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STACK EMISSIONS SURVEY
PETROTOMICS COMPANY
URANIUM MILL
SHIRLEY BASIN, WYOMING

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STACK EMISSIONS SURVEY
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INTRODUCTION

Western Environmental Services and Testing, Inc. (WEST, Inc.) of Casper, Wyoming,conducted a Stack Emissions Survey at the Petrotomics Company Uranium Mill located near Shirley Basin, Wyoming, on June 21, 1984. The purpose of this survey was to determine emissions of particulates, Uranium-natural (U), Radium-226, Thorium-230, Lead-210, and Radon-222 from the Yellow Cake Dryer Stack, Packaging Room Exhaust Stack, and Cooler Exhaust Stack.

The sampling followed the procedures set forth in the "Wyoming Air Quality Standards and Regulations," Wyoming Department of Environmental Quality, 1982; the Appendix to the Code of Federal Regulations, Title 40, Chapter I, Part 60; and the United States Nuclear Regulatory Commission Code of Federal Regulations, Title 10, Chapter I, Part 20.

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SUMMARY OF RESULTS

The principal conclusions are:

Yellow Cake Dryer Stack

1. The emissions of particulate matter from the Yellow Cake Dryer Stack were 0.208 pounds per hour (0.0169 grains per dry standard cubic foot), based on the test using the 'front-half' collections of the EPA-type sampling train.
2. The concentration of Uranium-natural (U) was 6.05×10^{-10} μCi/ml, based on the test using the 'front-half' collections of the EPA-type sampling train.
3. The U_3O_8 emission rate is 0.0056 pounds per hour, based on the test using the 'front-half' collections of the EPA-type sampling train.
4. The concentration of Radon gas in the stack gas was 0.9 ± 0.3 pCi/l.

Packaging Room Exhaust Stack

1. The emissions of particulate matter from the Packaging Room Exhaust Stack were 0.055 pounds per hour (0.0114 grains per dry standard cubic foot), based on the test using the 'front-half' collections of the EPA-type sampling train.

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2. The concentration of Uranium-natural (U) was 2.65×10^{-11} µCi/ml, based on the test using the 'front-half' collections of the EPA-type sampling train.

3. The U_3O_8 emission rate is 0.0010 pounds per hour, based on the test using the 'front-half' collections of the EPA-type sampling train.

4. The concentration of Radon gas in the stack gas was 0.1 ± 0.3 pCi/l.

Cooler Exhaust Stack

1. The emissions of particulate matter from the Cooler Exhaust Stack were 0.057 pounds per hour (0.0114 grains per dry standard cubic foot), based on the test using the 'front-half' collections of the EPA-type sampling train.

2. The concentration of Uranium-natural (U) was 6.52×10^{-9} µCi/ml, based on the test using the 'front-half' collections of the EPA-type sampling train.

3. The U_3O_8 emission rate is 0.0248 pounds per hour, based on the test using the 'front-half' collections of the EPA-type sampling train.

4. The concentration of Radon gas in the stack gas was 0.1 ± 0.3 pCi/ml.

SUMMARY OF RESULTS

	Yellow Cake	Packaging Room	Cooler Exhaust
Run Number	1	1	1
Stack Flow Rate - ACFM	2366	811	1078
Stack Flow Rate - DSCFM*	1433	566	585
% Water Vapor - % Vol.	9.82	3.35	1.29
% CO_2 - % Vol.	1.4	0.0	0.0
% O_2 - % Vol.	19.0	21.0	21.0
% Excess Air @ Sampling Point	907	----	----
Particulates			
Probe, Cyclone & Filter Catch (C_{an}) grains/dscf*	0.0169	0.0114	0.0114
grains/cf @ Stack Conditions (C_{at})	0.0102	0.0079	0.0062
lbs/hr (C_{aw})	0.208	0.055	0.057
Total Catch (C_{ao}) grains/dscf*	----	----	----
grains/cf @ Stack Conditions (C_{au})	----	----	----
lbs/hr (C_{ax})	----	----	----
Uranium-natural (U) μCi/ml	6.05×10^{-10}	2.65×10^{-11}	6.52×10^{-9}
U O Emissions lbs/hr	0.0056	0.0010	0.0248

* 68°F., 29.92 "Hg (20°C, 760 mm Hg)

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RADIOCHEMISTRY LABORATORY RESULTS
AS REPORTED BY ALPHA ENERGY LABORATORIES, INC.
ON AUGUST 27, 1984

YELLOW CAKE DRYER STACK

Sample Date: June 21, 1984

Radon-222*	pCi/l	0.9 ± 0.3
	LLD - pCi/l	0.2
Uranium-natural (U)	µg/sample	1231
	µgCi/ml	$6.05 \times 10^{-10} \pm 0.02 \times 10^{-10}$
	LLD - µCi/ml	3×10^{-13}
Radium-226		
	µCi/ml	$5.61 \times 10^{-13} \pm 2.69 \times 10^{-13}$
	LLD - µCi/ml	3×10^{-13}
Thorium-230		
	µCi/ml	$2.66 \times 10^{-13} \pm 6.35 \times 10^{-13}$
	LLD - µCi/ml	9×10^{-12}
Lead-210		
	µCi/ml	$3.09 \times 10^{-12} \pm 3.21 \times 10^{-12}$
	LLD - µCi/ml	5×10^{-13}

* Radon-222 analyzed by CORE Laboratories.

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RADIOCHEMISTRY LABORATORY RESULTS
AS REPORTED BY ALPHA ENERGY LABORATORIES, INC.
ON AUGUST 27, 1984

PACKAGING ROOM EXHAUST STACK

Sample Date: June 21, 1984

Radon-222*	pCi/l	0.1 ± 0.3
	LLD - pCi/l	0.2
Uranium-natural (U)	µg/sample	32.4
	µgCi/ml	$2.65 \times 10^{-11} \pm 0.03 \times 10^{-13}$
	LLD - µCi/ml	4×10^{-13}
Radium-226		
	µCi/ml	$1.58 \times 10^{-12} \pm 0.74 \times 10^{-12}$
	LLD - µCi/ml	9×10^{-13}
Thorium-230		
	µCi/ml	$4.28 \times 10^{-13} \pm 33.4 \times 10^{-13}$
	LLD - µCi/ml	5×10^{-12}
Lead-210		
	µCi/ml	$0.0 \pm 7.34 \times 10^{-12}$
	LLD - µCi/ml	1×10^{-12}

* Radon-222 analyzed by CORE Laboratories.

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RADIOCHEMISTRY LABORATORY RESULTS
AS REPORTED BY ALPHA ENERGY LABORATORIES, INC.
ON AUGUST 27, 1984

COOLER EXHAUST STACK

Sample Date: June 21, 1984

Radon-222*	pCi/l	0.1 ± 0.3
	LLD - pCi/l	0.2
Uranium-natural (U)	µg/sample	13984
	µgCi/ml	$6.52 \times 10^{-9} \pm 0.02 \times 10^{-9}$
	LLD - µCi/ml	2×10^{-13}
Radium-226		
	µCi/ml	$8.81 \times 10^{-13} \pm 4.32 \times 10^{-13}$
	LLD - µCi/ml	6×10^{-13}
Thorium-230		
	µCi/ml	$9.59 \times 10^{-12} \pm 3.47 \times 10^{-12}$
	LLD - µCi/ml	4×10^{-12}
Lead-210		
	µCi/ml	$5.76 \times 10^{-12} \pm 3.38 \times 10^{-12}$
	LLD - µCi/ml	5×10^{-13}

* Radon-222 analyzed by CORE Laboratories.

