Commonwealth of Pennsylvania
Environmental Resources
January 23, 1992

Subject: Source Test Review

To: SCA Services of Pennsylvania, Inc.
Stowe Power Production Plant
Pottstown Landfill

From: Richard St. Louis, Chief
Source Testing Unit
Division of Technical Services and Monitoring

Through: Chief, Source Testing and Monitoring Section

SCA Services of Pennsylvania, Inc., operates a 3,000 KW Centaur Model No. T-4500 gas turbine (Turbine No. 2) used to burn on-site landfill gas for the production of electrical power. The turbine has a design rating of 42 MMBTU/HR. Landfill gas is conditioned by an Air Pol, Inc., tray scrubber prior to firing in the turbine. Emissions from the turbine are vented to the atmosphere through a single exhaust stack.

ECM Engineers, Inc., conducted NO_x, heavy metals, and SO_2 stack emission tests on September 30 and October 1, 2 and 3, 1991, to satisfy the requirements of Plan Approval 46-399-063A. Heavy metals and SO_2 emissions were conducted while the turbine was performing at 100 percent load. NO_x emissions were determined at 100, 75, 50 and 30 percent of full load.

All the tests were conducted in accordance with a preapproved test protocol and are acceptable to the Department. The following test results were extracted from the reports:

NO_x EMISSIONS

Turbine Load, %	Run No.	Test Date	ppmv @ 15% O_2, dry basis	
			Uncorrected	ISO Conditions
100	1	10/3/91	28.8	33.7
100	2	10/3/91	27.7	29.0
100	3	10/3/91	27.6	28.7

NO_x EMISSIONS

Turbine Load, %	Run No.	Test Date	ppmv @ 15% O_2, dry basis	
			Measured	ISO Conditions
75	1	10/3/91	34.8	36.2
75	2	10/3/91	33.1	33.7
75	3	10/3/91	32.7	36.8
50	1	10/3/91	33.7	39.4
50	2	10/3/91	39.3	43.6
50	3	10/3/91	32.8	36.1
30	1	10/2/91	36.6	36.0
30	2	10/2/91	27.0	26.5
30	3	10/2/91	24.9	27.6

CO EMISSIONS

Run No.	Test Date	CO Emissions		
		ppmv	ppmv @ 15% O_2	Lb./hr.
1	9/30/91	1.7	3.1	0.712
3	10/1/91	1.0	1.3	0.393
3	10/2/91	2.4	3.1	0.909

HEAVY METALS CONCENTRATION (gr/dscf)

Metal	Run No. 1	Run No. 2	Run No. 3	Avg.
Arsenic	8.10×10^{-5}	8.34×10^{-5}	8.47×10^{-5}	8.30×10^{-5}
Beryllium	2.04×10^{-6}	2.16×10^{-6}	2.15×10^{-6}	2.11×10^{-6}
Cadmium	2.04×10^{-6}	2.16×10^{-6}	2.15×10^{-6}	2.11×10^{-6}
Chromium	4.08×10^{-6}	4.08×10^{-6}	4.31×10^{-6}	4.15×10^{-6}
Mercury	6.17×10^{-7}	8.93×10^{-7}	6.94×10^{-7}	7.35×10^{-7}
Nickel	1.61×10^{-5}	1.66×10^{-5}	1.67×10^{-5}	1.65×10^{-5}
Lead	4.04×10^{-5}	4.16×10^{-5}	4.24×10^{-5}	4.15×10^{-5}

Notes: All results (except Run No. 1, Mercury) were below detection limit. Detection limit used to calculate results.

cc: Ed Brown, Southeast Regional Office
46-399-0034A
AdrC
EPA/RSE
Reading File - Source Testing

EBEL:dlg

REPORT

FOR

COMPLIANCE EMISSION EVALUATION

OF THE

STOWE POWER PRODUCTION PLANT TURBINE NO. 2 AT THE
POTTSTOWN LANDFILL

FOR

SCA SERVICES OF PENNSYLVANIA, INCORPORATED
A DIVISION OF
WASTE MANAGEMENT OF NORTH AMERICA, INCORPORATED

OCTOBER 1991

BCM PROJECT NO. 00-5743-19

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1.0 EXECUTIVE SUMMARY

SCA Services of Pennsylvania, Incorporated (SCA Services), a division of Waste Management of North America, Inc. (Waste Management) operates a newly installed 3000 KW gas turbine power production plant (Termed Turbine No. 2) located at the Pottstown, Pennsylvania, landfill. The turbine is used to burn onsite landfill gas for the production of electrical power. Turbine No. 2 is the second of two identical gas turbines operated at the site.

Turbine No. 2 is a Centaur Model No. T-4500, manufactured by Solar Turbines, Inc., with a rating of 42 MM BTU/hr. The gas burned in the turbine is conditioned by an Air Pol, Inc. tray scrubber prior to firing in the turbine. Air emissions from the turbine are vented to the atmosphere through a single exhaust stack.

Waste Management, on behalf of SCA Services, retained BCM Engineers Inc. (BCM) to determine the compliance status of the turbine with respect to air emission standards. These standards were outlined in the turbine's Temporary Operating Permit No. 46-399-063A that was issued by the Pennsylvania Department of Environmental Resources (PADER).

Testing was performed to determine stack emissions of oxides of nitrogen (NO_x), metals, and sulfur dioxide (SO_2). NO_x emissions were determined with the turbine operating at 100, 75, 50, and 30 percent of full load. All other determinations were performed at 100 percent load only. Metals testing included emission determinations of arsenic (As), beryllium (Be), cadmium (Cd), total chrome (Cr), mercury (Hg), nickel (Ni), and lead (Pb). The measured stack emission rates were used to determine ground level concentrations of each metal by dispersion modeling.

Table A summarizes the results of the testing program, and shows turbine emissions meet permit conditions. Included in the Table are emission parameters, the turbine load condition at which testing was performed, and the emission testing results as compared to the allowable standards contained in the Temporary Operating Permit. Complete results are presented in Section 4.0 of this report.

During each SO_2 emission test run, a grab sample of the fuel gas was collected and submitted to the laboratory for total sulfur analysis. The average of the three analyses performed showed the sulfur content of the fuel to be 0.0052 percent by weight. Subpart GG, Section 60.33, paragraph (b), of the U.S. Environmental Protection Agency (EPA) New Source Performance Standards (NSPS), limits the sulfur content of the gas burned in the turbine to 0.8 percent by weight. Results of the sulfur in fuel analyses show the fuel meet NSPS standards.

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TABLE A

SUMMARY OF EMISSIONS MONITORING DATA FOR TURBINE NO. 2

Emission Parameter	Turbine Load (%)	Emission Results	Allowable Limit
Arsenic	100	<0.0235 ug/m^3	0.024 ug/m^3
Beryllium	100	<0.00060 ug/m^3	0.01 ug/m^3
Cadmium	100	<0.00060 ug/m^3	0.0556 ug/m^3
Hexavalent Chromium	100	<0.0012 ug/m^3	0.00833 ug/m^3
Mercury	100	<0.00021 ug/m^3	0.24 ug/m^3
Nickel	100	<0.0047 ug/m^3	0.24 ug/m^3
Lead	100	<0.012 ug/m^3	1.5 ug/m^3
SO_2	100	2.1 ppmv	150 ppmv @ 15% O_2
NO_x	100	28.8 ppmv	50 ppmv
NO_x	75	35.6 ppmv	50 ppmv
NO_x	50	39.4 ppmv	50 ppmv
NO_x	30	31.4 ppmv	50 ppmv

Notes: 1) All metals results include metals and their compounds
2) Metals emission results and allowable limits represent maximum annual ambient ground level concentrations
3) Chromium emission results represent total chrome
4) SO_2 results and allowable limits represent ppmv at 15% O_2
5) NO_x results and allowable limits represent ppmv at 15% O_2 and ISO standard ambient conditions

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2.0 SCOPE AND OBJECTIVES

The scope of the project was outlined in BCM's Intent-To-Test Protocol submitted to Mr. N. Rao Kona of the PADER on July 10, 1991. Copies of the Intent-To-Test Protocol and related correspondence are included as Appendix A of this report. The objective of the sampling program was to determine the following parameters:

- Gas Flow - acfm and scfm
- Gas temperature - °F
- Gas moisture content - percent by volume
- Combustion gas analysis - percent by volume CO_2, O_2, CO, and N_2 (by difference)
- NO_x emission concentration - ppmv at 15 percent O_2 expressed at ISO conditions
- O_2 emission concentration - percent by volume
- Sulfur content of fuel - percent by weight
- Metals emissions - gr/dscf and lb/hr
- Sulfur dioxide emissions - ppmv at 15 percent O_2 and lb/hr
- Ground level concentration of metals - ug/m^3

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3.0 PROCEDURES

3.1 FIELD WORK

Field testing was conducted on September 30, October 1, 2, and 3, 1991. The sampling team consisted of the following BCM personnel:

Phillip C. Burg, Project Manager
Karl Brenton, Technician
Nick Charno, Technician

NO_x emission testing was conducted according to procedures as outlined in U.S. Environmental Protection Agency (EPA) Reference Method 20 of the Federal Register, Volume 42, Number 160. Emissions of SO_2 were determined by PADER procedures. Metals emissions were determined by the PADER "Heavy Metals Test Method." Metals and SO_2 emission determinations were conducted simultaneously. Descriptions of test methodologies can be found in Appendix B of this report.

3.2 ANALYTICAL METHODS

All samples generated during the sampling program were returned to the laboratory for analysis. The analytical methodologies and the laboratory data are contained in Appendix C.

3.3 CALCULATIONS

Descriptions of the calculations performed to determine test results are contained in Appendix D. Appendix D also lists equations and all reduced field data used to obtain test results.

3.4 EQUIPMENT CALIBRATION

In accordance with accepted procedures published by the EPA, all gas velocity measuring equipment, gas volume metering equipment, and temperature measuring equipment was calibrated prior to the test program. Appendix E provides the calibration data.

4.0 TEST RESULTS

4.1 GAS FLOW RATE DATA

Gas flow rate data obtained during the metals testing are contained in Table 1. Gas flow rate determinations were conducted with the turbine operating at the 100 percent load condition.

4.2 OXIDES OF NITROGEN EMISSION RESULTS

Oxides of nitrogen emission results are contained in Table 2. Results include the measured O_2 and NO_x emission concentrations, the measured NO_x emissions corrected to 15-percent O_2, and the NO_x emissions expressed at ISO standard ambient conditions.

4.3 SULFUR DIOXIDE EMISSION RESULTS

Emissions of SO_2 were determined simultaneously with metals sampling. Results of the SO_2 testing are contained in Table 3.

Oxygen concentrations were determined for each test run by collecting an integrated sample of the stack effluent in a gas sample bag followed by Orsat analysis. These results were utilized in calculating SO_2 emission concentrations at 15 percent oxygen.

4.4 SULFUR CONTENT OF FUEL

During each SO_2 test run, a single grab sample of the fuel was collected in a Tedlar sample bag. The gas sample was taken from the system at a point after the tray scrubber. The samples were submitted to Atlantic Analytical Laboratory (AAL), Whitehouse, New Jersey, for total sulfur analysis. Results of these analyses are contained in Table 4.

4.5 METALS EMISSION AND AIR DISPERSION MODELING RESULTS

Results of the metals emission determinations are contained in Table Nos. 5 and 6. Table 5 contains metals emission concentrations and Table 6 contains metals emission rates.

Results of the metals air dispersion modeling are contained in Table No. 7. These results represent the annual average ground level concentrations of metals with Turbine No. 2 operating at 100 percent load.

4.6 TURBINE OPERATING DATA

Turbine operating data recorded during all test runs are contained in Table No. 8. The values presented were obtained by averaging all readings recorded for each test run.

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TABLE 1

GAS FLOW RATE DATA

Run No.	Test Date	Gas Temperature (°F)	Gas Moisture (%)	Velocity (fpm)	Gas Flow (acfm)	Gas Flow (dscfm)
1	9/30/91	736	4.3	7,629	95,863	41,086
2	10/1/91	737	5.7	7,323	92,027	38,652
3	10/2/91	741	5.5	7,191	90,362	37,903
Average	----	736	5.2	7,381	92,751	39,214

All flows determined with turbine at 100% load condition.

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TABLE 2

OXIDES OF NITROGEN EMISSION RESULTS

Turbine Load	Run No.	Test Date	Measured Emission Concentration Dry Basis O_2%	Measured Emission Concentration Dry Basis NO_x ppmv	NO_x Emissions ppmv at 15% O_2, Dry Basis Measured	NO_x Emissions ppmv at 15% O_2, Dry Basis ISO Conditions
100	1	10/3/91	16.7	19.1	26.8	28.7
100	2	10/3/91	16.9	18.8	27.1	29.0
100	3	10/3/91	16.8	19.2	27.6	28.7
Average	--	.....	16.8	19.0	27.3	28.8
75	1	10/3/91	17.6	18.3	34.8	36.2
75	2	10/3/91	17.6	18.5	33.1	33.7
75	3	10/3/91	17.8	17.2	32.7	36.8
Average	--	.....	17.7	18.0	33.5	35.6
50	1	10/3/91	18.4	14.3	33.7	39.4
50	2	10/3/91	18.8	14.0	39.3	43.8
50	3	10/3/91	18.2	15.0	32.8	35.1
Average	--	.....	18.5	14.4	35.4	39.4
30	1	10/2/91	16.9	12.4	36.5	38.0
30	2	10/2/91	16.8	9.6	27.0	28.5
30	3	10/2/91	16.5	9.7	24.9	27.8
Average	--	.....	16.8	10.6	29.8	31.4

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TABLE 3

SULFUR DIOXIDE EMISSION RESULTS

Run No.	Test Date	Gas Flow Rate (dscfm)	O_2 Concentration (%)	SO_2 Emissions (ppmv)	(SO_2 Emissions (ppmv @ 15% O_2))	(SO_2 Emissions (lb/hr))
1	9/30/91	41,063	16.1	1.7	2.1	0.712
2	10/1/91	38,652	16.1	1.0	1.2	0.393
3	10/2/91	37,903	16.3	2.4	3.1	0.909
Average	-----	39,214	16.2	1.7	2.1	0.671

Notes: ppmv at 15% O_2 = (ppmv) (5.9/20.9-%O_2)

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TABLE 4

SULFUR CONTENT OF FUEL

SO_2 Run No.	Test Date	Total Sulfur Content (ppmv)	Total Sulfur Content (% by wt.)
1	9/30/91	19	0.0022
2	10/1/91	72	0.0083
3	10/2/91	43	0.0050
Average	.....	45	0.0052

Note: 1. Allowable sulfur content of fuel = 0.8% by weight
2. ppmv expressed as H_2S

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TABLE 5

METAL EMISSION CONCENTRATIONS (gr/dscf)

Metal	Run No. 1	2	3	Average
Arsenic	8.10×10^{-5}	8.34×10^{-5}	8.47×10^{-5}	8.30×10^{-5}
Beryllium	2.04×10^{-6}	2.15×10^{-6}	2.15×10^{-6}	2.11×10^{-6}
Cadmium	2.04×10^{-6}	2.15×10^{-6}	2.15×10^{-6}	2.11×10^{-6}
Chromium	4.08×10^{-6}	4.06×10^{-6}	4.31×10^{-6}	4.15×10^{-6}
Mercury	8.17×10^{-7}	6.93×10^{-7}	6.94×10^{-7}	7.35×10^{-7}
Nickel	1.61×10^{-5}	1.66×10^{-5}	1.57×10^{-5}	1.65×10^{-5}
Lead	4.04×10^{-5}	4.16×10^{-5}	4.24×10^{-5}	4.15×10^{-5}

1 All results (except Run 1, Mercury) are less than values, sample concentrations were below detection limit, used detection limit to calculate results

2 All results represent metals and their compounds

TABLE 6

METAL EMISSION RATES (lb/hr)

Metal	Run No. 1	2	3	Average
Arsenic	2.85×10^{-2}	2.76×10^{-2}	2.75×10^{-2}	2.79×10^{-2}
Beryllium	7.19×10^{-4}	7.13×10^{-4}	7.00×10^{-4}	7.11×10^{-4}
Cadmium	7.19×10^{-4}	7.13×10^{-4}	7.00×10^{-4}	7.11×10^{-4}
Chromium	1.44×10^{-3}	1.35×10^{-3}	1.40×10^{-3}	1.40×10^{-3}
Mercury	2.88×10^{-4}	2.30×10^{-4}	2.25×10^{-4}	2.48×10^{-4}
Nickel	5.67×10^{-3}	5.51×10^{-3}	5.44×10^{-3}	5.54×10^{-3}
Lead	1.42×10^{-2}	1.38×10^{-2}	1.38×10^{-2}	1.39×10^{-2}

1 All results (except Run 1, Mercury) are less than value, sample concentrations were below detection limit, used detection limit to calculate results

2 All results represent metals and their compounds

TABLE 7

DISPERSION ANALYSIS RESULTS
FOR CENTAUR GAS TURBINE

Metal	Metal Emission Rate (lb/hr)	Maximum Annual Ambient Ground Level Concentration ($\mu g/m^3$)	PADER Annual Ambient Guideline ($\mu g/m^3$)
Arsenic	$<2.79 \times 10^{-2}$	<0.0235	0.024
Beryllium	$<7.11 \times 10^{-4}$	<0.00060	0.01
Cadmium	$<7.11 \times 10^{-4}$	<0.00060	0.556
Chromium	$<1.40 \times 10^{-3}$	<0.0012	0.00833
Mercury	$<2.48 \times 10^{-4}$	<0.00021	0.24
Nickel	$<5.54 \times 10^{-3}$	<0.0047	0.24
Lead	$<1.39 \times 10^{-2}$	<0.012	1.5

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TABLE 8

OPERATING DATA

Turbine Load	Test Parameter	Run No.	Fuel Flow Rate (scfm)	BTU Content (BTU/scf)	BTU Input (10^6BTU/hr)	Turbine Outlet Air Temperature (°F)	Combustor Inlet Pressure (psi)	Power Output kw)	Scrubber Delta P (in water)	Scrubber Water Flow (gpm)
100	Metals/SO_2	1	1,283	573.27	44.13	1,170	129.0	3,100	5	31.2
100	Metals/SO_2	2	1,268	573.25	43.54	1,170	126.7	3,017	5	31.2
100	Metals/SO_2	3	1,263	572.17	43.36	1,170	125.4	2,991	5	31.2
100	NO_x	1	1,237	574.99	42.68	1,170	124.7	2,950	4	30.4
100	NO_x	2	1,243	574.68	42.88	1,170	124.5	2,980	5	30.8
100	NO_x	3	1,253	574.39	43.18	1,170	125.8	3,000	5	30.8
75	NO_x	1	1,018	575.59	34.88	1,030	118.3	2,250	4	31.2
75	NO_x	2	1,016	575.58	35.09	1,021	117.6	2,250	4	30.1
75	NO_x	3	1,016	575.58	35.08	1,017	118.0	2,250	4	30.0
50	NO_x	1	771	575.69	26.63	855	110.0	1,450	4	31.2
50	NO_x	2	771	575.85	26.64	860	110.0	1,450	4	31.2
50	NO_x	3	762	576.82	26.34	860	110.0	1,450	4	31.2
30	NO_x	1	628	575.49	21.41	770	104.8	970	4	31.1
30	NO_x	2	630	576.18	21.78	760	104.0	1,000	4	31.2
30	NO_x	3	624	576.37	21.58	760	105.7	950	4	31.2

Note: Scrubber refers to the Air Pol, Inc. scrubber utilized for fuel conditioning, not an emission control device.

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5.0 DISCUSSION OF RESULTS

5.1 GENERAL

Testing went well and few problems were encountered. All leak checks conducted during the SO_2 and metals testing were within the allowable limit. Isokinetic derivations during the metals testing were within the 90 to 110 percent acceptable range. All calibration and zero drift checks of the NO_x and O_2 analyzers were within the ±2 percent allowable range. One exception, however, occurred during Run No. 3 at the 75 percent load condition where the NO_x analyzer exhibited a zero drift of 2.4 percent. As specified in 5.2.3 of EPA Method 20, NO_x results were calculated for that run utilizing the initial and recalibration data. An NO_x emission concentration of 36.8 ppmv at 15 percent O_2 ISO standard conditions represents the higher value obtained (Table 2).

The NO_x emissions at 15 percent O_2 ISO standard conditions are calculated to be 35.3 ppmv utilizing initial calibration data.

5.2 TEST RESULTS

All emission results as well as the sulfur content of the fuel obtained during the testing program were well within the allowable limits. The average measured SO_2 emission concentration was 2.1 ppmv at 15 percent O_2 which is 1.4 percent of the 150 ppmv allowable limit. The average sulfur content of the fuel was 0.0052 percent by weight, which is 0.65 percent of the allowable limit of 0.8 percent by weight. The highest NO_x emission concentration (39.4 ppm) was measured at 50 percent turbine load, and is 78.8 percent of the 50 ppm allowable limit. Finally, dispersion modeling of test results showed that the turbine meets permit operating conditions with respect to allowable ground level concentrations of metals.

APPENDIX B

FIELD SAMPLING PROGRAM

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APPENDIX B

FIELD SAMPLING PROGRAM

1.0 SAMPLING PROCEDURES

1.1 Test Station and Traverse Location

The Turbine No. 2 exhaust stack is round with an internal diameter of 4 feet. Two test ports are located on the same cross sectional plane, 90 degrees apart. The nearest upstream and downstream flow disturbances are located 1.25 and 6.75 duct diameters, respectively, from the test ports. A schematic drawing of the stack and port locations is at the end of this Appendix.

The number of traverse points used for the metals emission testing, as well as the preliminary oxygen traverse of the NO_x emission testing (as determined by EPA Method 1), was 24 (12 per port).

According to 6.1.2.1 of EPA Method 20, the minimum number of traverse points for NO_x sampling for stacks with cross-sectional areas less than 16.1 ft^2 is eight. The cross-sectional area of the exhaust stack was 12.6 ft^2; therefore, eight traverse points were utilized.

1.2 Gas Flow and Gas Temperature Determinations

The gas flow rate and temperature profiles were measured by conducting a velocity and temperature traverse simultaneous with the metals and SO_2 sampling. The gas velocity head was measured with a "S" type pitot tube connected to an inclined manometer. A Chromel-Alumel thermocouple connected to a potentiometer was used to determine the gas temperature.

1.3 Moisture Content

Sampling was conducted employing the principles presented in EPA Method 4 and concurrently with metals sampling. The parameters evaluated to determine the gas stream's moisture content were: sample gas volume, sample gas temperature, sample gas pressure, impinger moisture gain, and silica gel moisture gain.

1.4 Stack Gas Molecular Weight Determinations

Integrated samples of the exhaust gas were collected during each run by extracting a portion of stack gas at each traverse point and collecting them in a sample bag. Each sample was analyzed according to the following procedure.

