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/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP42 Section:	3.1
Background Chapter	2
Reference	4
Title:	Emissions Inventory Testing at Long Beach Combustion Turbine No. 3 for Inclusion in Air Toxins Hot Spots Inventory required under AB 2588. Bell. A.C. Prepared by Carnot, Tustin, California for Southern California Edison Company, Rosemead, California. May, 1989

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EMISSIONS INVENTORY
TESTING AT LONG BEACH
COMBUSTION TURBINE NO. 3

CARNOT

EMISSIONS INVENTORY TESTING AT LONG BEACH COMBUSTION TURBINE NO. 3

Prepared for:

SOUTHERN CALIFORNIA EDISON COMPANY
Rosemead, California

For Inclusion in:

Air Toxics Hot Spots Inventory
required under
AB2588

Prepared by:

Arlene C. Bell

CARNOT

formerly the California Division of
ENERGY SYSTEMS ASSOCIATES

Tustin, California

MAY, 1989

ESR 53304-2050

REPORT CERTIFICATION

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

Date 5/29/90

Arlene C. Bell
Director of Laboratory Services

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

Date 5/29/90

Arlene C. Bell
Director of Laboratory Services

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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 South Coast Air Quality Management District and by the California Air Resources Board (ARB).

This document is the source test report for the emissions tests that were conducted on SCE's Long Beach Generating Station Combustion Turbine No. 3. 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 (The 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 January 30 through February 1, 1990. The Carnot test team members were Bob Finken, Arlene Bell, Sheila Haythornthwaite, Jim Mulligan, and Russell Pence. Mr. Michael D. 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
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
NATURAL GAS FUEL
January 30, 1990

Species	
Benzene:	
ppb	ND <4
lb/hr	ND <2.36 x 10^{-2}
lb/MMBtu	ND <2.70 x 10^{-5}
Formaldehyde	
ppb	<443
lb/hr	<1.01
lb/MMBtu	<1.15 x 10^{-3}

TABLE 1-2
SUMMARY OF AB2588 EMISSIONS TEST RESULTS
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
DISTILLATE OIL
January 31, - February 1, 1990

Species	
Benzene:	
ppb	ND <4
lb/hr	ND <2.46×10^{-2}
lb/MMBtu	ND <2.92×10^{-5}
Formaldehyde	
ppb	<119
lb/hr	<2.88×10^{-1}
lb/MMBtu	<3.59×10^{-4}
Total PAH	
$\mu g/m^3$	<0.136
lb/hr	<2.52×10^{-4}
lb/MMBtu	<3.12×10^{-7}

TABLE 1-3
SUMMARY OF PAH EMISSION RESULTS
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
DISTILLATE OIL
January 31, - February 1, 1990

Species	$\mu g/m^3$	lb/hr	lb/MMBtu
Acenaphthene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Acenaphthylene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Anthracene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Benz[a]anthracene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Benzo[b+k]fluoranthene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Benzo[a]pyrene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Benzo[g,h,i]perylene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Chrysene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Dibenz[a,h]anthracene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Fluoranthene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Fluorene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Indeno[1,2,3-cd]pyrene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Naphthalene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
Phenanthrene	<0.012	$<2.16 \times 10^{-5}$	$<2.69 \times 10^{-8}$
Pyrene	ND <0.0009	ND $<1.65 \times 10^{-5}$	ND $<2.04 \times 10^{-8}$
TOTAL PAH	<0.136	$<2.52 \times 10^{-4}$	$<3.12 \times 10^{-7}$

TABLE 1-4
FUEL ANALYSIS SUMMARY
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
DISTILLATE OIL
January 31, - February 1, 1990

Parameter	
Btu/lb (HHV)	19,250
Carbon, %	84.07
Hydrogen, %	15.63
Nitrogen, %	0.19
Oxygen, %	0.20
Sulfur, %	0.055
Ash, %	<0.01
F factor, dscf/MMBtu @ 0% O_2 and 60°F	9,490
Chlorine, mg/l	ND <30
Arsenic, mg/l	ND <0.25
Beryllium, mg/l	ND <0.05
Cadmium, mg/l	ND <0.05
Chromium, mg/l	ND <0.05
Hexavalent Chromium, mg/l	ND <0.05
Copper, mg/l	ND <0.10
Lead, mg/l	ND <0.25
Mercury, mg/l	ND <0.10
Manganese, mg/l	ND <0.10
Nickel, mg/l	ND <0.05
Selenium, mg/l	ND <0.25
Zinc, mg/l	0.15

ND - not detected

SECTION 2.0

UNIT DESCRIPTION AND OPERATION

2.1 UNIT DESCRIPTION

Long Beach Generating Station is a combined cycle facility. The facility consists of seven combustion turbine generators, seven heat recovery boilers and two steam turbine generators. Hot gases passing through the combustion turbine exhaust to atmosphere through the heat recovery boilers. The steam generated in the boilers is used for three purposes: (1) to drive the steam turbines, (2) to provide injection steam to the combustor for NOx control, and (3) to provide heating and deaeration of the feedwater in the deaerator.

Combustion Turbine 3 consists of an Electric Machinery Manufacturing air cooled generator, a 17 stage axial compressor, a 5 stage gas turbine, a Brown-Boveri vertical combustion chamber and a hydraulically coupled electric starter motor. The combustion turbines are rated at 61,750 kW each and can fire natural gas or distillate fuel.

2.2 UNIT OPERATION

Long Beach Combustion Turbine No. 3 was operated at nominal full load while firing natural gas or distillate oil. Table 2-1 summarizes unit operation during each test. Complete unit operation data is in Appendix C.2.

TABLE 2-1
SUMMARY OF UNIT OPERATION
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
January 31, - February 1, 1990

Test	Date	Fuel	Load (MW)	Fuel Flow
1	1/30/90	Natural Gas	67	798 MCFH
2	1/30/90	Natural Gas	66	786 MCFH
3	1/30/90	Natural Gas	66	788 MCFH
4-PAH	1/31/90	Distillate Oil	63.3	107 GPM
5-PAH	2/1/90	Distillate Oil	64.3	107 GPM
6-PAH	2/1/90	Distillate Oil	64.5	105 GPM

SECTION 3.0

TEST DESCRIPTION

3.1 TEST DESCRIPTION AND SCHEDULE

The tests on Long Beach Generating Station Combustion Turbine No. 3 were conducted with the boiler firing at or near full normal load, at normal operating conditions. Testing was conducted with the boiler firing both distillate oil and natural gas fuels. Table 3-1 gives the tests that were conducted for each fuel type. Table 3-2 is a summary of the tests performed.

TABLE 3-1
TEST SUMMARY

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

3.2 SAMPLE LOCATIONS

Samples were collected from four ports installed in the exhaust stack. These ports are installed 2.9 stack diameters upstream and 4.3 stack diameters downstream of any flow disturbance in the 18'4" i.d. stack. This stack is shared with another combustion turbine. During sampling, only Combustion Turbine No. 3 was in service. The sample port location meets the acceptability criteria given in EPA Method 1. The 24-point sampling layout using the four ports also meets EPA Method 1 requirements. Figure 3-1 is a diagram of the sample location.

TABLE 3-2
TEST SCHEDULE AB2588 EMISSIONS TESTING
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
January 30, - February 1, 1990

Test No.	Date	Time	Fuel	Type of Test
1-LBCT-Vel	1/30/90	0930-1020	Gas	Velocity Traverse
1-LBCT-H_2O	1/30/90	0920-0950	Gas	Moisture
1-LBCT-Form	1/30/90	0920-0950	Gas	Formaldehyde
1-LBCT-Benzene	1/30/90	0920-0947	Gas	Benzene
1-LBCT-CEM	1/30/90	0920-0950	Gas	CEM (O_2, CO_2)
2-LBCT-Form	1/30/90	1010-1040	Gas	Formaldehyde
2-LBCT-Benzene	1/30/90	1010-1040	Gas	Benzene
2-LBCT-CEM	1/30/90	1010-1040	Gas	CEM (O_2, CO_2)
3-LBCT-Vel	1/30/90	1101-1144	Gas	Velocity
3-LBCT-H_2O	1/30/90	1055-1125	Gas	Moisture
3-LBCT-Form	1/30/90	1055-1125	Gas	Formaldehyde
3-LBCT-Benzene	1/30/90	1055-1125	Gas	Benzene
3-LBCT-CEM	1/30/90	1050-1120	Gas	CEM (O_2, CO_2)
4-LBCT-PAH	1/31/90	1348-1728	Distillate Oil	PAH
4-LBCT-CEM	1/31/90	1348-1718	Distillate Oil	CEM (O_2, CO_2)
4A-LBCT-Form	1/31/90	1527-1557	Distillate Oil	Formaldehyde
4B-LBCT-Form	1/31/90	1605-1635	Distillate Oil	Formaldehyde
4C-LBCT-Form	1/31/90	1644-1714	Distillate Oil	Formaldehyde
5-LBCT-PAH	2/1/90	0850-1318	Distillate Oil	PAH
5-LBCT-CEM	2/1/90	0850-1330	Distillate Oil	CEM (O_2, CO_2)
5A-LBCT-Benzene	2/1/90	0858-0918	Distillate Oil	Benzene
5B-LBCT-Benzene	2/1/90	0955-1015	Distillate Oil	Benzene
5C-LBCT-Benzene	2/1/90	1030-1050	Distillate Oil	Benzene
6-LBCT-PAH	2/1/90	1446-1936	Distillate Oil	PAH
6-LBCT-CEM	2/1/90	1445-1930	Distillate Oil	CEM (O_2, CO_2)

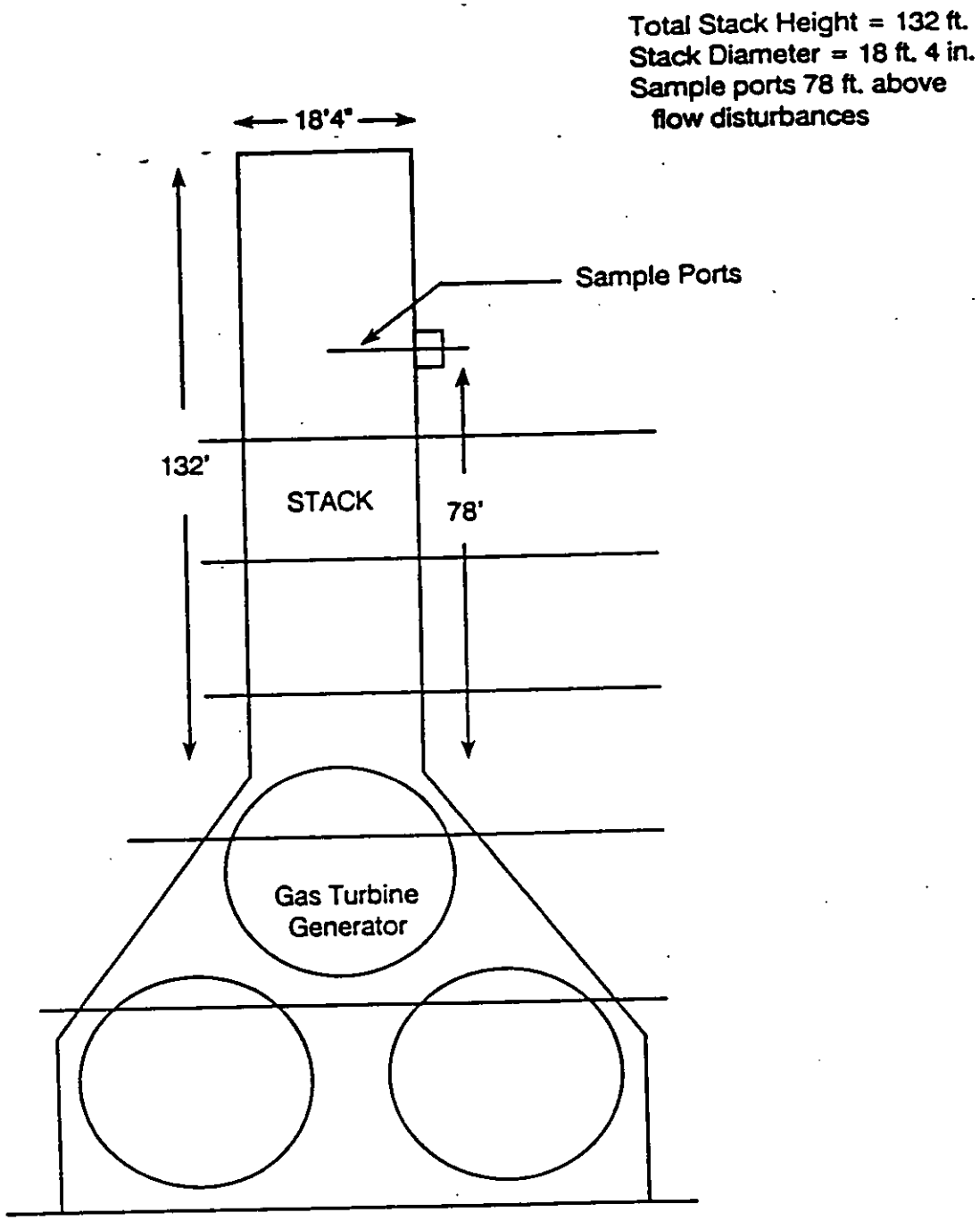


Figure 3-1. Long Beach Generating Station Combustion Turbine Sample Location.

3.3 TEST PROCEDURES

The test procedures for air emissions tests and related information that were used at Long Beach Combustion Turbine No. 3 are listed in Table 3-3. 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 and analyzed by gas chromatography according to CARB Method 410A by Truesdail Laboratories in Tustin, California.

3.3.2 Formaldehyde

Triplicate formaldehyde samples were collected non-isokinetically using midget impingers in acidic 2,4-dinitrophenylhydrazine solution. The analysis for formaldehyde was performed by reverse phase HPLC by Radian Laboratories, in Research Triangle Park, North Carolina.

3.3.3 Polycyclic Aromatic Hydrocarbons (PAH)

Triplicate PAH samples were collected according to the sampling procedures of CARB Method 429. This method is known as 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 species that might pass through the resin.

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 pre- and post-test laboratory spikes were introduced to the samples by Zenon and the percent recovery is reported along with the results.