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RADON-222 RESULTS

Sample Date: June 21, 1984

Yellow Cake Dryer Stack	pCi/l	0.9 ± 0.3
	LLD - pCi/l	0.2
Packaging Room Exhaust Stack	pCi/l	0.1 ± 0.3
	LLD - pCi/l	0.2
Cooler Exhaust Stack	pCi/l	0.1 ± 0.3
	LLD - pCi/l	0.2

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DISCUSSION OF RESULTS

The one test for particulates taken on each stack appeared to be valid representations of the actual emissions. The indicative parameters calculated from the field data were in close agreement to previous tests. The rates of sampling for the tests on the Packaging Room Exhaust Stack and the Cooler Exhaust Stack were well within the specified limits of the isokinetic rate. The rates of sampling for the test on the Yellow Cake Dryer Stack were lower than the specified limits, the greatest deviation being 15.59 percent. However, based on previous experience, WEST, Inc. feels that the particulate values were not biased greatly and do represent the actual emissions.

DESCRIPTION OF PROCESS OPERATION

In a uranium milling operation, uranium is extracted from ore, purified, and converted to U_3O_8. The raw ore is crushed and mixed with sulfuric acid to leach out the uranium. The mixture goes through a sand-slime separation to remove and wash the sand. The de-sanded pulp is collected and transferred to the resin-in-pulp circuit where ion-exchange resin is removed counter-current to the solution flow.

This mixture goes to the clarifier where a filter removes solids and routes the pregnant solution to the solvent extraction circuit. The uranium-sulfuric acid mixture is removed from the organic phase by ammonium sulfate. The solution then goes to a precipitation tank where yellow cake is precipitated upon addition of ammonia. The yellow cake is dried, converted to U_3O_8, and conveyed to a storage hopper where it is loaded into 55-gallon drums for shipment.

DESCRIPTION OF SAMPLING LOCATIONS

Yellow Cake Dryer Stack

The sampling ports on the Yellow Cake Dryer Stack are located approximately 35 feet above the ground. The sampling was performed from two ports on the circular stack located approximately 10 feet (10.0 stack diameters) downstream from the stack inlet and approximately 2 feet (2.0 stack diameters) upstream from the stack outlet.

Packaging Room Exhaust Stack

The sampling ports on the Packaging Room Exhaust Stack are located approximately 35 feet above the ground. The sampling was performed from two ports on the circular stack located approximately 8 feet 11 inches (10.44 stack diameters) downstream from the stack inlet and approximately 4 feet 1 inch (4.78 stack diameters) upstream from the stack outlet.

Cooler Exhaust Stack

The sampling ports on the Cooler Exhaust Stack are located approximately 35 feet above the ground. The sampling was performed from two ports on the circular stack located approximately 5 feet 10 inches (4.5 stack diameters) downstream from the stack inlet and approximately 3 feet (2.3 stack diameters) upstream of the stack outlet.

SAMPLING AND ANALYTICAL PROCEDURES

The sampling and analytical procedures used followed the procedures set forth in the "Wyoming Air Quality Standards and Regulations", Wyoming Department of Environmental Quality, 1982; the Appendix to the Code of Federal Regulations, Title 40, Chapter I, Part 60; and the United States Nuclear Regulatory Commission, Code of Federal Regulations, Title 10, Chapter I, Part 20.

A preliminary velocity traverse was made at each port in order to determine the uniformity of flow in the Yellow Cake Dryer Stack. Particulate samples of 5-minute duration at each of the six traverse points were taken from each port using an EPA-type, heated, glass-lined probe. The first and sixth points were not sampled because they were less than 1 inch from the stack wall. Instead, points 2 and 5 were sampled twice.

A preliminary velocity traverse was made at each port in both the Packaging Room Exhaust and Cooler Exhaust Stacks. Particulate samples of 5-minute duration at each of the six traverse points were taken from each port on the Packaging Room Exhaust Stack. Particulate samples of 3-minute duration at each of the 12 traverse points were taken from each port on the Cooler

Exhaust Stack. All samples taken from the Packaging Room Exhaust and Cooler Exhaust Stacks utilized an EPA-type, heated, glass-lined probe.

Before the test, the sampling train was leak-checked at 15 inches of mercury. After the test, the train was again leak-checked at the highest recorded vacuum reading during the test. Final leak-checking was performed in order to predetermine the possibility of a diluted sample.

Before and after each test, the pitot tube lines were checked for leaks under both a vacuum and pressure; the lines were checked for clearance; and the zero manometer reading verified.

The emissions were calculated from gravimetric analysis using the 'front-half' collections of the EPA-type sampling train. The 'front-half' particulate and filters were analyzed by Alpha Energy Laboratories, Inc., Dallas, Texas.

DESCRIPTION OF TESTS

Personnel from WEST, Inc. arrived at the Petrotomics Company Uranium Mill near Shirley Basin, Wyoming, at 0800 hours on Thursday, June 21, 1984. The sampling equipment was moved onto the Yellow Cake Dryer Stack and prepared for testing by 0845 hours. Testing began at 0851 hours and was completed by 0954 hours.

The equipment was moved onto the Packaging Room Exhaust Stack. Testing began at 1034 hours and continued until completion at 1137 hours. The equipment was moved onto the Cooler Exhaust Stack. Testing began at 1218 hours and continued until completion at 1321 hours. Radon-222 gas samples were taken from each stack during the test.

The equipment was moved off the stack and loaded into the mobile laboratory. The samples were recovered and taken to WEST, Inc.'s laboratory in Casper, Wyoming, for further analyses and evaluation.

Testing at Petrotomics Company's Uranium Mill was completed at 1400 hours on Thursday, June 21, 1984.

Bruce A. Hinchey
President

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Field Testing Supervisor

APPENDICES

A. Location of Sampling Points

B. Source Emission Calculations

C. Calibration of Equipment

D. Field Testing Data

E. Analytical Data

F. Chain of Custody

G. Resumes of Test Personnel

APPENDIX A

Location of Sampling Points

APPENDIX A

Location of Sampling Points

Yellow Cake Dryer Stack

The sampling ports are located approximately 10 feet (10.0 stack diameters) downstream from the stack inlet and approximately 2 feet (2.0 stack diameters) upstream of the stack outlet. The first and sixth sample points were not sampled because they were less than one inch from the stack wall; instead, points two and five were double sampled. The locations of the sampling points were calculated as follows:

Inside Stack Diameter = 12 inches

Port and Wall Thickness = 4 inches

Point No.	Percent of Diameter From Wall	Distance From Wall
1	4.4	-----
2	14.7	1-3/4"
3	29.5	3-1/2"
4	70.5	8-1/2"
5	85.3	10-1/4"
6	95.6	-----

Packaging Room Exhaust Stack

The sampling ports are located approximately 8 feet 11 inches (10.44 stack diameters) downstream from the stack inlet and approximately 4 feet 1 inch (4.78 stack diameters) upstream from the stack outlet. The locations of the sampling points were calculated as follows:

Inside Stack Diameter = 10-1/4 inches

Port and Wall Thickness = 4-1/2 inches

Point No.	Percent of Diameter From Wall	Distance From Wall
1*	4.4	1/2"
2	14.7	1-1/2"
3	29.5	3"
4	70.5	7-1/4"
5	85.3	8-3/4"
6*	95.6	9-3/4"

* Points 1 and 6 were adjusted to within 1/2" due to their proximity to the stack wall.