A Fisher Type B No. 10-605 Orsat gas analyzer was used to determine the molecular weight of the flue gas. The following parameters were measured to calculate the molecular weight: volume percent carbon dioxide (CO_2), volume percent oxygen (O_2), and volume percent carbon monoxide (CO). The volume percentage of nitrogen (N_2) was determined by difference.

These parameters were measured using the principle of gas absorption in specific absorbing solutions. A 100-ml flue gas sample was drawn through the glass manifold to the sample chamber using the leveling bottle after the sampling line had been purged. The system was then closed by adjusting the absorbing solutions, which selectively collected different gaseous components of the stack gas. Carbon dioxide was collected in a potassium hydroxide solution in the fist absorber, oxygen was collected in a potassium pyrogallate solution in the second absorber, and carbon monoxide was collected in a cupric chloride solution in the third absorber.

The volume of a specific gaseous component collected in an individual absorbing solution was determined by the change in volume of sample gas in the sample chamber after the bubbling through of that solution was complete. Because the original sample volume was 100 ml, any change in volume also represented the percentage of the specific gaseous component found in the stack gas stream. Temperature changes of the sample were minimized by using a jacket filled with isopropyl alcohol, which surrounded the sample chamber.

Results of the Orsat analyses are contained in Table A-1 of this Appendix. For the purpose of a quality control check, the oxygen concentrations obtained by the instrumentation analyses during the NO_x testing are included in the table.

1.5 Metals Sampling

All sampling procedures and sampling equipment employed were those outlined in the PADER "Heavy Metals Test Method."

The nozzle size required to maintain isokinetic sampling was calculated from the results of the previously completed velocity and temperature traverses. The sampling train used a glass-lined stainless steel probe that was heated to 250 degrees Farenheit by an internal heating element. The front of the glass liner had a glass nozzle of a calculated size required to maintain isokinetic sampling. An "S" type pitot tube and a Chromel-Alumel thermocouple were clamped to the probe in order to monitor the velocity head and the temperature at the traverse points during the sampling period. Sampled gas passed through the glass nozzle/probe liner to a preweighed glass fiber filter for the removal of the suspended particulates and metals. The filter was housed in a heated chamber with a temperature maintained at 250 degrees Farenheit. From the filter, the

stack gas passed to the impinger train. The first three impingers each contained 150 ml of 0.1 N nitric acid (HNO_3). The fourth impinger contained approximately 200 grams of coarse silica gel, which collected any moisture and/or vapors that were not captured in the preceding impingers.

The second impinger was a 500-ml Greenburg-Smith impinger; the first, third, and fourth were 500-ml impingers of the Greenburg-Smith design, modified by replacing the tip with a 1/2-inch inside diameter (I.D.) glass tube. The impinger train was immersed in an ice bath for the entire test period in order to prevent the exit gas temperature from exceeding 70 degrees Farenheit.

From the impinger train, the gas was conducted through an umbilical cord to the control console (an Anderson Universal Stack Sampler) that contained the following pieces of equipment (listed in the order in which sampled gas passed through them): a main valve, bypass valve for flow adjustment, an airtight vacuum pump, a dry gas meter, and a calibrated orifice. The orifice was equipped with pressure taps that were connected across the inclined manometer used to ensure that isokinetic conditions were being maintained. A schematic diagram of the EPA Method 12 sampling train is depicted at the end of this Appendix.

The sampling train was subjected to a leak check prior to and after each sample run. The inlet of the nozzle was plugged, and the pump vacuum was held at the highest vacuum attained during the testing period. In all cases, the leakage rate was minimal, not exceeding the maximum allowable leakage rate of 0.02 cfm.

The minimum sample volume collected for each sample run was 50 dscf.

Upon completion of a test, the soiled glass fiber filter was removed from its filter holder and placed in a petri dish that was subsequently sealed. The probe liner and nozzle were washed internally with 0.1 N HNO_3; the residual matter remaining in the probe was removed with a nylon brush attached to a polyethylene line. The front half of the glass filter holder was rinsed with 0.1 N HNO_3, and the washings obtained were added to those collected from the nozzle and probe. All washings were stored in sealed amber glass bottles for transfer to the laboratory. The silica gel used in the fourth impinger was removed and stored in a sealed sample bottle. The contents of the first, second, and third impingers were combined and measured volumetrically. The impingers were then rinsed with 0.1 N HNO_3 and the washings added to the impinger solution.

1.6 Sulfur Dioxide Emission Determinations

Sampling procedures as outlined in the Pennsylvania "Source Test Manual" for oxides of sulfur testing were utilized for the SO_2 sampling. The methodology was modified by the addition of an impinger containing an 80 percent solution of isopropyl alcohol (IPA). The IPA scrubbed any sulfur trioxide present in the sample, making the methodology specific for SO_2.

Sampling was conducted by extracting gas at the mid-point of the stack through a nozzle; a heated, stainless steel probe; and then conducting it to an impinger train that consisted of five separate impingers. The first and third impingers were of the Greenburg-Smith design. The second, fourth, and fifth impingers were of the Greenburg-Smith design modified by replacing the impactor end with an approximately 13-mm (0.5-in) I.D. glass tube. The first impinger contained 150 ml of 80-percent Isopropyl alcohol (IPA). The second, third, and fourth impingers contained a total of 400 ml of 5-percent sodium hydroxide (NaOH). The fifth impinger contained approximately 200 grams of coarse silica gel to collect any moisture or vapors not captured in the preceding impingers. A filter holder containing a glass fiber filter was placed between the first and second impingers. The impinger train was immersed in an ice bath for the entire sampling period.

A diagram illustrating the sample train is included at the end of this Appendix.

From the impinger train, the gas was conducted through an umbilical cord to the control console, an Anderson Universal Stack Sampler that contained the following pieces of equipment (listed in the order in which gas passed through them): a main valve, bypass valve for flow adjustment, an airtight vacuum pump, a dry gas meter, and a calibrated orifice. The orifice was equipped with pressure taps which were connected across an inclined manometer to measure sample gas flows through the sample train. Sampling rate was maintained at approximately 0.75 cubic feet per minute (cfm).

The sampling train was checked for leaks before and after each sample run. The inlet of the nozzle was plugged and the pump vacuum was held at the highest vacuum attained during that period of testing. In all cases, the leakage rate was minimal and did not exceed the maximum allowable leakage rate of 0.02 cfm.

Upon completion of the test, the sample train was purged for 15 minutes with ambient air at the approximate average flow rate used for sampling. This ensured that any oxides of sulfur remaining in the first impinger were purged from the 80-percent IPA solution.

The contents of the second and third impingers were placed in a clean, sealed sample bottle. The contents of the fourth impinger were placed in a separate sample bottle. The impingers were each thoroughly rinsed with 5-percent NaOH solution and the washings were added to the respective impinger solutions. Both the contents of the first impinger and the filter between the first and second impingers were discarded. All samples were kept on ice until reaching the laboratory for analysis.

1.7 Oxides of Nitrogen Emission Determinations

The sampling procedures and equipment used for oxides of nitrogen (NO_x) emission determinations are those outlined in Method 20 of the Federal Register, Volume 42, No. 160, January 29, 1988.

Testing was conducted by continuously extracting gas sample from the exhaust stream through a heated probe, a heated glass fiber filter, and conducting it through a conditioning system to the gas analyzers. All sample lines, prior to the conditioning system, were heated in order to prevent condensation. The conditioning system contained a refrigerator dryer, a water trap, and a secondary filter. Any condensate was continuously removed from the sampling system by the water trap, which minimized the contact between the condensate and sample gas.

The analyzers used were a Thermo Electron Corporation Model 10 AR chemiluminescent NO/NO_x analyzer and a Beckman Model 775 paramagnetic oxygen analyzer. The model 10 AR contains an NO_2 to NO converter and eight linear, full-scale ranges from 2.5 to 10,000 parts per million (ppm). The Beckman 775 has four linear, full-scale ranges from 5 to 25 percent. A schematic diagram of the sampling and calibration system is included at the end of this Appendix.

The following sections describe the measurement system performance checks, preliminary sampling procedures, and the NO_x emission determination procedures that were utilized.

1.7.1 Calibration Checks

Calibration gas used for the Model 10 AR had a concentration of 146.9 ppm NO_x in nitrogen and was documented traceable to National Bureau of Standards (NBS) Reference Materials. The oxygen calibration gas was 21.4 percent in nitrogen certified to ±2-percent accuracy. The mid- and low-level concentrations were achieved with a gas divider.

Prior to each individual test run, the zero- and mid-level gases were introduced to the analyzers and the responses set to the appropriate levels. Then the low-level and high-level calibration gases were introduced, and the instrument responses were recorded on the Calibration Data Sheets. After each test run, the gases were again introduced and the responses recorded on the Calibration Data Sheets.

1.7.2 Interference Response

Gaseous components were introduced separately into the measurement system and the responses noted. These gases contained components that may have acted as interferents to the analyzers.

In all cases, the response to the gases was less than the 2-percent allowable response for both instruments.

1.7.3 Response Time Determination

The response time of the sampling system was determined as follows:

Zero-level gas was introduced to the sampling system. After a stable reading was obtained, the system was switched to monitor the stack effluent. The upscale response time was measured and recorded on a data sheet. Then high-level gas was introduced. After a stable reading was obtained, the system was switched to monitor stack effluent. The downscale response time was measured and also recorded on a data sheet. This procedure was repeated three times. A stable value was equivalent to a change of less than 1 percent of span value for 30 seconds, or less than 5 percent of the measured average concentration for 2 minutes.

1.7.4 NO_2 to NO Conversion Efficiency Check

The 146.9 ppm NO_x calibration gas and 21.4-percent O_2 gas were mixed 1:1 and introduced into the NO_x analyzer. The sampling system was operated for 35 minutes with the NO_x responses recorded. The instrument response was stable over the 35-minute period and did not decrease more than 2 percent of the highest peak value.

1.7.5 Preliminary Oxygen Traverse

A preliminary oxygen traverse was conducted for the purpose of selecting sampling points for the NO_x emission determinations. With the turbine operating at 30 percent of peak load, the oxygen concentration at each of the 24 traverse points was determined. Results were recorded on the Method 20 Preliminary Diluent Traverse Data Sheet. Eight points with the lowest oxygen concentration were selected for the NO_x emission testing.

1.7.6 Oxides of Nitrogen and Oxygen Measurements

Oxides of nitrogen and oxygen concentrations were measured at each of the eight traverse points. The minimum sampling time at each point was at least 1 minute plus the longest average system response time. The average steady state concentration of NO_x and O_2 were determined and recorded on the Method 20 Field Data Sheets.

At the beginning of each NO_x test run and approximately every 10 minutes during the run, the turbine operating data was recorded.

2.0 FIELD DATA SHEETS

Copies of all field data sheets generated during the field testing are contained at the end of this Appendix.

TABLE B-1

ORSAT TEST RESULTS

Test Parameter	Run No.	Turbine Load (%)	Instrument O_2 (%)	Orsat Results (%) O_2	Orsat Results (%) CO_2	Orsat Results (%) CO
NO_x	1	100	16.7	15.8	3.5	0.0
NO_x	2	100	16.9	15.4	3.6	0.0
NO_x	3	100	16.8	15.4	3.0	0.0
NO_x	1	75	17.8	17.1	2.2	0.0
NO_x	2	75	17.6	17.8	2.1	0.0
NO_x (1)	3	75	17.8	.....	.....	.....
NO_x	1	50	18.4	18.5	1.8	0.0
NO_x	2	50	18.8	18.2	2.0	0.0
NO_x	3	50	18.2	18.1	1.9	0.0
NO_x	1	30	18.9	19.0	2.0	0.0
NO_x	2	30	18.8	18.7	1.6	0.0
NO_x	3	30	18.6	18.6	1.6	0.0
Metals/SO_2	1	100	---	16.1	3.8	0.0
Metals/SO_2	2	100	---	16.1	3.7	0.0
Metals/SO_2	3	100	---	16.3	3.6	0.0

(1) NO_x Run 3 at 75 percent load, orsat sample was lost.

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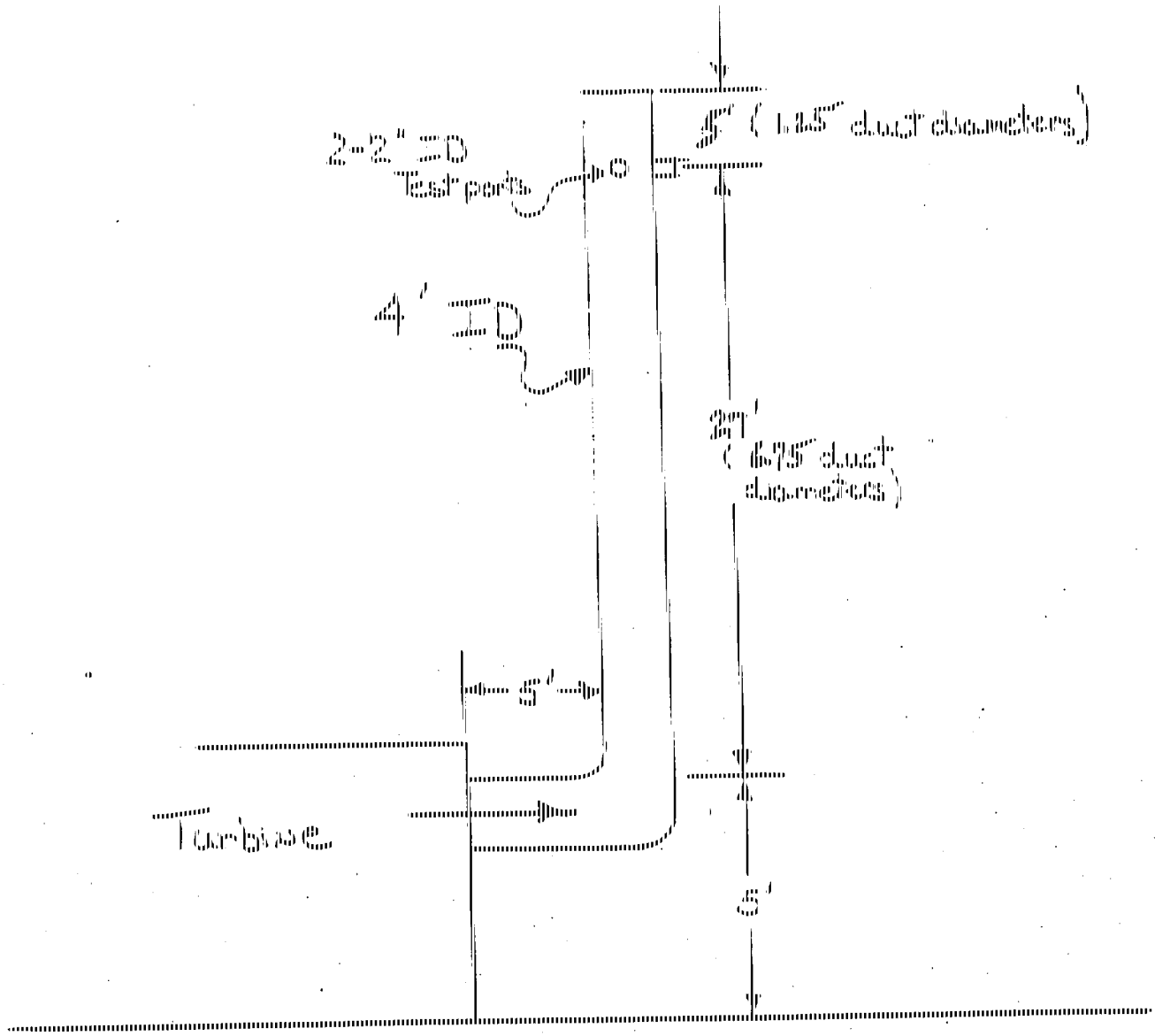
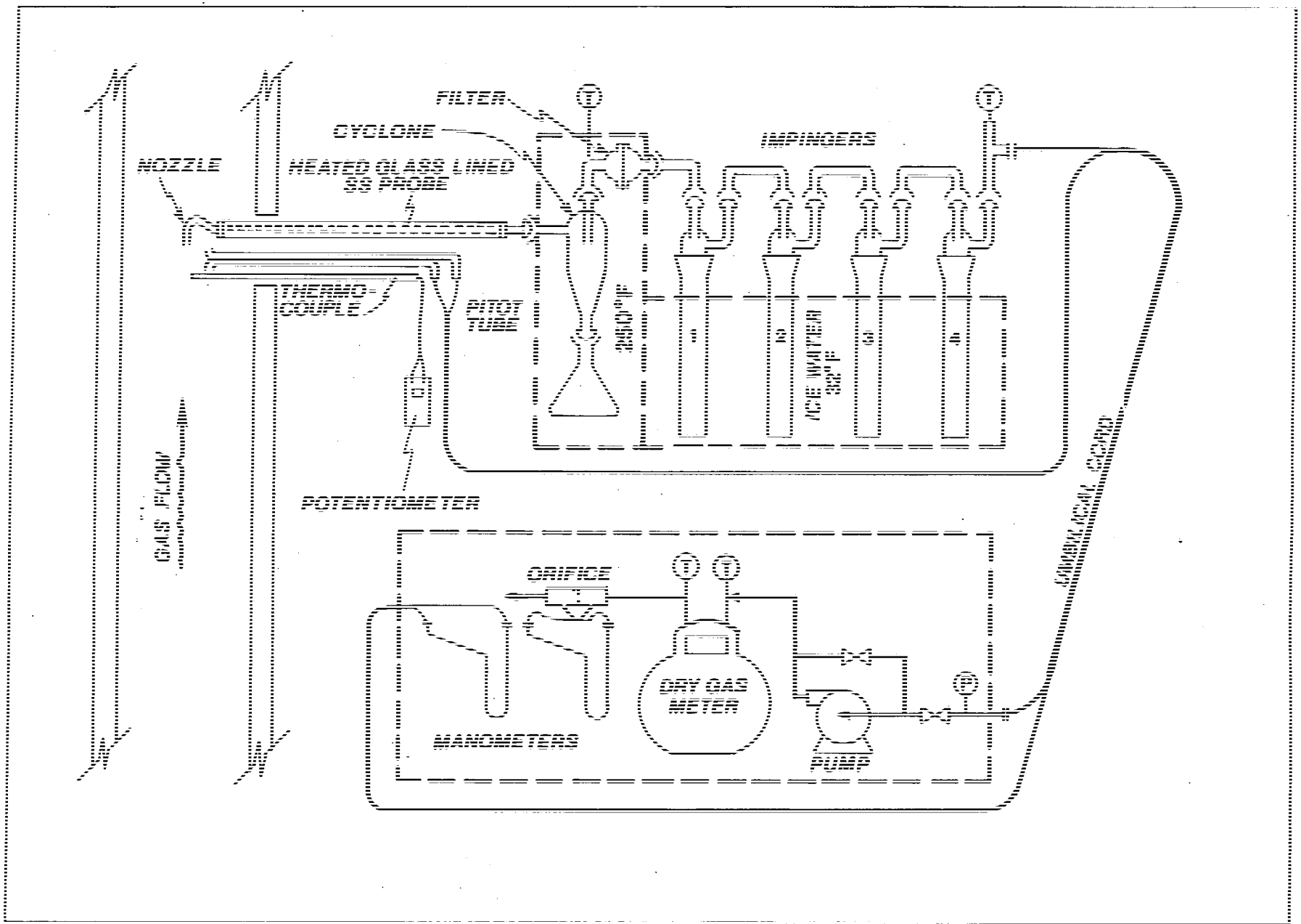
COMPUTATION SHEET

Sheet Number ____ of ____
Date 6/28/94
J. O. Number - 5293 - 2
Computed by G Swaab
Checked by ____

Name of Client Waste Management
Project Sapphire Detonation Facility
Description Sample Port Location Design





EPA METHOD 5

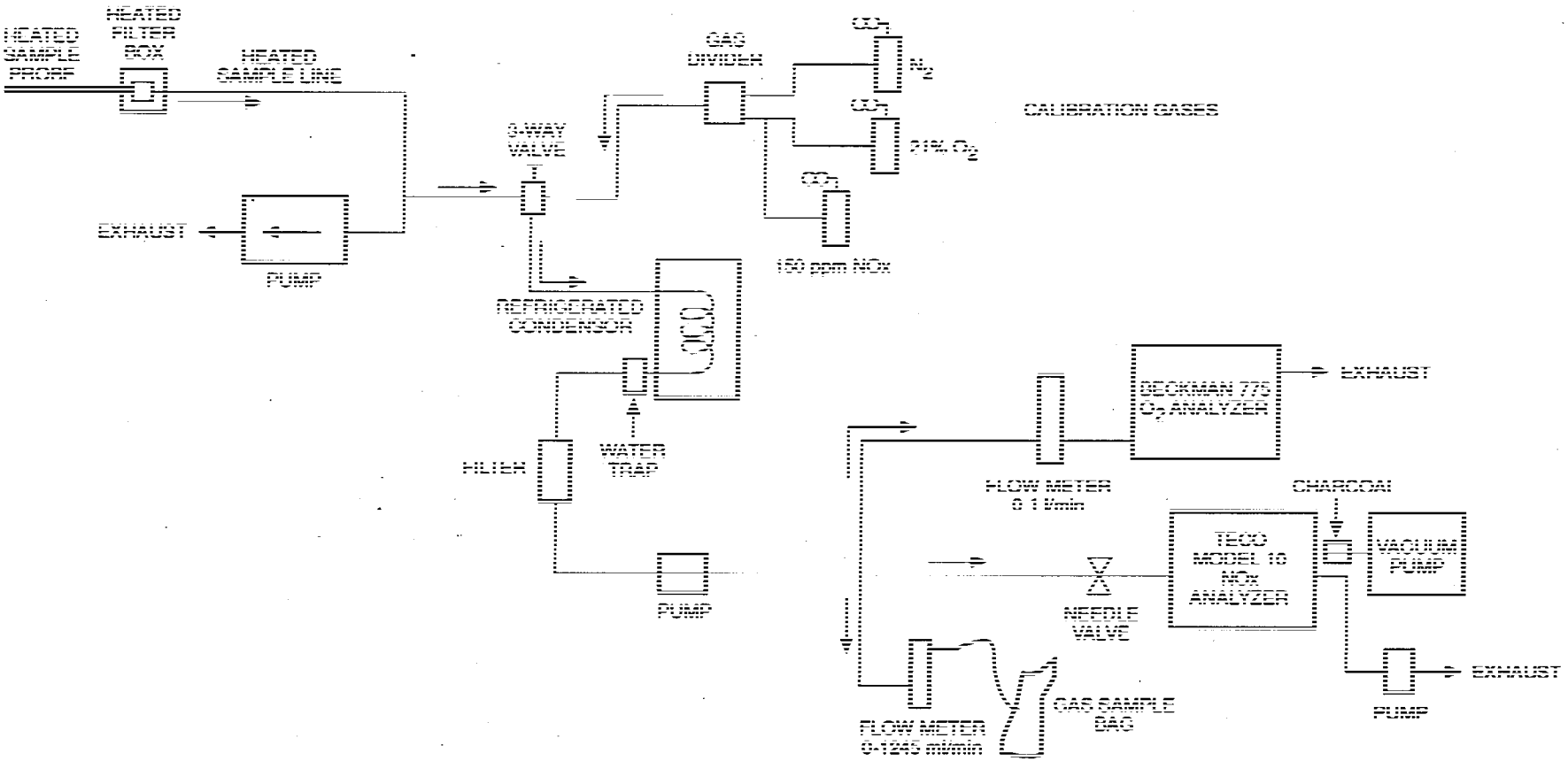


Figure 1
EPA Method 20 Sampling System

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TRAVERSE POINT LOCATION AND
GAS FLOW RATE DATA SHEETS

Betz • Converse • Murdoch • Inc. BCM

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Atlas Phosphate
DATE 9/28/89
SAMPLING LOCATION Loading Dock Scale
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, DISTANCE A
INSIDE OF REAR WALL TO
OUTSIDE OF NIPPLE, DISTANCE B
STACK I.D., DISTANCE A - DISTANCE B 60" (5')
NEAREST UPSTREAM DISTURBANCE 7.125 diameters 60" (5')
NEAREST DOWNSTREAM DISTURBANCE 6.25 diameters 324" (27')
CALCULATOR

