10.669 \text{ dcsf}$$

$$C_{DG} = \frac{10.737}{10.669} = \boxed{1.006 \checkmark}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 4)						Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out		P_m
End	1615	11.000	cf	75	°F	-2.25 "H_2O	310.766	cf	99	°F	81	°F	3.00 "H_2O
Start	1605	0.000	cf	75	°F	-2.20 "H_2O	299.689	cf	92	°F	81	°F	3.00 "H_2O
Avg.	10	11.000	cf	75	°F	-2.23 "H_2O	11.077	cf	88		°F		3.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11.000 \left[\frac{29.58 + \frac{-2.23}{13.6}}{75 + 460}\right] \times 1.004\ (C_f) = 10.718 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.077 \left[\frac{29.58 + \frac{3.00}{13.6}}{88 + 460}\right] = 10.632 \text{ dcsf}$$

$$C_{DG} = \frac{10.718}{10.632} = \boxed{1.008}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 31-1

Date: 3 Oct 2005

Calibrator: Phil Rowland

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.00

P_b: 29.58 "Hg

Control Module Vacuum: 5.0 "Hg

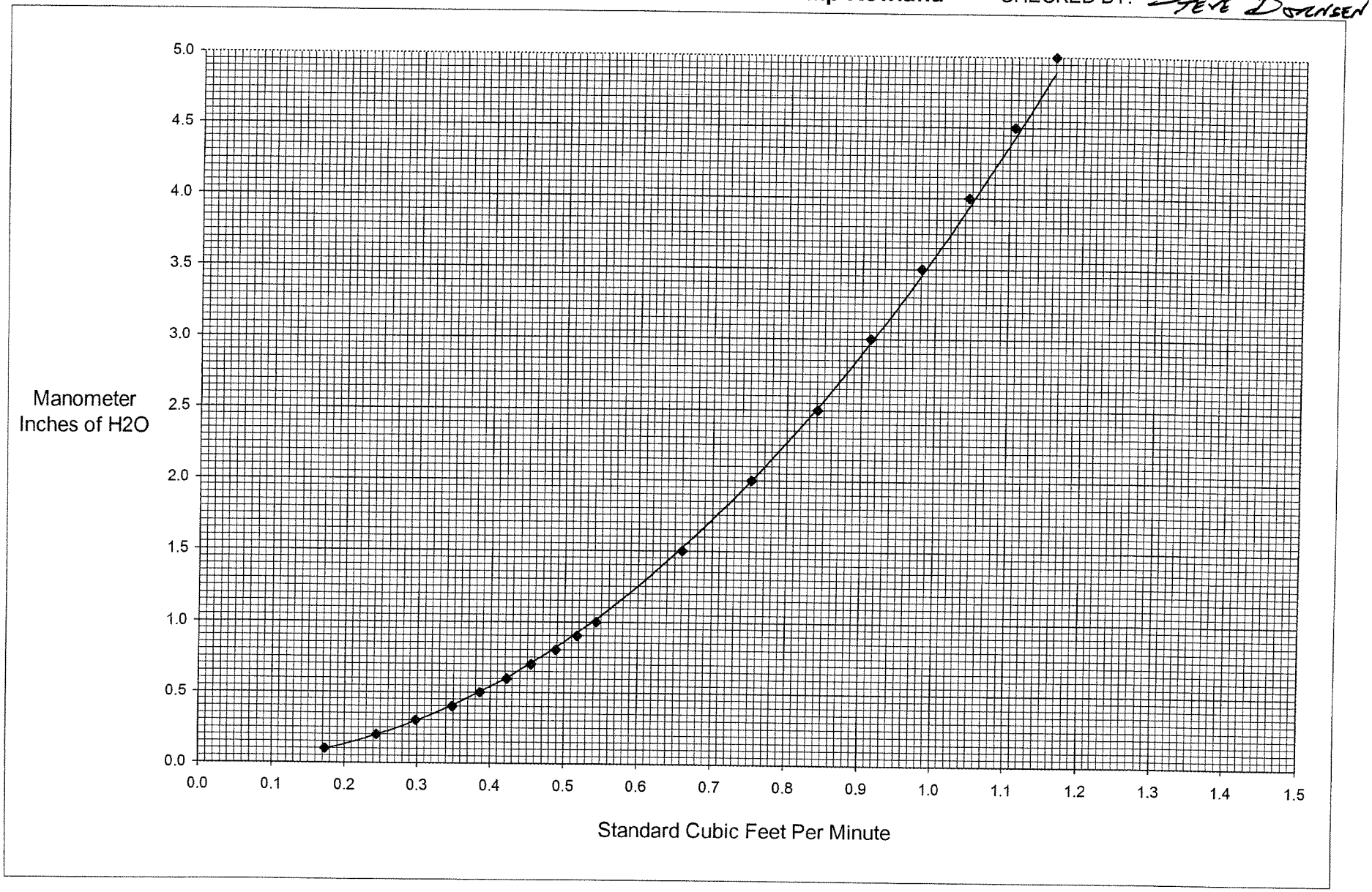
	Wet Test Meter (No. 4)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1630	11,000 cf	75 °F	-3.00 "H_2O	323.057 cf	100 °F	82 °F	4.00 "H_2O
Start	1620	0.000 cf	75 °F	-2.90 "H_2O	311.999 cf	94 °F	81 °F	4.00 "H_2O
Avg.	10	11,000 cf	75 °F	-2.95 "H_2O	11.058 cf	89 °F		4.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 11{,}000 \left[\frac{29.58 + \frac{-2.95}{13.6}}{75 + 460}\right] \times 1.004 \ (C_f) = 10{,}698 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 11.058 \left[\frac{29.58 + \frac{4.00}{13.6}}{89 + 460}\right] = 10{,}620 \text{ dcsf}$$

$$C_{DG} = \frac{10.698}{10.620} = \boxed{1.007 \ \checkmark}$$

STACK UNIT ORIFICE NO: **31-1** DATE: **10/04/05** CALIBRATED BY: **Phillip Rowland** CHECKED BY: Steve Bornsen



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 31-1

CALIBRATION DATA

DATE: 3 Oct 2005

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	1306	76	75
Ice Bath	1307	34	34
Boiling Water	1309	213	211
Oven	1325	376	375
Oven	1332	352	350
Oven	1339	301	300
Oven	1346	251	250

Meter Adjusted? YES _____ No ✓

Reference Thermometer No. D-1

Calibrator Phil Rorland

Checked By: Steve Bronsen

METCO ENVIRONMENTAL

JMG54

BAROMETER CALIBRATION

Barometer No. 30-1

Date: 8/26/05

Time: 1500

Barometric Pressure @ Baton Rouge Airport @ 70 ft.	=	29.87
	-	0.07
Absolute Pressure @ Baton Rouge Airport	=	29.80
	+	0.044
Absolute Pressure @ METCO - Baton Rouge @ 26 ft.	=	29.844
Barometer Reading	=	29.84
Variation	=	0.004
Barometer Adjusted?	Yes ____	No ✓
Barometer Reading (after adjustment)	=	—

Signature of Calibrator

APPENDIX D

Field Testing Data

METCO ENVIRONMENTAL

Job Number 05-236 ✓
Job Name ADA-ES ✓
Run Number 1 ✓
Unit Unit 2 ESP Inlet Duct ✓
Date 11-1-05 ✓
Operator Orr, Simpson / Bowman
Sample box No. 79 Meter Box No. 31-1 ✓

01H Field Data

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓ ✓

Ambient Temp. °F 68
Assumed Moisture % 12.0%
Probe Length 5'
C Factor 1.0 → 0.65 to reference.
Initial Leak @ 15.0 "Hg = 0.010 cfm ✓
Final Leak @ 12.0 "Hg = 0.002 cfm ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1340	723.250	1.30	0.85	0.85	9.0	310	249	266	45	66	61	
3	1344	724.95	1.20	0.78	0.78	8.0	312	252	265	45	66	61	
2	1348	726.65	1.10	0.72	0.72	7.5	311	256	262	46	67	62	
1	1352	728.40	1.10	0.72	0.72	7.5	309	256	262	46	66	62	
–	1352	730.15	–	–	–	–	–	–	–	–	–	–	
2-4	1356	730.15	1.10	0.72	0.72	7.5	313	257	262	46	67	62	
3	1400	731.95	1.00	0.65	0.65	7.5	311	260	262	46	67	63	
2	1404	736.75	1.00	0.65	0.65	7.5	310	267	259	47	67	63	
1	1408	738.55	0.95	0.62	0.62	7.0	300	268	259	47	67	63	
–	1412	740.45	–	–	–	–	–	–	–	–	–	–	
3-4	1412	740.45	1.00	0.65	0.65	7.5	300	257	258	48	66	63	
3	1416	742.05	1.00	0.65	0.65	7.5	299	258	257	48	67	64	
2	1420	743.96	0.90	0.59	0.59	7.0	299	256	266	47	68	64	
1	1424	745.835	0.60	0.40	0.40	5.0	300	256	256	47	68	64	
–	1428	747.435	–	–	–	–	–	–	–	–	–	–	

Pitot Tube Calibration Factor C_p 0.806 / ow ✓
Volume Collected V_m 55.443 ✓ ft^3
Water Collected V_w 110.4 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.5 ✓ "H_2O

Pitot Tube No. 31-5-1 ✓
Baro. Press. P_b 29.90 ✓ "Hg
Probe Tip Dia. D_n 0.190 ✓ in.
% CO_2 13.8 ✓ % CO 0.0 ✓
% O_2 5.0 ✓ % N_2 81.2 ✓
Area Stack A_s ~~24024~~ ✓ in^2
16279 ✓

Barometer No. 31-1 ✓ Probe Tip No. 05-233-7 ✓
Total Volume of Leak Checks After Start: 0.449 ft^3
V_m = Dry Gas Meter Calibration Factor 1.008 ✓ X 55.003 ✓

{Dry Gas Meter Reading ____ ft^3 – (T_t ____ min. X Leak Rate ____ cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 74

Impinger 1	Final Weight	~~764.8~~ 803.7	
	Initial Weight	734.5	
	Increase		
Impinger 2	Final Weight	~~229.6~~ 228.8	
	Initial Weight	712.4	
	Increase		
Impinger 3	Final Weight	~~749.5~~ ~~752.5~~ 750.1 so	
	Initial Weight	745.6	
	Increase		
Impinger 4	Final Weight	714.8	
	Initial Weight	712.9	
	Increase		
Impinger 5	Final Weight	745.6	
	Initial Weight	744.3	
	Increase		
Impinger 6	Final Weight	727.9	
	Initial Weight	726.2	
	Increase		
Impinger 7	Final Weight	630.8	
	Initial Weight	629.6	
	Increase		

Water Weight Gain

Imp 6 978.9
964.7
final 14.2

V_w =
g SO_2 = —
V_w =

Impinger 1	69.2
Impinger 2	~~14.2~~ so 16.4
Impinger 3	~~6.7~~ ~~3.5~~ 4.5 so
Impinger 4	1.9
Impinger 5	1.3
Impinger 6	1.7
Impinger 7	~~0.8~~ so 1.2
Total	~~108.8~~ 110.4 = V_w

P_b =	29.90	$\%CO_2$ =	13.8
V_m =	55.443	$\%O_2$ =	5.0
V_w =	110.4	%CO =	0.0
P_m =	0.583	$\%N_2$ =	81.2
Avg ΔP =	0.895	A_s =	~~21024~~ 16279
		D_n =	0.190
Avg$\sqrt{\Delta P}$ =	0.924	T_t =	128
C_p =	0.806		
P_s =	-14.5 "H_2O		28.83 "Hg
T_m =	~~65~~ 66 °F		~~525~~ 526 °R
T_s =	322 °F		782 °R

Moisture Content: %M = ~~8.54~~ 8.55 M_d = ~~0.9146~~ 0.9145 MW_d = 30.408 MW = 29.35

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 55.443 \left[\frac{29.90 + \frac{0.583}{13.6}}{65 + 460}\right] = \frac{\cancel{55.812}\ 55.706\ \text{sft}^3}{\cancel{0.436}\ 0.435\ \text{scfm}}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 110.4 = 5.211 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{5.211}{5.211 + \cancel{55.812}\ 55.706}$ x 100 = ~~8.54~~ 8.55 %

V_s = 5123.8 x 0.806 $\sqrt{\frac{782}{28.83 \times 29.35}}$ x 0.924 = 3668 fpm

%I = $\frac{1{,}039 \times \cancel{55.812}\ 55.706 \times 782}{28.83 \times 0.9146 \times 128 \times 3668 \times (0.190)^2}$ = ~~101.5~~ 101.3 %

ACFM: ~~535586~~ 414707

SCFM: ~~319830~~ 247,619

%EA: 30.3

VERSION 1
22 OCTOBER 2002

Run Number 1 ✓ OIt FIELD DATA

Unit Unit 2 ESP Inlet Duct ✓

Date 11-1-05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-4	1428	747.435	1.20	0.78	0.78	7.5	320	250	256	47	68	64	
3	1432	749.18	1.30	0.85	0.85	9.0	319	250	254	47	70	64	
2	1436	751.13	1.35	0.88	0.88	9.5	320	249	252	46	69	64	
1	1440	753.16	0.85	0.55	0.55	~~8.5~~ 7.5	321	249	255	46	69	68	
-	1444	754.815	-	-	-	-	-	-	-	-	-	-	V = 0.497
8-4	1459	755.312	0.25	0.16	0.16	2.5	329	256	259	60	66	65	
3	1503	756.22	0.25	0.16	0.16	2.5	329	256	255	55	68	66	
2	1507	757.09	0.20	0.13	0.13	2.5	331	260	257	56	69	65	
1	1511	757.93	0.25	0.16	0.16	3.0	301	269	257	56	65	66	
-	1515	758.775	-	-	-	-	-	-	-	-	-	-	
10-4	1515	758.775	0.80	0.52	0.52	6.5	336	262	261	56	67	67	
3	1519	760.15	0.80	0.52	0.52	6.5	337	260	260	52	66	66	
2	1523	761.75	0.75	0.49	0.49	6.5	336	259	260	53	66	66	
1	1527	763.27	0.40	0.26	0.26	5.5	335	252	262	51	68	66	
-	1531	764.415	-	-	-	-	-	-	-	-	-	-	
11-4	1531	764.415	1.00	0.65	0.65	7.5	338	260	262	52	68	66	
3	1535	766.02	1.05	0.68	0.68	7.5	339	260	262	53	68	66	
2	1539	767.89	0.90	0.59	0.59	8.0	339	255	260	52	69	65	
1	1543	769.49	0.50	0.33	0.33	6.0	339	265	266	52	69	65	
-	1547	770.865	-	-	-	-	-	-	-	-	-	-	
12-4	1547	770.865	1.20	0.78	0.78	9.0	342	261	262	52	69	65	
3	1551	772.61	1.20	0.78	0.78	9.0	342	261	262	52	69	65	
2	1555	774.45	1.40	0.91	0.91	10.5	343	254	261	53	70	65	
1	1559	776.49	0.75	0.49	0.49	8.0	344	259	263	51	71	67	
-	1603	778.850	-	-	-	-	-	-	-	-	-	-	

Version 1
22 OCTOBER 2002

83.5

METCO ENVIRONMENTAL

Job Number 05-236 ✓ | 014 Field Data | Ambient Temp. °F 75°
Job Name ADA ES Task 4 ✓ | Assumed Moisture % 10%
Run Number 3 ✓ | Read and record at the start of each test point. | Probe Length 5'
Unit Unit 2 ESP Inlet Duct ✓ | C Factor 1.0 - ~~0.70~~ 0.68 to reference.
Date 11-2-05 ✓ | Purge to: — | Initial Leak @ 15.0 "Hg = 0.000 cfm ✓
Operator Orr, Simpson, Borawski ✓ | Purge time: — | Final Leak @ 12.0 "Hg = 0.000 cfm ✓
Sample box No. 79 Meter Box No. 31-1 ✓ | Pitot Leak Check Initial ✓ Final ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1-4	1415	796.942	0.90	0.61	0.61	6.5	299	267	272	67	79	80	
3	1419	798.73	0.98	0.67	0.67	6.5	299	255	273	59	80	79	
2	1423	800.57	0.98	0.67	0.67	6.5	300	248	272	57	80	80	
1	1427	802.45	0.63	0.43	0.43	5.5	301	248	267	52	81	80	
—	1431	803.975	—	—	—	—	—	—	—	—	—	—	
2-4	1431	803.975	0.75	0.51	0.51	5.5	301	249	266	50	82	81	
3	1435	805.58	0.75	0.51	0.51	5.5	300	250	267	49	82	81	
2	1439	807.22	0.70	0.48	0.48	5.5	300	251	270	51	82	82	
1	1443	808.81	0.45	0.31	0.31	4.5	299	252	269	51	82	81	
—	1447	810.185	—	—	—	—	—	—	—	—	—	—	
3-4	1447	810.185	0.70	0.48	0.48	5.5	300	248	266	51	83	82	
3	1451	811.69	0.75	0.51	0.51	6.0	300	248	268	50	84	81	
2	1455	813.32	0.70	0.48	0.48	6.0	300	253	264	49	84	81	
1	1459	814.92	0.30	0.20	0.20	4.0	299	260	267	50	85	81	
—	1503	816.105	—	—	—	—	—	—	—	—	—	—	

Pitot Tube Calibration Factor C_p 0.806 1.000 ✓
Volume Collected V_m ~~48.790~~ ft^3 48.295
Water Collected V_w 74.2 ✓ ml
Time of Test T_t 128 ✓ min.
Stack Pressure P_s -14.5 ✓ "H_2O

Pitot Tube No. 31-5-1 ✓
Baro. Press. P_b 29.88 ✓ "Hg
Probe Tip Dia. D_n 0.190 ✓ in.
% CO_2 11.6 ✓ % CO 0.0 ✓
% O_2 7.2 ✓ % N_2 81.2 ✓
Area Stack A_s ~~7004~~ 16279 ✓ in^2

Barometer No. 31-1 ✓ Probe Tip No. 05-233-7 ✓
Total Volume of Leak Checks After Start: 0.494 ft^3
V_m = Dry Gas Meter Calibration Factor ~~0.1005~~ 1.008 ✓ X ~~48.403~~ 47.912 ✓
{Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 79

Impinger 1	Final Weight	776.8	Water Weight Gain	Impinger 1	41.8
	Initial Weight	735.0	974.3 / 965.4		
	Increase	41.8	Imp 8 8.9	Impinger 2	14.9
Impinger 2	Final Weight	726.2		Impinger 3	3.8
	Initial Weight	711.3			
	Increase	14.9		Impinger 4	1.5
			V_w =		
Impinger 3	Final Weight	748.6	g SO_2 = -	Impinger 5	1.2
	Initial Weight	744.8	V_w =		
	Increase	3.8		Impinger 6	1.6
Impinger 4	Final Weight	715.2		Impinger 7	0.5
	Initial Weight	713.7			8.9
	Increase	1.5		Total	74.2 ✓ = V_w
		744.7			
Impinger 5	Final Weight	~~744.1~~	P_b = 29.88	%CO_2 =	11.6 ✓
	Initial Weight	743.5	V_m = ~~48.790~~ 295	%O_2 =	7.2 ✓
	Increase	1.2	V_w = 74.2 ✓	%CO =	0.0 ✓
			P_m = 0.431 ✓	%N_2 =	~~81.4~~ 81.2 ✓
Impinger 6	Final Weight	728.2	Avg ΔP = 0.632 ✓	A_s =	~~21024~~ 20,279 ✓
	Initial Weight	726.6		D_n =	0.190 ✓
	Increase	1.6	Avg$\sqrt{\Delta P}$ = 0.773 ✓	T_t =	128 ✓
			C_p = 0.806 ✓		
Impinger 7	Final Weight	631.4	P_s = -14.5 ✓ H_2O		28.81 ✓ "Hg
	Initial Weight	630.9	T_m = 82 ✓ °F		542 ✓ °R
	Increase	0.5	T_s = ~~306~~ 307 °F		~~766~~ 767 ✓ °R

Moisture Content: %M = ~~6.86~~ 6.93 ✓ M_d = ~~0.9314~~ 0.9307 ✓ MW_d = 30.144 ✓ MW = ~~29.31~~ 29.30 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{48.790}\ 295 \left[\frac{29.88 + \frac{0.431}{13.6}}{82 + 460}\right] = \cancel{47.524}\ 47.042 \text{ sft}^3 = \cancel{0.371}\ 0.368 \text{ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 74.2 ✓ = 3.502 ✓ sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{3.502}{47.042 + 3.502}$ ✓ x 100 = ~~6.86~~ 6.93 ✓ %

V_s = 5123.8 x 0.806 ✓ $\sqrt{\frac{766 ✓}{28.81 \times \cancel{29.31}\ 29.30 ✓}}$ x 0.773 ✓ = ~~3040~~ 3043 ✓ fpm

ACFM: ~~443,909~~ 344,005 ✓

SCFM: ~~275,388~~ 213,006 ✓

%I = $\frac{1,039 \times 766 ✓ \times \cancel{47.524}\ 47.042 ✓}{3040 \times \cancel{0.9314}\ 0.9307 ✓ \times 28.81 ✓ \times 128 ✓ \times (0.190)^2}$ = ~~102.6~~ 99.4 ✓ %

%EA: 50.3

Run Number 3 ✓ 01+ **FIELD DATA**

Unit Unit 2 ESP Inlet Duct ✓

Date 11-2-05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-4	1503	816.105	0.85	0.58	0.58	6.5	307	254	263	50	85	81	
3	1507	817.73	0.85	0.58	0.58	6.5	300	255	263	50	85	81	
2	1511	819.44	0.88	0.60	0.60	7.0	300	255	262	50	85	81	
1	1515	821.18	0.60	0.41	0.41	6.5	301	250	265	51	86	80	
–	1519	822.732	–	–	–	–	–	–	–	–	–	–	V=0.491 ✓
8-4	1520	823.223	0.17	0.12	0.12	3.0	310	251	264	56	85	81	
3	1524	824.08	0.15	0.10	0.10	3.0	310	252	264	56	85	81	
2	1528	824.95	0.07	0.05	0.05	3.0	310	248	264	58	83	82	
1	1532	825.75	0.15	0.10	0.10	3.0	309	250	265	57	83	82	
–	1536	826.645	–	–	–	–	–	–	–	–	–	–	
10-4	~~1548~~ 1540	826.645	0.64	0.44	0.44	5.5	312	290	261	60	83	82	
3	1552	828.53	0.62	0.42	0.42	5.5	312	271	261	60	83	82	
2	1556	830.05	0.60	0.41	0.41	5.5	312	262	260	59	83	83	
1	1600	831.54	0.32	0.22	0.22	4.5	313	262	262	60	83	83	
–	1604	832.735	–	–	–	–	–	–	–	–	–	–	
11-4	1604	832.735	0.70	0.48	0.48	6.0	313	263	262	60	83	82	
3	1608	834.15	0.74	0.50	0.50	6.5	317	261	263	58	85	81	
2	1612	835.75	0.65	0.44	0.44	6.5	317	261	263	59	85	81	
1	1616	837.31	0.53	0.36	0.36	6.0	317	253	264	58	85	82	
–	1620	838.755	–	–	–	–	–	–	–	–	–	–	
12-4	1620	838.755	0.75	0.51	0.51	6.5	316	249	265	59	84	82	
3	1624	840.34	0.75	0.51	0.51	6.5	316	250	265	59	84	82	
2	1628	841.97	0.85	0.58	0.58	7.5	315	250	264	58	84	83	
1	1632	843.66	0.76	0.52	0.52	7.5	314	252	263	59	84	83	
–	1636	845.345	–	–	–	–	–	–	–	–	–	–	

Version 1
22 OCTOBER 2002

METCO ENVIRONMENTAL

Job Number: 05-234
Job Name: ADA Task 4
Run Number: 1
Unit: Unit 2 ESP Outlet
Date: 11-1-05
Operator: Trammell/Dodson/Bornsen
Sample box No. 76 Meter Box No. 27-3

Ontario Hydro Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 68
Assumed Moisture % 13.0
Probe Length 5'
C Factor 1.0 → 0.60 to reference.
Initial Leak @ 22.0" "Hg = 0.00° cfm
Final Leak @ 10.0 "Hg = 0.006 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual (P_m)	Pump Vacuum "Hg Gauge	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F (Heated Line)	Effluent Temp °F	Dry Gas Temp °F Inlet (T_m)	Dry Gas Temp °F Outlet	Remarks
1-4	1344	432.533	0.22	0.40	0.40	3.5	309	271	252	60	59	62	
1-3	1348	434.00	0.52	0.94	0.94	5.0	311	268	248	57	61	57	
1-2	1352	436.11	0.49	0.89	0.89	5.0	311	270	249	56	62	62	
1-1	1356	438.19	0.17	0.31	0.31	3.0	310	269	250	57	62	61	
END	1400	439.304	—	—	—	—	—		—	—	—	—	
2-4	1404	439.304	0.69	1.20	1.20	6.0	316	258	251	44	61	61	
2-3	1405	441.63	0.83	1.50	1.50	7.0	319	261	251	45	64	61	
2-2	1409	444.35	0.87	1.60	1.60	7.5	318	263	250	47	64	62	
2-1	1413	447.17	0.75	1.40	1.40	7.0	315	270	251	49	64	62	
END	1417	449.510	—	—	—	—	—	—	—	—	—	—	
3-4	1418	449.510	0.66	1.20	1.20	6.0	321	254	252	49	68	65	
3-3	1422	451.99	0.47	0.85	0.85	5.0	321	258	251	46	68	64	
3-2	1426	454.05	0.69	1.20	1.20	6.0	322	266	251	46	68	64	
3-1	1430	456.46	0.61	1.10	1.10	6.0	320	267	250	47	67	61	
END	1434	458.681	—	—	—	—	—	—	—	—	—	—	
4-4	1437	458.681	0.75	1.40	1.40	7.0	321	269	251	45	67	61	
4-3	1441	461.38	0.69	1.20	1.20	6.5	322	271	249	46	67	61	
4-2	1445	463.12	0.46	0.83	0.83	5.0	322	268	250	47	67	62	

Pitot Tube Calibration Factor C_p 0.805
Volume Collected V_m 71.429 ft^3
Water Collected V_w 148.0 ml
Time of Test T_t 128 min.
Stack Pressure P_s −15.0 "H_2O

Pitot Tube No. 31-5-3
Baro. Press. P_b 29.92 "Hg
Probe Tip Dia. D_n 0.246 in.
% CO_2 13.8 % CO 0.0
% O_2 5.2 % N_2 81.0
Area Stack A_s 21024 in^2

Barometer No. 31-1 Probe Tip No. 05-233-2
Total Volume of Leak Checks After Start: — ft^3
V_m = Dry Gas Meter Calibration Factor 0.991 X 72.079

{Dry Gas Meter Reading — ft^3 – (T_t — min. X Leak Rate — cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 76

Impinger 1	Final Weight	855.3		Impinger 1	108.6
	Initial Weight	746.7		Impinger 2	17.7
	Increase	108.6		Impinger 3	3.6
Impinger 2	Final Weight	690.0		Impinger 4	3.0
	Initial Weight	672.3		Impinger 5	0.3
	Increase	17.7		Impinger 6	0.2
Impinger 3	Final Weight	746.0		Impinger 7	1.0
	Initial Weight	742.4			13.6
	Increase	3.6		Total	148.0 = V_w
Impinger 4	Final Weight	697.6			
	Initial Weight	694.6			
	Increase	3.0			
Impinger 5	Final Weight	634.4			
	Initial Weight	634.1			
	Increase	0.3			
Impinger 6	Final Weight	736.9			
	Initial Weight	736.7			
	Increase	0.2			
Impinger 7	Final Weight	669.0			
	Initial Weight	668.0			
	Increase	1.0			

Water Weight Gain

V_w =
g SO_2 = -
V_w =

Imp 8 1004.2 − 990.6 = 13.6

P_b =	29.82	%CO_2 =	13.8
V_m =	71.429	%O_2 =	5.2
V_w =	148.0	%CO =	0.0
P_m =	1.055	%N_2 =	81.0
Avg ΔP =	0.583	A_s =	21.024
		D_n =	0.246
Avg$\sqrt{\Delta P}$ =	0.752	T_t =	126
C_p =	0.805		
P_s =	-15.0 "H_2O		28.72 "Hg
T_m =	64 °F		524 °R
T_s =	326 °F		786 °R

Moisture Content: %M = ~~9.90~~ 8.85 % DS M_d = 0.9115 MW_d = 30.416 MW = 29.32

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 71.429 \left[\frac{29.82 + \frac{1.055}{13.6}}{64 + 460}\right] = \frac{71.931}{0.562}\ \text{sft}^3 / \text{scfm}$$

71,932

Vw_{gas} = 0.0472 x Vw = 0.0472 x 148.0 = ~~7.023~~ 6.986 DS sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{\cancel{7.023}\ 6.986}{\cancel{7.023}\ 6.986 + \cancel{71.431}\ 71.932}$ x 100 = ~~7.90~~ 8.85 % DS

V_s = 5123.8 x 0.805 $\sqrt{\frac{786}{28.72 \times 29.32}}$ x 0.752 = 2997 fpm

ACFM: 437,518

SCFM: 258,122

%I = $\frac{1{,}039 \times 71.931 \times 786}{2997 \times 28.72 \times 0.9115 \times 126 \times (0.246)^2}$ = 96.7 %

%EA: 32.0 %

Run Number 1 ✓ Ontario Hydro FIELD DATA

Unit Unit 2 BSP Outlet ✓

Date 11/1/05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
4-1	1449	466.03	0.45	0.81	0.81	5.0	321	260	250	48	67	62	
END	1453	467.925	–	–	–	–	–	–	–	–	–	–	
9-4	1458	467.925	0.58	1.05	1.05	5.5	331	269	248	51	67	64	
3	1502	470.16	0.56	1.00	1.00	5.0	330	265	250	49	67	64	
2	1506	472.39	0.45	0.81	0.81	5.0	331	266	251	50	67	63	
1	1510	474.46	0.53	0.95	0.95	5.0	334	267	251	46	67	63	
END	1514	476.536	–	–	–	–	–	–	–	–	–	–	
10-4	1516	476.536	0.78	1.40	1.40	6.0	330	265	250	45	67	62	
3	1520	479.31	0.56	1.00	1.00	5.0	332	266	251	47	68	61	
2	1524	481.65	0.68	1.20	1.20	5.5	333	271	252	44	68	62	
1	1528	484.00	0.61	1.10	1.10	5.5	335	269	252	45	68	62	
END	1532	486.171	–	–	–	–	–	–	–	–	–	–	
11-4	1535	486.171	0.53	0.95	0.95	5.0	334	265	251	46	68	62	
3	1539	488.460	0.69	1.20	1.20	6.0	334	268	252	47	68	62	
2	1543	491.05	0.91	1.60	1.60	7.0	335	269	251	46	67	62	
1	1547	493.99	0.80	1.40	1.40	6.5	334	272	250	48	67	62	
END	1551	496.427	–	–	–	–	–	–	–	–	–	–	
12-4	1553	496.427	0.58	1.00	1.00	5.0	339	270	254	49	68	63	
3	1558	499.51	0.77	1.40	1.40	6.0	339	265	252	47	68	63	
2	1602	501.99	0.29	0.50	0.50	3.0	339	268	252	51	68	62	
1	1606	503.59	0.20	0.36	0.36	3.0	339	261	251	47	69	63	
END	1610	504.611	–	–	–	–	–	–	–	–	–	–	

Version 1
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METCO ENVIRONMENTAL

Job Number: 05-236
Job Name: ADA-ES Task 4
Run Number: 3
Unit: Unit 2 ESP Outlet Duct
Date: 11-2-05
Operator: Trammell/Dakon/Bernson
Sample box No. 76 Meter Box No. 27-3

Ontario Hydro Field Data

Read and record at the start of each test point.

Purge to: -
Purge time: -
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 81
Assumed Moisture % 13.0
Probe Length 5'
C Factor 1.854 to reference.
Initial Leak @ 15.0 "Hg = 0.004 cfm
Final Leak @ 10.0 "Hg = 0.001 cfm

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Heated Line ~~Oven~~ Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
12-4	1418	533.984	0.45	0.83	0.83	5.0	309	253	270	67	74	75	
3	1422	535.21	0.55	1.00	1.00	6.0	311	256	268	64	75	76	
2	1426	537.46	0.28	0.52	0.52	4.0	312	250	264	60	75	75	
1	1430	539.09	0.15	0.28	0.28	3.5	308	253	255	60	75	75	
END	1434	540.223	-	-	-	-	-	-	-	-	-	-	
11-4	1435	540.223	0.35	0.65	0.65	4.0	312	254	268	59	75	76	
3	1439	542.00	0.52	0.96	0.96	5.0	312	262	262	58	76	75	
2	1443	544.21	0.67	1.20	1.20	6.5	312	264	262	56	76	75	
1	1447	546.68	0.55	1.00	1.00	6.0	313	266	263	55	77	76	
END	1451	548.741	-	-	-	-	-	-	-	-	-	-	
10-4	1452	548.741	0.48	0.89	0.89	5.0	315	267	266	53	81	77	
3	1456	550.86	0.41	0.76	0.76	5.0	311	266	266	55	81	77	
2	1500	552.84	0.52	0.96	0.96	5.5	311	273	270	55	82	76	
1	1504	555.05	0.45	0.83	0.83	5.0	313	271	268	53	82	76	
END	1508	556.946	-	-	-	-	-	-	-	-	-	-	
9-4	1509	556.946	0.38	0.70	0.70	4.0	309	261	269	52	83	77	
3	1514	558.83	0.40	0.74	0.74	4.0	309	264	269	53	83	77	
2	1518	560.79	0.34	0.63	0.63	4.0	310	250	263	54	83	77	

Pitot Tube Calibration Factor C_p 0.805
Volume Collected V_m 61.949 ft^3
Water Collected V_w 71.9 99.9 ml
Time of Test T_t 128 min.
Stack Pressure P_s -14.5 "H_2O

Pitot Tube No. 31-5-3
Baro. Press. P_b 29.88 "Hg
Probe Tip Dia. D_n 0.246 in.
% CO_2 11.4 % CO 0.0
% O_2 7.4 % N_2 81.2
Area Stack A_s 21024 in^2

Barometer No. 31-1 Probe Tip No. 05-236-2
Total Volume of Leak Checks After Start: - ft^3
V_m = Dry Gas Meter Calibration Factor 0.991 x 62.512

{Dry Gas Meter Reading - ft^3 – (T_t - min. X Leak Rate - cfm)}

VERSION 1
22 OCTOBER 2002

Impinger Box No. 76

Impinger 1	Final Weight	823.5 ~~799.5~~ ~~810.5~~	
	Initial Weight	DS 748.7	
	Increase	~~49.8~~ 74.8	
Impinger 2	Final Weight	681.2	
	Initial Weight	673.3	
	Increase	7.9	
Impinger 3	Final Weight	748.9	
	Initial Weight	747.3	
	Increase	1.6	
Impinger 4	Final Weight	701.8	
	Initial Weight	699.9	
	Increase	1.9	
Impinger 5	Final Weight	630.9	
	Initial Weight	630.6	
	Increase	000.3	
Impinger 6	Final Weight	731.7	
	Initial Weight	732.5	
	Increase	~~3.8~~ -0.8	
Impinger 7	Final Weight	667.1	
	Initial Weight	666.3	
	Increase	0.8	

Water Weight Gain

Imp 8 1017.2 / 1003.8 / 13.4

V_w =	
g SO_2 =	-
V_w =	

Impinger 1	74.8 ~~49.8~~ DS
Impinger 2	7.9
Impinger 3	1.6
Impinger 4	1.9
Impinger 5	000.3
Impinger 6	~~-3.8~~ -0.8
Impinger 7	0.8 / 13.4
Total	~~71.9~~ DS = V_w ~~96.9~~ 99.9

P_b =	29.88	%CO_2 =	11.4
V_m =	61.949	%O_2 =	7.4
V_w =	DS ~~71.9~~ ~~96.9~~ 99.9	%CO =	0.0
P_m =	0.799	%N_2 =	81.2
Avg ΔP =	0.433	A_s =	21.02
		D_n =	0.246
Avg$\sqrt{\Delta P}$ =	0.649	T_t =	128
C_p =	0.805		
P_s =	-14.6 "H_2O	29.81	"Hg
T_m =	79 °F	539	°R
T_s =	306 °F	766	°R

Moisture Content: %M = ~~5.29~~ 7.00 / DS 7.20 M_d = ~~0.9471~~ ~~0.9300~~ / DS 0.9270 MW_d = 30.120 MW = ~~29.48~~ ~~29.27~~ / DS 29.25

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 61.949 \left[\frac{29.88 + \frac{0.799}{13.6}}{79 + 460}\right] = 60.733\ \text{sft}^3 \quad 0.974\ \text{scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x ~~71.9~~ ~~96.9~~ DS 99.9 = ~~3.394~~ ~~4.574~~ 4.715 sft³

% Moisture = Vw_{gas} / (Vm_{std} + Vw_{gas}) x 100 = ~~3.394~~ ~~4.574~~ 4.715 / (60.733 + ~~3.394~~ ~~4.574~~ 4.715) x 100 = ~~5.29~~ ~~7.00~~ 7.20 %

V_s = 5123.8 x 0.805 x 766 / (~~29.48~~ 29.27 x 28.81) x 0.649 = ~~2542~~ ~~2551~~ 2552 fpm (DS)

%I = 1,039 x 766 x 60.733 / (~~2542~~ ~~2551~~ 2552 x ~~0.9971~~ ~~0.9300~~ 0.9270 x 28.81 x 128 x (0.246)²) = ~~91.2~~ 91.5 %

DS ACFM: ~~371,162~~ ~~372,492~~ 372,619

SCFM: ~~230,742~~ 230,337

%EA: 52.4%

Run Number 3 ✓ O.H FIELD DATA

Unit Unit 2 ESP Outlet Duct ✓

Date 11/2/05 ✓

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Gauge	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Remarks
1	1522	562.87	0.35	0.65	0.65	4.0	312	253	265	54	83	77	
END	1526	564.380	–	–	–	–	–	–	–	–	–	–	
4-4	1531	564.390	0.55	1.00	1.00	5.0	302	273	269	58	81	77	
3	1535	566.74	0.49	0.91	0.91	5.0	302	271	267	58	82	77	
2	1539	568.916	0.39	0.72	0.72	4.5	303	269	267	59	83	77	
1	1543	570.93	0.29	0.54	0.54	4.0	303	267	268	54	83	77	
END	1547	572.435	–	–	–	–	–	–	–	–	–	–	
3-4	1549	572.435	0.45	0.83	0.83	4.0	302	261	267	53	83	77	
3	1553	574.48	0.36	0.67	0.67	4.0	302	264	266	53	83	76	
2	1557	576.38	0.50	0.93	0.93	5.0	303	266	267	51	83	76	
1	1601	578.52	0.41	0.76	0.76	4.5	301	258	264	55	83	75	
END	1605	580.365	–	–	–	–	–	–	–	–	–	–	
2-4	1607	580.365	0.51	0.95	0.95	5.0	299	259	265	55	83	75	
3	1611	582.94	0.66	1.20	1.20	6.0	300	260	267	57	84	75	
2	1615	585.35	0.69	1.30	1.30	6.5	301	256	265	55	86	76	
1	1619	587.96	0.53	0.98	0.98	6.0	300	256	266	55	86	76	
END	1623	589.981	–	–	–	–	–	–	–	–	–	–	
1-4	1624	589.981	0.18	0.33	0.33	3.0	297	258	266	56	86	76	
3	1628	591.36	0.40	0.74	0.74	4.0	294	257	267	58	83	75	
2	1632	593.30	0.44	0.82	0.82	4.5	296	258	264	58	83	75	
1	1636	595.38	0.16	0.30	0.30	3.0	296	259	266	59	83	75	
END	1640	596.496	–	–	–	–	–	–	–	–	–	–	

Version 1
22 OCTOBER 2002

APPENDIX E

Analytical Data

Data Analysis Technologies, Inc.

7715 Corporate Blvd.
Plain City, OH 43064
NELAP/LELAP Certification 03027

Sample Analysis Certificate

Client:	Metco Environmental	Date:	12/8/05
Address:	3226 Commander Drive	DAT Project #:	1105021
	Carrollton, TX 75006	Sample Date:	11/01-02/05
		Date Received:	11/15/05
		Date Analyzed:	12/08/05
		Analyst:	JL/DE

Attn: Steve Bornsen
Your Project: 05-236 ADA-ES
Sampled By: S.B.

Analysis: Mercury
Method: Ontario Hydro

Results: See attached summary tables.

QC: Met criteria for the method.

Reviewed and approved for release by: _____ Date: 12/8/05
President *DAT* Inc.

NELAP/LELAP Certification # 03027
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Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1105021
Client: Metco Environmental
Site: ADA-ES

Prep Date: 12/7/05
Analysis Date: 12/8/05

Client ID	DAT ID	*MDL*	Hg Total ug	Q	Dup Result Total ug
Inlet Run 1					
Filter/F.H. Rinse	1105021- 1,2	*0.02*	ND	PB	
B.H. Rinse Imp 1-3	1105021- 3a	*0.05*	ND	OV	
B.H. Rinse Imp 1-3	1105021- 3b	*0.04*	0.24		
Imp 4	1105021- 4	*0.24*	ND	E1	
Imp 5-7	1105021- 5	*0.08*	1.56		
Inlet Run 3					
Filter/F.H. Rinse	1105021- 6,7	*0.02*	0.02		
B.H. Rinse Imp 1-3	1105021- 8a	*0.07*	0.53		
B.H. Rinse Imp 1-3	1105021- 8b	*0.03*	ND		
Imp 4	1105021- 9	*0.27*	ND		
Imp 5-7	1105021- 10	*0.08*	1.58		

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1105021
Client: Metco Environmental
Site: ADA-ES

Prep Date: 12/7/05
Analysis Date: 12/8/05

Client ID	DAT ID	*MDL*	Hg Total ug	Q	Dup Result Total ug
Outlet Run 1					
Filter/F.H. Rinse	1105021- 11,12	*0.02*	0.29		
B.H. Rinse Imp 1-3	1105021- 13a	*0.08*	1.08		
B.H. Rinse Imp 1-3	1105021- 13b	*0.03*	ND		
Imp 4	1105021- 14	*0.26*	ND		
Imp 5-7	1105021- 15	*0.08*	0.48		
Outlet Run 3					
Filter/F.H. Rinse	1105021- 16,17	*0.02*	0.20		
B.H. Rinse Imp 1-3	1105021- 18a	*0.08*	0.37		
B.H. Rinse Imp 1-3	1105021- 18b	*0.03*	ND		
Imp 4	1105021- 19	*0.30*	ND		
Imp 5-7	1105021- 20	*0.08*	0.11		

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1105021
Client: Metco Environmental
Site: ADA-ES

Prep Date: 12/7/05
Analysis Date: 12/8/05

Client ID	DAT ID	*MDL*	Hg Total ug	Q	Dup Result Total ug
Field Blank					
Filter/F.H. Rinse	1105021- 21,22	*0.02*	ND		
B.H. Rinse Imp 1-3	1105021- 23	*0.77*	ND		
Imp 4	1105021- 24	*0.03*	ND		
Imp 5-7	1105021- 25	*0.08*	ND		
Reagent Blanks					
Filter/ 0.1N HNO3	1105021- 31,26	*0.02*	ND		
KCL	1105021- 27	*0.01*	ND		
5% HNO3/ 10% H2O2	1105021- 28	*0.10*	ND		
KMnO4	1105021- 29	*0.01*	ND		
10% Hydroxylamine	1105021- 30	*0.02*	ND		

ND = Not detected at the detection limit shown

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1105021
Client: Metco Environmental
Site: ADA-ES

Prep Date: 12/7/05
Analysis Date: 12/8/05

QC Summary		Hg ug/L	% Rec	%RPD
Front Method Blank	1105021-MB Front	0.05 ND		
Back Method Blank	1105021-MB Back	0.05 ND		
Laboratory Spike	1105021-LS Front	12.0	120	
Laboratory Spike	1105021-LS Back	10.4	104	
Matrix Spike	1105021-5 MS	9.94	99	
	1105021-5 MSD	9.73	97	2.1
Matrix Spike	1105021-14 MS	10.09	101	
	1105021-14 MSD	9.69	97	4.0
Matrix Spike	1105021-20 MS	10.03	100	
	1105021-20 MSD	10.09	101	0.6

ND = Not detected at the detection limit shown.

DOCUMENTATION

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064.

Project Number: 1105021

1 OF 3

Date Received:	11/15/2005	**Carrier:**	FedEx
Client Name:	Metco Environmental	**Analysis:**	Mercury (Hg)/Ontario Hy
Tracking number:	602557620798	**Package Temp:**	ambient
Custody Seals ?:	No	**COC:**	☑ check if COC from client

Sample Information

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
Run 1 Inlet Filter Cont. 1	1105021-1	11/1/2005	Air (filter)	glas jar	
Run 1 Inlet FW Cont. 2	1105021-2	11/1/2005	front wash	amber jar	
Run 1 Inlet Imp 1,2,3 Cont. 3	1105021-3a/b	11/1/2005	aqueous	amber jar	
Run 1 Inlet Imp 4 Cont. 4	1105021-4	11/1/2005	aqueous	amber jar	
Run 1 Inlet Imp 5,6,7 Cont. 5	1105021-5	11/1/2005	aqueous	amber jar	
Run 3 Inlet Filter Cont. 1	1105021-6	11/2/2005	Air (filter)	glas jar	
Run 3 Inlet FW Cont. 2	1105021-7	11/2/2005	front wash	amber jar	
Run 3 Inlet Imp 1,2,3 Cont. 3	1105021-8a/b	11/2/2005	aqueous	amber jar	
Run 3 Inlet Imp 4 Cont. 4	1105021-9	11/2/2005	aqueous	amber jar	
Run 3 Inlet Imp 5,6,7 Cont. 5	1105021-10	11/2/2005	aqueous	amber jar	
Run 1 Outlet Filter Cont. 1	1105021-11	11/1/2005	Air (filter)	glas jar	

KGS

Laboratory Receiving Initials

1105021

11/15/2005 11:37:14 AM

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064.

Project Number: 1105021

2 OF 3

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
Run 1 Outlet FW Cont. 2	1105021-12	11/1/2005	front wash	amber jar	
Run 1 Outlet Imp 1,2,3 Cont. 3	1105021-13a/b	11/1/2005	aqueous	amber jar	
Run 1 Outlet Imp 4 Cont. 4	1105021-14	11/1/2005	aqueous	amber jar	
Run 1 Outlet Imp 5,6,7 Cont. 5	1105021-15	11/1/2005	aqueous	amber jar	
Run 3 Outlet Filter Cont. 1	1105021-16	11/2/2005	Air (filter)	glas jar	
Run 3 Outlet FW Cont. 2	1105021-17	11/2/2005	front wash	amber jar	
Run 3 Outlet Imp 1,2,3 Cont. 3	1105021-18a/b	11/2/2005	aqueous	amber jar	
Run 3 Outlet Imp 4 Cont. 4	1105021-19	11/2/2005	aqueous	amber jar	
Run 3 Outlet Imp 5,6,7 Cont. 5	1105021-20	11/2/2005	aqueous	amber jar	
BT Filter Cont. 1	1105021-21	11/2/2005	Air (filter)	glas jar	
BT FW Cont. 2	1105021-22	11/2/2005	front wash	amber jar	
BT Imp 1,2,3 Cont. 3	1105021-23	11/2/2005	aqueous	amber jar	
BT Imp 4 Cont. 4	1105021-24	11/2/2005	aqueous	amber jar	
BT Imp 5,6,7 Cont. 5	1105021-25	11/2/2005	aqueous	amber jar	
RB 0.1N HNO3 Cont. 7	1105021-26	11/2/2005	HNO3	amber jar	
RB 1N KCl Cont. 8	1105021-27	11/2/2005	KCl	amber jar	

KAS

Laboratory Receiving Initials

1105021

11/15/2005 11:37:14 AM

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064.

Project Number: 1105021

3 of 3

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
RB HNO3/H2O2 Cont. 9	1105021-28	11/2/2005	HNO3/H2O2	amber jar	
RB KMnO4 Cont. 10	1105021-29	11/2/2005	HNO3/H2O2	amber jar	
RB Hydroxylamine Cont. 11	1105021-30	11/2/2005	hydrox.amine	amber jar	
RB Filter Cont. 12	1105021-31	11/2/2005	Air (filter0	glass jar	

Laboratory Receiving Initials

1105021

11/15/2005 11:37:14 AM

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Inlet Duct

Project Manager: Steve Bornsen
Project Supervisor: Steve Bornsen

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec. Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter Cont. 1	11-1-05	1645	1								✓		Steve Bornsen	
Run 1 Frontwash Cont. 2		1645	1								✓		Steve Bornsen	
Run 1 Imp. 1,2,3 Cont. 3		1815	2	KCl	300ml						✓		Steve Bornsen	
Run 1 Imp. 4 Cont. 4		1915	1	HNO_3 - H_2O_2	100ml						✓		Steve Bornsen	
Run 1 Imp 5,6,7 Cont. 5		1915	1	$KMnO_4$	300ml						✓		Steve Bornsen	
Run 3 Filter Cont. 1	11-2-05	1700	1								✓		Steve Bornsen	no run 2
Run 3 Frontwash Cont. 2		1700	1								✓		Steve Bornsen	

Samples Received for Transport/Shipment by:	Steve Bornsen	Date: 11-2-05	Time: 1930
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	DAT. Fed Ex Steve Bornsen	Date: 11-4-05	Time: 0830
Samples Received at Laboratory by:	[illegible]	Date: 11/15/05	Time: 11:20
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Inlet Duct

Project Manager: Steve Bonson
Project Supervisor: Steve Bonson

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	Spec Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 Imp. 1,2,3 Cont. 3	11-2-05	1730	2	KCl	300ml						✓		[illegible]	
Run 3 Imp. 4 Cont. 4		1730	1	HNO_3 - H_2O_2	100ml						✓		[illegible]	
Run 3 Imp. 5,6,7 Cont. 5		1730	1	$KMnO_4$	300ml						✓		[illegible]	

Samples Received for Transport/Shipment by:	[illegible]	Date: 11-2-05	Time: 1900
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	DAT - Fed Ex [illegible]	Date: 11-4-05	Time: 0830
Samples Received at Laboratory by:	[illegible]	Date: 11/15/05	Time: 19:20
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Outlet Duct

Project Manager: Steve Bonner
Project Supervisor: Steve Bonner
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	Speciation Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter Cont. 1	11-1-05	1630	1								✓		Steve Bonner	
Run 1 Frontwash Cont. 2		1630	1								✓		Steve Bonner	
Run 1 Imp. 1,2,3 Cont. 3		1745	2	KCl	300ml						✓		Steve Bonner	
Run 1 Imp. 4 Cont. 4		1745	1	HNO_3-H_2O_2	100ml						✓		Steve Bonner	
Run 1 Imp. 5,6,7 Cont. 5		1745	1	$KMnO_4$	300ml						✓		Steve Bonner	
Run 3 Filter Cont. 1	11-2-05	1710	1								✓		Steve Bonner	no run 2
Run 3 Frontwash Cont. 2		1710	1								✓		Steve Bonner	

Samples Received for Transport/Shipment by: Steve Bonner	Date: 11-2-05	Time: 1900
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Shipped Via: DAT - FedEx Steve Bonner	Date: 11-4-05	Time: 0830
Samples Received at Laboratory by: [illegible]	Date: 11/15/05	Time: 11:20
Samples Analyzed by:	Date:	Time:
Samples Analyzed by:	Date:	Time:
Data Checked by:	Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Outlet Duct

Project Manager: Steve Donnelly
Project Supervisor: Steve Bowen

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	See Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run-3 Imp. 1,2,3 Cont. 3	11-2-05	1745	2	KCl	300ml						✓		Steve Bowen	
Run 3 Imp. 4 Cont. 4		1745	1	$HNO_3 \cdot H_2O_2$	100 ml						✓		Steve Bowen	
Run 3 Imp 5,6,7 Cont 5		1745	1	$KMnO_4$	300ml						✓		Steve Bowen	

Samples Received for Transport/Shipment by:	Steve Bowen	Date: 11-2-05	Time: 1900
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	DAT-Fed Ex Steve Bowen	Date: 11-4-05	Time: 0830
Samples Received at Laboratory by:	[illegible]	Date: 11/15/05	Time: 11:20
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Inlet/Outlet Duct

Project Manager: [redacted]
Project Supervisor: [redacted]

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	Spec. Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Blank Train														
BT Filter Cont. 1	11-2-05	1530	1								✓		[illegible]	
BT Frontwash Cont. 2		1530	1								✓		[illegible]	
BT Imp 1,2,3 Cont. 3		1530	1	KCl	300ml						✓		[illegible]	
BT Imp. 4 Cont. 4		1530	1	$HNO_3 \cdot H_2O_2$	100ml						✓		[illegible]	
BT Imp 5,6,7 Cont. 5		1530	1	$KMnO_4$	300ml						✓		[illegible]	

Samples Received for Transport/Shipment by:	[illegible]	Date: 11-2-05	Time: 1900
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	DAT FedEx [illegible]	Date: 11-4-05	Time: 0830
Samples Received at Laboratory by:	[illegible]	Date: 11/15/05	Time: 11:20
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:		Date:	Time:

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Inlet/Outlet Duct

Project Manager: Steve Donsen
Project Supervisor: Steve Donsen
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Reagent Blanks														
RB 0.1N HNO_3 Cont. 7	11/2/05	1900	1								✓		Steve Donsen	
RB 1N KCl Cont. 8		1900	1								✓		Steve Donsen	
RB 5% HNO_3 - 10% H_2O_2 Cont. 9		1900	1								✓		Steve Donsen	
RB Acid $KMnO_4$ Cont. 10		1900	1								✓		Steve Donsen	
RB Hydroxylamine Cont. 11		1900	1								✓		Steve Donsen	
RB Filter Cont. 12		1900	1								✓		Steve Donsen	

Samples Received for Transport/Shipment by: Steve Donsen	Date: 11-2-05	Time: 1900	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via: DAS - FedEx Steve Donsen	Date: 11-4-05	Time: 0830	
Samples Received at Laboratory by: [illegible]	Date: 11/15/05	Time: 11:20	
Samples Analyzed by:	Date:	Time:	
Samples Analyzed by:	Date:	Time:	
Data Checked by:	Date:	Time:	

VERSION 2
10 MARCH 2003

DAT Labs, Inc. Extraction Form

Project # 1105021
METCO

Extraction	Solvent	Volume mls	Reps
Soxhlet	Hexane		
Sep Funnel	Methanol		
Sonication	Methylene Chloride		
Cont. Ext	ACN		
Vial	Ethyl Acetate		
SPE Distill	IPA		
Other	Toluene		
No Extract	X Water		

X Other (Describe) Digestion w/ 7mL HF + 5mL Aqua Regia

Sample: SOLIDS (LIQUID) AIR

Analysis: Hg - Ontario-Hydro

Prepared By: JEL

Date: Prep 12/5/05 12/6/05 Analysis 12/8/05

Spike Witness: DE

Solvent Manufac:

Solvent Lot #

SURROGATE ID	VOL mls / ul	CONC
SL-		
SL-		
SL-		

LS/MS ID	VOL mls / (ul)	CONC
SL- LSB	400	1µg/ml
SL- LSF	40 µL	1000µg/ml
SL-		

INT STD ID	VOL mls / ul	CONC
SL-		
SL-		
SL-		

COMMENTS

SAMPLE ID	Original Vol (mL) TOTAL ~~SAMPLE AMNT~~	Final Volume (mL) SAMPLE AMNT EXTRACTED	Aliquot Vol ~~TOTAL EXTRACT VOL~~ (ADD ALL REPS)	Final Vol. ~~FINAL EXTRACT VOL~~ mls / ul	SURR INIT	SPK INIT	IS INIT
1105021-1,2	(5) 295	100	10	40			
1105021-3a	260		10				
1105021-4	120		1				
1105021-5	395		10				
1105021-6,7	(7) 185	100	10				
1105021-8a	355		10				
1105021-9	135		1				
1105021-10	380		10	40			
1105021-3b	190		10				
1105021-8b	165		10				
1105021-11,12	(12) 180	100	10				
1105021-13a	420		10				
1105021-13b	140		10				
1105021-14	128		1				

If extract was split for additional analyses, please note the aliquot volume for this analysis and at what point the extract was spiked.

ALIQUOT VOLUME: mls ul (Circle one)

Extract was spiked: Before After the split. (Circle one)

Additional samples may be listed on the back of this page.

Project # 1105021 Continued from other side

SAMPLE ID	Orig. Vol. (mL) ~~TOTAL SAMPLE AMNT~~	Final Vol (mL) ~~SAMPLE AMNT EXTRACTED~~	Aliquot Vol ~~TOTAL EXTRACT VOL~~ (ADD ALL REPS)	Final Vol. ~~FINAL EXTRACT VOL~~ mls / ul	SURR INIT	SPK INIT	IS INIT
1105021-15	400	—	10	40			
1105021-16/17	(17) 140	100	10	↓			
1105021-18a	415	X	10	↓			
1105021-18b	145	X	10	↓			
1105021-19	150	X	1	↓			
1105021-20	390	X	10	↓			
1105021-21/22	(22) 160	100	10	40			
1105021-23	385	X	10	↓			
1105021-24	130	X	1	↓			
1105021-25	380	X	10	↓			
1105021-31,26	(26) 60	100	10	↓			
1105021-27	55	X	10	40			
1105021-28	50	X	1	↓			
1105021-29	55	X	10	↓			
1105021-30	100	—	10	↓			
1105021-mbf	100	100	40	40			
1105021-lsf	100	100	1	40			

Notes:

JBR
Initial

frmgcmex112601

004762

Data Analysis Technologies

Mercury by Ontario Hydro Method: Data Summary

Project Number: 1105021
Client: Metco Environmental
Site: ADA-ES

Prep Date: 12/7/05
Analysis Date: 12/8/05

Thimble Sample #	Weight Digested (g)
1105021-1	0.5291
1105021-6	0.584
1105021-11	0.5906
1105021-16	0.4958
1105021-21	0.5808
1105021-26	0.5952

SHIPPER'S DECLARATION FOR DANGEROUS GOODS **(Provide at least three copies to the airline.)**

Shipper
Robert Peel
Metco Environmental
3226 Commander Drive
CARROLLTON TX 75006 US

Air Waybill No. 602557620798 NZ CMHA
Page 1 of 1 Pages
Shipper's Reference Number *(optional)*

Consignee
Ron Mitchum
DAT, Inc.
7715 Corporate
Plain City OH 43064 US

FedEx Express

Two completed and signed copies of this Declaration must be handed to the operator

WARNING

Failure to comply with all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.

TRANSPORT DETAILS

This shipment is within the limitations prescribed for: *(delete non applicable)*

PASSENGER AND CARGO AIRCRAFT	CARGO AIRCRAFT ONLY

Airport of Departure: CARROLLTON

Airport of Destination: Plain City NCOMH

Shipment type: *(delete non-applicable)*
NON-RADIOACTIVE | RADIOACTIVE

NATURE AND QUANTITY OF DANGEROUS GOODS

UN Number or Identification Number, Proper Shipping name, Class or Division, Packing Group (if required), and all other required information

Corrosive liquid, oxidizing, n.o.s. 8 (5.1) UN3093 II 1 WOODEN CRATE X 613
(NITRIC ACID/HYDROGEN PEROXIDE) 9.50 L

Additional Handling Information

I declare that all of the applicable air transport requirements have been met.

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable International and National Governmental Regulations. I declare that all of the applicable air transport requirements have been met.

Emergency Telephone Number
8002553924

Name/Title of Signatory
ROBERT PEEL SHIPPER
Place and Date
DALLAS 11/07/2005
Signature *(see warning above)* Robert Peel

FOR RADIOACTIVE MATERIAL SHIPMENT ACCEPTABLE FOR PASSENGER AIRCRAFT, THE SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN OR INCIDENT TO RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.

M-1421C 146491 11/02 SRC

DAT Labs Inc.
Sample Receipt Report

Client: Metro Env.

Custodian Initial: KCS Date: 11/15/05

The client has been contacted.

_____ Yes _____ No

Upon receipt of samples, check if any of the following discrepancies have been noted.

	Discrepancy Type	*Specify applicable client ID or "all"*
	COC and samples do not match	
	No unique sample identifications	
	Samples received outside of the required temp criteria. **Receipt Temp:** Ambient	
	No preservation type was noted	
	No date of collection stated	
	No time of collection stated	
	The sample collector was not named	
	Sample containers were not appropriate	
	Sample labels were destroyed or unreadable	
	Samples were received outside of holding time	
	There was not enough sample to perform the requested analysis.	
	Samples showed sign of damage or contamination.	
	Aqueous samples for volatile analysis: Headspace? Y N If Y (es), details:	
	Sample pH acidic basic neutral Please describe any outliers or nonconformances below.	

Details: _____

Sample pH for nonvolatile aqueous samples and presence or absence of headspace (Y or N) for aqueous samples shall be recorded at time of sample log-in.
Under no circumstances shall VOA vials be opened at time of sample receipt.

Other Discrepancies:

Sample ID	**Discrepancy**

☑ ***Upon receipt, the samples met all of DAT's acceptance criteria.*** ***DAT Project #*** 110521

FRMSRR081501

APPENDIX F

Chain of Custody

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Inlet Duct

Project Manager: Steve Bonsen
Project Supervisor: Steve Bonsen

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	gas.		Recovered by	REMARKS (Specific Compounds/Methods)
Run 1 Filter Cont. 1	11-1-05	1645	1								✓		Steve Bonsen	
Run 1 Frontwash Cont. 2		1645	1								✓		Steve Bonsen	
Run 1 Imp. 1,2,3 Cont. 3		1815	2	KCl	300 ml						✓		Steve Bonsen	
Run 1 Imp. 4 Cont. 4		1815	1	HNO_3 - H_2O_2	100 ml						✓		Steve Bonsen	
Run 1 Imp 5,6,7 Cont. 5		1815	1	$KMnO_4$	300 ml						✓		Steve Bonsen	
Run 3 Filter Cont. 1	11-2-05	1700	1								✓		Steve Bonsen	no run 2
Run 3 Frontwash Cont. 2		1700	1								✓		Steve Bonsen	

Samples Received for Transport/Shipment by:	Steve Bonsen	Date:	11-2-05	Time:	1930
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Shipped Via:	DAT-Fed Ex Steve Bonsen	Date:	11-4-05	Time:	0830
Samples Received at Laboratory by:	[illegible]	Date:	11/15/05	Time:	11:20
Samples Analyzed by:		Date:		Time:	
Samples Analyzed by:		Date:		Time:	
Data Checked by:	[illegible]	Date:	12/13/05	Time:	1400

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Inlet Duct

Project Manager: Steve Bonner
Project Supervisor: Steve Bonner

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	SAMPLE ANALYSIS REQUIRED: PART	HCL	CL2	SO2	SO3	Spec Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run 3 Imp. 1,2,3 Cont. 3	11-2-05	1730	2	KCl	300ml						✓		[illegible]	
Run 3 Imp. 4 Cont. 4		1730	1	HNO_3 - H_2O_2	100ml						✓		[illegible]	
Run 3 Imp. 5,6,7 Cont. 5		1730	1	$KMnO_4$	300ml						✓		[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 11-2-05	Time: 1900	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via: DAT - Fed Ex [illegible]	Date: 11-4-05	Time: 0830	
Samples Received at Laboratory by: [illegible]	Date: 11/25/05	Time: 19:20	
Samples Analyzed by:	Date:	Time:	
Samples Analyzed by:	Date:	Time:	
Data Checked by: [illegible]	Date: 12/13/05	Time: 1400	

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Outlet Duct

Project Manager: Steve Bonner
Project Supervisor: Steve Bonner

Method: 01f

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Speciate Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run1 Filter Cont. 1	11-1-05	1630	1								✓		[illegible]	
Run1 Frontwash Cont. 2		1630	1								✓		[illegible]	
Run1 Imp. 1,2,3 Cont. 3		1745	2	KCl	300ml						✓		[illegible]	
Run1 Imp. 4 Cont. 4		1745	1	HNO_3-H_2O_2	100ml						✓		[illegible]	
Run1 Imp. 5,6,7 Cont. 5		1745	1	$KMnO_4$	300ml						✓		[illegible]	
Run3 Filter Cont. 1	11-2-05	1710	1								✓		[illegible]	no run 2
Run3 Frontwash Cont. 2		1710	1								✓		[illegible]	

Samples Received for Transport/Shipment by:	[illegible]	Date:	11-2-05	Time:	1900
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Received for Transport/Shipment by:		Date:		Time:	
Samples Shipped Via:	DAT - Fedex [illegible]	Date:	11-4-05	Time:	0830
Samples Received at Laboratory by:	[illegible]	Date:	11/15/05	Time:	11:20
Samples Analyzed by:		Date:		Time:	
Samples Analyzed by:		Date:		Time:	
Data Checked by:	[illegible]	Date:	12/13/05	Time:	1400

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Un. 1 + 2 ESP Outlet Duct

Project Manager: Steve Donnan
Project Supervisor: Steven Bowen
Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Run-3 Imp. 1,2,3 Cont. 3	11-2-05	1745	2	KCl	300ml						✓		[illegible]	
Run 3 Imp. 4 Cont. 4		1745	1	$HNO_3 \cdot H_2O_2$	100 ml						✓		[illegible]	
Run 3 Imp 5,6,7 Cont 5		1745	1	KMnO4	300ml						✓		[illegible]	

Samples Received for Transport/Shipment by:	[illegible]	Date: 11-2-05	Time: 1900
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Received for Transport/Shipment by:		Date:	Time:
Samples Shipped Via:	DAT-Fed Ex [illegible]	Date: 11-4-05	Time: 0830
Samples Received at Laboratory by:	[illegible]	Date: 11/15/05	Time: 11:20
Samples Analyzed by:		Date:	Time:
Samples Analyzed by:		Date:	Time:
Data Checked by:	[illegible]	Date: 12/13/05	Time: 1400

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Inlet/Outlet Duct

Project Manager: [illegible]
Project Supervisor: [illegible]

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec. Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Blank Train														
BT Filter Cont. 1	11-2-05	1530	1								✓		[illegible]	
BT Frontwash Cont. 2		1530	1								✓		[illegible]	
BT Imp 1,2,3 Cont. 3		1530	1	KCl	300ml						✓		[illegible]	
BT Imp. 4 Cont. 4		1530	1	$HNO_3 \cdot H_2O_2$	100ml						✓		[illegible]	
BT Imp 5,6,7 Cont. 5		1530	1	$KMnO_4$	300ml						✓		[illegible]	

Samples Received for Transport/Shipment by: [illegible]	Date: 11-2-05	Time: 1900
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Received for Transport/Shipment by:	Date:	Time:
Samples Shipped Via: DAT FedEx [illegible]	Date: 11-4-05	Time: 0830
Samples Received at Laboratory by: [illegible]	Date: 11/15/05	Time: 11:20
Samples Analyzed by:	Date:	Time:
Samples Analyzed by:	Date:	Time:
Data Checked by: [illegible]	Date: 12/15/05	Time: 1400

VERSION 2
10 MARCH 2003

METCO Environmental ©

CHAIN OF CUSTODY RECORD

Job No.: 05-236
Job Name: ADA-ES
Location: Newark, AR
Unit: Unit 2 ESP Inlet/Outlet Duct

Project Manager: Steve Donsen
Project Supervisor: Steve Donsen

Method: OH

SAMPLE I.D.	DATE	TIME	# OF CONT.	Absorb. Solution	Initial Vol.	PART	HCL	CL2	SO2	SO3	Spec Hg		Recovered by	REMARKS (Specific Compounds/Methods)
Reagent Blanks														
RB 0.1N HNO_3 Cont. 7	11-2-05	1900	1								✓		Steve Donsen	
RB 1N KCl Cont. 8		1900	1								✓		Steve Donsen	
RB 5% HNO_3 - 10% H_2O_2 Cont. 9		1900	1								✓		Steve Donsen	
RB Acid $KMnO_4$ Cont. 10		1900	1								✓		Steve Donsen	
RB Hydroxylamine Cont. 11		1900	1								✓		Steve Donsen	
RB Filter Cont. 12		1900	1								✓		Steve Donsen	

Samples Received for Transport/Shipment by: Steve Donsen	Date: 11-2-05	Time: 1900	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Received for Transport/Shipment by:	Date:	Time:	
Samples Shipped Via: DAS - FedEx Steve Donsen	Date: 11-4-05	Time: 0830	
Samples Received at Laboratory by: [illegible]	Date: 11/15/05	Time: 11:20	
Samples Analyzed by:	Date:	Time:	
Samples Analyzed by:	Date:	Time:	
Data Checked by: [illegible]	Date: 12/13/05	Time: 1400	

VERSION 2
10 MARCH 2003

APPENDIX G

Resumes of Test Personnel

ROBERT M. PATTERSON; President

Education	B. S. 1983, Central Michigan University; Mt. Pleasant, Michigan, in Geology and Earth Science-Meteorology.
Professional Training Courses	Attended a two-day short course, "Performing and Observing Source Sampling" in Dallas, Texas. Attended a one-day short course on basic supervision. Attended a four-week management course presented by the American Management Association, 1991-1992.
Certification	Certified Visible Emissions Evaluator Certified Cabot Full-Face Respirator Fit Tester
Professional Memberships	Source Evaluation Society American Management Association
Technical Experience	Participated in the sampling of over 1,000 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 1986-present. Over nineteen years experience with EPA and Texas Air Control Board methods of sampling - both stationary sources and ambient air. CFR, Title 40, Chapter I, Part 60, EPA Methods 1 through 25, and 101 through 110. Performance Specifications 1 through 5. CFR, Title 40, Chapter I, Part 50, Appendix A through F. "Sampling Procedures Manual, Texas Air Control Board, January 1983." Parts 1-1 through 14-6, Appendix B through Appendix M. Experienced with sampling Method 0010, Modified Method 5 Sampling Train; Method 0030, Volatile Organic Sampling Train; and various EPA and "Site Specific" multiple metal and acid gas sampling trains.