Cooler Exhaust Stack

The sampling ports are located approximately 5 feet 10 inches (4.5 stack diameters) downstream from the stack inlet and approximately 3 feet (2.3 stack diameters) upstream of the stack outlet. The first and twelfth points were not sampled because they were less than one inch from the stack wall; instead, points two and eleven were double sampled. The locations of the sampling points were calculated as follow:

Inside Stack Diameter = 15 1/2 inches
Port and Wall Thickness = 4 1/2 inches

Point No.	Percent of Diameter From Wall	Distance From Wall
1	2.1	-----
2	6.7	1"
3	11.8	1 13/16"
4	17.7	2 3/4"
5	25.0	3 7/8"
6	35.5	5 1/2"
7	64.5	10"
8	75.0	11 5/8"
9	82.3	12 3/4"
10	88.2	13 11/16"
11	93.3	14 1/2"
12	97.9	-----

APPENDIX B

Nomenclature and Equations
for
Calculation of Source Emissions

Nomenclature for Particulate Calculations

Symbol	English Units	Metric Units	Description
A_s	$in.^2$	m^2	Stack Area
C_{an}	gr/dscf	g/dscm	Particulate - Probe, Cyclone and Filter
C_{ao}	gr/dscf	g/dscm	Particulate - Total
C_{at}	gr/CF @ Stack Conditions	g/m^3	Particulate - Probe, Cyclone and Filter
C_{au}	gr/CF @ Stack Conditions	g/m^3	Particulate - Total
C_{aw}	lbs/hr	kg/hr	Particulate - Probe, Cyclone and Filter
C_{ax}	lbs/hr	kg/hr	Particulate - Total
C_p			Pitot Tube Calibration Factor
D_n	in.	m	Sampling Nozzle Diameter
%EA			Percent Excess Air At Sampling Point
g	32.2 ft/sec^2		Acceleration Of Gravity
%I			Percent Isokinetic
%M			Percent Moisture In The Stack Gas By Volume

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

Symbol	English Units	Metric Units	Description
M_d			Mole Fraction of Dry Gas
mf	mg	mg	Particulate - Probe, Cyclone and Filter
M_{H_2O}	18 lb/lb-mole		Molecular Weight Of Water
m_t	mg	mg	Particulate - Total
MW_{air}	lb/lb-mole	g/g-mole	Molecular Weight Of Stack Gas
MW	28.95 lb/ lb-mole		Molecular Weight Of Air
MW_d	lb/lb-mole	g/g-mole	Molecular Weight Of Dry Stack Gas
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H_2O	mm H_2O	Orifice Pressure Drop
P_s	"Hg Absolute	mm Hg	Stack Pressure
ΔP_s	"H_2O	mm H_2O	Velocity Head Of Stack Gas
P_{std}	29.92 "Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m^3/hr	Stack Gas Volume At Actual Stack Conditions
Q_s	DSCFM	dscm/hr	Stack Gas Volume At 29.92 "Hg, 528°R, Dry
R	21.83 "Hg-ft^3/lb-mole-°R		Universal Gas Constant

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

Symbol	English Units	Metric Units	Description
T_m	°F	°C	Average Gas Meter Temperature
T_t	min	min	Net Time Of Test
T_s	°F	°C	Stack Temperature
T_{std}	528°R	293°K	Standard Temperature
V_m	ft^3	m^3	Volume Of Dry Gas Sampled @ Meter Conditions
$V_{m_{std}}$	dscf	dscm	Volume Of Dry Gas Sampled @ Standard Conditions
V_s	fpm	m/sec	Stack Velocity @ Stack Conditions
V_w	ml	ml	Total Water Collected In Impingers And Silica Gel
$V_{w_{gas}}$	scf	scm	Volume Of Water Vapor Collected @ Standard Conditions
ρ_{air}	0.0748 lbs/ft^3		Density Of Air
ρ_{H_2O}	1 g/ml		Density Of Water
ρ_{man}	51.63 lbs/ft^3		Density Of Manometer Oil

Standard Conditions: 68°F, 29.92 "Hg (20°C, 760 mm Hg)

Example Particulate Calculations

1. Volume Of Dry Gas Sampled At Standard Conditions.*

$$V_{m_{std}} = V_m \left[\frac{T_{std}}{T_m + 460}\right] \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}}\right]$$

$$V_{m_{std}} = 17.65\ V_m \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = \text{dscf}$$

$$V_{m_{std}} = \text{dscf} \times 0.028317 = \text{dscm}$$

2. Volume Of Water Vapor Collected At Standard Conditions.*

$$V_{w_{gas}} = \frac{(V_w - \text{gms } SO_2 - \text{gms } H_2S)\ \rho_{H_2O}\ R\ T_{std}}{P_{std}\ M_{H_2O}\ 453.6}$$

$$V_{w_{gas}} = 0.0472\ (V_w - \text{gms } SO_2 - \text{gms } H_2S) = \text{scf}$$

$$V_{w_{gas}} = \text{scf} \times 0.028317 = \text{scm}$$

3. Percent Moisture In Stack Gas.

$$\%M = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \%$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

4. Mole Fraction Of Dry Gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average Molecular Weight Of Dry Stack Gas.

$$MW_d = \left(\%CO_2 \times \frac{44}{100}\right) + \left(\%O_2 \times \frac{32}{100}\right) + \left(\%N_2 \times \frac{28}{100}\right) + \left(\%CO \times \frac{28}{100}\right) = \text{lb/lb-mole}$$

$$= \text{g/g-mole}$$

6. Molecular Weight Of Stack Gas.

$$MW = MW_d \times M_d + 18\ (1-M_d) = \frac{\text{lb}}{\text{lb-mole}} = \text{g/g-mole}$$

7. Percent Excess Air At Sampling Point.

$$\%EA = \frac{100\ (\%O_2 - 0.5\%\ CO)}{0.265\ (\%N_2) - (\%O_2) + 0.5\ (\%CO)}$$

8. Stack Pressure.

$$P_s = P_b + \frac{\text{stack pressure "}H_2O}{13.6} = \text{"Hg Absolute}$$

$$P_s = \text{"Hg Abs.} \times 25.4 = \text{mm Hg}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

9. Stack Velocity At Stack Conditions.

$$V_s = C_p\, 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460) \times \Delta P_s}{12 \times \rho_{air} \times P_s \times MW \times T_{std}} \right]^{1/2}$$

$$V_s = 5123.8\, C_p \left[\frac{(T_s + 460)}{P_s \times MW} \right]^{\frac{1}{2}} \times \text{Average}\left[(\Delta P)^{\frac{1}{2}} \right] = \text{fpm}$$

$$V_s = \text{fpm} \times 0.00508 = \text{m/sec}$$

10. Dry Stack Gas Volume At Standard Conditions.*

$$Q_s = \frac{1}{144} V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

$$Q_s = \frac{0.123\, V_s \times A_s \times M_d \times P_s}{T_s + 460} = \text{DSCFM}$$

$$Q_s = \text{DSCFM} \times 1.6990 = \text{dscm/hr}$$

11. Actual Stack Gas Volume At Stack Conditions.

$$Q_a = \frac{V_s \times A_s}{144} = \text{ACFM}$$

$$Q_a = \text{ACFM} \times 1.6990 = m^3/hr$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

12. Percent Isokinetic.

$$\%I = \frac{V_{m_{std}} \times (T_s + 460) \times P_{std} \times 100 \times 144}{M_d \times T_{std} \times P_s \times T_t \times V_s \times \frac{\pi D_n^2}{4}}$$

$$\%I = \frac{1039\ V_{m_{std}} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s \times D_n^2}$$