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/4 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	2.6	48	1.2	7.25	9.0
2	8.2		3.9		11.7
3	14.6		7.0		14.8
4	22.6		10.8		18.6
5	34.2		16.4		24.2
6	65.8		31.6		39.4
7	77.4		37.2		44.9
8	85.4		41.0		48.7
9	91.8		44.1		51.8
10	97.4		46.8		54.5

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INSTRUMENT RESPONSE TIME

Date 10-2-91 Facility WASTE MANAGEMENT

Operator NC/PCD Location TUSCOLA #2 EAST

Analyzer BECKMAN 755 O2

Span Gas Concentration 21.4 ppm or %

Analyzer Range 0-25%

Analyzer Span Setting _____ ppm or %

Upscale:

1. 91 seconds
2. 92 seconds
3. 93 seconds

Average upscale response 92.1 seconds = System Response Time

Downscale:

1. 55 seconds
2. 59 seconds
3. 60 seconds

Average downscale response 57.7 seconds

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NO_x TESTING DATA SHEETS

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VELOCITY DETERMINATIONS

Client: West Management — Sample Port Locations: 8

Location: Eubank No. 2 Outlet

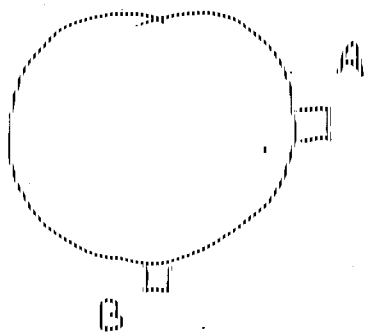
Date: 9/30/91

Stack Pressure: -.14

Barometric Pressure:

Pitot Factors:

Engineer:



Pitot/Temperature Readings

Point No.	Distance (Inches)	Port A		Port		Port		Port		Port	
		ΔP	T	ΔP	T	ΔP	T	ΔP	T	ΔP	T
1		1.2	610								
2		1.5	702								
3		1.9	723								
4		2.2	746								
5		2.8	715								
6		2.0	757								
7		2.0	742								
8		1.8	675								
9		1.6	654								
10		1.2	640								
			645								
			680								
			700								
			750								
AVGS.		1.91	699								

BCM

INSTRUMENT RESPONSE TIME

Date 10-2-91 Facility Waste Mgmt

Operator DC/PCS Location Portland #2 East

Analyzer NO_x

Span Gas Concentration 149 ppm or %

Analyzer Range X 250

Analyzer Span Setting _____ ppm or %

Upscale:

1. 50 seconds
2. 40 seconds
3. 45 seconds

Average upscale response 45 seconds

Downscale:

1. 65 seconds
2. 69 seconds
3. 67 seconds

Average downscale response 67 seconds

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METHOD 20 - PRELIMINARY DILUENT TRAVERSE

Date 10-2-91 Operator AC

Facility WASTE MANAGEMENT Location TRAPPE, MD #2 GAS

Turbine Identification

Manufacturer SOLAR

Model

Serial No.

Sample Point No.		Diluent Concentration (ppm-p-b)	
A 10	B 10	19.13	19.54
A 9	B 9	19.06	19.19
A 8	B 8	18.95	19.03
A 7	B 7	18.88	18.95
A 6	B 6	18.72	18.88
A 5	B 5	18.77	18.85
A 4	B 4	18.93	18.92
A 3	B 3	18.98	18.95
A 2	B 2	18.98	19.00
A 1	B 1	19.13	19.03

3CM

METHOD 20 FIELD DATA SHEET

Facility WMGMT Location _____

Test Operator MC Test Date 10-3-91

Turbine Type _____ Serial No. _____

Fuel _____ Operating Load 1895 Test Run No. ONE

TURBINE OPERATION RECORD

Ambient Temperature 70° , Humidity 74%, Barometric Pressure 29.66

Test Time Start 1821 Time Finish 1851

Fuel Flow Rate _____ Water or Steam Flow Rate _____

SAMPLE POINT RECORD

Diluent Instrument Type _____ Serial No. _____

Nox Instrument Type _____ Serial No. _____

Sample Point	Time	O_2(%)	NO_x(ppm)
A1	1824	12.1	19.1
A2	1824	12.2	19.2
A3	1830	12.5	20.0
A4	1835	12.8	18.2
B1	1840	12.8	17.1
B2	1844	12.8	19.4
B3	1848	12.6	19.4
B4	1853	12.6	19.3
	1852	12.4	19.1

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METHOD 20 FIELD DATA SHEET

Facility WMGMT Location TRUE 3E2

Test Operator MC Test Date 10-3-91

Turbine Type _____ Serial No. _____

Fuel _____ Operating Load 95% Test Run No. TWO

TURBINE OPERATION RECORD

Ambient-Temperature 70, Humidity 65%, Barometric Pressure 29.96

Test Time Start 1924 Time Finish 1957

Fuel Flow Rate _____ Water or Steam Flow Rate _____

SAMPLE POINT RECORD

Diluent Instrument Type _____ Serial No. _____

Nox Instrument Type _____ Serial No. _____

Sample Point	Time	O_2(%)	NO_x(ppm)
A7	1924	16.9	17.9
A6	1926	16.9	19.8
A5	1932	16.6	20.1
A4	1937	16.8	19.8
B4	1942	16.8	18.7
B5	1947	16.8	18.8
B6	1950	16.9	18.8
B7	1952	16.9	18.7
	1957		
	AVG	16.85	18.93

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METHOD 20 FIELD DATA SHEET

Facility WMGMT Location TURBINE #2

Test Operator NC Test Date 10-3-91

Turbine Type _____ Serial No. _____

Fuel _____ Operating Load 100% Test Run No. THR2

TURBINE OPERATION RECORD

Ambient Temperature 65°F Humidity 69% Barometric Pressure 29.96

Test Time Start 2013 Time Finish 2045

Fuel Flow Rate _____ Water or Steam Flow Rate _____

SAMPLE POINT RECORD

Diluent Instrument Type _____ Serial No. _____

Nox Instrument Type _____ Serial No. _____

Sample Point	Time	O_2 (%)	NO_x (ppm)
A7	2013	16.9	18.8
A6	2016	16.9	18.7
A5	2020	16.9	18.7
A4	2025	16.5	20.2
B4	2031	16.5	20.3
B5	2035	16.9	18.7
B6	2039	16.9	18.7
B7	2045	16.5	20.2
		16.8	19.2

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METHOD 20 FIELD DATA SHEET

Facility WEST MORGAN Location TRAILSIDE #2

Test Operator NC Test Date 10-3-94

Turbine Type _____ Serial No. _____

Fuel _____ Operating Load 75% Test Run No. ONE

TURBINE OPERATION RECORD

Ambient Temperature 78, Humidity 42%, Barometric Pressure 29.47

Test Time Start _____ Time Finish _____

Fuel Flow Rate _____ Water or Steam Flow Rate _____

SAMPLE POINT RECORD

Diluent Instrument Type _____ Serial No. _____

Nox Instrument Type _____ Serial No. _____

Sample Point	Time	O_2(%)	NO_x(ppm)
A7	1130	18.0	12.5
A6	1134	17.8	18.0
A5	1137	18.8	18.5
A4	1139	17.8	17.7
B7	1139	19.0	18.1
B6	1142	17.6	18.1
B5	1147	17.6	18.4
B4	1151	17.8	17.7
	31	17.78	18.31

BOM

METHOD 20 FIELD DATA SHEET

Facility WASTE LOGGANT Location TURBINE #2

Test Operator DEC Test Date 10-3-91

Turbine Type _____ Serial No. _____

Fuel _____ Operating Load 75% Test Run No. TWO

TURBINE OPERATION RECORD

Ambient Temperature 81, Humidity 42%, Barometric Pressure 29.90

Test Time Start 1546 Time Finish 1625

Fuel Flow Rate _____ Water or Steam Flow Rate _____

SAMPLE POINT RECORD

Diluent Instrument Type _____ Serial No. _____

Nox Instrument Type _____ Serial No. _____

Sample Point	Time	O_2(%)	NO_x(ppm)
A-7	1552	17.8	18.1
A-6	1556	17.7	18.8
A-5	1600	17.7	18.8
A-4	1604	17.8	17.7
A-3	1610	17.5	18.7
B-6	1614	17.7	19.0
B-5	1617	17.5	18.7
B-4	1621	17.7	17.9
	28	17.64	18.45

BOM

METHOD 20 FIELD DATA SHEET

Facility WST MNGMT Location TONEZ #2

Test Operator NC Test Date 10-3-91

Turbine Type Serial No.

Fuel Operating Load 75% Test Run No. THREE

TURBINE OPERATION RECORD

Ambient Temperature 70, Humidity 74, Barometric Pressure 29.86

Test Time Start 1120 Time Finish 1257

Fuel Flow Rate Water or Steam Flow Rate

SAMPLE POINT RECORD

Diluent Instrument Type Serial No.

Nox Instrument Type Serial No.

Sample Point	Time	O_2(%)	NO_x(ppm)
A7	1120	17.8	165
A6	1125	17.7	171
A5	1130	17.7	168
A4	1134	17.8	157
B7	1145	17.0	164
B6	1148	17.8	160
B5	1152	17.7	165
B4	1154	17.6	165
	3.4	0.38	10.5

3% O2 per Pub-Test calibrations

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METHOD 20 FIELD DATA SHEET

Facility Waste Management — Location Turbine #2

Test Operator MC — Test Date 10-3-97

Turbine Type _____ — Serial No. _____

Fuel _____ Operating Load 352 — Test Run No. Three

TURBINE OPERATION RECORD

Ambient Temperature 82, Humidity 54, Barometric Pressure 29.84

Test Time Start _____ Time Finish _____

Fuel Flow Rate _____ Water or Steam Flow Rate _____

SAMPLE POINT RECORD

Diluent Instrument Type _____ Serial No. _____

Nox Instrument Type _____ Serial No. _____

Sample Point	Time	O_2(%)	NO_x(ppm)
A7	1720	12.9	17.2
6	1725	12.7	18.0
5	1730	12.7	17.7
4	1734	12.7	16.5
3	1745	12.8	17.1
2	1748	12.8	17.1
1	1751	12.7	17.1
4	1754	12.6	16.1
			17.0

Same pre-test calibrations

BCM

METHOD 20 FIELD DATA SHEET

Facility MASIP Magazolbut Location TURBINE #2 ONLY

Test Operator NC Test Date 10-3-94

Turbine Type _____ Serial No. _____

Fuel _____ Operating Load 50% Test Run No. ONE

TURBINE OPERATION RECORD

Ambient Temperature 67, Humidity 76, Barometric Pressure 30.10

Test Time Start 1055 Time Finish 1124

Fuel Flow Rate _____ Water or Steam Flow Rate _____

SAMPLE POINT RECORD

Diluent Instrument Type Bald 9400 O_2 Serial No. _____

Nox Instrument Type TECO 10 04644 Serial No. _____

Sample Point	Time	O_2(%)	NO_x(ppm)
A7	1055	18.4	14.1
A6	1057	19.3	14.2
A5	1059	19.5	14.3
A4	1102	19.7	13.9
B7	1104	19.7	13.8
B6	1020	19.3	14.6
B5	1022	19.5	14.5
B4	1024	19.4	13.9
	AVG	19.41	14.25

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METHOD 20 FIELD DATA SHEET

Facility West Market — Location Turbine #2 exit

Test Operator MC — Test Date 10-3-94

Turbine Type _____ — Serial No. _____

Fuel _____ Operating Load 50% Test Run No. TWO

TURBINE OPERATION RECORD

Ambient Temperature 72, Humidity 64, Barometric Pressure 29.95

Test Time Start 1059 Time Finish 1127

Fuel Flow Rate _____ Water or Steam Flow Rate _____

SAMPLE POINT RECORD

Diluent Instrument Type Beckman 755 0424 Serial No. _____

Nox Instrument Type TECO 10 248244 Serial No. _____

Sample Point	Time	O_2(%)	NO_x(ppm)
A1	1059	18.8	13.7
A2	1102	18.7	0000 14.5
A3	1107	18.7	14.3
A4	1112	18.9	13.6
B1	1115	18.9	13.1
B2	1119	18.7	14.6
B3	1124	18.7	14.3
B4	1124	18.9	13.6
	1127		
	25	18.79	13.96

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METHOD 20 FIELD DATA SHEET

Facility WESTWARD Location TURBINE #2

Test Operator AC Test Date 10-3-91

Turbine Type _____ Serial No. _____

Fuel _____ Operating Load 50% Test Run No. THREE

TURBINE OPERATION RECORD

Ambient Temperature 75, Humidity 52%, Barometric Pressure 30.00

Test Time Start 1248 Time Finish 1325

Fuel Flow Rate _____ Water or Steam Flow Rate _____

SAMPLE POINT RECORD

Diluent Instrument Type BMN 255 02A Serial No. _____

Nox Instrument Type TECO 10 CHEM. Serial No. _____

Sample Point	Time	O_2(%)	NO_x(ppm)
A1	1248	18.2	14.5
A2	1251	18.1	15.3
A3	1254	18.1	15.1
A4	1257	18.2	14.6
B1	1307	18.2	14.1
B2	1310	18.1	15.5
B3	1316	18.1	15.4
B4	1321	18.2	14.9
	33	18.15	14.99

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METHOD 20 FIELD DATA SHEET

Facility WASTE MANAGEMENT Location TURBINE #2 OUT

Test Operator AC/PB Test Date 10-2-91

Turbine Type Serial No.

Fuel LANDFILL GAS Operating Load 30% Test Run No. ONE

TURBINE OPERATION RECORD

Ambient Temperature 96°F, Humidity 35%, Barometric Pressure 29.98

Test Time Start 1457 Time Finish 1625

Fuel Flow Rate Water or Steam Flow Rate

SAMPLE POINT RECORD

Diluent Instrument Type PARAMAGNETIC O_2 Serial No.

NO_x Instrument Type CHEMI 1562 12 Serial No.

30% LOAD 10-2-91

Sample Point		Time		O_2(%)		NO_x(ppm)	
A10	B10	1454	1732	19.13	19.69	12	9.0
A9	B9	1702	1745	19.00	19.19	12.0	11.0
A8	B8	1704	1747	19.95	19.03	12.0	10.0
A7	B7	1708	1749	18.98	18.96	11.9	11.0
A6	B6	1710	1752	18.72	18.88	11.9	11.0
A5	B5	1713	1755	18.77	18.85	11.9	11.0
A4	B4	1715	1758	18.98	18.92	12.0	11.0
A3	B3	1717	1801	18.98	18.85	12.0	11.0
A2	B2	1722	1804	19.08	18.80	12.0	11.0
A1	B1	1725	1806	19.13	18.93	12.0	11.0

O_2 Dec. = 18.89 (Avg A) NOx Dec. = 12.4 ppm (Avg B)

BCM

METHOD 20 FIELD DATA SHEET

Facility Waste Management Location Rome #2 GUC

Test Operator JTC Test Date 10-2-91

Turbine Type _____ Serial No. _____

Fuel _____ Operating Load 30% Test Run No. TRIO

TURBINE OPERATION RECORD

Ambient Temperature 79°F, Humidity 42%, Barometric Pressure 30.02

Test Time Start 1134 Time Finish 1209

Fuel Flow Rate _____ Water or Steam Flow Rate _____

SAMPLE POINT RECORD

Diluent Instrument Type BGM 755 Para Serial No. _____

Nox Instrument Type TEC 10 E644 Serial No. _____

Sample Point	Time	O_2(%)	NO_x(ppm)
A1	1134	18.75	9.4
A2	1137	18.75	10.0
A3	1140	18.75	9.8
A4	1142	18.88	9.4
A5	1154	18.93	9.4
A6	1156	18.69	10.2
A5	1159	18.85	9.6
A4	1201	18.93	9.0
	23	18.82	9.63

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METHOD 20 FIELD DATA SHEET

Facility WASTE MANAGEMENT Location DURHAM #2 OUT

Test Operator MC/PCS Test Date 10-24-91

Turbine Type _____ Serial No. _____

Fuel _____ Operating Load 30% Test Run No. DH2E

TURBINE OPERATION RECORD

Ambient Temperature 76°F, Humidity 52%, Barometric Pressure 30.10

Test Time Start 2052 Time Finish _____

Fuel Flow Rate _____ Water or Steam Flow Rate _____

SAMPLE POINT RECORD

Diluent Instrument Type BEMA Paramagnetic Serial No. _____

Nox Instrument Type TECO 10 Chemi Serial No. _____

Sample Point	Time	O_2(%)	NO_x(ppm)
A1	2052	14.8	8.0
A2	2055	13.4	10.4
A3	2058	13.2	10.2
A4	2101	13.6	9.4
B1	2105	13.5	9.2
B2	2110	13.4	10.4
B3	2114	13.5	10.0
B4	2118		
	12	13.61	9.66

BCM

NO_x TESTING CALIBRATION DATA

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer TEC 10 NOx

Operator NP Test Number one

195%

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Intial-Final (ppm or %)
Zero Gas	100	0	0	0	0
Low - Level Gas	100	14.7	12.5		
Mid - Level Gas	100	29.5	29.4	28.7	0.7/2.4%
High - Level Gas	100	44.1	44.2		

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$

0-45 PPM

NOx

MCS-94.5

RF = 0.50

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer BECKMAN 7500A

Operator NC Test Number ONE

18.2%

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Intial-Final (ppm or %)
Zero Gas	25	0	0	0	0
Low - Level Gas					
Mid - Level Gas	25	12.34	12.54	12.57	.03/.16
High - Level Gas	25	24.40	24.66		

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

$\bar{d} = .18$

$MLS = 90.7$

$\mu = .253$

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-97 Analyzer TECO 10 NOx

Operator MC Test Number TWO

100%

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)
Zero Gas	100	0	0	0	0
Low - Level Gas	100	47	47		
Mid - Level Gas	100	295	298	39.4	0
High - Level Gas	100	447	447		

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

$\phi = 2.8$

$MLS = 59.2$

$RF = .496$

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer BECKMAN 150

Operator MC Test Number TW05

10%

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)
Zero Gas	25	0	0	0	0
Low - Level Gas	25				
Mid - Level Gas	25	1284	1254	1269	.05/2.5
High - Level Gas	25	2440	2161		

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

$\phi = 15$

$MCS = 505$

$\Delta_p = .2528$

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer TEC NOx

Operator WC Test Number 1102E

100%

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differentials Intial-Final (ppm or %)
Zero Gas	100	0	0	-0.2	0.2 0.2%
Low - Level Gas	100	47			
Mid - Level Gas	100	294	294	294	0
High - Level Gas	100	947	947		

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$

$\phi = 2.8$

MLS = 91.3

LF = .958

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer BAM 755 04

Operator NC Test Number 2000 0425

100%

Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differentials Initial-Final (ppm or %)
Zero Gas 25	0	0	0	0
Low - Level Gas				
Mid - Level Gas 25	12.84	12.84	12.72	.12/.067
High - Level Gas 25	21.40			

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

$\bar{d} = .9$

$MCS = 50.6$

$s_d = .258$

BCM

INSTRUMENT CALIBRATION DATA

DATE 6-3-91 Analyzer TECO 10 NOx

Operator JDL Test Number ONE

75% LOAD

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Intial-Final (ppm or %)
Zero Gas	100	0	0	0.4	0.4/.4%
Low - Level Gas	100	14.7	15.4	15.1	0.1/.2%
Mid - Level Gas	100	29.4	29.4	29.5	0.5/1.0%
High - Level Gas	100	44.1	43.9	43.4	0.5/1.0%

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

$\bar{d}$ = 0.3

MLS = [illegible].564

RF = .513

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer BEAN 255 02

Operator NR Test Number SAVE

25%

Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Intial-Final (ppm or %)
Zero Gas	25	0	0	0
Low - Level Gas				
Mid - Level Gas	25	12.84	12.89	12.90	.99/.25%
High - Level Gas	25	21.50	21.96	22.06	.09/.42%

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$

$\phi = 1.9$

$P_{WS} = 30.0$

$\mu F = .2569$

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer TEC 10 NOx

Operator MC Test Number TU10

35% LOAD

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)
Zero Gas	100	0	0	0.7	0.7/1.3%
Low - Level Gas	100	19.7	19.1		
Mid - Level Gas	100	29.4	29.4	29.5	0.1/0.1%
High - Level Gas	100	64.1	63.4		

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

ϕ = 5.5

MLS = 57.3

QF = .513

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer BAM 155 O_2

Operator BRC Test Number TWO

15%

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differentials: Initial-Final (ppm or %)
Zero Gas	25	0	0	0	0%
Low - Level Gas					
Mid - Level Gas	25	12.84	12.84	13.28	.44/1.28%
High - Level Gas	25	21.40	21.25	21.31	.09/.45%

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

$\phi = (-5$

$MLS = 50.2$

$\Delta P = .2558$

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer BCM 755 O2

Operator JJC Test Number 10425

7570

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)
Zero Gas	25	0	0	0	0
Low - Level Gas	25				
Mid - Level Gas	25	12.94	12.94	12.99	.05/.39
High - Level Gas	25	21.40	21.60	21.93	.09/.69

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$

$\phi = 1.8$

$MCS = 50.0$

$DF = .758$

BCM

INSTRUMENT CALIBRATION DATA

DATE 12-3-91 Analyzer TECO NOx

Operator NC Test Number TH25

15%

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)
Zero Gas	100	0	0	-.2	.2/.3%
Low - Level Gas	100	47	44.6	45.0	.4/.8%
Mid - Level Gas	100	294	294	300	6/1.2%
High - Level Gas	100	941	942		

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$

b=6.5

MS=525

DF=.513

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer TECO NO_x

Operator JRC Test Number BME

50% LOAD

	Instrument Range	Cylinder Value (ppm e—6)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differentials: Initial-Final (ppm or %)	
Zero Gas	100	0	0	0.5	0.5	1.0
Low - Level Gas	100	49	50	55	05	10
Mid - Level Gas	100	294	294	297	03	0.
High - Level Gas	100	441	440	440	0	

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

Span = 49 ppm

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer BAM 250 #2

Operator NJC Test Number ONE

SO2 LOAD

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)	
Zero Gas	25	0	0	0	0	0
Low - Level Gas						
Mid - Level Gas	25	12.84	12.84	12.55	0.29	1
High - Level Gas	25	24.0	21.73	21.43	0.30	0

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$

Span = 21.43%

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer BECO 10 NOx

Operator MC Test Number TWO

50% LOAD

Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)	
Zero Gas	100	0	0.5	0.5	0.5%
Low - Level Gas	100	14.7	15.9	15.2	0.7%
Mid - Level Gas	100	29.4	29.7	28.8	0.9%
High - Level Gas	100	44.1	44.9	43.2	0.6%

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$

49 [illegible]

b = 0.0

m = 58.4

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer BAM 355 01

Operator MC Test Number TWO

SO2 Lab

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)
Zero Gas	25	0	0	0	0/0
Low - Level Gas					
Mid - Level Gas	25	12.84	12.85	13.0	0.16/0.8
High - Level Gas	25	21.40	22.1	21.91	0.19/0.87

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$ = .259

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer TECO NOx

Operator JC Test Number TN025

50% LOAD

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Intial-Final (ppm or %)
Zero Gas	100	0	0	0.9	.9/.9%
Low - Level Gas	100	147	155	161	.5/.5%
Mid - Level Gas	100	294	294	299	.5/.5%
High - Level Gas	100	441	441	443	.2/.2%

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

99ppm (.2)

MCS 97.1

RC = 99.9

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-3-91 Analyzer BAM 350

Operator MC Test Number TR-128

50% LOAD

Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)
Zero Gas	25	0	0	-.05 .05/.25
Low - Level Gas				
Mid - Level Gas	25	12.54	12.54	12.52 .38/1.34
High - Level Gas	25	21.40	20.98	21.52 .07/.98

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$

4-2-92

mcs = 600.59

ppmvm

P = .253

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-2-91 Analyzer TECO 10 NO$_x$

Operator NC Test Number SNE

302, 2nd

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)
Zero Gas	250	0	0	2	0
Low - Level Gas	250	154	154	156	0.9
Mid - Level Gas	250	235	236	241	1.4 (.8%)
High - Level Gas	250	445	450		

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$

$\frac{6}{250} \times 100 = .025$

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-2-91 Analyzer BAM 255 Os.