TABLE 3-3
TEST PROCEDURES FOR LONG BEACH COMBUSTION TURBINE
AIR EMISSIONS TESTS

Parameter	No. Replicates	Duration of Test (min.)	Sample Rate	Measurement Principle	Reference Method	Method Detection Limit
Benzene	3	20	0.5 l/min	GC/PID	CARB 410A	4 ppb
Formaldehyde	3	30	1 l/min	HPLC	CARB 430	0.1 $\mu g/m^3$
PAH	3	192	1 m^3/hr	GC/MS	CARB 429	10 ng/m^3 per species*
Metals, Chloride	2	--	--	Fuel Analysis	--	--

* assumes $3m^3$ samples

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	3 m^3 (3-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. All sample portions recovered with water, acetone, and hexane rinses.
Glassware Cleaning	Acid cleaning followed by DI H_2O, acetone, and hexane rinses and high temperature bake

PAH species were analyzed using GC/MS with selective ion monitoring. This procedure provides the lowest detection limits possible for these samples. PAH species to be quantitated are listed in Appendix C-1 of "Emission Inventory Criteria and Guidelines". These compounds are listed below:

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

In addition to the samples, 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 provides 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 and 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 in Los Angeles.

3.3.5 Natural Gas Analysis

An analysis for the natural gas used during this test series was provided by Southern California Gas Company. Their analysis includes Btu/lb and composition. No suitable location was available at the Long Beach facility to take a gas sample.

3.3.6 Gaseous Emissions

Gaseous emissions (O_2 and CO_2) were measured using Carnot's Continuous Emissions Monitor (CEM) described in Appendix A. This system meets EPA and CARB requirements for gaseous species. A preliminary traverse indicated that there was no significant stratification. Therefore, O_2 and CO_2 concentrations were determined at a single point.

O_2 and CO_2 were measured in conjunction with all tests according to EPA Method 3A to provide data for molecular weight and dilution calculations.

3.3.7 Velocity and Moisture

Velocity and moisture were determined in conjunction with all isokinetic tests according to EPA Methods 1, 2, and 4. For non-isokinetic single point tests, either separate velocity and moisture determinations were performed or the velocity measured during a simultaneous isokinetic test is used for emission calculations.

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 (see example form in Appendix B)

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 air emissions tests performed on SCE's Long Beach Combustion Turbine No. 3. Air emissions are presented on a concentration, mass emissions and lb/MMBtu basis. 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 Benzene
4.2 Formaldehyde
4.3 Polycyclic Aromatic Hydrocarbons (PAH)
4.4 Fuel Analysis
4.5 Test Summary and Isokinetics

TABLE 4-1
SUMMARY OF AB2588 EMISSIONS TEST RESULTS
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
NATURAL GAS FUEL
January 30, 1990

Species	
Benzene:	
ppb	ND <4
lb/hr	ND <2.36 x 10^{-2}
lb/MMBtu	ND <2.70 x 10^{-5}
Formaldehyde	
ppb	<443
lb/hr	<1.01
lb/MMBtu	<1.15 x 10^{-3}

TABLE 4-2
SUMMARY OF AB2588 EMISSIONS TEST RESULTS
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
DISTILLATE OIL
January 31, - February 1, 1990

Species	
Benzene:	
ppb	ND <4
lb/hr	ND <2.46 x 10^{-2}
lb/MMBtu	ND <2.92 x 10^{-5}
Formaldehyde	
ppb	<119
lb/hr	<2.88 x 10^{-1}
lb/MMBtu	<3.59 x 10^{-4}
Total PAH	
$\mu g/m^3$	<0.136
lb/hr	<2.52 x 10^{-4}
lb/MMBtu	<3.12 x 10^{-7}

TABLE 4-3
SUMMARY OF PAH EMISSION RESULTS
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
DISTILLATE OIL
January 31, - February 1, 1990

Species	$\mu g/m^3$	lb/hr	lb/MMBtu
Acenaphthene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Acenaphthylene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Anthracene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Benz[a]anthracene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Benzo[b+k]fluoranthene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Benzo[a]pyrene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Benzo[g,h,i]perylene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Chrysene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Dibenz[a,h]anthracene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Fluoranthene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Fluorene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Indeno[1,2,3-cd]pyrene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Naphthalene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
Phenanthrene	<0.012	<2.16 x 10^{-5}	<2.69 x 10^{-8}
Pyrene	ND <0.0009	ND <1.65 x 10^{-5}	ND <2.04 x 10^{-8}
TOTAL PAH	<0.136	<2.52 x 10^{-4}	<3.12 x 10^{-7}

TABLE 4-4
FUEL ANALYSIS SUMMARY
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
DISTILLATE OIL
January 31, - February 1, 1990

Parameter	
Btu/lb (HHV)	19,250
Carbon, %	84.07
Hydrogen, %	15.63
Nitrogen, %	0.19
Oxygen, %	0.20
Sulfur, %	0.055
Ash, %	<0.01
F factor, dscf/MMBtu @ 0% O_2 and 60°F	9,490
Chlorine, mg/l	ND <30
Arsenic, mg/l	ND <0.25
Beryllium, mg/l	ND <0.05
Cadmium, mg/l	ND <0.05
Chromium, mg/l	ND <0.05
Hexavalent Chromium, mg/l	ND <0.05
Copper, mg/l	ND <0.10
Lead, mg/l	ND <0.25
Mercury, mg/l	ND <0.10
Manganese, mg/l	ND <0.10
Nickel, mg/l	ND <0.05
Selenium, mg/l	ND <0.25
Zinc, mg/l	0.15

ND - not detected

4.1 BENZENE

The results of the benzene sampling are presented in Table 4-5. Benzene was not detected in any of the samples. Appendix C.4 contains additional information. Benzene was not detected at the 4 ppb level corresponding to an emission rate of 0.0236 lb/hr while firing gas fuel or an emission rate of 0.0246 lb/hr while firing distillate oil.

TABLE 4-5
BENZENE EMISSIONS
SCE/LONG BEACH COMBUSTION TURBINE NO. 3

GAS FUEL

Test No.	1-LBCT-Benzene	2-LBCT-Benzene	3-LBCT-Benzene	Average
Date:	1/30/90	1/30/90	1/30/90	
+ Flow rate, dscfm	478,569	478,569	478,569	
O_2, %	15.5	15.5	15.5	
ppb	ND < 4	ND < 4	ND < 4	ND < 4
lb/hr	ND $<2.36 \times 10^{-2}$	ND $<2.36 \times 10^{-2}$	ND $<2.36 \times 10^{-2}$	ND $<2.36 \times 10^{-2}$
lb/MMBtu	ND $<2.70 \times 10^{-5}$	ND $<2.70 \times 10^{-5}$	ND $<2.70 \times 10^{-5}$	ND $<2.70 \times 10^{-5}$

+ Flow rate is the average of two velocity determinations
O_2 concentration is the average O_2 concentration during these three tests

DISTILLATE OIL

Test No.	5A-LBCT-Benzene	5B-LBCT-Benzene	5C-LBCT-Benzene	Average
Date	2/1/90	2/1/90	2/1/90	
* Flow rate, dscfm	497,754	497,754	497,754	
O_2, %	15.3	15.3	15.3	
ppb	ND < 4	ND < 4	ND < 4	ND < 4
lb/hr	ND $<2.46 \times 10^{-2}$	ND $<2.46 \times 10^{-2}$	ND $<2.46 \times 10^{-2}$	ND $<2.46 \times 10^{-2}$
lb/MMBtu	ND $<2.92 \times 10^{-5}$	ND $<2.92 \times 10^{-5}$	ND $<2.92 \times 10^{-5}$	ND $<2.92 \times 10^{-5}$

* Flow rate and O_2 from Test 5-5V

4.2 FORMALDEHYDE

Formaldehyde results are presented in Table 4-6. Appendix C.5 presents additior data and Radian's Laboratory report. Both a field blank and field spike were collected a analyzed. Field spike recovery was 98% of nominal. Detectable formaldehyde levels we measured while firing gas fuel. Average emissions were 443 ppb or 1.01 lb/hr. Formaldehy emissions were at the detection limit while firing distillate oil. Average emissions while fir distillate oil were less than 119 ppb or 0.288 lb/hr.

TABLE 4-6
FORMALDEHYDE EMISSIONS
SCE/LONG BEACH COMBUSTION TURBINE NO. 3

GAS FUEL

Test No.	1-LBCT-Form	2-LBCT-Form	3-LBCT-Form	Average
Date:	1/30/90	1/30/90	1/30/90	
+ Flow rate, dscfm	478,569	478,569	478,569	
O_2, %	15.5	15.5	15.5	
ppb	833	<118	380	<443
lb/hr	1.89	$<2.68 \times 10^{-1}$	8.63×10^{-1}	<1.01
lb/MMBtu	2.16×10^{-3}	$<3.06 \times 10^{-4}$	9.86×10^{-4}	$<1.15 \times 10^{-3}$

+ Flow rate is the average of two velocity determinations
O_2 concentration is the average O_2 concentration during these three tests

DISTILLATE OIL

Test No.	4A-LBCT-Form	4B-LBCT-Form	4C-LBCT-Form	Average
Date	1/31/90	1/31/90	1/31/90	
+ Flow rate, dscfm	509,595	509,595	509,595	
O_2, %	15.7	15.7	15.7	
ppb	<100	<107	<151	<119
lb/hr	$<2.41 \times 10^{-1}$	$<2.58 \times 10^{-1}$	$<3.66 \times 10^{-1}$	$<2.88 \times 10^{-1}$
lb/MMBtu	$<3.01 \times 10^{-4}$	$<3.21 \times 10^{-4}$	$<4.56 \times 10^{-4}$	$<3.59 \times 10^{-4}$

+ Flow rate and O_2 from Test 4-SV

4.3 POLYCYCLIC AROMATIC HYDROCARBONS (PAH)

PAH results are presented in Table 4-7. Complete results are in Appendix C.6. The analysis for the fifteen target PAH compounds indicated that these species were not present at detectable levels with the exception of phenanthrene. Phenanthrene was measured in two samples at 0.032 and 0.040 μg. Phenanthrene was not detected in the third sample. The detection limit for this species is 0.025 μg. The average emission rate for total PAH was less than 2.52×10^{-4} lb/hr. This corresponds to an average total PAH concentration of less than 0.136 $\mu g/m^3$.

TABLE 4-7
POLYCYCLIC AROMATIC HYDROCARBON EMISSIONS
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
DISTILLATE OIL

Test No.	4-LBCT-SV	5-LBCT-SV	6-LBCT-SV	Average		
Date	1/31/90	2/1/90	2/1/90			
Flow Rate, dscfm	509,595	497,754	480,300			
O_2, %	15.7	15.3	15.5			
Species	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	lb/hr	lb/MMBtu
Naphthalene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Acenaphthylene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Acenaphthene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Fluorene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Phenanthrene	0.010	ND <0.009	0.016	<0.012	$<2.16 \times 10^{-5}$	$<2.69 \times 10^{-8}$
Anthracene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Fluoranthene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Pyrene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Benz(a)anthracene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Chrysene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Benzo(b+k)fluoranthene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Benzo(a)pyrene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Indeno(1,2,3-cd)pyrene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Dibenzo(a,h)anthracene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Benzo(g,h,i)perylene	ND <0.008	ND <0.009	ND <0.010	ND <0.009	ND $<1.65 \times 10^{-5}$	2.04×10^{-8}
Total PAH						
$\mu g/m^3$	<0.120	<0.128	<0.160	<0.136		
lb/hr	$<2.29 \times 10^{-4}$	$<2.39 \times 10^{-4}$	$<2.88 \times 10^{-4}$		$<2.52 \times 10^{-4}$	
lb/MMBtu	$<2.86 \times 10^{-7}$	$<2.83 \times 10^{-7}$	$<3.68 \times 10^{-7}$			$<3.12 \times 10^{-7}$

4.4 FUEL ANALYSIS

Distillate oil analyses are presented in Table 4-8. Natural gas analysis is presented in Table 4-9. The natural gas analysis was supplied by Southern California Gas Company and is used to calculate emissions in lb/MMBtu.

Due to the high volatility of the distillate fuel, the laboratory had difficulty in performing the elemental analysis. A large portion of the fuel 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 4-8
DISTILLATE OIL ANALYSIS
SCE/LONG BEACH COMBUSTION TURBINE NO. 3

Parameter	Sample No. 6A-LBCT-Fuel 2/1/90	Sample No. 6B-LBCT-Fuel 2/1/90	Average
Btu/lb (HHV)	19,300	19,200	19,250
Carbon, %	84.18	83.96	84.07
Hydrogen, %	15.55	15.71	15.63
Nitrogen, %	0.16	0.22	0.19
Oxygen, %	0.20	0.20	0.2
Sulfur, %	0.05	0.06	0.55
Ash, %	<0.01	<0.01	<0.01
F factor, dscf/MMBtu @ 0% O_2 and 60°F			9,490
Chlorine, mg/l	ND <30	ND <30	ND <30
Arsenic, mg/l	ND <0.25	ND <0.25	ND <0.25
Beryllium, mg/l	ND <0.05	ND <0.05	ND <0.05
Cadmium, mg/l	ND <0.05	ND <0.05	ND <0.05
Chromium, mg/l	ND <0.05	ND <0.05	ND <0.05
Hexavalent Chromium, mg/l	ND <0.05	ND <0.05	ND <0.05
Copper, mg/l	ND <0.10	ND <0.10	ND <0.10
Lead, mg/l	ND <0.25	ND <0.25	ND <0.25
Mercury, mg/l	ND <0.10	ND <0.10	ND <0.10
Manganese, mg/l	ND <0.10	ND <0.10	ND <0.10
Nickel, mg/l	ND <0.05	ND <0.05	ND <0.05
Selenium, mg/l	ND <0.25	ND <0.25	ND <0.25
Zinc, mg/l	0.21	0.09	0.15

TABLE 4-9
NATURAL GAS ANALYSIS
SCE/LONG BEACH COMBUSTION TURBINE NO. 3

Parameter	Sample Date 1/30/90
Methane, %	92.1
Ethane, %	3.75
Propane, %	1.00
Butane, %	0.23
Iso-butane, %	0.13
Pentane, %	0.06
Iso-pentane, %	0.07
C_6^+, %	0.10
Carbon dioxide, %	1.00
Nitrogen, %	1.51
Btu/mcf	1049.7
Specific Gravity	0.6098
F factor, dscf/MMBtu @ 0% O_2 and 60°F	8,476

4.5 TEST SUMMARY AND ISOKINETICS

A summary of the isokinetic and velocity tests performed is presented in Table 4-10. All tests were within the required range of 90-110% isokinetic.

