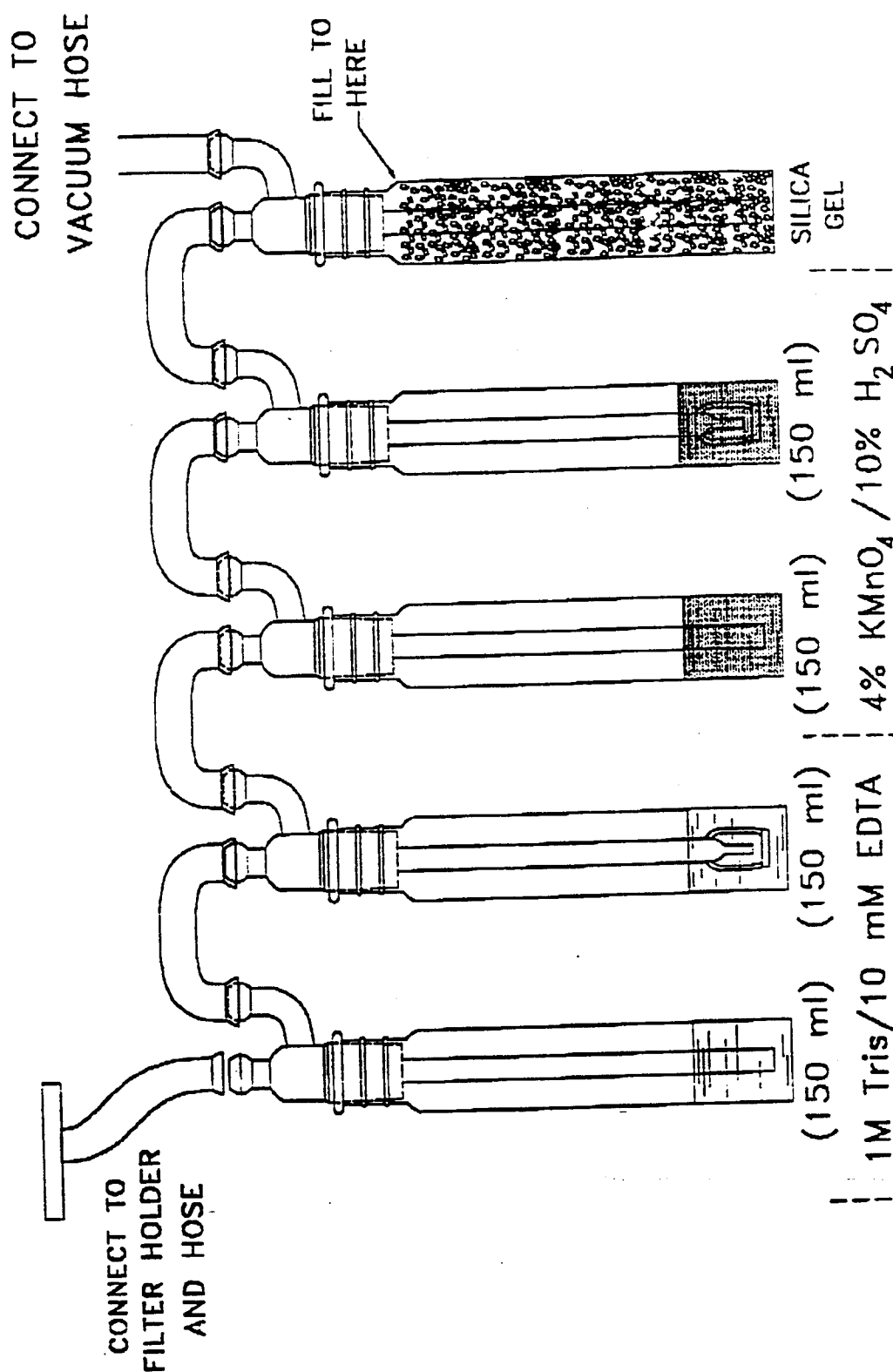


APPENDIX A  
EERC ONTARIO-HYDRO AND TRIS BUFFER  
MERCURY SPECIATION METHODS ANALYTICAL PLAN



# TRIS BUFFER METHOD

## TRAIN ASSEMBLY

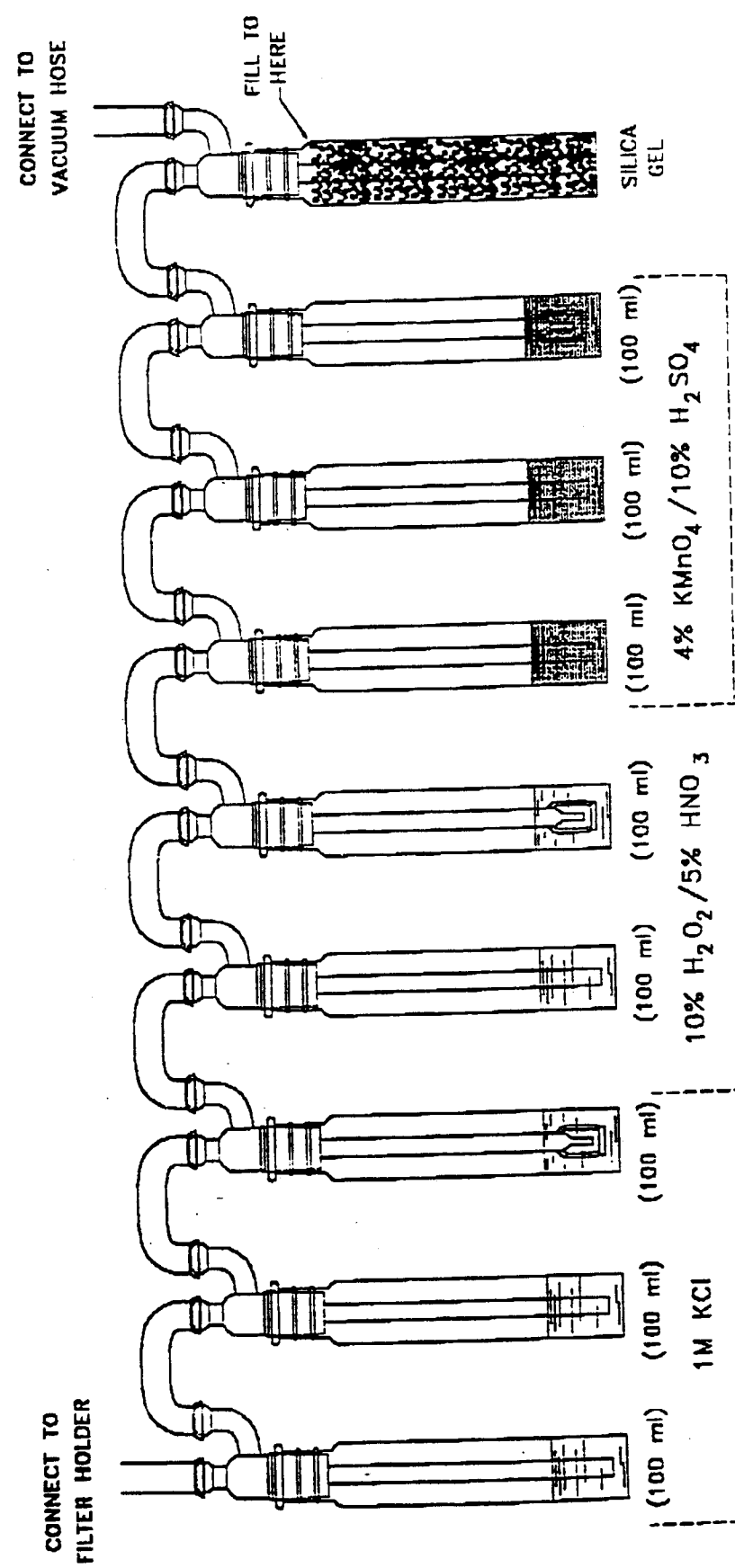






# ONTARIO-HYDRO METHOD

## TRAIN ASSEMBLY

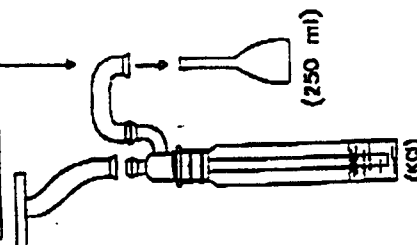


# ONTARIO-HYDRO METHOD

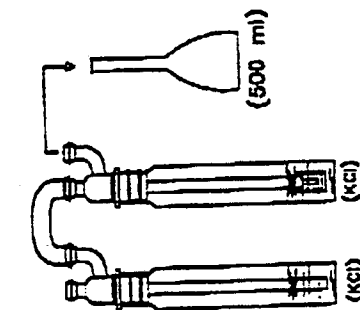
## SAMPLE RECOVERY

1. ADD  $\text{KMnO}_4/\text{H}_2\text{SO}_4$  TO EACH KCl IMPINGER BOTTLE UNTIL PURPLE COLOR REMAINS. (10-30 ml)
2. RINSE WITH .1N NITRIC ACID.
3. RINSE WITH 8N HCl IF BROWN RESIDUE REMAINS.
4. FINAL RINSE WITH .1N NITRIC ACID.

RINSE FILTER HOLDER  
AND HOSE WITH  
.1 N NITRIC ACID



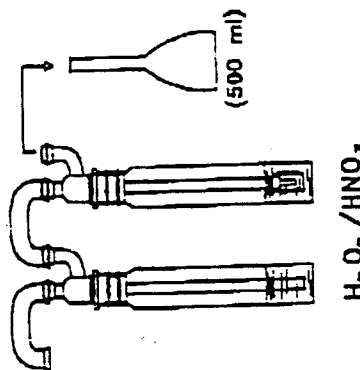
POTASSIUM CHLORIDE (KCl)



(KCl)

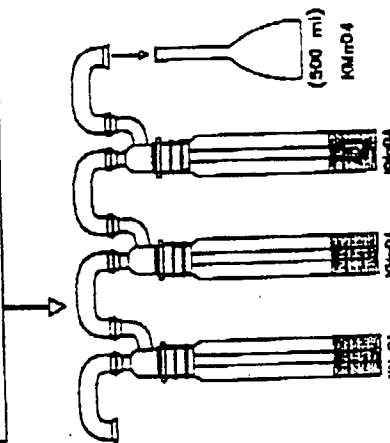
(KCl)

RINSE WITH  
.1N NITRIC ACID



$\text{H}_2\text{O}_2/\text{HNO}_3$

RINSE BOTTLES SPARINGLY WITH:  
—.1 N NITRIC ACID  
— 8 N HCl  
—.1 N NITRIC ACID



POTASSIUM PERMANGANATE  $\text{KMnO}_4$

RINSE ALL U-TUBES WITH  
.1N NITRIC ACID

## **PRESERVATION OF TRIS BUFFER IMPINGERS**

1. REMOVE THE GLASS CONNECTOR JOINING THE OUTLET OF THE FILTER TO THE FIRST IMPINGER. TURN THE PUMP ON TO ABOUT **10 SCFH**.
2. POUR **25mL OF 30% PEROXIDE** INTO THE FIRST IMPINGER VERY SLOWLY WHILE DRAWING AMBIENT AIR INTO THE IMPINGERS.
3. REMOVE THE GLASS CROSSOVER JOINING THE FIRST AND SECOND IMPINGERS.
4. POUR **25 mL OF 30% PEROXIDE** INTO THE SECOND IMPINGER.
5. REPLACE GLASS CROSSOVER JOINING THE FIRST AND SECOND IMPINGERS.
6. POUR **20 mL OF NITRIC ACID VERY SLOWLY** INTO THE FIRST IMPINGER **CO<sub>2</sub> IS EVOLVED FROM THIS SOLUTION DURING THIS STEP SO BE CAREFUL NOT TO ALLOW THE IMPINGER TO OVERFLOW WHILE OFF-GASSING.**
7. REMOVE THE CROSSOVER JOINING THE FIRST AND SECOND IMPINGERS.
8. POUR **20 mL NITRIC ACID** INTO THE SECOND IMPINGER. ADD THE NITRIC EVEN SLOWER THAN INTO THE FIRST IMPINGER.
9. REPLACE THE CROSSOVER AND INCREASE THE AMBIENT AIR SAMPLING RATE TO ABOUT 30 SCFH TO CAUSE INCREASED OR COMPLETE MIXING.
10. AFTER ABOUT 30 SECONDS STOP THE AMBIENT AIR SAMPLING, RECOVER AS USUAL.

## **KMnO<sub>4</sub> Impinger Preparation**

Updated 5-20-96

### **Reagents:**

Hydroxylamine Sulfate

### **Method:**

Add hydroxylamine sulfate to potassium permanganate impinger until the solution remains colorless.  
Analyze by CVAA.

### **Notes:**

Reaction is effervescent, use care when mixing.  
One duplicate should be analyzed every 5 samples.  
One triplicate and one spike should be analyzed every 10 samples.

### **Handling Procedures:**

Corrosive- contains H<sub>2</sub>SO<sub>4</sub>  
Hazardous- contains strong oxidizer, KMnO<sub>4</sub>

## H2O2 impinger preparation

updated 11-1-95

### Reagents:

HCl conc.  
KMnO<sub>4</sub> sat'd solution  
Hydroxylamine Sulfate

### Method:

Transfer 5 mL of sample to a 50 mL digestion tube,  
Add 0.25 mL conc. HCl  
Swirl, and let stand approximately 10 min.  
Place tubes in a sample rack, and place in an ice bath,  
Allow to cool for approximately 15 min.  
Slowly add saturated potassium permanganate, waiting 15 min. between additions, to the samples in 0.25 mL increments, swirling between additions, up to 1.25 mL, then in 0.5 mL increments until the solution remains brownish-purple.  
Reduce the excess potassium permanganate with solid hydroxylamine sulfate.  
Analyze by CVAA.

### Notes:

The overall addition of potassium permanganate takes approximately 4 hours.  
One duplicate should be analyzed every 5 samples.  
One triplicate and one spike should be analyzed every 10 samples.

### Handling Procedures:

Corrosive- contains HNO<sub>3</sub>, HCl  
Hazardous- contains strong oxidizers, KMnO<sub>4</sub>, H<sub>2</sub>O<sub>2</sub>

## KCl impinger digestion

Updated 4-6-95

### Reagents:

KMnO<sub>4</sub> sat'd solution  
K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> solution (5 g in 100 mL)  
H<sub>2</sub>SO<sub>4</sub> conc.  
HNO<sub>3</sub> conc.  
Hydroxylamine Sulfate

### Method:

Transfer 10 mL of sample to a 50 mL digestion tube.  
Add 0.5 mL of H<sub>2</sub>SO<sub>4</sub>,  
Add 0.25 mL of HNO<sub>3</sub>,  
Add 1.5 mL of KMnO<sub>4</sub> solution.  
Let the mixture stand for 15 minutes.  
Add 0.75 mL of K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> solution.  
Place the samples in a dry block heater at 95°C for two hours. Cool to room temperature.  
Reduce the excess potassium permanganate with solid hydroxylamine sulfate.  
Analyze by CVAA.

### Notes:

One duplicate should be analyzed every 5 samples.  
One triplicate and one spike should be analyzed every 10 samples.

### Handling Procedures:

Corrosive- contains HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>.  
Hazardous- contains strong oxidizers KMnO<sub>4</sub>, and K<sub>2</sub>S<sub>2</sub>O<sub>8</sub>.

## TRIS Buffer impinger preparation

updated 5-20-96

### Reagents:

KMnO<sub>4</sub> sat'd solution  
K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> solution (5g in 100 mL)  
H<sub>2</sub>SO<sub>4</sub> conc.  
HNO<sub>3</sub> conc.  
HCl conc.  
Hydroxylamine Sulfate

### Method:

Transfer 5 mL of sample to a 50 mL digestion tube  
Add 0.5 mL conc. H<sub>2</sub>SO<sub>4</sub>  
Add 0.25 mL conc. HNO<sub>3</sub>  
Add 0.25 mL conc. HCl  
Add 1.0 mL K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> solution  
Place sample tubes in a sample rack, and place in an ice bath, and allow to cool for approximately 15 min.  
Slowly add potassium permanganate, waiting 15 min. between additions, to the samples in 0.25 mL increments, up to 1.25 mL swirling between additions, then in 0.5 mL increments until the solution remains brownish-purple.  
Reduce the excess potassium permanganate with solid hydroxylamine sulfate.  
Analyze by CVAA.

### Notes:

The overall addition of potassium permanganate takes approximately 4 hours.  
One duplicate should be analyzed every 5 samples.  
One triplicate and one spike should be analyzed every 10 samples.

### Handling Procedures:

Corrosive- contains H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, HCl  
Hazardous- contains strong oxidizers, KMnO<sub>4</sub>, K<sub>2</sub>S<sub>2</sub>O<sub>8</sub>

## ARL QUALITY ASSURANCE/QUALITY CONTROL PROTOCOL

### Laboratory Glassware and Plasticware

All glass volumetric flasks and transfer pipets used in the preparation of analytical reagents and calibration standards are designated as class "A" to meet Federal specifications.

Special cleaning procedures are required for all laboratory glassware and plasticware related to mercury analysis. This procedure includes washing with hot soapy water, several rinses with tap water and several rinses with distilled deionized water.

All vessels are then soaked in 5% bromine monochloride ( $\text{BrCl}$ ) solution (see reagent preparation) for a minimum of 30 minutes followed by several rinses with distilled deionized water.

Any samples requiring mercury analysis that are stored for more than 24 hours are transferred to teflon FEP storage bottles that have undergone the above cleaning procedure.

### Analytical Reagents

All acids used for the analytical methods that pertain to trace metal analysis including mercury are trace-metal-grade. Other chemicals used in the preparation of analytical reagents are analytical-reagent-grade.

The calibration standards used for instrument calibration and the quality control (QC) standards used for calibration verification are purchased commercially and certified to be accurate within  $\pm 0.5\%$  and are traceable to NIST Standard Reference Materials.

### Instrument Setup and Calibration

The instrument used for mercury determination in the ARL is a Leeman Labs PS200 cold vapor mercury analyzer. The instrument is set up for absorption at 253.7 nm with a carrier gas of nitrogen and 10% stannous chloride in 10% HCl as the reductant. The instrument is set up by daily replacing the drying tube and acetate trap, containing magnesium perchlorate and soda-lime respectively. The tubing is checked and replaced if necessary. The rinse container is rinsed and filled with fresh solution of 10% HCl. The pump and lamp are turned on. After a warm up time of 45 minutes, the aperture is set to the manufacturer specifications. A four point calibration curve, with matrix matched standards is used. The detector response for a given standard is logged and compared to specifications to insure proper instrument setup and response.



water. This will not all dissolve, but all the solid must be wet. While swirling the bottle gently, 800 ml of low mercury Ultrex brand concentrated HCl are then slowly added. Caution must be shown, because of heat and toxic fumes generated during preparation. Once cooled, the reagent may be stored in a glass-stoppered bottle, in a cool place.

### Spiking Solution

The spiking solution used to spike the impinger trains will be prepared in the ARL from a commercially purchased ICP stock standard at a concentration of 1000 mg Hg/L. This standard is traceable to NBS standard reference materials and consists of mercury metal in 10% HNO<sub>3</sub>. The final spiking concentration has yet to be determined, however the concentration will be verified in the laboratory before being added to the impinger trains.

### Analytical Equipment

#### Leeman Labs Mercury Analyzer

The PS200 automated mercury analyzer is based on cold vapor atomic absorption spectroscopy. The calculated quantitation level is 200 ng/L.

#### Analytical Balance

The analytical balance used in the ARL for weighing solid materials prior to acid digestion is a Sartorius 1601 MP8. The readability of this balance is 0.1 mg with a maximum capacity of 111 g. The calibration of the balance is checked routinely with standardized weights traceable to NBS. It is also maintained annually by Northern Balance and Scale.

#### Microwave Sample Preparation System

The CEM MDS-2100 has a power output of 950 watts with an in-board pressure controller for safe and efficient acid digestion of solid materials such as coal and coal combustion by-products.

The digestion vessels used with this system are teflon lined and sealed during the digestion procedure to help insure zero loss of volatile analytes.

A recently purchased MDS-2100 equipped with temperature and pressure controllers as well as sealed heavy duty digestion vessels designed for high pressure applications such as coal dissolution is currently undergoing methods development. The ultimate goal is to increase the amount of solid material in the digestion which will in turn decrease the quantitation level in the sample.

### External Quality Control

immediately taken and analyzed for mercury. This includes both solutions prepared for the Method 29 impinger train as well as the acid mixture used for the microwave dissolution of solids.

#### Method blank

A method blank is prepared by following the procedure step by step adding all of the reagents in the quantities specified by the method. This is done to determine whether significant levels of mercury have accumulated during the procedures prior to analysis. If the method blank shows contamination above instrument background, steps must be taken to eliminate or reduce the contamination to below background levels. If the contamination cannot be eliminated, the magnitude of the contamination must be considered when calculating the concentration of mercury in the samples. The ARL has to date not produced a method blank that contained contamination above instrument background.

#### Reagent Preparation

##### Impinger Solutions

##### Potassium Permanganate/Sulfuric Acid solution

One hundred mL of concentrated sulfuric acid is added to approximately 700 mL of deionized water, mixed, and allowed to cool. Forty g of potassium permanganate is added, the solution is stirred until the solids are dissolved, and then the solution is diluted to 1 liter.

##### Hydrogen Peroxide/Nitric Acid solution

666 mL of 30% hydrogen peroxide is added to approximately 200 mL of deionized water and mixed. 35.1 mL of concentrated nitric acid is added and the solution is diluted to 1 liter.

##### Potassium Chloride solution

74.6g potassium chloride is added to approximately 200 mL H<sub>2</sub>O and dissolved and the solution is diluted to 1 liter.

Aliquots of these solutions are taken and analyzed for mercury or other analytes of interest and the remainder is refrigerated and used within 24 hours of combustion time.

##### Bromine Monochloride (BrCl) Solution

The reagent is prepared by adding 11.0g of reagent grade KBrO<sub>3</sub> and 15.0g of reagent grade KBr to 200 ml of high purity



Mr. William H. Maxwell  
United States Environmental Protection Agency  
OAQPS/ESD/CG  
Research Triangle Park  
North Carolina, 27711

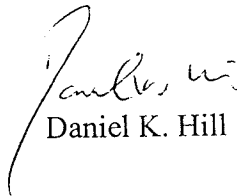
May 28, 1999

Dear Mr. Maxwell:

This correspondence is response to your letter dated May 7, 1999 requesting further documentation related to the speciated mercury emissions testing performed during 1996 on Unit 2 here at AES Cayuga, formerly Milliken Station. Attached you will find a substantial document which specifically addresses the mercury part of the test program and will hopefully satisfy your request. With regards to your comment on the "confidential" label on each page of the report, please consider the report non-confidential for the purposes of the EPA.

If you require any other information, please let me know.

Very truly yours,



Daniel K. Hill

CC: Al Vought  
Mark Adams  
Pete Batrowny  
Mark Buzel  
Andy Chadwick  
John Marabella



From: Daniel K. Hill <dhill@aesc.com>  
To: RTP3.RTMU546 (MAXWELL-BILL)  
Date: 2/14/00 9:55am  
Subject: Re: AES Cayuga test information

MAXWELL.BILL@epamail.epa.gov writes:

>We have received both the original report (July 1997) and the  
>supplemental, follow-up information  
>(also dated July 1997), on the testing performed on the AES Cayuga  
>(Milliken) facility. Your letter  
>of May 28, 1999, indicates that we may consider the "report  
>non-confidential for the purposes of  
>the EPA." To avoid any confusion, I would appreciate a letter stating  
>that this phrase applies to  
>both reports/submittals. Thank you.

Bill-

As you have requested, please consider this email as authorization to to  
use both referenced reports as non-confidential.

Dan

CC: RTP6.RTPEML (GRIMLEY-WILLIAM) , RTPMAINHUB.INTERNET ("...



**MERCURY SPECIATION TEST PROGRAM  
RESULTS FROM  
NEW YORK STATE ELECTRIC & GAS  
CORPORATION'S MILLIKEN STATION  
UNIT 2, LANSING, NEW YORK**

Prepared For:

**NEW YORK STATE ELECTRIC & GAS CORPORATION**  
Binghamton, New York

Prepared By:

Kusha D. Janati

**CARNOT**  
Tustin, California

FINAL: JULY 1997


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## REVIEW AND CERTIFICATION

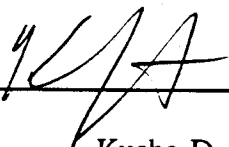
All work, calculations, and other activities and tasks performed and documented in this report were carried out under my direction and supervision.

  
\_\_\_\_\_

Date 6/6/97

Kusha D. Janati  
Senior Engineer  
S. Cal. Emis. Measurement Div.

I have reviewed, technically and editorially, details, calculations, results, conclusions and other appropriate written material contained herein, and hereby certify that the presented material is authentic and accurate.

  
\_\_\_\_\_

Date 6/6/97

Kusha D. Janati  
Senior Engineer  
S. Cal. Emis. Measurement Div.

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## ABBREVIATIONS

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AAS	Atomic Absorption Spectroscopy
APCD	Air Pollution Control Device
ASTM	American Society for Testing Materials
BIF	Boiler and Industrial Furnaces
BrCl	Bromine Monochloride
Btu	British Thermal Unit
°C	Degrees Celsius
CAAA	Clean Air Act Amendments
CaCl <sub>2</sub>	Calcium Chloride
CARB	California Air Resources Board
CCTD	Clean Coal Technology Demonstration
CE	Combustion Engineering
CEMS	Continuous Emissions Monitoring System
CI	Confidence Interval
Cl <sup>-</sup>	Chloride
CO <sub>2</sub>	Carbon Dioxide
CO	Carbon Monoxide
CONSOL	CONSOL Inc. Research and Development
Cr <sup>6+</sup>	Hexavalent Chromium
Cr <sup>3+</sup>	Trivalent Chromium
CTE	Commercial Testing and Engineering Company
CVAA	Cold Vapor Atomic Absorption
CVAFS	Cold Vapor Atomic Fluorescence Spectroscopy
DGA	Double Gold Amalgamation
DI	Deionized
DNPH	2,4-Dinitrophenylhydrazine

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## ABBREVIATIONS

DOE	United States Department of Energy
DSCF	Dry Standard Cubic Feet, 68°F and 1 atm
DSCFM	Dry Standard Cubic Feet per Minute
ECTC	Environmental Control Test Center
EDTA	Ethylenediaminetetracetic Acid
EERC	The Energy and Environmental Research Center
EPA	See USEPA
EPRI	Electric Power Research Institute
ESP	Electrostatic Precipitator
°F	Degrees Fahrenheit
F-Factor	Fuel-Factor
FCEM	Field Chemical Emissions Monitoring
FD	Forced Draft
FeCl <sub>3</sub>	Ferric Chloride
FGD	Flue Gas Desulfurizer or Flue Gas Desulfurization
F	Fluoride
g	grams
GC	Gas Chromatography
GFAAS	Graphite Furnace Atomic Absorption Spectrometry
gpm	gallons per minute
gr	grains
H <sub>2</sub> O <sub>2</sub>	Hydrogen Peroxide
H <sub>2</sub> SO <sub>4</sub>	Sulfuric Acid
HCl	Hydrochloric Acid
HDPE	High-D
HF	

## ABBREVIATIONS

---

Hg(0)	Elemental Mercury
Hg(II)	Oxidized Mercury
HGAA	Hydride Generation Atomic Absorption
HHV	Higher Heating Value
HNO <sub>3</sub>	Nitric Acid
HPLC	High Performance Liquid Chromatography
HRGC	High Resolution Gas Chromatography
HRMS	High Resolution Mass Spectrometry
HxCDD	Hexa-chlorinated Dibenzo-p-Dioxin
IC	Ion Chromatography
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
IC-PCR	Ion Chromatography with Post Column Reaction
IN	ESP Inlet
IR	Infrared
ISE	Ion-Selective Electrode
L or l	liters
KCl	Potassium Chloride
kg	Kilogram
klb	1000 pounds
KMnO <sub>4</sub>	Potassium Permanganate
KOH	Potassium Hydroxide
kW	Kilowatt
lb	Pound (mass)
LOI	Loss On Ignition
LRMS	Low-Resolution Mass Spectrometry

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## ABBREVIATIONS

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m <sup>3</sup>	Cubic Meter
MCW	Maintenance Cleaning Water
MESA	Mercury Speciation Absorption
mg	milligrams
ml	milliliter
MM	Micron or Micrometer
MS	Mass Spectrometry
MW	Megawatt
MWe	Megawatt Net
MMBtu or 10 <sup>6</sup> Btu	Million Btu (see Btu)
N	Normal
N <sub>2</sub>	Nitrogen
NaHCO <sub>3</sub> /Na <sub>2</sub> CO <sub>3</sub>	Sodium Carbonate/Sodium Bicarbonate
NBS	National Bureau of Standards
ND<	Non-detected less than
ng	nanograms
Nm <sup>3</sup>	Normal Cubic Meter, corrected to 0°C and 1 atm
NO <sub>x</sub>	Nitrogen Oxides
NYSEG	New York State Electric & Gas Corporation
10 <sup>12</sup> Btu.	Trillion Btu
ND	Not Detected
NDIR	Non-Dispersive Infrared
NH <sub>3</sub>	Ammonia
NIST	National Institute of Standards and Testing
O <sub>2</sub>	Oxygen
OUT	ESP Outlet

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## ABBREVIATIONS

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PAH	Polycyclic Aromatic Hydrocarbons
PCDD/PCDF	Polychlorinated Dibenzo-p-dioxins/Polychlorinated Dibenzofurans
PM	Particulate Matter
ppb	parts per billion
ppm	parts per million
PISCES	Power Plant Integrated Systems Chemical Emissions Studies
PSD	Particle Size Distribution
PVC	Polyvinyl Chloride
PWRF	Process Wastewater Reclamation Facility
QA	Quality Assurance
QC	Quality Control
RPDM	Relative Percent Difference from the Mean
RTI	Research Triangle Institute
S-H-U	Saarberg-Holter Umwelttechnik GmbH
Semi-VOST	Semi-Volatile Organic Sampling Train
SIM	Selective Ion-Monitoring
SO <sub>2</sub>	Sulfur Dioxide
SO <sub>3</sub>	Sulfuric Acid Mist
SO <sub>4</sub> <sup>2-</sup>	Sulfate
SnCl <sub>2</sub>	Stannous Chloride
STK	Stack
SW	Solid Waste
TCDD	Tetra-chlorinated Dibenzo-p-Dioxin
TDS/TSS	Total Dissolved Solids/Total Suspended Solids
TRIS	Tris (hydroxymethyl) aminomethane
USEPA	United States Environmental Protection Agency

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## ABBREVIATIONS

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UV	Ultraviolet
µg	micrograms
µm	micron or micrometer
VmStd	Sample Volume corrected to 68°F and 1 atm, dscf
VOC	Volatile Organic Compounds
VOST	Volatile Organic Sampling Train
WWTP	Wastewater Treatment Plant
Zenon	Zenon Environmental Laboratories

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## EXECUTIVE SUMMARY

To satisfy DOE's CCTD program requirements, NYSEG, through a competitive bidding process, selected Carnot to conduct a comprehensive measurement program to characterize the emissions of selected trace substances from Milliken Station's Unit 2, both pre- and post-retrofit of SO<sub>2</sub>, NO<sub>x</sub>, and particulate control systems. Prior to the pollution control system upgrades, Carnot performed a "baseline" comprehensive trace substance measurement program on Unit 2 in 1994. A post-retrofit test program was performed in August 1996.

To continue researching the viability and applicability of certain wet chemical techniques for collecting and subsequently detecting and quantifying species of mercury in coal-fired utility boiler flue gas streams, Carnot, under an extended contract with NYSEG with the cooperation and support of DOE, and the Energy & Environmental Research Center (EERC) at the University of North Dakota, under a separate contract with EPRI, performed a utility-scale field evaluation of two emerging techniques, the Ontario-Hydro and TRIS Buffer, for mercury speciation. Since EPA Method 29 and Frontier Geosciences' solid sorbent scrubber technique were already part of the post-retrofit test program scope, by expanding the program to include the Ontario-Hydro and TRIS Buffer methods, EPRI, DOE and NYSEG were afforded the opportunity to compare all four mercury measurement techniques under full-scale conditions. Although EPA Method 29 and Frontier Geoscience have been used extensively to measure mercury on full-scale test programs, Ontario-Hydro and TRIS Buffer sampling methods have not been included. Prior evaluations under bench- and pilot-scale conditions comparing these four methods have shown them to be in general agreement on total mercury.

EPA Method 29, Frontier Geoscience, Ontario-Hydro, and TRIS Buffer have undergone and are currently undergoing intensive bench- and pilot-scale evaluations by EERC at their University of North Dakota test center under the sponsorship of EPRI and DOE. While concerns exist whether EPA Method 29 and Frontier Geoscience can accurately quantify mercury species, the EERC results to date indicate that the Ontario-Hydro and TRIS Buffer methods are promising techniques to accurately measure Hg(II) and Hg(0), in addition to total mercury, in simulated coal-fired flue gas streams. The protocols for these methods developed by EERC were followed by Carnot at the Milliken Station.

EERC also operated a mercury instrumental analyzer at the FGD outlet/stack location. It should be noted that this test program did not attempt to evaluate all mercury speciation methods currently in development.

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## EXECUTIVE SUMMARY

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This report presents the results of these mercury speciation tests. To investigate the results of previous work performed in the area of mercury speciation methods development, please consult the references listed in Section 5.0 of this report.

A summary of the mercury speciation methods used on this test program is as follows:

- |                               |  |
|-------------------------------|--|
| 1) EPA Method 29              | <i>Wet chemical technique: nitric acid/peroxide and acidified potassium permanganate collection solutions.</i>       |
| 2) Frontier Geoscience (MESA) | <i>Solid sorbent cartridges containing potassium chloride (KCl) and iodated carbon granules.</i>                     |
| 3) Ontario-Hydro              | <i>Wet chemical technique: KCl, nitric acid/peroxide, and acidified potassium permanganate collection solutions.</i> |
| 4) TRIS Buffer                | <i>Wet chemical technique: TRIS/EDTA and acidified potassium permanganate collection solutions.</i>                  |
| 5) Semtech Hg 2000 Analyzer   | <i>Continuous, on-line elemental mercury analyzer.</i>   |

A summary of the key mercury speciation test program results are provided on the following tables:

- Table ES-1: Summary of Unit Operation and Criteria Pollutant Emissions  
Table ES-2: Summary of Mercury Speciation Test Results  
Table ES-3: Summary of Total Mercury Mass Balance Results

The following major conclusions were drawn from the results of this test program:

- For the FGD outlet/stack location, excellent agreement between the Frontier Geoscience, Ontario-Hydro and TRIS Buffer measurements can be seen for Hg(0) and Hg(II). Hg(0) results ranged from 2.45-2.94 ug/Nm<sup>3</sup> (excluding Method 29) and Hg(II) results ranged from 0.15-0.35 ug/Nm<sup>3</sup> (excluding Method 29). Good to excellent agreement exists between Frontier, Ontario-Hydro, TRIS and EPA Method 29 for total mercury with results ranging from 2.66-3.29 ug/Nm<sup>3</sup>.

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- For the ESP outlet/FGD inlet, excellent agreement between Frontier, Ontario-Hydro, and TRIS can be seen for Hg(0) with levels ranging from 2.28-2.70 ug/Nm<sup>3</sup>.
- For the ESP outlet/FGD inlet, Ontario-Hydro and TRIS Buffer values are in good agreement for Hg(II); and Ontario-Hydro, TRIS and EPA Method 29 are in excellent agreement for total mercury.
- In comparison with the Ontario-Hydro and TRIS Buffer results, the EPA Method 29 mercury speciation values obtained from this test program exhibit a high bias for Hg(II), and a low bias for Hg(0). This bias occurs when flue gas SO<sub>2</sub> collects in the nitric acid/peroxide impingers producing a solution that will oxidize a portion of the Hg(0) as it passes through these impingers. The amount of oxidation that occurs appears to be proportional to the amount of flue gas SO<sub>2</sub>.
- Coal flyash has been shown to oxidize Hg(0) to Hg(II) at typical flue gas conditions in bench- and pilot-scale evaluation programs. It is expected, therefore, that flyash trapped on a "Method 29-style" sampling filter would oxidize Hg(0) as it passes through it. Only at the ESP inlet using EPA Method 29 did an appreciable amount of flyash collect on the sampling filter. At this location the Hg(0) was biased even lower (and Hg(II) biased even higher) than at the ESP outlet/FGD inlet, suggesting that the oxidizing capacity of the flyash trapped on the filter and the SO<sub>2</sub> trapped in the nitric acid/peroxide impingers is additive.
- There is excellent agreement between the average FGD outlet/stack Hg(0) result as measured by the Semtech mercury analyzer with the other valid measurements at that location.
- FGD removal efficiencies were between 95-97% for Hg(II) (excluding EPA Method 29) and 59-65% for total mercury.
- Boiler/ESP mass balance results using Frontier Geoscience, Ontario-Hydro, TRIS Buffer, and EPA Method 29 total mercury values yielded 103%, 83%, 78%, and 85% agreement, respectively, between process streams.
- Total mercury FGD mass balance results for Frontier Geoscience, Ontario-Hydro, TRIS Buffer, and EPA Method 29 were 79%, 90%, 99%, and 93%, respectively.

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**TABLE ES-1**  
**SUMMARY OF UNIT OPERATION AND CRITERIA**  
**POLLUTANT EMISSIONS**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Unit Type	CE, tangentially-fired
Fuel Type	Eastern Bituminous Coal
Fuel Sulfur Level	2.2-2.4%
Air Pollution	Low-NO <sub>x</sub> Burners,
Control Devices	ESP & FGD
Test Period	Mercury Speciation Methods
Test Dates	Measurement Period August 7-9, 1996
Unit Load, MWnet	149
Coal Flow Rate, klb/hr	118.7
Boiler O <sub>2</sub> %	3.3%
FGD Inlet Opacity, %	5.8
SO <sub>2</sub> , dry ppm @ 3% O <sub>2</sub>	
FGD Inlet	1805
FGD Outlet	142
FGD Removal Efficiency	92.1%
SO <sub>3</sub> , dry ppm @ 3% O <sub>2</sub>	
FGD Inlet	6.8
FGD Outlet	5.7
FGD Removal Efficiency	15.3%
NO <sub>x</sub> , dry ppm @ 3% O <sub>2</sub> (FGD Outlet)	227
NO <sub>x</sub> , lb/10 <sup>6</sup> Btu (FGD Outlet)	0.304
Particulate Matter, lb/10 <sup>6</sup> Btu	
ESP Inlet	6.35
ESP Outlet/FGD Inlet	0.007
ESP Removal Efficiency	99.88%
FGD Outlet	0.014

Note: Unit operating data and criteria pollutant emissions results are from Unit 2 operation logs except for SO<sub>3</sub> and Particulate Matter which are from C<sub>100</sub> measurements.

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**TABLE ES-2**  
**SUMMARY OF MERCURY SPECIATION TEST RESULTS**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Mercury Species	Test Method	Emission Results, ug/Nm <sup>3</sup>			ESP Removal Efficiency <sup>(1)</sup>	FGD Removal Efficiency <sup>(1)</sup>
		ESP Inlet	ESP Outlet/ FGD Inlet	FGD Outlet/ Stack		
<u>Hg(0) - Elemental</u>						
	EPA Method 29	0.80	1.49	2.40	--	--
	Frontier Geoscience	2.12	2.66	2.94	--	--
	Ontario-Hydro	--	2.28	2.45	--	--
	TRIS Buffer	--	2.70	2.71	--	--
	Semtech Hg 2000 Analyzer <sup>(2)</sup>	--	NV	2.61	--	--
<u>Hg(II) - Oxidized</u>						
	EPA Method 29	7.43	6.23	0.62	18%	90%
	Frontier Geoscience	6.93	6.82	0.35	5%	95%
	Ontario-Hydro	--	5.24	0.21	--	96%
	TRIS Buffer	--	4.46	0.15	--	97%
<u>Hg(total) - Hg Solids</u>						
	EPA Method 29	0.86	ND<0.009	0.006	99.5%	--
	Frontier Geoscience <sup>(3)</sup>	0.06	0.07	0.003	--	--
	Ontario-Hydro	--	0.0003	0.0009	--	--
	TRIS Buffer	--	0.002	0.004	--	--
<u>TOTAL Hg<sup>(4)</sup></u>						
	EPA Method 29	9.09	7.72	3.02	17%	60%
	Frontier Geoscience	9.11	9.56	3.29	--	65%
	Ontario-Hydro	--	7.52	2.66	--	64%
	TRIS Buffer	--	7.16	2.87	--	59%

NV -- results not valid. Semtech analyzer measurements performed at this location were deemed invalid due to the use of an improper sample conditioning system and detrimental ambient conditions (i.e. high temperature and dust level).  
Notes:

- (1) Removal efficiencies calculated using emission units of lb/10<sup>12</sup>Btu to account for any differences in flue gas dilution between locations.
- (2) The Semtech Hg 2000 analyzer only measures elemental mercury.
- (3) The Frontier Geoscience method is not designed to representatively quantify the mercury solids fraction. These values represent mercury vapor that adsorbed on the flyash collected on the quartz wool plug during sampling.
- (4) Total Hg is the sum of Hg(0), Hg(II), and Hg solids.

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**TABLE ES-3A**  
**SUMMARY OF TOTAL MERCURY MASS BALANCE RESULTS -- BOILER/ESP**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Test Method	Mass Balance Results, lb/10 <sup>12</sup> Btu					Boiler/ESP Mass Balance <sup>(1)</sup>	ESP Mass Balance <sup>(2)</sup>
	Coal	ESP Inlet	Bottom Ash	Fly Ash	ESP Outlet/ FGD Inlet		
	7.4		0.01	0.57			
Frontier Geosciences		6.97			7.04	103%	109%
Ontario-Hydro		NP			5.58	83%	
TRIS Buffer		NP			5.22	78%	
EPA Method 29		6.89			5.74	85%	91%

Notes:

(1) Boiler/ESP Mass Balance, Output/Input = (Bottom Ash + Flyash - ESP Outlet)/Coal

(2) Mass Balance, ESP = (Flyash + ESP Outlet)/ESP Inlet

**TABLE ES-3B**  
**SUMMARY OF TOTAL MERCURY MASS BALANCE RESULTS -- FGD**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Test Method	Mass Balance Results, lb/10 <sup>12</sup> Btu					FGD Mass Balance (Outputs/Inputs)
	INPUTS		OUTPUTS			
	ESP Outlet/ FGD Inlet	Limestone	FGD Sludge	Gypsum	FGD Outlet/ Stack	
		0.04	0.31	2.76		
Frontier Geosciences	7.04				2.49	79%
Ontario-Hydro	5.58				2.01	90%
TRIS Buffer	5.22				2.14	99%
EPA Method 29	5.74				2.31	93%

Note: No mercury was detected in FGD liquid streams.

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## SECTION 1.0

### INTRODUCTION

#### 1.1 TEST PROGRAM BACKGROUND

The Clean Air Act Amendments (CAAA) of 1990 require the Environmental Protection Agency (EPA) to conduct an assessment of health and environmental effects posed by the emissions of 189 trace chemicals from electric utility steam generating units. Although mercury is only one of the targeted trace chemicals potentially emitted to the atmosphere by utilities, EPA has singled it out for a separate emissions and risk assessment study.

Since 1990, the Electric Power Research Institute (EPRI) and DOE have initiated programs to develop chemical emissions databases for the utility industry. More recently both groups have focussed their efforts on developing a measurement technique for the various species of mercury in utility combustion flue gas streams. Based on a formal validation study sponsored by EPRI, it was determined that EPA Method 29 can produce reliable measurement data for total mercury concentrations in coal combustion flue gas. A major methods development program of certain promising techniques for the collection and subsequent detection and quantification of various mercury species is currently being conducted by EPRI and DOE, in cooperation with EPA. This effort has involved intensive bench-scale and pilot-scale testing, in addition to limited utility-scale evaluations.

As part of the Department of Energy's (DOE) Clean Coal Technology Demonstration (CCTD) Program, New York State Electric & Gas (NYSEG) Corporation has installed and is operating a high-efficiency flue gas desulfurization (FGD) system for SO<sub>2</sub> emissions control, low-NO<sub>x</sub> burners for NO<sub>x</sub> emissions control, and electrostatic precipitator (ESP) and coal mill upgrades for particulate emissions control. The installation was completed to demonstrate innovative emissions control technology. This demonstration program is being conducted at NYSEG's Milliken Station, Units 1 & 2, in the Town of Lansing, New York. The primary objective of this CCTD project is to show that a retrofit of energy-efficient SO<sub>2</sub>, NO<sub>x</sub>, and particulate control systems can be made without a significant impact on overall plant efficiency.

To satisfy DOE's CCTD program requirements, NYSEG, through a competitive bidding process, selected Carnot to conduct a comprehensive measurement program to characterize the emissions of selected trace substances from Milliken Station's Unit 2, both pre- and post-retrofit of SO<sub>2</sub>, NO<sub>x</sub>, and particulate control systems. Prior to the pollution control system upgrades,

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Carnot performed a "baseline" comprehensive trace substance measurement program on Unit 2 in 1994. A post-retrofit test program was performed in August 1996.

To continue researching the viability and applicability of certain wet chemical techniques for collecting and subsequently detecting and quantifying species of mercury in coal-fired utility boiler flue gas streams, Carnot, under an extended contract with NYSEG with the cooperation and support of DOE, and the Energy & Environmental Research Center (EERC) at the University of North Dakota, under a separate contract with EPRI, performed a utility-scale field evaluation of two emerging techniques, the Ontario-Hydro and TRIS Buffer, for mercury speciation. Since EPA Method 29 and Frontier Geosciences' solid sorbent scrubber technique were already part of the post-retrofit test program scope, by expanding the program to include the Ontario-Hydro and TRIS Buffer methods, EPRI, DOE and NYSEG were afforded the opportunity to compare all four mercury measurement techniques under full-scale conditions. Although EPA Method 29 and Frontier Geoscience have been used extensively to measure mercury on full-scale test programs, Ontario-Hydro and TRIS Buffer sampling methods have not been included. Prior evaluations under bench- and pilot-scale conditions comparing these four methods have shown them to be in general agreement on total mercury.

EPA Method 29, Frontier Geoscience, Ontario-Hydro, and TRIS Buffer have undergone and are currently undergoing intensive bench- and pilot-scale evaluations by EERC at their University of North Dakota test center under the sponsorship of EPRI and DOE. While concerns exist whether EPA Method 29 and Frontier Geoscience can accurately quantify mercury species, the EERC results to date indicate that the Ontario-Hydro and TRIS Buffer methods are promising techniques to accurately measure Hg(II) and Hg(0), in addition to total mercury, in simulated coal-fired flue gas streams. The protocols for these methods developed by EERC were followed by Carnot at the Milliken Station.

EERC also operated a mercury instrumental analyzer at the FGD outlet/stack location. It should be noted that this test program did not attempt to evaluate all mercury speciation methods currently in development.

This report presents the results of these mercury speciation tests. To investigate the results of previous work performed in the area of mercury speciation methods development, please consult the references listed in Section 5.0 of this report.

## 1.2 TEST PROGRAM OBJECTIVES

The following objectives of the Milliken Unit 2 Mercury Speciation Test Program were accomplished:

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- Perform a utility-scale field evaluation of the Ontario-Hydro and TRIS Buffer mercury speciation sampling methods.
- Evaluate the performance of a Semtech Hg 2000 analyzer (owned by EPRI), a real-time continuous emissions mercury analyzer, at the FGD outlet/stack sampling location.
- Compare daily and average Hg(0), Hg(II), and total Hg results from the Ontario-Hydro, TRIS Buffer, Semtech Hg 2000 analyzer, Frontier Geosciences' solid sorbent scrubber, and EPA Method 29 mercury measurement techniques.
- Provide ESP and FGD removal efficiencies for targeted mercury species from each of the measurement techniques employed.
- Calculate mercury material balances around the boiler, ESP, and FGD process systems by examining the mercury distribution level across their various input and output process streams.

### 1.3 PROCESS DESCRIPTION

The NYSEG Milliken Station is composed of two identical, tangentially-fired, Combustion Engineering boilers with a nominal generating capacity of 150 MW each and associated pollution abatement equipment. Unit 2 was evaluated in this program while it burned a 2.2-2.4% sulfur, Pittsburg seam, bituminous coal. Low NO<sub>x</sub> burners, an ESP, and an FGD provide Unit 2 with NO<sub>x</sub>, particulate, and SO<sub>2</sub> emissions control, respectively. Up to 40% NO<sub>x</sub> reduction is achieved using the low-NO<sub>x</sub> burners, and the ESP and coal mills were recently upgraded reducing ESP outlet particulate levels by a factor of 10. The FGD uses a forced oxidation, formic acid-enhanced wet limestone system to reduce SO<sub>2</sub> emission by 90-98%. Commercial-grade gypsum and calcium chloride salt are marketable by-products of the FGD's zero wastewater discharge process. A detailed unit description can be found in Section 2.1.

### 1.4 SAMPLING APPROACH

Table 1-1 identifies the mercury speciation test program matrix. Representative samples were collected and analyzed for mercury from the targeted three flue gas streams, five solid streams, and three FGD liquid/sludge streams in triplicate (except for the FGD sludge) over the course of three days, August 7, 8, and 9, 1996. Measurements of ~~target mercury species were~~

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performed on the flue gas samples only. For the solid and liquid/sludge process stream samples, only total mercury was identified to show a mass balance around the boiler, ESP, and FGD process systems. Table 1-2 identifies which mercury speciation measurement procedures were performed at each of the three flue gas sampling locations.

## 1.5 PROGRAM ORGANIZATION

Carnot was the prime contractor for the Milliken Unit 2 Mercury Speciation Test Program. EERC, under a separate contract with EPRI, prepared, recovered, and performed the mercury speciation analyses of the Ontario-Hydro and TRIS sampling trains, in addition to operating the Semtech Hg 2000 instrumental analyzer. EERC also analyzed the solid stream samples for total mercury. Zenon Environmental Laboratories performed the EPA Method 29 sample analyses and the total mercury determinations of the liquid/sludge stream samples. Mr. Mehdi Rahimi and Mr. Walt Savichky are NYSEG's program managers for this study. EPRI serves as a technical consultant. The project team organization is identified in Figure 1-1.

## 1.6 DATA USE AND DATA CONFIDENTIALITY

The data generated from this test program are intended for use by NYSEG, DOE and EPRI for assessment and planning purposes. All sampling and analyses were conducted according to Carnot's approved July 1996 final test plan (Report Number NYS1A-11476/R107G264.T), which was developed using Carnot's May 1994 Milliken Unit 2 baseline report, EPRI's established FCEM PISCES protocol, and EERC's mercury speciation method protocols. Results generated by this field study are targeted to meet "compliance" quality standards.

The information generated on this program is treated by Carnot and its subcontract laboratories, and EERC as confidential. It will only be released to other parties at the expressed wishes of NYSEG.

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**TABLE 1-1**  
**MERCURY SPECIATION TEST PROGRAM MATRIX**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Process Stream	Target Mercury Species		
	Hg(0) - Elemental	Hg(II) - Oxidized	Total Hg
<b>Flue Gas Sample Streams</b>			
ESP Inlet	X	X	X
ESP Outlet / FGD Inlet	X	X	X
FGD Outlet / Stack	X	X	X
<b>Solid Sample Streams</b>			
Coal Feed			X
Bottom Ash			X
ESP Flyash			X
Limestone Solids			X
Gypsum Solids			X
<b>Liquid/Sludge Sample Streams</b>			
PWRF Outlet			X
Brine Product			X
FGD Blowdown Sludge			X

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**TABLE 1-2**  
**MERCURY SPECIATION MEASUREMENT METHODS**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

<b>Sample Location</b>	<b>Mercury Speciation Measurement Procedure</b>
ESP Inlet	EPA Method 29 Frontier Geoscience -- MESA Method
ESP Outlet / FGD Inlet	EPA Method 29 Frontier Geoscience -- MESA Method Ontario-Hydro Mercury Speciation Method TRIS Buffer Mercury Speciation Method
FGD Outlet / Stack	EPA Method 29 Frontier Geoscience -- MESA Method Ontario-Hydro Mercury Speciation Method TRIS Buffer Mercury Speciation Method Semtech Hg 2000 Analyzer (elemental Hg only)

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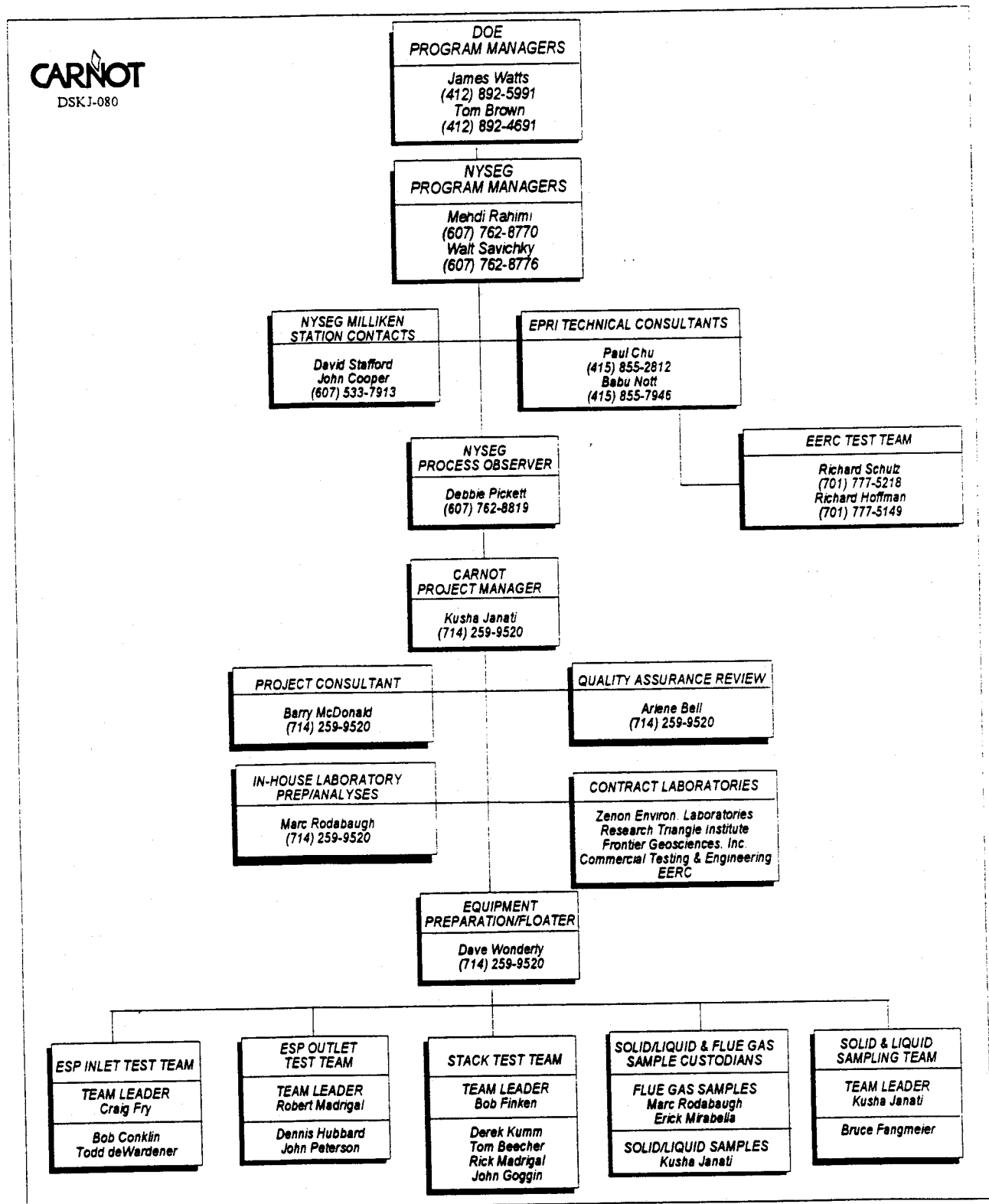


Figure 1-1. Project Team Organization Chart

## SECTION 2.0

### TEST DESCRIPTION

This section presents a description of Milliken Station's Unit 2 and the different sample locations that were used for the test program, followed by a review of the test schedule and process operation during testing.

#### 2.1 UNIT DESCRIPTION

The Milliken Station is located in the Town of Lansing, New York and is owned and operated by the NYSEG Corporation. Milliken Station Unit 1 and 2 were built in the late 1950s. The units are Combustion Engineering designed, tangentially-fired, pulverized coal boilers. Unit 2 has a design capacity of 1,145,000 lbs/hr steam at 1900 psig and 1005°F with a nominal generating capacity of 150 MW. Up to 40% NO<sub>x</sub> reduction is achieved using CE LNCFS-III low-NO<sub>x</sub> burners which were installed in 1994. The Unit 2 boiler is equipped with an ABB Heat Pipe air heater and a wide-spaced, rigid frame ESP manufactured by Belco, which was also installed in 1994. In addition, a Saarberg-Holter Umwelttechnik GmbH (S-H-U) flue gas desulfurization (FGD) process was installed and began operating at Milliken Station Unit 2 in January, 1995. The process is a forced oxidation, formic acid-enhanced wet limestone scrubber designed to reduce SO<sub>2</sub> emissions by 90% to 98%. The exhaust gas is discharged to the atmosphere through a wet flue without reheat. The plant has high dispatch priority and is generally base loaded. The capacity factor is typically >80%. This unit is among the most efficient in the United States.

The coal is delivered to Unit 2 from a common coal pile that serves both boilers. During this test program, Unit 2 burned a Pittsburg seam, bituminous coal containing 2.2% - 2.4% sulfur that was a 50/50 mix of raw and cleaned coal. The coal mills were upgraded in 1994 and produce no rejects.

Bottom ash is sluiced out to the bottom ash solids sedimentation basin where the solids are dewatered and removed from the plant site by truck. The bottom ash sluice water is recirculated in a closed loop. Make-up water from the lake intake is periodically added to maintain the liquid level of the sedimentation tank. The ESP flyash is pneumatically conveyed to a storage silo, then removed from the plant site by truck for use as a portland cement pozzolonic additive.

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Commercial-grade gypsum and calcium chloride salt are marketable by-products of the FGD's zero wastewater discharge process. During this test program, however, the brine concentrator was not in operation so the unconcentrated brine product was discharged to the PWRF for disposal to the lake. Gypsum is transported by conveyor belt to a gypsum storage building for subsequent loading onto trucks. Heavy metals are removed from the scrubber water blowdown, producing a sludge that is trucked for disposal.

The Milliken Station process wastewater generated from Units 1 and 2 is treated at the PWRF before returning to the lake. The coal pile runoff is collected in a first-stage catch basin located near the coal pile. The collected coal pile runoff is treated in the metals treatment plant located adjacent to the PWRF. The out-fall of the metals treatment plant discharges to the PWRF before returning to the lake. Sludge generated by the PWRF and metals treatment plant are removed from the station by truck for on-site disposal.

## 2.2 SAMPLE LOCATIONS AND COLLECTION PROCEDURES

Figure 2-1 is a process flow diagram for Unit 2 depicting the boiler/ESP/FGD system. Figure 2-2 provides a more detailed process flow description of the FGD system. Solid dots represent sampling locations for the flue gas, solids, and liquid/sludge sample streams.

### 2.2.1 Flue Gas Sample Streams

The primary sample streams of interest for the Milliken Unit 2 test program were the flue gas streams entering and exiting the ESP and FGD air pollution control devices (APCDs). An objective of this research study was to determine the effectiveness of these APCDs at removing targeted species of mercury released during coal combustion.

Tests requiring a full traverse of the sampling location (i.e. EPA Method 29) collected gas at each of the prescribed sampling points. The number and location of sampling points were used at the ESP inlet and outlet were based on the ESP inlet sampling grid used for the May 1994 baseline test program given the current location of existing port obstructions. The sampling grid was based on EPA Method 1 criteria. Tests conducted within a single port at the ESP inlet and outlet (either 1-3 sample points) alternated between the North and South ESP inlet and outlet traversed the entire sample port. Ontario-Hydro and TRIS Buffer tests at the ESP inlet and outlet sampled at a single point. Stack single point tests (i.e. Frontier Geoscience, Ontario-Hydro, TRIS Buffer, and Semtech Hg analyzer) were performed at the same active sampling point for each replicate.

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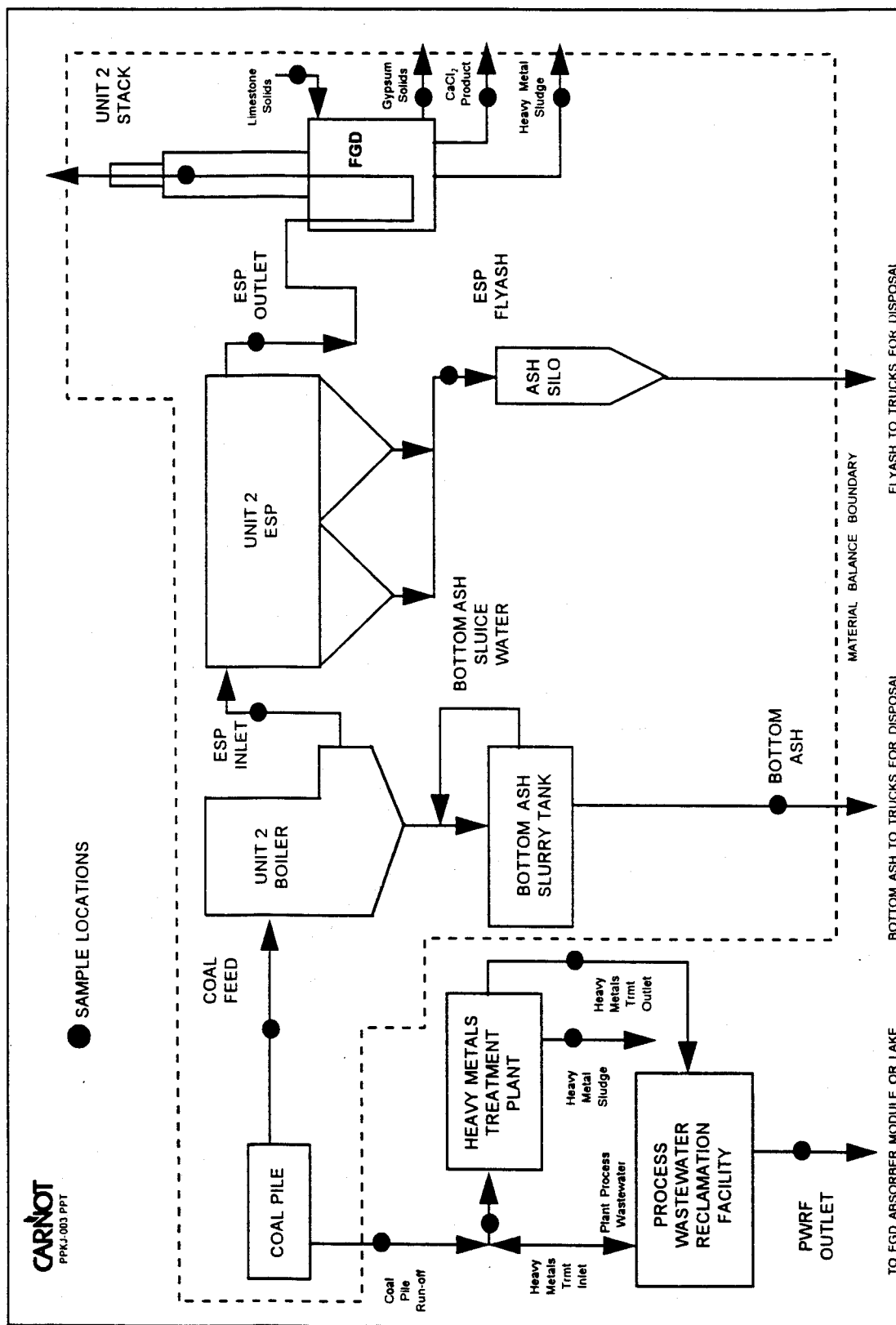


Figure 2-1. Process Flow Diagram and Sampling Locations for Milliken Power Station Unit 2

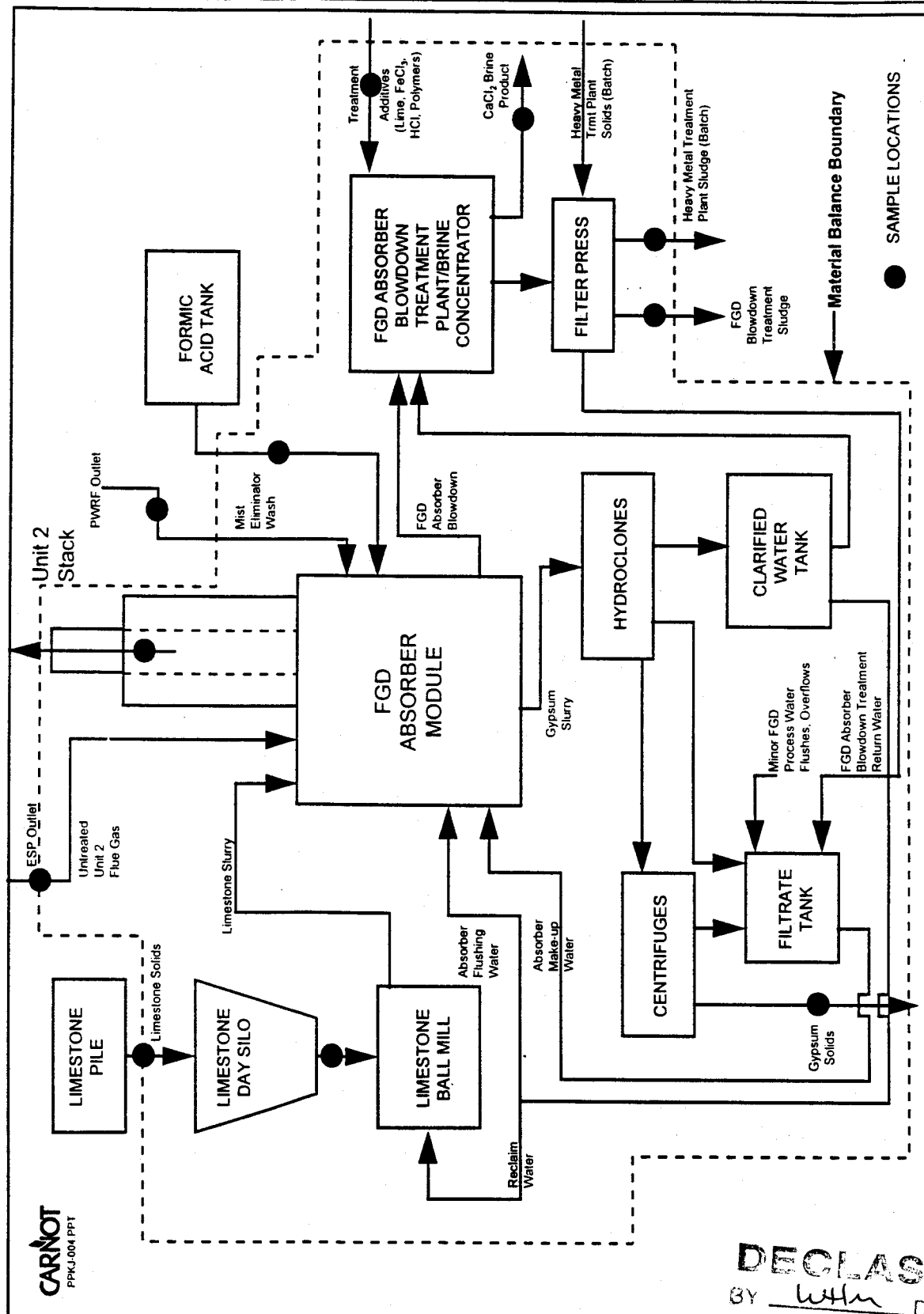


Figure 2-2. FGD/Stack Process Flow Diagram and Sample Locations

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One test replicate was performed for each method per day at each flue gas sample location for three days, with the exception of Frontier Geoscience, in which two replicates were performed on the third day to make-up for an invalid test on the first day.

#### 2.2.1.1 Unit 2 ESP Inlet

The ESP inlet location consists of two vertical ducts, each one 3 feet 6 inches deep by 33 feet 9 inches wide. The sample ports are located 80 feet (12.7 diameters) downstream and 40 feet (6.3 diameters) upstream of the nearest flow disturbances, satisfying EPA Method 1 minimum requirements for an acceptable sample location. Figure 2-3 presents a side-view of the ESP inlet sample location. There are 24 ports total, 12 per duct, designated as Ports A through X as shown in Figure 2-4. Seven of the ports, E, K, N, O, T, V, and X, were not available for sampling due to port obstructions.

Prior to testing, a full velocity traverse was performed through all 24 sample ports. EPA Method 1 requires a minimum of 12 traverse points per duct or 24 points total. The decision to use three sample points per port was judged technically sound during Carnot's May 1994 baseline test program based on the duct depth, and is consistent with previous ESP performance testing conducted by CONSOL. The preliminary velocity data were analyzed to select 8 sample ports (to provide a total of 24 points) that produce an average flue gas velocity that is representative of the overall duct velocity, but spaced-out enough to cover the entire duct length adequately. Figure 2-4 identifies which ports were chosen for the full-traverse isokinetic tests. This 8-port grid resulted in an average velocity that was 2.5% different from the entire 24-port velocity. The sample grid used at the ESP inlet is similar to the one used for the May 1994 baseline tests. Exhaust gas flow rates from the pitot traverses of the post-retrofit tests using this sampling grid agreed well (2-4% average differences) with those calculated from boiler efficiency, unit load, and an EPA Method 19 stoichiometric F-factor.

No cyclonic flow was measured at this location using EPA Method 1 indicating that a laminar flue gas flow profile exists.

#### 2.2.1.2 Unit 2 ESP Outlet

The Unit 2 ESP outlet location (inlet of the FGD) is a mirror image of the ESP inlet location with identical measurements and sampling scheme. Figure 2-5 illustrates the sampling grid for the ESP outlet. Nine of the ports, A, C, E, I, M, N, Q, T, and X, were not available for sampling due to port obstructions.

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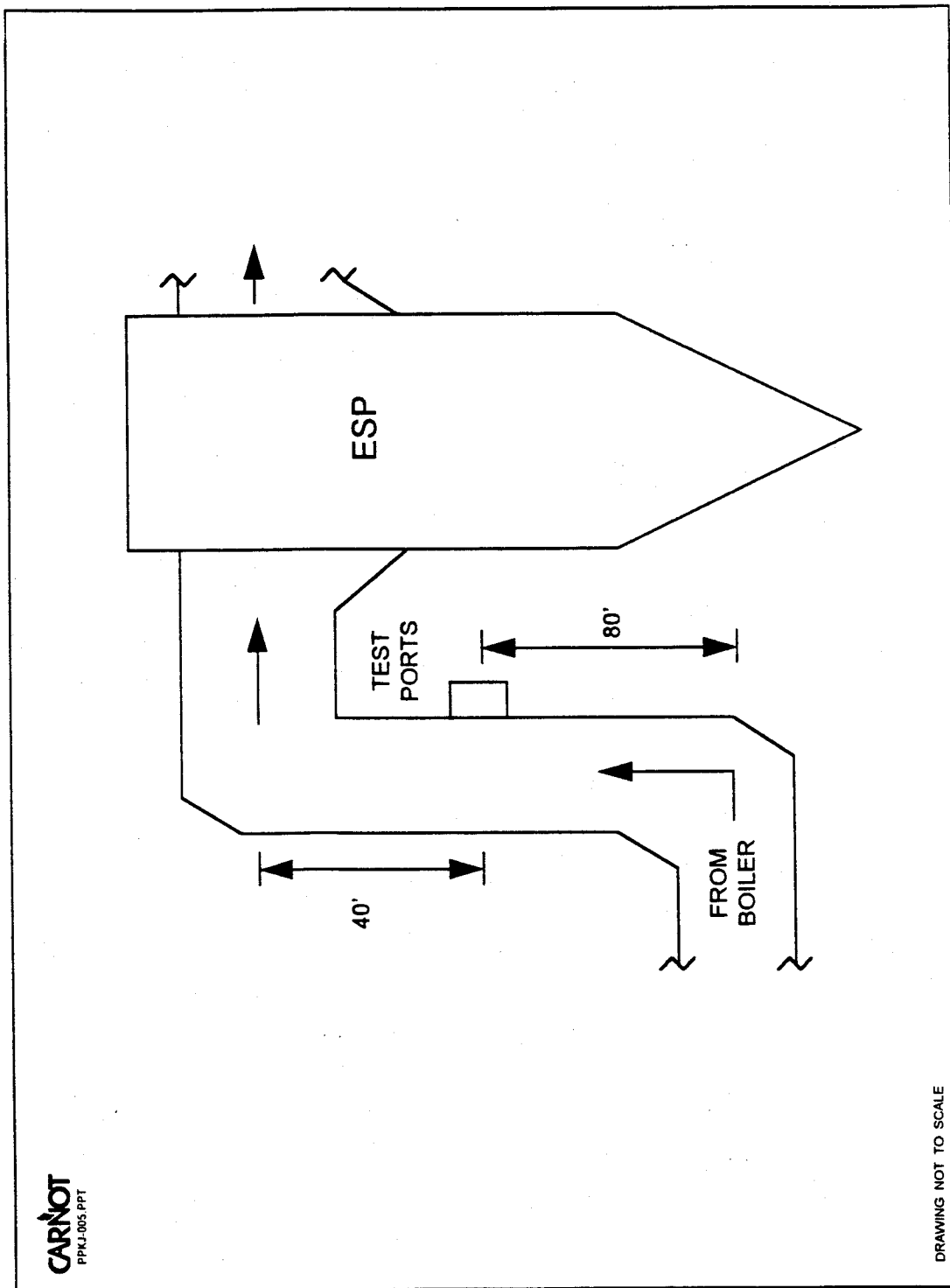
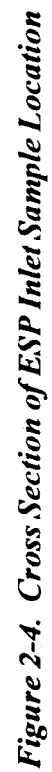


Figure 2-3. Unit 2 ESP Inlet Duct Test Site

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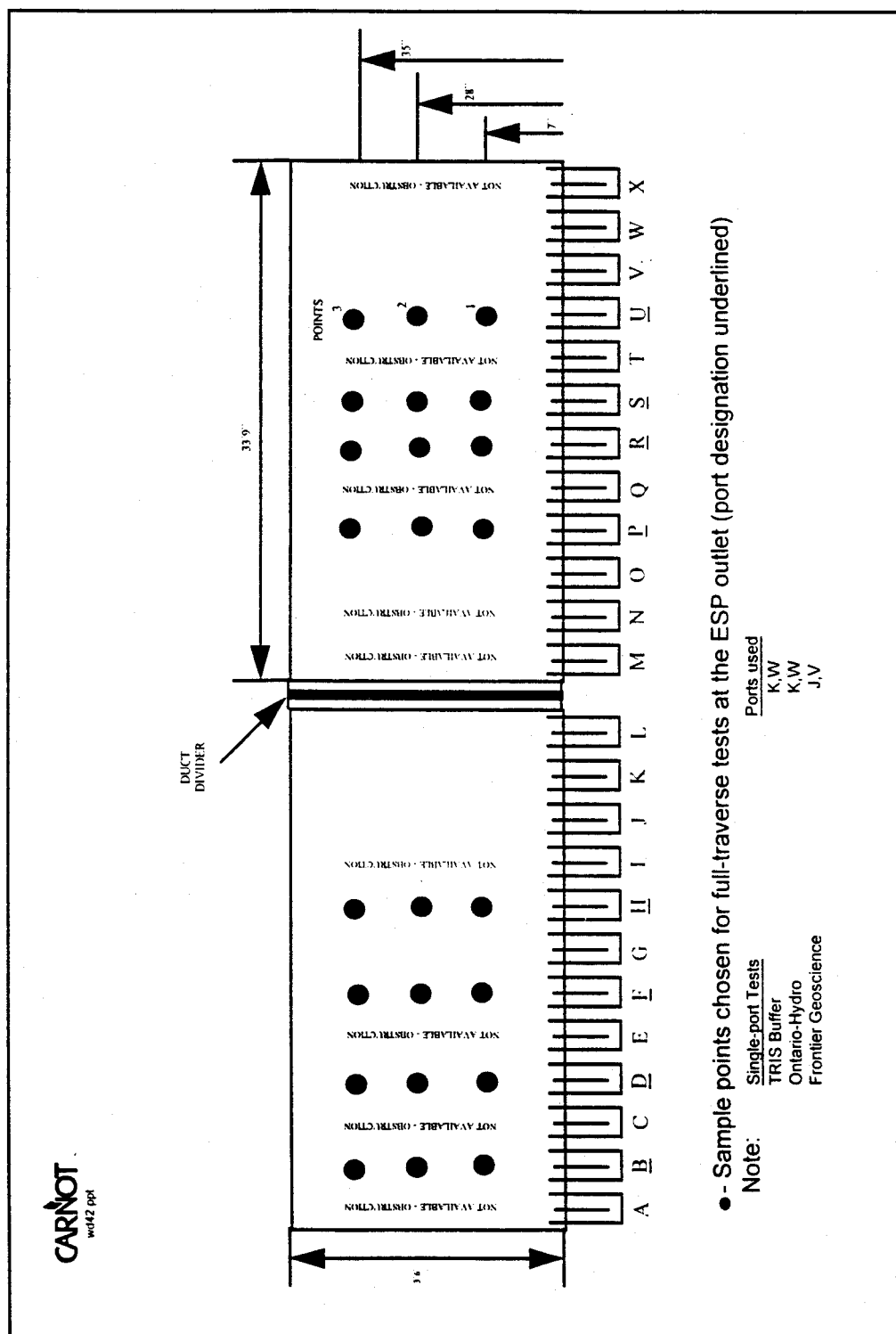
• - Sample points chosen for full-traverse tests at the ESP inlet (port designation underlined)  
Note: Single-port Frontier Geoscience mercury speciation tests performed in Ports I and W

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**Figure 2-5. Cross Section of ESP Outlet Sample Location.**

- - Sample points chosen for full-traverse tests at the ESP outlet (port designation underlined)

**Note:**

<u>Single-port Tests</u>	<u>Ports used</u>
TRIS Buffer	K,W
Ontario-Hydro	K,W
Frontier Geoscience	J,V

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A full velocity traverse was performed prior to testing through 23 of the 24 ports (one port cap was frozen shut). As identified on Figure 2-5, 8-ports were chosen for a 24-point total sample grid similar to the ESP inlet. This 8-port grid resulted in an average velocity that was 4.7% different from the overall 23-port velocity. Due to the numerous obstructions present at this location, no other port scheme for sampling could be found that provided a more representative velocity and still maintain satisfactory spacing across the ducts. Exhaust gas flow rates from the pitot traverses of the ESP outlet tests using this sample grid agreed well (0-4% average differences) with EPA Method 19 calculated flow rates.

Less than one degree of cyclonic flow was measured at this location (20° maximum cyclonic flow is allowed by EPA Method 1), indicating that a laminar flow profile exists.

#### 2.2.1.3 Stack

Figure 2-6 provides a profile of the Unit 2 flue test site and presents traverse point locations. The Unit 2 flue (FGD outlet stream) discharge point is approximately 375' from ground level and the stack sampling plane is located 304' from ground level. Figure 2-7 illustrates a cross-sectional view of the FGD stack location showing all three flues within the larger stack. Two identical 12 foot diameter flues each serving Unit 1 and 2, along with a smaller 8 foot diameter emergency bypass flue, are located inside the 40 foot diameter stack. Two sampling ports located at 90° offsets with coupling lengths of 6" were used for full traverse tests. A third sampling port offset 90° from one of the main sampling ports was used for single-point tests.

This location meets EPA Method 1 minimum requirements with almost 6 diameters upstream and 13 diameters downstream of the nearest flow disturbances; as a result, 12 sample points, 6 per port were used. Less than two degrees of cyclonic flow was found at this location indicating laminar flow.

#### 2.2.2 Solid Sample Streams

To substantiate the flue gas mercury data, coal feed, bottom ash, ESP flyash, limestone solids, and gypsum solids samples were collected throughout the test program. The samples were analyzed for total mercury and balanced with flue gas data in an attempt to obtain mass balance closure. Table 2-1 provides a solid stream sampling schedule.

##### 2.2.2.1 Coal Feed

Pulverized coal combined with combustion air is injected into the boiler through a series of burners supplied by four coal mills. Coal is supplied to each mill by belt feeders drawing coal

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**TABLE 2-1**  
**SOLID AND LIQUID/SLUDGE STREAM SAMPLING SCHEDULE**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Test Number	Date	Sample Time	Type of Sample	Sample To Size, in. <sup>(1)</sup>	No. of Increments	Increment Size, lbs.	Gross Sample Weight, lbs.	Number of Splits	Sample Size to Lab, lbs. <sup>(2)</sup>	Sample Container	No. of Containers
1-COAL	8/7/96	815/1545	Raw/Clean Coal	-5/8	24	5	120	2	30	HDPE Bck.	1
2-COAL	8/8/96	805/1545	Raw/Clean Coal	-5/8	24	5	120	2	30	HDPE Bck.	1
3-COAL	8/9/96	805/1545	Raw/Clean Coal	-5/8	24	5	120	2	30	HDPE Bck.	1
4.5-COAL	8/12/96	910/1900	Raw/Clean Coal	-5/8	18	5	90	1,3,2,3	30 each	HDPE Bck.	2
6-COAL	8/13/96	910/1530	Raw/Clean Coal	-5/8	12	5	60	1	30	HDPE Bck.	1
1-BottomAsh	8/7/96	1800	Bottom Ash	-2	14	6.9	96	0	96	HDPE Bck.	2
2-BottomAsh	8/8/96	1830	Bottom Ash	-2	14	5.9	82	0	82	HDPE Bck.	2
3-BottomAsh	8/9/96	1645	Bottom Ash	-2	14	6.5	91	0	91	HDPE Bck.	2
1-Flyash	8/7/96	910/1610	ESP Flyash	-60 mesh	7	1-17 (3)	47	6	50 grams each	120 ml	6
2-Flyash	8/8/96	909/1620	ESP Flyash	-60 mesh	8	0.5-30	101.5	7	50 grams each	glass jars	6
3-Flyash	8/9/96	919/1500	ESP Flyash	-60 mesh	6	5-46	133	7	50 grams each	plast. lid	6
1-Limestone	8/7/96	1830	Limest'n Solids	-2	25	4.3	107	0	107	HDPE Bck.	2
2-Limestone	8/8/96	1330	Limest'n Solids	-2	25	4.7	118	0	118	HDPE Bck.	2
3-Limestone	8/9/96	1430	Limest'n Solids	-2	24	4.3	104	0	104	HDPE Bck.	2
1-Gypsum	8/7/96	821/1429	Gypsum Solids	-8 mesh	7	10-11	74	3	9	Plastic Bag	1
2-Gypsum	8/8/96	930/1330	Gypsum Solids	-8 mesh	3	24-25	73	3	10	Plastic Bag	1
3-Gypsum	8/9/96	1005/1445	Gypsum Solids	-8 mesh	3	24-25	74	3	10	Plastic Bag	1
1-FGD Sludge	8/8/96	750/825	FGD Sludge	NA	8	1	8	0	8	Plastic Bag	2
2-FGD Sludge	8/9/96	810/830	FGD Sludge	NA	8	0.38	3	0	3	Plastic Bag	2
1-Brine	8/7/96	1446/1620	Brine Product	NA	3	400 ml	1.2 liters	0	500 ml. x 2	AW-500ml	2
2-Brine	8/8/96	808/1613	Brine Product	NA	9	400 ml	3.6 liters	0	500 ml. x 2	AW-500ml	2
3-Brine	8/9/96	800/1517	Brine Product	NA	8	400 ml	3.2 liters	0	500 ml. x 2	AW-500ml	2
1-PWRF	8/7/96	801/1610	PWRF Outlet	NA	9	400 ml	3.6 liters	0	500 ml. x 2	AW-500ml	2
2-PWRF	8/8/96	805/1610	PWRF Outlet	NA	9	400 ml	3.6 liters	0	500 ml. x 2	AW-500ml	2
3-PWRF	8/9/96	756/1513	PWRF Outlet	NA	8	400 ml	3.2 liters	0	500 ml. x 2	AW-500ml	2

NA -- not applicable

HDPE -- high density polyethylene

AW -- acid-washed HDPE Nalgene sample bottles

All solid stream sample collection and preparation procedures were in accordance with ASTM D2234 and ASTM D2013.

Notes:

(1) Sample top size defined as smallest screen opening in which less than 5% of sample is retained.

(2) Minimum sample size for laboratory analysis based on ASTM D2234.

(3) Isokinetic sampling of the flyash resulted in varying increment sample sizes based on ESP hopper evacuation intervals. Each increment was riffled on-site to a sample size less than or equal to 50 grams and composited with other 50 gram increments from that test period to obtain a single 50 gram test sample.