Operator NRC Test Number ONE

SO2 Rack

	Instrument Range	Cylinder Value (ppm-or %)	Initial Analyzer Response (ppm-or %)	Final Analyzer Response (ppm-or %)	Differential: Initial-Final (ppm-or %)
Zero Gas	25	0	0	0.05	0.05
Low - Level Gas	25	———	———	———	———
Mid - Level Gas	25	12.5	12.5	12.50	0.0
High - Level Gas	25	21.5	22.5	21.9	0.6 (2.4%)

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$

2.4% (24%, 5%)

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-2-91 Analyzer NOx

Operator NC Test Number TMD

302

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)
Zero Gas	250	20	0	0	0
Low - Level Gas	250	224	21.4	21.2	0.2%
Mid - Level Gas	250	135	14.9	15.1	0.2
High - Level Gas	250	244.9	153.0	153.0	0

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

175

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-2-91 Analyzer O_2

Operator NC Test Number TM8

30% Road

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differentials Intial-Final (ppm or %)
Zero Gas	25	0	0.05	0.44	0.39
Low - Level Gas	25	—	—	—	—
Mid - Level Gas	25	12.8	12.5	12.8	0.3
High - Level Gas	25	21.4	20.9	21.7	0.8

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-2-91 Analyzer TECO NOx

Operator MCPCB Test Number TN425

30% LOAD

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Intial-Final (ppm or %)
Zero Gas	250	0	0	0	0
Low - Level Gas	250	29.4	29.2		
Mid - Level Gas	250	73.5	75.1	74.3	0.8 (SV)
High - Level Gas	250	146.9	153.0		

Percent drift = $\frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$

BCM

INSTRUMENT CALIBRATION DATA

DATE 10-2-91 Analyzer O_2

Operator JRC/PCB Test Number TH2-25

30% LOAD

	Instrument Range	Cylinder Value (ppm or %)	Initial Analyzer Response (ppm or %)	Final Analyzer Response (ppm or %)	Differential: Initial-Final (ppm or %)
Zero Gas	25	0	0.0	0.5	0.5
Low - Level Gas	25	—	—	—	—
Mid - Level Gas	25	12.8	12.8	12.8	0.0
High - Level Gas	25	24	24.7		

$$\text{Percent drift} = \frac{\text{Absolute Difference}}{\text{Span Value}} \times 100$$

BCM

METALS TESTING DATA SHEETS

run Wash Management

date 9/30/1990

sampling location Tanker RD.2

sample type Metals

gas meter no. dry gas meter coef. RG/K6

barometric pressure 30.48 static pressure -.85

filter number(s)

cal number(s) +18.4

nozzle size(in) plate size

wp pump (ml) +46

BOM

ORSAT:

CO_2 8.0,8.7

O_2 12.2,12.0

CO .0,.0

meter box number 420 $\Delta H_@$ 1.80

pitot number C_p .84

probe no. meter(s)

probe length (ft) 6 T_s = 700

probe heat temperature 100

c factor .0 assume as: Exp 2.80

P_{bar} 29.43 ΔP .840 - .932 ΔH .64 165-150 ΔH

read and record all data every 5 minutes

traverse point number	sampling time (24 hr clock)	elapsed time (24 hr clock)	gas meter reading ft.³	velocity head (avg.) in. H2O	orifice pressure differential (avg.) in. H2O		stack temperature (T_s) °F	dry gas meter temperature		pump vacuum in. Hg	sample box temperature °F	oven temperature °F
					desired	actual		inlet (T_m) °F	outlet (T_m) °F			
	1535	1535	16.400									
A-10	05	1548	19.4	.1.5	1.00	1.00	660	89	88	3 gas	265	58
9	10	1548	22.5	1.7	1.15	1.15	684	98	89	4	248	60
8	15	1553	25.8	1.7	1.20	1.20	705	107	90	4	261	60
7	20	1558	29.7	2.5	1.70	1.70	742	111	92	4	255	60
6	25	1603	34.0	2.9	1.95	1.95	768	117	96	5	254	58
5	30	1608	37.7	3.0	2.00	2.00	776	121	100	6	259	58
4	35	1613	41.5	2.5	1.60	1.60	745	122	101	5	257	60
3	40	1618	45.0	2.2	1.40	1.40	732	121	103	4	256	60
2	45	1623	48.5	2.2	1.40	1.40	727	121	104	4	258	60
1	50	1628	52.000	2.1	1.35	1.35	726	121	105	4	253	60
			Shutdown, change probe, back duct @ 15' H_2 = .008 dp									
	50	1649	52.209									
B-10	55	1654	55.8	2.4	1.55	1.55	723	97	98	4	236	50
9	60	1659	59.5	2.4	1.55	1.55	720	106	98	4	235	50
8	65	1704	63.3	2.4	1.60	1.60	750	112	98	5	250	52
7	70	1709	67.3	3.1	2.00	2.00	767	117	99	5	253	56
6	75	1714	71.6	3.5	2.25	2.25	790	119	100	6	267	58
5	80	1719	76.3	3.4	2.35	1.65	763	120	101	5	260	60
4	85	1724	78.8	2.1	2.05	1.35	760	116	100	4	262	60
3	90	1729	83.0	1.9	2.05	1.35	734	114	100	4	258	60
2	95	1734	86.2	1.8	1.15	1.15	727	112	99	4	259	58
1	1000	1739	89.2	1.6	1.00	1.00	720	111	98	3	252	58

BOM

PLANT: WASTE MANAGEMENT
DATE: 10-1-91
SAMPLING LOCATION: TUBBIC #2 OUTLET
SAMPLE TYPE: METALS
RUN NUMBER: TWO OPERATOR: JOHNS
ORSAT: CO_2 3.5 3.8 O_2 18.2 18.0 CO 0.4 0.4
BAROMETRIC PRESSURE: 30.15 IN STATIC PRESSURE: -.85
30.10 HG
FILTER NUMBER(S):
CAL NUMBER(S): 410
TRIPLE PITOT: 0 PROBE LINER:
H_2O PROBE (in): 465 mL
PROBE NUMBER:
THERMOCOUPLE NUMBER:
NOZZLE DIAMETER: .190
DRY GAS METER BOX NUMBER: 420 $\Delta H_@$ 1.80
PITOT NUMBER: C_p .84
SAMPLE BOX NUMBER(S):
ASSUMED MOISTURE (%): 6 T_s 700
ASSUMED PROBE TEMPERATURE: 700
C FACTOR: 1.0 STACK ΔP: 2.80
READ AND RECORD ALL DATA EVERY 5 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) (min)	CLOCK TIME (24 HOUR CLOCK)	GAS METER READING (V_m) ft³	VELOCITY HEAD (Δp), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL, in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL, in. H_2O ACTUAL	STACK TEMPERATURE (T_s) °F	DRY GAS METER TEMPERATURE INLET ($T_{m_{in}}$) °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m_{out}}$) °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	00	1600	088.445									
A 10	05	1647	091.5	1.70	1.15	1.15	677	69	66	3	250	62
9	10	1652	094.6	1.70	1.65	1.65	669	82	67	3	250	62
8	15	1657	097.8	2.40	1.60	1.60	726	85	73	3	250	62
7	20	1702	101.7	2.90	1.90	1.90	760	103	77	3	250	62
6	25	1707	106.0	2.90	1.90	1.90	768	108	82	3	250	62
5	30	1712	109.4	2.50	1.60	1.60	742	108	93	4	250	62
9	35	1717	112.8	2.50	1.60	1.60	740	110	94	4	250	62
3	40	1722	116.0	1.90	1.20	1.20	708	110	85	4	250	62
2	45	1727	119.250	1.80	1.20	1.20	(VALVE) 707	108	86	4	250	62
1				LOST CREW MEMBER TO Turbine Wash								
A 2	42	1815	117.385									
7	45	1820	119.0	1.60	1.10	1.10	(VALVE) 647	88	80	3	240	64
1	50	1827	122.400	1.60	1.10	1.10	701	95	82	3	250	65
	3:00		V_m=07.749 ✓	ΔP= 1.444	ΔH=	1.408	T_s=731	T_m= 98 ✓				

PLANT WORMWOOD DATE 10-1-91 RUN METALS RUN TWO $P_s = .64$ P_b 0

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 HR CLOCK)	GAS METER READING (V_m, ft^3)	VELOCITY HEAD (Δp, in. H_2O)	ORIFICE PRESSURE DIFFERENTIAL, ΔH, in. H_2O		STACK TEMPERATURE (T_s, °F)	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
					DESIRED	ACTUAL		INLET ($T_{m_{in}}$, °F)	OUTLET ($T_{m_{out}}$, °F)			
	48	1648	77.820									
1	5	1653	126.4	2.20	1.80	1.85	737	103	90	3	250	60
2	10	1658	127.1	2.30	1.50	1.50	737	112	92	3	250	60
3	15	1703	127.4	2.30	1.50	1.50	741	117	95	4	250	55
4	20	1708	132.0	2.90	1.90	1.90	774	120	97	5	250	60
5	25	1713	132.1	2.50	1.70	1.70	782	122	97	5	250	60
6	30	1718	145.3	2.30	1.50	1.50	778	123	100	4	250	60
7	35	1723	145.4	1.80	1.20	1.20	746	117	102	3	250	60
8	40	1728	151.0	1.30	0.88	0.88	727	120	106	3	260	64
9	45	1733	151.7	1.30	0.92	0.92	718	120	103	3	260	64
10	60	1748	164.587	1.30	0.92	0.92	704	121	104	2	250	60

Washed and set back up. Held @ 72" H2O for 10

BOM

SO_2 TESTING DATA SHEETS

BCM

PLANT: Waste Management
DATE: 10/2/91
SAMPLING LOCATION: Turbine No. 2
SAMPLE TYPE: Metals Run 3
RUN NUMBER: Three OPERATOR: ALB/KB
BAROMETRIC PRESSURE: 30.28 STATIC PRESSURE: -.83
FILTER NUMBER(S):
GEL NUMBER(S): 16.5g
THIMBLE NUMBER: PLATE NUMBER:
H_2O PICKUP (ml): +63ml

ORSAT:
CO_2: 3.6 , 3.6
O_2: 16.2 , 16.4
CO: 0 , 0

PYROMETER NUMBER:
THERMOCOUPLE NUMBER:
PROBE NUMBER: TYPE:
NOZZLE NUMBER: I.D.:
METER BOX NUMBER: 410 $\Delta H_@$:
PITOT NUMBER: C_p: .84
SAMPLE BOX NUMBER(S):
ASSUMED MOISTURE (%): 6%
ASSUMED METER TEMPERATURE: 100
C FACTOR: 1.0 REFERENCE Δp: 2.80

READ AND RECORD ALL DATA EVERY 5 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	0922	157.304									
A-10	05	0927	160.2	1.5	1.00	1.00	680	69	65	4	270	60
9	10	0932	163.1	1.5	1.00	1.00	684	71	66	4	235	57
8	15	0937	166.2	1.9	1.25	1.25	708	89	69	4	231	52
7	20	0942	169.5	2.2	1.45	1.45	740	96	73	4	229	55
6	25	0947	173.4	2.6	1.75	1.75	775	101	76	6	245	56
5	30	0952	177.1	2.7	1.80	1.80	710	105	80	6	250	57
4	35	0957	180.6	2.2	1.45	1.45	747	106	82	5	252	58
3	40	1002	183.9	1.8	1.20	1.20	721	107	85	4	254	58
2	45	1007	187.0	1.7	1.15	1.15	706	108	87	4	254	58
1	50	1012	189.892	1.5	1.00	1.00	708	109	89	4	256	58
			Stop Test, change ports, leak check @ 15" Hg = .005									
	50	1105	190.050									
B-10	55	1106	193.4	2.0	1.35	1.35	746	83	91	4	280	58
9	60	1115	196.9	2.2	1.45	1.45	750	94	91	5	220	54
8	65	1120	200.8	2.6	1.70	1.70	771	102	84	6	230	52
7	70	1125	204.3	2.8	1.85	1.85	794	110	87	6	249	52
6	75	1130	208.5	3.0	2.00	2.00	810	113	88	7	250	52
5	80	1135	212.1	2.3	1.55	1.55	782	115	89	6	260	52
4	85	1140	215.4	1.8	1.20	1.20	762	115	93	4	260	51
3	90	1145	218.6	1.6	1.05	1.05	748	115	95	4	264	52
2	95	1150	221.3	1.4	0.94	0.94	716	116	97	4	263	50
[illegible]	[illegible]	1155	[illegible]	[illegible]	[illegible]	[illegible]	795	116	98	3	247	50

Leak check @ 14" Hg = .005 cfm T = 93 ✓

PLANT Utah Management

DATE 9/20/17 OPERATOR P.G / K.G

SAMPLING LOCATION Turbine No. 2 Outlet

BOM

METER BOX NUMBER A-2 $\Delta H_@$

SAMPLE BOX NUMBER(S) 7

PROBE NUMBER _____ TYPE _____

SO_2 Run 1

METHOD 6 FIELD DATA SHEET

TRAVERSE POINT NUMBER	SAMPLING TIME, Δθ	CLOCK TIME (MILITARY CLOCK)	GAS METER READING (V_m), ft^3	STACK TEMPERATURE (T_s), °F ΔH	DRY GAS METER TEMPERATURE INLET ($T_{m_{in}}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m_{out}}$), °F	PUMP VACUUM, in. Hg	IMPINGER TEMPERATURE, °F
Init	00	1538	128.770	1.9 680	88	82	5	63
	05	1543	132.4	1.9 687	102	83	5	64
	10	1548	136.2	1.9 705	110	85	5	64
	15	1553	140.0	1.9 708	116	89	4	64
	20	1558	143.6	1.9 708	120	91	4	64
	25	1603	147.7	1.9 726	116	94	4	64
	30	1608	151.2	1.9 745	127	97	4	64
	35	1613	155.0	1.9 732	128	98	3	65

CO_2 _____

O_2 _____

CO _____

P_b 30.42

	40	1618	158.9	1.9 739	128	100	3	65
	45	1623	161.6	1.9 726	126	100	3	65
	50	1628	165.460	1.9 726	129	100	3	65
			Stop Test, Leak Check		Leak Rate @		12" H_g	-.003
	50	1647	165.605	1.9 723	90	90	3	65
	55	1654	169.4	1.9 726	116	94	2	65
	60	1659	173.3	1.9 750	128	95	3	64
	65	1704	177.0	1.9 762	126	96	3	64

CO_2 _____

O_2 _____

CO _____

P_b _____

	70	1709	180.7	1.9 780	127	97	3	64
	75	1714	184.5	1.9 768	129	97	3	63
	80	1719	188.3	1.9 780	128	98	3	65
	85	1724	192.0	1.9 784	127	98	3	64
	90	1729	195.8	1.9 787	128	99	3	60
	95	1734	199.6	1.9 782	128	98	3	60
	100	1739	203.428	1.9 780	127	97	3	60
			Leak Check @	17" H_g =	.002			

CO_2 _____

O_2 _____

CO _____

P_b _____

V_m = 74.713 $\bar{\Delta H}$ T_m = 107

PLANT Waste Management

DATE 8-1-97 OPERATOR KB/MC

SAMPLING LOCATION Turbine #2 outlet

BOM

METER BOX NUMBER A-2 $\Delta H_@$

SAMPLE BOX NUMBER(S) 1

PROBE NUMBER TYPE

SO_2 Run 2 (SO_2^1) METHOD 6 FIELD DATA SHEET

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr clock)	GAS METER READING (V_m), ft^3	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	IMPINGER TEMPERATURE, °F
					INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F		
Avail	00	1041	217.666	1.9 671	72	66	5	62
	05	1046	221.4	1.9 672	83	66	5	62
	10	1051	225.3	1.9 672	93	69	5	62
	15	1056	228.8	1.9 682	97	70	5	62
	20	1101	232.5	1.9 689	91	71	5	62
	25	1106	236.4	1.9 724	100	76	5	62
	30	1111	239.2	1.9 730	105	77	5	62
	35	1116	241.78	1.9 740	109	79	5	62

CO_2

O_2

CO

P_b 30.15

	40	1121	245.4	1.9 709	112	82	5	62
	45	1126	249.66	1.9 709	112	83	5	62
	45	1126	249.665	1.9 687	80	69	5	18
	49	1131	252.1	1.9 697	82	70	5	68
	50	1132	252.701	1.9 703	83	71	5	68
			Started to bleed back					
			07					
	55							

CO_2 Analyzer Broke

CO

P_b

$V_m = 71.902$ ΔH $\bar{T}_m = 93$

$= 1.9$

CO_2

O_2

CO

P_b

PLANT WASTE MANAGEMENT

DATE 10-9-91 OPERATOR MC/PCB

SAMPLING LOCATION TOWERAGE #2, OUTLET

BOM

METER BOX NUMBER A2 $\Delta H_@$

SAMPLE BOX NUMBER(S)

PROBE NUMBER TYPE

METHOD 6 FIELD DATA SHEET

SO_2 RUN #2 (PART 2)

TRAVERSE POINT NUMBER	SAMPLING TIME, Θ	CLOCK TIME (MILITARY)	GAS METER READING (V_m), ft^3	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE, °F		PUMP VACUUM, in. Hg	IMPINGER TEMPERATURE, °F
					INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F		
START	0	1531	752.105	737	97	85	4	68
	5	1537	754.8	757	103	86	4	65
	10	1543	757.6	797	103	93	4	63
	15	1552	760.6	794	105	89	3	65
	20	1557	763.3	764	114	94	3	68
	25	1602	766.1	778	120	93	3	68
	30	1607	768.9	747	121	94	3	63
	35	1612	771.9	751	122	96	3	64

CO_2 ____

O_2 ____

CO ____

P_b ____

	40	1617	774.4	713	126	98	3	64
	45	1622	776.5	704	127	99	3	64
	50	1627	779.612	702	128	100	3	64
			STOP TEST AND TAKE FINAL READING @ 1627 hr $\Delta H_@$ 2.00 IN H2O					
			PUMP 2.75 HRS				10	
			PUMP					

CO_2 ____

O_2 20.9

CO ____

P_b 30.10

CO_2 ____

O_2 ____

CO ____

P_b ____

PLANT Waste Management

DATE 10/2/91 OPERATOR RB/KB

SAMPLING LOCATION Tanker No. 2

METER BOX NUMBER A-2 $\Delta H_@$

SAMPLE BOX NUMBER(S)

PROBE NUMBER TYPE

SO_2 Run 3

METHOD 6 FIELD DATA SHEET

TRAVERSE POINT NUMBER	SAMPLING TIME, Δθ	CLOCK TIME (24 HR CLOCK)	GAS METER READING (V_m), ft^3	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	IMPINGER TEMPERATURE, °F
					INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F		
			Start	ΔH				
Pre	00	0922	301.584	19 680	73	65	5	66
	05	0927	305.3	19 684	87	66	5	64
	10	0932	309.0	19 708	94	69	5	63
	15	0937	312.8	19 740	99	71	5	62
	20	0942	316.3	19 725	104	74	4	62
	25	0947	320.1	19 720	107	77	4	63
	30	0952	323.8	19 747	110	79	4	63
	35	0957	327.6	19 721	111	82	4	64
	40	1002	331.4	19 726	114	84	4	64
	45	1007	335.1	19 728	116	86	4	64
	50	1012	338.973					
			Stop/Start	change	pump	Problem @ 13"Hg - 1005		
	60	1022	339.128	19 746	87	79	4	61
	55	1017	342.9	19 720	99	80	4	61
	60	1115	346.5	19 721	107	82	4	62
	65	1120	350.0	19 744	114	85	4	62
	70	1125	353.1	19 810	116	87	4	63
	75	1130	356.6	19 782	118	89	4	63
	80	1135	361.7	19 762	121	91	4	60
	85	1140	365.4	19 748	122	94	4	60
	90	1145	368.5	19 716	125	95	4	60
	95	1150	372.1	19 685	126	97	4	60
	100	1155	376.914					
			Back check @ 13"Hg = 1005					

CO_2 _____

O_2 _____

CO _____

P_b 29.28

CO_2 _____

O_2 _____

CO _____

P_b _____

CO_2 _____

O_2 _____

CO _____

P_b _____

BCM

TURBINE OPERATING DATA SHEETS

BCM

TURBINE OPERATING DATA

Facility WASTE MGMT Location TRONE #E 2

Test Operator PCP Test Date 9-30-97

Fuel Landfill gas Test Run No. one Mtab/SO_x

100% load

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
1435	1291	300	129	1170	69
1451	1285	300	129	1170	67
1501	1281	300	129	1170	67
1516	1284	300	129	1170	67
1527	1285	300	129	1170	67
1654	1285	300	129	1170	65
1704	1288	300	129	1170	65
1721	1280	300	129	1170	64
1731	1285	300	129	1170	63
1757	1287	300	129	1170	63