TABLE 4-10
SUMMARY OF TEST CONDITIONS
SCE/LONG BEACH COMBUSTION TURBINE NO. 3
January 30; - February 1, 1990

Test No.	Flow Rate (dscfm)	Moisture, %	O_2, %	CO_2, %	% Isokinetic	Comments
1-LBCT-Vel/ H_2O	482,110	11.7	15.6	3.2	N/A	Tests 1-3 performed while firing gas fuel
3-LBCT-Vel/ H_2O	475,027	12.4	15.4	3.1	N/A	Benzene and Formaldehyde Tests #1, 2, and 3 calculated using average flow rate and O_2 from velocity traverses 1 and 3
4-LBCT-PAH	509,595	9.8	15.7	4.0	104.9	Tests 4-6 performed while firing distillate oil
5-LBCT-PAH	497,754	9.4	15.3	3.8	98.8	Flow rate for isokinetic tests used for non-isokinetic tests run during the same time period.
6-LBCT-PAH	480,300	9.4	15.5	3.8	97.3	

APPENDIX A

MEASUREMENT PROCEDURES

Continuous Emissions Monitoring System

Oxygen (O_2) by Continuous Analyzer

Carbon Dioxide (CO_2) by Continuous Analyzer

Benzene by Gas Chromatography

Determination of Moisture in Stack Gases

Semi-Volatile Organic Sampling Train Procedures

Formaldehyde by HPLC

Continuous Emissions Monitoring System

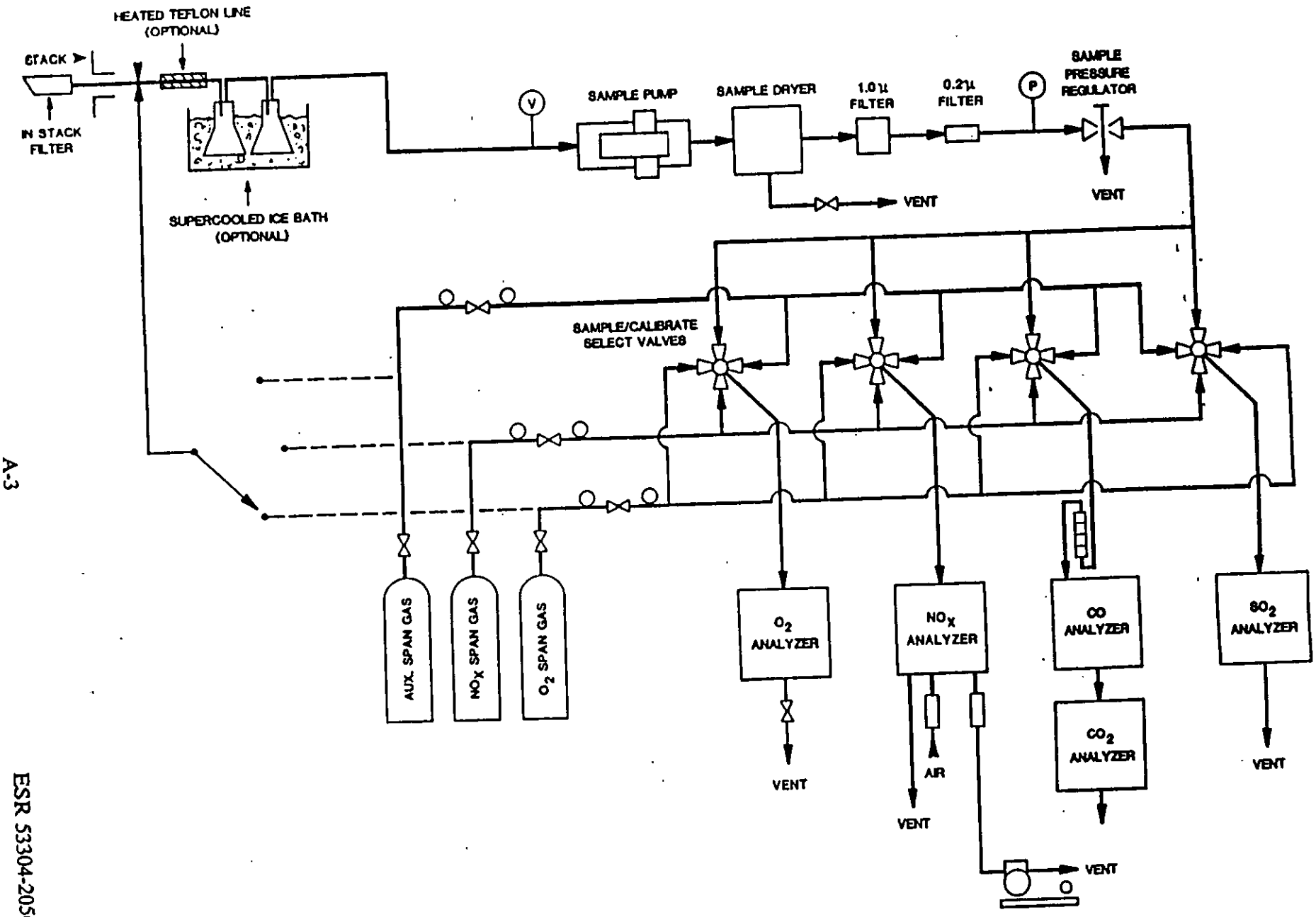
O_2, CO, CO_2, NO, NOx, and SO_2 are measured using an extractive continuous emissions monitoring (CEM) package, shown in the following figure. This package is comprised of three basic subsystems. They are: (1) the sample acquisition and conditioning system, (2) the calibration gas system, and (3) the analyzers themselves. This section presents a description of the sampling and calibration systems. Descriptions of the analyzers used in this program and the corresponding reference test methods follow. Information regarding quality assurance information on the system, including calibration routines and system performance data follows.

The sample acquisition and conditioning system contains components to extract a representative sample from the stack or flue, transport the sample to the analyzers, and remove moisture and particulate material from the sample. In addition to performing the tasks above, the system must preserve the measured species and deliver the sample for analysis intact. The sample acquisition system extracts the sample through a stainless steel probe. The probe is insulated or heated as necessary to avoid condensation. If the particulate loading in the stack is high, a sintered stainless steel filter is used on the end of the probe.

Where water soluble NO_2 and/or SO_2 are to be measured, the sample is drawn from the probe through a heated Teflon sample line into a supercooled (approximately -20 C) water removal trap. The trap consists of stainless steel flasks in a bath of dry ice and antifreeze. If dry ice is not locally available, ice and rock salt are used. This design removes the water vapor by condensation and freezes the liquid quickly. The contact between the sample and liquid water is minimized. Since the solubility of the NO_2 and SO_2 in ice is negligible, these species are conserved. This system meets the requirements of EPA Method 20. The sample is then drawn through a Teflon transport line and particulate filter, into the sample pump. The pump is a dual head, diaphragm pump. All sample-wetted components of the pump are stainless steel or Teflon. The pressurized sample leaving the pump flows through a stainless steel refrigerated (38 F) compressed air dryer for final moisture removal. A drain line and valve are provided to constantly expel any condensed moisture from the dryer. After the dryer, the sample is directed into a distribution manifold. Excess sample is vented through a back-pressure regulator, maintaining a constant pressure of 5-6 psig to the analyzers.

The calibration system is comprised of two parts: the analyzer calibration, and the system bias check (dynamic calibration). The analyzer calibration equipment includes pressurized cylinders of certified span gas. The gases used are, as a minimum, certified to 1% by the manufacturer where necessary, to comply with reference method requirements. EPA Protocol 1 gases are used. The cylinders are equipped with pressure regulators which supply the calibration gas to the analyzers at the same pressure and flow rate as the sample. The selection of zero, span, or sample gas directed to each analyzer is accomplished by operation of the sample/calibration selector valves.

The system bias check is accomplished by transporting the same gases used to zero and span the analyzers to the sample conditioner inlet (probe exit). The span gas is exposed to the same elements as the sample and the system response is documented. Where the supercooled moisture removal system is used, water is added to the knockout flasks before the pre-test check. The analyzer indications for the system calibration check must agree within 5% of the analyzer calibration. Values are adjusted and changes/repairs are made to the system to compensate for any difference in analyzer readings. Specific information on the analytical equipment and test methods used is provided in the following pages.

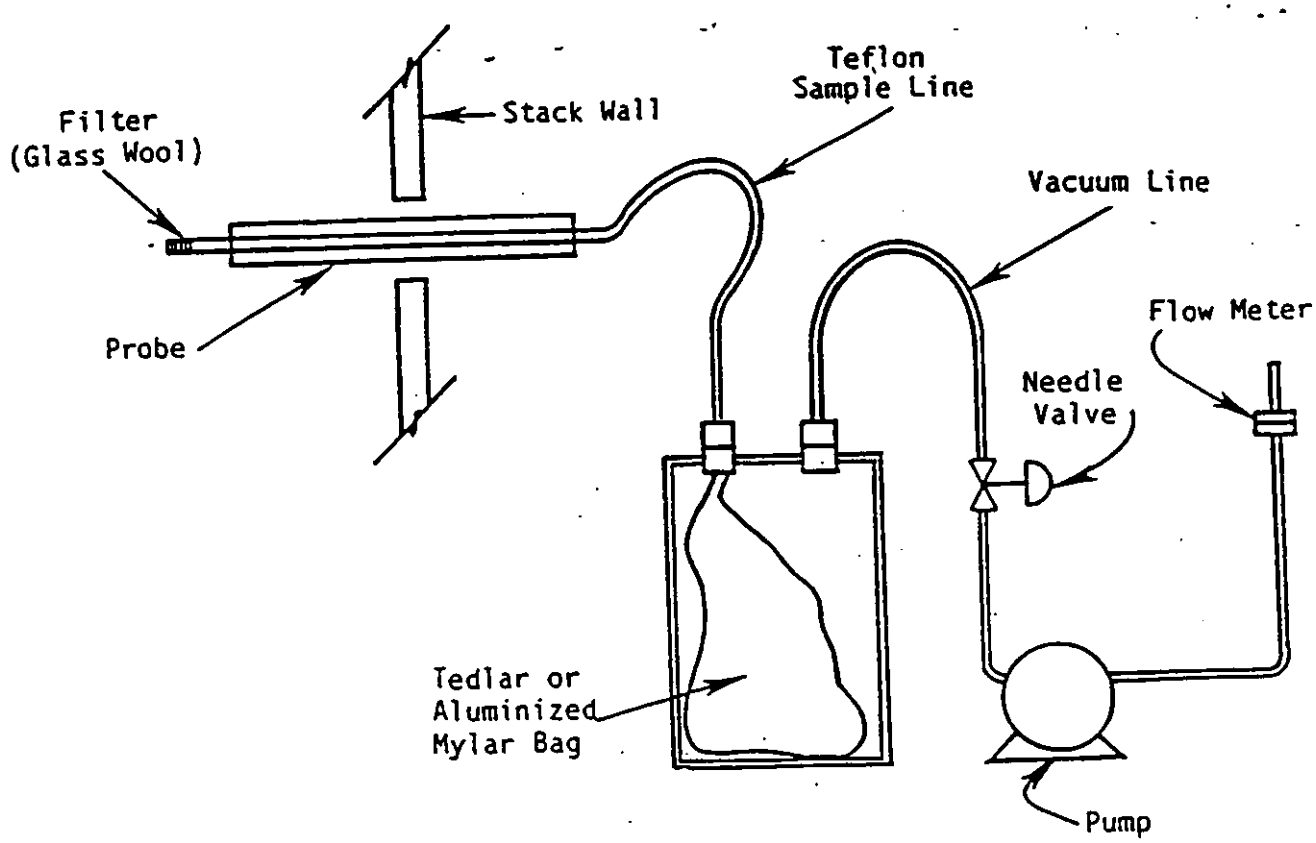


Continuous Emissions Monitoring System

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.

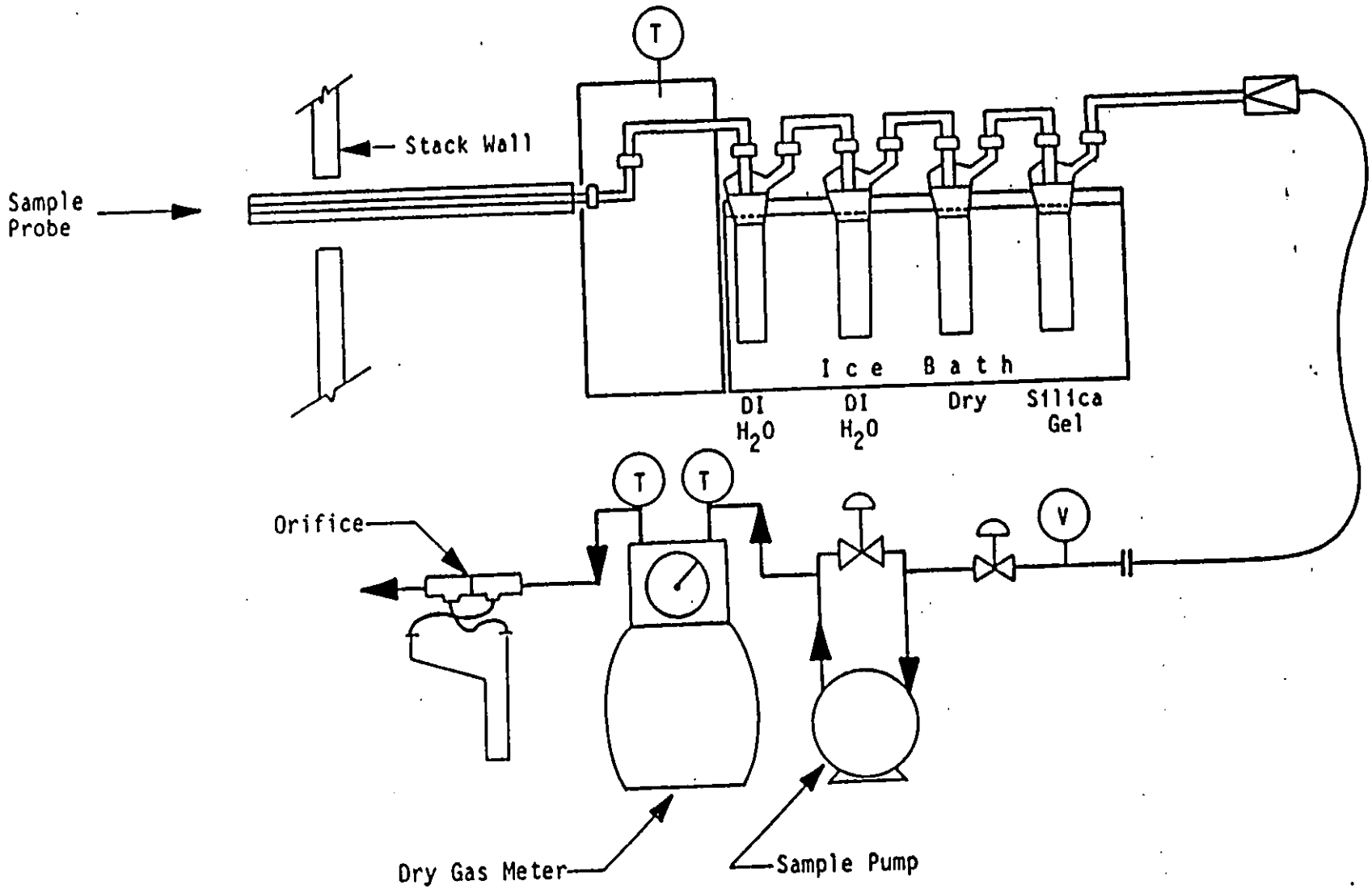
Method:	Carbon Dioxide (CO_2) by Continuous Analyzer
Applicable Ref. Methods:	EPA 3A, ARB 100, BA ST-5
Principle:	A sample is continuously drawn from the flue gas stream, conditioned, and conveyed to the instrument for direct readout of CO_2 concentration.
Analyzer:	Horiba PIR 2000
Measurement Principle:	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:	*Determination of Moisture in Stack Gases*
Applicable Ref. Methods:	EPA 4, ARB 1-4
Principle:	A gas sample is extracted at a constant rate from the source; moisture is removed from the sample stream and determined volumetrically or gravimetrically.
Sampling Procedure:	The sample train used in the tests is shown in the following figure. The sample is drawn at a constant rate through a stainless steel probe. The probe is connected to an impinger train by Teflon tubing. The train consists of two Smith-Greenburg impingers which contain 100 ml water, an empty impinger as a knockout, and an impinger containing silica gel to protect the pump from moisture.
Sample Recovery and Analysis:	Following testing, moisture content is determined gravimetrically from initial and final impinger weights.