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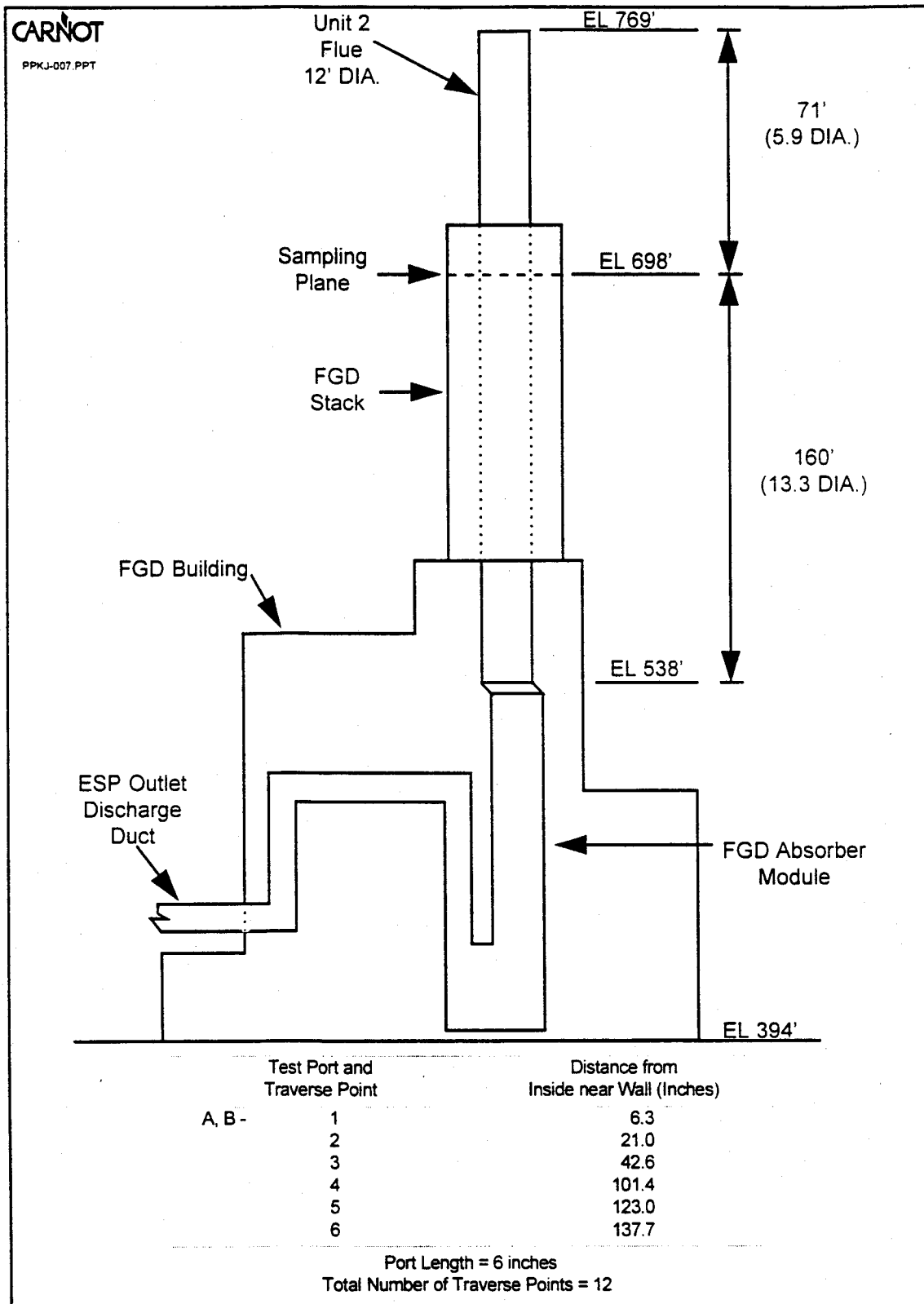


Figure 2-6. Stack Test Site and Traverse Point Location

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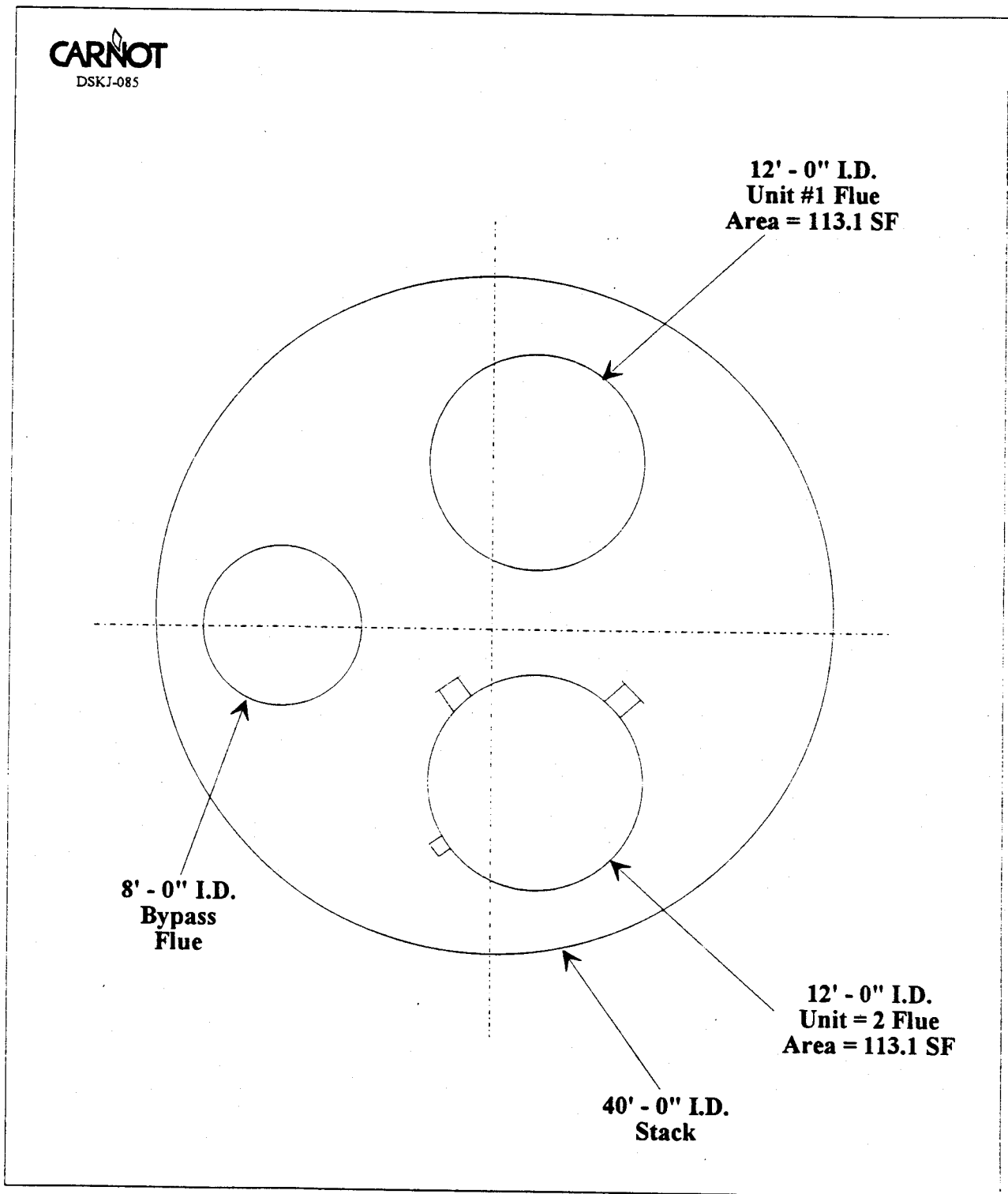


Figure 2-7. Cross-Sectional Area - Units 1 &amp; 2 FGD Stack

from the bunkers. Only three mills are necessary for full-load operation. During this test program one coal mill was not in service. As-fired coal samples representative of a complete cross-section of the unpulverized coal feed to the mills was obtained using each belt feeder's coal sampling system. After activating the coal sampling system, a 5 lb sample is provided within one minute.

The coal burned during this test program was a 50/50 split of raw and pre-cleaned bituminous coal, pre-crushed to a top size of less than 5/8 inch and supplied by CONSOL from its Pittsburgh seam. ASTM D2234 specifications for the collection of pre-cleaned coal was used during the post-retrofit test program, which call for a minimum of 15 sampling increments of at least two pounds each for a total minimum sample size of 30 pounds to be taken. Each belt feeder sampler was activated once per hour over a seven to eight-hour period providing 24 increments and a gross sample size of approximately 120 pounds. For gross sample sizes of more than 30 pounds ASTM D2234 allows for the sample to be properly size reduced to 30 pounds, e.g. riffled, before any reduction in the sample top size is necessary. Two sample splits were made on-site using the plant's large rifflers in accordance with ASTM D2013. Using the pre-cleaned coal collection procedure, as opposed to the one for raw coal (which would require 35 increments) or an average of the two (25 increments), was considered appropriate based on the 5 pound increment sample size and the resulting gross sample size of 120 pounds.

**COAL FLOW MEASUREMENTS.** As the coal travels from the coal bunkers to the mills, a gravimetric scale on each mill belt feeder determines the weight of coal that passes over the belt scale section. A digital totalizer on each mill tracks the amount of coal supplied to the mills. NYSEG quality assurance testing of the new belt feeders revealed that they are not capable of providing reliable fuel flow data "as-delivered." The vendor is currently working to correct this flow measurement problem and is scheduled to complete the re-work by June 1997. As a result, an alternate method of calculating the fuel flow rates was performed. Pitot flow rates from the ESP outlet EPA Method 29 tests were determined to accurately represent flue gas flow rates at this location, and were combined with a calculated EPA Method 19 F-factor to obtain fuel flow rates.

#### 2.2.2.2 Bottom Ash

Bottom ash from Unit 2 is batch sluiced approximately once per shift and conveyed to a hydrobin where the bottom ash solids are dewatered. The sluice procedure takes about 30 minutes. The liquids used in sluicing are continually recirculated in a closed-loop system that is assumed to be at equilibrium with the bottom ash solids and therefore an insignificant output stream of target trace elements. Solids are periodically emptied from the bottom ash storage silo into a transport truck and dumped at an off-site disposal area for use as an anti-skid material.

Obtaining a "dry" bottom ash sample prior to the sluicing operation is not possible; therefore, representative samples were collected from the pile after the bottom ash solids are dumped.

Prior to the start of each day's test activities the bottom ash was sluiced and the solids in the hydrobin emptied. Throughout the test day, the ash was sluiced normally. Following testing, the sluiced bottom ash solids were emptied into the transport truck, dumped at the off-site disposal area, and sampled that day. The bottom ash pile was divided into 14 cross-sections and one 6-7 pound increment shovel full was removed from the center of each cross-section. The entire daily gross sample was sent to the laboratory in two plastic buckets.

**BOTTOM ASH FLOW MEASUREMENTS.** The total weight of bottom ash generated for each test day was determined by obtaining a tare and final weight of the transport truck. NYSEG and the transport company conducted the weighings.

#### 2.2.2.3 ESP Flyash

The ESP is equipped with eight hoppers. The collected flyash from each hopper is periodically emptied and conveyed to a storage silo. An in situ sampler designed by CONSOL to collect a representative ash sample automatically extracts flyash isokinetically from the main discharge line between the ESP hoppers and storage silo. Prior to the start of each test day, the hoppers were emptied. Throughout the test day, the hoppers were evacuated into the silo in accordance with normal operation.

As hoppers discharge during each inorganic test day, representative flyash sample increments were collected into clean 5-gallon plastic buckets by the extractive sampling system. Following a 45-60 minute sampling interval, the bucket located inside the extractive system was replaced with an empty one. Increment sample sizes varied from 0.5 to 46 pounds depending on hopper discharge cycles. Six to 8 increments were collected over a 6-7 hour test period.

Each increment was size reduced as necessary and combined with the other daily increments. The flyash top size is assumed to be at most -60 mesh so daily samples were riffled according to ASTM D2013 to six 50 gram portions stored in 120 ml glass jars for each test day.

**ESP FLYASH FLOW MEASUREMENTS.** ESP flyash flow rates were calculated from the EPA Method 5 particulate test results from the ESP inlet and outlet.

#### 2.2.2.4 Limestone Solids

From the limestone pile located outside of the FGD building, conveyor belts transport limestone to day silos that can store up to a 2-day supply of material.

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silos are conveyed through belt feeders and dropped into ball mills where it is crushed and combined with reclaim water (gypsum slurry water) to obtain limestone slurry. Storage tanks provide a constant stream of limestone slurry to the absorber modules. Since the same limestone slurry is sent to both Unit 1 and Unit 2's absorbers, no attempt was made to isolate the limestone solids intended for Unit 2 from those intended for Unit 1.

Samples of the limestone solids were collected from an intermediate pile located near the main limestone pile outside the FGD building. The intermediate pile was formed each day by tractor above a hopper supplying limestone to the day silo conveyor belts. The perimeter of the pile was divided into 24-25 cross-sections and 4-5 pound shovel full increments were removed from the center of each cross-section. The entire daily gross sample was sent to the laboratory in two plastic buckets.

The limestone is considered to be fairly uniform and homogeneous. As a result, the collection of limestone prior to the day silo as opposed to prior to the absorber is not expected to affect the representative nature of the limestone samples.

**LIMESTONE SOLID FLOW RATE.** Hourly limestone slurry flow rates into the Unit 2 absorber module and percent slurry solids values were averaged over each daily test period from FGD control room data logs. The limestone solids flow rate into the absorber was then calculated by combining the average slurry flow rate and density results.

#### 2.2.2.5 Gypsum Solids

The gypsum slurry leaving the Unit 2 absorber is first treated by the primary hydroclones to separate out the larger particles (gypsum solids) which are dewatered in the centrifuges to produce the gypsum product. After primary hydroclone separation, the overflow slurry is treated by secondary hydroclones which produce clarified water (clear) consisting of only very fine particles. The clarified water may either return to the limestone ball mills as reclaim water, the absorber module as flushing water, or the FGD blowdown treatment plant. The secondary hydroclone underflow stream consists of medium size particles (untreated limestone) and small gypsum crystals which are combined with the filtrate that was removed by the centrifuges and stored in the filtrate tank which is sent directly to the absorber module.

Unit 2 gypsum product is removed from the FGD building by a conveyor to an enclosed building for off-site truck removal. Unit 2 centrifuges produce gypsum in batches every 15 minutes and were isolated from Unit 1's gypsum solids. The gypsum solids contained 8-9% moisture. A plastic scoop was used to collect a complete cross-section of the gypsum solids as they fell from the baskets onto the conveying system. For the first day of the mercury test program, seven 10-11 pound increments were collected. For the second and third days, only



three increments were collected at 24-25 pounds each due to intermittent gypsum solids production. Daily gross sample sizes of 73-74 pounds were coned, quartered and split using a large plastic tarp. Nine to 10 pound daily samples were sent to the laboratory in plastic bags.

**GYPSUM SOLIDS FLOW RATE.** The gypsum solids flow rate was calculated as the difference between the average flow rate of gypsum slurry entering the centrifuges and that leaving, combined with an average slurry percent solids value. There is no feasible method for determining the amount of solids that are separated with the gypsum water by the centrifuges and sent to the filtrate tank. As a result this means of calculating a gypsum solids flow rate slightly over-estimates gypsum output. Based on a solids mass balance around the FGD process, however, this over-estimation was considered negligible. Centrifuge flow rates and gypsum slurry density values were averaged over each daily test period from FGD control room data logs.

### 2.2.3 FGD Liquid/Sludge Sample Streams

FGD input and output liquid/sludge process streams were sampled in an effort to close the mercury FGD mass balance. These process streams are common to the desulfurization of both Unit 1 and Unit 2's flue gas. There was no way to isolate Unit 2 from Unit 1 for these process streams, as a result, flow rates were adjusted proportionally based on net MW output from both units.

#### 2.2.3.1 **PWRF Outlet Water**

Process Wastewater Reclamation Facility (PWRF) outlet samples were obtained from a pre-existing tap on the lake discharge line. A 400-ml increment sample was collected into a high-density polyethylene (HDPE) sample bottle approximately every hour over the course of an eight-hour test window (0800 to 1600 hours). Increments were combined into a HDPE 1-gallon container and 1-500 ml composite was removed for mercury analysis. The composite was treated with nitric acid to obtain a pH level of 2 and stored at 4°C in accordance with standard sample preservation requirements of EPA SW846 methodologies. Flow rates for this stream were taken from plant instrumentation.

#### 2.2.3.2 **Brine Product**

FGD blowdown and clarified water from the gypsum slurry secondary hydroclones are sent through a continuous treatment process that removes solids and metal hydroxides to produce a brine product stream. A brine concentrator is being demonstrated as a removal technique for chlorides that produces a marketable  $\text{CaCl}_2$  salt. The distillate water from the brine concentrator can then be recycled back to the FGD absorber make-up water tank. During this test program, however, the brine concentrator was not in operation. Samples of the brine product stream were

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collected prior to its discharge into the plant's PWRP system. Samples were collected in the same manner as the PWRP outlet water samples. Flow rates for this stream were taken from FGD control room data logs.

### 2.2.3.3 FGD Blowdown Treatment Heavy Metal Sludge

The solids and metal hydroxides contained in the FGD blowdown and clarified water streams removed by the treatment process are sent to a filter press that produces a heavy metal sludge. The sludge is deposited into a large bin and trucked off-site for landfill disposal. A single filter press operation produces one load of sludge in 4 hours. For this test program, sludge production was set-up to be a continuous operation that produced approximately 6 loads per day. FGD sludge production was suspended after the second day due to operational problems. Sludge samples were extracted from the sludge pile on the mornings of 8/8/96 and 8/9/96 corresponding to sludge produced the day before. Using a 1" PVC pipe approximately 10 foot long, four to six-inch long core samples were obtained at 4 sample points spaced along the center axis of the pile. Two core samples were taken at each sample point (for a total of eight core samples), first with the PVC pipe oriented vertically and second with the pipe at an angle of approximately 60°. Increment weights ranged from 0.4 to 1 pound based on sludge moisture levels. Increments were combined for a total daily sample size of 3-8 pounds and stored at <4°C, as per EPA SW846 protocols, before shipping to the laboratory. The sludge bin was emptied before the test program began and then weighed after the second day of sludge production. The flow rate for forty-eight hours of sludge was proportionally corrected to isolate Unit 2 production from Unit 1 based on unit load distribution.

## 2.3 TEST SCHEDULE

The test schedule for the mercury speciation test program is given on Table 2-2. All mercury speciation tests were performed on August 7, 8, and 9, 1996. EPA Method 29 and the Ontario-Hydro sampling trains were operated at the ESP outlet/FGD inlet and FGD outlet/stack locations simultaneously for 360 minutes. The TRIS Buffer sample trains were operated following the completion of the Ontario-Hydro testing. TRIS Buffer sampling was conducted for 60 minutes at the ESP outlet/FGD inlet and for 120 minutes at the FGD outlet/stack. The Semtech Hg 2000 analyzer was operated each day of the mercury measurements over time intervals that corresponded to Ontario-Hydro and TRIS Buffer sampling periods. Test 1-MESA-IN performed on 8/7/96 was lost after the test was completed, so two Frontier Geoscience replicates (Test Numbers 3 & 3A) were performed on 8/9/96 at each location in order to have a complete set of simultaneous data.

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**TABLE 2-2**  
**TEST SCHEDULE FOR MERCURY SPECIATION TESTING**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Test Number	Date	Time	0800				0900				1000				1100				1200				1300				1400				1500				1600				1700																															
			00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15																																		
1-MTLS-IN	08/07/96	0817/1227																																																																				
1-MTLS-OUT	08/07/96	0833/1512																																																																				
1-MTLS-STK	08/07/96	0817/1441																																																																				
1-OH-OUT	08/07/96	0840/1440																																																																				
1-OH-STK	08/07/96	0842/1442																																																																				
1-TRIS-OUT	08/07/96	1533/1633																																																																				
1-TRIS-STK	08/07/96	1515/1715																																																																				
1-MESA-OUT	08/07/96	1025/1325																																																																				
1-MESA-STK	08/07/96	1050/1350																																																																				
2-MTLS-IN	08/08/96	0803/1212																																																																				
2-MTLS-OUT	08/08/96	0822/1435																																																																				
2-MTLS-STK	08/08/96	0811/1540																																																																				
2-OH-OUT	08/08/96	0756/1356																																																																				
2-OH-STK	08/08/96	0753/1353																																																																				
2-TRIS-OUT	08/08/96	1417/1517																																																																				
2-TRIS-STK	08/08/96	1425/1625																																																																				
2-MESA-IN	08/08/96	0840/1040																																																																				
2-MESA-OUT	08/08/96	0845/1145																																																																				
2-MESA-STK	08/08/96	0845/1145																																																																				
3-MTLS-IN	08/09/96	0803/1210																																																																				
3-MTLS-OUT	08/09/96	0814/1435																																																																				
3-MTLS-STK	08/09/96	0815/1507																																																																				
3-OH-OUT	08/09/96	0817/1417																																																																				
3-OH-STK	08/09/96	0826/1426																																																																				
3-TRIS-OUT	08/09/96	1432/1532																																																																				
3-TRIS-STK	08/09/96	1520/1720																																																																				
3-MESA-IN	08/09/96	0930/1140																																																																				
3-MESA-OUT	08/09/96	0845/1145																																																																				
3-MESA-STK	08/09/96	0827/1127																																																																				
3A-MESA-IN	08/09/96	1340/1540																																																																				
3A-MESA-OUT	08/09/96	1245/1545																																																																				
3A-MESA-STK	08/09/96	1215/1515																																																																				

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## 2.4 PROCESS OPERATION DURING TESTING

Table 2-3 summarizes the process operating conditions for the mercury speciation test program. Operation of Unit 2 during this test program was representative of normal daily operation at or near full load. Opacity levels were in compliance and no ESP operating problems were identified. To obtain maximum uniformity and the most representative samples, steady-state process conditions were maintained throughout each test day with variations in unit load, excess oxygen, and ESP power levels well within acceptable tolerances. Prior to each test day, key operating parameters were stabilized, the bottom ash storage silo was emptied, and the ESP hoppers evacuated.

**Unit Load.** Load on Unit 2 during this test program was steady within an average range of 147-150 net MW. Main steam flows were around 1100 Klb/hr and total FD fan air flows were between 1000-1100 Klb/hr.

**Excess Oxygen.** The target boiler O<sub>2</sub> level set prior to the test program was 3.8% ± 0.5%, which matches the target oxygen level set during the baseline test program in May 1994. Excess O<sub>2</sub> levels measured during this test program were steady at the low end of this target range averaging 3.3% each day. May 1994's excess oxygen levels produced only a minimum amount of CO (8-11 ppm).

**Sootblowing.** Each morning after the unit load was stabilized and prior to the commencement of sampling, sootblowing was performed. During testing the normal sootblowing schedule was adhered to. Sootblowing schedules for this test program can be found in Appendix C.1.

**ESP Operation.** Unit 2's ESPs were operated at their peak efficiency with all fields in service. ESP power levels are documented in Appendix C.1.

**FGD Operation.** FGD SO<sub>2</sub> removal rate was maintained within the target range of 90-95% for the test program. The major process systems of the FGD were operated normally.

Unit operation was documented using plant instrumentation data logs. Data from Unit 2's CEM systems located at the ESP outlet/FGD inlet (SO<sub>2</sub>, CO and opacity) and FGD outlet/stack (NO<sub>x</sub>, SO<sub>2</sub>, and CO<sub>2</sub>) were also documented. Plant CO<sub>2</sub> measurements were used by Carnot for emission calculations. Unit operating data logs can be found in Appendix C.1. Unit CEMS data can be found in Appendix C.2.

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**TABLE 2-3**  
**UNIT OPERATING CONDITIONS SUMMARY**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Test Period	Date	Time	Gross Output, MW	Net Output, MW	Main Steam		Feedwater		Total Air Flow (Fans A/B), Klb/hr		Coal Flow Rate, lb/hr <sup>(1)</sup>	Temperatures, °F				Plant CEMS							
					Flow, Klb/hr	MW	Flow, Klb/hr	Flow, Klb/hr	Inlet	Outlet		O <sub>2</sub> , %	Boiler Opacity, %	FGD Inlet		FGD Outlet/Stack							
														SO <sub>2</sub> , ppm (raw)	lb/hr	SO <sub>2</sub> , ppm (raw)	lb/hr	SO <sub>2</sub> , ppm (raw)	lb/hr	SO <sub>2</sub> , ppm (raw)	lb/hr	Rem Eff, %	NO <sub>x</sub> , ppm (raw)
<b>Mercury Speciation Test Period:</b>																							
1	8/7/96	0800/1800	158.6	148.9	1,098	1,044	1,044	1,088	661	661	1,004	301	3.30	5.81	1,573	5,012	129.4	509.3	129.4	509.3	89.8%	182.2	
2	8/8/96	0800/1800	159.4	149.6	1,105	1,042	1,042	1,104	662	662	1,005	299	3.29	5.74	1,556	4,989	126.7	502.92	126.7	502.92	89.9%	194.3	
3	8/9/96	0800/1700	158.8	149.1	1,099	1,036	1,036	1,101	664	664	1,005	295	3.28	5.91	1,605	5,214	107.2	424.83	107.2	424.83	91.9%	203.1	

Note

(1) Calculated from Carnot pitot flow rate data and EPA Method 19 F-Factor (reported on an as-received basis)

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## SECTION 3.0

### MERCURY SAMPLING AND ANALYTICAL METHODS

This section describes the mercury speciation sampling and analytical methods that were used for this test program. Section 3.6 discusses the analytical approach used for total mercury analysis of the solid and FGD liquid/sludge samples. Section 3.7 explains how non-detected values, reagent blanks, field blanks, and uncertainty calculations were handled. Flow charts are presented in appropriate sections when complex analytical procedures for multi-fraction samples require illustration.

Table 3-1 lists the four sample trains that were used to conduct the mercury speciation flue gas sampling portion of the test program. Table 3-2 summarizes the sample train configurations including train materials and impinger contents. For the remainder of this report, "front-half" of the sample train refers to the section of train before and including the filter and any recovery portions from that section, and "back-half" refers to all train components and their recovery rinses downstream of the filter.

A "Method 5" style out-of-stack filtration sampling train with borosilicate glass nozzles, probes, and filter holders were used for the mercury speciation tests. Six-foot probes were used at the ESP inlet and outlet locations for EPA Method 29 and four-foot probes were used for the single-point tests. At the stack, 12' probes were used for EPA Method 29 and 4' probes for the single-point tests. Teflon sample lines were used to connect the back of the filter holder to the impingers.

#### 3.1 EPA METHOD 29

The back-half of the EPA Method 29 sample train used to collect volatile metals that passed through the nozzle/probe and filter consisted of a Teflon sample line followed by a series of six ice-water chilled impingers. Following an empty stub-stem impinger for moisture removal, the next two impingers contained a 5% nitric acid/10% hydrogen peroxide solution, followed by an empty "middle knockout" impinger to prevent the permanganate solution in the fifth impinger from contaminating the nitric acid impingers. The fifth and sixth impingers contained an acidified potassium permanganate solution to collect any mercury that was not removed by the nitric acid impingers.

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**TABLE 3-1**  
**TEST PROCEDURES FOR MERCURY SPECIATION MEASUREMENTS**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**

Sample Train	Sampling Method	Species Measured	Isokinetic/ Constant Flow Rate	Test Duration*	Traverse Points
1) Multi-Metals	EPA Method 29	Hg(0), Hg(II), Total Hg	Isokinetic	A1: 240 A2,A3: 360	Full Traverse
2) Frontier Geosciences	MESA	Hg(0), Hg(II), Total Hg	Constant Flow Rate	A1: 120 A2,A3: 180	A1,A2: Multi-Point <sup>(1)(2)</sup> A3: Single Point
3) Ontario-Hydro	Ontario-Hydro Hg Spec. Train	Hg(0), Hg(II), Total Hg	Isokinetic	A2,A3: 360	Single Point <sup>(1)</sup>
4) TRIS Buffer	TRIS Buffer Hg Spec. Train	Hg(0), Hg(II), Total Hg	Isokinetic	A2: 60 A3: 120	Single Point <sup>(1)</sup>

*Notes: During each test, an O<sub>2</sub> measurement was taken at every sampling point as per EPA 3A via a portable oxygen analyzer. In conjunction with each isokinetic test, velocity and moisture measurements were made according to EPA Methods 2 and 4.*

\* Key: A1 = ESP Inlet, A2 = ESP Outlet, A3 = Stack

Note:

(1) Replicates alternated ducts concurrently with opposite ESP location (if applicable).

(2) Each replicate traversed entire sample port.

Sample trains were pre-cleaned with concentrated HNO<sub>3</sub>/HCl. One field blank for the ESP inlet/outlet location and one for the stack location were collected prior to the inorganic test period, and then two more field blanks (same locations) were collected at the end of the inorganic test period to compare with the "clean glass" field blanks.

EPA Method 29 samples were recovered into the following fractions:

- 1) Particulate filter - Container No. 1
- 2) Front-half fraction
  - 2a) Acetone rinse and brush - Container No. 2 (ESP inlet samples only)
  - 2b) Nitric acid rinse - Container No. 3
- 3) Back-half empty and nitric acid/peroxide impingers/rinse - Container No. 4
- 4) Nitric acid rinse of middle knockout impinger - Container No. 5A
- 5) Potassium permanganate/sulfuric acid impingers/rinses - Container No. 5B
- 6) Hydrochloric acid rinse of permanganate impingers - Container No. 5C (combined with Container No. 5B at laboratory).

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TABLE 3-2  
MERCURY SPECIATION SAMPLE TRAIN CONFIGURATIONS  
NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM

Sample Train	Nozzle	Probe	Filter	Out-of-Stack Filter Holder	Sample Line	Impinger Contents				
						#1	#2	#3	#4	#5
EPA Method 29	BSG	BSG	110 mm Ultrapur quartz fiber	Method 5 BSG, Teflon frit	Teflon	Empty- stub stem	100 ml 5% HNO <sub>3</sub> /10% H <sub>2</sub> O <sub>2</sub>	100 ml 5% HNO <sub>3</sub> /10% H <sub>2</sub> O <sub>2</sub>	#5: 100 ml 4% KMnO <sub>4</sub> /10% H <sub>2</sub> SO <sub>4</sub>	#6: 100 ml 4% KMnO <sub>4</sub> /10% H <sub>2</sub> SO <sub>4</sub>
Frontier Geoscience	N/A	Quartz w/quartz wool at tip	Two KCl/soda lime traps followed by two iodated carbon traps	N/A	Teflon, 1/8"	Silica gel	N/A	N/A	N/A	#7:SG N/A
Ontario-Hydro	BSG	BSG	110mm Ultrapur Quartz fiber	Method 5 BSG, Teflon frit	Teflon	#1, #2, #3: 100ml 1M KCl	#4: 100ml 5% HNO <sub>3</sub> / 10% H <sub>2</sub> O <sub>2</sub>	#5: 100ml 5% HNO <sub>3</sub> / 10% H <sub>2</sub> O <sub>2</sub>	#6, #7, #8: 100ml 4% KMnO <sub>4</sub> / 10% H <sub>2</sub> SO <sub>4</sub>	#9: 300-400g silica gel
TRIS	BSG	BSG	110mm Ultrapur Quartz fiber	Method 5 BSG, Teflon frit	Teflon	150ml 1M TRIS/ 10mM EDTA	150ml 1M TRIS/ 10mM EDTA	150ml 4% KMnO <sub>4</sub> / 10% H <sub>2</sub> SO <sub>4</sub>	150ml 4% KMnO <sub>4</sub> / 10% H <sub>2</sub> SO <sub>4</sub>	300-400g silica gel

Key: BSG = Borosilicate glass N/A = Not applicable

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Analytical procedures used for mercury determination were in accordance with EPA Method 29 as illustrated in Figure 3-1. The front-half rinse is acidified with concentrated nitric acid to a pH of 2. Both the front-half and filter are decomposed separately using a nitric acid/hydrofluoric acid microwave digestion procedure to solubilize mercury and to remove organic constituents that may create analytical interferences and then combined. An aliquot of the combined front-half rinse and filter decomp along with an aliquot taken from the empty and nitric acid containing impinger catch/rinse are digested separately with nitric acid and permanganate and analyzed for mercury by cold vapor atomic absorption spectrophotometry (CVAAS). The middle knockout impinger rinse and the permanganate impinger catch/rinse are decomposed separately with nitric acid and permanganate and analyzed for mercury by CVAAS.

EPA Method 29 trace element results from previously sponsored EPRI and DOE toxic assessment programs for ESP/fabric filter inlet flue gas streams at coal-fired utility stations have shown poor agreement with fuel input and flyash levels. Method 29 attempts to digest the solids collected in the front-half of the sample train by dividing them into 0.5 gram portions and digesting them individually. This procedure becomes problematic when the quantity of ash collected exceeds 2-3 grams requiring over 5 separate digestions. Attempting and then combining more than 5 digests can not only introduce significant levels of contamination but any errors associated with solubilizing a single 0.5 gram portion are multiplied by the number of digests performed. For this test program, approximately 30 grams of solids were collected in the front-half of the ESP inlet sample trains. Digesting these sample train solids is further complicated when major ash elements are required. Oxides of silicon, aluminum and iron among others contribute 95-99% of Unit 2's flyash content creating a complex refractory matrix. These elements exist in a variety of compounds, a number of which are difficult to solubilize.

To address this problem of analyzing the ESP inlet samples and to be consistent with the May 1994 Unit 2 baseline test program, Method 29's recovery and analysis procedures were modified as illustrated in Figure 3-3 by asterisks. Instead of attempting to digest the entire amount of solids collected in the sample train, the solids were treated more like a flyash sample. ASTM ash methods allow for a representative aliquot to be removed for analysis when the sample is less than 50 grams and has a top size of -60 mesh or smaller. This not only allows for a smaller quantity of ash to be digested, but duplicate and confirmational analyses can be performed. EPA Method 29's option for obtaining a solid particulate weight from the train's front-half was exercised to correct ash aliquot concentrations to a total train basis.

An acetone rinse while brushing was performed on the front-half of the ESP inlet sample train components prior to the nitric acid rinse. After placing any loose particulate found on the filter into the acetone front-half rinse (designated as "probe-rinse solids"), it was evaporated at ambient temperature, desiccated and weighed. Aliquots of the evaporated probe-rinse solids were

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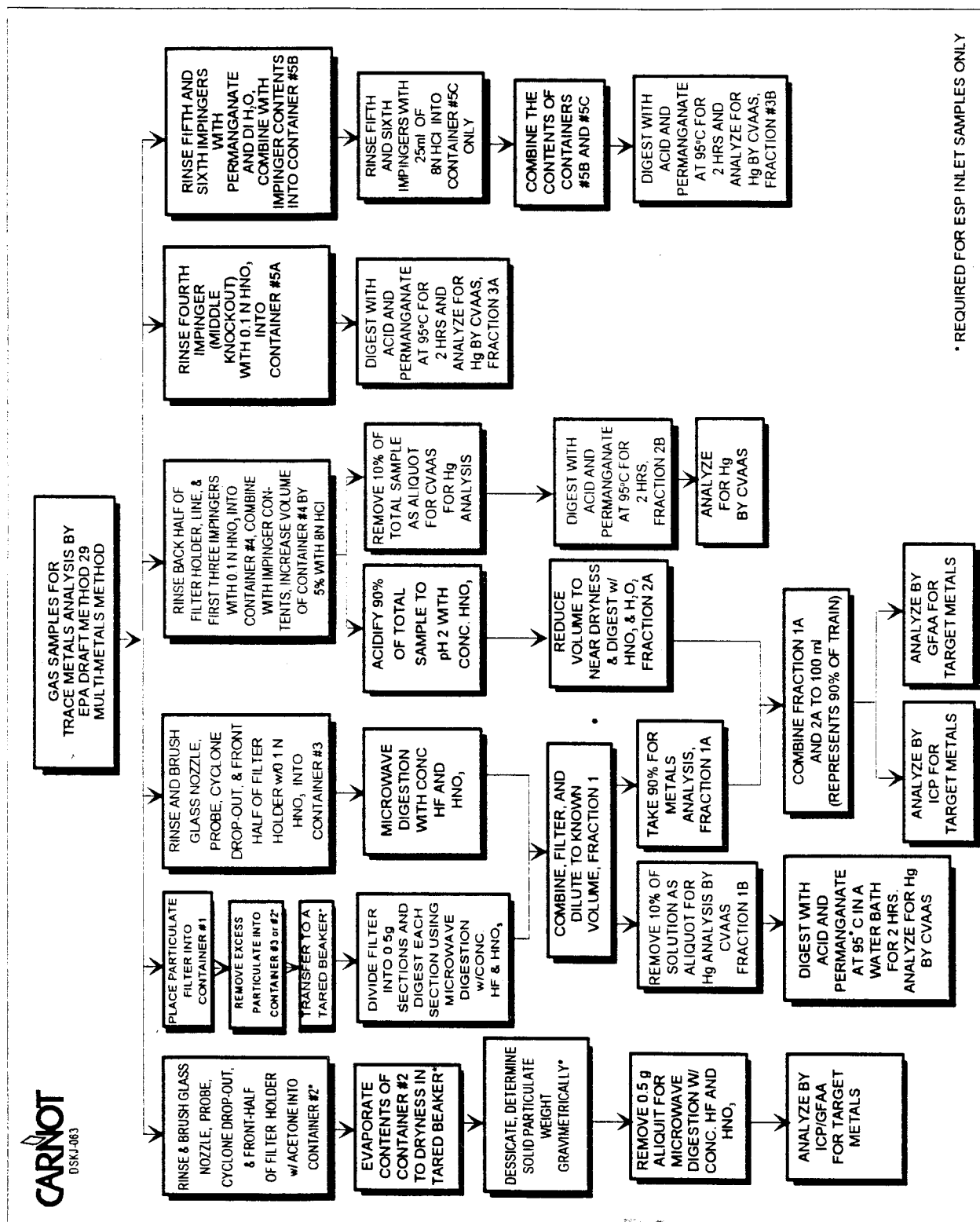


Figure 3-1. EPA Draft Method 29 Multi-Metals Analysis

analyzed by CVAAS for mercury after an EPA 29 nitric acid/HF microwave digestion. The probe-rinse solids, which include the cyclone catch, constituted approximately 99% of the total collected particulate. The filter, containing the remaining 1%, and the other sample fractions were analyzed according to the same standard procedures used for the ESP outlet and stack samples.

After examining the ash mass balance results which included the EPA Method 5 particulate values, it became apparent that the Method 29 sample trains for Runs 2 and 3 collected a disproportionately high amount of solids. Assuming the ash balance results provide a bench mark for ash distribution levels across the boiler/ESP process streams, Runs 2 and 3, which collected 36.6 and 33.7 grams of probe-rinse solids, respectively, collected 5-7 grams too much. A high bias in their solids catch could be the result of particulate stratification that is considered to exist at the ESP inlet location based on the May 1994 baseline test program data. To correct for this high bias, an adjustment factor based on the ash mass balance was applied to the total solids catch amounts for Runs 2 and 3 before multiplying them by the mercury solids concentration values.

Although EPA Method 29 was never intended as a test method for speciating mercury, Hg(0) and Hg(II) results were reported for informational purposes. The Hg(II) results were taken from the nitric acid front-half rinse, nitric acid/peroxide impingers/rinse, and middle knockout rinse sample fraction results. Results from the permanganate/HCl fraction were reported as Hg(0). Solid mercury results from the front-half of the sample train were reported as total Hg.

Three reagent blanks, one for each inorganic test day, that include the test filter were analyzed along with the flue gas samples. The two field blanks collected prior to the inorganic test period, in addition to the two field blanks collected at the end of the inorganic test period to compare with the "clean glass" field blanks, were also analyzed. The "clean glass" field blank collected at the ESP inlet/outlet was inadvertently lost during analysis. Analyses of matrix spikes and duplicates were performed for each metal species as required by Method 29 for both groups of ESP inlet/outlet and stack samples.

### 3.2 FRONTIER GEOSCIENCE MESA METHOD

Frontier Geoscience's mercury speciation absorption (MESA) sampling train selected for this test program is based generally on the sampling train and analytical procedures outlined in the Analytical and Sampling Methods for Mercury Speciation in Flue Gases, Nicolas Bloom, February 1993. This sampling train consists of the following components.

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- A quartz sample probe with quartz wool at the tip (to trap excess particulates). The probe pre-packed with wool is supplied and recovered by Frontier Geoscience.
- 2 pairs of tandem solid sorbent traps in series. The first pair of traps contains potassium chloride (KCl) impregnated soda lime granules. The second pair of traps contain iodated carbon.
- A section of Teflon tubing to connect the outlet of the final sorbent tube to a container of silica gel.
- A vacuum line to connect the outlet of the silica gel container to a control box.
- A control box containing a dry gas meter calibrated to 1-liter-per-minute, a sample pump, a temperature indicator and other components.

The quartz probe, with quartz wool and sorbent traps on opposite ends, was placed inside a borosilicate probe and heated to prevent moisture condensation prior to the traps. Non-isokinetic sampling was performed to determine only gas-phase mercury species. Sampling at the ESP inlet and outlet was performed within a single port at all three sample points. Single-point sampling was conducted at the stack.

No field blanks were collected. Two trip blank samples consisting of the probe with quartz wool and sorbent tubes were analyzed along with the samples.

Frontier Geosciences analyzed the MESA sample trains for elemental mercury or Hg(0), oxidized mercury or Hg(II), and total Hg. It should be noted that this method is still under evaluation and is considered only in a research/development stage. The KCl/soda lime and iodated charcoal traps were analyzed by a cold vapor atomic fluorescence spectroscopy (CVAFS) technique after appropriate sample treatment. The quartz probes and quartz wool were recovered by the lab (separate probe for each test) and analyzed for total Hg by CVAFS.

The analysis of the solid sorbent traps for mercury speciation was performed by closely following Frontier's standard operating procedures. The iodated carbon traps are leached with hot refluxing 7:3 solution of  $\text{H}_2\text{SO}_4:\text{HNO}_3$  and then diluted with 5% (v/v) BrCl solution. An aliquot of the iodated carbon digest is analyzed for Hg(0) by aqueous phase  $\text{SnCl}_2$  reduction, dual gold trap amalgamation and finally detected by CVAFS. The KCl/soda lime traps are first dissolved in a 5% (v/v)  $\text{HNO}_3/0.3$  M citric acid solution. For the analysis of Hg(II) in the  $\text{HNO}_3$ /citrate digest, an additional 10 ml of HCl is added to the  $\text{HNO}_3$ /citrate digest to ensure all of the Hg(II) is in solution. Then aliquots of this digest are analyzed for Hg(II) by aqueous

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phase  $\text{SnCl}_2$  reduction, dual gold trap amalgamation and finally detected by CVAFS. The analysis of the probe/wool recovery rinses for total Hg was accomplished by aqueous phase  $\text{SnCl}_2$  reduction, dual gold amalgamation and CVAFS detection of appropriate sized aliquots.

All standards are ultimately traceable to the lab stock standard for total Hg supplied by the NIST (formerly NBS). Also, where possible, certified standard materials were analyzed along with the samples.

### 3.3 ONTARIO-HYDRO/TRIS BUFFER MERCURY SPECIATION METHODS

The Ontario-Hydro and TRIS Buffer sampling trains are modifications of EPA Method 29 with the only differences being the number and content of the impingers. For the Ontario-Hydro method, the first three impingers contain a potassium chloride (KCl) solution, the fourth and fifth impingers contain a 10%  $\text{H}_2\text{O}_2$ /5%  $\text{HNO}_3$  solution, and the last three impingers contain 4%  $\text{KMnO}_4$ /10%  $\text{H}_2\text{SO}_4$ . For the TRIS Buffer technique, EPA 29's nitric acid/peroxide impinger contents are replaced with a tris(hydroxymethyl) aminomethane buffer solution. Ethylene di(tetraamine) or EDTA is added to the TRIS buffer solution as a complexing agent. Table 3-2 provides the exact sample train configurations for both methods.

Operation of the Ontario-Hydro and TRIS sampling trains followed EPA Method 29 sampling procedures. Both trains were operated at a single-point. The Ontario-Hydro sampling time was six hours to match EPA Method 29's. The TRIS Buffer train was operated for one hour at the ESP outlet and two hours at the stack in order to maintain the pH of the buffer above 6.5. The Ontario-Hydro and TRIS methods were performed simultaneously at both sampling locations and conducted in series.

Sample trains were pre-cleaned with concentrated  $\text{HNO}_3/\text{HCl}$ . For these sample trains no impinger glassware was used more than one time.

Daily field blanks and field blank spikes were taken at the ESP outlet location for each method.

EERC prepared, recovered, and performed the mercury speciation analysis of the Ontario-Hydro and TRIS Buffer sampling trains. Appendix A contains EERC's protocols for sample train recovery, sample preparation, and analysis procedures. It should be noted that along with Frontier Geoscience's method, the Ontario-Hydro and TRIS Buffer mercury speciation techniques are still under review and are not approved procedures at this time.

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Samples collected using the Ontario-Hydro method were recovered into the following fractions as shown in Figure 3-2:

- 1) Particulate filter and ash - Container No. 1
- 2) Front-half nitric acid rinse - Container No. 2A
- 3) Back-half nitric acid rinse and potassium chloride impingers and rinses (permanganate, hydrochloric acid, nitric acid) - Container No. 2B  
(Container 2A was combined with 2B for analysis on the first replicate)
- 4) Nitric acid/peroxide impingers and rinses (nitric acid) - Container No. 3
- 5) Permanganate/sulfuric acid impingers and rinses (hydrochloric and nitric acids) - Container No. 4

Samples collected using the TRIS Buffer technique were recovered into the following fractions as shown in Figure 3-3:

- 1) Particulate filter and ash - Container No. 1
- 2) Front-half nitric acid rinse - Container No. 2A
- 3) Back-half nitric acid rinse and TRIS/EDTA impingers and rinses (TRIS, DI H<sub>2</sub>O) - Container No. 2B
- 4) Permanganate/sulfuric acid impingers and rinses (hydrochloric and nitric acids) - Container No. 4

Potassium chloride sample fractions were immediately preserved with acidified potassium permanganate and then digested using a potassium persulfate digest procedure. Nitric acid/peroxide sample fractions were preserved with 10% HCl, then combined with potassium permanganate until solution remains purple. At this point, hydroxylamine sulfate was added until the solution becomes clear. TRIS/EDTA sample fractions are digested with potassium persulfate. Hydroxylamine sulfate is added to the potassium permanganate/sulfuric acid sample fractions until solution turns clear. All liquid sample fractions were then analyzed on-site for mercury by CVAAS.

The particulate filter fraction was HCl/HF microwave digested and analyzed at EERC's University of North Dakota laboratory.

For the Ontario-Hydro method, the KCl fraction results are reported as Hg(II), and the remaining fraction results are reported as Hg(0). For the TRIS Buffer technique, the TRIS/EDTA impinger results are reported as Hg(II), and the KMnO<sub>4</sub>/H<sub>2</sub>SO<sub>4</sub> impinger results are reported as Hg(0). Any mercury found on the filter is reported as total mercury. Any mercury found in the probe rinses for either method was considered Hg(II) for the following reasons:

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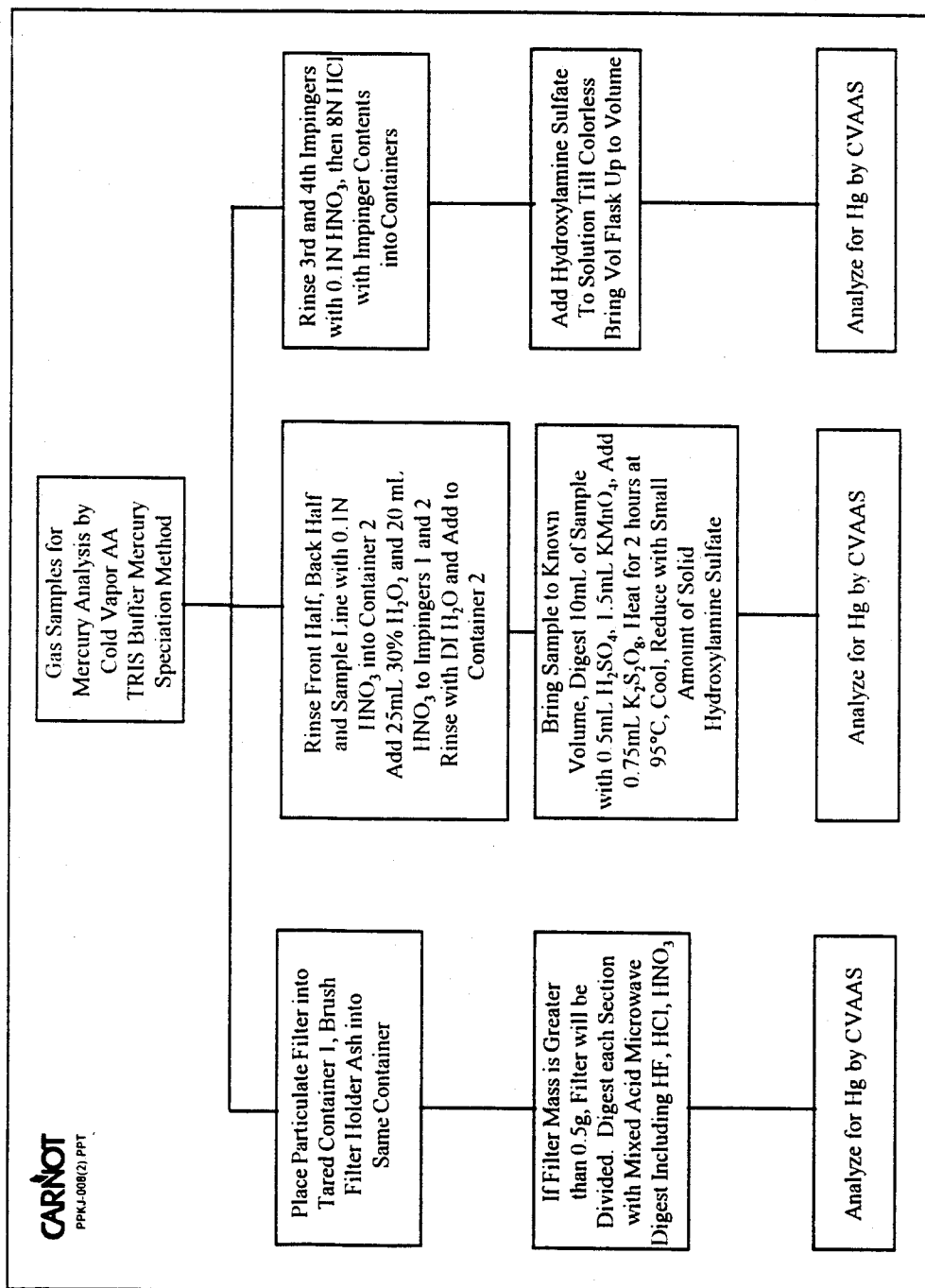


Figure 3-3. TRIS Buffer Mercury Speciation Analysis

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- Mercury levels in the flyash were measured just under 0.1 ppm. At this concentration, significant levels of mercury adsorbed on the ash will not be found in the front-half portions of the FGD inlet and outlet sample trains since such small levels of flue gas particulate are collected.
- Mercury analyses of the filters from FGD inlet/outlet TRIS, Ontario-Hydro and EPA Method 29 sample trains found little or no mercury.

As a result, any significant levels of mercury found in the front-half rinse of the trains was assumed to be Hg(II) that deposited on the probe/filter holder surfaces due to the lower than optimal probe/filter temperatures of approximately 250°F. Hg(II) is much more likely to deposit on front-half glassware surfaces than Hg(0) at this temperature range.

Since daily field blanks and field blank spikes were taken no reagent blanks were analyzed.

#### 3.4 SEMTECH HG 2000 ANALYZER

EERC provided a Semtech Hg 2000 instrumental analyzer manufactured by Semtech Metallurgy AB, Lund, Sweden for use at the stack location. The analyzer measures Hg(0) on a real-time continuous basis using a Zeeman-shifted ultraviolet sensor. The Semtech's Zeeman-shifted detection technology eliminates interference from SO<sub>2</sub> absorption.

A heated glass probe, a teflon sample line, and two ice water-chilled TRIS impingers were used to provide dry, Hg(II)-free conditioned flue gas to the analyzer. The Semtech was auto-zeroed and zero-checked on ambient air daily. No span calibrations can be performed on this analyzer. (It is uncertain whether the manufacturer will develop a spanning method for this analyzer.) The flow rate to the analyzer was set at approximately 3 L/min and data was logged in 1 minute intervals. Ambient air was used to purge the analyzer between test days. The analyzer was operated each day of the inorganic test period and instrument readings in ug/dscm were averaged over time intervals that corresponded to stack Ontario-Hydro and TRIS Buffer sampling periods.

The Semtech was also operated at the ESP outlet during the second-half of Day 3 (TRIS Buffer sampling period) of the inorganic test period, and for part of the following day; however, the instrument readings are considered unreliable and the results were deemed invalid due to the use of an improper sample conditioning system and detrimental ambient conditions (i.e. high temperature and dust level). For sampling at the ESP outlet (where flue gas temperatures were near 300°F) it would have been more appropriate to use a heated transfer line between the heated

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sampling probe and the chilled impingers to prevent Hg(II) deposition in the transfer line. It is not well understood but the deposition of Hg(II) on analyzer surfaces located prior to the detection and quantification of Hg(0) can cause interferences. Furthermore, a longer sampling probe should have been used due to the highly negative duct pressure (-14 to -15 iwg). The ambient temperature at the ESP outlet during sampling was around 120°F which was well beyond the instrument's recommended operating temperature range of 41°F to 95°F. Operation of the analyzer at this elevated temperature level overheated the power supply. Finally, the design of the analyzer does not include a sealed optical path, and the analyzer uses ambient air for ventilation. The ambient air at the ESP outlet contained a high level of dust which may have settled on the lamp and/or cell window surfaces interfering with the optical path of the Hg(0) detection system.

### 3.5 DILUENT GASES, FLUE GAS VELOCITY, AND MOISTURE

To determine the O<sub>2</sub> levels at each sample location and the integrity of each isokinetic, multi-point test train, a Teledyne portable O<sub>2</sub> analyzer using a paramagnetic cell sampled conditioned flue gas from the outlet of the calibrated orifice on each control box at every sample point. The portable O<sub>2</sub> analyzer's linearity was verified daily using EPA Protocol 1 certified gas standards.

For emission rate calculations, CO<sub>2</sub> levels at the stack were averaged from NYSEG's CEM system for corresponding stack test periods, and then corrected to ESP inlet and outlet test period O<sub>2</sub> values.

Flue gas velocity, moisture and flow rate determinations were performed according to EPA Methods 2 and 4 in conjunction with EPA Method 29. For single point tests (i.e. Frontier Geoscience, Ontario-Hydro, and TRIS Buffer) flow rates for mass emission calculations were taken from corresponding full traverse isokinetic tests.

### 3.6 PROCESS SAMPLES

Solid samples for total mercury were analyzed by EERC and FGD liquid/sludge samples were analyzed by Zenon.

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### 3.6.1 Solid Samples

Coal feed, bottom ash, flyash, limestone solids, and gypsum solids were analyzed for total mercury using EPA SW846-3051 modified for a closed vessel acid digestion and CVAAS. Sulfuric and nitric acids were used to digest the coal, and nitric acid, HF, and HCl were used to digest the ash and FGD solids. EERC has specially developed a complicated solids digestion procedure that consists of several microwave heating, cooling, and venting steps to obtain clear, solubilized solutions.

### 3.6.2 Liquid/Sludge Samples

FGD liquid/sludge samples were microwave-assisted acid digested according to EPA Methods 3015/3051 and analyzed for mercury by CVAAS.

## 3.7 TREATMENT OF NON-DETECTS, REAGENT/FIELD BLANK VALUES AND UNCERTAINTY CALCULATIONS

This section describes how non-detect and reagent/field blank values were treated in presenting results in the test report. A description of how uncertainties were calculated concludes this section.

### 3.7.1 Non-Detects

The discussion presented below explains how averages, sums and reported emission values were calculated for all species given various combinations of detected and non-detected values.

All values detected. The arithmetic average or sum is taken, as appropriate. No special techniques required.

All values below the detection limit. For individual test runs or species, the data is reported as "ND < (detection limit)." For cases where all three runs are below the detection limit, the average is reported as "ND < (average detection limit)."

Some values are detected and some are non-detects. As an approximation, half of the detection limit will be used for non-detect values and the full value for detects. As an example of averaging, an average for three tests runs with results of 10, 8, and ND < 6 would be 7. As an example for summing (such as for EPA Method 29 fractions), individual species values of 5, 8, ND < 1, and ND < 2 would be summed to provide a value of  $5+8+0.5+1$ , or 14.5. In reporting these types of sums or averages, no "<" sign is used. The only exception to this rule

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occurs when the average is less than the highest detection limit of the non-detected values. In this case, the average is reported as "ND < (the highest detection limit)." For example, 5, ND < 4 and ND < 3 would be reported as "ND < 4." For calculating APCD removal efficiencies when the inlet stream is reported above the detection limit but the outlet is below, a ">" sign is used with the percent removal value.

### 3.7.2 Reagent/Field Blank Values

In general, when reagent blank levels are found to contribute consistently to the field blank and sample values they are subtracted. Reagent blanks are considered representative of the batch of reagent used for testing. In no case were sample results blank corrected to levels below their analytical detection limit. When subtracting a reagent blank returned a value lower than the detection limit, the detection limit was used and reported as a "hit."

Field blanks are not subtracted from sample values when a single field blank is taken because it is considered only a qualitative assessment of the contamination level present in the samples. Only when more than one field blank are taken (ideally as many as there are samples) do they become a better means of quantitatively assessing the sample contamination level. For the Ontario-Hydro and TRIS Buffer tests, more than one field blank were taken and used for blank subtractions (as described below). Field blanks are intended to measure the amount of contamination introduced to the samples from a variety of sources that range from sample handling, sample train materials, sample recovery, and the reagents. It is assumed that by treating the field blanks as samples, their results will reflect actual sample contamination.

For each group of sample trains used on this test program, the following summarizes how many reagent and field blanks were taken in the field and what type of subtractions were made to the sample results:

**EPA Method 29.** Three reagent blanks, one for each inorganic test day, that include the test filter were analyzed along with the flue gas samples. Average detected reagent blank values were subtracted from sample results for both trace and major elements. One field blank for the ESP inlet/outlet location and one for the stack location collected prior to the inorganic test period, in addition to two more field blanks (same locations) collected at the end of the inorganic test period to compare with the "clean glass" field blanks, were also analyzed. The "clean glass" field blank collected at the ESP inlet/outlet was inadvertently lost during analysis.

**Frontier Geoscience.** An average value from two trip blanks were subtracted from detected sample results. No field blanks were taken.

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**Ontario-Hydro/TRIS Buffer.** Daily field blanks taken at the ESP outlet/FGD inlet location for each method were subtracted from corresponding daily sample results from both locations. No reagent blanks were analyzed.

**Semtech Hg 2000 Analyzer.** Detector and reference zero and span values were adjusted after setting-up the analyzer at the stack location. The analyzer was auto-zeroed and zero-checked on ambient air daily.

### 3.7.3 Uncertainty Calculations

A 95% confidence interval will be calculated for each average emissions value presented. The interval is expressed as a percentage of the mean. The confidence limits were calculated as follows:

$$\text{Uncertainty @ 95\% CI, \%} = \frac{S_{\bar{x}} * t_{N-1} / \sqrt{N}}{\bar{x}} * 100$$

where:

- $\bar{x}$  = Average sample value three replicates;
- $S_{\bar{x}}$  = Sample standard deviation;
- $t_{N-1}$  = Student "t" factor for a two-tailed distribution at 95% for N-1 degrees of freedom (4.3 for N=3); and
- N = Number of replicates or measurements.

Uncertainty calculations assume the population distribution of each measurement is normally distributed and that the samples collected reflect the true population.

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## SECTION 4.0

### MERCURY SPECIATION TEST RESULTS

This section presents the results of flue gas tests performed to collect and quantify species of mercury. More detailed results including laboratory analyses can be found in Appendix C. For this section, total mercury levels determined in the solids and liquid/sludge sample streams are combined with each set of flue gas mercury test results to calculate their individual material balances as a quality assurance measure. Support data for the total mercury measurements in the solids and liquid/sludge process streams are not contained in this report, but can be found in Carnot's post-retrofit multi-media test program report (number NYS1A-11476/R107G404.T).

The objective of performing these mercury speciation sampling methods at the Milliken Station was to evaluate and compare their performances at measuring mercury species on a full-scale, utility basis. This program did not attempt to evaluate all mercury speciation methods currently in development. From previous developmental work, the Ontario-Hydro and TRIS Buffer techniques have shown significant promise, whereas EPA Method 29 and Frontier Geosciences have produced questionable mercury speciation results. All four methods, however, have generally agreed on total mercury. To investigate the results of previous work performed in the area of mercury speciation methods development, please consult the references listed in Section 5.0 of this report.

#### 4.1 COMPARISON OF AVERAGE FLUE GAS MERCURY SPECIATION RESULTS

The Milliken Unit 2 mercury speciation results generally agree with previous EPRI and DOE sponsored research findings, namely:

- 1) EPA Method 29, Frontier Geoscience, Ontario-Hydro, and TRIS Buffer provide comparable total mercury results.
- 2) Ontario-Hydro and TRIS Buffer provide similar mercury speciation results. Given the agreement between these methods, and their success during bench- and pilot-scale evaluation programs, they are considered the "benchmarks" for mercury speciation method comparisons.
- 3) EPA Method 29 and Frontier Geoscience results suffer from biases associated with flue gas SO<sub>2</sub> and NO<sub>x</sub> (Frontier Geoscience only) levels.

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**TABLE 4-1**  
**SUMMARY OF MERCURY SPECIATION TEST RESULTS**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Mercury Species	Test Method	Emission Results, ug/Nm <sup>3</sup>			ESP Removal	FGD Removal
		ESP Inlet	ESP Outlet/ FGD Inlet	FGD Outlet/ Stack	Efficiency <sup>(1)</sup>	Efficiency <sup>(1)</sup>
<u>Hg(0) - Elemental</u>						
	EPA Method 29	0.80	1.49	2.40	--	--
	Frontier Geoscience	2.12	2.66	2.94	--	--
	Ontario-Hydro	--	2.28	2.45	--	--
	TRIS Buffer	--	2.70	2.71	--	--
	Semtech Hg 2000 Analyzer <sup>(2)</sup>	--	NV	2.61	--	--
<u>Hg(II) - Oxidized</u>						
	EPA Method 29	7.43	6.23	0.62	18%	90%
	Frontier Geoscience	6.93	6.82	0.35	5%	95%
	Ontario-Hydro	--	5.24	0.21	--	96%
	TRIS Buffer	--	4.46	0.15	--	97%
<u>Hg(total) - Hg Solids</u>						
	EPA Method 29	0.86	ND<0.009	0.006	99.5%	--
	Frontier Geoscience <sup>(3)</sup>	0.06	0.07	0.003	--	--
	Ontario-Hydro	--	0.0003	0.0009	--	--
	TRIS Buffer	--	0.002	0.004	--	--
<u>TOTAL Hg<sup>(4)</sup></u>						
	EPA Method 29	9.09	7.72	3.02	17%	60%
	Frontier Geoscience	9.11	9.56	3.29	--	65%
	Ontario-Hydro	--	7.52	2.66	--	64%
	TRIS Buffer	--	7.16	2.87	--	59%

NV -- results not valid. Semtech analyzer measurements performed at this location were deemed invalid due to the use of an improper sample conditioning system and detrimental ambient conditions (i.e. high temperature and dust level).  
 Notes:

(1) Removal efficiencies calculated using emission units of lb/10<sup>12</sup>Btu to account for any differences in flue gas dilution between locations.

(2) The Semtech Hg 2000 analyzer only measures elemental mercury.

(3) The Frontier Geoscience method is not designed to representatively quantify the mercury solids fraction. These values represent mercury vapor that adsorbed on the flyash collected on the quartz wool plug during sampling.

(4) Total Hg is the sum of Hg(0), Hg(II), and Hg solids.

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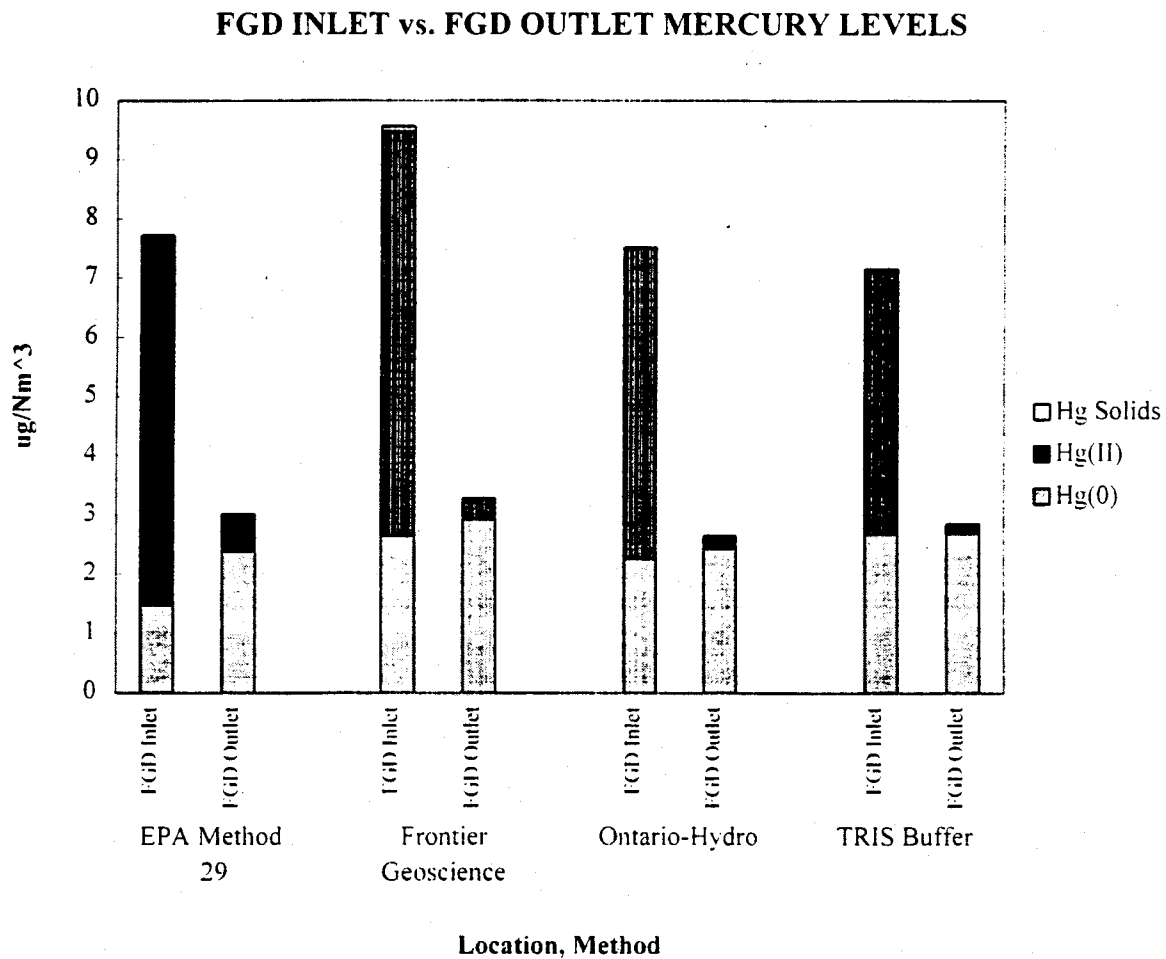
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TABLE 4-1A  
PARTITIONING OF MERCURY SPECIES BY METHOD  
NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM  
AUGUST 1996

Test Method	ESP Outlet/FGD Inlet		FGD Outlet/Stack	
	Hg(0)	Hg(II)	Hg(0)	Hg(II)
EPA Method 29	19%	81%	79%	21%
Frontier Geoscience	28%	71%	89%	11%
Ontario-Hydro	30%	70%	92%	8%
TRIS Buffer	38%	62%	94%	6%

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*Figure 4-1. FGD Inlet vs. FGD Outlet Mercury Levels*

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Table 4-1 provides a summary that compares each set of average mercury speciation test results including EPA Method 29. Table 4-1A shows the average percent split of mercury species found at the ESP outlet/FGD inlet and FGD outlet/stack. Figure 4-1 illustrates ESP outlet/FGD inlet versus FGD outlet/stack mercury levels as measured by each method. Table 4-2A and Table 4-2B present the mass balance results. Listed below are the key observations made in regards to this data set. Excellent agreement between a set of results is defined as differences less than  $0.6 \text{ ug/Nm}^3$ , and good agreement would be differences on the order of 0.6 to  $1.0 \text{ ug/Nm}^3$ . As a reminder, the Semtech Hg 2000 analyzer only measures elemental mercury.

### EPA Method 29

- In comparison with the Ontario-Hydro and TRIS Buffer results, the EPA Method 29 mercury speciation values obtained from this test program exhibit a high bias for Hg(II), and a low bias for Hg(0). This bias occurs when flue gas  $\text{SO}_2$  collects in the nitric acid/peroxide impingers producing a solution that will oxidize a portion of the Hg(0) as it passes through these impingers. The amount of oxidation that occurs appears to be proportional to the amount of flue gas  $\text{SO}_2$ .
- Coal flyash has been shown to oxidize Hg(0) to Hg(II) at typical flue gas conditions in bench- and pilot-scale evaluation programs. It is expected, therefore, that flyash trapped on a "Method 29-style" sampling filter would oxidize Hg(0) as it passes through it. Only at the ESP inlet using EPA Method 29 did an appreciable amount of flyash collect on the sampling filter. At this location the Hg(0) was biased even lower (and Hg(II) biased even higher) than at the ESP outlet/FGD inlet, suggesting that the oxidizing capacity of the flyash trapped on the filter and the  $\text{SO}_2$  trapped in the nitric acid/peroxide impingers is additive.

### Frontier Geoscience

- The Frontier Geoscience method reported Hg(II) levels for the ESP outlet/FGD inlet that were  $1.6\text{-}2.3 \text{ ug/Nm}^3$  higher than the average results from Ontario-Hydro and TRIS. Bench- and pilot-scale evaluations of the Frontier Geoscience method uncovered a high bias associated with its measurement of Hg(II). This high bias occurs when the flue gas contains high levels of  $\text{SO}_2$  (around 1500 ppm or higher) in the presence of  $\text{NO}_x$ , which will oxidize in the soda lime traps to form  $\text{NO}_2$ . A reaction then occurs between  $\text{NO}_2$  and Hg(0) to form Hg(II). This would mean, however, that Frontier's Hg(0) results should be biased low, which does not appear to be the case.
- The Frontier Geoscience and EPA Method 29 results for the ESP inlet location agreed at  $6.9\text{-}7.0 \text{ lb/10}^{12}\text{Btu}$  which amounts to approximately 94% of the total

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**TABLE 4-2A**  
**SUMMARY OF TOTAL MERCURY MASS BALANCE RESULTS -- BOILER/ESP**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Test Method	Mass Balance Results, lb/10 <sup>12</sup> Btu					Boiler/ESP Mass Balance <sup>(1)</sup>	ESP Mass Balance <sup>(2)</sup>
	Coal	ESP Inlet	Bottom Ash	Fly Ash	ESP Outlet/ FGD Inlet		
	7.4		0.01	0.57			
Frontier Geosciences		6.97			7.04	103%	109%
Ontario-Hydro		NP			5.58	83%	
TRIS Buffer		NP			5.22	78%	
<b>EPA Method 29</b>		<b>6.89</b>			<b>5.74</b>	<b>85%</b>	<b>91%</b>

Notes:

(1) Boiler/ESP Mass Balance, Output/Input = (Bottom Ash + Flyash - ESP Outlet)/Coal

(2) Mass Balance, ESP = (Flyash + ESP Outlet)/ESP Inlet

**TABLE 4-2B**  
**SUMMARY OF TOTAL MERCURY MASS BALANCE RESULTS -- FGD**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Test Method	Mass Balance Results, lb/10 <sup>12</sup> Btu					FGD Mass Balance (Outputs/Inputs)
	INPUTS		OUTPUTS			
	ESP Outlet/ FGD Inlet	Limestone	FGD Sludge	Gypsum	FGD Outlet/ Stack	
		0.04	0.31	2.76		
Frontier Geosciences	7.04				2.49	79%
Ontario-Hydro	5.58				2.01	90%
TRIS Buffer	5.22				2.14	99%
<b>EPA Method 29</b>	<b>5.74</b>				<b>2.31</b>	<b>93%</b>

Note: No mercury was detected in FGD liquid streams.

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mercury found in the coal. ESP inlet results from these two methods are not expected to agree, however, because Frontier's sampling method is not designed to measure the additional 10% of total mercury adsorbed on the flyash as found in the Method 29 sample trains. This suggests that the Frontier Geoscience ESP inlet results may be biased high by at least 10%.

#### EPA Method 29, Frontier Geoscience, Ontario-Hydro, and Tris Buffer

- For the FGD outlet/stack location, excellent agreement between the Frontier Geoscience, Ontario-Hydro and TRIS Buffer measurements can be seen for Hg(0) and Hg(II). Hg(0) results ranged from 2.45-2.94 ug/Nm<sup>3</sup> (excluding Method 29) and Hg(II) results ranged from 0.15-0.35 ug/Nm<sup>3</sup> (excluding Method 29). Good to excellent agreement exists between Frontier, Ontario-Hydro, TRIS and EPA Method 29 for total mercury with results ranging from 2.66-3.29 ug/Nm<sup>3</sup>.
- For the ESP outlet/FGD inlet, excellent agreement between Frontier, Ontario-Hydro, and TRIS can be seen for Hg(0) with levels ranging from 2.28-2.70 ug/Nm<sup>3</sup>.
- For the ESP outlet/FGD inlet, Ontario-Hydro and TRIS Buffer values are in good agreement for Hg(II); and Ontario-Hydro, TRIS and EPA Method 29 are in excellent agreement for total mercury.
- The partitioning of mercury between Hg(0) and Hg(II) at the ESP outlet/FGD inlet finds 28-38% as Hg(0) and 62-71% as Hg(II). At the FGD outlet/stack, 89-94% of the mercury was measured as Hg(0) with the remaining percentage as Hg(II). Method 29's high bias in measuring Hg(II) amounts to 10-20% at the ESP outlet/FGD inlet and 10-15% at the FGD outlet/stack. For the ESP outlet/FGD inlet, the Ontario-Hydro partitioning results show a 30/70 split between Hg(0) and Hg(II), whereas the TRIS results show almost a 40/60 split. Since total mercury as measured by both methods agree, there appears to be a small bias of some sort associated with one or both of the method's speciation capabilities. The 6 hour sampling time used for the Ontario-Hydro method verses 1-2 hours for TRIS may be a contributing factor.

#### Semtech HG 2000 Analyzer

- There is excellent agreement between the average FGD outlet/stack Hg(0) result as measured by the Semtech mercury analyzer with the other valid measurements at that location.

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**ESP/FGD Removal Efficiencies**

- Apparent ESP/FGD removal efficiencies for Hg(II) as measured by the EPA Method 29 sample train are not valid; rather an artifact of decreasing levels of Hg(0) oxidation.
- The ESP was effective at removing mercury adsorbed on the flyash at a rate of 99.5%. Mercury solids accounted for nearly 10% of total mercury levels found at the ESP inlet, resulting in an overall total mercury ESP removal efficiency of 17% as measured by EPA Method 29.
- FGD removal efficiencies were between 95-97% for Hg(II) (excluding EPA Method 29) and 59-65% for total mercury.

**Mass Balance Results**

- Boiler/ESP mass balance results using Frontier Geoscience, Ontario-Hydro, TRIS Buffer, and EPA Method 29 total mercury values yielded 103%, 83%, 78%, and 85% agreement, respectively, between process streams.
- Total mercury FGD mass balance results for Frontier Geoscience, Ontario-Hydro, TRIS Buffer, and EPA Method 29 were 79%, 90%, 99%, and 93%, respectively.
- Mercury levels found in the gypsum confirm the reported FGD total mercury removal efficiencies of 59-65%.
- Excellent FGD mass balance results for the wet chemical mercury speciation methods, and the agreement between all FGD outlet values including Frontier's suggests that the Frontier Geoscience ESP outlet/FGD inlet mercury level is biased high by 20%.
- Coal mercury levels appear to be biased high by 7-15% based on the EPA Method 29 ESP inlet measurements, the excellent agreement among wet chemical mercury data at the ESP outlet/FGD inlet, and their FGD mass balance results.
- An ESP mass balance for the Frontier Geoscience method was 109%. A 9-10% high bias in this balance is expected since the Frontier Geoscience results for the ESP inlet do not include any mercury adsorbed on the flyash.

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**TABLE 4-3**  
**DAILY COMPARISONS OF MERCURY SPECIATION RESULTS**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Parameter	Mercury Speciation Result, ug/Nm <sup>3</sup>					
	Test 1, 8/7/96			Test 2, 8/8/96		
	FGD Inlet	FGD Outlet	FGD Inlet	FGD Outlet	FGD Inlet	FGD Outlet
<b>Hg(0) - Elemental</b>						
<b>EPA Method 29</b>						
Frontier Geoscience	1.06	2.27	1.66	2.69	1.75	2.23
Ontario-Hydro	NA <sup>(1)</sup>	2.79	1.49	2.88	3.25 <sup>(3)</sup>	3.05 <sup>(3)</sup>
TRIS Buffer	2.00	2.33	2.25	2.35	2.60	2.68
Semtech Hg 2000 Analyzer	2.17	2.51	2.69	2.90	3.24	2.73
	NP	2.17	NP	3.03	NA <sup>(2)</sup>	2.63
<b>Average</b>						
					1.49	2.40
					2.66	2.94
					2.28	2.45
					2.70	2.71
					NA	2.61
<b>Hg(II) - Oxidized</b>						
<b>EPA Method 29</b>						
Frontier Geoscience	5.85	0.46	7.21	0.56	5.63	0.82
Ontario-Hydro	5.25	0.31	5.59	0.16	4.88	0.16
TRIS Buffer	NA <sup>(1)</sup>	0.27	8.37	0.40	6.05 <sup>(3)</sup>	0.36 <sup>(3)</sup>
	4.64	0.18	4.71	0.23	4.03	0.03
<b>Average</b>						
					6.23	0.61
					5.24	0.21
					6.82	0.35
					4.46	0.15
<b>TOTAL Hg</b>						
<b>EPA Method 29</b>						
Frontier Geoscience	6.92	2.74	8.86	3.25	7.38	3.07
Ontario-Hydro	NA <sup>(1)</sup>	3.06	9.87	3.29	9.37 <sup>(3)</sup>	3.41 <sup>(3)</sup>
TRIS Buffer	7.25	2.63	7.84	2.51	7.48	2.84
	6.81	2.69	7.40	3.14	7.27	2.76
<b>Average</b>						
					7.72	3.02
					9.56	3.29
					7.52	2.66
					7.16	2.87

NA -- data not available

NP -- test not performed

Notes:

- (1) Test run invalid, mercury levels reported by the laboratory were similar to those found in trip blanks. Test may not have sampled flue gas due to an undetected leak in sample train.
- (2) Semtech analyzer measurements performed at this location were deemed invalid due to the use of an improper sample conditioning system and detrimental ambient conditions (i.e. high temperature and dust level). Please see Section 3.1.11 for further discussion.
- (3) Results presented are an average of two sample runs performed on this day.

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## 4.2 COMPARISON OF DAILY FLUE GAS MERCURY SPECIATION RESULTS

Daily comparisons of mercury speciation results generated by each method are presented in Table 4-3 and illustrated in Figure 4-2 and Figure 4-3. Throughout the test program operation of the boiler and ESP/FGD control devices was steady within acceptable tolerances and not considered a contributing factor to any day to day fluctuations in mercury speciation results. In general, mercury speciation results for each method are consistent from day to day.

Examining the Ontario-Hydro and TRIS Buffer results more closely reveals a consistent yet minor difference between the methods. For both locations, Hg(0) levels reported by the Ontario-Hydro method were consistently lower (between 0.1-0.6 ug/Nm<sup>3</sup>) than the TRIS Buffer values suggesting the existence of a small bias in one or both method's measurement technique as mentioned in Section 4.1.

## 4.3 DETAILED MERCURY SPECIATION METHOD RESULTS

The following tables present detailed mercury speciation test results for each method:

Table 4-4:	EPA Method 29 Mercury Emission Results -- ESP Inlet
Table 4-5:	EPA Method 29 Mercury Emission Results -- ESP Outlet/FGD Inlet
Table 4-6:	EPA Method 29 Mercury Emission Results -- FGD Outlet/Stack
Table 4-7:	Frontier Geoscience Mercury Speciation Test Results -- ESP Inlet
Table 4-8:	Frontier Geoscience Mercury Speciation Test Results -- ESP Outlet/FGD Inlet
Table 4-9:	Frontier Geoscience Mercury Speciation Test Results -- FGD Outlet/Stack
Table 4-10:	TRIS Buffer and Ontario-Hydro Mercury Speciation Test Results -- ESP Outlet/FGD Inlet
Table 4-11:	TRIS Buffer and Ontario-Hydro Mercury Speciation Test Results -- FGD Outlet/Stack
Table 4-12:	Semtech Hg 2000 Analyzer Test Results

For almost all sets of valid mercury speciation measurements, agreement between individual replicates for the EPA Method 29, Frontier Geoscience, Ontario-Hydro, and TRIS Buffer methods were excellent (95% CI uncertainties of less than 50%) when concentration levels were measured above 0.5 ug/Nm<sup>3</sup>. Poor agreement (uncertainties above 150%) between Frontier Geoscience replicate results for Hg(0) at the ESP inlet and ESP outlet/FGD inlet locations was seen, which could be due to the high SO<sub>2</sub> levels.

