Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

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AP42 Section:	3.1
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Title:	Air Toxins Emissions Inventory Testing at Coolwater Generating Station Combustion Turbine No. 42 for Inclusion in Air Toxins Hot Spots Inventory Required under AB 2588. McDannel, M.D. Prepared by Carnot, Tustin, California for Southern California Edison Company, Rosemead, California. May, 1990.

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AIR TOXICS EMISSIONS INVENTORY TESTING AT ~~COOLWATER GENERATING STATION~~ COMBUSTION TURBINE ~~NO. 42~~

CARNOT

AIR TOXICS EMISSIONS INVENTORY TESTING AT COOLWATER GENERATING STATION COMBUSTION TURBINE NO. 42

Prepared for:

SOUTHERN CALIFORNIA EDISON COMPANY
Rosemead, California

For Inclusion in:

Air Toxics Hot Spots Inventory
required under
AB2588

Prepared by:

Mark D. McDannel, P.E.
Lisa A. Green

CARNOT

formerly the California Division of
ENERGY SYSTEMS ASSOCIATES

Tustin, California

MAY 1990

ESR 53304-2054

REPORT CERTIFICATION

The sampling and analysis performed for this report was carried out under my direction and supervision.

Date 5/30/90

Mark D. McDannel
Vice President and General Manager

I have reviewed all testing details and results in this test report and hereby certify that the test report is authentic and accurate.

Date 5/30/90

Mark D. McDannel
Vice President and General Manager

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SECTION 1.0

INTRODUCTION

Carnot, formerly the California Division of Energy Systems Associates, was contracted by the Southern California Edison Company (SCE) to provide emissions measurement services in support of their preparation of emission inventory reports as required by the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588). AB 2588 requires any facility which meets certain criteria to submit an emission inventory report to local air pollution regulatory agencies. Data is compiled by a combination of source test emission measurements and estimations. These reports are prepared according to inventory plans approved by the Ventura County Air Pollution Control District and by the California Air Resources Board (ARB).

This document is the test report for the emissions tests conducted on SCE's Coolwater Generating Station Combustion Turbine No. 42. The results of the tests on this unit were used to generate emissions data for it and other similar sources in the SCE power generating system. These results satisfy the requirements for measurements of substances that must be quantified by a source test as set forth in Appendix D of the Emission Inventory Criteria and Guidelines Regulation published by the ARB on June 2, 1989.

Triplicate emissions tests were conducted while firing gas fuel for:

- formaldehyde
- benzene

Triplicate emissions tests were conducted while firing distillate oil for

- formaldehyde
- benzene
- polycyclic aromatic hydrocarbons (PAH)

Two distillate oil samples were also analyzed for:

- Btu/lb (HHV)
- carbon, hydrogen, oxygen, nitrogen
- sulfur
- ash content

- chloride
- full set of metals to include:
  arsenic, beryllium, cadmium, total and hexavalent chromium, copper, lead, manganese, mercury, nickel, selenium and zinc

Testing was conducted March 26 through March 29, 1990. The Carnot test team was supervised by Mark McDannel, P.E. Other Carnot test team members were Vikram Reddy and Jim Mulligan. Mike Escarcega of SCE coordinated all test activities.

Table 1-1 summarizes the results of the emissions tests while firing natural gas. Tables 1-2 and 1-3 summarize the results of the emissions tests while firing distillate oil. Table 1-4 presents the results of the distillate oil analyses. Detailed results are included in Section 4.0.

TABLE 1-1
SUMMARY OF AB2588 EMISSIONS TEST RESULTS
NATURAL GAS FUEL
SCE/COOLWATER COMBUSTION TURBINE NO. 42
March 26-29, 1990

Species	
Benzene:	
ppb	ND <1
lb/hr	ND <7.3 x 10^{-3}
lb/MMBtu	ND <9.6 x 10^{-6}
Formaldehyde	
ppb	10,365
lb/hr	29.1
lb/MMBtu	.0382

TABLE 1-2
SUMMARY OF AB2588 EMISSIONS TEST RESULTS
DISTILLATE OIL FUEL
SCE/COOLWATER COMBUSTION TURBINE NO. 42

Species	
Benzene:	
ppb	12.7
lb/hr	0.090
lb/MMBtu	9.7×10^{-5}
Formaldehyde	
ppb	341
lb/hr	0.93
lb/MMBtu	1.02×10^{-3}
Total PAH	
$\mu g/m^3$	<0.17
lb/hr	$<3.8 \times 10^{-4}$
lb/MMBtu	$<4.3 \times 10^{-7}$

TABLE 1-3
SUMMARY OF PAH EMISSION RESULTS
DISTILLATE OIL FUEL
SCE/COOLWATER COMBUSTION TURBINE NO. 42

Species	$\mu g/m^3$	lb/hr	lb/MMBtu
Naphthalene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Acenaphthylene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Acenaphthene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Fluorene	<.01	$<2.3 \times 10^{-5}$	$<2.6 \times 10^{-8}$
Phenanthrene	<.02	$<5.1 \times 10^{-5}$	$<5.9 \times 10^{-8}$
Anthracene	<.01	$<3.0 \times 10^{-5}$	$<3.5 \times 10^{-8}$
Fluoranthene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Pyrene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Benz(a)anthracene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Chrysene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Benzo(b+k)fluoranthene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Benzo(a)pyrene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Indeno[1,2,3-cd]pyrene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Dibenzo(a,h)anthracene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Benzo(g,h,i)perylene	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
TOTAL PAH	<0.17	$<3.8 \times 10^{-4}$	$<4.3 \times 10^{-7}$

TABLE 1-4
FUEL ANALYSIS SUMMARY
DISTILLATE OIL
SCE/COOLWATER COMBUSTION TURBINE NO. 42
March 26-29, 1990

Parameter	
Btu/lb (HHV)	19,500
Carbon, %	84.64
Hydrogen, %	15.16
Nitrogen, %	0.15
Oxygen, %	0.2
Sulfur, %	0.06
F factor, dscf/MMBtu @ 0% O_2 and 60°F	9,325
Chlorine, mg/liter	ND <50
Arsenic, mg/liter	ND <0.25
Beryllium, mg/liter	ND <0.05
Cadmium mg/liter	ND <0.05
Chromium, mg/liter	0.06
Hexavalent Chromium, mg/liter	ND <0.06
Copper, mg/liter	0.4
Lead, mg/liter	0.5
Mercury, mg/liter	ND <0.1
Manganese, mg/liter	ND <0.1
Nickel, mg/liter	<0.07
Selenium, mg/liter	ND <0.25
Zinc, mg/liter	0.24

ND - not detected

SECTION 2.0

UNIT DESCRIPTION AND OPERATION

Units 3 and 4 at Coolwater are identical Westinghouse PACE 520 combined cycle units. Figure 2-1 shows a plan view of Unit 4. Each unit consists of two combustion turbines, two heat recovery steam generators (HRSG), and one steam turbine. The transition duct between each combustion turbine and HRSG inlet contains a duct burner (afterburner). The two turbines for each unit exhaust through a common stack.

The combustion turbine includes combustor baskets arranged in a circular array around the horizontal axis of the turbine. Also, included are a water injection system and an inlet air evaporative cooler. The combustion turbines are rated at 63 megawatts each and can fire natural gas or distillate fuel.

These tests were conducted on one of the two turbines of Unit 4 (Turbine No. 42, also referred to as CT 42). CT 41 was shut down during the tests so that only gases from CT 42 were being vented through the stack.

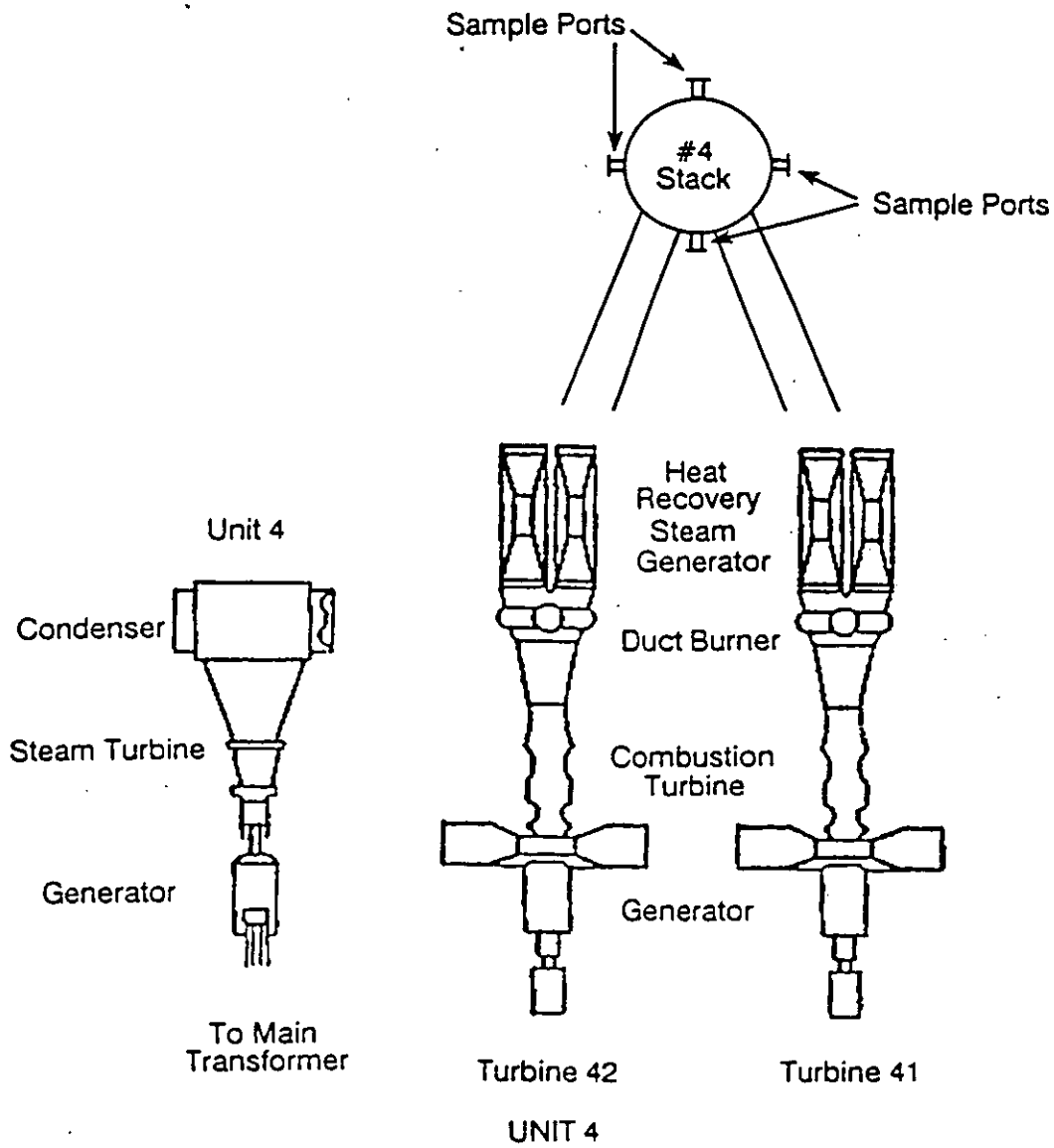


Figure 2-1. Coolwater Combined Cycle Unit 4

SECTION 3.0

TEST DESCRIPTION

3.1 TEST CONDITIONS AND TEST SCHEDULE

The tests on Coolwater Generating Station Combustion Turbine #42 were conducted with the turbine firing at or near full normal load, under normal operating conditions. Testing was conducted with the turbines firing both distillate oil and natural gas fuels. Table 3-1 gives the tests conducted for each fuel type.

Table 3-2 lists the unit operating conditions for each test. Test 1-PAH was begun on 3/26 but was interrupted due to a unit trip. The trip occurred while the sampling system was off and out of the stack during a port change, however, so there was no impact on the test. Since it was anticipated that it would be several hours before test conditions could be reestablished and since the sample location was secured from non-test personnel and protected from weather, the sample train was sealed overnight and the test was continued the next day (3/27/90).

TABLE 3-1
SUMMARY OF TESTS PERFORMED

Fuel	Species Measured by Source Test
Distillate Oil	Benzene, Formaldehyde, PAH (Also fuel analysis for Metals, Chloride)
Natural Gas	Benzene, Formaldehyde

TABLE 3-2
UNIT OPERATION DURING AB2588 TESTING
SOUTHERN CALIFORNIA EDISON
COOLWATER UNIT NO. 4
March 26-29, 1990

Test No.	Date	Time From/To	Fuel	Load MW	Comments
1-PAH	3/26/90	1726/1829	Oil	~60	Test interrupted due to unit trip
and	3/27/90	1000/1258	Oil	63	
2-PAH	3/27/90	1514/1947	Oil	63	
3-PAH	3/28/90	0924/1317	Oil	63	
3A-Benz	3/28/90	1451/1511	Oil	63	
3B-Benz	3/28/90	1520/1540	Oil	63	
3C-Benz	3/28/90	1550/1610	Oil	63	
3A-Form	3/28/90	1449/1519	Oil	63	
3B-Form	3/28/90	1527/1557	Oil	63	
3C-Form	3/28/90	1601/1631	Oil	63	
4-Vel	3/29/90	0907/1020	Gas	63	
4A-Benz	3/29/90	1117/1137	Gas	63	
4B-Benz	3/29/90	1142/1202	Gas	63	
4C-Benz	3/29/90	1205/1225	Gas	63	
4A-Form	3/29/90	0845/0915	Gas	63	
4B-Form	3/29/90	0925/0955	Gas	63	
4C-Form	3/29/90	1010/1040	Gas	63	
5-Vel	3/29/90	1035/1140	Gas	63	

3.2 SAMPLE LOCATIONS

Samples were collected in the common stack which vents the gases from CTs 41 and 42. In order to quantify emissions from CT 42 only, CT 41 was shut down for the tests. A sketch of the sample location is included in Appendix C.

Samples were collected from the 20 ft. diameter stack at the 159 ft. level. This location is 78 ft. (3.9 diameters) downstream of the top of the stack inlet and greater than 40 ft. (2 diameters) upstream of the stack exit. In accordance with EPA Method 1, velocity, moisture, and isokinetic test traverses were performed using a 24-point grid. Since O_2 traverses showed that the gases were well-mixed, non-isokinetic tests (benzene, formaldehyde, and O_2/CO_2) were performed at single points.

3.3 TEST PROCEDURES

The test procedures and related information used at Coolwater CT No. 42 are listed in Table 3-3. Table 3-3 lists the test procedures for air emission tests. Descriptions of standard procedures are included in Appendix A. Additional information and modifications to standard procedures are presented below.

3.3.1 Benzene

Triplicate samples for benzene analysis were collected in Tedlar bags on each fuel type. However, one tedlar bag for the test on oil fuel leaked during transport to the lab and therefore only two bags were analyzed. In order to obtain three analyses, one of the bags was analyzed twice. All three tedlar bags for the test on gas fuel were acceptable. The samples were analyzed by gas chromatography by Truesdail Laboratories in Tustin, California.

3.3.2 Formaldehyde

Triplicate formaldehyde samples on each fuel type were collected non-isokinetically using midget impingers in acidic 2,4-dinitrophenylhydrazine solution. The analyses for formaldehyde were performed by HPLC by Radian Laboratories, in Austin, Texas.

TABLE 3-3
TEST PROCEDURES FOR COOLWATER COMBUSTION TURBINE
AIR EMISSIONS TESTS

Parameter	No. Replicates	Duration of Test (min.)	Sample Rate	Measurement Principle	Reference Method	Method Detection Limit
Benzene	3*	20	.5 l/min	GC/PID	CARB 410A	1 ppb
Formaldehyde	3*	30	1 l/min	HPLC	CARB 430	0.9 $\mu g/m^3$
PAH	3*	180	1 m^3/hr	GC/MS	CARB 429	10 ng/m^3 per species
Metals, Chloride	2	---	---	Fuel Analysis	---	---

* 3 replicates on each fuel type

3.3.3 Polycyclic Aromatic Hydrocarbons (PAH)

Triplicate PAH samples were collected according to the sampling procedures of CARB Method 429 on oil fuel only. This method is known as the semi-VOST or "Modified Method 5". Table 3-4 summarizes the pertinent information for these tests. In this procedure, a sample is collected isokinetically and passed through a heated Method 5 filter followed by an XAD-2 sorbent module in a water-cooled jacket. The sorbent module is followed by an impinger train to collect moisture and any PAH that might pass through the resin.

TABLE 3-4
PAH TEST INFORMATION

Sampling Method	CARB 429
Analytical Method	GC/MS
Analytical Laboratory	Zenon Environmental
Expected Levels	Less than 10 ng/m^3 per species
Analytical Lower Detection Limit	10-100 ng per species
Sample Volumes	2-3 m^3 (2-hour sample)
Internal Standards	Added to post-test samples
Surrogate Standards	Added to resin prior to sampling
Blank	Full field blank train used
Fractions to be Analyzed	Probe wash, filter, sorbent module, connecting glassware rinse, and first impinger combined
Chain of Custody	Maintained by ESA and Zenon on all samples
Sample Train Assembly and Recovery	Performed in on-site clean room to minimize chance of contamination
Glassware Cleaning	Acid cleaning followed by DI H_2O, acetone, and hexane rinses and high temperature bake

Sample analysis was performed by Zenon Environmental in Burlington, Ontario. Zenon also prepared the resin, loaded the modules, and extracted the modules and other fractions according to CARB procedures. Appropriate laboratory spikes were introduced to the samples by Zenon and the percent recovery were reported along with the results.

GC/MS with selective ion monitoring was used to analyze PAH. This procedure provides the lowest detection limits possible for these samples. In accordance with Appendix C-1 of "Emission Inventory Criteria and Guidelines", the following PAH species were quantified:

Acenaphthene
Acenaphthylene
Anthracene
Benz[a]anthracene
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[a]pyrene
Benzo[g,h,i]perylene
Chrysene
Dibenz[a,h]anthracene
Fluoranthene
Fluorene
Indeno[1,2,3,-cd]pyrene
Naphthalene
Phenanthrene
Pyrene

A full field blank was collected and analyzed for PAH. For a field blank, a separate sample train was assembled, transported, leak checked, rinsed, and recovered in the same way as the sample train. This provided a blank value not only for the analytical procedures but also for the reagents, filter, and any possible contamination introduced by sample handling.

3.3.4 Distillate Oil Samples

Two distillate oil samples were collected by SCE to be analyzed for:

- Btu/lb
- carbon, hydrogen, oxygen, nitrogen
- sulfur
- ash content
- chloride
- full set of metals to include:
  arsenic, beryllium, cadmium, total and hexavalent chromium, copper, lead, manganese, mercury, nickel, selenium, and zinc.

These analyses were performed by Curtis and Tompkins.

3.4 QUALITY ASSURANCE

Carnot has a rigorous ongoing QA program to ensure that high-quality data is obtained and to ensure full documentation of test details. The QA program includes:

1. Appointment of a Quality Assurance Officer for Carnot's Source Test Division
2. Preparation of a QA manual for internal use
3. Standardization of reporting and review procedures
4. Implementation of chain of custody procedures on all samples and data sheets
5. Scheduling of internal QA and training meetings
6. Complete documentation of instrument calibration and CEM performance data
7. Adherence to method-specific QA procedures for all testing
8. Personnel training
9. Monitoring of new and emerging methods and technologies.

Specific QA data which will be included in the final report are:

1. Equipment calibration data
2. CEM calibration data
3. CEM performance data
4. Chain of custody on all samples

Carnot participates in EPA's audit programs for Methods 5, 6, and 7, and is certified by the California Air Resources Board under its Independent Source Tester's Approval program. Additional QA information is presented in Appendix B.

SECTION 4.0

RESULTS

This section presents the results of the emissions tests performed at SCE's Coolwater Generating Station Unit No. 4. All data sheets, calculations, laboratory reports and quality assurance information are included in the Appendices.

The results of the tests are summarized in Tables 4-1 through 4-4. Detailed results of the tests are presented in the following subsections.

4.1 Polycyclic Aromatic Hydrocarbons (PAH)
4.2 Benzene
4.3 Formaldehyde
4.4 Fuel Analyses
4.5 Test Summary and Isokinetics

4.1 PAH

PAH samples were analyzed by Zenon Environmental, Ontario, Canada. Results for the PAH tests are presented in Table 4-1. Detailed results are presented in Appendix C.6. The results show no detectable levels (above blank levels) for almost all species on all tests.

Test 1-PAH was started on 3/26/90. However, a unit trip occurred at 1841 during a port change, so the test was stopped and then continued on 3/27/90 at 1000.

On Test 2-PAH, the isokinetic ratio obtained was 85.69%. The reason that the ratio was below 90% was that the pump could not pull enough flow due to a higher than expected pressure drop through the sample train. The impact of sampling below a 90% isokinetic rate is that emissions may be slightly overstated for this test. However, since there was almost no PAH detected on any of the tests, it is concluded that the subisokinetic sampling had no impact on the results.

There were no irregularities concerning Test 3-PAH. Use of a smaller sampling nozzle on this test allowed achievement of target isokinetic values.