Sample Train for Determination of Moisture by EPA Method 4.

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.

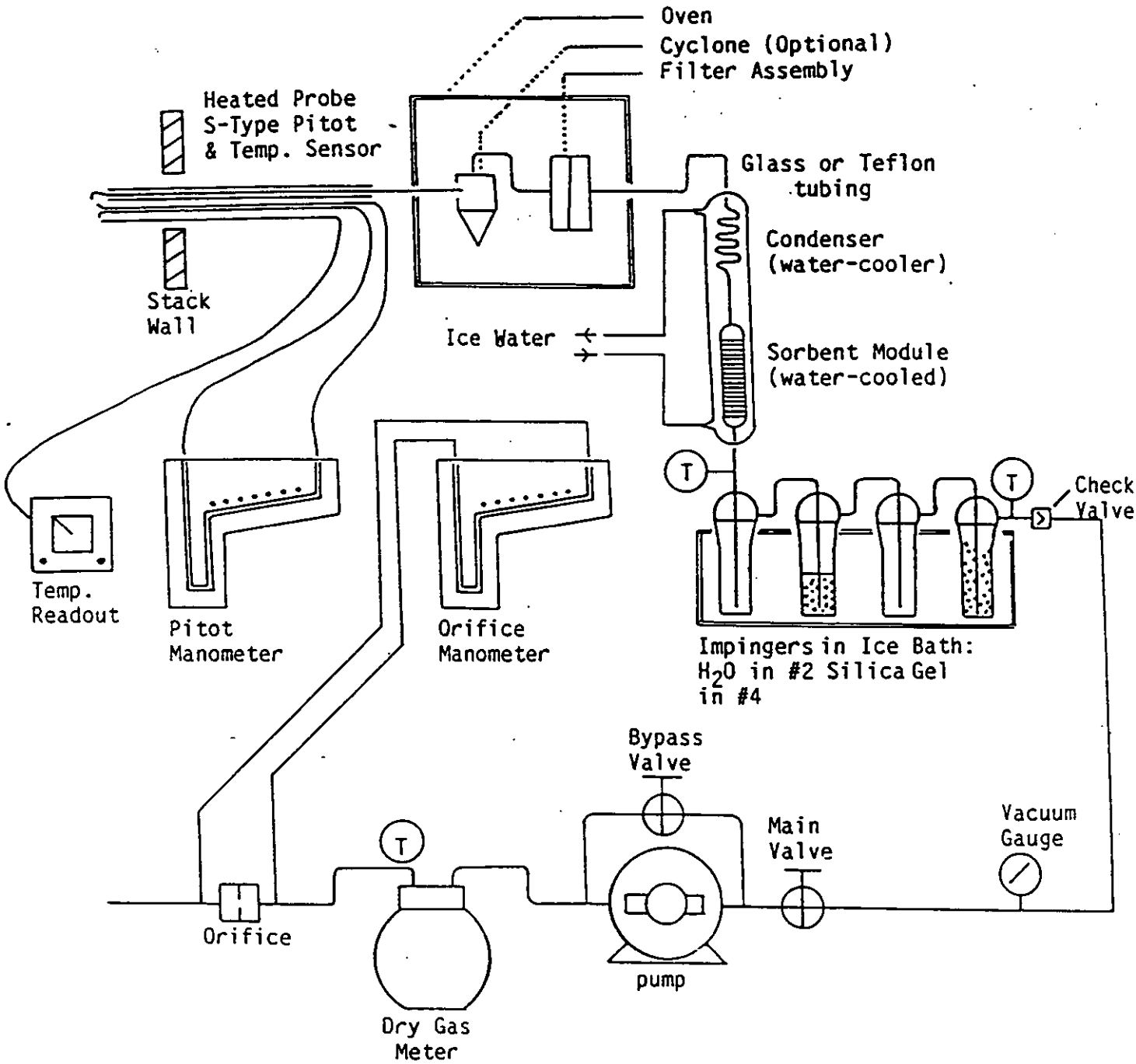
Sampling: The sample train is shown in the attached figure. Sample is pulled through the following components:

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

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.

Appendix B.2

Calibration Data

ANALYTICAL REPORT — cont'd

ENERGY SYSTEMS

ATTN: BOB FINKEN

Date: 12-9-88

Our Project No.: 415080

Your P.O. No.: 4560

Cyl. No. AAL 4678 Analytical Accuracy ±1%

Component	Concentration
Oxygen	12.50%
Carbon Monoxide	275.5 PPM
Carbon Dioxide	14.97%
Nitrogen	Balance
*Gravimetric Master	

Cyl. No. _____ Analytical Accuracy _____

Component	Concentration

Cyl. No. _____ Analytical Accuracy _____

Component	Concentration

Cyl. No. _____ Analytical Accuracy _____

Component	Concentration

Cyl. No. _____ Analytical Accuracy _____

Component	Concentration

Cyl. No. _____ Analytical Accuracy _____

Component	Concentration

CERTIFIED

*Certified to have been blended against NBS certified weights and verified correct by independent analysis.

Analyst _____

Approved By _____

CERTIFIED REFERENCE MATERIALS EPA PROTOCOL GASES
ACUBLEND® CALIBRATION & SPECIALTY GAS MIXTURES PURE GASES
ACCESSORY PRODUCTS CUSTOM ANALYTICAL SERVICES

AUG 2 3 1989

TELEX: 510-100-8831 (ScotGas)
FAX: 714-887-0549
PHONE: 714-887-2571

Scott Specialty Gases

a division of

Scott Environmental Technology Inc. 2600 CAJON BLVD., SAN BERNARDINO, CA 92405

Date: 8-9-89
Our Project No.: 01858
Your P.O. No.: 5264

ENERGY SYSTEMS ASSOCIATES
15991 RED HILL AVE., SUITE 110
TUSTIN, CA 92680
ATTN: JIM MULLIGAN

Gentlemen:

Thank you for choosing Scott for your Specialty Gas needs. The analyses for the gases ordered, as reported by our laboratory, are listed below. Results are in volume percent, unless otherwise indicated.

ANALYTICAL REPORT

Cyl. No. ALM 5688 — Analytical Accuracy ±2%

Component	Concentration
CARBON DIOXIDE	22.50%
CARBON MONOXIDE	422.6 PPM
OXYGEN	8.001%
*GRAVIMETRIC MASTER	
NITROGEN	BALANCE

Cyl. No. ALM 5692 — Analytical Accuracy ±2%*

Component	Concentration
CARBON DIOXIDE	22.50%
CARBON MONOXIDE	422.2 PPM
OXYGEN	8.000%
*GRAVIMETRIC MASTER	
NITROGEN	BALANCE

Cyl. No. ALM 5675 — Analytical Accuracy ±2%*

Component	Concentration
CARBON DIOXIDE	15.00%
CARBON MONOXIDE	54.56 PPM
OXYGEN	5.001%
*GRAVIMETRIC MASTER	
NITROGEN	BALANCE

Cyl. No. ALM 5598 — Analytical Accuracy ±2%*

Component	Concentration
CARBON DIOXIDE	15.00%
CARBON MONOXIDE	54.46 PPM
OXYGEN	5.000%
*GRAVIMETRIC MASTER	
NITROGEN	BALANCE

*Certified to have been blended against NBS certified weights and verified correct by independent analysis.

Analyst _____ Approved By _____

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost

TELEX: 510-100-8831 (ScotGas)
FAX: 714-887-0549
PHONE: 714-887-2571

Scott Specialty Gases a division of

Scott Environmental Technology Inc./2600 CAJON BLVD., SAN BERNARDINO, CA 92405

Shipped From: Scott SAN BERNARDINO
Date Shipped 7-26-89
Our Project No: 01864
Your PO. No: 5364
Page 1 of 1
Expiration Date: 1-26-91

ENERGY SYSTEMS
ATTN: JIM MULLIGAN

CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*

Cylinder No. ALM-6064 Cylinder Pressure 1900 psig Certified Accuracy ±1 % NBS Traceable

Certified Pr. Traceability Protocol No. 1 Procedure No. G1

REFERENCE STD

COMPONENTS	CERTIFIED CONC	SRM/CRM NO.	CYL. NO.	CONC.
Nitric Oxide	50.64 PPM	SRM 1684 B	CAL-12787	94.80 PPM
NOX	50.69 PPM			

GAS ANALYZER

MAKE/MODEL/SERIAL NO.	LAST CAL. DATE	ANALYTICAL PRINCIPLE
Thermo-Electron 10 AR S/N 14853-150	5-2-89	Chemi-Luminenscer

BALANCE GAS Nitrogen

ANALYZER READINGS: Z = Zero Gas T = Test Gas R = Reference Gas

Component Nitric Oxide
First Analysis Date 6-13-89 Units PPM

Z 0.03	R 94.68	T 50.38
R 94.65	Z 0.04	T 50.35
Z 0.03	T 50.40	R 94.63

Mean Test Assay 50.44 PPM

Second Analysis Date 7-25-89 Units PPM

Z 0.00	R 95.17	T 50.85
R 95.13	Z 0.08	T 50.83
Z 0.07	T 50.82	R 95.08

Mean Test Assay 50.64 PPM

Component ____ Date ____ Units ____

Z	R	T
R	Z	T
Z	T	R

Mean Test Assay ____

Date ____ Units ____

Z	R	T
R	Z	T
Z	T	R

Mean Test Assay ____

Component ____ Date ____ Units ____

Z	R	T
R	Z	T
Z	T	R

Mean Test Assay ____

Date ____ Units ____

Z	R	T
R	Z	T
Z	T	R

Mean Test Assay ____

Chronology: Date ____
Assay ____

Analyst Doug Hagberg

Approved By: R. Sleady

ENERGY SYSTEMS ASSOCIATES POST TEST DRY GAS METER CALIBRATION CHECK

CALIBRATED BY JJM
DATE 03/11/90
FIELD GAS METER I.D. ES-8
INITIAL Yd 0.990
INITIAL H@ 1.920

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@
5.67	77	62.5	1.00	10	5.46	58	0.57	0.984	1.81
5.70	86	67.5	1.00	10	5.44	58	0.57	0.988	1.81
5.72	88	71.5	1.00	10	5.42	58	0.57	0.985	1.81
						AVERAGES		0.986	1.81

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

E∫A

POST TEST DRY GAS METER CALIBRATION DATA

Calibrated By L. Mulligan

Date 3/11/90

Field Meter ID ES-8

Barometric Press 30.00

Test Meter ID ES-13

Test Meter Y (Y_t) 1.00

Test Meter Last Cal 12/14/89

Test Program Preceding Calibration Check _____

Average ΔH from Test Runs _____

Maximum Vacuum from Test Runs _____

Field Meter								Test Meter				
ΔH	Final Volume	Initial Volume	Volume (V_{dg})	Temperature Inlet (t_i)	Temperature Outlet (t_o)	Vacuum	Time (0)	Final Volume	Initial Volume	Volume (V_{tm})	Temperature Inlet	Temperature Outlet
1.0	140.153	134.485	5.668	75	61	2	10:00	284.357	278.791	5.466	58	58
				83	64						58	58
1.0	145.851	140.153	5.698	84	64	2	10:00	289.703	284.257	5.446	58	58
				88	65						58	58
1.0	151.574	145.851	5.723	84	70	2	10:00	295.127	289.703	5.424	58	58
				92	73						58	58

ANDERSEN
SAMPLERS INCORPORATED
4215 WENDELL DRIVE ▪ ATLANTA, GEORGIA 30336

CONTROL UNIT CALIBRATION

Date 1-28-87 Unit Number 187-342 (

Barometric pressure, P_b = 29.98 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	5.42	76/536	132	102/562	117/577	9.18	.99	1.
2.0	5	5.40	76/536	136	104/564	120/580	6.52	1.00	1.
4.0	5	5.38	76/536	141	105/565	123/583	4.64	1.00	1.
								1.00	1.