(continued)

PATTERSON, Rob (cont'd)

Technical Experience (cont'd)

Over twenty one years experience with EPA and Texas Air Control Board methods of analysis of both stationary and ambient air samples. Particulate matter, SO_3, SO_2, H_2SO_4, NO_x, CO, CO_2, O_2, H_2S, F, TRS, HCl, Cl_2, NH_3, VOC, C_1-C_7, and other organics. Both laboratory and on-site analyses were performed.

Experienced in the sampling and analysis of commercial calibration gas cylinders for sulfur dioxide, oxides of nitrogen, carbon dioxide, oxygen, carbon monoxide, and C_1-C_7 hydrocarbons.

Thoroughly trained in the operation and routine maintenance of the following:

- MSA LIRA Model 202S Infrared Analyzer
- Analytical Instrument Development, Inc. Model 340A Calibration System
- Shimadzu GC-Mini 2 Gas Chromatograph
- Thermo Environmental Model 10AR Oxides of Nitrogen Analyzer
- Thermo Oxygen Analyzer
- Teledyne Model 326 Oxygen Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer
- Thermo Environmental Model 40 Sulfur Dioxide Analyzer
- Ratfisch Model RS 100 Total Hydrocarbon Analyzer
- Western Research Model 721AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- Ratfisch Model RS 55 Total Hydrocarbon Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer

JAMES R. MONFRIES; Senior Quality Assurance Manager

Education	B. S. 1975, University of Texas at Arlington; Arlington, Texas, in Biology with a minor in Chemistry. Graduate work at the University of Texas at Dallas in the Environmental Science Department.
Professional Training Courses	Attended a two-day short course, "Performing and Observing Source Sampling" in Dallas, Texas, July 1976.
Certification	Certified Visible Emissions Evaluator
Professional Memberships	Air and Waste Management Association Source Evaluation Society - Past President
Technical Experience	Participated in the sampling of over 700 sources, serving in the supervisory capacity on over 500 sources. Many of the sources were sampled simultaneously using more than one sampling train at several points in the flue gas stream, 1976-present. Has also supervised several ambient air monitoring studies, including a permanent five-station high volume air sampling network in South Texas, a permanent four-station high volume air sampling network in Pennsylvania, and a permanent seven-station sulfur dioxide sampling network in East Texas. Was Quality Assurance Manager for several ambient air monitoring studies; including a four-station high volume air sampling network for TSP and PM10 in Midlothian, Texas; a single-station high volume air sampling network for PM10 in South Texas; a two-station high volume air sampling network for TSP in Wichita Falls, Texas; and a four-station continuous air sampling network for TSP and PM10 in Jewett, Texas using Thermo Andersen FH 62 C14 Beta Gauge Dust Monitors.

(continued)

MONFRIES, James (cont'd)

Twenty years experience with EPA and Texas Commission on Environmental Quality methods of analysis of both source and ambient air samples for particulates, SO_2, SO_3,, H_2SO_4, H_2S, HCl, Cl_2, NO_x, Hydrocarbons, and TRS.

Experienced in the analysis of commercial calibration gas cylinders for sulfur dioxide and oxides of nitrogen.

Experienced with VOST and Modified Method 5 Sampling Procedures.

Thoroughly trained in the operation and routine maintenance of the following:

- Lear Siegler, Inc. SM800 Stack Gas Monitor
- Du Pont Model 460/1 Photometric Analyzer System
- Lear Siegler, Inc. SM1000 Ambient SO_2 Monitor
- Calibrated Instruments Ultragas SO_2 Monitor
- Meloy 285E SO_2 Analyzer
- Meloy SA-700 Fluorescent SO_2 Analyzer
- MSA LIRA Model 202S Infrared Analyzer
- Analytical Instrument Development, Inc. Model 340A Calibration System
- Shimadzu GC-Mini 2 Gas Chromatograph
- Thermo Environmental Model 10S NO_x Analyzer
- Thermo Oxygen Analyzer
- Teledyne Model 326 Oxygen Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer
- Thermo Environmental Model 40 Sulfur Dioxide Analyzer
- Ratfisch Model RS 103 Total Hydrocarbon Analyzer
- Western Research Model 721AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- Ratfisch Model RS 55 Total Hydrocarbon Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer
- Thermo Andersen Model FH 62 C14 Dust Monitor

STEVEN J. BORNSEN; Utilities Associate

Education	B. S. in Geology, 1995; University of Texas at Arlington; Arlington, Texas.
Professional Training Courses	Attended 40-hour Occupational & Environmental Training Program on Hazardous Materials (CFR 1910.120); Dallas, Texas, January 1996. Attended a two-day short course, "Performing and Observing Source Sampling," Dallas, Texas; September 1996.
Certifications	Certified Visible Emissions Evaluator HAZMAT certified Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 400 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 1995-present. Experienced with Modified Method 5 Sampling Train (Method 0010). Experienced with VOST sampling procedure (Method 0030). Experienced with calibration techniques for all field testing equipment. Experienced with various multiple metal and acid gas sampling trains. Experienced with particle size and PM_{10} sampling procedures.

(continued)

BORNSEN, Steve (cont'd)

Technical Experience (cont'd)

Experienced with on-site gravimetric particulate matter analysis.

Has performed on-site SO_2 analysis and H_2S fuel gas analysis.

Thoroughly trained in the operation and routine maintenance of the following:

- Thermo Environmental Model 10S and 42C Oxides of Nitrogen Analyzers
- Teledyne Model 326 Oxygen Analyzer
- Western Research Model 721 AT Sulfur Dioxide Analyzer
- Horiba Model PIR 2000 Carbon Dioxide Analyzer
- J.U.M. Model VE-7 Total Hydrocarbon Analyzer
- Thermo Environmental Model 48 Carbon Monoxide Analyzer

DUSTIN J. SIMPSON; Environmental Scientist II

Education	B. S. in Environmental Science, August 2004; Stephen F. Austin State University, Nacogdoches, Texas.
Certifications	Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 50 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2004-present.

STEVE TRAMMELL; Environmental Scientist II

Education	B. S. Resource and Environmental, August 2003; Southwest Texas State University; San Marcos, Texas.
Certifications	HAZMAT certified Adult CPR certified Standard First Aid certified
Technical Experience	Participated in the sampling of over 50 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2004-present.

JOSHUA ORR; Environmental Scientist I

Education	B. S. Environmental Studies, Summer 2002; Southwest Texas State University; San Marcos, Texas.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

DUSTIN DODSON; Environmental Scientist I

Education	B. S. Industrial Engineering, May 2005; Northwestern State University; Natchitoches, Louisiana.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 2005-present.

APPENDIX D5: Source Testing—January 29–February 2, 2007

AIR SAMPLING ASSOCIATES, INC.
P.O. Box 1175 • Lewisville, TX 75067 • Phone: (972) 492-1400 • Toll-Free: (866) 311-9940 • Fax: (972) 492-1402
407-2B Holford's Prairie Rd.• Lewisville, TX 75056

STACK SAMPLING REPORT
FOR
PARTICULATE MATTER TESTING
ON THE
ENTERGY SERVICES, INC.
INDEPENDENCE POWER PLANT
UNIT NO. 2 STACK

NEWARK, ARKANSAS

PROJECT NO. 07-008

JANUARY AND FEBRUARY 2007

PREPARED FOR:
ADA-ES, INC.
8100 SOUTHPARK WAY
LITTLETON, CO 80120

PREPARED BY:
AIR SAMPLING ASSOCIATES, INC.
P.O. BOX 1175
LEWISVILLE, TEXAS 75067

(Total Number of Pages: 117 pages)

AIR SAMPLING ASSOCIATES, INC.

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EXECUTIVE SUMMARY

Air Sampling Associates, Inc. of Lewisville, Texas conducted testing on the Entergy Services, Inc., Independence Power Plant, located near Newark, Arkansas, for ADA-ES, Inc. The testing was performed to determine the amount of particulate matter being emitted to the atmosphere via the Unit No. 2 Stack. The testing was conducted on January 29 through February 2, 2007.

The sampling team consisted of Mr. Gary Goldman and Mr. Scot Jackson. Mr. Goldman was the test team leader.

The sampling followed the procedures set forth in Title 40 of the Code of Federal Regulations, Part 60 (40CFR60), Appendix A, Test Methods 1, 2, 3, 4, 5B, and 202.

The average emission rate of particulate matter for the five, six-hour tests from the Independence Unit No. 2 Stack was equal to 0.006 lbs/mmBtu - Front Half. The average emission rate of particulate matter for the five, six-hour tests from the Independence Unit No. 2 Stack was equal to 0.013 lbs/mmBtu - Total.

Billy J. Mullins, Jr. P.E., Q.E.P., D.E.E.

AIR SAMPLING ASSOCIATES, INC.

SUMMARY OF RESULTS

Table 1: Summary of Sampling Results

Run No.	*1*	*2*	*3*	*4*	*5*	*Average*
Test Date	01/29/07	01/30/07	01/31/07	02/01/07	02/02/07	-----
Test Time	0830-1533	0645-1336	0642-1320	0705-1342	0700-1336	-----
Flow Rate – DSCFM	2,072,263	2,113,513	2,128,865	2,124,346	2,149,896	2,117,777
Stack Temperature - °F	315	310	309	313	319	313
O_2 – % Volume dry	6.4	6.8	6.7	6.9	6.8	6.7
CO_2 – % Volume dry	13.0	13.0	13.0	12.8	13.0	13.0
Percent Excess Air	42.8	47.0	46.0	48.0	47.0	46.2
Moisture Content - %	10.02	9.73	9.64	10.53	10.07	10.00
Percent Isokinetic	98.5	98.3	98.9	100.1	99.7	99.1
Particulate Matter						
- gr/dscf (Front Half)	0.0032	0.0032	0.0030	0.0031	0.0033	0.0032
*- lbs/mmBtu (Front Half)**	0.006	0.007	0.006	0.006	0.007	0.006
- lbs/hr (Front Half)	57.52	58.03	55.24	55.62	60.40	57.36
Particulate Matter						
- gr/dscf (Total)	0.0062	0.0074	0.0065	0.0058	0.0066	0.0065
*- lbs/mmBtu (Total)**	0.012	0.015	0.013	0.012	0.014	0.013
- lbs/hr (Total)	110.24	134.70	118.43	105.90	121.03	118.06

* Calculated using an F_d Factor of 9,780

DISCUSSION OF SAMPLING RESULTS

The five tests for particulate matter appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train and the pitot tubes indicated no leaks before or after each test. The indicative parameters calculated from the field data were in reasonable agreement. The measured moisture contents for the tests were within 5.3% of the mean value. The measured flow rates (DSCFM) for the tests were within 2.1% of the mean value. The rates of sampling for the tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 1.7%.

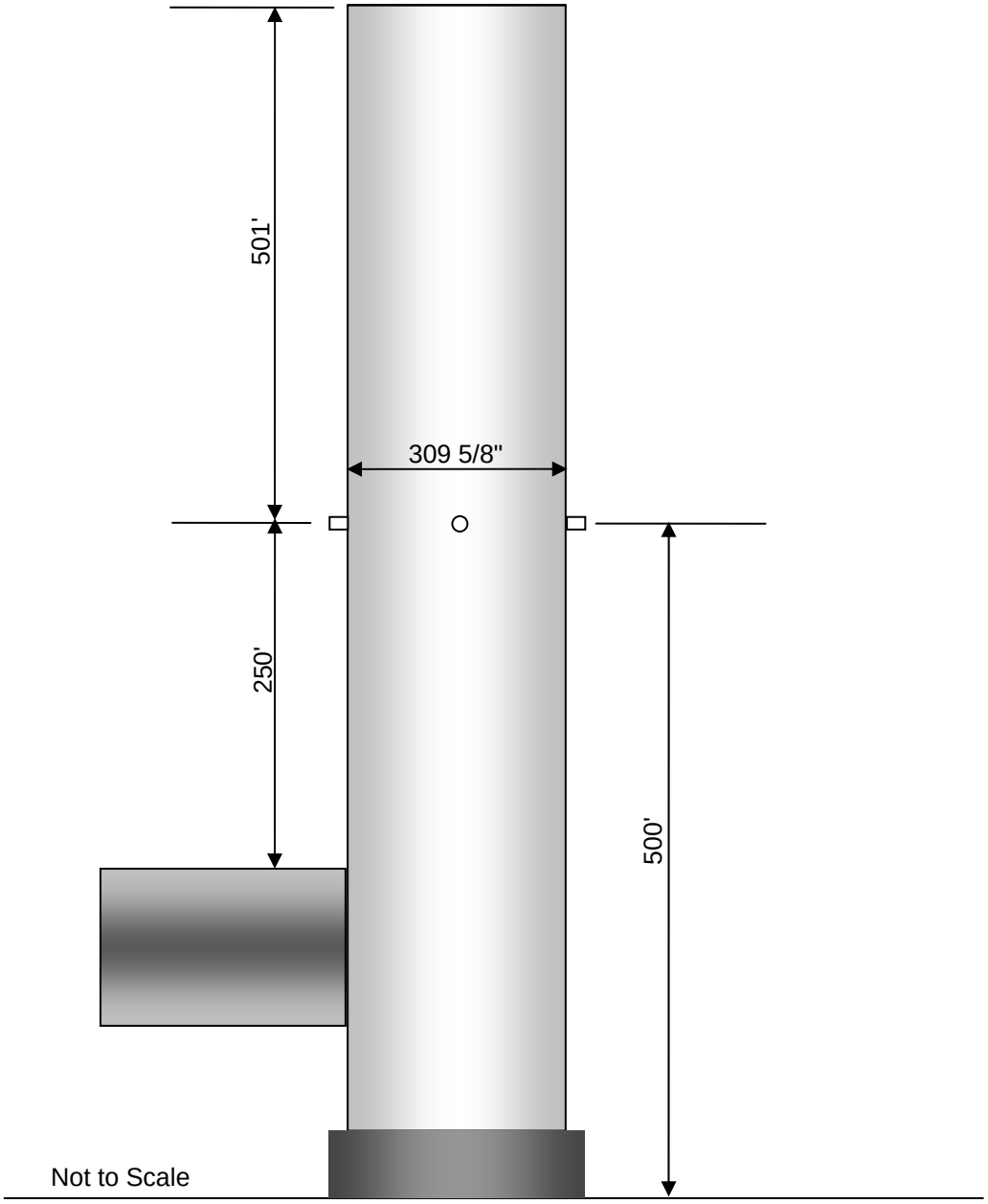
The calculated emissions (lbs/mmBtu-Front Half) of particulate matter for the five tests indicated a range of -6.3% to +9.4% deviation from the mean value.

DESCRIPTION OF SAMPLING LOCATION

The sampling ports on the Independence Unit No. 2 Stack are approximately 500 feet above the ground. The sampling ports are located 250 feet (9.69 stack diameters) downstream from the inlet to the stack and 501 feet (19.42 stack diameters) upstream from the outlet to the stack.

SAMPLING LOCATION

Figure 1: Independence Unit No. 2 Stack



SAMPLING AND ANALYTICAL PROCEDURES

The sampling followed the procedures set forth in 40CFR60, Appendix A, Test Methods 1, 2, 3, 4, 5B, and 202.

Three traverse points were sampled from each of the four ports on the stack for a total of twelve traverse points. All traverse points were checked for cyclonic flow and none was found to be present. For each run, samples of five-minute duration were taken at each of the twelve traverse points during each 60 minute period of testing. Each traverse point was sampled for 30 minutes during the total sampling time of 360 minutes. Data was recorded at five-minute intervals.

The pitot tube lines were checked for leaks before and after each test under a vacuum and a pressure. The lines were also checked for clearance and the manometer was zeroed before each test.

The sampling train was leak checked at the end of the sampling probe at 15" of mercury vacuum before each test, and again at the conclusion of each test at the highest vacuum recorded during sampling. This was done to predetermine the possibility of a diluted sample.

The “front-half” of the sampling train contained the following components:

Stainless steel nozzle
Heated glass lined probe@ 320°F ± 25°F
Heated glass fiber filter @ 320°F ± 25°F

The “back-half” of the sampling train contained the following components:

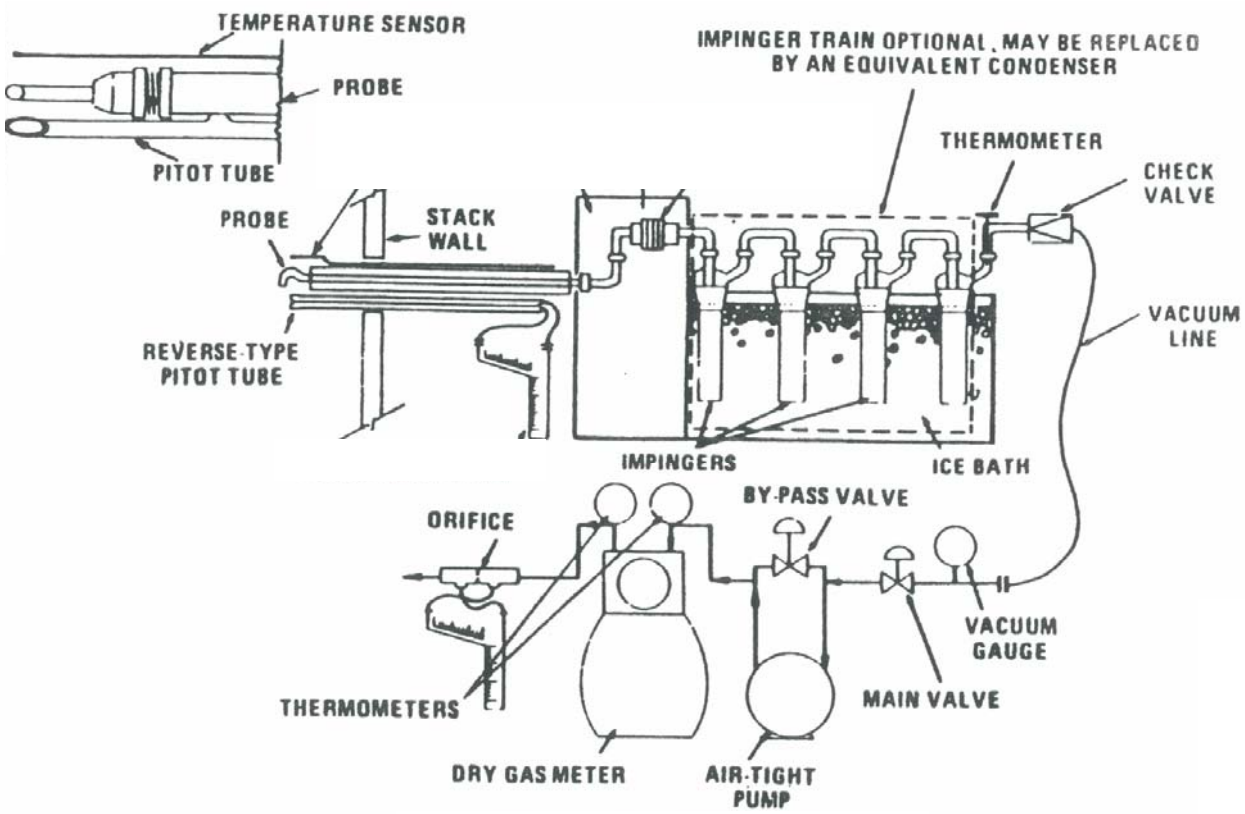
Table 2: Reference Method 5B and 202 Sampling Train

Impinger No.	Impinger Type	Impinger Contents	Amount	Parameter Collected
1	Modified	H.P.L.C. H_2O	100 ml	H_2O
2	Greenburg-Smith	H.P.L.C. H_2O	100 ml	H_2O
3	Modified	Empty	-----	H_2O
4	Modified	6% H_2O_2	200 ml	H_2O
5	Modified	Silica Gel	250 g	H_2O

At the completion of each run, the “back-half” of the sampling train was purged with nitrogen for 60 minutes at a rate of 20 liters per minute.

AIR SAMPLING ASSOCIATES, INC.

Figure 2: EPA Methods 1, 2, 3, 4, 5B, and 202 Sampling Train



TEST NARRATIVE

Personnel from Air Sampling Associates, Inc. arrived at the Entergy Services, Inc., Independence Power Plant, located near Newark, Arkansas, at 2:30 p.m. on Sunday, January 28, 2007. The sampling equipment was moved onto the Unit No. 2 Stack and the preliminary data was collected. Personnel departed the plant at 5:30 p.m.

On Monday, January 29, 2007, personnel returned to the plant at 7:00 a.m. The sampling equipment was prepared for testing. The first test for particulate matter began at 8:30 a.m. and was completed at 3:33 p.m. The samples were recovered and the equipment was secured for the night. Personnel departed the plant at 6:30 p.m.

On Tuesday, January 30, 2007, personnel returned to the plant at 6:00 a.m. The sampling equipment was prepared for testing. The second test for particulate matter began at 6:45 a.m. and was completed at 1:36 p.m. The samples were recovered and the equipment was secured for the night. Personnel departed the plant at 4:30 p.m.

On Wednesday, January 31, 2007, personnel returned to the plant at 6:00 a.m. The sampling equipment was prepared for testing. The third test for particulate matter began at 6:42 a.m. and was completed at 1:20 p.m. The samples were recovered and the equipment was secured for the night. Personnel departed the plant at 4:15 p.m.

On Thursday, February 1, 2007, personnel returned to the plant at 5:45 a.m. The sampling equipment was prepared for testing. The fourth test for particulate matter began at 7:05 a.m. and was completed at 1:42 p.m. The samples were recovered and the equipment was secured for the night. Personnel departed the plant at 4:00 p.m.

On Friday, February 2, 2007, personnel returned to the plant at 5:30 a.m. The sampling equipment was prepared for testing. The fifth test for particulate matter began at 7:00 a.m. and was completed at 1:36 p.m.

The samples were recovered and the equipment was secured. The data and samples were transported to the Air Sampling Associates, Inc. office in Lewisville, Texas for further review and analysis.

Operations at the Entergy Services, Inc., Independence Power Plant, Unit No. 2 Stack, located near Newark, Arkansas, for ADA-ES, Inc. were completed at 3:30 p.m. on Friday, February 2, 2007.

APPENDICES

Appendix A: **Location of Traverse Points**

Appendix B: **Nomenclature and Equations for Calculation of Source Emissions**

Appendix C: **Calibration Data**

Appendix D: **Field Data**

Appendix E: **Analytical Data**

Appendix F: **Chain of Custodies**

Appendix G: **Resumes of Test Personnel**

AIR SAMPLING ASSOCIATES, INC.

Appendix A:

Location of Traverse Points

Appendix A:

Location of Traverse Points
Independence Unit No. 2 Stack

The sampling ports are located 250 feet (9.69 stack diameters) downstream from the inlet to the stack and 501 feet (19.42 stack diameters) upstream from the outlet to the stack. The locations of the traverse points were calculated as follows:

Table 3: Location of Traverse Points Independence Unit No. 2 Stack

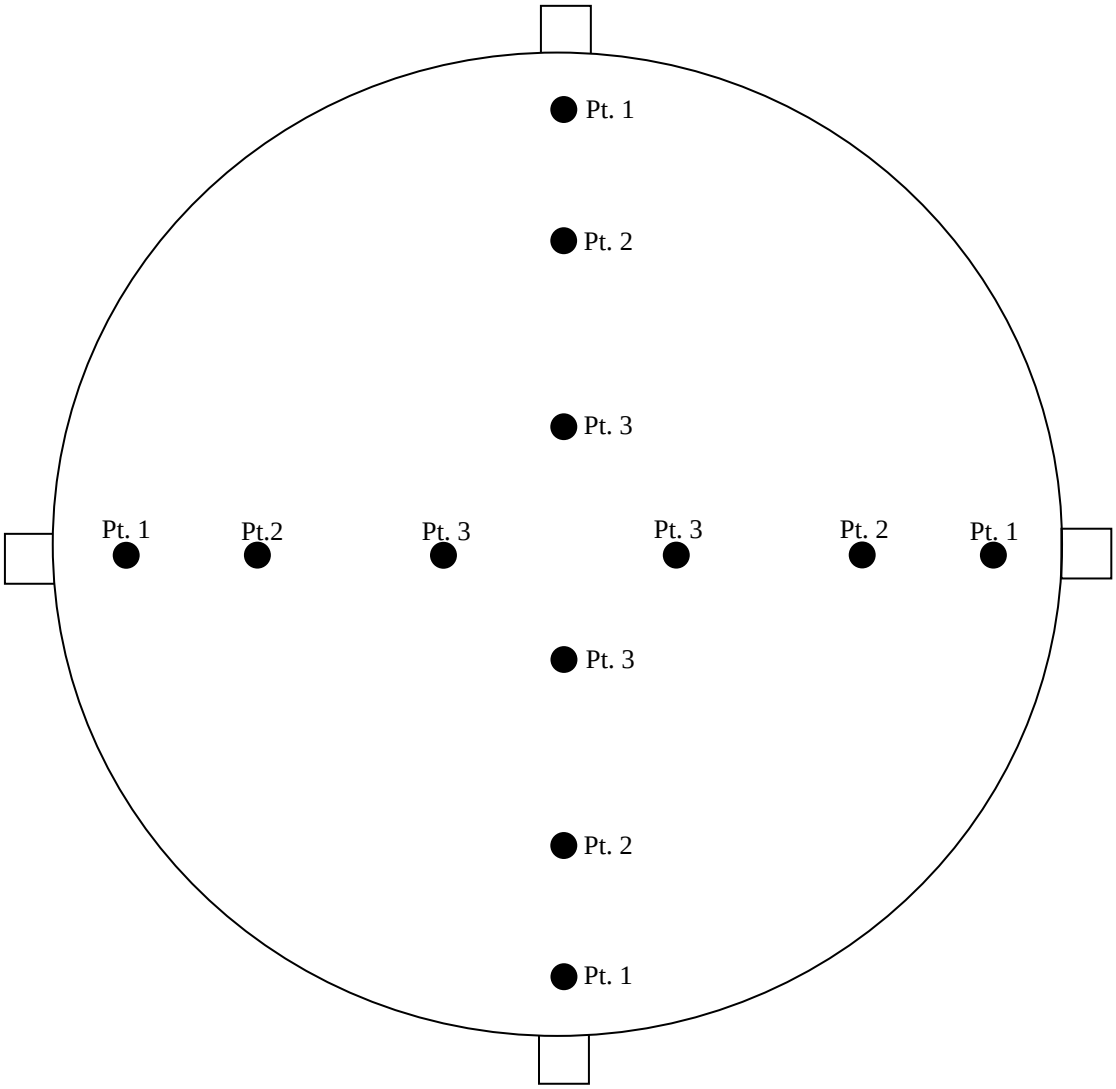
Port & Wall Thickness = 4 11/16 inches		
Inside Stack Diameter = 309 5/8 inches		
Point Number*	**Percent of Stack Diameter**	**Distance from Wall**
1	**4.4**	**13 5/8"**
2	**14.6**	**45 3/16"**
3	**29.6**	**91 5/8"**

*** Calculated as 1/2 of a six point traverse.**

Appendix A:

Figure 3: Location of Traverse Points

Independence Unit No. 2 Stack



Not to scale.

Appendix B:

Nomenclature and Equations for Calculation of Source Emissions

AIR SAMPLING ASSOCIATES, INC.

Nomenclature For Flow Rate and Moisture Calculations

Symbol	English Units	Metric Units	Description
A_s	in.^{2}	m^2	Stack Area
C_{an}	gr/dscf*	g/dscm*	Particulate – probe, cyclone, and filter
C_{ao}	gr/dscf*	g/dscm*	Particulate –total
C_{at}	gr/CF @ stack conditions	g/m3	Particulate – probe, cyclone, and filter
C_{au}	gr/CF @ stack conditions	g/m3	Particulate – total
C_{aw}	lbs/hr	kg/hr	Particulate – probe, cyclone, and filter
C_{ax}	lbs/hr	kg/hr	Particulate - total
C_p			Pitot Tube Calibration Factor
D_n	in.	m	Sampling Nozzle Diameter
%EA			Percent Excess Air at Sampling Point
g	32.2 ft/sec^2		Acceleration of gravity
%I			Percent Isokinetic
%M			Percent Moisture in the Stack Gas by Volume
M_d			Mole Fraction of Dry Gas
m_f	mg	mg	Particulate – probe, cyclone, and filter
mt	mg	mg	Particulate – total
M_{water}	18 lb/lb-mole		Molecular Weight of Water
MW	lb/lb-mole	g/g-mole	Molecular Weight of Stack Gas
MW_{air}	28.84 lb/lb-mole		Molecular Weight of Air

Symbol	English Units	Metric Units	Description
MW_d	lb/lb-mole	g/g-mole	Molecular Weight of Dry Stack Gas
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H_2O	mm H_2O	Orifice Pressure drop
Ps	"Hg Absolute	mm Hg	Stack Pressure
ΔP	"H_2O	mm H_2O	Velocity Head of Stack Gas
P_{std}	29.92" Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m^3/hr	Stack Gas Volume at Actual Stack Conditions
Q_s	DSCFM*	dscm/hr*	Stack Gas Volume at 29.92" Hg, 528° R, dry
R	21.83" Hg-ft^3/lb-mole °R		Universal Gas Constant
T_m	°F	°C	Average Gas Meter Temperature
T_t	min	min	Net Time of Test
T_s	°F	°C	Stack Temperature
T_{std}	528 °R	293 °K	Standard Temperature
V_m	ft^3	m^3	Volume of Dry Gas Sampled @ Meter Conditions
Vm_{std}	dscf*	dscm*	Volume of Dry Gas Sampled @ Standard Conditions
V_s	fpm	m/sec	Stack Velocity @ Stack Conditions
V_w	ml	ml	Total Water Collected in Impingers and Silica Gel
Vw_{gas}	scf*	scm*	Volume of Water Vapor Collected @ Standard Conditions
ρ_{air}	0.0748 lbs/ft^3		Density of Air

Symbol	English Units	Metric Units	Description
ρ_{water}	1 g/ml		Density of Water
ρ_{man}	62.32 lbs/ft^3		Density of Manometer Oil
			(Inches of Water)

Standard Conditions: 29.92" Hg, 68° F (760 mm Hg, 20 °C)

AIR SAMPLING ASSOCIATES, INC.

Example Calculations

1. Volume of dry gas sampled at standard conditions. *

$$V_{m_{std}} = V_m \left(\frac{T_{std}}{T_m + 460} \right) \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}} \right]$$

$$V_{m_{std}} = 17.65\ V_m \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = \text{dscf}$$

$$V_{m_{std}} = \text{dscf} \times 0.028317 = \text{dscm}$$

2. Volume of water vapor collected at standard conditions. *

$$V_{w_{gas}} = \frac{(V_w - gms\ SO_2 - gms\ H_2S)\ \rho_{water}\ RT_{std}}{P_{std}\ M_{water}\ 453.6}$$

$$V_{w_{gas}} = 0.0472\ (V_w - gms\ SO_2 - gms\ H_2S) = scf$$

$$V_{w_{gas}} = scf \times 0.028317 = scm$$

3. Percent moisture in stack gas.

$$\%M = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \%$$

* 29.92" Hg, 68° F (760 mm Hg, 20 °C)

4. Mole fraction of dry gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average molecular weight of dry stack gas.

$$MW_d = \left[\%CO_2 \times \frac{44}{100}\right] + \left[\%O_2 \times \frac{32}{100}\right] + \left[\%N_2 \times \frac{28}{100}\right] + \left[\%CO \times \frac{28}{100}\right] = lb/lb\text{-}mole$$

$$= g/g\text{-}mole$$

6. Molecular weight of stack gas.

$$MW = MW_d \times M_d + 18\,(1 - M_d) = \frac{lb}{lb\text{-}mole} = g/g\text{-}mole$$

7. Percent excess air at sampling point.

$$\%EA = \frac{100\,[\%O_2 - (0.5\,\%CO)]}{0.265\,(\%N_2) - [\%O_2 - (0.5\,\%CO)]}$$

8. Stack Pressure.

$$P_s = P_b + \frac{Stack\ Pressure\ "H_2O}{13.6} = "Hg\ Absolute$$

$$P_s = "Hg\ Abs. \times 25.4 = mm\ Hg$$

9. Stack velocity at stack conditions.

$$V_s = C_p\,60\left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460) \times \Delta P}{12 \times \rho_{air} \times P_s \times MW \times T_{std}}\right]^{1/2}$$

$$V_s = 5{,}123.8\,C_p\left[\frac{(T_s + 460)}{P_s \times MW}\right]^{1/2} \sqrt{\Delta P}\ \text{average} = \text{fpm}$$

$$V_s = \text{fpm} \times 0.00508 = \text{m/sec}$$

10. Dry stack gas volume at standard conditions. *

$$Q_s = \frac{1}{144} V_s \text{ x } A_s \text{ x } M_d \text{ x } \frac{T_{std}}{T_s + 460} \text{ x } \frac{P_s}{P_{std}}$$

$$Q_s = \frac{0.123\, V_s \text{ x } A_s \text{ x } M_d \text{ x } P_s}{T_s + 460} = DSCFM$$

$$Q_s = DSCFM \text{ x } 1.6990 = dscm/hr$$

11. Actual stack gas volume at stack conditions.

$$Q_a = \frac{V_s \text{ x } A_s}{144} = ACFM$$

$$Q_a = ACFM \text{ x } 1.6990 = m^3/hr$$

12. Percent Isokinetic

$$\%I = \frac{V_{mstd} \text{ x } (T_s + 460) \text{ x } P_{std} \text{ x } 100 \text{ x } 144\, in.^2/ft^2}{M_d \text{ x } T_{std} \text{ x } P_s \text{ x } T_t \text{ x } V_s \left(\frac{\Pi \text{ x } D_n^2}{4} \right)}$$

$$\%I = \frac{1039 \text{ x } V_{mstd} \text{ x } (T_s + 460)}{M_d \text{ x } P_s \text{ x } T_t \text{ x } V_s \text{ x } D_n^2}$$

*29.92" Hg, 68° F (760 mm Hg, 20 °C)

13. Particulate – Probe, cyclone, and filter.

$$C_{an} = \frac{m_f}{V_{mstd}} x \frac{1\,gr}{64.8\,mg}$$

$$C_{an} = 0.0154 \text{ x } \frac{mf}{V_{mstd}} \text{ gr/dscf *}$$

$$C_{an} = \text{gr/dscf x } 2.290 = \text{g/dscm *}$$

14. Particulate total.

$$C_{ao} = 0.0154 \text{ x } \frac{m_t}{V_{mstd}} = gr\,/\,dscf\ *$$

$$C_{ao} = \text{gr/dscf x } 2.290 = \text{g/dscm *}$$

15. Particulate – probe, cyclone, and filter at stack conditions.

$$C_{at} = C_{an} \text{ x } \frac{P_s}{P_{std}} \text{ x } \frac{(T_{std})}{(T_s + 460)} \text{ x } M_d$$

$$C_{at} = \frac{17.65 \text{ x } C_{an} \text{ x Ps x Md}}{Tx + 460} = \text{gr/CF}$$

$$C_{at} = \text{gr/CF x } 2.290 = \text{g/m}^3$$

16. Particulate – total, at stack conditions.

$$C_{au} = \frac{17.65 \text{ x } C_{ao} \text{ x } P_s \text{ x } M_d}{T_s + 460} = \text{gr/CF}$$

$$C_{au} = \text{gr/CF x } 2.290 = \text{g/m}^3$$

* 29.92" Hg, 68° F (760 mm Hg, 20 °C)

AIR SAMPLING ASSOCIATES, INC.

Emission Rate Calculations

$$\text{lbs/mmBtu} = \frac{\frac{\text{gr/dscf}}{7{,}000} \times F_d \times 20.9}{(20.9 - O_2\%)}$$

F_d = Oxygen based F factor

Fuel	F_d factor
Coal	9,780 dscf*/mmBtu

SOURCE EMISSION SURVEY

JOB NUMBER: 07-008
JOB NAME: ADA-ES
LOCATION: Newark/AR
UNIT TESTED: Unit No. 2 Stack

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
DATE			01/29/07	01/30/07	01/31/07
BEGIN TIME			0830	0645	0642
END TIME			1533	1336	1320
P(b)	BAROMETRIC PRESSURE	"Hg Abs.	29.67	29.72	29.70
		(mm Hg)	(754.00)	(755.00)	(754.00)
P(m)	ORIFICE PRESSURE DROP	"H2O	1.432	1.475	1.504
		(mm H2O)	(36.400)	(37.500)	(38.200)
	DGM CALIBRATION FACTOR		0.988	0.988	0.988
V(m)	VOLUME DRY GAS SAMPLED	ft.^3	237.553	239.240	238.480
	@ METER CONDITIONS	(m^3)	(6.727)	(6.775)	(6.753)
	LEAK CHECK VOLUME	ft.^3	0.248	0.000	0.000
T(m)	AVERAGE GAS METER	DEG.F	62	63	54
	TEMPERATURE	(DEG.C)	(17)	(17)	(12)
V(m[std])*	VOLUME DRY GAS SAMPLED	DSCF	239.161	240.828	244.120
	@ STANDARD CONDITIONS*	(DSCM)	(6.772)	(6.820)	(6.913)
V(w)	TOTAL WATER COLLECTED,	ml	564.2	549.7	551.5
	IMPINGERS & SILICA GEL				
V(w[gas])	VOLUME WATER VAPOR	SCF	26.630	25.946	26.031
	COLLECTED @ STANDARD	(SCM)	(0.754)	(0.735)	(0.737)
	CONDITIONS*				
%M	MOISTURE IN STACK GAS	%	10.02	9.73	9.64
	BY VOLUME				
Md	MOL FRACTION OF DRY GAS		0.8998	0.9027	0.9036
Tt	NET TIME OF TEST	MINUTES	360	360	360

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 07-008
JOB NAME: ADA-ES
LOCATION: Newark/AR
UNIT TESTED: Unit No. 2 Stack

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
CO2		%	13.0	13.0	13.0
O2		%	6.4	6.8	6.7
CO		%	0.0	0.0	0.0
N2		%	80.6	80.2	80.3
%EA	EXCESS AIR @ SAMPLING POINT	%	42.8	47.0	46.0
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.34 (30.34)	30.35 (30.35)	30.35 (30.35)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	29.10 (29.10)	29.15 (29.15)	29.16 (29.16)
Cp	PITOT TUBE CALIBRATION		0.825	0.825	0.825
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	2.656 (67.500)	2.728 (69.300)	2.765 (70.200)
DELTA P ^(1/2)		"H2O	1.629	1.651	1.661
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	315 (157)	310 (154)	309 (154)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	29.41 (747.00) -3.50	29.45 (748.00) -3.70	29.44 (748.00) -3.50
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	6,553 (33)	6,610 (34)	6,645 (34)
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	75,294 (49)	75,294 (49)	75,294 (49)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR)	2,072,263 (3,520,775)	2,113,513 (3,590,859)	2,128,865 (3,616,942)
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	3,426,273 (5,821,238)	3,456,006 (5,871,754)	3,474,675 (5,903,473)
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.177 (0.004)	0.176 (0.004)	0.176 (0.004)
%I	PERCENT ISOKINETIC	%	98.5	98.3	98.9

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 07-008
JOB NAME: ADA-ES
LOCATION: Newark/AR
UNIT TESTED: Unit No. 2 Stack

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	1	2	3
Mf	PARTICULATE - PROBE, CYCLONE AND FILTER	mg	50.3	50.1	48.0
Mt	PARTICULATE - TOTAL	mg	96.4	116.3	102.9
Can	PARTICULATE - PROBE, CYCLONE AND FILTER	gr/DSCF* (g/DSCM)	0.0032 (0.0074)	0.0032 (0.0073)	0.0030 (0.0069)
Cao	PARTICULATE - TOTAL	gr/DSCF* (g/DSCM)	0.0062 (0.0142)	0.0074 (0.0170)	0.0065 (0.0149)
Cat	PARTIC.-PROBE, CYCLONE AND FILTER @ STACK COND.	gr/CF (g/m3)	0.0020 (0.0046)	0.0020 (0.0046)	0.0018 (0.0041)
Cau	PARTICULATE - TOTAL @ STACK CONDITIONS	gr/CF (g/m3)	0.0037 (0.0085)	0.0045 (0.0103)	0.0040 (0.0092)
Caw	PARTICULATE - PROBE, CYCLONE AND FILTER	LBS/HR (Kg/HR)	57.52 (26.09)	58.03 (26.32)	55.24 (25.06)
Cax	PARTICULATE - TOTAL	LBS/HR (Kg/HR)	110.24 (50.00)	134.70 (61.10)	118.43 (53.72)

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION SURVEY

JOB NUMBER: 07-008
JOB NAME: ADA-ES
LOCATION: Newark/AR
UNIT TESTED: Unit No. 2 Stack

SOURCE EMISSION CALCULATIONS

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	4	5	
DATE			02/01/07	02/02/07	
BEGIN TIME			0705	0700	
END TIME			1342	1336	
P(b)	BAROMETRIC PRESSURE	"Hg Abs. (mm Hg)	29.37 (746.00)	29.42 (747.00)	
P(m)	ORIFICE PRESSURE DROP	"H2O (mm H2O)	1.544 (39.200)	1.585 (40.300)	
	DGM CALIBRATION FACTOR		0.988	0.988	
V(m)	VOLUME DRY GAS SAMPLED @ METER CONDITIONS LEAK CHECK VOLUME	ft.^3 (m^3) ft.^3	245.820 (6.961) 0.000	247.868 (7.019) 0.000	
T(m)	AVERAGE GAS METER TEMPERATURE	DEG.F (DEG.C)	59 (15)	60 (16)	
V(m[std])*	VOLUME DRY GAS SAMPLED @ STANDARD CONDITIONS*	DSCF (DSCM)	246.476 (6.979)	248.497 (7.037)	
V(w)	TOTAL WATER COLLECTED, IMPINGERS & SILICA GEL	ml	614.5	589.7	
V(w[gas])	VOLUME WATER VAPOR COLLECTED @ STANDARD CONDITIONS*	SCF (SCM)	29.004 (0.821)	27.834 (0.788)	
%M	MOISTURE IN STACK GAS BY VOLUME	%	10.53	10.07	
Md	MOL FRACTION OF DRY GAS		0.8947	0.8993	
Tt	NET TIME OF TEST	MINUTES	360	360	

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 07-008
JOB NAME: ADA-ES
LOCATION: Newark/AR
UNIT TESTED: Unit No. 2 Stack

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	4	5	
CO2		%	12.8	13.0	
O2		%	6.9	6.8	
CO		%	0.0	0.0	
N2		%	80.3	80.2	
%EA	EXCESS AIR @ SAMPLING POINT	%	48.0	47.0	
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	30.32 (30.32)	30.35 (30.35)	
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	29.03 (29.03)	29.11 (29.11)	
Cp	PITOT TUBE CALIBRATION		0.825	0.825	
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	2.840 (72.100)	2.906 (73.800)	
DELTA P ^(1/2)		"H2O	1.684	1.703	
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	313 (156)	319 (159)	
Ps	STACK PRESSURE	"Hg Abs. (mm Hg) "H20	29.11 (739.00) -3.60	29.16 (741.00) -3.50	
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	6,808 (35)	6,896 (35)	
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	75,294 (49)	75,294 (49)	
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR)	2,124,346 (3,609,264)	2,149,896 (3,652,673)	
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	3,559,846 (6,048,178)	3,605,890 (6,126,407)	
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.176 (0.004)	0.176 (0.004)	
%I	PERCENT ISOKINETIC	%	100.1	99.7	

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

JOB NUMBER: 07-008
JOB NAME: ADA-ES
LOCATION: Newark/AR
UNIT TESTED: Unit No. 2 Stack

			RUN NUMBER		
SYMBOL	DESCRIPTION	UNITS	4	5	
Mf	PARTICULATE - PROBE, CYCLONE AND FILTER	mg	48.9	52.9	
Mt	PARTICULATE - TOTAL	mg	93.1	106.0	
Can	PARTICULATE - PROBE, CYCLONE AND FILTER	gr/DSCF* (g/DSCM)	0.0031 (0.0070)	0.0033 (0.0075)	
Cao	PARTICULATE - TOTAL	gr/DSCF* (g/DSCM)	0.0058 (0.0133)	0.0066 (0.0150)	
Cat	PARTIC.-PROBE, CYCLONE AND FILTER @ STACK COND.	gr/CF (g/m3)	0.0018 (0.0041)	0.0019 (0.0044)	
Cau	PARTICULATE - TOTAL @ STACK CONDITIONS	gr/CF (g/m3)	0.0035 (0.0080)	0.0039 (0.0089)	
Caw	PARTICULATE - PROBE, CYCLONE AND FILTER	LBS/HR (Kg/HR)	55.62 (25.23)	60.40 (27.40)	
Cax	PARTICULATE - TOTAL	LBS/HR (Kg/HR)	105.90 (48.04)	121.03 (54.90)	

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

Appendix C:

Calibration Data

AIR SAMPLING ASSOCIATES, INC.

Appendix C

Table 4: Calibration Data

Pre-test Calibrations:

Equipment	Calibration Factor	Calibration Date
Dry Gas Meter 2-2	0.988	01/02/07
Digital Temperature Indicator 2-2		01/02/07
Dry Gas Meter 2-2 Orifice		01/03/07
Pitot Tube 1-4	0.825	01/02/07
Nozzle 1-2	0.176	01/05/07
Nozzle 2-2	0.177	01/05/07
Barometer 1	NIST Traceable	12/19/06

Post-test Calibrations:

Equipment	Calibration Factor	Calibration Date
Dry Gas Meter 2-2	1.002	03/16/07
Pitot Tube 1-4	0.825	03/28/07
Nozzle 1-2	0.174	03/28/07
Nozzle 2-2	0.176	03/28/07
Barometer 1	NIST Traceable	03/21/07

AIR SAMPLING ASSOCIATES, INC.

Appendix C

Table 4: Calibration Data

Pre-test Calibrations:

Equipment	Calibration Factor	Calibration Date
Dry Gas Meter 2-2	0.988	01/02/07
Digital Temperature Indicator 2-2		01/02/07
Dry Gas Meter 2-2 Orifice		01/03/07
Pitot Tube 1-4	0.825	01/02/07
Nozzle 1-2	0.176	01/05/07
Nozzle 2-2	0.177	01/05/07
Barometer 1	NIST Traceable	12/19/06

Post-test Calibrations:

Equipment	Calibration Factor	Calibration Date
Dry Gas Meter 2-2	1.002	03/16/07
Pitot Tube 1-4	0.825	03/28/07
Nozzle 1-2	0.174	03/28/07
Nozzle 2-2	0.176	03/28/07
Barometer 1	NIST Traceable	03/21/07

AIR SAMPLING ASSOCIATES, INC.

Calibration Data

Dry Gas Meter Calibration

Meter Console No. ASAI 2-2

Date Calibration Performed: 01/02/07

ΔH Setting (" H_2O)	C_{DG}
0.50	0.987
1.00	0.990
1.50	0.987
2.00	0.985
3.00	0.988
4.00	0.989
Average	0.988

Variation +: 0.20%

Variation -: -0.30%

Certified by: Scot Jackson 1/2/07

Calibrator (Signature / Date)

Bill Hefley 1/2/07

QA Officer (Signature / Date)

AIR SAMPLING ASSOCIATES, INC.

Calibration Data

Dry Gas Meter Calibration

Meter Console No. ASAI 2-2

Date Calibration Performed: 01/02/07

Run 1 at 0.5" ΔH

Pb = 30.05 " Hg

Wet Test Meter C_f = 1.018

Console Pump Vacuum = -5.0 " Hg

	Wet Test Meter No. ASAI-0								*Dry Gas Meter*							
	Time	Meter Reading		Temp.		P_m			Meter Reading		Temperature In		Out		P_m	
End	9:52	5.165	cf	62	°F	-0.3	" H_2O		305.368	cf	71	°F	71	°F	0.50	" H_2O
Start	9:39	0.000	cf	63	°F	-0.3	" H_2O		299.952	cf	72	°F	74	°F	0.50	" H_2O
Average		5.165	cf	63	°F	-0.3	" H_2O		5.416	cf	72	°F	73	°F	0.50	" H_2O

$$\textit{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{5.333} \text{ dcsf}$$

$$\textit{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{5.406} \text{ dcsf}$$

$$\textit{Calibration Factor } (C_{DG}) = \frac{\textit{Wet Test Meter } V_{mstd}}{\textit{Dry Gas Meter } V_{mstd}} = \underline{0.987}$$

AIR SAMPLING ASSOCIATES, INC.

Calibration Data

Dry Gas Meter Calibration

Meter Console No. ASAI 2-2

Date Calibration Performed: 01/02/07

Run 1 at 1.0" ΔH Pb = 30.05 " Hg

Wet Test Meter C_f = 1.018 Console Pump Vacuum = -5.0 " Hg

	Wet Test Meter No. ASAI-0								*Dry Gas Meter*								
	Time	Meter Reading		Temp.		P_m			Meter Reading		Temperature In		Out		P_m	
End	10:08	5.033	cf	61	°F	-0.3	" H_2O		312.051	cf	71	°F	69	°F	1.00	" H_2O
Start	9:59	0.000	cf	61	°F	-0.3	" H_2O		306.801	cf	70	°F	70	°F	1.00	" H_2O
Average		5.033	cf	61	°F	-0.3	" H_2O		5.250	cf	71	°F	70	°F	1.00	" H_2O

$$\textit{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{5.212} \text{ dcsf}$$

$$\textit{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{5.267} \text{ dcsf}$$

$$\textit{Calibration Factor } (C_{DG}) = \frac{\textit{Wet Test Meter } V_{mstd}}{\textit{Dry Gas Meter } V_{mstd}} = \underline{0.990}$$

AIR SAMPLING ASSOCIATES, INC.

Calibration Data

Dry Gas Meter Calibration

Meter Console No. ASAI 2-2

Date Calibration Performed: 01/02/07

Run 1 at 1.5" ΔH Pb = 30.05 " Hg

Wet Test Meter C_f = 1.018 Console Pump Vacuum = -5.0 " Hg

	Wet Test Meter No. ASAI-0								*Dry Gas Meter*							
	Time	Meter Reading		Temp.		P_m			Meter Reading		Temperature In		Temperature Out		P_m	
End	10:27	10.017	cf	64	°F	-0.6	" H_2O		322.946	cf	76	°F	70	°F	1.50	" H_2O
Start	10:12	0.000	cf	62	°F	-0.6	" H_2O		312.503	cf	70	°F	69	°F	1.50	" H_2O
Average		10.017	cf	63	°F	-0.6	" H_2O		10.443	cf	73	°F	70	°F	1.50	" H_2O

$$\textit{Wet Test Meter } V_{msd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{10.326} \text{ dcsf}$$

$$\textit{Dry Gas Meter } V_{msd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{10.464} \text{ dcsf}$$

$$\textit{Calibration Factor } (C_{DG}) = \frac{\textit{Wet Test Meter } V_{msd}}{\textit{Dry Gas Meter } V_{msd}} = \underline{0.987}$$

AIR SAMPLING ASSOCIATES, INC.

Calibration Data

Dry Gas Meter Calibration

Meter Console No. ASAI 2-2

Date Calibration Performed: 01/02/07

Run 1 at 2.0" ΔH Pb = 30.05 " Hg

Wet Test Meter C_f = 1.018 Console Pump Vacuum = -5.0 " Hg

	Wet Test Meter No. ASAI-0								*Dry Gas Meter*							
	Time	Meter Reading		Temp.		P_m			Meter Reading		Temperature In		Out		P_m	
End	10:45	10.750	cf	65	°F	-0.7	" H_2O		334.904	cf	77	°F	71	°F	2.00	" H_2O
Start	10:31	0.000	cf	65	°F	-0.7	" H_2O		323.701	cf	74	°F	70	°F	2.00	" H_2O
Average		10.750	cf	65	°F	-0.7	" H_2O		11.203	cf	76	°F	71	°F	2.00	" H_2O

$$\textit{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{11.037} \text{ dcsf}$$

$$\textit{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{11.203} \text{ dcsf}$$

$$\textit{Calibration Factor } (C_{DG}) = \frac{\textit{Wet Test Meter } V_{mstd}}{\textit{Dry Gas Meter } V_{mstd}} = \underline{0.985}$$

AIR SAMPLING ASSOCIATES, INC.

Calibration Data

Dry Gas Meter Calibration

Meter Console No. ASAI 2-2

Date Calibration Performed: 01/02/07

Run 1 at 3.0" ΔH — Pb = 30.05 " Hg

Wet Test Meter C_f = 1.018 — Console Pump Vacuum = -5.0 " Hg

	Wet Test Meter No. ASAI-0							*Dry Gas Meter*							
	Time	Meter Reading		Temp.		P_m		Meter Reading		Temperature In		Temperature Out		P_m	
End	10:59	10.389	cf	64	°F	-1.0	" H_2O	346.196	cf	78	°F	71	°F	3.00	" H_2O
Start	10:48	0.000	cf	65	°F	-1.0	" H_2O	335.407	cf	75	°F	71	°F	3.00	" H_2O
Average		10.389	cf	65	°F	-1.0	" H_2O	10.789	cf	77	°F	71	°F	3.00	" H_2O

$$\textit{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{10.668} \text{ dcsf}$$

$$\textit{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{10.800} \text{ dcsf}$$

$$\textit{Calibration Factor } (C_{DG}) = \frac{\textit{Wet Test Meter } V_{mstd}}{\textit{Dry Gas Meter } V_{mstd}} = \underline{0.988}$$

AIR SAMPLING ASSOCIATES, INC.

Calibration Data

Dry Gas Meter Calibration

Meter Console No. ASAI 2-2

Date Calibration Performed: 01/02/07

Run 1 at 4.0" ΔH Pb = 30.05 " Hg

Wet Test Meter C_f = 1.018 Console Pump Vacuum = -5.0 " Hg

	Wet Test Meter No. ASAI-0							*Dry Gas Meter*							
	Time	Meter Reading		Temp.		P_m		Meter Reading		Temperature In		Out		P_m	
End	11:12	10.882	cf	64	°F	-0.8	" H_2O	357.874	cf	78	°F	70	°F	4.00	" H_2O
Start	11:02	0.000	cf	64	°F	-0.8	" H_2O	346.605	cf	75	°F	71	°F	4.00	" H_2O
Average		10.882	cf	64	°F	-0.8	" H_2O	11.269	cf	77	°F	71	°F	4.00	" H_2O

$$\text{Wet Test Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] \times C_f = \underline{11.191} \text{ dcsf}$$

$$\text{Dry Gas Meter } V_{mstd} = 17.65 \times V_m \left[\frac{P_b + \frac{P_m}{13.6}}{(T_m + 460)} \right] = \underline{11.313} \text{ dcsf}$$

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{mstd}}{\text{Dry Gas Meter } V_{mstd}} = \underline{0.989}$$

AIR SAMPLING ASSOCIATES, INC.

Calibration Data

Digital Temperature Indicator Calibration

DTI Unit No. ASAI 2-2

Date Calibration Performed: 01/02/07

Reference Point	Time	ASTM Reference Thermometer (°F)	DTI (°F)
Ice Bath	9:29	32° F	33° F
Ambient Air	9:30	68° F	69° F
Boiling Water	9:31	212° F	216° F
Oven	9:32	250° F	255° F
Oven	9:33	300° F	305° F
Oven	9:34	350° F	355° F
Oven	9:35	400° F	406° F

Meter Adjusted? No

ASTM Reference Thermometer: SN: 06000047 Range: -0.1°C to 1360.6°C

Range:

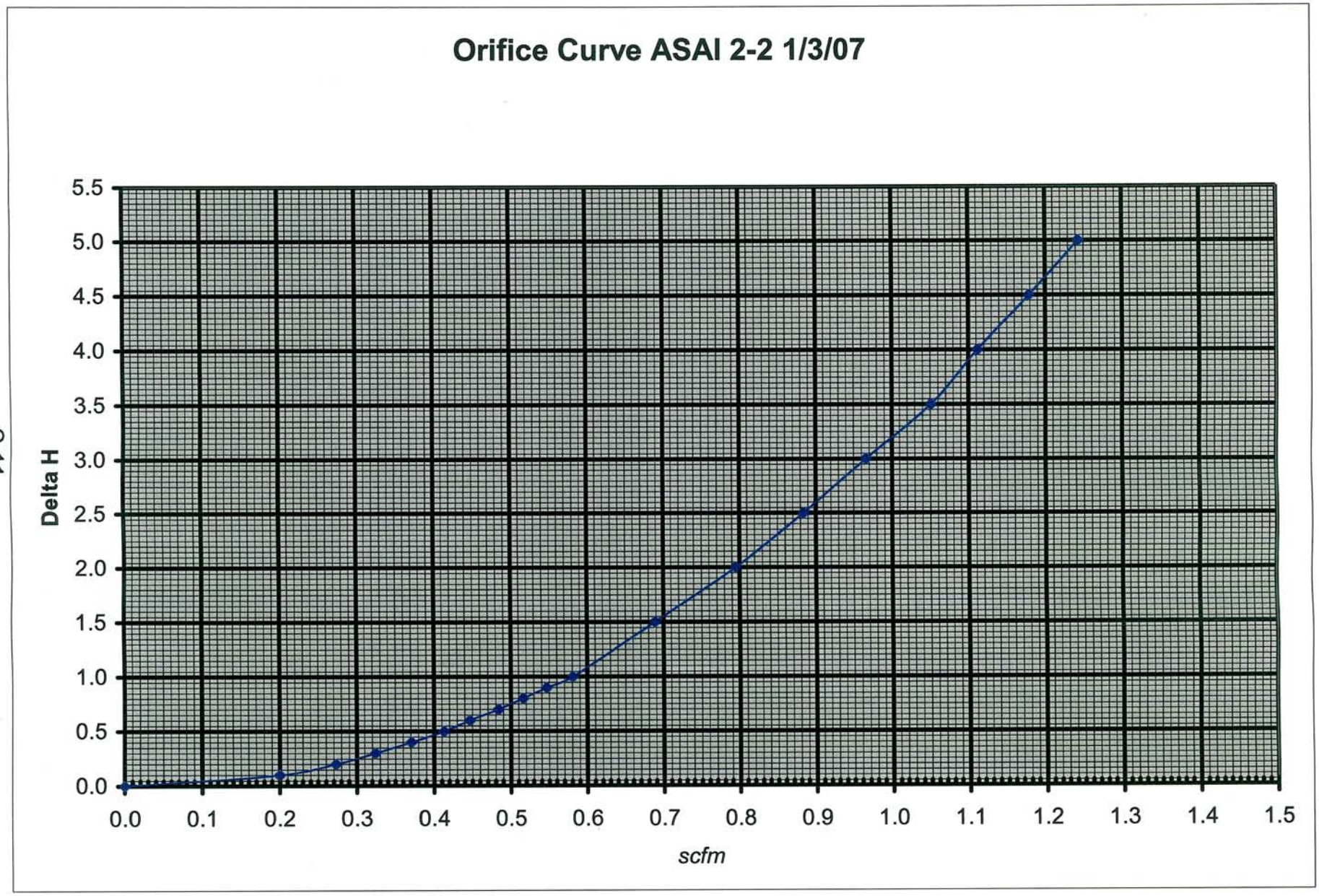
Range:

Certified by: Scot Jackson 1/02/07

Calibrator (Signature / Date)

Bill Hefley 1/02/07

QA Officer (Signature / Date)


Orifice Curve ASAI 2-2 1/3/07
Delta H
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
scfm

AIR SAMPLING ASSOCIATES, INC.

CALIBRATION DATA
PITOT TUBE CALIBRATION DATA

Date: 01/02/07
I.D. # ASAI 1-4
C_{pstd}: 0.990

Time: 13:00
T_s: 63 °F
Pb: 29.97 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard Start	Calibration Standard End	v Standard Average	High	v High	Cal. Factor	Low	v Low	Cal. Factor
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.21	0.21	0.21	0.458	0.30	0.548	0.828	0.30	0.548	0.828
40	0.37	0.37	0.37	0.608	0.54	0.735	0.819	0.54	0.735	0.819
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
60	0.83	0.83	0.83	0.911	1.20	1.095	0.823	1.20	1.095	0.823
70	1.13	1.15	1.15	1.072	1.65	1.285	0.826	1.65	1.285	0.826
80	1.48	1.50	1.50	1.225	2.15	1.466	0.827	2.15	1.466	0.827
90	1.87	1.85	1.85	1.360	2.65	1.628	0.827	2.65	1.628	0.827
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
50	0.58	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
Average							0.825			0.825

Summary of Results:

Normal high side calibraiton factor: 0.825
variation +: 0.36%
variation -: -0.73%
Normal low side calibration factor: 0.825
variation +: 0.36%
variation -: -0.73%

Certification:
I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.825

Certified by: *Patrick Selakovich 1/02/07*
Calibrator (Signature/Date)

Bill Hefley 1/02/07
QA Officer (Signature/Date)

AIR SAMPLING ASSOCIATES, INC.

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI 1-
Date Calibration Performed: 01/05/07

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	0.119	0.177	0.242	0.316	0.365	0.394	0.498	0.235
Measurement 2	0.117	0.176	0.242	0.315	0.366	0.395	0.496	0.237
Measurement 3	0.119	0.174	0.241	0.316	0.366	0.393	0.496	0.236
Measurement 4	0.119	0.176	0.240	0.317	0.368	0.394	0.496	0.234
Measurement 5	0.118	0.175	0.240	0.317	0.366	0.394	0.497	0.235
Measurement 6	0.120	0.176	0.240	0.316	0.367	0.394	0.497	0.235
Measurement 7	0.120	0.177	0.243	0.315	0.365	0.394	0.497	0.236
Measurement 8	0.120	0.177	0.241	0.317	0.368	0.394	0.497	0.236
Measurement 9	0.119	0.176	0.243	0.316	0.366	0.394	0.495	0.236
Measurement 1(	0.119	0.175	0.242	0.316	0.366	0.395	0.498	0.235
Average	0.119	0.176	0.241	0.316	0.366	0.394	0.497	0.236

Patrick Selakovich 1/05/07

Calibrator (Signature / Date)

Bill Hefley 1/05/07

QA Officer (Signature / Date)

AIR SAMPLING ASSOCIATES, INC.

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 2
Date Calibration Performed: 01/05/07

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	0.119	0.178	0.241	0.316	0.367	0.387	0.499	0.237
Measurement 2	0.117	0.175	0.242	0.316	0.366	0.387	0.497	0.237
Measurement 3	0.119	0.179	0.242	0.316	0.366	0.388	0.497	0.238
Measurement 4	0.118	0.177	0.239	0.318	0.365	0.386	0.496	0.238
Measurement 5	0.118	0.175	0.239	0.315	0.365	0.385	0.496	0.235
Measurement 6	0.119	0.176	0.240	0.316	0.367	0.385	0.497	0.237
Measurement 7	0.120	0.176	0.240	0.317	0.365	0.385	0.497	0.238
Measurement 8	0.120	0.178	0.242	0.318	0.365	0.387	0.498	0.239
Measurement 9	0.119	0.178	0.242	0.318	0.367	0.387	0.499	0.239
Measurement 10	0.118	0.177	0.242	0.319	0.368	0.387	0.497	0.237
Average	0.119	0.177	0.241	0.317	0.366	0.386	0.497	0.238

Patrick Selakovich 1/05/07

Calibrator (Signature / Date)

Bill Hefley 1/05/07

QA Officer (Signature / Date)

AIR SAMPLING ASSOCIATES, INC.

Calibration Data

Barometer Calibration Data

Date:	12/19/2006	Time:	08:30
I.D. #:	ASAI – 1	Temperature:	64

Mercury Barometer ASAI – 0 Reading:	29.92" Hg
Aneroid Barometer Reading:	29.97" Hg
Difference:	0.05" Hg
Barometer Adjusted?	YES

Certified by: Patrick Selakovich 12/19/06 — Calibrator (Signature/Date)

Bill Hefley 12/19/06 — QA Officer (Signature/Date)

AIR SAMPLING ASSOCIATES, INC.

Post-Test Calibration Data

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record data and information in the **GREEN** cells, YELLOW cells are calculated.

Quality - Service - Reliability

ENVIRONMENTAL SUPPLY COMPANY

ASAI 2-2 03/16/07

DATE: 3/16/2007

METER PART #: C-5000-SO

METER SERIAL #: 1509

CRITICAL ORIFICE SET SERIAL #: 1427s

BAROMETRIC PRESSURE (in Hg):	INITIAL	FINAL	AVG (P_{bar})
	30.28	30.3	30.29

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT^3) INITIAL	DGM READINGS (FT^3) FINAL	DGM READINGS (FT^3) NET (V_m)	TEMPERATURES °F AMBIENT	TEMPERATURES °F DGM INLET INITIAL	TEMPERATURES °F DGM INLET FINAL	TEMPERATURES °F DGM OUTLET INITIAL	TEMPERATURES °F DGM OUTLET FINAL	TEMPERATURES °F DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)	$\Delta H_@$
	1																		
	2																		
	3																		
																AVG =			
15	1	0.4202	20	214.813	220.287	5.474	66	67	68	69	68	68	10.00	0.9	5.5548	5.5512	0.999		1.67
	2	0.4202	20	220.287	225.750	5.463	66	68	68	68	67	67.75	10.00	0.86	5.5458	5.5512	1.001		1.59
	3	0.4202	20	225.750	231.222	5.472	66	68	69	67	67	67.75	10.00	0.86	5.5549	5.5512	0.999		1.59
																AVG =	1.000	-0.20	
19	1	0.5166	19	231.409	236.760	5.351	67	69	70	67	68	68.5	8.00	1.4	5.4315	5.4546	1.004		1.72
	2	0.5166	19	236.760	242.119	5.359	67	70	70	68	68	69	8.00	1.4	5.4344	5.4546	1.004		1.72
	3	0.5166	19	242.119	247.480	5.361	67	70	71	68	68	69.25	8.00	1.4	5.4339	5.4546	1.004		1.72
																AVG =	1.004	0.20	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.002

AVERAGE $\Delta H_@$ = 1.67

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions

K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)

T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions

T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

K' = Average K' factor from Critical Orifice Calibration

(3) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$

= DGM calibration factor

$$\Delta H_@ = \left(\frac{0.75\,\theta}{V_{cr}(std)}\right)^2 \Delta H \left(\frac{V_m(std)}{V_m}\right)$$

AIR SAMPLING ASSOCIATES, INC.

Calibration Data

Digital Temperature Indicator Calibration

DTI Unit No. ASAI 2-2

Date Calibration Performed: 03/16/07

Reference Point	Time	ASTM Reference Thermometer (°F)	DTI (°F)
Ice Bath	9:23	32° F	32° F
Ambient Air	9:24	68° F	68° F
Boiling Water	9:25	212° F	215° F
Oven	9:26	250° F	254° F
Oven	9:27	300° F	304° F
Oven	9:28	350° F	354° F
Oven	9:29	400° F	405° F

Meter Adjusted? No

ASTM Reference Thermometer: SN: 06000047 Range: -0.1°C to 1,360.6°

Range:

Range:

Certified by: Patrick Selakovich 3/16/07

Calibrator (Signature / Date)

Bill Hefley 3/16/07

QA Officer (Signature / Date)

AIR SAMPLING ASSOCIATES, INC.

CALIBRATION DATA
PITOT TUBE CALIBRATION DATA

Date: 03/28/07
I.D. # ASAI 1-4
C_{pstd}: 0.990

Time: 14:15
T_s: 76 °F
Pb: 29.59 " Hg

fps Mark	Desired Calibration Standard	Calibration Standard Start	Calibration Standard End	v Standard Average	High	v High	Cal. Factor	Low	v Low	Cal. Factor
20	0.09	0.09	0.09	0.300	0.13	0.361	0.824	0.13	0.361	0.824
30	0.20	0.21	0.21	0.458	0.30	0.548	0.828	0.30	0.548	0.828
40	0.36	0.37	0.37	0.608	0.54	0.735	0.819	0.54	0.735	0.819
50	0.56	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
60	0.80	0.83	0.83	0.911	1.20	1.095	0.823	1.20	1.095	0.823
70	1.09	1.15	1.15	1.072	1.65	1.285	0.826	1.65	1.285	0.826
80	1.43	1.50	1.50	1.225	2.15	1.466	0.827	2.15	1.466	0.827
90	1.80	1.85	1.85	1.360	2.65	1.628	0.827	2.65	1.628	0.827
50	0.56	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
50	0.56	0.58	0.58	0.762	0.84	0.917	0.823	0.84	0.917	0.823
Average							0.825			0.825

Summary of Results:

Normal high side calibraiton factor: 0.825
variation +: 0.36%
variation -: -0.73%
Normal low side calibration factor: 0.825
variation +: 0.36%
variation -: -0.73%

Certification:
I certify that the Type S pitot tube, the standard type pitot tube, and the calibration setup meet or exceed all specifications, criteria and/or applicable design features and hereby assign a pitot tube calibration factor C_p of: 0.825

Certified by: Scot Jackson 3/28/07
Calibrator (Signature/Date)

Bill Hefley 3/28/07
QA Officer (Signature/Date)

AIR SAMPLING ASSOCIATES, INC.

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI 1-
Date Calibration Performed: 03/28/07

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	0.119	0.175	0.242	0.316	0.365	0.394	0.498	0.235
Measurement 2	0.117	0.173	0.242	0.315	0.366	0.395	0.496	0.237
Measurement 3	0.119	0.173	0.241	0.316	0.366	0.393	0.496	0.236
Measurement 4	0.119	0.173	0.240	0.317	0.368	0.394	0.496	0.234
Measurement 5	0.118	0.174	0.240	0.317	0.366	0.394	0.497	0.235
Measurement 6	0.120	0.171	0.240	0.316	0.367	0.394	0.497	0.235
Measurement 7	0.120	0.172	0.243	0.315	0.365	0.394	0.497	0.236
Measurement 8	0.120	0.175	0.241	0.317	0.368	0.394	0.497	0.236
Measurement 9	0.119	0.174	0.243	0.316	0.366	0.394	0.495	0.236
Measurement 1(	0.119	0.175	0.242	0.316	0.366	0.395	0.498	0.235
Average	0.119	0.174	0.241	0.316	0.366	0.394	0.497	0.236

Patrick Selakovich 3/28/07

Calibrator (Signature / Date)

Bill Hefley 3/28/07

QA Officer (Signature / Date)

AIR SAMPLING ASSOCIATES, INC.