TABLE 4-1
POLYCYCLIC AROMATIC HYDROCARBON EMISSIONS
SCE COOLWATER COMBUSTION TURBINE NO. 42
MARCH 1990

Test No.	1-PAH	2-PAH	3-PAH	Average		
Date:	03/26/89	03/27/89	03/28/89			
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	lb/hr	lb/MMBtu
Naphthalene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Acenaphthylene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Acenaphthene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Fluorene	ND <.009	0.010	ND <.012	<.01	$<2.3 \times 10^{-5}$	$<2.6 \times 10^{-8}$
Phenanthrene	ND <.009	0.049	ND <.012	<.02	$<5.1 \times 10^{-5}$	$<5.9 \times 10^{-8}$
Anthracene	ND <.009	0.020	ND <.012	<.01	$<3.0 \times 10^{-5}$	$<3.5 \times 10^{-8}$
Fluoranthene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Pyrene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Benz(a)anthracene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Chrysene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Benzo(b+k)fluoranthene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Benzo(a)pyrene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Indeno(1,2,3-cd)pyrene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Dibenzo(a,h)anthracene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
Benzo(g,h,i)perylene	ND <.009	ND <.010	ND <.012	ND <.01	ND $<2.3 \times 10^{-5}$	ND $<2.6 \times 10^{-8}$
TOTAL PAH	ND <0.13	<0.20	ND <0.18	<0.17	$<3.8 \times 10^{-4}$	$<4.3 \times 10^{-7}$

4.2 BENZENE

Triplicate samples for benzene analysis were collected in tedlar bags for each fuel type and analyzed by Truesdail Laboratories, Inc. in Tustin, CA. Individual test results are shown in Table 4-2. Detailed results are presented in Appendix C.4.

One tedlar bag collected while using oil fuel was unsuitable for analysis due to gross leakage. The other two bags agreed favorably. A duplicate analysis was performed on tedlar bag 3-C to provide 3 data points.

Benzene was detected on oil fuel but not on gas fuel. The average benzene values oil fuel were ~12 ppb.

TABLE 4-2
BENZENE RESULTS
SCE COOLWATER COMBUSTION TURBINE NO. 42
MARCH 1990

WITH UNIT ON FUEL OIL				
Test No.	3B-Benz	3C-Benz	3C-Benz*	Average
Date	03/28/90	03/28/90	03/28/90	
ppb	12.7	11.5	11.5	11.9
lb/hr	0.090	0.082	0.082	0.085
lb/MMBtu	9.7×10^{-5}	8.8×10^{-5}	8.9×10^{-5}	9.2×10^{-5}

WITH UNIT ON NATURAL GAS				
Test No.	4A-Benz	4B-Benz	4C-Benz	Average
Date	03/29/90	03/29/90	03/29/90	
ppb	ND <1	ND <1	ND <1	ND <1
lb/hr	ND <0.0073	ND <0.0073	ND <0.0073	ND <0.0073
lb/MMBtu	ND $<9.6 \times 10^{-6}$	ND $<9.6 \times 10^{-6}$	ND $<9.6 \times 10^{-6}$	ND $<9.6 \times 10^{-6}$

* Tedlar bag for 3C-Benz analyzed twice since Tedlar bag leaked on 3A-Benz

4.3 FORMALDEHYDE

Formaldehyde samples were analyzed by Radian Corporation, Morrisville, N.C. The formaldehyde results are presented in Table 4-3. Detailed results are presented in Appendix C.5.

Average formaldehyde concentrations were 341 ppb on oil fuel and 10,360 ppb (10.36 ppm) on gas fuel.

TABLE 4-3
FORMALDEHYDE RESULTS
SCE COOLWATER COMBUSTION TURBINE NO. 42
MARCH 1990

WITH UNIT ON FUEL OIL				
Test No.	3A-Form	3B-Form	3C-Form	Average
Date	03/28/90	03/28/90	03/28/90	
ppb	406	280	339	341
lb/hr	1.11	0.77	0.93	0.93
lb/MMBtu	1.2×10^{-3}	8.25×10^{-4}	9.99×10^{-4}	1.02×10^{-3}

WITH UNIT ON NATURAL GAS				
Test No.	4A-Form	4B-Form	4C-Form	Average
Date	03/29/90	03/29/90	03/29/90	
ppb	11,249	10,021	9,824	10,365
lb/hr	31.5	28.1	27.5	29.0
lb/MMBtu	.0426	.0380	.0372	.039

4.4 FUEL ANALYSIS

The fuel analysis results are shown in Table 4-4 for oil fuel, and Table 4-5 for gas fuel. Detailed results are presented in Appendix C.7.

Due to the high volatility of the fuel, the laboratory had difficulty in performing the elemental analysis. A large portion of the fuel was evaporated during analysis, and was erroneously counted as oxygen (which is not measured but determined by difference). It was assumed that the oxygen content was 0.2% (a typical value for distillate fuels), and the analyses were adjusted. This adjustment was not made for heating value or the trace metals analyses, which are not impacted.

TABLE 4-4
FUEL ANALYSIS SUMMARY
DISTILLATE OIL
SCE/COOLWATER COMBUSTION TURBINE NO. 42
March 26-29, 1990

Parameter	
Btu/lb (HHV)	19,500
Carbon, %	84.64
Hydrogen, %	15.16
Nitrogen, %	0.15
Oxygen, %	0.2
Sulfur, %	0.06
F factor, dscf/MMBtu @ 0% O_2 and 60°F	9,325
Chlorine, mg/l	ND <50
Arsenic, mg/l	ND <0.25
Beryllium, mg/l	ND <0.05
Cadmium mg/l	ND <0.05
Chromium, mg/l	0.06
Hexavalent Chromium, mg/l	ND <0.06
Copper, mg/l	0.4
Lead, mg/l	0.5
Mercury, mg/l	ND <0.1
Manganese, mg/l	ND <0.1
Nickel, mg/l	<0.07
Selenium, mg/l	ND <0.25
Zinc, mg/l	0.24

ND - not detected

TABLE 4-5
FUEL ANALYSIS SUMMARY
NATURAL GAS FUEL
SCE/COOLWATER COMBUSTION TURBINE NO. 42
March 29, 1990

Volume %	
Methane	87.9
Ethane	3.5
Propane	1.3
Butane	0.3
CO_2	0.9
Nitrogen	2.6
Oxygen	0.4
Higher heating value, Btu/scf	995
F factor, dscf/MMBtu @ 0% O_2 and 60°F	8,472

4.5 TEST SUMMARY AND ISOKINETICS

A summary of the isokinetic tests performed is presented in Table 4-6.

TABLE 4-6
SUMMARY OF TEST CONDITIONS FOR ISOKINETIC AND VELOCITY TESTS
SCE/COOLWATER COMBUSTION TURBINE NO. 42
MARCH 1990

Test	Date	Time	Vm_{std}	Q sd (dscfm)	O_2	CO_2	% Isokinetic
1-PAH	3/26/90 and 3/27/90	1726/1829 1000/1258	98.53	620,710	16.10	3.31	90.40
2-PAH	3/27/90	1514/1947	86.63	575,737	16.16	3.07	85.69
3-PAH	3/28/90	0924/1317	73.38	575,747	15.67	3.33	104.00
4-Vel	3/29/90	0907/1020	27.73	593,256	16.10	2.36	–
5-Vel	3/29/90	1035/1140	30.86	590,602	17.10	1.87	–

APPENDIX A

MEASUREMENT PROCEDURES

Oxygen (O_2) by Continuous Analyzer

Carbon Dioxide (CO_2) by Continuous Analyzer

Benzene by Gas Chromatography

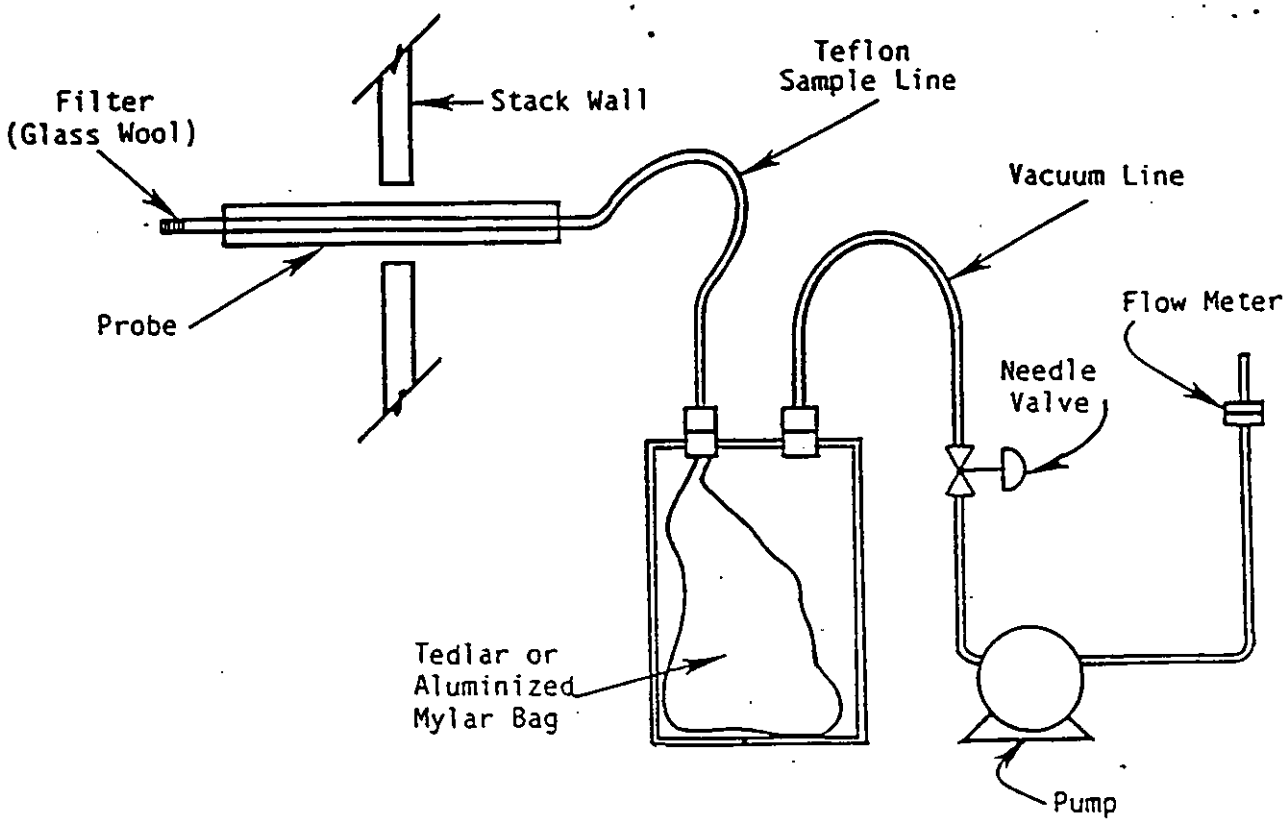
Semi-Volatile Organic Sampling Train Procedures

Formaldehyde by HPLC

Method:	Oxygen (O_2) by Continuous Analyzer
Applicable Ref. Methods:	EPA 3A, EPA 20, ARB 100, BA ST-14
Principle:	A sample is continuously drawn from the flue gas stream, conditioned, and conveyed to the instrument for direct readout of O_2 concentration.
Analyzer:	Teledyne Model 326A
Measurement Principle:	Electrochemical cell
Ranges:	0-5, 0-10, 0-25% O_2
Accuracy:	1% of full scale
Output:	0-100 mV, linear
Interferences:	Halogens and halogenated compounds will cause a positive interference. Acid gases will consume the fuel cell and cause a slow calibration drift.
Response Time:	90% <7 seconds
Sampling Procedure:	A representative flue gas sample is collected and conditioned using the CEM system described previously. If Method 20 is used, that method's specific procedures for selecting sample points are used. Otherwise, stratification checks are performed at the start of a test program to select single or multiple-point sample locations.
Analytical Procedure:	An electrochemical cell is used to measure O_2 concentration. Oxygen in the flue gas diffuses through a Teflon membrane and is reduced on the surface of the cathode. A corresponding oxidation occurs at the anode internally, and an electric current is produced that is proportional to the concentration of oxygen. This current is measured and conditioned by the instrument's electronic circuitry to give an output in percent O_2 by volume.
Special Calibration Procedure:	The measurement cells used with the O_2 instrument have to be replaced on a regular basis. After extended use, the cell tend to produce a nonlinear response. Therefore, a three-point calibration is performed at the start of each test day to check for linearity. If the response is not linear ($\pm$ 2% of scale), the cell is replaced.

Method:	Carbon Dioxide (CO_2) by Continuous Analyzer
Applicable Ref. Methods:	EPA 3A, ARB 100, BA ST-5
Principle:	A sample is continuously drawn from the flue gas stream, conditioned, and conveyed to the instrument for direct readout of CO_2 concentration.
Analyzer:	Horiba PIR 2000
Measurement Principle:	Nondispersive infrared (NDIR)
Accuracy:	1% of full scale
Ranges:	0-5, 0-10, 0-25%
Output:	0-10 mV
Interferences:	A possible interference includes water. Since the instrument receives dried sample gas, this interference is not significant.
Response Time:	1.2 seconds
Sampling Procedure:	A representative flue gas sample is collected and conditioned using the CEM system described previously.
Analytical Procedure:	Carbon dioxide concentrations are measured by short pathlength nondispersive infrared analyzers. These instruments measure the differential in infrared energy absorbed from energy beams passed through a reference cell (containing a gas selected to have minimal absorption of infrared energy in the wavelength absorbed by the gas component of interest) and a sample cell through which the sample gas flows continuously. The differential absorption appears as a reading on a scale of 0 to 100%.

Method:	Benzene by Gas Chromatography
Reference:	CARB Method 410, Modified EPA Method 601/602.
Principle:	A Tedlar bag is filled with flue gas at a constant rate. The bag contents are analyzed by gas chromatography/photo ionization detection for volatile organic compounds.
Sample Procedure:	Samples are collected using a lung-type sampling system shown in the attached figure. In this system, a bag is placed in a sealed container and the container is evacuated. Flue gas enters the bag as it expands to fill the container. Sampling rate is monitored by a rotameter on the container exhaust. This system allows sample collection without exposing the sample to pumps, flowmeters, oils, etc.
Analytical Procedure:	In the analytical phase, the contents of the Tedlar bags are injected directly on a capillary chromatographic column. Column type, instrument conditions and sample volume are optimized to obtain complete separation of all compounds of interest and detection limits of no more than 10 ppb. Carnot subcontracts these analyses to qualified local laboratories experienced in these analytical procedures.



Sample Train for Determination of Volatile Organic Compounds (VOC) by EPA 601/602

Method: Semi-volatile Organic Sampling Train (Semi-VOST)

References: CARB Method 429 (for PAH)
ASME Modified Method 5

Principle: A metered flue gas sample is collected isokinetically, and semi-volatile organic compounds are collected on a heated filter, on water-cooled XAD-2 resin module, and in an iced impinger bath. Depending upon the specific test requirements, the samples are then analyzed for polycyclic aromatic hydrocarbons (PAH) species. This section discusses the sampling and sample handling techniques for the semi-VOST method.

Sample Train Preparation: Because of the very low detection limits of the analytical techniques, thorough cleaning of sample train components prior to testing is vital. Prior to testing, all glassware is cleaned in Carnot's laboratory with high purity water, acetone, and hexane rinses, and then baked at high temperature. Resin modules are cleaned and loaded with purified resin by the contract laboratory within one week of the scheduled test date. Batches of Whatman 934AH fiberglass filters are toluene-rinsed and proofed by the contract laboratory. Individual filters are then tared and stored in petri dishes lined with hexane rinsed aluminum foil.

Sample train assembly is performed in an on-site clean room by experienced personnel.

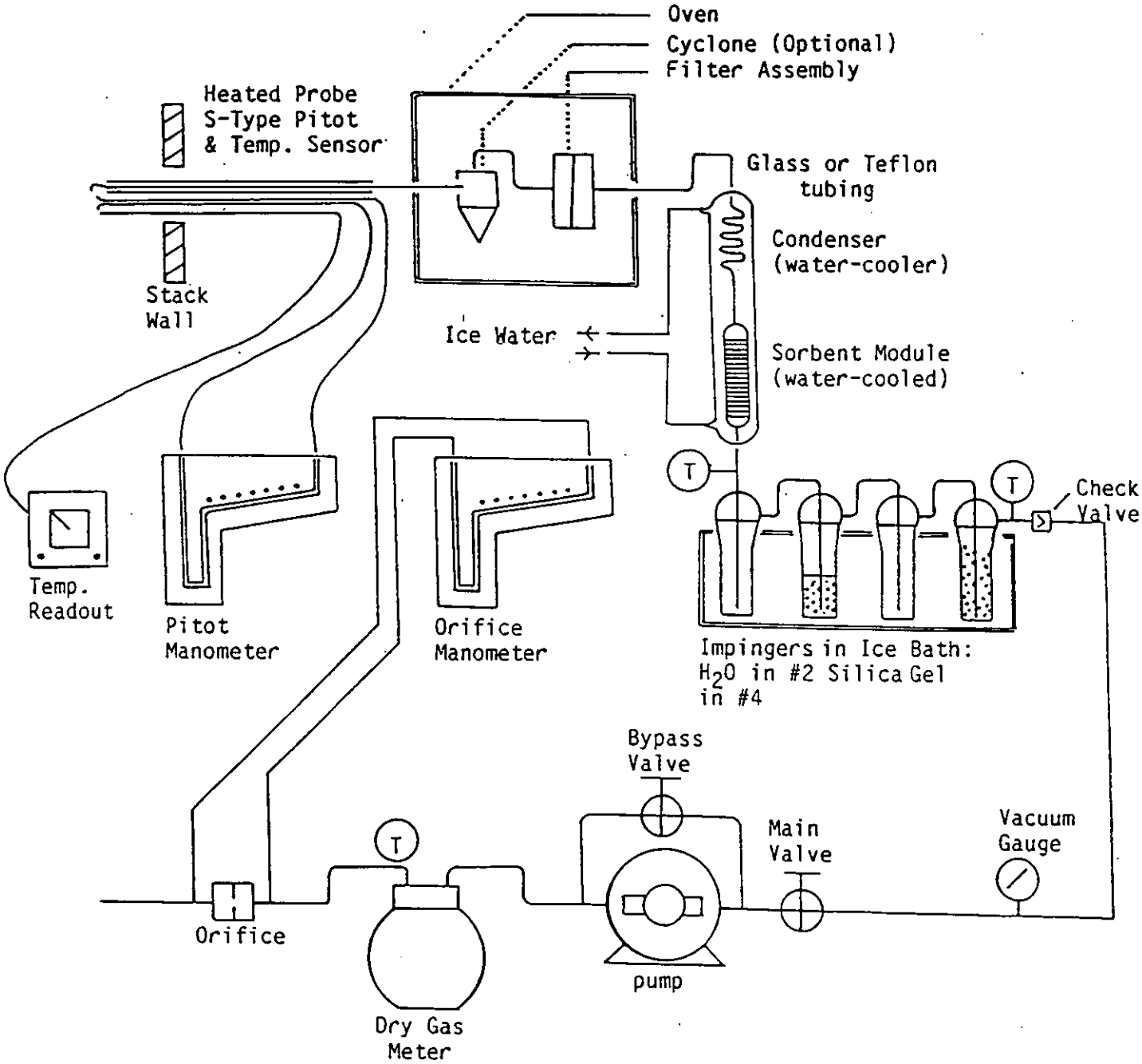
Sampling: The sample train is shown in the attached figure. Sample is pulled through the following components:

1. Glass or nickel-coated stainless steel nozzle
2. Heated glass probe (250 $\pm$ 15 F)
3. Optional cyclone in heated oven (250 $\pm$ 15 F)
4. Filter in heated oven
5. Glass or teflon tubing
6. Condenser/sorbent module cooled with circulating ice water from impinger bath
7. Dry impinger with stub stem
8. Smith-Greenburg impinger with 100 ml DI H_2O
9. Dry impinger as a knockout
10. Impinger containing silica gel
11. Leak-free vacuum pump
12. Calibrated dry gas meter

The pump, meter, manometers, and heater controllers are all contained in a single control box (Andersen Universal or equivalent).

During final sample train assembly and leak check procedures on the stack or duct, special precautions are taken to minimize the chance of contamination. Sample train components are open to the air for as short a time as possible; and during transport to and from the stack, all components are sealed with hexane rinsed aluminum foil.

Semi-VOST Sampling Train



Sample Recovery: All sample recovery is performed in Carnot's laboratory or an on-site clean room. Following sampling the resin module is sealed with glass caps and stored in a refrigerator or ice chest, the filter is placed in a light-proofed petri dish, and all glassware components are rinsed. The rinse consists of three rinses each of distilled water, acetone, hexane, and methylene chloride. All solvents are high purity GS/MC grade, the squirt bottles are teflon, and the sample bottles are amber glass with teflon-lined caps. Water fractions are placed in separate bottles from the solvent rinses to simplify extraction procedures for the contract laboratory.

Field Blank: At least once during each test series, a field blank sample is collected. This consists of assembling a sample train transporting it to and from the stack, leak checking it, and recovering it. This sample is analyzed using the same procedures as for the test samples.

Sample Custody: Full chain of custody is maintained on all reagents, sample trains, and samples by Carnot and by contract laboratories. In addition to formal documentation by the sample custodians, sample data sheets are initialed by the individuals who assemble and recover each sample train component.

Method:	Formaldehyde by HPLC
Reference:	CARB Method 430
Principle:	A metered gas sample is collected non-isokinetically in acidic 2,4-dinitrophenylhydrazine (DNPH) solution. Formaldehyde reacts with DNPH to form the 2,4-dinitrophenylhydrazone derivative. The concentration of this formaldehyde derivative is determined by reverse phase HPLC with an ultraviolet absorption detector.
Sampling Procedure:	A dry metered gas sample is collected through teflon tubing into an iced midget impinger train containing 20 ml of aqueous acidic DNPH solution. Samples are recovered with DNPH solution into precleaned glass bottles, refrigerated and analyzed within 7 days.
Analytical Procedure:	The concentration of the resulting formaldehyde derivative is quantitated after organic solvent extraction using reverse phase HPLC with an ultraviolet absorption detector. Formaldehyde in the sample is identified and quantitated by comparison of peak retention times and peak areas with those of standard solutions.

APPENDIX B

QUALITY ASSURANCE

Appendix B.1

Quality Assurance Program Summary and ARB Certification

QUALITY ASSURANCE PROGRAM SUMMARY AND ARB CERTIFICATION

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

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

Each of these areas is discussed individually below.

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

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

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

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

Sample acquisition and conditioning system leak check.