As mentioned in Section 4.1, the Frontier Geoscience method does not quantify the mercury solids fraction. Total mercury found on the quartz wool plug represents mercury vapor

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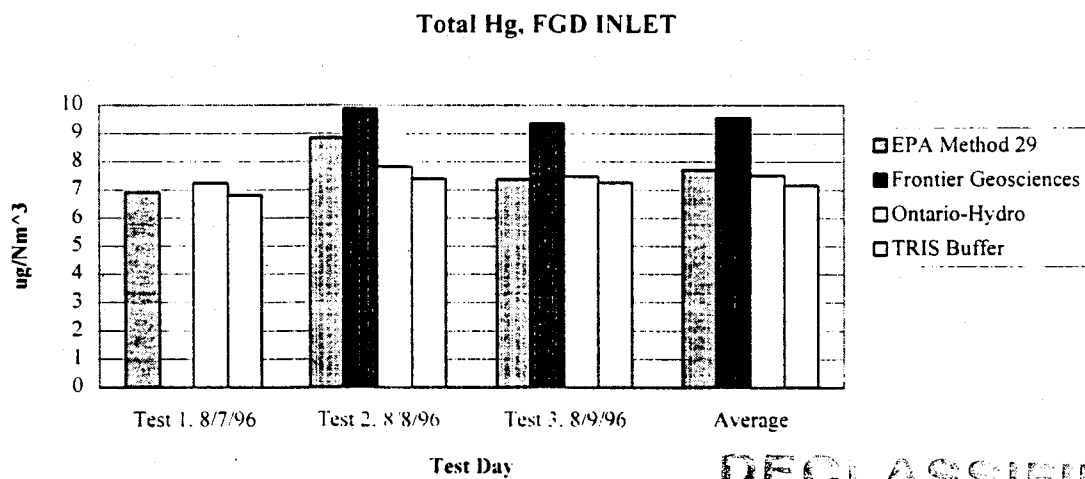
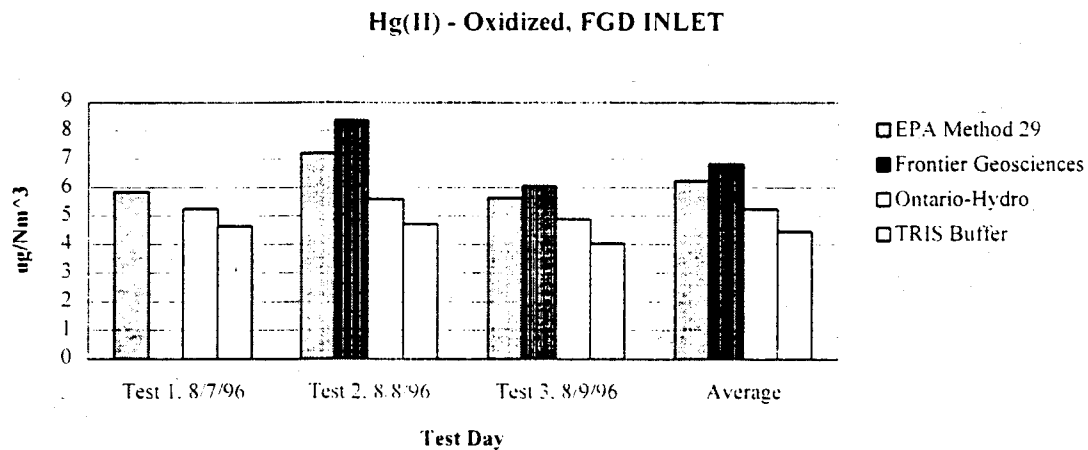
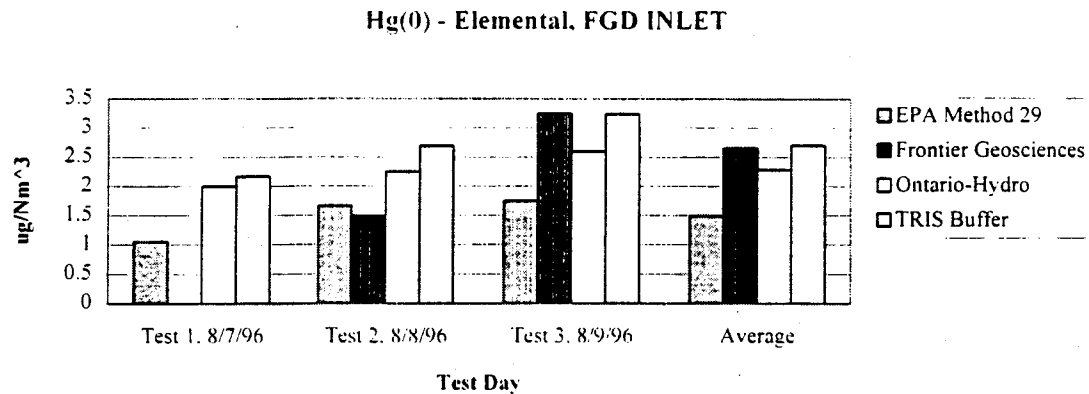
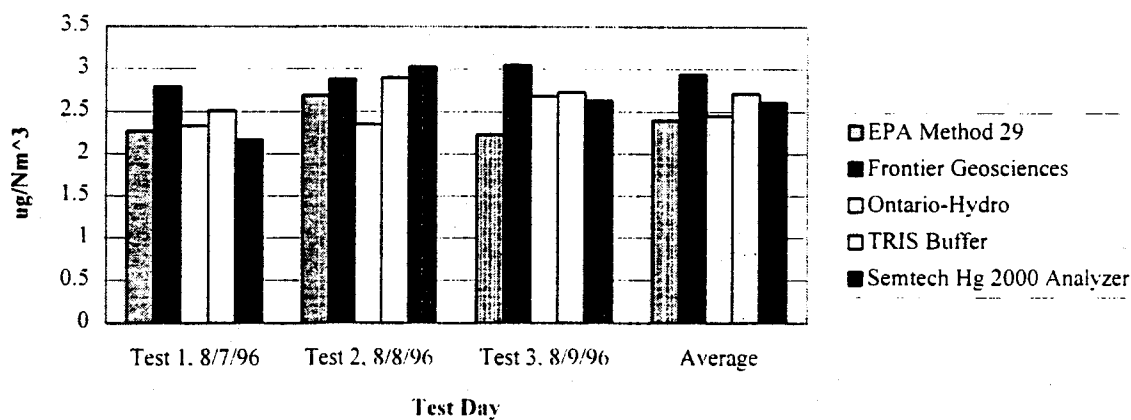


Figure 4-2. Comparison of Daily Mercury Speciation Method Results for FGD Inlet

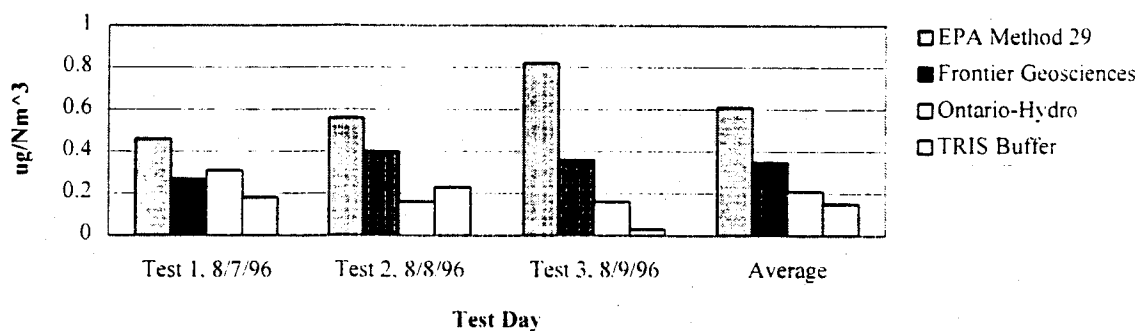
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## Hg(0) - Elemental, FGD OUTLET



## Hg(II) - Oxidized, FGD OUTLET



## Total Hg, FGD OUTLET

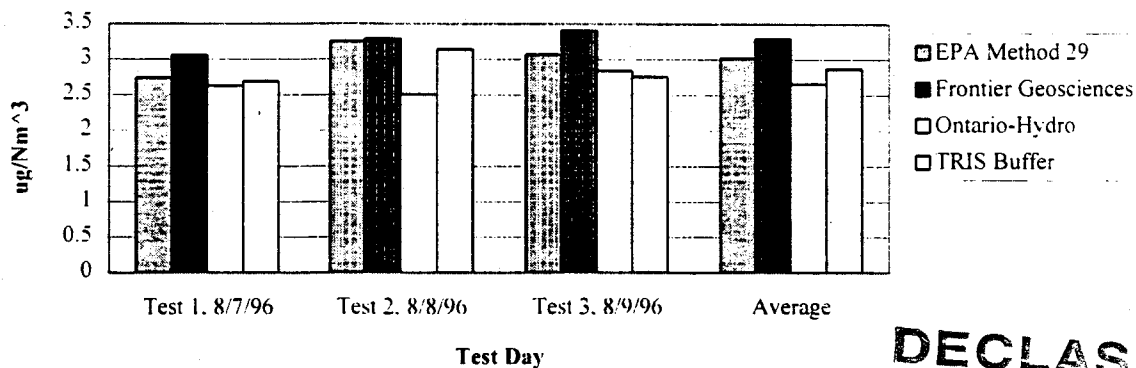


Figure 4-3. Comparison of Daily Mercury Speciation Method Results for FGD Outlet

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**TABLE 4-4**  
**EPA METHOD 29 MERCURY EMISSION RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM -- ESP INLET**  
**AUGUST 1996**

Test Number	1-MTLS-IN	2-MTLS-IN	3-MTLS-IN	AVERAGE			Uncertainty	
Date	8/7/96	8/8/96	8/9/96				@95%CI	
Pitot Flow Rate, dscfm	325.318	340.247	327.659					
Sample Volume, dscf	137.91	144.70	135.15					
Fuel Factor, dscf/10 <sup>6</sup> Btu	13.106	12.740	13.355					
O <sub>2</sub> , %	5.60	5.10	5.79					
CO <sub>2</sub> , %	13.86	13.94	13.64					
H <sub>2</sub> O, %	8.5	8.7	8.5					

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	0.80	0.76	0.84	0.80	0.001	0.61	13%	0.10
Hg(II) - oxidized	7.33	8.14	6.81	7.43	0.009	5.63	22%	1.67
Hg(total) - front 1/2 solid	0.93	0.99	0.66	0.86	0.001	0.65	50%	0.43
<b>Total Hg</b>	<b>9.05</b>	<b>9.89</b>	<b>8.32</b>	<b>9.09</b>	<b>0.011</b>	<b>6.89</b>	<b>21%</b>	<b>1.95</b>

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**TABLE 4-5**  
**EPA METHOD 29 MERCURY EMISSION RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM -- ESP OUTLET/FGD INLET**  
**AUGUST 1996**

Test Number	1-MTSL-OUT	2-MTSL-OUT	3-MTSL-OUT	AVERAGE			Uncertainty	
Date	8/7/96	8/8/96	8/9/96				±95%CI	
Pitot Flow Rate, dscfm	323.354	331.647	330.081					
Sample Volume, dscf	221.74	219.80	216.78					
Fuel Factor, dscf/10 <sup>6</sup> Btu	12.920	12.740	12.723					
O <sub>2</sub> , %	5.38	5.10	5.04					
CO <sub>2</sub> , %	14.06	13.94	14.32					
H <sub>2</sub> O, %	8.3	8.4	8.1					

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	1.06	1.66	1.75	1.49	0.002	1.10	62%	0.93
Hg(II) - oxidized	5.85	7.21	5.63	6.23	0.007	4.63	34%	2.12
Hg(total) - front 1/2 solids	ND< 0.02	ND< 0.005	ND< 0.005	ND< 0.009	ND< 9.8E-06	ND< 0.006	--	--
<b>Total Hg</b>	<b>6.92</b>	<b>8.86</b>	<b>7.38</b>	<b>7.72</b>	<b>0.009</b>	<b>5.74</b>	<b>33%</b>	<b>2.52</b>

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**TABLE 4-6**  
**EPA METHOD 29 MERCURY EMISSION RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM -- FGD OUTLET/STACK**  
**AUGUST 1996**

Test Number	1-MTLS-STK	2-MTLS-STK	3-MTLS-STK	AVERAGE			Uncertainty	
Date	8/7/96	8/8/96	8/9/96				@ 95%CI	
Pitot Flow Rate, dscfm	358.667	358.779	362.692					
Sample Volume, dscf	241.79	253.28	254.55					
Fuel Factor, dscf/10 <sup>6</sup> Btu	13.157	13.088	13.328					
O <sub>2</sub> , %	5.66	5.52	5.76					
CO <sub>2</sub> , %	13.81	13.57	13.67					
H <sub>2</sub> O, %	14.4	14.8	14.3					

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	2.27	2.69	2.23	2.40	0.003	1.84	26%	0.63
Hg(II) - oxidized	0.46	0.56	0.82	0.61	0.001	0.47	75%	0.46
Hg(total) - front 1/2 solids	ND< 0.005	ND< 0.004	0.015	0.006	8.2E-06	0.005	--	--
<b>Total Hg</b>	<b>2.74</b>	<b>3.25</b>	<b>3.07</b>	<b>3.02</b>	<b>0.004</b>	<b>2.31</b>	<b>21%</b>	<b>0.65</b>

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**TABLE 4-7**  
**FRONTIER GEOSCIENCE MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM -- ESP INLET**  
**AUGUST 1996**

Test Number	2-MESA-IN	3-MESA-IN	3A-MESA-IN	AVERAGE		Uncertainty @95%CI	
Date	8/8/96	8/9/96	8/9/96				
Pitot Flow Rate, dscfm	340.247	327.659	329.486				
Sample Volume, dscf	1.64	1.71	1.97				
Fuel Factor, dscf/10 <sup>6</sup> Btu	13.628	13.019	12.877				
O <sub>2</sub> , %	6.13	5.40	5.23				
CO <sub>2</sub> , %	12.93	13.64	13.75				

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	1.62	3.75	0.98	2.12	0.002	1.62	170%	3.59
Hg(II) - oxidized	7.03	6.15	7.62	6.93	0.008	5.31	26%	1.83
Hg(tot) - Quartz Wool Plug*	0.08	0.08	0.01	0.06	6.7E-05	0.04	186%	0.11
<b>Total Hg</b>	<b>8.74</b>	<b>9.98</b>	<b>8.61</b>	<b>9.11</b>	<b>0.011</b>	<b>6.97</b>	<b>21%</b>	<b>1.87</b>

\*Frontier Geoscience method is not designed to representatively quantify the mercury solids fraction, these values represent mercury vapor that adsorbed on the flyash collected on the quartz wool plug during sampling.

Note: The sample from test 1-MESA-IN performed on 8/7/96 was lost after the test was completed.

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**TABLE 4-8**  
**FRONTIER GEOSCIENCE MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM -- ESP OUTLET/FGD INLET**  
**AUGUST 1996**

Test Number	2-MESA-OUT	3-MESA-OUT	3A-MESA-OUT	AVERAGE		Uncertainty at 95%CI	
Date	8/8/96	8/9/96	8/9/96				
Pitot Flow Rate, dscfm	331.647	330.081	330.081				
Sample Volume, dscf	2.77	2.78	2.76				
Fuel Factor, dscf/10 <sup>6</sup> Btu	12.936	12.952	12.119				
O <sub>2</sub> , %	5.34	5.32	4.25				
CO <sub>2</sub> , %	13.62	13.71	14.61				

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>
Hg(0) - elemental	1.49	2.04	4.47	2.66	0.003	1.93	148% 3.94
Hg(II) - oxidized	8.37	7.05	5.06	6.82	0.008	5.05	61% 4.14
Hg(tot) - Quartz Wool Plug*	0.01	0.14	ND	0.07	8.4E-05	0.06	264% 0.19
Total Hg	9.87	9.22	9.52	9.56	0.011	7.04	8% 0.80

ND -- mercury not detected in sample fraction above trip blank level (treated as zero).

\*Frontier Geoscience method is not designed to representatively quantify the mercury solids fraction, these values represent mercury vapor that adsorbed on the flyash collected on the quartz wool plug during sampling.

Note: Test 1-MESA-OUT performed on 8/7/96 was deemed invalid, mercury levels reported by the laboratory were similar to those found in trip blanks. Test may not have sampled flue gas due to an undetected leak in sample train.

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**TABLE 4-9**  
**FRONTIER GEOSCIENCE MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM -- FGD OUTLET/STACK**  
**AUGUST 1996**

Test Number	1-MESA-STK	2-MESA-STK	3-MESA-STK	3A-MESA-STK	AVERAGE		Uncertainty at 95%CI	
Date	8/7/96	8/8/96	8/9/96	8/9/96				
Pitot Flow Rate, dscfm	358.667	358.779	362.692	362.692				
Sample Volume, dscf	1.80	1.67	3.23	2.86				
Fuel Factor, dscf/10 <sup>6</sup> Btu	13.131	12.928	12.977	12.960				
O <sub>2</sub> , %	5.63	5.33	5.35	5.33				
CO <sub>2</sub> , %	13.86	13.63	13.68	13.66				

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	2.79	2.88	3.19	2.91	2.94	0.004	2.22	9%	0.27
Hg(II) - oxidized	0.27	0.40	0.45	0.27	0.35	0.0004	0.26	42%	0.15
Hg(tot) - Quartz Wool Plug	NP	0.003	0.003	0.001	0.003	3.3E-06	0.002	121%	0.00
Total Hg	3.06	3.29	3.64	3.18	3.29	0.004	2.49	12%	0.39

NP -- analysis not performed

\*Frontier Geoscience method is not designed to representatively quantify the mercury solids fraction, these values represent mercury vapor that adsorbed on the flyash collected on the quartz wool plug during sampling.

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**TABLE 4-10**  
**ONTARIO-HYDRO AND TRIS BUFFER MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST RETROFIT TEST PROGRAM -- ESP OUTLET/FGD INLET**  
**AUGUST 1996**

ONTARIO-HYDRO								
Test Number	1-ONT-OUT	2-ONT-OUT	3-ONT-OUT	AVERAGE			Uncertainty	
Date	8/7/96	8/8/96	8/9/96				@95%CI	
Pitot Flow Rate, dscfm	323,354	331,647	330,081					
Sample Volume, dscf	261.06	224.41	209.72					
Fuel Factor, dscf/10 <sup>6</sup> Btu	12.532	12.837	12.739					
O <sub>2</sub> , %	4.90	5.28	5.16					
CO <sub>2</sub> , %	14.47	13.63	13.83					
Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	2.00	2.25	2.60	2.28	0.003	1.69	33%	0.75
Hg(II) - oxidized	5.25	5.59	4.88	5.24	0.006	3.88	17%	0.87
Hg(tot) - filter	ND	0.0008	ND	0.0003	3.3E-07	0.0002	--	--
Hg (total)	7.25	7.84	7.48	7.52	0.009	5.58	10%	0.73
TRIS BUFFER								
Test Number	1-TRIS-OUT	2-TRIS-OUT	3-TRIS-OUT	AVERAGE			Uncertainty	
Date	8/7/96	8/8/96	8/9/96				@95%CI	
Pitot Flow Rate, dscfm	323,354	331,647	330,081					
Sample Volume, dscf	35.83	39.46	39.22					
Fuel Factor, dscf/10 <sup>6</sup> Btu	12.355	12.821	12.433					
O <sub>2</sub> , %	4.67	5.20	4.67					
CO <sub>2</sub> , %	14.56	13.44	14.13					
Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	2.17	2.69	3.24	2.70	0.003	1.97	49%	1.33
Hg(II) - oxidized	4.64	4.71	4.03	4.46	0.005	3.25	21%	0.92
Hg(tot) - filter	0.001	0.006	ND	0.002	2.6E-06	0.002	--	--
Hg (total)	6.81	7.40	7.27	7.16	0.008	5.22	11%	0.77

ND -- mercury not detected in fraction (treated as zero).

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**TABLE 4-11**  
**ONTARIO-HYDRO AND TRIS BUFFER MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST RETROFIT TEST PROGRAM -- FGD OUTLET/STACK**  
**AUGUST 1996**

Test Number	ONTARIO-HYDRO						Uncertainty @ 95%CI	
	1-ONT-STK	2-ONT-STK	3-ONT-STK	AVERAGE				
Date	8/7/96	8/8/96	8/9/96					
Pitot Flow Rate, dscfm	358.667	358.779	362.692					
Sample Volume, dscf	215.77	224.11	225.28					
Fuel Factor, dscf/10 <sup>6</sup> Btu	13.114	12.862	12.870					
O <sub>2</sub> , %	5.61	5.31	5.32					
CO <sub>2</sub> , %	13.83	13.60	13.69					

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	2.33	2.35	2.68	2.45	0.003	1.85	20%	0.50
Hg(II) - oxidized	0.31	0.16	0.16	0.21	0.0003	0.16	101%	0.21
Hg(tot) - filter	ND	0.0010	0.0017	0.0009	1.1E-06	0.0007	--	--
<b>Hg (total)</b>	<b>2.63</b>	<b>2.51</b>	<b>2.84</b>	<b>2.66</b>	<b>0.003</b>	<b>2.01</b>	<b>15%</b>	<b>0.41</b>

Test Number	TRIS BUFFER						Uncertainty @ 95%CI	
	1-TRIS-STK	2-TRIS-STK	3-TRIS-STK	AVERAGE				
Date	8/7/96	8/8/96	8/9/96					
Pitot Flow Rate, dscfm	358.667	358.779	362.692					
Sample Volume, dscf	71.83	73.71	73.58					
Fuel Factor, dscf/10 <sup>6</sup> Btu	12.953	12.780	12.877					
O <sub>2</sub> , %	5.42	5.15	5.23					
CO <sub>2</sub> , %	13.89	13.48	13.64					

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	2.51	2.90	2.73	2.71	0.003	2.03	18%	0.50
Hg(II) - oxidized	0.18	0.23	0.03	0.15	0.0002	0.11	175%	0.26
Hg(tot) - filter	0.005	0.003	0.004	0.004	4.8E-06	0.003	190%	0.00
<b>Hg (total)</b>	<b>2.69</b>	<b>3.14</b>	<b>2.76</b>	<b>2.87</b>	<b>0.004</b>	<b>2.14</b>	<b>21%</b>	<b>0.59</b>

ND -- mercury not detected in fraction (treated as zero).

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**TABLE 4-12**  
**SEMTECH HG 2000 ANALYZER TEST RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM -- UNIT 2**  
**AUGUST 1996**

Parameter	Semtech Hg Analyzer Results		
	Ontario-Hydro Test Period	TRIS Buffer Test Period	Average*
<b><u>Test 1, 8/7/96</u></b>			
Hg(0) - Elemental, ug/dscm	1.86	2.50	2.02
Hg(0) - Elemental, ug/Nm <sup>3</sup>	2.00	2.68	2.17
<b><u>Test 2, 8/8/96</u></b>			
Hg(0) - Elemental, ug/dscm	2.73	3.08	2.82
Hg(0) - Elemental, ug/Nm <sup>3</sup>	2.93	3.31	3.02
<b><u>Test 3, 8/9/96</u></b>			
Hg(0) - Elemental, ug/dscm	2.45	NA	2.45
Hg(0) - Elemental, ug/Nm <sup>3</sup>	2.63	--	2.63
<b><u>Averages</u></b>			
Hg(0) - Elemental, ug/dscm	2.35	2.79	2.43
Hg(0) - Elemental, ug/Nm <sup>3</sup>	2.52	2.99	2.61

NA -- data not available for this test period.

\*Represents a weighted average that is based on test period durations.

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that adsorbed on the flyash collected on the wool plug during sampling. Given the flyash mercury concentration level, the small amount of flyash collected on the wool plug does not represent any significant level of mercury solids.

Figures 4-4, 4-5, and 4-6 present the daily data trend charts for the Semtech analyzer's operation during the inorganic test period for Ontario-Hydro and TRIS sampling periods. As shown on each figure, there is excellent agreement between the Semtech analyzer's Hg(0) output levels and those for the wet chemical techniques. For Test 1 on 8/7/96, Hg(0) Semtech results averaged  $2.2 \text{ ug/m}^3$  but ranged between 1 and  $5 \text{ ug/m}^3$ . For Test 2, Semtech results averaged  $2.9 \text{ ug/m}^3$  but only ranged between 1.5 and  $4 \text{ ug/Nm}^3$ ; and for Test 3 average results were  $2.5 \text{ ug/m}^3$  and the range was 1.5 to  $3.5 \text{ ug/Nm}^3$ .

#### 4.4 MERCURY SPECIATION METHODS QUALITY ASSURANCE/QUALITY CONTROL DATA

Tables 4-13, 4-14, 4-15, 4-15A present the quality assurance/quality control results for EPA Method 29, Frontier Geoscience, Ontario-Hydro, and TRIS Buffer test methods.

Matrix spike recoveries were all between 85-120%. No significant levels of mercury were found in any of the method's trip, reagent or field blanks. Distribution of mercury throughout the ESP outlet/FGD inlet Ontario-Hydro and TRIS Buffer sample trains found 17-19% of the total mercury in the probe rinses. As discussed in Section 3.3, probe rinse mercury was counted as Hg(II).

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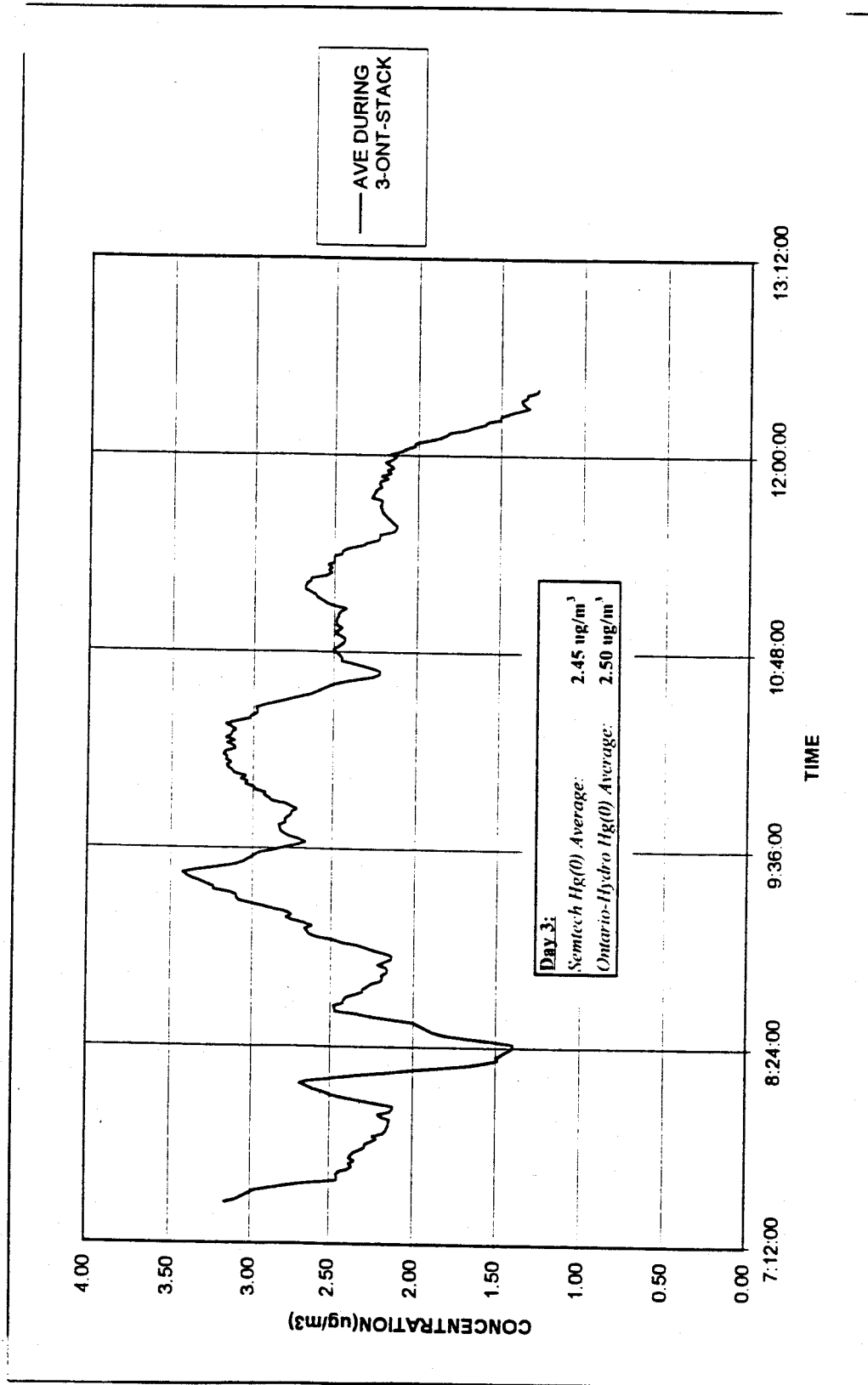


Figure 4-4. Semtech Hg 2000 Analyzer Raw Data -- Day 1, 8/7/96

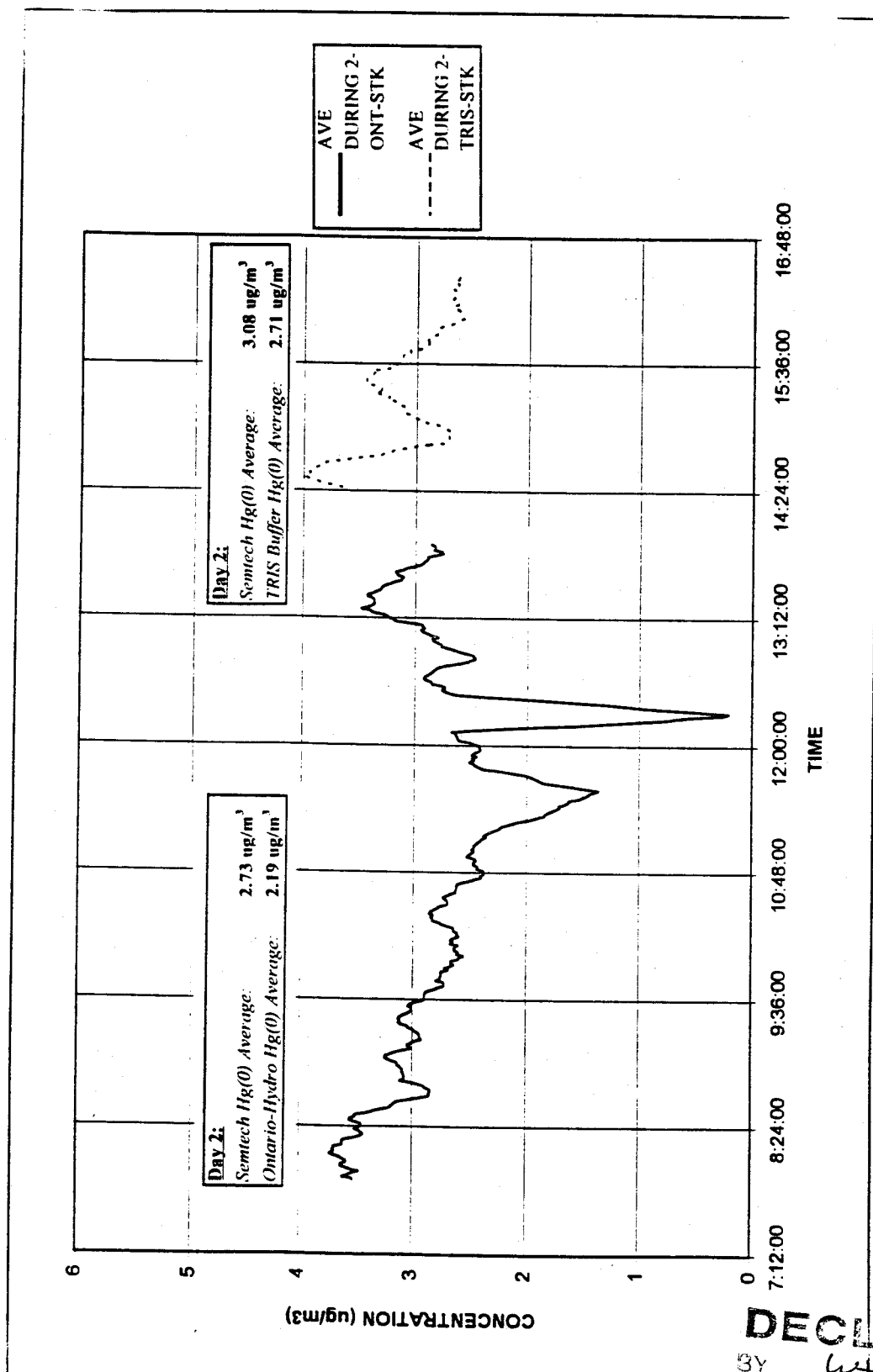


Figure 4-5. Semtech Hg 2000 Analyzer Raw Data -- Day 2, 8/8/96

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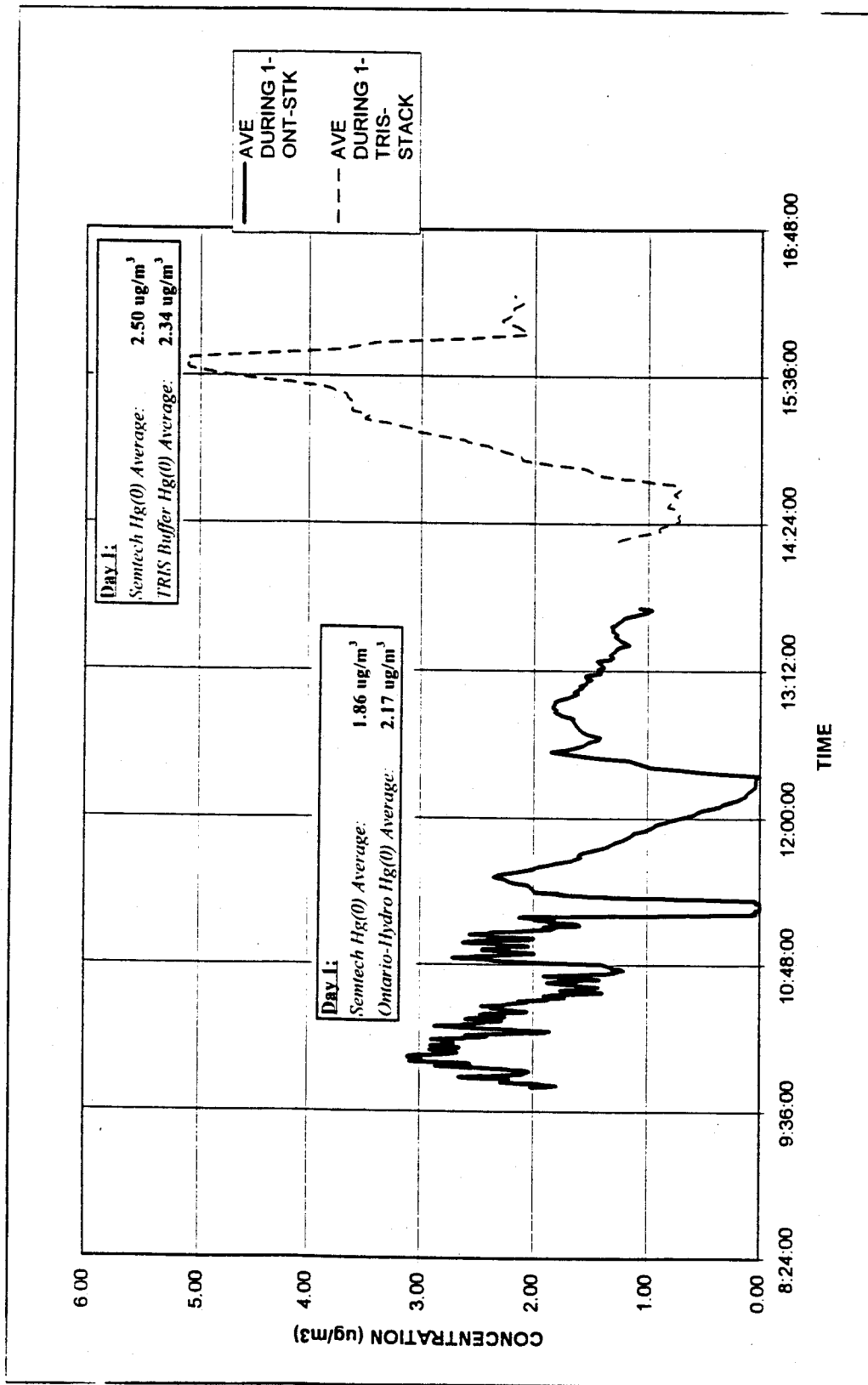


Figure 4-6. Semtech Hg 2000 Analyzer Raw Data -- Day 3, 8/9/96

**TABLE 4-13**  
**QUALITY ASSURANCE/QUALITY CONTROL RESULTS**  
**EPA METHOD 29 AND FRONTIER GEOSCIENCE METHODS**

Test Number	Train Fraction	Matrix Spike Analysis		Duplicate Analysis		
		Matrix Spike Recovery, %	Matrix Spike Duplicate Recovery, %	First Run	Second Run	Relative Difference, %
				ug/fraction		
I-MTLS-OUT	Front-Half	110	110	ND(0.090)	ND(0.090)	NC
	Back-Half	90	89	29	30	3.4
	MKO	85	85	4.8	4.7	2.1
	KMnO <sub>4</sub> /HCl	100	100	6.3	6.1	
I-MTLS-STK	Front-Half	120	120	ND(0.030)	ND(0.030)	NC
	Back-Half	100	110	2.9	2.9	0.0
	MKO	110	100	0.056	0.046	19.6
	KMnO <sub>4</sub> /HCl	100	100	15	14	6.9
MESA	Hg(0)	108	101	--	--	124
	Hg(II)	97	107	--	--	4.6

**RAW FIELD BLANK LABORATORY DATA**

Test Method	Train Fraction	FB-MTLS-OUT	2FB-MTLS-OUT	FB-MTLS-STK	2FB-MTLS-STK
		ug/train			
Method 29	Front-Half	ND<0.030	ND<0.030	ND<0.030	0.032
	Back-Half	ND<0.19	ND<0.19	ND<0.20	ND<0.20
	MKO	ND<0.010	ND<0.010	ND<0.010	ND<0.010
	KMnO <sub>4</sub> /HCl	ND<0.063	0.10	0.22	0.092

**RAW TRIP BLANK LABORATORY DATA**

Test Method	Train	Trip Blank 1	Trip Blank 2	ng/probe
	Fraction	ng/train		
MESA	Hg(0)	0.362	0.56	
	Hg(II)	1.23	3.26	
	Quartz Wool/ Probe	2.39	0.134	

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**TABLE 4-14**  
**QUALITY ASSURANCE/QUALITY CONTROL RESULTS**  
**ONTARIO-HYDRO AND TRIS BUFFER METHODS**

Test Number	Fraction	Spike Result	Spike Level	Spike
		ug/L		Recovery, %
<b><u>DAY 1 -- 8/7/96</u></b>				
TRIS-FB-SPK-1	TRIS	9.7	10	97
	KMnO4	9.8	10	98
OH-FB-SPK-1	KCl	9.8	10	98
	H2O2	9.6	10	96
	KMnO4	9.5	10	95
<b><u>DAY 2 -- 8/8/96</u></b>				
TRIS-FB-SPK-2	TRIS	9.5	10	95
	KMnO4	10.0	10	100
OH-FB-SPK-2	KCl	9.9	10	99
	H2O2	8.4	10	84
	KMnO4	9.8	10	98
<b><u>DAY 3 -- 8/9/96</u></b>				
TRIS-FB-SPK-3	TRIS	10.5	10	105
	KMnO4	9.1	10	91
OH-FB-SPK-3	KCl	9.9	10	99
	H2O2	9.2	10	92
	KMnO4	9.3	10	93

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**TABLE 4-15**  
**SUMMARY OF FIELD BLANK AND SAMPLE RESULT LABORATORY DATA**  
**TRIS BUFFER AND ONTARIO-HYDRO METHODS**

Test Number	Train Fraction	Field Blank	ESP Outlet/ FGD Inlet	Corrected Result, ug/train	FGD Outlet/ Stack	Corrected Result, ug/train
		Level, ug/train	Sample Result, ug/train		Sample Result ug/train	
<b><u>DAY 1 -- 8/7/96</u></b>						
1-ONT	KCl -- Hg(II)	ND(0.05)	36.15	36.15	1.75	1.75
	H2O2 -- Hg(0)	0.15	1.40	1.25	0.15	0.00
	KMnO4 -- Hg(0)	0.15	12.70	12.55	13.40	13.25
	Probe Rinse -- Hg(II) <sup>(2)</sup>	--		--		--
1-TRIS	TRIS -- Hg(II)	0.15	4.27	4.12	0.50	0.35
	KMnO4 -- Hg(0)	0.05	2.10	2.05	4.80	4.75
	Probe Rinse -- Hg(II) <sup>(1)</sup>	ND(0.03)	0.28	0.28	ND(0.03)	ND(0.03)
<b><u>DAY 2 -- 8/8/96</u></b>						
2-ONT	KCl -- Hg(II)	ND(0.05)	28.50	28.50	0.90	0.90
	H2O2 -- Hg(0)	ND(0.1)	1.70	1.70	ND(0.1)	ND(0.1)
	KMnO4 -- Hg(0)	ND(0.05)	11.62	11.62	13.88	13.88
	Probe Rinse -- Hg(II)	ND(0.03)	4.58	4.58	0.08	0.08
2-TRIS	TRIS -- Hg(II)	ND(0.15)	2.60	2.60	0.40	0.40
	KMnO4 -- Hg(0)	ND(0.05)	2.80	2.80	5.65	5.65
	Probe Rinse -- Hg(II)	ND(0.03)	2.30	2.30	0.05	0.05
<b><u>DAY 3 -- 8/9/96</u></b>						
3-ONT	KCl -- Hg(II)	ND(0.05)	17.40	17.40	0.80	0.80
	H2O2 -- Hg(0)	ND(0.1)	1.85	1.85	0.30	0.30
	KMnO4 -- Hg(0)	ND(0.05)	12.55	12.55	15.65	15.65
	Probe Rinse -- Hg(II)	ND(0.03)	9.63	9.63	0.13	0.13
3-TRIS	TRIS -- Hg(II)	0.30	2.85	2.55	0.30	0.00
	KMnO4 -- Hg(0)	ND(0.05)	3.35	3.35	5.30	5.30
	Probe Rinse -- Hg(II)	ND(0.03)	1.63	1.63	ND(0.03)	ND(0.03)

## Notes:

(1) TRIS Probe rinse field blank for Day 1 was not performed, results from Day 2.

(2) Probe rinses for the Ontario-Hydro samples were combined with the KCl impinger solution for Day 1 only.

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TABLE 4-15A  
DISTRIBUTION OF MERCURY WITHIN SAMPLE TRAIN  
ONTARIO-HYDRO AND TRIS BUFFER METHODS  
NYSEG POST-RETROFIT TEST PROGRAM -- UNIT 2  
AUGUST 1996

Test Method/ Sample Location	Sample Train Fraction			
	Mercury Distribution, %			
<b>Ontario-Hydro</b>	<u>KCl</u>	<u>H<sub>2</sub>O<sub>2</sub></u>	<u>KMnO<sub>4</sub></u>	<u>Probe Rinse</u>
FGD Inlet	52	4	27	17
FGD Outlet	7	1	92	0
<b>TRIS Buffer</b>	<u>TRIS/EDTA</u>	<u>KMnO<sub>4</sub></u>	<u>Probe Rinse</u>	
FGD Inlet	44	38	19	
FGD Outlet	5	95	0	

Note: Inconsequential amount of mercury found on sample filters.

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## SECTION 5.0

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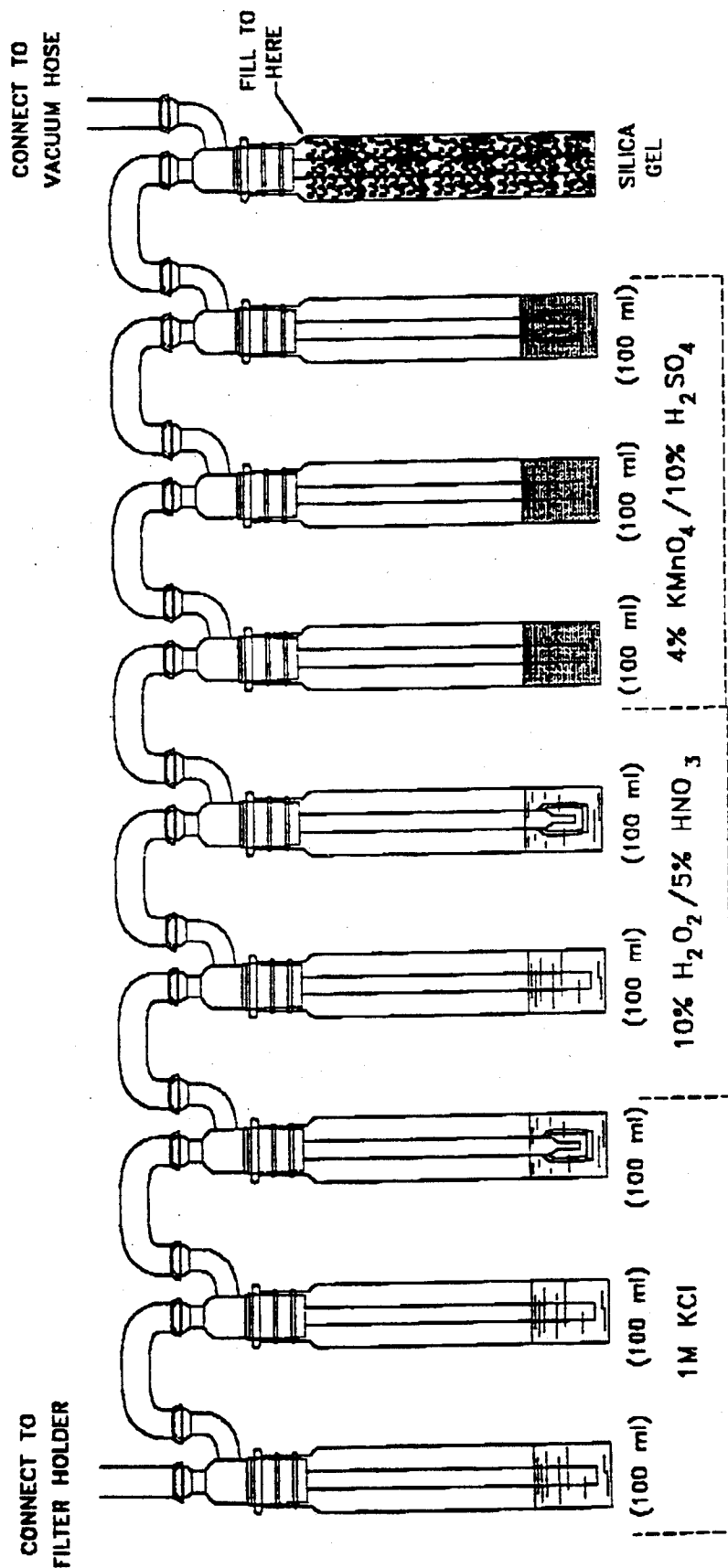
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APPENDIX A  
EERC ONTARIO-HYDRO AND TRIS BUFFER  
MERCURY SPECIATION METHODS ANALYTICAL PLAN



# ONTARIO-HYDRO METHOD

## TRAIN ASSEMBLY



# ONTARIO-HYDRO METHOD

## SAMPLE RECOVERY

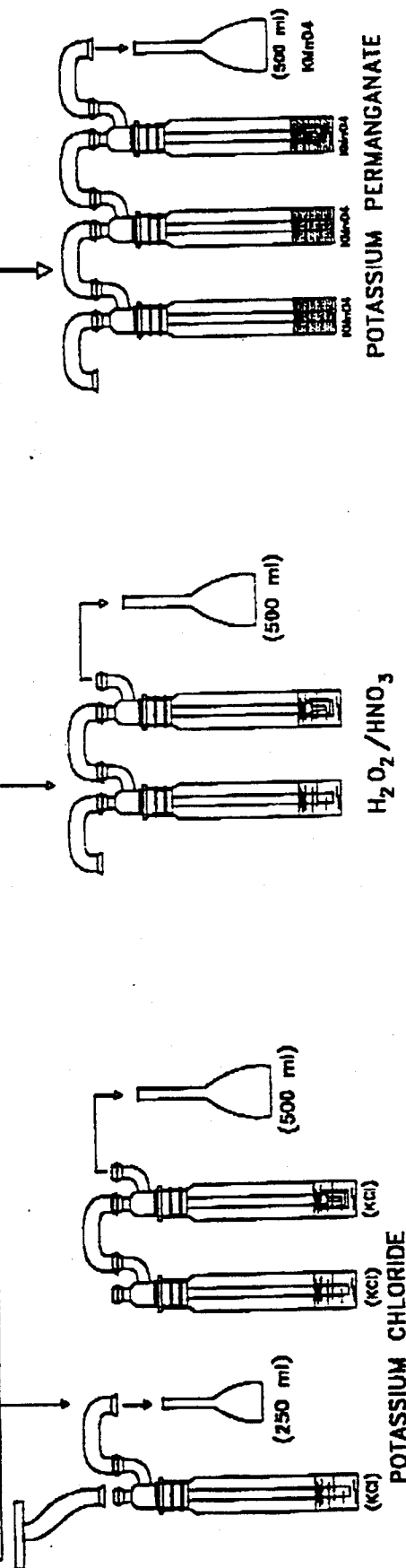
1. ADD  $\text{KMnO}_4/\text{H}_2\text{SO}_4$  TO EACH KCl IMPINGER BOTTLE UNTIL PURPLE COLOR REMAINS. (10-30 ml)
2. RINSE WITH .1N NITRIC ACID.
3. RINSE WITH 8N HCl IF BROWN RESIDUE REMAINS.
4. FINAL RINSE WITH .1N NITRIC ACID.

RINSE FILTER HOLDER  
AND HOSE WITH  
.1 N NITRIC ACID

RINSE WITH  
.1N NITRIC ACID

RINSE BOTTLES SPARINGLY WITH:

- .1 N NITRIC ACID
- 8 N HCl
- .1 N NITRIC ACID

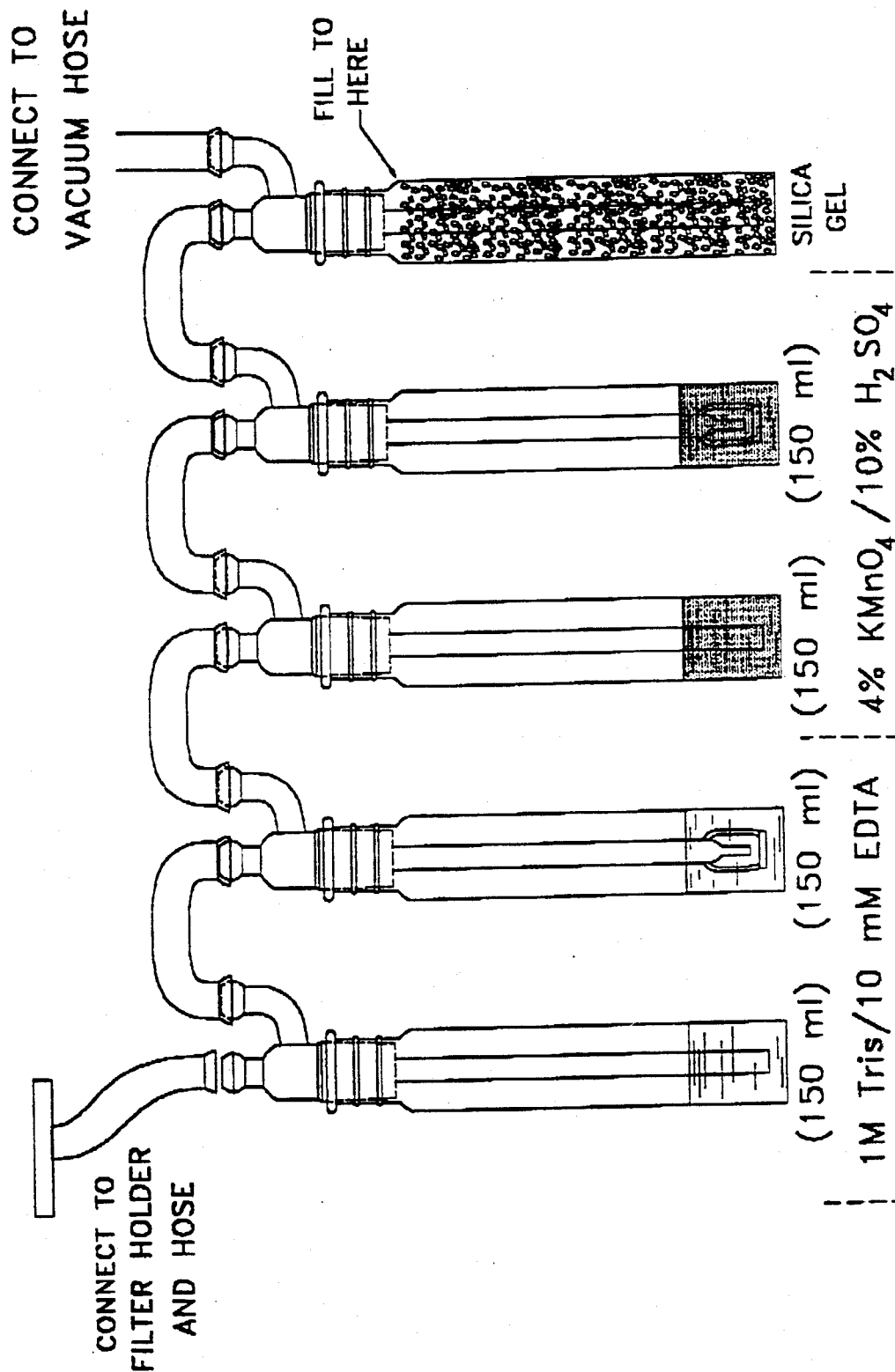


RINSE ALL U-TUBES WITH  
.1N NITRIC ACID



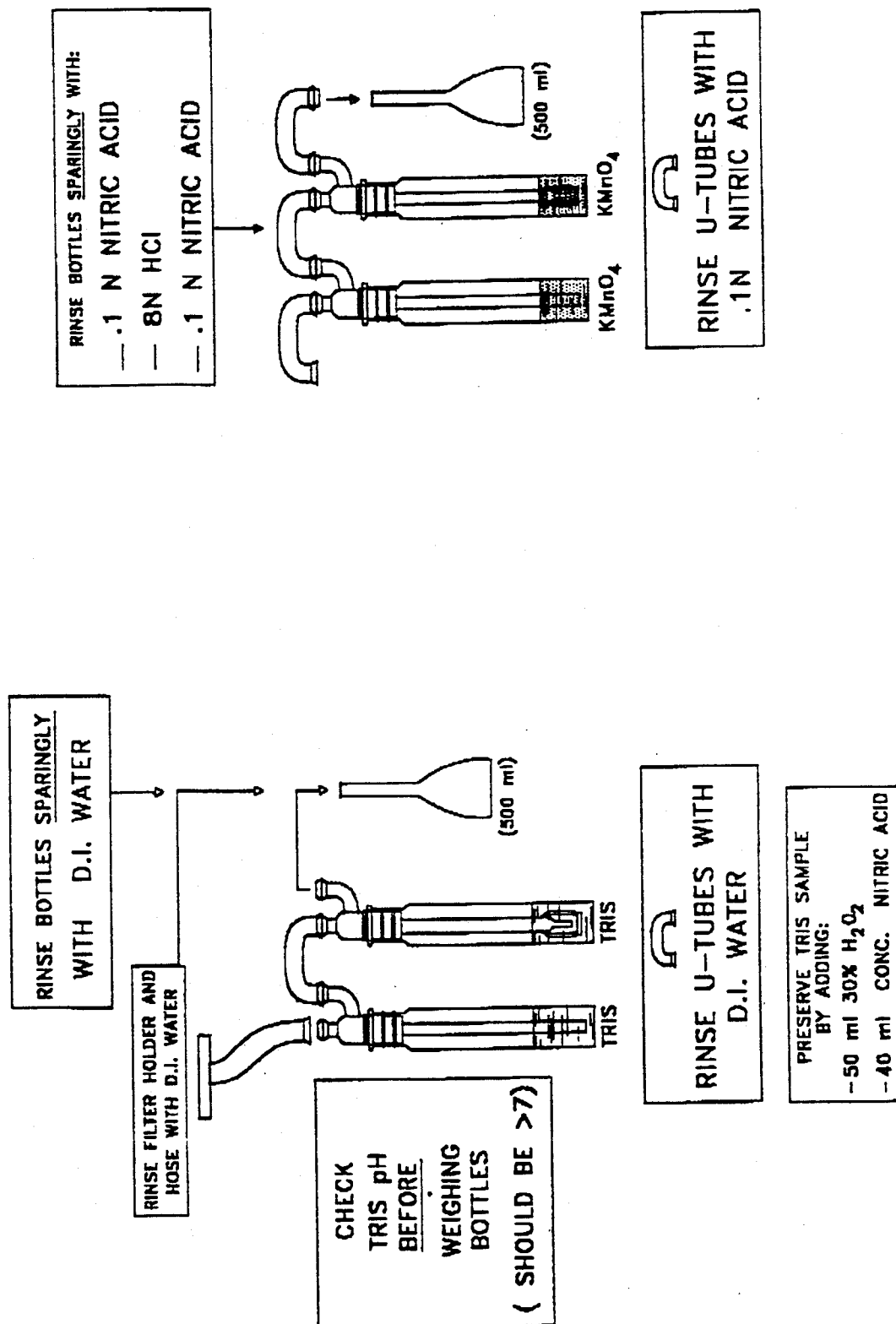
# TRIS BUFFER METHOD

## TRAIN ASSEMBLY



# TRIS BUFFER METHOD

## SAMPLE RECOVERY



SEE PROCEDURE

## **PRESERVATION OF TRIS BUFFER IMPINGERS**

1. REMOVE THE GLASS CONNECTOR JOINING THE OUTLET OF THE FILTER TO THE FIRST IMPINGER. TURN THE PUMP ON TO ABOUT 10 SCFH.
2. POUR 25mL OF 30% PEROXIDE INTO THE FIRST IMPINGER VERY SLOWLY WHILE DRAWING AMBIENT AIR INTO THE IMPINGERS.
3. REMOVE THE GLASS CROSSOVER JOINING THE FIRST AND SECOND IMPINGERS.
4. POUR 25 mL OF 30% PEROXIDE INTO THE SECOND IMPINGER.
5. REPLACE GLASS CROSSOVER JOINING THE FIRST AND SECOND IMPINGERS.
6. POUR 20 mL OF NITRIC ACID VERY SLOWLY INTO THE FIRST IMPINGER. **CO<sub>2</sub> IS EVOLVED FROM THIS SOLUTION DURING THIS STEP SO BE CAREFUL NOT TO ALLOW THE IMPINGER TO OVERFLOW WHILE OFF-GASSING.**
7. REMOVE THE CROSSOVER JOINING THE FIRST AND SECOND IMPINGERS.
8. POUR 20 mL NITRIC ACID INTO THE SECOND IMPINGER. ADD THE NITRIC EVEN SLOWER THAN INTO THE FIRST IMPINGER.
9. REPLACE THE CROSSOVER AND INCREASE THE AMBIENT AIR SAMPLING RATE TO ABOUT 30 SCFH TO CAUSE INCREASED OR COMPLETE MIXING.
10. AFTER ABOUT 30 SECONDS STOP THE AMBIENT AIR SAMPLING, RECOVER AS USUAL.

## **KMnO<sub>4</sub> Impinger Preparation**

Updated 5-20-96

### **Reagents:**

Hydroxylamine Sulfate

### **Method:**

Add hydroxylamine sulfate to potassium permanganate impinger until the solution remains colorless.  
Analyze by CVAA.

### **Notes:**

Reaction is effervescent, use care when mixing.  
One duplicate should be analyzed every 5 samples.  
One triplicate and one spike should be analyzed every 10 samples.

### **Handling Procedures:**

Corrosive- contains H<sub>2</sub>SO<sub>4</sub>

Hazardous- contains strong oxidizer, KMnO<sub>4</sub>

## H2O2 impinger preparation

updated 11-1-95

### Reagents:

HCl conc.  
KMnO<sub>4</sub> sat'd solution  
Hydroxylamine Sulfate

### Method:

Transfer 5 mL of sample to a 50 mL digestion tube,  
Add 0.25 mL conc. HCl  
Swirl, and let stand approximately 10 min.  
Place tubes in a sample rack, and place in an ice bath,  
Allow to cool for approximately 15 min.  
Slowly add saturated potassium permanganate, waiting 15 min. between additions, to the samples in 0.25 mL increments, swirling between additions, up to 1.25 mL, then in 0.5 mL increments until the solution remains brownish-purple.  
Reduce the excess potassium permanganate with solid hydroxylamine sulfate.  
Analyze by CVAA.

### Notes:

The overall addition of potassium permanganate takes approximately 4 hours.  
One duplicate should be analyzed every 5 samples.  
One triplicate and one spike should be analyzed every 10 samples.

### Handling Procedures:

Corrosive- contains HNO<sub>3</sub>, HCl  
Hazardous- contains strong oxidizers, KMnO<sub>4</sub>, H<sub>2</sub>O<sub>2</sub>

## KCl impinger digestion

Updated 4-6-95

### Reagents:

- KMnO<sub>4</sub> sat'd solution
- K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> solution (5 g in 100 mL)
- H<sub>2</sub>SO<sub>4</sub> conc.
- HNO<sub>3</sub> conc.
- Hydroxylamine Sulfate

### Method:

- Transfer 10 mL of sample to a 50 mL digestion tube.
- Add 0.5 mL of H<sub>2</sub>SO<sub>4</sub>,
- Add 0.25 mL of HNO<sub>3</sub>,
- Add 1.5 mL of KMnO<sub>4</sub> solution.
- Let the mixture stand for 15 minutes.
- Add 0.75 mL of K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> solution.
- Place the samples in a dry block heater at 95°C for two hours. Cool to room temperature.
- Reduce the excess potassium permanganate with solid hydroxylamine sulfate.
- Analyze by CVAA.

### Notes:

- One duplicate should be analyzed every 5 samples.
- One triplicate and one spike should be analyzed every 10 samples.

### Handling Procedures:

- Corrosive- contains HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>.
- Hazardous- contains strong oxidizers KMnO<sub>4</sub>, and K<sub>2</sub>S<sub>2</sub>O<sub>8</sub>.

**TRIS Buffer impinger preparation**

updated 5-20-96

**Reagents:**

KMnO<sub>4</sub> sat'd solution  
K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> solution (5g in 100 mL)  
H<sub>2</sub>SO<sub>4</sub> conc.  
HNO<sub>3</sub> conc.  
HCl conc.  
Hydroxylamine Sulfate

**Method:**

Transfer 5 mL of sample to a 50 mL digestion tube  
Add 0.5 mL conc. H<sub>2</sub>SO<sub>4</sub>  
Add 0.25 mL conc. HNO<sub>3</sub>  
Add 0.25 mL conc. HCl  
Add 1.0 mL K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> solution  
Place sample tubes in a sample rack, and place in an ice bath, and allow to cool for approximately 15 min.  
Slowly add potassium permanganate, waiting 15 min. between additions, to the samples in 0.25 mL increments, up to 1.25 mL swirling between additions, then in 0.5 mL increments until the solution remains brownish-purple.  
Reduce the excess potassium permanganate with solid hydroxylamine sulfate.  
Analyze by CVAA.

**Notes:**

The overall addition of potassium permanganate takes approximately 4 hours.  
One duplicate should be analyzed every 5 samples.  
One triplicate and one spike should be analyzed every 10 samples.

**Handling Procedures:**

Corrosive- contains H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, HCl  
Hazardous- contains strong oxidizers, KMnO<sub>4</sub>, K<sub>2</sub>S<sub>2</sub>O<sub>8</sub>

## ARL QUALITY ASSURANCE/QUALITY CONTROL PROTOCOL

### Laboratory Glassware and Plasticware

All glass volumetric flasks and transfer pipets used in the preparation of analytical reagents and calibration standards are designated as class "A" to meet Federal specifications.

Special cleaning procedures are required for all laboratory glassware and plasticware related to mercury analysis. This procedure includes washing with hot soapy water, several rinses with tap water and several rinses with distilled deionized water.

All vessels are then soaked in 5% bromine monochloride ( $\text{BrCl}$ ) solution (see reagent preparation) for a minimum of 30 minutes followed by several rinses with distilled deionized water.

Any samples requiring mercury analysis that are stored for more than 24 hours are transferred to teflon FEP storage bottles that have undergone the above cleaning procedure.

### Analytical Reagents

All acids used for the analytical methods that pertain to trace metal analysis including mercury are trace-metal-grade. Other chemicals used in the preparation of analytical reagents are analytical-reagent-grade.

The calibration standards used for instrument calibration and the quality control (QC) standards used for calibration verification are purchased commercially and certified to be accurate within  $\pm 0.5\%$  and are traceable to NIST Standard Reference Materials.

### Instrument Setup and Calibration

The instrument used for mercury determination in the ARL is a Leeman Labs PS200 cold vapor mercury analyzer. The instrument is set up for absorption at 253.7 nm with a carrier gas of nitrogen and 10% stannous chloride in 10% HCl as the reductant. The instrument is set up by daily replacing the drying tube and acetate trap, containing magnesium perchlorate and soda-lime respectively. The tubing is checked and replaced if necessary. The rinse container is rinsed and filled with fresh solution of 10% HCl. The pump and lamp are turned on. After a warm up time of 45 minutes, the aperture is set to the manufacturer specifications. A four point calibration curve, with matrix matched standards is used. The detector response for a given standard is logged and compared to specifications to insure proper instrument setup and response.



### Calibration Verification

A quality control standard of a known analyte concentration must be analyzed immediately after an instrument is standardized in order to verify the calibration. This quality control standard must be prepared from a separate stock as was the calibration standards and the values obtained must read within 5% of the true value. The values obtained from the initial QC analyses are plotted in a quality control chart to monitor the precision of the instrument. After the initial QC standard, periodic check standards are run every five samples to check the slope of the calibration curve. The check standards must read within 5% of the expected value.

### Duplicate Sample Analysis

In order to insure that adequate levels of precision are maintained by the ARL, duplicate samples selected on a random basis, must be performed on one of every ten samples analyzed with a minimum of one duplicate analysis per run. Any variation in the ten percent figure must be justified in the procedure. The results from duplicate analysis must read within 10%. The precision of the duplicate sample analyses are recorded and charted in a precision control chart. For the analysis of impinger samples, the practice in the ARL is that all samples are run in duplicate to help insure analytical precision and improve accuracy.

### Spike Sample Analysis

In order to account for background contamination and/or sample interferences, spiked sample analysis, selected on a random basis, will be performed on ten percent of all samples including the first sample analyzed. Accuracy is reported as percent recovery of the spike added.

$$\% \text{Recovery} = \frac{(\text{Sample} + \text{Spike}) - (\text{Sample})}{(\text{Spike})} \times 100\%$$

Recoveries are plotted on an accuracy control chart.

It is recommended that on a mass basis, the spike added should be approximately equal to the mass of the constituent sought in the sample or sample aliquot. Spike volume, relative to the sample aliquot volume should be as small as possible, but not so small that it cannot be dispensed accurately. The solution used for spiking is from a separate stock as the calibration standards.

### Reagent Blank

All acids, chemical reagents and deionized water used for mercury determination are analyzed for background levels of mercury. Each time a new batch of reagents is prepared an aliquot is

### Method blank

### Reagent Preparation

Potassium Permanganate/Sulfuric Acid solution

Hydrogen Peroxide/Nitric Acid solution

Potassium Chloride solution

Bromine Monochloride (BrCl) Solution

JUL-15-1996 17:06 FROM EERC TO 0017142030012910007

water. This will not all dissolve, but all the solid must be wet. While swirling the bottle gently, 800 ml of low mercury Ultrex brand concentrated HCl are then slowly added. Caution must be shown, because of heat and toxic fumes generated during preparation. Once cooled, the reagent may be stored in a glass-stoppered bottle, in a cool place.

#### Spiking Solution

The spiking solution used to spike the impinger trains will be prepared in the ARL from a commercially purchased ICP stock standard at a concentration of 1000 mg Hg/L. This standard is traceable to NBS standard reference materials and consists of mercury metal in 10% HNO<sub>3</sub>. The final spiking concentration has yet to be determined, however the concentration will be verified in the laboratory before being added to the impinger trains.

#### Analytical Equipment

##### Leeman Labs Mercury Analyzer

The PS200 automated mercury analyzer is based on cold vapor atomic absorption spectroscopy. The calculated quantitation level is 200 ng/L.

##### Analytical Balance

The analytical balance used in the ARL for weighing solid materials prior to acid digestion is a Sartorius 1601 MP8. The readability of this balance is 0.1 mg with a maximum capacity of 111 g. The calibration of the balance is checked routinely with standardized weights traceable to NBS. It is also maintained annually by Northern Balance and Scale.

##### Microwave Sample Preparation System

The CEM MDS-2100 has a power output of 950 watts with an in-board pressure controller for safe and efficient acid digestion of solid materials such as coal and coal combustion by-products.

The digestion vessels used with this system are teflon lined and sealed during the digestion procedure to help insure zero loss of volatile analytes.

A recently purchased MDS-2100 equipped with temperature and pressure controllers as well as sealed heavy duty digestion vessels designed for high pressure applications such as coal dissolution is currently undergoing methods development. The ultimate goal is to increase the amount of solid material in the digestion which will in turn decrease the quantitation level in the sample.

#### External Quality Control

The ARL has U.S. Environmental Protection Agency (EPA) certification through the state of North Dakota by participating annually in their water pollution study. An on-site evaluation is conducted every three years by the state in order to maintain full certification.

**MERCURY SPECIATION TEST PROGRAM  
RESULTS FROM  
NEW YORK STATE ELECTRIC & GAS  
CORPORATION'S MILLIKEN STATION  
UNIT 2, LANSING, NEW YORK  
VOLUME II**

Prepared For:

**NEW YORK STATE ELECTRIC & GAS CORPORATION**  
Binghamton, New York

Prepared By:

Kusha D. Janati

**CARNOT**  
Tustin, California

DRAFT: DECEMBER 1996  
FINAL DRAFT: FEBRUARY 1997  
FINAL: JUNE 1997

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BY WFM DATE 2-14-00

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**APPENDIX B**  
**QUALITY ASSURANCE AND QUALITY CONTROL**



**Appendix B.1**  
**Quality Assurance Program Summary**



## QUALITY ASSURANCE PROGRAM SUMMARY AND ARB CERTIFICATION

Carnot ensures the quality and validity of its emission measurement and reporting procedures through a rigorous quality assurance (QA) program. The program is developed and administered by an internal QA Officer and encompasses seven major areas:

1. Development and use of an internal QA manual.
2. QA reviews of reports, laboratory work, and field testing.
3. Equipment calibration and maintenance.
4. Chain of custody.
5. Training.
6. Knowledge of current test methods.
7. Agency certification.

Each of these areas is discussed individually below.

Quality Assurance Manual. Carnot has prepared a QA Manual according to EPA guidelines. The manual serves to document and formalize all of Carnot's QA efforts. The manual is constantly updated, and each member of the Source Test Division is required to read and understand its contents. The manual includes details on the other six QA areas discussed below.

QA Reviews. Carnot's review procedure includes review of each source test report by the QA Officer, and spot check reviews of laboratory and field work.

The most important review is the one that takes place before a test program begins. The QA Officer works closely with Source Test Division personnel to prepare and review test protocols. Test protocol review includes selection of appropriate test procedures, evaluation of any interferences or other restrictions that might preclude use of standard test procedures, and evaluation and/or development of alternate procedures.

Equipment Calibration and Maintenance. The equipment used to conduct the emissions measurements is maintained according to the manufacturer's instructions to ensure proper operation. In addition to the maintenance program, calibrations are carried out on each measurement device according to the schedule outlined by the California Air Resources Board (CARB). The schedule for maintenance and calibrations are given in Tables B-1 and B-2. Quality control checks are also conducted in the field for each test program. The following is a partial list of checks made as part of each CEM system test series.

- Sample acquisition and conditioning system leak check.
- 2-point analyzer calibrations (all analyzers)
- 3-point analyzer calibrations (analyzers with potential for linearity errors).
- Complete system calibration check ("dynamic calibration" through entire sample system).

- Periodic analyzer calibration checks (once per hour) are conducted at the start and end of each test run. Any change between pre- and post-test readings are recorded.
- All calibrations are conducted using gases certified by the manufacturer to be + 1 % of label value (NBS traceable).

Calibration and CEM performance data are fully documented, and are included in each source test report.

Chain of Custody. Carnot maintains full chain of custody documentation on all samples and data sheets. In addition to normal documentation of changes between field sample custodians, laboratory personnel, and field test personnel, Carnot documents every individual who handles any test component in the field (e.g., probe wash, impinger loading and recovery, filter loading and recovery, etc.).

Samples are stored in a locked area to which only Source Test Division personnel have access. Neither other Carnot employees nor cleaning crews have keys to this area.

Data sheets are copied immediately upon return from the field, and this first generation copy is placed in locked storage. Any notes made on original sheets are initialed and dated.

Training. Personnel training is essential to ensure quality testing. Carnot has formal and informal training programs which include:

1. Attendance at EPA-sponsored training courses.
2. Enrollment in EPA correspondence courses.
3. A requirement for all technicians to read and understand Carnot's QA Manual.
4. In-house training and QA meetings on a regular basis.
5. Maintenance of training records.

Knowledge of Current Test Methods. With the constant updating of standard test methods and the wide variety of emerging test methods, it is essential that any qualified source tester keep abreast of new developments. Carnot subscribes to services which provide updates on EPA and CARB reference methods, and on EPA, CARB and SCAQMD rules and regulations. Additionally, source test personnel regularly attend and present papers at testing and emission-related seminars and conferences. Carnot personnel maintain membership in the Air and Waste Management Association, the Source Evaluation Society, and the ASME Environmental Control Division.

## AGENCY CERTIFICATION

Carnot is certified by the CARB as an independent source test contractor for gaseous and particulate measurements. Carnot is certified by the SCAQMD as an independent source test contractor for gaseous and particulate measurements using SCAQMD Methods 1, 2, 3, 4, 5, 6, 7, 12 and 100.1. Carnot also participates in EPA QA audit programs for Methods 5, 6 and 7.

**TABLE B-1**  
**SAMPLING INSTRUMENTS AND EQUIPMENT CALIBRATION SCHEDULE**  
**As Specified by the CARB**

Instrument Type	Frequency of Calibration	Standard of Comparison or Method of Calibration	Acceptance Limits
Orifice Meter (large)	12 months	Calibrated dry test meter	$\pm 2\%$ of volume measured
Dry Gas Meter	12 months or when repaired	Calibrated dry test meter	$\pm 2\%$ of volume measured
S-Type Pitot (for use with EPA-type sampling train)	6 months	EPA Method 2	Cp constant (+5%) over working range; difference between average Cp for each leg must be less than 2%
Vacuum Gauges Pressure Gauges	6 months	Manometer	$\pm 3\%$
Field Barometer	6 months	Mercury barometer	$\pm 0.2''$ Hg
Temperature Measurement	6 months	NBS mercury thermometer or NBS calibrated platinum RTD	$\pm 4^\circ\text{F}$ for $< 400^\circ\text{F}$ $\pm 1.5\%$ for $> 400^\circ\text{F}$
Temperature Readout Devices	6 months	Precision potentiometer	$\pm 2\%$ full scale reading
Analytical Balance	12 months (check prior to each use)	Should be performed by manufacturer or qualified laboratory	$\pm 0.3$ mg of stated weight
Probe Nozzles	12 Months	Nozzle diameter check micrometer	Range $< \pm 0.10$ mm for three measurements
Continuous Analyzers	Depends upon use, frequency and performance	As specified by manufacturers operating manuals, EPA NBS gases and/or reference methods	Satisfy all limits specified in operating specifications

**TABLE B-2**  
**EQUIPMENT MAINTENANCE SCHEDULE**  
**Based on Manufacturer's Specifications and Carnot Experience**

Equipment	Performance Requirement	Maintenance Interval	Corrective Action
Pumps	1. Absence of leaks 2. Ability to draw manufacturer required vacuum and flow	Every 500 hours of operation or 6 months, whichever is less	1. Visual inspection 2. Clean 3. Replace worn parts 4. Leak check
Flow Measuring Device	1. Free mechanical movement 2. Absence of malfunction	Every 500 hours of operation or 6 months, whichever is less  After each test, if used in H <sub>2</sub> S sampling or other corrosive atmospheres	1. Visual inspection 2. Clean 3. Calibrate
Sampling Instruments	1. Absence of malfunction 2. Proper response to zero, span gas	As required by the manufacturer	As recommended by manufacturer
Integrated Sampling Tanks	Absence of leaks	Depends on nature of use	1. Steam clean 2. Leak check
Mobile Van Sampling Systems	Absence of leaks	Depends on nature of use	1. Change filters 2. Change gas dryer 3. Leak check 4. Check for system contamination
Sampling Lines	Sample degradation less than 2%	After each test or test series	Blow filtered air through line until dry



**Appendix B.2**  
**CARB Certification/SCAQMD Laboratory Approval Program**



State of California  
**Air Resources Board**  
Approved Independent Contractor

**Carnot**

This is to certify that the company listed above has been approved  
by the Air Resources Board to conduct compliance testing  
pursuant to Section 91207, Title 17, California Code of Regulations,  
until June 30, 1997, for those test methods listed below:

**ARB Source Test Method 100 NOx**

  
James J. Morgester, Chief  
Compliance Division

State of California  
**Air Resources Board**  
Approved Independent Contractor

Carnot

This is to certify that the company listed above has been approved  
by the Air Resources Board to conduct compliance testing  
pursuant to Section 91207, Title 17, California Code of Regulations,  
until June 30, 1997, for those test methods listed below:

ARB Source Test Methods:

1, 2, 3, 4, 5, 8

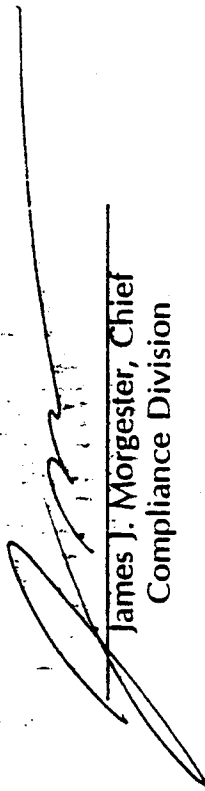
  
James J. Morgester, Chief  
Compliance Division

State of California  
**Air Resources Board**  
Approved Independent Contractor

**Carnot**

This is to certify that the company listed above has been approved by the Air Resources Board to conduct compliance testing pursuant to Section 91207, Title 17, California Code of Regulations, until June 30, 1997, for those test methods listed below:

**ARB Source Test Methods:  
10, 100 (CO2, O2, SO2)**



James J. Morgester, Chief  
Compliance Division



# South Coast Air Quality Management District

21865 E. Copley Drive, Diamond Bar, CA 91765-4182 (909) 396-2000

DEC 8 2 1996

CARNOT

November 21, 1996

Mr. Matthew R. McCune  
Carnot Technical Service, Inc.  
15991 Red Hill Avenue  
Tustin, CA 92780

Reference #: 93LA1103

Dear Mr. McCune:

Subject: LAP Renewal

I am pleased to inform you that the SCAQMD has approved the renewal application for Carnot Technical Service, Inc. to perform testing under SCAQMD's Laboratory Approval Program (LAP). In accepting LAP approvals, the applicant agrees to strictly follow the technical requirements of SCAQMD methods (or other methods as specified), as well as the procedures and policies of the Laboratory Approval Program. Approval means that your lab/test facilities have demonstrated the capability to meet SCAQMD testing and analysis criteria for the following methods:

SCAQMD Methods 1-4  
SCAQMD Method 6.1 (Incl. 5)  
SCAQMD Method 7.1 (sampling)  
SCAQMD Method 100.1

Approval is granted for the period beginning November 16, 1996 and ending November 16, 1997. Approval is granted subject to the following specific condition: Carnot shall provide adequate documentation that recent staffing changes have resulted in no negative impact upon your firm's ability to conduct approved tests and analyses. To assist you in providing this documentation, a Laboratory Personnel Change form is included. This form must be completed and returned to the LAP Coordinator by December 16, 1996. We will review the information you submit and determine whether it makes an adequate demonstration. If an adequate demonstration has not been made, you will be given 15 days from date of notification to rectify.

Please be advised that SCAQMD has the right to inspect or audit your facility or remote operations anytime during the approval period. The approved test firm must notify the LAP Coordinator in writing of any changes in procedures, personnel, equipment or policies which may affect your approval status. Failure to follow SCAQMD methods,

Mr. Matthew R. McCune

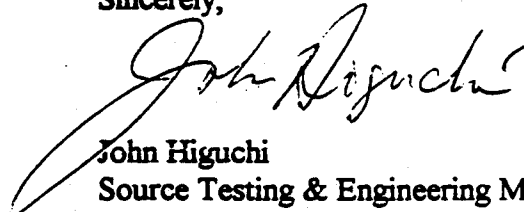
-2-

November 21, 1996

chain of custody procedures, or conditions of approval without notification and SCAQMD approval may result in the cancellation of your approval.

If you have any questions, please contact the LAP Coordinator at (909) 396-2228 or by FAX at (909) 396-2099.

Sincerely,

A handwritten signature in dark ink, appearing to read "John Higuchi", with a long, sweeping underline that extends to the left and under the printed name below.