13. Particulate - Probe, Cyclone, and Filter.

$$C_{an} = \frac{m_f}{V_{m_{std}}} \times \frac{1\ gr}{64.8\ mg}$$

$$C_{an} = 0.0154\ \frac{m_f}{V_{m_{std}}} = gr/dscf$$

$$C_{an} = gr/dscf \times 2.290 = g/dscm$$

14. Particulate - Total.

$$C_{ao} = 0.0154 \times \frac{m_t}{V_{m_{std}}} = gr/dscf$$

$$C_{ao} = gr/dscf \times 2.290 = g/dscm$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

15. Particulate - Probe, Cyclone, and Filter At Stack Conditions.

$$C_{at} = C_{an} \times \frac{P_s}{P_{std}} \times \frac{(T_{std})}{(T_s + 460)} \times M_d$$

$$C_{at} = \frac{17.65 \times C_{an} \times P_s \times M_d}{T_s + 460} = \text{gr/CF}$$

$$C_{at} = \text{gr/CF} \times 2.290 = \text{g/m}^3$$

16. Particulate - Total, At Stack Conditions.

$$C_{[illegible]} = \frac{17.65 \times C_{ao} \times P_s \times M_d}{T_s + 460} = \text{gr/CF}$$

$$C_{au} = \text{gr/CF} \times 2.290 = \text{g/m}^3$$

17. Particulate - Probe, Cyclone, and Filter.

$$C_{aw} = C_{an} \times Q_s \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ lb}}{7000 \text{ gr}}$$

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = \text{lbs/hr}$$

$$C_{aw} = \text{lbs/hr} \times 0.4536 = \text{kg/hr}$$

18. Particulate - Total.

$$C_{ax} = 0.00857 \times C_{ao} \times Q_s = \text{lbs/hr}$$

$$C_{ax} = \text{lbs/hr} \times 0.4536 = \text{kg/hr}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

Uranium Calculations

$$[\ \mu gU/Vmstd\ (m^3)\ ]\ \ [1 \times 10^{-6}\ m^3/ml]\ = \mu gU/ml$$

$$[\ \mu gU/ml]\ \ [6.77 \times 10^{-7}\ \mu Ci/\mu g\ ]\ =\ \mu Ci/ml\ \text{Uranium}$$

Ra^{226} Calculations

$$[\ pCi\ Ra^{226}/Vmstd\ (m^3)\ ]\ \ [\ 1 \times 10^{-6}\ m^3/ml\ ]\ =\ pCi/ml\ Ra^{226}$$

$$[\ pCi\ Ra^{226}/ml\ ]\ \ [\ 1 \times 10^{-6}\ \mu Ci/pCi\ ]\ =\ \mu Ci/ml\ Ra^{226}$$

Th^{230} Calculations

$$[\ pCi\ Th^{230}/Vmstd\ (m^3)\ ]\ \ [\ 1 \times 10^{-6}\ m^3/ml\ ]\ =\ pCi/ml\ Th^{230}$$

$$[\ pCi\ Th^{230}/ml\ ]\ \ [\ 1 \times 10^{-6}\ \mu Ci/pCi\ ]\ =\ \mu Ci/ml\ Th^{230}$$

Pb^{210} Calculations

$$[\ pCi\ Pb^{210}/Vmstd\ (m^3)\ ]\ \ [\ 1 \times 10^{-6}\ m^3/ml\ ]\ =\ pCi/ml\ Pb^{210}$$

$$[\ pCi\ Pb^{210}/ml\ ]\ \ [\ 1 \times 10^{-6}\ \mu Ci/pCi\ ]\ =\ \mu Ci/ml\ Pb^{210}$$

U_3O_8 Pound Per Hour

$$\frac{\frac{\mu gU}{Sample} \times (1 \times 10^{-3}) \times 1.1792731 \frac{mg\ U_3O_8}{mg\ U\text{-}Nat}}{Vmstd\ (ft^3)} \times 0.0154 = grains/dscf$$

$$\frac{grains}{dscf} \times 0.00857 \times \frac{DSCF}{Minute} = U_3O_8\ lbs/hour$$

STACK EMISSIONS SURVEY
PETROTOMICS COMPANY
URANIUM MILL
SHIRLEY BASIN, WYOMING

JUNE 1984

FILE NUMBER 8410-136

SOURCE EMISSION CALCULATIONS

Symbol	Description	Units	PKG EXHAUST	YCD
Run No.			1	1
Date			6/21/84	6/21/84
Begin			1034 MST	0851 MST
End			1137 MST	0954 MST
P_b	barometric pressure	"Hg Abs.	23.30	23.20
		(mm Hg)	591.82	589.28
P_m	orifice pressure drop	"H_2O	0.89	2.56
		(mm H_2O)	22.52	64.98
V_m	volume dry gas sampled @ meter conditions	$ft.^3$	37.996	62.648
		(m^3)	1.076	1.774
T_m	avg. gas meter temp	°F	76	72
		(°C)	24	22
$V_{m_{std}}$	volume dry gas sampled @ standard conditions*	dscf	29.248	48.611
		(dscm)	.828	1.377
V_w	total H_2O collected, impingers & silica gel	ml	21.5	112.2
$V_{w_{gas}}$	volume water vapor collected @ standard conditions*	scf	1.015	5.296
		(scm)	.029	.15
%M	moisture in stack gas by volume	%	3.35	9.82

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

Source Emission Calculations

Symbol	Description	Units	PKG EXHAUST 1	YCD 1
M_d	mol fraction of dry gas	-----	.9665	.9018
CO_2		%	0	1.4
O_2		%	21	19
N_2		%	79	79.6
%EA	excess air @ sampling point	%	-----	907
MW_d	molecular weight of dry stack gas	lb/lb-mole (g/g-mole)	28.84 28.84	28.98 28.98
MW	molecular weight of stack gas	lb/lb-mole (g/g-mole)	28.48 28.48	27.91 27.91
ΔPs	velocity head of stack gas	"H_2O (mm H_2O)	.134 3.40	.548 13.92
T_s	stack temperature	°F (°C)	112 45	152 67
P_s	stack pressure	"Hg Abs. (mm Hg)	23.30 591.91	23.21 589.43
V_s	stack velocity @ stack conditions	fpm (m/sec)	1424 7.24	3015 15.32
A_s	stack area	in.^{2} (m^2)	82 0.05	113 0.07
Q_s	dry stack volume @ standard conditions*	DSCFM (dscm/hr)	566 960.83	1433 2434.86
Q_a	actual stack gas volume @ stack conditions	ACFM (m^3/hr)	811 1378.08	2366 4019.66

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

PETROTOMICS COMPANY
FILE NUMBER 8410-136

Source Emission Calculations

Symbol	Description	Units	PKG EXHAUST 1	YCD 1
T_t	net time of test	min.	60	60
D_n	sampling nozzle diam.	in. (m)	.311 .008	.311 .008
%I	percent isokinetic	%	93.39	8[illegible].41
m_f	particulate - probe, cyclone and filter	mg	21.7	53.4
m_t	particulate - total	mg	---	---
C_{an}	particulate - probe, cyclone and filter	gr/dscf* (g/dscm)	.0114 .0261	.0169 .0387
C_{ao}	particulate - total	gr/dscf* (g/dscm)	--- ---	--- ---
C_{at}	particulate - probe, cyclone and filter @ stack conditions	gr/cf (g/m^3)	.0079 .0181	.0102 .0234
C_{au}	particulate total @ stack conditions	gr/cf (g/m^3)	--- ---	--- ---
C_{aw}	particulate - probe, cyclone and filter	lbs/hr (kg/hr)	.055 .025	.208 .094
C_{ax}	particulate - total	lbs/hr (kg/hr)	--- ---	--- ---