2-point analyzer calibrations (all analyzers)

3-point analyzer calibrations (analyzers with potential for linearity errors).

Complete system calibration check ("dynamic calibration" through entire sample system).

Periodic analyzer calibration checks (once per hour) are conducted at the start and end of each test run. Any change between pre- and post-test readings are recorded.

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

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

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

Equipment	Performance Requirement	Maintenance Interval	Corrective Action
Pumps	1. Absence of leaks 2. Ability to draw mfr required vacuum and flow	Every 500 hrs of operation or 6 months whichever is less	1. Visual insp. 2. Clean 3. Replace worn parts 4. Leak check
Flow Measuring Device	1. Free mechanical movement 2. Absence of malfunction	Every 500 hrs of operation or 6 months whichever is less After each test, if used in H_2S sampling or other corrosive atmospheres	1. Visual insp. 2. Clean 3. Calibrate
Sampling Instruments	1. Absence of malfunction 2. Proper response to zero, span gas	As required by manufacturer	As recommended by manufacturer
Integrated Sampling Tanks	Absence of leaks	Depends on nature of use	1. Steam clean 2. Leak check
Mobile Van Sampling Systems	Absence of leaks	Depends on nature of use	1. Change filters 2. Change gas dryer 3. Leak check 4. Check for system contamination
Sampling Lines	Sample degradation less than two percent	After each test or test series	Blow filtered air thru line until dry

All calibrations are conducted using gases certified by the manufacturer to be + 1% of label value (NBS traceable).

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

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

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

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

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

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

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

AGENCY CERTIFICATION

Carnot is certified by the CARB as an independent source test contractor for gaseous and particulate measurements. Carnot also participates in EPA QA audit programs for Methods 5, 6, and 7.

Additionally, Carnot's QA Officer is actively participating on a Source Evaluation Society committee to develop a nationwide accreditation program for source testers.

STATE OF CALIFORNIA

George Deukmejian, Governor

AIR RESOURCES BOARD
1102 Q STREET
P.O. BOX 2815
SACRAMENTO, CA 95812

June 21, 1989

Robert A. Finken
Director, Testing Services
Energy Systems Associates
15991 Red Hill Ave., Suite 110
Tustin, CA 92680

Dear Mr. Finken:

Testing Approval

We are pleased to inform you that we have renewed your approval to conduct the types of testing listed in the enclosed Executive Order. This approval is valid until June 30, 1990 during which time a field audit of your company's testing ability may be conducted.

If you have any questions regarding the approvals or other tests, please contact Ms. Kathryn Gugeler at (916) 327-1521 or Mr. Raak Veblen at (916) 327-1519. All correspondance should be addressed to me at the post office box above.

Sincerely,

James J. Morgester, Chief
Compliance Division

State of California
AIR RESOURCES BOARD

Executive Order G-482

WHEREAS, the Air Resources Board ("Board"), pursuant to Section 41512 of the California Health and Safety Code, has established the procedures contained in Section 91200-91220, Title 17, California Code of Regulations, to allow the use of independent testers for compliance tests required by the Board; and

WHEREAS, pursuant to Sections 91200-91220, Title 17, California Code of Regulations, the Executive Officer has determined that Energy Systems Associates meets the requirements of the Board for conducting ARB Test Methods 1-1, 1-2, 1-3, 1-4, 1-5, 1-6, 1-8, 1-10, and 1-100 (NOx, and O2).

NOW, THEREFORE, BE IT ORDERED that Energy Systems Associates is granted an approval, from the date of execution of this order, until June 30, 1990 to conduct the tests listed above, subject to compliance with Section 91200-91220, Title 17, California Code of Regulations.

BE IT FURTHER ORDERED that during the approved period the Executive Officer or his or her authorized representative may field audit one or more tests conducted pursuant to this order for each type of testing listed above.

Executed at Sacramento, California, this 19TH day of JUNE 1989.

James J. Morgester, Chief
Compliance Division

Appendix B.2

Calibration Data

ENERGY SYSTEMS ASSOCIATES POST TEST DRY GAS METER CALIBRATION CHECK

CALIBRATED BY VK
DATE 03/11/90
FIELD GAS METER I.D. ES-11
INITIAL Yd 1.000
INITIAL H@ 1.910

DATA ENTRY BY JJM
BAROMETRIC PRESSURE 30
TEST METER ES-13
TEST METER Y (Yt) 1.000
TEST METER LAST CAL. 12/89

FIELD METER				TEST METER				RESULTS	
VOLUME cu.ft.	TEMP. IN	TEMP OUT	DELTA "H2O	TIME min.	VOLUM cu.ft	TEMP. 'F	Q cfm	Y	H@
5.45	72.5	59.25	1.00	10	5.27	57.25	0.54	0.981	1.96
5.54	73.5	63	1.05	10	5.39	57.5	0.55	0.992	1.95
5.53	80	65.5	1.00	10	5.35	57.5	0.55	0.994	1.88
						AVERAGES		0.989	1.93

PASS - INDIVIDUAL Yd VALUES ACCEPTABLE
PASS - INDIVIDUAL DELTA H@ VALUES ACCEPTABLE
PASS - POST TEST Yd WITHIN LIMITS

ENERGY SYSTEMS ASSOCIATES POST TEST DRY GAS METER CALIBRATION CHECK

CALIBRATED BY MLS
DATE 04/12/90
FIELD GAS METER I.D. ES-11
INITIAL Yd 1.000
INITIAL H@ 1.910

DATA ENTRY BY MLS
BAROMETRIC PRESSURE 29.92
TEST METER ES-13
TEST METER Y (Yt) 1.000
TEST METER LAST CAL. 12/89

FIELD METER				TEST METER			RESULTS		
VOLUME cu.ft.	TEMP. IN	TEMP OUT	DELTA "H2O	TIME min.	VOLUM cu.ft	TEMP. 'F	Q cfm	Y	H@
7.23	103.	85	1.80	10	7.22	72	0.72	1.036	1.89
7.33	107.	98.5	1.80	10	7.22	72	0.73	1.038	1.85
7.38	108	91	1.80	10	7.22	72	0.74	1.026	1.87
						AVERAGES		1.033	1.88

PASS - INDIVIDUAL Yd VALUES ACCEPTABLE
PASS - INDIVIDUAL DELTA H@ VALUES ACCEPTABLE
PASS - POST TEST Yd WITHIN LIMITS

ANDERSEN
SAMPLERS INCORPORATED

4215 WENDELL DRIVE ▫ ATLANTA, GEORGIA 30336

CONTROL UNIT CALIBRATION

Date 2-18-85 Unit Number 385-260 (ES-

Barometric pressure, P_b = 30.28 in Hg. Model Number 90-800

Orifice manometer setting, ΔH in. H_2O	Gas volume, wet test meter V_w, ft^3	Gas volume, dry gas meter V_d, ft^3	Temperature: Wet test Meter t_w, °R	Temperature: Dry gas meter Inlet t_{di}, °R	Temperature: Dry gas meter Outlet t_{do}, °R	Temperature: Dry gas meter Average t_d, °R	Time θ, min	γ	ΔH@
1.0	5	5.37	72/532	125	95	110/570	9.40	1.00	1.89
2.0	5	5.37	72/532	131	97	114/574	6.69	1.00	1.90
4.0	5	5.36	72/532	136	98	117/577	4.77	1.00	1.93
								1.00	1.91

Calculations

ΔH	$\frac{\Delta H}{13.6}$	γ: $\frac{V_w P_b (\quad t_d \quad)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)(\quad t_w \quad)}$	ΔH@: $\frac{0.0317\ \Delta H}{P_b (\quad t_{do} \quad)} \left[\frac{(\quad t_w \quad)\ \theta}{V_w}\right]^2$
1.0	0.0735		
2.0	0.147		
4.0	0.294		

γ = Ratio of accuracy of wet test meter to dry test meter. Tolerance : ± 0.01

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance : ± 0.15

Calibrated by: MDC

Appendix B.3

CEM Performance Data

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE

Date 3/26/90 - 3/27/90 - 3/28/90

Test Location Coolwater CT42

Ambient Temperature, DB/WB ~60

Operator McDanel

Test No(s) 1, 2, 3

Barometric Pressure 27.76

Duct Static Pressure

Fuel Distillate

Test No.	Sample Time	Point	Dry, Uncorrected							Corrected to 15% O_2 Dry		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
3/26	1610	system leak ✓	ok - no flow at 23" Hg vacuum									
		zero & cal										
		linearity check	8.1	22.3	linearity ok							
		on aux gas										
1	1625-1725	Test 1, first part	15.65	3.65	19		66					
3/27 1	1111-1300	Test 1, second part	15.8	3.5	23							
	1300	post-test as-found zero	0.2	0.0	0							
	1305	post-test span	12.9	15.0	282							
2	1514-1917	Test 2	15.5	3.5	22							
	1950	post test zero	0.3	0.0	0							
	1953	post test span	12.7	14.9								
	1956	O_2 linearity/ambient air	20.6 - ok									
3	0929-1320	Test 3 - PAH	15.4	3.5								
	1325	post test zero/span	0.3/12.7	0.0/14.8								
Span Gas Concentration		normal	12.7	14.9	277	81.4						
		aux	22.5	8.0	422							

Comments:

ESA DS-001

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE Coolwater

Date 3/28/90 - 3/29/90

Test Location CT 42 Stack

Ambient Temperature, DB/WB

Operator McDaniel

Test No(s) 3

Barometric Pressure 27.67

Duct Static Pressure

Fuel Distillate - Test 3; Gas - Tests 4,5

Test No.	Sample Time	Point	Dry, Uncorrected							Corrected to ___% ___, Dry		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
3-Benz 3-Form	1430-1630		15.5	3.5	23							
	1635	Post-test zero	0.3	0.0								
	1638	Post-test span	12.5	14.9								
	1640	linearity ~~zero~~ set to air / read span	13.0									
4,5	0800	O_2 linearity, cylinder	13.0									
	0800-1245	Tests 4,5	15.0	2.85	60							
	1255	post-test zero	0.2	0.0								
	1257	post test span	12.3	14.8								
Span Gas Concentration			12.7	14.9								

Comments:

ESA DS-001

APPENDIX C

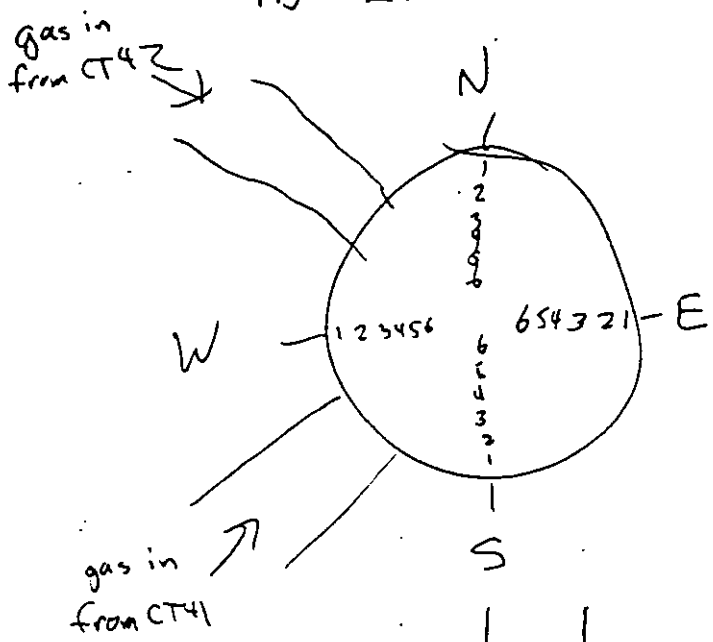
DATA SHEETS, LABORATORY REPORTS, AND SPECIFIC EMISSIONS CALCULATIONS

Appendix C.1

Sample Location

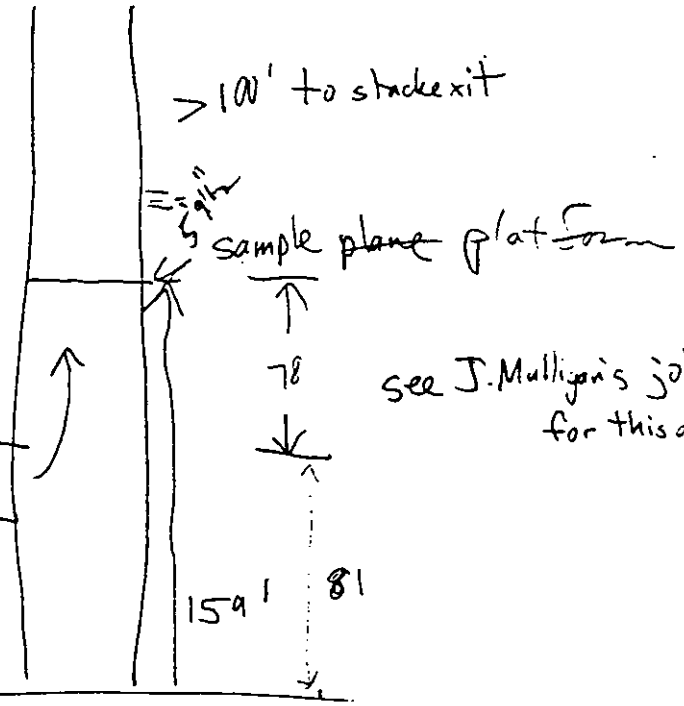
M-1 sheet needs drawn — all info is here

ID = 20'



CT41 shut d during all test

point	% of diam	distance from wall	distance + coupling length
1	2.1	5	11 1/4
2	6.7	16 1/8	22 3/8
3	11.8	28 1/4	34 1/2
4	17.7	42 1/2	48 3/4
5	25.0	60	66 1/4
6	35.6	85 1/2	91 3/4



coupling length = 6 1/4"

MDM
3/29/90

Client/Location _____ Unit _____ Test No. _____ Method _____ Page _____

Sample Location _____ Fuel _____ Ambient Temp., °F _____ of _____

Operators _____ Meter Vol. (Start/End) _____ / _____ Date _____

Pre Test Data:

Barometric Press, in. Hg _____

Stack Area, sq. ft. _____

Sample Time/ Pt, min. _____

Assumed Stack Press _____

Assumed Moisture _____

Assumed Molecular Wt _____

Equipment Info:

Meter No. _____

Meter, Yd _____

Pitot, Cp _____

CFM @ΔH = 1.0 _____

Probe I.D. _____

Nozzle No./Dia _____

Filter No. _____

Imp.	Matl	Wt(End)		Weight (Start)		Weight (g)
#1			-		=	
#2			-		=	
#3			-		=	
#4			-		=	
Total			-		=	

Impinger Box I.D. _____

Integrated Bag I.D. _____

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
Total/Average													

Test Summary

Initial _____

Sample Vol., c.f. _____

Stack Press, iwg _____

ΔP _____ iwg ΔH _____ iwg

Meter Temp., °F _____

Stack Temp., °F _____

Water Collected, g _____

O_2/CO_2 Method _____

Chain of Cust. Info (init.):

Impingers Loaded _____

Impingers Recovered _____

Filter Loaded _____

Filter Recovered _____

Probe Wash _____

Comments: _____

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SAMPLING POINT LOCATION DATA

EPA Method 1

Plant SCC / Coolwater

Date 2/8/90

Test Location Stack Unit 4

Incomplete from J. Willson

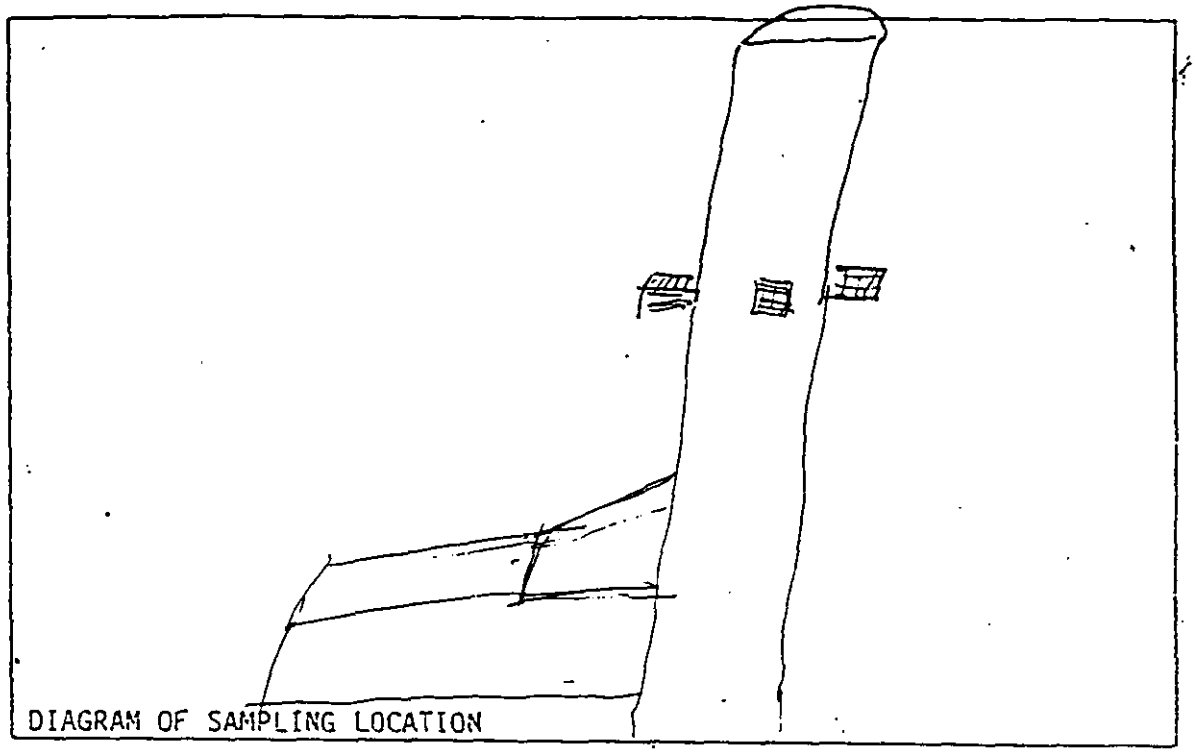

DIAGRAM OF SAMPLING LOCATION

Upstream Dist./Dia. 9.1'

Downstream Dist./Dia. 15.9'

No. of Sampling Pts.

Stack Dimension

Stack Area, ft^2

Sample Point	% of Diameter	Inches from near wall

ESA DS-009

Appendix C.2

Unit Data

E∫A

COOL WATER CT 42

CONTROL ROOM DATA

DISTILLATE FUEL

Client/Location COOL WATER - TOXIC HOT SPOTS Data by M. ESCARCEGA

Test No.	1	1	1	2	2	2
Date	3/27/90	3/27/90	3/27/90	3/27/90	3/27/90	3/27/90
Time	1005	1130	1250	1515	1645	1915
LOAD (MW)	63	63	63	63	63	63
BLADE PATH 1 TEMP. (°F)	970	975	975	980	980	970
BLADE PATH 2 TEMP. (°F)	1000	1000	1000	1000	1000	990
FUEL FLOW (GPM)	103	103	103	103	103	103
H_2O INJ. (GPM)	49	50	51	51	49	46
HRSG S.H. OUT TEMP. (°F)	840	840	840	840	840	840
HRSG INLET GAS TEMP. (°F)	900	905	900	905	905	900
HRSG STM FLOW (KLB/HR)	235	235	230	230	230	230
HRSG FDWTR. FLOW (KLB/HR)	250	250	260	250	250	245
GAS INLET TEMP. (°F)	910	910	910	910	910	900
SH STM. TEMP (°F)	840	840	845	845	845	840
STACK TOP TEMP. (°F)	325	325	320	325	320	320
FUEL REF. (%)	55	55	55	55	55	55
GAS TEMP. ST. PT.	500	500	500	500	500	500
INLET GUIDE VANES (%)	82	87	87	87	84	70
OIL VALVE (%)	9	9	9	9	9	9
S.H. BYPASS (%)	ON MANUAL					→
FDWTR. VALVE (%)	35	35	35	35	35	35
ECON. RECIRC. VALVE (%)	36	36	36	36	36	36
EVAP. COOLER (ON/OFF)	OFF	OFF	OFF	OFF	OFF	OFF
FUEL FLOW (BBLS/HR)	147.3	148.0	147.5	147.5	147.2	146.3
FUEL TYPE	DISTILL.	DIST.	DIST.	DIST.	DIST.	DIST.
BAROMETRIC PRESS.	27.90	27.92	—	27.84	—	—
RELATIVE HUMIDITY	52	36	36	44	46	64

Comments/Notes

ESA DS-002

E/A

COOL WATER CT 42

CONTROL ROOM DATA

DISTILLATE FUEL

Client/Location COOL WATER TOXIC HOT SPOTS Data by M. ESCARCEGA

Test No.	3	3	3	3	3	
Date	3/28/90	3/28/90	→	→	→	
Time	0930	1100	1245	1450	1610	
LOAD (MW)	63	63	63	63	63	
BLADE PATH 1 TEMP. (°F)	970	970	970	970	970	
BLADE PATH 2 TEMP. (°F)	995	1000	1000	1000	1000	
FUEL FLOW	103	103	103	103	103	
H_2O INJ. (GPM)	47	51	50	48	41	
HRSG S.H. OUT TEMP. (°F)	830	830	835	830	835	
HRSG INLET GAS TEMP. (°F)	900	900	905	905	905	
HRSG STM FLOW (KLB/HR)	230	230	225	225	225	
HRSG FDWTR. FLOW (KLB/HR)	245	235	230	245	240	
GAS INLET TEMP. (°F)	905	910	910	910	910	
SH STM. TEMP (°F)	840	840	840	840	840	
STACK TOP TEMP. (°F)	325	330	330	330	330	
FUEL REF. (%)	55	55	55	55	55	
GAS TEMP. ST. PT.	500	500	500	500	500	
INLET GUIDE VANES (%)	75	82	82	80	70	
OIL VALVE (%)	9	9	9	9	9	
S.H. BYPASS (%)	7	7	6	6	7	
FDWTR. VALVE (%)	35	34	34	35	34	
ECON. RECIR. VALVE (%)	34	35	35	35	34	
EVAP. COOLER (ON/OFF)	OFF	OFF	OFF	OFF	OFF	
FUEL TYPE	DIST.	DIST.	DIST.	DIST.	DIST.	
FUEL FLOW (BBLS/HR)	146.6	146.8	146.5	146.3	145.7	
BAROMETRIC PRES.	27.83	—	—	—	27.83	
REL. HUMIDITY	56	38	42	62	88	