John Higuchi

Source Testing & Engineering Manager

JH:TP:cv  
Enclosure





**Appendix B.3**  
**Field Sampling Equipment Calibration Data**



APEX INSTRUMENTS  
600 Series  
Meter Box Calibration

Rev. 4-28-94

Model #: 200                      Date: 7/30/96  
Serial #: NCC1                      Barometric Pressure 29.80

Pm	T i m e	DRY GAS METER VOLUME				CALIBRATION METER VOLUME (Yc= 1.0000 )					
		Initial	Final	Total	Temp 'F Init. Final	Initial	Final	Total	Temp 'F Init. Final		
										LITERS	
3.40	2.0	5403.17	5411.27	8.10	83 85	1.00	9.46	8.46	83 83		
2.40	24.5	5411.27	5459.57	48.30	85 89	9.46	58.62	49.16	83 83		
1.60	12.5	5459.57	5473.78	14.21	89 90	58.62	72.75	14.13	83 83		

METER Y	Dev.
1.0377	0.02
1.0193	0.00
1.0023	-0.02

AVG. 1.020

APEX INSTRUMENTS  
600 Series  
Meter Box Calibration

Rev. 4-28-94

Model #: 200  
Serial #: NCC2

Date: 8/1/96  
Barometric Pressure 29.73

Pm	T i m e	DRY GAS METER VOLUME				CALIBRATION METER VOLUME (Yc= 1.0000 )					
		Initial	Final LITERS	Total	Temp 'F		Initial	Final LITERS	Total	Temp 'F	
					Init.	Final				Init.	Final
3.20	6.0	1675.83	1692.83	17.00	66	69	0.00	17.90	17.90	72	72
2.00	8.5	1692.83	1708.84	16.01	68	69	17.90	34.60	16.70	72	72
1.40	15.0	1708.84	1722.51	13.67	69	69	34.60	48.76	14.16	72	72

METER Y	Dev.
1.0358	0.00
1.0311	0.00
1.0264	0.00

AVG. 1.031

APEX INSTRUMENTS  
600 Series  
Meter Box Calibration

Rev. 4-28-94

Model #: GALLUS  
Serial #: 002102404

Date: 8/1/96  
Barometric Pressure 29.70

Pm	Time	DRY GAS METER VOLUME			Temp 'F		CALIBRATION METER VOLUME (Yc= 1.0000 )			Temp 'F	
		Initial	Final	Total	Init.	Final	Initial	Final	Total	Init.	Final
		LITERS					LITERS				
4.60	24.5	1004.40	1174.40	170.00	74	73	0.00	173.62	173.62	74	73
4.20	11.5	1460.00	1550.00	90.00	73	74	446.50	533.18	86.68	73	73
3.10	13.0	1380.60	1457.00	76.40	74	74	360.27	434.61	74.34	73	73

METER Y	Dev.
1.0098	0.03
0.9541	-0.02
0.9674	-0.01

AVG. 0.977

Corrected  
T

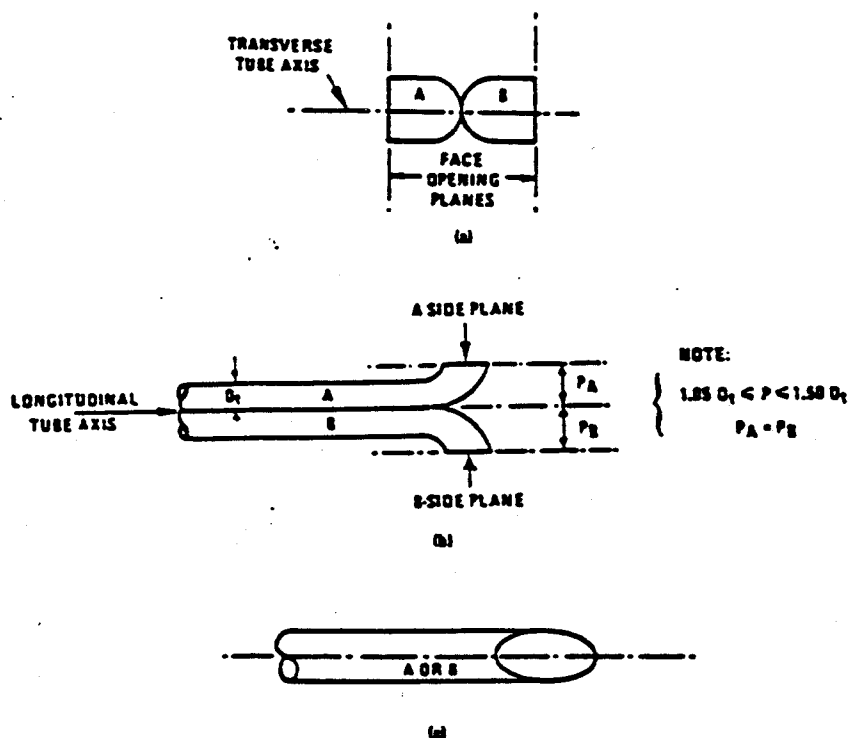


# PITOT TUBE DIMENSIONAL CALIBRATION

Pitot Tube I.D. 15 Date 6-3-96 By Dave Cony

$D_t$  .475  $P_A$  .50  $P_B$  .50

- (a) Face opening plane angle = 90 deg A Y B Y  
(Y/N)
- (b) Face opening planes parallel to longitudinal axis (Y/N) A Y B Y
- (c) Both legs equal length and centerline coincident View A Y B Y  
(Y/N)



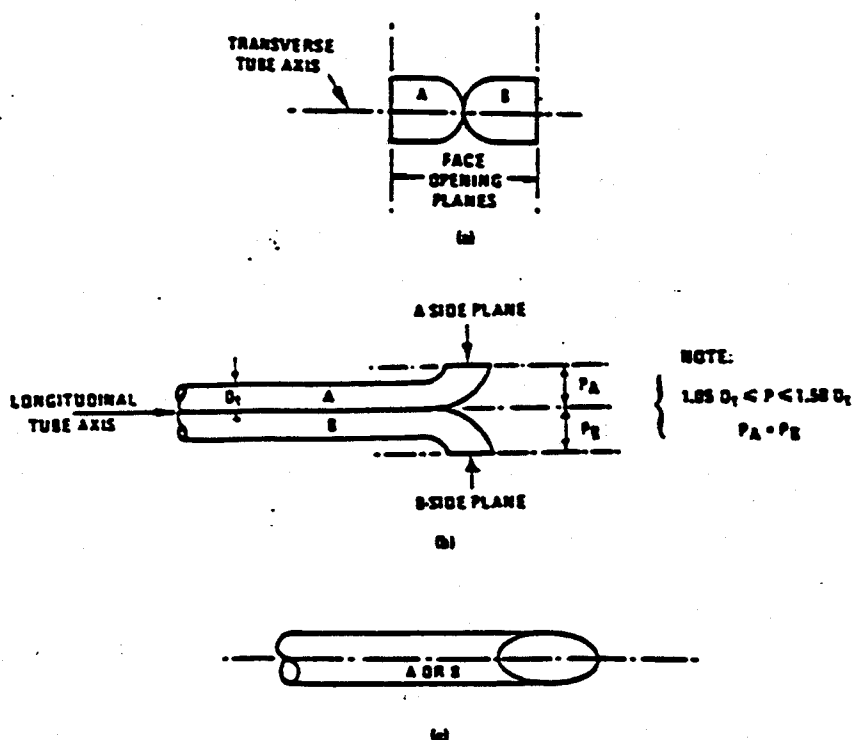
Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Base-line coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

# CARNOT

## PITOT TUBE DIMENSIONAL CALIBRATION

Pitot Tube I.D. 17 Date 6-3-96 By Dan Wong  
 $D_t$  .375  $P_A$  .440  $P_B$  .435

- (a) Face opening plane angle = 90 deg A Y B Y  
 (Y/N)
- (b) Face opening planes parallel to longitudinal axis (Y/N) A Y B Y
- (c) Both legs equal length and centerline coincident View (Y/N) A Y B Y



Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Base-line coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

# CARNOT

## PITOT TUBE DIMENSIONAL CALIBRATION

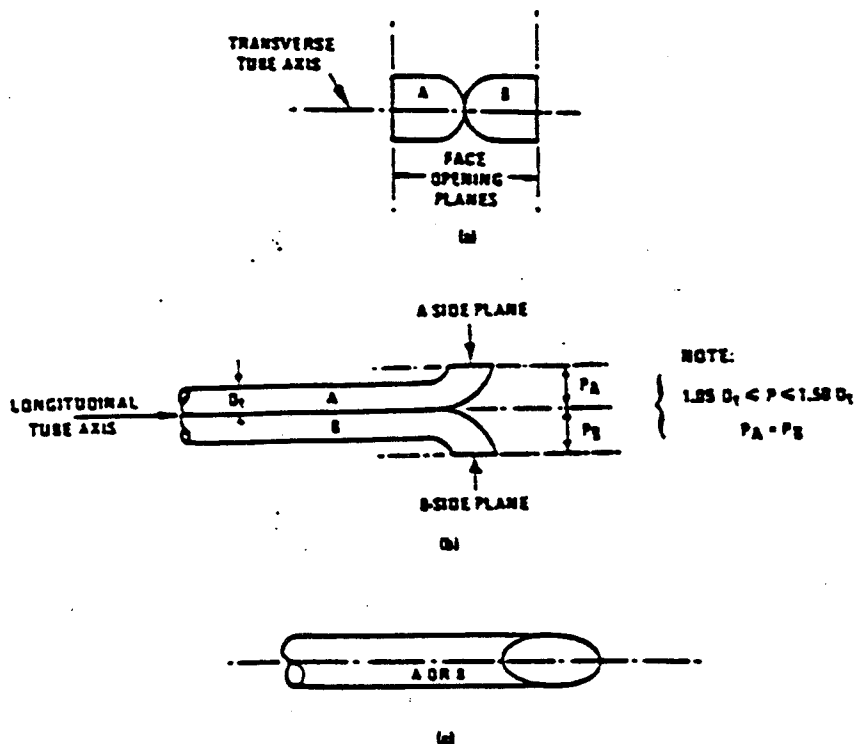
Pitot Tube I.D. 20 Date 6-3-96 By Dave Wondley

$D_t$  .375  $P_A$  .442  $P_B$  .435

(a) Face opening plane angle = 90 deg A Y B Y  
(Y/N)

(b) Face opening planes parallel to longitudinal axis (Y/N) A Y B Y

(c) Both legs equal length and centerline coincident View (Y/N) A Y B Y



Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Base-line coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

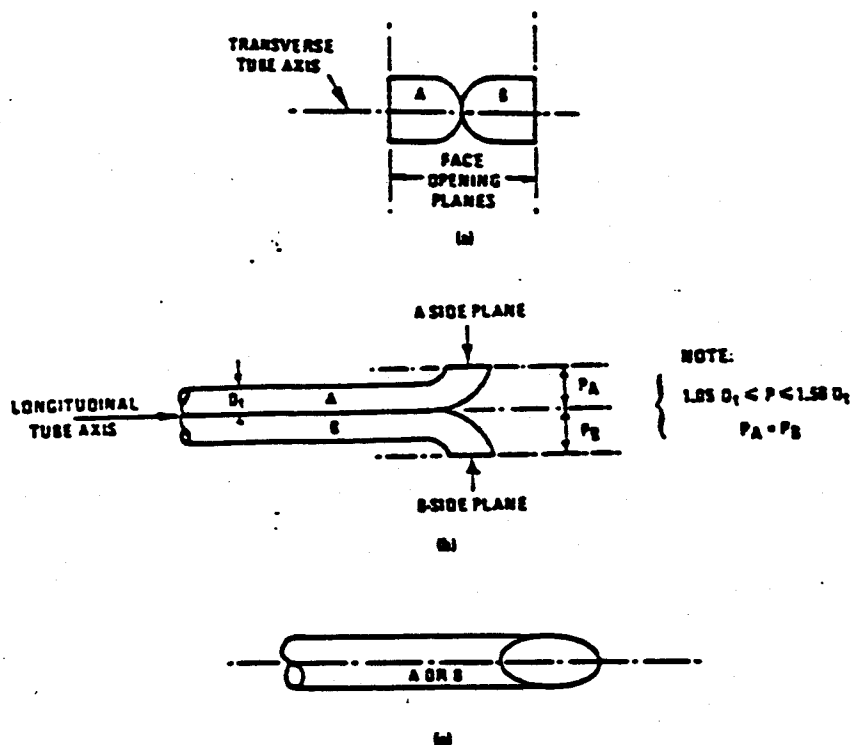


# CARNOT

## PITOT TUBE DIMENSIONAL CALIBRATION

Pitot Tube I.D. 26 Date 7-27-96 By DL  
 $D_t$  .775  $P_A$  .450  $P_B$  .448

- (a) Face opening plane angle = 90 deg A Y B Y  
 (Y/N)
- (b) Face opening planes parallel to longitudinal axis (Y/N) A Y B Y
- (c) Both legs equal length and centerline coincident View (Y/N) A Y B Y



Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Base-line coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

# CARNOT

## PITOT TUBE DIMENSIONAL CALIBRATION

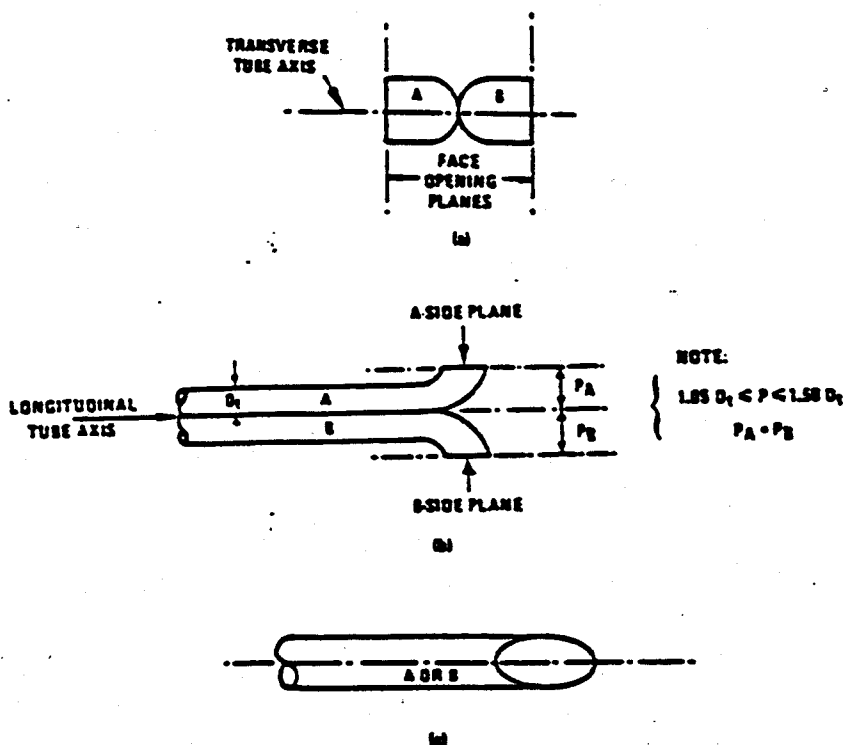
Pitot Tube I.D. 27 Date 7-27-76 By 1) W

$D_t$  .375  $P_A$  .442  $P_B$  .438

(a) Face opening plane angle = 90 deg (Y/N) A Y B Y

(b) Face opening planes parallel to longitudinal axis (Y/N) A Y B Y

(c) Both legs equal length and centerline coincident View (Y/N) A Y B Y



Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Base-line coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

# CARNOT

## PITOT TUBE DIMENSIONAL CALIBRATION

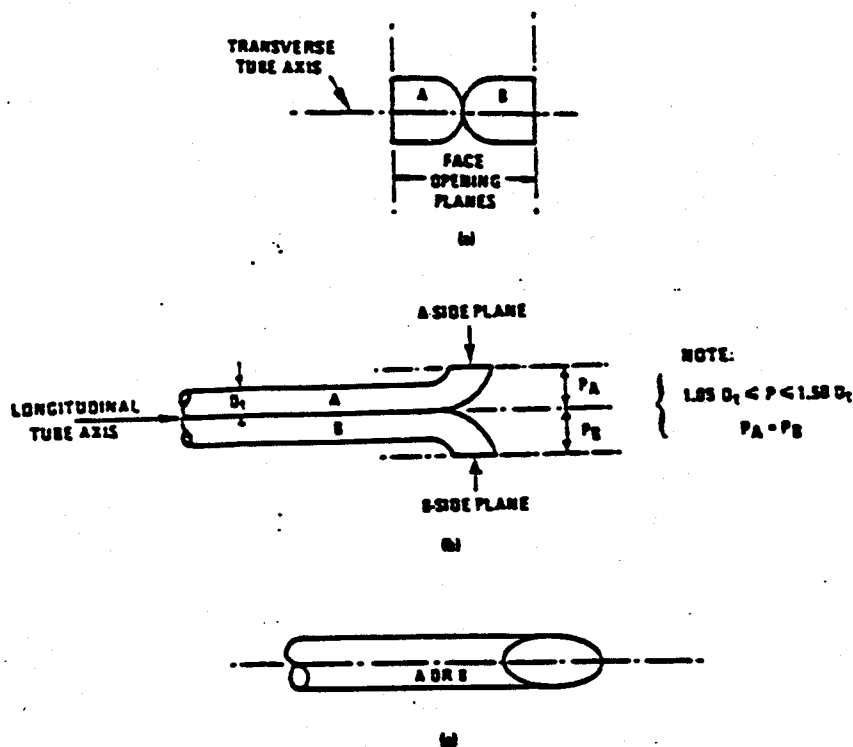
Pitot Tube I.D. 28 Date 7-29-96 By PLW

$D_t$  .375  $P_A$  .443  $P_B$  .440

(a) Face opening plane angle = 90 deg A ✓ B ✓  
(Y/N)

(b) Face opening planes parallel to longitudinal axis (Y/N) A ✓ B ✓

(c) Both legs equal length and centerline coincident View (Y/N) A ✓ B ✓



Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Base-line coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

## PITOT TUBE DIMENSIONAL CALIBRATION

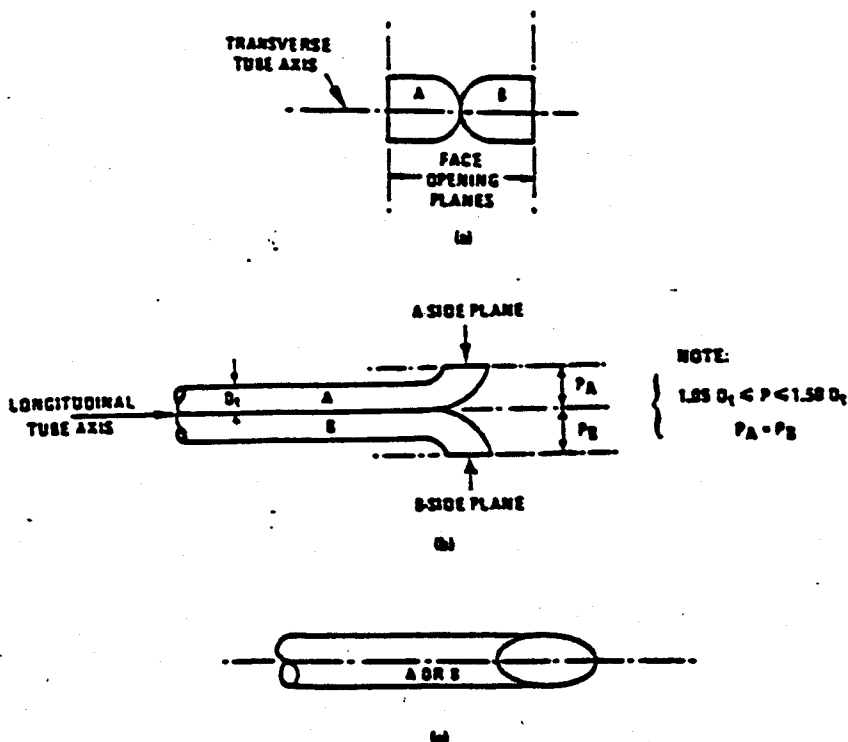
Pitot Tube I.D. 29 Date 7-29-76 By DW.

$D_t$  .775  $P_A$  .450  $P_B$  .445

(a) Face opening plane angle = 90 deg A Y B Y  
(Y/N)

(b) Face opening planes parallel to longitudinal axis (Y/N) A Y B Y

(c) Both legs equal length and centerline coincident View (Y/N) A Y B Y



Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Base-line coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

# PORTABLE O<sub>2</sub> METERS

## CARNOT SPAN GAS RECORD

CLIENT/LOCATION: NYSEC / Miliken Station DATE: 8/7/96  
BY: LOJ

GAS	SPAN CYLINDER		AUX. SPAN CYLINDER	
	CYLINDER NO.	CONCENTRATION	CYLINDER NO.	CONCENTRATION
ZERO	ALM043734	ZERO(N <sub>2</sub> )		
NOx				
O <sub>2</sub>	ALM020479	8.95	Ambient	20.9
<del>NO</del> O <sub>2</sub>	ALM029732	4.53		
CO <sub>2</sub>				
SO <sub>2</sub>				

## CARNOT INSTRUMENT LINEARITY

	STK 1	STK 2	ANALYZER EST. OUT	EST. IN	
	O <sub>2</sub>	SO <sub>2</sub>	NO <sub>2</sub>	NO <sub>2</sub>	SO <sub>2</sub>
ANALYZER RANGE	0-25	0-25	0-25	0-25	
SET TO HIGH STD (80-90% OF RANGE)	20.9	20.9	20.9	20.9	
AS-FOUND LOW STD (50-60% OF RANGE)	8.90	9.00	8.95	8.95	
ACTUAL VALUE OF LOW STD	8.95	8.95	8.95	8.95	
DIFFERENCE IN % OF FULL SCALE					

ALLOWABLE DEVIATION IS 2% OF FULL SCALE (2 SQUARES ON STRIP CHART).

PMF-009

**CARNOT**

As-Found Low O<sub>2</sub>      4.45      4.60      4.55      4.65

# PORTABLE O<sub>2</sub> METERS

## CARNOT SPAN GAS RECORD

CLIENT/LOCATION: NYSEG / Milliken Station DATE: 8/8/96  
BY: KD

GAS	SPAN CYLINDER		AUX. SPAN CYLINDER	
	CYLINDER NO.	CONCENTRATION	CYLINDER NO.	CONCENTRATION
ZERO	ALM 043774	ZER (N <sub>2</sub> )		
NO <sub>x</sub>				
O <sub>2</sub>	ALM 020479	8.95	Ambient	20.9
<del>CO</del> O <sub>2</sub>	ALM 029732	4.53		
CO <sub>2</sub>				
SO <sub>2</sub>				

## CARNOT INSTRUMENT LINEARITY

	STK 1	STK 2	ANALYZER PRODUCT	EST IN	
	O <sub>2</sub>	CO <sub>2</sub>	CO <sub>2</sub>	NO <sub>2</sub>	SO <sub>2</sub>
ANALYZER RANGE	0-25	0-25	0-25	0-25	
SET TO HIGH STD (80-90% OF RANGE)	20.9	20.9	20.9	20.9	
AS-FOUND LOW STD (50-60% OF RANGE)	9.1 <del>8.85</del>	8.8 <del>8.8</del>	9.0	9.1	
ACTUAL VALUE OF LOW STD	8.95	8.55	8.95	8.95	
DIFFERENCE IN % OF FULL SCALE					

ALLOWABLE DEVIATION IS 2% OF FULL SCALE (2 SQUARES ON STRIP CHART).

# CARNOT SPAN GAS RECORD

CLIENT/LOCATION: NYSEG / Milliken Station DATE: 8/9/86  
BY: KDJ

GAS	SPAN CYLINDER		AUX. SPAN CYLINDER	
	CYLINDER NO.	CONCENTRATION	CYLINDER NO.	CONCENTRATION
ZERO				
NOx				
O <sub>2</sub>	ALM 020479	8.95	ALM 029732	4.53
CO				
CO <sub>2</sub>				
SO <sub>2</sub>				

0-10 8.95 > O<sub>2</sub>  
0-5 4.53  
CARNOT  
INSTRUMENT LINEARITY

	STK 1	STK 2	ANALYZER ESP IN	ESP OUT	
	O <sub>2</sub>	NO <sub>2</sub>	NO <sub>2</sub>	NO <sub>2</sub>	SO <sub>2</sub>
ANALYZER RANGE	0-10	0-10	0-10	0-10	
SET TO HIGH STD (80-90% OF RANGE)	8.95	8.95	8.95	8.95	
AS-FOUND LOW STD (50-60% OF RANGE)	4.5	4.5	4.60	4.60	
ACTUAL VALUE OF LOW STD	4.53	4.53	4.53	4.53	
DIFFERENCE IN % OF FULL SCALE					

ALLOWABLE DEVIATION IS 2% OF FULL SCALE (2 SQUARES ON STRIP CHART).

**Appendix B.4**  
**Chain of Custodies**



10

PROJECT NO.: 11476

OUTSIDE LAB REQUIRED (Y/N): Y - ZENON

**CLIENT/LOCATION:** \_\_\_\_\_

**METHOD(S):** EPA 29

COMPLIANCE TEST (Y/N): Y

OUTSIDE LAB REQUIRED (Y/N): Y - ZENON

**METHOD(S):** EPA 29

\_\_\_\_\_

DATE	TIME	TEST #	SAMPLE DESCRIPTION	CONTAINERS	SAMPLER	COMMENTS
8/7/96		RB-MTUS-1	FH, F, TR, BH, MKO, KMnO <sub>4</sub> , HCl	6		
8/8/96		RB-MTUS-2	↓	↓		
8/9/96		RB-MTUS-3	↓			
8/9/96		4-MTUS-SPIC	FH, F, TR, BH, MKO, KMnO <sub>4</sub> , HCl	6		
8/7/96		FB-MTUS-OUT	FH, F, TR, BH, MKO, KMnO <sub>4</sub> , HCl	6		
↓		FB-MTUS-STK	↓	↓		
8/10/96		2FB-MTUS-OUT	↓			
		2FB-MTUS-STK	↓			
8/7		1-MTUS-IN	ACET FH, FH, F, TR, BH, MKO, KMnO <sub>4</sub> , HCl	7 + PETE DISH		
↓		1-MTUS-OUT	FH, F, TR, BH, MKO, KMnO <sub>4</sub> , HCl	7		
↓		1-MTUS-STK	↓	8		

TRANSFER OF SAMPLES FROM FIELD SAMPLE CUSTODIAN (FSC) 11/14/2011

RELEASED BY (FSG)	DATE AND TIME	RECEIVED BY	DATE AND TIME
<i>h/tm</i>	<i>2/15/96 900</i>	<i>Ston</i>	<i>08-15-96 930</i>

**ANALYSIS REQUIRED:** SEE PAGE 7

11.50

**SAMPLE DATE:** 8/8-13/96

**PROJECT MANAGER:** KDJ

**TECHNICIAN:**

**DATE DUE:**

OUTSIDE LAB REQUIRED (Y/N): -1 - ZENON

**TECHNICIAN:**

**DATE DUE:**

CUSTODIAN (FSC): *Maeda Yoshinori*

**TRANSFER OF SAMPLES FROM FIELD SAMPLE CUSTODIAN (FSC):**

RELEASED BY (FSG)	DATE AND TIME	RECEIVED BY	DATE AND TIME
<i>af</i>	8/15/96 9:10	<i>Kon Vukob</i>	8-15-96 9:50

1-mus. Inv.

For <sup>1-mus-In</sup> 2-mus-In, 3-mus-In, desiccate filters for 48 hours & weigh; evaporate FH acetone at ambient temp, desiccate 48 hrs & weigh. Take solid aliquot (second etc.) & digest empty for mms.  
For remaining samples & ~~rest~~ remaining fractions of 2-mus-In & 3-mus-In digest and analyze by EPA 29. <sup>1-mus-In</sup> 1-mus-In - DN

2-Mr. Tw used an untared filter, for ~~for~~ ~~for~~ ~~for~~ ~~for~~

**APPENDIX C**  
**DATA SHEETS, CALCULATIONS, AND LABORATORY REPORTS**



**Appendix C.1**  
**Unit Instrumentation Data Logs**



**TABLE 2-5**  
**UNIT OPERATING CONDITIONS SUMMARY**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Test Period	Date	Time	Gross Output, MW	Net Output, MW	Main Steam Flow, Klb/hr	Feedwater Flow, Klb/hr	Total Air Flow (Fans A/B), Klb/hr	Coal Flow Rate, lb/hr <sup>(1)</sup>	Temperatures, °F				Boiler O <sub>2</sub> , %	Opacity, %	FGD Inlet		Plant CEMS					
									Main Steam	Air- Heater Inlet	Air- Heater Outlet	Air- Heater			SO <sub>2</sub> , ppm (raw)	SO <sub>2</sub> , lb/hr	FGD Outlet/Stack		SO <sub>2</sub> , ppm (raw)	SO <sub>2</sub> , lb/hr	Rem. Eff.	NO <sub>x</sub> , ppm (raw)
																	SO <sub>2</sub> , ppm (raw)	SO <sub>2</sub> , lb/hr				
<b>Inorganic Test Period:</b>																						
1	8/7/96	0800/1800	158.6	148.9	1,098	1,044	1,088	114,895	1,004	661	301	3.30	5.81	1,573	5,012	129.4	509.3	89.8%	182.2			
2	8/8/96	0800/1800	159.4	149.6	1,105	1,042	1,104	120,199	1,005	662	299	3.29	5.74	1,556	4,989	126.7	502.92	89.9%	194.3			
3	8/9/96	0800/1700	158.8	149.1	1,099	1,036	1,101	121,123	1,005	661	295	3.28	5.91	1,605	5,214	107.2	424.83	91.9%	203.1			
<b>Organic Test Period:</b>																						
4	8/12/96	0800/1400	157.5	147.7	1,092	1,040	1,039	122,620	1,005	659	296	2.85	6.80	1,588	4,913	93.1	363.67	92.6%	231.0			
5	8/12/96	1400/2000	156.6	146.7	1,081	1,012	1,058	120,358	1,005	659	298	2.89	4.99	1,540	4,853	83.1	325.15	93.3%	228.8			
6	8/13/96	0800/1900	158.8	149.0	1,100	1,044	1,048	127,694	1,005	658	297	2.76	6.17	1,506	4,674	68.8	267.13	94.3%	240.4			

Note:  
(1) Calculated from Carnot pilot flow rate data and EPA Method 19 F-Factor (reported on an as-received basis).

**FGD SOLID PROCESS STREAM FLOW RATE CALCULATIONS**  
**NYSEG MILLIKEN UNIT POST-RETROFIT TEST PROGRAM**

**Table 1: Limestone Solids Flow Rate Calculation**

Date	Limestone Slurry Flow, gpm	Specific Gravity of Limestone Slurry	Specific Gravity of Water	Density of Slurry (lb/gal)	Density of Water (lb/gal)	Limestone Slurry Flow, lb/hr	Total Solids Slurry Content, % by wt	Limestone Solids Flow Rate, lb/hr
7-Aug	28.37	1.056	1.416	8.33	11.80	20,083	40.85%	8,204
8-Aug	32.16	1.056	1.379	8.33	11.49	22,172	37.64%	8,345
9-Aug	32.16	1.056	1.357	8.33	11.31	21,817	35.64%	7,775

Specific Gravity (SG) of Slurry = SG of Slurry Liquid / (1 - %Slurry Solids/100) (SG of Solids - SG of Slurry Liquid) / (SG of Solids)

Density of Slurry (lb/gal) = specific gravity of limestone slurry \* density of water (lb/gal)

Limestone Slurry Flow, lb/hr = limestone slurry flow, gpm \* 60 min/hr \* density of slurry, lb/gal

Limestone Solids Flow Rate, lb/hr = limestone slurry flow rate, lb/hr \* %total solids

**Table 2: Gypsum Solids Flow Rate Calculation**

Date	Gypsum Slurry Flow to Centrifuge, gpm	Gypsum Slurry Flow Out of Centrifuge, gpm	Net Gypsum Slurry Flow, gpm	Specific Gravity of Gypsum Slurry	Specific Gravity of Water	Density of Slurry (lb/gal)	Density of Water (lb/gal)	Gypsum Slurry Flow, lb/hr	Total Solids Slurry Content, % by wt	Gypsum Solids Flow Rate, lb/hr
7-Aug	1055.10	999.48	55.62	1.056	2.3	1.360	8.33	37,797	41.29%	15,606
8-Aug	1062.73	1014.25	48.48	1.056	2.3	1.410	8.33	34,175	46.46%	15,878
9-Aug	1094.02	1025.52	68.50	1.056	2.3	1.297	8.33	44,409	34.37%	15,263

Net Gypsum Slurry Flow Rate, gpm = Gypsum Slurry Flow to Centrifuges, gpm - Gypsum Slurry Flow Out of Centrifuges, gpm

Specific Gravity (SG) of Slurry = SG of Slurry Liquid / (1 - %Slurry Solids/100) (SG of Solids - SG of Slurry Liquid) / (SG of Solids)

Density of Slurry (lb/gal) = specific gravity of gypsum slurry \* density of water (lb/gal)

Gypsum Slurry Flow, lb/hr = gypsum slurry flow, gpm \* 60 min/hr \* density of slurry, lb/gal

Gypsum Solids Flow Rate, lb/hr = gypsum slurry flow rate, lb/hr \* %total solids

**Table 3: FGD Sludge Flow Rate Calculation**

Operational Period (Date)	FGD Sludge Prod., tons (per Op. Per.)	Sludge Moisture %	FGD Sludge Prod., tons (dry)	FGD Sludge Prod., lb/hr (dry)	Unit 1 Net MW	Unit 2 Net MW	% of Unit 2 MW / Total	Corrected FGD Sludge Flow, lb/hr (dry)
8/7 to 8/8	48	13.25	63	4.90	204.3	137.73	52.0	106.23 [For Unit 2 Only]

FGD Sludge Prod., dry = FGD Sludge Prod., wet \* (1 - Sludge Moisture)

FGD Sludge Prod., lb/hr (dry) = FGD Sludge Prod., tons (dry) \* 2000 lb/ton / Operation Period, hrs

% of Unit 2 MW/Total Output = Unit 2 Net MW / (Unit 1 + Unit 2 Net MW)

Corrected FGD Sludge Flow, lb/hr (dry) = FGD Sludge Flow, lb/hr (dry) \* % Unit 2 MW to Total



**FGD LIQUID PROCESS STREAM FLOW RATE CALCULATIONS  
AND SOLIDS CONTENT FLOW RATE CALCULATIONS  
NYSEG MILLIKEN UNIT POST-RETROFIT TEST PROGRAM**

**Table 1: PWRF Outlet to ABS Module Flow Rate Calculation & Solids Flow**

Date	PWRF Outlet to ABS Module, gpm	Unit 1 Net MW	Unit 2 Net MW	% of Unit 2 MW / Total Output	Corrected PWRF Outlet Flow, gpm	Corrected PWRF Outlet Flow, L/hr	PWRF Outlet TDS/TSS, mg/L	PWRF Outlet Solids Flow, lb/hr
7-Aug	558.01	138.22	148.87	51.9	289.36	65,713	260	38
8-Aug	528.76	137.23	149.60	52.2	275.78	62,630	250	34
9-Aug	553.07	104.39	149.08	58.8	325.29	73,874	260	42

[For Unit2 Only]

Note: Liquid flow rates for PWRF output to ABS Module process water holding tank not used;

process water holding tank pump discharge to ABS Module flow rates used instead.

% of Unit 2 MW/Total Output = Unit 2 Net MW / (Unit 1 + Unit 2 Net MW)

Corrected PWRF Outlet Flow, gpm = PWRF Outlet to ABS Module, gpm \* % Unit 2 MW to Total

PWRF Outlet Solids Flow, lb/hr = PWRF Outlet Flow, gpm \* 3.785 L/gal \* 60 min/hr \* PWRF Outlet TDS/TSS, mg/L / 454000mg/lb

**Table 2: Brine Product Flow Rate Calculation & Solids Flow**

Date	Brine Product Flow to PWRF, gpm	Brine Product Flow to Con- centrator, gpm	Total Brine Product Flow, gpm	Unit 1 Net MW	Unit 2 Net MW	% of Unit 2 MW / Total Output	Corrected Brine Product Flow, gpm	Corrected Brine Product Flow, L/hr	Brine Product Total Solids mg/L	Brine Product Solids Flow, lb/hr
7-Aug	17.26	0.00	17.26	138.22	148.87	51.9	8.95	2,033	44,000	197
8-Aug	13.98	0.00	13.98	137.23	149.60	52.2	7.29	1,656	41,000	150
9-Aug	11.61	0.00	11.61	104.39	149.08	58.8	6.83	1,551	43,000	147

[For Unit2 Only]

Note: Even though the Brine Concentrator was not in operation during this test program, Brine Product was diverted to it for diagnostic testing purposes.

No Flow: No substantial Brine Product flow was documented on August 9th, therefore an average of the previous two days was used instead.

Total Brine Product Flow = Brine Product Flow to PWRF + Brine Product Flow to Concentrator

10/1 hr (FGD  
aver)

Flow  
10/1 hr

DEP

DASH

ABS FLOW DENSITY  
FIT28720 DT28711 FIT28478 DT28700 LIT38615 FIT28391 FT37812 FT27812 O045X037

DATE  
08/07/96

TIME	FIT28720 HRLY AVG	DT28711 HRLY AVG	FIT28478 HRLY AVG	DT28700 HRLY AVG	LIT38615 HRLY AVG	FIT28391 HRLY AVG	FT37812 HRLY AVG	FT27812 HRLY AVG	O045X037 HRLY AVG
06:00:01 AM	23.69	40.78	1076.69	39.13	6.45	659.71	183.37	4.57	4635.15
07:00:01 AM	24.85	40.87	1072.75	38.78	3.93	659.51	184.46	5.53	4810.76
08:00:01 AM *	26.06	40.96	1073.07	38.09	2.42	527.00	192.01	4.20	4947.01
09:00:01 AM	29.50	40.99	1068.02	39.26	2.93	353.30	215.13	5.50	4993.30
10:00:01 AM	41.05	40.99	1069.54	41.29	3.26	344.08	415.73	4.86	5184.51
11:00:01 AM	41.54	40.97	1063.73	42.13	4.63	454.78	433.25	5.04	5063.84
12:00:01 PM	28.22	40.89	1057.30	42.66	5.83	658.37	275.70	5.15	5090.20
01:00:01 PM	12.00	40.81	1049.70	44.00	6.90	646.56	262.58	6.03	5068.77
02:00:01 PM	9.01	40.84	1048.15	41.67	7.74	704.42	260.59	5.98	4957.42
03:00:01 PM	23.47	40.78	1040.65	41.10	7.31	698.92	236.38	4.86	5011.87
04:00:01 PM	24.64	40.77	1037.26	42.37	7.45	653.82	206.71	4.36	4917.12
05:00:01 PM *	14.75	40.71	1040.84	41.44	8.69	656.68	246.99	8.89	4890.23
06:00:01 PM	28.42	40.79	1038.85	41.84	9.41	657.16	244.97	5.50	4797.58
07:00:01 PM	23.65	40.77	1034.80	42.89	9.36	652.48	250.93	6.40	4728.13
08:00:01 PM	25.31	40.78	1033.20	42.65	9.55	654.87	251.05	5.99	4790.35

[Not  
used]

41.29

[Data  
Not  
Taken  
From  
Here]

40.85

28.37

PPMS

5012.43

PPM = 1573.2

- ① Time period ~~not~~ unit data averaged over.
  - ② Time period FGD data averaged over due to batch cycle operation
- + considered data outliers and not included in daily average



LUG- AK (A) TEND IP Fan Amps 68ACV Rad-Jar boi 0~ PLDOK 100

DATE	TI5209	TI5212	IT5303	IT5304	FI270	AT5709	FI271	AI250	O045X036
TIME	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG
06:00:01 AM	302.48	295.41	154.41	151.54	1058.05	6.26	1001.74	3.26	311.28
07:00:01 AM	303.28	295.35	156.54	153.08	1100.35	6.68	1042.73	3.34	320.54
08:00:01 AM *	302.65	294.53	158.31	154.80	1100.74	7.57	1047.33	3.25	323.33
09:00:01 AM	297.84	296.19	158.92	154.89	1094.87	7.29	1032.78	3.28	323.61
10:00:01 AM	300.90	297.95	157.43	153.57	1101.75	6.67	1052.14	3.31	321.83
11:00:01 AM	304.30	299.46	156.66	152.52	1085.49	6.54	1047.04	3.29	317.09
12:00:01 PM	306.23	297.17	157.17	153.81	1094.58	6.22	1040.80	3.32	318.74
01:00:01 PM	305.91	293.39	155.77	153.60	1089.86	5.82	1031.16	3.30	319.88
02:00:01 PM	307.63	299.66	156.48	153.68	1101.89	5.05	1042.62	3.27	319.95
03:00:01 PM	306.90	298.74	157.01	153.70	1106.92	4.39	1068.01	3.33	319.19
04:00:01 PM	303.00	299.21	157.07	152.80	1102.07	4.35	1048.03	3.31	317.50
05:00:01 PM *	304.71	299.93	157.87	153.44	1101.03	4.22	1033.36	3.34	315.82
06:00:01 PM	307.29	298.88	156.44	152.86	1094.76	4.39	1036.61	3.29	314.18
07:00:01 PM	307.07	297.27	154.68	151.12	1079.27	4.92	1009.52	3.25	314.05
08:00:01 PM	307.79	296.77	154.28	151.56	1076.81	5.35	1008.87	3.32	314.64

306.82  
 5.81 1044.33 3.30 319.69

58, 106, 16, 15

DATE	AI128766	FT38643	FT215AC	FT215BC	FT251AC	FT251BC	PRCP1021	PRCP1024	PRCP1028
TIME	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG
06:00:01 AM	336.04	0.19	98.76	105.96	537.07	519.70	27.84	195.73	118.11
07:00:01 AM	No good d	0.21	98.93	106.24	550.66	530.05	27.71	194.35	116.12
08:00:01 AM	398.56	19.77	99.18	105.72	559.13	542.18	27.59	190.62	117.41
09:00:01 AM	No good d	29.02	98.72	105.21	556.02	537.91	27.46	185.72	115.24
10:00:01 AM	No good d	28.30	99.23	105.02	553.82	530.19	27.33	180.82	113.08
11:00:01 AM	386.96	17.73	98.39	104.79	553.47	528.72	27.21	175.92	110.91
12:00:01 PM	399.15	10.41	98.93	104.48	551.52	529.25	27.08	171.02	108.74
01:00:01 PM	396.79	23.20	97.98	104.61	548.54	527.41	26.96	183.34	106.57
02:00:01 PM	398.19	25.42	97.14	105.11	553.35	531.80	26.83	187.44	105.43
03:00:01 PM	No good d	25.16	97.28	104.93	555.28	534.58	26.70	184.98	106.61
04:00:01 PM	No good d	24.76	96.99	104.48	557.54	535.78	26.58	182.51	107.88
05:00:01 PM	No good d	24.65	96.72	104.97	555.94	535.13	26.45	180.04	109.15
06:00:01 PM	No good d	20.41	96.78	104.54	553.62	530.81	26.32	177.58	110.43
07:00:01 PM	No good d	2.53	96.28	104.08	544.84	522.95	26.19	175.11	111.70
08:00:01 PM	No good d	2.27	97.20	103.31	546.41	526.21	26.07	172.64	112.97

TMM: 1087.76

ESP Round Levels

DATE TIME	08/07/96	PRCP1031 HRLY AVG	PRCP1035 HRLY AVG	PRCP1038 HRLY AVG	PRCP1000 HRLY AVG	PRCP1003 HRLY AVG	PRCP1007 HRLY AVG	PRCP1010 HRLY AVG	PRCP1015 HRLY AVG	PRCP1017 HRLY AVG
06:00:01 AM	511.65	123.49	663.90	43.18	258.74	108.36	609.38	125.61	684.41	
07:00:01 AM	524.06	123.61	668.13	42.80	282.20	107.85	579.15	125.19	689.37	
08:00:01 AM	503.85	123.74	659.36	42.41	257.88	107.35	563.93	123.09	681.95	
09:00:01 AM	500.61	123.86	658.96	42.03	255.05	106.84	566.27	120.96	674.10	
10:00:01 AM	501.59	123.54	666.69	41.65	255.91	106.34	570.53	118.83	666.25	
11:00:01 AM	497.68	118.10	639.27	41.27	257.27	105.83	575.19	116.70	670.18	
12:00:01 PM	493.71	111.23	653.75	40.89	272.64	105.33	592.07	114.57	693.26	
01:00:01 PM	506.09	111.67	658.89	40.50	266.14	104.64	589.96	112.44	674.33	
02:00:01 PM	489.74	119.42	661.57	40.12	244.76	103.65	550.44	110.32	663.20	
03:00:01 PM	497.01	118.69	651.87	39.74	241.96	102.65	536.71	109.59	656.44	
04:00:01 PM	476.87	117.67	674.26	39.36	239.16	101.65	538.85	111.07	661.78	
05:00:01 PM	466.31	116.64	656.65	38.98	236.36	100.65	542.64	112.58	665.85	
06:00:01 PM	470.44	115.62	648.62	38.60	233.56	99.64	540.30	114.09	669.53	
07:00:01 PM	467.26	114.59	637.84	38.21	230.81	98.64	543.90	115.60	679.45	
08:00:01 PM	476.88	113.57	632.99	40.60	229.48	97.64	543.63	117.11	654.61	

DATE	ABS now	DE N	CRASH	DE N	STUCK LOW	FIT 28391	FT 37812	FT 27812	O045X037
TIME	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG
06:00:01 AM	23.86	37.59	1069.44	38.24	11.61	660.11	297.15	6.15	3724.02
07:00:01 AM	33.10	37.54	1077.60	40.81	11.66	651.61	232.65	4.54	4826.73
08:00:01 AM	30.44 *	37.57	1072.99	43.11	11.94	643.24	246.03	6.83	4946.99
09:00:01 AM	29.86	37.56	1067.86	44.54	9.35	642.83	229.15	6.88	4995.01
10:00:01 AM	30.44	37.62	1063.03	45.94	9.00	642.26	232.94	7.99	4919.58
11:00:01 AM	36.61	37.68	1060.03	47.34	9.38	639.41	226.07	5.27	4975.61
12:00:01 PM	40.94	37.71	1060.22	48.72	8.62	640.12	217.47	5.03	5103.61
01:00:01 PM	43.80	37.66	1052.93	50.15	9.17	640.66	248.10	6.28	4939.88
02:00:01 PM	37.29	37.68	1054.75	50.21	10.05	701.97	253.90	8.22	4934.33
03:00:01 PM	29.13	37.66	1052.87	49.13	10.45	667.56	257.25	6.15	5062.35
04:00:01 PM	16.19	37.63	1057.03	48.74	9.78	674.11	256.00	5.09	5025.58
05:00:01 PM	22.34	37.66	1060.05	48.50	10.70	675.30	250.86	4.45	4986.33
06:00:01 PM	32.46	37.70	1063.09	47.79	11.59	673.50	248.81	5.98	4969.27
07:00:01 PM	39.08	37.67	1066.39	47.11	11.81	672.28	254.26	5.63	5058.11
08:00:01 PM	36.86	37.74	1069.50	46.59	10.87	673.93	240.94	4.49	5008.48
AUG:	32.16	37.64		46.46	NOT USED				4,988.93
									PM = 1555.8

① > See notes for 8/7/96

②

Alt 6000 12m

Temp

% of 60

Flow

Net, MW

Gross, MW

G-PPS<sup>500</sup> Basket Count's

DATE	T4155101	T4155102	WT202	WT200	FI270	TOTFUEL	TI270	TI5207	TI5208
TIME	TOT HOUR	TOT HOUR	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG
08/08/96									
06:00:01 AM	2.27	1.08	112.31	104.29	775.12	63.59	983.69	623.00	614.21
07:00:01 AM	2.37	1.08	155.13	144.60	1061.68	78.56	1004.89	663.61	655.00
08:00:01 AM	0.53	0.24	160.36	*149.69	1102.44	*86.18	1004.71	670.99	661.73
09:00:01 AM	-0.00	-0.00	159.68	149.82	1111.08	84.31	1004.74	670.64	662.01
10:00:01 AM	-0.00	-0.00	159.29	150.38	1113.67	85.39	1004.19	667.42	661.18
11:00:01 AM	-0.00	-0.00	160.28	150.29	1113.57	89.36	1005.53	661.09	659.08
12:00:01 PM	-0.00	-0.00	159.43	149.09	1108.31	90.09	1005.12	660.03	656.52
01:00:01 PM	-0.00	-0.00	159.73	150.12	1107.01	90.08	1004.75	660.31	658.45
02:00:01 PM	-0.00	0.00	160.35	150.84	1114.07	90.30	1004.81	662.49	660.86
03:00:01 PM	0.05	0.09	158.64	149.16	1094.44	89.17	1005.11	663.08	661.32
04:00:01 PM	0.19	0.22	158.01	148.56	1092.58	*88.77	1005.05	663.85	661.71
05:00:01 PM	0.32	0.35	158.05	*148.07	1089.10	88.22	1004.91	663.93	660.93
06:00:01 PM	0.46	0.49	157.57	147.84	1083.14	88.55	1004.33	662.94	660.55
07:00:01 PM	0.59	0.61	156.34	146.68	1071.71	88.81	1004.64	658.88	657.73
08:00:01 PM	0.71	0.73	152.05	142.73	1041.53	79.91	1005.12	657.08	655.77
					1104.63		1064.84		662.30

28.18%

52.99 tph = 105,820 lb/hr

(DATA NOT USED)

Time Period: 800/1800

Avg: 159.38 149.60



DATE	TIME	VI	GA	mk	TA	W	PS	QA	1	2d	3d	02	0045X036
		TI5209	TI5212	IT5303	IT5304	FI270	AT5709	FI271	AI250	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG
08/08/96	06:00:01 AM	291.94	297.97	134.52	131.94	775.12	5.38	742.92	4.19	249.19			
	07:00:01 AM	301.90	295.02	154.88	150.10	1061.68	5.77	999.12	3.21	310.29			
	08:00:01 AM	303.00	295.64	159.36	153.85	1102.44	5.95	1031.18	3.28	319.75			
	09:00:01 AM	300.88	296.17	160.23	155.37	1111.08	5.69	1041.12	3.34	327.01			
	10:00:01 AM	306.85	295.45	158.14	154.62	1113.67	5.82	1046.26	3.27	324.27			
	11:00:01 AM	308.14	295.09	159.27	155.04	1113.57	5.58	1067.95	3.32	323.34			
	12:00:01 PM	306.03	296.69	158.55	154.47	1108.31	5.73	1056.61	3.29	322.44			
	01:00:01 PM	304.42	294.95	158.44	154.81	1107.01	5.04	1050.04	3.28	321.67			
	02:00:01 PM	303.42	294.02	158.63	154.59	1114.07	5.44	1054.75	3.27	320.93			
	03:00:01 PM	300.70	294.01	158.87	153.74	1094.44	5.85	1031.05	3.31	320.19			
	04:00:01 PM	299.09	294.00	157.96	152.62	1092.58	6.13	1020.61	3.26	319.45			
	05:00:01 PM	302.20	293.07	158.71	152.66	1089.10	6.14	1022.39	3.32	318.52			
	06:00:01 PM	303.27	291.87	155.77	152.59	1083.14	6.60	1018.18	3.35	316.81			
	07:00:01 PM	300.90	292.91	154.37	152.39	1071.71	6.60	1008.25	3.27	311.93			
	08:00:01 PM	297.92	294.25	152.45	150.42	1041.53	6.65	987.74	3.30	310.72			
							5.74	1042.20	3.29	321.74			

299.19

FD 1442

Total: 1,104.11

ES Loc 2 V8

DATE TIME	08/08/96	PRCP1031 HRLY AVG	PRCP1035 HRLY AVG	PRCP1038 HRLY AVG	PRCP1000 HRLY AVG	PRCP1003 HRLY AVG	PRCP1007 HRLY AVG	PRCP1010 HRLY AVG	PRCP1015 HRLY AVG	PRCP1017 HRLY AVG
06:00:01 AM		556.99	122.72	688.00	45.04	289.68	108.30	607.95	124.73	702.48
07:00:01 AM		487.00	120.11	670.55	44.31	235.27	107.42	558.21	124.95	702.73
08:00:01 AM		477.10	117.49	668.77	43.80	242.83	106.54	551.51	124.82	697.58
09:00:01 AM		493.50	114.87	668.00	43.30	227.43	105.67	555.02	124.70	673.92
10:00:01 AM		480.48	112.26	654.35	42.79	233.34	104.79	546.85	124.57	673.71
11:00:01 AM		462.74	109.64	649.53	42.29	242.66	103.91	531.20	124.45	673.50
12:00:01 PM		483.59	107.07	647.04	41.78	251.74	103.03	564.52	124.32	673.29
01:00:01 PM		495.32	109.46	661.12	41.28	260.71	102.32	571.00	124.20	672.12
02:00:01 PM		485.90	115.19	675.90	42.70	271.14	103.99	577.68	124.07	671.36
03:00:01 PM		496.28	118.71	665.85	46.60	286.02	106.41	584.91	124.26	672.42
04:00:01 PM		494.53	120.09	662.92	50.51	301.20	108.84	592.17	124.77	670.78
05:00:01 PM		504.99	121.47	666.74	54.42	300.87	111.26	599.44	125.27	674.70
06:00:01 PM		494.16	122.85	675.03	58.33	277.81	113.69	606.70	125.78	678.62
07:00:01 PM		516.82	124.23	675.49	62.23	263.02	116.11	613.96	126.29	682.57
08:00:01 PM		574.43	125.61	688.66	66.14	317.96	118.54	636.24	126.79	686.53

502, 1000  
FOP Direct

Flow  
Flow

Flow  
Flow

Flow  
Flow

Flow  
Flow

Flow  
Flow

Flow  
Flow

Flow  
Flow

DATE	TIME	FIT28720	DT28711	FIT28478	DT28700	LIT38615	FIT28391	FT37812	FT27812	O045X037
08/09/96	06:00:01 AM	30.46	35.68	1075.32	28.10	11.65	522.55	311.98	4.60	3705.41
	07:00:01 AM	62.24	35.68	1080.11	28.36	11.66	368.19	260.65	4.82	4963.58
	08:00:01 AM	70.92	35.70	1102.27	33.88	over range	569.91	278.66	5.95	5066.37
	09:00:01 AM	49.59	35.69	1106.31	35.60	over range	655.51	264.79	5.54	5137.46
	10:00:01 AM	10.23	35.60	1102.24	35.67	over range	655.40	257.46	6.95	5214.49
	11:00:01 AM	3.53	35.76	1099.49	35.29	over range	656.96	268.72	7.38	5282.64
	12:00:01 PM	12.56	35.61	1101.61	35.45	over range	654.70	261.12	4.36	5230.54
	01:00:01 PM	29.32	35.62	1099.03	35.40	over range	658.36	247.76	5.27	5267.46
	02:00:01 PM	34.47	35.57	1091.81	36.44	over range	661.67	248.85	4.29	5279.46
	03:00:01 PM	34.15	35.60	1090.99	36.70	over range	657.61	241.21	5.10	5257.29
	04:00:01 PM	32.42	35.58	1084.59	37.20	over range	657.12	241.97	5.40	5193.14
	05:00:01 PM	33.22	36.11	832.73	38.44	over range	658.12	223.42	6.27	5156.73
	06:00:01 PM	22.94	36.73	63.45	50.13	over range	551.34	225.11	7.00	4870.13
	07:00:01 PM	15.79	36.72	313.54	50.30	over range	730.49	223.29	6.98	3704.06
	08:00:01 PM	18.90	36.74	666.69	50.29	over range	729.24	207.16	4.84	3248.43

[NOT USED]

AVGS:

5,214.32

34.37

35.64

32.16

PPM = 1604.6

① See notes on 8/7/96

②

+

LUG-Air Gas Temps			ID Fan Amps		OPACITY		Fees- water		boiler or		Flow	
DATE	TI5209	TI5212	IT5303	IT5304	FI270	AT5709	FI271	AI250	O045X036			
TIME	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG			
08/09/96												
06:00:01 AM	278.81	306.01	136.69	135.13	787.32	4.38	747.73	4.16	258.56			
07:00:01 AM	292.42	294.69	154.01	151.07	1066.03	5.07	998.07	3.26	314.84			
08:00:01 AM *	294.67	291.82	156.88	153.98	1092.30	6.61	1020.33	3.27	322.91			
09:00:01 AM	293.12	293.67	156.80	155.18	1096.71	6.72	1026.70	3.32	324.60			
10:00:01 AM	295.62	295.27	158.02	155.49	1110.79	6.93	1042.82	3.28	325.06			
11:00:01 AM	297.64	293.09	156.72	154.35	1098.91	6.70	1051.53	3.29	325.66			
12:00:01 PM	297.58	292.29	156.29	154.78	1099.01	5.80	1036.66	3.23	327.02			
01:00:01 PM	298.69	291.35	156.73	154.69	1104.60	6.32	1040.24	3.23	328.49			
02:00:01 PM	299.05	294.47	157.59	156.29	1096.06	5.16	1039.20	3.33	329.70			
03:00:01 PM	297.99	294.80	157.54	155.14	1103.71	4.57	1036.29	3.36	327.32			
04:00:01 PM *	298.36	292.56	158.08	156.54	1089.67	4.35	1031.86	3.25	323.79			
05:00:01 PM	297.45	293.51	154.79	151.86	1066.37	4.08	1010.62	3.30	313.68			
06:00:01 PM	289.83	290.67	143.67	143.70	970.33	3.29	930.78	3.33	287.56			
07:00:01 PM	279.69	284.84	125.77	128.56	698.75	2.91	684.09	4.43	230.06			
08:00:01 PM	272.43	294.58	122.41	124.49	630.34	3.22	605.17	4.81	208.99			

295.11

5.911636.193.28326.06

5.91 1636.18 3.28 326.06

295.11

... T C T P S

100  
1000

WT202

WT200

WT202

WT202

WT202

WT202

DATE	TIME	T4155101	T4155102	TOT HOUR	WT202	WT202	WT200	FI270	TOT FUEL	TI270	TI5207	TI5208
08/09/96	06:00:01 AM	1.91	1.93	117.15	108.71	787.32	60.93	1003.63	623.25	620.41		
	07:00:01 AM	2.03	2.06	154.55	145.33	1066.03	62.51	1004.34	657.92	653.54		
	08:00:01 AM	0.03	0.09	157.45	147.85	1092.30	* 75.59	1004.72	663.01	658.86		
	09:00:01 AM	-0.00	0.20	157.94	148.34	1096.71	86.94	1005.22	663.66	660.43		
	10:00:01 AM	-0.00	0.34	160.81	150.86	1110.79	79.08	1004.20	663.79	659.96		
	11:00:01 AM	-0.00	0.48	158.52	149.42	1098.91	71.02	1005.00	660.77	657.06		
	12:00:01 PM	-0.00	0.61	157.94	148.33	1099.01	81.17	1005.20	661.33	658.56		
	01:00:01 PM	-0.00	0.76	159.47	149.88	1104.60	65.69	1004.59	661.58	660.21		
	02:00:01 PM	-0.00	0.89	158.46	148.46	1096.06	54.94	1005.14	660.93	659.07		
	03:00:01 PM	-0.00	1.03	159.32	149.60	1103.71	* 51.40	1005.16	661.24	658.29		
	04:00:01 PM	-0.00	1.17	159.37	148.99	1089.67	52.25	1005.29	663.18	660.23		
	05:00:01 PM	-0.00	1.31	155.64	144.52	1066.37	55.76	1004.81	659.76	657.61		
	06:00:01 PM	-0.00	1.33	142.31	133.02	970.33	60.35	1004.25	646.68	645.33		
	07:00:01 PM	-0.00	1.42	103.87	95.42	698.75	51.59	977.04	614.34	614.45		
	08:00:01 PM	-0.00	1.56	90.28	82.68	630.34	53.94	947.05	597.32	596.43		

1099.08 70.73% 1004.95

660.68

42.44 tph

Time period:

900/1700

(DATA NOT USED)

Aug 5: 158.81 149.08

**QUALITY ASSURANCE/QUALITY CONTROL RESULTS  
EPA METHOD 29 AND FRONTIER GEOSCIENCE METHODS**

Test Number	Train Fraction	Matrix Spike Analysis		Duplicate Analysis		
		Matrix Spike Recovery, %	Matrix Spike Duplicate Recovery, %	First	Second	Relative Difference, %
				Run	Run	
				ug/fraction		
I-MTLS-OUT	Front-Half	110	110	ND(0.090)	ND(0.090)	NC
	Back-Half	90	89	29	30	3.4
	MKO	85	85	4.8	4.7	2.1
	KMnO <sub>4</sub> /HCl	100	100	6.3	6.1	
I-MTLS-STK	Front-Half	120	120	ND(0.030)	ND(0.030)	NC
	Back-Half	100	110	2.9	2.9	0.0
	MKO	110	100	0.056	0.046	19.6
	KMnO <sub>4</sub> /HCl	100	100	15	14	6.9
MESA	Hg(0)	108	101	--	--	124
	Hg(II)	97	107	--	--	4.6

**RAW FIELD BLANK LABORATORY DATA**

Test Method	Train Fraction	FB-MTLS-OUT	2FB-MTLS-OUT	FB-MTLS-STK	2FB-MTLS-STK
		ug/train			
Method 29	Front-Half	ND<0.030	ND<0.030	ND<0.030	0.032
	Back-Half	ND<0.19	ND<0.19	ND<0.20	ND<0.20
	MKO	ND<0.010	ND<0.010	ND<0.010	ND<0.010
	KMnO <sub>4</sub> /HCl	ND<0.063	0.10	0.22	0.092

**RAW TRIP BLANK LABORATORY DATA**

Test Method	Train	Trip Blank 1	Trip Blank 2	
	Fraction	ng/train		
MESA	Hg(0)	0.362	0.56	
	Hg(II)	1.23	3.26	
	Quartz Wool/	2.39	0.134	ng/probe
	Probe			

**EPA METHOD 29 MERCURY EMISSION RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM – FGD OUTLET/STACK**  
**AUGUST 1996**

Parameter	FGD OUTLET/STACK			
	1-MTLS-STK	2-MTLS-STK	3-MTLS-STK	AVERAGE
<b>Date</b>	8/7/96	8/8/96	8/9/96	
<b>Pitot Flow Rate, dscfm</b>	358,667	358,779	362,692	360,046
<b>Sample Volume, dscf</b>	241.79	253.28	254.55	249.87
<b>Fuel Factor, dscf/10<sup>6</sup>Btu</b>	13,157	13,088	13,328	13,191
<b>O<sub>2</sub>, %</b>	5.66	5.52	5.76	5.65
<b>CO<sub>2</sub>, %</b>	13.81	13.57	13.67	13.68
<b>H<sub>2</sub>O, %</b>	14.4	14.8	14.3	14.5
<b><u>Hg(0) - elemental (KMnO<sub>4</sub>/HCl)</u></b>				
ug/sample	14.5	18.0	15.0	15.8
ug/dscm	2.12	2.51	2.08	2.24
ug/Nm <sup>3</sup>	2.27	2.69	2.23	2.40
lb/hr	0.003	0.003	0.003	0.003
lb/10 <sup>12</sup> Btu	1.74	2.05	1.73	1.84
<b><u>Hg(II) - oxidized (HNO<sub>3</sub>/H<sub>2</sub>O<sub>2</sub>)</u></b>				
ug/sample	3.0	3.7	5.5	4.1
ug/dscm	0.43	0.52	0.77	0.57
ug/Nm <sup>3</sup>	0.46	0.56	0.82	0.61
lb/hr	0.001	0.001	0.001	0.001
lb/10 <sup>12</sup> Btu	0.35	0.42	0.64	0.47
<b><u>Hg(total) - (Front 1/2 Solids)</u></b>				
ug/sample	ND< 0.030	ND< 0.030	0.10	0.043
ug/dscm	ND< 0.004	ND< 0.004	0.01	0.006
ug/Nm <sup>3</sup>	ND< 0.005	ND< 0.004	0.01	0.006
lb/hr	ND< 5.9E-06	ND< 5.6E-06	1.9E-05	8.2E-06
lb/10 <sup>12</sup> Btu	ND< 0.004	ND< 0.003	0.01	0.005
<b><u>Total Mercury</u></b>				
ug/sample	17.5	21.7	20.6	19.9
ug/dscm	2.55	3.03	2.86	2.81
ug/Nm <sup>3</sup>	2.74	3.25	3.07	3.02
lb/hr	0.003	0.004	0.004	0.004
lb/10 <sup>12</sup> Btu	2.09	2.47	2.38	2.31





5555 North Service Road  
Burlington, Ontario, Canada L7L 5H7  
Tel: (905) 332-8788  
Fax: (905) 332-9169

## Certificate of Analysis

### CLIENT INFORMATION

Attention: Marc Rodabaugh  
Client Name: Carnot  
Project: 11476  
Project Desc: NYSEG

Address: 110-15991 Red Hill Avenue  
Tustin, CA  
92680-7388

Fax Number: 714-259-0372  
Phone Number: 714-259-9520

### LABORATORY INFORMATION

Contact: Ron McLeod  
Project: AN960690  
Date Received: 96/08/15  
Date Reported: 96/09/16

Submission No.: 6H0748  
Sample No.: 033692-033712

### NOTES:

'-' = not analysed '<' = less than Method Detection Limit (MDL) 'NA' = no data available  
LOQ can be determined for all analytes by multiplying the appropriate MDL X 3.33  
Solids data is based on dry weight except for biota analyses.  
Organic analyses are not corrected for extraction recovery standards except for isotope  
dilution methods, (i.e. CARB 429 PAH, all PCDD/F and DBD/DBF analyses)

Methods used by Zenon are based upon those found in 'Standard Methods for the Examination of Water and Wastewater', Seventeenth Edition. Other methods are based on the principles of MISA or EPA methodologies.

All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies, quality assurance and quality control procedures except where otherwise agreed to by the client and testing company in writing. Any and all use of these test results shall be limited to the actual cost of the pertinent analysis done. There is no other warranty expressed or implied. Your samples will be retained at Zenon for a period of three weeks from receipt of data or as per contract.

### COMMENTS:

M29 Hg FH

Certified by:

Page 1

Component	MDL	Units	1M-IN PR	2M-IN PR	3M-IN PR	3M-IN PR	3M-IN PR
			Solids	Solids	Solids	Solids	Solids
Client ID:			033668 96	033669 96	033670 96	033670 96	033670 96
Zenon ID:			96/08/07	96/08/08	96/08/09	96/08/09	96/08/09
Date Sampled:							
						Duplicate	M. Spike
Probe Rinse Residue	0.1	mg	29.42	36.57	33.68	-	-
Metals via EPA Method 29(gfaa)							
Antimony	0.60	"	106	116	127	-	-
Arsenic	0.60	ug	2540	2770	2500	-	-
Beryllium	0.060	"	45.0	134	87.4	-	-
Cadmium	0.03	"	18.2	17.2	18.1	-	-
Lead	0.30	"	1510	1680	1780	-	-
Selenium (gfaa)	0.6	"	65.3	70.2	58.6	-	-
Mercury via SW846 Method 7421							
Mercury	0.030	"	325	325	277	277	27.0
Metals via Method 29 (ICP)			3.37*	2.76*	2.35*		
Aluminum	9.0	ug	3280000	3880000	3780000	-	-
Barium	0.30	"	24900	27900	26000	-	-
Beryllium	0.15	"	263	310	273	-	-
Calcium	30.0	"	1010000	1450000	1260000	-	-
Cobalt	3.0	"	1130	1450	1360	-	-
Chromium	1.20	"	3350	3910	3870	-	-
Copper	1.8	"	2270	2800	2600	-	-
Iron	3.0	"	2820000	4060000	3340000	-	-
Potassium	300.0	"	424000	537000	530000	-	-
Magnesium	15.0	"	163000	245000	205000	-	-
Manganese	1.8	"	6400	8410	7520	-	-
Molybdenum	3.0	"	448	479	442	-	-
Sodium	30.0	"	193000	218000	204000	-	-
Nickel	6.0	"	2540	3130	2860	-	-
Phosphorus	18.0	"	79300	92300	102000	-	-
Titanium	6.0	"	167000	202000	191000	-	-
Vanadium	1.5	"	5570	6480	6150	-	-

\*

Adjustment Factors = 1.005 0.822 0.856

These Ash correction factors are based on ash mass balance results and were applied to the solids catch amounts of the ESP inlet sample trains to correct a severe high bias associated with the solid catch amounts of Runs 2 and 3.

Page 2 of 6

Mercury	0.030	ug
---------	-------	----

	IM-IN F.H.	2M-IN F.H.	3M-IN F.H.	FB-M-OUT	2FB M-OUT	IM-OUT F.H.	IM-OUT F.H.	IM-OUT F.H.	IM-OUT F.H.	IM-OUT F.H.	1M-OUT F.H.
033692 96	033692 96	033693 96	033694 96	033695 96	033696 96	033697 96	033697 96	033697 96	033697 96	033697 96	033697 96
96/08/07	96/08/07	96/08/08	96/08/09	96/08/06	96/08/12	96/08/07	96/08/07	96/08/07	96/08/07	96/08/07	96/08/07
						Duplicate	M. Spike	MS % Rec.	MS Dup	MSD % Rec.	
	<	1.0	<	<	<	<0.090	0.94	110	0.94	110	

Client: Carnot Project: 11476

**Zenon Environmental Laboratories - Certificate of Analysis**

9/16/96

Client ID:		Zenon ID:		Date Sampled:		Component	MDL	Units
						Mercury	0.030	ug
2M-OUT	F.H.	033700	96	96/08/08	<			
3M-OUT	F.H.	033701	96	96/08/09	<			
FB-M-STK	F.H.	033702	96	96/08/06	<			
2FB-M-OUT	F.H.	033703	96	96/08/12	0.032			
IM-STK	F.H.	033704	96	96/08/07	<			
IM-STK	F.H.	033704	96	96/08/07	Duplicate			
IM-STK	F.H.	033704	96	96/08/07	M. Spike	1.0		
IM-STK	F.H.	033704	96	96/08/07	MS % Rec.	120		
IM-STK	F.H.	033704	96	96/08/07	MS Dup	1.0		
IM-STK	F.H.	033704	96	96/08/07	MSD % Rec.	120		

Client: Cannot Project: 11476

9/16/96

**Zenon Environmental Laboratories - Certificate of Analysis**

Page 4 of 6

**Client ID:**

**Zenon ID:**

**Date Sampled:**

**Component MDL Units**

2M-STK	3M-STK	4M-SPK	RB-M-1	RB-M-2	RB-M-3
F.H.	F.H.	F.H.	F.H.	F.H.	F.H.
033707 96	033708 96	033709 96	033710 96	033711 96	033712 96
96/08/08	96/08/09	96/08/09	96/08/07	96/08/08	96/08/09

Mercury	0.030	ug	<	0.10	0.045	<	<	<
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9/16/96

***Zenon Environmental Laboratories - Laboratory Method Blanks*** Page MB-5 of 6

Component	MDL	Units		
Batch Code:			0910ASA1	0910ASA2
Mercury	0.030	ug	<	<

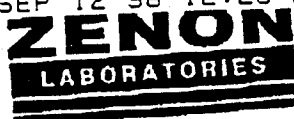
9/16/96

**ZEL Summary of Analysis Pre. Dates**

Page MS-6 of 6

Batch Code:	0910ASA1	0910ASA2
Mercury	033692 96	033704 96
	033693 96	033707 96
	033694 96	033708 96
	033695 96	033709 96
	033696 96	033710 96
	033697 96	033711 96
	033700 96	033712 96
	033701 96	
	033702 96	
	033703 96	
Date analysed	96/09/10	96/09/10
Date prepared	96/09/10	96/09/10

Client: Carnot Project: 11476



## Certificate of Analysis

### CLIENT INFORMATION

Attention: Marc Rodabaugh  
Client Name: Carnot  
Project: 11476  
Project Desc: NYSEG  
  
Address: 110-15991 Red Hill Avenue  
Tustin, CA  
92680-7388  
Fax Number: 714-259-0372  
Phone Number: 714-259-9520

### LABORATORY INFORMATION

Contact: Ron McLeod  
Project: AN960690  
Date Received: 96/08/15  
Date Reported: 96/09/11  
  
Submission No.: 6H0748  
Sample No.: 033713-033776

### NOTES:

'-' = not analysed ' $<$ ' = less than Method Detection Limit (MDL) 'NA' = no data available  
LOQ can be determined for all analytes by multiplying the appropriate MDL X 3.33  
Solids data is based on dry weight except for biota analyses.  
Organic analyses are not corrected for extraction recovery standards except for isotope  
dilution methods, (i.e. CARB 429 PAH, all PCDD/F and DBD/DBF analyses)

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### COMMENTS:

M29 MERCURY  
(NO FH)

Certified by:



# Zenon Environmental Laboratories - Certificate of Analysis

9/11/96

**Client ID:**  
**Zenon ID:**  
**Date Sampled:**  
**MDL Units**

Component	Method	Blank	Spike 1	Blank	Spike 2	Blank	Spike 2	IM-IN	2M-IN	3M-IN	FB-M-OUT
Impinger volume measured	Blank	033713 96	033713 96	033713 96	033713 96	033713 96	033713 96	033714 96	033715 96	033716 96	033717 96
Mercury	96/08/07	96/08/07	96/08/07	96/08/07	96/08/07	96/08/07	96/08/07	96/08/07	96/08/08	96/08/09	96/08/06
		M. Spike	MS % Rec.	MS Dup	MSD % Rec.						
	100	-	-	-	-	610	600	620	390		
	<	0.10	110	0.10	110	26	30	24	<0.19		

***Zenon Environmental Laboratories - Certificate of Analysis***

9/11/96

**Client ID:**

**Zenon ID:**

**Date Sampled:**

### MDL Units

Component

Impinger volume measured

## Mercury

iii

0.010 ug

	2FB-M-OUT	1M-OUT	1M-OUT B.H.	1M-OUT B.H.	1M-OUT B.H.	1M-OUT B.H.	1M-OUT B.H.	2M-OUT B.H.	3M-OUT B.H.
	033718 96	033719 96	033719 96	033719 96	033719 96	033719 96	033719 96	033722 96	033723 96
	96/08/12	96/08/07	96/08/07	96/08/07	96/08/07	96/08/07	96/08/07	96/08/08	96/08/09
		Duplicate	M Snake	MS % Rec.	MS Dup	MSD % Rec.			

MSD % Rec.

MS Dip

MS% Rec.

Ad Smiths

10/07/2006

79.5

**Zenon Environmental Laboratories - Certificate of Analysis**

9/11/96

Client ID:  
Zenon ID:  
Date Sampled:

MDL Units

Component

Impinger volume measured

Mercury

FB-M-STK B.H. 033724 96 96/08/06	2FB-M-STK B.H. 033725 96 96/08/12	IM-STK B.H. 033726 96 96/08/07	IM-STK B.H. 033726 96 96/08/07	IM-STK B.H. 033726 96 96/08/07	IM-STK B.H. 033726 96 96/08/07	IM-STK B.H. 033726 96 96/08/07	IM-STK B.H. 033726 96 96/08/07	2M-STK B.H. 033729 96 96/08/08
400	390	1100	-	-	-	-	-	1300
<0.20	<0.20	2.9	2.9	8.7	100	8.9	110	3.7
			Duplicate	M. Spike	MS % Rec.	MS Dup	MSD % Rec.	

*Zenon Environmental Laboratories - Certificate of Analysis*

9/11/96

Client ID: 3M-STK 4M-SPK RB-M-1 RB-M-2 RB-M-3 1M-IN 2M-IN 3M-IN FBM-OUT  
Zenon ID: B.H. B.H. B.H. B.H. B.H. MKO MKO MKO MKO  
Date Sampled: 033730 96 033731 96 033732 96 033733 96 033734 96 033735 96 033736 96 033738 96  
96/08/09 96/08/09 96/08/07 96/08/08 96/08/09 96/08/07 96/08/08 96/08/06

Component MDL Units

Impinger volume measured

ml

50

Mercury

0.010

ug

5.4

&lt;0.20

&lt;0.20

&lt;0.20

&lt;0.20

0.67

1.1

0.30

&lt;

*Zenon Environmental Laboratories - Certificate of Analysis*

9/11/96

Client ID: 2FB-M-OUT IM-OUT IM-OUT IM-OUT IM-OUT IM-OUT IM-OUT IM-OUT IM-OUT IM-OUT  
 Zenon ID: MKO MKO MKO MKO MKO MKO MKO MKO MKO MKO  
 Date Sampled: 033739 96 033740 96 033740 96 033740 96 033740 96 033740 96 033740 96 033740 96 033740 96 033744 96  
 MDL Units 96/08/12 96/08/07 96/08/07 96/08/07 96/08/07 96/08/07 96/08/07 96/08/07 96/08/07 96/08/08 96/08/09

Component

Impinger volume measured

Mercury

ml 53 110 4.8 4.7 8.5 8.5 8.5 8.5 8.5 48 52  
 ug < 4.8 4.7 8.5 8.5 8.5 8.5 8.5 8.5 1.8 1.2  
 4.75

*Zenon Environmental Laboratories - Certificate of Analysis*

9/11/96

Client ID: IM-STK MKO 033747 96  
 Zenon ID: IM-STK MKO 033747 96  
 Date Sampled: IM-STK MKO 033747 96  
 MDL Units

Component

Impinger volume measured

ml

93

Mercury

0.010 ug

52

<

50

<

0.056

0.046

0.54

110

0.51

100

0.051

Client: Carnot Project: 11476

**Zenon Environmental Laboratories - Certificate of Analysis**

9/11/96

Client ID: 2M-STK 3M-STK 4M-STK RB-M-1 RB-M-2 RB-M-3 1M-IN 2M-IN  
 Zenon ID: MKO 033750 96 033751 96 033752 96 033753 96 033754 96 033755 96 033756 96 033757 96  
 Date Sampled: 96/08/08 96/08/09 96/08/09 96/08/07 96/08/08 96/08/08 96/08/07 96/08/08

MDL Units

Component

Impinger volume measured

ml

60

58

50

52

58

57

580

590

Mercury

0.010 ug

<0.030

0.12

<

<

<

<

2.9

2.9

96/09/20

## Zenon Environmental Laboratories - Certificate of Analysis

Page 9 of 12

Client ID: 3M-IN FB-M-OUT 2FB-M-OUT 1M-OUT 1M-OUT 1M-OUT  
Zenon ID: KMNO4/HCl KMNO4/HCl KMNO4/HCl KMNO4/HCl KMNO4/HCl  
Date Sampled: 033758 96 033759 96 033760 96 033761 96 033761 96 033761 96  
MDL: 96/08/09 96/08/06 96/08/12 96/08/07 96/08/07 96/08/07  
Units: M. Spike MS % Rec.

## Component

Impinger volume measured

ml

Mercury

0.010

ug

570

630

570

540

3.0

&lt;0.063

0.10

6.3

6.1

17

100

Duplicate

6.2

Client: Carnot Project: 11476



9/11/96

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## Zenon Environmental Laboratories - Certificate of Analysis

	1M-OUT	1M-OUT <sup>†</sup>	2M-OUT	3M-OUT	FB-M-STK	2FB-M-STK	1M-STK
<i>Client ID:</i>	KMN04/HCI	KMN04/HCI	KMN04/HCI	KMN04/HCI	KMN04/HCI	KMN04/HCI	KMN04/HCI
<i>Zenon ID:</i>	033761 96	033761 96	033764 96	033765 96	033766 96	033767 96	033768 96
<i>Date Sampled:</i>	96/08/07	96/08/07	96/08/08	96/08/09	96/08/06	96/08/12	96/08/07
<b>MDL</b>	MS Dup	MSD % Rec.					
<b>Units</b>							

Component	MDL Units
1. <b>Introduction</b>	100
2. <b>Background</b>	100
3. <b>Methodology</b>	100
4. <b>Results</b>	100
5. <b>Discussion</b>	100
6. <b>Conclusion</b>	100
7. <b>References</b>	100
8. <b>Appendix</b>	100
9. <b>Summary</b>	100
10. <b>Index</b>	100
11. <b>Table of Contents</b>	100
12. <b>Abstract</b>	100
13. <b>Keywords</b>	100
14. <b>References</b>	100
15. <b>Appendix</b>	100
16. <b>Summary</b>	100
17. <b>Index</b>	100
18. <b>Table of Contents</b>	100
19. <b>Abstract</b>	100
20. <b>Keywords</b>	100
21. <b>References</b>	100
22. <b>Appendix</b>	100
23. <b>Summary</b>	100
24. <b>Index</b>	100
25. <b>Table of Contents</b>	100
26. <b>Abstract</b>	100
27. <b>Keywords</b>	100
28. <b>References</b>	100
29. <b>Appendix</b>	100
30. <b>Summary</b>	100
31. <b>Index</b>	100
32. <b>Table of Contents</b>	100
33. <b>Abstract</b>	100
34. <b>Keywords</b>	100
35. <b>References</b>	100
36. <b>Appendix</b>	100
37. <b>Summary</b>	100
38. <b>Index</b>	100
39. <b>Table of Contents</b>	100
40. <b>Abstract</b>	100
41. <b>Keywords</b>	100
42. <b>References</b>	100
43. <b>Appendix</b>	100
44. <b>Summary</b>	100
45. <b>Index</b>	100
46. <b>Table of Contents</b>	100
47. <b>Abstract</b>	100
48. <b>Keywords</b>	100
49. <b>References</b>	100
50. <b>Appendix</b>	100
51. <b>Summary</b>	100
52. <b>Index</b>	100
53. <b>Table of Contents</b>	100
54. <b>Abstract</b>	100
55. <b>Keywords</b>	100
56. <b>References</b>	100
57. <b>Appendix</b>	100
58. <b>Summary</b>	100
59. <b>Index</b>	100
60. <b>Table of Contents</b>	100
61. <b>Abstract</b>	100
62. <b>Keywords</b>	100
63. <b>References</b>	100
64. <b>Appendix</b>	100
65. <b>Summary</b>	100
66. <b>Index</b>	100
67. <b>Table of Contents</b>	100
68. <b>Abstract</b>	100
69. <b>Keywords</b>	100
70. <b>References</b>	100
71. <b>Appendix</b>	100
72. <b>Summary</b>	100
73. <b>Index</b>	100
74. <b>Table of Contents</b>	100
75. <b>Abstract</b>	100
76. <b>Keywords</b>	100
77. <b>References</b>	100
78. <b>Appendix</b>	100
79. <b>Summary</b>	100
80. <b>Index</b>	100
81. <b>Table of Contents</b>	100
82. <b>Abstract</b>	100
83. <b>Keywords</b>	100
84. <b>References</b>	100
85. <b>Appendix</b>	100
86. <b>Summary</b>	100
87. <b>Index</b>	100
88. <b>Table of Contents</b>	100
89. <b>Abstract</b>	100
90. <b>Keywords</b>	100
91. <b>References</b>	100
92. <b>Appendix</b>	100
93. <b>Summary</b>	100
94. <b>Index</b>	100
95. <b>Table of Contents</b>	100
96. <b>Abstract</b>	100
97. <b>Keywords</b>	100
98. <b>References</b>	100
99. <b>Appendix</b>	100
100. <b>Summary</b>	100

Impinger volume measured

Mercury	0.010	ug
---------	-------	----

-	560	560	530	570	590
100	9.6	10	0.22	0.092	15

**Client: Camot Project: 11476**

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## Zenon Environmental Laboratories - Certificate of Analysis

9611/6

	1M-STK	1M-STK	1M-STK	1M-STK	2M-STK	3M-STK
<b>Client ID:</b>	1M-STK	1M-STK	1M-STK	1M-STK	2M-STK	3M-STK
<b>Zenon ID:</b>	KMNO4/HCl	KMNO4/HCl	KMNO4/HCl	KMNO4/HCl	KMNO4/HCl	KMNO4/HCl
<b>Date Sampled:</b>	033768 96	033768 96	033768 96	033768 96	033771 96	033772 96
<b>MDL</b>	96/08/07	96/08/07	96/08/07	96/08/07	96/08/08	96/08/09
<b>Units</b>	Duplicate	M. Spike	MS % Rec.	MS Dup	MSD % Rec.	

Component

### Impinger volume measured

iii

**Mercury**

0.010 ug Zn

570 550

18 15

100

26

100

27

11

550

15

14.5

**Client: Carnot Project: 11476**

*Zenon Environmental Laboratories - Certificate of Analysis*

9/11/96

**Client ID:** 4M-SPK RB-M-1 RB-M-2 RB-M-3  
KMNO4/HCl KMNO4/HCl KMNO4/HCl KMNO4/HCl  
**Zenon ID:** 033773 96 033774 96 033775 96 033776 96  
**Date Sampled:** 96/08/09 96/08/07 96/08/08 96/08/09

**MDL Units****Component**

Impinger volume measured ml

Mercury 0.010 ug

540 550 540 550  
0.077 <0.055 <0.054 <0.055

Batch Code:	0906MGA1	0906MGA2	0906MGA3	0906MGA4	0906MGA5	0906MGA6
Mercury	033713 96	033726 96	033738 96	033747 96	033761 96	033768 96
	033714 96	033729 96	033739 96	033753 96	033765 96	
	033715 96	033730 96	033740 96	033754 96	033766 96	
	033716 96	033731 96	033743 96	033755 96	033767 96	
	033717 96	033732 96	033744 96	033756 96	033771 96	
	033718 96	033733 96	033745 96	033757 96	033772 96	
	033719 96	033734 96	033746 96	033758 96	033773 96	
	033722 96	033735 96	033750 96	033759 96	033774 96	
	033723 96	033736 96	033751 96	033760 96	033775 96	
	033724 96	033737 96	033752 96	033764 96	033776 96	
	033725 96					
Date analysed	96/09/06	96/09/06	96/09/09	96/09/06	96/09/06	96/09/06
Date prepared	96/09/06	96/09/06	96/09/06	96/09/06	96/09/06	96/09/06

Client: Carnot Project 11476

**CARNOT SOURCE TEST DATA SUMMARY**  
**MULTI-METALS – EPA METHOD 29**  
**ESP INLET**

Client/Location.....	NYSEG/Milliken	Reference Temp (F).....	68
Unit.....	2	Fuel.....	COAL
Sample Location.....	ESP INLET	Data By.....	DVK
Operating Condition.....	FULL LOAD	Date of Data Entry.....	10/1/96

Test No.....	1-MTLS-IN	2-MTLS-IN	3-MTLS-IN	Average
Date.....	8/7/96	8/8/96	8/9/96	*
Test Method.....	EPA 29	EPA 29	EPA 29	*
Sample Train.....	ES-42	ES-42	ES-42	*
Pitot Factor .....	0.840	0.840	0.840	*
Meter Cal Factor.....	1.0008	1.0008	1.0008	*
Stack Area (sq ft).....	236.25	236.25	236.25	*
Sample Time (Min).....	240	240	240	*
Bar Press (in Hg).....	29.86	29.83	29.68	*
Nozzle Diam (in).....	0.278	0.278	0.278	*

Start/Stop Time.....	0817/1227	0803/1212	0803/1210	*
Stack Press (iwg).....	-13.85	-14.81	-14.53	-14.40
Stack Temp (F).....	292.9	292.4	289.0	291.4
Velocity Head (iwg).....	0.3017	0.3321	0.3063	0.3132
Inlet O2 (%).....	5.60	5.10	5.79	5.50
Inlet CO2 (%).....	13.86	13.94	13.64	13.81
Meter Vol (acf).....	154.537	160.792	146.785	154.038
Meter Temp (F).....	132.7	127.4	110.9	123.7
Meter Press (iwg).....	1.25	1.37	1.14	1.25
Liquid Vol (ml).....	272.6	293.2	265.0	276.9

Std Sample Vol (SCF).....	137.908	144.702	135.145	139.251
Std Sample Vol (Nm^3).....	3.639	3.818	3.566	3.674
Moisture Fraction.....	0.085	0.087	0.085	0.086
Stack Gas Mol Wt.....	29.38	29.35	29.36	29.36
Stack Gas Velocity (ft/sec).....	37.12	39.02	37.47	37.87
Stack Flow Rate (wacfm).....	526,226	553,149	531,154	536,843
Stack Flow Rate (dscfm).....	325,318	340,247	327,659	331,075
Isokinetic Ratio (%).....	98.96	99.28	96.29	98.18

**PRE-TEST DATA:**  
Isometric Press., in. Hg: 29.86  
summed Slack Temp. °F:  
summed Meter Temp. °F:  
summed ΔP:  
summed Moisture %:  
slack Diameter, in.: 240  
sample Time: Total 10 per point 24  
total of Traverse Points 10  
slon Connecting Y  
kinetic Factor Line (YN)  
AH = 4.04 X ΔP 4.10

**EQUIPMENT INFO:**  
Meter ID No.: ES-42  
Meter, Yd.: 1.0028  
CFM @ ΔH = 1.0: 0.594  
Pilot: 17  
ID: 84  
Cp: 61422  
Probe: .6 ft  
Nozzle: 61422  
Filter: 278  
Tare Wt.: ES-42  
TC Readout ID: Meter Aux.