Barometric Pressure 30.42" Relative Humidity 35% @ 80°F

BOMI

TURBINE OPERATING DATA

Facility _____ Location _____

Test Operator _____ Test Date _____

Fuel _____ Test Run No. _____

100% LOAD

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
1035	1203	3100	129	1170	67
1045	1285	3100	129	1170	67
1054	1284	3100	129	1170	67
1114	1277	3100	129	1170	67
	STOP : TURBINE Noise				
1516	1252	2950	125	1170	74
1534	1239	2950	125	1170	75
1554	1238	2950	125	1170	75
1604	1246	2950	125	1170	75
1618	1242	2950	124	1170	75
1241	1258	3064	126.7	1170	91.6
	1064	3059	125.3		76

Barometric Pressure 30.15 Relative Humidity 62% @ 65°F

BOM

TURBINE OPERATING DATA

Facility Utah Management Location Tooele No. 2

Test Operator Pete/Ken Test Date 10/21/97

Fuel Centaur gas Test Run No. Data/Sep Run 3

100% Load

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
	1490				
0910	3580	3050	127	1170	65
0930	980	3050	126	1170	67
0945	968	3050	126	1170	68
0955	990	3000	126	1170	70
1005	989	3000	126	1170	72
1015	985	3000	126	1170	73
1026	980	2950	125	1130	77
1038	958	2950	125	1130	77
1048	994	2950	124	1170	78
1104	980	2950	124	1170	80
1116	984	2950	124	1170	80
2.46	1290	2991	125.4	1148	83.3

Barometric Pressure 30.18 Gage 30.14 End

Relative Humidity 31@65° Gage 32@84° End

BCM

TURBINE OPERATING DATA

Facility Gas Plant — Location Turbine 2

Test Operator WC — Test Date 12-3-91

Fuel — Test Run No. 2W 005

100%

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
1326	232	250	124	170	70
1328	239	250	125	1170	68
1330	241	250	125	170	67
30	2393	250	2497	170	683

Barometric Pressure 29.96 — Relative Humidity 74%

BCM

TURBINE OPERATING DATA

Facility Ubeda Management Location Taubeca No. 2

Test Operator NC Test Date 10/3/91

Fuel _____ Test Run No. Two

100%

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
2:00	1245	2980	124	1170	67
1945	1241	2980	125	1170	67
2:00	1243	2980	124.5	1170	67

Barometric Pressure _____ Relative Humidity _____

BOM

TURBINE OPERATING DATA

Facility WMATA Location TURBINE #2

Test Operator NC Test Date 10-3-91

Fuel _____ Test Run No. 1015 Run 3

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (F)
1945	1249	3,000	125	1170	65
2026	1260	3,000	125	1170	64
2046	1250	3000	125	1170	64
2131	1255	3,000	125	1170	64.5

Barometric Pressure _____ Relative Humidity _____

BCM

TURBINE OPERATING DATA

Facility Mobile Equipment Location Turbine #2 out

Test Operator MC / CB Test Date 10-3-94

Fuel Test Run No. 9NE

75% Load

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
12 1422	1010	2250	119	1030	73
1 1434	1010	2250	118	1030	73
1456	1009	2250	118	1030	73
38	1009	2250	118	1030	73

Barometric Pressure 29.94 Relative Humidity 68% @ 75°F

BCM

TURBINE OPERATING DATA

Facility WASTE MANAGE Location TURBINE #2

Test Operator NC Test Date 10-3-91

Fuel _____ Test Run No. TWO

75%

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
1547	1010	2250	119	1030	73
1600	1020	2250	119	1020	73
1615	1018	2250	117	1022	78
1625	1017	2250	117	1015	80
38	1063	2258	1178	1213	76

Barometric Pressure 29.90 Relative Humidity 42% @ 78°

3CM

TURBINE OPERATING DATA

Facility [illegible] Location [illegible]

Test Operator [illegible] Test Date 10-22-97

Fuel [illegible] Test Run No. [illegible]

[illegible]

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
23:02	1018	2260	118	1020	77
1:04	1015	2250	118	1015	78
1:52	1014	2250	118	1015	76
3:47	[illegible]	2250	118	[illegible]	75

Barometric Pressure [illegible] Relative Humidity [illegible]

BOM

TURBINE OPERATING DATA

Facility WASTE MANAGE Location TAMPA #2 SW

Test Operator NC Test Date 10-3-94

Fuel _____ Test Run No. 9WE

50% LOAD

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
1003	720	1450	110	830	72
1013	724	1450	110	850	72
1024	767	1450	110	850	70
1030	773	1450	110	850	70
23	740.8	1450	110	865	71

Barometric Pressure _____ Relative Humidity _____

BOM

TURBINE OPERATING DATA

Facility WPT Mobile Location Mobile, AL

Test Operator DJC Test Date 10-3-91

Fuel _____ Test Run No. TM10

50% Load

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
1100	773	1450	110	860	70
1104	770	1450	110	860	70
1124	769	1450	110	860	72
26	7703	1450	110	860	71

Barometric Pressure _____ Relative Humidity _____

BCM

TURBINE OPERATING DATA

Facility WESTWEGO Location TUBOWG #2

Test Operator NC/PCB Test Date 10-3-97

Fuel _____ Test Run No. TW2GW

90% LOAD

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
@1249	764	1450	110	860	73
@1307	763	1450	110	860	73
1324	763	1450	110	860	72
35	763	1450	110	860	72

Barometric Pressure 30.00 Relative Humidity 92%@75°F

BCM

TURBINE OPERATING DATA

Facility WASTE MANAGEMENT Location TURBINE #2 OUTLET

Test Operator NCJPCB Test Date 10-2-91

Fuel LANDFILL GAS Test Run No. NOx 30% (ON) (4 DIGEST)

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
1658	621	950	104	780	78
1709	624	1000	104	780	77
1737	621	1000	104	780	77
1800	616	950	104	775	75
1810	616	950	104	780	75
1:12	626	950	104	344	344

Barometric Pressure 29.98 Relative Humidity 382.86%

BCM

TURBINE OPERATING DATA

Facility WASTE MGMT Location SOBOBE #2

Test Operator AC Test Date 10-2-91

Fuel Test Run No. TWO

30% LOAD

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
1130	628	1000	104	740	65
1140	623	1000	104	760	63
1200	637	1000	104	760	63
1209	633	1000	104	765	62
38	6303	1000	104	760	63

Barometric Pressure 30.02 Relative Humidity 42% @ 79°F

BCM

TURBINE OPERATING DATA

Facility Waste Management Location Tulsa, OK

Test Operator WC/PB Test Date 10-2-91

Fuel _____ Test Run No. THB42

30% Load

Clock Time	Gas Flow Rate (scfm)	Turbine Output Power (kw)	Combustor Inlet Pressure (psi)	Turbine Air Temp. Outlet (F)	Ambient Temperature (°F)
1053	624	950	105	760	62
2114	626	950	106	760	62
2119	623	950	106	760	62
26	624.3	950	105.7	760	62

Barometric Pressure 30.10 Relative Humidity 52% @ 72°F

TIME	AVGCH4	AVGCO2	AVGN2	AVGO2
0	56.54726	42.46294	0.999794	2.577ME-02
1	56.51738	42.45642	0.9951998	3.103ME-02
2	56.4854	42.44726	1.038903	3.354E-02
3	56.46921	42.43259	1.063996	3.423E-02
4	56.4331	42.42282	1.103149	3.678E-02
5	56.41605	42.41601	1.134265	3.790E-02
6	56.49512	42.43536	1.176064	4.267E-02
7	56.4891	42.42459	1.212978	4.325E-02
8	56.46811	42.4	1.243216	4.412E-02
9	56.46058	42.4	1.2	4.47E-02
10	56.44791	42.4	1.2	4.498E-02
11	56.44729	42.42	1.2	4.341E-02
12	56.45581	42.4	1.2	4.195E-02
13	56.45324	42.4	1.2	4.13E-02
14	56.45626	42.4	1.2	4.14E-02
15	56.46171	42.4	1.2	4.083E-02
16	56.45911	42.4	1.2	4.068E-02
17	56.4609	42.4	1.2	4.046E-02
18	56.46074	42.4	1.2	4.038E-02
19	56.46303	42.4	1.2	4.038E-02
20	56.44695	42.4	1.2	4.038E-02
21	56.44551	42.29297	1.230455	4.195E-02
22	56.44326	42.29765	1.218516	4.181E-02
23	56.44098	42.3	1.2232	4.179E-02

TIME	AVGBARO	AVGETO	AVGPRES	AVGTEMP
0	0.9707531	574.1529	166.0763	98.94876
1	0.9703521	573.8482	166.0363	90.91897
2	0.9709366	573.5332	165.9629	87.98529
3	0.9709193	573.3578	165.9069	85.46303
4	0.970993	573.0412	165.8391	84.30616
5	0.9710283	572.8165	165.8277	82.44683
6	0.9708081	573.5156	165.8258	81.67647
7	0.9698538	573.5538	165.8469	82.31656
8	0.9696852	573.3397	165.8671	88.96719
9	0.9698557	573.2616	165.9177	92.69476
10	0.9696964	573.0969	165.9572	95.96971
11	0.9698496	573.1165	165.9676	98.36468
12	0.9698155	573.2133	165.7979	101.4573
13	0.9699087	573.1685	165.6245	104.9965
14	0.9699389	573.2195	165.6813	106.8596
15	0.9699688	573.2709	165.7383	108.1464
16	0.9700206	573.3221	165.7952	109.0018
17	0.9700724	573.3733	165.8522	109.4681

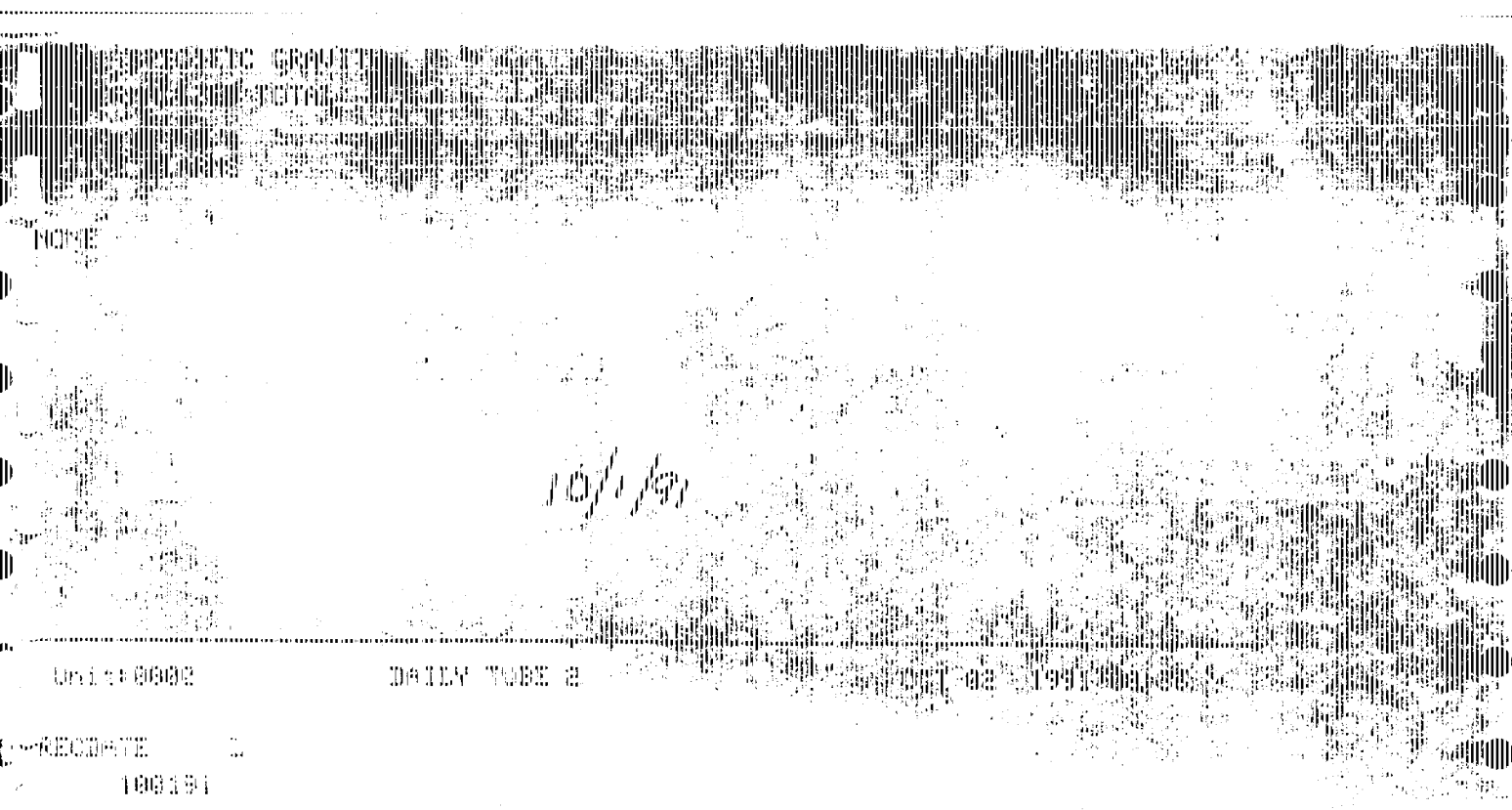
21		20	0.9708415	573.1113	165.4332	96.84593
22		21	0.9708415	573.1113	165.4332	96.84593
23		22	0.9702774	573.0686	165.4332	96.84593
24		23	0.9702782	573.0643	165.4468	96.83973

Rec No	TIME		BUCKETS	BTU	SCF	RUNTIME
1		0	66221.23	37991	56178	66
2		1	66482.91	38109	56408	66
3		2	66416.14	38055	66487	65
4		3	66438.22	38138	66465	61
5		4	66512.58	3833[illegible]	66462	55
6		5	66561.96	38211	66358	58
7		6	56695.7	35281	66736	46
8		7	66665.72	38221	65662	56
9		8	66636.55	38201	66631	54
10		9	66633.67	38193	66683	61
11		10	66525.57	3813[illegible]	66527	56
12		11	66329.45	37999	66381	59
13		12	71547.36	40757	71155	66
14		13	77525.64	44435	77523	66
15		14	77416.07	44355	77396	63
16		15	77135.74	44218	77133	59
17		16	76521.[illegible]	44114	76553	56
18		17	75662.44	44123	76556	66
19		18	77254.65	44274	77223	66
20		19	77425.83	44376	77436	63
21		20	77689.51	44548	77713	66
22		21	77624.85	44487	77634	66
23		22	77618.55	44476	77736	66
24		23	77652.84	44518	77658	63

AUTOSCALE	1
X1	0.000

Unit:00000 [illegible] 077 01 1991 00:00

Rec No	LO
1	OFF
2	ON
3	OFF
4	OFF



NONE

Unit=0000 DAILY TUBE 2 OCT-02 1991 00:00:00

RECORDS 1
100191

Rec No	TIME				
1		3	56.43577	42.29567	1.222722
2		4	56.44676	42.29587	1.215378
3		5	56.44552	42.29507	1.2077e
4		6	56.44736	42.3103	1.200866
5		7	56.4554	42.31e6e	1.16568
6		8	56.4e840	42.32631	1.16476e
7		9	56.39745	42.3846E	1.178158
8		10	56.3943	42.39035	1.174631
9		11	56.38625	42.39547	1.17668.1
10		12	56.38419	42.4e622	1.1718e
11		13	56.38262	42.4133	1.168701
12		14	56.38114	42.e2e41	1.16731e
13		15	56.36e31	42.44...	1.15e4e2
14		16	56.36867	42.45e12	1.1494111
15		17	56.35636	42.46631	1.14e31
16		18	56.e5e3e	42.4e2e3	1.1e4e2
17		19	56.5e48e	42.4e777	1.1e4e1
18		20	56.37e44	42.4e858	1.1e4e2
19		21	56.55105	42.51764	1.1e4e1
20		22	56.53e52	42.53118	1.1e4e2
21		23	56.51e65	42.53e0e	1.1e4e1
22		24	56.49e54	42.54e67	1.1e4e2
23		25	56.47e1	42.5561	1.1e4e1
24		26	56.45e71	42.5656e	1.1e4e2

Rec No	TIME				
1		2	0.9700216	572.9127	165.4452
2		3	0.9700233	572.1e4e	165.4427
3		4	0.9700384	573.1226	165.4213
4		5	0.9700356	573.1303	165.4386
5		6	0.9700319	573.213	165.4956
6		7	0.9700419	573.142	165.5672

Methods
SO_2
Rxn

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6					
9	8	0.9[illegible]	572.5938	165.5576	99.45326
10	9	0.9971879	572.4926	165.6247	102.1908
11	10	0.9931574	572.4769	165.6796	106.3254
12	11	0.973169	570.5064	164.6111	103.6191
13	12	0.9900371	554.0114	160.4177	101.7034
14	13	0.9668747	527.6735	167.1153	103.2834
15	14	0.9662603	525.2642	145.9136	110.2845
16	15	0.9704317	574.6971	166.0685	110.313
17	16	0.97067	574.5351	166.1436	109.2754
18	17	0.9707838	574.4585	166.1986	117.5211
19	18	0.9716044	574.1966	166.1493	111.3969
20	19	0.9711915	574.0336	166.0817	106.2861
21	20	0.9713304	573.8751	165.974	103.4755
22	21	0.9714387	573.5838	165.9673	121.9433
23	22	0.9715579	573.4248	165.8872	103.7851
24	23	0.9716801	573.281	165.8394	106.6556

Sec No	TIME		BTU	SCF	RUN TIME
1		0	77668.14	44508	77661	61
2		1	77670.06	44506	77658	61
3		2	77479.76	44436	77452	60
4		3	77561.39	44446	77546	59
5		4	77467.06	44401	77465	58
6		5	77442.	44389	77448	57
7		6	77456.76	44363	77507	56
8		7	77768.7	44491	77700	55
9		8	77546.22	44427	77599	54
10		9	77355.21	44358	77297	53
11		10	76865.62	44083	76857	52
12		11	76883.3	44091	76881	51
13		12	48938.71	1569	6293	7
14		13	34568.	1.36	17339	54
15		14	75861.12	43451	75150	50
16		15	76807.47	43984	76801	49
17		16	76854.44	44030	76867	48
18		17	76834.37	44019	76828	47
19		18	76851.11	44027	76811	46
20		19	76844.13	44023	76838	45
21		20	77691.	44454	77654	44
22		21	77525.59	44369	77547	43
23		22	77621.11	44431	77621	42
24		23	77673.62	44461	77675	41

SCF/SCF .. BTU/SCF ..
.. .1.036

10 of 91

Unit:00000 Daily TIES 2 CST 03 1991 07:14

RECDATE 1
100691

MLOG2

Rec No	TIME		AUG2=4	AUG2G2	AUGNE	A.G02
1		0	56.44664	42.55965	0.5562685	3.24862E-06
2		1	56.43542	42.56432	0.5567861	3.36462E-02
3		2	56.42352	42.57136	0.5700841	3.02190E-02
4		3	56.41163	42.57632	0.5773756	3.44685E-02
5		4	56.43012	42.57068	0.5685886	3.54035E-02
6		5	56.39638	42.57212	0.5655914	3.5784E-03
7		6	56.38962	42.55742	1.014266	3.84653E-05
8		7	56.36326	42.55659	1.0228609	2.75599E-02
9		8	56.3685	42.55331	1.0440269	3.7943E-02
10 Predala		9	56.35694	42.54591	1.057608	3.9544E-02
11 SO_2		10	56.3528	42.54037	1.0669665	3.9932E-02
12 R_{eff} 3		11	56.34759	42.54073	1.0721126	3.9570E-02
13		12	56.3480-	42.54619	1.06738	3.83192E-02
14		13	56.34876	42.55119	1.0619085	3.8117E-02
15		14	56.3523	42.55567	1.0228048	3.6355E-02
16		15	56.35082	42.55835	0.9703823	3.2411E-02
17		16	56.3-522	42.41003	0.917118	2.7534E-02
18 SO_2 R_{eff} 1		17	56.32537	42.42663	0.8754733	2.5764E-02
19		18	56.32846	42.43855	0.8376055	2.1678E-02
20 SO_2 R_{eff} 2		19	56.32441	42.43351	0.7923307	2.3582E-02
21 SO_2 R_{eff} 3		20	56.32535	42.44389	0.7e475e-	2.0842E-02
22		21	56.34539	-2.49491	0.7e7022	1.98552E-02
23		22	56.61-43	-2.61963	2.7473253	1.67055E-02
24		23	56.3975	-2.5816	2.7595451	1.15-2-E-02

Rec No	TIME		AUG2G2=4	AUG2_	AUGTEE	AUGTE2
1		0	0.9717139	572.1948	165.558e	133.61-6
2		1	0.9717978	571.6134	165.576-	100.115
3		2	0.9718573	572.8967	1e5.3e3	151.3139
4		3	0.9719628	572.7756	1e5.796-	94.13239
5		4	0.9722533	572.6611	165.7867	97.5366e
6		5	0.9720045	572.5621	1-5.753-	9-.23411
7		6	0.9719531	572.5557	1e5.e97e	95.61371
8		7	0.9719737	572.4885	1e5.6945	95.e3e52
9		8	0.9720173	572.3382	165.7547	93.747
10 Predala		9	0.972025	572.2203	165.8544	106.5727
11 SO_2		10	0.9720107	572.1777	165.9688	113.7536
12		11				

12			166.2815	122.8031	
13		0.9720855	572.1378	166.3718	125.3856
14	15	0.9720878	573.695	167.0623	124.9279
15	14	0.9701134	574.6781	167.6283	124.5971
16	15	0.9700682	575.1486	167.5155	123.5912
17	16	0.9700299	575.4987	167.5936	123.6063
18	17	0.9698573	575.9133	167.5315	114.3758
19	18	0.9693799	576.1778	167.4431	107.118
20	19	0.9697745	575.3725	167.3362	103.9682
21	20	0.9701346	576.169	166.4265	101.5108
22	21	0.9712512	574.8426	165.9444	103.7014
23	22	0.9714361	574.6695	165.9512	103.6456
24	23				

Rec No	TIME		AJCSPR	BTU	SCF	RUN-TIME
1		0	77879.79	44216	77144	60
2		1	77867.05	44413	77515	60
3		2	77801.67	44580	77816	60
4		3	78048.88	44717	78069	60
5		4	77838.38	44564	77823	60
6		5	77541.33	44373	77498	60
7		6	77868.99	44561	77862	60
8		7	77834.09	44547	77839	60
9		8	77455.63	44434	77638	60
10		9	76932.66	43861	76681	60
11		10	75753.45	43344	75755	60
12		11	75018.69	42957	74977	60
13		12	74486.17	42608	74424	60
14		13	73959.8	42318	73904	60
15		14	73546.79	42044	73447	60
16		15	73167.6	41866	73117	60
17		16	72852.12	41717	72841	60
18		17	72572.34	41451	72411	60
19		18	72363.44	41357	72263	60
20		19	72169.12	41299	72127	60
21		20	72027.11	41251	72077	60
22		21	71914.1	41214	72043	60
23		22	71804.7	41141	71918	60
24		23	71757.57	41116	71878	60