Comments/Notes

E/A

COOL WATER CT 42

CONTROL ROOM DATA
NATURAL GAS FUEL

Client/Location TOXIC HOT SPOTS Data by M. ESCARCEGA

Test No.	4	4	4	4		
Date	3/29/90	3/29/90	3/29/90	3/29/90		
Time	0840	1000	1100	1205		
LOAD (MW)	62	63	63	63		
BLADE PATH 1 TEMP. (°F)	960	960	960	960		
BLADE PATH 2 TEMP. (°F)	980	980	980	980		
? FUEL FLOW (KCF/HR)	870	870	870	870		
H_2O INJ. (GPM)	69	78	80	81		
HRSG S.H. OUT TEMP. (°F)	820	825	820	820		
HRSG INLET GAS TEMP. (°F)	890	895	895	895		
HRSG STM FLOW (KLB/HR)	230	225	225	230		
HRSG FDWTR. FLOW (KLB/HR)	235	235	235	240		
GAS INLET TEMP. (°F)	890	900	900	900		
SH STM. TEMP (°F)	830	830	830	840		
STACK TOP TEMP. (°F)	320	320	320	325		
FUEL REF. (%)	52	52	56	55		
GAS TEMP. ST. PT.	500	500	500	500		
INLET GUIDE VANES (%)	50	54	52	56		
OIL VALVE (%)	—	—	—	—		
S.H. BYPASS (%)	5	5	6	6		
FDWTR. VALVE (%)	38	38	37	38		
ECON. RECIRC. VALVE (%)	41	41	41	41		
EVAP. COOLER (ON/OFF)	OFF	OFF	OFF	OFF		
BAROMETRIC PRESS	27.94	—	—	—		
REL. HUMIDITY %	69	51	33	24		

Comments/Notes

ESA DS-002

Appendix C.4

Benzene

CARNOT
Benzene Emissions

Client/Location: SCE/COOLWATER

Reference Temp (F)	60		
F Factor,Gas	8472	F Factor, Oil	9325
O2,% Gas	17.1	O2,% Oil	15.67
Flow rate, Gas Fuel(dscfm)	590602	Flow rate, Oil (dscfm)	575747

Fuel		Gas		Oil
Test No.		4A	Test No.	3B
	ppb	ND< 1	ppb	12.7
	lb/hr	ND< 7.29E-03	lb/hr	9.03E-02
	lb/MMbtu	ND< 9.59E-06	lb/MMbtu	9.74E-05
Test No.		4B	Test No.	3C
	ppb	ND< 1	ppb	11.5
	lb/hr	ND< 7.29E-03	lb/hr	8.18E-02
	lb/MMbtu	ND< 9.59E-06	lb/MMbtu	8.82E-05
Test No.		4C	Test No.	3C*
	ppb	ND< 1	ppb	11.5
	lb/hr	ND< 7.29E-03	lb/hr	8.18E-02
	lb/MMbtu	ND< 9.59E-06	lb/MMbtu	8.82E-05
Average			Average	
	ppb	ND< 1	ppb	11.9
	lb/hr	ND< 7.29E-03	lb/hr	8.46E-02
	lb/MMbtu	ND< 9.59E-06	lb/MMbtu	9.13E-05

*TEDLAR BAG LEAKED FOR TEST 3A; TEST 3C ANALYZED IN DUPLICATE

E/A

TEDLAR BAG SAMPLE DATA

Client/Project SCE / Coolwater

Date 3/28/90 Unit 1/1 By J. Mulligan

	Bag ID No. 3A-Cont	Bag ID No. 3B-Cont	Bag ID No. 3C-Cont
Test No.	3A-BENZ-STACK	3B-BENZ-STACK	3C-BENZ-STACK
Sample Rate	.5 L/m	.5 L/m	.5 L/m
Start Time	14:51	15:20	15:50
Stop Time	15:11	15:40	16:10
Sample Location	STACK South port	STACK South port	STACK South port

Date _____ Unit _____ By _____

	Bag ID No.	Bag ID No.	Bag ID No.
Test No.			
Sample Rate			
Start Time			
Stop Time			
Sample Location			

Notes: O2 15.5

ESA DS-070

E/A

TEDLAR BAG SAMPLE DATA

Client/Project SCC/Coolwater

Date 3/25/90 Unit 4 By J. Mulligan

	Bag ID No.	Bag ID No.	Bag ID No.
Test No.	4A-BCM2-STC	4B-BCM-STC	4C-BCM-STC
Sample Rate	.5 L/m	.5 L/m	.5 L/m
Start Time	11:17	11 42	12 05
Stop Time	11:37	1202	1225
Sample Location	Stack South flue	stack south	stack south

Date _____ Unit _____ By _____

	Bag ID No.	Bag ID No.	Bag ID No.
Test No.	4C-BCM2-ST		
Sample Rate	.5 L/m		
Start Time	1230		
Stop Time	1250		
Sample Location	Stack Sample		

Notes: _____

ESA OS-070

REPORT

TRUESDAIL LABORATORIES, INC.

CHEMISTS - MICROBIOLOGISTS - ENGINEERS
RESEARCH - DEVELOPMENT - TESTING

14201 FRANKLIN AVE
TUSTIN, CALIFORNIA 92
AREA CODE 714 • 730-6
AREA CODE 213 • 225-1
CABLE: TRUELA

CLIENT **Carnot (ESA)**
15991 Red Hill Avenue, Suite 110
Tustin, California 92680-7388
Attention: Arlene Bell

DATE April 6, 1

RECEIVED March 30, 1

LABORATORY NO. 4

SAMPLE **Five (5) Tedlar bags labeled 3B, 3C, 3A, 3B and 3C.**
Project No.: 53304-5919

INVESTIGATION

Analyze for trace benzene by modified EPA method 602

RESULTS

MODIFIED EPA 602 (Benzene)

Received: 3/30/90
Analyzed: 3/30/90

	Nanoliters per Liter (ppb)
	Benzene
3B	12.7
3C	11.5
3C, Duplicate	11.5
4A	ND< 1
4B	ND< 1
4C	ND< 1

ND = Not detected.

Respectfully submitted,
TRUESDAIL LABORATORIES, INC.

Joe Bramblett, Manager
Instrumental Methods

This report applies only to the sample, or samples, investigated and is not necessarily indicative of the quality or condition of apparently identi or similar products. As a mutual protection to clients, the public and these Laboratories, this report is submitted and accepted for the exclusi use of the client to whom it is addressed and upon the condition that it is not to be used, in whole or in part in any advertising or publicity mat

Appendix C.5

Formaldehyde

FORMALDEHYDE EMISSION CALCULATIONS

CLIENT/LOCATION: SCE/COOLWATER
FUEL: oil
F Factor: 9325
Reference Temp (F) 60

Test	ug/train	Vmstd	%O2	Qsd	ug/dscf	ug/m3	ppb	lb/hr	lb/MMbtu
3A-FORM	4.81	0.33	15.67	575747	14.6	514.7	406	1.11E+00	1.20E-03
3B-FORM	9.55	0.95	15.67	575747	10.1	355.0	280	7.65E-01	8.25E-04
3C-FORM	14	1.15	15.67	575747	12.2	429.9	339	9.26E-01	9.99E-04

Average ug/m3

433.2

Average ppb

341

Average lb/hr

9.33E-01

Average lb/MMbtu

1.01E-03

FORMALDEHYDE EMISSION CALCULATIONS

CLIENT/LOCATION: SCE/COOLWATER
FUEL: gas
F Factor: 8472
Reference Temp (F) 60

Test	ug/train	Vmstd	%O2	Qsd	ug/dscf	ug/m3	ppb	lb/hr	lb/MMbtu
4A-FORM	68.7	0.17	17.1	590602	404.1	14271.4	11249	3.15E+01	4.15E-02
4B-FORM	64.8	0.18	17.1	590602	360.0	12713.4	10021	2.81E+01	3.69E-02
4C-FORM	60.0	0.17	17.1	590602	352.9	12464.1	9824	2.75E+01	3.62E-02

Average ug/m3

13149.6

Average ppb

10365

Average lb/hr

2.91E+01

Average lb/MMbtu

3.82E-02

PARTICULATE TEST DATA

Client/Location: SCE / Cool Water
Unit: 42
Test No.: 3-A-FORM
Method:
Page: 1 of 1
Sample Location: Stack
Fuel: Oil
Ambient Temp., °F:
Operators: VK / JH
Meter Vol. (Start/End): /
Date: 03-28-90

Pre Test Data:
- Barometric Press, in. Hg: 26.67
- Stack Area, sq. ft.:
- Sample Time/ Pt, min.:
- Assumed Stack Press:
- Assumed Moisture:
- Assumed Molecular Wt:

Equipment Info:
- Meter No.: CS-11
- Meter, Yd: 1.00
- Pitot, Cp:
- CFM @ΔH = 1.0:
- Probe I.D.:
- Nozzle No./Dia:
- Filter No.:

Imp.	Matl	Wt(End)		Weight (Start)		Weight (g)
#1			-		=	
#2			-		=	
#3			-		=	
#4			-		=	
Total			-		=	

Impinger Box I.D.:
Integrated Bag I.D.:

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test			OK		
Post-Test			OK		

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
S-2	2.44			568.967	360						15.5		
	2.59			569.106	361								
	3.09			569.23	361								
	3.19			569.34									
Total/Average													

Test Summary
- Initial: 46
- Sample Vol., c.f.: 0.373
- Stack Press, iwg:
- ΔP ___ iwg ΔH 0 iwg
- Meter Temp., °F:
- Stack Temp., °F: 360.7
- Water Collected, g:
- O_2/CO_2 Method: O_2 15.5
- Chain of Cust. Info (init.):
  - Impingers Loaded:
  - Impingers Recovered:
  - Filter Loaded:
  - Filter Recovered:
  - Probe Wash:
- Comments: Vmstd = 0.3366

used 68.8 for meter temp

30m

EST 05-022
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PARTICULATE TEST DATA

Client/Location: SCE / Cool Water
Sample Location: Stack
Operators: VR/JM

Unit: 42
Fuel: Oil
Test No.: 3-B-F0P11
Method:
Ambient Temp., °F:
Meter Vol. (Start/End): /
Page: 1 of 1
Date: 03-28-90

Pre Test Data:

Barometric Press, in. Hg	26.67
Stack Area, sq. ft.	
Sample Time/ Pt, min.	
Assumed Stack Press	
Assumed Moisture	
Assumed Molecular Wt	

Equipment Info:

Meter No.	ES-11
Meter, Yd	
Pitot, Cp	
CFM @ΔH = 1.0	
Probe I.D.	
Nozzle No./Dia	
Filter No.	

Imp.	Matl	Wt(End)		Weight (Start)		Weight (g)
#1			-		=	
#2			-		=	
#3			-		=	
#4			-		=	
Total			-		=	

Impinger Box I.D.
Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
S-2	3:27			369.347	360						15.5		
	3:37			369.370	360								
	3:47			369.87	360								
	3:57			370.113									
Total/Average													

Test Summary

Initial 66/66
Sample Vol., c.f. 4.083
Stack Press, iwg Dropped 30min
ΔP ____ iwg ΔH 0 iwg 10m
Meter Temp., °F
Stack Temp., °F 360
Water Collected, g
O_2/CO_2 Method O2 455
Chain of Cust. Info (init.):
Impingers Loaded
Impingers Recovered
Filter Loaded
Filter Recovered
Probe Wash
Comments: Vmcl = 0.95 cf
Used 68.8 meter temp

PARTICULATE STD DATA

Client/Location SCE / Cool Water
Sample Location Stack
Operators VP/JH

Unit 42
Fuel
Meter Vol. (Start/End) /

Test No. 3-C-1 DNP
Method
Ambient Temp., °F
Page 1
of 1
Date 03-28-90

Pre Test Data:
Barometric Press, in. Hg 26.67
Stack Area, sq. ft.
Sample Time/ Pt, min.
Assumed Stack Press
Assumed Moisture
Assumed Molecular Wt

Equipment Info:
Meter No. ES-11
Meter, Yd
Pitot, Cp
CFM @ΔH = 1.0
Probe I.D.
Nozzle No./Dia
Filter No.

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1		-	=	
#2		-	=	
#3		-	=	
#4		-	=	
Total		-	=	

Impinger Box I.D.
Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
3-2	4:01			370.43	360						15.5		
	4 11			370.55	360								
	4 21			370.42	360								
	4 31			371.58									
Total/Average													

Test Summary

Initial UG/LG
Sample Vol., c.f. 1.15
Stack Press, iwg
ΔP ____ iwg ΔH 0 iwg
Meter Temp., °F
Stack Temp., °F 360
Water Collected, g
O_2/CO_2 Method O_2 = 15.5 30 min
Chain of Cust. Info (init.):
Impingers Loaded
Impingers Recovered
Filter Loaded
Filter Recovered
Probe Wash
Comments: Vmstd = 1.01 UG
used 68.8 meter temp

PARTICULATE TEST DATA

Client/Location: SCE / Costwate
Sample Location: Stack
Operators: J. Mollinari

Unit: 42
Fuel: Gas
Test No.: 4A/FRO/SF
Ambient Temp., °F: 56
Meter Vol. (Start/End): 134.209/135.380

Method: 430
Page: 1 of 1
Date: 03/25/92

Pre Test Data:

Barometric Press, in. Hg	27.78
Stack Area, sq. ft.	314.20
Sample Time/ Pt, min.	30
Assumed Stack Press	-.10
Assumed Moisture	6 %
Assumed Molecular Wt	28.3

Equipment Info:

Meter No.	ES-2
Meter, Yd	1.000
Pitot, Cp	
CFM @ΔH = 1.0	
Probe I.D.	Teflon
Nozzle No./Dia	N/A
Filter No.	N/A

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1			-	=
#2			-	=
#3			-	=
#4			-	=
Total			-	=

Impinger Box I.D.
Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
2 PM	845	.05		134.200	348		66	66		56	16.1	2	
30 out	855	.05		134.255	348		67	66			16.4	2	
	905	.05		134.321	348		67	66		56	16.4	2	
	915	.05		134.380	348		67	66			16.5	2	
Total/Average													

Test Summary

Initial 66/66
Sample Vol., c.f. .180
Stack Press, iwg ~~0.15~~ 30m
ΔP ____ iwg ΔH 0 iwg nom
Meter Temp., °F 66.4
Stack Temp., °F 348.5
Water Collected, g
O_2/CO_2 Method O_2 = 16.35
Chain of Cust. Info (init.):
Impingers Loaded
Impingers Recovered
Filter Loaded
Filter Recovered
Probe Wash
Comments: 1/m sH = 0.17

PARTICULATE ST DATA

Client/Location: [illegible] / Coolwater
Unit: 42
Test No.: 40-[illegible]
Method: 430
Page: 1 of 1
Sample Location: Stack
Fuel: Gas
Ambient Temp., °F: 58
Operators: [illegible]
Meter Vol. (Start/End): 135.389 / 135.589
Date: 3/27/20

Pre Test Data:

Barometric Press, in. Hg	27.78
Stack Area, sq. ft.	314.20
Sample Time/ Pt, min.	30 min
Assumed Stack Press	-.80
Assumed Moisture	8%
Assumed Molecular Wt	28.3

Equipment Info:

Meter No.	ES 2
Meter, Yd	1.000
Pitot, Cp	—
CFM @ΔH = 1.0	
Probe I.D.	Teflon
Nozzle No./Dia	14/in
Filter No.	N/A

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1				
#2				
#3				
#4				
Total				

Impinger Box I.D.
Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
Initial	925	.05		135.389	349		68	66		Ice	15.5	2	
[illegible]	935	.05		135.420	350		68	66			15.8	2	
	945	.05		135.502	350		68	66		Ice	15.6	2	
	955	.05		135.589	350		68	66			15.6		
Total/Average													

Test Summary

Initial: 6/16
Sample Vol., c.f.: 0.200
Stack Press, iwg: [illegible]
ΔP ____ iwg ΔH [illegible] iwg 30min
Motor Temp., °F: 670
Stack Temp., °F: 349.8
Water Collected, g
O_2/CO_2 Method: O_2 = 15.55
Chain of Cust. Info (init.):
Impingers Loaded
Impingers Recovered
Filter Loaded
Filter Recovered
Probe Wash
Comments: $V_{m\,std}$ = 0.186

PARTICULATE FIELD DATA

Client/Location: SCE / Coolwater Unit: 4C Test No.: 1/C-[illegible] Method: 4-3a Page: 1 of 1

Sample Location: [illegible] Fuel: GAS Ambient Temp., °F: 60

Operators: [illegible] Meter Vol. (Start/End): 135.600 / 135.780 Date: 3/25/80

Pre Test Data:

Barometric Press, in. Hg	27.78
Stack Area, sq. ft.	314.20
Sample Time/ Pt, min.	20.0
Assumed Stack Press	-50
Assumed Moisture	8%
Assumed Molecular Wt	28.3

Equipment Info:

Meter No.	ES-[illegible]
Meter, Yd	1.000
Pitot, Cp	
CFM @ΔH = 1.0	
Probe I.D.	Teflon
Nozzle No./Dia	[illegible]
Filter No.	[illegible]

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1				
#2				
#3				
#4				
Total				

Impinger Box I.D.

Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg	Test Summary
	10.10	.05		135.600	350	N/A	70	70	N/A	50C	16.4	2		
	10.20	.05		135.650	350		70	70			16.0	2		Initial W/LW
	10.30	.05		135.720	350		70	70		50C	15.8	2		Sample Vol., c.f. 0.1816
	10.40	.05		135.781	350		70	70				2		Stack Press, iwg
														ΔP ____ iwg ΔH 0 iwg
														Meter Temp., °F 70
														Stack Temp., °F 350
														Water Collected, g
														O_2/CO_2 Method O_2 = 16.1
														Chain of Cust. Info (init.):
														Impingers Loaded
														Impingers Recovered
														Filter Loaded
														Filter Recovered
														Probe Wash
														Comments: Vmstd = 0.17
Total/Average														

30 min

LG

RADIAN CORPORATION

Radian Work Order P0-04-050

Analytical Report
05/02/90

Energy Systems Associates

Energy Systems Associates
15991 Red Hill Ave, Suite 110
Tustin, CA 92680-7388

Arlene Bell

Customer Work Identification 53304
Purchase Order Number 5937

Contents:

1 Analytical Data Summary
2 Sample History
3 Comments Summary
4 Notes and Definitions

Radian Analytical Services
900 Perimeter Park
Morrisville, NC 27560

919-481-0212

Client Services Coordinator: JFMCGAUGHEY

Certified by: _____

RADIAN CORPORATION

Analytical Data Summary

Energy Systems Associates
Radian Work Order: P0-04-050

Method:Aldehydes by HPLC (1)
List:ESA Analyte List

Sample ID:	BLANK #1	BLANK #2	SPIKE #1	SPIKE #2
Factor:	0.53	0.53	0.53	0.53
Results in:	total ug	total ug	total ug	total ug
	01A	02A	03A	04A
Matrix:	AIR	AIR	AIR	AIR

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Formaldehyde	30.6	0.47	16.8	0.47	13.4	0.47	7.67 B	0.47

B Inorg-result < CRDL but > than IDL/Org-detected in blank

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

RADIAN CORPORATION

Analytical Data Summary

Energy Systems Associates
Radian Work Order: P0-04-050

Method:Aldehydes by HPLC (1)
List:ESA Analyte List

Sample ID:	3A-FORM (A&B)	3B-FORM (A&B)	3C-FORM (A&B)	4A-FORM (A&B)
Factor:	0.53	0.53	0.53	0.53
Results in:	total ug	total ug	total ug	total ug
	05A	06A	07A	08A
Matrix:	AIR	AIR	AIR	AIR

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Formaldehyde	4.81 B	0.47	9.55 B	0.47	14.0	0.47	68.7	4.7

B Inorg-result < CRDL but > than IDL/Org-detected in blank

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

RADIAN CORPORATION

Analytical Data Summary

Energy Systems Associates
Radian Work Order: P0-04-050

Method:Aldehydes by HPLC (1)
List:ESA Analyte List

Sample ID:	4B-FORM (A&B)	4C-FORM (A&B)	MATRIX SPIKE	MATRIX SPIKE DUP
Factor:	0.53	0.53	20	20
Results in:	total ug	total ug	%	%
	09A	10A	11A	12A
Matrix:	AIR	AIR	AIR	AIR

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Formaldehyde	64.8	4.7	60.0	4.7	126		104	

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

RADIAN CORPORATION

Analytical Data Summary

Energy Systems Associates
Radian Work Order: PO-04-050

Method:Aldehydes by HPLC (1)
List:ESA Analyte List
Sample ID: METHOD BLANK

Factor: 0.53
Results in: total ug
13A
Matrix: AIR

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Formaldehyde	0.97 a	0.47						

a Est. result less than 5 times detection limit

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

RADIAN CORPORATION

Sample History

Energy Systems Associates
Radian Work Order: P0-04-050

Sample Identifications and Dates

Sample ID	BLANK #1	BLANK #2	SPIKE #1	SPIKE #2	3A-FORM (A&B)	3B-FORM (A&B)
Date Sampled						
Date Received	04/12/90	04/12/90	04/12/90	04/12/90	04/12/90	04/12/90
Matrix	AIR	AIR	AIR	AIR	AIR	AIR
	01	02	03	04	05	06
Aldehydes by HPLC						
Prepared	04/12/90	04/12/90	04/12/90	04/12/90	04/12/90	04/13/90
Analyzed	04/18/90	04/18/90	04/18/90	04/18/90	04/18/90	04/19/90
Analyst	LKK	LKK	LKK	LKK	LKK	LKK
File ID	LAUR 49,50	LAUR 74	LAUR 75	LAUR 76	LAUR 79	LAUR 89,90
Blank ID	LAUR 88	LAUR 88	LAUR 88	LAUR 88	LAUR 88	LAUR 88
Instrument	V5000	V5000	V5000	V5000	V5000	V5000
Report as	received	received	received	received	received	received

Energy Systems Associates
Radian Work Order: P0-04-050

Sample Identifications and Dates

Sample ID	3C-FORM (A&B)	4A-FORM (A&B)	4B-FORM (A&B)	4C-FORM (A&B)	MATRIX SPIKE	MATRIX SPIKE DUP
Date Sampled						
Date Received	04/12/90	04/12/90	04/12/90	04/12/90	04/12/90	04/12/90
Matrix	AIR	AIR	AIR	AIR	AIR	AIR
	07	08	09	10	11	12
Aldehydes by HPLC						
Prepared	04/13/90	04/13/90	04/13/90	04/13/90	04/13/90	[illegible]
Analyzed	04/19/90	04/24/90	04/24/90	04/24/90	04/19/90	[illegible]
Analyst	LKK	LKK	LKK	LKK	LKK	[illegible]
File ID	LAUR 91	LAUR 92,181	LAUR 93.182	LAUR 94,183	LAUR 80	[illegible]
Blank ID	LAUR 88	LAUR 88	LAUR 88	LAUR 88	LAUR 88	[illegible]
Instrument	V5000	V5000	V5000	V5000	V5000	[illegible]
Report as	rece[illegible]d	received	received	received	received	[illegible]

RADIAN CORPORATION

Sample History

Energy Systems Associates
Radian Work Order: P0-04-050

Sample Identifications and Dates

Sample ID	METHOD BLANK
Date Sampled	
Date Received	04/12/90
Matrix	AIR
	13

Aldehydes by HPLC						
Prepared	04/13/90					
Analyzed	04/19/90					
Analyst	LKK					
File ID	LAUR 88					
Blank ID	LAUR 88					
Instrument	V5000					
Report as	received					

RADIAN
CORPORATION

Appendix A

Comments, Notes and Definitions

Energy Systems Associates
Radian Work Order: P0-04-050

General Comments
Formaldehyde is a potential laboratory contaminant and may be present in the method blank above the detection limit. A sample result is flagged if it is less than ten times the methoc blank result.