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

STACK EMISSIONS SURVEY
PETROTOMICS COMPANY
URANIUM MILL
SHIRLEY BASIN, WYOMING

JUNE 1984

FILE NUMBER 8410-136

SOURCE EMISSION CALCULATIONS

Symbol	Description	Units	COOLER EXH.
Run No.			1
Date			6/21/84
Begin			1218 MST
End			1321 MST
P_b	barometric pressure	"Hg Abs. (mm Hg)	23.30 591.82
P_m	orifice pressure drop	"H_2O (mm H_2O)	0.00 0.00
V_m	volume dry gas sampled @ meter conditions	ft.^{3} (m^3)	67.729 1.918
T_m	avg. gas meter temp	°F (°C)	83 28
$V_{m_{std}}$	volume dry gas sampled @ standard conditions*	dscf (dscm)	51.277 1.452
V_w	total H_2O collected, impingers & silica gel	ml	14.2
$V_{w_{gas}}$	volume water vapor collected @ standard conditions*	scf (scm)	.67 .019
%M	moisture in stack gas by volume	%	1.29

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

Source Emission Calculations

Symbol	Description	Units	COOLER EXH 1
M_d	mol fraction of dry gas	-----	.9871
CO_2		%	0
O_2		%	21
N_2		%	79
%EA	excess air @ sampling point	%	-----
MW_d	molecular weight of dry stack gas	lb/lb-mole (g/g-mole)	28.84 28.84
MW	molecular weight of stack gas	lb/lb-mole (g/g-mole)	28.70 28.70
ΔPs	velocity head of stack gas	"H_2O (mm H_2O)	.037 0.94
T_s	stack temperature	°F (°C)	291 144
P_s	stack pressure	"Hg Abs. (mm Hg)	23.30 591.75
V_s	stack velocity @ stack conditions	fpm (m/sec)	822 4.17
A_s	stack area	in.^{2} (m^2)	189 0.12
Q_s	dry stack volume @ standard conditions*	DSCFM (dscm/hr)	585 994.17
Q_a	actual stack gas volume @ stack conditions	ACFM (m^3/hr)	1078 1831.91

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

Source Emission Calculations

Symbol	Description	Units	COOLER EXH 1
T_t	net time of test	min.	60
D_n	sampling nozzle diam.	in. (m)	.612 .016
%I	percent isokinetic	%	94.19
m_f	particulate - probe, cyclone and filter	mg	37.8
m_t	particulate - total	mg	---
C_{an}	particulate - probe, cyclone and filter	gr/dscf* (g/dscm)	.0114 .0261
C_{ao}	particulate - total	gr/dscf* (g/dscm)	--- ---
C_{at}	particulate - probe, cyclone and filter @ stack conditions	gr/cf (g/m^3)	.0062 .0142
C_{au}	particulate total @ stack conditions	gr/cf (g/m^3)	--- ---
C_{aw}	particulate - probe, cyclone and filter	lbs/hr (kg/hr)	.057 .026
C_{ax}	particulate - total	lbs/hr (kg/hr)	--- ---

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

APPENDIX C

Calibration of Equipment

APPENDIX C

Calibration Data

June 4, 1984

NOZZLES

Set #A

Nozzle No.	Diameter (inches)
3A	0.254
4A	0.318
5A	0.354
6A	0.377
7A	0.448
8A	0.493
9A	0.499
10A	0.576

Set #B

Nozzle No.	Diameter (inches)
1B	0.128
2B	0.176
3B	0.241
4B	0.300
5B	0.359
7B	0.500

Set I

Nozzle No.	Diameter (inches)
I-1	0.131
I-2	0.196
I-3	0.245
I-4	0.310
I-5	0.373
I-6	0.419
I-7	0.490
I-8	0.571
I-9	0.616

Set II

Nozzle No.	Diameter (inches)
II-1	0.123
II-2	0.197
II-3	0.249
II-4	0.311
II-5	0.374
II-6	0.430
II-7	0.498
II-8	0.555
II-9	0.612

Set III

Nozzle No.	Diameter (inches)
III-1	0.127
III-3	0.247
III-4	0.373
III-5	0.365
III-6	0.437
III-7	0.499
III-8	0.566
III-9	0.613

APPENDIX C

Calibration Data

June 4, 1984

PITOT TUBES

Pitot Length (effective length)	Calibration Factor	
32-1	High	0.818
	Low	0.820
46-1	High	0.824
	Low	0.824
49-1	High	0.823
	Low	0.831
72-1	High	0.832
	Low	0.826
73-1	High	0.829
	Low	0.836
74-1	High	0.828
	Low	0.836
96-1	High	0.823
	Low	0.824
128-1	High	0.826
	Low	0.828
129-1	High	0.825
	Low	0.826
132-1	High	0.833
	Low	0.832
156-1	High	0.824
	Low	0.823
156-2	High	0.831
	Low	0.831