Calibration Data
Nozzle Calibration

Nozzle Set No. ASAI - 2
Date Calibration Performed: 03/28/07

	-1	-2	-3	-4	-5	-6	-7	-8
Measurement 1	0.119	0.178	0.241	0.316	0.367	0.387	0.499	0.237
Measurement 2	0.117	0.175	0.242	0.316	0.366	0.387	0.497	0.237
Measurement 3	0.119	0.176	0.242	0.316	0.366	0.388	0.497	0.238
Measurement 4	0.118	0.174	0.239	0.318	0.365	0.386	0.496	0.238
Measurement 5	0.118	0.174	0.239	0.315	0.365	0.385	0.496	0.235
Measurement 6	0.119	0.178	0.240	0.316	0.367	0.385	0.497	0.237
Measurement 7	0.120	0.175	0.240	0.317	0.365	0.385	0.497	0.238
Measurement 8	0.120	0.178	0.242	0.318	0.365	0.387	0.498	0.239
Measurement 9	0.119	0.178	0.242	0.318	0.367	0.387	0.499	0.239
Measurement 10	0.118	0.175	0.242	0.319	0.368	0.387	0.497	0.237
Average	0.119	0.176	0.241	0.317	0.366	0.386	0.497	0.238

Patrick Selakovich 3/28/07

Calibrator (Signature / Date)

Bill Hefley 3/28/07

QA Officer (Signature / Date)

AIR SAMPLING ASSOCIATES, INC.

Calibration Data

Barometer Calibration Data

Date:	3/21/2007	Time:	13:30
I.D. #:	ASAI – 1	Temperature:	74

Mercury Barometer ASAI – 0 Reading:	29.74" Hg
Aneroid Barometer Reading:	29.84" Hg
Difference:	0.10" Hg
Barometer Adjusted?	YES

Certified by: Patrick Selakovich 3/21/07 — Calibrator (Signature/Date)

Bill Hefley 3/21/07 — QA Officer (Signature/Date)

Appendix D:

Field Data

Job Number 07-008
Job Name ADA-ES, NEWARK
Run Number 1
Unit UNIT NO. 2 STACK
Date 1/29/07
Operator GOLDMAN / JACKSON
Sample Box No. 1-1 Meter Box No. 2-2

5/202 Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: 1614-1714
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 40
Assumed Moisture % 10
Probe Length 9'
C Factor 5.4 to reference
Initial Leak @ 15.0 "Hg = 0.006 cfm
Final Leak @ 4.0 "Hg = 0.001 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H₂O	Orifice ΔH "H₂O Desired	Orifice ΔH "H₂O Actual	Pump Vacuum "Hg Guage	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet (T_m)	Dry Gas Temp. °F Outlet	Remarks
C 3	0830	528.963	2.80	1.50	1.50	0.0	306	271	301	35	48	45	INTEGRATED ORSAT
2	0835	532.32	2.80	1.50	1.50	0.0	306	277	301	35	49	45	FILTER NO. A129
1	0840	535.625	2.70	1.45	1.45	0.0	306	280	300	35	52	46	
—	0845	538.847	—	—	—	—	—	—	—	—	—	—	
B 3	0849	538.847	2.80	1.50	1.50	0.0	306	306	303	36	52	48	
2	0854	542.19	2.70	1.45	1.45	0.0	306	293	302	35	54	47	
1	0859	545.455	2.50	1.35	1.35	0.0	306	293	303	37	56	49	
—	0904	548.616	—	—	—	—	—	—	—	—	—	—	
A 3	0908	548.616	2.80	1.50	1.50	0.0	306	300	300	37	55	50	
2	0913	551.97	2.70	1.45	1.45	0.0	307	299	302	38	57	50	
1	0918	555.28	2.40	1.30	1.30	0.0	307	296	302	38	58	51	
—	0923	558.482	—	—	—	—	—	—	—	—	—	—	leak ✓ @ 5" Hg pond (-0.248)
D 3	0932	558.730	2.70	1.45	1.45	0.0	304	298	302	38	55	52	
2	0937	562.06	2.50	1.35	1.35	0.0	308	296	301	37	57	52	
1	0942	565.28	2.60	1.40	1.40	0.0	308	291	301	37	59	52	
—	0947	568.52	—	—	—	—	—	—	—	—	—	—	
D 3	0947	568.52	2.70	1.45	1.45	0.0	309	287	301	37	61	53	
2	0952	571.84	2.70	1.45	1.45	0.0	309	288	301	38	62	54	

Pitot Tube Calibration Factor C_p 0.84 (37.4)
Volume Collected V_m 237.553 ft³
Water Collected V_w 564.2 ml
Time of Test T_t 360 min.
Stack Pressure P_s -3.50 "H₂O

Pitot Tube No. 1-4 (20.1)
Baro. Press. P_b 29.67 "Hg
Probe Tip Dia. D_n 0.177 in.
% CO_2 13.0 % CO 0.0
% O_2 6.4 % N_2 80.6
Area Stack A_s 75,294 in² (4294)

Barometer No. 1 (1468)
Probe Tip No. 2-2
Total Volume of Leak Checks After Start: 0.248 ft³
V_m X Dry Gas Meter Calibration Factor 0.988 x 240.438

[Dry Gas Meter Reading — ft³ - (T_t — min. X Leak Rate — cfm)]

Impinger Box No. 1-1

Impinger 1	Final Weight	1006.7		Impinger 1	272.6
	Initial Weight	734.1			
	Increase			Impinger 2	248.5
Impinger 2	Final Weight	981.2		Impinger 3	2.4
	Initial Weight	732.7			
	Increase			Impinger 4	1.1
Impinger 3	Final Weight	634.1	V_w =	Impinger 5	39.6
	Initial Weight	631.7	g SO_2 =		
	Increase		V_w =	Impinger 6	
Impinger 4	Final Weight	667.8		Impinger 7	
	Initial Weight	~~984.1~~ 666.7			
	Increase			Total	564.2 = V_w ✓

Water Weight Gain

1/28/07

filter No. A129

Impinger 5	Final Weight	1021.1	P_b =	29.67 ✓	$\%CO_2$ =	13.0 ✓
	Initial Weight	981.5	V_m =	237.553 ✓	$\%O_2$ =	6.4 ✓
	Increase		V_w =	564.2 ✓	%CO =	0.0 ✓
			P_m =	1.432 ✓	$\%N_2$ =	80.6 ✓
Impinger 6	Final Weight		Avg ΔP =	2.656 ✓	A_s =	75.294 ✓
	Initial Weight				D_n =	0.177 ✓
	Increase		Avg$\sqrt{\Delta P}$ =	1.629 ✓	T_1 =	360 ✓
			C_p =	0.825 ✓		
Impinger 7	Final Weight		P_s =	-3.5 °H_2O ✓	29.41	°Hg ✓
	Initial Weight		T_m =	62 °F ✓	522	°R ✓
	Increase		T_s =	315 °F ✓	775	°R ✓

Moisture Content: %M = 10.02 ✓ M_d = 0.8998 ✓ MW_c = 30.336 ✓ MW = 29.10 ✓

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 237.553 \left[\frac{29.67 + \frac{1.432}{13.6}}{62 + 460}\right] = 239.161\ sft^3 \checkmark$$

0.664 scfm

Vw_{gas} = 0.0472 x Vw = 0.0472 x 564.2 = 26.630 sft^3 ✓

$$\%\ Moisture = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{26.630}{239.161 + 26.630} \times 100 = 10.02\ \% \checkmark$$

$$V_s = 5123.8 \times 0.825 \sqrt{\frac{775}{29.41 \times 29.10}} \times 1.629 = 6553\ fpm \checkmark$$

$$\%I = \frac{1.039 \times 239.161 \times 775}{6553 \times 0.8998 \times 29.41 \times 360 \times (0.177)^2} = 98.5\ \% \checkmark$$

ACFM: 3,426,273 ✓ 2/7/07 ~~3,424,225~~ ✓ ~~3,426,273~~ 2/6/07 ~~2,071,025~~ ✓

SCFM: ~~2,072,263~~ 2/6/07 2,072,263 ✓ 2/7/07

%EA: 42.8 ✓

Checked by: 2/6/07

Run Number 1

Unit UNIT NO. 2 STACK

Date 1/29/07

5/202 FIELD DATA

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual (P_m)	Pump Vacuum "Hg Guage	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet (T_m)	Dry Gas Temp. °F Outlet	Remarks
D1	0957	575.16	2.40	1.40	1.40	0.0	310	289	301	39	63	54	pg. 2
—	1002	578.460	—	—	—	—	—	—	—	—	—	—	
A3	1006	579.460	2.80	1.50	1.50	0.0	310	289	303	41	60	55	
2	1011	581.80	2.80	1.50	1.50	0.0	311	293	301	40	62	55	ΔP 2.80
1	1016	585.17	2.40	1.40	1.40	0.0	312	297	302	40	63	56	
—	1021	588.458	—	—	—	—	—	—	—	—	—	—	
B3	1024	588.458	2.80	1.50	1.50	0.0	312	301	303	40	62	56	
2	1029	591.81	2.80	1.50	1.50	0.0	312	299	301	39	63	56	
1	1034	595.155	2.50	1.35	1.35	0.0	313	299	302	40	64	56	
—	1039	598.439	—	—	—	—	—	—	—	—	—	—	
C3	1042	598.439	2.80	1.50	1.50	0.0	314	299	304	40	62	57	
2	1047	601.81	2.80	1.50	1.50	0.0	315	299	302	40	63	57	
1	1052	505.195	2.40	1.40	1.40	0.0	315	296	301	41	64	57	
—	1057	608.475	—	—	—	—	—	—	—	—	—	—	
C3	1057	608.475	2.80	1.50	1.50	0.0	316	294	302	41	66	57	
2	1102	611.920	2.80	1.50	1.50	0.0	316	293	301	41	66	58	
1	1107	615.335	2.50	1.35	1.35	0.0	317	293	301	42	67	58	
—	1112	618.558	—	—	—	—	—	—	—	—	—	—	
B3	1115	618.558	2.70	1.45	1.45	0.0	317	296	301	41	64	59	
2	1120	621.985	2.60	1.40	1.40	0.0	317	298	302	41	65	59	
1	1125	625.185	2.60	1.40	1.40	0.0	318	298	303	42	66	59	
—	1130	628.501	—	—	—	—	—	—	—	—	—	—	
A3	1133	628.501	2.50	1.35	1.35	0.0	319	300	304	42	64	60	
2	1138	631.96	2.70	1.45	1.45	0.0	320	299	301	42	65	59	
1	1143	635.13	2.50	1.35	1.35	0.0	319	300	302	42	66	59	
—	1148	638.44	—	—	—	—	—	—	—	—	—	—	
			87.6		47.4		10277				3770		

Run Number 1

Unit UNIT NO. 2 STACK

Date 1/29/07

5/202 FIELD DATA

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual (P_m)	Pump Vacuum "Hg Guage	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet (T_m)	Dry Gas Temp. °F Outlet	Remarks
D3	1151	638.404	2.80	1.50	1.50	0.0	318	300	303	42	65	60	pg.3
2	1156	641.825	2.70	1.45	1.45	0.0	317	299	302	42	66	60	
1	1201	645.195	2.50	1.35	1.35	0.0	317	298	301	42	67	60	
—	1206	648.57	—	—	—	—	—	—	—	—	—	—	
D3	1206	648.57	2.70	1.45	1.45	0.0	317	295	303	43	67	60	
2	1211	651.83	2.70	1.45	1.45	0.0	316	295	301	43	68	60	
1	1216	655.205	2.40	1.30	1.30	0.0	316	295	301	44	69	61	
—	1221	658.463	—	—	—	—	—	—	—	—	—	—	
A3	1224	658.463	2.80	1.50	1.50	0.0	315	295	302	45	67	61	
2	1229	661.92	2.80	1.50	1.50	0.0	315	298	302	44	67	61	
1	1234	665.30	2.40	1.30	1.30	0.0	315	300	302	44	68	61	
—	1239	668.535	—	—	—	—	—	—	—	—	—	—	
B3	1242	668.535	2.80	1.50	1.50	0.0	315	301	302	45	66	62	
2	1247	671.95	2.80	1.50	1.50	0.0	315	301	303	44	67	62	
1	1252	675.38	2.50	1.35	1.35	0.0	315	301	304	44	69	62	
—	1257	678.718	—	—	—	—	—	—	—	—	—	—	
C3	1300	678.718	2.80	1.50	1.50	0.0	315	300	302	45	67	62	
2	1305	682.14	2.70	1.45	1.45	0.0	315	300	303	44	68	62	
1	1310	685.53	2.50	1.35	1.35	0.0	315	299	302	44	69	62	
—	1315	688.76	—	—	—	—	—	—	—	—	—	—	
C3	1315	688.76	2.80	1.50	1.50	0.0	315	297	302	45	70	63	
2	1320	692.18	2.80	1.50	1.50	0.0	315	298	302	45	71	63	
1	1325	695.61	2.40	1.30	1.30	0.0	315	299	302	46	71	63	
—	1330	698.881	—	—	—	—	—	—	—	—	—	—	
B3	1333	698.881	2.80	1.50	1.50	0.5	315	301	301	47	69	64	
2	1338	702.305	2.80	1.50	1.50	0.5	316	299	303	46	70	64	
			141.1		76.15		16599				6364		

Run Number 1

Unit UNIT NO. 2 STACK

Date 1/29/07

5/202 FIELD DATA

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual (P_m)	Pump Vacuum "Hg Guage	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet (T_m)	Dry Gas Temp. °F Outlet	Remarks
B1	1343	705.72	2.50	1.35	1.35	0.5	316	301	302	46	71	64	pg. 4
—	1348	709.066	—	—	—	—	—	—	—	—	—	—	
A3	1351	709.066	2.80	1.50	1.50	0.5	317	298	303	47	69	65	
2	1356	712.51	2.80	1.50	1.50	0.5	317	300	302	47	70	65	
1	1401	715.950	2.50	1.35	1.35	0.5	318	300	302	46	71	65	
—	1406	719.263	—	—	—	—	—	—	—	—	—	—	
D3	1410	719.263	2.80	1.50	1.50	0.5	319	301	303	48	70	65	
2	1415	722.63	2.60	1.40	1.40	0.5	319	301	302	47	71	65	
1	1420	725.98	2.40	1.30	1.30	0.5	320	299	301	46	71	65	
—	1425	729.21	—	—	—	—	—	—	—	—	—	—	
D3	1425	729.21	2.70	1.45	1.45	0.5	320	299	302	47	72	65	
2	1430	732.595	2.60	1.40	1.40	0.5	321	300	302	48	73	66	
1	1435	735.95	2.50	1.35	1.35	1.0	321	300	304	48	74	66	
—	1440	739.228	—	—	—	—	—	—	—	—	—	—	
A3	1442	739.228	2.75	1.45	1.45	1.0	320	298	302	49	73	67	
2	1447	742.58	2.80	1.50	1.50	1.0	323	300	301	48	73	67	
1	1452	746.00	2.40	1.30	1.30	1.0	324	301	301	48	74	67	
—	1457	749.30	—	—	—	—	—	—	—	—	—	—	
B3	1500	749.30	2.80	1.50	1.50	1.0	325	302	304	49	72	67	
2	1505	752.74	2.70	1.45	1.45	1.0	325	300	301	49	73	67	
1	1510	756.18	2.50	1.35	1.35	1.0	325	301	303	48	73	67	
—	1515	759.509	—	—	—	—	—	—	—	—	—	—	
C3	1518	759.509	2.80	1.50	1.50	1.0	326	301	304	49	72	67	
2	1523	762.995	2.70	1.45	1.45	1.0	327	300	302	49	73	67	
1	1528	766.335	2.50	1.35	1.35	1.0	327	300	302	49	74	67	
—	1533	769.649	—	—	—	—	—	—	—	—	—	—	
			191.25		103.1		22698				8987		

Job Number 07-008
Job Name ADA-ES, NEWARK
Run Number 2
Unit UNIT NO. 2 STACK
Date 1/30/07
Operator GOLDMAN, JACKSON
Sample Box No. 1-1 Meter Box No. 2-2

5/202 Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: 1403 - 1503
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 45
Assumed Moisture % 10
Probe Length 9
C Factor 5.4 to reference
Initial Leak @ 15.0 "Hg = 0.004 cfm
Final Leak @ 5.0 "Hg = 0.001 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H₂O (ΔP_s)	Orifice ΔH "H₂O Desired	Orifice ΔH "H₂O Actual	Pump Vacuum "Hg Guage (P_m)	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet (T_m)	Dry Gas Temp. °F Outlet	Remarks
C 3	0645	776.178	2.80	1.50	1.50	0.0	307	241	301	42	50	49	INTEGRATED UNSAT
2	0650	779.54	2.70	1.45	1.45	0.0	308	257	299	41	51	49	FILTER NO. ABO
1	0655	782.82	2.40	1.30	1.30	0.0	309	267	300	39	53	50	
—	0700	785.978	—	—	—	—	—	—	—	—	—	—	
B 3	0703	785.978	2.80	1.50	1.50	0.0	307	281	301	40	56	51	
2	0708	789.33	2.80	1.50	1.50	0.0	309	287	301	39	57	51	
1	0713	792.67	2.70	1.45	1.45	0.0	309	291	307	38	59	52	
—	0718	795.967	—	—	—	—	—	—	—	—	—	—	
A 3	0720	795.967	2.90	1.60	1.60	0.0	309	301	303	39	61	53	
2	0725	799.39	2.80	1.50	1.50	0.0	308	299	301	39	62	54	
1	0730	802.72	2.40	1.30	1.30	0.0	308	302	303	39	63	54	
—	0735	805.913	—	—	—	—	—	—	—	—	—	—	
D 3	0747	805.913	2.80	1.50	1.50	0.0	309	279	300	41	59	56	
2	0752	809.24	2.70	1.45	1.45	0.0	310	286	301	39	60	56	
1	0757	812.55	2.40	1.30	1.30	0.0	310	290	300	38	61	56	
—	0802	815.72	—	—	—	—	—	—	—	—	—	—	
D 3	0802	815.72	2.80	1.50	1.50	0.0	310	287	301	39	63	56	
2	0807	819.08	2.80	1.50	1.50	0.0	310	287	301	39	64	57	

Pitot Tube Calibration Factor C_p 37.8 0.825
Volume Collected V_m 239.240 ft³
Water Collected V_w 549.7 ml
Time of Test T_t 360 min.
Stack Pressure P_s -3.70 "H₂O

Pitot Tube No. 1-4 20.35 4323
Baro. Press. P_b 29.72 "Hg
Probe Tip Dia. D_n 0.176 in.
% CO_2 13.0 % CO 0.0
% O_2 6.8 % N_2 80.2
Area Stack A_s 75.294 in²

Barometer No. 1 1563 Probe Tip No. 1-2
Total Volume of Leak Checks After Start: 0.000 ft³
V_m X Dry Gas Meter Calibration Factor 242.146 x 0.988

[Dry Gas Meter Reading — ft³ - (T_t — min. X Leak Rate — cfm)]

Impinger Box No. 1-2

Impinger 1	Final Weight	1019.8		Impinger 1	289.0
	Initial Weight	730.8			
	Increase			Impinger 2	217.8
Impinger 2	Final Weight	949.4		Impinger 3	-0.3
	Initial Weight	731.6			
	Increase			Impinger 4	43.2
Impinger 3	Final Weight	726.7	V_w =	Impinger 5	
	Initial Weight	727.0	g SO_2 =		
	Increase		V_w =	Impinger 6	
Impinger 4	Final Weight	1012.8		Impinger 7	
	Initial Weight	969.6	filter No. A130	Total	549.7 = V_w
	Increase				

Water Weight Gain

Impinger 5	Final Weight		P_b = 29.72	$\%CO_2$ = 13.0	
	Initial Weight		V_m = 239.240	$\%O_2$ = 6.8	
	Increase		V_w = 549.7	%CO = 0.0	
			P_m = 1.475	$\%N_2$ = 80.2	
Impinger 6	Final Weight		Avg ΔP = 2.728	A_s = 75294	
	Initial Weight			D_n = 0.176	
	Increase		Avg$\sqrt{\Delta P}$ = 1.651	T_1 = 360	
			C_p = 0.825		
Impinger 7	Final Weight		P_s = -3.7 °H_2O	29.45 °Hg	
	Initial Weight		T_m = 63 °F	523 °R	
	Increase		T_s = 310 °F	770 °R	

Moisture Content: %M = 9.73 M_d = 0.9027 MW_c = 30.352 MW = 29.15

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 239.240 \left[\frac{29.72 + \frac{1.475}{13.6}}{63 + 460}\right] = 240.828\ sft^3 = 0.669\ scfm$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 549.7 = 25.946 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{25.946}{25.946 +}$ x 100 = 9.73 %

V_s = 5123.8 x $0.825\sqrt{\frac{770}{29.15 \times 29.45}}$ x 1.651 = 6610 fpm

ACFM: 3,456,006

SCFM: 2,113,513

%I = $\frac{1.039 \times 770 \times 240.828}{6610 \times 360 \times 0.9027 \times 29.45 \times 0.176^2}$ = 98.3 %

%EA: 47.0

checked by: [illegible]

Run Number 2

Unit UNIT NO. 2 STACK

Date 1/30/07

5/202 FIELD DATA

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual (P_m)	Pump Vacuum "Hg Guage	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet (T_m)	Dry Gas Temp. °F Outlet	Remarks
D 1	0812	822.455	2.50	1.35	1.35	0.0	310	288	302	39	65	57	pg. 2
—	0817	825.717	—	—	—	—	—	—	—	—	—	—	
A 3	0819	825.717	2.80	1.50	1.50	0.0	308	288	301	40	65	58	
2	0824	829.08	2.80	1.50	1.50	0.0	310	288	300	40	65	58	
1	0829	832.44	2.50	1.35	1.35	0.0	310	293	302	39	66	59	
—	0834	835.706	—	—	—	—	—	—	—	—	—	—	
B 3	0836	835.706	2.80	1.50	1.50	0.0	310	303	304	40	65	59	
2	0841	839.09	3.00	1.65	1.65	0.0	310	302	302	39	66	60	
1	0846	842.655	2.80	1.50	1.50	0.0	310	299	302	39	67	60	
—	0851	846.057	—	—	—	—	—	—	—	—	—	—	
C 3	0854	846.057	2.80	1.50	1.50	0.0	309	301	302	40	65	60	
2	0859	849.45	2.80	1.50	1.50	0.0	310	299	302	39	66	60	
1	0904	852.81	2.70	1.45	1.45	0.0	310	295	301	39	67	60	
—	0909	856.165	—	—	—	—	—	—	—	—	—	—	
C 3	0909	856.165	2.80	1.50	1.50	0.0	310	292	301	39	67	60	
2	0914	859.58	2.70	1.45	1.45	0.0	309	291	301	40	68	61	
1	0919	862.92	2.50	1.35	1.35	0.0	309	289	301	40	68	61	
—	0924	866.170	—	—	—	—	—	—	—	—	—	—	
B 3	0926	866.170	3.00	1.65	1.65	0.0	308	295	303	40	67	61	
2	0931	869.70	2.80	1.50	1.50	0.0	309	293	300	39	67	61	
1	0936	873.10	2.70	1.45	1.45	0.0	309	296	303	39	67	61	
—	0941	876.462	—	—	—	—	—	—	—	—	—	—	
A 3	0943	876.462	2.80	1.50	1.50	0.0	309	302	302	40	65	61	
2	0948	879.855	2.80	1.50	1.50	0.0	310	299	301	40	67	61	
1	0953	883.235	2.40	1.30	1.30	0.0	310	303	302	40	67	61	
—	0958	886.447	—	—	—	—	—	—	—	—	—	—	
			89.8		49.35			~~8704~~ 10204			3962		

Run Number 2

Unit UNIT NO. 2 STACK

Date 11/30/07

5/202 FIELD DATA

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired (P_m)	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet (T_m)	Dry Gas Temp. °F Outlet	Remarks
D3	1000	886.447	2.80	1.50	1.50	0.0	308	302	303	40	67	61	pg.3
2	1005	889.83	2.80	1.50	1.50	0.0	310	300	299	40	67	61	
1	1010	893.20	2.40	1.30	1.30	0.0	309	297	300	40	67	61	
—	1015	896.39	—	—	—	—	—	—	—	—	—	—	
D3	1015	896.39	3.00	1.65	1.65	0.0	309	293	301	40	67	61	
2	1020	899.95	2.80	1.50	1.50	0.0	309	291	301	41	68	61	
1	1025	903.33	2.40	1.30	1.30	0.5	309	287	300	41	69	61	
—	1030	906.582	—	—	—	—	—	—	—	—	—	—	
A3	1032	906.582	2.80	1.50	1.50	0.5	307	288	303	42	67	62	
2	1037	910.03	2.80	1.50	1.50	0.5	309	294	300	41	68	62	
1	1042	913.40	2.40	1.30	1.30	0.0	309	292	301	41	68	62	
—	1047	916.614	—	—	—	—	—	—	—	—	—	—	
B3	1049	916.614	2.90	1.60	1.60	0.5	308	301	302	41	68	62	
2	1054	920.1.05	2.90	1.60	1.60	0.5	309	299	302	41	68	62	
1	1059	923.61	2.50	1.35	1.35	0.5	309	301	301	41	68	62	
—	1104	926.88	—	—	—	—	—	—	—	—	—	—	
C3	1107	926.88	2.90	1.60	1.60	0.5	309	301	303	41	65	62	
2	1112	930.375	2.80	1.50	1.50	0.5	310	300	302	40	67	62	
1	1117	933.78	2.50	1.35	1.35	0.0	310	298	301	40	68	61	
—	1122	937.015	—	—	—	—	—	—	—	—	—	—	
C3	1122	937.015	2.90	1.60	1.60	0.5	311	293	301	41	68	61	
2	1127	940.50	3.00	1.65	1.65	1.0	311	294	303	42	69	62	
1	1132	944.06	2.40	1.30	1.30	0.0	312	291	300	42	69	62	
—	1137	947.260	—	—	—	—	—	—	—	—	—	—	
B3	1140	947.260	3.00	1.65	1.65	1.0	313	295	304	42	67	62	
2	1145	950.90	3.00	1.65	1.65	1.0	313	294	300	41	68	62	
				29.9			6184				2585		

Run Number 2

Unit UNIT NO. 2 STACK

Date 1/30/07

5/202 FIELD DATA

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
B1	1150	954.38	2.50	1.35	1.35	0.0	313	297	304	41	68	62	pg.4
—	1155	957.698	—	—	—	—	—	—	—	—	—	—	
A3	1157	957.698	3.00	1.65	1.65	1.0	313	302	304	42	68	62	
2	1202	961.21	2.80	1.50	1.50	1.0	312	300	300	43	68	62	
1	1207	964.59	2.50	1.35	1.35	0.5	312	300	301	42	68	62	
—	1212	967.834	—	—	—	—	—	—	—	—	—	—	
D3	1214	967.834	2.80	1.50	1.50	0.5	310	302	301	42	67	62	
2	1219	971.20	2.70	1.45	1.45	0.5	311	300	302	42	68	62	
1	1224	974.55	2.50	1.35	1.35	0.5	312	296	300	42	68	62	
—	1229	977.79	—	—	—	—	—	—	—	—	—	—	
D3	1229	977.79	2.90	1.60	1.60	1.0	312	289	299	43	69	62	
2	1234	981.30	2.70	1.45	1.45	1.0	311	287	300	43	69	62	
1	1239	984.625	2.70	1.45	1.45	1.0	312	287	301	43	70	62	
—	1244	987.986	—	—	—	—	—	—	—	—	—	—	
A 3	1246	987.986	2.80	1.50	1.50	1.0	310	287	300	44	68	63	
2	1251	991.335	2.70	1.45	1.45	1.0	311	287	299	43	69	63	
1	1256	994.67	2.40	1.30	1.30	0.5	311	292	302	43	69	63	
—	1301	997.881	—	—	—	—	—	—	—	—	—	—	
B 3	1303	997.881	2.90	1.60	1.60	1.0	311	300	301	43	68	63	
2	1308	1001.36	2.90	1.60	1.60	1.0	311	302	301	42	69	63	
1	1313	1004.85	2.70	1.45	1.45	1.0	311	302	306	42	69	63	
—	1318	1008.217	—	—	—	—	—	—	—	—	—	—	
C 3	1321	1008.217	2.80	1.50	1.50	1.0	310	303	302	43	67	62	
2	1326	1011.59	2.90	1.60	1.60	1.0	311	301	301	42	68	62	
1	1331	1015.085	2.40	1.30	1.30	0.5	311	299	301	42	69	62	
—	1336	1018.324	—	—	—	—	—	—	—	—	—	—	
				27.95			5915			1	2482		

Job Number 07-008
Job Name ADA-ES, NEWARK
Run Number 3
Unit UNIT NO. 2 STACK
Date 11/31/07
Operator GOLDMAN / JACKSON
Sample Box No. 1-3 Meter Box No. 2-2

5/202 Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: 1344-1444
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 31
Assumed Moisture % 10
Probe Length 91
C Factor 5.4 to reference
Initial Leak @ 15.0 "Hg = 0.004 cfm
Final Leak @ 4.0 "Hg = 0.001 cfm

ΔP_s 37.9 P_m 20.45 T_s 4240 T_m 1258

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
C3	0642	27.827	2.80	1.50	1.50	0.0	304	240	303	31	37	36	INTEGRATED ORSAT
2	0647	31.135	2.80	1.50	1.50	0.0	304	254	301	34	39	37	filter A131
1	0652	34.42	2.40	1.30	1.30	0.0	303	263	303	33	42	37	
—	0657	37.468	—	—	—	—	—	—	—	—	—	—	
B3	0659	37.468	2.90	1.60	1.60	0.0	303	274	307	33	44	39	
2	0704	40.865	2.90	1.60	1.60	0.0	302	278	307	34	47	39	
1	0709	44.28	2.50	1.35	1.35	0.0	302	284	304	35	49	40	
—	0714	47.433	—	—	—	—	—	—	—	—	—	—	
A3	0716	47.433	2.80	1.50	1.50	0.0	302	289	309	35	48	42	
2	0721	50.22	2.80	1.50	1.50	0.0	302	291	301	35	50	42	
1	0726	53.48	2.40	1.30	1.30	0.0	302	296	303	36	52	43	
—	0731	56.594	—	—	—	—	—	—	—	—	—	—	
D3	0733	56.594	2.80	1.50	1.50	0.0	302	299	302	36	51	44	
2	0738	59.90	2.80	1.50	1.50	0.0	303	296	300	36	53	44	
1	0743	63.205	2.40	1.30	1.30	0.0	303	292	303	37	54	45	
—	0748	66.33	—	—	—	—	—	—	—	—	—	—	
D3	0748	66.33	2.80	1.50	1.50	0.0	304	286	301	37	55	46	
2	0753	69.66	2.80	1.50	1.50	0.0	304	282	300	38	56	47	97.6

Pitot Tube Calibration Factor C_p 0.825
Volume Collected V_m 238.490 ft^3
Water Collected V_w 557.5 ml
Time of Test T_t 360 min.
Stack Pressure P_s -3.50 "H_2O

Pitot Tube No. 1-4
Baro. Press. P_b 29.70 "Hg
Probe Tip Dia. D_n 0.176 in.
% CO_2 13.0 % CO 0.0
% O_2 6.7 % N_2 80.3
Area Stack A_s 75.294 in^2

Barometer No. 1 Probe Tip No. 1-2
Total Volume of Leak Checks After Start: 0.000 ft^3
V_m X Dry Gas Meter Calibration Factor 24.377 X 0.988

[Dry Gas Meter Reading — ft^3 - (T_t — min. X Leak Rate — cfm)]

Impinger Box No. 1-3

Impinger 1	Final Weight	1001.4		Impinger 1	270.7
	Initial Weight	730.7		Impinger 2	240.2
	Increase			Impinger 3	1.2
Impinger 2	Final Weight	987.0		Impinger 4	39.4
	Initial Weight	746.8		Impinger 5	
	Increase			Impinger 6	
Impinger 3	Final Weight	733.3		Impinger 7	
	Initial Weight	732.1		Total	551.5 = V_w
	Increase				
Impinger 4	Final Weight	1014.7			
	Initial Weight	975.3			
	Increase				
Impinger 5	Final Weight				
	Initial Weight				
	Increase				
Impinger 6	Final Weight				
	Initial Weight				
	Increase				
Impinger 7	Final Weight				
	Initial Weight				
	Increase				

Water Weight Gain

V_w =

g SO_2 = -

V_w =

filter A131

P_b = 29.70 | $\%CO_2$ = 13.0

V_m = 238.480 | $\%O_2$ = 6.7

V_w = 551.5 | %CO = 0.0

P_m = 1.504 | $\%N_2$ = 80.3

Avg ΔP = 2.765 | A_s = 75294

D_n = 0.176

Avg$\sqrt{\Delta P}$ = 1.661 | T_1 = 360

C_p = 0.825

P_s = -3.50 $^{\circ}H_2O$ | 29.44 $^{\circ}Hg$

T_m = 54 °F | 514 °R

T_s = 309 °F | 769 °R

Moisture Content: %M = 9.64 | M_d = 0.9036 | MW_c = 30.348 | MW = 29.16

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 238.480 \left[\frac{29.70 + \frac{1.504}{13.6}}{54 + 460}\right] = \frac{244.120\ sft^3}{0.678\ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 551.5 = 26.031 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{26.031}{26.301 +}$ x 100 = 9.64 %

V_s = 5123.8 x $0.825\sqrt{\frac{769}{29.44 \times 29.16}}$ x 1.661 = 6645 fpm

ACFM: 3,474,675

SCFM: 2,128,865

%I = $\frac{1.039 \times 769 \times 244.120}{6645 \times 0.9036 \times 29.44 \times 360 \times (0.176)^2}$ = 98.9 %

%EA: 46.0

checked by: 2/7/07

Run Number 3

Unit UNIT NO. 2 STACK

Date 1/31/07

5/202 FIELD DATA

ΔP_s 52.7 P_m 28.8 T_s 5853 T_m 2036

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
D1	0758	72.96	2.40	1.30	1.30	0.0	304	281	303	39	56	47	pg. 2
—	0803	76.168	—	—	—	—	—	—	—	—	—	—	
A3	0805	76.168	2.90	1.60	1.60	0.0	303	281	303	38	55	48	
2	0810	79.59	2.80	1.50	1.50	0.0	304	281	300	39	56	48	
1	0815	82.99	2.40	1.30	1.30	0.0	304	285	302	39	57	49	
—	0820	86.176	—	—	—	—	—	—	—	—	—	—	
B3	0822	86.176	3.00	1.65	1.65	0.0	304	295	303	38	56	50	
2	0827	89.68	2.90	1.60	1.60	0.0	305	295	304	39	57	50	
1	0832	93.145	2.40	1.30	1.30	0.0	305	298	302	38	57	50	
—	0837	96.323	—	—	—	—	—	—	—	—	—	—	
C3	0840	96.323	3.00	1.65	1.65	0.0	306	298	304	37	55	50	
2	0845	99.81	3.00	1.65	1.65	0.0	307	294	301	37	56	50	
1	0850	103.305	2.40	1.30	1.30	0.0	307	292	301	37	57	50	
—	0855	106.445	—	—	—	—	—	—	—	—	—	—	
C3	0855	106.445	3.00	1.65	1.65	0.0	308	290	305	37	57	50	
2	0900	109.90	3.00	1.65	1.65	0.0	309	287	302	38	58	50	
1	0905	113.425	2.40	1.30	1.30	0.0	310	287	301	38	59	51	
—	0910	116.575	—	—	—	—	—	—	—	—	—	—	
B3	0912	116.575	3.00	1.65	1.65	0.0	309	291	300	38	58	51	
2	0917	120.075	3.00	1.65	1.65	0.0	312	289	303	38	58	51	
1	0922	123.59	2.80	1.50	1.50	0.0	313	292	303	38	59	51	
—	0927	126.981	—	—	—	—	—	—	—	—	—	—	
A3	0929	126.981	3.00	1.65	1.65	0.0	314	294	300	37	57	52	
2	0934	130.465	2.90	1.60	1.60	0.0	314	295	301	38	58	52	
1	0939	133.94	2.40	1.30	1.30	0.0	315	297	299	38	58	52	
—	0944	136.919	—	—	—	—	—	—	—	—	—	—	98.8

Run Number 3

Unit UNIT NO. 2 STACK

Date 1/31/07

5/202 FIELD DATA

ΔP_s 55.5 P_m 30.2 T_s 6281 T_m 2229

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
D3	0946	136.99	3.00	1.65	1.65	0.0	315	299	302	37	57	52	pg. 3
2	0951	140.58	3.00	1.65	1.65	0.0	316	294	300	38	58	52	
1	0956	144.30	2.50	1.35	1.35	0.0	317	290	300	39	59	52	
—	1001	147.325	—	—	—	—	—	—	—	—	—	—	
D3	1001	147.325	2.80	1.50	1.50	0.0	318	285	300	40	59	52	
2	1006	150.68	2.80	1.50	1.50	0.0	318	283	302	41	59	52	
1	1011	154.05	2.40	1.30	1.30	0.0	317	283	300	41	59	52	
—	1016	157.215	—	—	—	—	—	—	—	—	—	—	
A3	1018	157.215	2.80	1.50	1.50	0.0	315	281	302	41	58	52	
2	1023	160.58	2.90	1.60	1.60	0.0	314	282	300	41	59	52	
1	1028	164.05	2.40	1.30	1.30	0.0	314	288	301	41	59	52	
—	1033	167.226	—	—	—	—	—	—	—	—	—	—	
B3	1036	167.226	3.00	1.65	1.65	0.0	314	296	302	40	57	53	
2	1041	170.715	2.80	1.50	1.50	0.0	314	298	304	41	58	52	
1	1046	174.08	2.50	1.35	1.35	0.0	315	297	304	41	59	52	
—	1051	177.332	—	—	—	—	—	—	—	—	—	—	
C3	1053	177.332	2.80	1.50	1.50	0.0	315	299	303	39	58	53	
2	1058	180.675	3.00	1.65	1.65	0.0	315	295	299	40	59	53	
1	1103	184.21	2.40	1.30	1.30	0.0	314	292	301	41	59	53	
—	1108	187.335	—	—	—	—	—	—	—	—	—	—	
C3	1108	187.335	3.00	1.65	1.65	0.0	313	289	303	41	60	53	
2	1113	190.855	3.00	1.65	1.65	0.0	311	288	300	42	61	53	
1	1118	194.40	2.40	1.30	1.30	0.0	310	288	300	42	61	53	
—	1123	197.585	—	—	—	—	—	—	—	—	—	—	
B3	1125	197.585	3.00	1.65	1.65	0.5	308	291	302	41	59	54	
2	1130	201.09	3.00	1.65	1.65	0.5	308	290	300	42	60	54	99.04

Run Number 3

Unit UNIT NO. 2 STACK

Date 1/31/07

5/202 FIELD DATA

ΔP_s .53 P_m 28.85 T_s 5860 T_m 2201

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
B1	1135	204.61	2.50	1.35	1.35	0.0	307	292	305	42	61	54	pg. 4
—	1140	207.916	—	—	—	—	—	—	—	—	—	—	
A3	1142	207.916	2.80	1.50	1.50	0.0	307	296	301	41	60	54	
2	1147	211.30	2.80	1.50	1.50	0.0	306	296	301	42	60	54	
1	1152	214.70	2.40	1.30	1.30	0.0	307	296	301	42	61	54	
—	1157	217.834	—	—	—	—	—	—	—	—	—	—	
D3	1159	217.834	2.80	1.50	1.50	0.0	307	299	301	41	60	54	
2	1204	221.18	3.00	1.65	1.65	0.5	307	295	302	42	60	54	
1	1209	224.73	2.40	1.30	1.30	0.0	307	285	301	42	61	54	
—	1214	227.86	—	—	—	—	—	—	—	—	—	—	
D3	1214	227.86	3.00	1.65	1.65	0.5	307	280	301	43	61	54	
2	1219	231.42	3.00	1.65	1.65	0.5	308	279	300	43	62	55	
1	1224	234.93	2.50	1.35	1.35	0.0	308	280	301	44	63	55	
—	1229	238.20	—	—	—	—	—	—	—	—	—	—	
A3	1231	238.20	2.90	1.60	1.60	0.5	308	280	298	43	61	55	
2	1236	241.67	2.90	1.60	1.60	0.5	309	284	298	43	62	56	
1	1241	245.13	2.50	1.35	1.35	0.0	310	289	302	43	63	56	
—	1246	248.343	—	—	—	—	—	—	—	—	—	—	
B3	1248	248.343	3.00	1.65	1.65	1.0	311	299	301	42	61	55	
2	1253	251.88	3.00	1.65	1.65	1.0	311	299	301	43	61	55	
1	1258	255.45	2.80	1.50	1.50	0.5	310	299	305	43	61	55	
—	1303	258.833	—	—	—	—	—	—	—	—	—	—	
C3	1305	258.833	3.00	1.65	1.65	1.0	310	303	302	42	60	55	
2	1310	262.35	3.00	1.65	1.65	1.0	310	300	304	43	61	55	
1	1315	265.86	2.70	1.45	1.45		310	299	303	43	62	55	
—	1320	269.204	—	—	—	—	—	—	—	—	—	—	

Job Number 07-008
Job Name ADA-ES, NEWARK
Run Number 4
Unit UNIT NO. 2 STACK
Date 2-1-07
Operator GOLDMAN / JACKSON
Sample Box No. 1-1 Meter Box No. 2-2

5/202 Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: 1403 - 1503
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 38
Assumed Moisture % 10%
Probe Length 9'
C Factor 5.4 to reference
Initial Leak @ 15.0 "Hg = 0.004 cfm
Final Leak @ 5.0 "Hg = 0.002 cfm

ΔP_s 40.8 P_m 22.25 T_s 460 T_m ~~1374~~ 1424

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
C3	0705	274.458	3.10	1.70	1.70	0.0	312	296	305	36	44	43	INTEGRATED ORSAT
2	0710	278.05	3.10	1.70	1.70	0.0	312	292	302	38	45	43	FILTER NO. A132
1	0715	281.575	2.40	1.30	1.30	0.0	313	290	301	36	48	43	
—	0720	284.777	—	—	—	—	—	—	—	—	—	—	
B3	0722	284.777	3.20	1.75	1.75	0.0	313	290	304	36	50	45	
2	0727	288.34	3.20	1.75	1.75	0.0	313	290	303	36	52	45	0727
1	0732	291.95	2.80	1.50	1.50	0.0	313	288	304	36	54	46	0732
—	0737	295.347	—	—	—	—	—	—	—	—	—	—	
A3	0739	295.347	3.10	1.70	1.70	0.0	314	293	306	37	55	48	
2	0744	298.93	3.00	1.65	1.65	0.0	315	292	298	37	57	48	
1	0749	302.44	2.50	1.35	1.35	0.0	316	294	303	37	58	49	
—	0754	305.660	—	—	—	—	—	—	—	—	—	—	
D3	0756	305.660	3.00	1.65	1.65	0.0	317	297	306	37	57	50	
2	0801	309.195	2.90	1.60	1.60	0.0	317	293	299	37	59	50	
1	0806	312.65	2.50	1.35	1.35	0.0	316	289	304	37	60	51	
—	0811	315.89	—	—	—	—	—	—	—	—	—	—	
D3	0811	315.89	3.00	1.65	1.65	0.0	315	281	298	38	60	51	
2	0816	319.355	3.00	1.65	1.65	0.0	314	277	300	38	61	52	

Pitot Tube Calibration Factor C_p 0.825
Volume Collected V_m 245.820 ft^3
Water Collected V_w 614.5 ml
Time of Test T_t 360 min.
Stack Pressure P_s -3.60 "H_2O

Pitot Tube No. 1-4
Baro. Press. P_b 29.37 "Hg
Probe Tip Dia. D_n 0.176 in.
% CO_2 12.8 % CO 0.0
% O_2 6.9 % N_2 80.3
Area Stack A_s 75,294 in^2

Barometer No. 1
Probe Tip No. 1-2
Total Volume of Leak Checks After Start: 0.000 ft^3
V_m X Dry Gas Meter Calibration Factor 248.806 X 0.988

[Dry Gas Meter Reading — ft^3 - (T_t — min. X Leak Rate — cfm)]

Impinger Box No. 1-1

			Water Weight Gain		
Impinger 1	Final Weight	1005.2		Impinger 1	270.5
	Initial Weight	734.7			
	Increase			Impinger 2	247.1
Impinger 2	Final Weight	978.2 ~~1044.2~~		Impinger 3	48.4
	Initial Weight	731.1			
	Increase			Impinger 4	48.5
Impinger 3	Final Weight	778.9	V_w =	Impinger 5	
	Initial Weight	730.5	g SO_2 =		
	Increase		V_w =	Impinger 6	
Impinger 4	Final Weight	1044.2	filter no.	Impinger 7	
	Initial Weight	995.7	A132		
	Increase			Total	614.5 = V_w

Impinger 5	Final Weight		P_b =	29.37	%CO_2 =	12.8	
	Initial Weight		V_m =	245.820	%O_2 =	6.9	
	Increase		V_w =	614.5	%CO =	0.0	
			P_m =	1.544	%N_2 =	80.3	
Impinger 6	Final Weight		Avg ΔP =	2.840	A_s =	75294	
	Initial Weight				D_n =	0.176	
	Increase		Avg$\sqrt{\Delta P}$ =	1.684	T_1 =	360	
			C_p =	0.825			
Impinger 7	Final Weight		P_s =	-3.60 °H_2O		29.11	°Hg
	Initial Weight		T_m =	~~57~~59 °F 2/27/07		~~517~~519	°R 2/27/07
	Increase		T_s =	313 °F		773	°R

Moisture Content: %M = ~~10.49~~ 10.53 2/27/07 M_d = ~~0.8957~~ 0.8947 2/27/07 MW_c = 30.324 MW = 29.03

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{245.820}\ 246.476 \left[\frac{29.37 + \frac{1.544}{13.6}}{\cancel{57}59 + 460}\right] = \frac{\cancel{247.429}\ 246.476}{\cancel{0.687}\ 0.685}\ \text{sft}^3/\text{scfm}$$

2/27/07

Vw_{gas} = 0.0472 x Vw = 0.0472 x 614.5 = 29.004 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{29.004}{29.004 + 246.476}$ x 100 = ~~10.49~~ 10.53 % 2/27/07

V_s = 5123.8 x $\frac{0.825}{\sqrt{29.03}}$ x $\frac{773}{29.11}$ x 1.684 = 6808 fpm

ACFM: ~~3,559,846~~ 2,124,346 2/27/07

SCFM: ~~2,125,295~~

$$\%I = \frac{1.039 \times 773 \times \cancel{247.429}\ 246.476}{6808 \times \cancel{0.8951}\ 0.8947 \times 29.11 \times 360 \times (0.176)^2} = \cancel{100.5}\ 100.1\ \%$$

2/27/07

%EA: 48.0

checked by: 2/27/07

Run Number 4

Unit UNIT NO. 2 STACK

Date 2-1-07

5/202 FIELD DATA

ΔP_s 54.5 P_m 29.7 T_s 588.2 T_m ~~2002~~ 224.8

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
D1	0821	322.91	2.50	1.35	1.35	0.0	313	277	301	39	62	53	pg. 2
—	0826	326.175	—	—	—	—	—	—	—	—	—	—	
A 3	0828	326.175	2.90	1.60	1.60	0.0	312	276	302	39	60	53	
2	0833	329.66	3.00	1.65	1.65	0.0	311	278	299	39	62	54	
1	0838	333.195	2.80	1.50	1.50	0.0	310	283	302	39	62	54	
—	0843	336.605	—	—	—	—	—	—	—	—	—	—	
B 3	0845	336.605	3.10	1.70	1.70	0.0	310	291	300	39	61	55	
2	0850	340.20	3.00	1.65	1.65	0.0	310	292	303	39	62	55	
1	0855	343.775	2.80	1.50	1.50	0.0	309	293	302	39	63	55	
—	0900	347.195	—	—	—	—	—	—	—	—	—	—	
C 3	0902	347.195	3.00	1.65	1.65	0.0	308	296	305	39	61	55	
2	0907	350.70	3.00	1.65	1.65	0.0	308	292	299	39	62	55	
1	0912	354.25	2.50	1.35	1.35	0.0	308	284	301	38	63	55	
—	0917	357.46	—	—	—	—	—	—	—	—	—	—	
C 3	0917	357.46	3.00	1.65	1.65	0.0	308	286	302	39	63	56	
2	0922	360.99	3.00	1.65	1.65	0.0	308	284	299	39	64	56	
1	0927	364.575	2.50	1.35	1.35	0.0	308	283	302	39	64	56	
—	0932	367.825	—	—	—	—	—	—	—	—	—	—	
B 3	0934	367.825	3.10	1.70	1.70	0.0	308	284	303	39	63	57	
2	0939	371.37	3.10	1.70	1.70	0.0	308	283	302	39	64	57	
1	0944	374.98	2.80	1.50	1.50	0.0	308	286	303	39	65	57	
—	0949	378.40	—	—	—	—	—	—	—	—	—	—	
A 3	0951	378.40	3.10	1.70	1.70	0.0	311	290	303	39	64	57	
2	0956	381.985	2.80	1.50	1.50	0.0	312	290	301	39	64	57	
1	1001	385.383	2.50	1.35	1.35	0.0	312	292	303	39	65	57	
—	1006	388.65	—	—	—	—	—	—	—	—	—	—	

Run Number 4

Unit UNIT NO. 2 STACK

Date 2-1-07

5/202 FIELD DATA

57.2 ΔP = 2.86

31.15 ~~174.7~~ P_m 1.5575

6307 T_s 315.4

61.975 T_m 2469 2479

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
D3	1008	388.65	3.00	1.65	1.65	0.0	312	296	302	40	64	58	pg. 3
2	1013	392.21	3.00	1.65	1.65	0.0	312	295	301	39	64	58	
1	1018	395.78	2.70	1.45	1.45	0.0	313	289	301	39	65	57	
—	1023	399.115	—	—	—	—	—	—	—	—	—	—	
D3	1023	399.115	2.80	1.50	1.50	0.0	313	284	303	40	66	58	
2	1028	402.49	2.80	1.50	1.50	0.0	313	282	301	40	66	58	
1	1033	405.87	2.50	1.35	1.35	0.0	313	279	302	40	66	58	
—	1038	409.161	—	—	—	—	—	—	—	—	—	—	
A3	1040	409.161	2.90	1.60	1.60	0.0	314	277	302	41	65	58	
2	1045	412.615	2.90	1.60	1.60	0.0	314	276	297	40	65	58	
1	1050	416.10	2.50	1.35	1.35	0.0	314	280	301	40	66	59	1055
—	1055	419.321	—	—	—	—	—	—	—	—	—	—	
B3	1058	419.321	3.00	1.65	1.65	0.0	315	284	303	40	64	59	
2	1103	422.84	3.10	1.70	1.70	0.0	315	298	305	40	65	59	
1	1108	426.46	2.80	1.50	1.50	0.0	316	304	308	39	66	59	
—	1113	429.853	—	—	—	—	—	—	—	—	—	—	
C3	1115	429.553	3.10	1.70	1.70	0.5	318	304	309	40	65	59	
2	1120	433.45	3.10	1.70	1.70	0.5	319	301	301	40	65	59	
1	1125	437.080	2.50	1.35	1.35	0.5	319	302	305	40	67	59	
—	1130	440.380	—	—	—	—	—	—	—	—	—	—	
C3	1130	440.380	3.10	1.70	1.70	0.5	319	302	307	40	67	59	
2	1135	444.010	3.10	1.70	1.70	1.0	319	303	307	40	67	59	
1	1140	447.680	2.50	1.35	1.35	0.5	318	303	304	40	67	59	
—	1145	451.076	—	—	—	—	—	—	—	—	—	—	
B3	1147	451.076	3.00	1.65	1.65	0.5	316	279	294	40	65	58	
2	1152	454.575	2.80	1.50	1.50	0.5	316	289	303	40	65	58	

Run Number 4

Unit UNIT NO. 2 STACK

Date 2-1-07

5/202 FIELD DATA

ΔP_s .52 P_m 28.05 T_s 596 T_m 232.2

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
B1	1157	458.070	2.70	1.45	1.45	0.5	315	302	302	40	65	58	pg. 4
—	1202	461.524	—	—	—	—	—	—	—	—	—	—	
A3	1204	461.524	2.80	1.50	1.50	0.5	314	305	306	40	63	58	
2	1209	464.980	2.80	1.50	1.50	0.5	314	304	306	40	64	58	
1	1214	468.400	2.50	1.35	1.35	0.5	314	305	307	40	66	58	
—	1219	471.763	—	—	—	—	—	—	—	—	—	—	
D3	1221	471.763	2.80	1.50	1.50	0.5	313	304	306	40	64	58	
2	1226	475.185	2.80	1.50	1.50	0.5	313	304	306	40	64	58	
1	1231	478.625	2.50	1.35	1.35	0.5	314	303	305	40	65	58	
—	1236	481.950	—	—	—	—	—	—	—	—	—	—	
D3	1236	481.950	2.80	1.50	1.50	0.5	313	302	304	40	65	58	
2	1241	485.380	2.80	1.50	1.50	0.5	313	302	304	41	66	58	
1	1246	488.830	2.50	1.35	1.35	0.5	313	301	306	41	66	58	
~~A3~~	1251	492.158	—	—	—	—	—	—	—	—	—	—	
A3	1253	492.158	2.80	1.50	1.50	1.0	312	302	307	41	64	58	
2	1258	495.580	2.80	1.50	1.50	1.0	313	302	303	41	64	57	
1	1303	499.035	2.50	1.35	1.35	0.5	313	303	306	41	65	57	
~~B3~~	1308	502.363	—	—	—	—	—	—	—	—	—	—	
B3	1310	502.363	3.00	1.65	1.65	1.0	313	304	306	41	64	58	B3
2	1315	505.875	2.80	1.50	1.50	1.0	314	305	306	42	64	57	
1	1320	509.340	2.60	1.40	1.40	1.0	315	305	307	42	65	57	
~~C3~~	1325	512.753	—	—	—	—	—	—	—	—	—	—	
C3	1327	512.753	3.00	1.65	1.65	1.0	315	304	304	41	63	58	C3
2	1332	516.295	3.00	1.65	1.65	1.5	315	302	307	41	64	57	
1	1337	519.910	2.50	1.35	1.35	1.0	315	302	306	41	65	57	
—	1342	523.264	—	—	—	—	—	—	—	—	—	—	

Job Number 07-008
Job Name AOA-ES, NEWARK
Run Number 5
Unit UNIT NO. 2 STACK
Date 2-2-07
Operator FOLOMAN / JACKSON
Sample Box No. 1-2 Meter Box No. 2-2

5/202 Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: 1358-1458
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 47
Assumed Moisture % 10
Probe Length 9'
C Factor 5.4 to reference
Initial Leak @ 16.0 "Hg = 0.001 cfm
Final Leak @ 6.0 "Hg = 0.001 cfm

ΔP_s 40.3 P_m 21.95 T_s 446 T_m 487

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
C3	0700	525.292	3.10	1.70	1.70	0.0	314	295	306	40	47	47	INTEGRATED ORSAT
2	0705	528.86	3.10	1.70	1.70	0.0	314	293	305	40	47	47	FILTER NO. A133
1	0710	532.40	2.50	1.35	1.35	0.0	314	294	304	39	50	47	
—	0715	535.58	—	—	—	—	—	—	—	—	—	—	
B3	0717	535.58	3.10	1.70	1.70	0.0	314	296	305	38	52	47	
2	0722	539.11	3.10	1.70	1.70	0.0	314	294	304	38	53	48	
1	0727	542.66	2.80	1.50	1.50	0.0	315	296	304	39	56	48	
—	0732	545.99	—	—	—	—	—	—	—	—	—	—	
A3	0734	545.99	3.10	1.70	1.70	0.0	318	297	308	40	56	50	
2	0739	549.57	3.00	1.65	1.65	0.0	318	295	304	41	58	49	
1	0744	553.11	2.50	1.35	1.35	0.0	319	300	304	41	60	51	
—	0749	556.324	—	—	—	—	—	—	—	—	—	—	
D3	0751	556.324	3.00	1.65	1.65	0.0	320	297	307	41	59	52	
2	0756	559.83	2.80	1.50	1.50	0.0	321	294	302	41	61	53	
1	0801	563.20	2.50	1.35	1.35	0.0	321	295	303	41	62	53	
—	0806	566.425	—	—	—	—	—	—	—	—	—	—	
D3	0806	566.425	2.80	1.50	1.50	0.0	322	293	303	42	63	54	
2	0811	569.77	2.90	1.60	1.60	0.0	322	294	301	42	63	54	

Pitot Tube Calibration Factor C_p 0.825
Volume Collected V_m 250.868 ft^3
Water Collected V_w 589.7 ml
Time of Test T_t 360 min.
Stack Pressure P_s -3.50 "H_2O

Pitot Tube No. 1-4
Baro. Press. P_b 29.42 "Hg
Probe Tip Dia. D_n 0.176 in.
% CO_2 13.0 % CO 0.0
% O_2 6.8 % N_2 80.2
Area Stack A_s 75.294 in^2

Barometer No. 1 Probe Tip No. 1-2
Total Volume of Leak Checks After Start: 0.000 ft^3
V_m X Dry Gas Meter Calibration Factor 250.879 x 0.988

[Dry Gas Meter Reading — ft^3 - (T_t — min. X Leak Rate — cfm)]

Impinger Box No. 1-2

			Water Weight Gain		
Impinger 1	Final Weight	999.3		Impinger 1	267.1
	Initial Weight	732.2		Impinger 2	247.5
	Increase			Impinger 3	27.8
Impinger 2	Final Weight	980.9		Impinger 4	47.3
	Initial Weight	733.4			
	Increase		V_w =		
Impinger 3	Final Weight	756.8	g SO_2 =	Impinger 5	
	Initial Weight	729.0	V_w =		
	Increase			Impinger 6	
Impinger 4	Final Weight	1026.2		Impinger 7	
	Initial Weight	978.9			
	Increase			Total	589.7 = V_w

FILTER # A133

Impinger 5	Final Weight		P_b = 29.42	$\%CO_2$ = 13.0		
	Initial Weight		V_m = 247.868	$\%O_2$ = 6.8		
	Increase		V_w = 589.7	%CO = 0.0		
			P_m = 1.585	$\%N_2$ = 80.2		
Impinger 6	Final Weight		Avg ΔP = 2.906	A_n = ~~75,249~~ 75,294 2/7/07		
	Initial Weight			D_n = 0.176		
	Increase		Avg$\sqrt{\Delta P}$ = 1.703	T_1 = 360		
			C_p = 0.825			
Impinger 7	Final Weight		P_s = -3.50	$^{\circ}H_2O$	29.16	$^{\circ}Hg$
	Initial Weight		T_m = 60	°F	520	°R
	Increase		T_s = 319	°F	779	°R

Moisture Content: %M = 10.07 M_d = 0.8993 MW_c = 30.352 MW = 29.11

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 247.868 \left[\frac{29.42 + \frac{1.585}{13.6}}{60 + 460}\right] = 248.497\ sft^3 = 0.690\ scfm$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 589.7 = 27.834 sft^3

$$\%\ Moisture = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{27.834}{27.834 + 248.497} \times 100 = 10.07\ \%$$

$$V_s = 5123.8 \times 0.825 \sqrt{\frac{779}{29.11 \times 29.16}} \times 1.703 = 6896\ fpm$$

ACFM: 3,605,890

SCFM: 2,149896

$$\%I = \frac{1.039 \times 779 \times 248.497}{6896 \times 0.8993 \times 29.16 \times 360 \times (0.176)^2} = 99.7\ \%$$

%EA: 47.0

checked by: 2/7/07

Run Number 5

Unit UNIT NO. 2 STACK

Date 2-2-07

5/202 FIELD DATA

ΔP_s .560 P_m 30.5 T_s 602 T_m 2323

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
D1	0816	573.23	2.70	1.45	1.45	0.0	321	293	304	42	64	56	pg. 2
—	0821	576.58	—	—	—	—	—	—	—	—	—	—	
A3	0823	576.58	3.10	1.70	1.70	0.0	320	294	304	43	61	56	
2	0828	580.125	3.10	1.70	1.70	0.0	319	294	301	43	64	56	
1	0833	583.72	2.50	1.35	1.35	0.0	319	296	302	43	64	56	
—	0838	586.95	—	—	—	—	—	—	—	—	—	—	
B3	0840	586.955	3.10	1.70	1.70	0.5	318	296	303	43	63	57	
2	0845	590.51	3.10	1.70	1.70	0.5	318	296	307	43	64	57	
1	0850	594.18	2.80	1.50	1.50	0.0	318	296	304	43	65	57	
—	0855	597.50	—	—	—	—	—	—	—	—	—	—	
C3	0857	597.50	3.10	1.70	1.70	0.5	318	296	303	42	63	58	
2	0902	600.995	3.00	1.65	1.65	0.5	318	294	304	42	64	58	
1	0907	604.545	2.50	1.35	1.35	0.0	318	295	302	42	65	58	
—	0912	607.75	—	—	—	—	—	—	—	—	—	—	
C3	0912	607.75	3.10	1.70	1.70	0.5	318	294	301	42	65	58	
2	0917	611.34	3.10	1.70	1.70	0.5	318	294	302	43	66	58	
1	0922	614.95	2.80	1.50	1.50	0.0	319	294	302	43	66	58	
—	0927	618.341	—	—	—	—	—	—	—	—	—	—	
B3	0929	618.341	3.10	1.70	1.70	0.5	319	297	301	43	64	59	
2	0934	621.92	3.10	1.70	1.70	1.0	319	294	304	43	66	59	
1	0939	625.50	2.80	1.50	1.50	0.5	319	297	303	43	66	59	
—	0944	628.916	—	—	—	—	—	—	—	—	—	—	
A3	0946	628.916	3.10	1.70	1.70	1.0	318	296	306	43	64	59	
2	0951	632.48	3.10	1.70	1.70	1.0	318	296	300	43	66	59	
1	0956	636.04	2.80	1.50	1.50	0.5	317	297	303	44	66	59	
—	1001	639.462	—	—	—	—	—	—	—	—	—	—	

Run Number 5

Unit UNIT NO. 2 STACK

Date 2-2-07

5/202 FIELD DATA

ΔP_s 57.7 P_m 31.55 T_s 629.4 T_m 250.8

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
D3	1003	639.462	3.10	1.70	1.70	1.0	316	297	303	43	65	60	pg.3
2	1008	643.05	3.00	1.65	1.65	1.0	316	294	304	43	66	60	
1	1013	646.590	2.50	1.35	1.35	1.0	316	294	302	43	66	59	
—	1018	649.945	—	—	—	—	—	—	—	—	—	—	
D3	1018	649.945	3.10	1.70	1.70	1.0	316	294	302	44	67	59	
2	1023	653.50	3.00	1.65	1.65	1.0	315	294	302	44	67	60	
1	1028	657.070	2.50	1.35	1.35	1.0	315	294	303	44	67	60	
—	1033	660.407	—	—	—	—	—	—	—	—	—	—	
A3	1035	660.407	3.10	1.70	1.70	1.0	315	294	302	44	66	60	
2	1040	663.960	3.00	1.65	1.65	1.5	315	295	303	44	66	60	
1	1045	667.580	2.50	1.35	1.35	0.5	315	296	302	45	66	60	
—	1050	670.998	—	—	—	—	—	—	—	—	—	—	
B3	1052	670.998	3.10	1.70	1.70	1.5	314	296	302	44	65	60	
2	1057	674.480	3.00	1.65	1.65	1.5	314	298	302	44	66	60	
1	1102	678.075	2.50	1.35	1.35	0.5	314	296	305	44	67	60	
—	1107	681.425	—	—	—	—	—	—	—	—	—	—	
C3	1109	681.425	3.10	1.70	1.70	0.5	313	296	304	43	65	60	
2	1114	684.980	3.00	1.65	1.65	1.5	314	295	303	43	65	59	
1	1119	688.595	2.50	1.35	1.35	1.0	314	295	302	43	65	59	
—	1124	691.880	—	—	—	—	—	—	—	—	—	—	
C3	1124	691.880	3.10	1.70	1.70	1.5	314	293	305	44	65	59	
2	1129	695.480	3.00	1.65	1.65	1.5	314	295	302	44	66	59	
1	1134	699.075	2.50	1.35	1.35	1.5	314	295	303	44	66	60	
—	1139	702.424	—	—	—	—	—	—	—	—	—	—	
B3	1141	702.424	3.10	1.70	1.70	1.0	315	294	303	43	65	59	
2	1146	705.985	3.00	1.65	1.65	1.5	315	295	303	44	65	59	

Run Number 5

Unit UNIT NO. 2 STACK

Date 2-2-07

5/202 FIELD DATA

ΔP_s 55.2 P_m 30.15 T_s 618.4 T_m 238.8

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
B1	1151	709.605	2.50	1.35	1.35	1.0	315	296	302	44	66	59	pg.4
—	1156	712.953	—	—	—	—	—	—	—	—	—	—	
A3	1158	712.953	3.10	1.70	1.70	1.5	317	297	304	43	65	59	
2	1203	716.490	3.00	1.65	1.65	2.0	317	296	302	44	65	59	
1	1208	720.090	2.50	1.35	1.35	1.0	318	297	303	45	66	60	
—	1213	723.427	—	—	—	—	—	—	—	—	—	—	
D3	1215	723.427	3.10	1.70	1.70	1.5	321	297	303	44	65	60	
2	1220	726.995	3.00	1.65	1.65	2.0	323	295	302	44	65	59	
1	1225	730.601	2.70	1.50	1.50	1.5	324	294	302	45	66	59	
—	1230	734.08	—	—	—	—	—	—	—	—	—	—	
D3	1230	734.08	3.10	1.70	1.70	2.0	325	293	303	46	67	60	
2	1235	737.65	3.10	1.70	1.70	2.0	326	293	302	46	67	59	
1	1240	741.25	2.70	1.45	1.45	1.0	327	293	302	47	67	59	
—	1245	744.645	—	—	—	—	—	—	—	—	—	—	
A3	1247	744.645	3.10	1.70	1.70	2.0	329	296	303	46	66	60	
2	1252	748.240	3.00	1.65	1.65	2.0	329	295	305	46	66	60	
1	1257	751.825	2.70	1.45	1.45	1.5	330	297	303	47	67	61	
—	1302	755.176	—	—	—	—	—	—	—	—	—	—	
B3	1304	755.176	3.10	1.70	1.70	2.0	331	297	303	46	65	60	
2	1309	758.700	3.00	1.65	1.65	2.0	331	298	304	47	66	61	
1	1314	762.270	2.70	1.45	1.45	2.0	332	297	303	46	66	60	
—	1319	765.635	—	—	—	—	—	—	—	—	—	—	
C3	1321	765.635	3.10	1.70	1.70	2.0	330	296	304	45	65	60	
2	1326	769.215	3.00	1.65	1.65	2.0	330	297	304	46	66	60	
1	1331	772.830	2.70	1.45	1.45	2.0	329	296	305	47	67	60	
—	1336	776.171	—	—	—	—	—	—	—	—	—	—	

PRELIMINARY VELOCITY TRAVERSE DATA
AND
SAMPLING LOCATION DATA

Job Number 07-008

Job Name ADA-ES, NEWARK

Sampling Location UNIT NO. 2 STK

Date _____ Time _____

Stack Height _____ ft.

Sampling Port Height Above Ground _____ ft.