Calculations

ΔH	$\frac{\Delta H}{13.6}$	γ: $\frac{V_w P_b (t_d)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)(t_w)}$	$\Delta H_@$: $\frac{0.0317\ \Delta H}{P_b (t_{do})}\left[\frac{(t_w)\theta}{V_w}\right]^2$
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

$\Delta H_@$ = 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: [illegible]

ENERGY SYSTEMS ASSOCIATES

DRY GAS METER CALIBRATION

FIELD GAS METER I.D. ES-19 TEST METER ES-13

DATE 1/19/90 TEST METER LAST CAL. 1.000 = Yt

BAROMETRIC PRESSURE 30.15

FIELD METER			TEST METER				RESULTS				
VOLUME cu.ft.	TEMP. 'F	DELTA H "H2O	TIME min.	VOLUME cu.ft.	TEMP. 'F	PRESS. "H2O	Q cfm	Y	H@	AVE.Y	AVG. H@
6.01	84.5	0.4	15.5	5.759	65	0	0.39	0.993	1.54	0.9941	1.49
5.21	88	0.4	13	4.965	65	0	0.40	0.994	1.45		
5.18	91.5	0.4	13	4.907	65	0	0.40	0.995	1.47		
6.10	102	0.7	12	5.886	66	0	0.51	1.029	1.50	1.0306	1.49
5.12	106	0.7	10	4.898	66	0	0.51	1.029	1.49		
9.80	110	0.7	19	9.364	66	0	0.52	1.034	1.47		
5.44	99.5	1	9	5.198	66	0	0.60	1.014	1.55	0.9961	1.57
6.01	100	1	10	5.747	66	0	0.60	1.016	1.57		
5.71	100	1	9	5.153	66	0	0.63	0.958	1.58		
5.50	101	2	7	5.543	66	0	0.79	1.070	1.65	1.0276	1.68
4.97	101	2	6	4.73	66	0	0.83	1.010	1.66		
7.39	99.5	2	9	7.005	66	0	0.82	1.003	1.71		
6.83	102	4	6	6.467	65.5	0	1.14	1.003	1.77	1.0042	1.74
6.97	102	4	6	6.594	65.5	0	1.16	1.002	1.71		
8.05	102	4	7	7.66	65.5	0	1.15	1.008	1.72		
								AVERAGE		1.0105	1.59
										*******	*********

E/A

POST TEST DRY GAS METER CALIBRATION DATA

Calibrated By GWB

Date 2/16/90

Field Meter ID ES-19

Barometric Press 30.17

Test Meter ID ES-13

Test Meter Y (Y_t) 1.000

Test Meter Last Cal 12/14/89

Test Program Preceding Calibration Check OBrien

Average ΔH from Test Runs _____

Maximum Vacuum from Test Runs _____

Field Meter								Test Meter				
ΔH	Final Volume	Initial Volume	Volume (V_{dg})	Temperature Inlet (t_i)	Temperature Outlet (t_o)	Vacuum	Time (θ)	Final Volume	Initial Volume	Volume (V_{tm})	Temperature Inlet	Temperature Outlet
1.0	100.255	93.905	6.345	94	70	5	10	101.978	95.830	6.148	62	64
				94	70						62	64
1.0	6.623	0.250	6.373	95	72	5	10	108.111	101.978	6.133	62	64
				96	73						62	64
1.0	13.070	6.623	6.447	96	74	5	10	114.285	108.111	6.174	62	64
				97	75						62	64

Appendix B.3

CEM Performance Data

ENERGY SYSTEMS ASSOCIATES

DRY GAS METER CALIBRATION

FIELD GAS METER I.D. ES-8 TEST METER ES-13

DATE 1/22/90 TEST METER LAST CAL. 1.000 = Yt

BAROMETRIC PRESSURE 30.17

FIELD METER			TEST METER				RESULTS				
VOLUME cu.ft.	TEMP. 'F	DELTA H "H2O	TIME min.	VOLUME cu.ft.	TEMP. 'F	PRESS. "H2O	Q cfm	Y	H@	AVE.Y	AVG. H@
4.55	90.5	0.4	13	4.55	64	0	0.35	1.050	1.71	1.0069	1.68
4.94	91.5	0.4	13	4.63	64	0	0.38	0.985	1.64		
4.91	93	0.4	13	4.59	64	0	0.38	0.986	1.67		
5.01	94	0.72	10	4.69	64.5	0	0.50	0.987	1.70	1.0046	1.63
4.98	96	0.72	10	4.87	64.5	0	0.50	1.035	1.57		
5.14	97	0.72	10	4.81	64.5	0	0.51	0.992	1.61		
4.66	97	1	8	4.37	65.5	0	0.58	0.992	1.74	0.9915	1.75
4.65	99	1	8	4.35	66.5	0	0.58	0.991	1.76		
4.68	100	1	8	4.38	67	0	0.59	0.992	1.73		
5.79	102	2	7	5.456	68	0	0.83	0.998	1.71	0.9981	1.71
5.85	102.	2	7	5.511	68	0	0.84	0.999	1.68		
5.77	102.	2	7	5.426	68	0	0.82	0.997	1.73		
6.77	103	4	6	6.414	68	0	1.13	1.000	1.82	1.0026	1.80
6.82	104.	4	6	6.459	68	0	1.14	1.003	1.79		
6.82	104.	4	6	6.468	68	0	1.14	1.004	1.78		
								AVERAGE		1.0007	1.71
										*******	*********

ANDERSEN
SAMPLERS INCORPORATED

4215 WENDELL DRIVE ◻ ATLANTA, GEORGIA 30336

CONTROL UNIT CALIBRATION

Date 1-20-84 Box No. 184-209 (ES-8)

Barometric pressure, P_b = 30.30 in. Hg Dry Gas Meter No. _____

rifice nometer etting, ΔH n. 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	Dry gas meter Inlet t_{di}, °R	Outlet t_{do}, °R	Average t_d, °R	Time θ, min	γ	$\Delta H@$
1.0	5	5.43	71/531	120	92	106/566	9.5	.982	1.88
2.0	5	5.42	71/531	127	93	110/570	6.8	.990	1.91
4.0	5	5.41	71/531	134	94	114/574	4.9	.999	1.97
)								.990	1.92

lculations

H	$\frac{\Delta H}{13.6}$	γ: $\frac{V_w P_b (\ t_d\ )}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)(\ t_w\ )}$	$\Delta H@$: $\frac{0.0317\ \Delta H}{P_b\ (t_d\ )} \left[\frac{(t_w\ )\ \theta}{V_w}\right]^2$
.0	0.0735		
.0	0.147		
.0	0.294		

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

$\Delta H@$ = 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

SPAN GAS RECORD

Date 1/24/90

Client/Location SCE/Long Beach

By SMH

Gas	Span Cylinder		Aux. Span Cylinder	
	Cylinder No.	Concentration	Cylinder No.	Concentration
Zero	ALM-6093		ALM-6093	
NOx	—	—	—	—
O2	AAL-4678	12.5	ALM-5692	8.000
CO	↓	275.5 289 ppm	↓	422.2 442 ppm
CO2	↓	14.97	↓	22.5
SO2	—	—	—	—

INSTRUMENT LINEARITY 1/30/90 SMH

	Analyzer				
	O2	CO2	CO	NOx	SO2
Analyzer Range	25%	25%	500	—	—
Set to High STD (80-90% of Range)	20.9	22.5	442 422.2	—	—
As-Found Low STD (50-60% of Range)	12.75	14.9	290	—	—
Actual Value of Low STD	12.5	14.97	289	—	—
Difference in % of Full Scale	1%	0.3%	0.2%	—	—

Allowable deviation is 2% of full scale (2 squares on strip chart).

ESA DS-063
Rev. 9/89

APPENDIX C

DATA SHEETS, CALCULATIONS, AND LABORATORY REPORTS

Appendix C.1

Sample Location

E/A

SAMPLING POINT LOCATION DATA
EPA Method 1

Plant SCE/LONG BEACH CT#3 Data by SMH

Date 1/29/96

Test Location STACK

i.d. = 18'4"

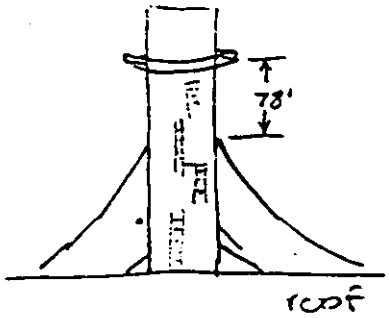


DIAGRAM OF SAMPLING LOCATION

Upstream Dist./Dia. > 2 (2.9)

Downstream Dist./Dia. 80/4.3

Coupling Length 11" inside

No. of Sampling Pts. 24

Stack Dimension 18'4"

Stack Area, ft^2 264 ft^2

Total stack height = 132 ft

Sample Point	% of Diameter	In. from near Wall	In. from Nozzle*
1	2.1	4.62	15.6
2	6.7	14.74	25.7
3	11.8	26.0	37.0
4	17.7	38.9	49.9
5	25.0	55.0	66.0
6	35.6	78.3	89.3

*Inches from wall plus coupling length

Use all 4 ports w/ 6 sample points per radius → 24 pts

ESA DS-009

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.

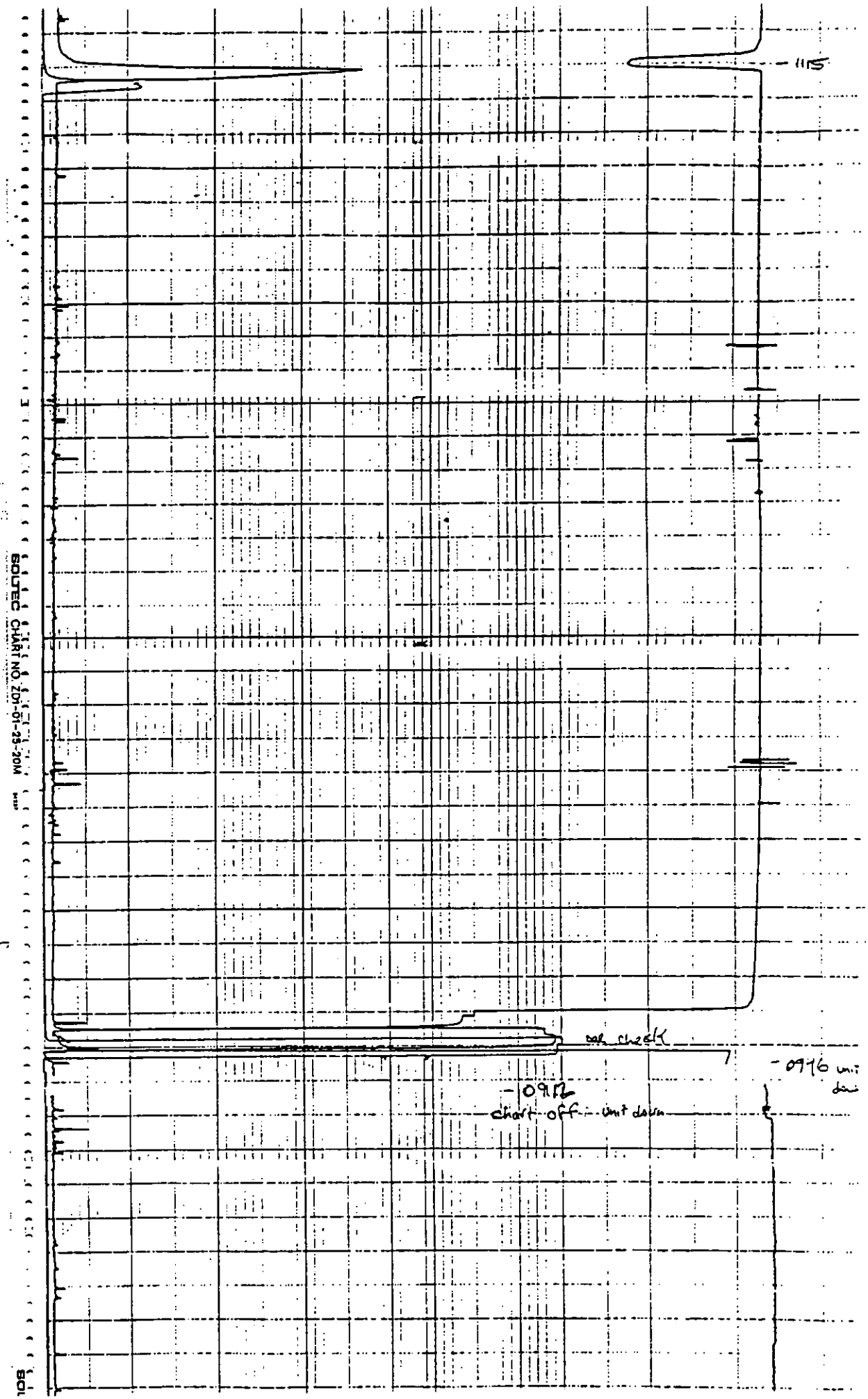
BE IT FURTHER ORDERED that during the approved period the Executive Officer or his or her authorized representative may field audit one or more tests conducted pursuant to this order for each type of testing listed above.

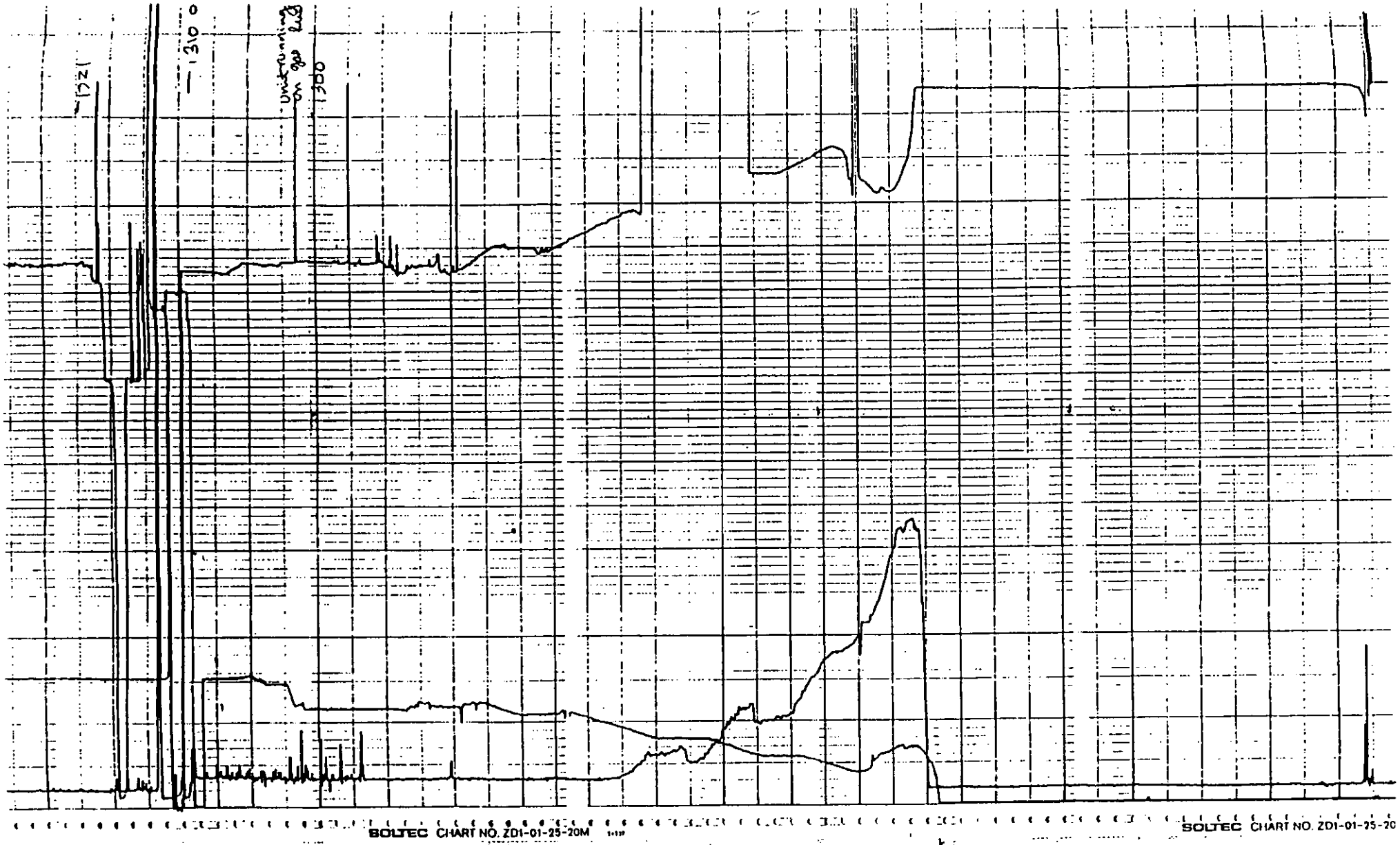
Executed at Sacramento, California, this 19TH day of JUNE 1989.