APPENDIX C

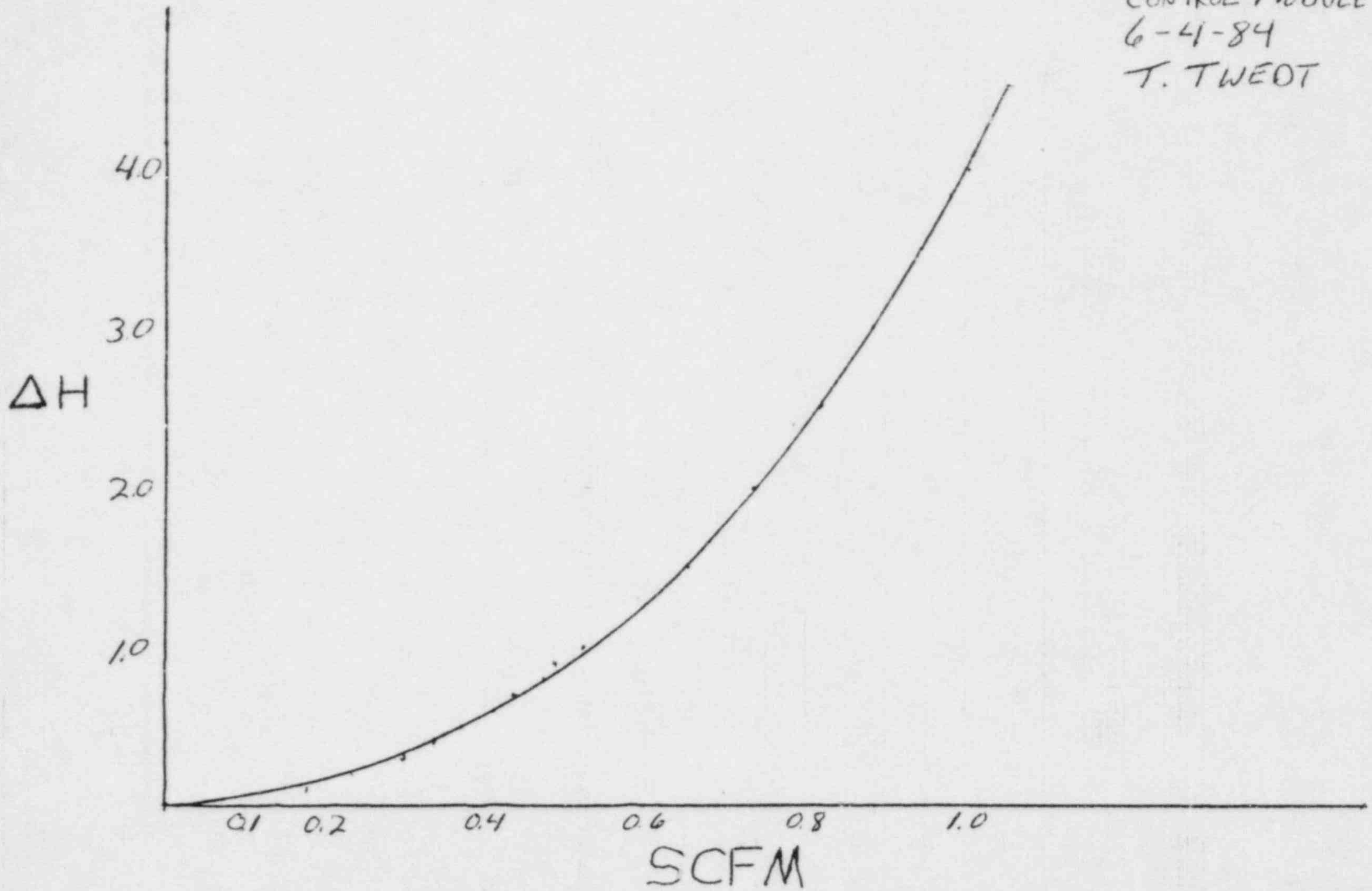
Calibration Data

June 4, 1984

DRY GAS METERS

Unit Number	Calibration Factor
1	1.034
2	1.037
3	1.021
4	0.990

WEST, INC.
ORIFICE CURVE
CONTROL MODULE #2
6-4-84
T. TWEDT



APPENDIX D

Field Testing Data

Job No. 8410-136 | Port, U_3O_8 FIELD DATA | Nomograph Setting ΔP 0.45 ΔH 2.10

Job Name Petrotomics

Run No. 1

Location YCD

Date 6-21-84

Operator Hinchey - Vincent

Sample Box No. 4 Meter Box No. 2

Read and Record at the Start of Each Test Point.

Ambient Temp. °F 60

Assumed Moisture % 22

Probe Length 32"

Pitot Tube Leak Check Before ok After ok

Initial Leak @ 15 "Hg = 0.000 cfm

Final Leak @ 10 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (Δ Ps)	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual (Pm)	Pump Vacuum In. Hg Gauge	Stack Temp °F (Ts)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet (Tm)	Dry Gas Temp °F Outlet	Remarks
A-6	851	312.200	0.51	2.45	2.45	6.0	151	230	267	64	68	66	
5	856	317.12	0.54	2.50	2.50	6.5	151	233	267	59	69	67	
4	901	322.00	0.56	2.60	2.60	6.5	152	235	265	54	70	67	
3	06	327.05	0.56	2.60	2.60	7.0	152	240	228	61	72	67	
2	11	332.32	0.54	2.50	2.50	7.0	151	232	268	66	74	67	
1	16	337.08	0.54	2.50	2.50	7.0	151	233	264	71	76	68	
END	921	342.078	—	—	—	—	—	—	—	—	—	—	
B-6	924	342.078	0.54	2.50	2.50	7.0	153	233	261	70	75	68	
5	29	347.52	0.58	2.70	2.70	7.0	153	237	269	66	78	68	
4	34	352.55	0.60	2.80	2.80	7.5	153	238	264	64	80	69	
3	39	357.55	0.56	2.60	2.60	7.0	153	236	259	65	81	69	
2	44	362.76	0.54	2.50	2.50	7.0	151	237	258	66	83	70	
1	49	368.20	0.51	2.45	2.45	6.0	152	238	252	66	84	70	
END	954	372.613	—	—	—	—	—	—	—	—	—	—	
All													

Pitot Tube Calibration Factor C_p 0.818 Pitot Tube No. 32-1

Volume Collected V_m 62.648 ft^3 $\%CO_2$ 1.4 $\%CO$ 0.0

Water Collected V_w 112.2 ml $\%O_2$ 19.0 $\%N_2$ 79.6

Time of Test T_t 60 min Area Stack A_2 113 in^2

Baro. Press. P_b 23.20 "Hg Stack Press. +0.08 in. H_2O

Sample Purge: Initial ______ Final ______

Probe Tip No. I-4 Probe Tip Dia. 0.311 in

V_m = Dry Gas Meter Calibration Factor 1.037 x 60.413

[Dry Gas Meter Reading ______ ft^3 - (T_t ___ min x Leak Rate ___ cfm)]

M_F = 53.4 M_T = —

IMPINGER CATCH

SAMPLE NO.: 1- YCD

IMPINGER NO.	SOLUTION USED	AMOUNT OF SOLUTION (ml)	IMP. TIP CONFIGURATION	WEIGHT (grams)	
1	DI H2O	100	MOD	Final	593.3
				Initial	540.3
				Wt. Gain	53.0
2	DI-H2O	100	S. Greenburg	Final	590.8
				Initial	561.9
				Wt. Gain	28.9
3	DRY	—	MOD	Final	469.4
				Initial	459.5
				Wt. Gain	9.9
4	Silica Gel	—	MOD	Final	807.1
				Initial	786.7
				Wt. Gain	20.4
5				Final	
				Initial	
				Wt. Gain	
6				Final	
				Initial	
				Wt. Gain	
Flask				Final	
				Initial	
				Wt. Gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 112.2

DATE: 6-21-84

SIGNATURE: [signature]

ORSAT ANALYSIS RESULTS

Gas Fractional Part

CO_2 1.4

O_2 19.0

CO 0.0

N_2 79.6

SIGNATURE: [signature]

DATE: 6-21-84

TIME: 1000

Job No. 8410-136

Part 4308 FIELD DATA

Nomograph Setting ΔP 0.16 ΔH 1.05

Job Name Petrotomics

Ambient Temp. °F

Run No. 1

Assumed Moisture % 10

Location Pack-Exh

Read and Record at the Start of Each Test Point.

Probe Length 32"

Date 6-21-84

Pitot Tube Leak Check Before ok After ok

Operator Hinchey Vincent

Initial Leak @ 15 "Hg = 0.000 cfm

Sample Box No. 5 Meter Box No. 2

Final Leak @ 10 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (Δ Ps)	Orifice ΔH in. H_2O (Pm) Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp °F (Ts)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp °F (Tm) Inlet	Dry Gas Temp °F Outlet	Remarks
A-6	1034	373.744	0.12	0.80	0.80	3.0	110	231	256	65	73	71	
5	39	376.45	0.15	0.99	0.99	3.0	111	237	246	59	74	71	
4	44	379.37	0.15	0.99	0.99	3.0	111	232	262	50	77	72	
3	49	382.51	0.13	0.86	0.86	3.0	110	236	264	48	78	72	
2	54	385.60	0.13	0.86	0.86	3.0	119	228	264	48	79	72	
1	59	388.80	0.13	0.86	0.86	3.0	112	238	265	49	79	73	
END	1104	391.566	—	—	—	—	—	—	—	—	—	—	
B-6	1107	391.566	0.12	0.80	0.80	3.0	110	234	266	58	79	73	
5	12	394.50	0.13	0.86	0.86	3.0	111	230	262	50	80	73	
4	17	397.70	0.14	0.92	0.92	3.0	111	246	260	50	80	74	
3	22	400.64	0.14	0.92	0.92	3.0	110	251	261	50	81	74	
2	27	403.72	0.14	0.92	0.92	3.0	111	240	260	51	82	74	
1	32	406.90	0.13	0.86	0.86	3.0	120	246	257	51	83	74	
END	1137	409.884	—	—	—	—	—	—	—	—	—	—	
All													