	Port A	Port B	Port C	Port D	Average
Port & Inside Diameter (in.)					314 5/16 "
Port & Wall Thickness (in.)	4 5/8	4 3/4	4 7/8	4 5/8	4 11/16 "
Inside Stack Diameter (in.)					309 5/8 "

Sampling Ports are ~~225~~ 247 ft. ~~0~~ 3/4 in. 9.58 ~~8.72~~ stack diameters) downstream from disturbance (inlet, constriction, bend, expansion) (25.7') from eng. diam

Sampling Ports are 501 ft. 0 in. ~~12~~ stack diameters) upstream from disturbance 19.42 (outlet, constriction, bend, expansion)

Point Number	Percent Diameter	Distance from Ref. Point (decimal in.)	Distance from Ref. Point (fractional in.)	Port A $\Delta P/T_s/\alpha$	Port B $\Delta P/T_s/\alpha$	Port C $\Delta P/T_s/\alpha$	Port D $\Delta P/T_s/\alpha$
1	4.4	13.624	13 5/8	1 110	1 18	1 110	1 15
2	14.6	45.205	45 3/16	1 15	1 15	1 15	1 18
3	29.6	91.649	91 5/8	1 14	1 115	1 15	1 110
4				/ /	/ /	/ /	/ /
5				/ /	/ /	/ /	/ /
6				/ /	/ /	/ /	/ /
7				/ /	/ /	/ /	/ /
8				/ /	/ /	/ /	/ /
9				/ /	/ /	/ /	/ /
10				/ /	/ /	/ /	/ /
11				/ /	/ /	/ /	/ /
12				/ /	/ /	/ /	/ /
13				/ /	/ /	/ /	/ /
14				/ /	/ /	/ /	/ /
15				/ /	/ /	/ /	/ /
16				/ /	/ /	/ /	/ /
17				/ /	/ /	/ /	/ /
18				/ /	/ /	/ /	/ /
19				/ /	/ /	/ /	/ /
20				/ /	/ /	/ /	/ /
21				/ /	/ /	/ /	/ /
22				/ /	/ /	/ /	/ /
23				/ /	/ /	/ /	/ /
24				/ /	/ /	/ /	/ /

Pitot Tube No. 1-4

C_p = 0.825

P_b = _____ "Hg

P_s = _____ "H_2O _____ "Hg

A_s = 75,294 in.^{2}

Average ΔP _____

Average $\Delta P^{1/2}$ _____

Average T_x ~~57.5~~ 8 °F

Average α _____ degrees

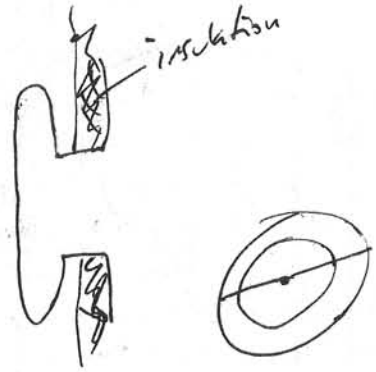
$27\frac{1}{2}$ flange to flange

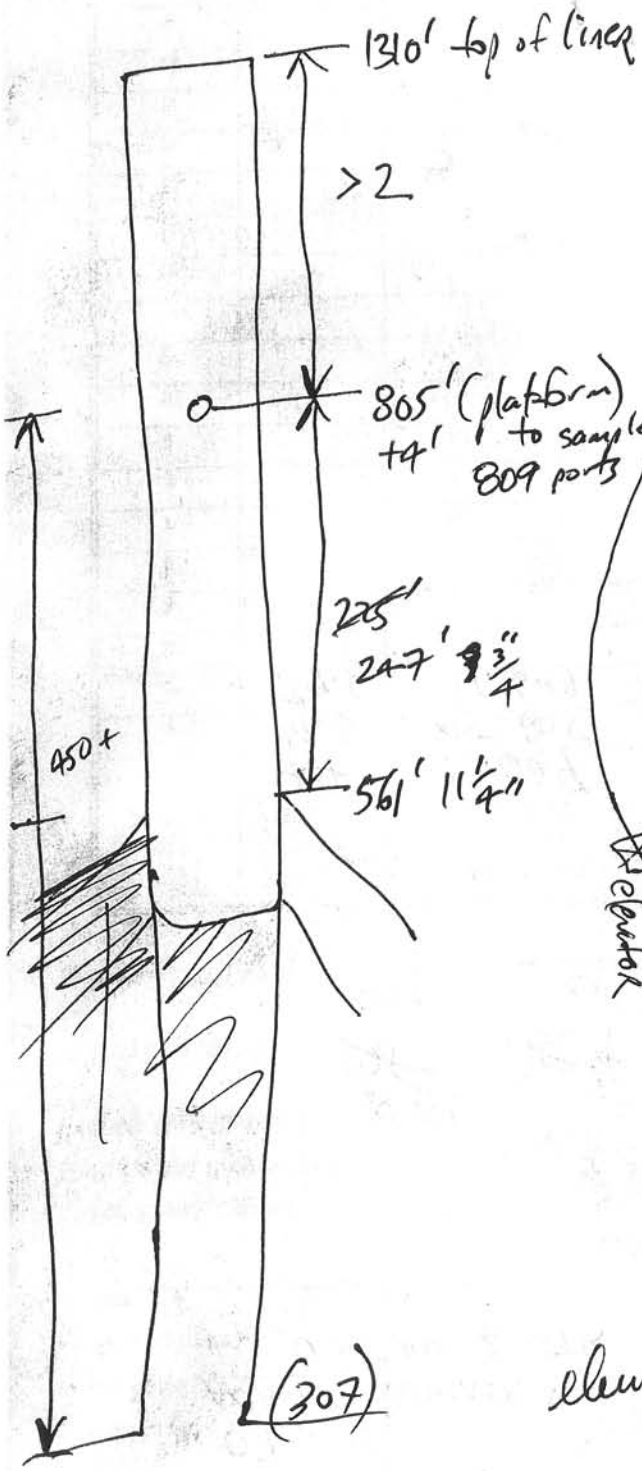
flange 2.5

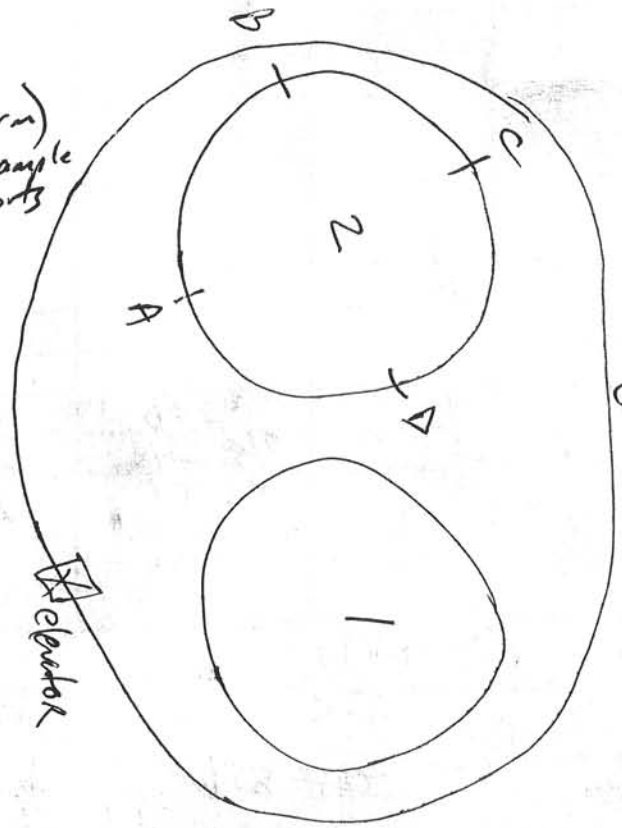
27.5 − 2(4.718

320.5625

full load ~890 MW







ID $309\frac{5}{8}$

AD = 247

DC = 248

CB = 247

BA = 248

C = 990"

$990 = 2\pi r$

$\frac{990}{2\pi} = 157.563$

$d = 315.1268 - 2(2.75) = 309.6$

	A	B	C	D
	$4\frac{5}{8}$	$4\frac{3}{4}$	$4\frac{7}{8}$	$4\frac{5}{8}$
	4.625	4.75	4.875	4.62

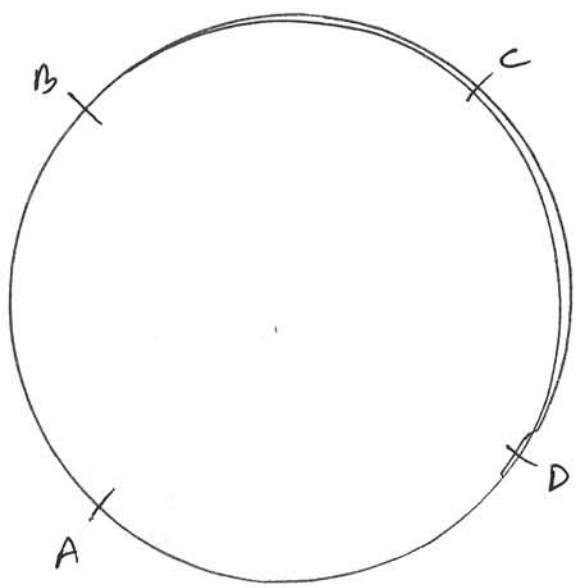
$\bar{x} = 4.718$

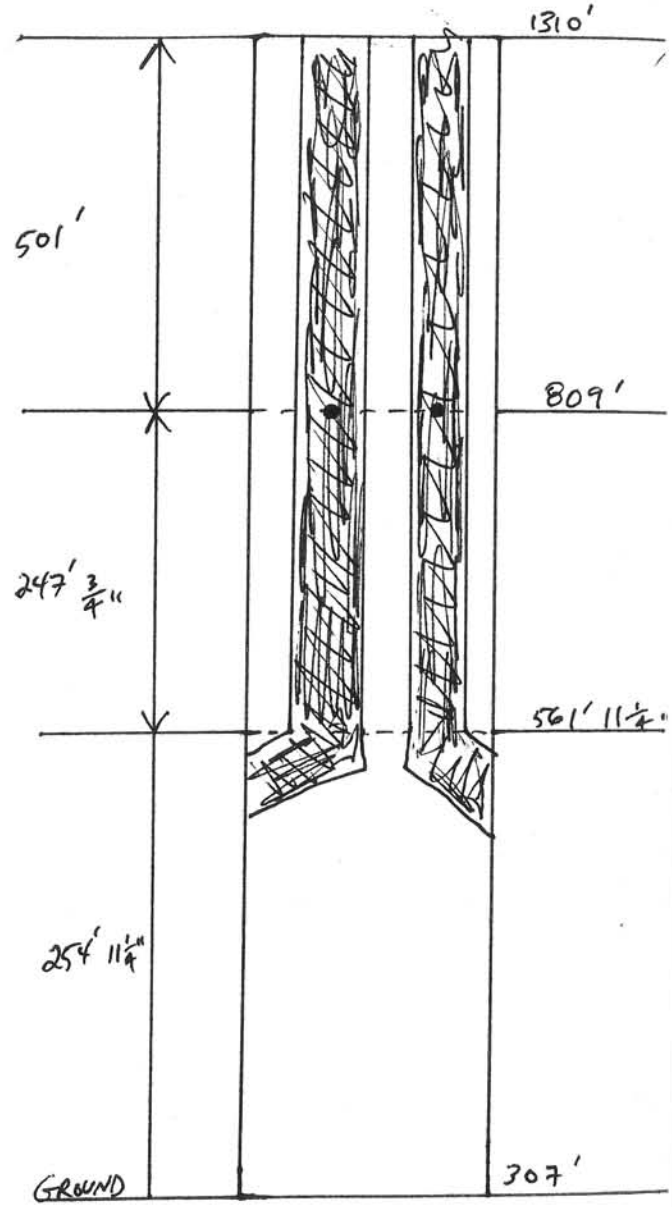
insulation thickness ~$2\frac{3}{4}$"

P&W

elevator $\frac{150'}{min}$

UNIT NO. 2 STK





AD = 247"
DC = 248"
CB = 247"
BA = 248"

C = 990"

r = 157.563"

d = 315.1268"

– twice insulation thickness
(2 × 2.75)
= 309.627
= 309 5/8

A_c = 75794 "^{2}

ORSAT ANALYSIS DATA FORM

Job #: 07-008
Job Name: ADA-ES
Location: NEWARK, AR
Date: 1/29/07
Operator: GOLDMAN

Sample Location: UNIT NO. 2 STACK
Analytical Method: 3
Sample Type: Single Point / Multi Point Grab / Integrated
Leak Check: Time: >4min (≥ 4 minutes) Rate: Ø
Ambient Air Check:

CO_2 - % Vol.	0.0
O_2 - % Vol.	20.9
N_2 - % Vol.	79.1

Run #: 1 (1/29/07)
Run Time: 0830-1533

CO_2 - % Vol.	12.9	13.0	13.1	13.0
O_2 - % Vol.	6.5	6.4	6.4	6.4
CO - % Vol.	0.0	0.0	0.0	0.0
N_2 - % Vol.	80.6	80.6	80.5	80.6

Run #: 2 (1/30/07)
Run Time: 0645-1336

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO_2 - % Vol.	12.9	13.0	13.1	13.0
O_2 - % Vol.	6.9	6.8	6.7	6.8
CO - % Vol.	0.0	0.0	0.0	0.0
N_2 - % Vol.	80.2	80.2	80.2	80.2

Run #: 3 (1/31/07)
Run Time: 0642-1320

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO_2 - % Vol.	13.0	13.1	13.0	13.0
O_2 - % Vol.	6.7	6.7	6.7	6.7
CO - % Vol.	0.0	0.0	0.0	0.0
N_2 - % Vol.	80.3	80.2	80.3	80.3

ORSAT ANALYSIS DATA FORM

Job #: 07-008
Job Name: ADA-ES
Location: NEWARK, AR
Date: 2-1-07
Operator: GOLDMAN

Sample Location: UNIT NO. 2 STACK
Analytical Method: 3
Sample Type: Single Point / Multi Point Grab / Integrated
Leak Check: Time: 24 min (≥ 4 minutes) Rate: Ø
Ambient Air Check:

CO_2 - % Vol.	0.0
O_2 - % Vol.	21.0
N_2 - % Vol.	79.0

Run #: 4 (2-1-07)
Run Time: 0705-1342

CO_2 - % Vol.	12.8	12.8	12.7	12.8
O_2 - % Vol.	6.9	6.9	7.0	6.9
CO - % Vol.	0.0	0.0	0.0	0.0
N_2 - % Vol.	80.3	80.3	80.3	80.3

Run #: 5 (2-2-07)
Run Time: 0700-1336

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO_2 - % Vol.	13.0	13.0	12.9	13.0
O_2 - % Vol.	6.8	6.8	6.9	6.8
CO - % Vol.	0.0	0.0	0.0	0.0
N_2 - % Vol.	80.2	80.2	80.2	80.2

Run #:
Run Time:

	Analysis #1	Analysis #2	Analysis #3	Average - % Volume
CO_2 - % Vol.				
O_2 - % Vol.				
CO - % Vol.				
N_2 - % Vol.				

AIR SAMPLING ASSOCIATES, INC.

Appendix E:

Analytical Data

AIR SAMPLING ASSOCIATES, INC.

Air Sampling Associates, Inc.

Particulate Analysis Summary

Project Number: 07-008

Date Analysis Completed: 2/13/07

Project Name: ADA-ES

Unit Tested: Unit No. 2 Stack

Project Location: Newark, AR

Run Number:	1	2	3
Particulate Matter on Filter (mg):	39.9	38.7	38.4
Particulate Matter in Front Wash (mg):	10.4	11.4	9.6
Total Particulate Matter in "Front-Half" – MF (mg):	50.3	50.1	48.0
Particulate Matter in "Back-Half" (mg):	46.1	66.2	54.9
Total Particulate Matter in Sample – MT (mg):	96.4	116.3	102.9

Analyst

Date: 2/14/07

Data Checked By

Version No. 1 5/30/06

AIR SAMPLING ASSOCIATES, INC.

Air Sampling Associates, Inc.

Particulate Analysis Summary

Project Number: 07-008

Date Analysis Completed: 2/13/07

Project Name: ADA-ES

Unit Tested: Unit No. 2 Stack

Project Location: Newark, AR

Run Number:	4	5	
Particulate Matter on Filter (mg):	39.8	43.6	
Particulate Matter in Front Wash (mg):	BH ~~9.3~~ 9.1	9.3	
Total Particulate Matter in "Front-Half" – MF (mg):	48.9	52.9	
Particulate Matter in "Back-Half" (mg):	44.2	53.1	
Total Particulate Matter in Sample – MT (mg):	93.1	106.0	

Bill Hafley
Analyst

Billy J. Mullins Jr. Date: 2/14/07
Data Checked By

Version No. 1 5/30/06

AIR SAMPLING ASSOCIATES, INC.

Particulate Analysis EPA Method 5

Stack Filters

Project No. 07-008
Project Name ADA-ES

Location Newark, AR
Unit Tested Unit No. 2 Stack

Desiccator Time In	0830 2/9/07	0855 2/12/07			
Desiccator Time Out	0845 2/12/07	0830 2/13/07			

Run No. 1		Filter No. A129		Sample I.D.	
Filter & Particulate (g)	0.4244	0.4244 ✓			

Filter & Particulate Average (g) 0.4244 ✓
Initial Filter Weight (g) 0.3845 ✓
Total Particulate (mg) 39.9 ✓

Run No. 2		Filter No. A130		Sample I.D.	
Filter & Particulate (g)	0.4204	0.4205 ✓			

Filter & Particulate Average (g) 0.4205 ✓
Initial Filter Weight (g) 0.3818 ✓
Total Particulate (mg) 38.7 ✓

Run No. 3		Filter No. A131		Sample I.D.	
Filter & Particulate (g)	0.4239	0.4239 ✓			

Filter & Particulate Average (g) 0.4239 ✓
Initial Filter Weight (g) 0.3855 ✓
Total Particulate (mg) 38.4 ✓

Bill Hogg
Analyst

AIR SAMPLING ASSOCIATES, INC.

Particulate Analysis EPA Method 5

Stack Filters

Project No. 07 - 008
Project Name ADA - ES

Location Newark, AR
Unit Tested Unit No. 2 Stack

Desiccator Time In	0830 2/5/07	0855 2/12/07			
Desiccator Time Out	0845 2/12/07	0835 2/13/07			

Run No. 4		Filter No. A132		Sample I.D.	
Filter & Particulate (g)	0.4234	0.4236 ✓			

Filter & Particulate Average (g) 0.4236 ✓
Initial Filter Weight (g) 0.3838 ✓
Total Particulate (mg) 39.8 ✓

Run No. 5		Filter No. A133		Sample I.D.	
Filter & Particulate (g)	0.4237	0.4236 ✓			

Filter & Particulate Average (g) 0.4236 ✓
Initial Filter Weight (g) 0.3800 ✓
Total Particulate (mg) 43.6 ✓

Run No.		Filter No.		Sample I.D.	
Filter & Particulate (g)					

Filter & Particulate Average (g) _____
Initial Filter Weight (g) _____
Total Particulate (mg) _____

Bill [illegible]
Analyst

AIR SAMPLING ASSOCIATES, INC.

Filter Weight Log
EPA Method 5

Filter No.	Into Desicator Date Time	Weight Date Time	Weight Date Time	Weight Date Time	Weight Date Time	Weight Date Time	Weight Used
A121	10/2/06 0800	0.3612 11/20/06 1251	0.3612 11/21/06 0810				0.3612
A122	10/2/06 0800	0.3608 11/20/06 1252	0.3608 11/21/06 0811				0.3608
A123	10/2/06 0800	0.3830 11/20/06 1253	0.3827 11/21/06 0812				0.3827
A124	10/2/06 0800	0.3763 11/20/06 1254	0.3762 11/21/06 0813				0.3762
A125	↓ ~~10/15/06~~ ~~1703~~	0.3791 12/15/06 1703	0.3792 12/16/06 1044				0.3792
A126	10/2/06 0800	0.3803 12/15/06 1703	0.3804 12/16/06 1044				0.3804
A127	10/2/06 0800	0.3795 12/15/06 1704	0.3794 12/16/06 1045				0.3794
A128	10/02/06 0800	0.3812 12/15/06 1704	0.3811 12/16/06 1045				0.3811
A129	10/2/06 0800	0.3843 12/15/06 1705	0.3845 12/16/06 1045				0.3845
A130	10/2/06 0800	0.3817 12/15/06 1705	0.3818 12/16/06 1046				0.3818
A131	10/2/06 0800	0.3857 12/15/06 1706	0.3855 12/16/06 1046				0.3855
A132	10/2/06 0800	0.3840 12/15/06 1706	0.3838 12/16/06 1047				0.3838
A133	10/2/06 0800	0.3799 12/15/06 1707	0.3800 12/16/06 1047				0.3800
A134	11/25/07 0900	0.3772 11/26/07 1000	0.3772 11/27/07 0631				0.3772
A135	↓	0.3780 11/26/07 1001	0.3781 11/27/07 0632				0.3781

AIR SAMPLING ASSOCIATES, INC.

Particulate Analysis EPA Method 5

Front Wash

Project No. 07-008
Project Name ADA-ES

Location Newark, OH
Unit Tested Unit No. 2 Stack

Desiccator Time In	1015 2/6/07	0905 2/8/07			
Desiccator Time Out	0855 2/11/07	0835 2/15/07			

Run No. 1		Volume (ml) 87		Sample I.D.	
Final Weight (g)	113.8991	113.8995 ✓			
Initial Weight (g)	113.8889	113.8889 ✓			
Particulate Weight (g)		0.0106			

Particulate Average (mg) 10.6 ✓
Less Acetone Blank (mg) 0.2 ✓
Total Particulate (mg) 10.4 ✓

Run No. 2		Volume (ml) 66		Sample I.D.	
Final Weight (g)	91.4990	91.4993 ✓			
Initial Weight (g)	91.4877	91.4877 ✓			
Particulate Weight (g)		0.0116			

Particulate Average (mg) 11.6 ✓
Less Acetone Blank (mg) 0.2 ✓
Total Particulate (mg) 11.4 ✓

Run No. 3		Volume (ml) 65		Sample I.D.	
Final Weight (g)	111.8457	111.8457 ✓			
Initial Weight (g)	111.8359	111.8359 ✓			
Particulate Weight (g)		0.0098			

Particulate Average (mg) 9.8 ✓
Less Acetone Blank (mg) 0.2 ✓
Total Particulate (mg) 9.6 ✓

Acetone Blank		Volume (ml)		Sample I.D.	
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Average (mg) _____
* mg/l _____

* Note: if greater than 7.9 mg/l, use 7.9 mg/l

Bill [illegible] Date: 2/13/07
Analyst

Version No.2 10/22/06

AIR SAMPLING ASSOCIATES, INC.

Particulate Analysis EPA Method 5

Front Wash

Project No. 07-008
Project Name AOH-ES

Location Newark, AR
Unit Tested Unit No. 2 Stack

Desiccator Time In	1015 2/6/07	0905 2/12/07			
Desiccator Time Out	0855 2/12/07	0835 2/13/07			

Run No. 4		Volume (ml) 75		Sample I.D.	
Final Weight (g)	113.8321	113.8323 ✓			
Initial Weight (g)	113.8230	113.8230 ✓			
Particulate Weight (g)		0.0093			

Particulate Average (mg) 9.3 ✓
Less Acetone Blank (mg) 0.2 ✓
Total Particulate (mg) 9.1 ✓

Run No. 5		Volume (ml) 59		Sample I.D.	
Final Weight (g)	114.1803	114.1807 ✓			
Initial Weight (g)	114.1713	114.1713 ✓			
Particulate Weight (g)		0.0094			

Particulate Average (mg) 9.4 ✓
Less Acetone Blank (mg) 0.1 ✓
Total Particulate (mg) 9.3 ✓

Run No.		Volume (ml)		Sample I.D.	
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Particulate Average (mg) _____
Less Acetone Blank (mg) _____
Total Particulate (mg) _____

Acetone Blank		Volume (ml) 200		Sample I.D.	
Final Weight (g)	91.0516	91.0517 ✓			
Initial Weight (g)	91.0512	91.0512 ✓			
Particulate Weight (g)		0.0005			

Average (mg) 0.5 ✓
* mg/l 2.5 ✓

* Note: if greater than 7.9 mg/l, use 7.9 mg/l

Bill Hyly
Analyst

Date: 2/13/07

Version No.2 10/22/06

AIR SAMPLING ASSOCIATES, INC.

Particulate Analysis EPA Method 5

Front Half Tare Weights

Project No. 07-008
Project Name ADA-ES

Location Newark, AR
Unit Tested Unit No. 2 Stack

Desiccator Time In	0930 2/1/07	1105 2/2/07			
Desiccator Time Out	1100 2/2/07	0650 2/4/07			

Run No. 1				Sample I.D.	
Weight (g)	113.8893	113.8889 ✓			

Run No. 2				Sample I.D.	
Weight (g)	91.4877	91.4877 ✓			

Run No. 3				Sample I.D.	
Weight (g)	111.8364	111.8359 ✓			

Acetone Blank				Sample I.D.	
Weight (g)					

Bill Hyby
Analyst

AIR SAMPLING ASSOCIATES, INC.

Particulate Analysis EPA Method 5

Front Half Tare Weights

Project No. 07-008
Project Name ADA-ES

Location Navark, AR
Unit Tested Unit No. 2 Stack

Desiccator Time In	1000 2/1/07	1110 2/2/07			
Desiccator Time Out	1105 2/2/07	0650 2/4/07			

Run No. 4				Sample I.D.	
Weight (g)	113.8228	113.8230 ✓			

Run No. 5				Sample I.D.	
Weight (g)	114.1714	114.1713 ✓			

Run No. 6				Sample I.D.	
Weight (g)	110.4922	110.4926 ✓			

Acetone Blank				Sample I.D.	
Weight (g)	91.0508	91.0512 ✓			

Bill [illegible]
Analyst

ADA-ES
Newark, AR
202 - Back half Particulate Analyses

	MeCl			DI Water					
Run No.	Particulate Weight (mgs)	Sample Vol. (ml)	Blank Corrected (mgs)	Particulate Weight (mgs)	Sample Vol. (ml)	Blank Corrected (mgs)	Less Chlorides (mgs)	Less Sulfates (mgs)	Total (mgs)
1	3.9	290	1.1	72.3	948	57.4	0.007	12.338	46.1
2	18.1	272	15.4	77.7	985	62.2	0.007	11.498	66.2
3	2.9	261	0.3	84.6	1,040	68.3	0.007	13.743	54.9
4	2.0	257	-0.5	73.9	1,045	57.5	0.007	12.779	44.2
5	3.1	271	0.5	82.2	1,030	66.0	0.007	13.399	53.1
Blank	2.6	266		9.1	580				

Methylene Chloride Rinse

Job Number	**07-4013**
Client Name	**Air Sampling Assoc./ Newark, AR**
Unit Name	**Unit No. 2 Stack**

Method: 202

RUN 1	**BEAKER**	9737	**VOLUME**	ml	290	**AVERAGE**
1/29/2007						
Beaker + Particulate (g)		120.3062	120.3066			120.3064
Beaker Tare (g)		120.3024	120.3026			120.3025
Particulate Weight (g)		0.0038	0.0040			0.0039

RUN 2	**BEAKER**	9739	**VOLUME**	ml	272	**AVERAGE**
1/30/2007						
Beaker + Particulate (g)		95.3705	95.3708			95.3707
Beaker Tare (g)		95.3525	95.3526			95.3526
Particulate Weight (g)		0.0180	0.0182			0.0181

RUN 3	**BEAKER**	9741	**VOLUME**	ml	261	**AVERAGE**
1/31/2007						
Beaker + Particulate (g)		107.2765	107.2770			107.2768
Beaker Tare (g)		107.2738	107.2739			107.2739
Particulate Weight (g)		0.0027	0.0031			0.0029

Analyst LB

FINAL REPORT

Started 2/7/2007
Completed 3/1/2007

Methylene Chloride Rinse

Job Number	**07-4013**
Client Name	**Air Sampling Assoc./ Newark, AR**
Unit Name	**Unit No. 2 Stack**

Method: 202

RUN 4	**BEAKER**	9743	**VOLUME**	ml	257	**AVERAGE**
2/1/2007						
Beaker + Particulate (g)		107.2188	107.2192			107.2190
Beaker Tare (g)		107.2170	107.2169			107.2170
Particulate Weight (g)		0.0018	0.0023			0.0020

RUN 5	**BEAKER**	9745	**VOLUME**	ml	271	**AVERAGE**
2/2/2007						
Beaker + Particulate (g)		114.7220	114.7225			114.7223
Beaker Tare (g)		114.7192	114.7191			114.7192
Particulate Weight (g)		0.0028	0.0034			0.0031

Blank	**BEAKER**	9747	**VOLUME**	ml	266	**AVERAGE**
Beaker + Particulate (g)		110.0620	110.0623			110.0622
Beaker Tare (g)		110.0595	110.0597			110.0596
Particulate Weight (g)		0.0025	0.0026			0.0026

Analyst LB

FINAL REPORT

Started 2/7/2007
Completed 3/1/2007

DI Water Analysis

Job Number	**07-4013**
Client Name	**Air Sampling Assoc./ Newark, AR**
Unit Name	**Unit No. 2 Stack**

Method: 202

RUN 1	**BEAKER**	9736	**VOLUME**	ml	948	**AVERAGE**
1/29/2007						
Beaker + Particulate (g)		114.8605	114.8609			114.8607
Beaker Tare (g)		114.7883	114.7885			114.7884
Particulate Weight (g)		0.0722	0.0724			0.0723

RUN 2	**BEAKER**	9738	**VOLUME**	ml	985	**AVERAGE**
1/30/2007						
Beaker + Particulate (g)		118.7273	118.7276			118.7275
Beaker Tare (g)		118.6497	118.6499			118.6498
Particulate Weight (g)		0.0776	0.0777			0.0777

RUN 3	**BEAKER**	9740	**VOLUME**	ml	1040	**AVERAGE**
1/31/2007						
Beaker + Particulate (g)		120.1920	120.1924			120.1922
Beaker Tare (g)		120.1074	120.1077			120.1076
Particulate Weight (g)		0.0846	0.0847			0.0846

Analyst LB

FINAL REPORT

Started 2/7/2007
Completed 3/1/2007

DI Water Analysis

Job Number	**07-4013**
Client Name	**Air Sampling Assoc./ Newark, AR**
Unit Name	**Unit No. 2 Stack**

Method: 202

RUN 4	**BEAKER**	9742	**VOLUME**	ml	1045	**AVERAGE**
2/1/2007						
Beaker + Particulate (g)		114.5761	114.5763			114.5762
Beaker Tare (g)		114.5023	114.5023			114.5023
Particulate Weight (g)		0.0738	0.0740			0.0739

RUN 5	**BEAKER**	9744	**VOLUME**	ml	1030	**AVERAGE**
2/2/2007						
Beaker + Particulate (g)		107.1044	107.1046			107.1045
Beaker Tare (g)		107.0221	107.0225			107.0223
Particulate Weight (g)		0.0823	0.0821			0.0822

Blank	**BEAKER**	9746	**VOLUME**	ml	580	**AVERAGE**
Beaker + Particulate (g)		115.2109	115.2108			115.2109
Beaker Tare (g)		115.2017	115.2018			115.2018
Particulate Weight (g)		0.0092	0.0090			0.0091

Analyst LB

FINAL REPORT

Started 2/7/2007
Completed 3/1/2007

Sulfate **07-4013**

	Sample No.	Sample Volume, ml	Lab Volume, ml	Lab Results, ug/ml	Blank, ug/ml	Final Results, mg
Run 1	4013-1	848	20	41.1	0	12.338
Run 2	4013-2	885	20	36.7	0	11.498
Run 3	4013-3	940	20	41.3	0	13.743
Run 4	4013-4	945	20	38.2	0	12.779
Run 5	4013-5	930	20	40.7	0	13.399
Blank	4013-6	580	20	0		

Chloride **07-4013**

	Sample No.	Lab Results, ug	Blank, ug	Final Results, mg Corrected to NH4Cl
Run 1	9736	<1.0	5.9	-0.007
Run 2	9738	<1.0	5.9	-0.007
Run 3	9740	<1.0	5.9	-0.007
Run 3	9742	<1.0	5.9	-0.007
Run 3	9744	<1.0	5.9	-0.007
Blank	9746	5.9		

AIR SAMPLING ASSOCIATES, INC.

Appendix F:

Chain of Custodies

AIR SAMPLING ASSOCIATES, INC.

Chain of Custody Record

Client: ADA-ES ; NEWARK	Project No.: 07-008	Page 1 of 1	
Address:	Unit No.: UNIT NO. 2 STACK	Lab: ASAI / WESTERN	
City: NEWARK State: AR Zip Code:	Project Manager: FOLSMAN	Lab Contact: L. BULL	
Run No.: 1	Test Method: 5/202	Lab Phone No.:	

Sample I.D.	Date	Time	Absorbing Solution	No. of Containers	Comments	PM	Sulfates	Chlorides	Volume	Beakers
CONTAINER 1 RUN1	1/29/07	1745	—	1	filter A129	✓				
CONTAINER 2 RUN1	↓	↓	Acetone	1	Acetone F.W.	✓				
CONTAINER 4 RUN1	↓	↓	DI H2O.	1	IMPS 1, 2, 3/4 + DI H2O Rinse	✓	✓	✓	948	9736
CONTAINER 5 RUN1	↓	↓	MeCl	1	IMPS 1, 2, 3/4 MeCl RINSE	✓	✓	✓	770	9737

Special Instructions:

Turn Around Time Required: ☑ Normal ☐ Rush

Sample Disposal: ☐ Return to ASAI ☑ Disposal By Lab ☐ Archive For 3 Months

	Date	Time		Date	Time
1. Recovered By: [signature]	1/29/07	1745	1. Relinquished By: [signature]	2/5/07	0830
2. Received By: Bill [signature]	2/5/07	0830	2. Relinquished By: Bill Jeffery	2/6/07	1115
3. Received By: [signature]	2/7/07	1200	3. Relinquished By:		

Comments: SHIPPED TO WESTERN VIA FED EX 2/6/07

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AIR SAMPLING ASSOCIATES, INC.

Chain of Custody Record

Client: ADA-ES; NEWARK	Project No.: 07-008	Page: 1 of 1	Analysis
Address:	Unit No.: UNIT NO. 2 STACK	Lab: ASAI / WESTERN	
City: NEWARK State: AR Zip Code:	Project Manager: GOLDMAN	Lab Contact: L. BULL	
Run No.: 2	Test Method: 5/202	Lab Phone No.:	

Sample I.D.	Date	Time	Absorbing Solution	No. of Containers	Comments	MD	Sulfate	Chloride	Volume	Beaker
Container 1 RUN 2	1/30/07	1600		1	filter A130	✓				
Container 2 RUN 2	↓	↓		1	Acetone F.W.	✓				
Container 3/4 RUN 2				1	IMPS 1,2,3 + DI Rinse	✓	✓	✓	985	4738
Container 5 RUN 2				1	IMPS 1,2,3 MeCl Rinse	✓	✓	✓	272	9737

Special Instructions:

Turn Around Time Required: ☑ Normal ☐ Rush

Sample Disposal: ☐ Return to ASAI ☑ Disposal By Lab ☐ Archive For 3 Months

1. Recovered By: [signature]	Date: 1/30/07	Time: 1600	1. Relinquished By: [signature]	Date: 2/5/07	Time: 0830
2. Received By: Bill [signature]	Date: 2/5/07	Time: 0830	2. Relinquished By: Bill Heffley	Date: 2/6/07	Time: 1130
3. Received By: Ken Pry	Date: 2/7/07	Time: 1200	3. Relinquished By:	Date:	Time:

Comments: SHIPPED TO WESTERN VIA FED EX 2/6/07

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AIR SAMPLING ASSOCIATES, INC.

Chain of Custody Record

Client: ADA-ES NEWARK	Project No.: ~~06~~ 07-008	Page 1 of 1	
Address:	Unit No.: UNIT NO. 2 STACK	Lab: ASAI / WESTERN	
City: NEWARK / State: AR / Zip Code:	Project Manager: GOLDMAN	Lab Contact: L. BULL	
Run No.: 3	Test Method: 5/202	Lab Phone No.:	

Sample I.D.	Date	Time	Absorbing Solution	No. of Containers	Comments	M5	Sulfates	Chlorides	Volume	Beaker
Cont. 1 Run 3	1/31/07	1519	—	1	filter	✓				
Cont. 2 Run 3	↓	↓	Acetone	1	Acetone F.W.	✓				
Cont. 4 Run 3			DI H_2O	1	DMS 1/2/3 + DI H_2O Rinse	✓	✓	✓	1040	9740
Cont. 5 Run 3	↓	↓	MeCl	1	DMS 1/2/3 MeCl Rinse	✓	✓	✓	261	9741

Special Instructions:

Turn Around Time Required: ☑ Normal ☐ Rush

Sample Disposal: ☐ Return to ASAI ☑ Disposal By Lab ☐ Archive For 3 Months

1. Recovered By: [signature]	Date: 1/31/07	Time: 1519	1. Relinquished By: [signature]	Date: 2/5/07	Time: 0830
2. Received By: Bill Hefley	Date: 2/5/07	Time: 0830	2. Relinquished By: Bill Hefley	Date: 2/6/07	Time: 1130
3. Received By: Ken Posey	Date: 2/7/07	Time: 1200	3. Relinquished By:	Date:	Time:

Comments: SHIPPED TO WESTERN VIA FEDEX 2/6/07

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AIR SAMPLING ASSOCIATES, INC.

Chain of Custody Record

Client: ADA-ES, NEWARK	Project No.: 07-008	Page: 1 of 1	Analysis
Address:	Unit No.: UNIT NO. 2 STACK	Lab: ASAI / WESTERN	
City: NEWARK State: AR Zip Code:	Project Manager: GOLDMAN	Lab Contact: L. BULL	
Run No.: 4	Test Method: 5/202	Lab Phone No.:	

Sample I.D.	Date	Time	Absorbing Solution	No. of Containers	Comments	pH	Sulfate	Chloride	10/Lock	13 Beaker
CONT. 1 RUN 4	2-1-07	1515	—	1	FILTER A132	✓				
CONT. 2 RUN 4	↓	1515		1	ACETONE F.W.	✓				
CONT. 4 RUN 4	↓	1515		1	IMPS 1/2/3 + DI H_2O RINSE	✓	✓	✓	1045	1100 7 4 9442 14
CONT. 5 RUN 4	↓	1515		1	IMPS 1/2/3 MeCl RINSE	✓	✓	✓	257	~~943~~ 976 14
CONT. 6 DI. H_2O BLANK		1525		1	Reagent BLANK (D.I. H_2O)	✓	✓	✓	580	9946
CONT. 7 MeCl BLANK		1525		1	Reagent BLANK (MeCl)	✓	✓	✓	266	9947 ~~9949~~ 14
CONT. 8 Acetone BLANK		1525		1	Reagent BLANK (Acetone)	✓				

Special Instructions:

Turn Around Time Required: ☑ Normal ☐ Rush

Sample Disposal: ☐ Return to ASAI ☑ Disposal By Lab ☐ Archive For 3 Months

1. Recovered By: [signature]	Date: 2/1/07	Time: 1515/1525	1. Relinquished By: [signature]	Date: 2/5/07	Time: 0830
2. Received By: Bill Hefley	Date: 2/5/07	Time: 0830	2. Relinquished By: Bill Hefley	Date: 2/6/07	Time: 1130
3. Received By: Ken Posey	Date: 2/7/07	Time: 1200	3. Relinquished By:	Date:	Time:

Comments: SHIPPED TO WESTERN VIA FED EX 2/6/07 [signature]

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AIR SAMPLING ASSOCIATES, INC.

Chain of Custody Record

Client: ADA-ES, NEWARK	Project No.: 07-008	Page 1 of 1	Analysis
Address:	Unit No.: UNIT NO. 2 STACK	Lab: ASAI / WESTERN ENV.	
City: NEWARK State: AR Zip Code:	Project Manager: GOLDMAN	Lab Contact: J. MEADOR / L. BULL	
Run No.: 5	Test Method: 5/202	Lab Phone No.:	

Sample I.D.	Date	Time	Absorbing Solution	No. of Containers	Comments	M5	Sulfates	Chlorides	Volume	Beaker
Cont. 1 RUN 5	2/2/07	1315	—	1	FILTER (A133)	✓				
Cont. 2 RUN 5	↓	1315	Acetone	1	ACETONE F.W.	✓				
Cont. 4 RUN 5	↓	1315	DI H_2O	1	IMPS 1,2,3 + DI H_2O RINSE	✓	✓	✓	1030	917
Cont. 5 RUN 5	↓	1315	NaCl	1	IMPS 1,2,3 NaCl RINSE	✓	✓	✓	270	915

Special Instructions:

Turn Around Time Required: ☑ Normal ☐ Rush

Sample Disposal: ☐ Return to ASAI ☑ Disposal By Lab ☐ Archive For 3 Months

1. Recovered By: [signature]	Date: 2/2/07	Time: 1315	1. Relinquished By: [signature]	Date: 2/5/07	Time: 0830
2. Received By: Bill Bejley	Date: 2/5/07	Time: 0830	2. Relinquished By: Bill Bejley	Date: 2/6/07	Time: 1130
3. Received By: Ken Posey	Date: 2/7/07	Time: 1200	3. Relinquished By:	Date:	Time:

Comments: SHIPPED TO WESTERN VIA FED EX 2/6/07

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ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 1

PLEASE PRINT, provide as much information as possible. Refer to corresponding notes on reverse side.

Company Name: Western Env.

Project Name, PWS #, Permit #, Etc.: ASA 07-4013

Report Mail Address: 913 Foster Rd

Contact Name, Phone, Fax, E-mail: Lonnie Bull 234-5511

Sampler Name if other than Contact:

Invoice Address: Casper, WY 82601

Invoice Contact & Phone #:

Purchase Order #:

ELI Quote #:

Report Required For: POTW/WWTP ☐ DW ☐

Other _____

Special Report Formats - ELI must be notified prior to sample submittal for the following:

NELAC ☐ A2LA ☐ Level IV ☐

Other _____

EDD/EDT ☐ Format _____

ANALYSIS REQUESTED

Notify ELI prior to RUSH sample submittal for additional charges and scheduling

Comments:

Shipped by: Hand

Cooler ID(s)

Receipt Temp 7.8 °C

Custody Seal Y N

Intact Y N

Signature Match Y N

Lab ID

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	Number of Containers / Sample Type: A W S V B O / Air Water Soils/Solids Vegetation Bioassay Other / MATRIX	Chloride	SEE ATTACHED	Normal Turnaround (TAT)	RUSH Turnaround (TAT)
1 9736			W	X			
2 9738				X			
3 9740				X			
4 9742				X			
5 9744				X			
6 9746				X			
7							
8							
9							
10							

LABORATORY USE ONLY

W:7020972

Custody Record MUST be Signed

Relinquished by (print): Lonnie Bull Date/Time: 2/27/07 1345 Signature:

Received by (print): Linda Traher Date/Time: 2-27-07 13:45 Signature:

Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Sample Disposal: Return to client: _____ Lab Disposal: _____

LABORATORY USE ONLY

Sample Type: _____ # of fractions _____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.

Visit our web site at *www.energylab.com* for additional information, downloadable fee schedule, forms, & links.

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Track#C07020972 Page 4

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CHAIN OF CUSTODY RECORD

PROJECT NO.: [illegible] CONTACT NAME [illegible] TELEPHONE NO. [illegible]

Recovered By: Print Name | Signature

SAMPLE ID	SAMPLE LOCATION	RUN	RECOVERY DATE	RECOVERY TIME	SOLUTION / FILTER #	No. of Containers	SCANNED	ANALYSIS							REMARKS
[illegible]	[illegible]	1			4°C	1	X								
[illegible]		2			4°C		X								
[illegible]		3			4°C		X								
[illegible]		4			4°C		X								
[illegible]		5			4°C	1	X								
[illegible]		6			4°C	1	X								

COMMENTS: * method 202

Relinquished by: (Signature)	Company	Date	Time	Received by: (Signature)	Company	Date	Time
[illegible]	WEST	8/9/07	0930	Tim Holler	ELI	2/9/07	0930
Relinquished by: (Signature)	Company	Date	Time	Received by: (Signature) 17-6 / Hand	Company CC7020335	Date	Time
Dispatched by: (Signature)	Company	Date	Time	Received for Laboratory by:	Company	Date	Time
Method of Shipment:							

WHITE COPY—WEST YELLOW COPY—CUSTOMER PINK COPY—COPY

M00953 11/94

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AIR SAMPLING ASSOCIATES, INC.

Appendix G:

Resumes of Test Personnel

BILLY J. MULLINS, JR.; President

Education	Post Graduate Study Environmental Engineering at Southern Methodist University; Dallas, Texas 1970. M.S. 1969, New York University; New York, New York, in Civil Engineering (Air Resources). B.S. 1968, Texas Tech University; Lubbock, Texas, in Civil Engineering (Water Resources). Studies in Engineering at the U.S. Naval Academy; Annapolis, Maryland, 1963-1964
Professional Training Courses	Attended Short Course on Air Pollution Engineering at the University of Texas at Austin, February 1970. Attended four-week management course presented by the American Management Association, 1976.
Certification	Registered Professional Engineer Certified Visible Emissions Evaluator Licensed Private Pilot (Multi-Engine-Land, Instrument) Diplomat in the American Academy of Environmental Engineers Inductee into the Stack Sampling Hall of Fame Certified as Qualified Environmental Professional (QEP)
Professional Memberships	**Air & Waste Management Association** – Past Chairman, Past Vice Chairman, and Past Board of Directors of North Texas Chapter and Southwest Section; Past Chairman, Consultants Committee; Past Chairman, Source Measurement Committee **Source Evaluations Society** – Past President, Past Board of Directors **American Management Association**

Publications

Authored "Real World Experience with USEPA's New Sampling and Analytical Methods for Conducting Risk Burn," May 1998.

Co-authored "Sulfur Compound Emissions of the Petroleum Production Industry," December 1974.

Co-authored "Field Procedure for Stabilizing Hydrogen Sulfide Samples to be Analyzed Using Modified Methylene Blue Technique," presented at the Conference on Ambient Air Quality Measurements, Austin, Texas, March 1975.

Co-authored "Atmospheric Emissions Survey of the Sour Gas Industry," October 1975.

Co-authored "Technique for Insuring the Validity of Samples for High Concentrations of Sulfur Dioxide Using the EPA Method 5 Sampling Train," presented at the Third National Conference on Energy and the Environment, College Corner, Ohio, September 1975.

Teaching Experience

Conducted training seminars on sampling methods periodically since 1974 to present.

Conducted a one-day seminar on Part 75 Testing over ten times in 1993 and 1994.

Served as a lecturer in the Environmental Protection Agency's (EPA) training course number 450, "Source Sampling for Particulate Pollutants," for two years from January 1974 to October 1975 and March, 1992.

Conducted a two-day training course entitled "technical Assistance in Source Sampling" at Iowa State University, Ames, Iowa, for the Environmental Protection Agency (EPA), October 1974.

Conducted Environmental Protection Agency's (EPA) training course number 450, "Source Sampling for Particulate Pollutants," at Research Triangle Park, North Carolina, September 1975.

Teaching Experience (Cont'd)

Conducted a two-day short course entitled "Performing and Observing Source Sampling," Dallas, Texas, July 1976, May 1977, October 1977, November 1987 and November 1988; Lake Charles, Louisiana, May 1977; Casper Wyoming, May 1977; Point Comfort, Texas, November 1992.

Served as a lecturer in the Environmental Protection Agency's two-day seminar entitled "Asphalt Industry Environmental Solutions," presented in Dallas, Texas, March 21-22, 1979.

Conducted a two-day short course entitled "Performing and Observing Source Sampling," Phoenix, Arizona, August, 1990, for the State of Arizona, Department of Environmental Quality; Lincoln, Nebraska, March 1980, for the State of Nebraska, Air Quality Control Division.

Technical Experience

Directed and performed stack sampling on over 2000 sources of which over 500 were sampled simultaneously using more than one sampling train at several points in the flue gas stream; 1972-present.

Directed and performed over 200 short-term ambient air studies using mobile sampling vans and various ambient air sampling equipment; 1972-present.

Designed, directed and operated over 20 permanent ambient air networks of various size and duration for a variety of parameters; 1972-present.

Designed surface and underground drainage systems for residential subdivisions, public works projects, and shopping centers; 1969-1972.

Designed several residential subdivisions including lot layout, street design, drainage design, and utility design; 1969-1972.

Research Projects

Supervised and conducted a study made by the Hawaiian Sugar Planters' Association to characterize the emissions for several bagasse-fired boilers, April-May 1976.

Supervised and conducted a study made by the Rio Grande Valley Sugar Growers, Inc. to determine the area affected by the burning of sugarcane fields prior to harvesting, November 1974-April 1975.

Supervised and conducted a study by a lightweight aggregate manufacturer to develop a material balance around the process through sampling and analysis of several parameters, November 1973.

Conducted a study in New York City to attempt to develop a correlation in the ambient air between carbon dioxide and sulfur dioxide to provide a tool for predicting air pollution predicting air pollution episodes, January-May 1969.

Related Projects

Served as Chairman of the Engineering Foundation Conference on Stack Sampling and Source Evaluation in Destin, Florida, 2002, and Santa Barbara, California, 1985.

Served as Co-Chairman of the Engineering Foundation Conference on Stack Sampling and Source Evaluation in Destin, Florida, 2001.

Served as Session Chairman at the Engineering Foundation Conference on Stack Sampling and Source Evaluation in Hershey, Pennsylvania, 1984; San Diego, California, 1993; and in Palm Coast, Florida, 1994.

GARY B. GOLDMAN; Associate

Education	B.S. 1993, University of Texas at Arlington; Arlington, Texas, in Geology.
Certification	Certified Visible Emissions Evaluator
Professional Memberships	**Source Evaluation Society**
Technical Experience	Senior Emissions Evaluator with the Texas Commission on Environmental Quality, responsible for oversight of all source testing activities within the State of Texas, Region 4, which encompasses 19 counties in the North Texas region, 1999-2005. Participated in the sampling of over 750 sources, including several of which were sampled simultaneously utilizing more than one sampling train, 1994-1999. Thoroughly trained in all EPA testing procedures specified in Title 40 of the Code of Federal Regulations, Part 60. Thoroughly trained in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 0010 Through 0100 Series. Participated in EPA's 3-D probe study. May – August 1997. Experienced in the analysis of commercial calibration gas cylinders for NO_x, SO_2, CO_2, and O_2. Experienced with calibration techniques for all field testing equipment. Thoroughly trained in the operation and routine maintenance of the following: Anarad Model AR50-C Carbon Dioxide Analyzer Anarad Model AR880 Oxides of Nitrogen Analyzer Anarad Model AR23 Oxygen Analyzer Anarad Model AR30C2 Sulfur Dioxide Analyzer

California Analytical Model 300-HFID Total Hydrocarbon Analyzer
Servomex Model 1440 Carbon Dioxide Analyzer
Servomex Model 1440 Oxygen Analyzer
Teledyne Model 326 Oxygen Analyzer
Thermo Environmental Model 10AR/S Oxides of Nitrogen Analyzer
Thermo Electron Model 46C Oxides of Nitrogen Analyzer
Thermo Electron Model 48C Oxides of Nitrogen Analyzer
Western Research Model 721A Sulfur Dioxide Analyzer

Professional Training

Attended 40-hour Occupational and Environmental Training Program on Hazardous Materials (CFR 1910.120) Dallas, Texas, April 1993.

Attended HAZWOPER 8-hour refresher course, 1994-2005.

Attended the following Environmental Protection Agency (EPA) Courses:

Course 345, Emission Capture and Gas Handling System Inspection
Course 380, Fugitive Source Inspection
Course 400, Introduction to Hazardous Air Pollutants
Course 413, Control of Particulate Emissions
Course 415, Control of Gaseous Emissions
Course 418, Control of Nitrogen Oxide Emissions
Course 427, Combustion Evaluation
Course 444, Air Pollution Field Enforcement
Course 445, Inspection of Particle Control Devices
Course 446, Inspection Safety Procedures
Course 450, Source Sampling for Particulate Pollutants
Course 452, Principles and Practice of Air Pollution Control
Course 455, Inspection of Gas Control Devices and Selected Industries
Course 474, Continuous Emission Monitoring
Course 482, Sources and Control of Volatile Organic Air Pollutants

Attended the following California Air Resources Board (CARB) Courses

Course 221, Continuous Emission Monitoring
Course 233, Solvent Cleaning: Degreasing Operations
Course 242, Hot Mix Asphalt Facilities
Course 245, Cement Plants
Course 270, Incinerators

SCOT JACKSON; Associate

Education	B.S.B.A. May 1978, Mountain View Jr. College, in General Business.
Professional Training	Purchasing Supervisor for METCO Environmental, Inc. in charge of inventory and supplies. January 1995 – April 2005. Attended 40-hour Occupational and Environmental Training Program on Hazardous Materials (CFR 1910.120), Dallas, Texas, May 2000. Attended Fed-Ex Hazardous Goods Shipping Training, June 2004.
Certification	Certified Visible Emissions Evaluator
Technical Experience	Participated in the sampling of over 100 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures, 1995-present. Experience with calibration techniques for all field testing equipment. Thoroughly trained in the operation and routine maintenance of the following: California Analytical Model 300-HFID Total Hydrocarbon Analyzer Servomex Model 1440 Carbon Dioxide Analyzer Servomex Model 1440 Oxygen Analyzer Thermo Electron Model 42C Oxides of Nitrogen Analyzer Thermo Electron Model 48C Oxides of Nitrogen Analyzer Western Research Model 721A Sulfur Dioxide Analyzer

APPENDIX E:

Consulting Reports

APPENDIX E1: REI, Lance Modeling—May 31, 2006

CFD Modeling of TOXECON II at Independence

Lance Simulation Results

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INTERNATIONAL

May 31, 2006

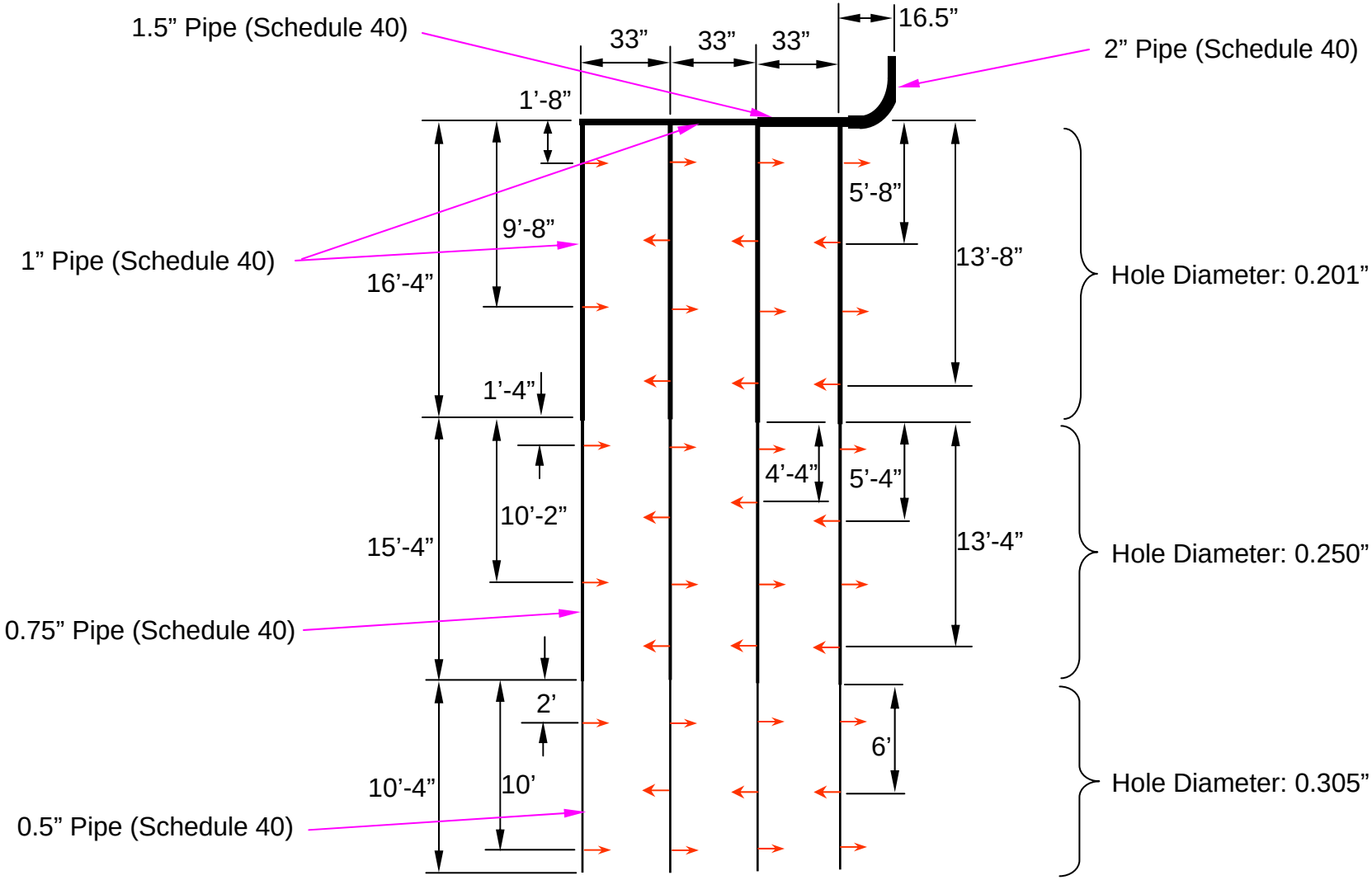
Overview of Project

- Objective: Estimate the distribution of injected activated carbon between the 2nd and 3rd ESP fields

- Approach:
  - » Build a CFD model of the multi-nozzle lance arrangement to predict the distribution of AC exiting the lance
  - » Build a CFD model of the ESP to estimate the resulting distribution of AC entering the third ESP field

- Status:
  - » A CFD model of one-half of the injection lance has been developed and AC distribution out of the lance has been predicted – results are presented here
  - » The ESP model is being developed

Lance Dimensions



Lance near left side wall was modeled (1/4 of injection grid)

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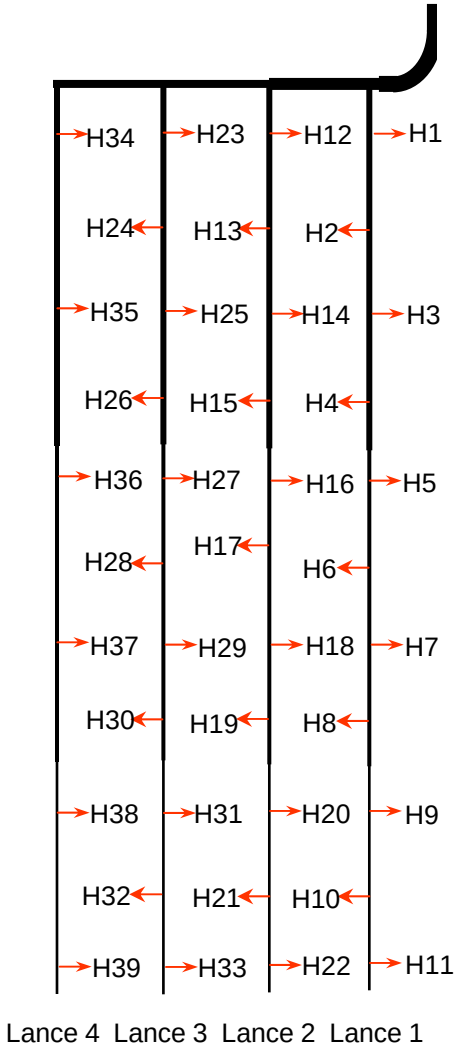
Lance and Hole Identifiers



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Lance Model Inputs

Carrier Air Flow (acfm) [1]	28.1
Carrier Air Flow (lb/hr)	116.4
Activated Carbon Flow (lb/hr) [2]	32.5
Average Carbon Concentration (lb/mmacf) [3]	5
Mass Flow Ratio of Carrier Air to Carbon	3.58
Carrier Air Temperature (°F)	110

1. Based on 112.5 acfm for entire injection grid
2. Based on 65 lb/hr for one half of injection grid
3. Approximately matches the carbon flow rate based on 3.35 ft/s flue gas velocity inside ESP

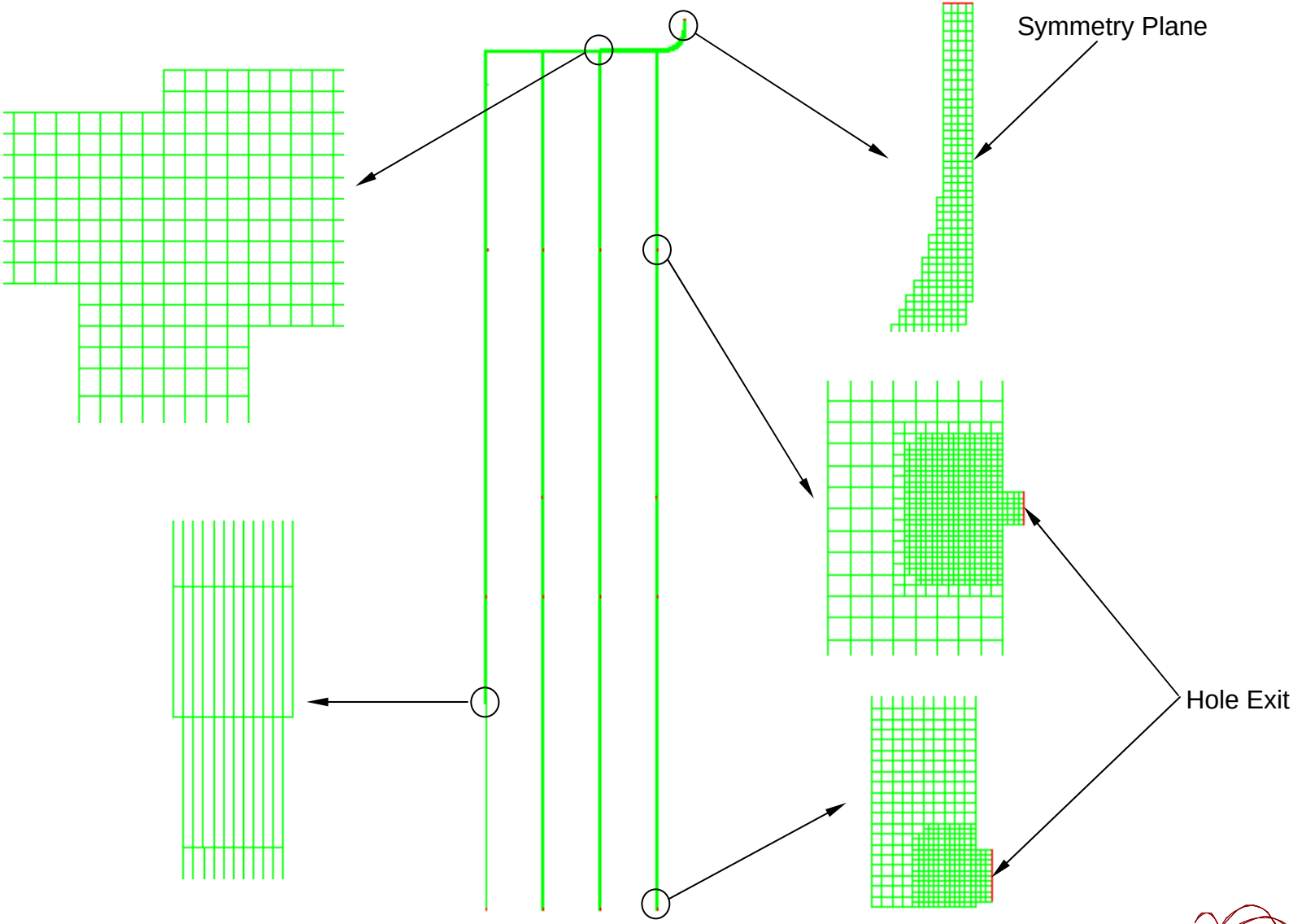
Activated Carbon

Particle Size Distribution

Size Bin	Diameter (μm)	Weight %
1	1.5	2%
2	3.3	4%
3	4.8	6%
4	6.7	9%
5	9.2	12.5%
6	13.1	16.5%
7	19.0	16.5%
8	27.2	12.5%
9	37.7	9%
10	52.3	6%
11	74.9	4%
12	122.5	2%

Based on the lab report provided by ADA-ES

Computational Grid



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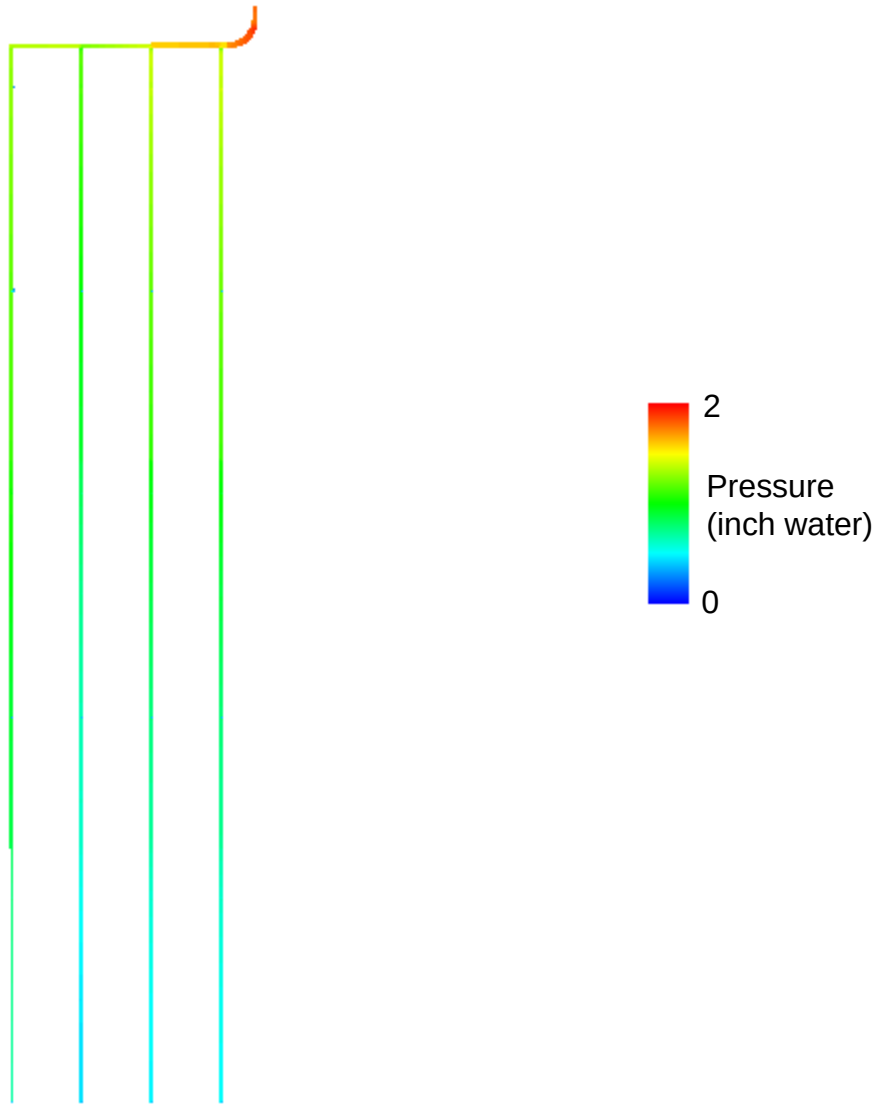
Pressure Distribution

Inside Multiple Nozzle Lance



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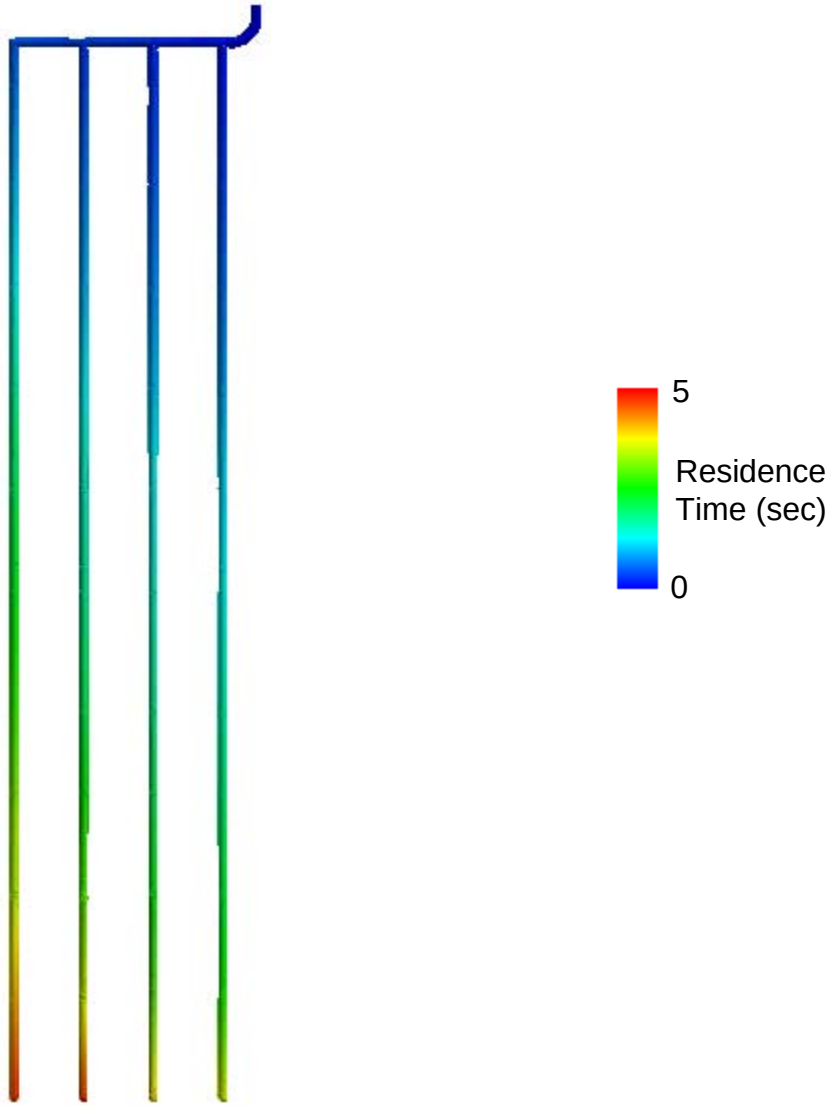
Particle Residence Time



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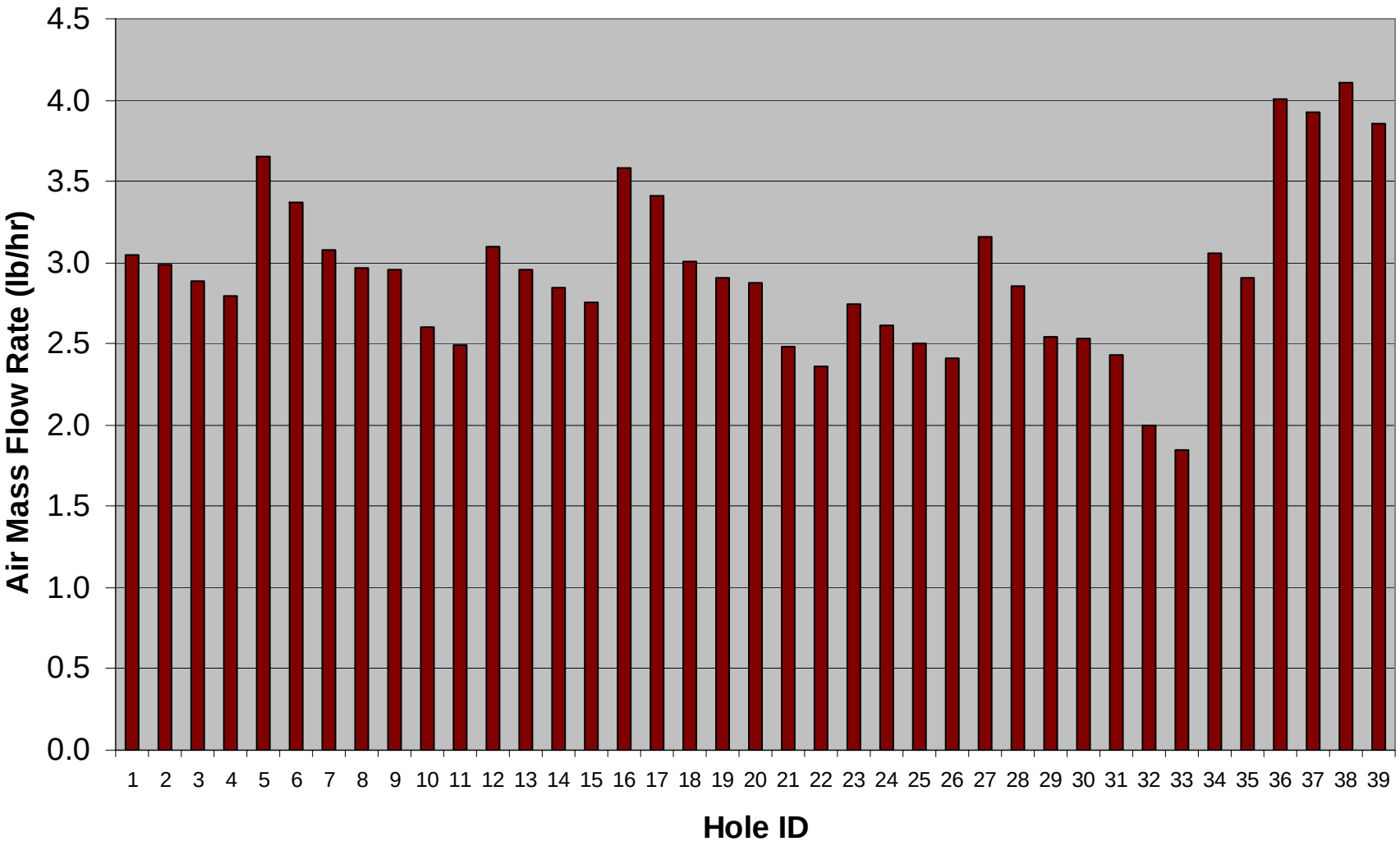
Air Flow Distribution