Energy Systems Associates
Radian Work Order: P0-04-050

a ALL METHODS EXCEPT CLP
The results which are less than five times the method specified detection limit.
EXPLANATION
Uncertainty of the analysis will increase as the method detection limit is approached. These results should be considered approximate.

B. INORGANIC CLP
This flag indicates that a reported value is less than the Contract Required Detection Limit (CRDL), but greater than the Instrument Detection Limit (IDL).
ORGANIC METHODS
This flag indicates that an analyte is found in the associated blank, but the sample results are not corrected for the amount in the blank.

Energy Systems Associates
Radian Work Order: P0-04-050

TERMS USED IN THIS REPORT:
Analyte - A chemical for which a sample is to be analyzed. The analysis will meet EPA method and QC specifications.

Compound - See Analyte.

Detection Limit - The method specified detection limit, which is the lower limit of quantitation specified by EPA for a method. Radian staff regularly assess their laboratories' method detection limits to verify that they meet or are lower than those specified by EPA. Detection limits which are higher than method limits are based on experimental values at the 99% confidence level. The detection limits for EPA CLP (Contract Laboratory Program) methods are CRQLs (contract required quantitation limits) for organics and CRDLs (contract required detection limits) for inorganics. Note, the detection limit may vary from that specified by EPA based on sample size, dilution or cleanup. (Refer to Factor, below)

EPA Method - The EPA specified method used to perform an analysis. EPA has specified standard methods for analysis of environmental samples. Radian will perform its analyses and accompanying QC tests in conformance with EPA methods unless otherwise specified.

Factor - Default method detection limits are based on analysis of clean water samples. A factor is required to calculate sample specific detection limits based on alternate matrices (soil or water), reporting units, use of cleanup procedures, or dilution of extracts/digestates. For example, extraction or digestion of 10 grams of soil in contrast to 1 liter of water will result in a factor of 100.

Matrix - The sample material. Generally, it will be soil, water, air, oil, or solid waste.

Radian Work Order - The unique Radian identification code assigned to the samples reported in the analytical summary.

Units -	ug/L	micrograms per liter (parts per billion);liquids/water
	ug/kg	micrograms per kilogram (parts per billion); soils/solids
	ug/M3	micrograms per cubic meter; air samples
	mg/L	milligrams per liter (parts per million);liquids/water
	mg/kg	milligrams per kilogram (parts per million);soils/solids
	%	percent; usually used for percent recovery of QC standards
	uS/cm	conductance unit; microSiemans/centimeter
	mL/hr	milliliters per hour; rate of settlement of matter in water
	NTU	turbidity unit; nephelometric turbidity unit
	CU	color unit; equal to 1 mg/L of chloroplatinate salt

Appendix C.6

PAH

ANALYTICAL RESULTS REPORT

CW

CLIENT INFORMATION
Name: ENERGY SYSTEMS ASSOCIATES
Project: PAH ANALYSIS

LAB INFORMATION
Contact: OC
Project: AN898506
Date: May.04 1990

Notes: "-" = Not Analyzed
"<" = Less than MDL

		Client ID:	BLANK-PAH	1-PAH	2-PAH	3-PAH
		Lab ID:	007589 90	007590 90	007591 90	007592 90
Component	MDL	Units				
Naphthalene	0.025	ug	8.2	3.1	3.2	1.8
Acenaphthylene	0.025		<	<	<	<
Acenaphthene	0.025		0.5	0.035	0.44	0.16
Fluorene	0.025		0.068	0.033	0.093	0.046
Phenanthrene	0.025		0.18	0.11	0.3	0.11
Anthracene	0.025		0.14	<	0.19	0.044
Fluoranthene	0.025		<	<	<	<
Pyrene	0.025		<	<	<	<
Chrysene	0.025		<	<	<	<
Benz(a)anthracene	0.025		<	<	<	<
Benzo(b+k)fluoranthene	0.025		<	<	<	<
Benzo(a)pyrene	0.025		<	<	<	<
Indeno(1,2,3-cd)pyrene	0.025		<	<	<	<
Dibenzo(ah)anthracene	0.025		<	<	<	<
Benzo(ghi)perylene	0.025		<	<	<	<
Surrogate Recoveries %						
d10 Acenaphthene			99	87	68	73
d10 Anthracene			73	32	74	80
d12 Chrysene			80	71	65	85
d12 Benzo(a)pyrene			56	23	65	73

Prepared by ZENON Environmental Inc.

CARNOT LATIONS

CLIENT:	SCE/COOLWATER	INITIALS:	LG
		VMSTD(DSCF):	98.53
PROJECT NO:	53304	QSD(DSCF/MIN):	620710
TEST DATE:	03/27/90	CO2,%:	3.31
TEST NUMBER:	1-PAH	O2,%:	16.1
T REF (F)	60	F Factor	9325

Fuel: oil

SPECIES	ug/train		ug/dscm		lb/hr	lb/MMbtu
Naphthalene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Acenaphthylene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Acenaphthene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Fluorene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Phenanthrene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Anthracene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Fluoranthene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Pyrene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Benz(a)anthracene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Chrysene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Benzo(b+k)fluoranthene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Benzo(a)pyrene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Indeno(1,2,3-cd)pyrene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Dibenzo(a,h)anthracene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
Benzo(g,h,i)perylene	ND<	0.025	ND<	0.009	ND< 2.08E-05	2.27E-08
TOTAL PAH	<	0.375	<	0.134	< 3.12E-04	3.40E-07

Corrected for Field Blank

15991 Red Hill Ave., Suite 110, Tustin, California 92680 (714) 259-9520 · FAX (714) 259-0372

CARNOT ULATIONS

CLIENT:	SCE/COOLWATER	INITIALS:	LG
		VMSTD(DSCF):	86.63
PROJECT NO:	53304	QSD(DSCF/MIN):	575737
TEST DATE:	03/27/90	CO2,%:	3.07
TEST NUMBER:	2-PAH	O2,%:	16.16
T REF (F)	60	F Factor	9325

Fuel: oil

SPECIES		ug/train	ug/dscm	lb/hr	lb/MMbtu
Naphthalene	ND<	0.025	0.010	2.20E-05	2.61E-08
Acenaphthylene	ND<	0.025	0.010	2.20E-05	2.61E-08
Acenaphthene	ND<	0.025	0.010	2.20E-05	2.61E-08
Fluorene		0.025	0.010	2.20E-05	2.61E-08
Phenanthrene		0.120	0.049	1.05E-04	1.25E-07
Anthracene		0.050	0.020	4.39E-05	5.23E-08
Fluoranthene	ND<	0.025	0.010	2.20E-05	2.61E-08
Pyrene	ND<	0.025	0.010	2.20E-05	2.61E-08
Benz(a)anthracene	ND<	0.025	0.010	2.20E-05	2.61E-08
Chrysene	ND<	0.025	0.010	2.20E-05	2.61E-08
Benzo(b+k)fluoranthene	ND<	0.025	0.010	2.20E-05	2.61E-08
Benzo(a)pyrene	ND<	0.025	0.010	2.20E-05	2.61E-08
Indeno(1,2,3-cd)pyrene	ND<	0.025	0.010	2.20E-05	2.61E-08
Dibenzo(a,h)anthracene	ND<	0.025	0.010	2.20E-05	2.61E-08
Benzo(g,h,i)perylene	ND<	0.025	0.010	2.20E-05	2.61E-08
TOTAL PAH	<	0.495	< 0.202	< 4.35E-04	5.17E-07

Corrected for Field Blank

15991 Red Hill Ave., Suite 110, Tustin, California 92680 (714) 259-9520 · FAX (714) 259-0372

CARNOT ULATIONS

CLIENT:	SCE/COOLWATER	INITIALS:	LG
		VMSTD(DSCF):	73.38
PROJECT NO:	53304	QSD(DSCF/MIN):	575747
TEST DATE:	03/28/90	CO2,%:	3.33
TEST NUMBER:	3-PAH	O2,%:	15.67
T REF (F)	60	F Factor	9325
Fuel: oil			

SPECIES		ug/train	ug/dscm	lb/hr	lb/MMbtu
Naphthalene	ND<	0.025	0.012	2.59E-05	2.80E-08
Acenaphthylene	ND<	0.025	0.012	2.59E-05	2.80E-08
Acenaphthene	ND<	0.025	0.012	2.59E-05	2.80E-08
Fluorene	ND<	0.025	0.012	2.59E-05	2.80E-08
Phenanthrene	ND<	0.025	0.012	2.59E-05	2.80E-08
Anthracene	ND<	0.025	0.012	2.59E-05	2.80E-08
Fluoranthene	ND<	0.025	0.012	2.59E-05	2.80E-08
Pyrene	ND<	0.025	0.012	2.59E-05	2.80E-08
Benz(a)anthracene	ND<	0.025	0.012	2.59E-05	2.80E-08
Chrysene	ND<	0.025	0.012	2.59E-05	2.80E-08
Benzo(b+k)fluoranthene	ND<	0.025	0.012	2.59E-05	2.80E-08
Benzo(a)pyrene	ND<	0.025	0.012	2.59E-05	2.80E-08
Indeno(1,2,3-cd)pyrene	ND<	0.025	0.012	2.59E-05	2.80E-08
Dibenzo(a,h)anthracene	ND<	0.025	0.012	2.59E-05	2.80E-08
Benzo(g,h,i)perylene	ND<	0.025	0.012	2.59E-05	2.80E-08
TOTAL PAH	<	0.375	< 0.180	< 3.89E-04	4.19E-07

Corrected for Field Blank

15991 Red Hill Ave., Suite 110, Tustin, California 92680 (714) 259-9520 · FAX (714) 259-0372

CARNOT

AVERAGE PAH EMISSIONS

SPECIES	ug/dscm		lb/hr	lb/MMbtu
Naphthalene	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Acenaphthylene	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Acenaphthene	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Fluorene	<	0.01	< 2.29E-05	< 2.56E-08
Phenanthrene	<	0.02	< 5.07E-05	< 5.87E-08
Anthracene	<	0.01	< 3.02E-05	< 3.43E-08
Fluoranthene	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Pyrene	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Benz(a)anthracene	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Chrysene	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Benzo(b+k)fluorant	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Benzo(a)pyrene	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Indeno(1,2,3-cd)py	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Dibenzo(a,h)anthra	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Benzo(g,h,i)peryle	ND<	0.01	ND< 2.29E-05	ND< 2.56E-08
Average Total PAH	<	0.17	< 3.79E-04	< 4.26E-07

15991 Red Hill Ave., Suite 110, Tustin, California 92680 (714) 259-9520 · FAX (714) 259-0372

CARNOT 04/02/9

SAMPLE TRAIN TEST SUMMARY

Client/Location	COOLWATER	Date	3/27/9
Test Number	1-PAH	Data By	MDM/L
Test Method	CARB 429	Sample Location	Stac
Fuel	Distillate	Reference Temp (F)	6
Control Box #	ES-11	Unit	CT 4
Pitot Factor	0.840	Meter Cal Factor	1.000
Stack Area (sq ft)	314.16	Sample Time (Min)	18
Bar Press (in Hg)	27.76	Nozzle Diam (in)	0.23
Meter Vol (acf)	111.067	Meter Temp (F)	85.
Stack Press (iwg)	-0.85	Stack Temp (F)	351.
Vel Head (iwg)	0.6454	O2 (%): from CEM	15.7
		from portable	16.1
Liquid Vol (ml)	104.4	CO2 (%): from CEM	3.5
		calculated	3.3
Meter Press (iwg)	1.40	Start/Stop Time	1726/12

Std Sample Vol (SCF)	98.5
Metric Sample Vol (cubic meters)	2.79
Moisture Fraction	0.047
Stack Gas Mol Wt	28.6
Stack Gas Velocity (ft/sec)	58.2
Stack Flow Rate (wacfm)	1.10E+0
Stack Flow Rate (dscfm)	620,71
Isokinetic Ratio (%)	90.4

PARTICULATE TEST DATA

Client/Location: SCE / Coolwater | Unit: 42 | Test No.: 1-PAH-Stack | Method: 425 | Page: 1
Sample Location: Stack | Fuel: Oil | Ambient Temp., °F: 60 | of: 2
Operators: J Mulligan & V. Reddy | Meter Vol. (Start/End): 265.325/381.485 | Date: 5/26/91

Pre Test Data:

Barometric Press, in. Hg	27.76
Stack Area, sq. ft.	314.20
Sample Time/ Pt, min.	7.5
Assumed Stack Press	
Assumed Moisture	8.0
Assumed Molecular Wt	28.2

Equipment Info:

Meter No.	ES-11
Meter, Yd	1.00
Pitot, Cp	.84
CFM @ΔH = 1.0	.564
Probe I.D.	10' 5/35
Nozzle No./Dia	0.237
Filter No.	110-507

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	~~0~~	592.5	- 469.2	= 123.3
#2	1+20	500.0	- 578.0	= -78.0
#3	~~0~~ SIAD	515	- 511.0	= 4.0
#4	S/G	487.1	- 432	= 55.1
Total		2498.6	- 2394.2	= 104.4
Impinger Box I.D.				
Integrated Bag I.D.				109.4

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	.006	18	JM	OK	
Post-Test	.017	21	JM		

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

ΔH = 2.1

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Coil Imp. Out	O_2	Vacuum	Static Press. iwg
Start	1726	.81	1.7	265.325	362	225	91	82	250	56	15.1	15	
South 6	1733 30	1.0	2.1	273.656	362	237	97	82	225		15.0	20	+.85
5	1741	.83	1.78	279.178	361	235	97	82	235	56	16.4	20	
4	1745/1803/1830	.77	1.61	281.321/283.487	358	225	86	77	225	57	15.9	20	
3	1814	.57	1.19	288.376	357	230	91	80	226	57	15.5	18	
2	1821 30	.35	.73	293.987	357	227	96	82	256	58	15.9	12	
Stop 1	1829			298.478									
Start	1000	.86	1.8	299.131	356	224	84	73	225	64	16.2	17	
West 6	1007 30	.98	2.05	304.398	355	229	89	75	225	40	16.0	20	
5	1015	.95	1.99	309.425	355	235	90	76	228	37	16.2	20	
4	1022 30	.85	1.55	314.472	354	229	91	74	230	37	16.1	20	
3	1030	.87	1.82	319.564	353	248	95	79	230	35	17	21	
2	1037.30	.70	1.4	324.741	332	246	96	80	230	35	16.8	21	
Stop 1	1045			329.631									
Start	1104 30	.69	1.44	329.705	326	228	87	80	325	30	16.2	20	
North 6	1112	.75	1.57	334.1	352	270	92	81	225	40	16.0	20	
5	1118 30	.64	1.34	338.528	2352	246	92	80	225	41	16.5	20	
4	1126	.75	1.57	343.185		229	91	80	228	42	16.5	21	
Total/Average													

Test Summary

Initial	MM
Sample Vol., c.f.	111.067
Stack Press, iwg	.85
ΔP .645 iwg	ΔH 1.35 iwg 1.40
Meter Temp., °F	85.5
Stack Temp., °F	349.1 351.3
Water Collected, g	104.4
O_2/CO_2 Method	15.75/3.55 by GM
Chain of Cust. Info (init.):	16.10 port
Impingers Loaded	JM
Impingers Recovered	MM
Filter Loaded	JM
Filter Recovered	MM
Probe Wash	JM/VR
Comments:	Reagent L/C 20" cm .015 3/07 L/C St 20" .012 cfm

.8990 cfm

PARTICULATE TEST DATA

Client/Location: SCE / Coolwater
Sample Location: Stack
Operators: V. Reddy & J. Mulligan

Unit: 42
Fuel: oil
Test No.: 1-PAH-STCH
Ambient Temp., °F: 60
Meter Vol. (Start/End): 381.485

Method: 429
Page: 1 of 2
Date: 3/27/90

Pre Test Data:
- Barometric Press, in. Hg
- Stack Area, sq. ft.
- Sample Time/ Pt, min.
- Assumed Stack Press
- Assumed Moisture
- Assumed Molecular Wt

Equipment Info:
- Meter No.
- Meter, Yd
- Pitot, Cp
- CFM @ ΔH = 1.0
- Probe I.D.
- Nozzle No./Dia
- Filter No.