**TEMPERATURES, °F**

METER	STACK	PROBE	METER		OVEN	IMP.	O <sub>2</sub>	VAC.	STATIC PRESS. hwg	CHAIN OF CUSTODY INFORMATION
			IN	OUT						
B3	283	261	125	125	284	62	5.0	7	-13.8	Impingers Loaded EM
2	283	251	126	126	283	64	5.2	6		Impingers Recovered
1	282	254	126	126	276	66	5.6	5.0		Filter Loaded MLC
										Filter Recovered
D3	297	252	127	127	282	67	5.2	7		Probe Wash
2	305	259	135	130	283	65	5.4	6	-13.9	TEST SUMMARY
1	294	252	130	127	272	58	5.3	6		Calculated by: CHIF
										Checked by: DK
G3	272	253	129	127	266	61	6.7	6		Stack Press (hwg) -13.9
2	287	264	135	130	266	61	6.5	6	-14.1	Stack Temp (°F) 292.4 ✓
1	295	261	129	127	267	62	5.2	5		ΔP (hwg) 0.3017 ✓
										O <sub>2</sub> /CO <sub>2</sub> 5.6/13.86 ✓
										Meter Vol. (act) 154.537 ✓
I3										Meter Temp (°F) 132.7 ✓
2	287	259	136	129	264	64	5.5	8		Meter Press. (hwg) 1.25 ✓
1	271	261	133	129	271	58	7.2	8	-13.7	Liquid Vol. (g) 272.6 ✓
	276	255	135	131	272	58	6.8	8		Comments:

**PRE-TEST CALIBRATION CHECK:**

Time	ΔH	Meter Reading	Meter Temp
Init			
Final			

**POST TEST INFO:**  
Filter Appearance: Hazy Grey - 10  
Impinger Appearance: CLEAR  
Silica Gel Spent (Y/N): N

**SAMPLE TRAIN LEAK CHECK:**

CEM	Vac	Pilot	Inlet
6005	12	12	CHIF
6005	13	13	CHIF



-27 PAGE 1 OF 2  
PROJECT # 11476  
DATE 8/8/96

SAMPLE TRAIN LEAK CHECK:			
CEM	Vac	Pilot	Inlet
Pre-Test	004	15	DC
Post-Test	004	16	CH

PRE-TEST CALIBRATION CHECK:			
Time	ΔH	Reading	Meter Temp
Inlet			
Final			

Mat'l	WM (End)	WM (Start)	WM (g)
K.O	524.4	444.1	80.3
SEHN03	678.4	591.4	87.0
0211202	745.5	702.3	43.2
K.O	587.9	563.4	24.5
4211104	662.5	652.7	9.8
1021159	683.4	673.9	9.5
557	898.6	859.7	38.9
			293.2

TEST INFO:	
Appearance	Heavy Grey - pm
finger Appearance	Clear
as Gel Spent (Y/N)	N

[illegible]





**PRE-TEST DATA:**  
Isometric Press., in. Hg. 29.68  
Isometric Slack Temp. °F \_\_\_\_\_  
Isometric Meter Temp. °F \_\_\_\_\_  
Isometric ΔP \_\_\_\_\_  
Isometric Moisture % \_\_\_\_\_  
Isometric Diameter, in. \_\_\_\_\_  
Isometric Time: Total \_\_\_\_\_ per point  
Isometric of Traverse Points \_\_\_\_\_  
Isometric of Non Connecting \_\_\_\_\_  
Isometric Line (Y/N) Y  
Isometric Factor 3.74 X ΔP  
ΔH = 3.74 X ΔP  
3.64

**EQUIPMENT INFO:**  
Meter ID No. \_\_\_\_\_  
Meter, Yd. ES-42  
CFM @ ΔH = 1.0 1.0008  
Pilot: ID 1.7  
Cp .84  
Probe: 6423  
Length 6.51  
ID/Mat'l 6.51  
Nozzle: 6.51  
Diam. 0.378  
Filter: \_\_\_\_\_  
Tare Wt. \_\_\_\_\_  
TC Readout ID: Meter \_\_\_\_\_ Aux. \_\_\_\_\_

**POST TEST INFO:**  
Filter Appearance ES-42  
Impinger Appearance #16 Imp Partic-0-7 #5  
Silica Gel Spent (Y/N) N

**IMP. MAT'L WT. (End) WT. (Start) WT. (g)**  
#1 KO 644 495.2 =  
#2 SBT 679.3 608.5 =  
#3 102 633.8 635.0 =  
#4 K.O. 512.5 510.0 =  
#5 42 62.4 643.1 =  
#6 102 637.3 651.7 =  
#7 S.G. 892.4 863.6 =  
Total \_\_\_\_\_  
POST TEST INFO: \_\_\_\_\_  
Filter Appearance \_\_\_\_\_  
Impinger Appearance \_\_\_\_\_  
Silica Gel Spent (Y/N) \_\_\_\_\_

**SAMPLE TRAIN LEAK CHECK:**  
CFM Vac Pilot Inlet  
Pre-Test .008 15 CH CH  
Post-Test .008 16 CH CH

**PRE-TEST CALIBRATION CHECK:**  
Meter Meter Temp  
Time ΔH Reading In Out  
Inlet \_\_\_\_\_  
Final \_\_\_\_\_

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F						O <sub>2</sub>	VAC.	STATIC PRESS. Inwg	CHAIN OF CUSTODY INFORMATION
		AP	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP. OUT				
							IN	OUT						
B3	803	0.33	1.25	162.944	282	258	100	99	275	58		7		Impingers Loaded EM
2	813	0.33	1.25	169.0	284	252	105	101	268	49	-14.6	7		Impingers Recovered EM
1	823	0.24	0.88	175.8	285	252	108	103	269	51		6		Filter Loaded EM
	833			180.910										Filter Recovered MR
D3	833	0.37	1.38	180.910	294	253	104	105	280	53		8		Probe Wash DW
2	843	0.29	1.07	187.8	294	261	104	105	290	54	-14.1	7		TEST SUMMARY
1	853	0.22	0.81	193.9	292	258	109	105	285	50		6		Calculated by: CHF
	903			199.435										Checked by: -14.53
G3	904	0.27	0.99	197.435	278	255	110	106	282	58		7		Stack Press (Inwg) <del>14.4</del>
2	914	0.29	1.07	204.3	293	254	110	106	283	58	-14.4	6		Stack Temp. (°F) 289.0
1	924	0.22	0.81	210.6	292	263	111	107	283	59		6		ΔP (Inwg) 0.3063
	934			216.184										O <sub>2</sub> /CO <sub>2</sub> 5.79/13.64
I3	935	0.40	1.48	216.184	288	260	111	107	284	60		8		Meter Vol. (Incl) 146.785
2	945	0.30	1.09	223.3	267	257	113	108	285	61	-14.5	7		Meter Temp. (°F) 110.9
1	955	0.30	1.09	230.0	275	254	114	109	285	61		7		Meter Press. (Inwg) 1.14
	1005			235.798										Liquid Vol (g) 265.0
														Comments:

1. YS. -  
 SAMPLE LOCATION Inlet ESP  
 OPERATOR/ASSISTANT CHP  
 UP 2 TEST CONDITION \_\_\_\_\_  
 STN 3-A-1-1 AETI E-11-27 PROJECT # 11776  
 METER VOL. (START/END) \_\_\_\_\_ DATE 8-9-96  
 AMB. TEMP., °F 1

E-TEST DATA:			EQUIPMENT INFO:			SAMPLE TRAIN LEAK CHECK:		
Isometric Press., In. Hg	Meter ID No.		Imp. Mat'l	Wt (End)	Wt (Start)	Wt (g)	CFM	Vac
Turned Slack Temp. °F	Meter, Yd.		#1					Pilot
Turned Meter Temp. °F	CEM @ ΔH = 1.0		#2					Init.
Turned ΔP	Pilot:		#3					
Turned Moisture %	Cp		#4					
Blank Diameter, In.	Probe:		#5					
Sample Time: Total	Nozzle:		Total					
Time of Traverse Points	Filter:		POST TEST INFO:					
Time on Connecting	Tare Wt.		Filter Appearance					
Line (Y/N)	TC Readout ID: Meter		Impinger Appearance					
Line Factor	Aux.		Silica Gel Spent (Y/N)					
ΔH = 3.64								

[illegible]

**CARNOT SOURCE TEST DATA SUMMARY**  
**MULTI-METALS -- EPA METHOD 29**  
**ESP OUTLET**

Client/Location.....	NYSEG/Milliken	Reference Temp (F).....		68
Unit.....	2	Fuel.....		COAL
Sample Location.....	ESP OUTLET	Data By.....		DVK
Operating Condition.....	FULL LOAD	Date of Data Entry.....		10/1/96
Test No.....	1-MTLS-OUT	2-MTLS-OUT	3-MTLS-OUT	Average
Date.....	8/7/96	8/8/96	8/9/96	*
Test Method.....	EPA 29	EPA 29	EPA 29	*
Sample Train.....	ES-55	ES-55	ES-55	*
Pitot Factor .....	0.840	0.840	0.840	*
Meter Cal Factor.....	0.9970	0.9970	0.9970	*
Stack Area (sq ft).....	236.25	236.25	236.25	*
Sample Time (Min).....	360	360	360	*
Bar Press (in Hg).....	29.86	29.83	29.68	*
Nozzle Diam (in).....	0.277	0.280	0.280	*
Start/Stop Time.....	0833/1512	0822/1435	0814/1435	*
Stack Press (iwg).....	-14.50	-14.50	-14.50	-14.50
Stack Temp (F).....	283.9	285.8	279.5	283.1
Velocity Head (iwg).....	0.2940	0.3106	0.3058	0.3034
Outlet O2 (%).....	5.38	5.10	5.04	5.17
Outlet CO2 (%).....	14.06	13.94	14.32	14.11
Meter Vol (acf).....	245.612	241.640	232.576	239.943
Meter Temp (F).....	123.3	118.4	101.5	114.4
Meter Press (iwg).....	1.01	1.04	0.97	1.00
Liquid Vol (ml).....	425.4	426.5	405.9	419.3
Std Sample Vol (SCF).....	221.735	219.798	216.781	219.438
Std Sample Vol (Nm^3).....	5.851	5.800	5.720	5.790
Moisture Fraction.....	0.083	0.084	0.081	0.083
Stack Gas Mol Wt.....	29.43	29.39	29.48	29.43
Stack Gas Velocity (ft/sec).....	36.43	37.53	37.12	37.03
Stack Flow Rate (wacfm).....	516,354	532,048	526,240	524,881
Stack Flow Rate (dscfm).....	323,354	331,647	330,081	328,361
Isokinetic Ratio (%).....	107.49	101.68	100.76	103.31

SE - 1 LI - 1  
SAMPLE LOCATION ESPOUTLE  
CENTROLOGICAL

PRE-TEST DATA:		EQUIPMENT INFO:		SAMPLE TRAIN LEAK CHECK:	
Barometric Press., in. Hg.		Meter ID No.		CFM	Vac
Summed Slack Temp. °F	290	Meter, Yd.		Pre-Test	Post-Test
Summed Meter Temp. °F	110	CFM @ ΔH = 1.0		0.062	16
Summed ΔP	0.30	Pilot:	ID	0.002	8
Summed Moisture %	6.7	Cp			
Slack Diameter, in.		Probe:	Mat'l		
Sample Time: Total		Length			
per point		ID/Mat'l			
Total of Traverse Points		Diam.			
Non Connecting		No.			
		Tare Wt.			
Line (Y/N)		TC Readout ID: Meter			
Stochastic Factor		Aux.			
ΔH = 3.12	X ΔP				
2.5	3.2				

SAMPLE POINT	TIME	METER CONDITIONS				TEMPERATURES, °F						STATIC PRESS. Inwg	CHAIN OF CUSTODY INFORMATION	
		AP	AH	METER READING	STACK	PROBE	METER		OVEN	IMP. OUT	O <sub>2</sub>			VAC.
							IN	OUT						
B-3	0833	0.38	2.6	014.905	293	262	116	112	240	67	5.4	15	Inpingers Loaded MR	
B-2	0848			30.430									Inpingers Recovered EM	
B-2	0910	0.34	1.1	35.727	242	261	116	113	247	65	5.2	9	Filter Loaded DCW	
B-1	0925	0.32	0.948	41.000	287	261	115	112	246	62	5.3	6	Filter Recovered EM	
D-3	0940	0.38	1.19	60.0	261	240	120	119	247	54	5.4	6.5	Probe Wash DCW	
D-2	0955	0.37	1.15	69.30	232	260	121	115	245	54	5.8	6.5	TEST SUMMARY	
D-1	1010	0.26	0.37	79.60	259	251	123	117	241	53	5.8	5.5	Calculated by: OK	
F-3	1025	0.29	0.90	88.75	233	257	124	119	247	53	5.6	5.9	Checked by: OK	
F-2	1040	0.20	0.31	47.8	235	259	124	120	245	54	5.9	6.0	Stack Press (Inwg) -14.5 ✓	
F-1	1055	0.24	0.75	107.1	285	259	125	120	245	52	5.4	6.0	Stack Temp (°F) 283.9 ✓	
H-3	1110	0.30	0.97	115.5	287	250	126	121	244	51	5.4	6.0	ΔP (Inwg) 0.2940 ✓	
H-2	1125	0.29	0.95	126.0	238	257	123	122	245	56	5.8	6.0	O <sub>2</sub> CO <sub>2</sub> 5.38/14.06	
H-1	1140	0.29	0.95	136.0	290	256	128	123	244	54	5.4	6.0	Meter Vol. (act) 245.612 ✓	
SOP	1155			144.744									Meter Temp (°F) 123.3 ✓	
P-3	1159	0.32	1.07	147.80	284	257	127	123	248	53	5.8	6.5	Meter Press. (Inwg) 1.01 ✓	
P-2	1214	0.29	0.95	155.5	282	257	123	124	245	53	5.6	6.0	Liquid Vol (g) 425.4 ✓	
P-1	1229	0.24	0.85	165.5	279	257	128	124	244	56	5.8	6.0	Comments: 360 min ✓	

EQUIPMENT INFO:

Meter ID No. \_\_\_\_\_

Meter, Yd. \_\_\_\_\_

CFM @ ΔH = 1.0 \_\_\_\_\_

Pilot: ID \_\_\_\_\_

Cp \_\_\_\_\_

Probe: Mat'l \_\_\_\_\_

Length \_\_\_\_\_

Nozzle: ID/Mat'l \_\_\_\_\_

Diam. \_\_\_\_\_

Filler: No. \_\_\_\_\_

Tare Wt. \_\_\_\_\_

TC Readout ID: Meter \_\_\_\_\_

Aux. \_\_\_\_\_

IE TEST DATA:

Isometric Press., In. Hg. \_\_\_\_\_

Summed Slack Temp. °F \_\_\_\_\_

Summed Meter Temp. °F \_\_\_\_\_

Summed ΔP \_\_\_\_\_

Summed Moisture % \_\_\_\_\_

Slack Diameter, In. \_\_\_\_\_

Sample Time: Total \_\_\_\_\_

per point \_\_\_\_\_

Level of Traverse Points \_\_\_\_\_

Non Connecting \_\_\_\_\_

Line (Y/N) \_\_\_\_\_

Kinetic Factor \_\_\_\_\_

ΔH = 3.26 X ΔP

POST TEST INFO:

Filter Appearance \_\_\_\_\_

Impinger Appearance \_\_\_\_\_

Silica Gel Spent (Y/N) \_\_\_\_\_

PRE-TEST CALIBRATION CHECK:

Meter Meter Temp \_\_\_\_\_

Time ΔH Reading In Out \_\_\_\_\_

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F				IMP. OUT	OVEN	STATIC PRESS.			CHAIN OF CUSTODY INFORMATION
		AP	ΔH	METER READING	STACK	PROBE	METER				O <sub>2</sub>	VAC.	Inwg	
R-3	1244	0.20	0.91	176.3	282	286	IN	OUT	58	244	4.4	6.0	246	Impingers Loaded
R-2	1259	0.25	0.61	185.2	281	256	129	129	59	244	6.2	5.5	246	Impingers Recovered
R-1	1314	0.23	0.75	194.0	279	255	130	125	57	243	6.2	5.0	246	Filter Loaded
S-3	1329	0.24	0.65	202.7	261	251	130	125	63	246	4.8	6.0	246	Filter Recovered
S-2	1344	0.24	0.85	211.3	286	256	131	126	72	243	4.4	6.0	246	Probe Wash
S-1	1359	0.24	0.85	221.5	288	256	131	127	59	240	4.5	6.0	246	TEST SUMMARY
U-3	1404			231.55									315	Calculated by:
U-2	1409												310	Checked by:
U-1	1444			231.65										Stack Press (Inwg)
U-3	1427	0.33	1.08	231.65	236	257	124	125	78	237	4.2	7.0	315	Stack Temp (°F)
U-2	1442	0.31	1.01	243.6	286	257	130	125	63	242	4.4	7.0	310	ΔP (Inwg)
U-1	1457	0.30	0.98	252.5	287	256	130	124	64	260	4.2	6.0	315	O <sub>2</sub> /CO <sub>2</sub>
	1512			260.623										Meter Vol. (scf)
														Meter Temp. (°F)
														Meter Press. (Inwg)
														Liquid Vol. (g)
														Comments:

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SAMPLE LOCATION ESP Outlet TEST CONDITION \_\_\_\_\_ PROJECT # \_\_\_\_\_  
 RATOR/ASSISTANT OH METER VOL. (START/END) \_\_\_\_\_ / \_\_\_\_\_ AMB. TEMP., °F \_\_\_\_\_  
 DATE 8/8/76

EST DATA:		EQUIPMENT INFO:					
		Imp.	Mat'l	Wt (End)	Wt (Start)	Wt (Q)	
	74 Q1						SAMPLE TRAIN LEAK CHECK:

[illegible]

TEST	TEST CONDITIONS		TEMPERATURES °F	STATIC
	TEMPERATURE	WETNESS		
1	70	100	70	100
2	70	100	70	100
3	70	100	70	100
4	70	100	70	100
5	70	100	70	100
6	70	100	70	100
7	70	100	70	100
8	70	100	70	100
9	70	100	70	100
10	70	100	70	100
11	70	100	70	100
12	70	100	70	100
13	70	100	70	100
14	70	100	70	100
15	70	100	70	100
16	70	100	70	100
17	70	100	70	100
18	70	100	70	100
19	70	100	70	100
20	70	100	70	100
21	70	100	70	100
22	70	100	70	100
23	70	100	70	100
24	70	100	70	100
25	70	100	70	100
26	70	100	70	100
27	70	100	70	100
28	70	100	70	100
29	70	100	70	100
30	70	100	70	100
31	70	100	70	100
32	70	100	70	100
33	70	100	70	100
34	70	100	70	100
35	70	100	70	100
36	70	100	70	100
37	70	100	70	100
38	70	100	70	100
39	70	100	70	100
40	70	100	70	100
41	70	100	70	100
42	70	100	70	100
43	70	100	70	100
44	70	100	70	100
45	70	100	70	100
46	70	100	70	100
47	70	100	70	100
48	70	100	70	100
49	70	100	70	100
50	70	100	70	100
51	70	100	70	100
52	70	100	70	100
53	70	100	70	100
54	70	100	70	100
55	70	100	70	100
56	70	100	70	100
57	70	100	70	100
58	70	100	70	100
59	70	100	70	100
60	70	100	70	100
61	70	100	70	100
62	70	100	70	100
63	70	100	70	100
64	70	100	70	100
65	70	100	70	100
66	70	100	70	100
67	70	100	70	100
68	70	100	70	100
69	70	100	70	100
70	70	100	70	100
71	70	100	70	100
72	70	100	70	100
73	70	100	70	100
74	70	100	70	100
75	70	100	70	100
76	70	100	70	100
77	70	100	70	100
78	70	100	70	100
79	70	100	70	100
80	70	100	70	100
81	70	100	70	100
82	70	100	70	100</

[illegible]

E-TEST DATA:		EQUIPMENT INFO:		SAMPLE TRAIN LEAK CHECK:	
_____	_____	Meter ID No.	_____	Imp. Mat'l	Wt (Start)
_____	_____	Meter, Yd.	_____	#1	Wt (End)
_____	_____	CFM @ ΔH = 1.0	_____	#2	_____
_____	_____	Pilot:	_____	#3	_____
_____	_____	Probe:	_____	#4	_____
_____	_____	Nozzle:	_____	#5	_____
_____	_____	Filter:	_____	Total	_____
_____	_____	Tare Wt.	_____	POST TEST INFO:	
_____	_____	TC Readout ID: Meter	_____	Filter Appearance	_____
_____	_____	Aux.	_____	Impinger Appearance	_____
_____	_____	Line (Y/N)	_____	Silica Gel Spent (Y/N)	_____
_____	_____	Inlet Factor	_____		_____
_____	_____	ΔH = _____ X ΔP	_____		_____

E-TEST DATA:		EQUIPMENT INFO:		SAMPLE TRAIN LEAK CHECK:	
_____	_____	Meter ID No.	_____	Imp. Mat'l	Wt (Start)
_____	_____	Meter, Yd.	_____	#1	Wt (End)
_____	_____	CFM @ ΔH = 1.0	_____	#2	_____
_____	_____	Pilot:	_____	#3	_____
_____	_____	Probe:	_____	#4	_____
_____	_____	Nozzle:	_____	#5	_____
_____	_____	Filter:	_____	Total	_____
_____	_____	Tare Wt.	_____	POST TEST INFO:	
_____	_____	TC Readout ID: Meter	_____	Filter Appearance	_____
_____	_____	Aux.	_____	Impinger Appearance	_____
_____	_____	Line (Y/N)	_____	Silica Gel Spent (Y/N)	_____
_____	_____	Inlet Factor	_____		_____
_____	_____	ΔH = _____ X ΔP	_____		_____

[illegible]





TEST DATA:		EQUIPMENT INFO:		SAMPLE TRAIN LEAK CHECK:							
Manometric Press., in. Hg.	_____	Meter ID No.	_____	Imp. Mat'l	Wt (End)	Wt (Start)	Wt (g)	CFM	Vac	Pilot	Init
Unleaded Stack Temp. °F	_____	Meter, Yd.	_____	#1	_____	_____	_____	_____	_____	_____	_____
Unleaded Meter Temp. °F	_____	CFM @ ΔH = 1.0	_____	#2	_____	_____	_____	Pre-Test	_____	_____	_____
Unleaded ΔP	_____	Pilot:	_____	#3	_____	_____	_____	Post-Test	_____	_____	_____
Unleaded Moisture %	_____	Cp	_____	#4	_____	_____	_____	_____	_____	_____	_____
Stack Diameter, in.	_____	Probe	_____	#5	_____	_____	_____	_____	_____	_____	_____
Sample Time: Total	_____	Nozzle:	_____	Total	_____	_____	_____	_____	_____	_____	_____
_____ per point	_____	Filter:	_____	PRE-TEST CALIBRATION CHECK:							
_____ of Traverse Points	_____	Tare Wt.	_____	Time ΔH Reading In Out							
_____ on Connecting	_____	TC Readout ID: Meter	_____	Meter Meter Temp							
_____ Line (Y/N)	_____	Aux.	_____	Init							
_____ Inelastic Factor	_____	_____	_____	Final							
_____ ΔH = 3.6 X ΔP	_____	_____	_____	_____							

[illegible]

**CARNOT SOURCE TEST DATA SUMMARY**  
**MULTI-METALS – EPA METHOD 29**  
**FGD STACK**

Client/Location.....	NYSEG/Milliken	Reference Temp (F).....	68	
Unit.....	2	Fuel.....	COAL	
Sample Location.....	FGD STACK	Data By.....	DVK	
Operating Condition.....	FULL LOAD	Date of Data Entry.....	10/3/96	
Test No.....	1-MTLS-STK	2-MTLS-STK	3-MTLS-STK	Average
Date.....	8/7/96	8/8/96	8/9/96	*
Test Method.....	EPA 29	EPA 29	EPA 29	*
Sample Train.....	ES-19	ES-19	ES-19	*
Pitot Factor .....	0.840	0.840	0.840	*
Meter Cal Factor.....	1.0164	1.0164	1.0164	*
Stack Area (sq ft).....	113.10	113.10	113.10	*
Sample Time (Min).....	360	360	360	*
Bar Press (in Hg).....	29.12	29.08	29.06	*
Nozzle Diam (in).....	0.200	0.200	0.200	*
Start/Stop Time.....	0817/1441	0811/1540	0815/1507	*
Stack Press (iwg).....	-0.65	-0.65	-0.71	-0.67
Stack Temp (F).....	118.7	119.4	117.5	118.5
Velocity Head (iwg).....	1.3594	1.3718	1.3859	1.3723
Stack O2 (%).....	5.66	5.52	5.76	5.65
Stack CO2 (%).....	13.81	13.57	13.67	13.68
Meter Vol (acf).....	270.043	279.008	280.827	276.626
Meter Temp (F).....	126.0	117.4	117.8	120.4
Meter Press (iwg).....	1.81	1.95	1.95	1.90
Liquid Vol (ml).....	864.7	933.1	900.1	899.3
Std Sample Vol (SCF).....	241.791	253.275	254.550	249.872
Std Sample Vol (Nm^3).....	6.380	6.683	6.717	6.593
Moisture Fraction.....	0.144	0.148	0.143	0.145
Stack Gas Mol Wt.....	28.64	28.56	28.64	28.61
Stack Gas Velocity (ft/sec).....	69.69	70.21	70.37	70.09
Stack Flow Rate (wacfm).....	472,937	476,412	477,557	475,635
Stack Flow Rate (dscfm).....	358,667	358,779	362,692	360,046
Isokinetic Ratio (%).....	97.04	101.62	101.03	99.90

CLIENT 115589 UNIT 2 TEST NO. 1-11115-516 METHOD EPA 1A PAGE 1 OF 2  
SAMPLE LOCATION Stack TEST CONDITION Normal AMB. TEMP. °F 14.6 PROJECT # 11476  
OPERATOR/ASSISTANT P. NATION / REEHER / DK METER VOL. (START/END) DATE 8/7/96

PRE-TEST DATA:  
Isometric Press., In. Hg. 29.12  
summed Slack Temp. °F 120  
summed Meter Temp. °F 120  
summed ΔP 1.2  
summed Moisture % 13.6  
slack Diameter, In. 12  
sample Time: Total 360  
per point 30  
Total of Traverse Points 12  
Non Connecting Line (Y/N) Y  
Kinetic Factor AH = 1.241 ft X AP

EQUIPMENT INFO:  
Meter ID No. ES-19  
Meter, Yd. 1.0164  
CFM @ ΔH = 1.0 .596  
Pilot: ID 20  
Cp 0.84  
Mat'l 61.55  
Length 141  
Nozzle: Gl 55  
Diam. 0.200  
Filler: No.  
TC Readout ID: Meter TC009  
Aux.

TEMPERATURES, °F  
METER READING METER IN OUT  
W1 0817 1.1 1.32 708.543 119 245 268 51 4.0  
W2 0847 1.2 1.44 728.5 120 252 259 54 6.4  
W3 917 1.2 1.44 749.650 119 250 256 55 5.8  
W4 947 1.5 1.80 769.000 118 249 256 57 5.7  
W5 1017 1.3 1.56 791.750 119 262 261 65 5.2  
W6 1100 1.4 1.68 802.80 119 247 261 56 5.9  
W7 1130 1.4 1.68 834.300 118 244 256 60 5.5  
W8 1200 1.45 2.03 856.9 118 253 249 65 5.8  
W9 1230 1.5 2.2 879.9 118 259 253 60 5.3

IMPERINGERS RECOVERED  
Imp. Mat'l Wt (End) Wt (Start) Wt (g)  
W1 869.7 493.8 375.9  
W2 802.2 571.6 230.6  
W3 741.9 631.4 110.5  
W4 527.1 483.0 44.1  
W5 608.9 585.0 23.9  
W6 646.1 629.4 16.7  
W7 831.9 767.9 64.0  
Total 864.7  
POST TEST INFO:  
Filter Appearance  
Impinger Appearance  
Silica Gel Spent (Y/N)

PRE-TEST CALIBRATION CHECK:  
Meter Meter Temp  
Time ΔH Reading In Out  
Init Final

SAMPLE TRAIN LEAK CHECK:  
CFM Yag Pilot Inlet  
Pre-Test 2.01 16 28 BF  
Post-Test 0.05 16 36 BF

SAMPLE POINT	TIME	METER CONDITIONS		TEMPERATURES, °F				IMP. OUT	OVEN	VAC.	STATIC PRESS. InHg	CHAIN OF CUSTODY INFORMATION
		ΔP	ΔH	METER READING	STACK	PROBE	METER IN	METER OUT				
W1	0817	1.1	1.32	708.543	119	245	123	99	268	8	-0.60	Impingers Loaded EM
W2	0847	1.2	1.44	728.5	120	252	131	109	259	8		Impingers Recovered
W3	917	1.2	1.44	749.650	119	250	132	112	256	8		Filter Loaded
W4	947	1.5	1.80	769.000	118	249	135	114	256	11		Filter Recovered
W5	1017	1.3	1.56	791.750	119	262	126	113	261	8		Probe Wash OK
W6	1100	1.4	1.68	802.80	119	247	138	117	261	10		TEST SUMMARY
W7	1130	1.4	1.68	834.300	118	244	140	118	256	10		Calculated by: OK
W8	1200	1.45	2.03	856.9	118	253	140	119	249	12		Checked by: DK
W9	1230	1.5	2.2	879.9	118	259	143	120	253	13		Slack Press (InHg) -0.65
												Slack Temp (°F) 118.7
												ΔP (InHg) 1.3594
												O <sub>2</sub> /CO <sub>2</sub> 5.66
												Meter Vol. (act) 270.013
												Meter Temp. (°F) 126.8
												Meter Press. (InHg) 1.81
												Liquid Vol (g) 864.7
												Comments:





**REPORT OF WORK**

**EQUIPMENT INFO:**  
Meter ID No. ES-19  
Meter, Yd. 1.0164  
CFM @ ΔH = 1.0 0.556  
Pilot: ID 20  
Cp 0.84  
Mat'l 1.11  
Probe: 9/1.55  
Nozzle: 0.200  
Diam. 9/6.55  
No. UP QTZ  
Tare Wt. ES-19  
TC Readout ID: Meter Aux. TC 069

**EQUIPMENT INFO:**  
Imp. Mat'l Wt (End) Wt (Start) Wt (g)  
#1 R.O. 493.5  
#2 SHNO3 513.9  
#3 10% H2O 635.7  
#4 R.O. 488.0  
#5 48% H2O 585.6  
#6 10% H2O 650.4  
#7 5% 942.1  
Total 874.2  
POST TEST INFO:  
Filler Appearance  
Impinger Appearance  
Silica Gel Spent (Y/N)

**EQUIPMENT INFO:**  
Meter ID No. ES-19  
Meter, Yd. 1.0164  
CFM @ ΔH = 1.0 0.556  
Pilot: ID 20  
Cp 0.84  
Mat'l 1.11  
Probe: 9/1.55  
Nozzle: 0.200  
Diam. 9/6.55  
No. UP QTZ  
Tare Wt. ES-19  
TC Readout ID: Meter Aux. TC 069

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F						STATIC PRESS. Inwg	CHAIN OF CUSTODY INFORMATION		
		AP	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP. OUT				
W1	0815	1.0	1.4	263.308	117	258	112	88	260	52	5.8	8	0.61	Impingers Loaded EM
	08													Impingers Recovered MR
W2	0845	1.15	1.6	283.65	117	271	120	97	271	46	5.8	8		Filter Loaded MR
														Filter Recovered MR
W3	0915	1.25	1.75	304.85	116	256	125	101	264	48	5.8	9		Probe Wash DW
														TEST SUMMARY
W4	0945	1.55	2.17	327.2	117	249	128	103	255	40	5.8	13		Calculated by: BF
208	1015			351.663	129K	OK	14"							Checked by: BF
														Stack Press (Inwg) -1.41
208	1030	1.3	1.81	351.780	118	263	125	104	257	47	5.8	10		Stack Temp (°F) 117.8
														AP (Inwg) 1.3859
N-2	1100	1.36	2.10	374.15	117	249	135	109	253	45	5.8	12		O <sub>2</sub> CO <sub>2</sub> 5.76 / 13.62
														Meter Vol. (act) 280.837
N-6	1130	1.50	2.10	398.8	119	241	137	112	250	48	5.6	12		Meter Temp (°F) 117.8
														Meter Press. (Inwg) 1.95
N-5	1200	1.6	2.25	422.765	118	275	138	113	268	51	5.7	14		Liquid Vol (g) 900.1
														Comments:

0.739



CLIENT  
PROJECT #  
DATE  
EST  
ME  
PA

OPERATOR/ASSISTANT  
TEST CONDITION  
METER VOL. (START/END)

AMBIENT TEMP., °F  
DATE 8-9-96

PRE-TEST DATA:  
Barometric Press., in. Hg.  
Assumed Stack Temp. °F  
Assumed Meter Temp. °F  
Assumed ΔP  
Assumed Moisture %  
Stack Diameter, in.  
Sample Time: Total  
Total of Traverse Points  
Teflon Connecting  
Line (Y/N)  
Isokinetic Factor  
AH = 1.4 X ΔP

EQUIPMENT INFO:  
Meter ID No.  
Meter, Yd.  
CFM @ ΔH = 1.0  
Pilot:  
Probe:  
Nozzle:  
Filter:  
TC Readout ID: Meter  
Aux.

Imp. Mat'l  
WM (End)  
WM (Start)  
WM (g)

POST TEST INFO:  
Filter Appearance  
Impinger Appearance  
Silica Gel Spent (Y/N)

PRE-TEST CALIBRATION CHECK:  
Time ΔH Reading In Out  
Meter Meter Temp

SAMPLE TRAIN/TEAR CHECK:  
CFM Vac Pilot Inlet  
Pre-Test  
Post-Test

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F				IMP. OUT	O <sub>2</sub>	VAC.	STATIC PRESS. lwg	CHAIN OF CUSTODY INFORMATION
		ΔP	ΔH	METER READING	STACK	PROBE	METER IN	OUT					
N-4	1230	1.5	2.1	448.05	118	246	137	113	52	5.6	13	-0.8	Impingers Loaded Impingers Recovered
N-3 stop	1300 1330	1.5	2.1	472.45 496.667	117	264	137	112	49	5.8	13		Filter Loaded Filter Recovered Probe Wash
W-5	14:07	1.4 0.90	1.96	496.710	119	303	131	106	49	5.8	12		TEST SUMMARY Calculated by: Checked by:
W-6	14:37	1.45	2.03	518.965	117	269	135	140	56	5.8	13		Stack Press (lwg) Stack Temp (°F) ΔP (lwg) O <sub>2</sub> /CO <sub>2</sub> Meter Vol., (act) Meter Temp. (°F) Meter Press. (lwg)
END	1507			544.130									Liquid Vol (g) Comments:



**Appendix C.5**  
**Frontier Geoscience**

1  
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**FRONTIER GEOSCIENCE MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM – ESP INLET**  
**AUGUST 1996**

Test Number	2-MESA-IN	3-MESA-IN	3A-MESA-IN		Uncertainty
Date	8/8/96	8/9/96	8/9/96	AVERAGE	@95%CI
Pitot Flow Rate, dscfm	340,247	327,659	329,486		
Sample Volume, dscf	1.64	1.71	1.97		
Fuel Factor, dscf/10 <sup>6</sup> Btu	13,628	13,019	12,877		
O <sub>2</sub> , %	6.13	5.40	5.23		
CO <sub>2</sub> , %	12.93	13.64	13.75		

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>
Hg(0) - elemental	1.62	3.75	0.98	2.12	0.002	1.62	170% 3.59
Hg(II) - oxidized	7.03	6.15	7.62	6.93	0.008	5.31	26% 1.83
Hg(tot) - Quartz Wool Plug*	0.08	0.08	0.01	0.06	6.7E-05	0.04	186% 0.11
<b>Total Hg</b>	<b>8.74</b>	<b>9.98</b>	<b>8.61</b>	<b>9.11</b>	<b>0.011</b>	<b>6.97</b>	<b>21% 1.87</b>

\*Frontier Geoscience method is not designed to representatively quantify the mercury solids fraction, these values represent mercury vapor that adsorbed on the flyash collected on the quartz wool plug during sampling.

Note: The sample from test 1-MESA-IN performed on 8/7/96 was lost after the test was completed.

**FRONTIER GEOSCIENCE MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM – ESP OUTLET/FGD INLET**  
**AUGUST 1996**

Test Number	2-MESA-OUT	3-MESA-OUT	3A-MESA-OUT	Uncertainty	
Date	8/8/96	8/9/96	8/9/96	AVERAGE	@95%CI
Pitot Flow Rate, dscfm	331,647	330,081	330,081		
Sample Volume, dscf	2.77	2.78	2.76		
Fuel Factor, dscf/10 <sup>6</sup> Btu	12,936	12,952	12,119		
O <sub>2</sub> , %	5.34	5.32	4.25		
CO <sub>2</sub> , %	13.62	13.71	14.61		

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>
Hg(0) - elemental	1.49	2.04	4.47	2.66	0.003	1.93	148% 3.94
Hg(II) - oxidized	8.37	7.05	5.06	6.82	0.008	5.05	61% 4.14
Hg(tot) - Quartz Wool Plug*	0.01	0.14	ND	0.07	8.4E-05	0.06	264% 0.19
Total Hg	9.87	9.22	9.52	9.56	0.011	7.04	8% 0.80

ND – mercury not detected in sample fraction above trip blank level (treated as zero).

\*Frontier Geoscience method is not designed to representatively quantify the mercury solids fraction, these values represent mercury vapor that adsorbed on the flyash collected on the quartz wool plug during sampling.

Note: Test 1-MESA-OUT performed on 8/7/96 was deemed invalid, mercury levels reported by the laboratory were similar to those found in trip blanks. Test may not have sampled flue gas due to an undetected leak in sample train.

**FRONTIER GEOSCIENCE MERCURY SPECIATION TEST RESULTS  
NYSEG POST-RETROFIT TEST PROGRAM -- FGD OUTLET/STACK  
AUGUST 1996**

Test Number	1-MESA-STK	2-MESA-STK	3-MESA-STK	3A-MESA-STK	AVERAGE		Uncertainty @95%CI	
Date	8/7/96	8/8/96	8/9/96	8/9/96				
Pitot Flow Rate, dscfm	358,667	358,779	362,692	362,692				
Sample Volume, dscf	1.80	1.67	3.23	2.86				
Fuel Factor, dscf/10 <sup>6</sup> Btu	13,131	12,928	12,977	12,960				
O <sub>2</sub> , %	5.63	5.33	5.35	5.33				
CO <sub>2</sub> , %	13.86	13.63	13.68	13.66				

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	2.79	2.88	3.19	2.91	2.94	0.004	2.22	9%	0.27
Hg(II) - oxidized	0.27	0.40	0.45	0.27	0.35	0.0004	0.26	42%	0.15
Hg(tot) - Quartz Wool Plug	NP	0.003	0.003	0.001	0.003	3.3E-06	0.002	121%	0.00
Total Hg	3.06	3.29	3.64	3.18	3.29	0.004	2.49	12%	0.39

NP -- analysis not performed

\*Frontier Geoscience method is not designed to representatively quantify the mercury solids fraction, these values represent mercury vapor that adsorbed on the flyash collected on the quartz wool plug during sampling.

**FRONTIER GEOSCIENCES**  
**MERCURY SPECIATION LABORATORY SUMMARY**

Test Number	Raw Laboratory Data		Corrected Data <sup>(1)</sup>		Total Mercury, ng/trap	% of TripBlank to Reported Lab Data
	Trap A, ng/trap	Trap B, ng/trap	Trap A, ng/trap	Trap B, ng/trap		
<b>ELEMENTAL MERCURY – Hg(0)</b>						
TRIP BLANK 1	0.362	0.307	--	--	0.362	--
TRIP BLANK 2	0.56	0.398	--	--	0.56	--
2-MESA-IN	70.8	0.591	70.3	NB (2)	70.3	0.7%
3-MESA-IN	169	0.344	168.5	NB (2)	168.5	0.3%
3A-MESA-IN	51.5	0.475	51.0	NB (2)	51.0	0.9%
1-MESA-OUT	1.9	0.254	1.4	NB (2)	1.4	32.0%
2-MESA-OUT	109	0.356	108.5	NB (2)	108.5	0.4%
3-MESA-OUT	150	0.277	149.5	NB (2)	149.5	0.3%
3A-MESA-OUT	326	0.456	325.5	NB (2)	325.5	0.1%
1-MESA-STK	133	0.353	132.5	NB (2)	132.5	0.3%
2-MESA-STK	127	1.08	126.5	0.728	127.3	0.6%
3-MESA-STK	272	0.384	271.5	NB (2)	271.5	0.2%
3A-MESA-STK	220	0.353	219.5	NB (2)	219.5	0.2%
<b>OXIDIZED MERCURY – Hg(II)</b>						
TRIP BLANK 1	0.245	0.984	--	--	1.23	--
TRIP BLANK 2	1.57	1.69	--	--	3.26	--
2-MESA-IN	283	24	282.1	22.7	304.8	0.7%
3-MESA-IN	175	104	174.1	102.7	276.8	0.8%
3A-MESA-IN	306	91.4	305.1	90.1	395.2	0.6%
1-MESA-OUT	0.546	0.173	0.55	NB (2)	0.55	
2-MESA-OUT	441	172	440.1	170.7	610.8	0.4%
3-MESA-OUT	461	58.6	460.1	57.3	517.4	0.4%
3A-MESA-OUT	295	75.8	294.1	74.5	368.6	0.6%
1-MESA-STK	13.8	0.635	12.9	NB (2)	12.9	17.4%
2-MESA-STK	18.7	0.137	17.8	NB (2)	17.8	12.6%
3-MESA-STK	30.1	10.2	29.2	8.9	38.1	5.9%
3A-MESA-STK	21.2	0.208	20.3	NB (2)	20.3	11.1%
<b>OXIDIZED MERCURY ON QUARTZ WOOL FILTER, ng/probe</b>						
TRIP BLANK 1	2.39 (3)	NA	--	--	2.39	--
TRIP BLANK 2	0.134	NA	--	--	0.134	--
2-MESA-IN	3.81	NA	3.68	--	3.68	4%
3-MESA-IN	3.72	NA	3.59	--	3.59	4%
3A-MESA-IN	0.534	NA	0.400	--	0.400	34%
2-MESA-OUT	0.696	NA	0.562	--	0.562	24%
3-MESA-OUT	10.3	NA	10.2	--	10.2	--
3A-MESA-OUT	0.130	NA	ND	--	ND	
2-MESA-STK	0.284	NA	0.150	--	0.150	89%
3-MESA-STK	0.416	NA	0.282	--	0.282	--
3A-MESA-STK	0.221	NA	0.087	--	0.087	154%

NA - not applicable

NB - no significant breakthrough past Trap A was detected.

ND - not detected, sample value below trip blank level.

Notes:

(1) Average of trip blanks subtracted from sample values.

(2) Trap B mercury levels less than twice average trip blank value, therefore Trap B is treated as zero.

(3) Trip Blank 1 not subtracted from sample results, high value is anomalous.



**FRONTIER GEOSCIENCES MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM – ESP INLET**  
**AUGUST 1996**

Fuel Type:	COAL	Test Method:	MESA
Avg. Trip Blank (ng/train):	0.46	Analytical Method:	CVAFS
	0.91	Laboratory:	Frontier Geosciences
	0.134	Date Analyzed:	August 1996
F-factor @0%O <sub>2</sub> :	9594	Reference Temp., F:	68

Test No.	ng/train	ug/m <sup>3</sup>	ug/Nm <sup>3</sup>	O <sub>2</sub> %	CO <sub>2</sub> %	Sample Volume, dscf	Pitot Flowrate, dscfm <sup>(1)</sup>	lb/hr	lb/ 10 <sup>12</sup> Btu
<b>2-MESA-IN</b>									
Hg(0) - elemental	70.3	1.51	1.62	6.13	12.93	1.642	340,247	0.002	1.29
Hg(II) - oxidized	304.8	6.55	7.03					0.008	5.57
Hg(tot) - Quartz Wool Plug	3.68	0.08	0.08					1.0E-04	0.07
Hg (total)	378.8	8.15	8.74					0.010	6.92
<b>3-MESA-IN</b>									
Hg(0) - elemental	168.5	3.49	3.75	5.40	13.64	1.705	327,659	0.004	2.83
Hg(II) - oxidized	276.8	5.73	6.15					0.007	4.65
Hg(tot) - Quartz Wool Plug	3.59	0.07	0.08					9.1E-05	0.06
Hg (total)	448.9	9.30	9.98					0.011	7.55
<b>3A-MESA-IN</b>									
Hg(0) - elemental	51.0	0.92	0.98	5.23	13.75	1.966	329,486	0.001	0.74
Hg(II) - oxidized	395.2	7.10	7.62					0.009	5.70
Hg(tot) - Quartz Wool Plug	0.40	0.01	0.01					0.000	0.01
Hg (total)	446.6	8.02	8.61					0.010	6.44
<b>AVERAGE:</b>									
Hg(0) - elemental	96.64	1.97	2.12	5.59	13.44	1.771	332,464	0.002	1.62
Hg(II) - oxidized	325.56	6.46	6.93					0.008	5.31
Hg(tot) - Quartz Wool Plug	2.554	0.05	0.06					6.7E-05	0.04
Hg (total)	424.7	8.49	9.11					0.011	6.97

ND -- mercury not detected above trip blank level in sample fraction (treated as zero).  
Trip blank levels subtracted from sample values.

**Notes:**

(1) Pitot flow rate from corresponding isokinetic tests.

**CALCULATIONS:**

ug/m<sup>3</sup> = ng/train \* ng/1000ug \* 35.31/sample volume, dscf

lb/hr = ng/train \* lb/454\*10<sup>-9</sup> ng l/sample volume, dscf \* Qsd \* 60 min/hr

lb/10<sup>12</sup>Btu = ng/train \* lb/454\*10<sup>-9</sup> ng \* l/sample volume,dscf \* F-factor@0%O<sub>2</sub>,dscf/mmBtu \* 10<sup>-6</sup>\* 20.9/(20.9-%O<sub>2</sub>)

**FRONTIER GEOSCIENCES MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM – ESP OUTLET/FGD INLET**  
**AUGUST 1996**

Fuel Type:	COAL	Test Method:	MESA
Avg. Trip Blank (ng/train):	0.46 Hg(0) - Trap A only	Analytical Method:	CVAFS
	0.91 Hg(II) - Traps A&B	Laboratory:	Frontier Geosciences
	0.134 Hg (tot) - Probe	Date Analyzed:	August 1996
F-factor @0%O <sub>2</sub> :	9594 9631 9655 dscf/MMBtu	Reference Temp., F:	68

Test No.	ng/train	ug/m <sup>3</sup>	ug/Nm <sup>3</sup>	O <sub>2</sub> %	CO <sub>2</sub> %	Sample Volume, dscf	Pitot Flowrate, dscfm <sup>(1)</sup>	lb/hr	lb/ 10 <sup>12</sup> Btu
<b>2-MESA-OUT</b>									
Hg(0) - elemental	108.5	1.39	1.49	5.34	13.62	2.765	331,647	0.002	1.12
Hg(II) - oxidized	610.8	7.80	8.37					0.010	6.29
Hg(tot) - Quartz Wool Plug	0.56	0.01	0.01					8.9E-06	0.01
Hg (total)	719.9	9.19	9.87					0.011	7.42
<b>3-MESA-OUT</b>									
Hg(0) - elemental	149.5	1.90	2.04	5.32	13.71	2.782	330,081	0.002	1.53
Hg(II) - oxidized	517.4	6.57	7.05					0.008	5.31
Hg(tot) - Quartz Wool Plug	10.2	0.13	0.14					1.6E-04	0.10
Hg (total)	677.1	8.59	9.22					0.011	6.94
<b>3A-MESA-OUT</b>									
Hg(0) - elemental	325.5	4.16	4.47	4.25	14.61	2.762	330,081	0.005	3.15
Hg(II) - oxidized	368.6	4.71	5.06					0.006	3.56
Hg(tot) - Quartz Wool Plug	ND	ND	ND					ND	ND
Hg (total)	694.1	8.87	9.52					0.011	6.71
<b>AVERAGE:</b>									
Hg(0) - elemental	194.54	2.48	2.66	4.97	13.98	2.770	330,603	0.003	1.93
Hg(II) - oxidized	498.89	6.36	6.82					0.008	5.05
Hg(tot) - Quartz Wool Plug	5.36	0.07	0.07					8.4E-05	0.06
Hg (total)	698.8	8.91	9.56					0.011	7.04

ND – mercury not detected above trip blank level in sample fraction (treated as zero).  
Trip blank levels subtracted from sample values.

**Notes:**

(1) Pitot flow rate from corresponding isokinetic tests.

**CALCULATIONS:**

ug/m<sup>3</sup> = ng/train \* ng/1000ug \* 35.31/sample volume, dscf

lb/hr = ng/train \* lb/454\*10<sup>-9</sup> ng 1/sample volume, dscf \* Qsd \* 60 min/hr

lb/10<sup>12</sup>Btu = ng/train \* lb/454\*10<sup>-9</sup> ng \* 1/sample volume,dscf \* F-factor@0%O<sub>2</sub>,dscf/MMBtu \* 10<sup>6</sup> \* 20.9/(20.9-%O<sub>2</sub>)

**FRONTIER GEOSCIENCES MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM – FGD OUTLET/STACK**  
**AUGUST 1996**

Fuel Type:	COAL	Test Method:	MESA
Avg. Trip Blank (ng/train):	0.46 Hg(0) - Trap A only	Analytical Method:	CVAFS
	0.91 Hg(II) - Traps A&B	Laboratory:	Frontier Geosciences
	0.134 Hg (tot) - Probe	Date Analyzed:	August 1996
F-factor @0%O <sub>2</sub> :	9594 9631 9655 dscf/MMBtu	Reference Temp., F:	68

Test No.	ng/train	ug/m <sup>3</sup>	ug/Nm <sup>3</sup>	O <sub>2</sub> %	CO <sub>2</sub> %	Sample Volume, dscf	Pitot Flowrate, dscfm <sup>(1)</sup>	lb/hr	lb/ 10 <sup>12</sup> Btu
<b>1-MESA-STK</b>									
Hg(0) - elemental	132.5	2.60	2.79	5.63	13.86	1.802	358,667	3.5E-03	2.13
Hg(II) - oxidized	12.9	0.25	0.27					3.4E-04	0.21
Hg(tot) - Quartz Wool Plug	NP	NP	NP					NP	NP
Hg (total)	145.4	2.85	3.06					3.8E-03	2.33
<b>2-MESA-STK</b>									
Hg(0) - elemental	127.3	2.68	2.88	5.33	13.63	1.674	358,779	3.6E-03	2.16
Hg(II) - oxidized	17.8	0.38	0.40					5.0E-04	0.30
Hg(tot) - Quartz Wool Plug	0.15	0.003	0.003					4.2E-06	0.003
Hg (total)	145.2	3.06	3.29					4.1E-03	2.47
<b>3-MESA-STK</b>									
Hg(0) - elemental	271.5	2.97	3.19	5.35	13.68	3.226	362,692	4.0E-03	2.41
Hg(II) - oxidized	38.1	0.42	0.45					5.7E-04	0.34
Hg(tot) - Quartz Wool Plug	0.28	0.003	0.003					4.2E-06	0.002
Hg (total)	309.9	3.39	3.64					4.6E-03	2.75
<b>3A-MESA-STK</b>									
Hg(0) - elemental	219.5	2.71	2.91	5.33	13.66	2.862	362,692	3.7E-03	2.19
Hg(II) - oxidized	20.3	0.25	0.27					3.4E-04	0.20
Hg(tot) - Quartz Wool Plug	0.09	0.001	0.001					1.5E-06	0.001
Hg (total)	239.9	2.96	3.18					4.0E-03	2.39
<b>AVERAGE:</b>									
Hg(0) - elemental	187.72	2.74	2.94	5.34	13.66	2.587	361,388	3.7E-03	2.22
Hg(II) - oxidized	22.26	0.32	0.35					4.4E-04	0.26
Hg(tot) - Quartz Wool Plug	0.17	0.002	0.003					3.3E-06	0.002
Hg (total)	210.2	3.07	3.29					4.1E-03	2.49

ND – mercury not detected above trip blank level in sample fraction (treated as zero).  
Trip blank levels subtracted from sample values.

**Notes:**

(1) Pitot flow rate from corresponding isokinetic tests.

**CALCULATIONS:**

ug/m<sup>3</sup> = ng/train \* ng/1000ug \* 35.31/sample volume, dscf

lb/hr = ng/train \* lb/454\*10<sup>9</sup> ng l/sample volume, dscf \* Qsd \* 60 min/hr

lb/10<sup>12</sup>Btu = ng/train \* lb/454\*10<sup>9</sup> ng \* l/sample volume, dscf \* F-factor@0%O<sub>2</sub>, dscf/mmBtu \* 10<sup>-6</sup> \* 20.9/(20.9-%O<sub>2</sub>)

**TABLE 5**  
**SUMMARY OF FRONTIER GEOSCIENCE MERCURY SPECIATION RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Species	Mercury Emissions, ug/Nm <sup>3</sup>		
	ESP INLET	ESP OUTLET	STACK
Hg(0) -- Elemental	2.12	2.66	2.94
Hg(II) - Oxidized	6.93	6.82	0.35
Hg(tot) - Quartz Wool Filter	0.06	0.07	0.00
Hg - Total	9.11	9.56	3.29

**DECLASSIFIED**

BY WHM DATE ~~2-14-00~~

DRAFT RESULTS -- CONFIDENTIAL  
DO NOT CITE OR QUOTE

**ESP AND FGD REMOVAL EFFICIENCIES FOR MERCURY SPECIES**  
**NYSEG POST RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Species	Mercury Emissions, lb/10 <sup>6</sup> Btu			ESP Removal Efficiency	FGD Removal Efficiency*
	ESP INLET	ESP OUTLET	STACK		
Hg(0)	1.62	1.93	2.22	-19.4%	-
Hg(II) - oxidized	5.31	5.05	0.26	4.8%	94.8%
Hg(tot) - Quartz Wool Plug	0.04	0.06	0.00	-23.8%	96.4%
Hg (total)	6.97	7.04	2.49	-1.0%	64.7%

\* Assumes Unit 1 and Unit 2 concentrations are equal.

**QUALITY ASSURANCE/QUALITY CONTROL RESULTS  
EPA METHOD 29 AND FRONTIER GEOSCIENCE METHODS**

Test Number	Train Fraction	Matrix Spike Analysis		Duplicate Analysis		Relative Difference, %
		Matrix Spike Recovery, %	Matrix Spike Duplicate Recovery, %	First Run	Second Run	
				ug/fraction		
1-MTLS-OUT	Front-Half	110	110	ND(0.090)	ND(0.090)	NC
	Back-Half	90	89	29	30	3.4
	MKO	85	85	4.8	4.7	2.1
	KMnO <sub>4</sub> /HCl	100	100	6.3	6.1	
1-MTLS-STK	Front-Half	120	120	ND(0.030)	ND(0.030)	NC
	Back-Half	100	110	2.9	2.9	0.0
	MKO	110	100	0.056	0.046	19.6
	KMnO <sub>4</sub> /HCl	100	100	15	14	6.9
MESA	Hg(0)	108	101	--	--	124
	Hg(II)	97	107	--	--	4.6

**RAW FIELD BLANK LABORATORY DATA**

Test Method	Train Fraction	FB-MTLS-OUT	2FB-MTLS-OUT	FB-MTLS-STK	2FB-MTLS-STK
		ug/train			
Method 29	Front-Half	ND<0.030	ND<0.030	ND<0.030	0.032
	Back-Half	ND<0.19	ND<0.19	ND<0.20	ND<0.20
	MKO	ND<0.010	ND<0.010	ND<0.010	ND<0.010
	KMnO <sub>4</sub> /HCl	ND<0.063	0.10	0.22	0.092

**RAW TRIP BLANK LABORATORY DATA**

Test Method	Train	Trip Blank 1	Trip Blank 2	
	Fraction	ng/train		
MESA	Hg(0)	0.362	0.56	
	Hg(II)	1.23	3.26	
	Quartz Wool/	2.39	0.134	ng/probe
	Probe			

# Report on Mercury Speciation in a NYSEG Coal Burning Facility

prepared for

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Carnot

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September 10, 1996

## Case Narrative

### SAMPLE COLLECTION

MESA method samples were collected by Carnot personnel for this series of experiments. Further details about the MESA sampling effort should be addressed to Carnot personnel. It is assumed that the MESA method samples were collected following standard operating procedure (SOP) for sample collection (FGS-023). Appendix A includes our observations of the sample trains during receipt and digestion.

### SAMPLE C.O.C.

Sample 3A-MESA-STK on the COC was assumed to be the field labeled sample 3B-MESA-OUT as discussed with Kusha Janati. Samples 1-MESA-OUT, 1-MESA-STK and 2-MESA-IN were void (do not analyzed) on the COC. These samples were analyzed anyway.

### SAMPLE ANALYSIS

The analysis of the solid sorbent traps for mercury speciation was completed by closely following SOP FGS-024 and FGS-031 for MESA method sample analysis and the peer reviewed article by Prestbo and Bloom, 1995.

The iodated carbon traps ( $\text{Hg}^0$  and quartz wool particulate plug ( $\text{Hg}_p$ ) were leached with hot refluxing 7:3 solution of  $\text{HNO}_3:\text{H}_2\text{SO}_4$  and then diluted with 5% (v/v)  $\text{BrCl}$  solution. An aliquot of the digest was analyzed for Hg by aqueous phase  $\text{SnCl}_2$  reduction, dual gold trap amalgamation and finally detected by cold vapor atomic fluorescence spectroscopy (CVAFS).

The entire contents of the  $\text{KCl/lime}$  traps ( $\text{Hg(II)}$ ) were dissolved in 100 mL of 6%/4%  $\text{BrCl/HCl}$  (v/v) solution. An aliquot of the digest was analyzed for Hg by aqueous phase  $\text{SnCl}_2$  reduction, dual gold trap amalgamation detection by CVAFS.

A large number of quality assurance measurements were made during the analysis of the MESA method samples. A 4-point standard curve was generated at the beginning of each day and check standards were analyzed approximately every 10 samples. Most of the sorbent trap digests were analyzed in duplicate. Analysis spike recoveries were performed on both  $\text{KCl/lime}$ , iodated carbon and quartz wool plug digests at a rate of approximately 1 per 10 samples analyzed. A laboratory internal reference standard, DORM-2, was analyzed each analysis day to test for method control. Two field blanks trains were also analyzed for quality control. For your



information, we are not currently doing any spike recoveries directly into a sample digest. All of the above QA information is reported for each Hg species in Tables 2-4.

Overall the analysis of the MESA method sorbent traps was under control at all times and thus were well within the acceptable QA boundaries. There were approximately 6 transcription errors which were discovered and reconciled by recalculation and/or sample reruns.

All original lab bench sheets, calculations and other pertinent information will be kept on file at Frontier Geosciences for 3 years and is available if needed.

## RESULTS - DISCUSSION

All of the results of analysis are found in Tables 2-4. Only ng/trap are reported because we were not provided with accurate sample volume data. The values of ng/trap are not field blank corrected.

A method detection limit is reported for each species of mercury measured. For  $\text{Hg}^0$  the field blank and B-trap values were combined to arrive at a mean blank and standard deviation of the blank for the purpose of calculating a more meaningful method detection limit. For  $\text{Hg(II)}$  only the trip blank values are used to calculate a blank. For  $\text{Hg}_p$ , only the single low value was used for the blank value.

Note that the values reported for Hg on the wool plug/quartz probe are only qualitatively indicative of the amount of particulate Hg. The MESA method does not sample isokinetically.

Total Hg is the sum of  $\text{Hg(II)}$ ,  $\text{Hg}^0$  and  $\text{Hg}_p$

Site Carnot Results of Hg Speciation in Combustion Flue Gas  
Frontier Geosciences, August-1996, Eric M. Prestbo

Table 2: Elemental Hg

Sample ID	Stream/ Run	A Trap ng/trap	RPD A Trap ng/trap (n)	B Trap ng/trap	RPD B Trap ng/trap (n)	Sample Volume liters#	Hg(0) ug/m3
1-MESA	OUT	1.90	1.58 (2)	0.254		70	0.02
1-MESA	STACK	133		0.353		55	2.41
2-MESA	IN	70.8	3.95 (2)	0.591		50	1.41
2-MESA	OUT	109		0.356		80	1.36
2-MESA	STACK	127		1.08	124 (2)	50	2.53
2A-MESA	IN	7.82	0.38 (2)	0.434		50	0.15
2A-MESA	OUT	128	1.56 (2)	0.636	136 (2)	80	1.59
2A-MESA	STACK	145	5.52 (2)	0.555		50	2.89
3-MESA	IN	169	4.73 (2)	0.344		50	3.37
3-MESA	OUT	150	2.01 (2)	0.277		80	1.87
3-MESA	STACK	272	0.74 (2)	0.384		95	2.86
3A-MESA	IN	51.5	5.05 (2)	0.475		60	0.85
3A-MESA	OUT	326	1.53 (2)	0.456		80	4.07
3A-MESA	STACK	220	4.55 (2)	0.353		95	2.31
4-MESA	OUT	381	6.82 (2)	0.416		85	4.48
4-MESA	STACK	116	3.45 (2)	digest w/A trap		80	1.44
TRIP BLANK 1		0.362		0.307			
TRIP BLANK 2		0.56		0.398			

Detection limit (3 X sigma field blank/0.060 cubic meters)

Hg(0) ug/m<sup>3</sup> 0.009

Mean Blank*	Std Dev
ng/trap	ng/trap
0.452	0.185

Laboratory Spike Recovery - 1.0 ng

pg expect	pg recovered	%Rec
5.070	5.455	108
4.191	4.251	101

SRM DORM-2 (Expect 4.64 ng/ml)

4.85
4.94

\* Grand average of field blank and B Trap values

Example Calculation for Field Blank Correct Elemental Hg ug/m<sup>3</sup>

(TrapA-Mean Blank)/Volume

#ug/m<sup>3</sup> - volume qualitative by Carnot

RPD = Relative Percent Difference - when n>2 then %RSD is calculated

Site Carnot Results of Hg Speciation in Combustion Flue Gas  
Frontier Geosciences, August-1996, Eric Prestbo Ph.D.

Table 3: Oxidized Hg(II)

Sample ID	Stream/ Run	A Trap ng/trap	RPD A Trap ng/trap (n)	B Trap ng/trap	RPD B Trap ng/trap (n)	Sample Volume liters#	Hg(II) ug/m <sup>3</sup>
1-MESA	OUT	0.546	78.1 (2)	0.173	72.8 (2)	70	<0.033
1-MESA	STACK	13.8	49.3 (2)	0.635		55	0.23
2-MESA	IN	283	6.82 (3)	24	1.67 (2)	50	6.10
2-MESA	OUT	441	4.08 (2)	172	4.08 (2)	80	5.50
2-MESA	STACK	18.7	18.2 (2)	0.137		50	0.35
2A-MESA	IN	205	19.8 (3)	69.2	2.6 (2)	50	4.08
2A-MESA	OUT	465	0.43 (2)	43.9	12.5 (3)	80	5.80
2A-MESA	STACK	3.9	32.8 (2)	0.332	38.8 (3)	50	0.06
3-MESA	IN	175	5.71 (2)	104	5.77 (2)	50	3.48
3-MESA	OUT	461	5.21 (2)	58.6	1.19 (2)	80	5.75
3-MESA	STACK	30.1	15.2 (2)	10.2	10.7 (2)	95	0.31
3A-MESA	IN	306	2.28 (2)	91.4	16.0 (2)	60	5.08
3A-MESA	OUT	295	6.78 (2)	75.8	2.51 (2)	80	3.67
3A-MESA	STACK	21.2	1.42 (2)	0.208		95	0.21
4-MESA	OUT	4.45	<0.1 (2)	5.30	22.1 (2)	85	0.04
4-MESA	STACK	5.58	7.53	1.74	26.9 (2)	80	0.06
TRIP BLANK 1		0.245		0.984			
TRIP BLANK 2		1.57		1.69			

Detection limit (3 X sigma field blank/0.060 cubic meters)

Hg(II) ug/m<sup>3</sup> 0.033

Mean Blank*	Std Dev
ng/trap	ng/trap
1.12	0.66

Laboratory Spike Recovery - 1.0 ng

pg expect	pg recovered	%Recovery
1.252	1.103	88.1
1.114	1.175	105
3.266	3.597	110
1.319	1.366	104

SRM DORM-2 (Expect 4.64 ng/ml)

4.97  
4.85

\* Grand average of trip blank trap values

Example Calculation for Field Blank Correct Oxidized Hg (II) ug/m<sup>3</sup>

((TrapA+Trapb)-2\*Mean Blank)/Volume

# Volume not available from Carnot

RPD = Relative Percent Difference - when n>2 then %RSD is calculated

Site Carnot Results of Hg Speciation in Combustion Flue Gas  
Frontier Geosciences, August-1996, Eric Prestbo Ph.D

Table 4: Probe Total Hg

Sample ID	Stream/ Run	Probe ng/probe	RPD Probe ng/probe (n)	Sample Volume liters	Probe Hg ug/Nm3#
1-MESA	OUT	na		70	na
1-MESA	STACK	na		55	na
2-MESA	IN	3.81	12.1 (3)	50	0.074
2-MESA	OUT	0.696		80	0.007
2-MESA	STACK	0.284		50	0.003
2A-MESA	IN	na		50	na
2A-MESA	OUT	0.259		80	0.002
2A-MESA	STACK	0.631		50	0.010
3-MESA	IN	3.72		50	0.072
3-MESA	OUT	10.3	6.05 (3)	80	0.127
3-MESA	STACK	0.416		95	0.003
3A-MESA	IN	0.534		60	0.007
3A-MESA	OUT	0.130		80	0.000
3A-MESA	STACK	0.221		95	0.001
4-MESA	OUT	0.091		85	<0.005
4-MESA	STACK	0.570		80	0.005
TRIP BLANK 1		2.39 X			
TRIP BLANK 2		0.134			

Detection limit (3 X sigma field blank/0.060 cubic meters)

Probe Hg ug/m<sup>3</sup>: Est. 0.005

Mean Blank*	Std Dev
ng/trap	ng/trap
0.134	

Laboratory Spike Recovery - 1.0 ng

ng expect	ng recovered	%Recovery
1.034	1.056	102
1.583	1.534	97

SRM DORM-2 (Expect 4.64 ng/ml)

4.85
4.94

\* Grand average of field blank and B Trap values

Example Calculation for Field Blank Correct Elemental Hg ug/m<sup>3</sup>

(TrapA-Mean Blank)/Volume

#ug/Nm<sup>3</sup> @ 1 Atm and 70 degrees F

RPD = Relative Percent Difference - when n>2 then %RSD is calculated

**MESA SAMPLE TRAIN STANDARD VOLUMES**  
**NYSEG POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Test No.	Test Type	Sample Volume, liters	Barometric Pressure, "Hg	Meter Press., iwg	Meter Temp., deg. F	Yd	Std. Vol., dscf	Sample Train Information			
								O <sub>2</sub> , %	CO <sub>2</sub> , %	Pitot Flow Rate, dscfm	Corresponding Iso. Test
2-MESA-IN	Normal	52.5	29.83	1.0	122.2	0.977	1.642	6.13	12.93	340,247	2-MTLS-IN
3-MESA-IN	Normal	52.1	29.68	1.0	93.5	0.977	1.705	5.40	13.64	327,659	3-MTLS-IN
3A-MESA-IN	Normal	61.7	29.68	1.0	108.4	0.977	1.966	5.23	13.75	329,486	3-PM/AN-IN
1-MESA-OUT	Normal	73.46	29.86	1.0	126.0	1.031	2.411	5.20	14.25	323,354	1-MTLS-OUT
2-MESA-OUT	Normal	82.42	29.83	1.0	112.6	1.031	2.765	5.34	13.62	331,647	2-MTLS-OUT
2A-MESA-OUT	Low Temp	84.77	29.83	1.0	101.8	1.031	2.899	5.20	13.54	331,647	2-MTLS-OUT
3-MESA-OUT	Normal	81.04	29.68	1.0	96.8	1.031	2.782	5.32	13.71	330,081	3-MTLS-OUT
3A-MESA-OUT	Normal	81.32	29.68	1.0	102.7	1.031	2.762	4.25	14.61	330,081	3-MTLS-OUT
4-MESA-OUT	High Temp	53.42	29.79	1.0	104.4	1.031	1.816	4.60	15.28	321,047	3-SV-OUT
1-MESA-STK	Normal	55.14	29.12	0.5	106.8	1.02	1.802	5.63	13.86	358,667	1-MTLS-STK
2-MESA-STK	Normal	50.18	29.08	1.0	95.5	1.020	1.674	5.33	13.63	358,779	2-MTLS-STK
2A-MESA-STK	Low Temp	50.11	29.08	1.0	90.3	1.020	1.687	5.20	13.54	358,779	2-MTLS-STK
3-MESA-STK	Normal	96.26	29.07	1.0	92.6	1.020	3.226	5.35	13.68	362,692	3-MTLS-STK
3A-MESA-STK	Normal	85.86	29.07	1.0	95.7	1.020	2.862	5.33	13.66	362,692	3-MTLS-STK
4-MESA-STK	High Temp	49.91	29.08	1.0	93.5	1.020	1.671	5.70	14.25	328,348	3-SV-STK

**PRE-TEST DATA:**  
Isometric Press., in. Hg. 29.83  
summed Slack Temp. °F  
summed Meter Temp. °F  
summed ΔP  
summed Moisture %  
slack Diameter, in.  
sample Time: Total  
per point  
Total of Traverse Points  
Non Connecting  
Line (Y/N)  
Kinetic Factor  
ΔH = X ΔP

**EQUIPMENT INFO:**  
Meter ID No. 2983  
Meter, Yd. Low flow  
CFM @ ΔH = 1.0 0.977  
Pilot: Quartz  
Probe: 4"  
Nozzle:  
Filter:  
TC Readout ID: Meter  
Aux.

**PRE-TEST CALIBRATION CHECK:**  
Meter Meter Temp  
Time ΔH Reading In Out  
Ink Final

**SAMPLE TRAIN LEAK CHECK:**  
CFM Vac Pilot Inlet  
Pre-Test 0.00 16" 0.8  
Post-Test 0.00 16" 0.8

**POST TEST INFO:**  
Imp. Mat'l Wt (End) Wt (Start) Wt (g)  
#1  
#2  
#3  
#4  
#5  
Total  
Filter Appearance  
Impinger Appearance  
Silica Gel Spent (Y/N)

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F				STATIC PRESS. InHg	CHAIN OF CUSTODY INFORMATION	
		NO. 1	ΔH	METER READING	CHART STACK	PROBE	METER IN	METER OUT			
I-3	830	1.0	544	644.7	217	195	125	127	6.5	Impingers Loaded	
	850		"	650.2	223	195	125	125	6.5	Impingers Recovered	
	900		"	654.9	226	195	122	124	6.5	Filter Loaded	
	910		"	660.1	235	199	123	125	6.5	Filter Recovered	
	920		"	665.0	236	197	122	124	8	Probe Wash	
I-2	930		"	670.0	234	196	120	123	8	TEST SUMMARY	
	940		"	675.0	235	196	120	123	10	Calculated by: DK	
	950		"	679.3	232	195	120	122	15	Checked by: DK	
	1000		"	682.8	233	196	120	122	15	Stack Press (InHg)	
	1010		"	686.0	232	196	121	123	15	Stack Temp (°F)	
STOP	1020		"	690.6	234	196	121	124	15	ΔP (InHg) 6.13	12.93
	1030		"	694.0	230	197	115	119	15	O <sub>2</sub> /CO <sub>2</sub> <del>52.5</del>	
	1040			697.2						Meter Vol. (scf) 52.5	1.0
										Meter Temp (°F) 122.2	
										Meter Press. (InHg) 1.0	
										Liquid Vol. (g)	
										Comments: 0.434 l/min	

From 2-MESA-W  
9/1/86

C. 2 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

SAMPLE LOCATION ESP Duct TEST CONDITION (willow) AMB. TEMP., °F 11  
 OPERATOR/ASSISTANT EC METER VOL. (START/END) 1 DATE 8/9/06

**PRE-TEST DATA:**

Barometric Press., in. Hg. 29.68  
 Assumed Slack Temp. °F 100  
 Assumed Meter Temp. °F 100  
 Assumed ΔP 1.0  
 Assumed Moisture % 0  
 Slack Diameter, in. 16"  
 Sample Time: Total 100 per point 100  
 Total of Traverse Points 100  
 Teflon Connecting 100  
 Isothetic Factor 1.0  
 ΔH = 1.0 X ΔP

**EQUIPMENT INFO:**

Meter ID No. 0.937  
 Meter, Yd. 0.937  
 CFM @ ΔH = 1.0 0.937  
 Pilot: 1  
 Probe: 1  
 Nozzle: 1  
 Filter: 1  
 TC Readout ID: Meter 1  
 Aux. 1

**TEMPERATURES, °F**

METER	TEMPERATURES, °F	
	IN	OUT
1	92	92
2	92	92
3	91	93
4	91	92
5	91	92
6	92	93
7	92	93
8	92	93
9	92	93
10	92	93
11	92	93
12	92	93
13	92	93
14	92	93
15	92	93
16	92	93
17	92	93
18	92	93
19	92	93
20	92	93
21	92	93
22	92	93
23	92	93
24	92	93
25	92	93
26	92	93
27	92	93
28	92	93
29	92	93
30	92	93
31	92	93
32	92	93
33	92	93
34	92	93
35	92	93
36	92	93
37	92	93
38	92	93
39	92	93
40	92	93
41	92	93
42	92	93
43	92	93
44	92	93
45	92	93
46	92	93
47	92	93
48	92	93
49	92	93
50	92	93
51	92	93
52	92	93
53	92	93
54	92	93
55	92	93
56	92	93
57	92	93
58	92	93
59	92	93
60	92	93
61	92	93
62	92	93
63	92	93
64	92	93
65	92	93
66	92	93
67	92	93
68	92	93
69	92	93
70	92	93
71	92	93
72	92	93
73	92	93
74	92	93
75	92	93
76	92	93
77	92	93
78	92	93
79	92	93
80	92	93
81	92	93
82	92	93
83	92	93
84	92	93
85	92	93
86	92	93
87	92	93
88	92	93
89	92	93
90	92	93
91	92	93
92	92	93
93	92	93
94	92	93
95	92	93
96	92	93
97	92	93
98	92	93
99	92	93
100	92	93

**POST TEST INFO:**

Filter Appearance 1  
 Impinger Appearance 1  
 Silica Gel Spent (Y/N) 1

**SAMPLE TRAIN LEAK CHECK:**

CEM Vac Pilot Init  
 Pre-Test 16"  
 Post-Test 16"

**PRE-TEST CALIBRATION CHECK:**

Meter Meter Temp  
 Time ΔH Reading In Out  
 Init Final

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F				STATIC PRESS.	CHAIN OF CUSTODY INFORMATION
		ΔH	METER READING	STACK	PROBE	METER IN	METER OUT	OVEN		
2-3	930	1.0	734.8	299	196	92	92			Impingers Loaded
	940	"	741.8	301	204	92	92			Impingers Recovered
	950	"	746.2	302	205	91	93			Filter Loaded
	1000	"	749.2	296	200	91	92			Filter Recovered
2-2	1010	"	751.0	301	196	91	92			Probe Wash
	1020	"	752.4	300	197	92	93			TEST SUMMARY
START	1030	"	752.6	299	204	92	92			Calculated by: OK
STOP	1040	"	752.6	299	204	92	92			Checked by: OK
W-1	1050	"	757.2	299	207	93	93			Slack Press (inHg)
	1100	"	762.1	298	201	93	96			Slack Temp (°F)
	1110	"	765.0	299	202	94	93			ΔP (inHg)
	1120	"	772.2	299	202	94	93			O <sub>2</sub> CO <sub>2</sub>
	1130	"	778.1	299	203	93	99			Meter Vol. (scf)
	1140	"	783.5	299	203	93	99			Meter Temp (°F)
			789.9	299	203	93	99			Meter Press. (inHg)
				299						Liquid Vol (g)
										Comments: 0.4341/min

\* From 3-point test

TEST DATA:

ometric Press., in. Hg. 29.68

umed Slack Temp. °F 17

umed Meter Temp. °F 12

umed ΔP RC

umed Moisture % RC

x Diameter, in. RC

ple Time: Total RC

per point RC

il of Traverse Points RC

on Connecting RC

Line (Y/N) RC

hletic Factor RC

ΔH = RC X ΔP RC

EQUIPMENT INFO:

Meter ID No. 0.773

Meter, Yd. 0.773

CFM @ ΔH = 1.0 0.773

Pilot: Quartz

Probe: 41

Nozzle: 41

Filter: 1

Tare Wt. 1

TC Readout ID: Meter 1

Aux. 1

PRE-TEST CALIBRATION CHECK:

Time ΔH Reading In Out

Init RC

Final RC

SAMPLE TRAIN LEAK CHECK:

CEM Vac Pilot Inlet

Pre-Test 100 17 12 RC

Post-Test 100 12 12 RC

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F						STATIC PRESS. Inwg	CHAIN OF CUSTODY INFORMATION		
		Initial PWS #	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP. OUT			O <sub>2</sub>	VAC.
							IN	OUT						
W-3	1340	1.0	54	789.8	211	202	100	100				5	Impingers Loaded	
	1350		"	795.2	214	198	100	100				5	Impingers Recovered	
	1400		"	801.2	215	200	107	107				5	Filter Loaded	
	1410		"	807.8	214	203	107	108				6.5	Filter Recovered	
	1420		"	811.6	214	200	107	109				6.5	Probe Wash	
W-2	1430		"	815.8	213	199	109	109				6.5	TEST SUMMARY	
	1440		"	820.7	214	199	109	109				6.5	Calculated by: AL	
	1450		"	826.2	212	197	108	110				6.5	Checked by: DK	
	1500		"	831.7	213	196	109	110				9	Slack Press (Inwg)	
	1510		"	835.2	213	196	109	110				9	Slack Temp (°F)	
W-1	1520		"	840.9	213	193	110	111				10	ΔP (Inwg) 5.23# 13.75	
	1530		"	845.4	212	197	110	112				10.5	O <sub>2</sub> /CO <sub>2</sub> <del>61.7/11.45</del>	
	1540		"	851.5									Meter Vol. (act) 61.7 Liters	
													Meter Temp. (°F) 108.4	
													Meter Press. (Inwg) 1.0	
STOP													Liquid Vol. (g)	
Comments: 0.514 g/min														

From 3-PM to 11-PM



**EQUIPMENT INFO:**

Meter ID No. 1002

Meter, Yd. 1.021

CFM @  $\Delta H = 1.0$

Pilot: ID 1.021 Cp 1.021

Probe: Mat'l 1.021 Length 1.021

Nozzle: ID/Mat'l 1.021 Diam. 1.021

Filter: No. 1.021 Tare Wt. 1.021

TC Readout ID: Meter 1.021 Aux. 1.021

**PRE-TEST DATA:**

rometeric Press., in. Hg. 29.86

summed Slack Temp. °F 1.021

summed Meter Temp. °F 1.021

summed  $\Delta P$  1.021

summed Moisture % 1.021

ick Diameter, in. 1.021

mple Time: Total 1.021 per point 1.021

el of Traverse Points 1.021

ion Connecting 1.021

Line (Y/N) 1.021

Kinetic Factor 1.021

$\Delta H =$  1.021 X  $\Delta P$

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F						O <sub>2</sub>	VAC.	STATIC PRESS. Inwg	CHAIN OF CUSTODY INFORMATION
		ΔH ΔP	1/m ΔH	METER READING	STACK	PROBE	METER °C		OVEN	IMP. OUT				
							IN	OUT						
V3	1025	1.0	.45	1725.56	274	180		47				3		Impingers Loaded
V3	1040	1.0	.42	1731.81	274	186		46				2.5		Impingers Recovered
V3	1055	1.0	.40	1737.95	275	204		49				2.5		Filter Loaded
V3	1100	1.0	.50	1744.70	274	204		51				3		Filter Recovered
V3	1125	1.0	.50	1750.92	275	204		52				2.5		Probe Wash
V2	1140	1.0	.50	1757.72	278	201		53				3.0		TEST SUMMARY
V2	1155	1.0	.48	1764.01	278	180		54				2.5		Calculated by: DK
V2	1210	1.0	.45	<del>1775.61</del>	276	202		54				2.5		Checked by:
V2	1225	1.0	.45	1775.61	276	202		54				2.5		Slack Press (Inwg)
V2	1240	1.0	.45	1781.41	275	206		55				2.5		Slack Temp (°F)
V1	1255	1.0	.45	1787.51	275	198		55				2.5		ΔP (Inwg) * 5.20 / 14.25
V1	1300	1.0	.45	1793.11	274	201		56				2.5		O <sub>2</sub> CO <sub>2</sub> <del>1.021</del> 1.021
V1	1325			1799.02				STOP						Meter Vol. (L) 73.46 L ✓
														Meter Temp (°F) 52.2 °C ✓
														Meter Press. (Inwg) 1.0 ✓
														Liquid Vol (g) 175.46
														Comments: 0.41 L/min

**TEST DATA:**  
Metric Press., In. Hg. 29.83  
ned Slack Temp. °F  
ned Meter Temp. °F  
ned ΔP  
ned Moisture %  
Diameter, In.  
ile Time: Total  
per point  
of Traverse Points  
Connecting  
Line (Y/N)  
Metric Factor  
AH = X ΔP

**EQUIPMENT INFO:**  
Meter ID No. NCC2  
Meter, Yd. 1.031  
CFM @ ΔH = 1.0  
Pilot: ID  
Cp  
Mat'l  
Length  
ID/Mat'l  
Diam.  
No.  
Tare Wt.  
TC Readout ID: Meter  
Aux.

**TEMPERATURES, °F**  
Imp. Mat'l Wt (End) Wt (Start) Wt (g)  
#1  
#2  
#3  
#4  
#5  
Total  
POST TEST INFO:  
Filter Appearance  
Impinger Appearance  
Silica Gel Spent (Y/N)

**PRE-TEST CALIBRATION CHECK:**  
Time ΔH Reading In Out  
Meter Meter Temp

**SAMPLE TRAIN LEAK CHECK:**  
CEM Vac Pilot Init  
Pre-Test 0000 10" SP  
Post-Test 0100 10" SP

METER CONDITIONS	TIME	TEMPERATURES, °F			STATIC PRESS. lwg	CHAIN OF CUSTODY INFORMATION		
		ΔH	METER READING	STACK	PROBE	IMP. IN	IMP. OUT	OVEN
V3	0845	1.0	1801.74	277	181	46	—	—
V3	0900	1.0	1807.79	277	192	46	—	—
V3	0915	1.0	1813.97	277	204	47	—	—
V3	0930	1.0	1819.83	278	195	47	—	—
V2	0945	1.0	1826.69	279	201	47	—	—
V2	1000	1.0	1833.70	279	210	47	—	—
V2	1015	1.0	1841.05	278	210	48	—	—
V2	1030	1.0	1848.05	279	198	46	—	—
V1	1045	1.0	1855.40	279	188	43	—	—
V1	1100	1.0	1862.74	282	200	41	—	—
V1	1115	1.0	1869.85	281	208	40	—	—
V1	1130	1.0	1877.00	281	205	40	—	—
V1	1145	1.0	1884.16			STOP	—	—
			7.141	1993	4183			

Comments: 0.46 l/min  
From 2-0H-OUT 1/11

CLIENT ALISE U 2 STI YES MEI 1 T 1 PA 1  
SAMPLE LOCATION OUTLET ESP TEST CONDITION Full Flow PROJECT # 11410  
OPERATOR/ASSISTANT JAW METER VOL. (START/END) 1 AMB. TEMP. °F 81.4 DATE 8/9/94

**PRE-TEST DATA:**  
Barometric Press., in. Hg. 29.68  
Assumed Slack Temp. °F 100  
Assumed Meter Temp. °F 100  
Assumed  $\Delta P$  1.0  
Assumed Moisture % 0  
Slack Diameter, in. 3/8  
Sample Time: Total 1hr  
per point 3  
Total of Traverse Points 3  
Teflon Connecting 3  
Line (Y/N) X  
Isokinetic Factor 1  
 $\Delta H =$  X  $\Delta P$

**EQUIPMENT INFO:**  
Meter ID No. ACC 2  
Meter, Yd. 1.031  
CFM @  $\Delta H = 1.0$  1.031  
Probe: Quant  
ID 4'  
Cp 4'  
Mat'l 4'  
Length 4'  
ID/Mat'l 4'  
Diam. 4'  
No. 4'  
Tare Wt. 4'  
TC Readout ID: Meter 4'  
Aux. 4'

**SAMPLE TRAIN LEAK CHECK:**  
CEM Vac Pilot Init  
Pre-Test 0.000 10" 10" 10"  
Post-Test 0.000 10" 10" 10"

**PRE-TEST CALIBRATION CHECK:**  
Meter Meter Temp  
Time  $\Delta H$  Reading In Out  
Init Final

SAMPLE POINT	TIME	METER CONDITIONS				TEMPERATURES, °F				O <sub>2</sub>	VAC.	STATIC PRESS. l/wg	CHAIN OF CUSTODY INFORMATION
		4m	$\Delta H$	METER READING	STACK	PROBE	METER		OVEN				
J3	0845	145	1.0	1968.96	281	210	IN	OUT	~	~	7	*	Impingers Loaded
J3	0800	145	1.0	1976.56	281	179	IN	OUT	~	~	6	*	Impingers Recovered
J3	0915	145	1.0	1983.42	279	181	IN	OUT	~	~	10	*	Filter Loaded
J3	0930	145	1.0	1990.36	280	179	IN	OUT	~	~	6	*	Filter Recovered
J2	0945	145	1.0	1996.63	282	183	IN	OUT	~	~	6	*	Probe Wash
J2	1000	145	1.0	2003.21	282	185	IN	OUT	~	~	6	*	TEST SUMMARY
J2	1015	145	1.0	2009.73	284	212	IN	OUT	~	~	6	*	Calculated by: <u>OK</u>
J2	1030	145	1.0	2016.13	282	212	IN	OUT	~	~	6	*	Checked by: <u>OK</u>
W1	1045	145	1.0	2023.00	283	212	IN	OUT	~	~	6	*	Slack Press (l/wg)
J1	1100	145	1.0	2029.55	286	197	IN	OUT	~	~	6	*	Slack Temp (°F)
J1	1115	145	1.0	2036.21	287	184	IN	OUT	~	~	6	*	$\Delta P$ (l/wg) <u>5.32</u> / 13.31
J1	1130	145	1.0	2043.53	287	185	IN	OUT	~	~	6	*	O <sub>2</sub> CO <sub>2</sub> <u>81.04</u>
J1	1145	145	1.0	2050.00	287	185	IN	OUT	~	~	6	*	Meter Vol. (l/wg) <u>36.0</u> / 96.8
													Meter Temp (°F) <u>1.0</u>
													Meter Press. (l/wg) <u>1.0</u>
													Liquid Vol (g)
													Comments: *Temp as high as

FROM 3-OH-OUT 0.45 l/min 280 of

**EQUIPMENT INFO:**  
Meter ID No. NCC.2  
Meter, Yd. 1.031  
CFM  $\Delta H = 1.0$   
Pilot: Quartz  
Probe: 4"  
Nozzle: 36c  
Filter: 1bc  
TC Readout ID: Meter 3 Aux. X AP

**TEST DATA:**  
Metric Press., in. Hg. 29.68  
Unsed Stack Temp. °F X  
Unsed Meter Temp. °F X  
Unsed  $\Delta P$  X  
Unsed Moisture % X  
Stack Diameter, in. X  
Sample Time: Total 36c per point  
# of Traverse Points 1bc  
on Connecting 3  
Line (Y/N) X  
Inlet Factor X  
 $\Delta H =$  X AP

**PRE-TEST CALIBRATION CHECK:**  
Time  $\Delta H$  Reading In Out  
Meter Meter Temp  
Pre-Test 0.000 10" SP  
Post-Test 0.000 10" SP

**SAMPLE TRAIN LEAK CHECK:**  
CEM VAC Pilot Init  
Pre-Test 0.000 10" SP  
Post-Test 0.000 10" SP

**POST TEST INFO:**  
Filler Appearance  
Impinger Appearance  
Silica Gel Spent (Y/N)

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F						O <sub>2</sub>	VAC.	STATIC PRESS. lwg	CHAIN OF CUSTODY INFORMATION
		4m	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP. OUT				
							IN	OUT						
J3	1245	145	1.0	2050.13	282	190	36	~	~	~	7	*	Impingers Loaded	
J3	1300	145	1.0	2056.79	283	191	37	~	~	~	7	*	Impingers Recovered	
J3	1315	145	1.0	2063.55	284	191	37	~	~	~	7	*	Filler Loaded	
J3	1330	145	1.0	2070.31	283	191	38	~	~	~	7	*	Filler Recovered	
J2	1345	145	1.0	2077.01	283	191	39	~	~	~	7	*	Probe Wash	
J2	1400	145	1.0	2083.81	283	191	40	~	~	~	7	*	TEST SUMMARY	
J2	1415	145	1.0	2090.29	284	191	40	~	~	~	7	*	Calculated by: <u>OK</u>	
J2	1430	145	1.0	2096.82	284	191	40	~	~	~	7	*	Checked by: <u>OK</u>	
J1	1445	145	1.0	2103.41	286	193	41	~	~	~	7	*	Stack Press (hwg)	
J1	1500	145	1.0	2110.34	286	193	41	~	~	~	7	*	Stack Temp. (°F)	
J1	1515	145	1.0	2117.45	286	193	41	~	~	~	7	*	ΔP (hwg) <u>4.25</u> <u>14.61</u>	
J1	1530	145	1.0	2124.45	286	193	42	~	~	~	7	*	O <sub>2</sub> /CO <sub>2</sub> <u>8.32</u>	
	1545			2131.45				STOP					Meter Vol. (gas) <u>8.32</u>	
													Meter Temp. (ET) <u>39.3 °C</u>	
													Meter Press. (hwg) <u>1.0</u> ✓ <u>102.3</u>	
													Liquid Vol. (g)	
						191.6							Comments: <u>0.458/min</u>	

\* From 3-0H-out 0.458/min

CLIENT NY 206  
SAMPLE LOCATION STAC 12  
OPERATOR/ASSISTANT NM.