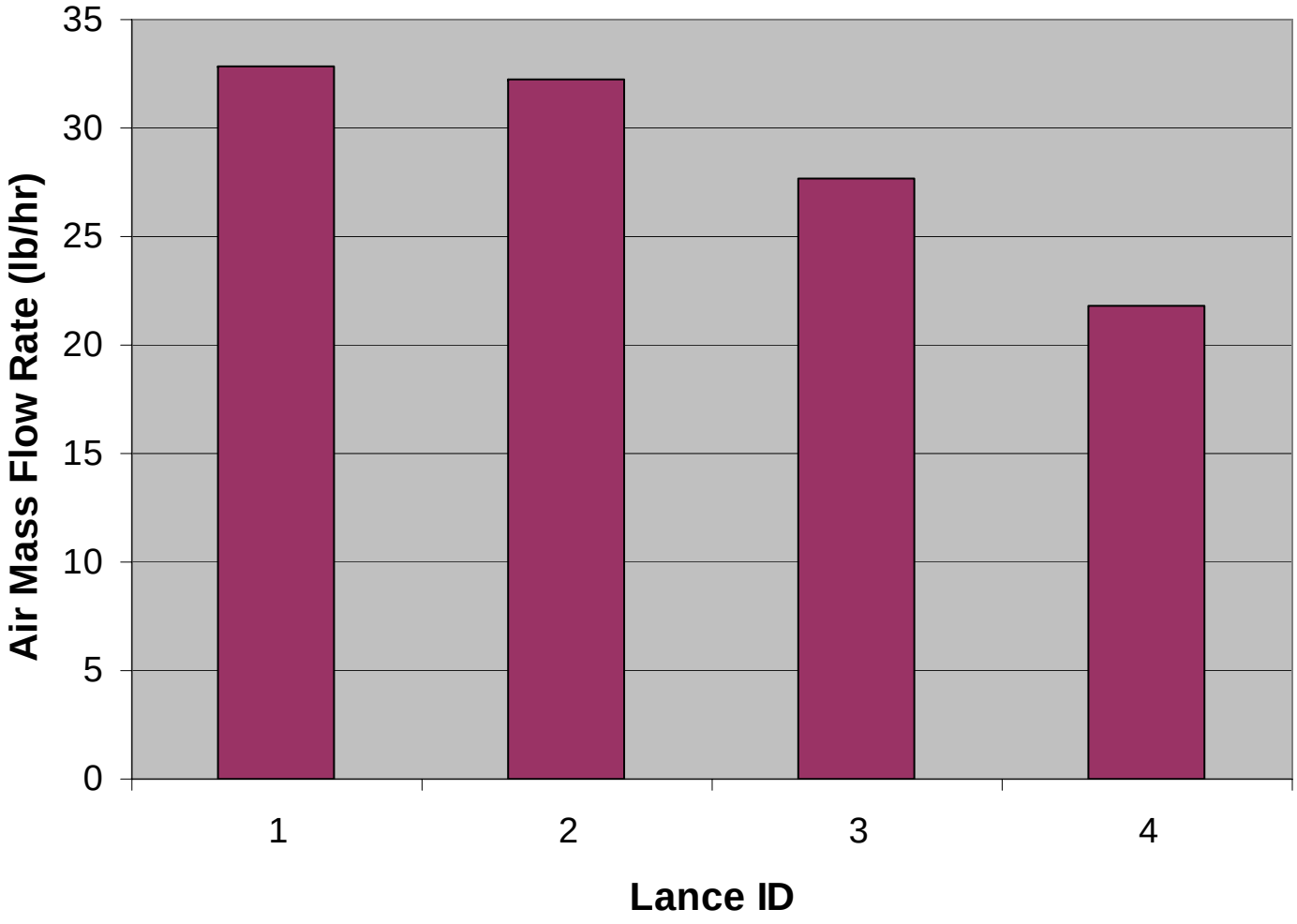
Hole ID	Mass Flow (lb/hr)	Deviation From Average (%)	Hole ID	Mass Flow (lb/hr)	Deviation From Average (%)
1	3.050	4	**21**	2.487	-15
2	2.984	2	**22**	2.358	-20
3	2.882	-2	**23**	2.745	-7
4	2.796	-5	**24**	2.614	-11
5	3.655	24	**25**	2.504	-15
6	3.366	15	**26**	2.411	-18
7	3.075	5	**27**	3.161	8
8	2.964	1	**28**	2.855	-3
9	2.956	1	**29**	2.538	-14
10	2.606	-11	**30**	2.535	-14
11	2.495	-15	**31**	2.429	-17
12	3.093	5	**32**	1.998	-32
13	2.955	1	**33**	1.844	-37
14	2.844	-3	**34**	3.057	4
15	2.750	-6	**35**	2.902	-1
16	3.583	22	**36**	4.010	36
17	3.411	16	**37**	3.924	34
18	3.007	2	**38**	4.102	40
19	2.904	-1	**39**	3.855	31
20	2.874	-2			

Air Flow Through Individual Holes



REACTION ENGINEERING INTERNATIONAL

Air Flow Through Individual Lances

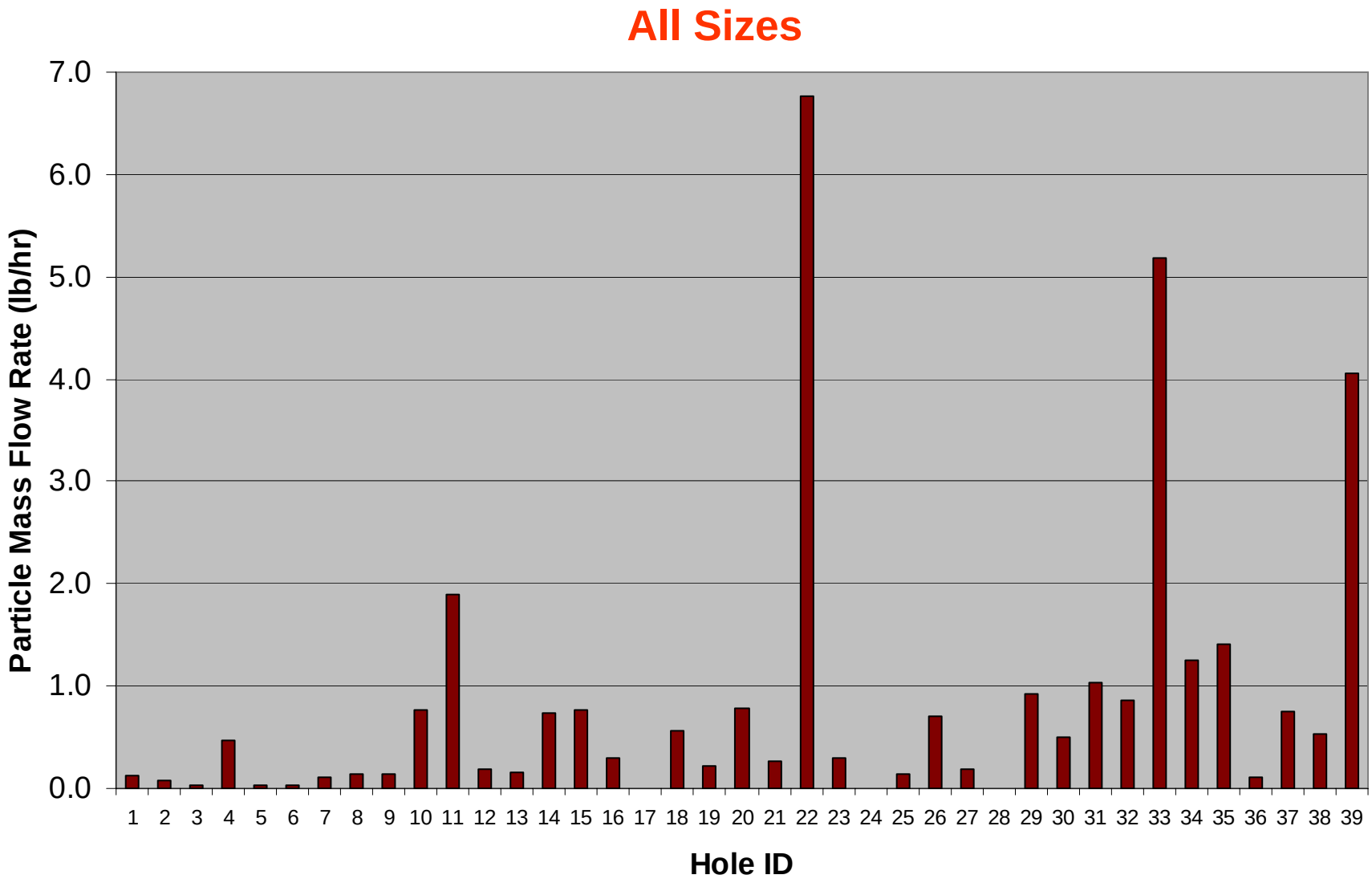


REACTION ENGINEERING INTERNATIONAL

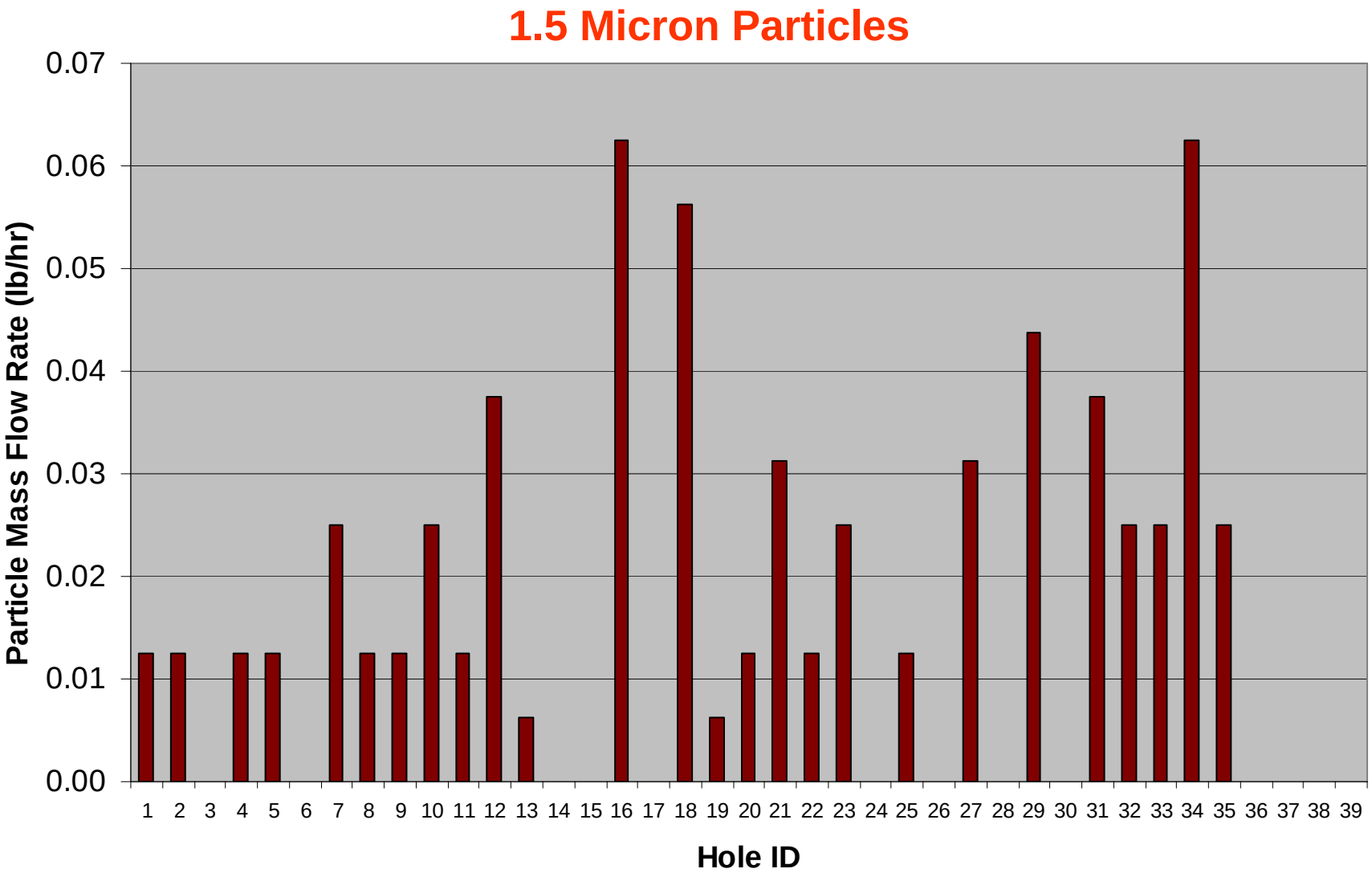
Particle Flow Distribution (All Sizes)

Hole ID	Mass Flow (lb/hr)	Deviation From Average (%)	Hole ID	Mass Flow (lb/hr)	Deviation From Average (%)
1	0.125	-85	**21**	0.270	-68
2	0.075	-91	**22**	6.771	712
3	0.031	-96	**23**	0.300	-64
4	0.469	-44	**24**	0.000	-100
5	0.038	-96	**25**	0.148	-82
6	0.028	-97	**26**	0.697	-16
7	0.112	-87	**27**	0.181	-78
8	0.144	-83	**28**	0.000	-100
9	0.144	-83	**29**	0.919	10
10	0.769	-8	**30**	0.495	-41
11	1.897	128	**31**	1.026	23
12	0.194	-77	**32**	0.856	3
13	0.161	-81	**33**	5.187	522
14	0.733	-12	**34**	1.252	50
15	0.772	-7	**35**	1.406	69
16	0.300	-64	**36**	0.103	-88
17	0.000	-100	**37**	0.750	-10
18	0.559	-33	**38**	0.534	-36
19	0.219	-74	**39**	4.055	387
20	0.780	-6			

Particle Flow Through Individual Holes

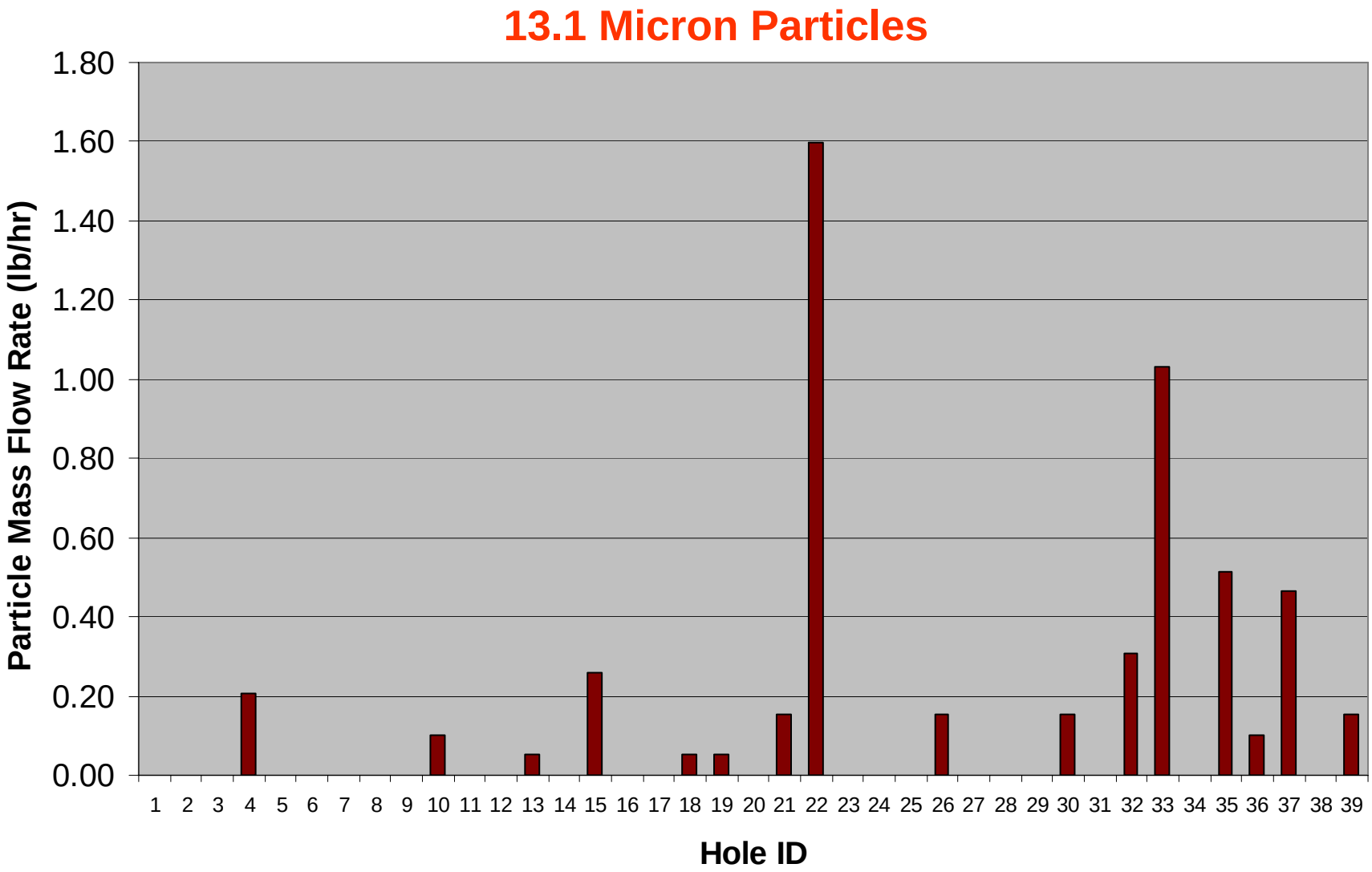


Particle Flow Through Individual Holes



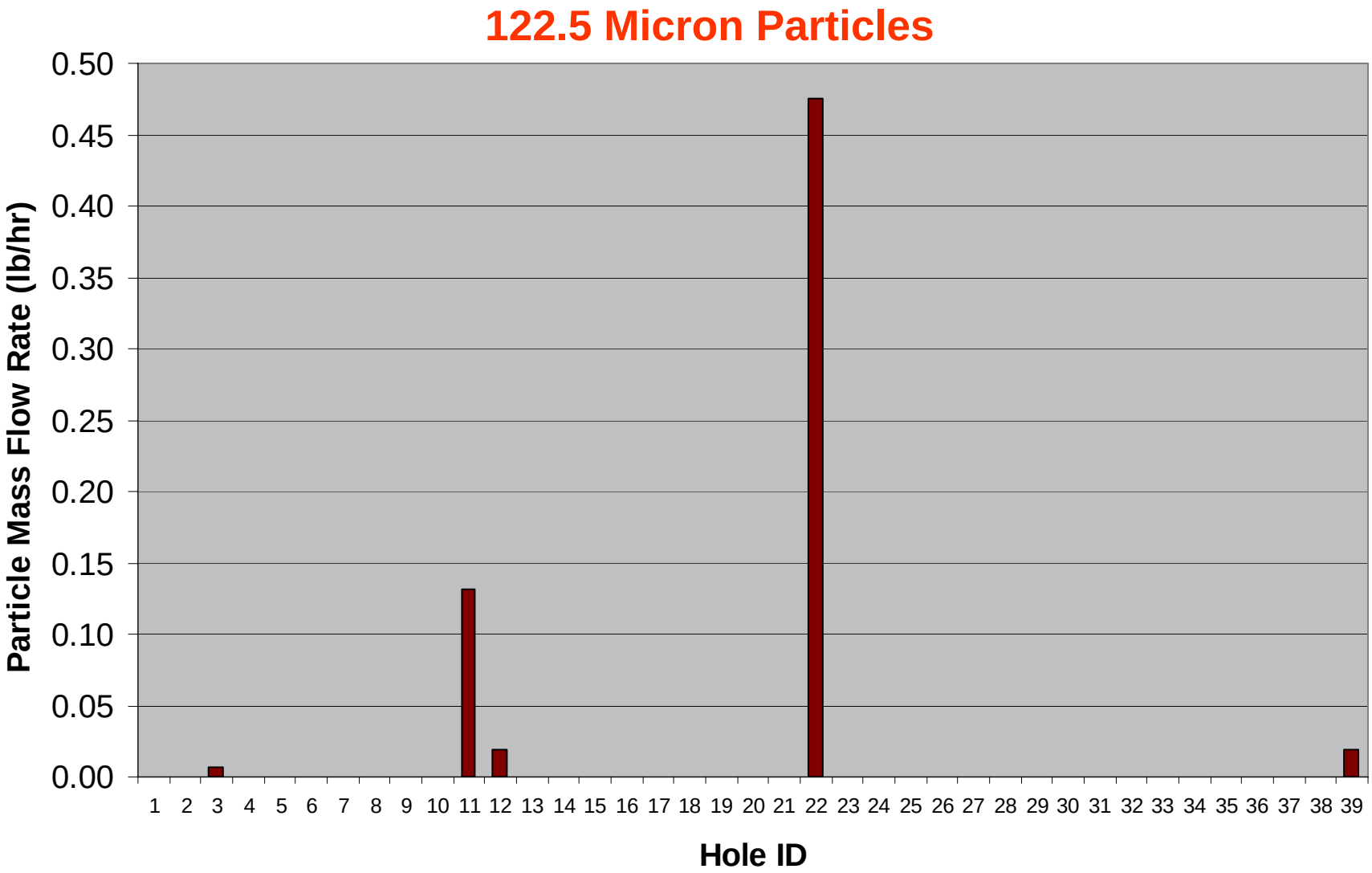
REACTION ENGINEERING INTERNATIONAL

Particle Flow Through Individual Holes

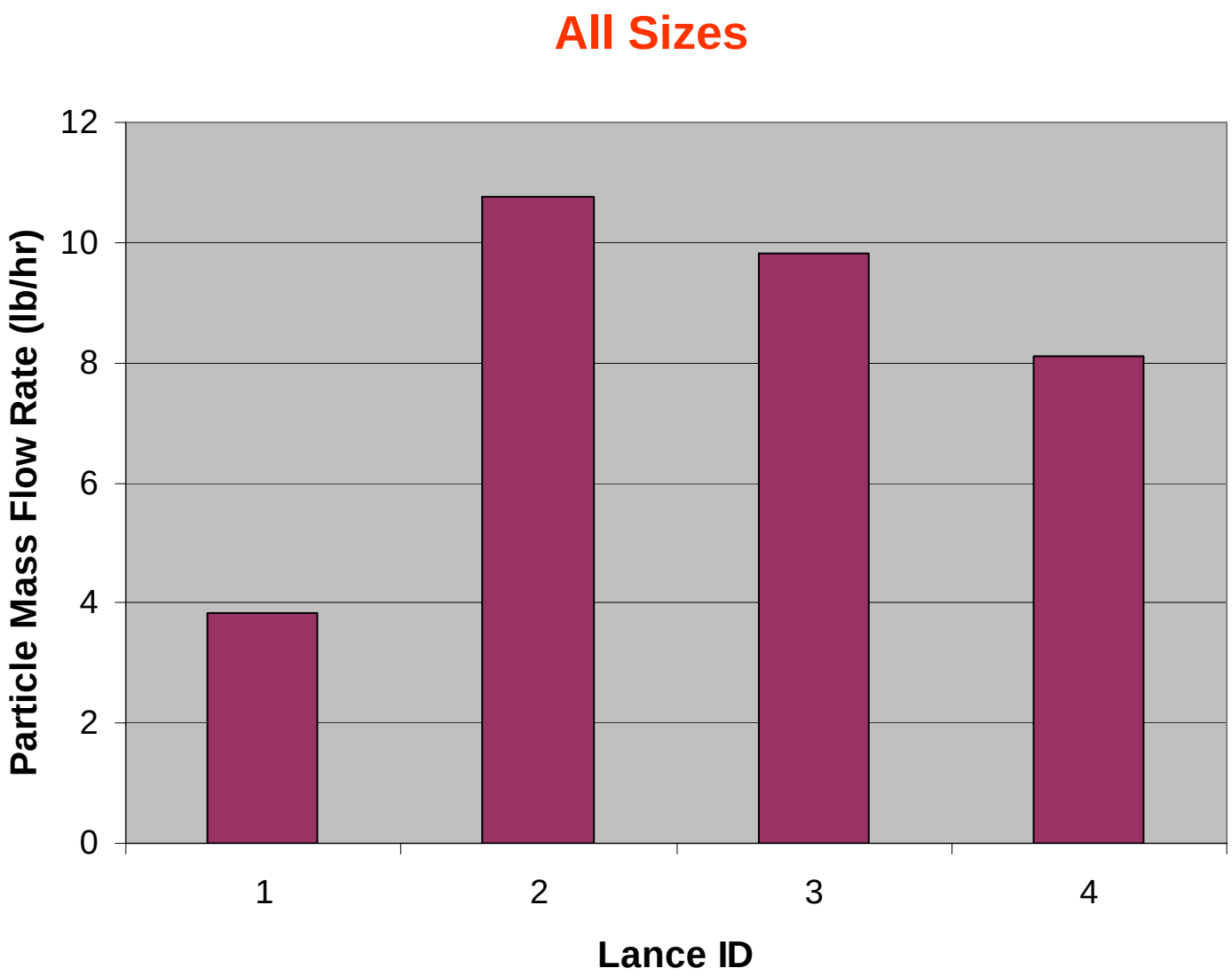


REACTION ENGINEERING INTERNATIONAL

Particle Flow Through Individual Holes



Particle Flow Through Individual Lances



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Summary

- Carrier air flows through 39 holes are quite evenly distributed
  - » Holes in Lance 4 have higher air flow due fewer holes drilled along the lance height
- Particle flows through 39 holes are severely biased
  - » Holes near the bottom end of the lances have much higher particle flows
  - » Large particles tend to leave the holes at the bottom end of the lances
  - » Small particles are more likely to leave the holes at higher elevations than large particles
  - » Among 4 lances, Lance 1 has the lowest particle flow
  - » The bottom holes on lances 1, 2, and 3 (holes 11, 22, 33) have high particle flow but low air flow indicating a potential for pluggage

APPENDIX E2: REI, Lance Modeling—August 11, 2006

CFD Modeling of TOXECON II at Independence

ESP ACI Model Results

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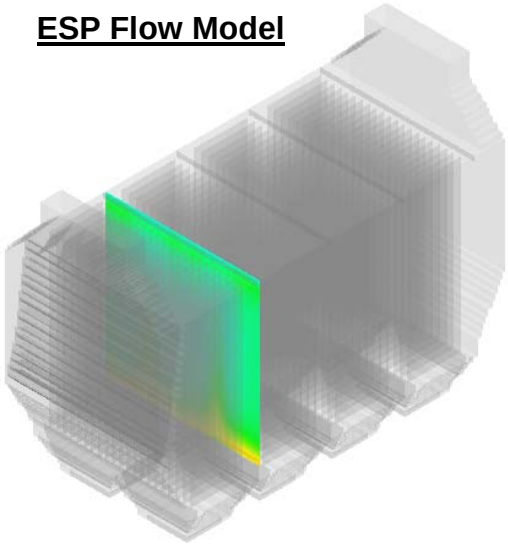
August 11, 2006

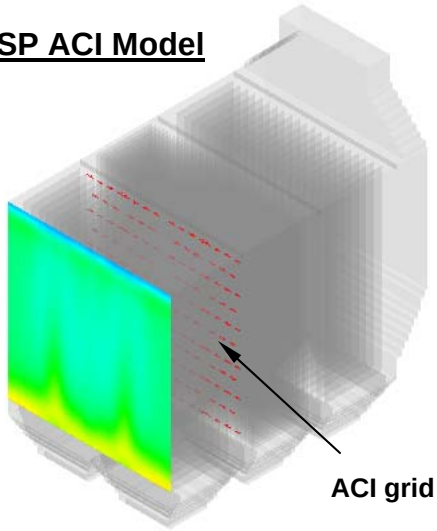
ESP Models

- ESP flow model is for ½ of one ESP box
- ESP flow model extends from ESP inlet duct to outlet duct including inlet and outlet plenums and associated turning vanes
- Activated carbon injection grid located between 2nd and 3rd ESP fields
- ACI is simulated within the ESP ACI model
- Flue gas flow field from the ESP flow model is mapped to inlet of ESP ACI model between 1st and 2nd ESP fields
- Results of ACI grid model were mapped into the ESP ACI model to predict dispersion of carbon
  - » Four injection lances were modeled in detail in the injection grid model
  - » Symmetry was assumed in order to specify carbon injection rates through all 16 lances (156 holes) within ½ of the ESP box

ESP Flow Model



ESP ACI Model



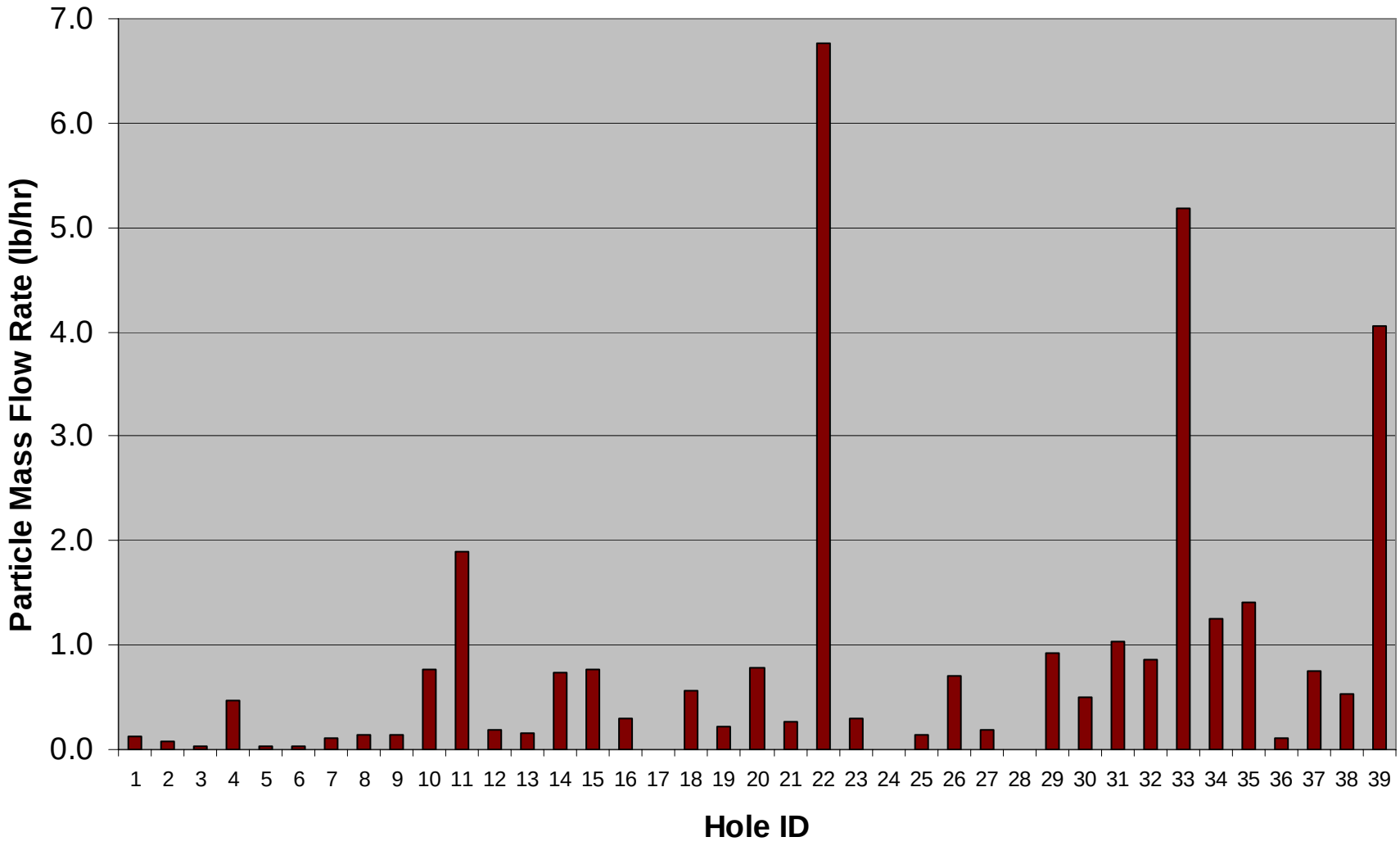
REACTION ENGINEERING INTERNATIONAL

Case Descriptions

- Case 1: Uniform particle flow distribution among 156 holes
- Case 2: ACI grid model results
- Case 3: Smoothed distribution from ACI grid model results

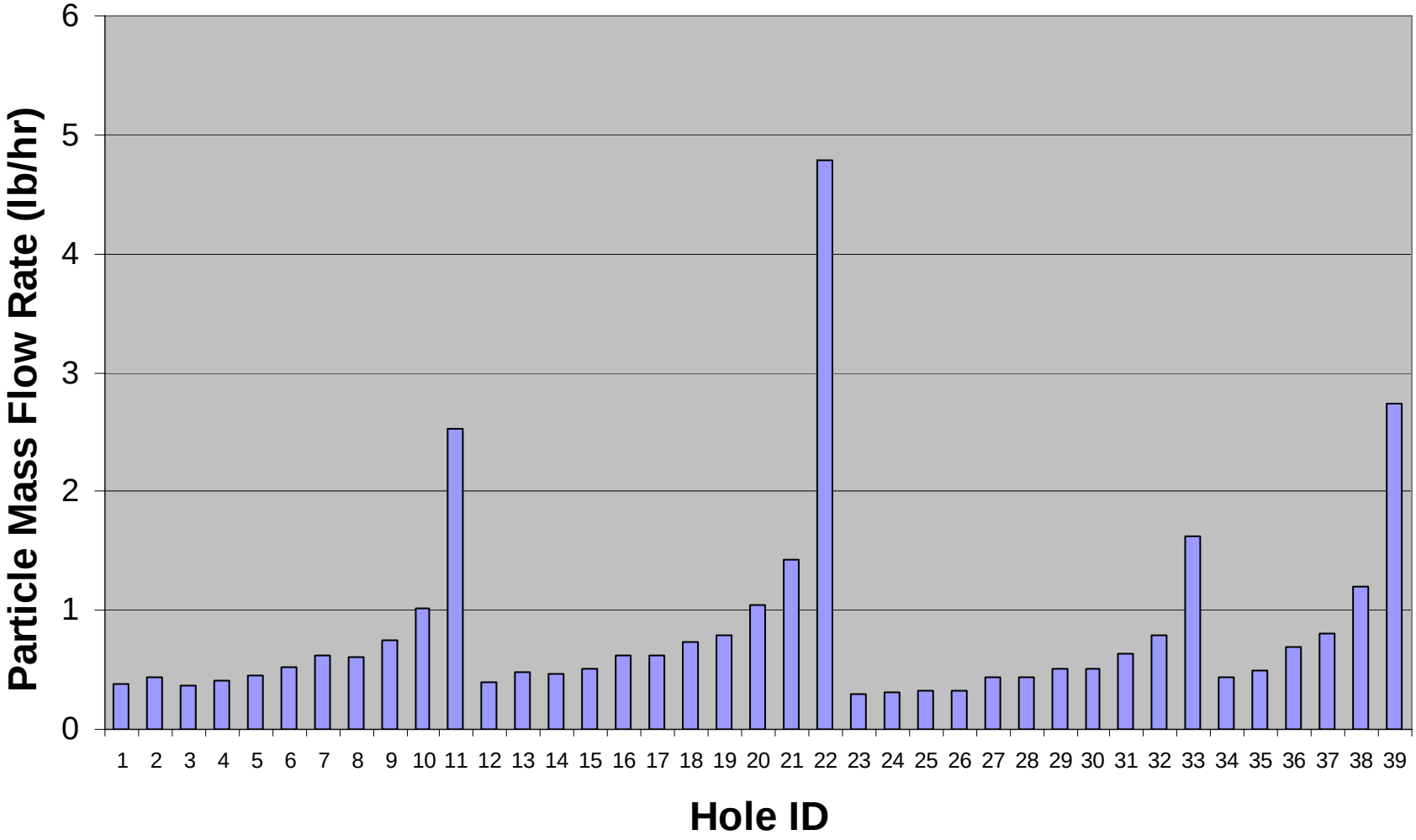
Particle Flow Through Injection Grid

Case 2



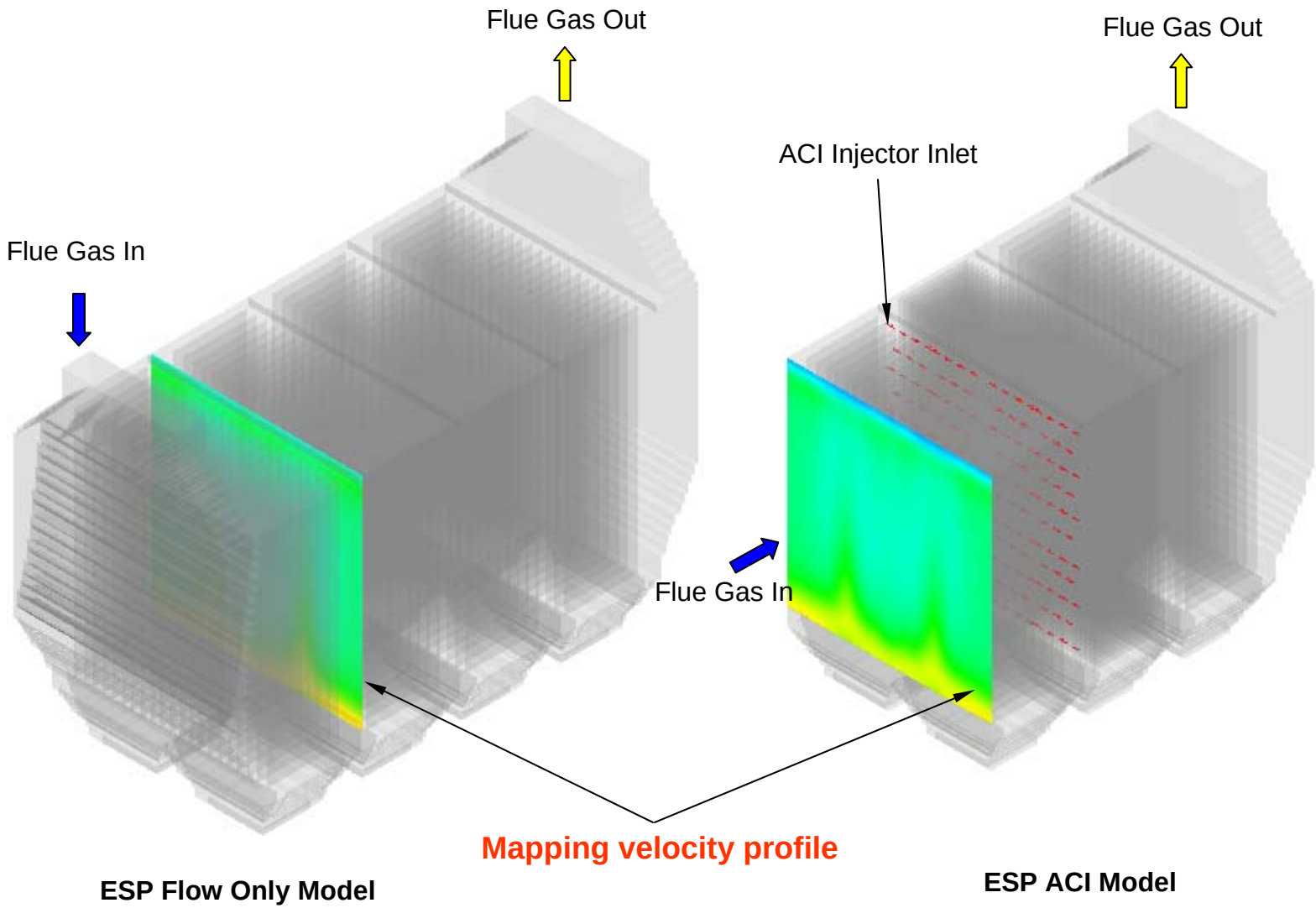
Particle Flow Through Injection Grid

Case 3



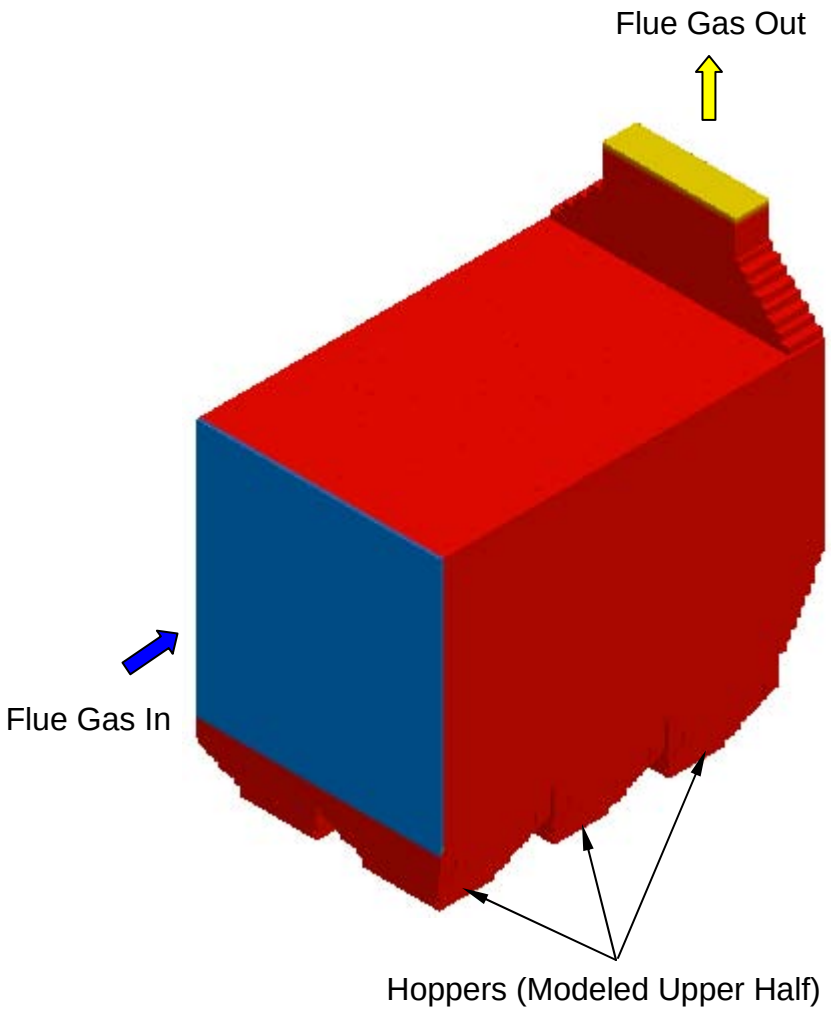
REACTION ENGINEERING INTERNATIONAL

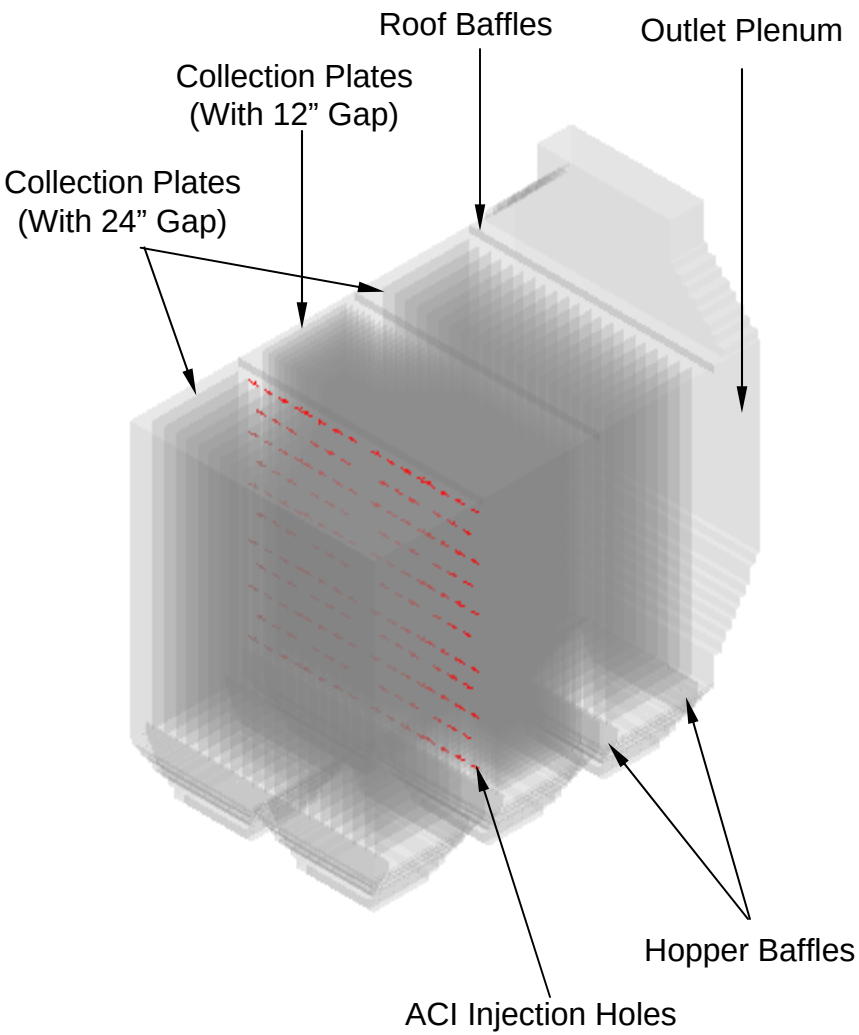
Mapping ESP Flow Model Results



REACTION ENGINEERING INTERNATIONAL

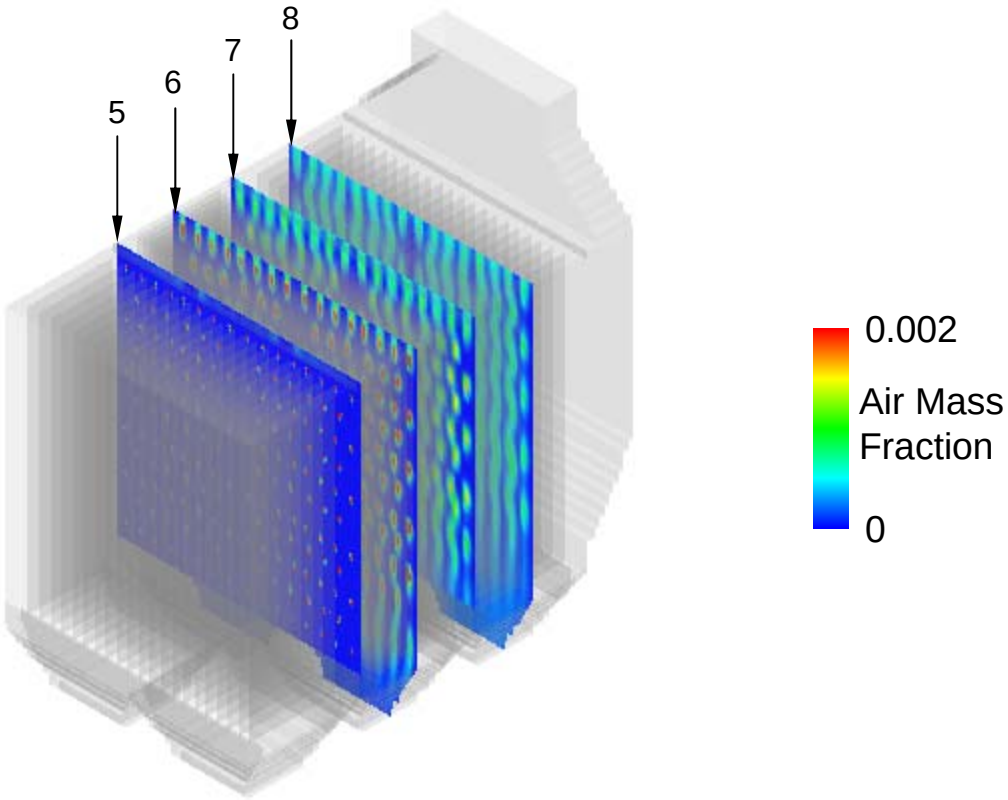
Computational Model (ESP ACI)





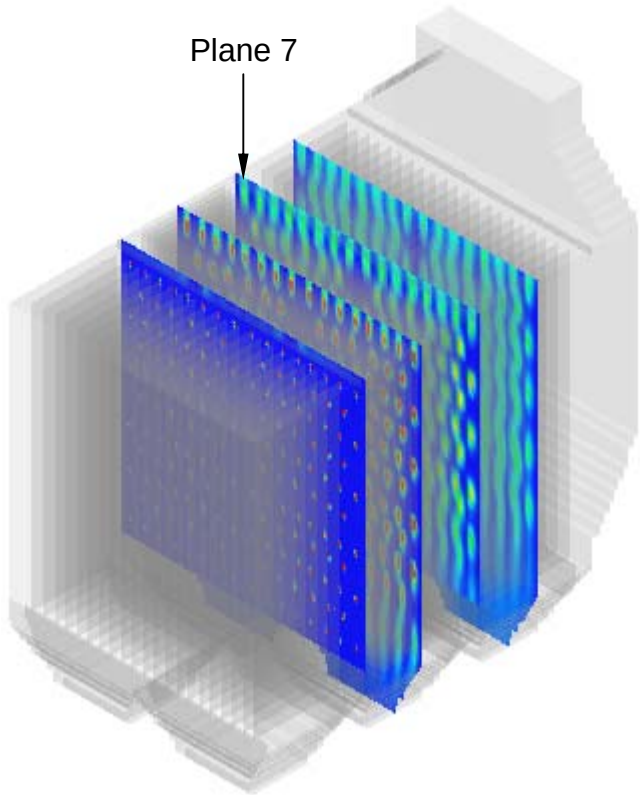
One half of a lower ESP box was modeled

Contour Plot Locations



	Description
Plane 5	ACI Plane
Plane 6	3rd Field Centerline
Plane 7	Between 3rd and 4th Fields
Plane 8	4th Field Centerline

Standard Deviation of Particle Bulk Density

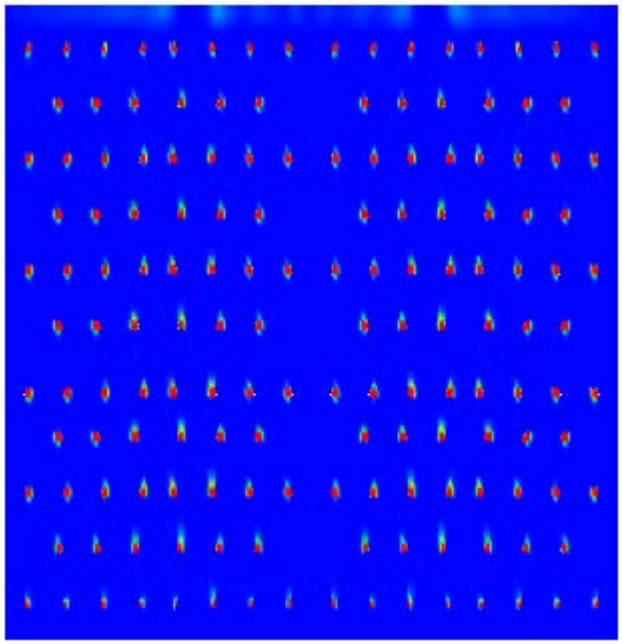


Ratio of Standard Deviation to Average at Plane 7

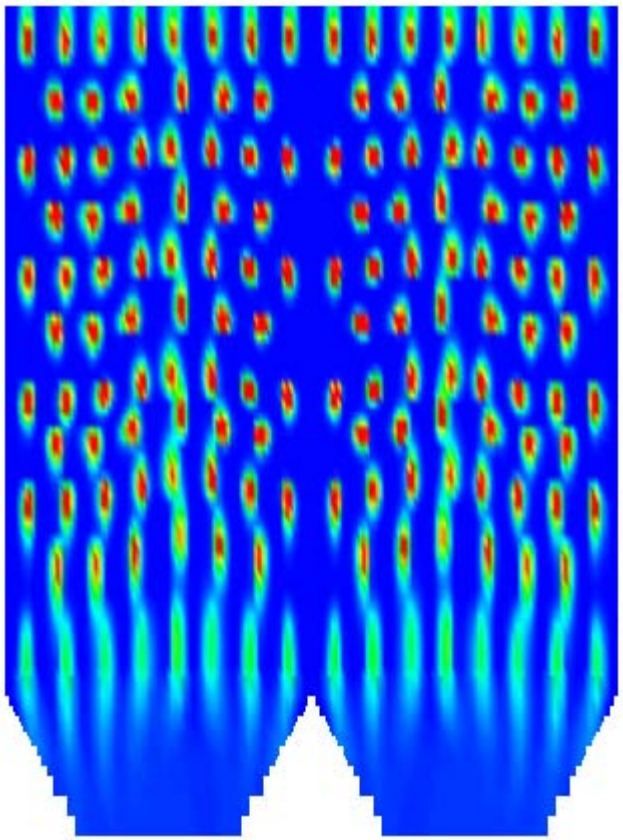
Case 1	125%
Case 2	260%
Case 3	163%

Mass Fraction of Carrier Air (Case 1)

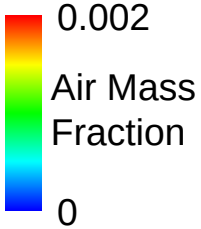
Predicted air flow distributions for cases 1, 2, and 3 are nearly identical



Plane 5

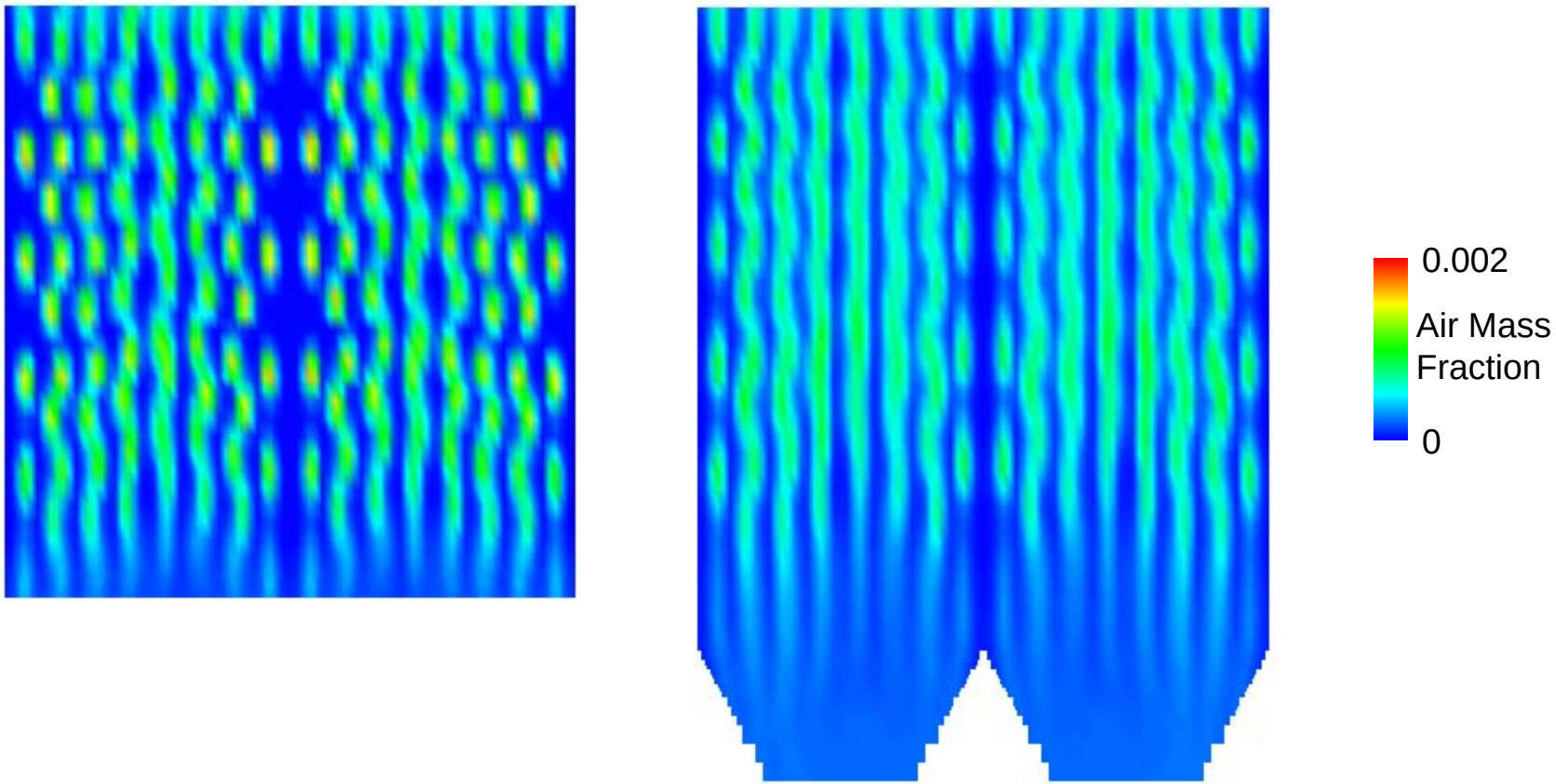


Plane 6



Mass Fraction of Carrier Air (Case 1)

Predicted air flow distributions for cases 1, 2, and 3 are nearly identical

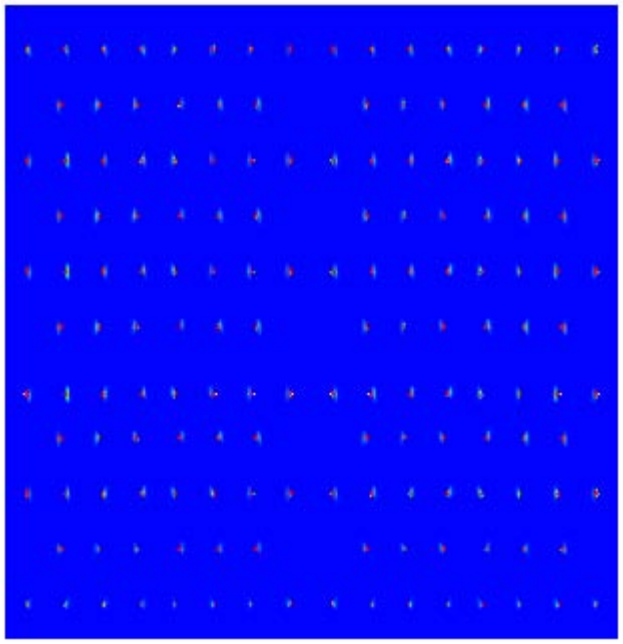


Plane 7

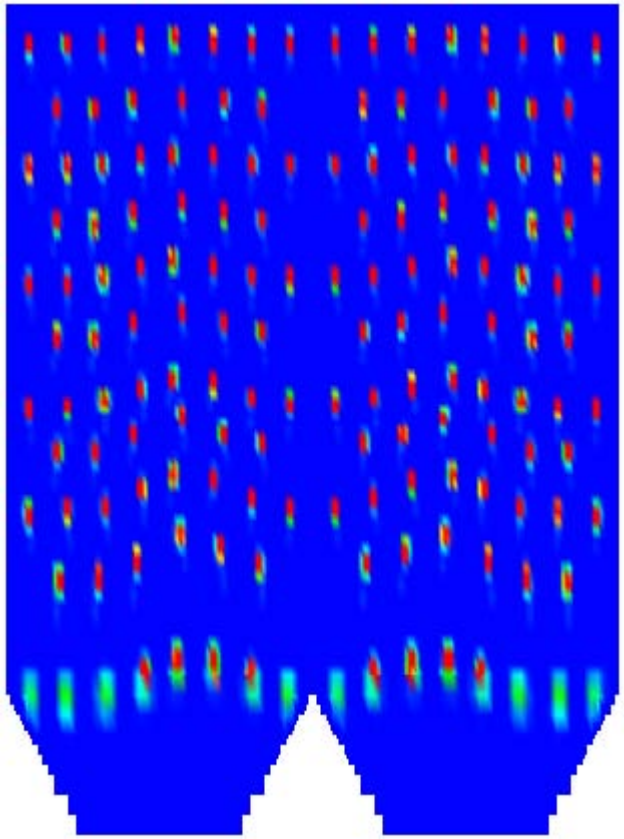
Plane 8

Channeling flow along ESP width

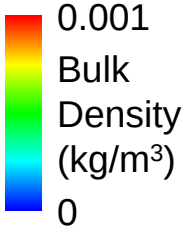
Particle Bulk Density (Case 1)



Plane 5

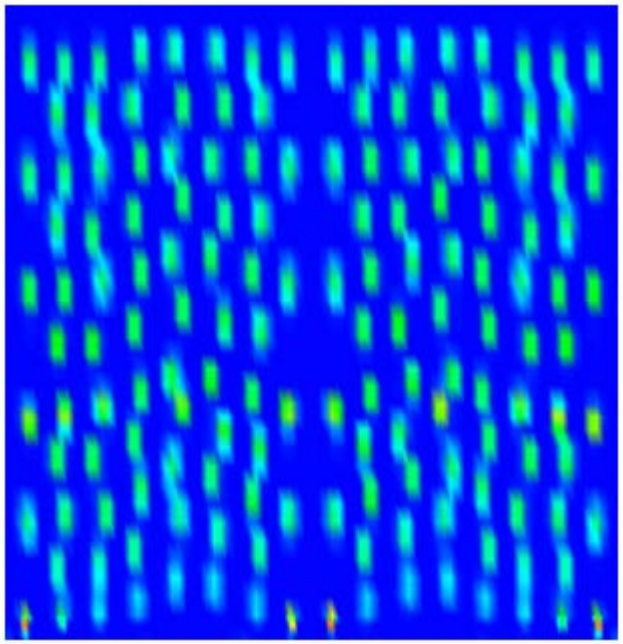


Plane 6

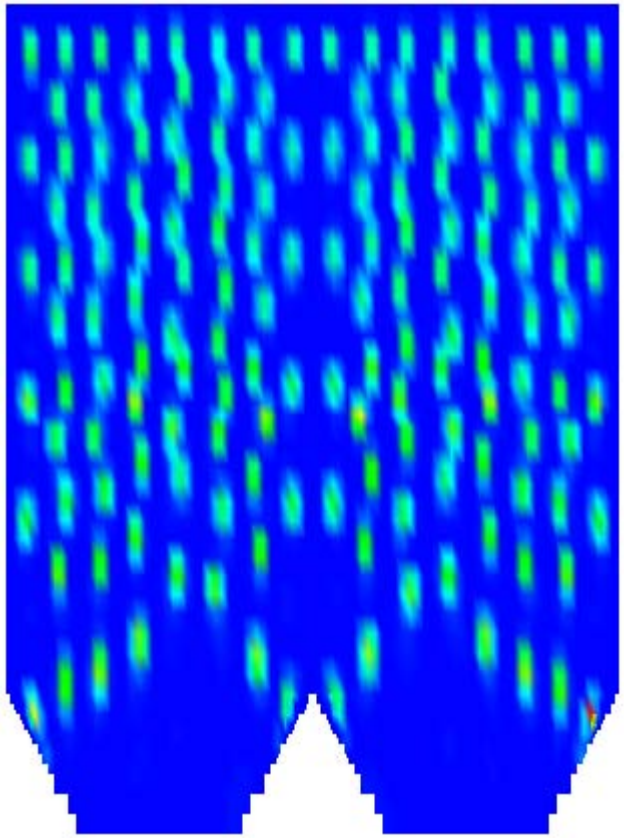


Particles not well dispersed

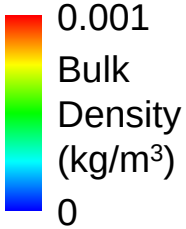
Particle Bulk Density (Case 1)



Plane 7

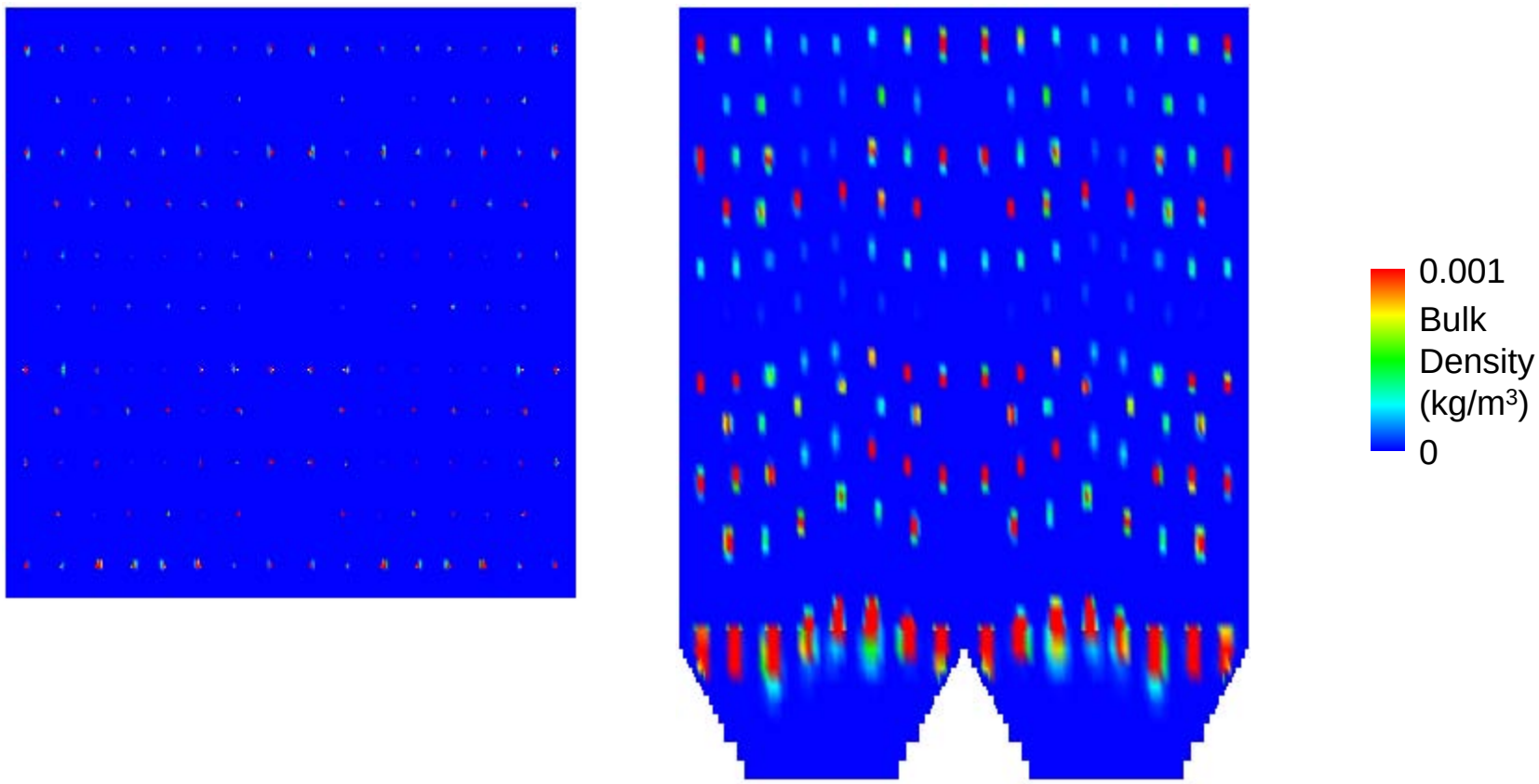


Plane 8



Particles not well dispersed

Particle Bulk Density (Case 2)