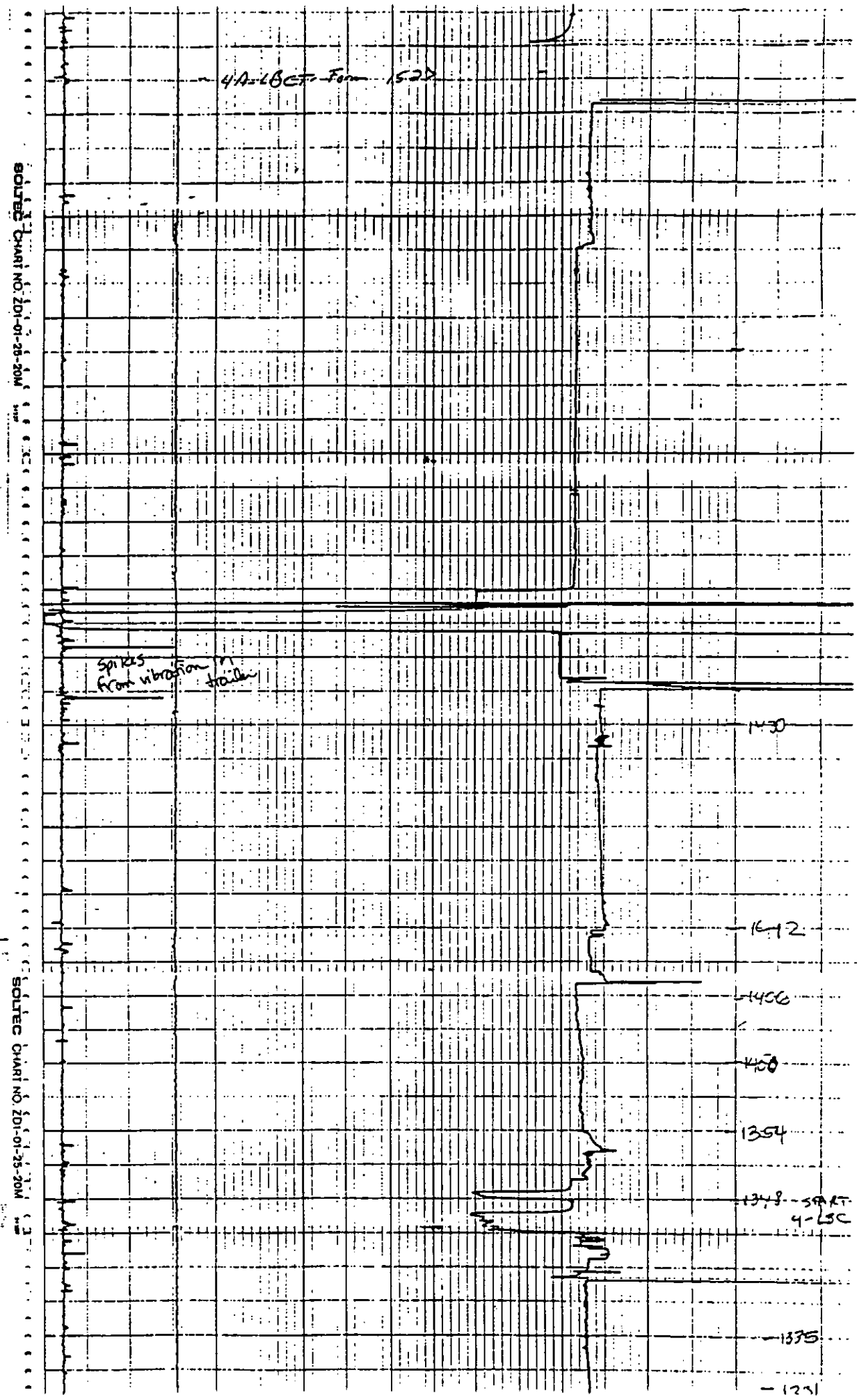
James J. Morgester, Chief
Compliance Division

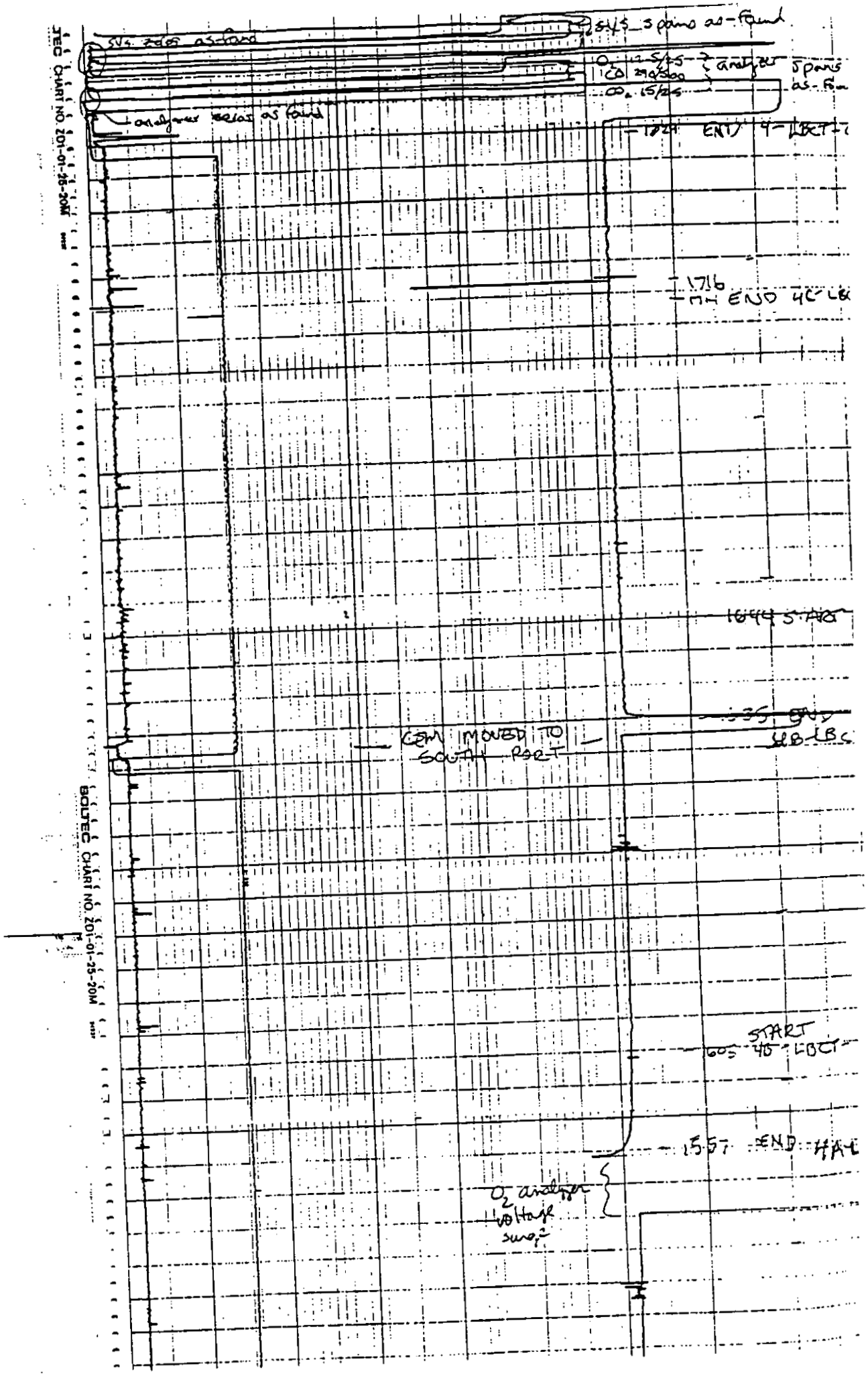
Appendix C.2

Unit Operating Data


1115
car check
-0916
chart off - unit down
SOLTEC CHART NO. ZD1-01-25-20M


1310
1300
BOLTEC CHART NO. ZD1-01-25-20M
SOLTEC CHART NO. ZD1-01-25-20


4A-LBCT-Form 1527
Spikes from vibration in trailer
1430
1412
1406
1400
1354
1348 - START 4-LSC
1335
1331
SOLTEC CHART NO. ZD1-01-25-20M
SOLTEC CHART NO. ZD1-01-25-20M



SVS zeros as-found
SVS spans as-found
O_2 12.5/25
CO 290/500
CO_2 15/25
analyzer spans as-found
analyzer zeros as found
1024 END 4-LBCT
1716
END 4C LB
1644 START
CEM MOVED TO SOUTH PORT
4B LBC
START
605 4B LBCT
1557 END HAL
O_2 analyzer voltage sweep
BOLTEC CHART NO. Z01-01-25-20M

Appendix C3

CEM Data

Energy Systems Associates A CORPORATION
15991 RED HILL AVE., SUITE 110, TUSTIN, CALIFORNIA 92680

SUBJECT O_2, CO_2 drift calculations as per SCAQMD Guidelines — JOB NO. 53304

SCE / Long Beach Combustion Turbine — SHEET NO. ___ of ___

COMPUTED BY A. Bell DATE 3/27/90 CHECKED BY ___ DATE ___

$$C_{gas} = (\bar{C} - C_0)\frac{C_{ma}}{C_m - C_0}$$

$\bar{C}$ = average gas conc. from CEM

C_{ma} = actual span gas concentration : for these tests
O_2 = 12.5 %
CO_2 = 14.97 %

C_m = average of initial & final calibration bias checks for span gas

C_0 = average of initial & final readings for zero gas

Test/Date	$\bar{C}$, %	C_{ma}, %	C_m, %	C_0, %	C_{gas}
O_2					
#1 (1/30/90)	15.5	12.5	12.5	.25	15.6
#2 (1/30/90)	15.3	12.5	12.57	.25	15.3
#3	15.4				15.4
#4 (1/31/90)	15.6	12.5	12.48	.25	15.7
#5 (2/1/90)	15.4	12.5	12.57	0.1	15.3
#6 (2/1/90)	15.5	12.5	12.54	0	15.5
CO_2					
#1 (1/30/90	3.1	14.97	14.69	0	3.2
#2 (1/30/90	3.1	14.97	14.79	0	3.1
#3	3.1				3.1
#4 (1/31/90)	3.9	14.97	14.68	0	4.0
#5 (2/1/90)	3.8	14.97	14.85	0	3.8
#6 (2/1/90)	3.8	14.97	14.89	0	3.8

128097

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE / LBCT

Date 1/30/90

Test Location STACK

Ambient Temperature, DB/WB

Operator SMH

Test No(s) 1- LBCT-CEM

Barometric Pressure 30.09

Duct Static Pressure

Fuel GAS

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
	0920		15.5	3.1	10				7.2 ~~7.2~~			
	0926		15.5	3.1	10				7.2 ~~7.2~~			
	0932		15.5	3.1	11				8.2 ~~8.2~~			
	0938		15.4	3.1	11				8.2 ~~8.2~~			
	0944		15.4	3.1	11				8.2 ~~8.2~~			
	0950		15.4	3.1	11				8.2 ~~8.2~~			
	AVG		15.5	3.1	11				7.9 ~~7.9~~			
Span Gas Concentration			12.5	15	~~210~~				276			

Comments:

ESA DS-001

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE / LBCT

Date 1/30/90

Test Location STACK

Ambient Temperature, DB/WB ~60 °F

Operator SMH

Test No(s) 2-LBCT-CEM

Barometric Pressure 30.09

Duct Static Pressure

Fuel GAS

Test No.	Sample Time	Point	Dry, Uncorrected						CO-(9)CO_2	Corrected to % , Dry		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
	1010		15.3	3.1	10				7.2			
	1016		15.3	3.1	10				7.2			
	1022		15.3	3.1	11				8.2			
	1028		15.3	3.1	12				9.2			
	1034		15.3	3.1	12				9.2			
	1040		15.3	3.1	12				9.2			
	AVG		15.3	3.1					8.4			
Span Gas Concentration			12.5	15	~~210~~				276			

Comments:

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE/LBCT

Date 1/30/90

Test Location STACK

Ambient Temperature, DB/WB ~60°F

Operator SMH

Test No(s) 3-LB-CT-CEM

Barometric Pressure 30.09

Duct Static Pressure

Fuel GAS

Test No.	Sample Time	Point	Dry, Uncorrected						CO-(.9)CO_2	Corrected to ___% ___, Dry		
			O_2	CO_2	CO	NOx	NO	NO_2	~~SO_2~~	CO	NOx	SO_2
	1050		15.4	3.1	18				12.2 ~~7.2~~			
	1056		15.4	3.1	18				12.2 ~~7.2~~			
	1102		15.4	3.1	18				12.2 ~~7.2~~			
	1108		15.4	3.1	18				12.2 ~~7.2~~			
	1114		15.5	3.1	18				12.2 ~~7.2~~			
	1120		15.5	3.1	15				12.2			
	AVG		15.4	3.1					12.2			
Span Gas Concentration			12.5	15. ~~[illegible]~~					276			

Comments:

ESA DS-001

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE / LBCT

Date 1/31/90

Test Location STK

Ambient Temperature, DB/WB ~60°F

Operator SMH

Test No(s) 4-LBCT-CEM

Barometric Pressure 29.95

Duct Static Pressure

Fuel Distillate Oil

Test No.	Sample Time	Point	Dry, Uncorrected O_2	CO_2	CO	NOx	NO	NO_2	SO_2	Corrected to % , Dry CO	NOx	SO_2
	1348		15.5	3.9	10				6.5			
	1403		15.5	3.9	11				7.5			
	1418		16.1	3.9	11				7.5			
	1433		16.1	3.9	11				7.5			
	1448		15.4	3.9	11				7.5			
	1503		15.5	3.9	11				7.5			
	1518		15.8	3.9	11				7.5			
	1533		15.3	3.9	11				7.5			
	1548		15.4	3.9	11				7.5			
	1603		15.4	3.9	11				7.5			
	1618		15.5	3.9	12				8.5			
	1633		15.5	3.9	12				8.5			
	1648		15.5	3.9	11				7.5			
	1703		15.5	3.9	10				6.5			
Span Gas Concentration	1718		12.5	15.0	289							
	1718		15.5	3.9	10				6.5			
Comments:	AVG		15.6	3.9	11				7.4			