U... 2  
TEST CONDITION:  
METER VOL. (STA

STA 1-M. A  
Fullond,  
T/END) 551,833

NET: Free 'ng.  
AMB. TEMP.: °F 1557.347

PROJECT # 11476  
DATE 8-7-96

atmos. Press., in. Hg.	67.16
assumed Slack Temp. °F	120
assumed Meter Temp. °F	111.5
assumed $\Delta P$	1.2
assumed Moisture %	13%
Black Diameter, in.	1.80
Sample Time: Total	20
total of Traverse Points	Sample Point -
Station Connecting	
Line (YN)	Y.
okinetic Factor	Y $\Delta P$
$\Delta H =$	1.0 <del>Y</del>

Meter ID No.	
Meter, Yd.	1.00
CFM @ $\Delta H = 1.0$	
Pilot:	ID
Probe:	Cp
Nozzle:	Mat'l
	Length
	ID/Mat'l
	Diam.
	No.
	Tare Wt.
TC Readout ID:	Meter
	Aux.

#1		-	.		
#2		-	.		
#3		-	.		
#4		-	.		
#5		-	.		
Total		-	.		

**POST TEST INFO:**  
 Filter Appearance \_\_\_\_\_  
 Impinger Appearance \_\_\_\_\_  
 Col Count (VNI) \_\_\_\_\_

CEM	Vac	Pilot	Ink
Pre-Test	0.000 15"	—	RM
Post-Test	0.000 5"	—	RM

**PRE-TEST CALIBRATION CHECK:**

Time	AH	Reading	In	Meter	Temp

Ink \_\_\_\_\_  
Elect \_\_\_\_\_

Time	ΔH	Meter Reading	Meter Temp
Initial			
Final			

[illegible]



*[Handwritten signature]*

**PRE-TEST DATA:**  
Barometric Press., in. Hg. 29.07  
Assumed Slack Temp. °F 123  
Assumed Meter Temp. °F 90  
Assumed ΔP .47/in  
Assumed Moisture % 1.4%  
Slack Diameter, in. 12.1  
Sample Time: Total 180  
per point 30  
Total of Traverse Points SP.  
Reflow Connecting Y  
Line (Y/N) Y  
Solubility Factor 1.0 X ΔP

**EQUIPMENT INFO:**  
Meter ID No. NCC-1  
Meter, Yd. 1.020  
CFM @ ΔH = 1.0 90  
Pilot: ID 41  
Probe: RTX/Telco  
Nozzle: 41  
Filler: TC 021  
Tare Wt. TC 021  
TC Readout ID: Meter TC 021  
Aux. TC 021

**TEMPERATURES, °F**  
Imp. Mat'l Wt (End) Wt (Start) Wt (g)  
#1 - - -  
#2 - - -  
#3 - - -  
#4 - - -  
#5 - - -  
Total - - -  
POST TEST INFO:  
Filter Appearance -  
Impinger Appearance -  
Silica Gel Spent (Y/N) -

**SAMPLE TRAIN LEAK CHECK:**  
CFM Vac Pilot Inlet  
Pre-Test 8002 15" - RM  
Post-Test 0.000 8" - RM

**PRE-TEST CALIBRATION CHECK:**  
Time ΔH Reading In Out  
Meter Meter Temp  
Inlet Final

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F				STATIC PRESS. InHg	CHAIN OF CUSTODY INFORMATION	
		ΔH	METER READING	STACK	PROBE	METER IN	OUT	OVEN			
<u>Sample</u>	<u>1215</u>	<u>.46</u>	<u>5788.89</u>		<u>196</u>	<u>96</u>				<u>5.4</u>	<u>6.1</u>
<u>Sample</u>	<u>1245</u>	<u>.49</u>	<u>5803.49</u>		<u>203</u>	<u>97</u>				<u>5.4</u>	<u>6.6</u>
	<u>1315</u>	<u>.50</u>	<u>5817.76</u>		<u>203</u>	<u>96</u>				<u>5.3</u>	<u>6.5</u>
	<u>1345</u>	<u>.50</u>	<u>5832.38</u>		<u>205</u>	<u>95</u>				<u>5.3</u>	<u>6.5</u>
	<u>1415</u>	<u>.50</u>	<u>5846.65</u>		<u>200</u>	<u>95</u>				<u>5.3</u>	<u>6.5</u>
	<u>1445</u>	<u>.50</u>	<u>5860.57</u>		<u>202</u>	<u>95</u>				<u>5.3</u>	<u>6.5</u>
<u>End</u>	<u>1515</u>		<u>5874.75</u>								
TEST SUMMARY											
Calculated by: <u>DK</u>											
Checked by: <u>DK</u>											
Slack Press (InHg)											
Slack Temp (°F)											
ΔP (InHg)											
O <sub>2</sub> CO <sub>2</sub> <u>5.33</u> <u>13.66</u>											
Meter Vol., (cc) <u>85.86</u> <u>2</u>											
Meter Temp. (°F) <u>108.95</u> <u>3</u>											
Meter Press. (InHg) <u>0.49</u>											
Liquid Vol. (g)											
Comments: <u>Probe Temp</u>											



UNIT 04 G SAMPLE LOCATION OUTLET ESP OPERATOR/ASSISTANT JP  
 TEST 2A METER 2A PROJECT # 8196  
 DATE 8/26  
 TEST CONDITION FULL LOAD METER VOL. (START/END) 1  
 AMBI. TEMP. °F 7

**PRE-TEST DATA:**  
 Isometric Press., In. Hg. 29.83  
 Isured Slack Temp. °F 3he  
 Isured Meter Temp. °F 1he  
 Isured ΔP 3  
 Isured Mixture %  
 Slack Diameter, In.  
 Sample Time: Total  
 per point  
 Total of Traverse Points  
 Non Connecting  
 Line (Y/N)  
 Kinetic Factor  
 ΔH = X ΔP

**EQUIPMENT INFO:**  
 Meter ID No. 10031  
 Meter, Yd.  
 CFM @ ΔH = 1.0  
 Pilot: ID  
 Probe: ID  
 Nozzle: ID  
 Filter: No.  
 TC Readout ID: Meter  
 Aux.

**POST TEST INFO:**  
 Filter Appearance  
 Impinger Appearance  
 Silica Gel Spent (Y/N)

**IMP. MAT'L** Wt. (End) Wt. (Start) Wt. (g)  
 #1  
 #2  
 #3  
 #4  
 #5  
 Total  
 Filter Appearance  
 Impinger Appearance  
 Silica Gel Spent (Y/N)

**SAMPLE TRAIN LEAK CHECK:**  
 CFM Vac Pilot Init  
 Pre-Test 0000 10" JP  
 Post-Test 0100 10" JP

**PRE-TEST CALIBRATION CHECK:**  
 Meter Meter Temp  
 Time ΔH Reading In Out  
 Init Final

SAMPLE POINT	TIME	METER CONDITIONS		TEMPERATURES, °F				O <sub>2</sub>	VAC.	STATIC PRESS. lwg	CHAIN OF CUSTODY INFORMATION	
		ΔP	ΔH	METER READING	STACK	PROBE	METER IN OUT	OVEN	IMP. OUT			
V3	1210	.45	1.0	1884.16	278	150	37	~	~	*	Impingers Loaded	
V3	1225	.45	1.0	1891.32	277	145	37	~	~	*	Impingers Recovered	
V3	1240	.45	1.0	1898.41	277	140	37	~	~	*	Filter Loaded	
V3	1255	.45	1.0	1905.46	276	145	38	~	~	*	Filter Recovered	
V2	1310	.45	1.0	1912.69	277	148	38	~	~	*	Probe Wash	
V2	1325	.45	1.0	1919.59	278	147	37	~	~	*	TEST SUMMARY	
V2	1340	.45	1.0	1926.60	277	162	39	~	~	*	Calculated by: <u>OK</u>	
V2	1355	.45	1.0	1933.79	278	162	40	~	~	*	Checked by: <u>OK</u>	
V1	1410	.45	1.0	1940.77	278	160	40	~	~	*	Stack Press (lwg)	
V1	1425	.45	1.0	1947.71	277	158	41	~	~	*	Stack Temp (°F)	
V1	1440	.45	1.0	1954.72	277	149	42	~	~	*	ΔP (lwg) <u>5.20" / 13.54</u>	
V1	1455	.45	1.0	1962.05	277	150	40	~	~	*	O <sub>2</sub> /CO <sub>2</sub> <u>START</u>	
	1510			1968.93			STOP				Meter Vol. (lwg) <u>84.77</u>	
											Meter Temp. (°F) <u>38.8°C</u>	
											Meter Press. (lwg)	
											Liquid Vol. (g)	
											Comments: <u>0.47 l/min</u>	

A From 2-0H-OUT  
 2-0H-OUT

CLIENT Nyco UNIT #2 TEST NO. 41-MC-5-001 METHOD PRNT. 6EL PAGE 1 OF 1  
SAMPLE LOCATION OUTLET 62R TEST CONDITION Full Load AMB. TEMP., °F 71-72.6 PROJECT # 11-476  
OPERATOR/ASSISTANT W METER VOL. (START/END) 1 DATE 8-13-86

[illegible]

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F							STATIC PRESS. lbw	CHAIN OF CUSTODY INFORMATION	
		Wm RPL	AH	METER READING	STACK	OF PROBE	METER		OVEN	IMP. OUT	O <sub>2</sub>			VAC.
							IN	OUT						
1-2	903	.48	1.1	2320.00	~	284°	~	~	~	~	~	7	Impingers Loaded	
1	913	.45	1.0	2324.42	~	284°	~	~	~	~	~	7	Impingers Recovered	
	923	.46	1.0	2329.12	~	284°	~	~	~	~	~	7	Filler Loaded	
	933	.45	1.0	2335.51	~	284°	~	~	~	~	~	6	Filler Recovered	
	943	.45	1.0	2339.25	~	284°	~	~	~	~	~	6	Probe Wash	
	953	.45	1.0	2343.76	~	284°	~	~	~	~	~	6	TEST SUMMARY	
1	1003	.45	1.0	2348.15	~	284°	~	~	~	~	~	6	Calculated by: AK	
	1013	.45	1.0	2352.51	~	284°	~	~	~	~	~	6	Checked by: AK	
	1023	.45	1.0	2356.42	~	284°	~	~	~	~	~	6	Slack Press (w/g)	
	1033	.45	1.0	2360.31	~	284°	~	~	~	~	~	6	Slack Temp (°F)	
	1043	.45	1.0	2364.81	~	284°	~	~	~	~	~	6	ΔP (w/g)	
V	1053	.45	1.0	2368.00	~	284°	~	~	~	~	~	6	O <sub>2</sub> CO <sub>2</sub> 4.50 15.20	
	1103			2373.42				STOP					Meter Vol. 1.0 53.42 ✓	
													Meter Temp (°F) 40.2 °C ✓	
													Meter Press. (w/g) 1.0 ✓	
													Liquid Vol (g) → 104.4°F	
													Comments: Possible up to	

Time	Temp	Pressure	Flow	Level	Notes
5 min	24.5	1.0	1.0	1.0	1.0

CLIENT Y 6 illi no fio. EST 7A. ka PROJECT # 112116  
 SAMPLE LOCATION STACK TEST CONDITION Full Load AMB. TEMP. °F 56.7  
 OPERATOR/ASSISTANT RM METER VOL. (START/END) 562.494 DATE 8-8-96

**RE-TEST DATA:**  
 Isometric Press., In. Hg. 29.08  
 Isometric Slack Temp. °F 223  
 Isometric Meter Temp. °F 95  
 Isometric ΔP 14  
 Isometric Moisture % 121  
 Slack Diameter, In. 180  
 Sample Time: Total 30  
 per point Single Pt.  
 No. of Traverse Points Y  
 If on Connecting Y  
 Line (Y/N)  
 Hydraulic Factor Y  
 AH = 1.0 X AP

**EQUIPMENT INFO:**  
 Meter ID No. NCC1  
 Meter, Yd. 1020  
 CFM @ ΔH = 1.0 Q12/12.110  
 Pilot: ID 4"  
 Probe: 4"  
 Nozzle: 4"  
 Filter: TC 021  
 Tare Wt. TC 021  
 TC Readout ID: Meter TC 021  
 Aux.

**POST TEST INFO:**  
 Filter Appearance TC 021  
 Impinger Appearance TC 021  
 Silica Gel Spent (Y/N) TC 021

**PRE-TEST CALIBRATION CHECK:**  
 Time ΔH Reading In Out  
 Meter Meter Temp

**SAMPLE TRAIN LEAK CHECK:**  
 CFM Vac Pilot Inlet  
 Pre-Test 0.002 15" RM  
 Post-Test 0.000 6" RM

SAMPLE POINT	TIME	METER CONDITIONS		TEMPERATURES, °F				STATIC PRESS. InHg	CHAIN OF CUSTODY INFORMATION
		ΔH	METER READING	STACK	PROBE	METER IN	OUT		
SP. 1	1237	.45	562.494	150	89	8.3	2.9		Impingers Loaded
SP. 2	1307	.45	563.357	149	92	9.3	2.9		Impingers Recovered
SP. 3	1337	.45	564.178	149	91	9.2	2.9		Filter Loaded
SP. 4	1407	.45	564.999	149	90	9.2	2.9		Filter Recovered
SP. 5	1437	.45	565.888	149	90	9.1	2.9		Probe Wash
SP. 6	1507	.45	566.678	151	90	9.1	2.9		TEST SUMMARY
End.	1537	.	567.505						Calculated by: <u>OK</u>
									Checked by: <u>DIC</u>
									Slack Press (InHg)
									Slack Temp. (°F)
									ΔP (InHg)
									O <sub>2</sub> /CO <sub>2</sub> <u>5.20</u> <u>13.51</u>
									Meter Vol., (acft) <u>50.11</u> ✓
									Meter Temp. (°F) <u>90.3</u> ✓
									Meter Press. (InHg) <u>0.00</u> <u>1.0</u> ✓
									Liquid Vol. (g)
									Comments:

30.11.1.1  
 13.51  
 50.11  
 90.3  
 0.00  
 1.0

UNIT: 11476 PROJECT # 11476 TEST NO. 11476 METHOD 11476  
PLE LOCATION STACK TEST CONDITION Full Load AMB. TEMP. °F 90°F DATE 8/13/96  
RATOR/ASSISTANT Full Load METER VOL. (START/END) 1

**TEST DATA:**  
Electric Press., In. Hg. 79.08  
Lead Stack Temp. °F 1020  
Lead Meter Temp. °F 1020  
Lead AP 1020  
Lead Moisture % 1020  
Diameter, In. 1020  
Time: Total 1020  
per point 1020  
of Traverse Points 1020  
Connecting 1020  
Line (YN) 1020  
Electric Factor 1020  
AH = 1020 X AP

**EQUIPMENT INFO:**  
Meter ID No. NCC-1  
Meter, Yd. 1.020  
CFM @ AH = 1.0 1.020  
Pilot: ID Cp Mat'l Length ID/Mat'l Diam. No. Tare Wt.  
Probe: Quartz  
Nozzle: 4'  
Filter: 1020  
TC Readout ID: Meter Aux.  
TC Readout ID: Meter Aux.

**POST TEST INFO:**  
Filter Appearance 1020  
Impinger Appearance 1020  
Silica Gel Spent (Y/N) 1020

**PRE-TEST CALIBRATION CHECK:**  
Meter Meter Temp  
Time AH Reading In Out  
Initial Final

**SAMPLE TRAIN LEAK CHECK:**  
CEM Vac Pilot Init  
Pre-Test 0 15  
Post-Test 0 15

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F			STATIC PRESS.		CHAIN OF CUSTODY INFORMATION	
		AP	AH	METER READING	STACK	PROBE	METER IN OUT	IMP. OUT	O <sub>2</sub>	VAC.	Impingers Loaded
2	0909		1.1	6045.10			87	283		8	Impingers Recovered
	0919		1.1	6051.48			90	287		7	Filter Loaded
	0929		1.0	6057			92	287	5.6	6	Filter Recovered
	0941		1.0	6062.6			93	282		6	Probe Wash
	0949		1.0	6066.4			93	285		7	TEST SUMMARY
	0959		1.0	6071.2			94	286	6.5	6.5	Calculated by: OK
	1010		1.0	6076.65			95	281		6	Checked by: OK
	1019		1.0	6080.85			95	285		6	Stack Press (hwg)
	1029		1.0	6086.85			96	289	5.8	6	Stack Temp (°F)
	1043		1.0	6091.92			97	289		6	AP (hwg)
	1049		1.0	6094.6			97	289		6	O <sub>2</sub> /CO <sub>2</sub> 5.7/14.25
	1050			6095.01							Meter Vol., (acft) 44.911 ✓
											Meter Temp. (°F) 93.5 ✓
											Meter Press. (hwg) 1.0 ✓
											Liquid Vol (g)
											Comments:
								285.7	5.7		

Appendix C.6  
Ontario-Hydro/TRIS Buffer



**ONTARIO-HYDRO AND TRIS BUFFER MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST RETROFIT TEST PROGRAM -- ESP OUTLET/FGD INLET**  
**AUGUST 1996**

<b>ONTARIO-HYDRO</b>								
Test Number	1-ONT-OUT	2-ONT-OUT	3-ONT-OUT	AVERAGE		Uncertainty		
Date	8/7/96	8/8/96	8/9/96			@95%CI		
Pitot Flow Rate, dscfm	323,354	331,647	330,081					
Sample Volume, dscf	261.06	224.41	209.72					
Fuel Factor, dscf/10 <sup>6</sup> Btu	12,532	12,837	12,739					
O <sub>2</sub> , %	4.90	5.28	5.16					
CO <sub>2</sub> , %	14.47	13.63	13.83					
Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	2.00	2.25	2.60	2.28	0.003	1.69	33%	0.75
Hg(II) - oxidized	5.25	5.59	4.88	5.24	0.006	3.88	17%	0.87
Hg(tot) - filter	ND	0.0008	ND	0.0003	3.3E-07	0.0002	--	--
Hg (total)	7.25	7.84	7.48	7.52	0.009	5.58	10%	0.73
<b>TRIS BUFFER</b>								
Test Number	1-TRIS-OUT	2-TRIS-OUT	3-TRIS-OUT	AVERAGE		Uncertainty		
Date	8/7/96	8/8/96	8/9/96			@95%CI		
Pitot Flow Rate, dscfm	323,354	331,647	330,081					
Sample Volume, dscf	35.83	39.46	39.22					
Fuel Factor, dscf/10 <sup>6</sup> Btu	12,355	12,821	12,433					
O <sub>2</sub> , %	4.67	5.20	4.67					
CO <sub>2</sub> , %	14.56	13.44	14.13					
Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	2.17	2.69	3.24	2.70	0.003	1.97	49%	1.33
Hg(II) - oxidized	4.64	4.71	4.03	4.46	0.005	3.25	21%	0.92
Hg(tot) - filter	0.001	0.006	ND	0.002	2.6E-06	0.002	--	--
Hg (total)	6.81	7.40	7.27	7.16	0.008	5.22	11%	0.77

ND -- mercury not detected in fraction (treated as zero).

**ONTARIO-HYDRO AND TRIS BUFFER MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST RETROFIT TEST PROGRAM – FGD OUTLET/STACK**  
**AUGUST 1996**

Test Number	ONTARIO-HYDRO			AVERAGE	Uncertainty @95%CI
	1-ONT-STK	2-ONT-STK	3-ONT-STK		
Date	8/7/96	8/8/96	8/9/96		
Pitot Flow Rate, dscfm	358,667	358,779	362,692		
Sample Volume, dscf	215.77	224.11	225.28		
Fuel Factor, dscf/10 <sup>6</sup> Btu	13,114	12,862	12,870		
O <sub>2</sub> , %	5.61	5.31	5.32		
CO <sub>2</sub> , %	13.83	13.60	13.69		

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu		ug/Nm <sup>3</sup>
Hg(0) - elemental	2.33	2.35	2.68	2.45	0.003	1.85	20%	0.50
Hg(II) - oxidized	0.31	0.16	0.16	0.21	0.0003	0.16	101%	0.21
Hg(tot) - filter	ND	0.0010	0.0017	0.0009	1.1E-06	0.0007	--	--
Hg (total)	2.63	2.51	2.84	2.66	0.003	2.01	15%	0.41

Test Number	TRIS BUFFER			AVERAGE	Uncertainty @95%CI
	1-TRIS-STK	2-TRIS-STK	3-TRIS-STK		
Date	8/7/96	8/8/96	8/9/96		
Pitot Flow Rate, dscfm	358,667	358,779	362,692		
Sample Volume, dscf	71.83	73.71	73.58		
Fuel Factor, dscf/10 <sup>6</sup> Btu	12,953	12,780	12,877		
O <sub>2</sub> , %	5.42	5.15	5.23		
CO <sub>2</sub> , %	13.89	13.48	13.64		

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu		ug/Nm <sup>3</sup>
Hg(0) - elemental	2.51	2.90	2.73	2.71	0.003	2.03	18%	0.50
Hg(II) - oxidized	0.18	0.23	0.03	0.15	0.0002	0.11	175%	0.26
Hg(tot) - filter	0.005	0.003	0.004	0.004	4.8E-06	0.003	190%	0.00
Hg (total)	2.69	3.14	2.76	2.87	0.004	2.14	21%	0.59

ND -- mercury not detected in fraction (treated as zero).



**SUMMARY OF EERC LABORATORY RESULTS  
TRIS BUFFER MERCURY SPECIATION METHOD  
NYSEG POST-RETROFIT TEST PROGRAM**

Test Number	Fraction	Field Blank			Sample Result			Field Blank
		Vol., ml	ug/L	ug/train	Vol., ml	ug/L	ug/train	Corrected Results, ug/train
<b>DAY 1 – 8/7/96</b>								
1-TRIS-OUT	TRIS -- Hg(II)	502	0.3	0.15	502	8.5	4.27	4.12
	KMnO4 -- Hg(0)	500	0.1	0.05	500	4.2	2.10	2.05
	Probe Rinse -- Hg(II) <sup>(1)</sup>	250	ND(0.1)	ND(0.03)	250	1.1	0.28	0.28
1-TRIS-STK	TRIS -- Hg(II)	502	0.3	0.15	1000	0.5	0.50	0.35
	KMnO4 -- Hg(0)	500	0.1	0.05	500	9.6	4.80	4.75
	Probe Rinse -- Hg(II) <sup>(1)</sup>	250	ND(0.1)	ND(0.03)	250	ND(0.1)	ND(0.03)	ND(0.03)
<b>DAY 2 – 8/8/96</b>								
2-TRIS-OUT	TRIS -- Hg(II)	500	ND(0.3)	ND(0.15)	500	5.2	2.60	2.60
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	5.6	2.80	2.80
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	9.2	2.30	2.30
2-TRIS-STK	TRIS -- Hg(II)	500	ND(0.3)	ND(0.15)	1000	0.4	0.40	0.40
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	11.3	5.65	5.65
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	0.2	0.05	0.05
<b>DAY 3 – 8/9/96</b>								
3-TRIS-OUT	TRIS -- Hg(II)	500	0.6	0.30	500	5.7	2.85	2.55
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	6.7	3.35	3.35
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	6.5	1.63	1.63
3-TRIS-STK	TRIS -- Hg(II)	500	0.6	0.30	1000	0.3	0.30	0.00
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	10.6	5.30	5.30
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	ND(0.1)	ND(0.03)	ND(0.03)

Notes:

(1) Probe rinse field blank for Day 1 was not performed, results from Day 2.

**SUMMARY OF EERC LABORATORY RESULTS  
ONTARIO-HYDRO MERCURY SPECIATION METHOD  
NYSEG POST-RETROFIT TEST PROGRAM**

Test Number	Fraction	Field Blank			Sample Result			Field Blank
		Vol., ml	ug/L	ug/train	Vol., ml	ug/L	ug/train	Corrected Results, ug/train
<b>DAY 1 – 8/7/96</b>								
1-ONT-OUT	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	35.2	35.20	36.15
					500	1.9	0.95	
	H2O2 -- Hg(0)	500	0.3	0.15	500	2.8	1.40	1.25
	KMnO4 -- Hg(0)	500	0.3	0.15	500	25.4	12.70	12.55
	Probe Rinse -- Hg(II) <sup>(1)</sup>	--	--	--	Combined with KCl fraction			--
1-ONT-STK	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	1.6	1.60	1.75
					500	0.3	0.15	
	H2O2 -- Hg(0)	500	0.3	0.15	500	0.3	0.15	0.00
	KMnO4 -- Hg(0)	500	0.3	0.15	500	26.8	13.40	13.25
	Probe Rinse -- Hg(II) <sup>(1)</sup>	--	--	--	Combined with KCl fraction			--
<b>DAY 2 – 8/8/96</b>								
2-ONT-OUT	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	28.5	28.50	28.50
	H2O2 -- Hg(0)	500	ND(0.2)	ND(0.1)	500	3.4	1.70	1.70
	KMnO4 -- Hg(0)	505	ND(0.1)	ND(0.05)	503	23.1	11.62	11.62
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	18.3	4.58	4.58
2-ONT-STK	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	0.9	0.90	0.90
					500	ND(0.1)	ND(0.05)	
	H2O2 -- Hg(0)	500	ND(0.2)	ND(0.1)	500	ND(0.2)	ND(0.1)	ND(0.1)
	KMnO4 -- Hg(0)	505	ND(0.1)	ND(0.05)	501	27.7	13.88	13.88
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	0.3	0.08	0.08
<b>DAY 3 – 8/9/96</b>								
3-ONT-OUT	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	17.4	17.40	17.40
	H2O2 -- Hg(0)	500	ND(0.2)	ND(0.1)	500	3.7	1.85	1.85
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	25.1	12.55	12.55
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	38.5	9.63	9.63
3-ONT-STK	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	0.8	0.80	0.80
					500	ND(0.1)	ND(0.05)	
	H2O2 -- Hg(0)	500	ND(0.2)	ND(0.1)	500	0.6	0.30	0.30
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	31.3	15.65	15.65
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	0.5	0.13	0.13

**Notes:**

(1) Probe rinses for the Ontario-Hydro samples were combined with the KCl impinger solution for Day 1 only. LabSum\_OH

**SUMMARY OF EERC LABORATORY RESULTS**  
**TRIS BUFFER AND ONTARIO-HYDRO MERCURY SPECIATION METHODS**  
**NYSEG POST-RETROFIT TEST PROGRAM**

Test Number	Fraction	Field Blank			Sample Result			Field Blank
		Vol., ml	ug/L	ug/train	Vol., ml	ug/L	ug/train	Corrected Results, ug/train
DAY 1 - 8/7/96								
1-TRIS-OUT	TRIS -- Hg(II)	502	0.3	0.15	502	8.5	4.27	4.12
	KMnO4 -- Hg(0)	500	0.1	0.05	500	4.2	2.10	2.05
	Probe Rinse -- Hg(II) <sup>(1)</sup>	250	ND(0.1)	ND(0.03)	250	1.1	0.28	0.28
1-TRIS-STK	TRIS -- Hg(II)	502	0.3	0.15	1000	0.5	0.50	0.35
	KMnO4 -- Hg(0)	500	0.1	0.05	500	9.6	4.80	4.75
	Probe Rinse -- Hg(II) <sup>(1)</sup>	250	ND(0.1)	ND(0.03)	250	ND(0.1)	ND(0.03)	ND(0.03)
1-ONT-OUT	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	35.2	35.20	36.15
					500	1.9	0.95	
	H2O2 -- Hg(0)	500	0.3	0.15	500	2.8	1.40	1.25
	KMnO4 -- Hg(0)	500	0.3	0.15	500	25.4	12.70	12.55
	Probe Rinse -- Hg(II) <sup>(2)</sup>	--	--	--	Combined with KCl fraction			--
1-ONT-STK	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	1.6	1.60	1.75
					500	0.3	0.15	
	H2O2 -- Hg(0)	500	0.3	0.15	500	0.3	0.15	0.00
	KMnO4 -- Hg(0)	500	0.3	0.15	500	26.8	13.40	13.25
	Probe Rinse -- Hg(II) <sup>(2)</sup>	--	--	--	Combined with KCl fraction			--
DAY 2 - 8/8/96								
2-TRIS-OUT	TRIS -- Hg(II)	500	ND(0.3)	ND(0.15)	500	5.2	2.60	2.60
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	5.6	2.80	2.80
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	9.2	2.30	2.30
2-TRIS-STK	TRIS -- Hg(II)	500	ND(0.3)	ND(0.15)	1000	0.4	0.40	0.40
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	11.3	5.65	5.65
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	0.2	0.05	0.05
2-ONT-OUT	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	28.5	28.50	28.50
	H2O2 -- Hg(0)	500	ND(0.2)	ND(0.1)	500	3.4	1.70	1.70
	KMnO4 -- Hg(0)	505	ND(0.1)	ND(0.05)	503	23.1	11.62	11.62
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	18.3	4.58	4.58
2-ONT-STK	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	0.9	0.90	0.90
					500	ND(0.1)	ND(0.05)	
	H2O2 -- Hg(0)	500	ND(0.2)	ND(0.1)	500	ND(0.2)	ND(0.1)	ND(0.1)
	KMnO4 -- Hg(0)	505	ND(0.1)	ND(0.05)	501	27.7	13.88	13.88
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	0.3	0.08	0.08

**SUMMARY OF EERC LABORATORY RESULTS**  
**TRIS BUFFER AND ONTARIO-HYDRO MERCURY SPECIATION METHODS**  
**NYSEG POST-RETROFIT TEST PROGRAM**

Test Number	Fraction	Field Blank			Sample Result			Field Blank
		Vol., ml	ug/L	ug/train	Vol., ml	ug/L	ug/train	Corrected Results, ug/train
<b>DAY 3 -- 8/9/96</b>								
3-TRIS-OUT	TRIS -- Hg(II)	500	0.6	0.30	500	5.7	2.85	2.55
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	6.7	3.35	3.35
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	6.5	1.63	1.63
3-TRIS-STK	TRIS -- Hg(II)	500	0.6	0.30	1000	0.3	0.30	0.00
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	10.6	5.30	5.30
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	ND(0.1)	ND(0.03)	ND(0.03)
3-ONT-OUT	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	17.4	17.40	17.40
	H2O2 -- Hg(0)	500	ND(0.2)	ND(0.1)	500	3.7	1.85	1.85
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	25.1	12.55	12.55
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	38.5	9.63	9.63
3-ONT-STK	KCl -- Hg(II)	500	ND(0.1)	ND(0.05)	1000	0.8	0.80	0.80
					500	ND(0.1)	ND(0.05)	
	H2O2 -- Hg(0)	500	ND(0.2)	ND(0.1)	500	0.6	0.30	0.30
	KMnO4 -- Hg(0)	500	ND(0.1)	ND(0.05)	500	31.3	15.65	15.65
	Probe Rinse -- Hg(II)	250	ND(0.1)	ND(0.03)	250	0.5	0.13	0.13

**Notes:**

- (1) Probe rinse field blank for Day 1 was not performed, results from Day 2.
- (2) Probe rinses for the Ontario-Hydro samples were combined with the KCl impinger solution for Day 1 only.

**SUMMARY OF FIELD BLANK AND SAMPLE RESULT LABORATORY DATA  
TRIS BUFFER AND ONTARIO-HYDRO METHODS**

Test Number	Train Fraction	Field Blank Level, ug/train	ESP Outlet/ FGD Inlet Sample Result, ug/train	Corrected Result, ug/train	FGD Outlet/ Stack Sample Result ug/train	Corrected Result, ug/train
<b>DAY 1 - 8/7/96</b>						
1-ONT	KCl - Hg(II)	ND(0.05)	36.15	36.15	1.75	1.75
	H2O2 - Hg(0)	0.15	1.40	1.25	0.15	0.00
	KMnO4 - Hg(0)	0.15	12.70	12.55	13.40	13.25
	Probe Rinse - Hg(II) <sup>(2)</sup>	-		-		-
1-TRIS	TRIS - Hg(II)	0.15	4.27	4.12	0.50	0.35
	KMnO4 - Hg(0)	0.05	2.10	2.05	4.80	4.75
	Probe Rinse - Hg(II) <sup>(1)</sup>	ND(0.03)	0.28	0.28	ND(0.03)	ND(0.03)
<b>DAY 2 - 8/8/96</b>						
2-ONT	KCl - Hg(II)	ND(0.05)	28.50	28.50	0.90	0.90
	H2O2 - Hg(0)	ND(0.1)	1.70	1.70	ND(0.1)	ND(0.1)
	KMnO4 - Hg(0)	ND(0.05)	11.62	11.62	13.88	13.88
	Probe Rinse - Hg(II)	ND(0.03)	4.58	4.58	0.08	0.08
2-TRIS	TRIS - Hg(II)	ND(0.15)	2.60	2.60	0.40	0.40
	KMnO4 - Hg(0)	ND(0.05)	2.80	2.80	5.65	5.65
	Probe Rinse - Hg(II)	ND(0.03)	2.30	2.30	0.05	0.05
<b>DAY 3 - 8/9/96</b>						
3-ONT	KCl - Hg(II)	ND(0.05)	17.40	17.40	0.80	0.80
	H2O2 - Hg(0)	ND(0.1)	1.85	1.85	0.30	0.30
	KMnO4 - Hg(0)	ND(0.05)	12.55	12.55	15.65	15.65
	Probe Rinse - Hg(II)	ND(0.03)	9.63	9.63	0.13	0.13
3-TRIS	TRIS - Hg(II)	0.30	2.85	2.55	0.30	0.00
	KMnO4 - Hg(0)	ND(0.05)	3.35	3.35	5.30	5.30
	Probe Rinse - Hg(II)	ND(0.03)	1.63	1.63	ND(0.03)	ND(0.03)

Notes:

(1) TRIS Probe rinse field blank for Day 1 was not performed, results from Day 2.

(2) Probe rinses for the Ontario-Hydro samples were combined with the KCl impinger solution for Day 1 only.

**ONTARIO-HYDRO AND TRIS BUFFER MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST RETROFIT TEST PROGRAM – ESP OUTLET/FGD INLET**  
**AUGUST 1996**

Fuel Type:	COAL			Test Method:	TRIS Buffer/Ontario-Hydro
Detection Limits (ug/L):	0.3	TRIS Buffer		Analytical Method:	CVAAS
	0.1	KMnO4 & KCl		Laboratory:	EERC
	0.2	H2O2		Date Analyzed:	August 1996
F-factor @0%O2:	9594	9631	9655	Reference Temp., F:	68
			dscf/MMBtu		

Test No.	ng/train	ug/m <sup>3</sup>	ug/Nm <sup>3</sup>	O <sub>2</sub> %	CO <sub>2</sub> %	Sample Volume, dscf	Pitot Flowrate, dscfm <sup>(1)</sup>	lb/hr	lb/ 10 <sup>12</sup> Btu
<b>1-ONT-OUT</b>				4.90	14.47	261.060	323.354		
Hg(0) - elemental	13.80	1.87	2.00					0.002	1.46
Hg(II) - oxidized	36.15	4.89	5.25					0.006	3.82
Hg(tot) - filter	ND<0.005	ND	ND					ND	ND
<b>TOTAL Hg</b>	<b>49.95</b>	<b>6.76</b>	<b>7.25</b>					<b>0.008</b>	<b>5.28</b>
<b>2-ONT-OUT</b>				5.28	13.63	224.406	331.647		
Hg(0) - elemental	13.32	2.10	2.25					0.003	1.68
Hg(II) - oxidized	33.08	5.20	5.59					0.006	4.18
Hg(tot) - filter	0.005	0.0008	0.0008					9.8E-07	0.0006
<b>TOTAL Hg</b>	<b>46.40</b>	<b>7.30</b>	<b>7.84</b>					<b>0.009</b>	<b>5.87</b>
<b>3-ONT-OUT</b>				5.16	13.83	209.721	330.081		
Hg(0) - elemental	14.40	2.42	2.60					0.003	1.94
Hg(II) - oxidized	27.03	4.55	4.88					0.006	3.64
Hg(tot) - filter	ND<0.005	ND	ND					ND	ND
<b>TOTAL Hg</b>	<b>41.43</b>	<b>6.97</b>	<b>7.48</b>					<b>0.009</b>	<b>5.58</b>
<b>AVERAGE:</b>				5.11	13.98	231.729	328.361		
Hg(0) - elemental	13.84	2.13	2.28					0.003	1.69
Hg(II) - oxidized	32.08	4.88	5.24					0.006	3.88
Hg(tot) - filter	0.003	0.0003	0.0003					3.3E-07	0.0002
<b>Hg (total)</b>	<b>45.93</b>	<b>7.01</b>	<b>7.52</b>					<b>0.009</b>	<b>5.58</b>
<b>1-TRIS-OUT</b>				4.67	14.56	35.832	323.354		
Hg(0) - elemental	2.05	2.02	2.17					0.002	1.56
Hg(II) - oxidized	4.39	4.33	4.64					0.005	3.34
Hg(tot) - filter	0.001	0.001	0.001					1.2E-06	0.0008
<b>TOTAL Hg</b>	<b>6.44</b>	<b>6.35</b>	<b>6.81</b>					<b>0.008</b>	<b>4.89</b>
<b>2-TRIS-OUT</b>				5.20	13.44	39.461	331.647		
Hg(0) - elemental	2.80	2.51	2.69					0.003	2.00
Hg(II) - oxidized	4.90	4.38	4.71					0.005	3.51
Hg(tot) - filter	0.006	0.005	0.006					6.7E-06	0.0043
<b>TOTAL Hg</b>	<b>7.71</b>	<b>6.90</b>	<b>7.40</b>					<b>0.009</b>	<b>5.51</b>
<b>3-TRIS-OUT</b>				4.67	14.13	39.219	330.081		
Hg(0) - elemental	3.35	3.02	3.24					0.004	2.34
Hg(II) - oxidized	4.18	3.76	4.03					0.005	2.92
Hg(tot) - filter	ND<0.005	ND	ND					ND	ND
<b>TOTAL Hg</b>	<b>7.53</b>	<b>6.77</b>	<b>7.27</b>					<b>0.008</b>	<b>5.25</b>
<b>AVERAGE:</b>				4.85	14.04	38.171	328.361		
Hg(0) - elemental	2.73	2.51	2.70					0.003	1.97
Hg(II) - oxidized	4.49	4.16	4.46					0.005	3.25
Hg(tot) - filter	0.004	0.002	0.002					2.6E-06	0.0017
<b>Hg (total)</b>	<b>7.23</b>	<b>6.67</b>	<b>7.16</b>					<b>0.008</b>	<b>5.22</b>

Field blank levels subtracted from sample values.

Note: (1) Pitot flow rates from EPA Method 29 multi-metals tests (full traverse).

**ONTARIO-HYDRO AND TRIS BUFFER MERCURY SPECIATION TEST RESULTS**  
**NYSEG POST RETROFIT TEST PROGRAM – FGD OUTLET/STACK**  
**AUGUST 1996**

Fuel Type:	COAL	Test Method:	TRIS Buffer/Ontario-Hydro
Detection Limits (ug/L):	0.3 TRIS Buffer	Analytical Method:	CVAAS
	0.1 KMnO4 & KCl	Laboratory:	EERC
	0.2 H2O2	Date Analyzed:	August 1996
F-factor @0%O2:	9594 9631 9655 dscf/MMBtu	Reference Temp., F:	68

Test No.	ng/train	ug/m <sup>3</sup>	ug/Nm <sup>3</sup>	O <sub>2</sub> %	CO <sub>2</sub> %	Sample Volume, dscf	Pitot Flowrate, dscfm <sup>(1)</sup>	lb/hr	lb/ 10 <sup>12</sup> Btu
<b>1-ONT-STK</b>									
Hg(0) - elemental	13.25	2.17	2.33	5.61	13.83	215.765	358.667	2.9E-03	1.77
Hg(II) - oxidized	1.75	0.29	0.31					3.8E-04	0.23
Hg(tot) - filter	ND<0.005	ND	ND					ND	ND
<b>TOTAL Hg</b>	<b>15.00</b>	<b>2.45</b>	<b>2.63</b>					<b>3.3E-03</b>	<b>2.01</b>
<b>2-ONT-STK</b>									
Hg(0) - elemental	13.88	2.19	2.35	5.31	13.60	224.112	358.779	2.9E-03	1.76
Hg(II) - oxidized	0.98	0.15	0.16					2.1E-04	0.12
Hg(tot) - filter	0.006	0.0009	0.0010					1.3E-06	0.0008
<b>TOTAL Hg</b>	<b>14.86</b>	<b>2.34</b>	<b>2.51</b>					<b>3.1E-03</b>	<b>1.89</b>
<b>3-ONT-STK</b>									
Hg(0) - elemental	15.95	2.50	2.68	5.32	13.69	225.284	362.692	3.4E-03	2.02
Hg(II) - oxidized	0.93	0.14	0.16					2.0E-04	0.12
Hg(tot) - filter	0.010	0.0016	0.0017					2.1E-06	0.0013
<b>TOTAL Hg</b>	<b>16.89</b>	<b>2.65</b>	<b>2.84</b>					<b>3.6E-03</b>	<b>2.14</b>
<b>AVERAGE:</b>									
Hg(0) - elemental	14.36	2.28	2.45	5.41	13.71	221.720	360.046	3.1E-03	1.85
Hg(II) - oxidized	1.22	0.19	0.21					2.6E-04	0.16
Hg(tot) - filter	0.005	0.0008	0.0009					1.1E-06	0.0007
<b>Hg (total)</b>	<b>15.58</b>	<b>2.48</b>	<b>2.66</b>					<b>3.3E-03</b>	<b>2.01</b>
<b>1-TRIS-STK</b>									
Hg(0) - elemental	4.75	2.34	2.51	5.42	13.89	71.828	358.667	3.1E-03	1.89
Hg(II) - oxidized	0.35	0.17	0.18					2.3E-04	0.14
Hg(tot) - filter	0.009	0.004	0.005					5.9E-06	0.0036
<b>TOTAL Hg</b>	<b>5.11</b>	<b>2.51</b>	<b>2.69</b>					<b>3.4E-03</b>	<b>2.03</b>
<b>2-TRIS-STK</b>									
Hg(0) - elemental	5.65	2.71	2.90	5.15	13.48	73.709	358.779	3.6E-03	2.16
Hg(II) - oxidized	0.45	0.22	0.23					2.9E-04	0.17
Hg(tot) - filter	0.006	0.003	0.003					3.9E-06	0.0023
<b>TOTAL Hg</b>	<b>6.11</b>	<b>2.93</b>	<b>3.14</b>					<b>3.9E-03</b>	<b>2.33</b>
<b>3-TRIS-STK</b>									
Hg(0) - elemental	5.30	2.54	2.73	5.23	13.64	73.577	362.692	3.5E-03	2.04
Hg(II) - oxidized	ND<0.06	ND<0.03	ND<0.03					ND<3.9E-05	ND<0.02
Hg(tot) - filter	0.007	0.003	0.004					4.6E-06	0.0027
<b>TOTAL Hg</b>	<b>5.37</b>	<b>2.58</b>	<b>2.76</b>					<b>3.5E-03</b>	<b>2.07</b>
<b>AVERAGE:</b>									
Hg(0) - elemental	5.23	2.53	2.71	5.27	13.67	73.038	360.046	3.4E-03	2.03
Hg(II) - oxidized	0.29	0.14	0.15					1.9E-04	0.11
Hg(tot) - filter	0.008	0.004	0.004					4.8E-06	0.0028
<b>Hg (total)</b>	<b>5.53</b>	<b>2.67</b>	<b>2.87</b>					<b>3.6E-03</b>	<b>2.14</b>

Field blank levels subtracted from sample values.

Note: (1) Pitot flow rates from EPA Method 29 multi-metals tests (full traverse).

**SUMMARY OF MERCURY SPECIATION TEST RESULTS  
NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM  
AUGUST 1996**

Mercury Species	Test Method	Emission Results, ug/Nm <sup>3</sup>			ESP Removal Efficiency <sup>(1)</sup>	FGD Removal Efficiency <sup>(1)</sup>
		ESP Inlet	ESP Outlet/ FGD Inlet	FGD Outlet/ Stack		
<u>Hg(0) - Elemental</u>						
	EPA Method 29	0.80	1.49	2.40	--	--
	Frontier Geoscience	2.12	2.66	2.94	--	--
	Ontario-Hydro	--	2.28	2.45	--	--
	TRIS Buffer	--	2.70	2.71	--	--
	Semtech Hg 2000 Analyzer	--	NV	2.61	--	--
<u>Hg(II) - Oxidized</u>						
	EPA Method 29	7.43	6.23	0.62	18%	90%
	Frontier Geoscience	6.93	6.82	0.35	5%	95%
	Ontario-Hydro	--	5.24	0.21	--	96%
	TRIS Buffer	--	4.46	0.15	--	97%
<u>Hg(total) - Hg Solids</u>						
	EPA Method 29	0.86	ND<0.009	0.006	99.5%	--
	Frontier Geoscience <sup>(2)</sup>	0.06	0.07	0.003	--	--
	Ontario-Hydro	--	0.0003	0.0009	--	--
	TRIS Buffer	--	0.002	0.004	--	--
<u>TOTAL Hg<sup>(3)</sup></u>						
	EPA Method 29	9.09	7.72	3.02	17%	60%
	Frontier Geoscience	9.11	9.56	3.29	--	65%
	Ontario-Hydro	--	7.52	2.66	--	64%
	TRIS Buffer	--	7.16	2.87	--	59%

NV -- results not valid. Semtech analyzer measurements performed at this location were deemed invalid due to the use of an improper sample conditioning system and detrimental ambient conditions (i.e. high temperature and dust level).

Notes:

(1) Removal efficiencies calculated using emission units of lb/10<sup>12</sup>Btu to account for any differences in flue gas dilution between locations.

(2) Frontier Geoscience method is not designed to representatively quantify the mercury solids fraction, these values represent mercury vapor that adsorbed on the flyash collected on the quartz wool plug during sampling.

(3) Total Hg is the sum of Hg(0), Hg(II), and Hg solids.



**PARTITIONING OF MERCURY SPECIES BY METHOD  
NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM  
AUGUST 1996**

Test Method	ESP Outlet/FGD Inlet		FGD Outlet/Stack	
	Hg(0)	Hg(II)	Hg(0)	Hg(II)
EPA Method 29	19%	81%	79%	21%
Frontier Geoscience	28%	71%	89%	11%
Ontario-Hydro	30%	70%	92%	8%
TRIS Buffer	38%	62%	94%	6%

**DAILY COMPARISONS OF MERCURY SPECIATION RESULTS**  
**NYSEG MILLIKEN UNIT 2 POST-RETROFIT TEST PROGRAM**  
**AUGUST 1996**

Parameter	Mercury Speciation Result, ug/Nm <sup>3</sup>					
	Test 1, 8/7/96			Test 2, 8/8/96		
	FGD Inlet	FGD Outlet	FGD Inlet FGD Outlet	FGD Inlet FGD Outlet	FGD Inlet FGD Outlet	Average
<b>Hg(0) - Elemental</b>						
EPA Method 29	1.06	2.27	1.66	2.69	1.75	2.23
Frontier Geoscience	NA <sup>(1)</sup>	2.79	1.49	2.88	3.25 <sup>(3)</sup>	3.05 <sup>(3)</sup>
Ontario-Hydro	2.00	2.33	2.25	2.35	2.60	2.68
TRIS Buffer	2.17	2.51	2.69	2.90	3.24	2.73
Semtech Hg 2000 Analyzer	NP	2.17	NP	3.03	NA <sup>(2)</sup>	2.63
					NA	2.61
<b>Hg(II) - Oxidized</b>						
EPA Method 29	5.85	0.46	7.21	0.56	5.63	0.82
Ontario-Hydro	5.25	0.31	5.59	0.16	4.88	0.16
Frontier Geoscience	NA <sup>(1)</sup>	0.27	8.37	0.40	6.05 <sup>(3)</sup>	0.36 <sup>(3)</sup>
TRIS Buffer	4.64	0.18	4.71	0.23	4.03	0.03
					4.46	0.15
<b>TOTAL Hg</b>						
EPA Method 29	6.92	2.74	8.86	3.25	7.38	3.07
Frontier Geoscience	NA <sup>(1)</sup>	3.06	9.87	3.29	9.37 <sup>(3)</sup>	3.41 <sup>(3)</sup>
Ontario-Hydro	7.25	2.63	7.84	2.51	7.48	2.84
TRIS Buffer	6.81	2.69	7.40	3.14	7.27	2.76
					7.16	2.87

NA -- data not available

NP -- test not performed

Notes:

- (1) Test run invalid, mercury levels reported by the laboratory were similar to those found in trip blanks. Test may not have sampled flue gas due to an undetected leak in sample train.
- (2) Semtech analyzer measurements performed at this location were deemed invalid due to the use of an improper sample conditioning system and detrimental ambient conditions (i.e. high temperature and dust level). Please see Section 3.1.1 for further discussion.
- (3) Results presented are an average of two sample runs performed on this day.

Daily  
6/3/97

**DISTRIBUTION OF MERCURY WITHIN SAMPLE TRAIN  
ONTARIO-HYDRO AND TRIS BUFFER METHODS  
NYSEG POST-RETROFIT TEST PROGRAM – UNIT 2  
AUGUST 1996**

Test Method/ Sample Location	Sample Train Fraction			
	Mercury Distribution, %			
<b><u>Ontario-Hydro</u></b>	<b><u>KCl</u></b>	<b><u>H<sub>2</sub>O<sub>2</sub></u></b>	<b><u>KMnO<sub>4</sub></u></b>	<b><u>Probe Rinse</u></b>
FGD Inlet	52	4	27	17
FGD Outlet	7	1	92	0
<b><u>TRIS Buffer</u></b>	<b><u>TRIS/EDTA</u></b>	<b><u>KMnO<sub>4</sub></u></b>	<b><u>Probe Rinse</u></b>	
FGD Inlet	44	38	19	
FGD Outlet	5	95	0	

Note: Inconsequential amount of mercury found on sample filters.

**QUALITY ASSURANCE/QUALITY CONTROL RESULTS  
ONTARIO-HYDRO AND TRIS BUFFER METHODS**

Test Number	Fraction	Spike Result	Spike Level	Spike Recovery, %
		ug/L		
<b><u>DAY 1 - 8/7/96</u></b>				
TRIS-FB-SPK-1	TRIS	9.7	10	97
	KMnO4	9.8	10	98
OH-FB-SPK-1	KCl	9.8	10	98
	H2O2	9.6	10	96
	KMnO4	9.5	10	95
<b><u>DAY 2 - 8/8/96</u></b>				
TRIS-FB-SPK-2	TRIS	9.5	10	95
	KMnO4	10.0	10	100
OH-FB-SPK-2	KCl	9.9	10	99
	H2O2	8.4	10	84
	KMnO4	9.8	10	98
<b><u>DAY 3 - 8/9/96</u></b>				
TRIS-FB-SPK-3	TRIS	10.5	10	105
	KMnO4	9.1	10	91
OH-FB-SPK-3	KCl	9.9	10	99
	H2O2	9.2	10	92
	KMnO4	9.3	10	93

# Analysis Report Form (Hg)

Requestor Richard Schulz  
 Fund # 4819  
 Sample Info. Hg Analysis at NYSEG / Milliken Station  
 Date Submitted August 14, 1996

Day One	TRIS Buffer	FB-1	FGD-In-1 1-TRIS-OUT Tris	FGD-out-1 1-TRIS-STACK Tris	FB-sp-1	FB-1	FGD-In-1 1-TRIS-OUT KMnO4	FGD-out-1 1-TRIS-STACK KMnO4
CARNOT SAMPLE #	FB-sp-1							
IMPINGER SOLN	Tris							
Lab #	49231-1	49231-2	49231-3	49231-4	49231-5	49231-6	49231-11	49231-12
Vol (mL)	500	502	502	1000	500	500	500	500
Units ug/L	9.7	0.3	8.5	0.5	9.8	0.1	4.2	9.5
Day One	Ontario Hydro							
CARNOT SAMPLE #	FB-sp-1							
IMPINGER SOLN	KCl							
Lab #	49231-13	49231-14	49231-15	49231-16	49231-17	49231-18	49231-19	49231-20
Vol (mL)	500	500	1000	500	1000	500	500	500
Units ug/L	8.8	< 0.1	35.2	1.9	1.5	0.3	9.5 (9.6)	0.3
Day One	TRIS							
CARNOT SAMPLE #	FGD-In-1							
IMPINGER SOLN	1-ONT-OUT							
Lab #	H2O2							
Vol (mL)	49231-21	49231-22	49231-7	49231-8	49231-9	49231-10	49231-23	49231-24
Units ug/L	500	500	505	500	500	500	250	250
	2.8	0.3	9.5	0.3	25.4	26.8	1.1	< 0.1

NOTE: SPIKED FIELD BLANKS WERE SPIKED WITH 10 ug/L.

REGULAR FIELD BLANKS SHOULD READ A LESS THAN NUMBER.

NOTE: PROBE RINSES FOR THE ONTARIO-HYDRO WERE COMBINED WITH THE KCl IMPINGER SOLUTION.

Day Two	TRIS Buffer	FB-2	FGD-In-2	FGD-out-2	FB-sp-2	FB-2	FGD-In-2	FGD-out-2
	FB-sp-2		2-TRIS-OUT	2-TRIS-STACK	KMnO4	49231-30	49231-35	2-TRIS-STACK
	Tris	49231-28	49231-27	49231-28	49231-29	500	500	KMnO4
	49231-25	500	500	1000	500	500	500	49231-36
	9.6	<0.3	6.2	0.4	10.0	<0.1	5.8 (5.6)	500
								11.3
Units ug/L								
Day Two	Ontario Hydro	FB-2	FGD-In-2	FGD-out-2	FB-sp-2	FB-2	FGD-In-2	FGD-out-2
	FB-sp-2		2-ONT-OUT	2-ONT-STACK	H2O2	H2O2	2-ONT-OUT	2-ONT-STACK
	KCl	49231-38	49231-39	49231-40	49231-41	49231-42	49231-43	
	49231-37	500	1000	1000	500	500	500	
	9.9	<0.1	28.5	0.9	<0.1	8.4	<0.2	
Units ug/L								
Day Two	OH-	FGD-In-2	FB-sp-2	FGD-out-2	FGD-In-2	FGD-out-2	FGD-In-2	FGD-out-2
	2-ONT-OUT	2-ONT-STACK	KMnO4	49231-32	49231-33	49231-34	2-ONT-OUT	2-ONT-STACK
	H2O2	49231-45	500	505	503	501	Probe Rns	Probe Rns
	49231-44	500	9.8	<0.1	23.1	27.7	49231-47	49231-48
	3.4	<0.2					250	250
							18.3	0.3
Units ug/L								
Day Two	TRIS	FB-FGD-In-2	FGD-In-2	FGD-out-2	OH-	FB-FGD-In	FGD-In-2	FGD-out-2
	Probe Rinses		2-TRIS-OUT	2-TRIS-STACK		-2	2-ONT-OUT	2-ONT-STACK
	CARNOT SAMPLE #		Probe Rns	Probe Rns	Probe Rns	49231-50	49231-47	49231-48
	IMPINGER SOLN		49231-48	49231-51	49231-50	250	250	250
	Lab #		250	0.2	<0.1	9.2		
	Vol (mL)							
	Units ug/L							

NOTE: SPIKED FIELD BLANKS WERE SPIKED WITH 10 ug/L.  
REGULAR FIELD BLANKS SHOULD READ A LESS THAN NUMBER.

NYSEG

Day Three	TRIS-Buffer	FB-3	FGD-In-3	FGD-out-3	FB-sp-3	FB-3	FGD-In-3	FGD-out-3
CARNOT SAMPLE #	FB-sp-3		3-TRIS-OUT	3-TRIS-STACK	KMnO4	KMnO4	3-TRIS-OUT	3-TRIS-STACK
IMPINGER SOLN	Tris	Tris	Tris	Tris	49231-56	49231-57	49231-62	49231-63
Lab #	49231-52	49231-53	49231-54	49231-65	500	500	500	500
Vol (mL)	500	500	500	1000	500	500	500	500
Units ug/L	10.5	0.6	5.7	0.3	8.1	< 0.1	6.7	10.6
Day Three	Ontario Hydro	FB-3	FGD-In-3	FGD-out-3	FB-sp-3	FB-3	FGD-In-3	FGD-out-3
CARNOT SAMPLE #	FB-sp-3		3-ONT-OUT	3-ONT-STACK	KCI	KCI	3-ONT-OUT	3-ONT-STACK
IMPINGER SOLN	KCI	KCI	KCI	KCI	49231-68	49231-69	H2O2	H2O2
Lab #	49231-64	49231-65	49231-66	49231-67	500	500	49231-70	500
Vol (mL)	500	500	1000	1000	500	500	500	500
Units ug/L	8.9	< 0.1	17.4	0.8 (1.3)	< 0.1	9.2	< 0.2	
Day Three	FGD-In-3	FGD-out-3	FB-sp-3	FB-3	FGD-In-3	FGD-out-3	FGD-In-3	FGD-out-3
CARNOT SAMPLE #	3-ONT-OUT	3-ONT-STACK			3-ONT-OUT	3-ONT-STACK	3-ONT-OUT	3-ONT-STACK
IMPINGER SOLN	H2O2	H2O2	KMnO4	KMnO4	KMnO4	KMnO4	Probe Rns	Probe Rns
Lab #	49231-71	49231-72	49231-58	49231-59	49231-80	49231-61	49231-74	49231-73
Vol (mL)	500	500	500	500	500	500	250	250
Units ug/L	3.7	0.6	9.3	< 0.1	25.1	31.3	38.5	0.5
Day Three	TRIS-Buffer	FB-3	FGD-In-3	FGD-out-3	FB-sp-3	FB-3	FGD-In-3	FGD-out-3
Probe Rinses	FB-3		3-TRIS-OUT	3-TRIS-STACK			3-ONT-OUT	3-ONT-STACK
CARNOT SAMPLE #			Probe Rns	Probe Rns	Probe Rns	Probe Rns	Probe Rns	Probe Rns
IMPINGER SOLN	49231-76	49231-76	49231-75	49231-78	49231-77	49231-74	49231-73	49231-73
Lab #	250	250	250	250	250	250	250	250
Vol (mL)	< 0.1	< 0.1	6.5	< 0.1	< 0.1	< 0.1	38.5	0.5
Units ug/L								

NOTE: SPIKED FIELD BLANKS WERE SPIKED WITH 10 ug/L.  
REGULAR FIELD BLANKS SHOULD READ A LESS THAN NUMBER.

## ASH

## Analysis Report Form (Hg)

Requestor Richard Schulz  
Fund # 4819  
Sample Info Hg Analysis at NYSEG / Milliken Station  
Date Submitted 8/14/96

<b>Day One</b>					
Ash					
CARNOT SAMPLE #	1-ONT-OUT	1-TRIS-OUT	1-ONT-STACK	1-TRIS-STACK	
Lab #	49235-1	49235-2	49235-3	49235-4	
Units ug	<0.005	0.001	<0.005	0.009	
<b>Day Two</b>					
Ash					
CARNOT SAMPLE #	2-ONT-OUT	2-TRIS-OUT	2-ONT-STACK	2-TRIS-STACK	
Lab #	49235-5	49235-6	49235-7	49235-8	
Units ug	0.005	0.006	0.006	0.006	
<b>Day Three</b>					
Ash				TRIS	
CARNOT SAMPLE #	3-ONT-OUT	3-TRIS-OUT	3-ONT-STACK	3-ONT-STACK	
Lab #	49235-13	49235-14	49235-11	49235-12	
Units ug	<0.005	<0.005	0.010	0.007	
<b>FIELD BLANKS</b>					
Ash					
CARNOT SAMPLE #	2-ONT-FB	3-TRIS-FB			
Lab #	49235-9	49235-10			
Units ug	<0.005	<0.005			

NOTE: THE NUMBER FOR EACH ASH IS THE TOTAL AMOUNT OF MERCURY IN THE SAMPLE.  
THE TOTAL SAMPLE WAS DIGESTED.



Line ID	ACL	Vol (ml)	DF	Cond $\mu\text{S}/\text{cm}$	Reported $\mu\text{S}/\text{cm}$
<u>KES Buffer</u>					
-FB-Spk-1 DI-1		500	2.75	3.55, 3.47, 3.56	9.7
-FB-1 DI-2		500 + v2	2.75	.100	0.3
-FGD-IN-1 DI-3		500 + v2	2.55	3.32	8.5
-FGD-OUT-1 DI-4		1000	2.16	.223	0.5
<u>1000</u>					
-FB-Spk-1 DI-5		500	1.0	9.77	9.8
-FB-1 DI-6		500	1.0	.128	0.1
-FB-Spk-1 DI-7		500 + v5	1.0	9.54	9.5
-B-1 DI-8		500	1.0	.287	0.3
-FGD-IN-1 DI-9		500	2.0	12.7	25.4
-FGD-OUT-1 DI-10		500	2.0	13.4	26.8
-FGD-IN-1 DI-11		500	1.0	4.17	4.2
-FGD-OUT-1 DI-12		500	1.0	9.61, 9.54, 9.55	9.6
-FB-Spk-1 DI-13		500	1.3	7.52, 7.58, 7.46	9.8
-FB-1 DI-14		500	1.3	.005	< 0.1
-FGD-IN-1 DI-15		1000	1.3	27.1	35.2
-FGD-IN-1 DI-16		500	1.3	1.47	1.9
-FGD-OUT-1 DI-17		1000	1.3	1.21, 1.22, 1.21	1.6
-FGD-OUT-1 DI-18		500	1.3	.225	0.3
<u>1000</u>					
-FB-Spk-1 DI-19		500	2.1	4.61, 4.62, 4.53	9.6
-FB-1 DI-20		500	2.1	.145	0.3
-FGD-IN-1 DI-21		500	1.7	1.66	2.8
-FGD-OUT-1 DI-22		500	2.2	.122	0.3
<u>1000</u>					
-FGD-IN-1 DI-23		250	1.3	.948, .837, .512	1.1
-FGD-OUT-1 DI-24		250	1.3	.005	< 0.1

$$\text{Spk} = \frac{(500 \text{ ml})(1000 \text{ ppm})}{13,800 \text{ ml}} = 3.6$$

$$\text{read} = \frac{6.44 - 3.55}{3.62} \times 100 = 9.4 \text{ ml}$$

$$\text{Spk} = \frac{(400 \text{ ml})(1000 \text{ ppm})}{12,790 \text{ ml}} = 3.1$$

$$\text{read} = \frac{6.55 - 3.32}{3.12} \times 100 = 103.2$$

$$\text{Spk} = \frac{(600 \text{ ml})(1000 \text{ ppm})}{10,100 \text{ ml}} = 9.9$$

$$\text{read} = \frac{18.1 - 4.57}{9.9} \times 100 = 86.2$$

$$\text{Spk} = \frac{(400 \text{ ml})(1000 \text{ ppm})}{13,100 \text{ ml}} = 7.1$$

$$\text{read} = \frac{14.6 - 7.52}{7.63} \times 100 = 92.3$$

$$\text{Spk} = \frac{(200 \text{ ml})(1000 \text{ ppm})}{13,020 \text{ ml}} = 1.5$$

$$\text{read} = \frac{2.78 - 1.21}{1.54} \times 100 = 102.7$$

$$\text{Spk} = \frac{(500 \text{ ml})(1000 \text{ ppm})}{10,550 \text{ ml}} = 4.1$$

$$\text{read} = \frac{8.83 - 4.57}{4.74} \times 100 = 89.9$$

$$\text{Spk} = \frac{(200 \text{ ml})(1000 \text{ ppm})}{8550 \text{ ml}} = 2.34$$

$$\text{read} = \frac{4.04 - 1.60}{2.34} \times 100 = 104$$

$$\text{Spk} = \frac{(100 \text{ ml})(1000 \text{ ppm})}{13,100 \text{ ml}} = 7.1$$

$$\text{read} = \frac{8.00 - 0.82}{7.65} \times 100 = 95.2$$

Sample ID	ARL #	Vol (mL)	DF	Read $\mu\text{g/L}$	Reported $\mu\text{g/L}$
= 2. After					
IS-FB-2	D2-1	500	2.55	3.80, 3.68	9.5
IS-FB-2	D2-2	500	2.55	-0.009	< 0.3
IS-FGD-IN-2	D2-3	500	2.65	1.97	5.2
IS-FGD-OUT-2	D2-4	1000	2.65	.144, .154, .294	0.4
= 1					
IS-FB-SpK-2	D2-5	500	1.0	10.1, 9.99	10.0
IS-FB-2	D2-6	500	1.0	-0.006	< 0.1
-FB-SpK-2	D2-7	500	1.0	9.97, 9.75	9.8
-FB-2	D2-8	+ ~ 5 500	1.0	-0.014	< 0.1
-FGD-IN-2	D2-9	+ ~ 3 500	1.0	23.1	23.1
-FGD-OUT-2	D2-10	+ ~ 1 500	1.0	27.7	27.7
IS-FGD-IN-2	D2-11	500	1.0	5.56	5.6
IS-FGD-OUT-2	D2-12	500	1.0	11.2, 11.3, 11.4	11.3
= 1					
-FB-SpK-2	D2-13	500	1.3	7.61, 7.59	9.9
-FB-2	D2-14	500	1.3	-0.075	< 0.1
-FGD-IN-2	D2-15	1000	1.3	21.9	28.5
-FGD-OUT-2	D2-16	1000	1.3	.735, .639, .244	0.9
-FGD-OUT-2	D2-17	500	1.3	.049	< 0.1
= 2					
-FB-SpK-2	D2-18	500	2.0	4.49, 3.90	8.4
-FB-2	D2-19	500	2.0	-0.005	< 0.2
-FGD-IN-2	D2-20	500	2.7	2.00, 1.95, 1.46	3.4
-FGD-OUT-2	D2-21	500	2.0	-0.001	< 0.2
= 2					
Red RinsC-2	D2-22	250	1.3	.135	0.3
IS-FGD-OUT-2	D2-23	250	1.3	.246, .227, .231	0.3
H-Stack-2	D2-23	250	1.3	14.1	18.3
H-ESP-OUT-2	D2-23	250	1.3	7.11	9.2

$$\text{Spk} = \frac{(500 \text{ mL})(1000 \text{ ppb})}{10,300 \text{ mL}} = 4.9$$

$$\text{read} = \frac{4.97 - 0.194}{4.85} \times 100\% = 98.4\%$$

$$\text{Spk} = \frac{(500 \text{ mL})(1000 \text{ ppb})}{8050 \text{ mL}} = 6.2$$

$$\text{read} = \frac{11.2 - 11.3}{6.21} \times 100\% = 88.6$$

$$\text{Spk} = \frac{(1000 \text{ mL})(1000 \text{ ppb})}{13,100 \text{ mL}} = 7.6$$

$$\text{read} = \frac{8.25 - 0.766}{7.63} \times 100\% = 98.9\%$$

$$\text{Spk} = \frac{(500 \text{ mL})(1000 \text{ ppb})}{8550 \text{ mL}} = 5.8$$

$$\text{read} = \frac{7.52 - 1.98}{5.85} \times 100\% = 95.4$$

$$\text{Spk} = \frac{(1000 \text{ mL})(1000 \text{ ppb})}{13,100 \text{ mL}} = 7.6$$

$$\text{read} = \frac{7.63 - 0.235}{7.63} \times 100\% = 96.1$$

Id	ATL #	Vol (mL)	DF	Read %/L	Expected %/L
<u>Buffer</u>					
FB-Spk-3	D3-1	500	2.75	3.86, 3.81	10.5
IS-FB-3	D3-2	500	2.75	.203	0.6
FD-IN-3	D3-3	500	2.45	2.46, 2.32, 2.26	5.7
FD-OUT-3	D3-4	1000	2.25	.146	0.3
<u>1 in 10</u>					
FB-Spk-3	D3-5	500	1.0	9.09, 9.21	9.1
IS-FB-3	D3-6	500	1.0	.043	<0.1
FB-Spk-3	D3-7	500	1.0	9.36, 9.23	9.3
FB-3	D3-8	500	1.0	.009	<0.1
FD-IN-3	D3-9	500	1.0	25.1	25.1
FD-OUT-3	D3-10	500	1.0	31.3	31.3
FD-IN-3	D3-11	500	1.0	6.69	6.7
IS-FGD-OUT-3	D3-12	500	1.0	10.6, 10.6, 10.7	10.6
FB-Spk-3	D3-13	500	1.3	7.57, 7.60	9.9
FB-3	D3-14	500	1.3	.032	<0.1
FD-IN-3	D3-15	1000	1.3	13.4	17.4
FD-OUT-3	D3-16	1000	1.3	.629, .642, .665	0.8
FD-OUT-3	D3-17	500	1.3	.004, .062	<0.1
<u>Rinse</u>					
FD-OUT-3	D3-22	250	1.3	.435, .408, .414	0.5
FD-IN-3	D3-23	250	1.3	39.6	38.5
FD-IN-3	D3-24	250	1.3	4.97	6.5
FB-FGD-IN-3	D3-25	250	1.3	.027	<0.1
FB-FGD-IN-3	D3-26	250	1.3	.019	<0.1
FD-OUT-3	D3-29	250	1.3	.070	<0.1

$$\text{Spk} = \frac{(50 \text{ mL})(1000 \text{ ppb})}{12,300 \text{ mL}} = 4.06$$

$$\text{read} @ \frac{6.54 - 2.35}{4.06} \times 100\% = 104\%$$

$$\text{Spk} = \frac{(50 \text{ mL})(1000 \text{ ppb})}{8050 \text{ mL}} = 6.2$$

$$\text{read} @ \frac{16.3 - 10.6}{6.21} \times 100\% = 91.8\%$$

$$\text{Spk} = \frac{(100 \text{ mL})(1000 \text{ ppb})}{13,100 \text{ mL}} = 7.6$$

$$\text{read} @ \frac{8.08 - .645}{7.63} \times 100\% = 97.4\%$$

$$\text{Spk} = \frac{(50 \text{ mL})(1000 \text{ ppb})}{9050 \text{ mL}} = 5.5$$

$$\text{read} @ \frac{7.61 - 2.26}{5.52} \times 100\% = 100\%$$

$$\text{Spk} = \frac{(100 \text{ mL})(1000 \text{ ppb})}{13,100 \text{ mL}} = 7.6$$

$$\text{read} @ \frac{7.76 - .419}{7.63} \times 100\% = 96.5\%$$

**CARNOT SOURCE TEST DATA SUMMARY  
ONTARIO HYDRO METHOD  
ESP OUTLET**

Client/Location.....	NYSEG/Milliken	Reference Temp (F).....	68
Unit.....	2	Fuel.....	COAL
Sample Location.....	ESP OUTLET	Data By.....	DVK
Operating Condition.....	FULL LOAD	Date of Data Entry.....	10/10/96

Test No.....	1-OH-OUT	2-OH-OUT	3-OH-OUT	Average
Date.....	8/7/96	8/8/96	8/9/96	*
Test Method.....	Ontario Hydro	Ontario Hydro	Ontario Hydro	*
Sample Train.....	Box # 1	Box # 1	Box # 1	*
Pitot Factor .....	0.840	0.840	0.840	*
Meter Cal Factor.....	0.9900	0.9900	0.9900	*
Duct Area (sq ft).....	236.25	236.25	236.25	*
Sample Time (Min).....	360	360	360	*
Bar Press (in Hg).....	29.86	29.83	29.68	*
Nozzle Diam (in).....	0.278	0.278	0.278	*

Start/Stop Time.....	0840/1440	0756/1356	0817/1417	*
Stack Press (iwg).....	-14.50	-14.50	-14.50	-14.50
Stack Temp (F).....	274.6	278.6	284.6	279.27
Velocity Head (iwg).....	0.4358	0.3087	0.3116	0.3497
Outlet O2 (%).....	4.90	5.28	5.16	5.11
Outlet CO2 (%).....	14.47	13.63	13.83	13.98
Meter Vol (acf).....	291.652	245.938	226.749	254.780
Meter Temp (F).....	125.2	112.8	102.1	113.4
Meter Press (iwg).....	1.70	1.20	1.09	1.33
Liquid Vol (ml).....	480.5	420.2	389.8	430.2

Std Sample Vol (SCF).....	261.060	224.406	209.721	231.729
Std Sample Vol (Nm^3).....	6.888	5.921	5.534	6.114
Moisture Fraction.....	0.080	0.081	0.081	0.081
Stack Gas Mol Wt.....	29.51	29.39	29.42	29.44
Stack Gas Velocity (ft/sec).....	44.01	37.24	37.64	39.63
Stack Flow Rate (wacfm).....	623,848	527,878	533,607	561,778
Stack Flow Rate (dscfm).....	396.941	333.249	332.608	354.266
Isokinetic Ratio (%).....	102.36	104.80	98.13	101.76

EST. 11-11-94  
TEST CONDITION 135K Outlet  
METER VOL. (START/END) 1  
SAMPLE LOCATION 135K Outlet  
OPERATOR/ASSISTANT  
DATE 8/7/94  
PROJECT # 1176  
AMB. TEMP. 76  
PAGE 1

**RE-TEST DATA:**  
Barometric Press., in. Hg. 29.83  
assumed Slack Temp. °F  
assumed Meter Temp. °F  
assumed ΔP  
assumed Molature %  
ack Diameter, in.  
mple Time: Total  
per point  
ital of Traverse Points  
ifion Connecting  
Line (Y/N)  
oknetic Factor  
AH = 3.6 X ΔP  
3.97

**EQUIPMENT INFO:**  
Meter ID No. #7275  
Meter, Yd. 199  
CFM @ ΔH = 1.0 1144  
Pilot: 26  
Probe:  
Nozzle:  
Filter:  
TC Readout ID: Meter  
Aux.