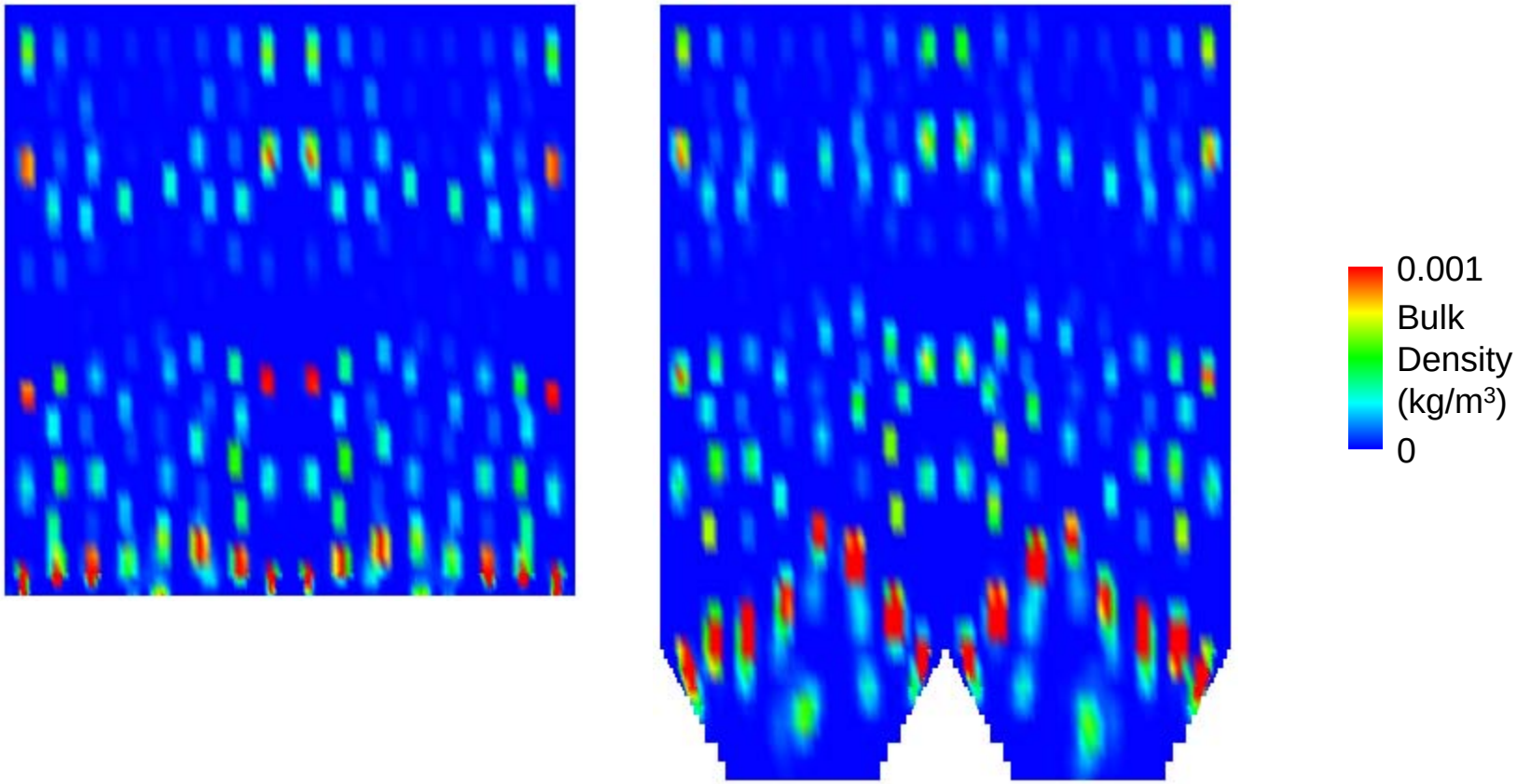


Plane 5

Plane 6

More particles near hoppers

Particle Bulk Density (Case 2)



Plane 7

Plane 8

More particles near hoppers

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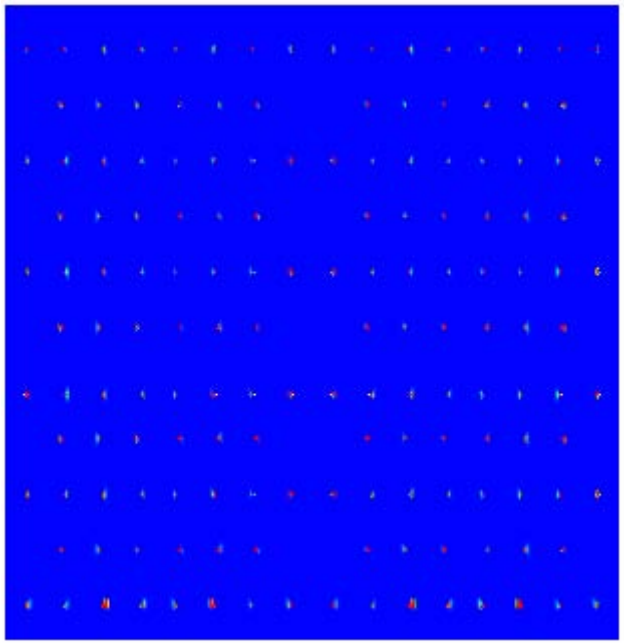
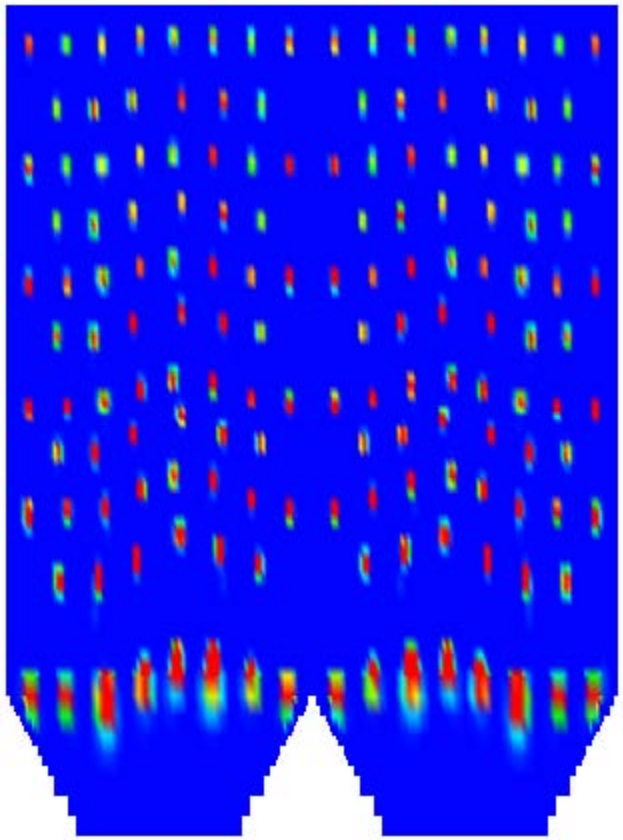
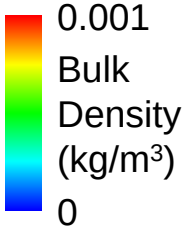
Particle Bulk Density (Case 3)



Plane 5

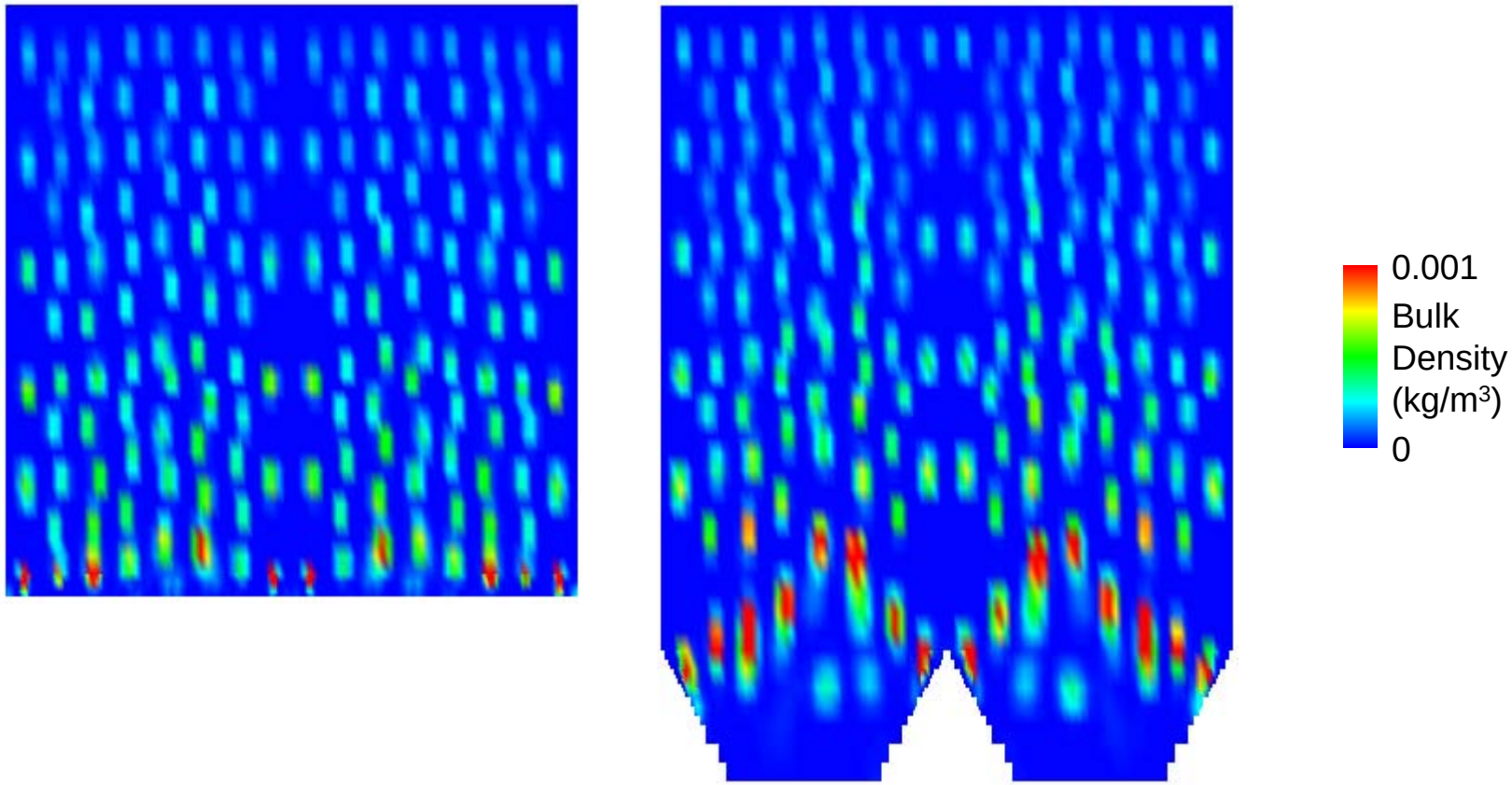


Plane 6



Particles concentrated near hoppers

Particle Bulk Density (Case 3)

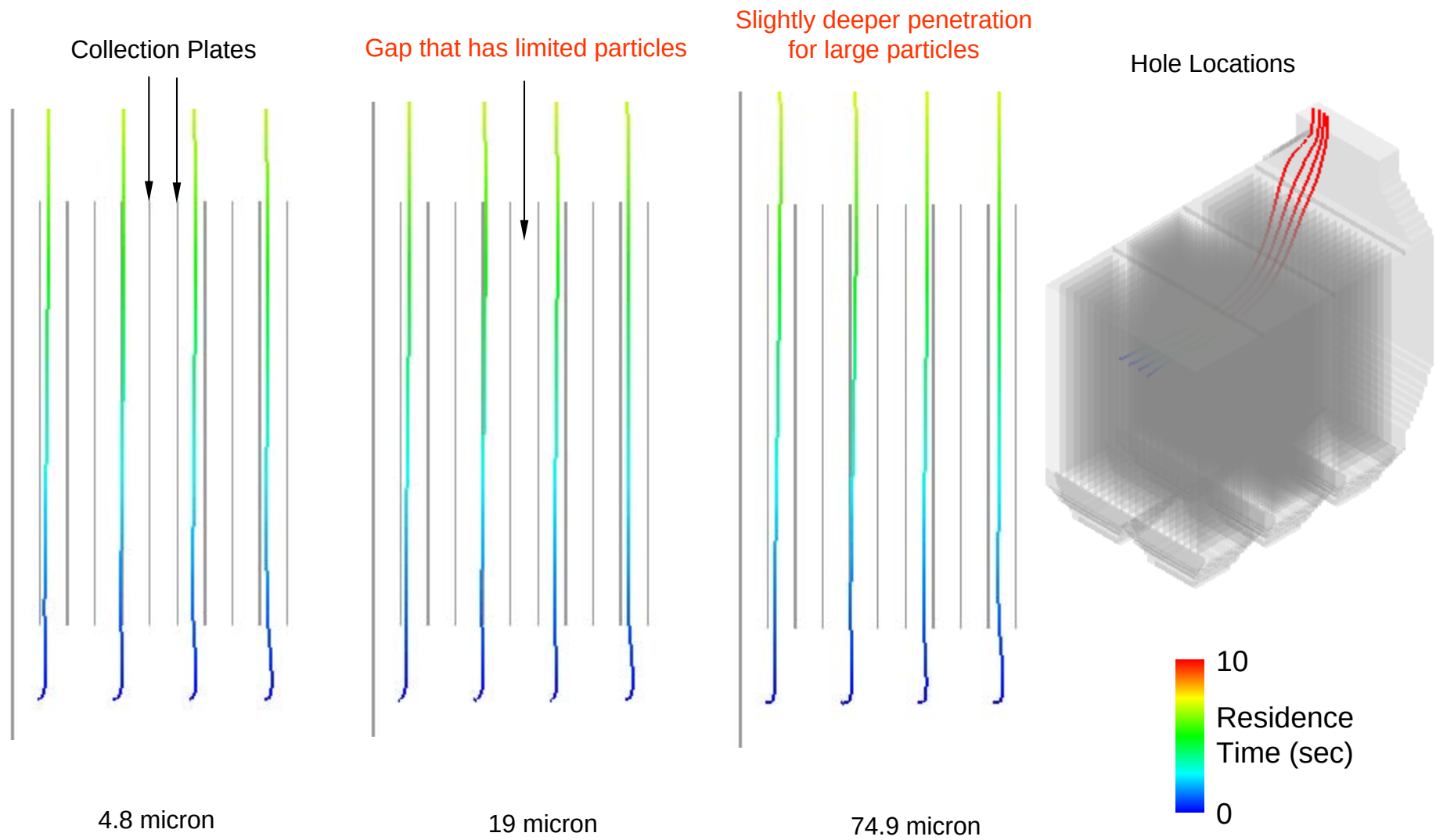


Plane 7

Plane 8

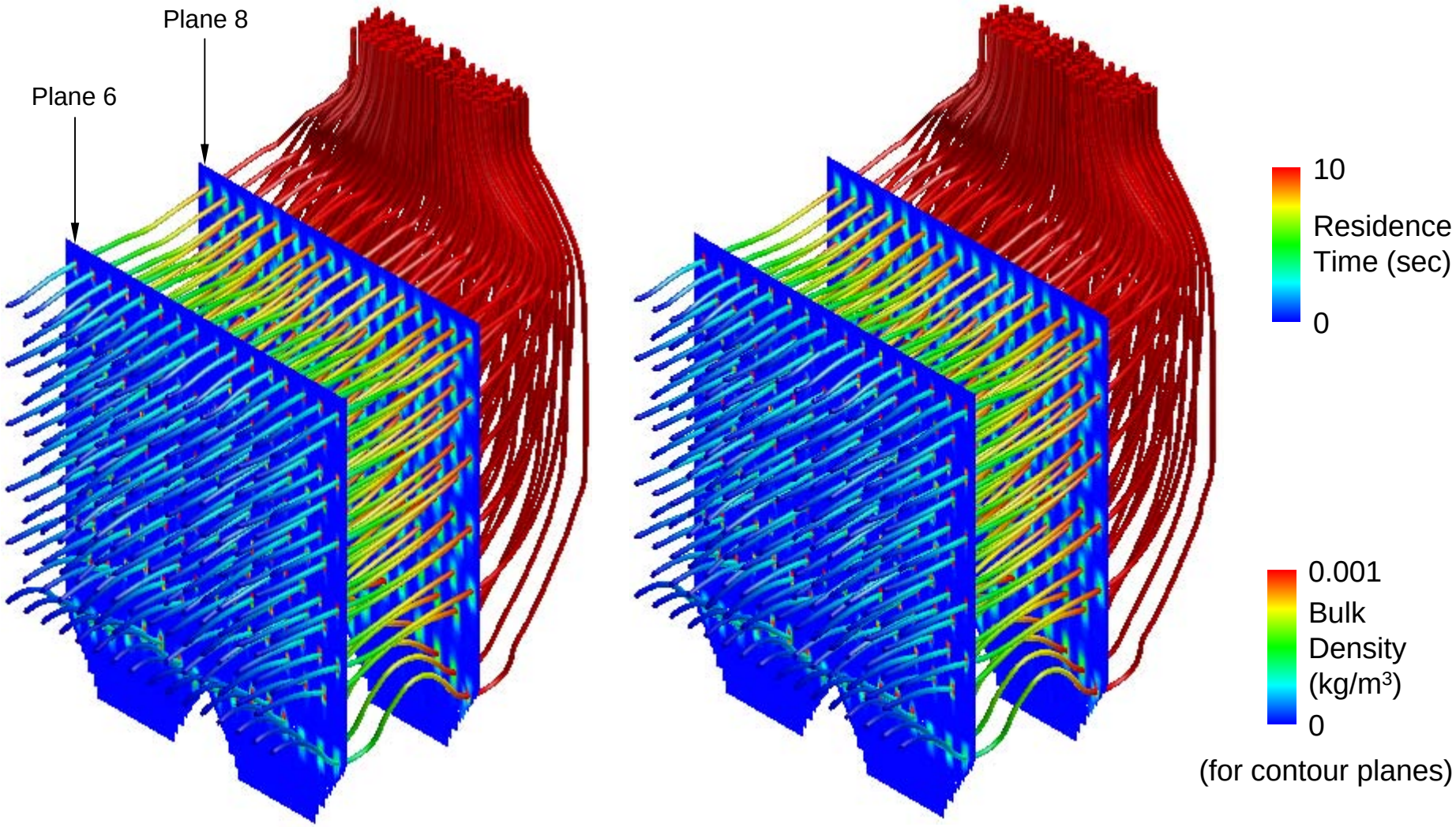
Particle distribution smoother than Case 2

Particle Average Trajectory (Plan View)



Particles have limited penetration along ESP width

Particle Trajectory (Case 1)



4.8 micron

19 micron

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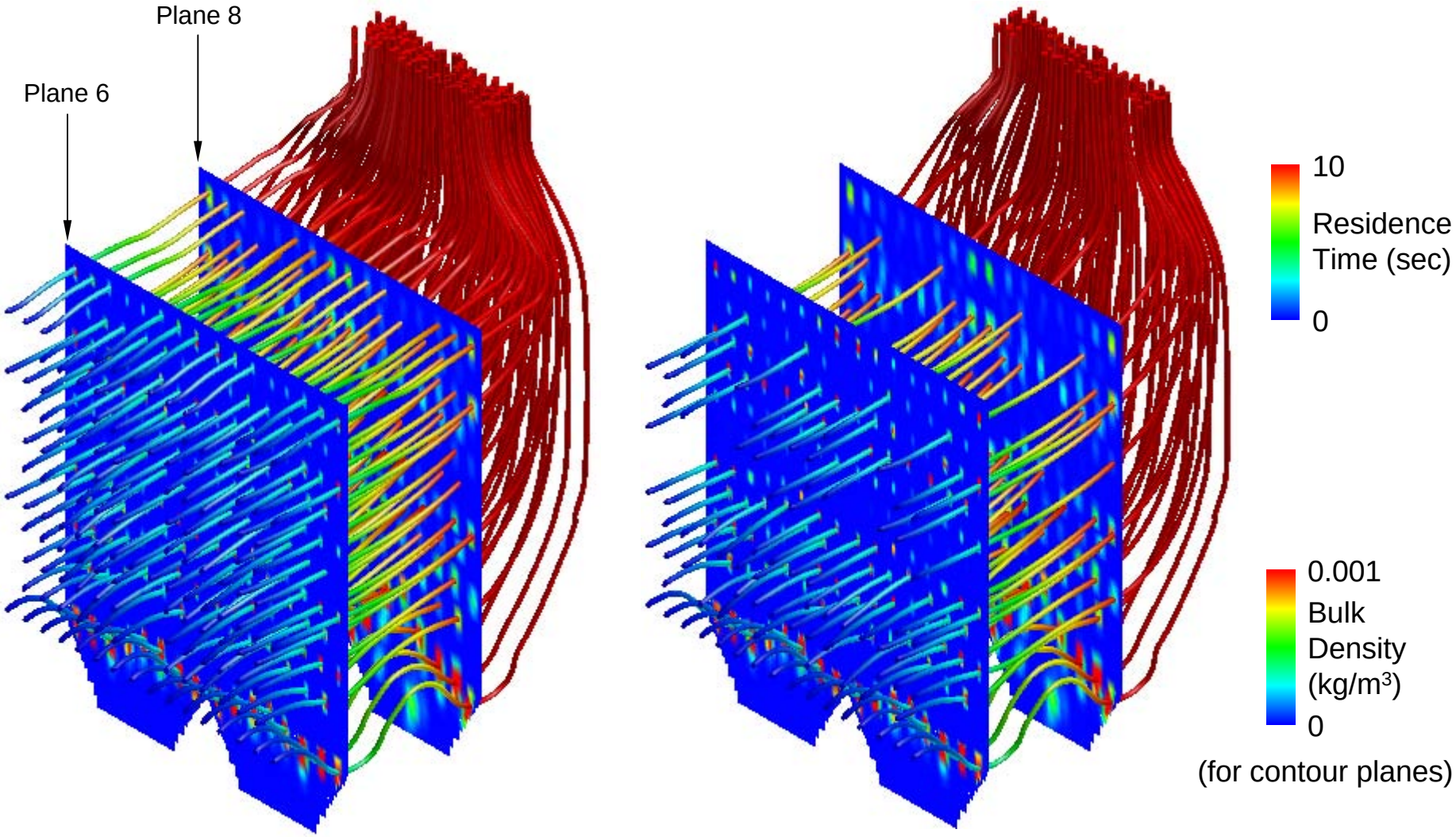
Particle Trajectory (Case 2)



4.8 micron

19 micron

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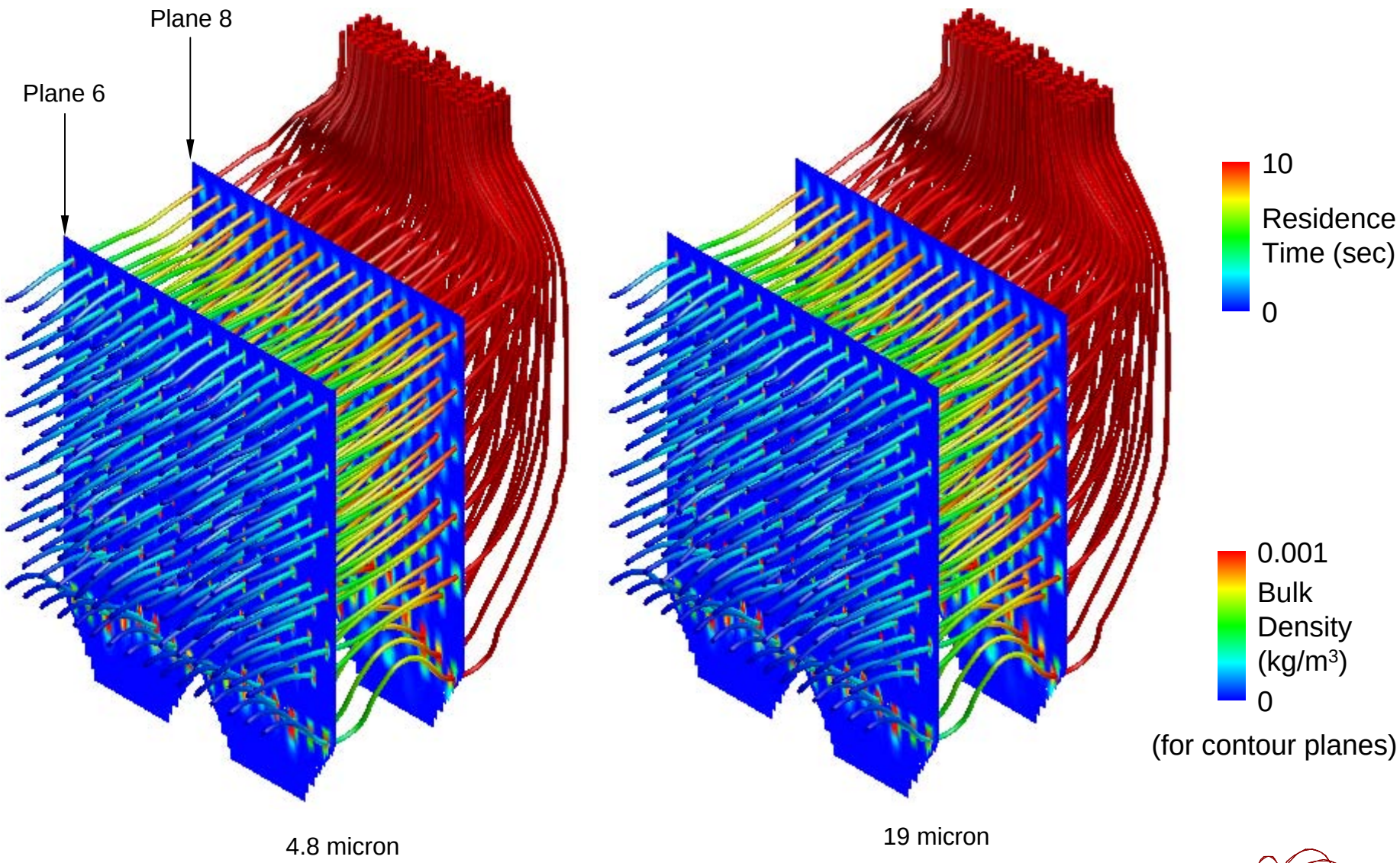
Particle Trajectory (Case 3)



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Conclusions

- Carrier air does not mix well with flue gas
  - » There are low air concentration gaps due to existence of collection plates
- Particle distribution has negligible effect on carrier air distribution inside ESP
  - » All three cases show very similar air concentration predictions
- Activated carbon particles are not well dispersed in the 3rd and 4th fields
  - » Very limited particle penetration along ESP width
  - » Some gaps between collection plates have almost no particles entering
- Higher particle bulk densities are predicted near hopper in Cases 2 and 3
  - » The hole at the bottom of each lance has higher particle flow rate, especially for large particles (mapped from grid model)
  - » Flue gas tends to enter hoppers and so are the particles

APPENDIX E3: REI, Lance Modeling—September 14, 2006

CFD Modeling of TOXECON II at Independence

Domed Nozzle Model

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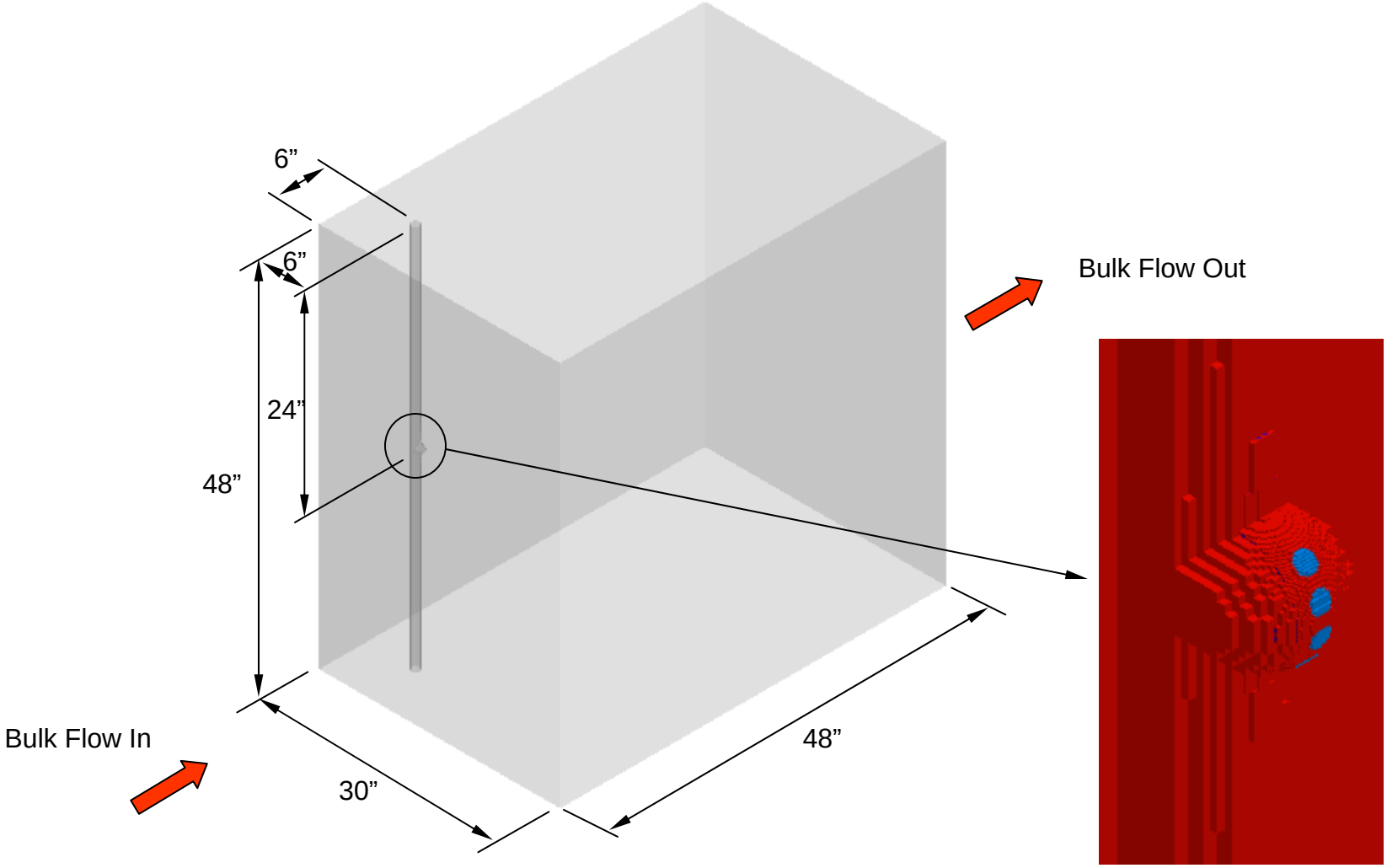
INTERNATIONAL

Sept. 14, 2006

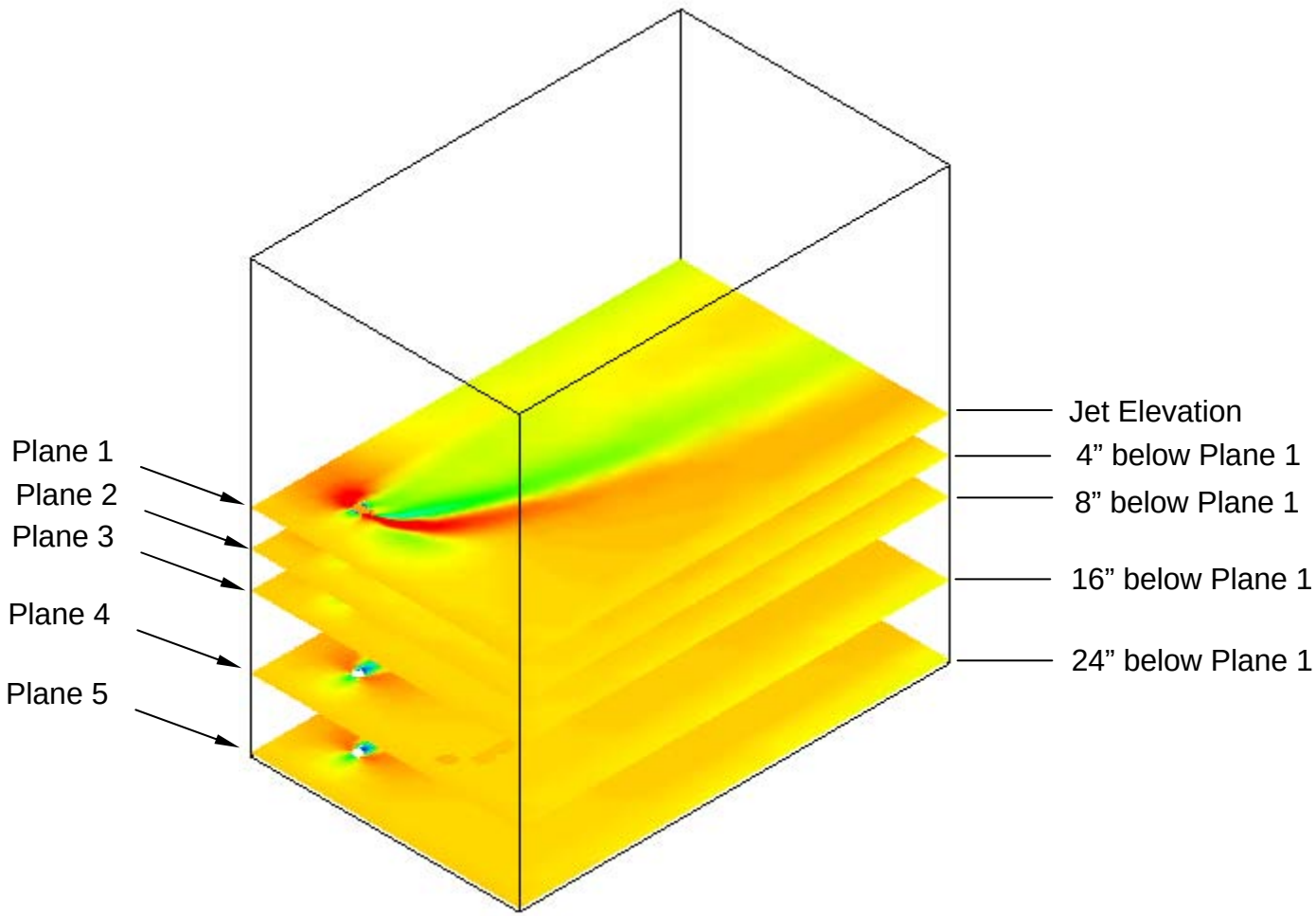
Computational Model



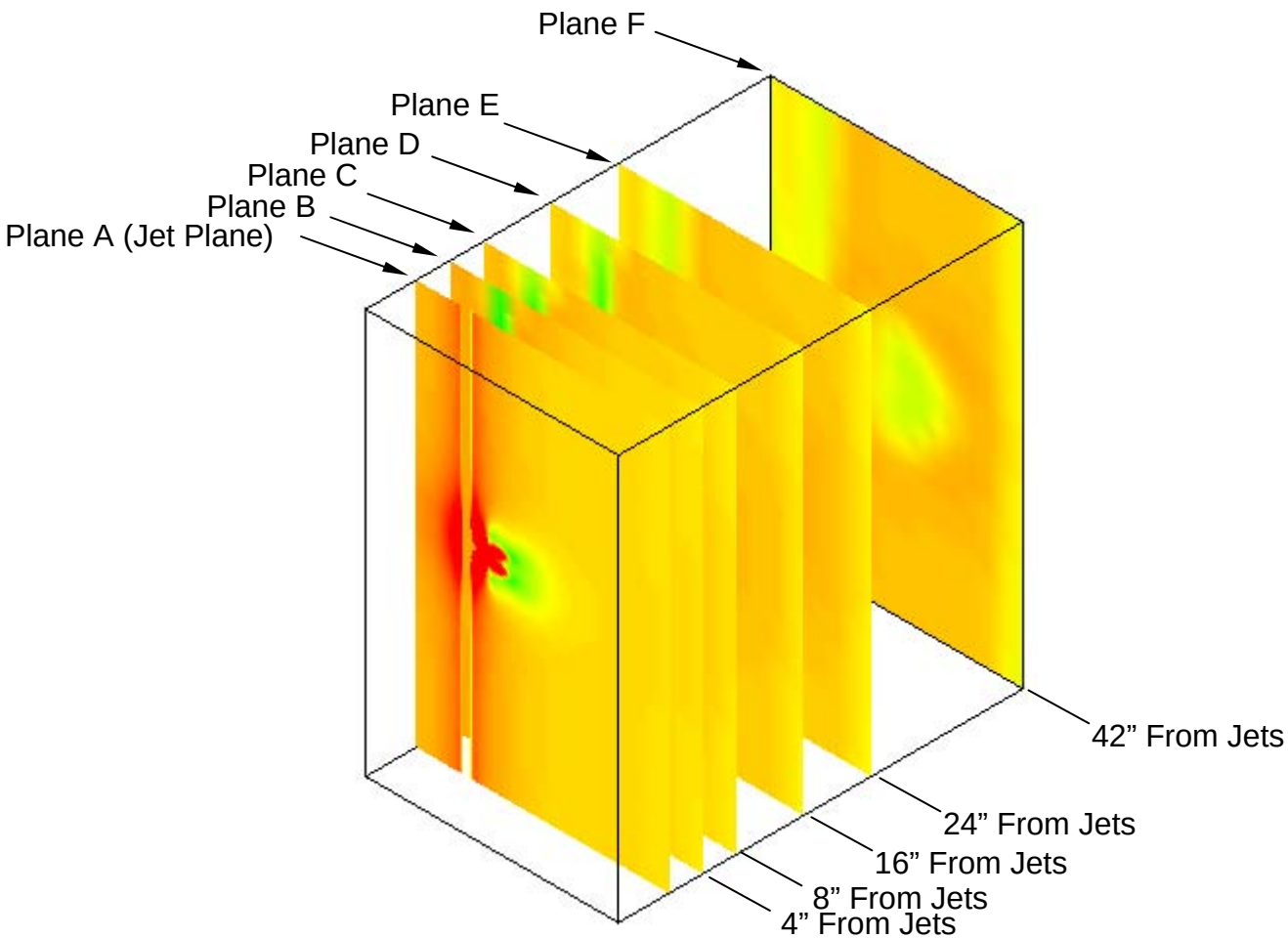
Model Inputs

- Bulk flow velocity: 4 ft/s
- Flue gas temperature: 300 °F
- Pipe O.D.: 1.0625”
- Hole diameter: 0.16”
- Number of holes: 4
- Angle between holes: 30°
- Air jet velocity: 84.4 ft/s
- Air temperature: 110 °F

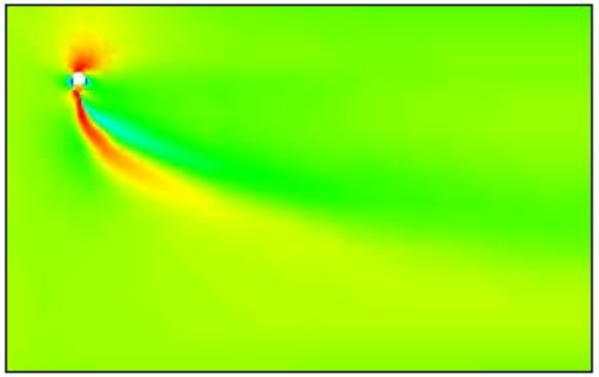
Locations of Contour Plots



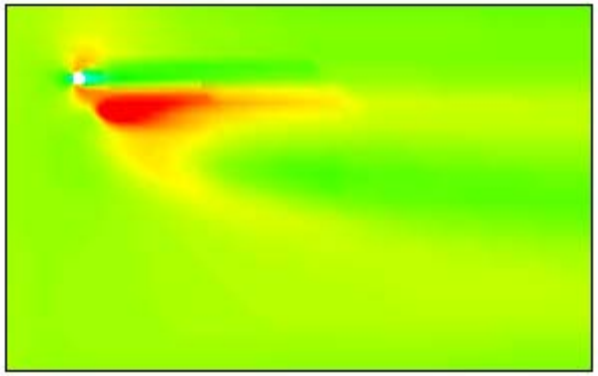
Locations of Contour Plots



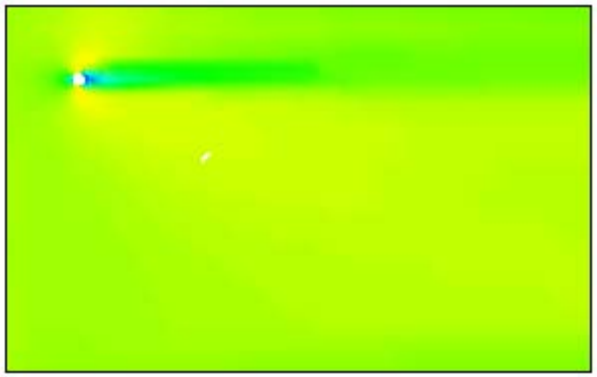
Velocity Magnitude



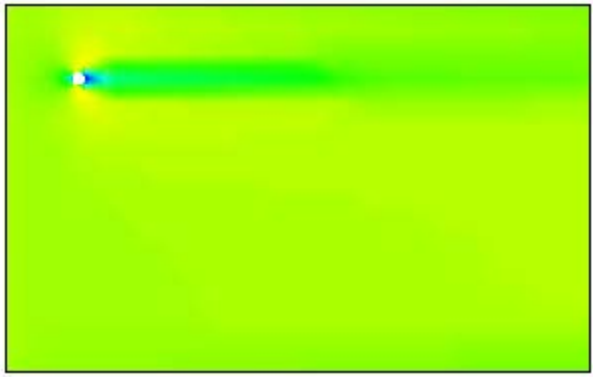
Plane 1



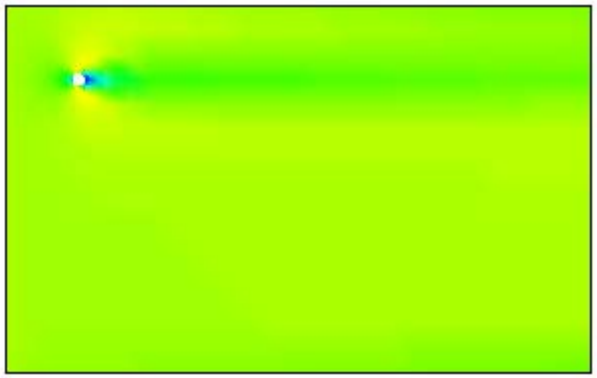
Plane 2



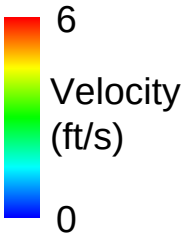
Plane 3



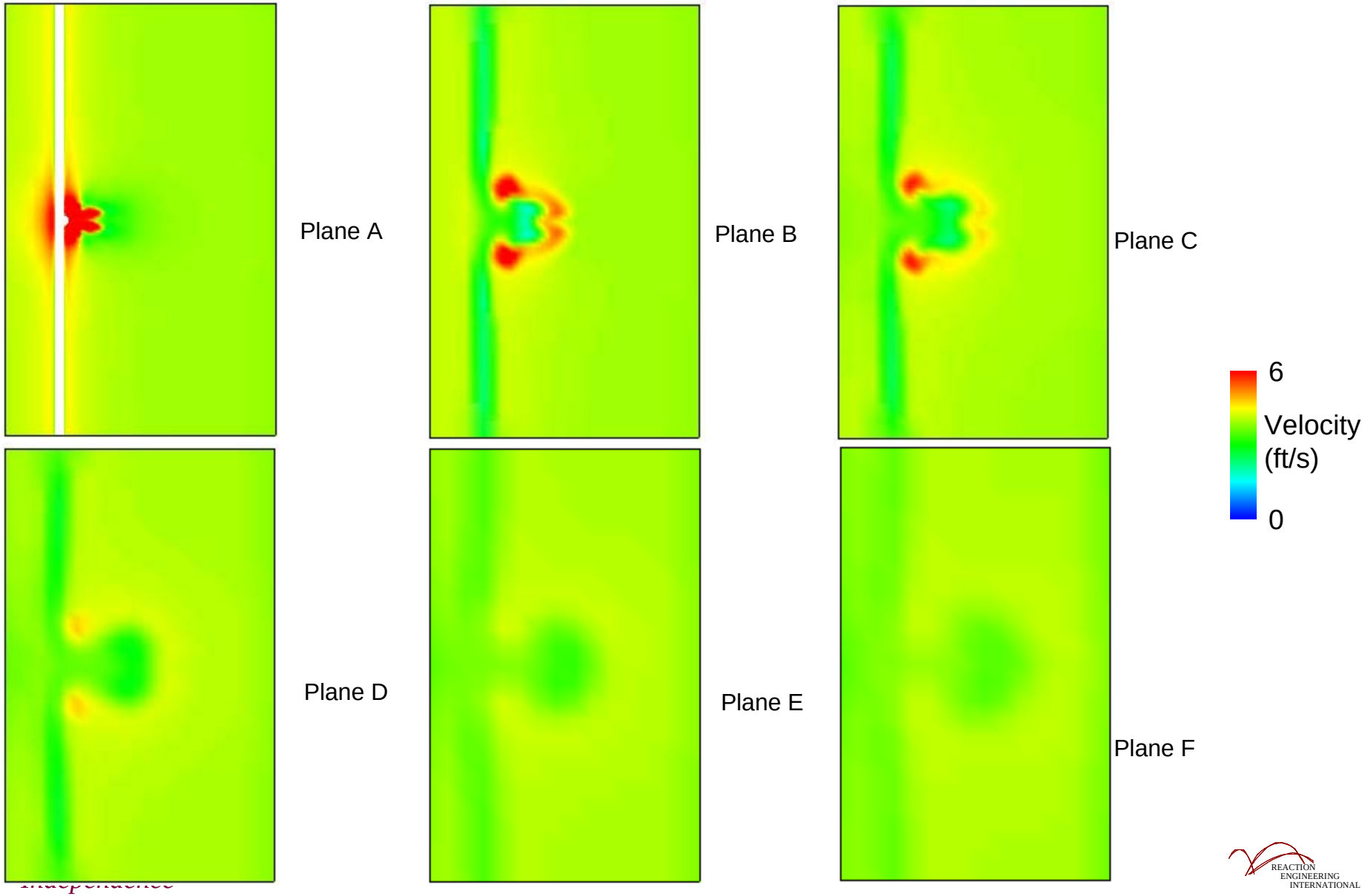
Plane 4



Plane 5



Velocity Magnitude



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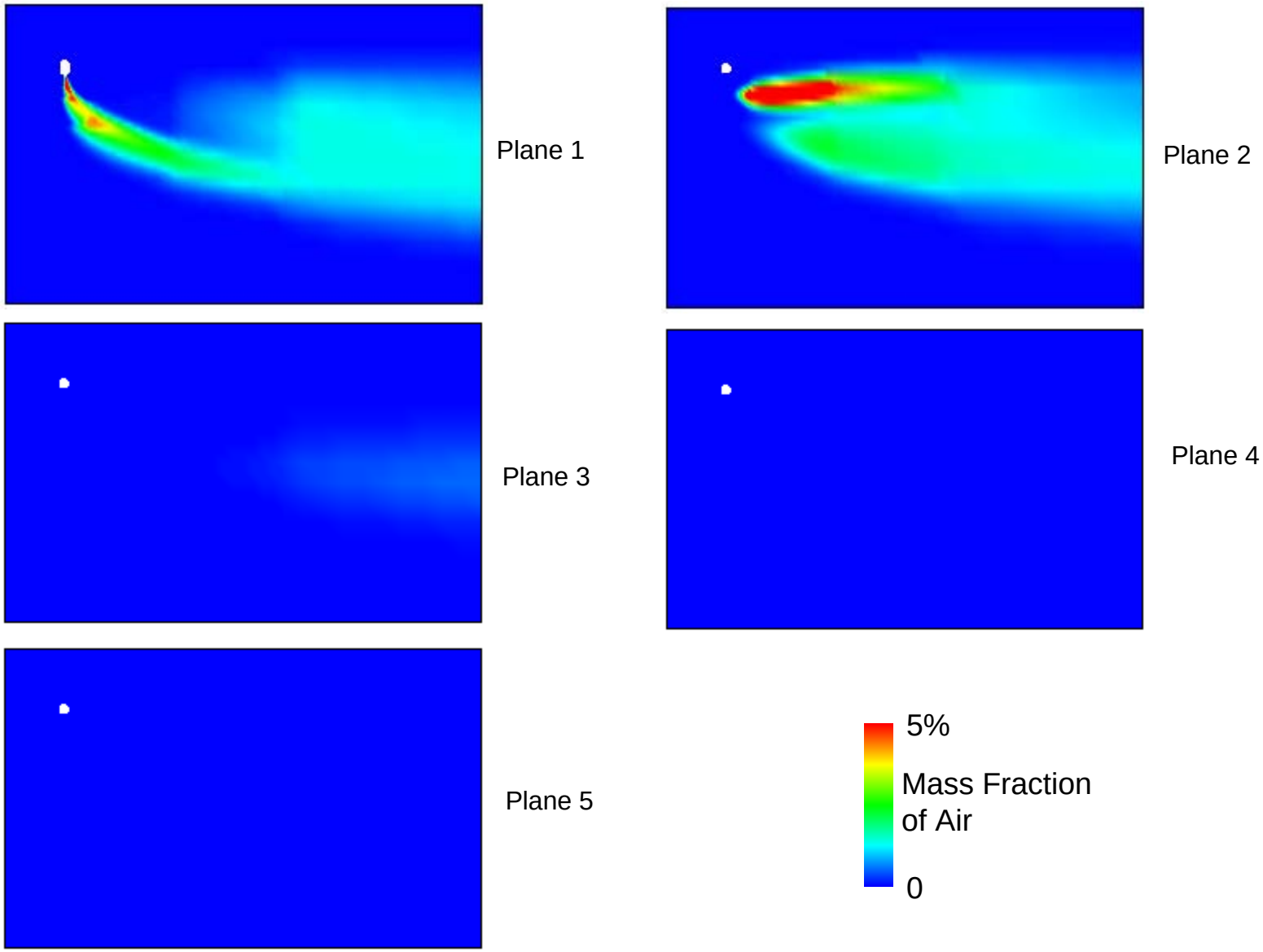
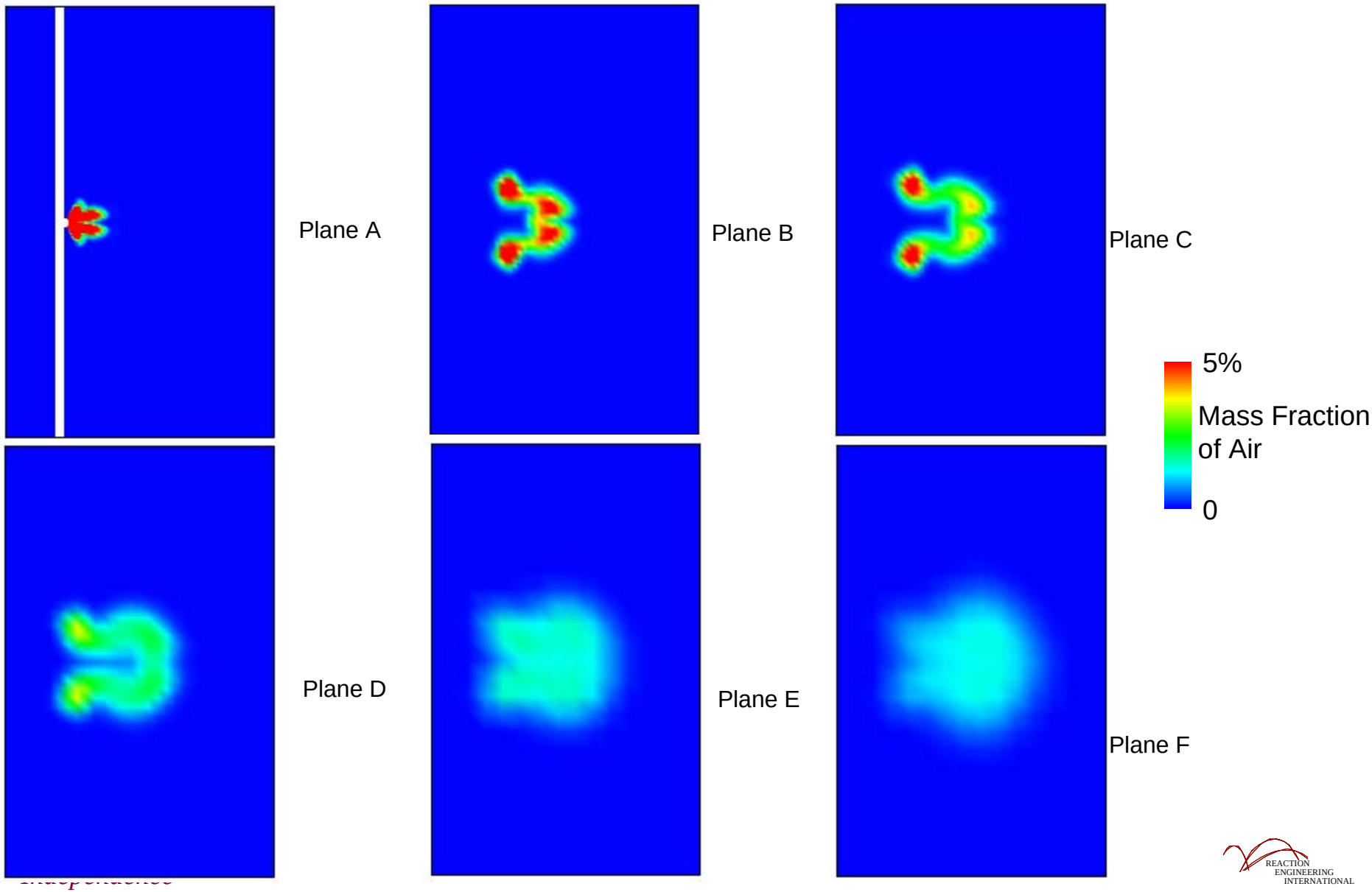
Mass Fraction of Carrier Air



REACTION ENGINEERING INTERNATIONAL

Mass Fraction of Carrier Air



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APPENDIX E4: NELS, ESP Flow Modeling—December 2006

ADA – ES INC

Littleton, Colorado

AIR FLOW MODEL STUDY
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP
TOXICON II PROJECT, CARBON INJECTION

FINAL REPORT

ADA-ES Purchase Order No. AD06 - 448

NELS Project No. P119.06

NELS CONSULTING SERVICES, INC.

ST. CATHARINES, ONTARIO, CANADA

(905) 682 2969

December 2006

ABSTRACT

This report describes the airflow model study of the unit 2 electrostatic precipitator (PAC) carbon injection grid at the Independence Station located near Batesville, Arizona.

The objectives achieved by the study were as follows:

(a) To determine the existing configuration precipitator velocity distributions at the outlet of the first, second, third and last fields of collector curtains.

(b) To determine the existing configuration PAC injection grid distribution.

(c) To determine in the NELS wind tunnel the lance injection distribution using a full-scale section.

(d) To determine the existing configuration precipitator system pressure loss.

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8	Details Inlet & Outlet Plenums Truss Details
9	Details Precipitator Inlet Duct And Turning Vanes
10	Details Precipitator Outlet Duct And Turning Vanes
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1 INTRODUCTION

1.1 General Introduction

Detailed in this report are the findings of the airflow model study conducted for the existing unit 2-precipitator installation at Entergy's, Independence Station located near Batesville, Arizona.

NELS Consulting Services Inc. conducted this study for ADA – ES Inc of Littleton, Colorado.

The unit 2 cold side precipitator, which was converted from a hot side installation, cleans particulate emissions from a coal-fired boiler. The existing precipitator installation has four casings that were supplied by CE Walther Pollution Control. The casings are paired with one pair above the other forming a double deck arrangement.

A 1/12 scale air flow model of half of a lower precipitator casing as shown on Plates 1 and 2, Photographs A to F and the accompanying video of the unit 2 precipitator with associated inlet and outlet ductwork was constructed and tested to determine the PAC injection distribution, precipitator velocity distribution and system pressure loss.

1.2 Terms of Reference

The objectives of the study were as follows:

a) To measure precipitator velocity distributions at the outlet of the first, second, third and last fields of collector curtains.

b) To measure the PAC injection grid distribution at the middle of the third and last field using CO gas as a tracer.

c) To measure system pressure loss.

d) To video in the NELS wind tunnel the injection distributions using a full-scale section of the lance grid with similar precipitator cross flow.

2 SUMMARY OF MODEL STUDY

It was established by the model study that velocity distributions in the precipitator at the outlet of the first, second, third and fourth fields were not within the ICAC criteria stating that 85% and 99% of the measured velocities shall be less than 1.15 and 1.40 times the mean velocity.

Velocity distributions at the outlet of the first and second fields had 72.1%, 94.2% and 77.1%, 99.2% of the velocities within 1.15 and 1.40 times the mean as shown on Plates 18 and 19. At the outlet of the third field the distribution measured improved slightly with 83.8% and 100.0% within 1.15 and 1.40 as shown on Plate 20. Further downstream at the outlet of the fourth field the distribution measured had 68.8%, 77.9% less than 1.15 and 1.40 and was severely skewed with high velocities towards the top as shown on Plate 21. NELS believes that high velocities along the lower collection area of the field, bottom of the opening and bottom of the collecting plates are a cause for particulate re-entrainment, opacity spiking and reduced overall collection efficiency.

Inlet and outlet ductwork velocity distributions were satisfactory and acceptable as shown on Plates 14 to 17, 22 and 23.

In the 1/12th scale model a test of the (PAC) injection lances as shown on Plates 11 and 12 was conducted by using CO gas as a tracer and measuring the distributions in the middle of the third and fourth fields as shown on Plates 24 and 25. The CO concentrations measured had RMS deviations of 111.5% and 68.8% with high to low cycling across the width of the test plane and higher concentrations being skewed towards the top.

Wind tunnel testing of the (PAC) lances as shown on Plate 13 were conducted by injecting bulk smoke and recording the observations on DVD. Having an orifice acfm of 0.735 (3,340 fpm), smoke can be seen exiting the lance and penetrating past half of the distance between two lances however no wind tunnel cross flow had been introduced. With the wind tunnel fan running and set for 4 ft/s cross flow, observations at the lances show the smoke path had folded with the direction of the cross flow and the distance of injection between lances was reduced considerably. With increased lance flow to 2.695 acfm (12,250 fpm), observations

show an improved distance of injection to about mid way between two lances was achieved with the 4 ft/s wind tunnel cross flow. The injection penetration had increased to about three quarters of the distance between lances when the orifice rate was increased to 3.675 acfm (16,704 fpm).

From this study it can be concluded that modifications to the existing inlet plenum flow devices are necessary to achieve a velocity distribution that would be acceptable to ICAC flow criteria however NELS believes a reduction in high velocities in the lower section of the ESP causing particulate re-entrainment would be more beneficial but the resulting distribution may not be within the 85%, 99% recommendations. The (PAC) injection distribution should improve with a more uniform inlet flow upstream and with an increase in the lance orifice acfm flow but the extent of the inlet plenum modifications is unknown. The addition of a variable porosity screen in the outlet plenum would improve the velocity distribution and the lance distribution through the fourth field but an increase in system pressure loss would occur.

Further testing of the model to investigate these modifications would only be applicable to the lower precipitator casings and the evaluation of the upper precipitator casings may show a different outcome. Because the installation is a double deck arrangement, flow balance and dust loading to individual precipitators maybe biased.

3 DESCRIPTION OF FULL SIZE INSTALLATION

Details of the existing unit 2 precipitator installation at Entergy's, Independence Station were supplied on the drawings listed in Table 1. The general arrangement of half of a lower precipitator casing is shown on Plates 1 and 2. The associated design and gas flow requirements for half of the full size precipitator casing are detailed in Table 2.

The unit 2 installation has four precipitator casings that clean particle emissions from an 800MW coal fired boiler. Each casing has two chambers that are 4 fields deep and each field has 42 gas passages that are 48' tall. The existing precipitators are arranged as pairs with one pair situated above the other as a double deck arrangement and had operated as a hot side installation but was converted to a cold side system.

The unit is part of the EPRI Toxecon II test project. The test project consists of injecting a carbon sorbent into the precipitator gas flow between the second and third collecting fields to control Mercury emissions. The injection grid for half of a precipitator casing consists of two trains having 8 lances for each train that extend down for 42'-2 ½" between the second and third collecting fields.

Based on the information contained in the supplied drawings, the model design as shown in Photographs A to F and the accompanying video was developed, the simplified layouts shown on Plates 3 to 13 were drawn and the relevant gas flow parameters determined as described in Section 4.

4 MODEL DESIGN AND CONSTRUCTION

4.1 Similitude

In gas flow modeling, it is theoretically necessary to simultaneously maintain geometric, kinematic and dynamic similarity. However, such a condition is not possible under modeling conditions. Therefore, this airflow model study was conducted using a geometric linear scale factor of 1/12 and a velocity scale of 1/1. These particular scaling factors were chosen based on the following rationale:

1. When a sufficiently large geometric scaling factor is used, the most critical aspect of geometric similarity is satisfied and the reliability of measurement can be ensured. A linear scale of 1/12 was determined to be sufficient to satisfy this criterion and yet economical to build and test.
2. Kinematic similarity is dependent upon the Reynolds Number (Re) and has no significant influence if this number is maintained above an approximate value of 20 000 (i.e., the minimum Re to ensure fully turbulent flow conditions). Based on the velocities used in the system the typical Reynolds Numbers for the full size installation and the model were 5.91×10^5 and 9.16×10^4 respectively, thus satisfying the above criterion. As fully turbulent flow conditions were maintained in this study, velocity distributions and pressure losses can be accurately measured in the model and predictions made for the full size installation.
3. As this particular model study was based upon uniform air density, the forces of gravity are negligible in comparison with inertia forces. Therefore, it was not essential to maintain dynamic similarity during the airflow testing.

A comparison between the full size installation and the model is detailed in Table 3 and the necessary airflow scaling parameters listed in Tables 4 and 5, respectively.

4.2 Model Construction

A 1/12 scale three dimensional model, geometrically similar to half of a typical precipitator casing of the full size unit 2 installation at Entergy's, Independence Station, as detailed on Plates 3 to 13, shown in Photographs A to F and video was constructed from 1/4 inch plexiglass. The model of the installation extends from a point upstream of the precipitator inlet plenum, through half of a typical casing to the outlet plenum and to a point downstream in the outlet ductwork.

The precipitator section included:

i) all gas distribution devices made from sheet metal and plastic

ii) internal trusses made from plastic and wood doweling

iii) all collecting plates simulated by flat sheets

iv) all hoppers and baffles

v) PAC injection grid having 16 lances

A full-scale section of the injection grid was constructed and installed in the NELS wind tunnel.

The wind tunnel lance grid included:

vi) single header from half of a train with 4 outlets

vii) 4 lances

Specified internal structural members considered significant to the gas flow were included in the precipitator model. The velocity distribution upstream of the model limits was considered uniform for this study. One single inlet centrifugal fan driven by a 30-hp motor provided flow through the model, which was operated under negative pressure.

A 30" positive pressure blower provided flow to the wind tunnel lances. A double inlet centrifugal fan driven by a 200-hp motor, which was operated under negative pressure, provided wind tunnel flow. Flow entering the tunnel was considered uniform.

5 INSTRUMENTATION

The airflow velocities and pressures in the model were measured using the following equipment:

(a) Ductwork Velocities

Pitot static tube (AMCA Std. 210-74, ASHRAE Std. 5175) or 'S' type Pitot static tube 12 inches long by 2.3 mm diameter, with an Airflow Testing Mark 5 inclined manometer, range 0 to 0.5, 1, 2, 10 and 20 inches of water.

(b) Total Pressures

Total pressure hole of the Pitot static tube and inclined manometer as in (a) above.

(c) Volume Flow

The volume flow through the model section was monitored using test locations with sufficiently uniform velocity distributions as indicated by a Root Mean Square Deviation (RMS) of less than 15 % of the mean velocity.

(d) Precipitator Gas Passage Velocities

Thermo-Systems Inc. (TSI) constant temperature linearized anemometer Model No. 1054-B1 with a TSI Model 1051-1 monitor/power supply with a slo-syn present indexer for continuous traversing and a Heathkit SR-201A chart recorder. This equipment was calibrated throughout the testing on a Thermo-Systems Inc. Model 1125 Calibrator and against the pitot static tube using the NELS wind tunnel.

(e) Air Flow

The airflow patterns in the model were identified with:

- Smoke Generator.
- Digital video camera.

(f) CO Distributions

MultiGas Model MG140 Carbon Monoxide Analyzer

Range 0 – 1000 ppm

Resolution 1 ppm

Accuracy +/- 1% of full scale

6 TEST LOCATIONS AND PROCEDURES

6.1 Test Locations

The test locations used in the precipitator model study shown on Plates 1 and 2 are described in Tables 6 and 7. Velocity and total pressure distributions were measured at each test location within the model. These test positions were selected such that the flow patterns within the ductwork and precipitator could be accurately evaluated and the associated pressure losses calculated. Specifically, these test locations were chosen such that the influence of changes in flow direction and magnitude, imparted by directional and size variations, could be quantified and qualified.

6.2 Test Procedures

The precipitator model was operated under negative pressures at velocities similar to those in the operating installation to ensure that representative flow patterns were maintained (i.e. Reynolds Number greater than 20 000). Air velocities and total pressures were measured at the centres of equal areas across each duct section where the minimum number of measurements was determined by,

$$No.\ of\ Test\ Points = 1.5\ x\ \sqrt{A}$$

Where A = cross section area (ft^2) of duct (full size dimensions).

The airflow velocities and pressure distributions at each test location within the inlet and outlet ductwork were evaluated based on a traverse of measurements across the duct using the Pitot tube and manometer as described in Section 5 (a and b). The velocity distribution within the precipitator was evaluated based on continuous airflow velocity traverses taken in every third gas passage across the fields using the equipment described in Section 5(d). Within each test plane (gas passage), 16 velocity measurements distributed over 17 equal spaces of the precipitator opening, listed in Table 7 and shown on Plates 1 and 2, were determined from these continuous traces. The velocities within the projected inlet and outlet openings were used to determine the average velocity, RMS deviation

and statistical percentages. Velocities at the top of collecting plates (TP), top of opening (TO), bottom of opening (BO), and bottom of collecting plates (BP) were measured to evaluate gas flow anomalies outside the effective collection zone.

To evaluate the performance of the (PAC), the as designed carbon injection system was installed in the model. The full size carbon injection system was modeled to scale using brass tubing. The tracer gas, (CO), to each lance manifold was balanced using a control valve so that each manifold had an equal amount to represent the equivalent amount of carbon. The model scaling was based on the momentum ratio between the gas flow and the carbon injection lances for the full size and scale model as shown in Table 5.

In the wind tunnel a single header (half of one train) with 4 lances was installed to represent the upper section. A blower with 30" of water lift and operating under positive pressure was connected to the lance header. Wind tunnel flow representing the precipitator gas flow was set at 4 ft per second. Smoke was injected near the blower and observations of the lance injection were recorded on video.

7 MODEL STUDY TEST RESULTS

7.1 Existing Configuration

The existing configuration of Entergy's, Independence Station unit 2 precipitator as shown on Plates 1 to 10, was tested from the inlet duct, locations T1L and T1R, to the outlet duct, location T8 and their respective velocity distributions are shown on Plates 14 to 23 and further summarized in Tables 8 to 10.

Flow entering the model at locations T1L and T1R was uniform and acceptable as shown on Plates 14 and 15. The inlet ducting then turns down towards the precipitator inlet plenum and the velocity distributions measured at locations, T2L and T2R, remained acceptable as shown on Plates 16 and 17.

At the outlet of the first field, location T3, the velocity distribution measured had 72.1% and 94.2% of the velocities less than 1.15 and 1.40 times the mean velocity as shown on Plate 18. ICAC recommends that 85% and 99% of the measured velocities shall be less than 1.15 and 1.40 times the mean velocity. Velocities are higher across the upper half of the collecting field, rows 1 to 8 then lower between rows 9 to 12 and then increase higher between rows 13 to 16 as shown on the Row Average graph. The side-to-side flow balance to the gas passages across the collecting field width slowly cycles high to low as shown on the Column Average graph. NELS believes that high velocities across the bottom three rows (14, 15 & 16), bottom of the opening and bottom of the collector plates are a cause for particle re-entrainment, opacity spiking and reduced overall collection efficiency.

Further downstream at the outlet of the second field, location T4 the distribution improved slightly having 77.1% and 99.2% of the measured velocities less than 1.15 and 1.40 times the mean velocity as shown on Plate 19. Flow to the upper half, rows 1 to 8 has decreased slightly with an increase in flow between rows 9 to 12 and high flow remaining across the bottom between rows 13 to 16 as shown on the Row Average graph. The side to side flow balance has improved however gas passage 22 shows low flow near the structural column at the chamber centerline as shown on the Column Average graph. Velocities across rows 14, 15, 16 and bottom of the opening remained high and unacceptable.

At the outlet of the third field, location T5, the distribution improved with respect to ICAC recommendations having 83.8% and 100.0% of the measured velocities less than 1.15 and 1.40 times the mean velocity as shown on Plate 20. Flow to the upper half of the collecting field between rows 1 to 8 has increased. Rows 9 to 12 remained similar as before and flow between rows 13 to 16 was reduced as shown by the Row Average graph. The Column Average graph shows an acceptable flow balance side to side with the localized low gas passage 22 near the structural column.

At the outlet of the last field, location T6, the velocity distribution has 68.8% and 77.9% of the velocities within 1.15 and 1.40 times the mean velocity as shown on Plate 21. The Row Average graph shows a skewed trend towards the top of the collecting field with an extremely high band of velocities in rows 1 to 6 and decreasing flow towards the bottom of the opening and bottom of the collector plates. Flow balance side to side across the collecting field gas passages shown by the Column Average graph was similar as before. With this velocity distribution, even though rows 14, 15, 16, bottom of the opening and bottom of the collecting plates have low velocities with respect to NELS recommendations, opacity spiking and particle re-entrainment will occur and are caused by the higher velocities with a severely skewed distribution since the existing outlet plenum has no flow devices installed.

Flow exiting the last field of the precipitator turns up to the outlet ducting and the velocity distribution measured at location T7 was acceptable and satisfactory as shown on Plate 22. The outlet ducting turns horizontal and the velocity distribution measured at location T8 was uniform as shown on Plate 23.

From the inlet duct, locations T1L and T1R, to the outlet duct location T8 the estimated pressure loss measured from the model was 1.80" H_2O for a flow of 482,169 acfm at 299 °F.