See page one

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1		-	=	
#2		-	=	
#3		-	=	
#4		-	=	
Total		-	=	

Impinger Box I.D.
Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Coil Imp. Out	O_2	Vacuum	Static Press. iwg
Nozl 3	1133	.64	1.42	347.862	352	225	92	80	251	44	16.6	20	
2	1141	.62	1.30	357.506	340	236	91	80	234	45	16.0	20	
Stop 1	1148 30			357.158									
Start	1213	.30	.63	357.520	347	227	91	78	250	48	16.4	10	
Nozl 6	1220 30	.37	.81	361.550	349	245	90	79	230	50	16.3	17	
5	1228	.45	.94	365.805	351	250	93	79	235	51	16.0	18	
4	123530	.43	.90	369.902	350	235	93	80	240	53	15.8	17	
3	1243	.38	.81	373.592	349	226	93	79	258	53	15.4	17	
2	125030	.25	.52	377.922	349	225	94	79					
Stop 1	1258			381.485									
Total/Average													

Test Summary
- Initial
- Sample Vol., c.f.
- Stack Press, iwg
- ΔP ____ iwg ΔH ____ iwg
- Meter Temp., °F
- Stack Temp., °F
- Water Collected, g
- O_2/CO_2 Method
- Chain of Cust. Info (init.):
  - Impingers Loaded
  - Impingers Recovered
  - Filter Loaded
  - Filter Recovered
  - Probe Wash
- Comments: Nozzle L/C 20" .015 - .51

CARNOT 04/02/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	COOLWATER	Date	3/27/90
Test Number	2-PAH	Data By	MDM/LG
Test Method	CARB 429	Sample Location	Stack
Fuel	Distillate	Reference Temp (F)	60
Control Box #	ES-11	Unit	CT 42
Pitot Factor	0.840	Meter Cal Factor	1.0000
Stack Area (sq ft)	314.16	Sample Time (Min)	180
Bar Press (in Hg)	27.68	Nozzle Diam (in)	0.237
Meter Vol (acf)	96.375	Meter Temp (F)	76.1
Stack Press (iwg)	-0.85	Stack Temp (F)	352.0
Vel Head (iwg)	0.5580	O2 (%): from CEM	15.50
		from portable	16.16
Liquid Vol (ml)	94.6	CO2 (%): from CEM	3.50
		calculated	3.07
Meter Press (iwg)	0.90	Start/Stop Time	1514/194

Std Sample Vol (SCF)	86.63
Metric Sample Vol (cubic meters)	2.45
Moisture Fraction	0.048
Stack Gas Mol Wt	28.60
Stack Gas Velocity (ft/sec)	54.31
Stack Flow Rate (wacfm)	1.02E+06
Stack Flow Rate (dscfm)	575,7
Isokinetic Ratio (%)	85.6

PARTICULATE TEST DATA

Client/Location: SCE / Coolwater
Sample Location: Stack
Operators: J. Mallison & V. Reddy
Unit: 4/2
Fuel: oil
Test No.: 2-RAH-Stck
Method: 429
Ambient Temp., °F: 62
Meter Vol. (Start/End): 385.240 / 423.128
Page: 1 of 2
Date: 3/27

Pre Test Data:

Barometric Press, in. Hg	27.68
Stack Area, sq. ft.	314.20
Sample Time/ Pt, min.	7.5/100
Assumed Stack Press	.85
Assumed Moisture	8%
Assumed Molecular Wt	28

Equipment Info:

Meter No.	E3-11
Meter, Yd	1.00
Pitot, Cp	.84
CFM @ΔH = 1.0	.564
Probe I.D.	10' glass
Nozzle No./Dia	0.237
Filter No.	110-990

Imp.	Mat'l	Wt(End)	Weight (Start)	Weight (g)
#1	ø	5165	- 4662.2 =	54.3
#2	HZ	6053	- 6060.0 =	-0.7
#3	ø	5055.5	- 5054.2 =	1.3
#4	S/G	8539	- 8142.2 =	39.7
Total				94.6

Impinger Box I.D.
Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	.018	15	MM	OK	
Post-Test	.018	25	MM		

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

ΔH = 2.25

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out (coil)	O_2	Vacuum	Static Press. iwg
START	1514	.40	.90	385.240	354	233	78	74	225	Ice	16.2	16	
EAST 6	1521 30	.31	.69	389.785	352	242	83	74	228	40	16.0	14	
5	1529	.34	.76	393.320	351	248	83	73	236	40	15.8	16	
4	1536 30	.24	.54	397.028	351	243	85	74	238	46	16.1	15	
3	1544	.20	.45	400.358	351	237	84	74	240	51	16.1	12	
2	1551 30	.16	.36	403.387	350	233	86	74	241	55	15.6	12	
STOP 1	1559			406.168									
START	1633 30	.98	2.20	406.624	352	261	82	74	225	35	16.4	20	
SOUTH 6	1641	.91	2.04	411.238	353	265	85	75	270	34	16.3	20	
5	1648 30	.88	1.98	415.212	353	247	84	76	259	48	16.6	20	
4	1656	.75	1.68	419.365	353	234	84	76	251	52	16.0	20	
3	1703 30	.65	1.46	423.50	353	253	84	76	254	52	16.5	20	
2	1711	.55	1.23	427.66	353	274	84	76	250	33	16.1	21	
STOP 1	1718 30		1.0	431.795									
Total/Average													

Test Summary

Initial	MM / MM
Sample Vol., c.f.	96.367 - 96.375
Stack Press, iwg	-.85
ΔP .5580 iwg	ΔH .91 iwg
Motor Temp., °F	761
Stack Temp., °F	352.0
Water Collected, g	94.6
O_2/CO_2 Method	16.16
Chain of Cust. Info (init.):	
Impingers Loaded	MM
Impingers Recovered	MM
Filter Loaded	MM
Filter Recovered	MM
Probe Wash	SM/VR

Comments: RESO-4/6 16" .018 cfm

CEM O_2 15.5 CO_2 3.5

.624 - .168 = .456

PARTICULATE DATA

Client/Location: SCC / Coolwater
Unit: 4L
Test No.: 2/PM/St
Method: 5
Page: 2 of 2
Sample Location: Stack
Fuel: oil
Ambient Temp., °F:
Operators: J. Mulligan & V. Reddy
Meter Vol. (Start/End): /
Date:

Pre Test Data:
- Barometric Press, in. Hg
- Stack Area, sq. ft.
- Sample Time/ Pt, min.
- Assumed Stack Press
- Assumed Moisture
- Assumed Molecular Wt

Equipment Info:
- Meter No.
- Meter, Yd
- Pitot, Cp
- CFM @ ΔH = 1.0
- Probe I.D.
- Nozzle No./Dia
- Filter No.

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1		-	=	
#2		-	=	
#3		-	=	
#4		-	=	
Total		-	=	

Impinger Box I.D.
Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test	.018	25	1		

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg	Test Summary
start	1752	.45	.61	433.428	337	225	77	71	250	42	16.0	20		
West 6	1759 30	.59	1.32	436.918	351	230	77	71	245	44	16.2	20		Initial
5	1807	.74	1.66	440.48	352	232	77	71	253	46	16.0	20		Sample Vol., c.f.
4	1814 30	.71	1.59	445.587	353	238	77	70	225	52	16.6	20		Stack Press, iwg
3	1825	.85	1.91	450.782	356	241	82	74	230	54	16.0	20		ΔP ____ iwg ΔH ____ iwg
2	1832 30	.51	1.37	455.988	356	247	82	73	238	55	16.4	20		Meter Temp., °F
stop 1	1840			460.249										Stack Temp., °F
														Water Collected, g
														O_2/CO_2 Method
start	1902	.54	1.21	460.277	353	225	70	68	220	50	16.0	20		Chain of Cust. Info (init.):
West 6	1909 30	.71	1.59	464.000	352	232	74	68	234	51	16.2	20		Impingers Loaded
5	1917	.74	1.66	468.138	352	236	76	68	238	53	16.5	21		Impingers Recovered
4	1924 30	.65	1.46	472.089	353	251	75	68	243	54	16.0	21		Filter Loaded
3	1932	.69	1.55	476.43	354	246	75	68	250	56	16.3	21		Filter Recovered
2	1939 30	.45	1.0	479.882	352	241	75	68	245	60	16.0	21		Probe Wash
stop 1	1947			483.128										Comments: Resinet 2/c @ .15" .006 cfm
Total/Average														

EST DS-022

CARNOT 04/02/

SAMPLE TRAIN TEST SUMMARY

Client/Location	COOLWATER	Date	3/28/
Test Number	3-PAH	Data By	MDM/
Test Method	CARB 429	Sample Location	Sta
Fuel	Distillate	Reference Temp (F)	
Control Box #	ES-11	Unit	CT
Pitot Factor	0.840	Meter Cal Factor	1.0(
Stack Area (sq ft)	314.16	Sample Time (Min)	1
Bar Press (in Hg)	27.67	Nozzle Diam (in)	0.1
Meter Vol (acf)	82.806	Meter Temp (F)	83
Stack Press (iwg)	-0.85	Stack Temp (F)	356
Vel Head (iwg)	0.5657	O2 (%): from CEM	15.
		from portable	15.
Liquid Vol (ml)	87.1	CO2 (%): from CEM	3.
		calculated	3.
Meter Press (iwg)	0.64	Start/Stop Time	0924/1

Std Sample Vol (SCF)	73.
Metric Sample Vol (cubic meters)	2.
Moisture Fraction	0.0
Stack Gas Mol Wt	28.
Stack Gas Velocity (ft/sec)	54.
Stack Flow Rate (wacfm)	1.03E+
Stack Flow Rate (dscfm)	575,7
Isokinetic Ratio (%)	104.

PARTICULATE TEST DATA

Client/Location: SCE/Coolwater | Unit: 42 | Test No.: 3-PAH-Stack | Method: 429 | Page: 1 of 2

Sample Location: Stack | Fuel: oil | Ambient Temp., °F: 58

Operators: J. Mulligan & V. Reddy | Meter Vol. (Start/End): 453.853/568.085 | Date: 3/22/90

Pre Test Data:

Barometric Press, in. Hg	27.67
Stack Area, sq. ft.	314.20
Sample Time/ Pt, min.	7.5/180
Assumed Stack Press	.25
Assumed Moisture	8
Assumed Molecular Wt	28.3

Equipment Info:

Meter No.	ES-11
Meter, Yd	1.0
Pitot, Cp	.84
CFM @ΔH = 1.0	.564
Probe I.D.	10' Glass
Nozzle No./Dia	.198
Filter No.	110-909

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	dry	540	468.9	71.2
#2	H_2O	573.5	576.1	-26
#3	dry	520.7	519.0	1.7
#4	SG	749.4	732.6	16.8
Total				87.1

Impinger Box I.D.

Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	.015	15	JM	OK	
Post-Test	.016	17	JM		

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

ΔH =

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
start	924 30	.54	.59	481.853	352	231	73	69	225	Ice	15.6	7	
Nozzle 6	932	.59	.64	488.112	353	235	83	72	229	37	15.8	10	
5	939 30	.61	.67	491.891	354	244	85	73	275	37	15.6	11	
4	947	.73	.80	495.105	354	246	87	73	265	38	15.5	12	
3	954 30	.70	.77	498.989	355	241	87	74	240	38	15.6	12	
2	1002	.59	.64	502.815	353	237	89	74	242	37	15.8	11	
stop 1	1009 30			506.432									
start	1023 30	.45	.49	506.606	337	225	81	75	250	38	15.5	11	
west 1	1031	.55	.60	509.752	350	264	88	76	248	38	15.8	11	
2	1038 30	.74	.81	512.895	357	256	89	76	253	38	15.4	13	
3	1046	.71	.78	516.772	360	271	90	79	251	35	15.6	14	
4	1053 30	.65	.71	520.	360	261	92	77	268	36	15.4	13	
5	1101	.63	.69	524.587	361	252	91	78	225	36	15.4	13	
stop 6	1108 30			528.130									
Total/Average													

Test Summary

Initial	MM/MM
Sample Vol., c.f.	82.806
Stack Press., iwg	~~.857~~ -.85
ΔP .5657 iwg	ΔH 0.64 iwg
Meter Temp., °F	83.2
Stack Temp., °F	356.7
Water Collected, g	87.1
O_2/CO_2 Method	15.67 CCMD O_2 = 15.4 CO_2 = 3
Chain of Cust. Info (init.):	
Impingers Loaded	MMCD
Impingers Recovered	MM
Filter Loaded	MMCD
Filter Recovered	MM
Probe Wash	JM/VR

Comments: Restart L/C 15"
.005 cfm
-.174 cfm

PARTICULATE TEST DATA

Client/Location: SCE / Coolwater
Sample Location: STACK
Operators: V. Reddy, E. J. Mulligan

Unit: 42
Fuel: Oil
Meter Vol. (Start/End): 1

Test No.: 3-PAH-Stack
Ambient Temp., °F: 60

Method: 429
Date: 3/28/90

Page 2 of 2

Pre Test Data:
- Barometric Press, in. Hg
- Stack Area, sq. ft.
- Sample Time/ Pt, min.
- Assumed Stack Press
- Assumed Moisture
- Molecular Wt

Equipment Info:
- Meter No.
- Meter, Yd
- Pitot, Cp
- CFM @ ΔH @ 1.0
- Probe I.D.
- Nozzle No./Dia
- Filter No.

Imp.	Matl	Wt(End)		Weight (Start)		Weight (g)
#1			-		=	
#2			-		=	
#3			-		=	
#4			-		=	
Total			-		=	

Impinger Box I.D.
Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
start	1134 30	.31	.34	528.256	355	223	75	76	250	[illegible]	15.6	10	
start 1	1142	.56	.61	530.741	351	242	85	77	248	51	16.0	11	
2	1149 30	.75	.82	534.060	360	232	90	78	240	57	16.2	13	
3	1157	.91	1.0	537.945	361	245	97	78	245	52	15.8	15	
4	1204 30	.95	1.04	542.278	361	262	96	80	255	53	15.6	15	
5	1212	.84	.92	546.752	362	244	98	81	260	51	15.6	14	
stop 4	1219 30			551.293									
start	1232	.41	.45	551.423	360	225	84	81	231	51	15.6	11	
East 6	1239 30	.36	.39	554.500	360	235	94	81	235	50	15.4	10	
5	1247	.37	.46	557.382	361	263	95	83	248	50	15.6	9	
4	1254 30	.40	.44	560.169	361	268	94	83	235	50	15.8	10	
3	1302	.42	.46	563.087	362	255	94	84	268	52	16.0	10	
2	1309 30	.20	.22	566.072	361	251	89	83	228	53	15.8	6	
stop 1	1317			568.089									
Total/Average													

Test Summary
- Initial
- Sample Vol., c.f.
- Stack Press, iwg
- ΔP ____ iwg ΔH ____ iwg
- Meter Temp., °F
- Stack Temp., °F
- Water Collected, g
- O_2/CO_2 Method
- Chain of Cust. Info (init.):
  - Impingers Loaded
  - Impingers Recovered
  - Filter Loaded
  - Filter Recovered
  - Probe Wash

Comments: -.256 fn
Rinse L/C @ 18" .012 ch
Resin L/C @ 15" .012 ch

Client/Location: SCE/Coolwater
Unit: CT42
Test No.: Field Blank
Method: PAH
Page: 1 of 1
Sample Location:
Fuel:
Ambient Temp., °F:
Operators:
Meter Vol. (Start/End): /
Date: 3/28/90

Pre Test Data:

- Barometric Press, in. Hg
- Stack Area, sq. ft.
- Sample Time/ Pt, min.
- Assumed Stack Press
- Assumed Moisture
- Assumed Molecular Wt

Equipment Info:

- Meter No.
- Meter, Yd
- Pitot, Cp
- CFM @ΔH = 1.0
- Probe I.D.
- Nozzle No./Dia
- Filter No. 110-908

Imp.	Matl	Wt(End)		Weight (Start)		Weight (g)
#1			-		=	
#2			-		=	
#3			-		=	
#4			-		=	
Total			-		=	

Impinger Box I.D.
Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
Total/Average													

Test Summary

- Initial
- Sample Vol., c.f.
- Stack Press, iwg
- ΔP ____ iwg ΔH ____ iwg
- Meter Temp., °F
- Stack Temp., °F
- Water Collected, g
- O_2/CO_2 Method
- Chain of Cust. Info (init.):
  - Impingers Loaded
  - Impingers Recovered
  - Filter Loaded
  - Filter Recovered
  - Probe Wash
- Comments:

Appendix C.7

Fuel Analysis

EPA Fuel "F" factor calculations
Coolwater distillate sample

Reference temp, F:	60
Composition by wt, %:	
Carbon	84.34
Hydrogen	15.45
Nitrogen	0.16
Sulfur	0.06
Oxygen	0.2
Ash	
Heating value, btu/lb:	19,400
F factor, dscf/mmbtu @ 0% O2:	9,404

EPA Fuel "F" factor calculations
Coolwater, sample 2

Reference temp, F:	60
Composition by wt, %:	
Carbon	84.94
Hydrogen	14.86
Nitrogen	0.14
Sulfur	0.06
Oxygen	0.2
Ash	0
Heating value, btu/lb:	19,600
F factor, dscf/mmbtu @ 0% O2:	9,246

Gas Fuel F Factor Calculation

Species	Vol %	Pounds per mole C	H	N	O
Methane	87.9	10.55	3.52		
Ethane	3.5	0.84	0.21		
Propane	1.3	0.47	0.10		
Butane +	0.3	0.14	0.03		
Carbon dioxide	0.9	0.11			0.29
Carbon monoxide	0	0.00			0.00
Nitrogen	2.6			0.73	
Oxygen	0.4				0.13
Hydrogen	0		0.00		
Total		12.11	3.86	0.73	0.42
Molecular weight		17.11			
Weight percent		70.76	22.56	4.25	2.43

EPA Fuel "F" factor calculations: Alamitos 5 AB2588
Natural gas fuel

Reference temp, F:	60
Composition by wt, %:	
Carbon	70.76
Hydrogen	22.56
Nitrogen	4.25
Sulfur	0.00
Oxygen	2.43
Heating value, btu/scf:	995
Heating value, btu/lb:	22,069
F factor, dscf/mmbtu @ 0% O2:	8,472
Ash content, lb/mmbtu:	0.000

Curtis & Tompkins, Ltd.

LABORATORY NUMBER: 25745-1
CLIENT: CARNOT
PROJECT #: 5932
LOCATION: SUBMITTED BY CLIENT
SAMPLE ID: #1

DATE RECEIVED: 04/06/90
DATE ANALYZED: 04/12/90
DATE REPORTED: 05/09/90

METHODS: EPA 6010/7000
CAC TITLE 22 METALS IN AQUEOUS SOLUTIONS

METAL	RESULT	REGULATORY LIMITS STLC
	--mg/L--	
Arsenic	ND (0.25)	5
Beryllium	ND (0.05)	0.75
Cadmium	ND (0.05)	1
Chromium (total)	0.06	560
Chromium (VI)	ND (0.06)	--
Copper	0.5	25
Lead	0.5	5
Mercury	ND (0.1)	0.2
Manganese	ND (0.1)	350
Nickel	0.08	20
Selenium	ND (0.25)	1
Zinc	0.22	250

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES.

QA/QC DATA SUMMARY:

	RPD	SPIKE		RPD	SPIKE
Arsenic	3	121	Mercury	6	101
Beryllium	<1	120	Manganese	3	108
Cadmium	5	85	Nickel	<1	109
Chromium	18	110	Selenium	5	89
Copper	13	119	Zinc	3	92
Lead	4	89			

Curtis & Tompkin

LABORATORY NUMBER: 25745-2
CLIENT: CARNOT
PROJECT #: 5932
LOCATION: SUBMITTED BY CLIENT
SAMPLE ID: #2

DATE RECEIVED: 04/06/
DATE ANALYZED: 04/12/
DATE REPORTED: 05/09/

METHODS: EPA 6010/7000
CAC TITLE 22 METALS IN AQUEOUS SOLUTIONS

METAL	RESULT	REGULATORY LIMITS STLC
	--mg/L--	
Arsenic	ND (0.25)	5
Beryllium	ND (0.05)	0.75
Cadmium	ND (0.05)	1
Chromium (total)	0.06	560
Chromium (VI)	ND (0.06)	--
Copper	0.3	25
Lead	0.5	5
Mercury	ND (0.1)	0.2
Manganese	ND (0.1)	350
Nickel	ND (0.05)	20
Selenium	ND (0.25)	1
Zinc	0.26	250

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES.

QA/QC DATA SUMMARY:

	RPD	SPIKE		RPD	SPIKE
Arsenic	3	121	Mercury	6	101
Beryllium	<1	120	Manganese	3	108
Cadmium	5	85	Nickel	<1	109
Chromium	18	110	Selenium	5	89
Copper	13	119	Zinc	3	92
Lead	4	89			

Curtis & Tompkins, L

LABORATORY NUMBER: 25745-1
CLIENT: CARNOT
PROJECT #: 5932
LOCATION: SUBMITTED BY CLIENT
SAMPLE ID: #1

DATE RECEIVED: 04/06/90
DATE ANALYZED: 05/08/90
DATE REPORTED: 05/09/90

ULTIMATE AND PROXIMATE ANALYSIS

PARAMETER	AS RECEIVED BASIS (% by Weight)
ASH CONTENT	<0.01
CARBON	70.28
HYDROGEN	12.87
NITROGEN	0.13
OXYGEN	16.67
SULFUR	0.05
SPECIFIC GRAVITY	0.786
CHLORINE BY X-RAY DIFF. (mg/L)	ND (50)
BTU/LB.	19,400

by difference, but is an artifact of evaporation - correct to 0.2% ℓ (from Steam by B&W), reapport

C: 84.34
H: 15.45
N: 0.16
O: 0.2
S: 0.06

MM 5/10/90

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES

Curtis & Tomp

LABORATORY NUMBER: 25745-2
CLIENT: CARNOT
PROJECT #: 5932
LOCATION: SUBMITTED BY CLIENT
SAMPLE ID: #2

DATE RECEIVED: 04/06/90
DATE ANALYZED: 05/08/90
DATE REPORTED: 05/09/90

ULTIMATE AND PROXIMATE ANALYSIS

PARAMETER	AS RECEIVED BASIS (% by Weight)	
ASH CONTENT	<0.01	
CARBON	73.46	84.94
HYDROGEN	12.85	14.86
NITROGEN	0.12	0.14
OXYGEN	13.52 see previous page	
SULFUR	0.05	0.06
SPECIFIC GRAVITY	0.787	
CHLORINE BY X-RAY DIFF. (mg/L)	ND (50)	
BTU/LB.	19,600	

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES

15991 Red Hill Avenue
Suite 110
Tustin, CA 92680-7388

Purchase Order

Vendor: C+T

Phone:

Code:

P.O. Number 5932

Charge Number 53313 53304

Date 4/3/90

California Resale No: SR EA 24-816623

Date Required	Contact	Ship via	Terms	___ Resale — Non Taxable ___ Co Use — Taxable
4/28/90				

ITEM NO.	DESCRIPTION	QUANTITY	PRICE	TOTAL
	2 fuel oil samples analyze for BTU/lb, HHV C, H, O, N, S ash content specific gravity - chlorides As, Be, Cd, Cr, Cr⁶⁺, Cu Pb, Mg, Ni, Se, Zn	2	465.00	930.00

Sub Total $ 930.00

Sales Tax $

Freight $

TOTAL $ 930.00

Paid

Paul Ewing

PURCHASE ORDER NUMBER MUST APPEAR ON ALL INVOICES, SHIPPING MEMOS, BILLS OF LADING AND PACKAGES.

Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Samples:

Sample No. (Project No. Test No.	Complete Description
#1	
#2	fuel oil samples

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
Paul Ewing	4/4/90		

Samples shipped to: C+T

Samples shipped from ESA by: C+T Date 4/4/90

Carrier: h.c. Air Bill No.

Samples received by: Paul Mead Date 4/5/90

Company: Curtis + Tompkins, Ltd.