Pitot Tube Calibration Factor C_p 0.818

Pitot Tube No. 32-1

Volume Collected V_m 37.996 ft^3

$\%CO_2$ 0.0 %CO 0.0

Water Collected V_w 21.5 ml

$\%O_2$ 21.0 $\%N_2$ 79.0

Time of Test T_t 60 min

Area Stack A_2 82 in^2

Baro. Press. P_b 23.30 "Hg

Stack Press. +0.05 in. H_2O

Sample Purge: Initial ______ Final ______

Probe Tip No. I-4 Probe Tip Dia. 0.311 in

V_m = Dry Gas Meter Calibration Factor 1.037 x [Dry Gas Meter Reading ______ ft^3 - (T_t ___ min x Leak Rate ___ cfm)]

M_F = 21.7 M_T = —

IMPINGER CATCH

SAMPLE NO.: 1 - PACK. Exh

IMPINGER NO.	SOLUTION USED	AMOUNT OF SOLUTION (ml)	IMP. TIP CONFIGURATION	WEIGHT (grams)	
1	DI-H2O	100	Mod	Final	555.0
				Initial	542.6
				Wt. Gain	12.4
2	DI-H2O	100	S. Greenburg	Final	570.0
				Initial	567.7
				Wt. Gain	2.3
3	DRY	—	Mod	Final	494.7
				Initial	493.2
				Wt. Gain	1.5
4	Silicagel	—	Mod	Final	890.9
				Initial	885.6
				Wt. Gain	5.3
5				Final	
				Initial	
				Wt. Gain	
6				Final	
				Initial	
				Wt. Gain	
Flask				Final	
				Initial	
				Wt. Gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 21.5

DATE: 6-21-84

SIGNATURE: [signature]

ORSAT ANALYSIS RESULTS

Gas Fractional Part

CO_2 ______

O_2 ______

CO ______

N_2 ______

Air

SIGNATURE: [signature] DATE: 6-21-84

TIME: ______

Job No. 8410-136

Job Name Petco Tronics

Run No. 1

Location Cooler Exh.

Date 6-21-84

Operator Hinchey - Vincent

Sample Box No. 6 Meter Box No. 2

Part-H_2O_2 FIELD DATA

Read and Record at the Start of Each Test Point.

Nomograph Setting ΔP 0.019 ΔH 1.50

Ambient Temp. °F

Assumed Moisture % 3

Probe Length 32"

Pitot Tube Leak Check Before & after ok

Initial Leak @ 15 "Hg = 0.000 cfm

Final Leak @ 10 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (Δ Ps)	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge (Pm)	Stack Temp °F (Ts)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp °F Inlet (Tm)	Dry Gas Temp °F Outlet	Remarks
A-12	12:18	410.308	0.04	3.20	3.20	7.0	290	228	235	56	79	77	
11	20½	413.08	0.04	3.20	3.20	7.0	292	236	247	48	80	77	
10	23	415.85	0.04	3.20	3.20	7.0	294	237	248	51	81	77	
9	25½	418.60	0.04	3.20	3.20	7.0	293	241	251	52	82	77	
8	28	421.60	0.04	3.20	3.20	7.0	295	248	247	53	83	77	
7	30½	424.30	0.04	3.20	3.20	7.0	295	254	252	53	84	77	
6	33	427.20	0.04	3.20	3.20	7.0	289	257	268	52	86	78	
5	35½	430.00	0.04	3.20	3.20	7.0	279	248	255	52	87	78	
4	38	432.90	0.03	2.40	2.40	5.0	278	245	261	51	87	78	
3	40½	435.40	0.02	1.60	1.60	4.0	280	248	269	51	89	78	
2	43	437.50	0.02	1.60	1.60	4.0	285	247	248	52	88	79	
1	45½	439.50	0.02	1.60	1.60	4.0	282	244	255	52	88	79	
END	1248	441.552	—	—	—	—	—	—	—	—	—	—	
B-12	1251	441.552	0.05	4.00	4.00	8.0	286	234	271	55	87	79	
11	53½	444.60	0.05	4.00	4.00	8.0	289	234	272	49	88	79	
10	56	447.95	0.05	4.00	4.00	8.0	295	234	273	49	89	80	
9	58½	451.00	0.05	4.00	4.00	8.0	297	234	276	51	90	80	
B-8	1301	454.20	0.05	4.00	4.00	8.5	297	236	269	51	90	80	

Pitot Tube Calibration Factor C_p 0.818 Pitot Tube No. 32-1

Volume Collected V_m 67.729 ft^3 $\%CO_2$ 0.0 %CO 0.0

Water Collected V_w 14.2 ml $\%O_2$ 21.0 $\%N_2$ 79.0

Time of Test T_t 60 min Area Stack A_2 189 in^2

Baro. Press. P_b 23.30 "Hg Stack Press. -0.04 in. H_2O

Sample Purge: Initial Final

Probe Tip No. ~~T-6~~ T-9 Probe Tip Dia. ~~0.430~~ ~~0.498~~ 0.612 in

V_m = Dry Gas Meter Calibration Factor 1.037 x 65.313

Dry Gas Meter Reading ft^3 - (T_t min x Leak Rate cfm)

M_F = 37.8 M_T = —

PARTICULATE FIELD DATA

Run No. 1

Location Cooler Exh

Date 6-21-84

Point	Clock Time	Dry Gas Meter, CF	Δ Ps Pitot in. H_2O	Pm Orifice ΔH in. H_2O Desired	Actual	Pump Vacuum In. Hg Gauge	Ts Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Tm Dry Gas Temp °F Inlet	Outlet	Remarks
B-7	12:03½	457.20	0.05	4.00	4.00	9.0	278	247	268	51	91	80	
6	06	460.40	0.05	4.00	4.00	9.0	294	236	267	51	91	81	
5	08½	463.76	0.04	3.20	3.20	7.0	294	239	263	52	92	81	
4	11	466.50	0.03	2.40	2.40	6.0	297	237	263	52	91	81	
3	13½	469.00	0.03	2.40	2.40	6.0	291	244	256	53	90	81	
2	16	471.50	0.02	1.60	1.60	4.0	296	236	256	52	90	82	
1	18½	473.70	0.02	1.60	1.60	4.0	287	240	258	52	90	82	
END	1321	475.621	—	—	—	—	—	—	—	—	—	—	
A-1													

IMPINGER CATCH

SAMPLE NO.: 1- Cond...4

IMPINGER NO.	SOLUTION USED	AMOUNT OF SOLUTION (ml)	IMP. TIP CONFIGURATION	WEIGHT (grams)	
1	DI-H_2O	100	Lu OD	Final	570.1
				Initial	576.1
				Wt. Gain	-6.0
2	DI-H_2O	100	S. Greenburg	Final	588.2
				Initial	583.9
				Wt. Gain	4.3
3	Dry	–	Lu OD	Final	478.3
				Initial	475.6
				Wt. Gain	2.7
4	Silica Gel	–	Mod	Final	825.7
				Initial	812.5
				Wt. Gain	13.2
5				Final	
				Initial	
				Wt. Gain	
6				Final	
				Initial	
				Wt. Gain	
Flask				Final	
				Initial	
				Wt. Gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 14.2

DATE: 6-21-84

SIGNATURE: [signature]

ORSAT ANALYSIS RESULTS

Gas Fractional Part

CO_2 Air

O_2

CO

N_2

SIGNATURE: [signature] DATE: 6-21-84

TIME:

APPENDIX E

Analytical Data

PARTICULATE ANALYSIS

Date 8-27-84

Job No. 8410-136

Name Petrotomics

Location YCD, Pack. Exh, Cooler Exh

Run No. 1-YCD

Filter No. I-71	Front Wash 325 ml	Impinger 1	Impinger 2
Final 0.6738	100.0749		
Initial 0.6380	100.0558		
0.0358 = 35.8	0.0191 = 19.1		
17.6	− 1.5 blank		
53.4	17.6		

MF 53.4 mg MT — mg

Run No. 1-Packaging Exh

Filter No. I-70	Front Wash 300 ml	Impinger 1	Impinger 2
Final 0.6412	112.9758		
Initial 0.6390	112.9550		
0.0022 = 2.2	0.0208 = 20.8		
19.5	− 1.3 blank		
21.7	19.5		

MF 21.7 mg MT ______ mg

Run No. ______

Filter No. I-69	Front Wash 285 ml	Impinger 1	Impinger 2
Final 0.6516	105.1195		
Initial 0.6443	105.0777		
0.0073 = 7.3	0.0318 = 31.8		
30.5	− 1.3 blank		
37.8	30.5		

MF 37.8 mg MT ______ mg

Acetone Blank:	D.I. Water Blank
Volume 700 ml	Volume ______ ml
Final 104.5135	Final
Initial 104.5126	Initial ______
0.0009	
Blank: 0.0045 mg/ml	Blank: ______ mg/ml
Total Weight 0.9 mg	Total Weight ______

ALPHA
NUCLEAR
LABORATORIES INC.