7.2 CO Distribution – Existing Configuration

With the precipitator configuration shown on Plates 3 to 10 the PAC injection grid as shown on Plates 11 and 12 was tested using carbon monoxide as a tracer gas to represent the carbon injection and the measured distributions are shown on

Plates 24 and 25 and further summarized in Table 10. The model had both trains installed with tracer gas being injected and sampling of the distribution was taken in gas passages 6 to 16. Midway through the third field at location T5A, the CO distribution measured would not be consider uniform having a very high RMS deviation of 111.5% as shown on Plate 24. The Column Average graph shows high and low cycles side to side across gas passages 6 to 16 with similar cycling in the Row Average graph. The higher CO concentration and poor distribution measured at location T5A maybe influenced by the velocity distribution within the precipitator. The lance itself may have an imbalance top to bottom however ADA-ES noted that their earlier test results show a reasonable balance over the length of their test lance was achieved.

Further downstream at location T6A, middle of the fourth field, the CO distribution measured has improved but again was not uniform with respect to the high RMS deviation of 68.8% as shown on Plate 25. Side to side balance across the collecting field width has improved with reduced high to low cycling as shown by the Column Average graph. The CO distribution shown by the Row Average graph has shifted towards the upper half, rows 1 to 6 and again maybe influenced by the velocity distribution within the precipitator collecting plates.

7.3 Wind Tunnel Observations - Existing Configuration

A full scale version of four lances representing a portion of the top section of half of an injection train was constructed and installed in the NELS wind tunnel as shown on Plate 13 and the test observations were recorded on video.

Two lances outside of the tunnel were closed and flow from the positive pressure blower was set for orifice flows of 0.735 acfm (3,340 fpm) for the lances inside of the tunnel test section. On the accompanying video, when bulk smoke was injected near the blower, observations in the tunnel show smoke had exited the lances past mid distance between the pair however there was no wind tunnel cross flow representing the precipitator gas flow. With the wind tunnel fan running and set for 4 ft/s cross flow, the positive blower lance flow unchanged, observations at the lances show the smoke path had folded with the direction of the cross flow and the distance of injection between lances seen earlier was reduced considerably.

Flow to the lances was increased to 2.695 acfm (12,250 fpm) exiting the orifices and the wind tunnel cross flow remained at 4 ft/s. On the video smoke exiting the lance orifice had penetrated half of the distance between two lances before folding into the direction of cross flow. Flow to the lances was then increased to 3.675 acfm (16,704 fpm) exiting the orifice and the wind tunnel cross flow remained at 4 ft/s. Smoke penetration had reached about three quarters of the distance between lances before folding into the direction of the cross flow.

7.4 Precipitator Model Visual and Video

On the accompanying video the general model arrangement of the unit 2 existing precipitator can be seen. Bulk smoke was injected to show velocity paths and interactions through the system.

Observations along the bottom of the inlet plenum and first field show smoke jetting down below the collector curtains and into the hopper. Smoke was also observed exiting the hopper quickly near the walkway.

Bulk smoke observations with the third field removed show the flow had angled upwards. In the outlet plenum bulk smoke had cleared quickly along the upper section of the collecting field indicating higher velocities.

8 DISCUSSION AND RECOMMENDATIONS

The model study of the existing unit 2 precipitator installation showed velocity distributions through the inlet and outlet ductwork, as shown on Plates 14 to 17, 22 and 23, were satisfactory and acceptable. Velocity distributions measured at the outlet of the first, second, third and fourth fields were not within the ICAC flow criteria stating that 85% and 99% of the measured velocities shall be less than 115% and 140% of the mean velocity. Distributions at the outlet of the first and second fields had 72.1%, 94.2% and 77.1%, 99.2% of the velocities measured less than 1.15 and 1.40 times the mean velocity as shown on Plates 18 and 19. NELS believes that high velocities across the lower collection area of the field, bottom of the opening (BO) and bottom of the collector plates (BP) result in particulate re-entrainment, causing opacity spiking and an overall reduction in collection efficiency. At the outlet of the third field the distribution measured had 83.8% of the velocities less than 1.15 and slightly below the 85% limit with 100.0% of the velocities less than 1.40 times the mean as shown on Plate 20. The distribution measured further downstream at the outlet of the last field was severely skewed high towards the top of the field having 68.8%, 77.9% of the velocities less than 1.15 and 1.40 times the mean velocity as shown on Plate 21. The existing outlet plenum had no flow devices installed and this type of velocity distribution would only cause increased particle re-entrainment with opacity spiking.

Simulation of the (PAC) injection lances using tracer gas has shown the distribution downstream in the middle of the third and last fields was biased high towards the upper section of the collecting fields and cycled high to low across the collecting field width as shown on Plates 24 and 25. High to low cycles across the width of the third field maybe caused by the internal bracing and velocity distribution upstream and by the close proximity of the gas passages near the lances. In the fourth field this high to low effect had reduced suggesting that some of the tracer gas concentration had shifted gas passages when exiting the third field and before entering the fourth field gas passages. Also the injection point coverage for the lance is short as seen in the full size wind tunnel test.

The model and wind tunnel testing of the (PAC) lances have shown a possible poor injection of sorbent would occur. With precipitator cross flow, wind tunnel observations indicate more delivery air would be required to carry the sorbent further away from the lance orifices and into the precipitator gas flow. Model study testing has shown that the precipitator inlet flow devices maybe causing the sorbent injection to become biased towards the upper section of the collecting fields.

NELS believes that the existing inlet plenum velocity distribution having high unacceptable velocities along the bottom of the first and second collecting fields is a cause for particulate re-entrainment, opacity spiking and reduced collection efficiency. For the lower precipitator casings and assuming the inlet plenum and turning vanes shown on Plates 5 and 6 were relatively clear of ash buildup the velocity distribution entering the precipitator would be similar to the model however from NELS experience similar vane designs and plenums have shown ash builds up along the plenum floor and in the inside vane radius therefore reducing the horizontal turning ability causing gas flow to angle downward and increasing higher velocities along the bottom of the collection fields and into the hoppers. The existing outlet plenum with no flow devices is a problem area by itself having high velocities along the top section of the last collecting field and again causing particulate re-entrainment and opacity spiking.

Modifications to the inlet plenum flow devices to improve the velocity distribution with respect to minimizing high velocities based on NELS experience and to minimize ash build up along the plenum floor upstream of the inlet screen. Investigate the installation of devices between the first and second fields to further reduce particulate re-entrainment. Investigate the modifications to the outlet plenum by installing a variable porosity screen to improve flow distribution and to reduce particulate re-entrainment however these modifications would add some pressure loss to the existing system. It is possible that by using the current model of half of the lower casing the above recommendations can be achieved however the complete precipitator installation may have additional problems with respect to an equal amount of flow and ash loading to the four casings and there maybe areas in the existing system for some pressure loss savings.

TABLES

Table 1: List of Drawings

Drawing No.	Rev.	Title	Source
Drawings Received by E-mail on February 23, 2006			
27-E19		Inlet & Outlet Vertical Duct Turning Vanes	CE Walther
27-E34		PPTR Duct Baffles & Blanking Plates	CE Power Systems
27-E7		Inlet & Outlet Vertical Flue Elevations & Sections	Pollution Control
28-E13		Illegible	Illegible
28-E3		Illegible	Illegible
2-E1-1		Illegible	Illegible
04-7007-05-400	1	Toxecon II Injection Lance	ADA-ES
04-7007-05-401	1	Toxecon II Manifold Assembly	ADA-ES
04-7007-74-40	1	ESP Section 2-3 Gen Arrgt	ADA-ES
04-7007-74-41	1	Entergy Independence Toxecon II Standard Drawing Dimensions	ADA-ES
Drawings Received by E-mail on March 9, 2006			
1-e17_1		ESP Section PP	Pollution Control
1-e12_1		ESP Plans	Pollution Control
1-e13_1		ESP Side Elevation KK	Pollution Control
1-e14_1		ESP Outlet Elevation	Pollution Control
1-e16_1		ESP Section NN	Pollution Control
2-E1_1		Illegible	Illegible
3-E1_1		DE System Installation	Pollution Control
Drawings Received by E-mail on June 26, 2006			
27 – E52		Field Work to Inlet Vertical Duct (Add Turning Vanes)	CE Power Systems
28 – E13		Inlet Plenum	CE Walther Inc.
Drawings Received by E-mail on June 27, 2006			
28 – E11		Lower PPTR Inlet Plenum Turning Vane Design	Pollution Control Walther
28 – E12		Upper Inlet Transition Splitter Vane Design	CE Walther Inc.
27 – E36		Field Work @ Inlet Vertical Duct Turning Vanes	CE Walther Inc.
27 – E37		Field Work to Outlet Duct Turning Vanes	CE Power Systems
Drawings Received by E-mail on June 28, 2006			
28 – E14	B	Lower PPTR Inlet Plenum Turning Vane Details	Pollution Control Walther
28 – E15		Lower PPTR Inlet Transition Splitter Vane Design	CE Walther Inc.

Table 1: Continued

28 – E16		Upper PPTR Inlet Transition Splitter Vane Design	CE Walther Inc.
28 – E4		Inlet & Outlet Plenum Truss Details	Pollution Control Walther
Drawings Received by E-mail on July 12, 2006			
1-E12		Plans Lower PPTR A&B	Pollution Control Walther
1-E15		Inlet Elevation M-M Lower PPTR A&B	Pollution Control Walther
1-E18		PPTR Section R-R & R'-R'	Pollution Control Walther
1-E19		PPTR Section S-S	Pollution Control Walther
1-E20		PPTR Section T-T	Pollution Control Walther
Drawings Received by E-mail on July 14, 2006			
27-E52	A	Field Work to Inlet Vertical Duct (Add Turning Vanes)	CE Power Systems
27-E54		Field Work to Inlet Duct (PPTR B)	CE Power Systems
27-E56		Field Work to Inlet & Outlet (Vertical)	CE Power Systems

Table 2: Full Size Installation - Design and Gas Flow Parameters

SYSTEM REQUIREMENTS	
ESP Construction: Unit 2	
No. of Precipitator Casings	4
No. of Inlets per Casing	2 – Plenum
No. of Screens per Inlet Plenum	1 – Perforated Plate
No. of Outlets per Casing	2 – Plenum
No. of Screens per Outlet Nozzle	None
No. of Chambers per Casing	2
No. of Fields per Chamber	4
No. of Gas Passages per Chamber	43
Collecting Plate Spacing	1'- 0"
Collecting Plate Height	48' – 0"
Collecting Plate Depth	15' – 2"
Gas Flow Parameters	
Gas Passage Velocity	4 ft/s
Estimated Chamber Flow (44' x 45'-8")	482169 acfm
Flue Gas Temperature	299 °F
Flue Gas Density	0.0522 lb/ft^3

Table 3: Comparison between Full Size and Model

Criteria	Full Size Installation	Model
Construction:		
Geometric Linear Scale	1:1	1:12
Gas Flow:		
Chamber Gas Flow (acfm)	482,169	3348
Duct Velocity (T8)(fpm)	3282	3282
Gas Temperature (°F)	299	70
Gas Density (lbs/ft^3)	0.0522	0.0747

Table 4: Summary of Flow Scaling Parameters

1. ***Reynolds Number, Re:*** $\mathrm{Re} = \frac{V\,D}{\nu}$

Where: V = velocity

D = characteristic length

ν = kinematic viscosity

Full Size Installation

V = 4.04 ft/s (Location – inlet flange)

D = 44.59 feet (equivalent duct diameter)

ν = 3.05 x 10^{-4} ft^2/s at 299 °F

$$\mathrm{Re}_{Full\ Size} = \frac{4.04\ x\ 44.59}{3.05\ x\ 10^{-4}} = 5.91\ x\ 10^5$$

Model

V = 4.04 ft/s (Location – inlet flange)

D = 3.72 feet (equivalent duct diameter)

ν = 1.64 x 10^{-4} ft^2/s at 70 °F

$$\mathrm{Re}_{Model} = \frac{4.04\ x\ 3.72}{1.64\ x\ 10^{-4}} = 9.16\ x\ 10^4$$

$$\mathrm{Re}_{Model} = \frac{8.0\ x\ 2.84}{1.64\ x 10^{-4}} = 1.38\ x 10^5$$

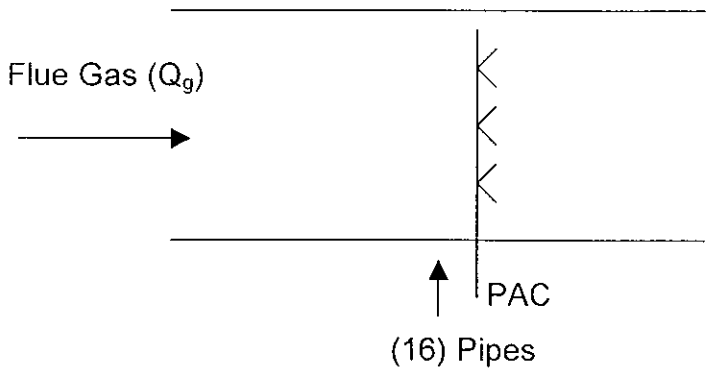
The model Reynolds Number is above the minimum required value (20 000) for fully turbulent flow.

2. ***Conversion of Model to Full Size Pressures***

$$P_{Full\ Size} = P_{Model}\ x \left(\frac{Q_{Full\ Size}}{Q_{Model}} \right)^2 x \frac{\rho_{Gas\ Full\ Size}}{\rho_{Air\ Model}}$$

Table 5: Powdered Activated Carbon (PAC) Injection Scaling Theory

The momentum ratio of the 'flue gas flow' to the 'PAC injection flow' should be the same when comparing the full size prototype to the model.



Flue Gas (Q_g)	PAC (Q_N)
Q_g= 482,169 acfm	Q_N= 154 acfm (77 acfm per train)
T_g= 299 °F	m_{air} = 653 lb/hr
ρ_g= 0.0522 lb/ft^3	T_N= 100 °F, ρ_{air} = 0.0707 lb/ft^3
	ρ_N= 0.0863 lb/ft^3
	Carbon = 144 lb/hr

Effective Density

$$\text{Effective Density} = \frac{m_{air} + m_{carbon}}{m_{air}} \times \rho_{air}$$

$$\text{Effective Density} = \frac{653 \text{ lb/hr} + 144 \text{ lb/hr}}{653 \text{ lb/hr}} \times 0.0707 \text{ lb/ft}^3$$

$$\text{Effective Density} = 0.0863 \text{ lb/ft}^3$$

Table 5: Continued

Prototype		Model	
$\frac{m_N * v_N}{m_g * v_g}$	=	$\frac{m_N' * v_N'}{m_g' * v_g'}$	
$\frac{\rho_N * A_N * v_N^2}{\rho_g * A_g * v_g^2}$	=	$\frac{\rho_N' * A_N' * v_N'^2}{\rho_g' * A_g' * v_g'^2}$	
$\frac{A_N'}{A_N}$	=	$\frac{A_g'}{A_g}$	(similar) $(1/12)^2$
v_g	=	v_g'	(precondition)
ρ_g'	=	ρ_N'	(tracer gas)

Therefore $v_N' = (\rho_N / \rho_g)^{1/2} * v_N$

$Q_N' = v_N' * A_N' = (\rho_N / \rho_g)^{1/2} * Q_N * (A_N' / A_N)$

Test Condition on the Model

$Q_N' = (0.0863/ 0.0522)^{1/2} * 154 * (1/12)^2$

$Q_N' = 1.38$ acfm

Therefore:

$Q_N'=0.000421 \times Q_g'$

The factor 0.000412 when multiplied by the 100% model flow rate will give the PAC + Air, flow rate. This value can be applied when operating the model at reduced flow rates.

For Example:

Max Model Flow Rate (typical) = 3,348 acfm

$Q_N'=0.000412 \times Q_g'$

$Q_N'=0.000412 \times 3{,}348$

Therefore PAC Simulation Flow Set at 1.38 acfm (82.8 cfh)

Table 6: Description of Test Locations

Test Location	Description
Inlet Ducting	
T1L & T1R	Inlet Duct to Precipitator
T2L & T2R	Inlet Duct to Precipitator
Precipitator	
T3	Outlet of First Field
T4	Outlet of Second Field
T5	Outlet of Third Field
T6	Outlet of Last Field
Outlet Ducting	
T7	Outlet Duct from Precipitator
T8*	Outlet Duct from Precipitator (Model Volume Control)

Notes:

*Model Volume Control

Refer to Plates 1 and 2 for test locations

Table 7: Precipitator Gas Passage Test Locations

Precipitator Test Location (within each gas passage)	**Description**
TP	Top of Collector Plates
TO	Top of Precipitator Projected Opening
1 to 16	17 Evenly Spaced Measurements over the Height of the Precipitator Projected Opening
BO	Bottom of Precipitator Projected Opening
BP	Bottom of Collector Plates

Notes:

Refer to Plates 1 and 2 for test locations

Table 8: Summary of Volume Flows

Precipitator Inlet Ducts T1L & T1R to Outlet Duct T8

Existing Configuration

Test Location	Full Size Area (ft^2)	RMS Deviation (%)	Mean Velocity (fpm)	Volume Flow (acfm)	Ref. Plates
T1L	50.73	6.2	4614	234068	14
T1R	50.73	4.9	4599	233307	15
T2L	50.73	10.1	4416	224024	16
T2R	50.73	9.2	4551	230872	17
T7	146.88	13.2	3361	493664	22
T8*	146.88	6.1	3257	478388	23

Notes:

Existing Configuration

*Model Volume Control

Refer to Plates 1 and 2 for test locations

Table 9: Static and Total Pressures Determined from Model
Precipitator Inlet Ducts T1L & T1R to Outlet Duct T8
Existing Configuration

Test Location	Model Data			Model x 0.706		Test Increment Location	Model ΔP		Prototype ΔP	
	Static	Velocity	Total	Static	Total		Static	Total	Static	Total
	(Inches of Water)			(Inches of Water)			(Inches of Water)		(Inches of Water)	
T1L	-2.23	1.327	-0.90	-1.57	-0.64	T1L – T2L	0.43	0.54	0.30	0.38
T2L	-2.66	1.215	-1.44	-1.87	-1.02	T2L – T3	0.21	1.43	0.16	1.01
T1R	-2.23	1.318	-0.91	-1.57	-0.64	T1R – T2R	0.50	0.53	0.36	0.38
T2R	-2.73	1.291	-1.44	-1.93	-1.02	T2R – T3	0.14	1.43	0.10	1.01
T3	-2.87		-2.87	-2.03	-2.03	T3 – T6	0.02	0.02	0.01	0.01
T6	-2.89		-2.89	-2.04	-2.04	T6 – T7	1.08	0.38	0.76	0.27
T7	-3.97	0.704	-3.27	-2.80	-2.31	T7 – T8	0.15	0.19	0.11	0.13
T8	-4.12	0.661	-3.46	-2.91	-2.44					
						T1(L&R) – T3	0.64	1.97	0.46	1.39
						T6 – T8	1.23	0.57	0.87	0.40
						T1(L&R) – T8	1.89	2.56	1.34	1.80

Notes:

Existing Configuration

Model flow representative of 478,388 acfm at 62.0 °F (ρ = 0.0751 lb/ft^3)

Prototype flow = 482,169 acfm at 299 °F (ρ = 0.0522 lb/ft^3)

$$\text{Prototype } \Delta P = \text{Model } \Delta P \times \left(\frac{\text{Prototype Flow}}{\text{Model Representative Flow}}\right)^2 \times \left(\frac{\text{Prototype Gas Density}}{\text{Model Air Density}}\right)$$

$$i.e. \quad \Delta P_p = \Delta P_m \times \left(\frac{482169}{478388}\right)^2 \times \left(\frac{0.0522}{0.0751}\right)$$

or $\Delta P_{\text{Full Size}} = \Delta P_{\text{Model}}$ x **0.706** (Correction Factor)

Table 10: Summary of Precipitator Velocity & CO Injection Distributions

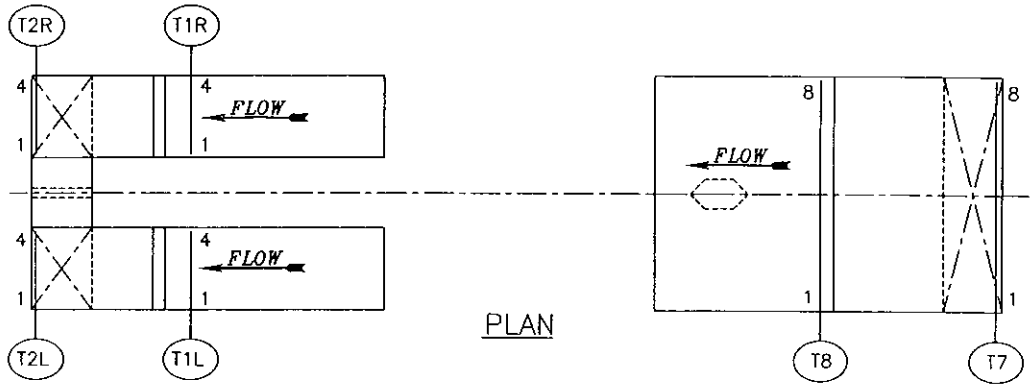
Test Location	RMS Deviation % of Mean	% Below 115%	% Below 140%	Ref. Plates
Existing Configuration Velocity Distributions				
T3	25.5	72.1	94.2	18
T4	21.0	77.1	99.2	19
T5	17.9	83.8	100.0	20
T6	43.3	68.8	77.9	21

Existing Configuration (PAC) Injection Distributions						
Test Location	**RMS Deviation % of Mean**	**Mean PPM**	**% < 100**	**% 100 - 200**	**% > 200**	**Ref. Plates**
T5A (Mid Field)	111.5	156.4	64.4	17.4	18.2	24
T6A (Mid Field)	68.8	80.0	50.4	38.8	10.7	25

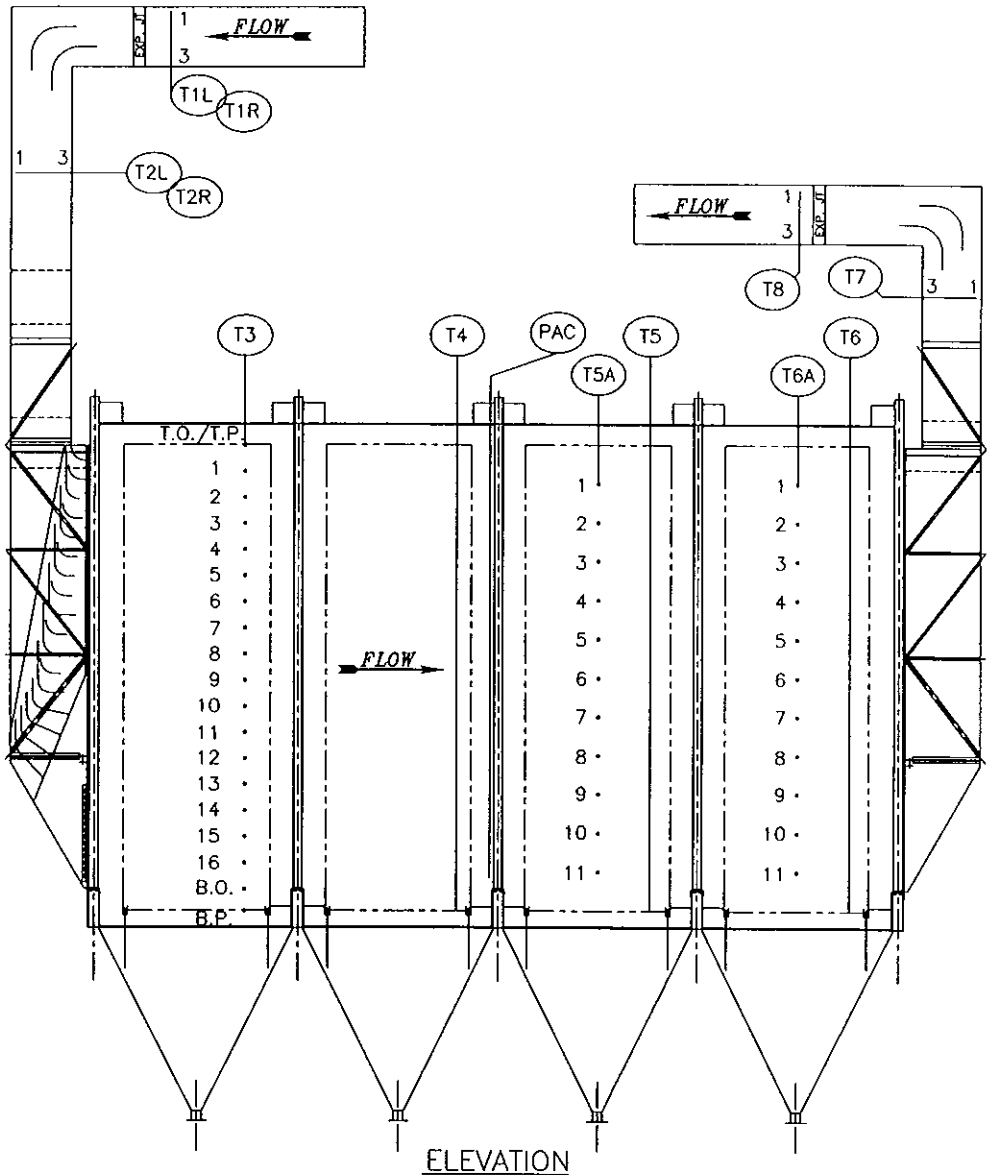
Notes:

Refer to Plates 1 and 2 for test locations

PLATES

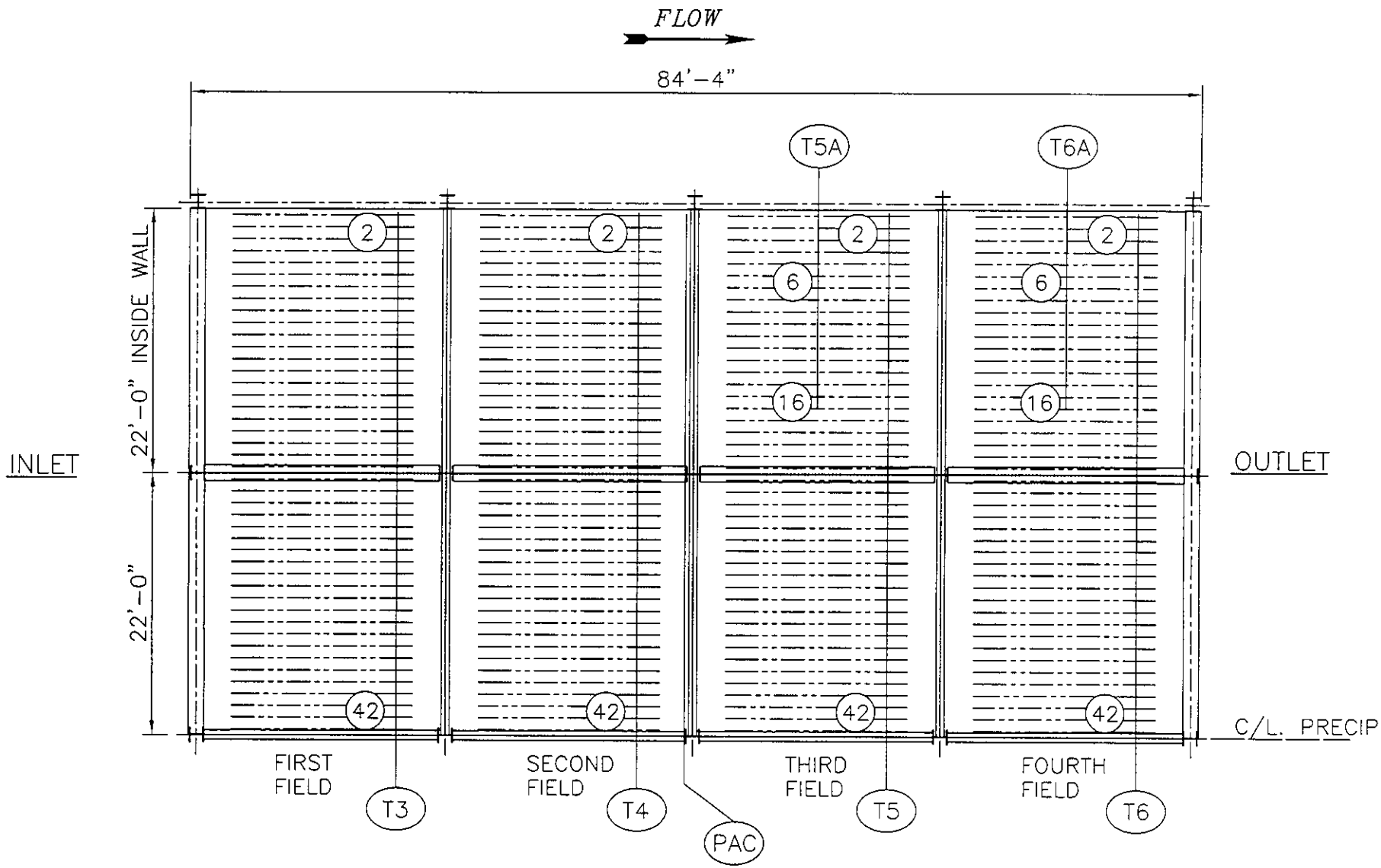


PLAN



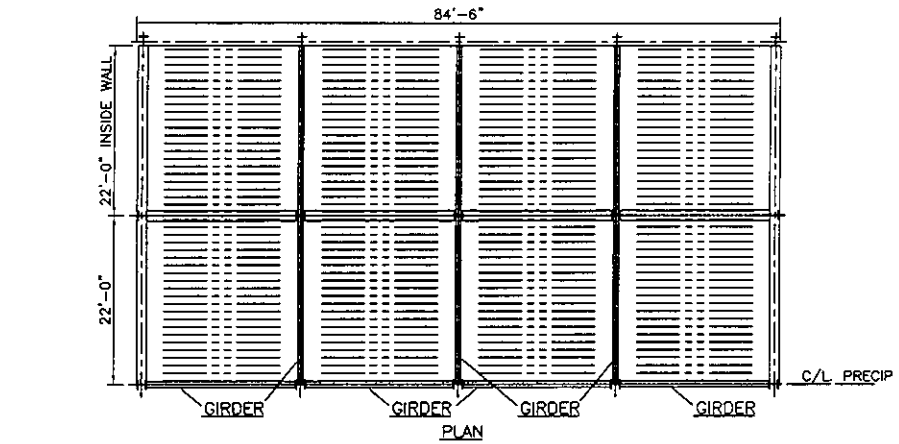
ELEVATION

ADA - ES INC LITTLETON, COLORADO		DATE DEC 2006
ENTERGY, INDEPENDANCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY		DR. BY DG MODEL SCALE 1/12
NCS INC. P119.06 P11906-PL1	GENERAL MODEL ARRNGEMENT AND TEST LOCATIONS PLAN AND ELEVATION	PLATE No. 1

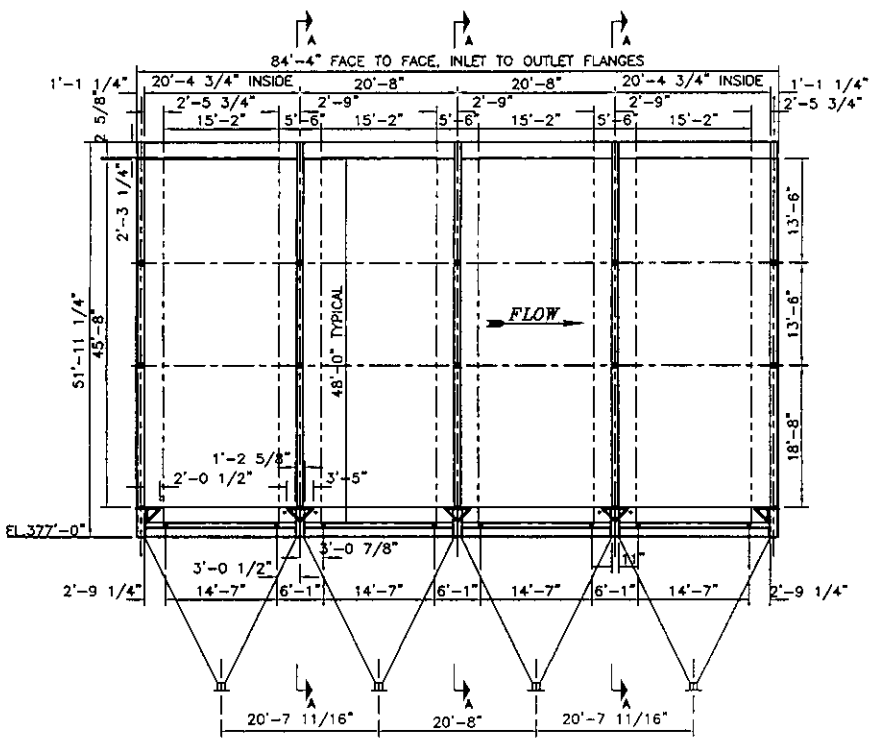


PLAN

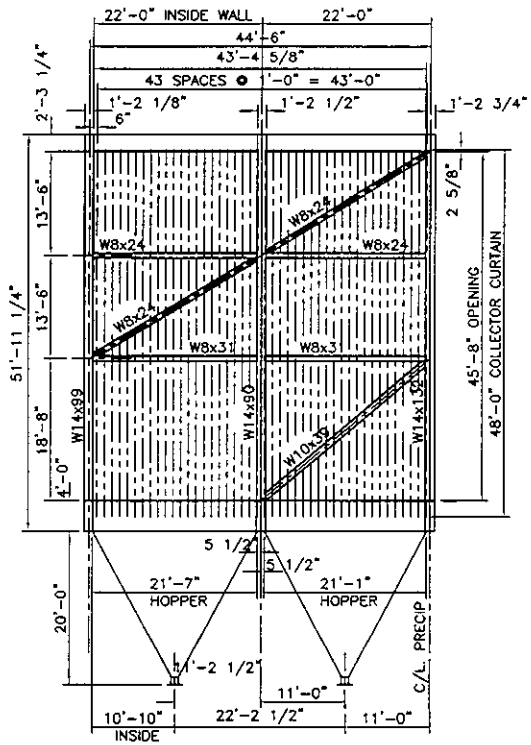
NCS INC. P119.06 PL11906-PL2	ADA - ES INC LITTLETON, COLORADO	ENTERGY, INDEPENDANCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY	GENERAL MODEL ARRANGEMENT AND TEST LOCATIONS PLAN	ISSUE DATE DEC 2006	MODEL SCALE 1/12
				DR. BY DG	PLATE No. 2



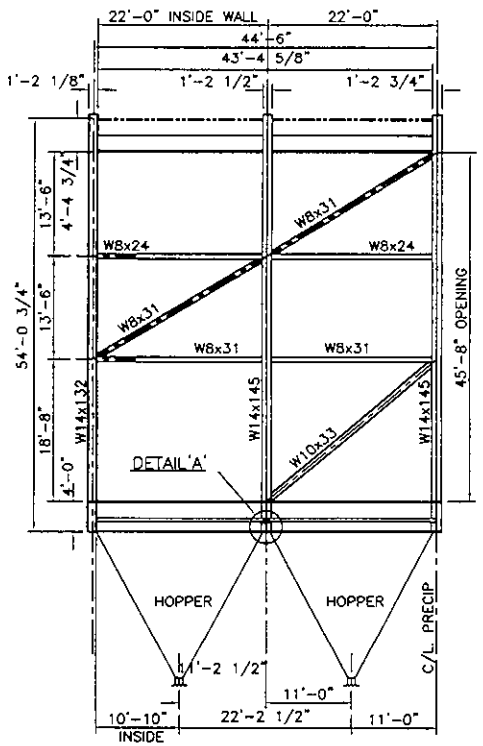
PLAN



ELEVATION

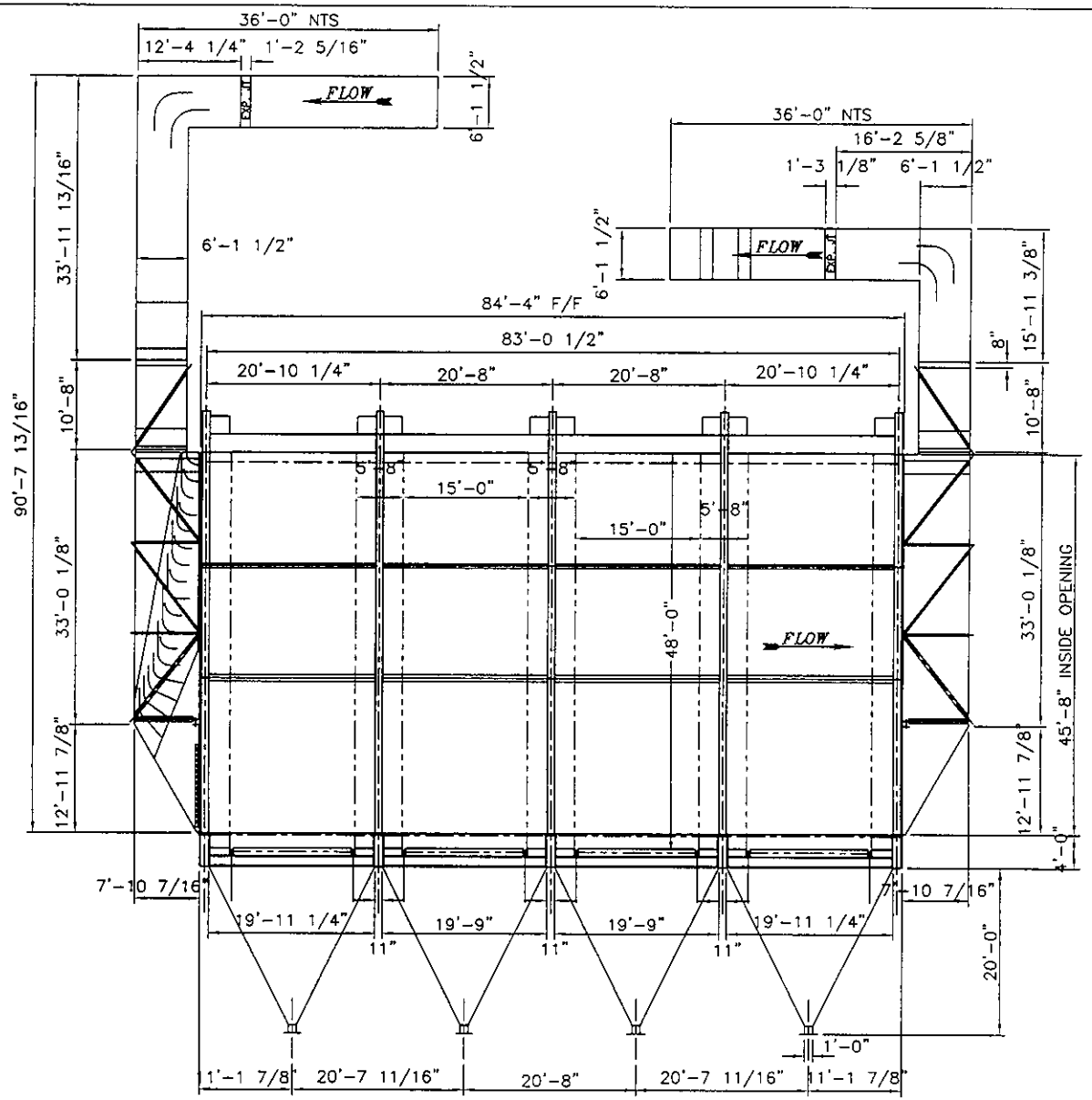


INLET END VIEW
OUTLET OPP HAND



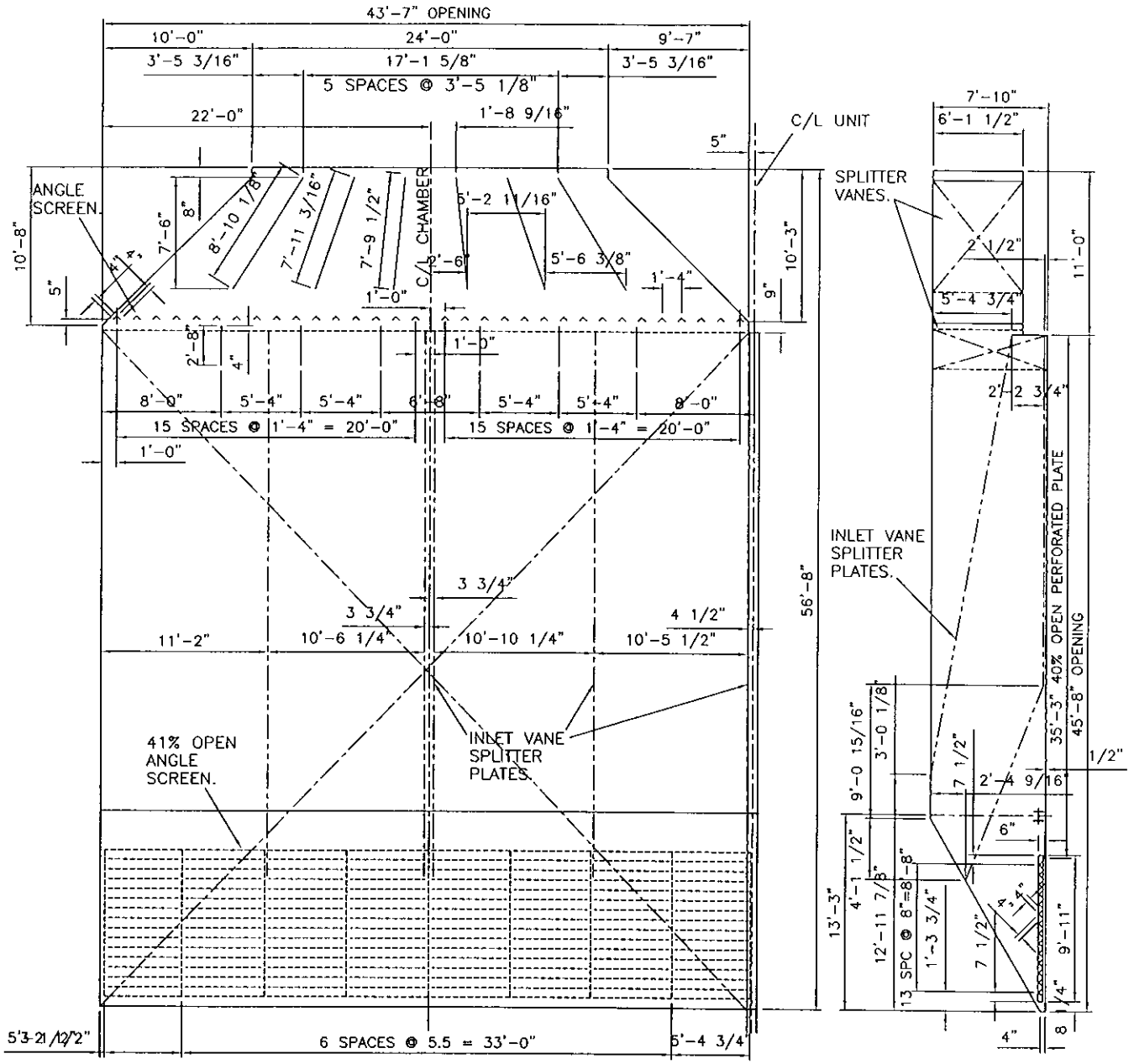
SECTION 'A-A'

NCS INC.	ADA - ES INC LITTLETON, COLORADO	ENTERGY, INDEPENDANCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY	GENERAL ARRANGEMENT PRECIPITATOR PLAN AND ELEVATIONS	ISSUE DATE DEC 2006	MODEL SCALE 1/12
P119.06				DR. BY J.GARDNER	PLATE No. 3
P11906-PL3					



ELEVATION

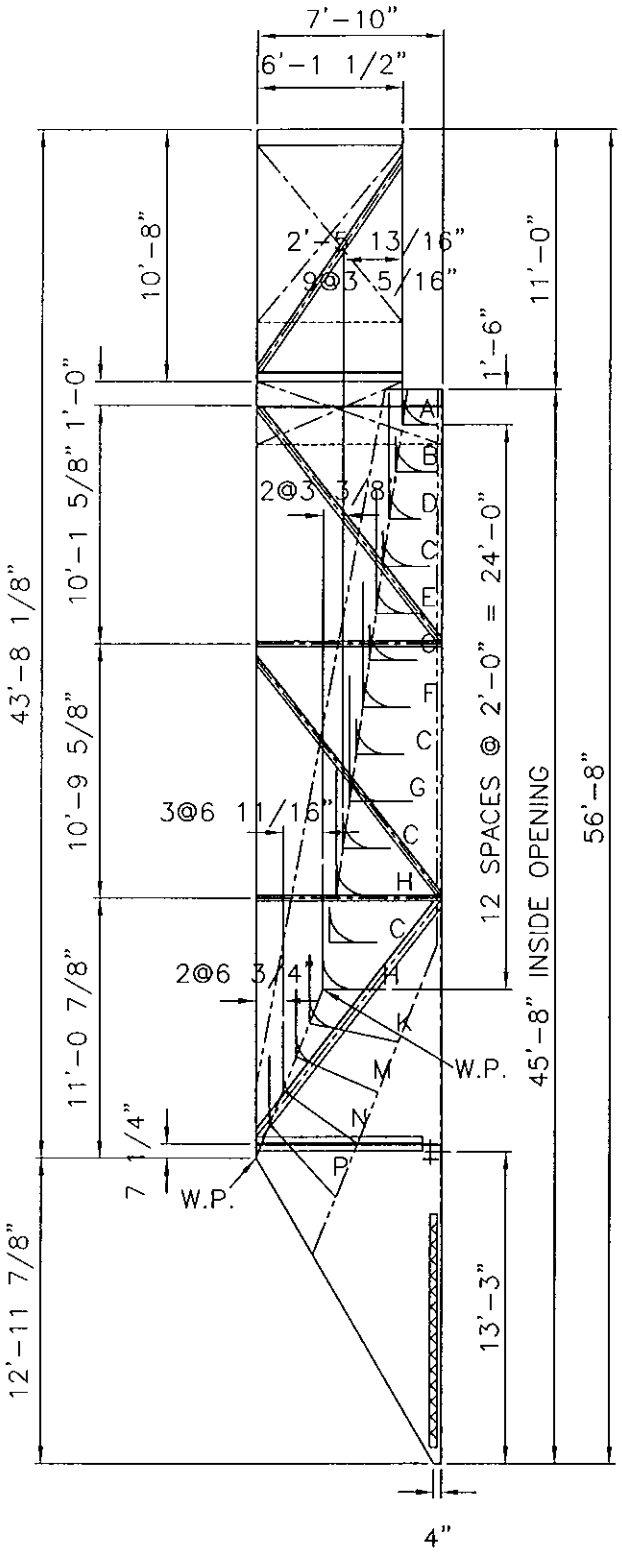
NCS INC.	ADA - ES INC	ENTERGY, INDEPENDANCE STATION UNIT 2 ESP	GENERAL ARRANGEMENT	ISSUE DATE	MODEL SCALE
P119.06	LITTLETON, COLORADO	TOXICON II PROJECT, CARBON INJECTION	PRECIPITATOR AND DUCTING	DEC 2006	1/12
P11906-PL4		AIR FLOW MODEL STUDY	ELEVATION	DR. BY J GARDNER	PLATE No 4

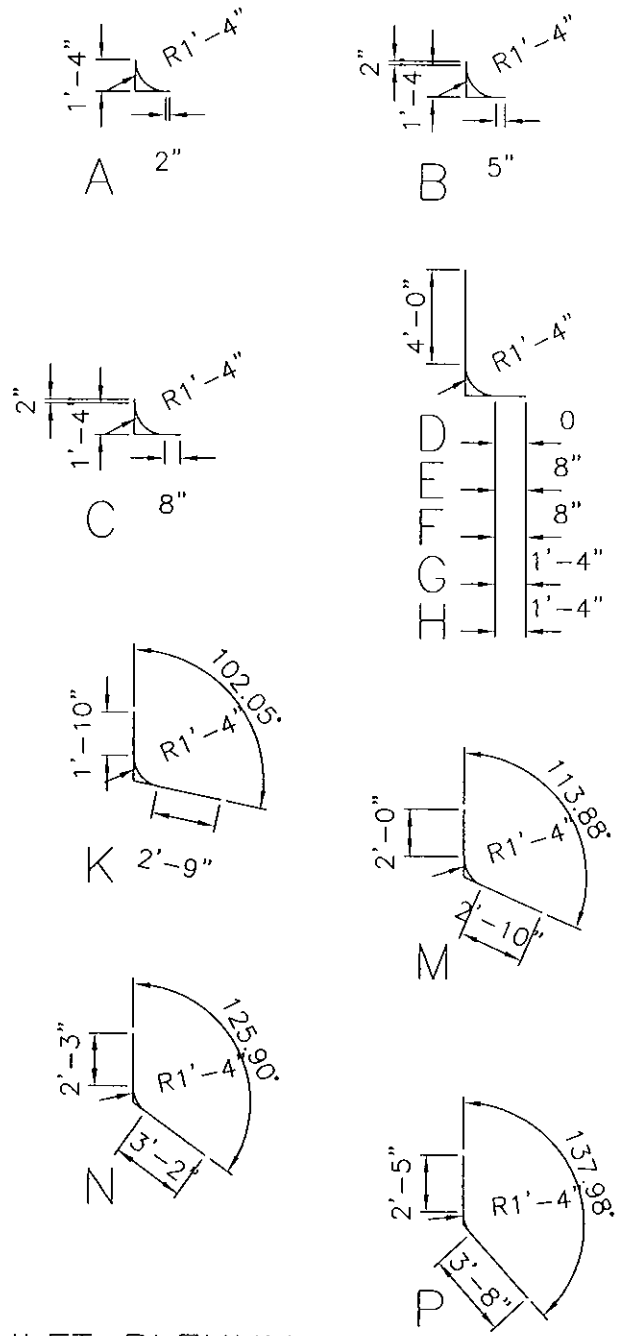


ELEVATION
LOOKING IN DIRECTION OF FLOW

END VIEW

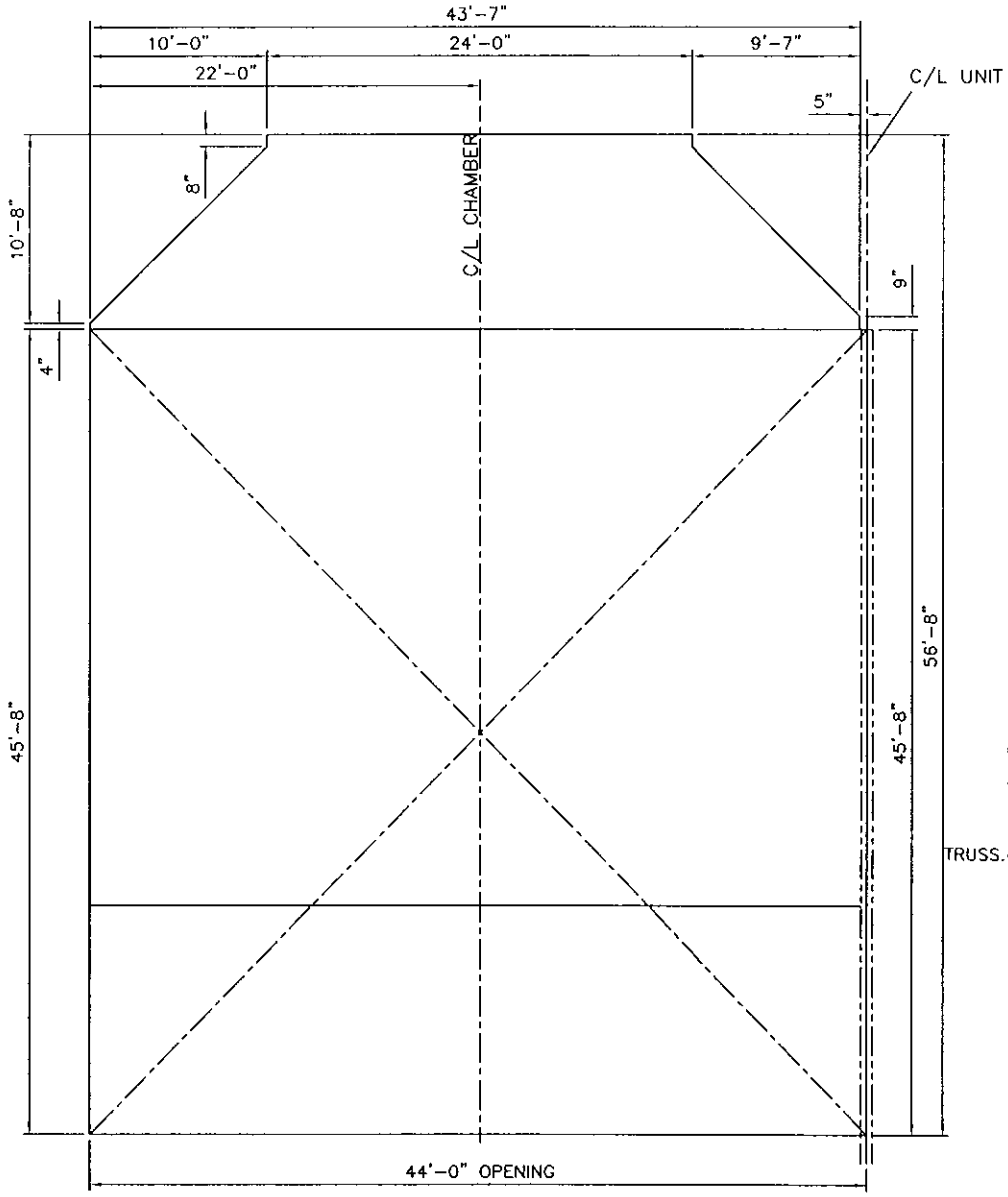
ADA - ES INC LITTLETON, COLORADO		DATE DEC 2006
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY		DR. BY J.G. MODEL SCALE 1/12
NCS INC. P119.06 P11906-PL5	DETAILS PRECIPITATOR INLET PLENUM ELEVATION	PLATE No. 5



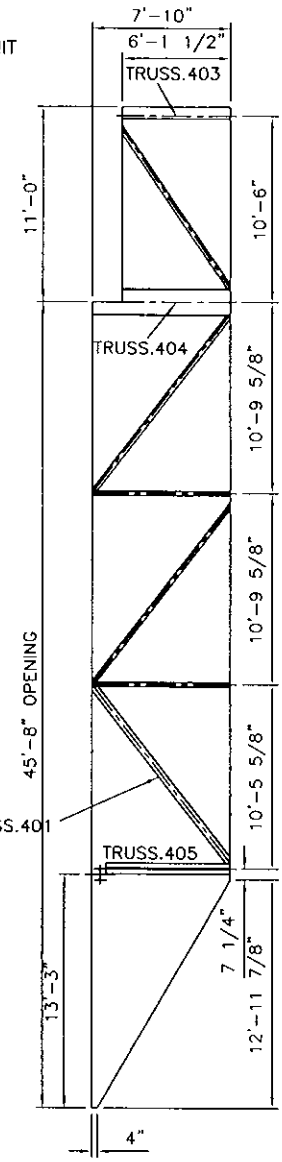


INLET PLENUM
VANE DETAILS

ADA - ES INC LITTLETON, COLORADO		DATE DEC 2006
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY		DR. BY J.G. MODEL SCALE 1/12
NCS INC. P119.06 P11906-PL6	ARRANGEMENT & DETAILS INLET PLENUM TURNING VANES EXISTING CONFIGURATION	PLATE No. 6

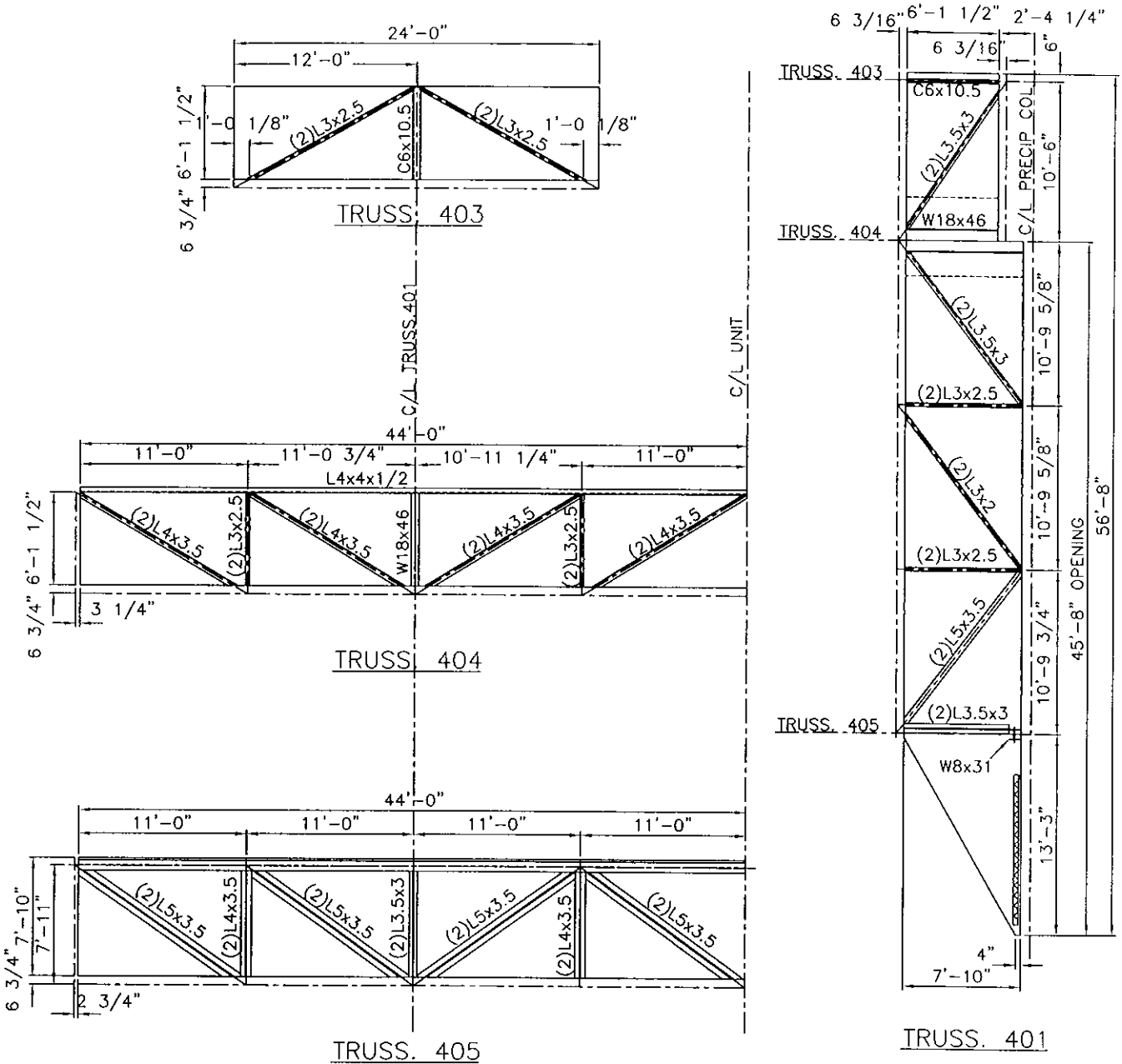


ELEVATION
LOOKING IN DIRECTION OF FLOW



END VIEW
SHOWING TRUSS. 401

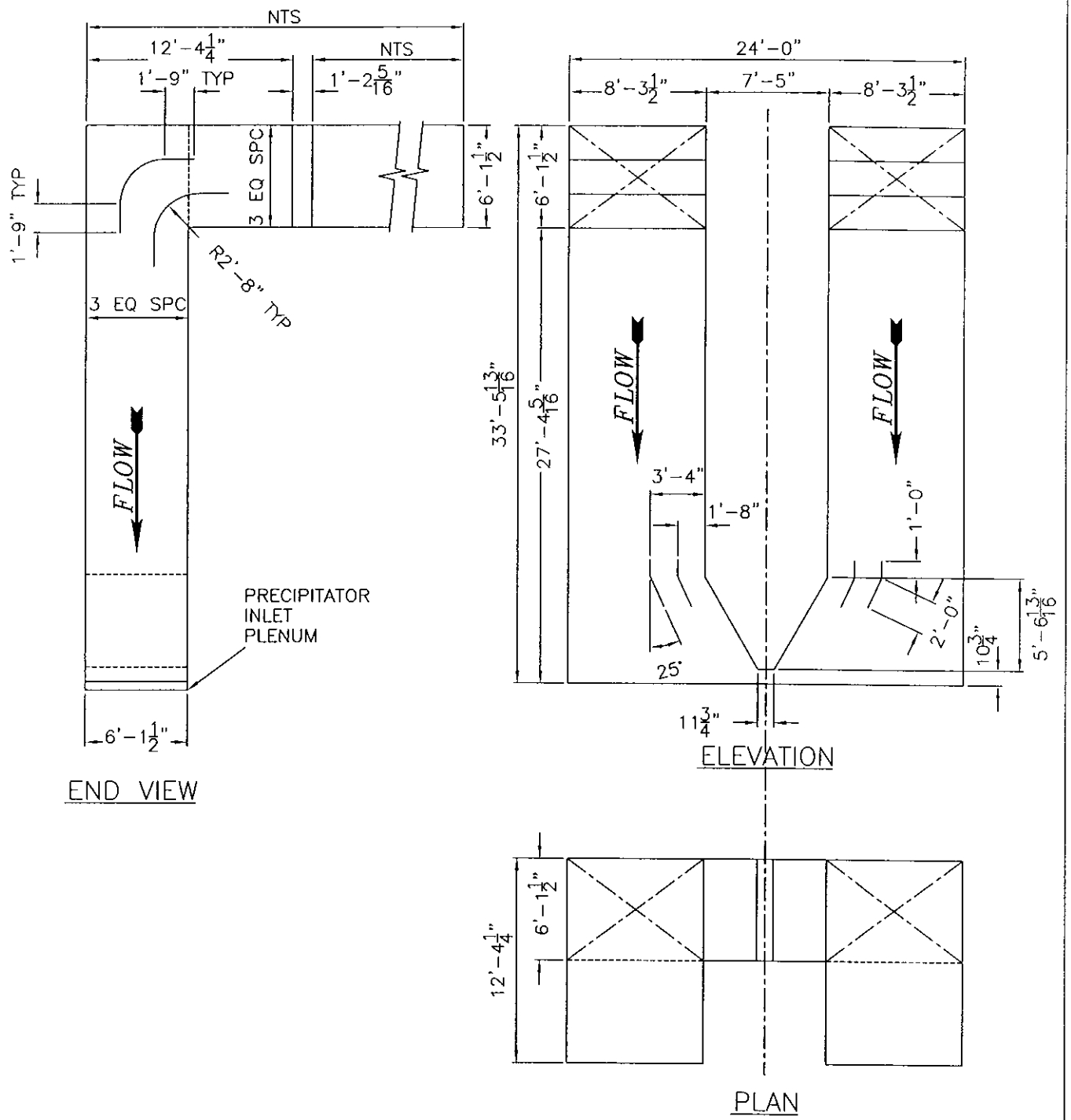
ADA - ES INC LITTLETON, COLORADO		DATE DEC 2006
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY		DR. BY J.G. MODEL SCALE 1/12
NCS INC. P119.06 P11906-PL7	DETAILS PRECIPITATOR OUTLET PLENUM ELEVATION	PLATE No. 7



INLET TRUSS AS SHOWN

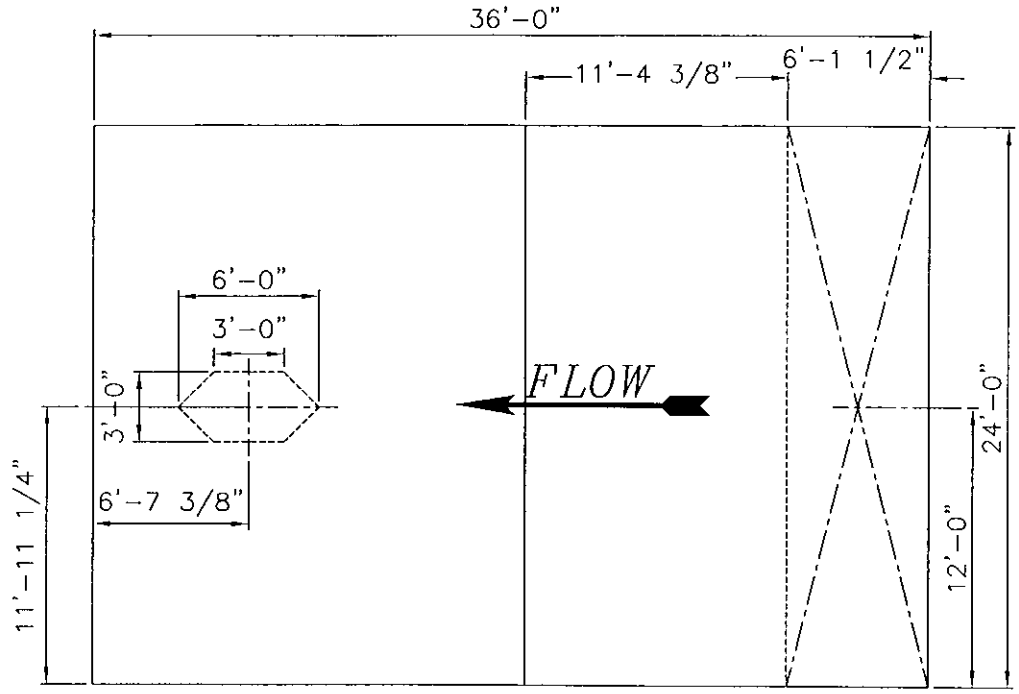
OUTLET TRUSS OPP HAND

ADA - ES INC LITTLETON, COLORADO		DATE DEC 2006
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY		DR. BY J.G. MODEL SCALE 1/12
NCS INC. P119.06 P11906-PL8	DETAILS INLET & OUTLET PLENUMS TRUSS DETAILS	PLATE No. 8

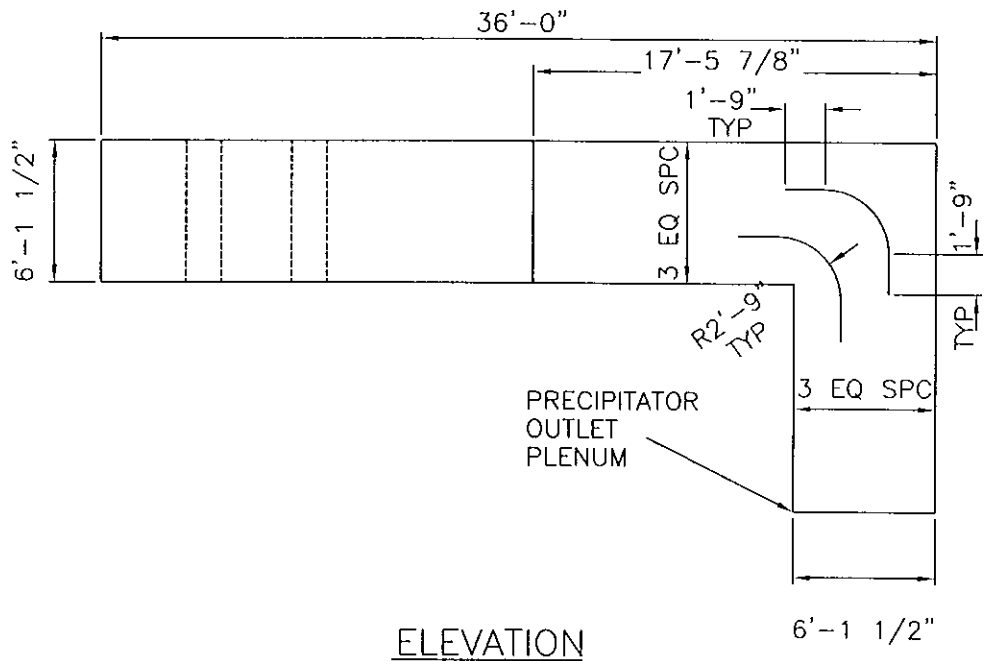


INLET DUCT

ADA - ES INC LITTLETON, COLORADO		DATE DEC 2006
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY		DR. BY J.G. MODEL SCALE 1/12
NCS INC. P119.06 P11906-PL9	DETAILS PRECIPITATOR INLET DUCT AND TURNING VANES	PLATE No. 9