15991 RED HILL AVENUE, SUITE 110, TUSTIN, CA 92680-7388 / (714) 259-9520 / Telecopy: (714) 259-0372

ESA DS-057

CW

CARNOT (P.O. 5918)

SAMPLE	% V/V	BTU HIGH	BTU LOW	BTU HIGH	BTU LOW	S.G.	S.G.
O_2	0.4	–	–	–	–	1.105	0.004
N_2	2.6	–	–	–	–	0.967	0.025
CH_4	97.9	1012	911	990	891	0.554	0.487
CO_2	0.9	–	–	–	–	1.519	0.014
C_2	3.5	1773	1622	62	57	1.038	0.036
C_3	1.3	2523	2321	33	30	1.522	0.020
nC_4	0.2	3270	3018	7	6	2.007	0.004
iC_4	0.1	3260	3008	3	3	2.007	0.002
He	–	–	–	–	–	0.138	–
	96.9			~~1095~~ 995	897		0.592

Appendix C.8

Velocity and Moisture

CARNOT 04/02/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	COOLWATER	Date	3/29/90
Test Number	4-Vel	Data By	MDM/L
Test Method	EPA 2/4	Sample Location	Stack
Fuel	Nat Gas	Reference Temp (F)	60
Control Box #	ES-11	Unit	CT 42
Pitot Factor	0.840	Meter Cal Factor	1.0000
Stack Area (sq ft)	314.16	Sample Time (Min)	40
Bar Press (in Hg)	27.78	Nozzle Diam (in)	N/A
Meter Vol (acf)	30.737	Meter Temp (F)	77.7
Stack Press (iwg)	-0.90	Stack Temp (F)	340.2
Vel Head (iwg)	0.6060	O2 (%): from CEM	15.00
		from portable	16.10
Liquid Vol (ml)	47.6	CO2 (%): from CEM	2.90
		calculated	2.36
Meter Press (iwg)	2.00	Start/Stop Time	0907/1020

Std Sample Vol (SCF)	27.73
Metric Sample Vol (cubic meters)	0.79
Moisture Fraction	0.074
Stack Gas Mol Wt	28.21
Stack Gas Velocity (ft/sec)	56.47
Stack Flow Rate (wacfm)	1.06E+06
Stack Flow Rate (dscfm)	593,256

PARTICULATE FIELD DATA

Client/Location: SCE Coolwater
Sample Location: Stack
Operators: VR / MDM
Unit: CT 4
Fuel: Gas
Test No.: 4-Vel
Ambient Temp., °F:
Meter Vol. (Start/End): 572.522 603.259
Method: 2/4
Page 1 of 2
Date: 03-29-90

Pre Test Data:
- Barometric Press, in. Hg: 27.78
- Stack Area, sq. ft.:
- Sample Time/ Pt, min.:
- Assumed Stack Press:
- Assumed Moisture:
- Assumed Molecular Wt:

Equipment Info:
- Meter No.: ES-11
- Meter, Yd: 1.00
- Pitot, Cp: 0.84
- CFM @ΔH = 1.0: 0.564
- Probe I.D.: 10' glass
- Nozzle No./Dia: –
- Filter No.: –

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	H_2O	665.9	- 627.0	= 38.9
#2	H_2O	603.0	- 601.9	= 1.1
#3	dry	465.0	464.0	= 1.0
#4	sg	716.5	- 709.9	= 6.6
Total		2450.4	- 2402.8	= 47.6

Impinger Box I.D.:
Integrated Bag I.D.:

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	0.001	6"	VR	OK	
Post-Test	0.001	6"	VR	OK	

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
N-6	9:07	0.64	2.0	572.522	349		76	65			16.5	5.5	
-5	9:08	0.73		573.5	349		82	66			16.5	"	
-4	9:09	0.75		574.5	349		84	66			16.5		
-3	9:10	0.82		575.5	349		84	67			16.5	"	
-2	9:11	0.82		577.4	349		84	67			16.5		
-1	9:12	0.67	2.0	578.5	349		85	68			16.5		
	9:16½			579.125									
W-6	9:31	0.75	2.0	579.125	349		80	68			16.0	5.5	
-5	9:32	0.84		580.3	349		86	68			15.9	"	
-4	9:33	0.92		581.3	350		88	69			15.7	"	
-3	9:35	0.80		582.7	350		88	69			15.8	"	
-2	9:37	0.75		584.25	349		88	70			15.8	"	
-1	9:38	0.78		585.15	343		88	70			15.8		
	9:39			585.878									
S-6													
-5													
-4													
-3													
Total/Average													

Test Summary
- Initial: 66/66
- Sample Vol., c.f.: 30.737
- Stack Press, iwg: -0.9
- ΔP ~~2.65~~ iwg ΔH 2.0 iwg ΔP = .606
- Motor Temp., °F: ~~76.0~~ 77.7
- Stack Temp., °F: 340.2
- Water Collected, g: 47.6
- O_2/CO_2 Method: O_2 = 16.1
- Chain of Cust. Info (init.): 39.5 m
  - Impingers Loaded: MM
  - Impingers Recovered: MM
  - Filter Loaded: –
  - Filter Recovered: –
  - Probe Wash: –
- Comments: CEM O_2 = 15.0
  CO_2 = 2.9

PARTICULATE TEST DATA

Client/Location _____ Unit 42 Test No. 4-Vel Method _____ Page 2 of 2

Sample Location Stack Fuel Gas Ambient Temp., °F _____

Operators VR/MDM Meter Vol. (Start/End) _____ / _____ Date 03-29-90

Pre Test Data:
- Barometric Press, in. Hg _____
- Stack Area, sq. ft. _____
- Sample Time/ Pt, min. _____
- Assumed Stack Press _____
- Assumed Moisture _____
- Assumed Molecular Wt _____

Equipment Info:
- Meter No. _____
- Meter, Yd _____
- Pitot, Cp _____
- CFM @ ΔH = 1.0 _____
- Probe I.D. _____
- Nozzle No./Dia _____
- Filter No. _____

Imp.	Matl	Wt(End)		Weight (Start)		Weight (g)
#1			-		=	
#2			-		=	
#3			-		=	
#4			-		=	
Total			-		=	

Impinger Box I.D. _____

Integrated Bag I.D. _____

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg	Test Summary
S-6	9:48	0.5	2.0	585.878	349		79	69			16.0	6.0		
-5	9:50	0.81	"	587.4	349		88	70			16.0	4		Initial _____
-4	9:52	0.87	"	589.05	349		88	70			16.0	"		Sample Vol., c.f. _____
-3	9:54	0.87	"	590.70	349		89	70			16.0	"		Stack Press, iwg _____
-2	9:56	0.64		592.2	349		89	71			16.0			ΔP ____ iwg ΔH ____ iwg
-1	9:58	0.35	2.0	593.0	337		69	71			16.0			Meter Temp., °F _____
				594.62										Stack Temp., °F _____
	9:59										17.5			Water Collected, g _____
E-6	10:09	0.4	2.0	594.62	350		77	70			16.4	6.0		O_2/CO_2 Method _____
-5	10:14	0.33	"	598.6	349		91	72			16.4			Chain of Cust. Info (init.):
-4	10:15	0.34	"	599.4	349		90	72			16.2			Impingers Loaded _____
-3	10:17	0.28	"	600.9	348		91	72			15.7	"		Impingers Recovered _____
-2	10:18	0.28	"	601.67	347		91	72			15.7			Filter Loaded _____
-1	10:19	0.19		602.45	190		90	73			15.7	"		Filter Recovered _____
	10:20			603.258										Probe Wash _____
														Comments: _____
otal/Average														

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CARNOT 04/02/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	COOLWATER	Date	3/29/90
Test Number	5-Vel	Data By	MDM
Test Method	EPA 2/4	Sample Location	Stack
Fuel	Nat Gas	Reference Temp (F)	6
Control Box #	ES-11	Unit	CT 42
Pitot Factor	0.840	Meter Cal Factor	1.000C
Stack Area (sq ft)	314.16	Sample Time (Min)	44
Bar Press (in Hg)	27.78	Nozzle Diam (in)	N/A
Meter Vol (acf)	34.619	Meter Temp (F)	84.2
Stack Press (iwg)	-0.80	Stack Temp (F)	332.0
Vel Head (iwg)	0.5918	O2 (%): from CEM	15.0
		from portable	17.
Liquid Vol (ml)	51.7	CO2 (%): from CEM	2..
		calculated	1.8
Meter Press (iwg)	2.00	Start/Stop Time	1035/11

Std Sample Vol (SCF)	30.8
Metric Sample Vol (cubic meters)	0.8
Moisture Fraction	0.07
Stack Gas Mol Wt	28.1
Stack Gas Velocity (ft/sec)	55.5
Stack Flow Rate (wacfm)	1.05E+0
Stack Flow Rate (dscfm)	590,60

PARTICULATE TEST DATA

Client/Location: SCE Coolwater
Sample Location: Stack
Operators: VL/MDM
Unit: 42
Fuel: Gas
Test No.: S-V01
Method: 2/4
Ambient Temp., °F:
Meter Vol. (Start/End): 605.191 /
Page 1 of 2
Date 03-29-90

Pre Test Data:
Barometric Press, in. Hg: 27.78
Stack Area, sq. ft.:
Sample Time/ Pt, min.:
Assumed Stack Press:
Assumed Moisture:
Assumed Molecular Wt:

Equipment Info:
Meter No.: ES-11
Meter, Yd: 1.00
Pitot, Cp: 0.84
CFM @ΔH = 1.0: 0.564
Probe I.D.: 10' glass
Nozzle No./Dia: —
Filter No.: —

Imp.	Matl	Wt(End)		Weight (Start)		Weight (g)
#1	H_2O	596.0	-	560.0	=	36.0
#2	"	552.1	-	545.1	=	7.0
#3	dry	519.4	-	520.7	=	-1.3
#4	SG	803.5	-	793.5	=	10.0
Total		2471.0	-	2419.3	=	51.7

Impinger Box I.D.:
Integrated Bag I.D.:

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	0.004	6"	VK	OK.	
Post-Test	0.02	8"	VK	OK	

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
E-6	10:35	0.32	2.0	605.191	349		86	74			18.0	3.0	
-5	10:37	0.32	"	606.83	350		90	74			17.5	"	
-4	10:39	0.27		608.37	350		90	74			17.6	"	
-3	10:41	0.41		609.88	350		89	74			17.5	"	
-2	10:43	0.21		611.42	349		89	75			16.9	"	
-1	10:45	2.15	2.0	612.88	212	170	90	75			15.9		
	10:46			613.565									
S-6	10:53	0.45	2.0	613.565	351		82	74			17.6	3.0	
-5	10:55	0.85	"	615.2	350		89	75			17.5	"	
-4	10:57	0.75	"	616.8	350		90	75			17.5	"	
-3	10:59	0.77	"	618.35	350		91	75			17.0	"	
-2	11:01	0.70	"	619.89	349		91	75			16.2	"	
-1	11:03	0.55	"	621.45	332		92	75			16.2		
	11:04			622.051									
Total/Average													

Test Summary:
Initial: 46
Sample Vol., c.f.: 34.619
Stack Press, iwg: -0.8
ΔP .5918 iwg ΔH 2.0 iwg
Meter Temp., °F: 84.2
Stack Temp., °F: 332.0
Water Collected, g: 51.7
O_2/CO_2 Method: O_2 = 17.1 44 min
Chain of Cust. Info (init.):
Impingers Loaded
Impingers Recovered
Filter Loaded
Filter Recovered
Probe Wash
Comments:

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PARTICULATE TEST DATA

Client/Location _____ Unit 42 Test No. 5-Vel Method _____ Page 2

Sample Location Stack Fuel Gas Ambient Temp., °F _____ of 2

Operators VC/MDM Meter Vol. (Start/End) _____ / _____ Date 03-29-90

Pre Test Data:

Barometric Press, in. Hg _____

Stack Area, sq. ft. _____

Sample Time/ Pt, min. _____

Assumed Stack Press _____

Assumed Moisture _____

Assumed Molecular Wt _____

Equipment Info:

Meter No. _____

Meter, Yd _____

Pitot, Cp _____

CFM @ΔH = 1.0 _____

Probe I.D. _____

Nozzle No./Dia _____

Filter No. _____

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1		-	=	
#2		-	=	
#3		-	=	
#4		-	=	
Total		-	=	

Impinger Box I.D. _____

Integrated Bag I.D. _____

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
W-6	11:11	0.78	2.0	622.050	351		91	76			16.5	3.5	
-5	11:13	0.90	"	623.64	350		93	76			16.5	"	
-4	11:15	0.94	"	625.30	351		94	77			16.5	"	
-3	11:17	0.98	"	626.90	351		95	77			16.0	"	
-2	11:19	0.67	"	628.55	349		95	78			16.0	"	
-1	11:21	0.47	2.0	630.	340		95	78			16.0	3.5	
	11:22			630.953									
N-6	11:29	0.57	2.0	630.953	351		89	78			18.0	3.5	
-5	11:31	0.8	"	632.57	352		94	79			17.8	"	
-4	11:33	0.84		634.3	352		96	79			16.0	"	
-3	11:35	0.82	"	635.8	352		97	79			16.0		
-2	11:37	0.79		637.35	351		96	79			15.7	"	
-1	11:39	0.66	"	639.0	2176		96	80			15.6	"	
	11:40			639.81									
Total/Average													

Test Summary

Initial _____

Sample Vol., c.f. _____

Stack Press, iwg _____

ΔP _____ iwg ΔH _____ iwg

Meter Temp., °F _____

Stack Temp., °F _____

Water Collected, g _____

O_2/CO_2 Method _____

Chain of Cust. Info (init.):

Impingers Loaded _____

Impingers Recovered _____

Filter Loaded _____

Filter Recovered _____

Probe Wash _____

Comments: _____

APPENDIX D

CALCULATIONS

Appendix D.1

General Emission Calculations

E∫A

EMISSION CALCULATIONS

1. Sample Volume and Isokinetics

a. Sample gas volume, dscf

$$V_{m\ std} = 0.03342 V_m [P_{bar} + (H/13.6)](T_{ref}/T_m)(Y)$$

b. Water vapor volume, scf

$$V_{w\ std} = 0.0472\ V_{lc}\ (T_{ref}/528°R)$$

c. Moisture content, nondimensional

$$Bwo = V_{w\ std}/(V_{m\ std} + V_{w\ std})$$

d. Stack gas molecular weight, lb/lb mole

$$MW_{dry} = 0.44(\%\ CO_2) + 0.32(\%\ O_2) + 0.28(\%\ N_2)$$

$$MW_{wet} = MW_{dry}\ (1 - B_{wo}) + 18\ (B_{wo})$$

e. Absolute stack pressure, iwg

$$Ps = P_{bar} + P_{sg}/13.6$$

f. Stack velocity, ft/sec

$$V_s = 2.90\ C_p \sqrt{\Delta PTs} \sqrt{\frac{29.92}{Ps} \times \frac{28.95}{MW_{wet}}}$$

g. Actual stack gas flow rate, wacfm

$$Q = (V_s)(A_s)(60)$$

h. Standard stack gas flow rate, dscfm

$$Q_{sd} = Q\ (1 - Bwo)(T_{ref}/Ts)(Ps/29.92)$$

i. Percent isokinetic

$$I = \frac{17.32 \times T_s\ (V_{m\ std})}{(1-Bwo)\theta \times V_s \times Ps \times Dn^2} \times \frac{528\ °R}{T_{ref}}$$

2. Particulate Emissions

a. Grain loading, gr/dscf

$$C = 0.01543\ (M_n/V_{m\ std})$$

b. Grain loading at 12% CO_2, gr/dscf

$$C_{12\%\ CO_2} = C\ (12/\%\ CO_2)$$

c. Mass emissions, lb/hr

$$M = C \times Qsd \times (60\ min/hr)/(7000\ gr/lb)$$

3. Gaseous Emissions, lb/hr

$$M = ppm \times 10^{-6} \frac{MW_i\ lb/lb\ mole}{SV} \times Qsd \times 60\ min/hr$$

where SV = specific molar volume of an ideal gas:

385.3 ft^3/lb mole for T_{ref} = 528 °R
379.5 ft^3/lb mole for T_{ref} = 520 °R

4. Emissions Rates, lb/10^6 Btu

a. Fuel factor at 68 °F, dscf/10^6 Btu at 0% O_2

$$F_{68} = \frac{10^6[3.64(\%H) + 1.53(\%C) + 0.14(\%N) + 0.57(\%S) - 0.46(\%O_2,\ fuel)]}{HHV,\ Btu/lb}$$

b. Fuel factor at 60 °F

$$F_{60} = F_{68}\ (520\ °R/528\ °R)$$

c. Gaseous emission factor

$$lb/10^6\ Btu_i = ppm_i \times 10^{-6} \times \frac{MW_i\ lb}{lb\ mole} \times \frac{1}{SV} \times F \times \frac{20.9}{20.9-\%O_2}$$

d. Particulate emission factor

$$lb/10^6\ Btu = C \times \frac{1\ lb}{7000\ gr} \times F \times \frac{20.9}{20.9-\%O_2}$$

These calculations are routinely performed on ESA's computer.

Nomenclature:

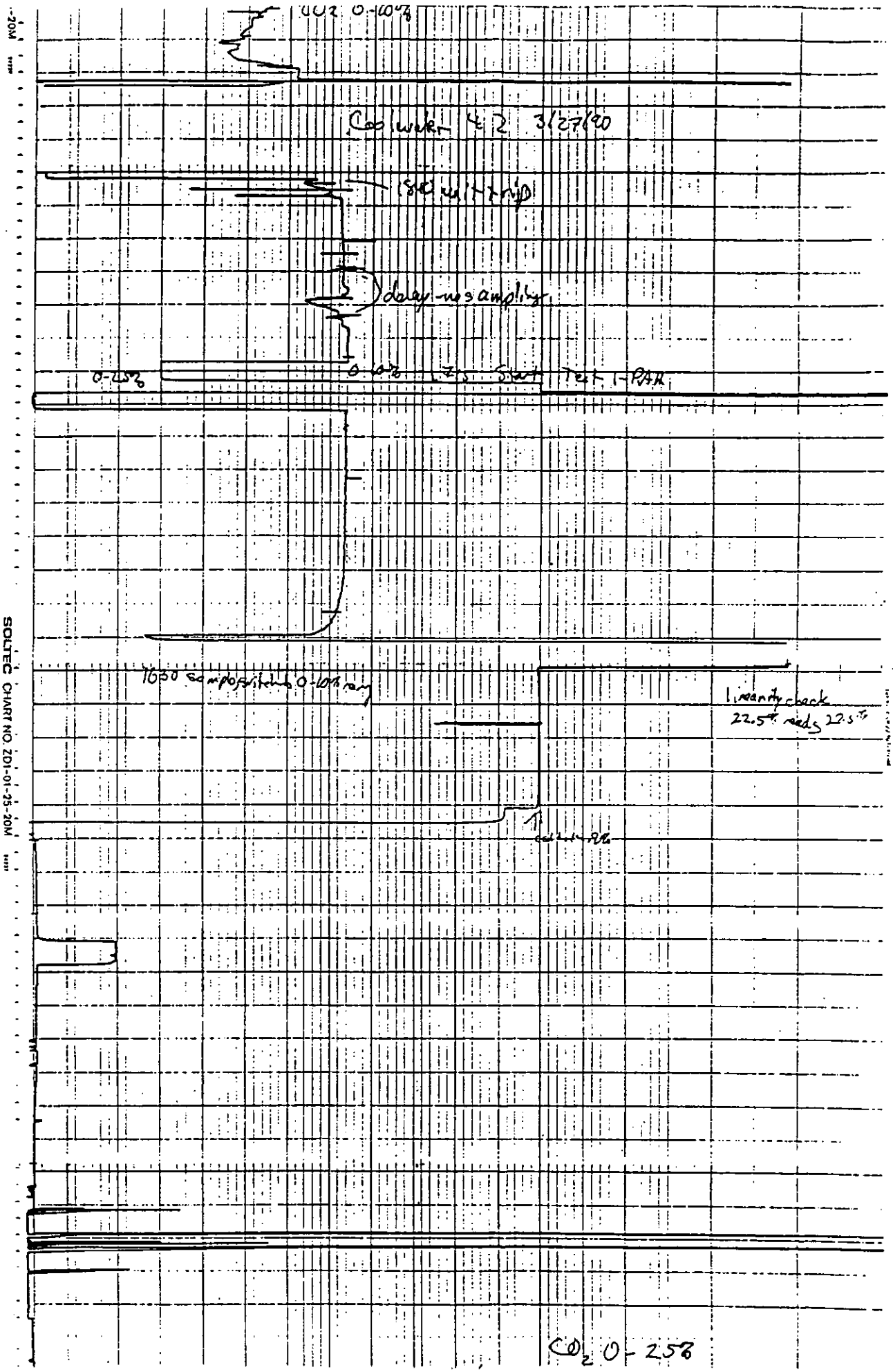
A_s	=	stack area, ft^2
Bwo	=	flue gas moisture content
$C_{12\%\ CO_2}$	=	particulate grain loading, gr/dscf corrected to 12% CO_2
C	=	particulate grain loading, gr/dscf
C_p	=	pitot calibration factor, dimensionless
Dn	=	nozzle diameter, in.
F	=	fuel F factor, dscf/10^6 Btu at 0% O_2
H	=	orifice pressure differential, iwg
I	=	% isokinetics
M_n	=	mass of collected particulate, mg
M_i	=	mass emissions of species i, lb/hr
MW	=	molecular weight of flue gas
MW_i	=	molecular weight of species i:

NOx: 46
CO: 28
SO_2: 64
HC: 16

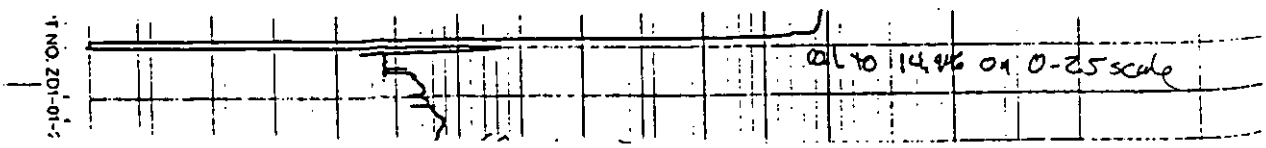
θ	=	sample time, min.
ΔP	=	average velocity head, iwg $=\left(\overline{\sqrt{\Delta P}}\right)^2$
P_{bar}	=	barometric pressure, in.Hg
Ps	=	stack absolute pressure, in.Hg.
Psg	=	stack static pressure, iwg
Q	=	wet stack gas flow rate at actual conditions, wacfm
Qsd	=	dry stack gas flow rate at standard conditions, dscfm
SV	=	specific molar volume of an ideal gas at std conditions, ft^3/lb mole
Tm	=	meter temperature, °R
T_{ref}	=	reference temperature, °R
Ts	=	stack temperature, °R
V_s	=	stack velocity, ft/sec
V_{lc}	=	volume of liquid collected in impingers, ml
Vm	=	dry meter volume uncorrected, dcf
$V_{m\ std}$	=	dry meter volume at standard conditions, dscf
$V_{w\ std}$	=	volume of water vapor at standard conditons, scf
Y	=	meter calibration coefficient