SAMPLE 1 SAMPLE 1

1 .230

10/3/91

U 1100060 D-TEK TUBE S OCT 04 1991 05:50

STATE 1

198891

Sec no	TIME		BLOCK			
			AUGM4	AUGC02	AUGN2	AUGO2
1		0	56.58388	42.6375	0.7654633	2.3288E-01
2		1	56.73838	42.47933	0.7607891	2.6618E-02
3		2	56.82389	42.46458	0.6986497	3.0797E-03
4		3	56.62851	42.53609	0.7152788	1.0136E-23
5		4	56.59516	42.65621	0.7853561	2.2877E-04
6		5	56.5831	42.65794	0.7238585	1.4631E-22
7		6	56.55185	42.66239	0.7580795	3.7851E-02
8		7	56.55571	42.66384	0.757788	2.6476E-38
9		8	56.61573	42.58756	0.7641456	2.2195E-36
10		9	56.63539	42.56044	0.7538229	2.6811E-23
11	50% R_{Sec} 4	10	56.69542	42.50455	0.7344255	2.6548E-31
12	62% R_{Sec} 2	11	56.71335	42.54865	0.7140644	2.4461E-32
13		12	56.73513	42.55336	0.6910582	2.3245E-01
14	50% R_{Sec} 3	13	56.73883	42.55534	0.6911841	1.9777E-02
15	62% R_{Sec} 1	14	56.58606	42.69165	0.6507166	1.5382E-02
16		15	56.68761	42.59586	0.6371671	1.5405E-03
17	76% R_{Sec} 4	16	56.68656	42.59691	0.6296429	1.8875E-01
18	76% R_{Sec} 3	17	56.64801	42.63511	0.6033679	2.0511E-02
19	76% R_{Sec} 1	18	56.66515	42.61811	0.6137481	1.2191E-02
20	100% R_{Sec} 2	19	56.59961	42.68285	0.5746457	1.2276E-02
21	100% R_{Sec} 3	20	56.55952	42.72255	0.5499465	1.0678E-02
22		21	56.54695	42.73725	0.5491335	1.0508E-01
23		22	56.53374	42.75158	0.5405215	1.0088E-01
24		23	56.49979	42.78622	0.5283756	1.9993E-23

Sec no	TIME		AUGRho	AUGDT $\sqrt{\text{sec}}$	AUGPRES	AUGTEMP
1		0	1.9715561	574.551	162.9557	184.5173
2		1	0.9720854	576.0461	165.8777	182.5013
3		2	0.9696813	576.9665	165.8875	182.9761
4		3	0.9713561	574.9664	165.8669	183.1877
5		4	0.971654	576.1574	165.9666	184.3[illegible]
6		5	0.9717151	574.2152	165.9351	184.3[illegible]
7		6	0.9718225	574.3897	165.8594	183.884
8		7	0.9713583	574.2161	165.8884	184.6691
9		8	0.9711655	574.8954	166.7634	186.5886
10		9	0.9711[illegible]	574.[illegible]	166.[illegible]	184.4783

11	50% Run 1	10	0.970667	575.0777	167.1572	113.9996
12	62% Run 2	11	0.970667	575.0777	167.1572	113.9996
13		12	0.970667	574.0240	166.8638	113.4827
14	62% Run 3	13	0.970656	575.0303	166.8656	113.5338
15	75% Run 1	14	0.971732	575.5684	166.842	122.1753
16		15	0.971254	575.5684	166.842	122.1753
17	75% Run 2	16	0.971333	575.5805	166.8115	122.2517
18	75% Run 3	17	0.971382	575.4982	166.7116	119.0016
19	100% Run 1	18	0.971875	574.9869	166.3814	116.3431
20	100% Run 2	19	0.971875	574.9869	166.3814	116.3431
21	100% Run 3	20	0.972184	575.2921	166.2854	116.1919
22		21	0.972297	574.1609	166.1307	106.8109
23		22	0.972369	573.9244	166.053	105.2714
24		23	0.972458	573.6892	166.0575	104.575

Exp No	TIME		BOOSTR	BTU	SCF	RUNTIME
1		0	76884.75	44125	76866	60
2		1	76618.38	44144	76634	60
3		2	76484.38	44063	76467	60
4	10/3/91	3	76613.58	44071	76648	60
5		4	76576.77	43996	76568	60
6		5	76699.38	44042	76650	60
7		6	76703.67	44057	76712	60
8		7	76685.48	44033	76684	60
9		8	55629.51	31918	53543	60
10		9	51532.6	29355	51029	60
11	50% Run 3	10	46287.49	26598	46197	60
12	50% Run 2	11	46265.82	26638	46268	60
13		12	46334.87	26519	46091	60
14	50% Run 3	13	56042.93	31769	55191	60
15	75% Run 1	14	60786.53	34961	60743	60
16		15	60925.86	35075	60937	60
17	75% Run 2	16	61056.1	35145	61061	60
18	75% Run 3	17	60974.79	35120	60990	60
19	100% Run 1	18	73286.66	42863	74483	60
20	100% Run 2	19	74764.91	42966	74778	60
21	100% Run 3	20	73567.57	42871	74535	60
22		21	73661.44	42798	74359	60
23		22	73613.63	42735	74191	60
24		23	73464.22	42654	74450	60

SCISCRIZ ... STOSCRIZ ...

A1306

BCM

APPENDIX C

LABORATORY PROCEDURES

ECM

APPENDIX C

LABORATORY PROCEDURES

1.0 TOTAL SULFUR IN FUEL ANALYSES

The fuel samples collected during the testing project were submitted to Atlantic Analytical Laboratory (AAL) in Whitehouse, New Jersey, for total sulfur analyses. Copies of the AAL reports can be found following this page.

A gas chromatograph (GC) equipped with a Hall detector was used to determine the total sulfur content of the samples.

Total sulfur concentrations were determined on a volume basis as hydrogen sulfide. Results of these analyses are presented in Table 4 of Section 4.0 of this report.

2.0 METAL ANALYSIS

Analysis of the metal samples was conducted in accordance with the PADER Heavy Metals Test Methodology.

A copy of the analytical procedures contained in this test method appear at the end of this Appendix. Laboratory results of the metal analyses are summarized in Table C-1 which can be found following the AAL reports. A complete copy of the metals laboratory report follows Table C-1.

3.0 SULFUR DIOXIDE ANALYSES

Samples from the SO_2 emission testing were submitted to Air Quality Services, Inc. located in Pittsburgh, Pennsylvania. Sample analyses were conducted in accordance with PADER methodology. Copies of these procedures are included in this Appendix following the metals analytical procedures.

A copy of Air Quality Services, Inc. report containing SO_2 analytical results follows the metals laboratory report.

ATLANTIC ANALYTICAL LABORATORY

Mr. Philip C. Burg
BCM Engineers
One Plymouth Meeting Mall
Plymouth Meeting, PA 19462

Report No. AAL-5444
Date Requested 10-01-91
Date Reported 10-04-91
P.O. No.

Material Submitted: One Gas Sample in a Tedlar Bag
Project 5743-19 Waste Management

Information Requested: Gas Chromatography Analysis

Notebook: CK051,p42

Sample Identification: Turbine #2 Run 1 9/30/91 1700

Results of Analysis

	Conc. ppm by volume
Total sulfur as H2S	19

Victor E. Given

dl004

A T L A N T I C
A N A L Y T I C A L
L A B O R A T O R Y

Mr. Philip C. Burg
BCM Engineers
One Plymouth Meeting Mall
Plymouth Meeting, PA 19462

Report No. AAL-5452
Date Requested 10-02-91
Date Reported 10-04-91
P.O. No.

Material Submitted: One Gas Sample in a Tedlar Bag
Project 5743-19 BCM

Information Requested: Gas Chromatography Analysis

Notebook: CE051, p42

Results are reported on the following page.

d1004

Victor H. Given

Sample Identification: Turbine #2 Outlet 10/1/91

Results of Analysis

	Conc. ppm by volume
Total sulfur as H2S	72
Total non-methane hydrocarbons as hexane *	2000

* Excludes C2 and C3 compounds, value is approximate.
The majority of constituents are heavier than C8.

ATLANTIC
ANALYTICAL
LABORATORY

Mr. Philip C. Burg
BCM Engineers
One Plymouth Meeting Mall
Plymouth Meeting, PA 19462

Report No. AAL-5466
Date Requested 10-03-91
Date Reported 10-04-91
P.O. No. 22222

Material Submitted: One Gas Sample in a Tedlar Bag
Project 5743-19 BCM

Information Requested: Gas Chromatography Analysis

Notebook: CK051,p50

Sample Identification: Turbine #2 Inlet 10/3/91

Results of Analysis

Components	Mole %
Total sulfur as H2S	43

dk004

Victor E. Given

ATLANTIC ANALYTICAL LABORATORY, INC.
P.O. BOX 220 • SALEM INDUSTRIAL PARK • BUILDING 64 • WHITEHOUSE, N.J. 08888
PHONE 908-534-6600 • FAX 908-534-2017

TABLE C-1

METALS LABORATORY RESULTS (mg)

Run No.	Metal	Impinger Catch (mg)	Filter Catch (mg)	Total Catch (mg)
1	As	<0.320	<0.037	<0.357
1	Be	<0.008	<0.001	<0.009
1	Cd	<0.008	<0.001	<0.009
1	Cr	<0.016	<0.002	<0.018
1	Hg*	0.0034	0.0002	0.0036
1	Ni	<0.064	<0.007	<0.071
1	Pb	<0.160	<0.018	<0.178
2	As	<0.308	<0.041	<0.349
2	Be	<0.008	<0.001	<0.009
2	Cd	<0.008	<0.001	<0.009
2	Cr	<0.015	<0.002	<0.017
2	Hg**	<0.0026	<0.0003	<0.0029
2	Ni	<0.062	<0.008	<0.0696
2	Pb	<0.154	<0.020	<0.174
3	As	<0.312	<0.042	<0.354
3	Be	<0.008	<0.001	<0.009
3	Cd	<0.008	<0.001	<0.009
3	Cr	<0.016	<0.002	<0.018
3	Hg**	<0.0026	<0.0003	<0.029
3	Ni	<0.062	<0.008	<0.070
3	Pb	<0.156	<0.021	<0.177
Blank	As	<0.304	<0.036	----
Blank	Be	<0.008	<0.0009	----
Blank	Cd	<0.008	<0.0009	----
Blank	Cr	<0.015	<0.002	----
Blank	Hg	0.0026	0.0003	----
Blank	Ni	<0.061	<0.008	----
Blank	Pb	<0.152	<0.019	----

* Results blank corrected.

** Blank values were higher than sample results, blank results expressed as less than values were reported as sample results.

BCM Laboratory Division
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FAL REPORT

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CLIENT

MASTE MANAGEMENT OF
ATTN: PHIL BUSS
3CM MAIL

00-5743-19

Date : 10/22/91
BCM # : 00-5743-19
P.O.# :
Order# : 43433

BCM Sample # : 132364
Location : METALS 3/W 1
Client ID : 1305

Date Sampled : 09/30/91
Date Received : 10/02/91
Sampler :

Test Description	Results	Units	Test Method
Arsenic by ICP by G. HARPEL on 10/15/91			EPA # 6010
Arsenic	< 0.320	mg	
Beryllium by G. HARPEL on 10/15/91			EPA # 200.7
Beryllium	< 0.008	mg	
Cadmium by G. HARPEL on 10/15/91			EPA # 200.7
Cadmium	< 0.008	mg	
Chromium as Cr by G. HARPEL on 10/15/91			EPA # 200.7
Chromium	< 0.015	mg	
Mercury by DIANE RYALLS on 10/16/91			EPA # 245.1
Mercury	0.006	mg	
Mercury Digestion by DIANE RYALLS on 10/16/91			EPA # 245.1
Mercury Digestion	10/16/91	M/D/Y	
Metal Digestion (No Charge) by DIANE RYALLS on 10/08/91			EPA - METALS
Metal Digestion	10/8/91	M/D/Y	
Nickel by G. HARPEL on 10/15/91			EPA # 200.7
Nickel	< 0.064	mg	
Lead by G. HARPEL on 10/15/91			EPA # 200.7
Lead	< 0.160	mg	
Completion of Accelerated TAT Analysis by L. COX on 10/21/91			
Date Quick Turn-Around Analyses Complete	10/21/91 P	M/D/Y	

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WASTE MANAGEMENT OF
ATTN: PHIL BURG
BCM MAIL

00-5743-19

Date : 10/22/91
BCM #: 00-5743-19
P.O.#:
Order#: 43433

BCM Sample #: 132385
Location : METALS RUN 2
Client Id : BMCS

Date Sampled : 10/01/91
Date Received : 10/02/91
Sampler :

Test Description	Results	Units	Test Method
Arsenic by ICP by G. HARPEL on 10/15/91			EPA # 6010
Arsenic	< 0.306	mg	
Beryllium by G. HARPEL on 10/15/91			EPA # 200.7
Beryllium	< 0.006	mg	
Cadmium by G. HARPEL on 10/15/91			EPA # 200.7
Cadmium	< 0.008	mg	
Chromium as Cr by G. HARPEL on 10/15/91			EPA # 200.7
Chromium	< 0.015	mg	
Mercury by DIANE RYALLS on 10/16/91			EPA # 245..
Mercury	0.0019	mg	
Mercury Digestion by DIANE RYALLS on 10/16/91			EPA # 245..
Mercury Digestion	10/16/91	M/D/Y	
Metal Digestion (No Charge) by DIANE RYALLS on 10/08/91			EPA - METALS
Metal Digestion	10/8/91	M/D/Y	
Nickel by G. HARPEL on 10/15/91			EPA # 200.7
Nickel	< 0.06	mg	
Lead by G. HARPEL on 10/15/91			EPA # 200.7
Lead	< 0.56	mg	

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MASTE MANAGEMENT OF
ATTN: PHIL BURG
BCM MAIL

CC-5743-19

Date : 10/22/91
BCM # : 00-5743-19
P.O.# :
Order# : 43433

BCM Sample #: 132386
Location : METALS RUN 3
Client ID : HM03

Date Sampled : 10/02/91
Date Received : 10/02/91
Sampler :

Test Description	Results	Units	Test Method
Arsenic by ICP by G. HARPEL on 10/15/91			EPA # 6010
Arsenic	< 0.312	mg	
Beryllium by G. HARPEL on 10/15/91			EPA # 200.7
Beryllium	< 0.008	mg	
Cadmium by G. HARPEL on 10/15/91			EPA # 200.7
Cadmium	< 0.006	mg	
Chromium as Cr by G. HARPEL on 10/15/91			EPA # 200.7
Chromium	< 0.016	mg	
Mercury by DIANE RYALLS on 10/16/91			EPA # 245.1
Mercury	0.003	mg	
Mercury Digestion by DIANE RYALLS on 10/16/91			EPA # 245.1
Mercury Digestion	10/16/91	M/D/Y	
Metal Digestion (No Charge) by DIANE RYALLS on 10/08/91			EPA - METALS
Metal Digestion	10/8/91	M/D/Y	
Nickel by G. HARPEL on 10/15/91			EPA # 200.7
Nickel	< 0.064	mg	
Lead by G. HARPEL on 10/15/91			EPA # 200.7
Lead	< 0.156	mg	

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MASTE MANAGEMENT OF
ATTN: PHIL BURG
BCM MAIL

00-5743-19

Date : 10/22/91
BCM # : 00-5743-19
P.O.# :
Order# : 43433

BCM Sample #: 132387
Location : METALS FIELD
Client ID : BLANK

Date Sampled : 10/02/91
Date Received : 10/02/91
Sampler :

Test Description	Results	Units	Test Method
Arsenic by ICP by G. HARPEL on 10/15/91			EPA # 6010
Arsenic	< 0.304	mg	
Beryllium by G. HARPEL on 10/15/91			EPA # 200.7
Beryllium	< 0.008	mg	
Cadmium by G. HARPEL on 10/15/91			EPA # 200.7
Cadmium	< 0.008	mg	
Chromium as Cr by G. HARPEL on 10/15/91			EPA # 200.7
Chromium	< 0.015	mg	
Mercury by DIANE RYALLS on 10/16/91			EPA # 245.1
Mercury	0.0026	mg	
Mercury Digestion by DIANE RYALLS on 10/15/91			EPA # 245.1
Mercury Digestion	10/16/91	M/D/Y	
Metal Digestion (No Charge) by DIANE RYALLS on 10/08/91			EPA - METALS
Metal Digestion	10/8/91	M/D/Y	
Nickel by G. HARPEL on 10/15/91			EPA # 200.7
Nickel	< 0.061	mg	
Lead by G. HARPEL on 10/15/91			EPA # 200.7
Lead	< 0.152	mg	

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WASTE MANAGEMENT OF
ATTN: PHIL BUEG
BCM MAIL

CO-5743-19

Date : 10/22/91
BCM # : CO-5743-19
P.O.# :
Order# : 43433

BCM Sample #: 132556
Location : FILTER RUN 1
Client ID :

Date Sampled : 10/02/91
Date Received : 10/02/91
Sampler : PB

Test Description	Results	Units	Test Method
Arsenic by ICP by G. HARPEL on 10/15/91			EPA # 6010
Arsenic	< 0.037	mg	
Beryllium by G. HARPEL on 10/15/91			EPA # 200.7
Beryllium	< 0.0009	mg	
Cadmium by G. HARPEL on 10/15/91			EPA # 200.7
Cadmium	< 0.0009	mg	
Chromium as Cr by G. HARPEL on 10/15/91			EPA # 200.7
Chromium	< 0.002	mg	
Mercury by DIANE RYALLS on 10/18/91			EPA # 7471
Mercury	0.0005	mg	
Mercury Digestion by DIANE RYALLS on 10/18/91			EPA # 245.1
Mercury Digestion	10/18/91	M/D/Y	
Metal Digestion (No Charge) by DIANE RYALLS on 10/08/91			EPA - METALS
Metal Digestion	10/8/91	M/D/Y	
Nickel by G. HARPEL on 10/15/91			EPA # 200.7
Nickel	< 0.007	mg	
Lead by G. HARPEL on 10/15/91			EPA # 200.7
Lead	< 0.018	mg	

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MASTS MANAGEMENT CF
ATTN: PHIL BURG
BCM MAIL

CO-5743-19

Date : 10/22/91
BCM # : 00-5743-19
P.O.# :
Order# : 43433

BCM Sample #: 13255
Location : FILTER RUN 2
Client ID :

Date Sampled : 10/02/91
Date Received : 10/02/91
Sampler : PB

Test Description	Results	Units	Test Method
Arsenic by ICP by G. HARPEL on 10/15/91			EPA # 6010
Arsenic	< 0.044	mg	
Beryllium by G. HARPEL on 10/15/91			EPA # 200.7
Beryllium	< 0.001	mg	
Cadmium by G. HARPEL on 10/15/91			EPA # 200.7
Cadmium	< 0.001	mg	
Chromium as Cr by G. HARPEL on 10/15/91			EPA # 200.7
Chromium	< 0.002	mg	
Mercury by DIANE RYALLS on 10/18/91			EPA # 747.
Mercury	0.0003	mg	
Mercury Digestion by DIANE RYALLS on 10/16/91			EPA # 245.1
Mercury Digestion	10/16/91	M/D/Y	
Metal Digestion (No Charge) by DIANE RYALLS on 10/08/91			EPA - METALS
Metal Digestion	10/8/91	M/D/Y	
Nickel by G. HARPEL on 10/15/91			EPA # 200.7
Nickel	< 0.008	mg	
Lead by G. HARPEL on 10/15/91			EPA # 200.7
Lead	< 0.020	mg	

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MASTE MANAGEMENT OF
ATTN: PHIL BURG
BCM MAIL

00-5743-19

Date : 10/22/91
BCM # : 00-5743-19
P.O.# :
Order# : 43433

BCM Sample #: 132568
Location : FILTER RUM 3
Client ID :

Date Sampled : 10/02/91
Date Received : 10/02/91
Sampler : PB

Test Description	Results	Units	Test Method
Arsenic by ICP by G. HARPEL on 10/15/91			EPA # 6010
Arsenic	< 0.042	mg	
Beryllium by G. HARPEL on 10/15/91			EPA # 200.7
Beryllium	< 0.00.	mg	
Cadmium by G. HARPEL on 10/15/9.			EPA # 200.7
Cadmium	< 0.001	mg	
Chromium as Cr by G. HARPEL on 10/15/9.			EPA # 200.7
Chromium	< 0.002	mg	
Mercury by DIANE RYALLS on 10/18/91			EPA # 7471
Mercury	0.0001	mg	
Mercury Digestion by DIANE RYALLS on 10/18/91			EPA # 245.1
Mercury Digestion	10/18/91	M/D/Y	
Metal Digestion (3o Charge) by DIANE RYALLS on 10/08/91			EPA - METALS
Metal Digestion	10/8/91	M/D/Y	
Nicked by G. HARPEL on 10/15/91			EPA # 200.7
Nickel	< 0.005	mg	
Lead by G. HARPEL on 10/15/91			EPA # 200.7
Lead	< 0.021	mg	

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MASTE MANAGEMENT CP
ATTN: PETE BUBG
BCM MAIL

CO-5743-19

Date : 10/22/91
BCM # : 00-5743-19
P.O.# :
Order# : 43433

BCM Sample #: 132569
Location : FILTER BLANK
Client ID :

Date Sampled : 10/02/91
Date Received : 10/02/91
Sampler : PB

Test Description	Results	Units	Test Method
Arsenic by ICP by G. HARPEL on 10/15/9.			EPA # 6010
Arsenic	< 0.056	mg	
Beryllium by G. HARPEL on 10/15/91			EPA # 200.7
Beryllium	< 0.0009	mg	
Cadmium by G. HARPEL on 10/15/9.			EPA # 200.7
Cadmium	< 0.0009	mg	
Chromium as Cr by G. HARPEL on 10/15/9.			EPA # 200.7
Chromium	< 0.00.	mg	
Mercury by DIANE RYALLS on 10/18/9.			EPA # 747.
Mercury	0.0003	mg	
Mercury Digestion by DIANE RYALLS on 10/18/91			EPA # 245.1
Mercury Digestion	10/18/91	M/D/Y	
Metal Digestion (No Charge) by DIANE RYALLS on 10/08/91			EPA - METALS
Metal Digestion	10/8/91	M/D/Y	
Nickel by G. HARPEL on 10/15/91			EPA # 200.7
Nickel	< 0.008	mg	
Lead by G. HARPEL on 10/15/91			EPA # 200.7
Lead	< 0.015	mg	

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Norristown, PA 19401
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WASTE MANAGEMENT OF
ATTN: PHIL BURG
BCM MAIL

DC-5743-19

Date : 10/22/91
BCM # : DC-5743-19
P.O.# :
Order# : 43433

BCM Sample #: 132569
Location : FILTER BLANK
Client ID :

Date Sampled : 10/02/91
Date Received : 10/02/91
Sampler : PB

Test Description	Results	Units	Test Method

End of Report

Certified by :

BCM Laboratory Director

Lab Certifications:

PA - 46-007	NJ - 77175	MA	AL - 40300	MD - 136
VA - 00023	SC - 89005	WV	DE	RI
NYDOH - 11136	AIHA - 19401			

AIR QUALITY SERVICES, INC.