REPORT OF ANALYSIS

ANL JOB# 84-198

WESTERN ENVIRONMENTAL

3 AIR SAMPLES FOR RA 226 TH 230 PB 210 U NAT---FOR JOB #8410-136 PETROTOMICS 6-21-84

SAMPLE I. D.	ISOTOPE	CONCENTRATION(UCI/ML)	LLD(UCI/ML)
RUN 1 COOLER FRONT 6-21-84	RA-226	$(8.81 \pm 4.32) \times 10^{-13}$	6×10^{-13}
	TH-230	$(9.59 \pm 3.47) \times 10^{-12}$	4×10^{-12}
	PB-210	$(5.76 \pm 3.38) \times 10^{-12}$	5×10^{-12}
	U-NAT	$(6.52 \pm 0.02) \times 10^{-9}$	2×10^{-13}
RUN 1 PACK EXH. FRONT 6-21-84	RA-226	$(1.58 \pm 0.74) \times 10^{-12}$	9×10^{-13}
	TH-230	$(4.28 \pm 33.4) \times 10^{-13}$	5×10^{-12}
	PB-210	$(0.00 \pm 7.34) \times 10^{-12}$	1×10^{-11}
	U-NAT	$(2.65 \pm 0.03) \times 10^{-11}$	4×10^{-13}
RUN 1 YCD FRONT 6-21-84	RA-226	$(5.61 \pm 2.69) \times 10^{-13}$	3×10^{-13}
	TH-230	$(2.66 \pm 6.35) \times 10^{-13}$	9×10^{-13}
	PB-210	$(3.09 \pm 3.21) \times 10^{-12}$	5×10^{-12}
	U-NAT	$(6.05 \pm 0.02) \times 10^{-10}$	3×10^{-13}

CORE LABORATORIES, INC.

P. O. Box 2794
Casper, Wyoming

ANALYTICAL REPORT

From: Western Environmental — Product: Water

Address: Casper, Wyoming — Date: 6-21-84

Other Pertinent Data:

Analyzed by: — Date: 6-26-84 — Lab. No. R40251

Sample				Rn^{222} pCi/l	Rn^{222} LLD pCi/l		
1	YCD			0.9 ± 0.3	0.2		
2	Packaging exhaust			0.1 ± 0.3	0.2		
3	Cooler exhaust			0.1 ± 0.3	0.2		
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
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22							
23							
24							
25							
26							
27							
28							
29							
30							

ND - Not detected at level given in parentheses

Remarks

APPENDIX F

Chain of Custody
and
Analysis Request

WESTERN ENVIRONMENTAL SERVICES & TESTING

Chain of Custody and Analysis Request

Job Number 8410-136 Date(s) Sampled 6-21-84

Job Name Petro Tanks Number of Runs 3

Source Location Shirley Basin, WY.

Unit Tested VCD - cooler - pack-exh.

Absorbing Solution/Analysis For

Run	Filter Number	Imp 1	Imp 2	Imp 3	Imp 4	Probe Wash
1-VCD	I-71	DI H2O / Moist	DI H2O / Moist	DRY / Moist	Silica Gel / Moist	Acetone / Part
1-Pack exh	I-70	"	"	"	"	"
1-cooler	I-69	"	"	"	"	"
4						

No_x: ______

Other ______

Total Number of Sample Bottles: 3

Total Number of Filters: 3

Comments: ______

Person Responsible for Samples: [signature]

Sample No.	Recovered by	Date	Time	Location
1	[signature]	6-21-84	10:15	On site
2	[signature]	6-21-84	12:00	onsite
3	[signature]	6-21-84	13:30	onsite
4				

Samples Received by [signature] for transport Date: 6-21-84 Time: 1400

Samples Received at lab by [signature] Date: 6-21-84 Time: 1550

Samples Analyzed by Alan Henglaine Date: 8-21-84 Time: —

APPENDIX G

Resumes of Test Personnel

BRUCE A. HINCHEY

CURRENT: 6-1-81 to present	President, Western Environmental Services and Testing, Inc., Casper, Wyoming, Dallas, Texas, and Bismarck, North Dakota; an environmental monitoring and consulting firm.
PROFESSIONAL: 6-1-78 to 5-31-81	Vice President, Air Quality Department, Kumpe and Associates, P.C., Casper, Wyoming; an engineering and consulting firm.
9-1-72 to 6-1-78	Manager, Air Quality Studies, Ecology Audits, Inc., an environmental monitoring and consulting firm. Former Laboratory Manager for same in Casper, Wyoming.
EDUCATION:	Attended the University of Missouri at Rolla for 3½ years; Major - Petroleum Engineering.
TECHNICAL EXPERIENCE:	Managed over 120 ambient air studies in the past years; managed the operation of 40 ambient air networks at Wyoming coal and uranium mines; conducted over 1500 source emission surveys in the western and southwestern United States; qualified as an expert witness in air pollution litigation.
TEACHING EXPERIENCE:	Lectured in the U. S. Environmental Protection Agency's training course "Source Sampling for Particulate Pollutants," September 1975; lectured in short course "Performing and Observing Source Sampling," May 1977; conducted source sampling training for industrial personnel at various locations.
PROFESSIONAL TRAINING:	Attended short course for consultants "Performing and Observing Source Sampling," Dallas, Texas, 1976; E.P.A. short course, "Source Sampling Techniques and Reporting," Denver, Colorado, December 1976; National Asphalt Producers Association short course, "Asphalt Plant Construction, Design and Servicing for Air Quality," December 1977.
CERTIFICATIONS:	Visible Emissions Evaluator Licensed Private Pilot, multi-engine-land, instrument rated
PROFESSIONAL MEMBERSHIPS:	Air Pollution Control Association Society of Petroleum Engineers of A.I.M.E. Society of Mining Engineers of A.I.M.E. Source Evaluation Society Wyoming Mining Association Colorado Mining Association

MARCELO A. VINCENT

CURRENT:	
October 1983 to present	Technician, Western Environmental Services and Testing, Inc., Casper, Wyoming and Bismarck, North Dakota; an environmental monitoring and consulting firm.
PROFESSIONAL:	
3/15/83 to 7/15/83	Loss Prevention Agent, Internal Loss Investigations, J.W. Robinson Company, Pasadena, California
7/80 to 10/82	Security Officer, Casper College, Casper, Wyoming
5/75 to 4/79	Law Enforcement Specialist, United States Air Force
EDUCATION:	Attended Los Angeles City College, Los Angeles, California and Casper College, Casper, Wyoming, for 1½ years. Currently attending Casper College majoring in Criminal Justice.