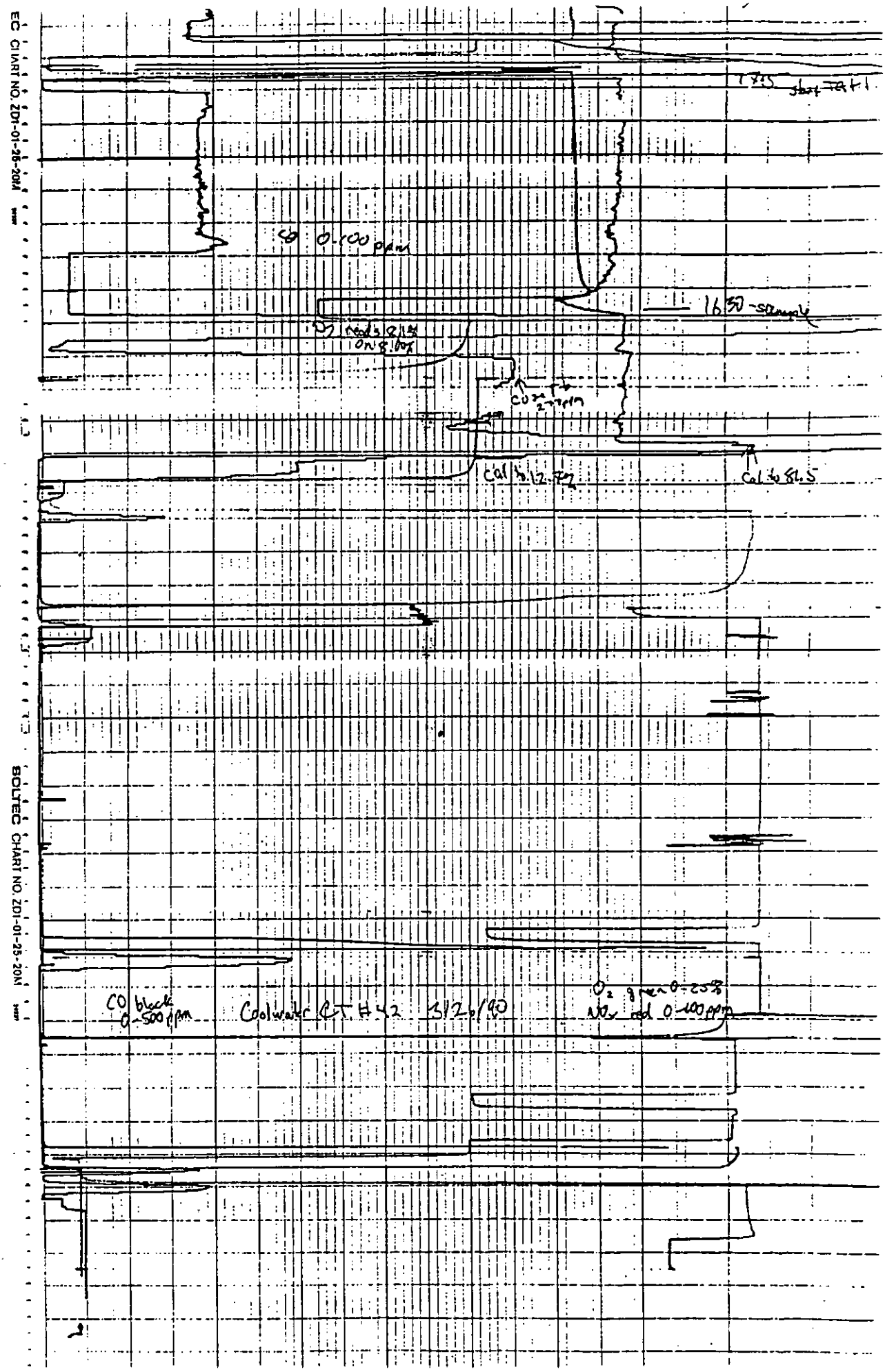
APPENDIX E

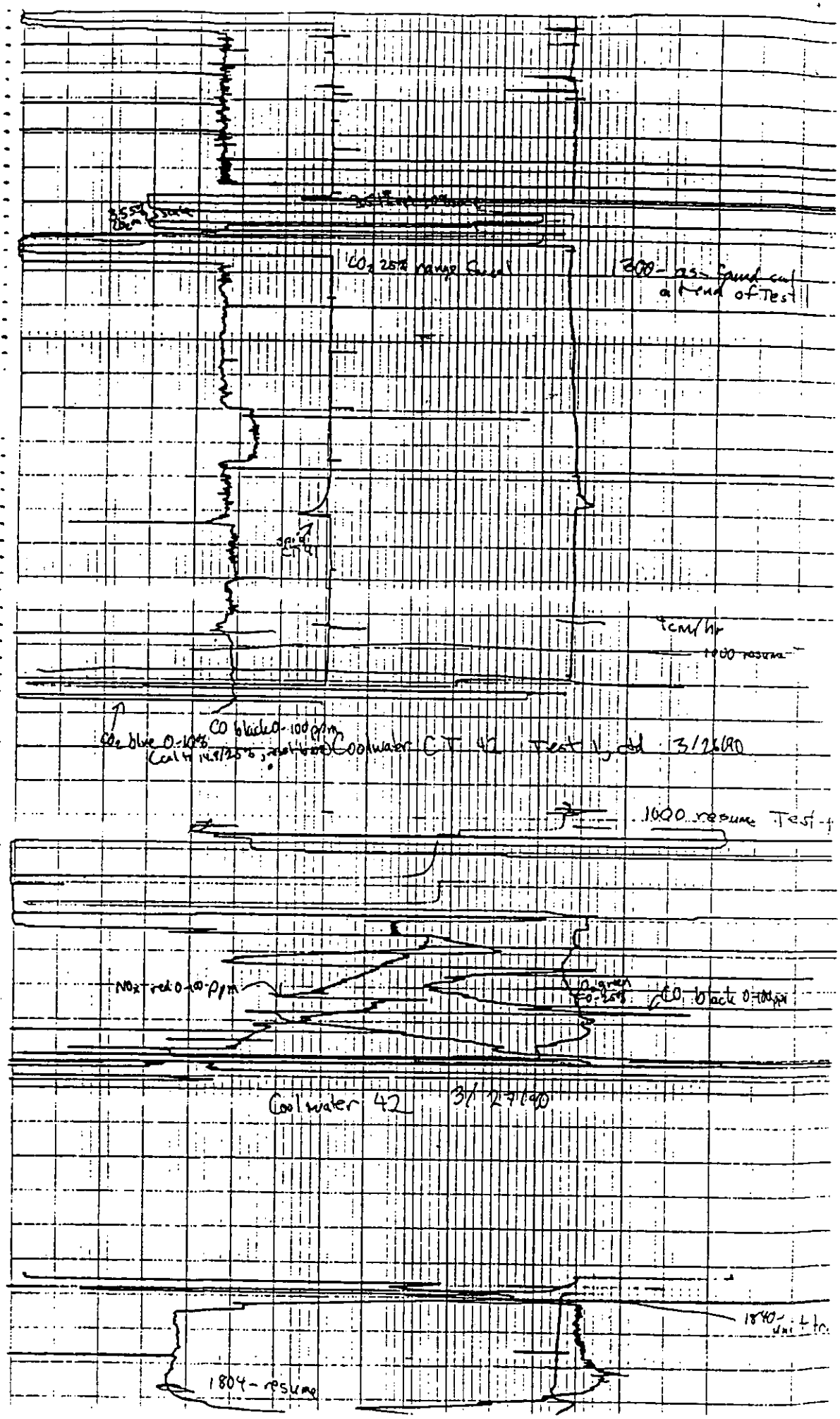
INSTRUMENT STRIP CHARTS



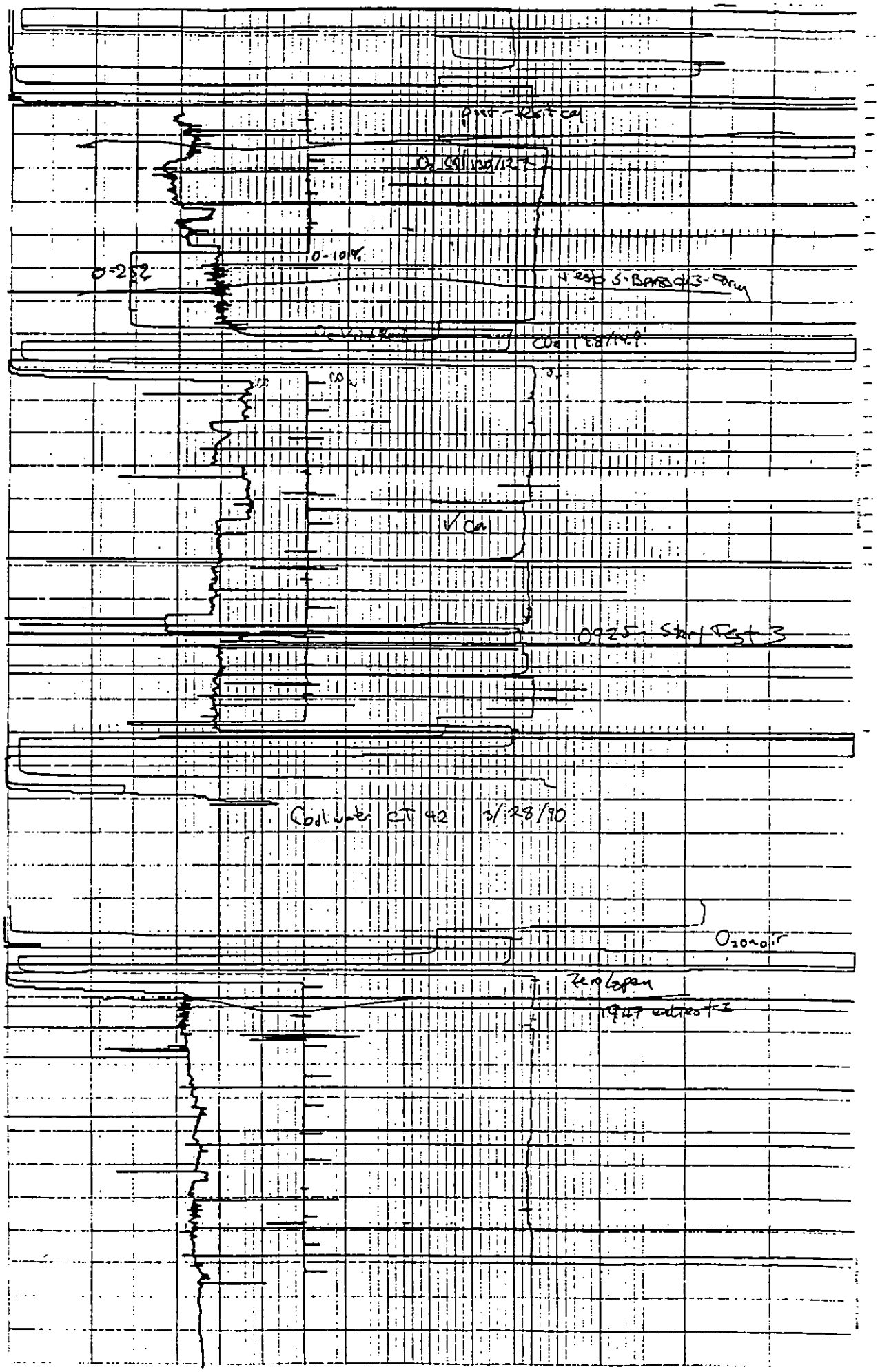
SOLTEC CHART NO. ZD1-01-25-20M

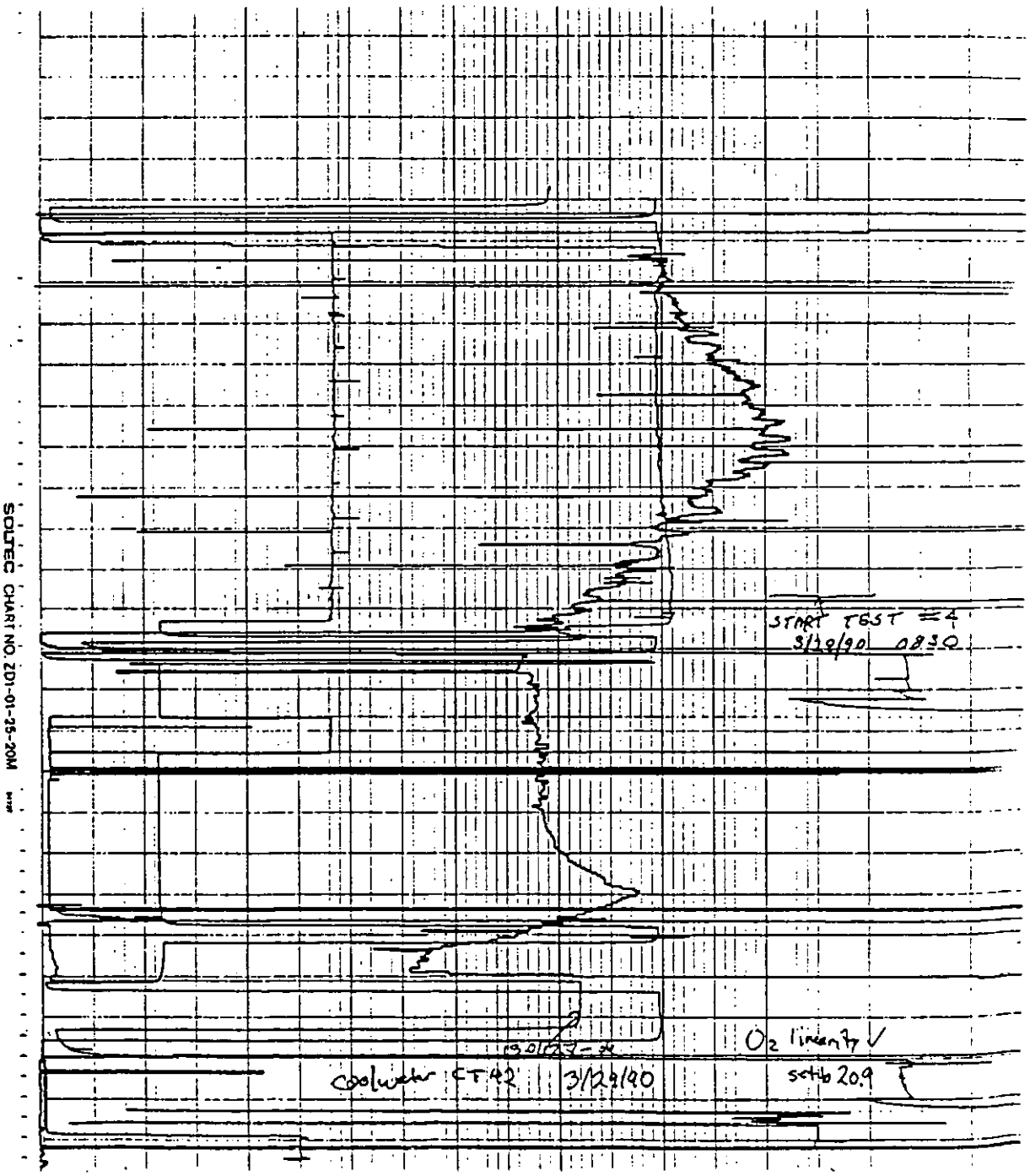

0 40 14 46 01 0-25 scale


EC CHART NO. ZD1-01-26-20M
SOLTEC CHART NO. ZD1-01-25-20M
CO 0-100 ppm
1630 - sample
Cal to 12.72
Cal to 81.5
CO black
0-500 ppm
Coolwater CT. H42 3/2/90
O2 green 0-25%
NOx red 0-100 ppm



SOLTEC CHART NO. ZD1-01-25-2014


0-10%
0-2%
✓ Ca
0925 - Start Test 3
Coal water CT 42 3/28/90
Zero Lapse
BOLTEC CHART NO. ZD1-01-25-20M
BOLTEC CHART NO. ZD1-01-2



SOLTEC CHART NO. ZD1-01-25-20M

APPENDIX F

CHAIN OF CUSTODY

APR 1 6 1990

ESA Energy Systems Associates A CORPORATION

Formaldehyde
Benzaldehyde
Acetaldehyde

CERTIFICATION OF SAMPLE RECEIPT

Samples:

Sample No. (Project No. Test No. 53304-CW

	Complete Description	
BLANK #1		1 vial
BLANK #2		1 vial
Spike #1		1 vial
Spike #2		1 vial
3A-Form	combine vials A+B	2 vials
3B-Form	"	2 vials
3C-Form	"	2 vials
4A-Form	"	2 vials
4B-Form	"	2 vials
4C-Form	"	2 vials
	4969939914 #1	

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
Paul Ewing	4/4/90		

Samples shipped to: Radian

Samples shipped from ESA by: Fed ex Date 4/4/90

Carrier: " Air Bill No. 4969939914

Samples received by: Randy Hamaglia Date 4/11/90

Company: Radian Temp: Ambient

15991 RED HILL AVENUE, SUITE 110, TUSTIN, CA 92680-7388 / (714) 259-9520 / Telecopy: (714) 259-0372

ESA OS-057

"Truesdail Lab" 44410

Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Samples:

Sample No. (Project No. Test No.	Complete Description
53304-CW	
3B	
3C	
4A	5 Tedlar Bags
4B	
4C	
	Do analysis on 3C twice and report it twice

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
Paul Ewing	3/30/90		

Samples shipped to: Truesdail

Samples shipped from ESA by: Hand carried Date 3/30/90

Carrier: Paul Ewing Air Bill No.

Samples received by: Joe Bigatto Date 3/30/90

Company: Truesdail Labs

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ESA DS-057

Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Samples:

Sample No. (Project No. Test No.	Complete Description
NG	Natural gas sample

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
Paul Ewing	3/30/90		

Samples shipped to: Truesdail

Samples shipped from ESA by: hand carried Date 3/30/90

Carrier: Paul Ewing Air Bill No.

Samples received by: [illegible] Date 3/30/90

Company: Truesdail Labs

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ESA DS-057

(xtra)

REAGENT CHAIN OF CUSTODY

Client: SCE / Alamitos Charge No.: 53304

Project Manager: AB / HDM

REGENTS - Enter quantity and circle description

✓	Water	DI (B&J) 2	Lot #
✓	Acetone	ACS (GC2) 2	Lot #
✓	Hexane	ACS (GC2) 2	Lot #
	IPA	ACS	Lot #
	H_2O_2	30% Other	Lot #
	$MeCl_2$	ACS GC2	Lot #

4l 0.1 N NaOH
8l 5% HNO_3 / 10% H_2O_2
3l $KMnO_4$
500 ml DNPH sol

FILTERS - Quantity and Description

Glass Fiber 110mm 63mm 47mm 45mm 37mm

Teflon 110mm 63mm T63-216 through T63-223
T47-218 through T47-226

✓ Hexane Rinsed
47-181 through 47-212 T47-227 through T241

8 Tedlar bags

6 XAD-2 modules

ESA MSC-136

BOTTLES - Quantity

_____ 1000ml Nalgene

_____ 500ml Nalgene

_____ 250ml Nalgene

_____ 500ml I-chem

2cs 1000ml Acid Washed

2cs 500ml Acid Washed

_____ 250ml Acid Washed

LAB SUPPLY CHECK LIST

✓ Silica Gel

✓ Gloves (small and large)

✓ Wash Bottles

✓ Foil

✓ Baggies

✓ Sample Labels

✓ Pens

✓ Paper Towels

~~Scissors~~

✓ Tweezers

~~Brushes~~

~~50,~~ 1,000 X Formaldehyde soln
2- 10 ml pipettes
2- 5 ml pipettes
2- 1 ml pipettes

✓ Teflon tape
✓ Parafilm

Released By _____ Date 3/9/90

Received By _____ Date _____

Returned By _____ Date _____

Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Samples:

Sample No. (Project No. Test No.	Complete Description
53304	ORGANIC fraction for MMS trains
	2 shipment total

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
[illegible]	4/3/90		

Samples shipped to: ZENON

Samples shipped from ESA by: Fed ex Date 4/3/90

Carrier: Air Bill No. 400-7667-6

Samples received by: [illegible] Date

Company: ZENON

15991 RED HILL AVENUE, SUITE 110, TUSTIN, CA 92680-7388 · (714) 259-9520 / Telecopy: (714) 259-0372

ESA DS-057

Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Samples:

Sample No. (Project No. Test No.	Complete Description
#1	fuel oil samples
#2	

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
Paul Ewing	4/4/90		

Samples shipped to: C+T

Samples shipped from ESA by: C+T Date 4/4/90

Carrier: h. C. Air Bill No.

Samples received by: Paul Ewing Date 4/5/90

Company: Curtis + Tompkins, Ltd.

15991 RED HILL AVENUE, SUITE 110, TUSTIN, CA 92680-7388 / (714) 259-9520 / Telecopy: (714) 259-0372

ESA DS-057

ESA Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Samples:

Sample No. (Project No. Test No.	Complete Description
007589 BLANK-PAH	H_2O, organic, column, filter #110-908, ~~column~~
007590 1-PAH	" filter #110-907, column
007591 2-PAH	" filter # 110-910, ~~column~~
007592 3-PAH	" filter # 110-909, ~~column~~

2 shipments

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
Paul Emery	4/3/90		

Samples shipped to: ZENON

Samples shipped from ESA by: Fed ex Date 4/3/90

Carrier: Air Bill No. 400-7667-64 400-7667-64

Samples received by: [illegible] Date

Company: Zenon

15991 RED HILL AVENUE, SUITE 110, TUSTIN, CA 92680-7388 / (714) 259-9520 / Telecopy: (714) 259-0372

ESA OS-057