4527 Clairton Boulevard
Pittsburgh, PA 15236
(412) 881-5630

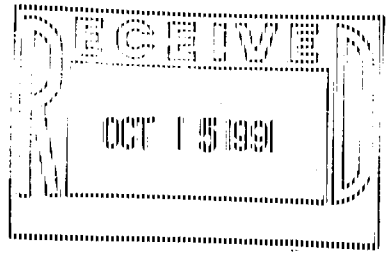

TABLE I
ANALYSIS OF SODIUM HYDROXIDE SAMPLES FOR SO2 PER DER METHOD
BCM ENGINEERS
ONE PLYMOUTH MEETING MALL
PLYMOUTH MEETING, PENNSYLVANIA 19462
PURCHASE ORDER #22241
SAMPLES RECEIVED: OCTOBER 3, 1991

BCM SAMPLE IDENTIFICATION	AQS LABORATORY NUMBER	SAMPLE VOLUME MILLILITERS	TOTAL SO2 MILLIGRAMS
RUN #1 IMPINGERS 2-3	59755	390	9.10
RUN #1 IMPINGER 4	59756	135	0.41
RUN #2 IMPINGERS 2-3	59757	435	5.13
RUN #2 IMPINGER 4	59758	165	0.27
RUN #3 IMPINGERS 2-3	59759	384	12.97
RUN #3 IMPINGER 4	59760	137	0.49
SODIUM HYDROXIDE BLANK	59761	196	ALREADY SUBTRACTED

SAMPLES WERE ANALYZED AND CALCULATED ACCORDING TO THE DER METHOD.
THE SAMPLES HAVE BEEN CORRECTED FOR THE BLANK.

AIR QUALITY SERVICES, INC.

JOB 3097

BCM

APPENDIX D

CALCULATIONS

BCM

APPENDIX D

CALCULATIONS

1.0 OXIDES OF NITROGEN EMISSION CALCULATIONS

Emission concentrations of NO_x at 15 percent oxygen and at ISO conditions were calculated in accordance with EPA Method 20 and according to New Source Performance Standards (NSPS) Subpart GG - Standards of Performance for Stationary Gas Turbines as described in the following sections. Table D-1, which appears at the end of this Appendix, contains the average measured NO_x and O_2 concentrations, all results of the NO_x emission calculations, and all ambient test condition data and turbine operating data used to calculate the results.

1.1 Oxides of Nitrogen at 15 Percent Oxygen

The NO_x pollutant concentrations were corrected to 15 percent oxygen (O_2) according to equation 20-4 of EPA Method 20. This equation appears in Method 20 as follows:

$$C_{adj} = C_d \frac{5.9}{20.9 - \%O_2}$$

Where:

C_{adj} = Pollutant concentration corrected to 15 percent O_2, ppm.
C_d = Pollutant concentration measured, dry basis, ppm.
$\%O_2$ = Measured O_2 concentration dry basis, percent.

The measured NO_x concentration (C_d) and the measured O_2 concentration ($\%O_2$) for each test run were obtained by averaging the individual measurements obtained at each traverse point. This data, as well as the NO_x concentrations corrected to 15 percent O_2, are contained in Table D-1 of this Appendix.

1.2 Oxides of Nitrogen Emission at ISO Conditions

The NO_x emission concentration at ISO standard conditions (ppmv) for each test run was calculated according to 60.334(c)(1) of NSPS Subpart GG. This paragraph lists the following equation:

$$NO_x = (NO_{xo})(P_r/P_o)^{0.5}(e)^{19(H_o - 0.00633)}(288°K/T_a)^{1.53}$$

Where:

NO_x = Emission rate of NO_x at 15 percent O_2 and ISO standard ambient conditions, ppm by volume.

NO_{xo} = Observed NO_x concentration at 15 percent O_2, ppm by volume.

P_r = Reference combustor inlet absolute pressure at 101.3 kilopascals ambient pressure, mm Hg.

P_o = Observed combustor inlet absolute pressure at test, mm Hg.

H_o = Observed humidity of ambient air, g H_2O/g air.

e = Transcendental constant, 2.718.

T_a = Ambient temperature, °K.

Table D-1, presented at the end of this Appendix, contains all ambient test condition data observed combustor inlet pressures, and the observed NO_x concentrations (ppmv at 15 percent O_2) used to calculate the NO_x concentrations at ISO conditions.

1.2.1 Combustor Inlet Pressure

The reference combustor inlet absolute pressure (P_r) at standard atmospheric pressure (101.3 kilopascals) was determined from the manufacturer to be 141.7 psi (7326 mm Hg) at 100 percent load.

The observed combustor inlet absolute pressure at test (P_o) expressed as psia was calculated as follows:

$$P_o = psig + (P_{bar}/760)(14.70)$$

Where:

P_o = observed combustor inlet absolute pressure (psia)
psig = recorded combustor inlet pressure
P_{bar} = Barometric pressure, mm Hg
760 = mm Hg/atmosphere
14.70 = psi/atmosphere

P_o expressed as mm Hg was then calculated as follows:

$$P_o = (psia/14.70)(760)$$

Where:

P_o = observed combustor inlet absolute pressure (mm Hg)
14.70 = psi/atmosphere
760 = mm Hg/atmosphere

1.2.2 Observed Humidity

The observed humidity (H_o) of the ambient air during each test run was calculated according to the following equation:

$$H_o = (\%RH/1000)(H_{sat})$$

Where:

H_o = Observed humidity, g water/g dry air
%RH = Relative humidity, percent
H_{sat} = Saturation humidity, g water/g dry air

The relative humidity was determined by wet bulb/dry bulb measurements taken during each test run. The saturation humidity was determined from a psychrometric table utilizing the ambient temperature and barometric pressure. A copy of the psychrometric table used can be found following Table D-1.

2.0 METALS AND SO_2 EMISSION CALCULATIONS

Metals and SO_2 emissions were calculated according to equations contained in EPA Methods 2, 3, 4, and 5 of 40 CFR 60, Appendix 1. These equations were programmed into a personal computer to facilitate the calculation of the test program results. The equations can be found following the psychrometric table.

Complete results of the computer analyses are presented on the computer output sheets which follow the equations. Also contained on the sheets are all input data used to calculate the results.

2.1 BCM Computation Sheets

The conversion of ppmv total sulfur content of the fuel expressed as H_2S to percent by weight sulfur was carried out by hand. This calculation is described on the BCM Computation Sheets that follow the computer output sheets.

TABLE D-1

NOx EMISSIONS CORRECTED TO 15-PERCENT O2
AND ISO STANDARD AMBIENT CONDITION

Run No.	Turbine load (%)	Combustor Inlet Pressure (psig)	Combustor Inlet Pressure (psia)	Ambient Temperature (F)	Ambient Temperature (K)	Barometric Pressure (in Hg)	Barometric Pressure (mm Hg)	Relative Humidity (%)	Saturation Humidity g H20/g air	Observed Humidity g H20/g air	NOx Observed (ppm)	O2 Emission concentration (%)	NOx Observed (ppm at 15% O2)	NOx at ISO condition (ppm)
1	100	124.7	139.37	66	292.0	29.86	758.48	74	0.01470	0.01088	19.1	16.7	26.8	28.7
2	100	124.5	139.22	67	292.4	29.96	761.02	66	0.01419	0.00937	18.8	16.9	27.7	29.0
3	100	125.0	139.72	64	290.8	29.96	761.02	69	0.01276	0.00880	19.2	16.8	27.6	28.7
1	75	118.3	133.01	76	297.4	29.94	760.51	48	0.01941	0.00932	18.3	17.8	34.8	36.2
2	75	117.8	132.49	76	297.4	29.90	759.49	42	0.01941	0.00815	18.5	17.6	33.1	33.7
3	75	118.0	132.67	73	295.8	29.86	758.48	74	0.01751	0.01296	17.2	17.8	32.7	34.8
1	50	110.8	124.79	73	295.8	30.10	764.57	76	0.01751	0.01331	14.3	18.4	33.7	39.4
2	50	110.8	124.76	71	294.7	30.05	763.30	64	0.01633	0.01045	14.8	18.8	39.3	43.6
3	50	110.8	124.74	71	294.7	30.00	762.03	52	0.01633	0.00849	15.8	18.2	32.8	35.1
1	30	104.8	118.73	62	289.7	29.98	761.52	35	0.01187	0.00415	12.4	18.9	36.6	38.0
2	30	104.8	118.75	63	290.2	30.02	762.54	42	0.01231	0.00517	9.6	18.8	27.0	28.5
3	30	104.8	118.79	76	297.4	30.10	764.57	52	0.01941	0.01009	9.7	18.6	24.9	27.8

TABLE 4—CONTINUED

SATURATION HUMIDITY OF AIR AT VARIOUS BAROMETRIC PRESSURES

Temperature Range, −10 to +79°F.; Pressure Range, 26 to 31" Hg

Temp., °F.	Saturation humidity, lb. water vapor per lb. dry air × 10³, at 26" Hg	27" Hg	28" Hg	29" Hg	30" Hg	31" Hg
−10	0.6585	0.6353	0.6154	0.5942	0.5744	0.5557
−9	.6923	.6705	.6465	.6242	.6034	.5830
−8	.7019	.7041	.6790	.6555	.6337	.6132
−7	.7676	.7356	.7128	.6882	.6653	.6438
−6	.8059	.7760	.7464	.7225	.6984	.6758
−5	0.8458	0.8144	0.7863	0.7582	0.7329	0.7092
−4	.8876	.8540	.8249	.7956	.7690	.7442
−3	.9309	.8964	.8650	.8345	.8066	.7806
−2	.9763	.9401	.9084	.8751	.8459	.8183
−1	1.0238	.9858	.9504	.9176	.8869	.8582
0	1.078	1.033	0.9969	0.9618	0.9297	0.8997
1	1.125	1.083	1.0441	1.0080	0.9744	0.9430
2	1.179	1.133	1.0940	1.0562	1.0209	0.9880
3	1.234	1.189	1.1460	1.1064	1.0696	1.0350
4	1.293	1.245	1.2002	1.1587	1.1201	1.0839
5	1.354	1.303	1.257	1.213	1.172	1.135
6	1.417	1.365	1.316	1.270	1.228	1.188
7	1.483	1.428	1.377	1.330	1.285	1.244
8	1.552	1.495	1.441	1.391	1.345	1.301
9	1.623	1.540	1.505	1.454	1.366	1.361
10	1.699	1.635	1.577	1.522	1.471	1.424
11	1.776	1.710	1.649	1.592	1.537	1.488
12	1.857	1.790	1.724	1.665	1.606	1.557
13	1.941	1.868	1.802	1.740	1.681	1.627
14	2.029	1.953	1.883	1.816	1.759	1.701
15	2.120	2.041	1.966	1.899	1.837	1.777
16	2.215	2.133	2.056	1.985	1.919	1.857
17	2.315	2.227	2.143	2.073	2.004	1.939
18	2.418	2.326	2.245	2.165	2.092	2.025
19	2.523	2.429	2.349	2.261	2.185	2.114
20	2.633	2.535	2.444	2.360	2.281	2.207
21	2.748	2.646	2.551	2.463	2.381	2.304
22	2.867	2.761	2.663	2.570	2.484	2.405
23	2.992	2.880	2.777	2.681	2.591	2.507
24	3.121	3.004	2.897	2.795	2.703	2.615
25	3.254	3.133	3.021	2.916	2.819	2.727
26	3.393	3.267	3.150	3.041	2.939	2.844
27	3.538	3.406	3.284	3.170	3.064	2.964
28	3.687	3.550	3.422	3.304	3.193	3.090
29	3.843	3.700	3.567	3.443	3.328	3.220
30	4.004	3.855	3.716	3.587	3.467	3.355
31	4.171	4.016	3.871	3.737	3.612	3.496
32	4.363	4.190	4.042	3.898	3.777	3.642
33	4.542	4.372	4.215	4.069	3.933	3.794
34	4.730	4.556	4.390	4.237	4.086	3.952

Temp., °F.	Saturation humidity, lb. water vapor per lb. dry air, at 26" Hg	27" Hg	28" Hg	29" Hg	30" Hg	31" Hg
35	0.004924	0.004740	0.004570	0.004411	0.004263	0.004125
36	.005125	.004924	.004750	.004591	.004437	.004294
37	.005333	.005124	.004940	.004777	.004617	.004467
38	.005559	.005340	.005150	.004971	.004804	.004649
39	.005773	.005558	.005358	.005171	.004998	.004836
40	0.006006	0.005781	0.005572	0.005379	0.005199	0.005030
41	.006245	.006012	.005795	.005594	.005406	.005232
42	.006494	.006251	.006026	.005816	.005622	.005440
43	.006752	.006499	.006266	.006047	.005843	.005655
44	.007019	.006758	.006512	.006285	.006074	.005878
45	0.007294	0.007021	0.006768	0.006532	0.006312	0.006108
46	.007580	.007298	.007033	.006787	.006558	.006346
47	.007878	.007581	.007307	.007052	.006814	.006594
48	.008186	.007878	.007590	.007325	.007079	.006849
49	.008505	.008179	.007884	.007606	.007352	.007113
50	0.008836	0.008496	0.008187	0.007901	0.007635	0.007388
51	.009168	.008820	.008501	.008204	.007927	.007670
52	.009518	.009159	.008826	.008517	.008230	.007961
53	.009877	.009506	.009161	.008841	.008542	.008263
54	.01025	.009866	.009509	.009176	.008866	.008576
55	0.01064	0.01024	0.009868	0.009522	0.009200	0.008900
56	.01104	.01062	.01023	.009880	.009546	.009234
57	.01145	.01102	.01062	.01025	.009902	.009579
58	.01188	.01143	.01101	.01063	.01027	.009936
59	.01233	.01186	.01142	.01102	.01065	.01030
60	0.01278	0.01230	0.01185	.01143	0.01105	0.01069
61	.01325	.01275	.01229	.01185	.01145	.01108
62	.01374	.01322	.01274	.01229	.01187	.01149
63	.01425	.01371	.01321	.01274	.01231	.01191
64	.01477	.01421	.01369	.01321	.01276	.01234
65	0.01530	0.01472	0.01419	0.01369	0.01322	0.01279
66	.01586	.01526	.01470	.01419	.01370	.01325
67	.01643	.01581	.01523	.01470	.01419	.01373
68	.01703	.01639	.01578	.01522	.01470	.01422
69	.01764	.01697	.01634	.01577	.01523	.01473
70	0.01827	0.01757	0.01693	.01633	0.01577	0.01526
71	.01892	.01820	.01753	.01691	.01633	.01579
72	.01960	.01885	.01815	.01751	.01691	.01635
73	.02030	.01951	.01879	.01813	.01751	.01692
74	.02105	.02020	.01946	.01877	.01812	.01752
75	0.02174	0.02091	0.02014	0.01942	0.01876	0.01815
76	.02251	.02164	.02085	.02010	.01941	.01877
77	.02330	.02240	.02157	.02080	.02009	.01943
78	.02411	.02318	.02233	.02153	.02079	.02012
79	.02495	.02399	.02310	.02227	.02151	.02079

EQUATIONS FOR PARTICULATE, MOISTURE, AND FLOW CALCULATIONS
(BASED ON STANDARD CONDITIONS OF 68°F AND 29.92"Hg)

1. $V_{w(std)} = 0.0473\ W_{wc}$

2. $V_{m(std)} = 17.64\ V_m \dfrac{P_{bar} + .07355\ \Delta H}{T_m + 460}\ Y$

3. $B_{ws} = \dfrac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$

4. $M_d = 0.44(\%CO_2) + 0.28(\%CO) + 0.32(\%O_2) + 0.28(\%N_2)$

5. $M_s = M_d\ (1 - B_{ws}) + 18\ B_{ws}$

6. $EA = \dfrac{(\%O_2) - 0.5(\%CO)}{0.264(\%N_2) - (\%O_2) + 0.5(\%CO)}\ 100$

7. $V_s = (85.49)(60)(C_p)\sqrt{\Delta P}\sqrt{\dfrac{T_s + 460}{(P_s)(M_s)}}$

8. $Q_m = \dfrac{(V_s)(A_n)}{144}$

9. $Q_{m(std)} = Q_m(1 - B_{ws})\ 17.64\ \dfrac{P_s}{T_s + 460}$

10. $C'_s = 0.0154\ \dfrac{W_t}{V_{m(std)}}$

11. $C'_w = 0.01554\ \dfrac{W_t}{V_{m(std)} + V_{w(std)}}$

12. $C'_c = \dfrac{1.2\ C'_s}{\%CO_2}$

13. $C'_a = W_w\ \dfrac{(T_s + 460)(29.92)}{(528)(P_s)}$

14. $E = 0.00857\ Q_{s(std)}\ C'_s$

15. $A_n = \dfrac{(\pi)(D_n)^2}{(144)(4)}$

16. $I = \dfrac{(60)(1.667)(T_s + 460)(0.00267\ W_{wc} + V_{m(std)}/17.64)}{(\theta)(V_s)(P_s)(D_n)}$

LEGEND

A_n = Area of nozzle, ft^2

A_s = Area of stack, in^2

B_{wo} = Moisture content of gas stream, dimensionless

C_p = Pitot correction factor, dimensionless

C'_a = Particulate concentration (stack conditions), gr/ft^3

C'_c = Particulate concentration at 12% CO_2 (dry), gr/dscf

C'_s = Particulate concentration (dry), gr/dscf

C'_w = Particulate concentration (wet), gr/scf

D_n = Diameter of nozzle, in.

E = Particulate emission rate, lb/hr

EA = Excess air, percent

ΔH = Orifice pressure drop, in. H_2O

I = Isokinetic ratio, percent

M_d = Dry molecular weight of stack gas, lb/lb-mole

M_s = Molecular weight of stack gas, lb/lb-mole

P_{bar} = Barometric pressure, in. Hg

P_s = Stack pressure (absolute), in. Hg

$\sqrt{\Delta P}$ = Average of square roots of pitot pressure differential, in. H_2O

Q_s = Stack gas flow, acfm

$Q_{s(std)}$ = Stack gas flow, scfm

T_m = Average dry gas meter temperature, ^oF

T_s = Average stack temperature, ^oF

V_m = Dry sample volume (meter conditions), ft^3

$V_{m(std)}$ = Dry sample volume (standard conditions), ft^3

V_s = Stack velocity, ft/min

V_{wc} = Volume of liquid collected in impingers and silica gel, ml

$V_{w(std)}$ = Volume of liquid collected, ft^3

W_t = Total weight of particulates collected, mg

θ = Duration of test, min.

Metal Emission Determination
Results Summary

BCM Project #	5743-18
Plant	Waste Management
Location	Turbine No. 2
Test Date	6/30/04
Run Number	One
Operator	PCB/KB

OPSAT:

Barometric Pressure:	30.42	" Hg			Duct Diameter	48.0	inches
			CO2:	3.8 %	Duct Width	0.0	inches
Static Pressure:	-0.05	" H2O			Duct Length	0.0	inches
			O2:	16.1 %	Duct Area:	12.57	sq.ft.
Stack Pressure:	30.36	" Hg					
			CO:	0.0 %	Pitot Factor	0.84	
Water Pickup					Meter Box #	430	
silica gel:	19.4	grams	N2:	80.1 %	Meter Box Factor	0.995	
impingers:	46	ml			Nozzle Dia. Diam.	0.160	inches
					Nozzle Area	1.39E-04	sq.ft.
Start Time	1638				Isokinetic Ratio	106.43	
Duration	100	(min)					

Average Stack Temp	736	°F
Average Gas Meter Temperature	105	°F
Avg Square Root of Velocity Pressure	1.513	inches water
Orifice Pressure Drop	1.513	inches water
Sample Volume	71.548	DACF
Sample Volume, corrected to standard conditions (dry)	67.863	DSCF
Molecular Weight of Stack Gas (dry)	28.25	lb/lb-mole
Molecular Weight of Stack Gas (wet)	28.77	lb/lb-mole
Stack Gas Velocity	7628	ft/min
Stack Gas Flow Rate	66883	ACFM
Stack Gas Flow Rate, standard conditions (dry)	41086	DSCFM
Stack Gas Flow Rate, standard conditions (wet)	42883	SCFM
Volume of Moisture Collected	3.033	SCF
Moisture Content Calculated:	4.28 %	4.28 %
Moisture Content Saturated:	NA %	
Mass of As Collected	0.367	mg
Emission Concentration of As	8.19E-05	gr/dscf
Mass Emission Rate of As	2.85E-02	lb/hr
Mass of Be collected	0.000	mg
Emission Concentration of Be	2.04E-05	gr/dscf
Mass Emission Rate of Be	7.10E-06	lb/hr
Mass of Cd collected	0.000	mg
Emission Concentration of Cd	2.04E-05	gr/dscf
Mass Emission Rate of Cd	7.10E-06	lb/hr

Metal Emission Concentration
Results Summary

EPCM Project #	5749-16
Plant	Waste Management
Location	Tulsa No. 2
Test Date	9/30/91
Run Number	One
Operator	PCB/DB

Mass of Cr collected	0.018 mg
Emission Concentration of Cr	4.00E-05 gr/dscf
Mass Emission Rate of Cr	1.44E-03 lb/hr
Mass of Hg collected	0.0030 mg
Emission Concentration of Hg	6.77E-07 gr/dscf
Mass Emission Rate of Hg	2.38E-04 lb/hr
Mass of Ni collected	0.071 mg
Emission Concentration of Ni	1.61E-05 gr/dscf
Mass Emission Rate of Ni	5.67E-03 lb/hr
Mass of Pb collected	0.178 mg
Emission Concentration of Pb	4.06E-05 gr/dscf
Mass Emission Rate of Pb	1.42E-02 lb/hr

Metal Emission Determination
Fluoride Summary

BCM Project #	5743-98
Plant	Waste Management
Location	Turbine No. 2
Test Date	10/1/01
Run Number	Two
Operator	PCB/DB

Barometric Pressure:	30.12 " Hg	CO2:	3.7 %	Duct Diameter	48.0 inches
Static Pressure:	-0.85 " H2O			Duct Width	0.0 inches
		O2:	16.1 %	Duct Length	0.0 inches
Stack Pressure:	30.06 " Hg			Duct Area	12.57 sq.ft.
		CO:	0.0 %	Pitot Factor	0.84
Water Pickup				Meter Box #	420
silica gel:	17 grams	N2:	80.2 %	Meter Box Factor	0.995
Impinger:	85 ml			Nozzle In. Diam.	0.190 inches
				Nozzle Area	1.97E-04 sq.ft.
Start Time	10:40			Isokinetic Ratio	100.37
Duration	100 (min)				