ESA DS-001

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE / LBCT
Date 2/1/90
Test Location STK.
Ambient Temperature, DB/WB 60 °F
Operator SMH

Test No(s) S-LBCT-CEM
Barometric Pressure
Duct Static Pressure
Fuel Distillate Oil

Test No.	Sample Time	Point	Dry, Uncorrected O_2	CO_2	CO	NOx	NO	NO_2	corrected CO ~~SO_2~~	Corrected to ___% ___, Dry CO	NOx	SO_2
	0850		15.3	3.8	13				9.6		/	
	0910		15.3	3.8	14				10.6			
	0930		15.3	3.8	15				11.6			
	0950		15.3	3.8	15				11.6			
	1010		15.3	3.8	15				11.6			
	1030		15.5	3.8	16				12.6			
	1050		15.5	3.8	17				13.6			
	1110		15.5	3.8	17				13.6			
	1130		15.6	3.8	18				14.6			
	1150		15.4	3.8	12				8.6			
	1210		15.4	3.8	11				>6			
	1230		15.4	3.8	11				>6			
	1250		15.4	3.8	11				>6			
	1310		15.4	3.8	11				>6			
Span Gas Concentration			12.5	15.0	289							
	1330		15.4	3.8	11				>6			
	AVG		15.4	3.8	13				10.4			

Comments:

ESA DS-0C

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE/LBCT 3
Date 2/1/90
Test Location STK
Ambient Temperature, DB/WB
Operator SMH

Test No(s) 6-LBCT-CEM
Barometric Pressure
Duct Static Pressure
Fuel Distillate Oil

Test No.	Sample Time	Point	Dry, Uncorrected							Corrected to ___% ___, Dry		
			O_2	CO_2	CO	NOx	NO	NO_2	~~SO_2~~ corrected CO	CO	NOx	SO_2
	1445		15.4	3.8	11				>6			
	1515		15.4	3.8	11				>6			
	1630		15.5	3.8	13				9.6			
	1700		15.5	3.8	13				9.6			
	1730		15.5	3.8	13				9.6			
	1800		15.5	3.8	13				9.6			
	1830		15.5	3.8	13				9.6			
	1900		15.5	3.8	13				9.6			
	1930		15.5	3.8	13				9.6			
	AVGS		15.5	3.8	13				9.2			
Span Gas Concentration			12.5	15.0	289							

Comments:

ESA DS-001

Appendix C.4

Benzene

CARNOT

Benzene Emissions

Client/Location: W.W. SCE/LONG BEACH CT #3

Reference Temp (F)	60		
F Factor,Gas	8476	F Factor, Oil	9490
O2,% Gas	15.5	O2,% Oil	15.3
Flow rate, Gas Fuel(dscfm)	478569	Flow rate, Oil (dscfm)	497754

Fuel	Gas		Oil		
Test No.	1-LBCT-BENZENE		Test No.	4A-LBCT-BENZENE	
ppb	ND<	4	ppb	ND<	4
lb/hr	ND<	2.36E-02	lb/hr	ND<	2.46E-02
lb/MMbtu	ND<	2.70E-05	lb/MMbtu	ND<	2.92E-05
Test No.	2-LBCT-BENZENE		Test No.	4B-LBCT-BENZENE	
ppb	ND<	4	ppb	ND<	4
lb/hr	ND<	2.36E-02	lb/hr	ND<	2.46E-02
lb/MMbtu	ND<	2.70E-05	lb/MMbtu	ND<	2.92E-05
Test No.	3-LBCT-BENZENE		Test No.	4C-LBCT-BENZENE	
ppb	ND<	4	ppb	ND<	4
lb/hr	ND<	2.36E-02	lb/hr	ND<	2.46E-02
lb/MMbtu	ND<	2.70E-05	lb/MMbtu	ND<	2.92E-05
Average			Average		
ppb	ND<	4	ppb	ND<	4
lb/hr	ND<	2.36E-02	lb/hr	ND<	2.46E-02
lb/MMbtu	ND<	2.70E-05	lb/MMbtu	ND<	2.92E-05

E∫A

TEDLAR BAG DATA

Client/Project SCE/23 CT

Date 1/30/90 Unit CT By N. M

	Bag ID No. 1-LBCT-Ben	Bag ID No.	Bag ID No.
Test No.	1-LBCT-Ben	2-LB-CT-Ben	3-LB CT-Ben
Sample Rate	.5 L/M	1 L/m	1 L/m
Start Time	9:20	1010	1035
Stop Time	9:47	1040	1125
Sample Location	Stack, ~~East~~ EAST port	Stack ~~East~~ port	Stack EAST port

Gas Fuel

Date _____ Unit _____ By _____

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

Notes: _____

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CARNOT 03/28/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBCT	Date	1/30/90
Test Number	1-CT-1/4	Data By	ACB
Test Method	CARB 1,4	Sample Location	STACK
Fuel	GAS	Reference Temp (F)	60
Control Box #	ES-8	Unit	CT 3
Pitot Factor	0.840	Meter Cal Factor	0.9900
Stack Area (sq ft)	264.0	Sample Time (Min)	
Bar Press (in Hg)	30.09	Nozzle Diam (in)	
Meter Vol (acf)	17.475	Meter Temp (F)	96.1
Stack Press (iwg)	-0.53	Stack Temp (F)	341.9
Vel Head (iwg)	0.5686	O2 (%): from CEM	15.60
		from portable	15.60
Liquid Vol (ml)	46.5	CO2 (%): from CEM	3.20
		calculated	3.20
Meter Press (iwg)	1.00	Start/Stop Time	0920/102[illegible]

Std Sample Vol (SCF)	16.30
Metric Sample Vol (cubic meters)	0.46
Moisture Fraction	0.117
Stack Gas Mol Wt	27.83
Stack Gas Velocity (ft/sec)	52.94
Stack Flow Rate (wacfm)	838,583
Stack Flow Rate (dscfm)	482,110

E/A

VELOCITY TRAVERSE DATA

1/2

Plant LBCT

Date 1/30/90

Boiler No. CT-3

Data Taken By RJP / RAF

Fuel Type N. GAS

Test Description VELOCITY / CYCLONIC FLOW

Test No. 1-LBT-M2

Baro. Press (in.Hg) 30.09

Pitot Tube Coefficient .84 Cp

Abs. Static Press in Stack (in.Hg) -.53 (in H_2O) P_s

$$V_s = 2.90\ Cp \sqrt{\Delta P\ T_s} \sqrt{\frac{29.92}{P_s} \times \frac{28.95}{MW}}$$

Time	Traverse Point Port	Traverse Point Depth	Velocity Head, in. H_2O, ΔP	Gas Temp °F	Gas Temp °R, T_s	Velocity, ft/sec	Comments	O_2, %	Null angle
9:30	N	1	.61	335					≈<5
		2	.70	342					0°
		3	.71	343					0°
		4	.74	344					0°
		5	.67	344					~5
		6	.50	344					0°
	S E	1	.59	342					0°
		2	.78	344					0°
		3	.76	344					0°
		4	.71	345					0°
		5	.67	345					0°
		6	.57	345					0°

P_s, corrected _____ in.Hg

MW _____ lb/lb·mole

A_s 264 ft^2

Q _____ WACFM

Q_s _____ WSCFM

Q_{sd} _____ DSCFM

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EJA

VELOCITY TRAVERSE DATA

2/2

Plant LBCT

Date 1/30/90

Boiler No. CT-3

Data Taken By RJP/RAF

Fuel Type N. GAS

Test Description Velocity, Cyclonic Flow

Test No. 1-LBCT-M2

Baro. Press (in.Hg) 30.09

Pitot Tube Coefficient .84 Cp

Abs. Static Press in Stack (in.Hg) -.53 P_s

$$V_s = 2.90\ Cp \sqrt{\Delta P\ T_s} \sqrt{\frac{29.92}{P_s} \times \frac{28.95}{MW}}$$

Time	Traverse Point Port	Traverse Point Depth	Velocity Head, in.H_2O, ΔP	Gas Temp °F	Gas Temp °R, T_s	Velocity, ft/sec	Comments	O_2,%	Null Angle
1000	S	1	.53	340					0°
		2	.67	340					0°
		3	.73	342					0°
		4	.69	342					0°
		5	.61	341					~6°
		6	.54	342					~4°
1015	W	1	.25	337					0°
		2	.33	340					0°
		3	.39	340					0°
		4	.37	341					0°
		5	.39	340					0°
		6	.40	343					~4°
1020									
			.5686 √	341.9					

P_s, corrected _____ in.Hg Q _____ WACFM

MW _____ lb/lb·mole Q_s _____ WSCFM

A_s _____ ft^2 Q_{sd} _____ DSCFM

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PARTICULATE TEST DATA

Client/Location SCE/LONG BEACH Unit CT 3 Test No. 1-2BCT-4 Method Mtl. 4 Page 1

Sample Location Stack / south port Test Condition Gas Ambient Temp, °F 60 of 1

Operators Mulligan, Pearce Meter Vol. (Start/End) 837.925 + 849.400 Date 1/30/90

Pre-Test Data:

Barometric Press, in.Hg 30.09
Stack Area, sq.ft. 264
Sample Time/Pt, min. 36
Assumed Stack Press ~~[illegible]~~
Assumed Moisture 5%
Assumed Molecular Wt 28

Equipment Information:

Meter No. LS-8
Box No. N (.9900)
Meter Factor, Yd ~~1.0~~
Pitot Factor, Cp .84
CFM at H = 1.0 .588
Probe I.D. 4' SS
Nozzle No./Dia N/A
Filter No. N/A

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	—	543.4	500.0	= 43.4 ✓
#2	H_2O	593.6	592.0	= 1.6 ✓
#3	—	487.7	487.7	= 0 ✓
#4	SG	831.2	879.7	= 1.5 ✓
Total		-		= 46.5 ✓

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	.00	8	JM		
Post-Test	.00	8	JM		

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Meter In	Meter Out	O_2, %	Vacuum	Impinger Out Temp.	O_2 Cal
start	920		1.0	831.925		92	85		2	2cc	
	925		1.0	835.4		106	86		2	52	
	930		1.0	837.892		107	88		2	50	
	935		1.0	840.80		107	87		2	50	
	940		1.0	843.382	345	107	88	15.3	2	52	
	945		1.0	846.		108	89		2		
stop	950			849.400							
Total/Average											

Test Summary

Initial SMH ✓ RS
Sample Vol., c.f. 17.475 ✓
Stack Press, iwg —
ΔP — iwg ΔH 1.0 ✓ iwg
Meter Temp., °F 96.1 ✓
Stack Temp., °F —
Water Collected, g 46.5 ✓
O_2 ~~15.3~~ 15.5 / 3.1 CFM ✓
Chain of Custody (initials):
Impingers Loaded SMH 1/26/90
Impingers Recovered AB
Filter Loaded SMH
Filter Recovered —
Probe Wash —
Comments: In Conj. w/ ~~[illegible]~~ 1-LBCT-1

592.0
-472.9
119.1

472.9

E/A

TEDLAR BAG DATA

Client/Project SCE / LONG BEACH

Date 2/1/90 Unit CT-3 By RJP / JM

	Bag ID No.	Bag ID No.	Bag ID No.
Test No.	5A-LBCT-BENZENE	5B-LBCT-BENZENE	5C-LBCT-BENZENE
Sample Rate	.5 l/min	.5 l/min	.5 l/min
Start Time	858	955	1030
Stop Time	918	1015	1050
Sample Location	STACK	STACK	STACK

Fuel: Distillate Oil

Date _____ Unit _____ By _____

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

Notes: _____

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CARNOT 03/28/

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBCT	Date	1/30/
Test Number	3-CT-1/4	Data By	A
Test Method	CARB 1,4	Sample Location	STA
Fuel	GAS	Reference Temp (F)	
Control Box #	ES-8	Unit	CT
Pitot Factor	0.840	Meter Cal Factor	0.99
Stack Area (sq ft)	264.0	Sample Time (Min)	
Bar Press (in Hg)	30.09	Nozzle Diam (in)	
Meter Vol (acf)	21.232	Meter Temp (F)	109
Stack Press (iwg)	-0.53	Stack Temp (F)	342
Vel Head (iwg)	0.5589	O2 (%): from CEM	15.
		from portable	15.
Liquid Vol (ml)	59.0	CO2 (%): from CEM	3.
		calculated	3.
Meter Press (iwg)	1.50	Start/Stop Time	1055/1

Std Sample Vol (SCF)	19.
Metric Sample Vol (cubic meters)	0.5
Moisture Fraction	0.1
Stack Gas Mol Wt	27.
Stack Gas Velocity (ft/sec)	52.
Stack Flow Rate (wacfm)	832,9
Stack Flow Rate (dscfm)	475,0

Average velocity = 52.26 ft/sec

Average Flow rate (of Tests 1 and 3) = 478,569 dscfm

Average O_2 = 15.5 %

E/A

1/2

VELOCITY TRAVERSE DATA

Plant LBCT

Date 1/30/90

Boiler No. CT-3

Data Taken By RJP/JM

Fuel Type N. GAS

Test Description VELOCITY

Test No. 3-LBCT-M2

Baro. Press (in.Hg) 30.09

Pitot Tube Coefficient .84 Cp

Abs. Static Press in Stack (in.Hg) -.53 P_s

$$V_s = 2.90\ Cp \sqrt{\Delta P\ T_s} \sqrt{\frac{29.92}{P_s} \times \frac{28.95}{MW}}$$

Time	Traverse Point Port	Traverse Point Depth	Velocity Head, in.H_2O, ΔP	Gas Temp °F	Gas Temp °R, T_s	Velocity, ft/sec	Comments	O_2,%
1101	North	6	0.52	343				
		5	0.57	343				
		4	0.65	343				
		3	0.74	343				
		2	0.78	343				
1103		1	0.55	341				
1107	West	6	0.41	340				
		5	0.38	339				
		4	0.34	339				
		3	0.35	337				
		2	0.34	337				
1109		1	0.31	338				

P_s, corrected _____ in.Hg Q _____ WACFM

MW _____ lb/lb·mole Q_s _____ WSCFM

A_s _____ ft^2 Q_{sd} _____ DSCFM

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E/A

2/2

VELOCITY TRAVERSE DATA

Plant SCC / LB — Date 1/30/90

Boiler No. CT-3 — Data Taken By KJP / JB

Fuel Type GAS — Test Description

Test No. 3-LBCT-M2

Baro. Press (in.Hg) 30.09 — Pitot Tube Coefficient .84 Cp

Abs. Static Press in Stack (in.Hg) -.54 P_s

$$V_s = 2.90\ Cp \sqrt{\Delta P\ T_s} \sqrt{\frac{29.92}{P_s} \times \frac{28.95}{MW}}$$