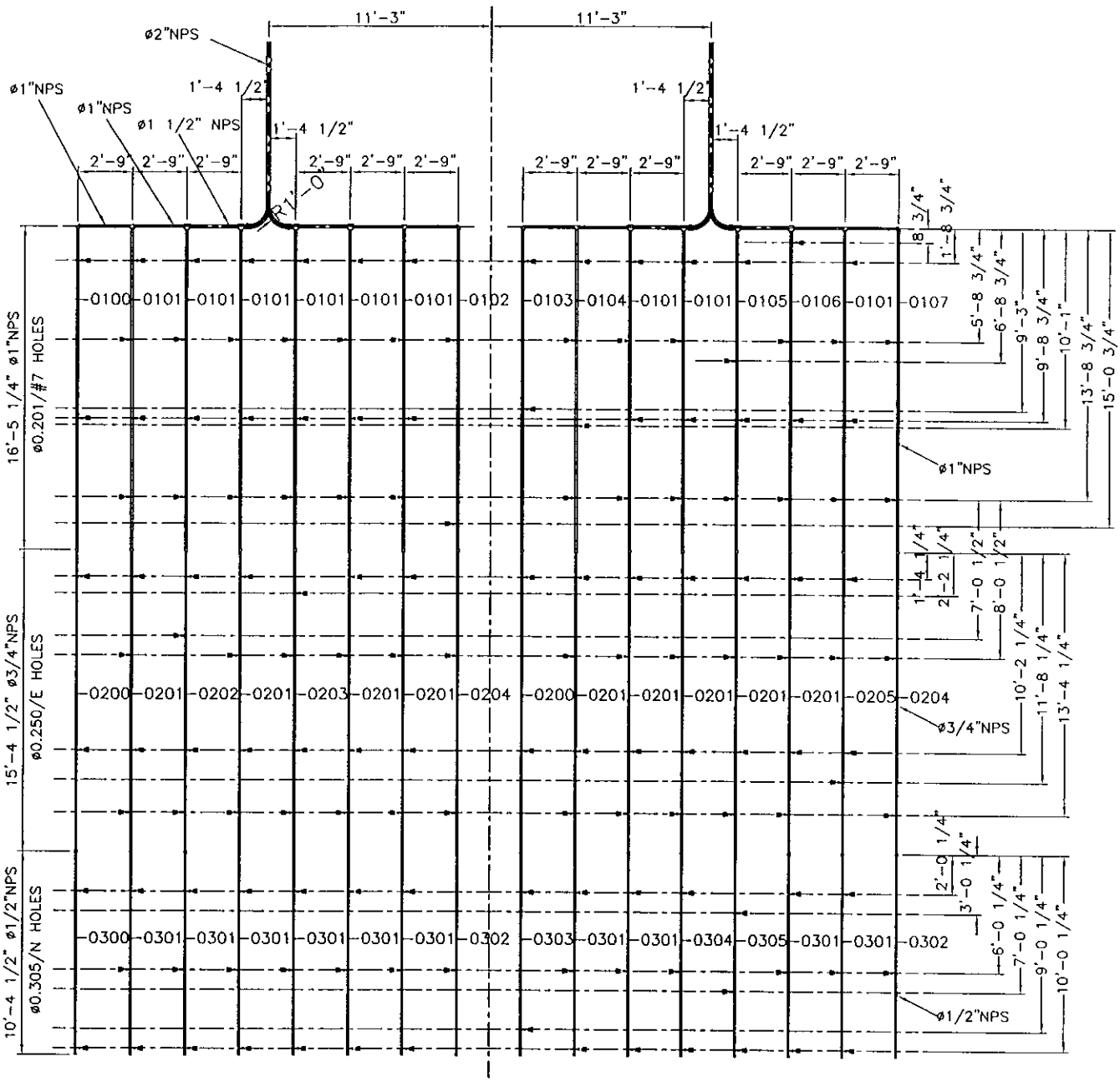


PLAN



ELEVATION

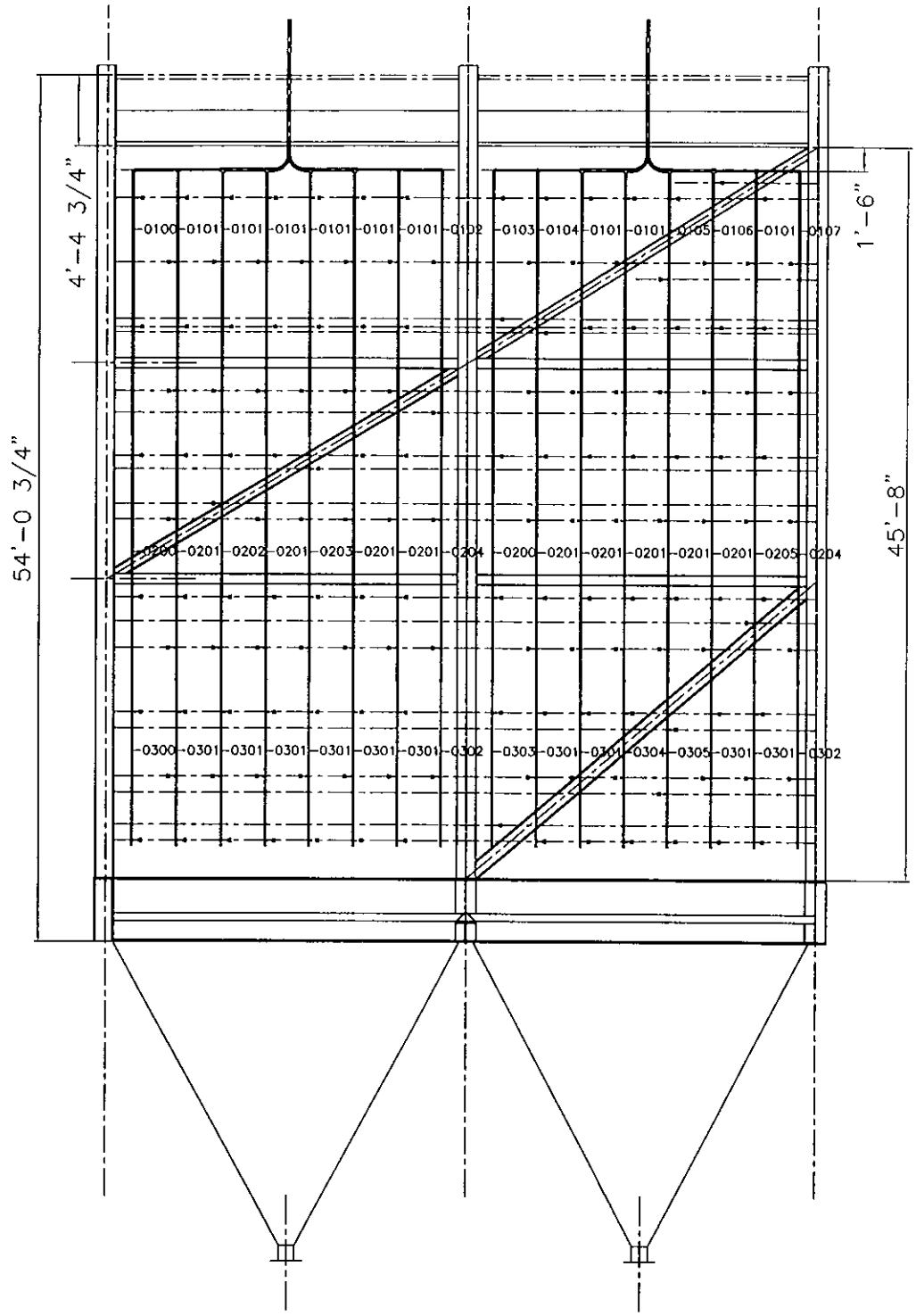
ADA - ES INC LITTLETON, COLORADO		DATE DEC 2006
ENTERGY, INDEPENDENCE STATION UNIT 2 TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY		DR. BY J.G. MODEL SCALE 1/12
NCS INC. P119.06 P11906-PL10	DETAILS PRECIPITATOR OUTLET DUCT AND TURNING VANES	PLATE No. 10



VIEW LOOKING INTO FLOW

ALL HOLES PERPENDICULAR TO GAS FLOW

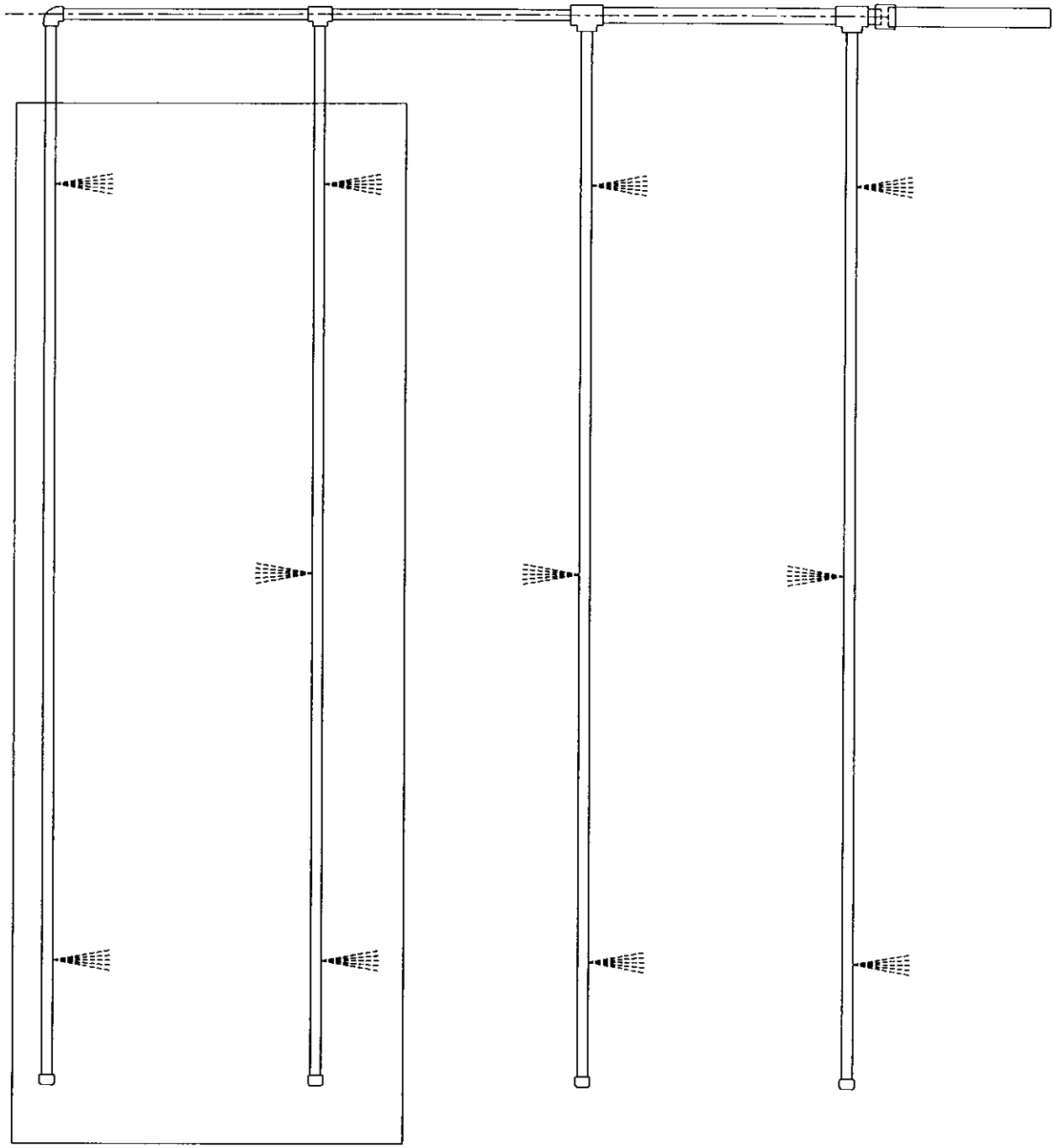
ADA - ES INC LITTLETON, COLORADO		DATE DEC 2006
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY		DR. BY J.G. MODEL SCALE 1/12
NCS INC. P119.06 P11906-PL11	GENERAL ARRANGEMENT CARBON INJECTON GRID ELEVATION	PLATE No. 11



VIEW LOOKING INTO FLOW

BETWEEN 2nd AND 3rd FIELD

ADA - ES INC LITTLETON, COLORADO		DATE DEC 2006
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY		DR. BY J.G. MODEL SCALE 1/12
NCS INC. P119.06 P11906-PL12	GENERAL ARRANGEMENT CARBON INJECTON GRID LOCATION ELEVATION - BETWEEN 2nd & 3rd FIELD	PLATE No. 12

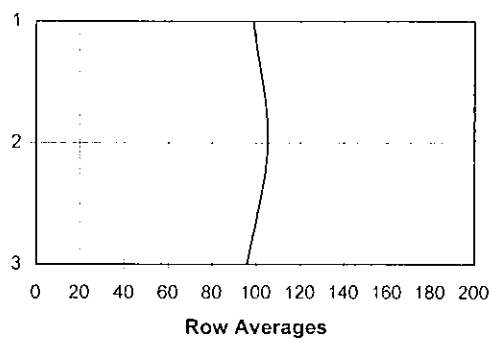


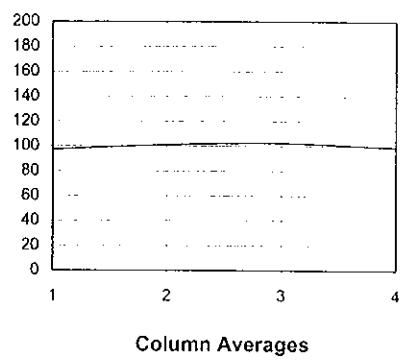
ADA - ES INC LITTLETON, COLORADO		DATE DEC 2006
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY		DR. BY J.G. MODEL SCALE 1/1
NCS INC. P119.06 P11906-PL13	GENERAL ARRANGEMENT WIND TUNNEL INJECTON GRID ELEVATION	PLATE No. 13

	1	2	3	4	Row Averages
1	99	98	101	98	99
2	99	110	110	102	105
3	94	96	97	98	96
Column Averages	97	101	103	99	

T1L

RMS Deviation = **4.9** % of the Mean Velocity
100.0% of the data are within ± 15 % of the Mean
100.0% of the data are within ± 25 % of the Mean





$$\frac{\textit{MEASURED VELOCITY}}{\textit{MEAN VELOCITY}} \times 100 = \textit{NORMALIZED VELOCITY}$$

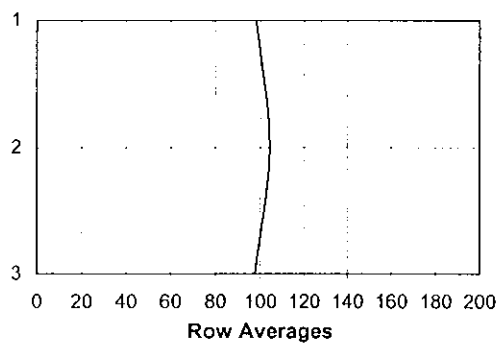
NORMALIZED VELOCITY DISTRIBUTION VIEWED IN DIRECTION OF FLOW

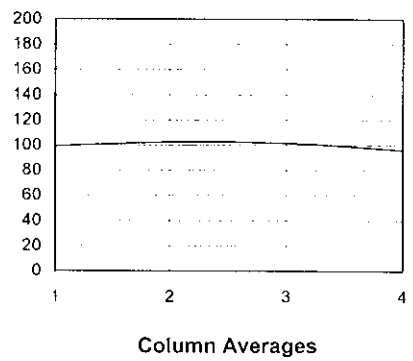
	ADA - ES INC *LITTLETON, COLORADO*	***DATE*** *DEC 2006*
	ENTERGY, INDEPENDENCE STATION UNIT 2 ESP *TOXICON II PROJECT, CARBON INJECTION* *AIR FLOW MODEL STUDY*	*T1L*
NCS Inc. *P119.06* *101306*	*NORMALIZED VELOCITY DISTRIBUTION* *INLET DUCT TO PRECIPITATOR, LOCATION T1L* *EXISTING CONFIGURATION*	***PLATE No.*** *14*

	1	2	3	4	Row Averages
1	100	97	97	99	98
2	103	112	112	90	104
3	96	98	96	100	98
Column Averages	100	102	102	96	

T1R

RMS Deviation = **6.2** % of the Mean Velocity
100.0% of the data are within ± 15 % of the Mean
100.0% of the data are within ± 25 % of the Mean





$$\frac{\textit{MEASURED VELOCITY}}{\textit{MEAN VELOCITY}} \times 100 = \textit{NORMALIZED VELOCITY}$$

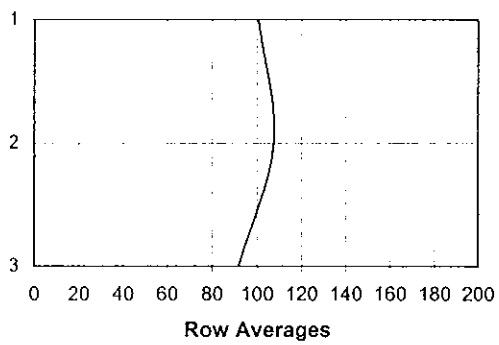
NORMALIZED VELOCITY DISTRIBUTION VIEWED IN DIRECTION OF FLOW

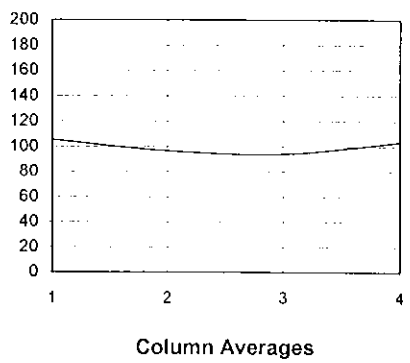
	ADA - ES INC *LITTLETON, COLORADO*	***DATE*** *DEC 2006*
	ENTERGY, INDEPENDENCE STATION UNIT 2 ESP *TOXICON II PROJECT, CARBON INJECTION* *AIR FLOW MODEL STUDY*	*T1R*
NCS Inc. *P119.06* *101306*	*NORMALIZED VELOCITY DISTRIBUTION* *INLET DUCT TO PRECIPITATOR, LOCATION T1R* *EXISTING CONFIGURATION*	***PLATE No.*** *15*

	1	2	3	4	Row Averages
1	102	101	100	100	101
2	118	104	101	106	107
3	96	85	80	105	92
Column Averages	105	97	94	104	

T2L

RMS Deviation = **9.2** % of the Mean Velocity
83.3% of the data are within ± 15 % of the Mean
100.0% of the data are within ± 25 % of the Mean





$$\frac{\textit{MEASURED VELOCITY}}{\textit{MEAN VELOCITY}} \times 100 = \textit{NORMALIZED VELOCITY}$$

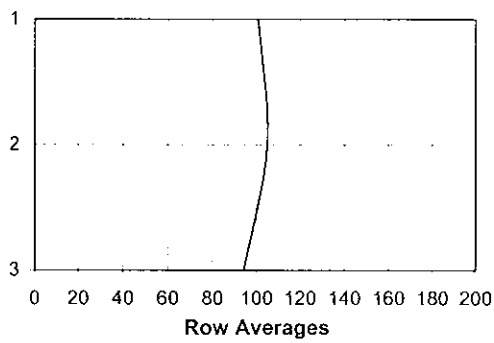
NORMALIZED VELOCITY DISTRIBUTION VIEWED IN DIRECTION OF FLOW

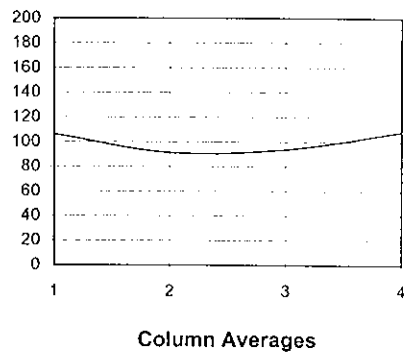
	ADA - ES INC *LITTLETON, COLORADO*	***DATE*** *DEC 2006*
	ENTERGY, INDEPENDENCE STATION UNIT 2 ESP *TOXICON II PROJECT, CARBON INJECTION* *AIR FLOW MODEL STUDY*	*T2L*
NCS Inc. *P119.06* *101306*	*NORMALIZED VELOCITY DISTRIBUTION* *INLET DUCT TO PRECIPITATOR, LOCATION T2L* *EXISTING CONFIGURATION*	***PLATE No.*** *16*

	1	2	3	4	Row Averages
1	101	99	101	102	101
2	112	95	99	114	105
3	106	80	82	109	94
Column Averages	107	91	94	108	

T2R

RMS Deviation = **10.1** % of the Mean Velocity
83.3% of the data are within ± 15 % of the Mean
100.0% of the data are within ± 25 % of the Mean



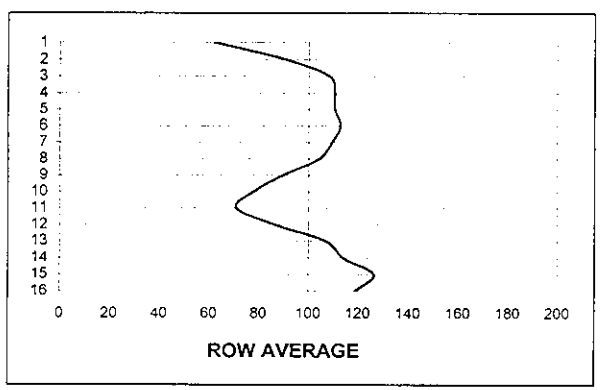


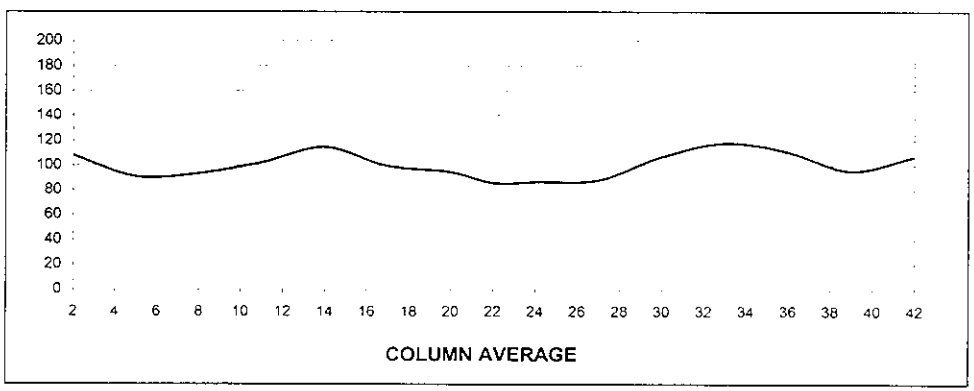
$$\frac{\textit{MEASURED VELOCITY}}{\textit{MEAN VELOCITY}} \times 100 = \textit{NORMALIZED VELOCITY}$$

NORMALIZED VELOCITY DISTRIBUTION VIEWED IN DIRECTION OF FLOW

	ADA - ES INC *LITTLETON, COLORADO*	***DATE*** *DEC 2006*
	ENTERGY, INDEPENDENCE STATION UNIT 2 ESP *TOXICON II PROJECT, CARBON INJECTION* *AIR FLOW MODEL STUDY*	*T2R*
NCS Inc. *P119.06* *101306*	*NORMALIZED VELOCITY DISTRIBUTION* *INLET DUCT TO PRECIPITATOR, LOCATION T2R* *EXISTING CONFIGURATION*	***PLATE No.*** *17*

	2	5	8	11	14	17	20	22	24	27	30	33	36	39	42	ROW AVG.
T.P./T.O.	79	48	19	16	58	29	23	35	25	23	33	41	44	23	67	38
1	68	41	37	49	94	51	51	82	55	46	76	87	80	35	79	62
2	85	41	65	107	123	100	112	109	93	71	109	127	99	38	84	91
3	132	79	77	117	133	124	124	95	94	76	122	131	109	70	142	108
4	142	89	86	122	127	122	101	89	89	89	114	139	112	94	143	110
5	134	91	98	114	134	101	110	93	89	91	119	141	119	99	124	111
6	129	95	101	109	129	110	108	86	99	100	129	142	122	106	124	113
7	119	104	95	101	119	110	94	82	96	104	133	139	115	110	119	110
8	109	96	91	104	118	101	87	79	91	104	122	131	115	109	106	104
9	87	82	76	82	99	86	76	67	81	94	108	113	101	100	94	90
10	53	60	68	71	91	76	71	66	80	81	91	94	91	94	79	78
11	30	56	74	71	84	76	76	75	76	79	79	79	89	84	38	71
12	63	76	105	108	94	93	93	84	78	76	66	94	112	95	60	86
13	112	105	114	124	112	114	100	89	90	94	89	122	120	106	114	107
14	129	122	120	79	134	117	103	91	93	106	110	122	119	120	146	114
15	148	166	150	148	124	104	104	91	91	101	127	112	138	147	145	126
16	186	148	133	127	114	104	101	91	87	95	117	112	132	119	116	119
B.O.	132	106	106	107	82	84	51	71	84	96	106	113	112	101	104	97
B.P.	81	75	90	84	46	38	30	51	57	56	98	84	76	79	71	68
COL.AVG.	108	91	93	102	114	99	94	86	86	88	107	118	111	95	107	



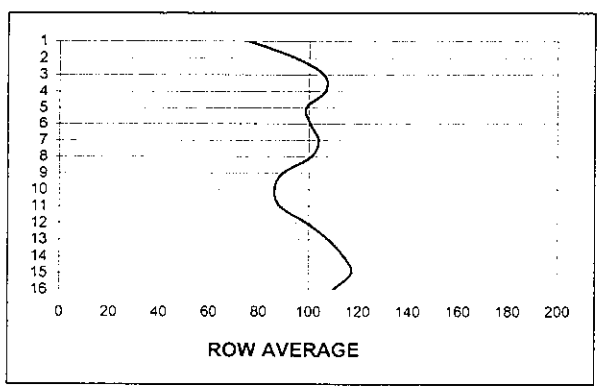


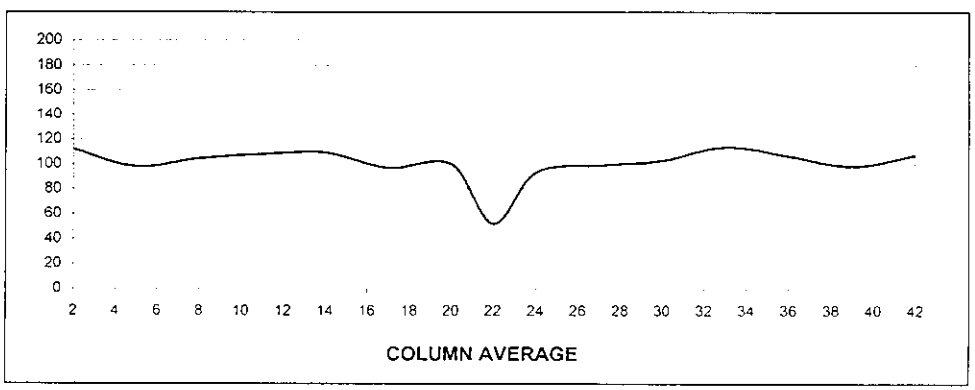
RMS DEVIATION= 25.5 % OF MEAN
% BELOW 115%= 72.1 %
% BELOW 140%= 94.2 %

VELOCITY DISTRIBUTION VIEWED IN DIRECTION OF FLOW

	ADA - ES INC *LITTLETON, COLORADO*	***DATE*** *DEC 2006*
	ENTERGY, INDEPENDENCE STATION UNIT 2 ESP *TOXICON II PROJECT, CARBON INJECTION* *AIR FLOW MODEL STUDY*	T3
NCS INC *P119.06* *10/16/06*	*NORMALIZED VELOCITY DISTRIBUTION* *OUTLET OF FIRST FIELD, LOCATION T3* *EXISTING CONFIGURATION*	***PLATE No.*** *18*

	2	5	8	11	14	17	20	22	24	27	30	33	36	39	42	ROW AVG.
T.P./T.O.	45	25	45	40	64	54	45	32	43	28	34	60	55	30	25	42
1	86	49	78	85	105	50	93	40	89	69	86	109	85	34	78	76
2	110	79	95	113	117	74	107	53	100	88	110	113	98	66	98	95
3	127	90	100	120	119	108	110	54	103	98	108	120	113	95	123	106
4	137	97	104	119	119	108	107	44	94	93	104	129	117	100	128	107
5	123	98	102	109	112	98	88	43	75	90	104	121	110	102	110	99
6	117	93	105	105	109	95	95	50	89	93	115	123	115	103	102	101
7	118	100	103	103	103	104	100	55	98	108	118	129	109	108	102	104
8	111	102	93	94	103	103	94	59	95	112	113	123	102	108	106	101
9	95	93	78	84	88	86	88	53	83	100	100	108	93	98	98	90
10	80	75	83	83	88	86	99	58	84	94	93	97	93	92	88	86
11	75	75	97	88	97	97	108	58	88	95	88	93	97	85	88	88
12	84	91	109	113	118	109	114	59	97	104	93	102	102	91	102	99
13	108	107	120	119	120	114	117	58	103	117	97	111	100	107	122	108
14	123	131	132	129	123	113	115	55	107	115	100	108	115	121	127	114
15	138	148	139	135	117	109	105	48	110	104	103	114	129	132	128	117
16	158	138	133	127	110	97	58	44	75	103	113	120	128	128	120	110
B.O.	148	122	86	104	83	70	75	14	34	75	105	109	115	110	103	90
B.P.	100	50	34	45	45	31	14	3	10	33	60	63	68	53	44	43
COL.AVG.	112	98	104	108	109	97	100	52	93	99	103	114	107	98	107	



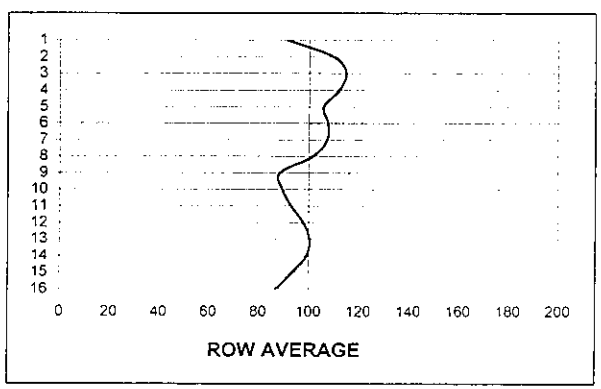


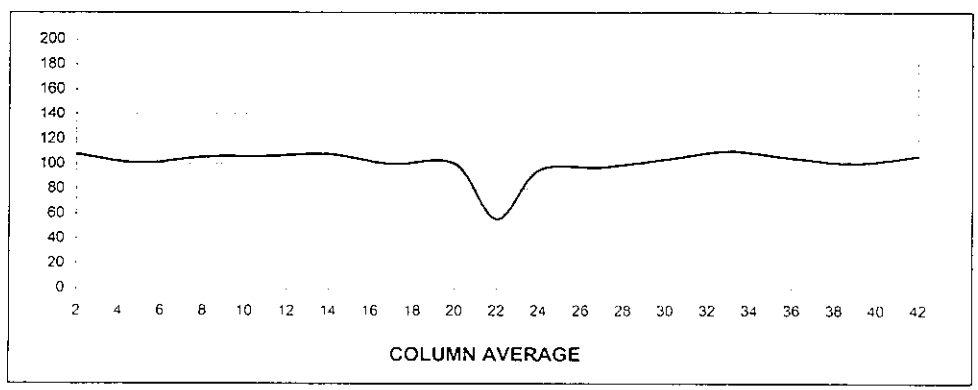
RMS DEVIATION= 21.0 % OF MEAN
% BELOW 115%= 77.1 %
% BELOW 140%= 99.2 %

VELOCITY DISTRIBUTION VIEWED IN DIRECTION OF FLOW

	ADA - ES INC *LITTLETON, COLORADO*	***DATE*** *DEC 2006*
	ENTERGY, INDEPENDENCE STATION UNIT 2 ESP *TOXICON II PROJECT, CARBON INJECTION* *AIR FLOW MODEL STUDY*	T4
NCS INC *P119.06* *10/16/06*	*NORMALIZED VELOCITY DISTRIBUTION* *OUTLET OF SECOND FIELD, LOCATION T4* *EXISTING CONFIGURATION*	***PLATE No.*** *19*

	2	5	8	11	14	17	20	22	24	27	30	33	36	39	42	ROW AVG.
T.P./T.O.	58	32	55	59	71	39	71	44	65	39	38	57	61	29	35	50
1	99	55	95	104	112	97	113	64	94	75	99	105	97	71	92	91
2	115	95	112	120	124	115	120	72	111	103	119	112	114	98	114	110
3	123	106	115	123	127	125	118	66	113	112	114	125	121	110	123	115
4	130	106	114	121	124	120	103	64	94	105	117	127	117	114	124	112
5	113	94	106	108	115	105	101	65	99	105	114	123	115	108	113	106
6	113	98	108	108	108	101	108	65	105	111	120	126	114	111	115	108
7	113	110	106	98	106	105	106	66	103	113	118	125	111	113	118	107
8	108	108	90	98	106	99	101	59	93	111	113	121	104	107	107	102
9	90	85	86	87	94	87	101	54	84	94	94	97	93	92	90	89
10	82	85	94	92	94	92	108	55	90	94	92	97	93	88	85	89
11	85	92	103	100	104	97	109	52	95	98	93	100	98	82	88	93
12	97	104	108	108	110	104	110	50	100	101	95	106	90	87	99	98
13	106	115	111	111	110	104	105	47	101	98	99	100	91	101	108	100
14	112	123	118	112	104	95	85	42	98	90	92	94	104	108	113	99
15	115	123	113	108	98	84	68	37	75	77	80	101	107	111	108	94
16	120	111	106	99	88	70	47	32	61	66	97	101	106	104	100	87
B.O.	112	80	79	85	70	48	28	23	34	59	85	90	95	94	80	71
B.P.	80	38	39	45	40	24	21	5	15	33	44	57	62	61	51	41
COL.AVG.	108	101	105	106	108	100	100	56	95	97	104	110	105	100	106	



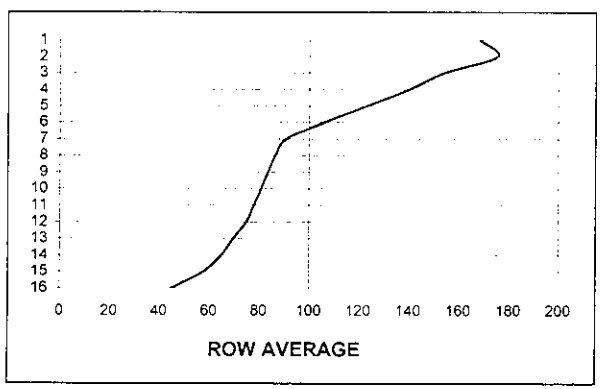


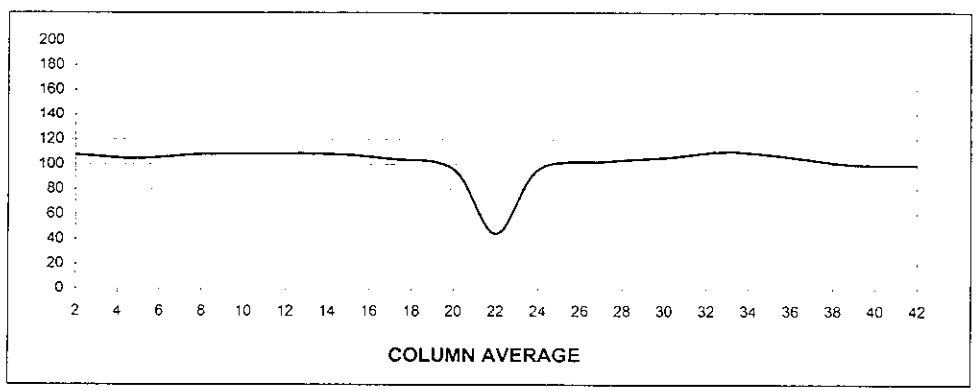
RMS DEVIATION= 17.9 % OF MEAN
% BELOW 115%= 83.8 %
% BELOW 140%= 100.0 %

VELOCITY DISTRIBUTION VIEWED IN DIRECTION OF FLOW

ADA - ES INC *LITTLETON, COLORADO*		***DATE*** *DEC 2006*
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP TOXICON II PROJECT, CARBON INJECTION AIR FLOW MODEL STUDY		T5
NCS INC *P119.06* *10/16/06*	*NORMALIZED VELOCITY DISTRIBUTION OUTLET OF THIRD FIELD, LOCATION T5 EXISTING CONFIGURATION*	***PLATE No.*** 20

	2	5	8	11	14	17	20	22	24	27	30	33	36	39	42	ROW AVG.
T.P./T.O.	96	82	114	113	111	109	118	92	97	86	97	104	112	90	99	101
1	164	154	176	179	181	185	178	137	181	173	180	175	169	150	143	168
2	176	164	177	185	193	195	181	139	178	190	178	183	176	158	159	175
3	154	149	156	158	166	169	156	116	155	164	162	165	156	144	142	154
4	142	136	142	142	146	144	148	92	141	150	150	153	144	135	134	140
5	131	126	125	118	128	132	128	63	120	132	132	139	127	123	124	123
6	116	109	104	109	113	112	115	43	105	114	115	123	111	105	106	107
7	92	89	95	95	97	97	101	31	92	98	97	102	98	90	89	91
8	87	88	92	94	95	97	99	24	92	96	92	95	92	80	74	87
9	87	88	92	94	92	92	90	20	87	92	89	94	86	72	80	84
10	86	90	91	94	92	89	82	12	83	87	86	90	75	72	83	81
11	86	94	90	91	89	83	77	8	76	76	80	79	76	82	84	78
12	86	94	91	90	83	79	67	6	72	72	68	69	83	83	81	75
13	87	90	89	84	76	65	53	5	59	60	60	75	83	81	80	70
14	86	86	83	77	70	53	35	5	51	49	67	76	82	81	74	65
15	79	69	69	67	64	46	23	5	29	43	72	77	76	79	70	58
16	65	49	57	53	47	34	5	6	6	39	58	74	58	64	62	45
B.O.	27	23	28	28	23	21	9	10	5	22	31	42	35	47	35	26
B.P.	5	8	9	7	8	10	5	2	2	5	8	18	12	24	13	9
COL.AVG.	108	105	108	108	108	104	96	44	95	102	105	110	106	100	99	





RMS DEVIATION= 43.3 % OF MEAN
% BELOW 115%= 68.8 %
% BELOW 140%= 77.9 %

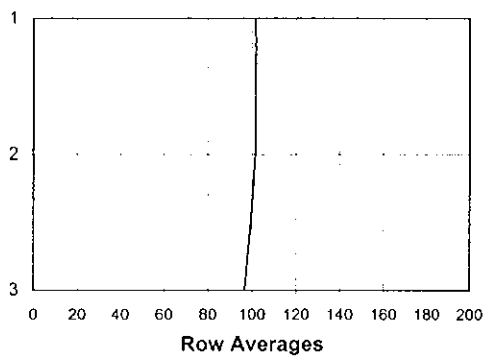
VELOCITY DISTRIBUTION VIEWED IN DIRECTION OF FLOW

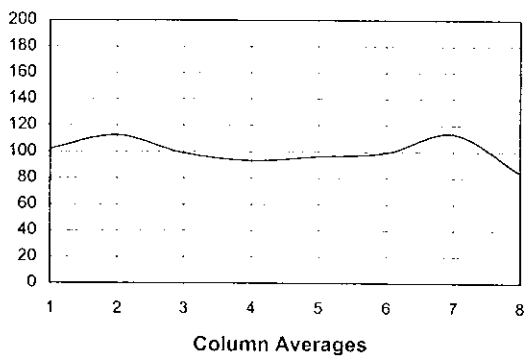
ADA - ES INC *LITTLETON, COLORADO*		***DATE*** *DEC 2006*
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP *TOXICON II PROJECT, CARBON INJECTION* *AIR FLOW MODEL STUDY*		T6
NCS INC *P119.06* *10/16/06*	*NORMALIZED VELOCITY DISTRIBUTION* *OUTLET OF LAST FIELD, LOCATION T6* *EXISTING CONFIGURATION*	***PLATE No.*** *21*

	1	2	3	4	5	6	7	8	Row Averages
1	110	120	97	78	86	98	122	103	102
2	105	115	91	104	109	90	116	81	102
3	91	102	108	98	94	109	103	68	97
Column Averages	102	112	99	93	96	99	114	84	

T7

RMS Deviation = **13.1** % of the Mean Velocity
62.5% of the data are within ± 15 % of the Mean
100.0% of the data are within ± 25 % of the Mean





$$\frac{\textit{MEASURED VELOCITY}}{\textit{MEAN VELOCITY}} \times 100 = \textit{NORMALIZED VELOCITY}$$

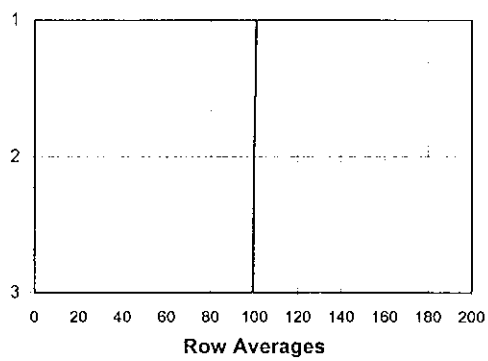
NORMALIZED VELOCITY DISTRIBUTION VIEWED IN DIRECTION OF FLOW

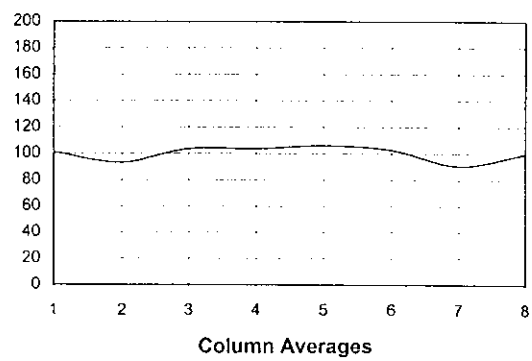
	ADA - ES INC *LITTLETON, COLORADO*	***DATE*** *DEC 2006*
	ENTERGY, INDEPENDENCE STATION UNIT 2 ESP *TOXICON II PROJECT, CARBON INJECTION* *AIR FLOW MODEL STUDY*	*T7*
NCS Inc. *P119.06* *101306*	*NORMALIZED VELOCITY DISTRIBUTION* *OUTLET DUCT FROM PRECIPITATOR, LOCATION T7* *EXISTING CONFIGURATION*	***PLATE No.*** *22*

	1	2	3	4	5	6	7	8	Row Averages
1	96	99	106	106	107	105	94	94	101
2	100	93	105	102	105	104	90	99	100
3	106	87	100	103	106	99	87	106	99
Column Averages	101	93	104	104	106	103	90	99	

T8

RMS Deviation = 6.1 % of the Mean Velocity
100.0% of the data are within ± 15 % of the Mean
100.0% of the data are within ± 25 % of the Mean





$$\frac{\textit{MEASURED VELOCITY}}{\textit{MEAN VELOCITY}} \times 100 = \textit{NORMALIZED VELOCITY}$$

NORMALIZED VELOCITY DISTRIBUTION VIEWED IN DIRECTION OF FLOW

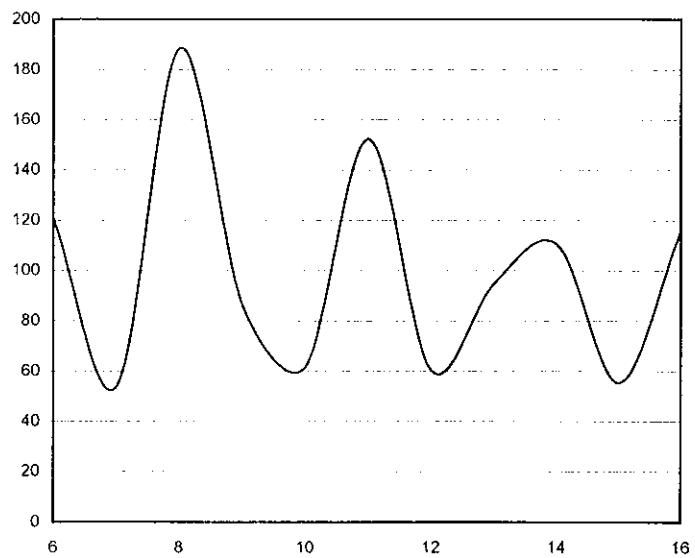
	ADA - ES INC *LITTLETON, COLORADO*	***DATE*** *DEC 2006*
	ENTERGY, INDEPENDENCE STATION UNIT 2 ESP *TOXICON II PROJECT, CARBON INJECTION* *AIR FLOW MODEL STUDY*	*T8*
NCS Inc. *P119.06* *101306*	*NORMALIZED VELOCITY DISTRIBUTION* *OUTLET DUCT FROM PRECIPITATOR, LOCATION T8* *EXISTING CONFIGURATION*	***PLATE No.*** *23*

NORMALIZED GAS DISTRIBUTION

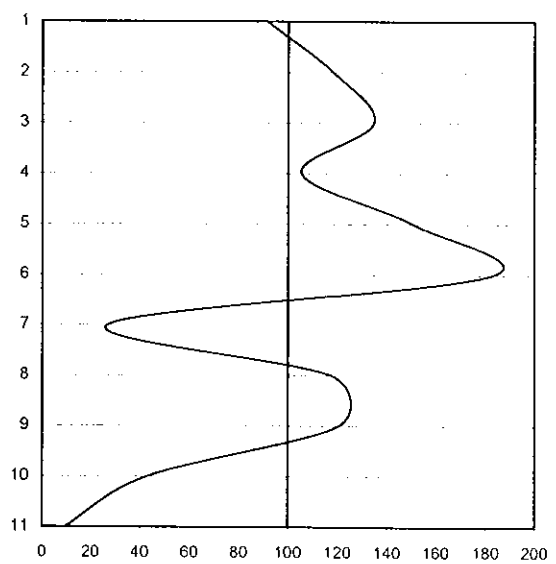
	6	7	8	9	10	11	12	13	14	15	16	ROW AVG.
1	291	34	286	13	69	60	6	107	11	15	113	91
2	176	15	285	116	7	256	120	10	235	62	17	118
3	16	73	315	10	144	206	10	262	56	36	350	134
4	136	26	174	153	10	134	183	13	215	59	56	105
5	33	31	352	159	70	230	66	240	38	21	419	151
6	266	27	384	105	27	449	88	42	460	63	99	183
7	38	20	38	37	8	26	20	31	21	34	22	27
8	348	74	30	262	10	166	98	6	153	136	10	118
9	12	146	196	10	270	136	24	262	13	88	167	120
10	8	132	8	74	50	8	41	49	6	82	15	43
11	4	15	6	9	12	6	7	20	5	13	8	9
COL. AVG.	121	54	189	86	62	152	60	95	110	55	116	

LANCE LANCE LANCE LANCE

<100%
100-200%
>200%



COLUMN AVERAGE



ROW AVERAGE

MEAN CO VALUE= **156.4 PPM**
RMS DEVIATION= **111.5 % OF MEAN**

GAS DISTRIBUTION VIEWED IN DIRECTION OF FLOW
NORMALIZED GAS DISTRIBUTION EXPRESSED AS A PERCENT OF MEAN

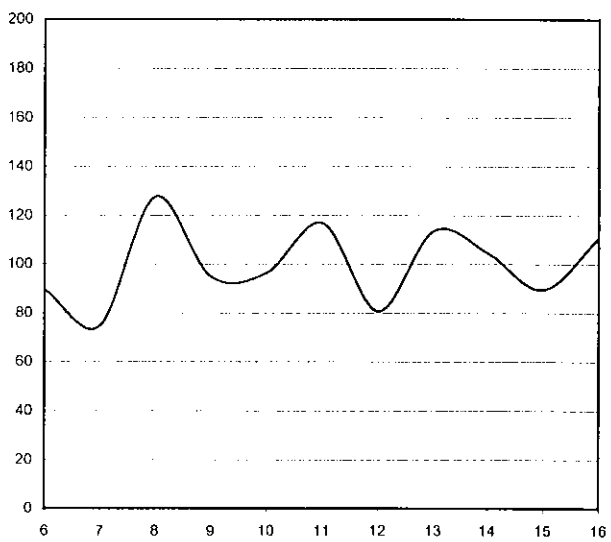
ADA - ES INC *LITTLETON, COLORADO*	***DATE*** *DEC 2006*
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP *TOXICON II PROJECT, CARBON INJECTION* *AIR FLOW MODEL STUDY*	*T5A*
NCS Inc. *P119.06* *102406* *CARBON MONOXIDE DISTRIBUTION* *MIDDLE OF THIRD FIELD, LOCATION T5A* *EXISTING CONFIGURATION*	***PLATE No.*** *24*

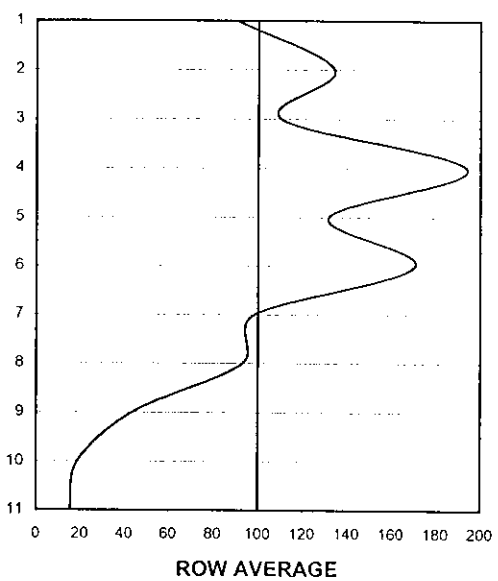
NORMALIZED GAS DISTRIBUTION

	6	7	8	9	10	11	12	13	14	15	16	ROW AVG.
1	105	45	169	124	75	103	39	49	146	106	35	91
2	66	75	216	124	123	156	55	194	155	78	284	134
3	166	84	96	109	60	113	141	83	123	131	109	110
4	138	78	319	234	144	266	173	260	233	105	186	194
5	154	84	131	84	153	218	125	116	131	96	156	132
6	218	118	201	204	135	198	164	174	175	153	138	171
7	54	110	109	58	216	101	50	71	65	114	133	98
8	41	116	109	33	49	88	66	204	73	100	145	93
9	24	68	30	45	69	24	38	46	25	66	44	43
10	10	24	13	20	21	10	23	31	14	20	21	19
11	10	21	11	13	16	10	15	23	13	16	19	15
COL. AVG.	90	75	128	95	96	117	81	114	105	90	111	

LANCE LANCE LANCE LANCE

<100%
100-200%
>200%





MEAN CO VALUE= 80.0 PPM
RMS DEVIATION= 68.8 % OF MEAN

GAS DISTRIBUTION VIEWED IN DIRECTION OF FLOW
NORMALIZED GAS DISTRIBUTION EXPRESSED AS A PERCENT OF MEAN

ADA - ES INC *LITTLETON, COLORADO*	***DATE*** *DEC 2006*
ENTERGY, INDEPENDENCE STATION UNIT 2 ESP *TOXICON II PROJECT, CARBON INJECTION* *AIR FLOW MODEL STUDY*	*T6A*
NCS Inc. *P119.06* *10/24/2006* *CARBON MONOXIDE DISTRIBUTION* *MIDDLE OF LAST FIELD, LOCATION T6A* *EXISTING CONFIGURATION*	***PLATE No.*** *25*

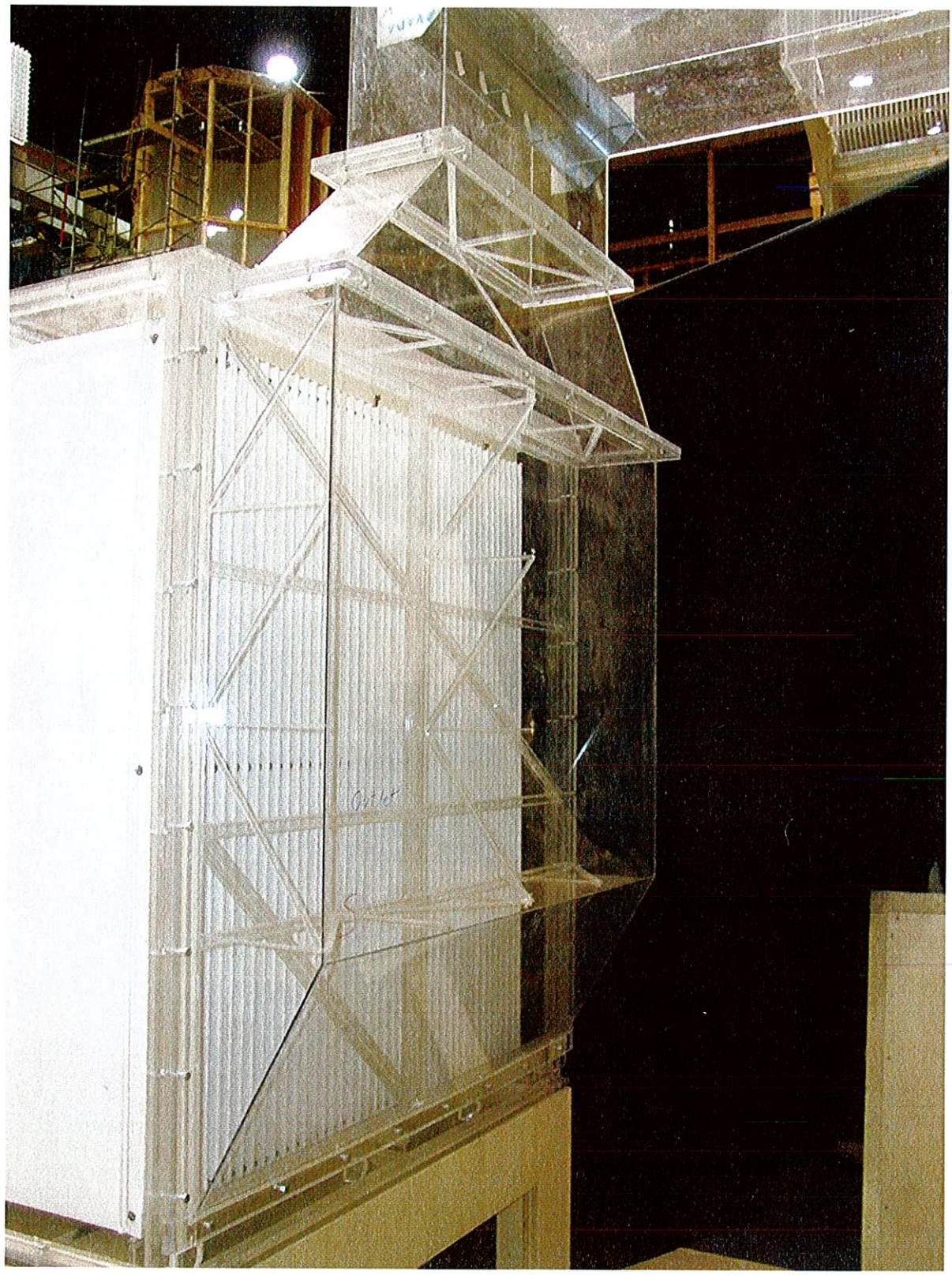
A – General Model Arrangement

B – Bottom of Inlet Plenum

C – Vanes Upstream of The Inlet Plenum

D – Inlet Duct Vanes

E – (PAC) Injection Lance Arrangement



F – Existing Outlet Plenum

APPENDIX F:

Sample Collection and Management Plan

LABORATORY MERCURY FIELD EVALUATION

Evaluation of Sorbent Injection for Mercury Control at Entergy Independence Station

Sample Collection and Management Plan

Prepared by:

ADA Environmental Solutions, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120

July 25, 2005

ADA-ES, Inc. is conducting an evaluation looking at sorbent injection for mercury control at Entergy's Independence Station. The overall objective of this project is to determine the cost and effects of sorbent injection for control of mercury in stack emissions using a TOXECON II sorbent injection configuration.

During the evaluation, fuel samples and certain process byproducts will be collected for determination of mercury content, stability, and other analytes. Process byproduct of primary interest is fly ash; however, other process byproducts may also be collected.

Sample and data management are needed for tracking approximately 500 samples from various solid process streams at Independence Station. ADA-ES has developed a Sample and Data Management System (SDMS) that will store test data from the evaluation. These data can be used to generate reports, track sample history, and input results from laboratory analyses.

ADA-ES will also store plant operational data and other test data during the evaluation. Pertinent plant operating parameters will be logged electronically. For data control and security, full access will be limited to the project manager and site manager at ADA-ES and the sample manager. Operators collecting samples will be able to upload information to the database and print sample labels and Chain-of-Custody forms. ADA-ES will include results with regularly issued reports to the test team.

Sampling Locations

Samples of various gaseous and solid process streams will be collected during the evaluation. Specific flue gas samples are not included in this document. Sampling locations for Independence Station Unit 2 are shown in Figure 1.

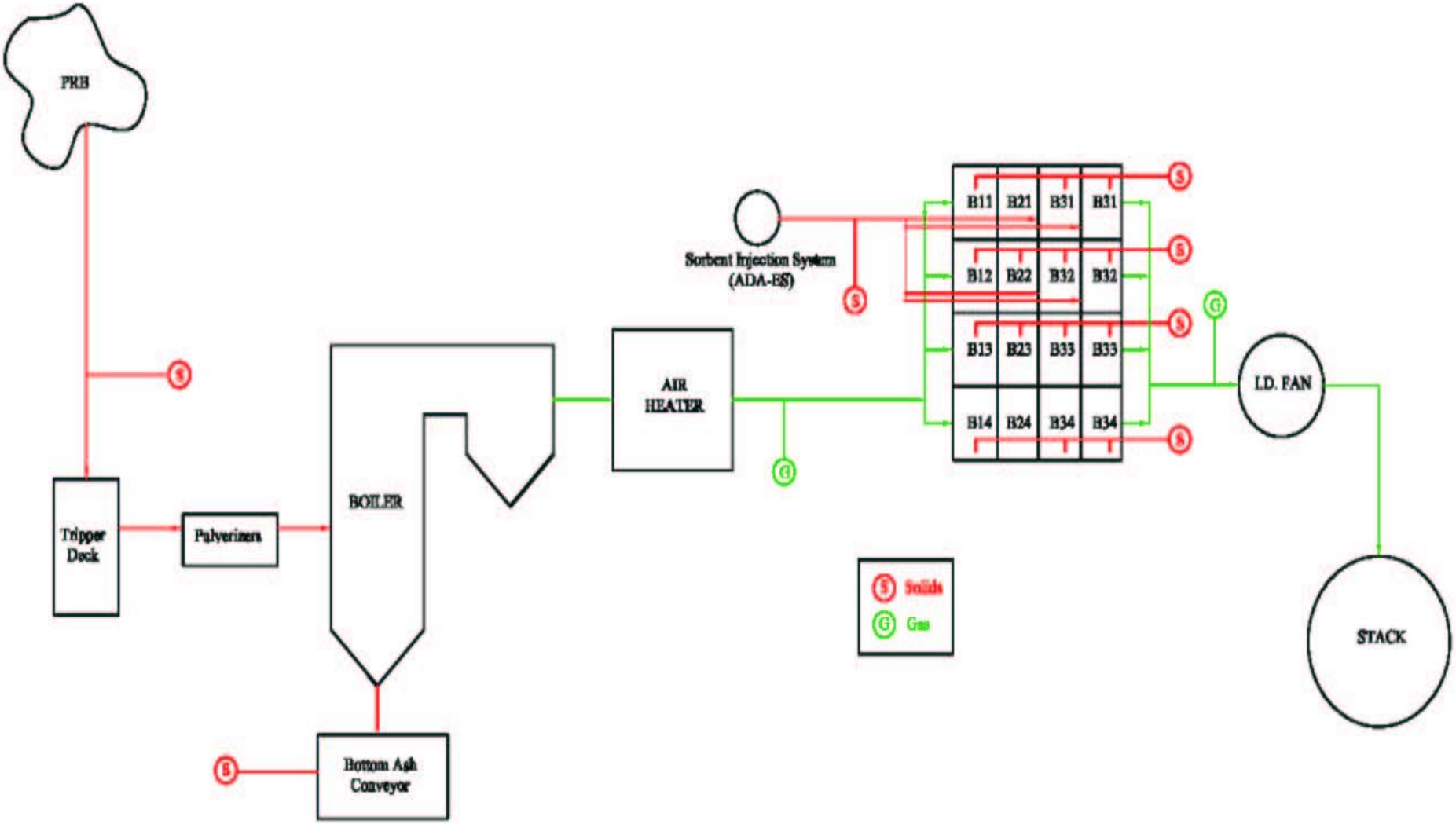


Figure 1. Independence Station Unit 2 Configuration and Sampling Locations.

Sample Collection

Coal and combustion byproducts will be collected during the mercury control evaluation. Samples will be segregated by the test condition (baseline, each parametric test, and long-term test). Collecting a representative sample is the primary objective of the sampling strategy. Representative samples will be collected only under stable and normal operating conditions unless otherwise directed by ADA-ES personnel.

Sample Streams

Coal Samples – Daily grab samples will be collected from the coal conveyor that feeds the unit 2 coal silos. Independence plant personnel will collect the sample between 5:00 am and 11:00 am, thus representing the coal fired between 10:00am and 4:00pm. ADA-ES will provide the sample schedule and sample bottles.

ESP Fly Ash – Grab samples of ash will be collected from the ESP hoppers each day of testing. Samples will be segregated by the test condition (baseline, each parametric test, and long-term test). The samples will be stored in 1-liter or 5-gallon sample containers for shipping to the analytical laboratories.

The schedule indicates sampling from multiple rows on both the control side and test side of the ESP. These samples will be used to determine if stratification exists throughout the system and to compare ash properties of the test side with the control side. A sketch showing the hoppers from the ESP is shown in Figure 2. The shaded hoppers indicate the hoppers from which fly ash samples will be collected.

During testing, the ESP hoppers should be emptied around 10:00am with ash samples being collected at 3:00 pm. This will ensure the sample collected represents the ash collected by the ESP during the test period which typically starts at 10am and ends around 5:00pm. ADA will coordinate ash sampling and hopper emptying activities with plant operations.

Gas Flow

B14*	**B13***	**B12***	**B11***
B24	**B23***	**B22***	**B21***
B34	**B33***	**B32***	**B31***
B44	**B43***	**B42***	**B41***

*Sampled Hopper

Figure 2. ESP Hopper Layout and Sampling Locations.

If possible, plant personnel may collect a fly ash sample inside the ESP at the end of the long-term testing period. This sample should be collected from any surface structures (e.g., ledges, corners) that are capable of holding fly ash material in place for a long period of time. This sample should be exposed to coal-derived flue gas for long periods of time. This sample will be analyzed for metals content (e.g., Hg, As, Se) to help determine if these toxics accumulate over time and surpass any recommended exposure limits.

Table 1. Tentative Sampling Schedule.

Test Condition	Type	Frequency	Volume Collected
Baseline	Coal	Daily	2 liters
	ESP Ash	Daily: One Hopper Each Row on Test Side, Inlet Hopper on Control Side (B12, B22, B32, B42, B13) 2 samples per week: All Hoppers on Test Side, All inlet Hoppers and one Hopper each row on Control Side (B11, B21, B31, B41, B14, B23, B33, B43)	1 liter 1 liter
Parametric	Coal	Daily	2 liters
	ESP Ash	Daily: One Hopper Each Row on Test Side, Inlet Hopper on Control Side (B12, B22, B32, B42, B13) 2 samples per week: All Hoppers on Test Side, One Hopper each row on Control Side (B11, B21, B31, B41, B23, B33, B43)	1 liter 1 liter
Long-Term	Coal	Daily	2 liters
	ESP Ash	Daily: One Hopper Each Row on Test Side, Inlet Hopper on Control Side (B12, B22, B32, B42, B13) 2 samples per week: All Hoppers on Test Side, One Hopper each row on Control Side (B11, B21, B31, B41, B23, B33, B43)	1 liter 1 liter

Sample Management Strategy

During the mercury control evaluation, Independence plant personnel, as directed by ADA-ES, will collect the coal samples. ADA-ES personnel will collect the fly ash samples. ADA-ES will deliver a sampling schedule, which shows the sampling times, volume, and specific samples to collect during each testing day. A sample management flow chart is shown in Figure 3.

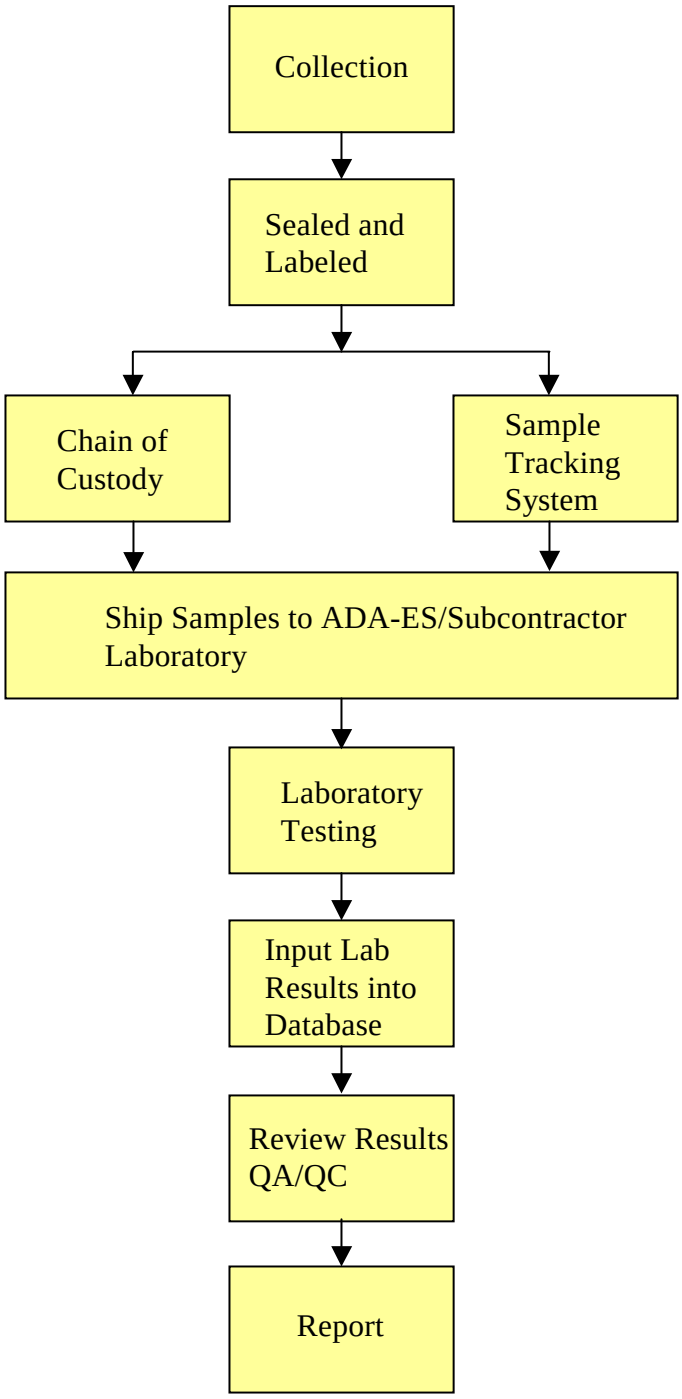


Figure 3. Sample Management Flowchart.

Once the samples have been collected, they will be delivered to ADA-ES personnel to be sealed and labeled. The samples will be logged into a database and given a sample identification number. Authorized project team members will have access to the database to see which samples have been collected and are available for testing.

Once the samples have been sealed and labeled, ADA-ES personnel will generate a Chain-of Custody (COC) form to be delivered with each shipment of samples. The COC will be used for sample tracking and identification. Although ADA-ES will not enforce the strict COC procedures (e.g., signatures to release sample custody, controlled access), all pertinent information will be recorded.

The samples, along with a COC, will be shipped to the ADA-ES laboratory for storage. Once received, ADA-ES will identify samples for mercury, and other, analyses. Other analyses will include ultimate and proximate analyses for coal, elemental analyses for coal and ash samples (including chlorine and fluorine contents), and size distribution analyses for sorbent samples.

Sample Analysis

Although previous tests from other programs have shown that the byproducts mixed with activated carbon are highly stable, it is important to continue evaluating these byproducts for each condition using well-established and documented techniques, and new techniques designed to perform even more robust analyses of the byproducts. Additional ash samples will be collected and archived for other tests, including tests requested by EPA, DOE, and independent companies approved by DOE. No samples will be shipped to outside firms without prior approval of Entergy and DOE.

Standard leaching test methods conducted on the fly ash samples will include the Toxicity Characteristic Leaching Procedure (TCLP, SW846-1311) and the synthetic groundwater leaching procedure (SGLP). Solid and liquid samples will be collected and analyzed according to the methods as prescribed in Table 2. If a chemically treated sorbent is chosen for long-term tests, leaching of the chemical used in the treatment process will be reviewed.

The final series of tests are optional, based on whether a determination is made that additional analyses are needed for purposes of troubleshooting or for gaining additional insight into control options. For example, it may be desirable to determine the size and composition of the ash for certain applications. These analyses will provide information on the impacts of mercury control on ash properties. The properties have a significant impact on the performance of combustion and environmental control systems.

Table 2. Summary of Byproduct and Waste Characterization Testing

Series	Test Purpose	Test Method	Comments
1	Ash Disposal	TCLP (SW846-1311)	Measures leachable Hg, As, Ba, Cd, Cr, Pb, Se, Ag
2	Environmental Stability – Leaching	EERC SGLP	Measures leachable Hg at 18 hours, 2 weeks, and 4 weeks
3	Special Testing	Various	As needed for troubleshooting or site-specific information needs

Once the laboratory testing is complete, results will be logged into the SDMS. Authorized project team members will have access to the database to view the results. A report will be generated summarizing results from the sample analyses.

Flue Gas Samples

Flue gas measurements will be made at the locations indicated on Figure 1. Flue gas analyses include Ontario Hydros, Method 17, and Method 26a. Hg analyzers and sorbent trap method tests (STM) will also be used at selected locations measuring near-real-time vapor-phase mercury concentrations in the flue gas.

Table 3. Sampling and Analytical Matrix.

Sampling Location	Sample/Type	Sampling Method	Analytical Method
ESP Inlet	Speciated Mercury	Ontario Hydro	EPA SW 846 7470 cold vapor atomic absorption spectrometry (CVAAS)
	HBr, HCl, HF, BR_2, CL_2	M26a	Ion chromatography per the promulgated EPA Method 26a
	Particulate Matter	M17	Gravimetrically
	Hg	STM	EPA Method 1631
	Total/Elemental Mercury	Continuous	AF or AA -Analysis
ESP Outlet	Speciated Mercury	Ontario Hydro	EPA SW 846 7470 cold vapor atomic absorption spectrometry (CVAAS)
	HBr, HCl, HF, BR_2, CL_2	M26a	Ion chromatography per the promulgated EPA Method 26a
	Particulate Matter	M17	Gravimetrically
	Hg	STM	EPA Method 1631
	Total/Elemental Mercury	Continuous	AF or AA-Analysis
Coal Fuel to Boiler	Hg	Grab Sample	ASTM D6414-99 or 01
	Cl	Grab Sample	Modified ASTM D5808 (Oxidative Hydrolysis Microcoulometry)
	F	Grab Sample	TBD
	Ultimate Analysis	Grab Sample	
	Proximate Analysis	Grab Sample	
	Trace Metals	Grab Sample	
Bottom Ash, Fly Ash	Hg	Grab Sample	ASTM D6414-99 or 01
	Cl	Grab Sample	Modified ASTM D5808 (Oxidative Hydrolysis Microcoulometry)
	LOI / Carbon Content	Grab Sample	ASTM C311-04
	Leaching	Grab Sample	TCLP, SW846-1311, SGLP
	Trace Metals	Grab Sample	