**POST TEST INFO:**  
Filter Appearance  
Impinger Appearance  
Silica Gel Spent (Y/N)

**PRE-TEST CALIBRATION CHECK:**  
Time ΔH Reading In Out  
Meter Meter Temp

**SAMPLE TRAIN LEAK CHECK:**  
CFM Yag Pilot Inlet  
Pre-Test 101 15" ✓ SP  
Post-Test 01000 10" ✓ SP

SAMPLE POINT	TIME	METER CONDITIONS				TEMPERATURES, "F						STATIC PRESS. X hwg	CHAIN OF CUSTODY INFORMATION
		X ΔP	X ΔH	METER READING	X STACK	PROBE	METER		OVEN	IMP. OUT			
							IN	OUT					
	0840	.40	1.44	786.319	275	246	110	112	242	ICE	7.5	Impingers Loaded	
	0855	.41	1.48	798.43	275	245	121	113	243	ICE	6.5	Impingers Recovered	
	0910	.41	1.48	808.65	276	243	121	114	245	ICE	6.5	Filter Loaded	
	0925	.47	1.69	820.29	275	245	123	114	244	ICE	6.5	Filter Recovered	
	0940	.41	1.60	833.00	275	245	124	116	244	ICE	6.5	Probe Wash	
	0955	.42	1.64	844.39	275	244	127	117	245	ICE	6.5	TEST SUMMARY	
	1010	.42	1.64	856.21	275	245	130	118	245	ICE	6.5	Calculated by: DL✓	
	1025	.36	1.40	867.62	275	245	130	120	244	ICE	6.5	Checked by: DL✓	
	1040	.43	1.67	879.38	275	245	130	121	244	ICE	6.5	Slack Press (hwg) -14.5✓	
	1055	.44	1.72	891.28	276	244	130	121	245	ICE	6.5	Slack Temp (°F) 274.6✓	
	1110	.43	1.71	903.42	275	245	132	123	244	ICE	6.5	ΔP (hwg) 9.4358✓	
	1125	.45	1.79	916.19	275	245	133	124	244	ICE	6.5	O <sub>2</sub> /CO <sub>2</sub> 4.9 ✓ 114.47	
	1140	.45	1.79	927.99	276	245	132	124	244	ICE	7.0	Meter Vol. (act) 291.652✓	
	1155	.46	1.83	940.72	276	245	132	124	244	ICE	7.0	Meter Temp (°F) 125.2✓	
	1200	.46	1.83	953.61	275	245	131	123	244	ICE	7.0	Meter Press. (hwg) 1.70✓	
	1225	.44	1.75	966.81	274	245	131	122	245	ICE	7.0	Liquid Vol (g) 480.5✓	
									Day 1	8-7-98		Comments:	

OH FGD IN



Sample Pt. \_\_\_\_\_

Date \_\_\_\_\_

Day 1

8-7-96

Run \_\_\_\_\_

OH FGD IN

Train Type : ONTARIO-HYDRO METHOD

Fund # \_\_\_\_\_

Cost Center # \_\_\_\_\_

Stopper Type	Type Of Solution	Initial Wt. (g)	Final Wt. (g)	Net Wt. (g)
BUBBLER	KCl	609.8	756.8	147.0
BUBBLER	KCl	605.4	825.8	220.4
IMPINGER	KCl	601.6	619.7	18.1
BUBBLER	H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub>	740.5	766.3	25.8
BUBBLER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	611.0	612.6	1.6
BUBBLER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	699.5	708.5	9.0
IMPINGER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	611.8	607.4	-4.4
BUBBLER	SILICA GEL	856.8	919.8	63.0
			Total H <sub>2</sub> O (g)	480.5 ✓
FILTER				
			Total Dust (g)	

$$V_{wstd} = 0.0474 * (H_2O \text{ g})$$

$$V_{mCorrected} = V_m * C_m$$

$$V_{mstd} = \frac{17.71 V_m C (P_b + \Delta H/13.6)}{T_m}$$

$$V_{istd} = V_{wstd} + V_{mstd}$$

$$\%H_2O = (V_{wstd} / V_{istd}) * 100$$

$$Q_{nstd} = 17.71 Q_n P_s / T_s$$

$$\% \text{ Isokinetic} = V_{istd} / (Q_{nstd} * \text{Time})$$

**DUST LOADING CALCULATIONS (Concentration Basis)**

$$DCL = 15.432 (\text{dust g}) / V_{istd}$$

$$\% \text{ Efficiency} = \frac{(\text{Inlet DCL} - \text{Outlet DCL})}{\text{Inlet DCL}} * 100$$

$$ACFM = V_s * \text{Pipe Area (ft}^2\text{)}$$

$$SCFM = ACFM * P_s / 29.92 * 530 / T_s = ACFM * P_s / T_s * 17.71$$

\_\_\_\_\_ SCF

\_\_\_\_\_ ACF

\_\_\_\_\_ SCF

\_\_\_\_\_ SCF

\_\_\_\_\_ %H<sub>2</sub>O

\_\_\_\_\_ SCFM

\_\_\_\_\_ %

\_\_\_\_\_ grains/scf

\_\_\_\_\_ %

\_\_\_\_\_ ACFM

\_\_\_\_\_ SCFM

lbs/hour

**E-TEST DATA:**  
Osmetric Press., In. Hg 74.96  
umed Stack Temp. °F \_\_\_\_\_  
umed Meter Temp. °F \_\_\_\_\_  
umed ΔP \_\_\_\_\_  
umed Molature % \_\_\_\_\_  
ck Diameter, In. 6.45  
mple Time: Total 6.45  
per point \_\_\_\_\_  
il of Traverse Points 5P  
on Connecting \_\_\_\_\_  
Line (Y/N) \_\_\_\_\_  
Inch Factor \_\_\_\_\_  
ΔH = 3.99 X ΔP 3.87

**EQUIPMENT INFO:**  
Meter ID No. B201 5047275  
Meter, Yd. 1.99  
CFM @ ΔH = 1.0 1.44  
Pilot: ID 26  
Cp \_\_\_\_\_  
Probe: \_\_\_\_\_  
Length \_\_\_\_\_  
ID/Mat'l \_\_\_\_\_  
Diam. \_\_\_\_\_  
No. \_\_\_\_\_  
Tare Wt. \_\_\_\_\_  
TC Readout ID: Meter \_\_\_\_\_  
Aux. \_\_\_\_\_

**POST TEST INFO:**  
Filter Appearance \_\_\_\_\_  
Impinger Appearance \_\_\_\_\_  
Silica Gel Spent (Y/N) \_\_\_\_\_

**SAMPLE TRAIN LEAK CHECK:**  
CFM Vac Pilot Init  
Pre-Test 0.00 15" JP  
Post-Test 0.002 9" JP

**PRE-TEST CALIBRATION CHECK:**  
Meter Meter Temp  
Time ΔH Reading In Out  
Init \_\_\_\_\_  
Final \_\_\_\_\_

SAMPLE POINT	TIME	METER CONDITIONS				TEMPERATURES, °F						STATIC PRESS. hwg	CHAIN OF CUSTODY INFORMATION	
		AP	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP. OUT				
							IN	OUT						
	0756	.30	1.19	120.918	267	246	116	118	241	ICE	—	6	Impingers Loaded	
	0811	.30	1.19	131.62	278	245	124	119	244	ICE	5.2	6	Impingers Recovered	
	0826	.31	1.23	142.00	278	245	124	119	244	ICE	—	5.5	Filter Loaded	
	0841	.31	1.23	152.83	279	245	125	120	244	ICE	5.4	5.5	Filter Recovered	
	0856	.31	1.23	164.01	279	245	123	119	244	ICE	—	6.0	Probe Wash	
2-2	0911	.31	1.23	173.39	279	245	124	119	244	ICE	5.4	6.0	TEST SUMMARY	
	0926	.31	1.23	184.62	280	245	124	118	244	ICE	—	6.0	Calculated by: BAF	
	0941	.31	1.23	194.62	280	245	123	119	244	ICE	5.2	6.0	Checked by: - DV	
	0956	.31	1.23	204.79	279	245	124	119	244	ICE	—	6.0	Slack Press (hwg) # -14.5	
	1011	.31	1.23	217.01	279	244	125	120	244	ICE	5.6	6.0	Slack Temp. (°F) 278.6 ✓	
	1026	.31	1.23	225.79	279	244	120	119	240	ICE	—	6.0	ΔP (hwg) 0.3087 ✓	
	1041	.31	1.21	236.31	278	244	113	112	243	ICE	5.4	6.0	O <sub>2</sub> /CO <sub>2</sub> 5.88/13.63	
	1056	.30	1.17	246.72	280	244	108	107	243	ICE	—	6.0	Meter Vol. (acf) 245.938	
	1111	.30	1.17	256.60	280	244	109	105	243	ICE	5.2	6.0	Meter Temp. (°F) 112.8 ✓	
	1126	.30	1.17	272	281	244	109	104	243	ICE	—	6.0	Meter Press. (hwg) 1.2033 ✓	
	1141	.30	1.15	276.38	281	244	109	104	243	ICE	5.2	6.0	Liquid Vol (g) 420.2 ✓	
									DAY 2		5.2	6.0	Comments: 2-2	

OH FGD IN



E-TEST DATA:		EQUIPMENT INFO:		Imp. Mat'l		WT (End)	WT (Start)	WT (g)	SAMPLE TRAIN LEAK CHECK:			
Isometric Press., in. Hg.		Meter ID No.		Meter, Yd.		CFM @ $\Delta H = 1.0$		Pilot:	CFM	Vac	Pilot	Init
Unumed Slack Temp. °F		Probe:		Length		ID/Mat'l		Diam.	Pre-Test			
Unumed Meter Temp. °F		Nozzle:		Diam.		No.		Tare Wt.	Post-Test			
Unumed $\Delta P$		Filter:		TC Readout ID: Meter		Aux.		PRE-TEST CALIBRATION CHECK:				
Unumed Moisture %		Line (Y/N)		AH = 3.80		X $\Delta P$		Meter Meter Temp				
Pick Diameter, in.		Line (Y/N)		AH = 3.80		X $\Delta P$		Time $\Delta H$ Reading In Out				
Sample Time: Total		Line (Y/N)		AH = 3.80		X $\Delta P$		Init				
per point		Line (Y/N)		AH = 3.80		X $\Delta P$		Final				
Total of Traverse Points		Line (Y/N)		AH = 3.80		X $\Delta P$						
on Connecting		Line (Y/N)		AH = 3.80		X $\Delta P$						

# OH FGD IN

Sample Pt. ESP - Outlet

DAY 2 8-8-96

Date \_\_\_\_\_  
 Run OH FGD IN  
 Fund # ESP Out  
 Cost Center # \_\_\_\_\_

Train Type : ONTARIO-HYDRO METHOD

3.F.3

Stopper Type	Type Of Solution	Initial Wt. (g)	Final Wt. (g)	Net Wt. (g)
BUBBLER	KCl	568.4	844.9	276.5
BUBBLER	KCl	591.3	648.1	56.8
IMPINGER	KCl	604.6	602.3	(2.3)
BUBBLER	H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub>	811.9	834.8	22.90
BUBBLER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	609.0	605.4	(3.6)
BUBBLER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	628.4	651.3	22.90
IMPINGER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	689.7	678.6	(11.1)
BUBBLER	SILICA GEL	861.4	919.5	58.1
			Total H <sub>2</sub> O (g)	420.2
FILTER				
			Total Dust (g)	

$$V_{wstd} = 0.0474 * (H_2O \text{ g})$$

\_\_\_\_\_ SCF

$$V_{m \text{ Corrected}} = V_m * C_m$$

\_\_\_\_\_ ACF

$$V_{mstd} = \frac{17.71 V_m C (P_b + \Delta H / 13.6)}{T_m}$$

\_\_\_\_\_ SCF

$$V_{std} = V_{wstd} + V_{mstd}$$

\_\_\_\_\_ SCF

$$\%H_2O = (V_{wstd} / V_{std}) * 100$$

\_\_\_\_\_ %H<sub>2</sub>O

$$Q_{nstd} = 17.71 Q_n P_s / T_s$$

\_\_\_\_\_ SCFM

$$\% \text{ Isokinetic} = V_{std} / (Q_{nstd} * \text{Time})$$

\_\_\_\_\_ %

#### DUST LOADING CALCULATIONS (Concentration Basis)

$$DCL = 15.432 (\text{dust g}) / V_{std}$$

\_\_\_\_\_ grains/scf

$$\% \text{ Efficiency} = \frac{(\text{Inlet DCL} - \text{Outlet DCL}) * 100}{\text{Inlet DCL}}$$

\_\_\_\_\_ %

$$ACFM = V_s * \text{Pipe Area (ft}^2\text{)}$$

\_\_\_\_\_ ACFM

$$SCFM = ACFM * P_s / 29.92 * 530 / T_s = ACFM * P_s / T_s * 17.71$$

\_\_\_\_\_ SCFM

DATE 8-10-98  
TIME 11:11  
TEST CONDITION 100%  
METER VOL. (START/END) 100%  
METER ID No. 100%  
METER Yd. 100%  
CFM @  $\Delta H = 1.0$  100%  
Pilot: ID Cp Mat'l Length ID/Mat'l Diam. No. Tare Wt.  
Probe: 100%  
Nozzle: 100%  
Filter: 100%  
TC Readout ID: Meter Aux.  
Line (Y/N)  
Inlet Factor  
 $\Delta H = 3.9 \times 3.4 \times \Delta P$

EQUIPMENT INFO:										SAMPLE TRAIN LEAK CHECK:																			
Meter ID No.		Meter, Yd.		CFM @ ΔH = 1.0		Pilot:		ID		Cp		Mat'l		Length		ID/Mat'l		Diam.		Filler:		Tare Wt.		TC Readout ID:		Meter		Aux.	
B#1 - 7275		1.99		1.44		26										1.278													
														</															

OH FGD IN  
99.4  
92.790 283.3  
1.128  
1.312

**TEST DATA:**  
Metric Press., in. Hg. \_\_\_\_\_  
Unmetered Slack Temp. °F \_\_\_\_\_  
Unmetered Meter Temp. °F \_\_\_\_\_  
Unmetered ΔP \_\_\_\_\_  
Unmetered Moisture % \_\_\_\_\_  
x Diameter, in. \_\_\_\_\_  
Sample Time: Total \_\_\_\_\_ per point  
of Traverse Points \_\_\_\_\_  
in Connecting \_\_\_\_\_  
Line (Y/N) \_\_\_\_\_  
Inlet Factor \_\_\_\_\_  
ΔH = \_\_\_\_\_ X ΔP

**EQUIPMENT INFO:**  
Meter ID No. \_\_\_\_\_  
Meter, Yd. \_\_\_\_\_  
CFM @ ΔH = 1.0 \_\_\_\_\_  
Pilot: ID \_\_\_\_\_ Cp \_\_\_\_\_  
Probe: Mat'l \_\_\_\_\_ Length \_\_\_\_\_  
Nozzle: ID/Mat'l \_\_\_\_\_ Diam. \_\_\_\_\_  
Filter: No. \_\_\_\_\_ Tare Wt. \_\_\_\_\_  
TC Readout ID: Meter \_\_\_\_\_ Aux. \_\_\_\_\_

**POST TEST INFO:**  
Filter Appearance \_\_\_\_\_  
Impinger Appearance \_\_\_\_\_  
Silica Gel Spent (Y/N) \_\_\_\_\_

**TEMPERATURES, °F**

METER	METER		STACK	PROBE	METER		OVEN	IMP.	O <sub>2</sub>	VAC.	STATIC PRESS. InHg	CHAIN OF CUSTODY INFORMATION
	IN	OUT			IN	OUT						
1217	130	102	285	244	105	101	244	ICE	—	5.5	*	Impingers Loaded
1232	130	102	285	244	105	101	244	ICE	—	5.5	*	Impingers Recovered
1247	131	105	286	244	104	101	243	ICE	4.2	5.5	*	Filter Loaded
1302	131	105	286	244	105	101	244	ICE	—	5.5	*	Filter Recovered
1317	131	105	286	244	107	102	243	ICE	—	5.5	*	Probe Wash
1332	131	105	286	245	108	103	243	ICE	4.3	5.5	*	TEST SUMMARY
1347	132	108	286	244	109	104	244	ICE	—	5.5	*	Calculated by:
1402	132	109	286	244	110	105	244	ICE	—	5.5	*	Checked by:
1417						STOP						Stack Press (InHg)
						88						Stack Temp (°F)
												ΔP (InHg)
												O <sub>2</sub> /CO <sub>2</sub>
												Meter Vol., (scf)
												Meter Temp. (°F)
												Meter Press. (InHg)
												Liquid Vol. (qt)
												Comments:

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F						STATIC PRESS. InHg	CHAIN OF CUSTODY INFORMATION
		ΔP	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP.		
	1217	130	102	561.00	285	244	IN	OUT	244	ICE	*	Impingers Loaded
	1232	130	102	571.30	285	244	IN	OUT	244	ICE	*	Impingers Recovered
	1247	131	105	580.64	286	244	IN	OUT	243	ICE	*	Filter Loaded
	1302	131	105	590.09	286	244	IN	OUT	244	ICE	*	Filter Recovered
	1317	131	105	599.54	286	244	IN	OUT	243	ICE	*	Probe Wash
	1332	131	105	608.97	286	245	IN	OUT	243	ICE	*	TEST SUMMARY
	1347	132	108	618.46	286	244	IN	OUT	244	ICE	*	Calculated by:
	1402	132	109	628.29	286	244	IN	OUT	244	ICE	*	Checked by:
	1417			637.919					STOP			Stack Press (InHg)
									88			Stack Temp (°F)
												ΔP (InHg)
												O <sub>2</sub> /CO <sub>2</sub>
												Meter Vol., (scf)
												Meter Temp. (°F)
												Meter Press. (InHg)
												Liquid Vol. (qt)
												Comments:

DAY 3 8-10-95  
OH FGD IN  
7:30 PM

Sample Pt. ESP OUTTrain Type : METHOD OHDate DAY 3 8-10-96  
Run OH FGD IN  
Fund # ESP OUT  
Cost Center 3 of 3

Stopper Type	Type Of Solution	Initial Wt. (g)	Final Wt. (g)	Net Wt. (g)
BUBBLER	<del>KCl</del> <del>H<sub>2</sub>O<sub>2</sub>/HNO<sub>3</sub></del>	564.5	736.4	
IMPINGER	<del>KCl</del> <del>H<sub>2</sub>O<sub>2</sub>/HNO<sub>3</sub></del>	599.4	735.7	
BUBBLER	<del>KCl</del> DRY	608.9	612.2	
BUBBLER	<del>H<sub>2</sub>O<sub>2</sub></del> <del>KMnO<sub>4</sub>/H<sub>2</sub>SO<sub>4</sub></del>	734.3	753.8	
IMPINGER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	626.2	629.8	
BUBBLER	<del>KMnO<sub>4</sub></del> GEL	613.4	617.7	
	KMnO <sub>4</sub>	605.6	604.2	
	SSL Gel	821.9	874.2	
			Total H <sub>2</sub> O (g)	389.8 ✓
FILTER				
			Total Dust (g)	

$$V_{wstd} = 0.0474 * (H_2O \text{ g})$$

$$V_{m \text{ Corrected}} = V_m * C_m$$

$$V_{mstd} = \frac{17.71 V_m C (P_s + \Delta H / 13.6)}{T_m}$$

$$V_{std} = V_{wstd} + V_{mstd}$$

$$\%H_2O = (V_{wstd} / V_{std}) * 100$$

$$Q_{nstd} = 17.71 Q_n P_s / T_s$$

$$\% \text{ Isokinetic} = V_{std} / (Q_{nstd} * \text{Time})$$

## DUST LOADING CALCULATIONS (Concentration Basis)

$$DCL = 15.432 (\text{dust g}) / V_{std}$$

$$\% \text{ Efficiency} = \frac{(\text{Inlet DCL} - \text{Outlet DCL}) * 100}{\text{Inlet DCL}}$$

$$ACFM = V_s * \text{Pipe Area (ft}^2\text{)}$$

$$SCFM = ACFM * P / 29.92 * 530 / T = ACFM * P / T * 17.71$$

SCF

ACF

SCF

SCF

%H<sub>2</sub>O

SCFM

%

grains/scf

%

ACFM

SCFM

**CARNOT SOURCE TEST DATA SUMMARY**  
**TRIS BUFFER METHOD**  
**ESP OUTLET**

Client/Location.....	NYSEG/Milliken	Reference Temp (F).....	68
Unit.....	2	Fuel.....	COAL
Sample Location.....	ESP OUTLET	Data By.....	DVK
Operating Condition.....	FULL LOAD	Date of Data Entry.....	10/10/96

Test No.....	1-TRIS OUT	2-TRIS OUT	3-TRIS OUT	Average
Date.....	8/7/96	8/8/96	8/9/96	*
Test Method.....	TRIS BUFFER	TRIS BUFFER	TRIS BUFFER	*
Sample Train.....	Box 1	Box 1	Box 1	*
Pitot Factor .....	0.840	0.840	0.840	*
Meter Cal Factor.....	0.9900	0.9900	0.9900	*
Duct Area (sq ft).....	236.25	236.25	236.25	*
Sample Time (Min).....	60	60	60	*
Bar Press (in Hg).....	29.83	29.86	29.68	*
Nozzle Diam (in).....	0.278	0.278	0.278	*

Start/Stop Time.....	1533/1633	1417/1517	1432/1532	*
Stack Press (iwg).....	-14.50	-14.50	-14.50	-14.50
Stack Temp (F).....	277.7	277.3	285.7	280.23
Velocity Head (iwg).....	0.2883	0.3500	0.3667	0.3341
Outlet O2 (%).....	4.67	5.20	4.67	4.85
Outlet CO2 (%).....	14.56	13.44	14.13	14.04
Meter Vol (acf).....	40.065	43.022	42.884	41.990
Meter Temp (F).....	124.3	110.6	108.8	114.6
Meter Press (iwg).....	1.14	1.35	1.32	1.27
Liquid Vol (ml).....	73.9	82.5	78.3	78.2

Std Sample Vol (SCF).....	35.832	39.461	39.219	38.171
Std Sample Vol (Nm^3).....	0.945	1.041	1.035	1.007
Moisture Fraction.....	0.089	0.090	0.086	0.088
Stack Gas Mol Wt.....	29.41	29.25	29.38	29.34
Stack Gas Velocity (ft/sec).....	35.95	39.69	40.90	38.85
Stack Flow Rate (wacfm).....	509,651	562,610	579,707	550,656
Stack Flow Rate (dscfm).....	319,503	352,834	358,664	343,667
Isokinetic Ratio (%).....	104.73	104.44	102.11	103.76

TRIS BUFFER R. SCHULZ

**TEST DATA:**  
Metric Press., in. Hg. 29.86  
Unad Slack Temp. °F  
Unad Meter Temp. °F  
Unad AP  
Unad Moisture %  
X Diameter, in.  
Up Time: Total  
per point  
of Traverse Points  
on Connecting  
Line (Y/N)  
Metric Factor  
AH = 3.9 X ΔP

**EQUIPMENT INFO:**  
Meter ID No.  
Meter, Yd.  
CFM @ ΔH = 1.0  
Pilot:  
Probe:  
Nozzle:  
Filter:  
Tare Wt.  
TC Readout ID: Meter  
Aux.

**IMP. MAT'L WM (END) WM (START) WM (g)**  
#1 TRIS 642.3 - 672.4 = 19.9  
#2 TRIS 662.0 - 617.6 = 44.4  
#3 KM<sub>2</sub>O<sub>4</sub> 762.4 - 758.8 = 3.6  
#4 KM<sub>2</sub>O<sub>4</sub> 699.4 - 698.1 = 1.3  
#5 S:1 61855.9 842.6 = 13.3  
Total  
POST TEST INFO:  
Filter Appearance  
Impinger Appearance  
Silica Gel Spent (Y/N)

**SAMPLE TRAIN LEAK CHECK:**  
CFM Vac Pilot Inlet  
Pre-Test 0.000 15" V VP  
Post-Test 0.000 6" V VP

**PRE-TEST CALIBRATION CHECK:**  
Meter Meter Temp  
Time ΔH Reading In Out

SAMPLE POINT	TIME	METER CONDITIONS				TEMPERATURES, °F						O <sub>2</sub>	VAC.	STATIC PRESS. InHg	CHAIN OF CUSTODY INFORMATION
		ΔP	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP. OUT					
							IN	OUT							
N2	1417	1.35	1.33	367.468	275	250	112	108	243	1CE	-	3	*	Impingers Loaded	
	1427	1.35	1.33	374.51	277	247	112	108	243	1CE	-	3	*	Impingers Recovered	
	1437	1.35	1.33	381.74	278	250	115	109	242	1CE	5.2	3	*	Filter Loaded	
	1447	1.35	1.33	389.16	279	260	114	109	243	1CE	-	3	*	Filter Recovered	
	1457	1.35	1.37	396.08	277	262	113	108	243	1CE	-	3	*	Probe Wash	
✓	1507	1.35	1.37	404.21	278	263	112	107	243	1CE	2.2	3	*	TEST SUMMARY	
	1517			410.490			370.0						-14.5	Calculated by: BAF	
														Checked by: BAF	
														Stack Press. (InHg) -14.5	
														Stack Temp. (°F) 277.3 ✓	
														ΔP (InHg) 0.35 ✓	
														O <sub>2</sub> CO <sub>2</sub> 5.20 / 13.44 ✓	
														Meter Vol. (scf) 43.022 ✓	
														Meter Temp. (°F) 110.6 ✓	
														Meter Press. (InHg) 1.35 ✓	
														Liquid Vol. (g) 82.5 ✓	
														Comments:	
														DAY 2 8-8-96	



ESP

**CARNOT SOURCE TEST DATA SUMMARY  
ONTARIO HYDRO METHOD  
FGD STACK**

Client/Location.....	NYSEG/Milliken	Reference Temp (F).....	68	
Unit.....	2	Fuel.....	COAL	
Sample Location.....	FGD STACK	Data By.....	DVK	
Operating Condition.....	FULL LOAD	Date of Data Entry.....	10/9/96	
Test No.....	1-OH-STK	2-OH-STK	3-OH-STK	Average
Date.....	8/7/96	8/8/96	8/9/96	*
Test Method.....	ONT HYDRO	ONT HYDRO	ONT HYDRO	*
Sample Train.....	Box 6	Box 6	Box 6	*
Pitot Factor .....	0.840	0.840	0.840	*
Meter Cal Factor.....	1.0000	1.0000	1.0000	*
Stack Area (sq ft).....	113.10	113.10	113.10	*
Sample Time (Min).....	360	360	360	*
Bar Press (in Hg).....	29.12	29.08	29.07	*
Nozzle Diam (in).....	0.190	0.190	0.190	*
Start/Stop Time.....	0842/1442	0753/1353	0826/1426	*
Stack Press (iwg).....	-0.71	-0.75	-0.70	-0.72
Stack Temp (F).....	121.8	122.8	121.9	122.2
Velocity Head (iwg).....	1.3397	1.3932	1.4000	1.3775
Stack O2 (%).....	5.61	5.31	5.32	5.41
Stack CO2 (%).....	13.83	13.60	13.69	13.71
Meter Vol (acf).....	240.629	245.958	246.933	244.507
Meter Temp (F).....	115.0	105.2	104.3	108.2
Meter Press (iwg).....	1.34	1.43	1.46	1.41
Liquid Vol (ml).....	754.5	800.9	779.1	778.2
Std Sample Vol (SCF).....	215.765	224.112	225.284	221.720
Std Sample Vol (Nm^3).....	5.693	5.913	5.944	5.850
Moisture Fraction.....	0.142	0.144	0.140	0.142
Stack Gas Mol Wt.....	28.68	28.60	28.66	28.65
Stack Gas Velocity (ft/sec).....	69.34	70.91	70.96	70.40
Stack Flow Rate (wacfm).....	470,525	481,225	481,551	477,767
Stack Flow Rate (dscfm).....	355,987	361,791	364,222	360,667
Isokinetic Ratio (%).....	96.68	98.81	98.66	98.05

**PRE-TEST DATA:**  
Barometric Press., in. Hg. 29.12  
Assumed Slack Temp. °F 120  
Assumed Meter Temp. °F 111.5  
Assumed ΔP 1.2  
Assumed Moisture % 13.2  
Slack Diameter, in. 360  
Sample Time: Total 30  
Total of Traverse Points 30  
Teflon Connecting Single Point  
Line (Y/N) Y  
Isokinetic Factor AH = 1.0 X ΔP

**EQUIPMENT INFO:**  
Meter ID No. 6076 Serial # 7243  
Meter, Yd. 1.000  
CFM @ ΔH = 1.0 0.5978  
Pilot: ID 0.27  
Cp 0.84  
Mat'l 0.84  
Length 0.84  
ID/Mat'l 0.84  
Diam. 0.190  
No. 0.190  
Tare Wt. 0.190  
TC Readout ID: Meter 0.190  
Aux. 0.190

**POST TEST INFO:**  
Filter Appearance  
Impinger Appearance  
Silica Gel Spent (Y/N)

**SAMPLE TRAIN LEAK CHECK:**  
CEM Vac Pilot Ind  
Pre-Test 0.005 15" 76  
Post-Test 0.005 15" 76

**PRE-TEST CALIBRATION CHECK:**  
Meter Meter Temp  
Time ΔH Reading In Out

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F						STATIC PRESS. InHg	CHAIN OF CUSTODY INFORMATION		
		ΔP	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP. OUT			O <sub>2</sub>	VAC.
							IN	OUT						
SP.	0842	1.5	1.5	475.251	122	247	103	96	265	65	5.6	3.0	Impingers Loaded	
South	0908												Impingers Recovered	
	0912	1.5	1.5	496.225	122	247	117	100	242	60	5.6	3.0	Filter Loaded	
	0942	1.5	1.5	518.204	122	249	120	103	249	60	5.6	3.0	Filter Recovered	
	1012	1.4	1.4	538.255	121	249	122	106	250	61	5.6	3.0	Probe Wash	
	1042	1.3	1.3	558.365	121	250	125	108	250	61	5.7	3.0	TEST SUMMARY	
	1112	1.3	1.3	578.223	122	250	125	109	251	62	5.7	3.0	Calculated by: DK	
	1142	1.3	1.3	598.264	121	250	126	110	257	62	5.6	3.3	Checked by: DK	
	1212	1.3	1.3	618.228	122	250	126	110	251	62	5.6	3.3	Slack Press. (InHg) -0.71 ✓	
	1242	1.3	1.3	638.283	121	250	127	111	251	62	5.6	3.3	Slack Temp. (°F) 121.8 ✓	
													ΔP (InHg) 1.3382 ✓	
													O <sub>2</sub> CO <sub>2</sub> 5.61 ✓ 113.83	
													Meter Vol. (Inch) 240.6829	
													Meter Temp. (°F) 115.0 ✓	
													Meter Press. (InHg) 1.34 ✓	
													Liquid Vol. (g) 754.5 ✓	
													Comments:	

OH FGD OUT

CLIENT NY SRG / 11.11.11.11.11.11 UNIT 2 TEST NO. 1-044-5TK METHOD ONT-H4P PAGE 2 OF 2  
SAMPLE LOCATION STACK TEST CONDITION F-11 AMB. TEMP., °F 64 PROJECT # 11476  
OPERATOR/ASSISTANT KM. METER VOL. (START/END) 1 METER VOL. (START/END) 1 DATE 8/2/90

**PRE-TEST DATA:**  
Barometric Press., in. Hg. 29.12  
Assumed Stack Temp. °F \_\_\_\_\_  
Assumed Meter Temp. °F \_\_\_\_\_  
Assumed ΔP \_\_\_\_\_  
Assumed Moisture % \_\_\_\_\_  
Stack Diameter, in. \_\_\_\_\_  
Sample Time: Total \_\_\_\_\_ per point  
Total of Traverse Points \_\_\_\_\_  
Effort Connecting \_\_\_\_\_  
Line (Y/N) \_\_\_\_\_  
Isokinetic Factor 1.0 X ΔP \_\_\_\_\_  
ΔH = \_\_\_\_\_

**EQUIPMENT INFO:**  
Meter ID No. \_\_\_\_\_  
Meter, Yd. \_\_\_\_\_  
CFM @ ΔH = 1.0 \_\_\_\_\_  
Pilot: ID \_\_\_\_\_ Cp \_\_\_\_\_  
Probe: Mat'l \_\_\_\_\_ Length \_\_\_\_\_  
Nozzle: ID/Mat'l \_\_\_\_\_ Diam \_\_\_\_\_  
Filter: No. \_\_\_\_\_ Tare Wt. \_\_\_\_\_  
TC Readout ID: Meter \_\_\_\_\_ Aux. \_\_\_\_\_

**POST TEST INFO:**  
Filter Appearance \_\_\_\_\_  
Impinger Appearance \_\_\_\_\_  
Silica Gel Spent (Y/N) \_\_\_\_\_

**PRE-TEST CALIBRATION CHECK:**  
Meter Meter Temp  
Time ΔH Reading In Out  
Inlet \_\_\_\_\_  
Final \_\_\_\_\_

**SAMPLE TRAIN LEAK CHECK:**  
CFM Vac Pilot Inlet  
Pre-Test \_\_\_\_\_  
Post-Test \_\_\_\_\_

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F						STATIC PRESS. InHg	CHAIN OF CUSTODY INFORMATION
		ΔP	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP. OUT		
							IN	OUT				
SP, South	1312	1.3	1.3	658.332	123	250	127	111	249	63		Impingers Loaded
	1342	1.2	1.2	678.012	123	250	127	112	250	62	-0.25	Impingers Recovered
	1412	1.2	1.2	695.998	122	250	127	112	250	61		Filter Loaded
End.	1442			715.880								Filter Recovered
												Probe Wash
												TEST SUMMARY
												Calculated by:
												Checked by:
												Stack Press. (InHg)
												Stack Temp. (°F)
												ΔP (InHg)
												O <sub>2</sub> /CO <sub>2</sub>
												Meter Vol., (scf)
												Meter Temp. (°F)
												Meter Press. (InHg)
												Liquid Vol. (g)
												Comments: Sampled = 2.5 hr

## GENERAL EMISSION CALCULATIONS

### 1. To Calculate Sample Volume, Actual Exhaust Flow Rate and Isokinetics for Each Sample Train

- a. Sample gas volume, dscf

$$V_{m\ std} = 0.03342 V_m \left( P_{bar} + \frac{H}{13.6} \right) \left( \frac{T_{ref}}{T_m} \right) (Y)$$

- b. Water vapor volume, scf

$$V_{w\ std} = 0.0472 V_{lc} \left( \frac{T_{ref}}{528\ ^\circ R} \right)$$

- c. Moisture content, non-dimensional

$$B_{wo} = \frac{V_{w\ std}}{V_{m\ std} + V_{w\ std}}$$

- d. Stack gas molecular weight, lb/lb mole

$$MW_{dry} = 0.44 (\%CO_2) + 0.32 (\%O_2) + 0.28 (\%N_2)$$

$$MW_{wet} = MW_{dry} (1 - B_{wo}) + 18 (B_{wo})$$

- e. Absolute stack pressure, in. of Hg

$$P_s = P_{bar} + \frac{P_{sg}}{13.6}$$

- f. Stack velocity, ft./sec.

$$V_s = 2.90 C_p \sqrt{\Delta PT_s} \sqrt{\left( \frac{29.92}{P_s} \right) \left( \frac{28.95}{MW_{wet}} \right)}$$

- g. Actual stack flow rate, wacfm

$$Q = (V_s)(A_s)(60)$$

- h. Standard stack gas flow rate, dscfm

$$Q_{sd} = Q (1 - B_{wo}) \left( \frac{T_{ref}}{T_s} \right) \left( \frac{P_s}{29.92} \right)$$

- i. Percent isokinetic

$$I = \left( \frac{17.32(T_s)(V_{m\ std})}{(1 - B_{wo})(\Theta)(V_s)(P_s)(D_n^2)} \right) \left( \frac{528\ ^\circ R}{T_{ref}} \right)$$

### 2. To Calculate Particulate Emissions

- a. Grain loading, gr/dscf

$$C = 0.01543 \left( \frac{M_n}{V_{m, std}} \right)$$

- b. Grain loading at 12% CO<sub>2</sub>, gr/dscf

$$C_{12\% CO_2} = C \left( \frac{12}{\% CO_2} \right)$$

- c. Mass emissions, lb/hr

$$M = C(Q_{std}) \frac{(60 \text{ min/hr})}{(7000 \text{ gr/lb})}$$

3. To Calculate Gaseous Emissions, lb/hr

$$a. \quad M = (ppm)(10^{-6}) \left( \frac{MW_i \text{ lb/lb mole}}{SV} \right) (Q_{std})(60 \text{ min/hr})$$

where,

*SV* = specific molar volume of an ideal gas:

*SV* = 385.3 ft<sup>3</sup>/lb mole for *T*<sub>ref</sub> = 528 °R

*SV* = 379.5 ft<sup>3</sup>/lb mole for *T*<sub>ref</sub> = 520 °R

4. To Calculate Emission Rates in lb/10<sup>6</sup> Btu or lb/10<sup>12</sup> Btu using EPA Method 19 and Given Fuel Analysis

- a. Fuel factor at 68 °F, dscf/10<sup>6</sup> Btu at 0% O<sub>2</sub>

$$F_{68} = \frac{10^6 [3.64(\%H) + 1.53(\%C) + 0.14(\%N) + 0.57(\%S) - 0.46(\%O_{2, fuel})]}{HHV, \text{ Btu/lb}}$$

- b. Gaseous emission factor, lb/10<sup>6</sup> Btu

$$\left( \frac{\text{lb}}{10^6 \text{ Btu}} \right)_i = (ppm)_i (10^{-6}) \left( \frac{MW_i \text{ lb}}{\text{lb mole}} \right) \left( \frac{1}{SV} \right) (F) \left( \frac{20.9}{20.9 - \%O_2} \right)$$

- c. Particulate emission factor, lb/10<sup>6</sup> Btu

$$\left( \frac{\text{lb}}{10^6 \text{ Btu}} \right) = C \left( \frac{1 \text{ lb}}{7000 \text{ gr}} \right) (F) \left( \frac{20.9}{20.9 - \%O_2} \right)$$

- d. Emission factor, lb/10<sup>12</sup> Btu

$$\left( \frac{\text{lb}}{10^{12} \text{ Btu}} \right) = \left( \frac{\text{lb}}{10^6 \text{ Btu}} \right) \times 10^6$$

5. To Calculate Trace Species Emissions Given Laboratory Results

- a.  $\text{ng/sample train} = (\text{ng detected}) - (\text{reagent blank})^*$
- b.  $\text{ng/dscm} = \text{ng/sample train} \times (35.31/V_{\text{std}})$
- c.  $\text{ng/Nm}^3 = \text{ng/sample train} \times (35.31/V_{\text{std}}) \times (528/492)$
- d.  $\text{lb/hr} = \text{ng/dscm} \times (1 \text{ g}/10^9 \text{ ng}) \times (1 \text{ lb}/454 \text{ g}) \times (1 \text{ m}^3/35.31 \text{ ft}^3) \times Q_{\text{sd}} \times (60 \text{ min/hr})$

(where  $Q_{\text{sd}}$  = Exhaust Gas Flow Rate, dscfm)

- e.  $\text{lb}/10^{12} \text{ Btu} = \text{ng/dscm} \times (1 \text{ m}^3/35.31 \text{ ft}^3) \times \text{F-factor @ } 0\% \text{ O}_2, \text{ dcsf/MMBtu} \times 10^6 \times 20.9/(20.9 - \text{O}_2\%) \times (1 \text{ lb}/454 \text{ g}) \times 10^{-9}$

Note: Laboratory results could be in either ng,  $\mu\text{g}$  or mg. PCDD/PCDF results will be in ng; PAH, metals, chromium and formaldehyde results will be in  $\mu\text{g}$ ; and anion results will be in mg.

f. For Formaldehyde Results

$$\text{ppb} = (\mu\text{g/sample train}) \times (1/V_{\text{std}}) \times (1 \text{ lb}/454 \text{ g}) \times (1 \text{ g}/10^6 \mu\text{g}) \times \text{SV}/\text{MW}_i \times 10^9$$

$$\text{lb/hr} = \text{ppb} \times 10^{-9} \times \text{MW}_i/\text{SV} \times Q_{\text{sd}} \times 60 \text{ min/hr}$$

g. For Anion Results

$$\text{ppm} = (\text{mg/sample train}) \times (1/V_{\text{std}}) \times (1 \text{ lb}/454 \text{ g}) \times (1 \text{ g}/10^3 \text{ mg}) \times \text{SV}/\text{MW}_i \times 10^6$$

$$\text{lb/hr} = \text{ppm} \times 10^{-6} \times \text{MW}_i/\text{SV} \times Q_{\text{sd}} \times 60 \text{ min/hr}$$

6. To calculate lb/hr and lb/10<sup>12</sup> Btu of a species (i) in fuel (f)

- a.  $\mu\text{g}(i)/\text{g}(f) = \text{lb}(i)/10^6 \text{ lb}(f)$
- b.  $\text{lb}(i)/\text{hr} = \text{lb}(i)/10^6 \text{ lb}(f) \times \text{Fuel Flow, lb}(f)/\text{hr} \times 10^{-6}$
- c.  $\text{lb}(i)/10^{12} \text{ Btu}(f) = \text{lb}(i)/10^6 \text{ lb}(f) \times 1/\text{HHV, Btu}(f)/\text{lb}(f) \times 10^6$

---

\* Reagent blank values must be evaluated before subtracting them. For example, very low blanks may merely indicate "noise" and might be disregarded. On the other hand, very high blank values may indicate sampling or analysis problems which should be investigated. It may not be acceptable to use a blank correction on some projects or with some reference methods. Typically a reagent blank is a more appropriate indicator of blank levels than a field blank.

7. To calculate lb/hr and lb/10<sup>12</sup> Btu of a species (i) in ash (a)

- a.  $\mu\text{g}(i)/\text{g}(a) = \text{lb}(i)/10^6 \text{ lb}(a)$
- b.  $\text{lb}(i)/\text{hr} = \text{lb}(i)/10^6 \text{ lb}(a) \times \text{Ash Flow, lb}(a)/\text{hr} \times 10^{-6}$
- c.  $\text{lb}(i)/10^{12} \text{ Btu}(f) = \text{lb}(i)/10^6 \text{ lb}(a) \times \text{Ash Flow, lb}(a)/10^6 \text{ Btu}(f)$

8. To calculate lb/hr and lb/10<sup>12</sup> Btu of a species (i) in liquid stream (l)

- a.  $\text{lb}(i)/\text{hr} = \text{mg}(i)/\text{L}(l) \times \text{Liquid Stream Flow, L}(l)/\text{hr} \times \text{lb}/454,000\text{mg}$
- b.  $\text{lb}(i)/10^{12} \text{ Btu}(f) = \text{mg}(i)/\text{L}(l) \times \text{Liquid Stream Flow, L}(l)/10^6 \text{ Btu}(f) \times \text{lb}/454,000\text{mg} \times 10^6$

9. Nomenclature

$A_s$	=	stack area, ft <sup>2</sup>
$B_{wo}$	=	flue gas moisture content
$C_{12\% \text{ CO}_2}$	=	particulate grain loading, gr/dscf corrected to 12% CO <sub>2</sub>
$C$	=	particulate grain loading, gr/dscf
$C_p$	=	pitot calibration factor, dimensionless
$D_n$	=	nozzle diameter, in.
$F$	=	fuel F factor, dscf/10 <sup>6</sup> Btu at 0% O <sub>2</sub>
$H$	=	orifice pressure differential, iwg
$I$	=	% isokinetics
$M_n$	=	mass of collected particulate, mg
$M_i$	=	mass emissions of species i, lb/hr
$MW$	=	molecular weight of flue gas
$MW_i$	=	molecular weight of species i:
		NO <sub>x</sub> : 46
		CO : 28
		SO <sub>x</sub> : 64
		HC : 16
$\theta$	=	sample time, min.
$\Delta P$	=	average velocity head, iwg = $(\sqrt{\Delta P})^2$
$P_{bar}$	=	barometric pressure, in.Hg
$P_s$	=	stack absolute pressure, in.Hg
$P_{sg}$	=	stack static pressure, iwg



$Q$	= wet stack gas flow rate at actual conditions, wacfm
$Q_{sd}$	= dry stack gas flow rate at standard conditions, dscfm
$SV$	= specific molar volume of an ideal gas at standard conditions, ft <sup>3</sup> /lb mole
$T_m$	= meter temperature, °R
$T_{ref}$	= reference temperature, °R
$T_s$	= stack temperature, °R
$V_s$	= stack velocity, ft/sec
$V_{lc}$	= volume of liquid collected in impingers, ml
$V_m$	= dry meter volume uncorrected, dcf
$V_{m\ std}$	= dry meter volume at standard conditions, dscf
$V_{w\ std}$	= volume of water vapor at standard conditions, scf
$Y$	= meter calibration coefficient



Sample Pt. \_\_\_\_\_

Date \_\_\_\_\_

Day 1 8-7-70**OH EGD OUT**

Run \_\_\_\_\_

Fund # \_\_\_\_\_

**STACK**

Cost Center # \_\_\_\_\_

Train Type : **ONTARIO-HYDRO METHOD**

Stopper Type	Type Of Solution	Initial Wt. (g)	Final Wt. (g)	Net Wt. (g)
BUBBLER	KCl	615.5	866.6	251.1
BUBBLER	KCl	632.0	964.2	332.2
IMPINGER	KCl	649.6	758.1	108.5
BUBBLER	H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub>	732.1	733.6	1.5
BUBBLER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	730.1	728.5	-1.6
BUBBLER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	613.3	618.5	5.2
IMPINGER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	612.2	607.9	-4.3
BUBBLER	SILICA GEL	875.9	937.8	61.9
			Total H <sub>2</sub> O (g)	754.5 ✓
FILTER				
			Total Dust (g)	

$$V_{wstd} = 0.0474 * (H_2O \text{ g})$$

\_\_\_\_\_ SCF

$$V_{mCorrected} = V_m * C_m$$

\_\_\_\_\_ ACF

$$V_{mstd} = \frac{17.71 V_m C (P_b + \Delta H / 13.6)}{T_m}$$

\_\_\_\_\_ SCF

$$V_{tstd} = V_{wstd} + V_{mstd}$$

\_\_\_\_\_ SCF

$$\%H_2O = (V_{wstd} / V_{tstd}) * 100$$

\_\_\_\_\_ %H<sub>2</sub>O

$$Q_{nstd} = 17.71 Q_n P_s / T_s$$

\_\_\_\_\_ SCFM

$$\% \text{ Isokinetic} = V_{tstd} / (Q_{nstd} * \text{Time})$$

\_\_\_\_\_ %

**DUST LOADING CALCULATIONS (Concentration Basis)**

$$DCL = 15.432 (\text{dust g}) / V_{tstd}$$

\_\_\_\_\_ grains/scf

$$\% \text{ Efficiency} = \frac{(\text{Inlet DCL} - \text{Outlet DCL}) * 100}{\text{Inlet DCL}}$$

\_\_\_\_\_ %

$$ACFM = V_s * \text{Pipe Area (ft}^2\text{)}$$

\_\_\_\_\_ ACFM

$$SCFM = ACFM * P_s / 29.92 * 530 / T_s = ACFM * P_s / T_s * 17.71$$

\_\_\_\_\_ SCFM

CLIENT VYSLG - MILLIKEN Station UNIT 2 TEST NO. 2-044 - STACK METHOD ONT Hydro PAGE 1 OF 3  
 SAMPLE LOCATION STACK TEST CONDITION Full 100% AMB. TEMP. °F 92 PROJECT # 11478  
 OPERATOR/ASSISTANT RP METER VOL. (START/END) 797.362 1 1043.320 DATE 8-8-96

**RE-TEST DATA:**  
 aromatic Press., in. Hg. 29.08  
 assumed Slack Temp. °F 125  
 assumed Meter Temp. °F 130  
 assumed ΔP ~1.2  
 assumed Moisture % 14  
 sack Diameter, in. 12.1  
 sample Time: Total 360  
 per point 30  
 total of Traverse Points 5.2 g/6 pt.  
 Non Connecting Y  
 Line (Y/N) Y  
 Kinetic Factor Y  
 ΔH = 1.08 X ΔP

**EQUIPMENT INFO:**  
 Meter ID No. Box #6 7243  
 Meter, Yd. 1.000  
 CFM @ ΔH = 1.0 0.5978  
 Pilot: ID #27  
 Cp 0.84  
 Probe: Mat'l qtz.  
 Length 4'  
 Nozzle: ID/Mat'l #17 / qtz.  
 Diam. 0.190  
 Filter: No. 50A #6  
 Tare Wt. 50A #6  
 TC Readout ID: Meter 50A #6  
 Aux. 50A #6

**POST TEST INFO:**  
 Filter Appearance 50A #6  
 Impinger Appearance 50A #6  
 Silica Gel Spent (Y/N) 50A #6

**SAMPLE TRAIN LEAK CHECK:**  
 CEM Vac Pilot Init  
 Pre-Test 0.000 15" ✓  
 Post-Test 0.000 7"

**PRE-TEST CALIBRATION CHECK:**  
 Meter Meter Temp  
 Time ΔH Reading in Out  
 Init \_\_\_\_\_  
 Final \_\_\_\_\_

SAMPLE POINT	TIME	METER CONDITIONS			TEMPERATURES, °F						STATIC PRESS. lwg	CHAIN OF CUSTODY INFORMATION		
		ΔP	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP. OUT			O <sub>2</sub>	VAC.
							IN	OUT						
SP.	0753	1.3	1.34	797.362	124	249	101	90	246	63	5.3	2.7	-74	Impingers Loaded
auth	0823	1.42	1.46	817.445	123	250	111	95	249	62	5.3	2.7		Impingers Recovered
	0853	1.40	1.44	837.486	123	250	114	98	249	63	5.3	2.9		Filter Loaded
	0923	1.40	1.44	858.353	122	250	115	99	250	61	5.3	2.9	-176	Filter Recovered
	0953	1.40	1.44	878.702	122	262	116	100	260	60	5.5	3.0		Probe Wash
	1023	1.40	1.44	899.458	122	264	117	101	264	60	5.5	3.0		TEST SUMMARY
	1053	1.40	1.44	920.023	123	264	116	100	264	59	5.5	3.0	-75	Calculated by: DK
	1123	1.40	1.44	940.402	123	264	115	99	264	59	5.2	3.0		Checked by:
														Slack Press (lwg) -0.75
														Slack Temp (°F) 122.8
														ΔP (lwg) 1.3932
														O <sub>2</sub> /CO <sub>2</sub> 5.31 1360
														Meter Vol. (act) 245.958
														Meter Temp. (°F) 105.2
														Meter Press. (lwg) 1.43
														Liquid Vol. (g) 800.9
														Comments: DAY 2 8-8-96

DATE 1/31/11 1:00 PM  
TEST CONDITION Stack  
METER VOL. (START/END) 1000  
SAMPLE LOCATION Stack  
OPERATOR/ASSISTANT RM

RE-TEST DATA:  
Arithmetic Press., In. Hg. 29.08  
Assumed Slack Temp. °F  
Assumed Meter Temp. °F  
Assumed ΔP  
Assumed Moisture %  
Slack Diameter, In.  
Sample Time: Total  
Total of Traverse Points  
Flow Connecting  
Line (Y/N)  
Kinetic Factor  
ΔH = 1.03 X ΔP

EQUIPMENT INFO:  
Meter ID No. 60X #6  
Meter, Yd. 1,000  
CFM @ ΔH = 1.0 8,5978  
Pilot: ID Cp  
Probe: Mat'l Length  
Nozzle: ID/Mat'l Diam.  
Filter: No. Tare Wt.  
TC Readout ID: Meter Aux.

IMPINGERS:

Imp.	Mat'l	Wt (End)	Wt (Start)	Wt (g)
#1				
#2				
#3				
#4				
#5				
Total				

POST TEST INFO:  
Filter Appearance  
Impinger Appearance  
Silica Gel Spent (Y/N)

PRE-TEST CALIBRATION CHECK:  
Time ΔH Reading In Out  
Meter Meter Temp

SAMPLE TRAIN LEAK CHECK:  
CFM Vac Pilot Init  
Pre-Test  
Post-Test

SAMPLE POINT	TIME	METER CONDITIONS				TEMPERATURES, °F						STATIC PRESS. Inwg	CHAIN OF CUSTODY INFORMATION
		ΔP	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP.			
							IN	OUT		OUT	OUT		
SP.	1153	1.1	1.44	961.112	123	263	114	98	264	59			Impingers Loaded
South.													Impingers Recovered
	1223	1.4	1.44	981.4	123	263	113	97	264	66	vac		Filter Loaded
													Filter Recovered
	1253	1.4	1.44	1002.012	123	263	112	97	264	63			Probe Wash
													TEST SUMMARY
	1323	1.4	1.44	1022.702	123	263	112	96	263	60			Calculated by:
													Checked by:
	1353			1043.320									Slack Press. (Inwg)
													Slack Temp. (°F)
													ΔP (Inwg)
													O <sub>2</sub> /CO <sub>2</sub>
													Meter Vol. (acf)
													Meter Temp. (°F)
													Meter Press. (Inwg)
													Liquid Vol. (g)
													Comments:

DAY 2 8-8

OH FGD OUT

Sample Pt. StackDAY 2 8-8-96Date OH EGD OUTRun STACKFund # 30R3Cost Center # 30R3

Train Type : ONTARIO-HYDRO METHOD

Stopper Type	Type Of Solution	Initial Wt. (g)	Final Wt. (g)	Net Wt. (g)
BUBBLER	KCl	572.1	785.6	
BUBBLER	KCl	627.4	898.2	
IMPINGER	KCl	599.4	843.3	
BUBBLER	H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub>	763.9	773.5	
BUBBLER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	605.7	609.9	
BUBBLER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	599.4	604.9	
IMPINGER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	577.8	573.6	
BUBBLER	SILICA GEL	866.2	923.8	
			Total H <sub>2</sub> O (g)	800.9 ✓
FILTER				
			Total Dust (g)	

$$V_{wstd} = 0.0474 * (H_2O \text{ g})$$

$$V_{mCorrected} = V_m * C_m$$

$$V_{mstd} = \frac{17.71 V_m C (P_o + \Delta H/13.6)}{T_m}$$

$$V_{tstd} = V_{wstd} + V_{mstd}$$

$$\%H_2O = (V_{wstd} / V_{tstd}) * 100$$

$$Q_{nstd} = 17.71 Q_n P_s / T_s$$

$$\% \text{ Isokinetic} = V_{tstd} / (Q_{nstd} * \text{Time})$$

**DUST LOADING CALCULATIONS (Concentration Basis)**

$$DCL = 15.432 (\text{dust g}) / V_{tstd}$$

$$\% \text{ Efficiency} = \frac{(\text{Inlet DCL} - \text{Outlet DCL}) * 100}{\text{Inlet DCL}}$$

$$ACFM = V_s * \text{Pipe Area (ft}^2\text{)}$$

$$SCFM = ACFM * P_s/29.92 * 530/T_s = ACFM * P_s/T_s * 17.71$$

SCF

ACF

SCF

SCF

%H<sub>2</sub>O

SCFM

%

grains/scf

%

ACFM

SCFM

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Sample Pt. STACKDate DAY 3 8-10-96  
Run OH FGD OUT  
Fund # STACK  
Cost Center # 3053

Train Type : ONTARIO-HYDRO METHOD

Stopper Type	Type Of Solution	Initial Wt. (g)	Final Wt. (g)	Net Wt. (g)
BUBBLER	KCl	572.3	832.6	
BUBBLER	KCl	601.1	868.5	
IMPINGER	KCl	612.0	803.2	
BUBBLER	H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub>	721.3	721.3	
BUBBLER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	607.9	603.3	
BUBBLER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	607.6	627.9	
IMPINGER	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub>	591.3	578.9	
BUBBLER	SILICA GEL	834.9	891.3	
			Total H <sub>2</sub> O (g)	779.1 ✓
FILTER				
			Total Dust (g)	

$$V_{wstd} = 0.0474 * (H_2O \text{ g})$$

$$V_{m \text{ Corrected}} = V_m * C_m$$

$$V_{mstd} = \frac{17.71 V_m C (P_b + \Delta H/13.6)}{T_m}$$

$$V_{tstd} = V_{wstd} + V_{mstd}$$

$$\%H_2O = (V_{wstd} / V_{tstd}) * 100$$

$$Q_{nstd} = 17.71 Q_n P_s / T_s$$

$$\% \text{ Isokinetic} = V_{tstd} / (Q_{nstd} * \text{Time})$$

**DUST LOADING CALCULATIONS (Concentration Basis)**

$$DCL = 15.432 (\text{dust g}) / V_{tstd}$$

$$\% \text{ Efficiency} = \frac{(\text{Inlet DCL} - \text{Outlet DCL}) * 100}{\text{Inlet DCL}}$$

$$ACFM = V_s * \text{Pipe Area (ft}^2\text{)}$$

$$SCFM = ACFM * P_s/29.92 * 530/T_s = ACFM * P_s/T_s * 17.71$$

$$\text{lb/hr} = \text{grains/sec} * 0.000143 * SCFM * 60$$

\_\_\_\_\_ SCF

\_\_\_\_\_ ACF

\_\_\_\_\_ SCF

\_\_\_\_\_ SCF

\_\_\_\_\_ %H<sub>2</sub>O

\_\_\_\_\_ SCFM

\_\_\_\_\_ %

\_\_\_\_\_ grains/scf

\_\_\_\_\_ %

\_\_\_\_\_ ACFM

\_\_\_\_\_ SCFM

\_\_\_\_\_ lbs/hour

**CARNOT SOURCE TEST DATA SUMMARY**  
**TRIS BUFFER METHOD**  
**FGD STACK**

Client/Location.....	NYSEG/Milliken	Reference Temp (F).....		68
Unit.....	2	Fuel.....		COAL
Sample Location.....	FGD STACK	Data By.....		DVK
Operating Condition.....	FULL LOAD	Date of Data Entry.....		10/10/96
Test No.....	1-Tris-STK	2-Tris-STK	3-Tris-STK	Average
Date.....	8/7/96	8/8/96	8/9/96	*
Test Method.....	TRIS BUFFER	TRIS BUFFER	TRIS BUFFER	*
Sample Train.....	BOX 6	BOX 6	BOX 6	*
Pitot Factor .....	0.840	0.840	0.840	*
Meter Cal Factor.....	1.0000	1.0000	1.0000	*
Stack Area (sq ft).....	113.10	113.10	113.10	*
Sample Time (Min).....	120	120	120	*
Bar Press (in Hg).....	29.12	29.08	29.07	*
Nozzle Diam (in).....	0.191	0.191	0.191	*
Start/Stop Time.....	1515/1715	1425/1625	1520/1720	*
Stack Press (iwg).....	-0.68	-0.63	-0.54	-0.62
Stack Temp (F).....	122.0	123.3	121.8	122.37
Velocity Head (iwg).....	1.3249	1.3000	1.3247	1.3165
Stack O2 (%).....	5.42	5.15	5.23	5.27
Stack CO2 (%).....	13.89	13.48	13.64	13.67
Meter Vol (acf).....	80.717	79.925	80.531	80.391
Meter Temp (F).....	119.4	98.3	103.4	107.0
Meter Press (iwg).....	1.35	1.34	1.38	1.36
Liquid Vol (ml).....	287.0	271.6	261.1	273.2
Std Sample Vol (SCF).....	71.828	73.709	73.577	73.038
Std Sample Vol (Nm^3).....	1.895	1.945	1.941	1.927
Moisture Fraction.....	0.159	0.148	0.143	0.150
Stack Gas Mol Wt.....	28.47	28.53	28.61	28.54
Stack Gas Velocity (ft/sec).....	69.22	68.60	69.07	68.96
Stack Flow Rate (wacfm).....	469,693	465,532	468,679	467,968
Stack Flow Rate (dscfm).....	348,242	348,257	353,408	349,969
Isokinetic Ratio (%).....	97.67	100.22	98.58	98.82

**PRE-TEST DATA:**  
Barometric Press., in. Hg. 29.12  
Assumed Slack Temp. °F 122  
Assumed Meter Temp. °F 107  
Assumed ΔP 1.3  
Assumed Moisture % 14%  
Slack Diameter, in. 1.00  
Sample Time: Total 30 per point Single Pt.  
Total of Traverse Points 30  
Teflon Connecting Y. Line (Y/N)  
Isokhelic Factor ΔH = 1.02 X ΔP \* 1.03

**EQUIPMENT INFO:**  
Meter ID No. Box #6 59414  
Meter, Yd. 1,000  
CFM @ ΔH = 1.0 0.5978  
Pilot: ID 0.84 Cp QTZ  
Probe: 41 Mat'l 1021  
Nozzle: 0.191 Length 1.021  
Filler: Box #6 ID/Mat'l Diam. 0.191  
Tare Wt. Box #6  
TC Readout ID: Meter Aux.

**POST TEST INFO:**  
Filter Appearance Box #6  
Impinger Appearance Box #6  
Silica Gel Spent (Y/N)

**SAMPLE TRAIN LEAK CHECK:**  
CEM Vac Pilot Init  
Pre-Test 0.003 15.4 ✓  
Post-Test 0.009 5" ✓  
Init Final

**PRE-TEST CALIBRATION CHECK:**  
Meter Meter Temp  
Time ΔH Reading In Out  
✓ 47.7 287.0

SAMPLE POINT	TIME	METER CONDITIONS				TEMPERATURES, °F						STATIC PRESS. lwg	CHAIN OF CUSTODY INFORMATION	
		ΔP	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP. OUT	O <sub>2</sub>			VAC.
							IN	OUT						
SP. 1	1515	1.35	1.35	716.170	123	250	118	109	252	63	5.4	2.5	Impingers Loaded	
South													Impingers Recovered	
✓	1545	1.3	1.34	736.638	123	250	128	112	250	63	5.4	2.5	Filter Loaded	
✓	1615	1.3	1.34	756.751	122	250	149	114	251	61	5.4	2.5	Filter Recovered	
✓	1645	1.35	1.39	776.786	120	250	130	115	251	60	5.5	2.5	Probe Wash	
END	1715			796.887									TEST SUMMARY	
													Calculated by: DK	
													Checked by: DK	
													Slack Press (lwg) - 0.88	
													Slack Temp. (°F) 122 ✓	
													ΔP (lwg) 1.3249 ✓	
													O <sub>2</sub> /CO <sub>2</sub> 5.42 ✓ 13.89	
													Meter Vol., (ac) 80.717 ✓	
													Meter Temp. (°F) 119.4 ✓	
													Meter Press. (lwg) 1.35 ✓	
													Liquid Vol. (g) 287.0 ✓	
													Comments:	
									Day 1	8-7-96				
									TRIS RECD OUT					

PRE-TEST DATA:

Barometric Press., in. Hg. 29.08

Assumed Slack Temp. °F 125

Assumed Meter Temp. °F 107

Assumed ΔP 1.2

Assumed Moisture % 14%

Slack Diameter, in. 121

Sample Time: Total 120

per point 30

Total of Traverse Points Sample Pt.

Leak Connecting Y.

Line (Y/N) Y.

Isokinetic Factor Y.

ΔH = 1.03 X ΔP

EQUIPMENT INFO:

Meter ID No. Box #6

Meter, Yd. 7243

CFM @ ΔH = 1.0 1.000

Probe: ID 0.5978

Cp 0.84

Mat'l 5242

Length 121

ID/Mat'l 120

Diam. 30

No. Sample Pt.

Filler: 0.191

Tare Wt. Box #6

TC Readout ID: Meter Box #6

Aux. Box #6

POST TEST INFO:

Filter Appearance Box #6

Impinger Appearance Box #6

Silica Gel Spent (Y/N) Box #6

SAMPLE TRAIN LEAK CHECK:

CEM Vac Pilot Init

Pre-Test 0.000 15" OK

Post-Test 0.000 5" OK

PRE-TEST CALIBRATION CHECK:

Meter Meter Temp

Time ΔH Reading In Out

Init

Final

SAMPLE POINT	TIME	METER CONDITIONS				TEMPERATURES, °F						STATIC PRESS. lwg	CHAIN OF CUSTODY INFORMATION
		ΔP	ΔH	METER READING	STACK	PROBE	METER		OVEN	IMP.			
							IN	OUT		OUT	OUT		
SP.	1425	1.3	1.34	1043.886	124	262	101	89	260	60	5.1	2.1	Impingers Loaded
South	1455	1.3	1.34	1064.135	123	263	107	90	263	60	5.1	2.1	Impingers Recovered
	1455	1.3	1.34	1064.135	123	263	107	90	263	60	5.1	2.1	Filter Loaded
	1525	1.3	1.34	1083.902	123	262	108	92	263	60	5.2	2.1	Filter Recovered
	1555	1.3	1.34	1104.252	123	263	107	92	264	60	5.2	2.1	Probe Wash
	1625			123.811									TEST SUMMARY
													Calculated by: OK
													Checked by: OK
													Slack Press. (lwg) -063 ✓
													Slack Temp. (°F) 123.3 ✓
													ΔP (lwg) 1.3000 ✓
													O <sub>2</sub> /CO <sub>2</sub> 5.15 ✓ 1348
													Meter Vol. (act) 79.925 ✓
													Meter Temp. (°F) 98.3 ✓
													Meter Press. (lwg) 1.384 ✓
													Liquid Vol. (g) 271.6 ✓
													Comments:
											DAY 2	8-8-98	

CLIENT ALBERTA PROJECT STACK DATE 8-9-98  
SAMPLE LOCATION STACK TEST CONDITION Full Load AMB. TEMP. °F 45.2  
OPERATOR/ASSISTANT RM METER VOL. (START/END) 372.389 / 452.920

RE-TEST DATA:  
atmospheric Press., in. Hg. 29.07  
assumed Stack Temp. °F \_\_\_\_\_  
assumed Meter Temp. °F \_\_\_\_\_  
assumed ΔP \_\_\_\_\_  
assumed Moisture % \_\_\_\_\_  
stack Diameter, in. 120  
sample Time: Total \_\_\_\_\_ per point \_\_\_\_\_  
total of Traverse Points \_\_\_\_\_  
after Connecting \_\_\_\_\_ Line (Y/N) Y  
synthetic Factor \_\_\_\_\_  
ΔH = 1.04 X ΔP

EQUIPMENT INFO:  
Meter ID No. \_\_\_\_\_ Meter, Yd. \_\_\_\_\_  
CFM @ ΔH = 1.0 \_\_\_\_\_ Pilot: \_\_\_\_\_ ID \_\_\_\_\_ Cp \_\_\_\_\_  
Probe: \_\_\_\_\_ Mat'l \_\_\_\_\_ Length \_\_\_\_\_  
Nozzle: \_\_\_\_\_ ID/Mat'l \_\_\_\_\_ Diam. \_\_\_\_\_  
Filter: \_\_\_\_\_ No. \_\_\_\_\_ Tare Wt. \_\_\_\_\_  
TC Readout ID: Meter \_\_\_\_\_ Aux. \_\_\_\_\_

TEST INFO:  
EST. 7.5 MEI 4 PA 1  
TEST CONDITION Full Load AMB. TEMP. °F 45.2  
METER VOL. (START/END) 372.389 / 452.920

PRE-TEST CALIBRATION CHECK:  
Time ΔH Reading In Out  
Meter Meter Temp  
Pre-Test 0.002 15" ✓ RM  
Post-Test 0.000 54 ✓ RM

SAMPLE TRAIN LEAK CHECK:  
CEM Vac Phot Init  
Pre-Test 0.002 15" ✓ RM  
Post-Test 0.000 54 ✓ RM

SAMPLE POINT	METER CONDITIONS				TEMPERATURES, °F				O <sub>2</sub>	VAC.	STATIC PRESS. lwg	CHAIN OF CUSTODY INFORMATION	
	ΔP	ΔH	METER READING	STACK	PROBE	METER		OVEN					
TIME						IN	OUT					Impingers Loaded	Impingers Recovered
<u>SP1</u>	<u>1.4</u>	<u>1.46</u>	<u>372.389</u>	<u>122</u>	<u>262</u>	<u>105</u>	<u>90</u>	<u>260</u>	<u>5.2</u>	<u>2.6</u>		Filter Loaded	Filter Recovered
<u>SP2</u>	<u>1.3</u>	<u>1.352</u>	<u>393.265</u>	<u>122</u>	<u>263</u>	<u>113</u>	<u>96</u>	<u>258</u>	<u>5.2</u>	<u>2.5</u>		Probe Wash	
<u>SP3</u>	<u>1.3</u>	<u>1.352</u>	<u>412.987</u>	<u>121</u>	<u>263</u>	<u>113</u>	<u>98</u>	<u>265</u>	<u>5.2</u>	<u>2.5</u>		TEST SUMMARY	
<u>SP4</u>	<u>1.3</u>	<u>1.352</u>	<u>432.852</u>	<u>122</u>	<u>263</u>	<u>114</u>	<u>98</u>	<u>265</u>	<u>5.3</u>	<u>2.6</u>		Calculated by: <u>DL</u>	
<u>SP5</u>	<u>1.3</u>	<u>1.352</u>	<u>452.920</u>									Checked by: <u>DL</u>	
												Stack Press (lwg) <u>-0.54</u>	
												Stack Temp. (°F) <u>121.75</u>	
												ΔP (lwg) <u>1.3247</u>	
												O <sub>2</sub> CO <sub>2</sub> <u>5.23</u> <u>✓</u> <u>13.64</u>	
												Meter Vol. (act) <u>80.531</u>	
												Meter Temp. (°F) <u>103.4</u>	
												Meter Press. (lwg) <u>1.38</u>	
												Liquid Vol. (g) <u>261.1</u>	
												Comments:	

TRIS FGD OUT  
STACK



**Appendix C.7**  
**Semtech Hg 2000 Analyzer**





**SEMTECH HG 2000 ANALYZER TEST RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM – UNIT 2**  
**AUGUST 1996**

Parameter	Semtech Hg Analyzer Results		
	Ontario-Hydro Test Period	TRIS Buffer Test Period	Average*
<b><u>Test 1, 8/7/96</u></b>			
Hg(0) - Elemental, ug/dscm	1.86	2.50	2.02
Hg(0) - Elemental, ug/Nm <sup>3</sup>	2.00	2.68	2.17
<b><u>Test 2, 8/8/96</u></b>			
Hg(0) - Elemental, ug/dscm	2.73	3.08	2.82
Hg(0) - Elemental, ug/Nm <sup>3</sup>	2.93	3.31	3.02
<b><u>Test 3, 8/9/96</u></b>			
Hg(0) - Elemental, ug/dscm	2.45	NA	2.45
Hg(0) - Elemental, ug/Nm <sup>3</sup>	2.63	--	2.63
<b><u>Averages</u></b>			
Hg(0) - Elemental, ug/dscm	2.35	2.79	2.43
Hg(0) - Elemental, ug/Nm <sup>3</sup>	2.52	2.99	2.61

NA -- data not available for this test period.

\*Represents a weighted average that is based on test period durations.

NYSEG 01

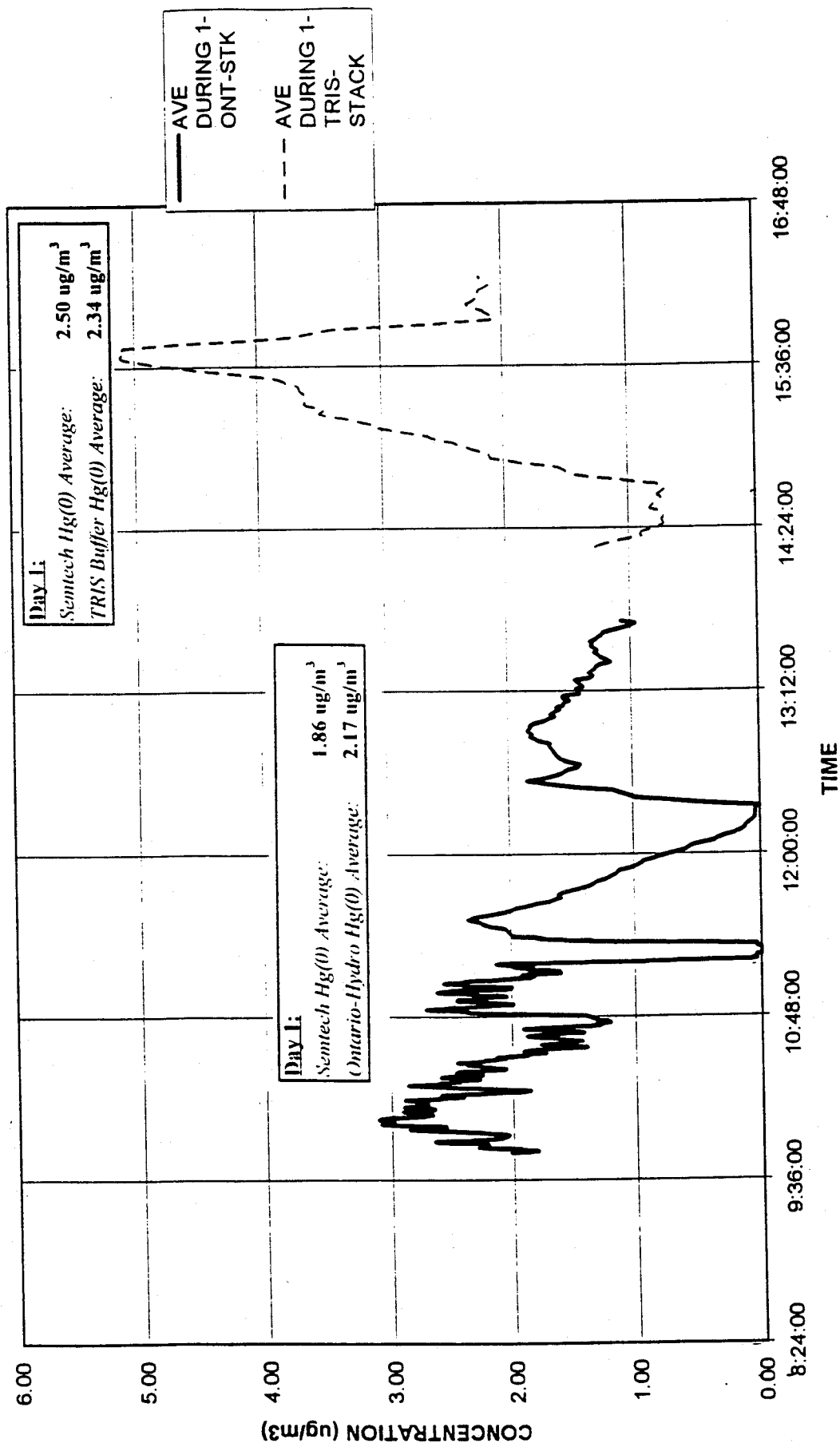
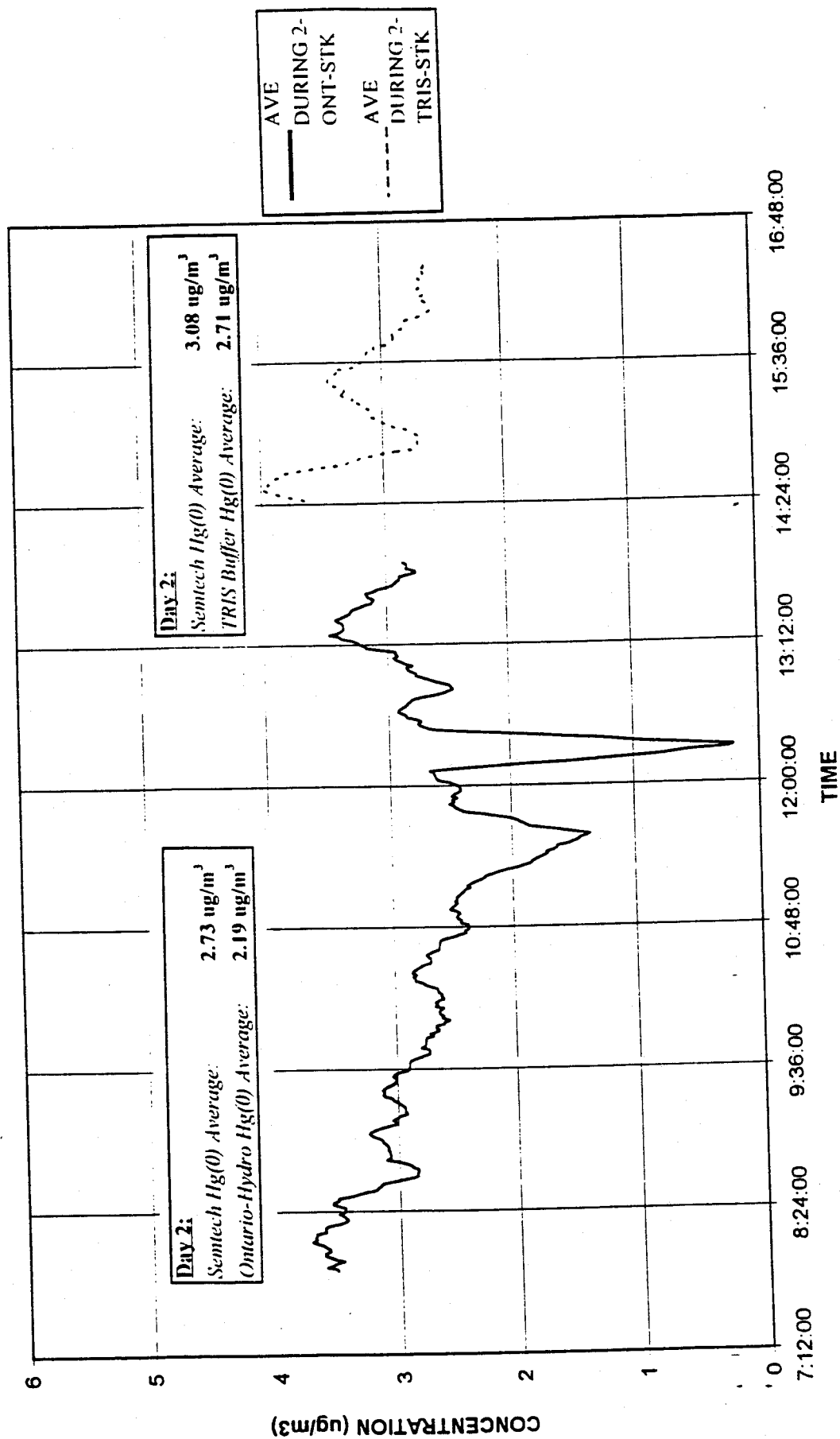


Chart2

NYSEG 2



NYSEG 3

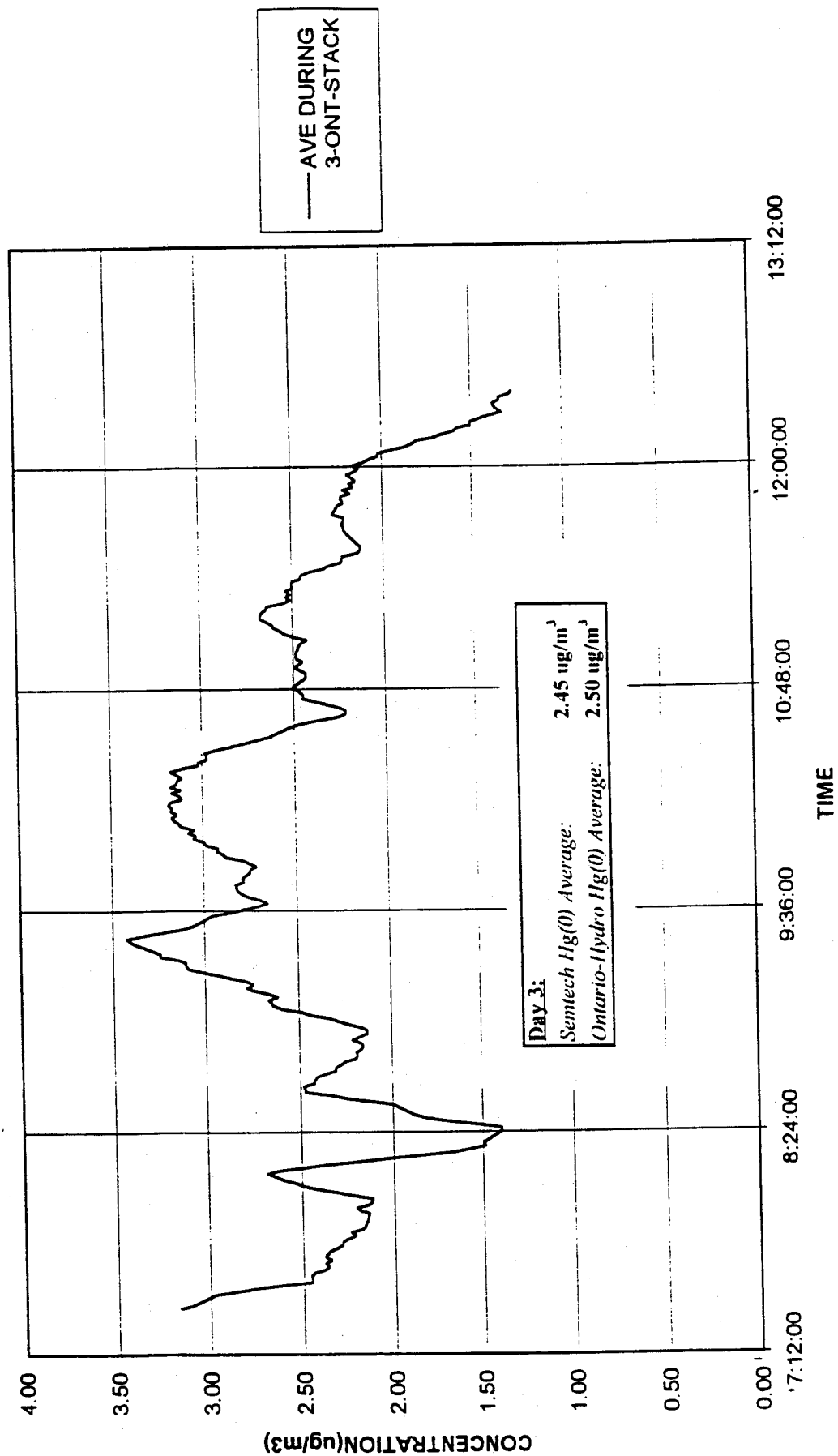
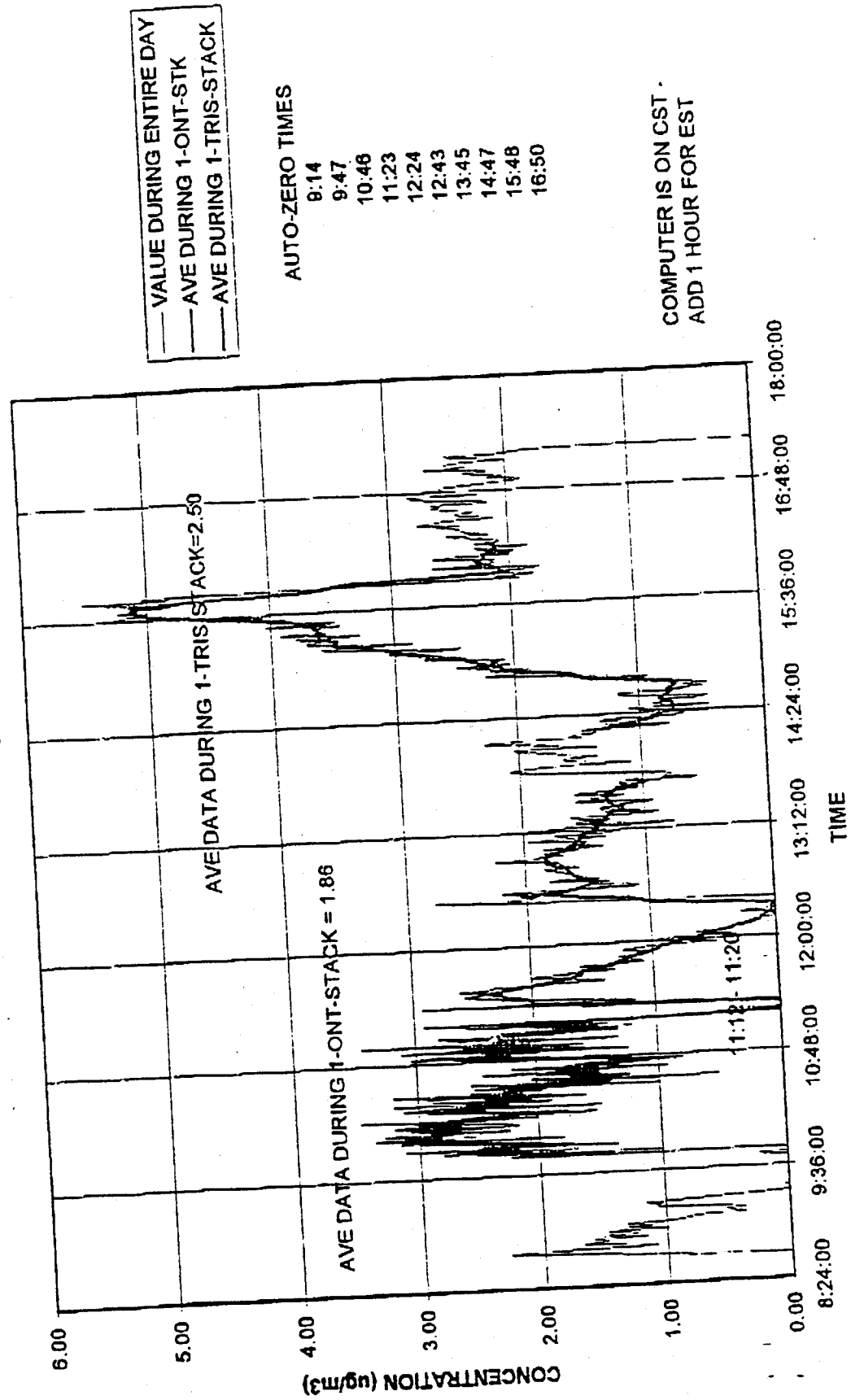


Chart2

NYSEG 1  
8-7-96



NYSEG 2  
8-8-96

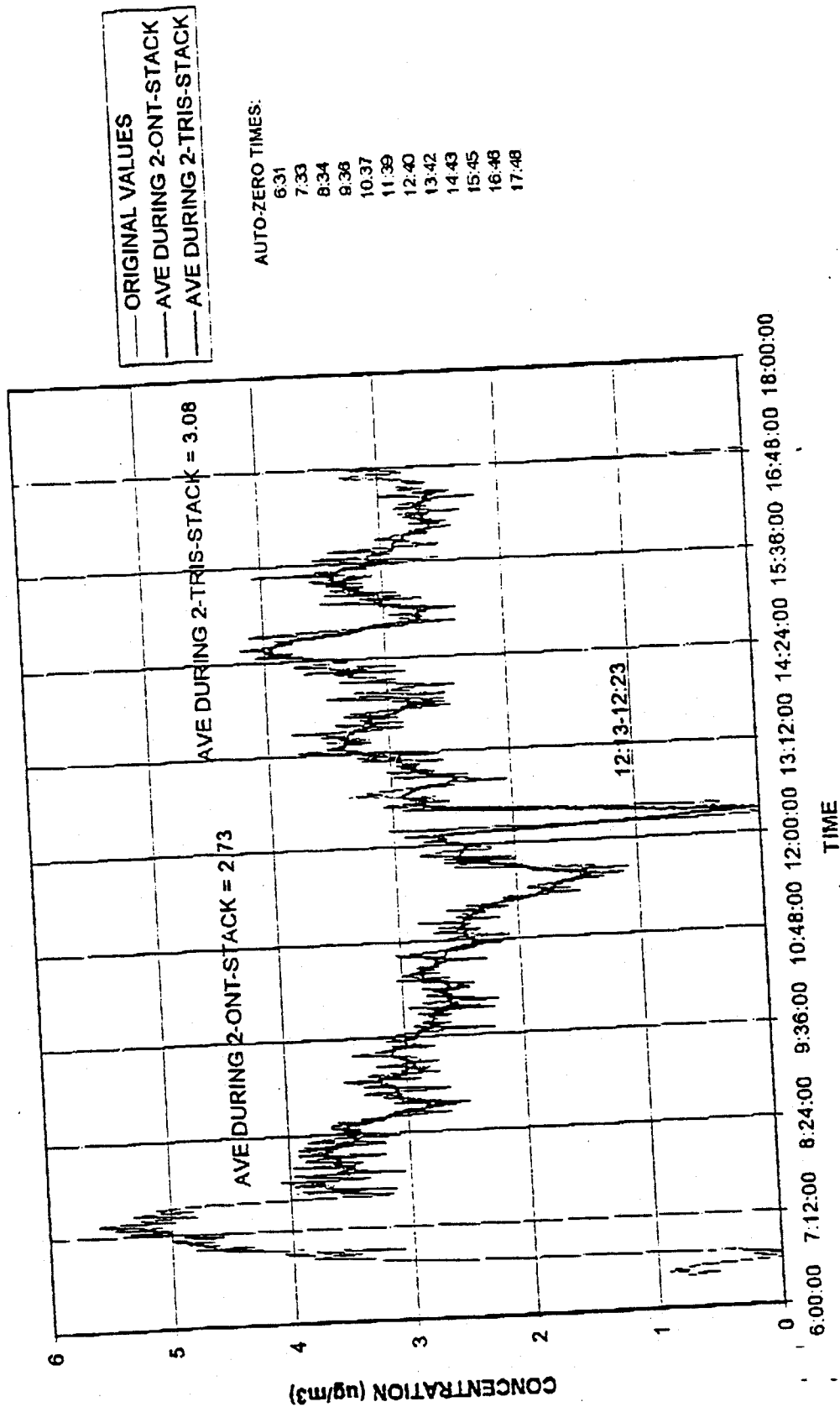
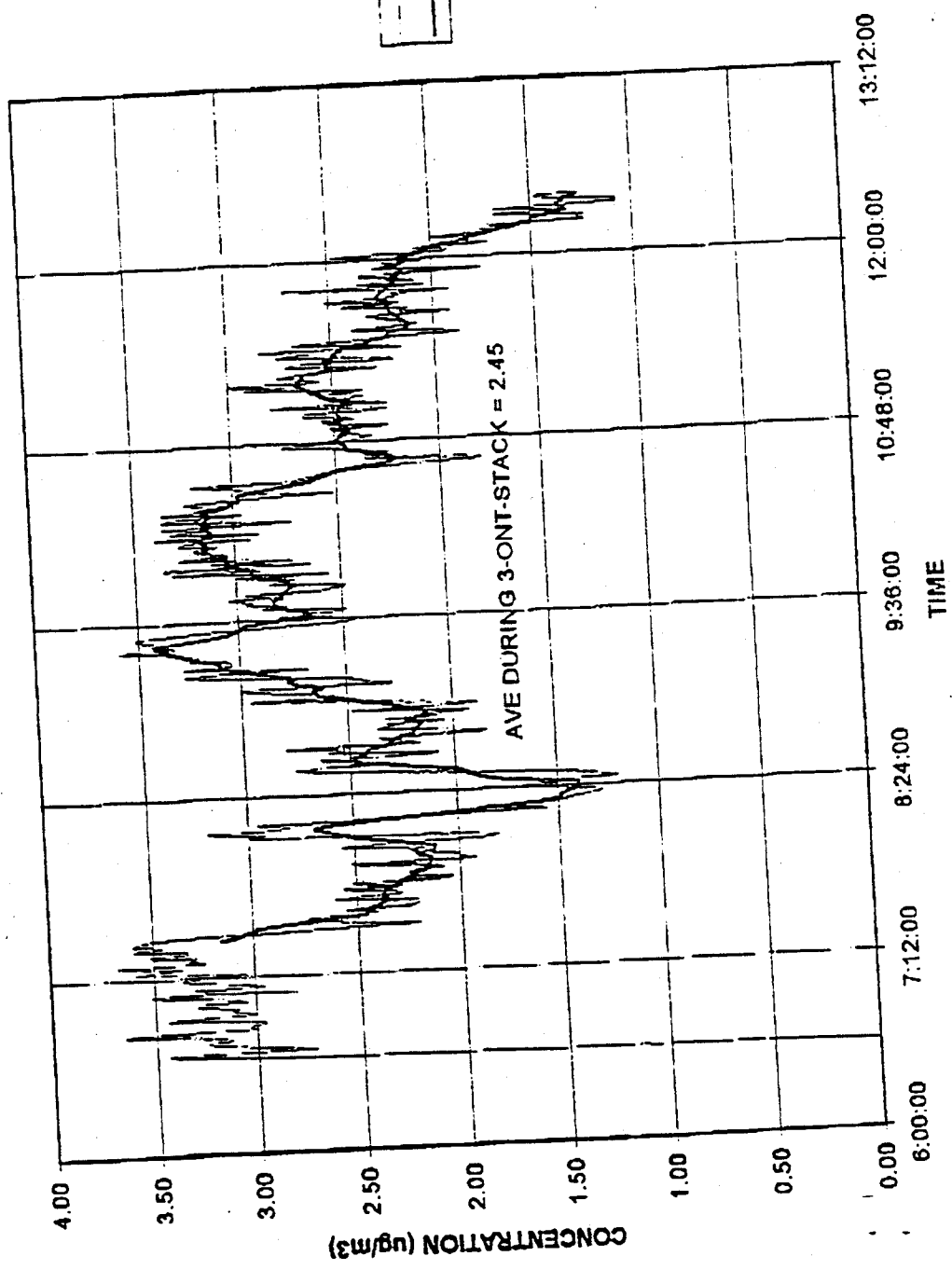


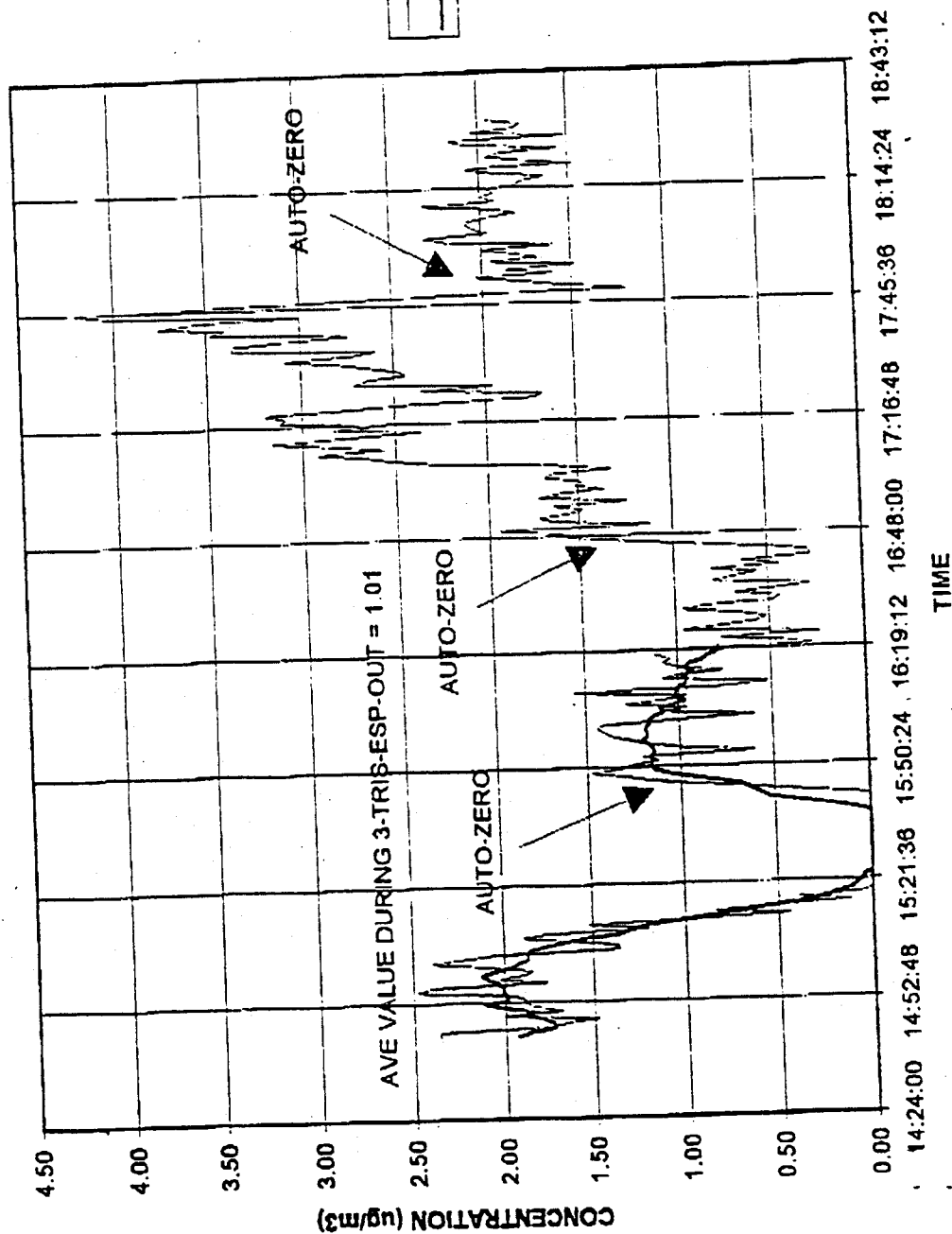
Chart1

NYSEG 3  
8-9-96



AUTO-ZERO  
TIMES  
7:27  
8:28  
9:30  
10:32  
11:33

NYSEG 3.8  
8-9-96



VALUES DURING DAY 3  
AVE DURING 3-TRIS-ESP-OUT

AUTO-ZERO TIMES  
15:42  
16:44  
17:49

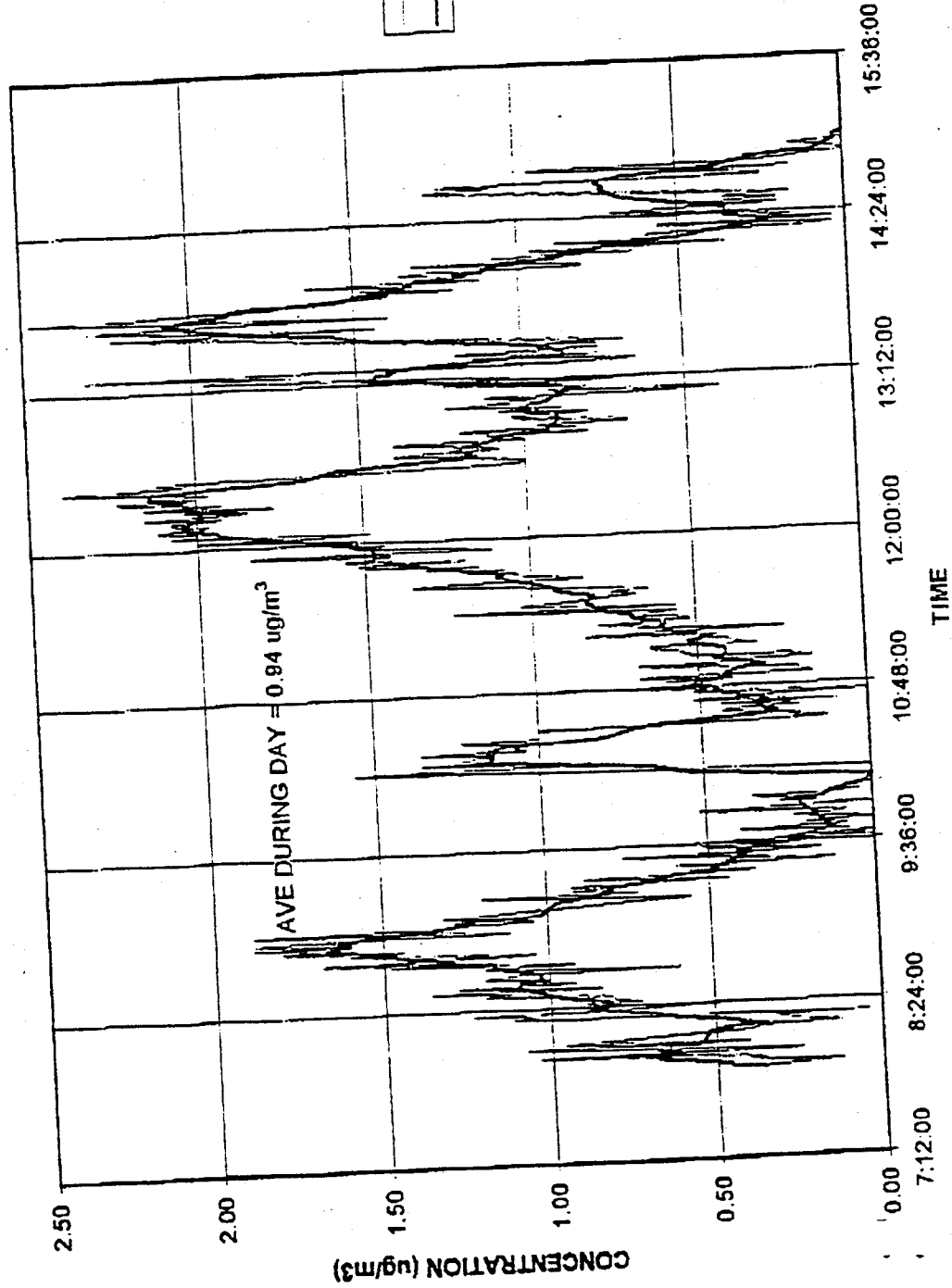
DATA  
INVALID -  
See Report



Chart1

NYSEG 4  
8-10-96

Data  
Invalid,  
See  
Report



VALUES DURING DAY 4  
AVE VALUES

AUTO-ZERO TIMES

8:06  
9:08  
10:09  
10:27  
11:28  
12:30  
13:31

Laboratory Notes Transcribed from the notebook of Richard Schulz.