Average Stack Temp	731	°F
Average Gas Meter Temperature	88	°F
Avg Square Root of Velocity Pressure	1.464	inches water
Orifice Pressure Drop	1.408	inches water
Sample Volume	87.748	DNCF
Sample Volume, corrected to standard conditions (dry)	84.407	DSCF
Molecular Weight of Stack Gas (dry)	28.24	lb/lb-mole
Molecular Weight of Stack Gas (wet)	26.90	lb/lb-mole
Stack Gas Velocity	7323	ft/min
Stack Gas Flow Rate	83027	ACFM
Stack Gas Flow Rate, standard conditions (dry)	30652	DSCFM
Stack Gas Flow Rate, standard conditions (wet)	40650	SCFM
Volume of Moisture Collected	3.651	SCF
Moisture Content	5.88 % (Calculated)	5.68 %
	MA % (Saturated)	
Mass of As Collected	0.340	mg
Emission Concentration of As	6.34E-05	gr/cfscf
Mass Emission Rate of As	2.78E-02	lb/hr
Mass of Be collected	0.005	mg
Emission Concentration of Be	2.78E-05	gr/cfscf
Mass Emission Rate of Be	7.13E-04	lb/hr

Metal Emission Concentration
Results Summary

BCM Project #	5743-19
Plant	Waste Management
Location	Turbine No. 3
Test Code	10/1/91
Run Number	Two
Operator	PCS/DB

Mass of Cd collected	0.000 mg
Emission Concentration of Cd	2.19E-08 gr/dscf
Mass Emission Rate of Cd	7.13E-04 lb/hr
Mass of Cr collected	0.017 mg
Emission Concentration of Cr	4.30E-06 gr/dscf
Mass Emission Rate of Cr	1.36E-03 lb/hr
Mass of Hg collected	0.0029 mg
Emission Concentration of Hg	6.83E-07 gr/dscf
Mass Emission Rate of Hg	2.30E-04 lb/hr
Mass of Ni collected	0.0690 mg
Emission Concentration of Ni	1.69E-05 gr/dscf
Mass Emission Rate of Ni	5.51E-03 lb/hr
Mass of Pb collected	0.174 mg
Emission Concentration of Pb	4.10E-05 gr/dscf
Mass Emission Rate of Pb	1.38E-02 lb/hr

Metals Emission Determination

Results Summary

BCM Project #	5703-10
Plant	Waste Management
Location	Turbine No. 2
Test Date	10/2/01
Run Number	Three
Operator	PCB/DB

ORSAT:

CO2:	3.6	%
O2:	16.3	%
CO:	0.0	%
N2:	80.1	%

Barometric Pressure:	30.28	" Hg
Static Pressure:	-0.83	" H2O
Stack Pressure:	30.22	" Hg
Water Pickup		
silica gel:	16.5	grams
impinger:	63	ml
Start Time	08:22	
Duration	100	(min)

Duct Diameter	48.0	inches
Duct Width	0.0	inches
Duct Length	0.0	inches
Duct Area	12.57	sq.ft.
Pitot Factor	0.84	
Meter Box #	420	
Meter Box Factor	0.995	
Nozzle in. Diam.	0.190	inches
Nozzle Area	1.827E-04	sq.ft.
Isokinetic Ratio	100.40	

Average Stack Temp	741	°F
Average Gas Meter Temperature	83	°F
Avg Square Root of Velocity Pressure	1.419	inches water
Orifice Pressure Drop	1.356	inches water
Sample Volume	88.748	DNCF
Sample Volume, corrected to standard conditions (dry)	84.351	DSCF
Molecular Weight of Stack Gas (dry)	28.23	lb/lb-mole
Molecular Weight of Stack Gas (wet)	28.01	lb/lb-mole
Stack Gas Velocity	7191	ft/min
Stack Gas Flow Rate	90362	ACFM
Stack Gas Flow Rate, standard conditions (dry)	37609	DSCFM
Stack Gas Flow Rate, standard conditions (wet)	40107	SCFM
Volume of Moisture Collected	3.743	SCF
Moisture Content: Calculated:	9.90	%
Saturated:	NA	%
	9.90	%
Mass of As Collected	0.364	mg
Emission Concentration of As	6.67E-05	gr/dscf
Mass Emission Rate of As	3.75E-02	lb/hr
Mass of Be collected	0.006	mg
Emission Concentration of Be	1.15E-06	gr/dscf
Mass Emission Rate of Be	7.00E-04	lb/hr

Metals Emission Concentration
Results Summary

BCM Project #	9749-19
Plant:	Waste Management
Location	Turbine No. 2
Test Date	10/22/01
Run Number	Three
Operator	PCB/WB

Mass of Cd collected	0.006 mg
Emission Concentration of Cd	2.76E-08 gr/dscf
Mass Emission Rate of Cd	7.00E-04 lb/hr
Mass of Cr collected	0.011 mg
Emission Concentration of Cr	4.31E-08 gr/dscf
Mass Emission Rate of Cr	1.09E-03 lb/hr
Mass of Hg collected	0.0026 mg
Emission Concentration of Hg	6.04E-07 gr/dscf
Mass Emission Rate of Hg	2.28E-04 lb/hr
Mass of Ni collected	0.070 mg
Emission Concentration of Ni	1.07E-06 gr/dscf
Mass Emission Rate of Ni	5.44E-03 lb/hr
Mass of Pb collected	0.177 mg
Emission Concentration of Pb	4.24E-06 gr/dscf
Mass Emission Rate of Pb	1.38E-02 lb/hr

Sulfur Dioxide Emission Determination
Results Summary

BCM Project #	5703-01
Plant	Waste Management
Location	Turbine No. 3
Test Date	6/30/01
Run Number	One
Operator	PCB/DB

CONSTANTS

Barometric Pressure:	30.02	" Hg		Duct Diameter	48.0	inches
			CO2: 3.8 %	Duct Width	0.0	inches
Static Pressure:	-0.08	" H2O		Duct Length	0.0	inches
			O2: 16.1 %	Duct Area	12.57	sq.ft.
Stack Pressure:	30.30	" Hg				
			CO: 0.0 %	Pitot Factor	0.84	
Water Pickup				Meter Box #	A2	
silica gel:	18.4	grams	N2: 80.1 %	Meter Box Factor	1.020	
impinger:	40	ml		Nozzle in. Diam.	0.190	inches
				Nozzle Area	1.97E-04	sq.ft.
Start Time	18:30					
Duration	100	(min)				

Average Stack Temp		736	°F
Average Gas Meter Temperature		107	°F
Avg Square Root of Velocity Pressure		1.593	inches water
Orifice Pressure Drop		1.80	inches water
Sample Volume		24.713	DCF
Sample Volume, corrected to standard conditions (dry)		22.454	DSCF
Molecular Weight of Stack Gas (dry)		30.28	lb/lb-mole
Molecular Weight of Stack Gas (wet)		28.77	lb/lb-mole
Stack Gas Velocity		7526	ft/min
Stack Gas Flow Rate		65984	ACFM
Stack Gas Flow Rate, standard conditions (dry)		41088	DSCFM
Stack Gas Flow Rate, standard conditions (wet)		43523	SCFM
Volume of Moisture Collected		3.033	SCF
Moisture Content	Calculated: 6.28 %	6.28	%
	Saturated: N/A %		
Mass of SO2 Collected		0.51	mg
Emission Concentration of SO2		1.34	ppmv
Mass Emission Rate of SO2		0.7117	lb/hr

Sulfur Dioxide Emission Concentration
Results Summary

BCM Project #	5743-96
Plant:	Waste Management
Location	Yorktown No. 2
Test Date	10/1/91
Run Number	Two
Operator	PCB/RB

CONSTANTS:

Barometric Pressure:	30.12 " Hg	CO2:	3.0 %
Static Pressure:	-0.85 " H2O	O2:	18.1 %
Stack Pressure:	30.08 " Hg	CO:	0.0 %
Water Pickup			
silica gel:	17 grams	N2:	80.1 %
Impinger:	85 ml		
Start Time	1040		
Duration	100 (min)		

Duct Diameter	48.0	inches
Duct Width	0.0	inches
Duct Length	0.0	inches
Duct Area	12.57	sq.ft.
Pitot Factor	0.84	
Meter Box dH	.02	
Meter Box Factor	1.030	
Nozzle In. Diam.	0.160	inches
Nozzle Area	1.67E-04	sq.ft.

Average Stack Temp	731	°F
Average Gas Meter Temperature	88	°F
Avg Square Root of Velocity Pressure	1.444	inches water
Orifice Pressure Drop	1.800	inches water
Sample Volume	71.802	DACF
Sample Volume, corrected to standard conditions (dry)	70.157	DSCF
Molecular Weight of Stack Gas (dry)	28.25	lb/lb-mole
Molecular Weight of Stack Gas (wet)	28.62	lb/lb-mole
Stack Gas Velocity	7323	ft/min
Stack Gas Flow Rate	92027	ACFM
Stack Gas Flow Rate, standard conditions (dry)	38652	DSCFM
Stack Gas Flow Rate, standard conditions (wet)	40680	SCFM
Volume of Moisture Collected	3.081	SCF
Moisture Content	Calculated: 5.66 %	5.66 %
	Saturated: 5.4 %	
Mass of SO2 collected	5.40	mg
Emission Concentration of SO2	1.02	ppmv
Mass Emission Rate of SO2	0.3628	lb/hr

Sulfur Dioxide Emission Determination
Results Summary

EC&M Project #	6703-10
Plant	Waste Management
Location	Turbine No. 2
Test Date	10/2/01
Run Number	Three
Operator	PCB/RB

Barometric Pressure:	30.28	" Hg			Duct Diameter	43.0	inches
			CO2:	3.6 %	Duct Width	0.0	inches
Static Pressure:	-0.83	" H2O			Duct Length	0.0	inches
			O2:	16.3 %	Duct Area	12.57	sq.ft.
Stack Pressure:	30.22	" Hg					
			CO:	0.0 %	Pitot Factor	0.84	
Water Pickup					Meter Box #	A2	
silica gel:	16.5	grams	N2:	80.1 %	Meter Box Factor	1.020	
impinger:	83	ml			Nozzle In. Diam.	0.190	inches
					Nozzle Area	1.83E-04	sq.ft.
Start Time	08:22						
Duration	100	(min)					

Average Stack Temp		701	°F
Average Gas Meter Temperature		86	°F
Avg Square Root of Velocity Pressure		1.410	inches water
Orifice Pressure Drop		1.900	inches water
Sample Volume		75.123	DNCF
Sample Volume, corrected to standard conditions (dry)		74.088	DSCF
Molecular Weight of Stack Gas (dry)		29.23	lb/lb-mole
Molecular Weight of Stack Gas (wet)		28.01	lb/lb-mole
Stack Gas Velocity		71.01	ft/min
Stack Gas Flow Rate		60382	ACFM
Stack Gas Flow Rate, standard conditions (dry)		37503	DSCFM
Stack Gas Flow Rate, standard conditions (wet)		40107	SCFM
Volume of Moisture Collected		3.743	SCF
Moisture Content	Calculated: 5.05 %	5.50	%
	Saturated: NA %		
Mass of SO2 collected		13.40	mg
Emission Concentration of SO2		2.40	ppmv
Mass Emission Rate of SO2		0.6088	lb/hr

BCM

COMPUTATION SHEET

Sheet Number 1 of 2

Name of Client Waste Management

Project Hatchet Ridge

Description Molecular Weight of Landfill Gas

Date

Job Number

Computed by Checked by

$$MW_{\text{of Landfill Gas}} = (\text{Vol fraction } CH_4)(mw\ CH_4) + (\text{Vol fraction } CO_2)(mw\ CO_2) + (\text{Vol fraction } N_2)(mw\ N_2)$$

where: mw = molecular weight

Vol fraction CH_4 = 0.565

mw CH_4 = 16.04 lb/mole

Vol fraction CO_2 = 0.423

mw CO_2 = 44.01 lb/mole

Vol fraction N_2 = 0.012

mw CO_2 = 44.01 lb/mole

MW Landfill Gas = 28.85 lb/mole

BM COMPUTATION SHEET

Sheet Number 2 of 2
Date
Job Number
Computed by Checked by

Name of Client Waste Management
Project Chiquita Bay
Description Bay Lake S content of fuel

$$\text{Sulfur content} = \frac{(\text{ppmv } H_2S)(\text{mol. wt. of } S)}{(10^6)(\text{mol. wt. of Landfill gas})} \times 100$$

where: 1) ppmv H_2S, Run 1 =
2) ppmv H_2S, Run 2 =
3) ppmv H_2S, Run 3 =
4) mol. wt. of S = 32.06
5) Mol. wt. of Landfill gas = 27.85 lb/mole

Run 1:

$$\frac{(89 \text{ ppmv } H_2S)(32.06 \text{ lb/mole})}{(10^6)(27.85 \text{ lb/mole})} \times 100 = 0.0012 \text{ \% by wt.}$$

Run 2

$$\frac{(72 \text{ ppmv } H_2S)(32.06 \text{ lb/mole})}{(10^6)(27.85 \text{ lb/mole})} \times 100 = 0.0083 \text{ \% by wt}$$

Run 3

$$\frac{(93 \text{ ppmv } H_2S)(32.06 \text{ lb/mole})}{(10^6)(27.85 \text{ lb/mole})} \times 100 = 0.0050 \text{ \% by wt}$$

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APPENDIX E

EQUIPMENT CALIBRATION

1.0 DRY GAS METER AND ORIFICE METER

The dry gas meter and orifice were calibrated using a wet test meter. Gases were moved through the dry gas meter at orifice pressure differentials (ΔH's) of 0.5, 1.0, and 2.0 inches of water. With the information obtained, Y, the ratio of accuracy of wet test meter to dry test meter; and $\Delta H_@$, the orifice pressure differential that gives 0.75 cfm of air at 68°F and 29.92 inches of mercury, were calculated. The Y has a tolerance of 1.00 ±0.01 and the $\Delta H_@$ has a tolerance of 1.84 +0.26 -0.24. The Y and $\Delta H_@$ are determined as follows:

$$Y = \frac{V_w P_b (t_d + 460)}{V_d [P_b + .0735 (\Delta H)] (t_w + 460)}$$

$$\Delta H_@ = \frac{0.0317 (\Delta H)}{P_b (t_d + 460)} \left(\frac{(T_w + 460)\ \theta}{V_w} \right)^2$$

Where:

ΔH = Orifice pressure differential, in H_2O

P_b = Barometric pressure, in Hg

t_d = Average temperature of dry gas meter, °F

t_w = Average temperature of wet test meter, °F

θ = Duration of test, min.

V_d = Dry gas meter volume, ft^3

V_w = Wet test meter volume, ft^3

2.0 POTENTIOMETER CALIBRATION

The Therm - Electron potentiometers were calibrated by using a known voltage source as an input to the potentiometer.

3.0 PROBE CALIBRATION

The probes were calibrated by measuring the outlet temperatures at various variable transformer settings while passing air through at approximately 0.75 cubic feet per minute.

BOM METER BOX CALIBRATION SHEET

Date 6-4-91 Serial No. A2 Tested by J.S.

Type New ☑ Widget Rep Serial No. _____

Remarks _____ Leaks OK ☑ OK Wiring OK

Orifice Gaskets _____ Vacuum Cap ✓ Valves ✓

Dry Gas Meter _____ Volume 956.7 ft³ Serial No. _____

Barometer 29.32 in. Hg at 72 °F Ambient 72 °F

Impeller ✓ Vanes ✓ Switches ✓ Varies ✓

Leak Check - Max. Vacuum 25 in. Hg Leak Rate 0 cfm

Remarks 29.28 Begin, Disconnected for calibration

Pump Type BOM Meter Box No. _____

Min. Orifice	Q_s	ΔH	T_d	V_d	θT_d	T_d	Time
							0
0.5	0.500	1.067	75	104.2	63.4	73.8	10 min
1.0	0.999	1.065	75	104.4	69.8	72.6	4.53
2.0	1.999	1.028	75	101.3	64.4	70.4	5 min

Tolerances: $1.66 \le \Delta H_@ \le 2.1$ $0.98 \le Y \le 1.01$

$$\Delta H_@ = \frac{(0.0317)(\Delta W)[(T_w+460)(\theta)]^2}{(P_b)(\theta T_d+460)\left[\left(\frac{\theta}{60}\right)(Q_s)\right]^2}$$

$$Y = \frac{(Q_s)(P_b)(T_d+460)}{(Q_d)(P_b+\Delta W/13.6)(T_w+460)}$$

1.99	$\frac{(0.0317)(0.5)}{(20.29)(0.5)}\left[\frac{(75+460)(5.22)}{(5)}\right]^2$	1.020	$\frac{(5)(20.29)(70.0+460)}{(5.067)(29.37+0.0358)(75+460)}$ 29.3265 561.8
2.00	$\frac{(0.0317)(1.0)}{(29.29)(20.8+460)}\left[\frac{(75+460)(9.53)}{(5)}\right]^2$ 536	1.023	$\frac{(5)(29.29)(72.6+460)}{(5.035)(29.14+0.0737)(75+460)}$ 29.3631 533
1.96	$\frac{(0.0317)(2.0)}{(28.29)(20.4+460)}\left[\frac{(75+460)(13.35)}{(10)}\right]^2$ 535	1.016	$\frac{(10)(29.29)(101.4+460)}{(10.28)(29.29+0.347)(75+460)}$ 29.433 561.4

$\bar{Y} = 1.02$ Avg $\pm .02$ (ea) $1.00 \le Y \le 1.04$

BOM METER BOX CALIBRATION SHEET

Date 6-10-91 Box no. 420 Inspector Joel S.
Pump Kay-Ray
Rebuilt pump, oil, new wick, ok pump serial no. 8484444
Manometers ok Probe ok oil ok Tubing ok
Replace
Quick Connects/Gauges Vacuum Gage ok Valves ok
Dry Gas Meter ok Volume 975 ft³ Serial No. — —
Thermometers ✓ In 74 °F Out 74 °F Ambient 75 °F
All Five
Manifold ✓ Lights Switches ok Varian —
Leak Check - Max. Vacuum 28 in. Hg Leak Rate .005 cfm
Remarks Re-plumbed sample line with Replaced old
thermal Ohms, cleaned and brass Re-silicone-ized
pump, re-assembled all gas pipe joints.
Barom. 29.64

Man. Orifice	$\Delta H_@$	ΔP_d	T_w	T_{d_1}	T_{d_2}	T_d	Time θ
0.5	1.500	1.77	74	100	84	92	10:00 / 10:15
1.0	3.—	5.01	74	97.8	78.5	88.2	10:30 / 10:45
2.0	10.—	16.64	75	120.8	94.2	107.5	11:00 / 11:15

Tolerances: $1.68 \leq \Delta H_@ \leq 2.1$ $\quad 0.99 \leq Y \leq 1.01$

$$\Delta H_@ = \frac{(0.0317)(\Delta H)\left[(T_w+460)(\theta)\right]^2}{(P_b)(T_d+460)\left[(CF_w)\right]}$$

$$Y = \frac{(CF_w)(P_b)(T_d+460)}{(CF_d)(P_b+\Delta H/13.6)(T_w+460)}$$

$\Delta H_@$		Y
1.68	$\frac{(0.0317)(0.5)}{(29.64)(84+460)}\left[\frac{(74+460)(10.15)}{(5)}\right]^2$	.998
1.77	$\frac{(0.0317)(1.0)}{(29.64)(98.5+460)}\left[\frac{(74+460)(9.85)}{(5)}\right]^2$	1.00
1.85	$\frac{(0.0317)(2.0)}{(29.64)(94.2+460)}\left[\frac{(75+460)(10.93)}{(10)}\right]^2$	.987

1.77 AVE

.995 Avg ± 2% (.01m) .993 ≤ Y ≤ 1.015

Scott Specialty Gases, Inc.

E. P. A. PROTOCOL CERTIFICATE OF ANALYSIS

Shipped from:
Scott Specialty Gases
Route 611
Plumsteadville, PA 18949
Purchase order #
21976
0

Shipped to:
BCM
ATTN: NICK CHARGO
1850 GRAVERS ROAD
NORRISTOWN, PA 19401

Project no. 31549

Certified per E.P.A. Protocol # 1 Procedure #G1 Section # 3.0.4
Certified accuracy +/- 1 % NIST Traceable

Cylinder number	BAL-1596	Cylinder pressure 2030 psig.		Date of assay:	9-25-91
Component		Certified concentration		Expiration date:	9-25-93
NITRIC OXIDE		346.8	ppm		
OXIDES OF NITROGEN		349.9			
NITROGEN		Balance			

Standard
Type: EPA-1685
Concentration: 250.3 ppm
Cylinder #: ALM-008727

Analyzer
Make: TECO
Model: 10
Serial number: 9741-111-6
Analytical principle: Chemiluminescence
Date of calibration: 7-10-91

Raw data units:	mV			Concentration of Customer Cylinder		
First analysis	9-16-91					
Z1=0.0000	R1=785.3	T1=458.9		345.1	ppm	
R2=771.3	Z2=0.0000	T2=455.1		345.2	ppm	
Z3=0.0001	R3=60.3	R3=777.6		345.1	ppm	
Second analysis	9-25-91					
Z1=0.0000	R1=847.5	T1=465.3		347.1	ppm	
R2=859.6	Z2=0.0000	T2=503.1		345.3	ppm	
Z3=0.0000	R3=97.9	R3=854.8		345.3	ppm	

Analyzer Approved by
Mark S. Striniste

ALPHAGAZ

a division of Liquid Air Corporation

CERTIFICATE OF ANALYSIS

Date: September 24, 1991

Customer: BCM Field Services

Order Number: 1099650

P.O.#: 22201

Serial No: CC101359

Lot Number: 978-9-23-91

COMPONENT	REQUESTED	ACTUAL
Oxygen	21.9 %	21.4 %
Nitrogen	Balance	Balance

Cylinder: 30AL
CGA: 590

Pressure: 2000 psig
Contents: 4135 liters

Chemist: _____

BCM

TABLE E-1

GAS DIVIDER
ACCURACY CHECK(1)

Gas Divider Setting	PPMV Propane	FID Response (%)	Response Factor
0	0.0	0.0	0.0
10	9.5	8.5	1.12
20	19.0	17.0	1.12
30	28.5	25.4	1.12
40	38.0	34.0	1.12
50	47.5	42.5	1.12
60	57.0	51.2	1.11
70	65.5	60.0	1.11
80	76.0	68.7	1.11
90	85.5	77.7	1.10
100	95.0	86.1	1.10
		SD(2)	0.01
		RSD(3)	0.74%

(1) Accuracy check performed on 10/2/91 utilizing 95.0 ppmv propane standard and Beckman Model 400 Flame Ionization Detector (FID)
(2) SD = Standard Deviation
(3) RSD = Relative Standard Deviation

6277y