NYSEG-Milliken Station Unit No.2 Stack      SE Port

8-7-96

*Computer times*

- 08:05      Adjusting Detector and Reference zero values.
- 08:13      Adjusting Detector and Reference span values. Tris impinger used for H<sub>2</sub>O knockout.
- 08:32      Starting computer logging at 60 second integration times  
Note: Computer time is 1 hour earlier than Eastern Daylight Savings Time, so 6:00 computer time is 7:00 EDT.
- 09:45      Auto-zeroed the Semtech.
- 09:46      Changing the sample integration time to 10 seconds.
- 09:48      Power was off to the computer, computer was powering down. Log since 08:32 not complete. Plugged power in at an alternate location. Computer is logging okay now.
- 11:12      Added ice to the impinger knockout box.  
Disconnected Semtech inlet line from impinger train, checking for Semtech to zero on ambient air.
- 11:20      Flow back through impinger.
- 11:24      Changing to 60 second integration time.
- 12:43      Auto-zeroed Semtech manually.
- 17:12      Semtech line open to ambient air for zero check.
- 17:16      Unit off line for the day. Terminated logging of NYSEG 1. The impingers need to be changed.  
Hg<sup>o</sup> levels appear to be  $\approx 2.7 \text{ ug/m}^3$ . (Dry)  
Highest value  $\approx 3.2 \text{ ug/m}^3$ .  
Lowest value  $\approx 2.2 \text{ ug/m}^3$ .

8-8-96

- 06:22 Start Semtech logging. Changed out Tris impingers and added ice. Checked detector and reference signal values and they are okay. Sampling ambient air.
- 06:28 Starting sample flow through impingers - stack line is not connected to analyzer. Performed manual auto-zero.
- 06:35 Auto-zero complete. Sampling air through impinger still.
- 06:40 Leak checked impingers and Semtech - everything is okay.
- 06:42 Started sampling stack gases. Flow rate  $\approx 3$  l/min.
- 12:09 Disconnected Semtech from stack to change out first impinger for a fresh one.
- 12:12 Leak check is good. Unit is drawing ambient air through the impingers.
- 12:21 Stack gases flowing through impingers to Semtech.  
Ave  $Hg^0 \approx 3.0$  ug/m<sup>3</sup> at this point.  
Highest reading  $\approx 5.5$  ug/m<sup>3</sup>.  
Lowest reading  $\approx 1.5$  ug/m<sup>3</sup>.
- 16:46 Disconnecting Semtech from flue gas stream, will allow it to sample ambient air overnight.

8-9-96

- 06:10 Changing out tris impingers and adding ice. Reference and detector outputs are okay.
- 06:25 Leak check of impingers and Semtech is okay.
- 06:30 Terminated logging from overnight ambient air sampling.
- 06:31 Started logging NYSEG 3.
- 06:35 Connected impingers to flue gas sample line.
- 12:23 Shutting system down, we are going to move to the ESP outlet location. Semtech set up at ESP outlet, unit is leak checked and is okay. The reference and detector values are okay. Started logging NYSEG 3.5.

14:44 Floating point error, so rebooting. Computer time is correct. Logging is restarted as NYSEG 3.8, unit is auto-zeroed. Static pressure is 14.5 inches of H<sub>2</sub>O.

18:29 Shutting Semtech logger off  
Hg<sup>o</sup> levels  $\approx$  2 ug/m<sup>3</sup>. Ranging from 1-4 ug/m<sup>3</sup>.

## 8-10-96

07:51 Installed new impingers and iced box down. Started logging as NYSEG 4.  
Manually auto-zeroed unit.

08:06 Checked reference and detector outputs and they are okay. Auto-zeroed unit again.

08:16 Leak checked Semtech and impingers which are okay.

08:17 Connecting sample line from ESP Outlet Port T to impingers.

08:30 80% load increasing to 100%.

10:27 Manually auto-zeroed.

15:34 Took Semtech off-line.

Note: This location was very hot and dirty. The instrument was operating out of its specified temperature range. Hg<sup>o</sup> numbers from this test location may not be valid.

**APPENDIX D**  
**EMISSION CALCULATIONS**



ft. W. 300. 50 300. 300

DATE	AI128766	FT38643	FT215AC	FT215BC	FT251AC	FT251BC	PRCP1021	PRCP1024	PRCP1028
TIME	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG	HRLY AVG
06:00:01 AM	175.19	0.16	95.88	103.41	419.14	399.12	49.19	285.80	131.94
07:00:01 AM	over range	0.15	101.63	107.95	541.61	522.01	47.80	261.67	127.81
08:00:01 AM	297.72	0.15	101.45	108.21	558.79	538.56	46.41	215.71	119.87
09:00:01 AM	282.37	0.15	102.14	108.18	561.97	540.38	45.02	192.58	112.20
10:00:01 AM	292.65	0.16	101.86	107.62	563.25	545.50	43.64	207.02	116.10
11:00:01 AM	359.25	0.17	101.54	107.39	561.31	539.83	44.75	213.75	120.38
12:00:01 PM	over range	0.18	101.44	107.26	560.99	537.70	48.02	191.63	133.18
01:00:01 PM	over range	0.21	101.73	107.48	558.61	536.60	51.26	281.89	141.38
02:00:01 PM	381.37	0.21	101.97	107.31	560.21	540.15	53.83	344.50	144.24
03:00:01 PM	385.77	0.21	101.78	106.93	561.40	543.75	56.16	320.60	146.92
04:00:01 PM	389.64	0.22	101.67	107.24	561.93	541.40	58.48	343.87	148.31
05:00:01 PM	347.25	0.23	99.76	105.77	542.77	520.75	60.81	312.11	149.71
06:00:01 PM	315.17	0.24	96.76	104.23	485.61	465.45	63.13	288.17	151.10
07:00:01 PM	142.54	0.23	88.85	98.55	364.98	344.29	65.40	357.72	152.49
08:00:01 PM	76.76	0.20	88.35	98.45	325.58	303.62	67.50	345.30	153.89

TOTAL: 1,101.37

# ESP POWER LEVELS

DATE TIME	08/09/96	PRCP1031 HRLY AVG	PRCP1035 HRLY AVG	PRCP1038 HRLY AVG	PRCP1000 HRLY AVG	PRCP1003 HRLY AVG	PRCP1007 HRLY AVG	PRCP1010 HRLY AVG	PRCP1015 HRLY AVG	PRCP1017 HRLY AVG
06:00:01 AM	620.23	118.72	701.43	59.68	379.02	120.22	640.74	128.80	712.00	
07:00:01 AM	614.37	116.19	709.88	57.70	350.62	120.40	636.67	125.19	696.00	
08:00:01 AM	544.87	113.79	674.01	55.84	282.30	120.58	614.93	120.20	685.29	
09:00:01 AM	521.58	114.65	668.76	54.40	256.54	120.77	590.80	115.21	684.47	
10:00:01 AM	534.25	116.92	670.89	53.00	318.30	120.96	627.27	112.74	685.29	
11:00:01 AM	567.86	119.19	668.95	51.64	332.10	121.35	635.08	114.57	683.28	
12:00:01 PM	536.98	121.46	667.56	56.87	312.52	121.86	605.27	116.48	685.20	
01:00:01 PM	629.38	123.73	694.05	66.63	387.81	122.36	657.55	118.39	689.13	
02:00:01 PM	673.01	126.00	696.03	71.79	476.82	122.87	688.91	120.30	691.47	
03:00:01 PM	671.93	128.27	688.32	75.33	431.05	123.38	677.60	122.21	689.63	
04:00:01 PM	654.65	130.33	679.90	78.86	466.70	123.88	675.12	124.12	686.57	
05:00:01 PM	636.38	129.05	686.57	82.21	426.56	124.39	676.35	126.03	687.46	
06:00:01 PM	629.23	126.61	704.53	84.84	396.33	124.90	677.57	127.13	688.35	
07:00:01 PM	648.59	124.16	699.54	86.59	474.72	125.60	680.58	127.38	689.24	
08:00:01 PM	664.01	121.82	702.15	85.55	470.70	126.36	684.78	127.63	690.12	



Creation Date: 17-Dec-96

Print Date: 19-Dec-96

File: k:/docs/fgd/carnot.wk4

Subject: Additional FGD Process Information

Author: Al Vought

Point Tag	Tag English Description	Tag Units
FIT28478	CENTR FD PP-211 DISCH FLOW	GPM
FIT28479	CENTR RTN TO CENTR FD TK-2	GPM
FIT37810	IPRCS WTR TO IPRCS WTR TK FL	GPM
FIT38539	IBRINE CONCENTRATOR INLET F	GPM
FT17812	IPRCS WTR PP PP-103 DISCH F	GPM
FT27812	IPRCS WTR PP PP-203 DISCH F	GPM
FT37812	IPRCS WTR PP PP-303 FLOW	GPM
WT100	NET MW	IMW

# DAY 1

Creation Date: 17-Dec-96

Print Date: 19-Dec-96

File: k:\docs\fgd\carnot.wk4

Subject: Additional FGD Process Information

Author: Al Vought

Raw data extracted as hour averages from:

Start Date: 07-aug-96  
End Date: 07-aug-96  
Start Time: 06:01  
End Time: 20:01

Date	Time	FIT28478	FIT28479	FIT37810	FIT38539	FT17812	FT27812	FT37812	WT100
07-Aug-96	06:01:00 AM	1078.28	1037.69	395.78	71.31	226.63	4.48	182.12	136.16
07-Aug-96	07:01:00 AM	1072.86	1003.86	409.90	10.99	226.39	5.52	184.85	133.34
07-Aug-96	08:01:00 AM	1073.03	1003.57	398.99	10.80	215.85	4.31	192.30	138.06
07-Aug-96	09:01:00 AM	1067.82	999.41	458.60	22.80	266.45	5.39	216.96	138.64
07-Aug-96	10:01:00 AM	1069.42	1034.70	691.61	19.29	441.49	4.88	417.74	139.22
07-Aug-96	11:01:00 AM	1063.72	1014.17	754.10	16.34	456.44	5.02	431.44	140.23
07-Aug-96	12:01:00 PM	1057.16	1008.89	753.51	19.03	332.11	5.17	275.37	139.56
07-Aug-96	01:01:00 PM	1049.39	1002.82	565.60	18.01	302.32	6.00	263.77	135.60
07-Aug-96	02:01:00 PM	1048.38	996.92	526.80	19.28	297.49	6.12	260.08	140.02
07-Aug-96	03:01:00 PM	1040.50	977.36	472.22	24.77	278.08	4.73	234.63	139.29
07-Aug-96	04:01:00 PM	1037.27	972.25	423.65	1.96	242.74	4.36	207.34	138.83
07-Aug-96	05:01:00 PM	1040.91	982.95	468.51	0.59	282.32	8.89	249.69	139.20
07-Aug-96	06:01:00 PM	1038.77	981.50	486.23	0.21	281.36	5.49	243.22	138.95
07-Aug-96	07:01:00 PM	1034.38	976.61	510.93	0.20	277.78	6.41	248.44	137.98

PROCESS WATER TO ABS

BEING TO PUFF (TO MOD)

GS CENT IN GS CENT OUT PUFF OUT

[NOT USED]

Must be at least over 6 ppm to account for time additive

294.92 5.48 257.71 138.22

Avg: 1055.1 999.48

17.26

558.01 TOTAL

→ Entire ~~test~~ period used since FGD operates in batch cycles + considered data outliers and not included in daily average.

Creation Date: 17-Dec-96

Print Date: 19-Dec-96

File: k:\docs\fgd\carnot.wk4

Subject: Additional FGD Process Information

Author: Al Vought

Raw data extracted as hour averages from:

Start Date: 08-Aug-96 Start Time: 06:01  
End Date: 08-Aug-96 End Time: 20:01

65 cent in

OUT

FIT28478

FIT28479

FIT37810

FIT38539

FT17812

FT27812

FT37812

Unit 1

WT100

101.45

126.57

137.37

135.10

136.17

142.66

142.81

144.78

144.47

142.58

141.30

142.00

142.20

141.72

1069.51

1077.41

1072.91

1067.81

1062.95

1059.96

1060.25

1052.50

1054.38

1053.10

1057.82

1060.01

1063.11

1066.53

1008.48

1063.80

1058.66

1052.73

1047.93

1043.89

1044.06

1033.73

1008.50

967.00

977.89

979.60

980.63

982.20

598.29

488.99

509.99

477.05

483.29

476.56

468.58

458.91

499.66

512.24

502.57

489.43

493.47

500.89

0.19

0.18

0.22

1.23

9.33

11.93

12.81

0.21

0.20

2.26

4.77

14.46

21.39

2.58

346.90

272.78

274.20

254.90

260.23

261.72

263.47

260.76

283.80

281.24

279.89

270.51

279.15

279.67

6.12

4.57

6.79

6.97

7.91

5.26

5.17

6.14

8.26

6.11

5.08

4.46

6.00

5.61

295.38

231.73

247.51

228.84

232.27

225.53

217.16

251.03

253.14

256.43

255.91

249.59

248.91

255.51

13.98

276.37

6.03

246.35

137.23

528.76

Must be over 6 gm to account for lime additive

Unit 1

WT100

101.45

126.57

137.37

135.10

136.17

142.66

142.81

144.78

144.47

142.58

141.30

142.00

142.20

141.72

295.38

231.73

247.51

228.84

232.27

225.53

217.16

251.03

253.14

256.43

255.91

249.59

248.91

255.51

13.98

276.37

6.03

246.35

137.23

528.76

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WT100

101.45

126.57

137.37

135.10

136.17

142.66

142.81

144.78

144.47

142.58

141.30

142.00

142.20

141.72

295.38

231.73

247.51

228.84

232.27

225.53

217.16

251.03

253.14

256.43

255.91

249.59

248.91

255.51

13.98

276.37

6.03

246.35

137.23

528.76

Must be over 6 gm to account for lime additive

Unit 1

WT100

101.45

126.57

137.37

135.10

136.17

142.66

142.81

144.78

144.47

142.58

141.30

142.00

142.20

141.72

295.38

231.73

247.51

228.84

232.27

225.53

217.16

251.03

253.14

256.43

255.91

249.59

248.91

255.51

13.98

276.37

6.03

246.35

137.23

528.76

Must be over 6 gm to account for lime additive

Unit 1

WT100

101.45

126.57

137.37

135.10

136.17

142.66

142.81

144.78

144.47

142.58

141.30

142.00

142.20

141.72

295.38

231.73

247.51

228.84

232.27

225.53

217.16

251.03

253.14

256.43

255.91

249.59

248.91

255.51

13.98

276.37

6.03

246.35

137.23

528.76

Must be over 6 gm to account for lime additive

Unit 1

WT100

101.45

126.57

137.37

135.10

136.17

142.66

142.81

144.78

144.47

142.58

141.30

142.00

142.20

141.72

295.38

231.73

247.51

228.84

232.27

225.53

217.16

251.03

253.14

256.43

255.91

249.59

248.91

255.51

13.98

276.37

&lt;

Creation Date: 17-Dec-96

Print Date: 19-Dec-96

File: k:/docs/fgd/carnot.wk4

Subject: Additional FGD Process Information

Author: Al Vought

Raw data extracted as hour averages from:

Start Date: 09-Aug-96 Start Time: 06:01  
End Date: 09-Aug-96 End Time: 20:01

GS CENT IN

OUT

PURGE OUT

ADJUST TO  
Purge

PROCESS WATER  
TO ABS MOD

Unit 1  
Inlet

Date	Time	FIT28478	FIT28479	FIT37810	FIT38539	FT17812	FT27812	FT37812	WT100
09-Aug-96	06:01:00 AM	1075.35	916.30	619.13	11.13	329.19	4.59	311.96	92.83
09-Aug-96	07:01:00 AM	1080.70	950.72	531.81	12.88	298.63	4.88	261.72	95.36
09-Aug-96	08:01:00 AM	1102.76	1034.79	558.05	13.35	295.91	5.89	276.77	117.24
09-Aug-96	09:01:00 AM	1106.40	1039.83	538.71	9.07	289.84	5.65	264.49	135.95
09-Aug-96	10:01:00 AM	1101.64	1017.23	536.21	0.25	272.89	7.00	259.23	122.84
09-Aug-96	11:01:00 AM	1100.02	1033.91	530.15	0.23	278.84	7.34	265.60	111.08
09-Aug-96	12:01:00 PM	1101.55	1034.70	521.14	0.21	281.03	4.24	262.73	127.65
09-Aug-96	01:01:00 PM	1098.25	1022.08	527.54	1.13	273.87	5.27	247.27	101.82
09-Aug-96	02:01:00 PM	1092.37	1018.71	512.77	1.33	281.04	4.33	246.71	80.17
09-Aug-96	03:01:00 PM	1091.02	1025.21	502.76	0.76	273.33	5.07	243.07	81.70
09-Aug-96	04:01:00 PM	1084.15	1003.20	491.23	0.19	267.61	5.54	242.26	81.67
09-Aug-96	05:01:00 PM	815.15	783.34	475.71	0.18	246.66	6.13	221.14	85.42
09-Aug-96	06:01:00 PM	67.97	362.43	454.19	0.22	245.71	7.00	226.34	91.94
09-Aug-96	07:01:00 PM	316.26	752.77	466.24	0.21	241.63	7.04	223.63	78.46

[not  
used]

Must be at least over 6 gpm  
to account for lime

NGS: 1094.02 1025.52

285.65 5.41 261.98 104.39

553.07

→ Valid Test Period

to consider data outliers and not included in daily average.

714 259-9120

## NYSEG POST-RETROFIT PROJECT MEMORANDUM

TO: Debbie Pickett, NYSEG  
 FROM: Kusha Janani, Carnot  
 SUBJECT: Additional FGD Process Information Needed

DATE: November 25, 1996

Debbie, below is a list of additional FGD process information that I need to complete the mass balance. Please give me a call if any of these items are not available. I appreciate your help in this matter.

- 1) Limestone Slurry Specific Gravity (1.34)
- 2) Gypsum Slurry Specific Gravity (1.29)
- 3) I have two groups of process data that I need clarified, they are designated
  - FT27812 PRCS WTR PP PP-203 DISCH F
  - FT37812 PRCS WTR PP PP-303 FLOW

$$S_m = \frac{S_L}{1 - \frac{C_w}{100} \left( \frac{S - S_L}{S} \right)}$$

$C_w = \% \text{ by weight in Absor}$   
 $S_m = \text{Specific Gravity of mixture}$

$S_L = \text{Specific Gravity of liquid}$   
 (1.056)

$S = \text{Specific Gravity of Solids}$

I believe one or both of them is for the PWRP outlet flowrate to the FGD absorber module. (2.3 Gpm - 2.8 L/min)

- 4) Is the process flowrate data designated as
  - FIT28478 CENTR FD PP-211 DISCH FLOW
 refer to Unit 2's gypsum slurry entering the centrifuges for dewatering as part of the production of the gypsum product. 55.5
- 5) Since brine product and FGD sludge production are common to both units, I need to know the average load for Unit 1 in units of Net MW for 8/7/96, 8/8/96, and 8/9/96 between the hours of 8am and 4pm.

6am 8pm

FIT 38539

Not in System.

- 3) FIT 37810 PP-301 Process water to Process water Tank (From PWRP)
- \* FIT 17812 PP-103 Pump Discharge Flow to Absorber
- FIT 27812 PP-203
- FIT 37812 PP-303

- 4) FIT 28478 Centrifuge Feed Pump Discharge Flow
- \* FIT 28479 Centrifuge Return to Centrifuge Feed Tank
- FIT 28478 - FIT 28479 = Gypsum Slurry Entering Centrifuge

**NYSEG POST-RETROFIT PROJECT MEMORANDUM**

TO: John Marabella, NYSEG  
FROM: Kusha Janati, Carnot  
SUBJECT: Additional FGD Process Information on Brine Product Flow

DATE: December 6, 1996

John, I have another question for you regarding brine product flow rates. It is my understanding that the Brine Concentrator was not in operation during my test program on the dates of August 7-9, 1996. With the Brine Concentrator off-line, I was told that the (unconcentrated) brine product is diverted to the PWRP for discharge to the lake. Is this true?

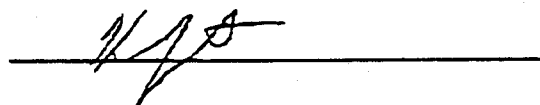
If so, I need to find out what the flow rate of brine product to the PWRP was during the test program (August 7, 8, and 9th) from 6am to 8pm each day. I may have this information already if the flow rate I need is designated:

~~FF38643~~ BC EVAPORATOR FEED FLOW

*FIT38539*

The reason I am questioning these numbers is that for most hours between 6am and 8pm flow rates are around 0.20 gpm, which is much lower than the expected levels of 20-25 gpm.

Your assistance in this matter is greatly appreciated.



/kj

My Phone Number : (714) 259-9520  
My FAX Number : (714) 259-0372

12:30  
AT Vowj Lt

**Appendix C.2**

**Unit CEMS Data/Sample Train Diluent Gas Data**





**DILUENT GAS CONCENTRATIONS**  
**NYSEG POST-RETROFIT TEST PROGRAM – MILLIKEN UNIT 2**  
**AUGUST 1996**

Test No	Date	ESP Inlet		ESP Outlet		FGD Stack	
		O <sub>2</sub> , % <sup>(1)</sup>	CO <sub>2</sub> , % <sup>(3)</sup>	O <sub>2</sub> , % <sup>(1)</sup>	CO <sub>2</sub> , % <sup>(3)</sup>	O <sub>2</sub> , % <sup>(1)</sup>	CO <sub>2</sub> , % <sup>(2)</sup>
1-MTLS	8/7/96	5.60	13.86	5.38	14.06	5.66	13.81
1-PM/AN	8/7/96	5.66	13.84	5.38	14.09	5.77	13.74
1-SO3	8/7/96	—	—	5.57	13.86	5.52	13.91
1-PSD	8/7/96	—	—	5.68	13.76	5.52	13.90
1-MESA	8/7/96	—	—	5.20	14.25	5.63	13.86
1-TRIS	8/7/96	—	—	4.67	14.56	5.42	13.89
1-OH	8/7/96	—	—	4.90	14.47	5.61	13.83
2-MTLS	8/8/96	5.10	13.94	5.10	13.94	5.52	13.57
2-PM/AN	8/8/96	5.53	13.58	5.61	13.51	5.51	13.60
2-SO3	8/8/96	—	—	5.48	13.59	5.52	13.55
2B-SO3	8/8/96	—	—	—	—	5.40	13.42
2-PSD	8/8/96	—	—	5.24	13.73	5.52	13.48
2-MESA	8/8/96	6.13	12.93	5.34	13.62	5.33	13.63
2A-MESA	8/8/96	—	—	5.20	13.54	5.20	13.54
2-TRIS	8/8/96	—	—	5.20	13.44	5.15	13.48
2-OH	8/8/96	—	—	5.28	13.63	5.31	13.60
3-MTLS	8/9/96	5.79	13.64	5.04	14.32	5.76	13.67
3-PM/AN	8/9/96	5.74	13.70	4.98	14.38	5.76	13.68
3A-SO3	8/9/96	—	—	5.77	13.58	5.73	13.62
3B-SO3	8/9/96	—	—	—	—	5.81	13.66
3-PSD	8/9/96	—	—	5.50	13.86	5.73	13.65
3-MESA	8/9/96	5.40	13.64	5.32	13.71	5.35	13.68
3A-MESA	8/9/96	5.23	13.75	4.25	14.61	5.33	13.66
3-TRIS	8/9/96	—	—	4.67	14.13	5.23	13.64
3-OH	8/9/96	—	—	5.16	13.83	5.32	13.69
1-SV	8/12/96	5.40	14.00	4.40	14.90	5.45	13.95
2-SV	8/12/96	5.73	13.81	4.96	14.51	5.78	13.76
1-Cr	8/12/96	5.60	13.66	—	—	5.44	13.80
1-SE	8/12/96	6.00	13.61	4.95	14.57	5.78	13.81
1A-VOST	8/12/96	—	—	4.50	14.78	5.70	13.70
1B-VOST	8/12/96	—	—	4.50	14.78	5.70	13.70
1C-VOST	8/12/96	—	—	4.50	14.93	5.80	13.75
1D-VOST	8/12/96	—	—	4.70	14.81	5.80	13.80
2A-VOST	8/12/96	—	—	4.60	14.85	5.70	13.85
2B-VOST	8/12/96	—	—	4.70	14.81	5.70	13.90
2C-VOST	8/12/96	—	—	4.70	14.81	5.80	13.80
2D-VOST	8/12/96	—	—	4.70	14.41	5.50	13.70
3-SV	8/13/96	5.15	14.17	4.22	15.00	4.98	14.32
2-Cr	8/13/96	5.32	14.21	—	—	5.24	14.28
3-Cr	8/13/96	5.64	13.84	—	—	5.33	14.12
1-FORM	8/13/96	—	—	4.44	14.57	4.66	14.38
2-FORM	8/13/96	—	—	3.97	15.22	5.12	14.19
3-FORM	8/13/96	—	—	4.49	14.80	5.25	14.11
4-MESA	8/13/96	—	—	4.60	15.28	5.70	14.25
3A-VOST	8/13/96	—	—	4.70	14.77	5.00	14.50
3B-VOST	8/13/96	—	—	4.70	15.06	5.30	14.50
3C-VOST	8/13/96	—	—	4.70	14.57	5.00	14.30
3D-VOST	8/13/96	—	—	4.80	14.74	5.12	14.45
3E-VOST	8/13/96	—	—	—	—	5.80	14.20

Notes:

(1) From Teledyne portable O<sub>2</sub> meter.

(2) From Unit 2 CEMS located at the FGD stack.

(3) Calculated by using stack O<sub>2</sub> to correct stack CO<sub>2</sub> to the oxygen level found at this location.

# CONTINUOUS EMISSIONS MONITORING DATA

MILLIKEN STATION UNIT #2

FOR TIME PERIOD 96/07/08

QTR		S O 2		N O X		C O 2		F L O W	
HR	HR	PPM	CODE	PPM	CODE	%	CODE	CFM	CODE
1	0	17.1	0	195.0	0	11.6	0	274364.	0
1	1	50.6	0	201.3	0	11.8	0	272872.	0
1	2	47.3	0	201.4	0	11.9	0	272365.	0
1	3	31.1	0	197.5	0	12.0	0	273567.	0
2	0	35.7	0	196.5	0	12.3	0	280611.	0
2	1	53.3	0	192.4	0	12.9	0	315889.	0
2	2	85.5	0	197.3	0	13.3	0	341813.	0
2	3	95.4	0	218.4	0	13.6	0	369783.	0
3	0	106.4	0	231.2	0	13.4	0	389706.	0
3	1	106.9	0	230.7	0	13.3	0	396454.	0
3	2	102.6	0	218.2	0	13.7	0	404164.	0
3	3	113.8	0	229.5	0	13.4	0	401646.	0
4	0	90.0	0	219.0	0	13.6	0	390611.	0
4	1	113.3	0	230.1	0	13.5	0	397306.	0
4	2	93.9	0	218.3	0	13.5	0	376305.	0
4	3	95.5	0	221.8	0	13.6	0	387725.	0
5	0	103.2	0	223.6	0	13.6	0	395728.	0
5	1	91.2	0	210.8	0	13.5	0	389399.	0
5	2	84.4	0	212.0	0	13.4	0	377413.	0
5	3	75.5	0	210.5	0	13.3	0	379411.	0
6	0	87.5	0	208.8	0	13.4	0	375283.	0
6	1	97.0	0	217.0	0	13.4	0	387618.	0
6	2	103.5	0	223.6	0	13.3	0	395473.	0
6	3	112.0	0	218.6	0	13.4	0	400227.	0
7	0	-99.0	16	-99.0	16	-99.0	16	397842.	256
7	1	122.1	256	194.4	256	14.0	256	396618.	0
7	2	115.1	0	191.5	0	13.8	0	393176.	0
7	3	116.7	0	191.2	0	13.6	0	394438.	0
8	0	117.7	0	193.5	0	13.7	0	398417.	0
8	1	114.9	0	191.3	0	13.7	0	398589.	0
8	2	114.1	0	195.1	0	13.5	0	405012.	0
8	3	109.7	0	195.7	0	13.5	0	405665.	0
9	0	108.3	0	185.1	0	13.4	0	405614.	0
9	1	119.1	0	178.5	0	13.5	0	407133.	0
9	2	119.2	0	177.4	0	13.6	0	401205.	0
9	3	119.6	0	177.8	0	13.5	0	397551.	0
10	0	120.0	0	181.9	0	13.7	0	390680.	0
10	1	123.9	0	180.3	0	13.7	0	394892.	0
10	2	120.6	0	176.0	0	13.9	0	392348.	0
10	3	121.2	0	169.8	0	13.7	0	393259.	0

Press RETURN to continue

1/6 & 256  
ARE CALIBRATED

• DATA ATTACHED  
TO 256'S VAL

• DATA ATTACHED  
TO 16 IS NOT VAL

11	0	116.2	0	170.9	0	13.9	0	389344.	0
11	1	113.3	0	171.1	0	13.7	0	382884.	0
	2	105.1	0	174.8	0	13.9	0	392974.	0
	3	115.1	0	176.3	0	13.9	0	396016.	0
12	0	121.9	0	178.1	0	13.8	0	397528.	0
	1	114.0	0	176.8	0	13.7	0	404295.	0
	2	108.0	0	178.4	0	13.8	0	399192.	0
12	3	115.7	0	179.1	0	13.8	0	396779.	0
	0	119.5	0	177.2	0	13.7	0	402520.	0
	1	116.8	0	180.6	0	13.8	0	403975.	0
13	2	123.1	0	181.8	0	13.9	0	396280.	0
	3	122.4	0	184.4	0	14.0	0	383854.	0
	0	129.2	0	186.1	0	13.9	0	382874.	0
14	1	128.2	0	185.8	0	14.0	0	384860.	0
14	2	142.3	0	188.3	0	14.0	0	389651.	0
	3	160.9	0	187.5	0	14.0	0	388124.	0
	0	169.7	0	184.2	0	13.8	0	399266.	0
15	1	158.6	0	182.8	0	13.8	0	396949.	0
	2	157.7	0	186.3	0	14.0	0	391376.	0
	3	144.3	0	186.2	0	13.9	0	393263.	0
16	0	135.3	0	185.7	0	13.9	0	394699.	0
	1	134.7	0	186.1	0	13.9	0	399239.	0
	2	137.3	0	187.3	0	13.8	0	396628.	0
	3	136.5	0	187.6	0	13.9	0	396705.	0
17	0	132.5	0	188.8	0	13.9	0	397138.	0
	1	129.6	0	189.4	0	13.9	0	391448.	0
	2	137.7	0	189.5	0	13.9	0	392056.	0
17	3	157.9	0	189.3	0	13.9	0	395747.	0
	0	143.6	0	191.0	0	13.9	0	392718.	0
	1	129.0	0	189.0	0	14.0	0	395991.	0
18	2	120.8	0	190.8	0	13.9	0	393017.	0
	3	113.1	0	188.8	0	14.0	0	388442.	0
	0	121.5	0	187.7	0	13.8	0	388665.	0
	1	115.5	0	187.1	0	13.8	0	390158.	0
19	2	118.3	0	188.5	0	13.8	0	387729.	0
	3	130.3	0	188.8	0	13.9	0	386588.	0
	0	125.9	0	186.4	0	13.8	0	387971.	0
20	1	119.8	0	184.9	0	13.8	0	389510.	0
	2	117.8	0	186.5	0	13.7	0	389337.	0
	3	123.1	0	187.2	0	13.7	0	387829.	0
21	0	117.8	0	186.6	0	13.7	0	388062.	0
	1	102.8	0	187.7	0	13.8	0	383854.	0
	2	93.7	0	182.7	0	13.8	0	385502.	0
	3	94.9	0	182.9	0	13.8	0	381192.	0
22	0	98.9	0	180.2	0	13.7	0	387982.	0
	1	99.9	0	182.4	0	13.5	0	390698.	0
	2	95.6	0	180.7	0	13.6	0	384905.	0

Press RETURN to continue

1-TRIS

CO<sub>2</sub> = 13.89

1 - SO<sub>3</sub> - STK  
CO<sub>2</sub> = 13.91

1 - PSD - STK  
CO<sub>2</sub> = 13.90

1 - OH - STK  
CO<sub>2</sub> = 13.83

800/1730, 8/7 → NO<sub>x</sub> = 182.2  
SO<sub>2</sub> = 129.4  
RAW = 394.92

22	3	100.2	0	179.4	0	13.5	0	373900.	0
23	0	109.4	0	185.2	0	13.8	0	393220.	0
23	1	103.6	0	181.1	0	13.5	0	385250.	0
23	2	100.3	0	180.8	0	13.5	0	383108.	0
23	3	98.3	0	180.5	0	13.5	0	379457.	0
24	0	94.9	0	181.1	0	13.6	0	377253.	0
24	1	81.4	0	173.6	0	13.4	0	364284.	0
24	2	82.3	0	185.4	0	13.3	0	356482.	0
24	3	96.2	0	201.1	0	13.3	0	357809.	0

# CONTINUOUS EMISSIONS MONITORING DATA

ELLIKEN STATION UNIT #2

FOR TIME PERIOD 96/08/08

QTR	HR	S O 2		N O X		C O 2		F L O W	
		PPM	CODE	PPM	CODE	%	CODE	CFM	CODE
1	0	105.1	0	216.3	0	13.1	0	367093.	0
	1	102.4	0	211.0	0	13.2	0	365721.	0
	2	100.0	0	211.0	0	13.2	0	364417.	0
1	3	92.1	0	210.0	0	13.3	0	362079.	0
2	0	95.5	0	208.2	0	13.3	0	359795.	0
2	1	91.0	0	211.4	0	13.3	0	365416.	0
2	2	73.5	0	208.6	0	13.3	0	357452.	0
2	3	62.4	0	198.3	0	13.2	0	342792.	0
3	0	59.5	0	190.2	0	13.0	0	332761.	0
3	1	41.9	0	176.4	0	12.4	0	309221.	0
3	2	30.3	0	167.5	0	11.9	0	272292.	0
3	3	55.4	0	166.3	0	12.0	0	253741.	0
	0	158.5	0	175.5	0	11.8	0	255188.	0
4	1	158.9	0	190.2	0	11.7	0	260946.	0
4	2	148.1	0	181.2	0	11.8	0	255941.	0
	3	150.2	0	175.6	0	11.8	0	255524.	0
5	0	139.3	0	173.5	0	11.8	0	254317.	0
5	1	154.3	0	170.4	0	11.9	0	256724.	0
5	2	174.5	0	173.4	0	12.1	0	262493.	0
5	3	149.8	0	175.7	0	11.8	0	259541.	0
6	0	146.3	0	177.0	0	11.8	0	249904.	0
6	1	200.2	0	173.0	0	12.4	0	272595.	0
6	2	78.1	0	171.7	0	13.1	0	312721.	0
6	3	91.4	0	187.3	0	13.5	0	350360.	0
7	0	-99.0	16	-99.0	16	-99.0	16	369866.	256
7	1	96.9	256	198.8	256	14.0	256	381401.	0
7	2	92.0	0	197.8	0	13.8	0	389682.	0
7	3	93.7	0	194.4	0	13.7	0	390803.	0
8	0	93.4	0	198.6	0	13.6	0	395030.	0
8	1	98.8	0	201.0	0	13.6	0	398869.	0
8	2	96.3	0	202.1	0	13.6	0	400641.	0
8	3	91.5	0	201.8	0	13.7	0	399551.	0
9	0	-93.7	0	-197.6	0	-13.5	0	404845.	0
9	1	93.0	0	198.0	0	13.4	0	405791.	0
9	2	95.1	0	194.4	0	13.5	0	405174.	0
9	3	92.3	0	192.3	0	13.5	0	395384.	0
10	0	85.6	0	196.7	0	13.7	0	391815.	0
10	1	79.2	0	196.3	0	13.7	0	390087.	0
10	2	81.7	0	193.3	0	13.7	0	385605.	0
10	3	84.0	0	194.1	0	13.7	0	389075.	0

Press RETURN to continue

16+256 ARE  
CALIBRATIONS

• DATA ATTACHED TO  
256 IS VALID

• DATA ATTACHED TO  
16 IS NOT VALID

1-1000  
2-1000

11	0	91.1	0	191.4	0	13.6	0	392502.	0
11	1	86.6	0	190.0	0	13.5	0	404177.	0
11	2	81.6	0	194.3	0	13.7	0	402827.	0
11	3	79.7	0	194.9	0	13.7	0	403263.	0
12	0	81.1	0	190.8	0	13.6	0	404631.	0
12	1	84.7	0	191.2	0	13.6	0	402597.	0
12	2	78.7	0	192.3	0	13.6	0	400268.	0
12	3	74.0	0	192.1	0	13.6	0	398966.	0
13	0	64.5	0	190.6	0	13.6	0	405628.	0
13	1	63.2	0	191.0	0	13.6	0	395745.	0
13	2	58.0	0	190.9	0	13.6	0	395542.	0
13	3	55.3	0	192.5	0	13.6	0	402964.	0
14	0	133.1	0	192.2	0	13.6	0	398515.	0
14	1	174.2	0	192.4	0	13.6	0	404968.	0
14	2	162.8	0	193.7	0	13.6	0	399856.	0
14	3	172.7	0	191.6	0	13.6	0	396779.	0
15	0	172.8	0	191.6	0	13.5	0	398209.	0
15	1	175.6	0	190.7	0	13.5	0	394887.	0
15	2	167.3	0	192.3	0	13.5	0	394566.	0
15	3	158.9	0	192.6	0	13.5	0	397810.	0
16	0	166.2	0	192.6	0	13.5	0	399145.	0
16	1	173.1	0	194.0	0	13.4	0	396049.	0
16	2	183.4	0	196.7	0	13.5	0	394335.	0
16	3	180.6	0	199.3	0	13.5	0	397787.	0
17	0	193.9	0	201.1	0	13.4	0	399864.	0
17	1	194.2	0	199.2	0	13.5	0	396472.	0
17	2	211.4	0	199.5	0	13.4	0	399384.	0
17	3	210.1	0	200.8	0	13.4	0	396154.	0
18	0	192.0	0	200.3	0	13.4	0	396898.	0
18	1	189.5	0	199.8	0	13.4	0	396030.	0
18	2	188.7	0	200.8	0	13.6	0	394426.	0
18	3	195.5	0	196.9	0	13.6	0	393047.	0
19	0	191.7	0	195.3	0	13.6	0	388646.	0
19	1	190.4	0	194.3	0	13.5	0	393273.	0
19	2	192.7	0	197.1	0	13.5	0	391541.	0
19	3	185.6	0	196.7	0	13.6	0	392845.	0
20	0	169.5	0	185.6	0	13.4	0	384703.	0
20	1	185.5	0	198.8	0	13.6	0	397167.	0
20	2	180.5	0	207.7	0	13.5	0	388047.	0
20	3	150.2	0	214.3	0	13.4	0	378450.	0
21	0	115.4	0	203.8	0	13.3	0	339349.	0
21	1	91.1	0	213.6	0	12.8	0	320131.	0
21	2	91.1	0	216.2	0	13.0	0	317121.	0
21	3	101.9	0	217.7	0	13.1	0	323764.	0
22	0	122.4	0	219.9	0	13.1	0	334959.	0
22	1	93.2	0	217.9	0	12.8	0	321659.	0
22	2	79.0	0	229.0	0	12.5	0	301740.	0

Press RETURN to continue

2-TRIS

CO<sub>2</sub> = 13.48

2B-SO<sub>x</sub>

CO<sub>2</sub> = 13.42

2-OH

CO<sub>2</sub> = 13.6

2A-MESA

CO<sub>2</sub> = 13.59

2-MESA

CO<sub>2</sub> = 13.63

8/8, 800 / 1730  
 NO<sub>x</sub>, ppm = 194.3  
 = 126.7

2-PSD-STK  
 CO<sub>2</sub> = 13.48  
 2-SO<sub>3</sub>-STK  
 13.55

22	3	86.5	0	225.8	0	12.6	0	299073.	0
23	0	76.2	0	224.7	0	12.5	0	293532.	0
23	1	72.8	0	230.1	0	12.3	0	282917.	0
23	2	40.5	0	245.0	0	11.8	0	256238.	0
23	3	41.7	0	234.6	0	11.9	0	255395.	0
24	0	41.8	0	233.5	0	11.9	0	259085.	0
24	1	51.6	0	208.6	0	11.9	0	265002.	0
24	2	64.6	0	201.7	0	12.2	0	281529.	0
24	3	35.8	0	196.2	0	11.7	0	268448.	0

# CONTINUOUS EMISSIONS MONITORING DATA

MILLIKEN STATION UNIT #2

FOR TIME PERIOD 96/09/08

QTR		S O 2		N O X		C O 2		F L O W	
HR	HR	PPM	CODE	PPM	CODE	%	CODE	CFM	CODE
1	0	29.1	0	197.9	0	11.8	0	261900.	0
1	1	29.2	0	201.0	0	11.9	0	258866.	0
1	2	25.0	0	198.5	0	11.8	0	259304.	0
1	3	29.2	0	198.0	0	11.9	0	264849.	0
2	0	39.7	0	196.0	0	11.9	0	266594.	0
2	1	48.1	0	196.3	0	12.0	0	269938.	0
2	2	51.8	0	199.6	0	12.2	0	275466.	0
2	3	43.5	0	200.0	0	12.1	0	272792.	0
3	0	39.7	0	198.1	0	11.8	0	268437.	0
3	1	28.6	0	200.4	0	11.8	0	257606.	0
3	2	27.4	0	198.2	0	11.8	0	259485.	0
3	3	47.6	0	201.1	0	12.1	0	272197.	0
4	0	29.3	0	196.3	0	11.7	0	270087.	0
4	1	28.0	0	196.8	0	11.9	0	261700.	0
4	2	36.4	0	197.0	0	11.9	0	275314.	0
4	3	25.5	0	198.8	0	11.8	0	263542.	0
5	0	22.6	0	200.3	0	11.6	0	264449.	0
5	1	48.4	0	200.8	0	12.1	0	279843.	0
5	2	41.5	0	194.2	0	11.8	0	277515.	0
5	3	30.4	0	195.0	0	11.6	0	259651.	0
6	0	35.7	0	195.1	0	11.8	0	259787.	0
6	1	79.1	0	196.2	0	12.3	0	294343.	0
6	2	122.0	0	213.5	0	12.8	0	328616.	0
6	3	161.0	0	223.2	0	13.4	0	364567.	0
7	0	-99.0	16	-99.0	16	-99.0	16	377196.	256
7	1	174.2	256	241.2	256	13.9	256	387681.	0
7	2	164.7	0	242.7	0	13.8	0	388061.	0
7	3	153.2	0	230.1	0	13.5	0	393473.	0
8	0	153.6	0	230.9	0	13.5	0	396412.	0
8	1	80.2	0	223.4	0	13.5	0	402316.	0
8	2	73.9	0	220.9	0	13.6	0	396823.	0
8	3	73.9	0	215.8	0	13.6	0	398233.	0
9	0	-71.2	0	-219.1	0	-13.4	0	404474.	0
9	1	73.6	0	220.8	0	13.6	0	405342.	0
9	2	70.8	0	218.9	0	13.6	0	400038.	0
9	3	66.9	0	216.9	0	13.6	0	394547.	0
10	0	68.4	0	218.6	0	13.6	0	392428.	0
10	1	78.4	0	218.6	0	13.6	0	399658.	0
10	2	80.9	0	220.4	0	13.6	0	397277.	0
10	3	84.2	0	220.1	0	13.7	0	395036.	0

Press RETURN to continue



11	0	90.0	0	217.9	0	13.7	0	394782.	0
11	1	99.1	0	215.5	0	13.6	0	396189.	0
	2	101.3	0	199.7	0	13.8	0	397618.	0
	3	108.6	0	198.1	0	13.9	0	400625.	0
12	0	113.7	0	195.7	0	13.8	0	404257.	0
	1	124.9	0	197.5	0	13.7	0	404890.	0
	2	139.7	0	201.5	0	13.8	0	398644.	0
12	3	155.2	0	202.4	0	13.8	0	400014.	0
	0	160.7	0	201.8	0	13.8	0	400365.	0
	1	164.0	0	201.1	0	13.7	0	397413.	0
13	2	155.5	0	200.1	0	13.7	0	402676.	0
13	3	147.7	0	196.1	0	13.7	0	402338.	0
	0	148.6	0	195.5	0	-13.6	0	401028.	0
14	1	101.5	0	197.7	0	13.6	0	395880.	0
14	2	97.1	0	198.1	0	13.5	0	395092.	0
	3	99.7	0	195.6	0	13.7	0	394747.	0
	0	104.9	0	195.0	0	-13.7	0	398456.	0
15	1	110.7	0	197.4	0	-13.7	0	400159.	0
	2	116.5	0	199.8	0	13.7	0	398761.	0
	3	117.7	0	197.7	0	13.7	0	402125.	0
16	0	115.0	0	197.0	0	13.6	0	399378.	0
	1	113.8	0	199.7	0	13.6	0	400755.	0
	2	112.7	0	201.1	0	13.7	0	397057.	0
	3	112.7	0	202.0	0	13.8	0	399216.	0
17	0	93.0	0	197.8	0	13.6	0	403591.	0
	1	96.7	0	197.5	0	13.6	0	399816.	0
	2	87.4	0	192.1	0	13.6	0	392492.	0
17	3	85.6	0	185.4	0	13.6	0	375945.	0
	0	97.0	0	185.6	0	13.6	0	369502.	0
18	1	92.5	0	185.3	0	13.7	0	368936.	0
18	2	86.6	0	184.0	0	13.7	0	367671.	0
19	3	67.2	0	171.5	0	13.6	0	343890.	0
	0	59.9	0	182.5	0	13.0	0	325164.	0
19	1	53.4	0	182.4	0	12.6	0	309426.	0
19	2	36.2	0	185.8	0	12.1	0	270454.	0
	3	27.4	0	192.2	0	11.9	0	253121.	0
	0	28.2	0	186.3	0	12.1	0	255704.	0
20	1	30.2	0	208.7	0	12.4	0	262349.	0
	2	27.7	0	217.0	0	12.2	0	269187.	0
	3	37.0	0	210.9	0	12.5	0	274690.	0
21	0	69.5	0	210.9	0	12.4	0	276472.	0
21	1	76.1	0	213.6	0	12.4	0	279798.	0
	2	49.0	0	219.6	0	12.0	0	261854.	0
	3	48.3	0	223.2	0	11.9	0	254179.	0
22	0	49.9	0	222.3	0	11.9	0	255768.	0
	1	50.7	0	225.2	0	11.9	0	258118.	0
	2	45.6	0	230.7	0	12.0	0	253110.	0

Press RETURN to continue

8/9, 1800/1745  
 NOx ppm = 203.1  
 SO<sub>2</sub> ppm = 107.2  
 = 297.64

3A-MESA  
 CO<sub>2</sub> = 13.66

3-MESA  
 CO<sub>2</sub> = 13.68

3A-SO<sub>x</sub>  
 CO<sub>2</sub> = 13.62

3-TRIS  
 CO<sub>2</sub> = 13.64

3B-SO<sub>3</sub>  
 CO<sub>2</sub> = 13.66

3-PSD-STIC  
 CO<sub>2</sub> = 13.65

3-OH  
 CO<sub>2</sub> = 13.69

22	3	44.6	0	192.4	0	11.8	0	254266.	0
23	0	27.4	0	185.0	0	11.1	0	233331.	0
23	1	23.2	0	188.1	0	11.2	0	223235.	0
23	2	23.6	0	183.5	0	11.4	0	218750.	0
23	3	22.9	0	179.9	0	11.4	0	217223.	0
24	0	22.1	0	185.5	0	11.2	0	221040.	0
24	1	20.2	0	183.6	0	11.3	0	219914.	0
24	2	21.6	0	180.1	0	11.1	0	222784.	0
24	3	21.9	0	182.0	0	11.4	0	216947.	0

**Appendix C.3**  
**Sample Locations and Preliminary Velocity Traverses**



**FLUE GAS FLOWS AND CONDITIONS**  
**NYSEG MILLIKEN UNIT 2 POST RETROFIT TEST PROGRAM**  
**AUGUST 1996 – MERCURY SPECIATION TESTS**

TEST NO.	DATE	TIME	O <sub>2</sub> <sup>(1)</sup> %	CO <sub>2</sub> <sup>(2)</sup> %	H <sub>2</sub> O, %	FLUE GAS	SAMPLE	PITOT	UNIT	HEAT RATE	% DIFF,	ISOKIN-
						TEMP., F	OLUME dscf	FLOW RATE, dscfm	LOAD, NET MW	FLOW RATE, dscfm <sup>(3)</sup>	Pitot vs. Heat Rate	ETIC RATIO, %
1-MTLS-IN	08/07/96	0817/1227	5.60	13.86	8.5	293	137.91	325,318	149	337,574	-3.6	99.0
1-MTLS-OUT	08/07/96	0833/1512	5.38	14.06	8.3	284	221.74	323,354	149	332,789	-2.8	107.5
1-MTLS-STK	08/07/96	0817/1441	5.66	13.81	14.4	119	241.79	358,667	149	338,903	+5.8	97.0
1-TRIS-OUT	08/07/96	1533/1633	4.67	14.56	8.9	278	35.83	SP	149	SP	--	104.7
1-TRIS-STK	08/07/96	1515/1715	5.42	13.89	15.9	122	71.83	SP	149	SP	--	97.7
1-OH-OUT	08/07/96	0840/1440	4.90	14.47	8.0	275	261.06	SP	149	SP	--	102.4
1-OH-STK	08/07/96	0842/1442	5.61	13.83	14.2	122	215.77	SP	149	SP	--	96.7
1-MESA-OUT	08/07/96	1025/1325	5.20	14.25	NA	NA	2.41	SP	149	SP	--	NA
1-MESA-STK	08/07/96	1050/1350	5.63	13.86	NA	NA	1.80	SP	149	SP	--	NA
2-MTLS-IN	08/08/96	0803/1212	5.10	13.94	8.7	292	144.70	340,247	150	329,765	+3.2	99.3
2-MTLS-OUT	08/08/96	0822/1435	5.10	13.94	8.4	286	219.80	331,647	150	329,765	+0.6	101.7
2-MTLS-STK	08/08/96	0811/1540	5.52	13.57	14.8	119	253.28	358,779	150	338,771	+5.9	101.6
2-TRIS-OUT	08/08/96	1417/1517	5.20	13.44	9.0	277	39.46	SP	150	SP	--	104.4
2-TRIS-STK	08/08/96	1425/1625	5.15	13.48	14.8	123	73.71	SP	150	SP	--	100.2
2-OH-OUT	08/08/96	0756/1356	5.28	13.63	8.1	279	224.41	SP	150	SP	--	104.8
2-OH-STK	08/08/96	0753/1353	5.31	13.60	14.4	123	224.11	SP	150	SP	--	98.8
2-MESA-IN	08/08/96	0840/1040	6.13	12.93	NA	NA	1.64	SP	150	SP	--	NA
2-MESA-OUT	08/08/96	0845/1145	5.34	13.62	NA	NA	2.77	SP	150	SP	--	NA
2-MESA-STK	08/08/96	0845/1145	5.33	13.63	NA	NA	1.67	SP	150	SP	--	NA
3-MTLS-IN	08/09/96	0803/1210	5.79	13.64	8.5	289	135.15	327,659	149	344,476	-4.9	96.3
3-MTLS-OUT	08/09/96	0814/1435	5.04	14.32	8.1	280	216.78	330,081	149	328,186	+0.6	100.8
3-MTLS-STK	08/09/96	0815/1507	5.76	13.67	14.3	118	254.55	362,692	149	343,793	+5.5	101.0
3-TRIS-OUT	08/09/96	1432/1532	4.67	14.13	8.6	286	39.22	SP	149	SP	--	102.1
3-TRIS-STK	08/09/96	1520/1720	5.23	13.64	14.3	122	73.58	SP	149	SP	--	98.6
3-OH-OUT	08/09/96	0817/1417	5.16	13.83	8.1	285	209.72	SP	149	SP	--	98.1
3-OH-STK	08/09/96	0826/1426	5.32	13.69	14.0	122	225.28	SP	149	SP	--	98.7
3-MESA-IN	08/09/96	0930/1140	5.40	13.64	NA	NA	1.71	SP	149	SP	--	NA
3-MESA-OUT	08/09/96	0845/1145	5.32	13.71	NA	NA	2.78	SP	149	SP	--	NA
3-MESA-STK	08/09/96	0827/1127	5.35	13.68	NA	NA	3.23	SP	149	SP	--	NA
3A-MESA-IN	08/09/96	1340/1540	5.23	13.75	NA	NA	1.97	SP	149	SP	--	NA
3A-MESA-OUT	08/09/96	1245/1545	5.33	13.66	NA	NA	2.76	SP	149	SP	--	NA
3A-MESA-STK	08/09/96	1215/1515	5.33	13.66	NA	NA	2.86	SP	149	SP	--	NA

NA -- not available

SP -- single port traverse

Notes:

(1) Test O<sub>2</sub> levels measured using daily calibrated portable Teledyne O<sub>2</sub> meters (electrochemical cell).

(2) Stack CO<sub>2</sub> levels taken from Unit 2 CEMS located at the FGD stack location for corresponding time periods.

ESP inlet and outlet CO<sub>2</sub> levels calculated for each test period using corresponding stack CO<sub>2</sub> levels corrected from stack O<sub>2</sub> values to oxygen levels found at that location.

(3) Calculated Heat Rate Flow Rate, dscfm = Boiler Eff., Btu/kW-hr \* Unit 2 Load, MW (gross) \* 1000 \* F-Factor, dscf/MMBtu / 10<sup>6</sup> \* 20.9/(20.9-Flue Gas, O<sub>2</sub>%) / 60 min/hr

# CARNOT VELOCITY TRAVERSE DATA

CLIENT/LOCATION: NUSSE DATE: 3/10/96  
 SAMPLE LOCATION: GSP N DATA TAKEN BY: BC  
 UNIT NO.: 2 TEST DESCRIPTION: \_\_\_\_\_  
 TEST NO.: PRECIA (REPEAT)  
 BARO. PRESS. (In. Hg): \_\_\_\_\_ PITOT TUBE COEFFICIENT .84 Cp  
 ABS. STATIC PRESS. IN STACK (In. Hg) -13.9 Ps NORTH

$$V_s = 2.90 C_p \sqrt{\Delta P T_s} \sqrt{\frac{29.92}{P_s} \times \frac{28.95}{MW}}$$

TIME	TRAVERSE POINT		VELOCITY HEAD, in. H <sub>2</sub> O, ΔP	GAS TEMP., °F	TIME	TRAVERSE POINT		VELOCITY HEAD, in. H <sub>2</sub> O, ΔP	GAS TEMP., °F
	PORT	POINT				PORT	POINT		
1430	A	3	<u>.12</u>	275		G	3	<u>.11</u>	278
	4=0	2	.27	275		4=0	2	.22	278
		1	.20	270			1	.25	284
	B	3	.24	273		H	3	<u>.16</u>	293
	4=0	2	.32	284		4=0	2	.26	295
		1	.27	284			1	.21	297
	C	3	<u>.12</u>	286		I	3	.20	292
	4=0	2	.32	292		4=0	2	.28	282
		1	.24	293			1	.26	279
	D	3	.22	295		J	3	.18	300
	4=0	2	.30	297		4=0	2	.30	300
		1	.23	298			1	.26	299
*	E	3	<u>.09</u>	289	*	K	3	<u>.04</u>	296
	4=0	2	.27	300		4=0	2	.33	305
		1	.16	302			1	.28	306
	F	3	<u>.10</u>	300		L	3	<u>.08</u>	301
	4=0	2	.26	300		4=0	2	.27	305
		1	.22	301			1	.22	308

DUCT AVG: 0.2497  
 4-PORT AVG: 0.2525

Circled values  
~~invalid~~

**CARNOT**  
 considered  
 invalid.

# CARNOT VELOCITY TRAVERSE DATA

CLIENT/LOCATION: WISSE DATE: \_\_\_\_\_  
 SAMPLE LOCATION: ESP IN DATA TAKEN BY: \_\_\_\_\_  
 UNIT NO.: \_\_\_\_\_ TEST DESCRIPTION: \_\_\_\_\_  
 TEST NO.: \_\_\_\_\_  
 BARO. PRESS. (In. Hg): \_\_\_\_\_ PITOT TUBE COEFFICIENT \_\_\_\_\_ Cp  
 ABS. STATIC PRESS. IN STACK (In. Hg) -14.1 Ps SOUTH

(2) of (2)

$$V_s = 2.90 C_p \sqrt{\Delta P T_s} \sqrt{\frac{29.92}{P_s} \times \frac{28.95}{MW}}$$

TIME	TRAVERSE POINT		VELOCITY HEAD, in. H <sub>2</sub> O, ΔP	GAS TEMP., °F	TIME	TRAVERSE POINT		VELOCITY HEAD, in. H <sub>2</sub> O, ΔP	GAS TEMP., °F
	PORT	POINT				PORT	POINT		
	M	3	(.03)	298	*	S	3	.21	302
	K=0	2	.134	302		K=0	2	.33	303
		1	.30	302			1	.27	304
*	N	3	(.2)	300	*	T	3	(.05)	296
	K=0	2	.41	302		K=0	2	.28	296
		1	.33	304			1	.27	297
*	O	3	(.03)	304		U	3	.30	294
	K=0	2	.37	304		K=0	2	.34	294
		1	.30	304			1	.32	294
	P	3	.20	304	*	V	3	.27	294
	K=0	2	.37	304		K=0	2	.20	306
		1	.32	305			1	.28	305
	Q	3	.20	292	*	W	3	(.15)	291
	K=0	2	.29	293			2	.38	299
		1	.23	299		K=0	1	.31	301
	R	3	.13	300	*	X	3	.45	299
		2	.36	302		K=0	2	.35	299
	K=0	1	.28	305			1	.20	302

Circled Values considered invalid.

DUCT AVG: 0.2965

4-Port AVG: 0.3075

0.02 ... 2.0%

**CARNOT**

Overall AVG = 0.2725  
 2-Port AVG = 0.2793

OVERALL DIFF = 2.5%

# CARNOT VELOCITY TRAVERSE DATA

CLIENT/LOCATION: WILCOX/MILKMAN

DATE: 8-6-46

SAMPLE LOCATION: ESP OUTLET

DATA TAKEN BY: DH/JP/12m

UNIT NO.: \_\_\_\_\_

TEST DESCRIPTION: \_\_\_\_\_

TEST NO.: 1-VEL

BARO. PRESS. (In. Hg): \_\_\_\_\_

PITOT TUBE COEFFICIENT 0.34 Cp

ABS. STATIC PRESS. IN STACK (In. Hg) \_\_\_\_\_ P<sub>s</sub>

$$V_s = 2.90 C_p \sqrt{\Delta P T_s} \sqrt{\frac{29.92}{P_s} \times \frac{28.95}{MW}}$$

STANDARD CORRECTION FACTOR  $\alpha = 0.5$

TIME	TRAVERSE POINT		VELOCITY HEAD, in. H <sub>2</sub> O, ΔP	GAS TEMP., °F	TIME	TRAVERSE POINT		VELOCITY HEAD, in. H <sub>2</sub> O, ΔP	GAS TEMP., °F
	PORT	POINT				PORT	POINT		
0915	<u>W*</u>	3	0.33	269	0930	<u>L</u>	3	0.30	277
		2	0.32	270	4=0		2	0.37	281
		1	0.30	270			1	0.34	252
4=0	<u>V*</u>	3	0.34	270		<u>K*</u>	3	0.37	277
		2	0.34	269			2	0.36	279
		1	0.27	269			1	0.33	282
4=0	<u>S</u>	3	0.27	277	4=5	<u>J*</u>	3	0.31	278
		2	0.26	278			2	0.41	281
		1	0.24	277			1	0.38	283
4=0	<u>R</u>	3	0.24	271	4=0	<u>H</u>	3	0.30	273
		2	0.29	273			2	0.33	276
		1	0.24	264			1	0.41	270
4=0	<u>P</u>	3	0.33	271	4=0	<u>G</u>	3	0.34	273
		2	0.35	273			2	0.28	280
		1	0.30	273			1	0.20	279
4=0	<u>O</u>	3	0.30	274	0950	<u>F</u>	3	0.30	276
		2	0.34	280	4=0		2	0.28	280
		1	0.33	277			1	0.25	276
0937									

\* DIFFICULT

CARNOT



# CARNOT VELOCITY TRAVERSE DATA

CLIENT/LOCATION: NYSEB DATE: 8-6-96  
 SAMPLE LOCATION: ESP outlet DATA TAKEN BY: DA/JP/EM  
 UNIT NO.: \_\_\_\_\_ TEST DESCRIPTION: \_\_\_\_\_  
 TEST NO.: i-VEL  
 BARO. PRESS. (In. Hg): \_\_\_\_\_ PITOT TUBE COEFFICIENT 0.84  $C_p$   
 ABS. STATIC PRESS. IN STACK (In. Hg) \_\_\_\_\_  $P_s$

$$V_s = 2.90 C_p \sqrt{\Delta P T_s} \sqrt{\frac{29.92}{P_s} \times \frac{28.95}{MW}}$$

PORT B STATIC ~~-14.8~~ -14.8

PORT D STATIC -14.0

TIME	TRAVERSE POINT		VELOCITY HEAD, in. H <sub>2</sub> O, $\Delta P$	GAS TEMP., °F	TIME	TRAVERSE POINT		VELOCITY HEAD, in. H <sub>2</sub> O, $\Delta P$	GAS TEMP., °F
	PORT	POINT				PORT	POINT		
	<u>D</u>	3	0.36	280		<u>I</u>	3	0.31	282
	<u>4-5</u>	2	0.38	282			2	0.33	286
		1	0.34	283			1	0.29	281
	<u>R*</u>	3	0.33	272		<u>M</u>	3	0.29	286
	<u>4-0</u>	2	0.36	281			2	0.29	287
		1	0.32	283			1	0.24	283
<u>50</u>	<u>A</u>	3	0.19	284		<u>N</u>	3	0.27	288
		2	0.20	284			2	0.29	288
		1	0.22	281			1	0.23	288
	<u>C</u>	3	0.26	281		<u>Q</u>	3	0.21	282
		2	0.27	283			2	0.14	283
		1	0.26	280			1	0.16	277
	<u>D</u>	3	0.26	279		<u>T</u>	3	0.24	282
		2	0.31	283			2	0.23	285
		1	0.25	279			1	0.27	285
	<u>E</u>	3	0.28	285		<u>U</u>	3	0.33	286
		2	0.22	285			2	0.31	286
<u>55</u>		1	0.15	273			1	0.30	287
						<u>X</u>	<u>NA</u>		

\* DIFFICULT

Ports X ~~and~~ FROZEN

CARNOT

ALL PORTS: 0.2856

8 PORTS: 0.2991

OVERALL DIFF = 4.7

### VELOCITY TRAVERSE DATA

CLIENT/LOCATION: 11V SES DATE: 8/6/96

SAMPLE LOCATION: STACK DATA TAKEN BY: RAF

UNIT NO.: 2 TEST DESCRIPTION: \_\_\_\_\_

TEST NO.: Prelim. Velocity / Flow Angle

BARO. PRESS. (In. Hg): \_\_\_\_\_ PITOT TUBE COEFFICIENT 0.84  $C_p$

ABS. STATIC PRESS. IN STACK (In. Hg) \_\_\_\_\_ P<sub>s</sub>

$$V_s = 2.90 \text{ Cp} \sqrt{\Delta P T_s} \sqrt{\frac{29.92}{P_s} \times \frac{28.95}{MW}}$$

[illegible]

**Appendix C.4**  
**EPA Method 29**



**EPA METHOD 29 MERCURY EMISSION RESULTS  
NYSEG POST-RETROFIT TEST PROGRAM – ESP INLET  
AUGUST 1996**

Test Number	1-MTLS-IN	2-MTLS-IN	3-MTLS-IN	AVERAGE			Uncertainty	
Date	8/7/96	8/8/96	8/9/96				@95%CI	
Pitot Flow Rate, dscfm	325,318	340,247	327,659					
Sample Volume, dscf	137.91	144.70	135.15					
Fuel Factor, dscf/10 <sup>6</sup> Btu	13,106	12,740	13,355					
O <sub>2</sub> , %	5.60	5.10	5.79					
CO <sub>2</sub> , %	13.86	13.94	13.64					
H <sub>2</sub> O, %	8.5	8.7	8.5					

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	0.80	0.76	0.84	0.80	0.001	0.61	13%	0.10
Hg(II) - oxidized	7.33	8.14	6.81	7.43	0.009	5.63	22%	1.67
Hg(total) - front 1/2 solid	0.93	0.99	0.66	0.86	0.001	0.65	50%	0.43
Total Hg	9.05	9.89	8.32	9.09	0.011	6.89	21%	1.95

**EPA METHOD 29 MERCURY EMISSION RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM – ESP OUTLET/FGD INLET**  
**AUGUST 1996**

Test Number	1-MTILS-OUT	2-MTILS-OUT	3-MTILS-OUT	AVERAGE			Uncertainty	
Date	8/7/96	8/8/96	8/9/96				@95%CI	
Pitot Flow Rate, dscfm	323,354	331,647	330,081					
Sample Volume, dscf	221.74	219.80	216.78					
Fuel Factor, dscf/10 <sup>6</sup> Btu	12,920	12,740	12,723					
O <sub>2</sub> , %	5.38	5.10	5.04					
CO <sub>2</sub> , %	14.06	13.94	14.32					
H <sub>2</sub> O, %	8.3	8.4	8.1					

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	1.06	1.66	1.75	1.49	0.002	1.10	62%	0.93
Hg(II) - oxidized	5.85	7.21	5.63	6.23	0.007	4.63	34%	2.12
Hg(total) - front 1/2 solids	ND< 0.02	ND< 0.005	ND< 0.005	ND< 0.009	ND< 9.8E-06	ND< 0.006	--	--
<b>Total Hg</b>	<b>6.92</b>	<b>8.86</b>	<b>7.38</b>	<b>7.72</b>	<b>0.009</b>	<b>5.74</b>	<b>33%</b>	<b>2.52</b>

**EPA METHOD 29 MERCURY EMISSION RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM -- FGD OUTLET/STACK**  
**AUGUST 1996**

Test Number	1-MTLS-STK	2-MTLS-STK	3-MTLS-STK	AVERAGE			Uncertainty	
Date	8/7/96	8/8/96	8/9/96				@95%CI	
Pitot Flow Rate, dscfm	358,667	358,779	362,692					
Sample Volume, dscf	241.79	253.28	254.55					
Fuel Factor, dscf/10 <sup>6</sup> Btu	13,157	13,088	13,328					
O <sub>2</sub> , %	5.66	5.52	5.76					
CO <sub>2</sub> , %	13.81	13.57	13.67					
H <sub>2</sub> O, %	14.4	14.8	14.3					

Parameter	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	ug/Nm <sup>3</sup>	lb/hr	lb/10 <sup>12</sup> Btu	ug/Nm <sup>3</sup>	
Hg(0) - elemental	2.27	2.69	2.23	2.40	0.003	1.84	26%	0.63
Hg(II) - oxidized	0.46	0.56	0.82	0.61	0.001	0.47	75%	0.46
Hg(total) - front 1/2 solids	ND< 0.005	ND< 0.004	0.015	0.006	8.2E-06	0.005	--	--
<b>Total Hg</b>	<b>2.74</b>	<b>3.25</b>	<b>3.07</b>	<b>3.02</b>	<b>0.004</b>	<b>2.31</b>	<b>21%</b>	<b>0.65</b>

**ESP INLET SOLIDS CATCH ADJUSTMENT CALCULATIONS**  
**BASED ON ASH BALANCE RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM**

Parameter	1-MTLS-IN		2-MTLS-IN		3-MTLS-IN	
	PR Solids Concentrations ug/g	PR Solids Adj. Totals ug/fraction	PR Solids Concentrations ug/g	PR Solids Adj. Totals ug/fraction	PR Solids Concentrations ug/g	PR Solids Adj. Totals ug/fraction
Actual PR Solids Weight Gain, g/train		29.42		36.57		33.68
EPA M29 Ash Correction Factor		1.005		0.822		0.856
Adjusted PR Solids Weight Gain, g/train		29.58		30.06		28.83
Antimony	3.6	107	3.2	95	3.8	109
Arsenic	86	2,553	76	2,277	74	2,140
Barium	846	25,032	763	22,935	772	22,254
Beryllium	8.9	264	8.5	255	8.1	234
Cadmium	0.62	18	0.47	14	0.54	15
Chromium	114	3,368	107	3,214	115	3,312
Cobalt	30	891	29	880	30	856
Copper	77	2,282	77	2,302	77	2,225
Lead	51	1,518	46	1,381	53	1,524
Manganese	218	6,434	230	6,913	223	6,436
Mercury	0.114	3.37	0.092	2.76	0.081	2.35
Molybdenum	15	453	16	469	16	476
Nickel	86	2,553	86	2,573	85	2,448
Selenium	2.2	66	1.9	58	1.7	50
Vanadium	189	5,600	177	5,327	183	5,264

Note: Ash correction factors based on ash mass balance results were applied to the solids catch amounts of the ESP inlet sample trains to correct a severe high bias associated with the solids catch amounts of Runs 2 and 3.



# EPA METHOD 29 REAGENT BLANK CALCULATION

	RB-MTLS-1	RB-MTLS-2	RB-MTLS-3	AVG. REAGENT BLANK
	ug/train			
Antimony	ND< 0.67	ND< 0.67	ND< 0.67	ND< 0.67
Arsenic	ND< 0.67	ND< 0.67	ND< 0.67	ND< 0.67
Barium	4.3	4.0	7.2	5.2
Beryllium	ND< 0.06	ND< 0.06	ND< 0.06	ND< 0.06
Cadmium	0.08	0.05	0.11	0.08
Chromium	10	2.8	2.5	5.1
Cobalt	ND< 0.67	ND< 3.3	ND< 3.3	ND< 2.4
Copper	ND< 2.0	2.2	ND< 2.0	ND< 2.1
Lead	0.47	0.48	0.85	0.60
Manganese	4.3	3.7	3.6	3.9
Mercury - FH PRS	--	--	--	--
Front-Half no PRS	ND< 0.030	ND< 0.030	ND< 0.030	ND< 0.030
Back-Half	ND< 0.20	ND< 0.20	ND< 0.20	ND< 0.20
MKO	ND< 0.010	ND< 0.010	ND< 0.010	ND< 0.010
KMnO4/HCl	ND< 0.055	ND< 0.054	ND< 0.055	ND< 0.055
Molybdenum	13	13	13	13
Nickel (1)	6.9	ND< 6.7	ND< 6.7	6.9
Selenium	ND< 0.7	ND< 0.7	ND< 0.7	ND< 0.7
Vanadium	ND< 1.7	ND< 1.7	ND< 1.7	ND< 1.7

Note: (1) For nickel, RB-MTLS-1 was used for the average since it was reanalyzed along with the stack samples by GFAA at lower detection limits to obtain detectable nickel levels.

**MERCURY LABORATORY SUMMARY – EPA METHOD 29 ANALYSIS**  
**NYSEG POST-RETROFIT TEST PROGRAM – ESP INLET**  
**AUGUST 1996**

Mercury, ug/train:	Reagent Blank	<u>1-MTILS-IN</u>	<u>2-MTILS-IN</u>	<u>3-MTILS-IN</u>	<u>FB-MTILS-OUT</u>	<u>2FB-MTILS-OUT</u>
<b>Sample Fraction</b> <b>(EPA Method 29):</b>						
FH – Probe Rinse Solids	ND< 0.030	3.37	2.76	2.35	–	–
FH – No Probe Rinse Solids	ND< 0.030	ND< 0.030	1.0	ND< 0.030	ND< 0.030	ND< 0.030
BH	ND< 0.20	26	30	24	ND< 0.19	ND< 0.19
MKO	ND< 0.010	0.67	1.1	0.30	ND< 0.010	ND< 0.010
KMnO4 / HCl (combined)	ND< 0.055	2.9	2.9	3.0	ND< 0.063	0.10
<b>Total Hg per train:</b>						
RAW	ND< 0.33	33.0	37.8	29.7	ND< 0.29	– 0.22
CORR. FOR RB		33.0	37.8	29.7		

NA – not available

**MERCURY LABORATORY SUMMARY – EPA METHOD 29 ANALYSIS**  
**NYSEG POST-RETROFIT TEST PROGRAM – ESP OUTLET/FGD INLET**  
**AUGUST 1996**

Mercury, ug/train:	Reagent Blank	1-MTLS-OUT	2-MTLS-OUT	3-MTLS-OUT	FB-MTLS-OUT	2FB-MTLS-OUT
<b>Sample Fraction</b> <b>(EPA Method 29):</b>						
FH – Probe Rinse Solids	ND< 0.030	NP <sup>(1)</sup>	NP <sup>(1)</sup>	NP <sup>(1)</sup>	--	--
FH – No Probe Rinse Solids	ND< 0.030	ND< 0.090	ND< 0.030	ND< 0.030	ND< 0.030	ND< 0.030
BH	ND< 0.20	29.5	40	31	ND< 0.19	ND< 0.19
MKO	ND< 0.010	4.8	1.8	1.2	ND< 0.010	ND< 0.010
KMnO4 / HCl (combined)	ND< 0.055	6.2	9.6	10	ND< 0.063	0.10
<b>Total Hg per train:</b>						
RAW	ND< 0.33	40.5	51.4	42.2	ND< 0.29	0.22
CORR. FOR RB		40.5	51.4	42.2		

NA -- not available

Notes:

(1) Probe rinse solids were not analyzed separately for the ESP outlet and stack samples.

**MERCURY LABORATORY SUMMARY – EPA METHOD 29 ANALYSIS**  
**NYSEG POST-RETROFIT TEST PROGRAM – FGD OUTLET/STACK**  
**AUGUST 1996**

Mercury, ug/train:	Reagent Blank	1-MTILS-STK	2-MTILS-STK	3-MTILS-STK	FB-MTILS-STK	2FB-MTILS-STK
<b>Sample Fraction</b> <b>(EPA Method 29):</b>						
FH – Probe Rinse Solids	ND< 0.030	NP <sup>(1)</sup>	NP <sup>(1)</sup>	NP <sup>(1)</sup>	–	–
FH – No Probe Rinse Solids	ND< 0.030	ND< 0.030	ND< 0.030	0.10	ND< 0.030	0.032
BH	ND< 0.20	2.9	3.7	5.4	ND< 0.20	ND< 0.20
MKO	ND< 0.010	0.051	ND< 0.030	0.12	ND< 0.010	ND< 0.010
KMnO4 / HCl (combined)	ND< 0.055	14.5	18	15	0.22	0.092
<b>Total Hg per train:</b>						
RAW	ND< 0.33	17.5	21.7	20.6	0.34	0.23
CORR. FOR RB		17.5	21.7	20.6		

NA – not available

Notes:

(1) Probe rinse solids were not analyzed separately for the ESP outlet and stack samples.

**EPA METHOD 29 MERCURY EMISSION RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM – ESP INLET**  
**AUGUST 1996**

Parameter	ESP INLET			
	1-MTLS-IN	2-MTLS-IN	3-MTLS-IN	AVERAGE
Date	8/7/96	8/8/96	8/9/96	
Pitot Flow Rate, dscfm	325,318	340,247	327,659	331,075
Sample Volume, dscf	137.91	144.70	135.15	139.25
Fuel Factor, dscf/10 <sup>6</sup> Btu	13,106	12,740	13,355	13,067
O <sub>2</sub> , %	5.60	5.10	5.79	5.50
CO <sub>2</sub> , %	13.86	13.94	13.64	13.81
H <sub>2</sub> O, %	8.5	8.7	8.5	8.6
<u>Hg(0) - elemental (KMnO<sub>4</sub>/HCl)</u>				
ug/sample	2.9	2.9	3.0	2.9
ug/dscm	0.74	0.71	0.78	0.74
ug/Nm <sup>3</sup>	0.80	0.76	0.84	0.80
lb/hr	0.001	0.001	0.001	0.001
lb/10 <sup>12</sup> Btu	0.61	0.56	0.65	0.61
<u>Hg(II) - oxidized (HNO<sub>3</sub>/H<sub>2</sub>O<sub>2</sub>)</u>				
ug/sample	26.7	31.1	24.3	27.4
ug/dscm	6.83	7.59	6.35	6.92
ug/Nm <sup>3</sup>	7.33	8.14	6.81	7.43
lb/hr	0.008	0.010	0.008	0.009
lb/10 <sup>12</sup> Btu	5.58	6.03	5.29	5.63
<u>Hg(total) - (Front 1/2 Solids)</u>				
ug/sample	3.38	3.76	2.36	3.2
ug/dscm	0.87	0.92	0.62	0.80
ug/Nm <sup>3</sup>	0.93	0.99	0.66	0.86
lb/hr	0.001	0.001	0.001	0.001
lb/10 <sup>12</sup> Btu	0.71	0.73	0.51	0.65
<u>Total Mercury</u>				
ug/sample	33.0	37.8	29.7	33.5
ug/dscm	8.44	9.21	7.75	8.47
ug/Nm <sup>3</sup>	9.05	9.89	8.32	9.09
lb/hr	0.010	0.012	0.010	0.011
lb/10 <sup>12</sup> Btu	6.90	7.32	6.46	6.89

**EPA METHOD 29 MERCURY EMISSION RESULTS**  
**NYSEG POST-RETROFIT TEST PROGRAM – ESP OUTLET/FGD INLET**  
**AUGUST 1996**

Parameter	ESP OUTLET/FGD INLET			
	1-MTLS-OUT	2-MTLS-OUT	3-MTLS-OUT	AVERAGE
Date	8/7/96	8/8/96	8/9/96	
Pitot Flow Rate, dscfm	323,354	331,647	330,081	328,361
Sample Volume, dscf	221.74	219.80	216.78	219.44
Fuel Factor, dscf/10 <sup>6</sup> Btu	12,920	12,740	12,723	12,794
O <sub>2</sub> , %	5.38	5.10	5.04	5.17
CO <sub>2</sub> , %	14.06	13.94	14.32	14.11
H <sub>2</sub> O, %	8.3	8.4	8.1	8.3
<u>Hg(0) - elemental (KMnO<sub>4</sub>/HCl)</u>				
ug/sample	6.2	9.6	10.0	8.6
ug/dscm	0.99	1.54	1.63	1.39
ug/Nm <sup>3</sup>	1.06	1.66	1.75	1.49
lb/hr	0.001	0.002	0.002	0.002
lb/10 <sup>12</sup> Btu	0.80	1.23	1.29	1.10
<u>Hg(II) - oxidized (HNO<sub>3</sub>/H<sub>2</sub>O<sub>2</sub>)</u>				
ug/sample	34.3	41.8	32.2	36.1
ug/dscm	5.45	6.72	5.24	5.80
ug/Nm <sup>3</sup>	5.85	7.21	5.63	6.23
lb/hr	0.007	0.008	0.006	0.007
lb/10 <sup>12</sup> Btu	4.40	5.34	4.16	4.63
<u>Hg(total) - (Front 1/2 Solids)</u>				
ug/sample	ND< 0.090	ND< 0.030	ND< 0.030	ND< 0.050
ug/dscm	ND< 0.01	ND< 0.005	ND< 0.005	ND< 0.008
ug/Nm <sup>3</sup>	ND< 0.02	ND< 0.005	ND< 0.005	ND< 0.009
lb/hr	ND< 1.7E-05	ND< 6.0E-06	ND< 6.0E-06	ND< 9.8E-06
lb/10 <sup>12</sup> Btu	ND< 0.01	ND< 0.004	ND< 0.004	ND< 0.006
<u>Total Mercury</u>				
ug/sample	40.5	51.4	42.2	44.7
ug/dscm	6.45	8.26	6.88	7.19
ug/Nm <sup>3</sup>	6.92	8.86	7.38	7.72
lb/hr	0.008	0.010	0.008	0.009
lb/10 <sup>12</sup> Btu	5.20	6.56	5.46	5.74