Time	Traverse Point Port	Traverse Point Depth	Velocity Head, in.H_2O, ΔP	Gas Temp °F	Gas Temp °R, T_s	Velocity, ft/sec	Comments	O_2,%
11	South	6	0.57	343				
		5	0.58 ~~0.54~~	342				
		4	0.61	343				
		3	0.68	343				
		2	0.71	342				
1114		1	0.68	342				
1142	East	6	0.57	344				
		5	0.62	342				
		4	0.66	345				
		3	0.73	345				
		2	0.71	344				
1144		1	0.60	343				
AVG			.5589	342				

P_s, corrected _____ in.Hg — Q _____ WACFM

MW _____ lb/lb-mole — Q_s _____ WSCFM

A_s _____ ft^2 — Q_{sd} _____ DSCFM

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Client/Location: SCE/LONG BEACH
Sample Location: STACK
Operators: Mulligan

Unit: CT#3
Fuel: GAS

Test No.: 2-LBCT-H_2O
Method: 4
Ambient Temp., °F: 60
Meter Vol. (Start/End): 851.593/872.820

Page 1 of 1
Date: 1/30/8

Pre Test Data:

Barometric Press, in. Hg	30.09
Stack Area, sq. ft.	264
Sample Time/ Pt, min.	30
Assumed Stack Press	
Assumed Moisture	9%
Assumed Molecular Wt	28

Equipment Info:

Meter No.	ES-8
Meter, Yd	~~1.0~~ .99
Pitot, Cp	.84
CFM @ΔH = 1.0	.594
Probe I.D.	4' SS
Nozzle No./Dia	N/A
Filter No.	N/A

Imp.	Matl	Wt(End)		Weight (Start)		Weight (g)
#1	H_2O	244	-	100	=	44 ✓
#2	H_2O	111	-	100	=	11 ✓
#3	—	0	-	0	=	0 ✓
#4	SG	755.0	-	751.0	=	4 ✓
Total			-		=	59 ✓

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

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	.003	8	[illegible]		
Post-Test	.002	7	[illegible]		

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	1055		1.5	851.593	343		115	98		Rec	15.4	2	
	1100		1.5	855.468	344		118	98		61		3	
	1105		1.5	858.672	343		119	99		60		3	
	1110		1.5	862.310	343		120	101		62	15.1	3	
	1115		1.5	866.321	343		120	101		64		3	
	1120		1.5	869.263	343		122	102		66		3	
	1125			872.820									

Test Summary

Initial: SWH ✓
Sample Vol., c.f.: 21.232 ✓
Stack Press, iwg: —
ΔP — iwg ΔH 1.5 iwg
Meter Temp., °F: 109.3 ✓
Stack Temp., °F: —
Water Collected, g: 59 ✓
O_2/CO_2 Method: CEM 15.4/[illegible]
Chain of Cust. Info (init.):
Impingers Loaded: SWH
Impingers Recovered: SWH
Filter Loaded: —
Filter Recovered: —
Probe Wash: —
Comments: In conjunction w/2-LBCT-VEL

REPORT

TRUESDAIL LABORATORIES, INC.

CHEMISTS - MICROBIOLOGISTS - ENGINEERS
RESEARCH - DEVELOPMENT - TESTING

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

CLIENT **Energy Systems Associates**
15991 Red Hill Ave., Suite 110
Tustin, California 92680-7388
Attention: Arlene Bell/Robt. A. Finken

DATE February 22,

RECEIVED January 30,

LABORATORY NO. 3

SAMPLE **Three (3) Tedlar bags**
labeled 1-LBCT, 2-LBCT & 3-LBCT
P.O. No.: 53304-LBCT/Edison PO# C0138903

INVESTIGATION

Analyze for trace Benzene by modified EPA Method 602

RESULTS

MODIFIED EPA 602 (Benzene)

Received: 1/30/90
Analyzed: 1/31/90

	Nanoliters per Liter (ppb)
	Benzene
1-LBCT	ND< 4
2-LBCT	ND< 4
3-LBCT	ND< 4

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 identical or similar products. As a mutual protection to clients, the public and these Laboratories, this report is submitted and accepted for the exclusive 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 matter without prior written authorization from these Laboratories.

RUES - - LAB - INC.

HEMISTS - MICROBIOLOGISTS - ENGINEERS
SEARCH - DEVELOPMENT - TESTING

14201 FRANKLIN AVENUE
TUSTIN, CALIFORNIA 92680
AREA CODE 714 • 730-6239
AREA CODE 213 • 225-1564
CABLE: TRUELABS

LIENT Energy Systems Associates
15991 Red Hill Avenue, Suite 110
Tustin, California 92680-7388
Attention: Arlene Bell/Robert A. Finken

DATE February 22, 1990

RECEIVED February 2, 1990

LABORATORY NO. 37975

AMPLE Six (6) Tedlar bags labelled 1A-LBAX, 1B-LBAX, 1C-LBAX, 5A-LBCT, 5B-LBCT, & 5C-LBCT
P.O. No.: ESA PO# 53304-LBAX & -LBCT/Edison PO# C0130903

NVESTIGATION Analyze for trace benzene by modified EPA Method 602

RESULT

MODIFIED EPA 602 (Benzene)

Received: 2/2/90
Analyzed: 2/2/90

	Nanoliters per Liter (ppb) Benzene
1A-LBAX	ND<4
1B-LBAX	ND<4
1C-LBAX	ND<4
5A-LBCT	ND<4
5B-LBCT	ND<4
5C-LBCT	ND<4

ND - Not Detected.

Respectfully submitted,
TRUESDAIL LABORATORIES, INC.

Joe Bramlett, Manager
Instrumental Methods

This [illegible] to the sample, or samples investigated and is not nece[illegible] [illegible] of the quality or condit[illegible] apparently identi[illegible] [illegible] a mutual protection to clients, the public and these [illegible] report is submitted and [illegible] for the exclusi[illegible]

Appendix C.5

Formaldehyde

FORMALDEHYDE EMISSION CALCULATIONS

CLIENT/LOCATION: SCE/LONG BEACH CT #3
FUEL: oil
F Factor: 9490
Reference Temp (F) 60

Test	ug/train	Vmstd	%O2	Qsd	ug/dscf	ug/m3	ppb	lb/hr	lb/MMbtu
4A-FORM	< 4.4	1.23	15.7	509595	< 3.6	< 126.3	< 100	< 2.41E-01	< 3.01E-04
4B-FORM	< 4.4	1.15	15.7	509595	< 3.8	< 135.1	< 107	< 2.58E-01	< 3.21E-04
4C-FORM	< 4.4	0.81	15.7	509595	< 5.4	< 191.8	< 151	< 3.66E-01	< 4.56E-04

Average ug/m3

< 151.1

Average ppb

< 119

Average lb/hr

< 2.88E-01

Average lb/MMbtu

< 3.59E-04

FORMALDEHYDE EMISSION CALCULATIONS

CLIENT/LOCATION: SCE/LONG BEACH CT #3
FUEL: gas
F Factor: 8476
Reference Temp (F) 60

Test	ug/train	Vmstd	%O2	Qsd	ug/dscf	ug/m3	ppb	lb/hr	lb/MMbtu
1-FORM	13.8	0.46	15.5	478569	29.9	1056.4	833	1.89E+00	2.16E-03
2-FORM	< 4.4	1.04	15.5	478569	< 4.2	< 149.4	< <118	< 2.68E-01	< 3.06E-04
3-FORM	30.0	2.20	15.5	478569	13.6	481.9	380	8.63E-01	9.86E-04

Average ug/m3

< 562.6

Average ppb

< 443

Average lb/hr

< 1.01E+00

Average lb/MMbtu

< 1.15E-03

CARNOT 03/28/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBCT	Date	1/30/90
Test Number	1-CT-FORM	Data By	ACB
Test Method	CARB 430	Sample Location	STACK
Fuel	GAS	Reference Temp (F)	60
Control Box #	ES-19	Unit	CT 3
Pitot Factor		Meter Cal Factor	1.0000
Stack Area (sq ft)	264.0	Sample Time (Min)	30
Bar Press (in Hg)	30.09	Nozzle Diam (in)	
Meter Vol (acf)	0.476	Meter Temp (F)	76.7
Stack Press (iwg)		Stack Temp (F)	
Vel Head (iwg)		O2 (%): from CEM	15.6
		from portable	15.60
Liquid Vol (ml)		CO2 (%): from CEM	3.20
		calculated	3.20
Meter Press (iwg)	0.01	Start/Stop Time	0920/0950

Std Sample Vol (SCF)	0.46
Metric Sample Vol (cubic meters)	0.01

PARTICU TEST DATA

Client/Location: SCE/Long Beach
Unit: CT 3
Test No.: L-LBCT-Form
Method: 430
Page: 1 of 1
Sample Location: Stack East port
Fuel: Gas
Ambient Temp., °F: 60
Operators: McMegan
Meter Vol. (Start/End): 392.882/393.358
Date: 1/3

Pre Test Data:
- Barometric Press, in. Hg: 30.09
- Stack Area, sq. ft.: 264
- Sample Time/ Pt, min.: 30 min total, single point
- Assumed Stack Press:
- Assumed Moisture: 9%
- Assumed Molecular Wt: 28

Equipment Info:
- Meter No.: ES-18
- Meter, Yd: 1.0
- Pitot, Cp: .84
- CFM @ΔH = 1.0: .594
- Probe I.D.:
- Nozzle No./Dia: N/A
- Filter No.: N/A

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	DWPH		100	
#2	DWPH		100	
#3	–		–	
#4	N/A			
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
Std	920		.01	392.882			76	76		Ice		0	
	925		.01	392.960			76	77		Ice		0	
	930		.01	392.040			76	77		Ice		0	
	935		.01	393.074			76	77		Ice		0	
	940		.01	393.157	345		76	77		Ice	15.3	0	
	945		.01	393.208	344		77	78		Ice		0	
	950			393.358									

Test Summary
- Initial: SMH ✓ NS
- Sample Vol., c.f.: 0.476 ✓
- Stack Press, iwg:
- ΔP ____ iwg ΔH .010 iwg ✓
- Meter Temp., °F: 76.7 ✓
- Stack Temp., °F:
- Water Collected, g:
- O_2/CO_2 Method: 15.5/I/CFI
- Chain of Cust. Info (init.):
  - Impingers Loaded: ACS
  - Impingers Recovered: N/A
  - Filter Loaded: N/A
  - Filter Recovered: N/A
  - Probe Wash: N/A
- Comments: *corrected O_2/CO_2

CARNOT 03/28/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBCT	Date	1/30/90
Test Number	2-CT-FORM	Data By	ACB
Test Method	CARB 430	Sample Location	STACK
Fuel	GAS	Reference Temp (F)	60
Control Box #	ES-19	Unit	CT 3
Pitot Factor		Meter Cal Factor	1.0000
Stack Area (sq ft)	264.0	Sample Time (Min)	30
Bar Press (in Hg)	30.09	Nozzle Diam (in)	
Meter Vol (acf)	1.086	Meter Temp (F)	85.8
Stack Press (iwg)		Stack Temp (F)	
Vel Head (iwg)		O2 (%): from CEM	15.30
		from portable	15.30
Liquid Vol (ml)		CO2 (%): from CEM	3.10
		calculated	3.10
Meter Press (iwg)	0.01	Start/Stop Time	1010/1040

Std Sample Vol (SCF)	1.04
Metric Sample Vol (cubic meters)	0.03

PARTICULATE TEST DATA

Client/Location: SCE / Long Beach
Unit: CT 3
Test No.: 2-LBCT-Form
Method: 430
Page: 1 of 1
Sample Location: Stack
Fuel: Gas
Ambient Temp., °F: 60
Operators: Mattingson
Meter Vol. (Start/End): 293.36 / 394.452
Date: 1/30/90

Pre Test Data:
- Barometric Press, in. Hg: 30.09
- Stack Area, sq. ft.: 264
- Sample Time/ Pt, min.: 30 min/single point
- Assumed Stack Press:
- Assumed Moisture: 9%
- Assumed Molecular Wt: 28

Equipment Info:
- Meter No.: ES-19
- Meter, Yd: 1.0
- Pitot, Cp: .84
- CFM @ΔH = 1.0: .595
- Probe I.D.:
- Nozzle No./Dia: N/A
- Filter No.: N/A

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	DNPH		10 ml	
#2	DNPH		10 ml	
#3	–		–	
#4	N/A			
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					

Field Blank in 15 ml DNPH
Field Spike in 15 ml DNPH + 1 ml 5000X Formaldehyde soln (≈ 2.4 µg)

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	10:10		.010	393.367	345		83	84		Ice	15.3	0	
	10:15		.010	393.542	342		85	85		"		0	
	10:20		.010	393.662	343		85	86		Ice		0	
	10:25		.010	393.850	344		87	86				0	
	10:30		.010	394.077	345		87	87				0	
	10:35		.010	394.245	345		88	87				0	
	10:40			394.453									

Test Summary
- Initial: OM / JB
- Sample Vol., c.f.: 1.086
- Stack Press., iwg:
- ΔP ____ iwg ΔH .01 iwg
- Meter Temp., °F: 85.8
- Stack Temp., °F:
- Water Collected, g:
- O_2/CO_2 Method: 15.3/3.0C
- Chain of Cust. Info (init.):
  - Impingers Loaded: MCB
  - Impingers Recovered: N/A
  - Filter Loaded: N/A
  - Filter Recovered: N/A
  - Probe Wash: N/A
- Comments: * corrected values the sum

CARNOT 03/28/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBCT	Date	1/30/90
Test Number	3-CT-FORM	Data By	ACB
Test Method	CARB 430	Sample Location	STACK
Fuel	GAS	Reference Temp (F)	60
Control Box #	ES-19	Unit	CT 3
Pitot Factor		Meter Cal Factor	1.0000
Stack Area (sq ft)	264.0	Sample Time (Min)	30
Bar Press (in Hg)	30.09	Nozzle Diam (in)	
Meter Vol (acf)	2.351	Meter Temp (F)	91.5
Stack Press (iwg)		Stack Temp (F)	
Vel Head (iwg)		O2 (%): from CEM	15.40
		from portable	15.40
Liquid Vol (ml)		CO2 (%): from CEM	3.10
		calculated	3.10
Meter Press (iwg)	0.01	Start/Stop Time	1055/1125

Std Sample Vol (SCF)	2.23
Metric Sample Vol (cubic meters)	0.06

PARTICU[illegible] TEST DATA

Client/Location: SCE / Long Beach
Unit: CT 3
Test No.: 3-LBCT-[illegible]
Method: 430
Page: 1 of 1
Sample Location: Stack
Fuel: Gas
Ambient Temp., °F:
Operators: Mullgrom
Meter Vol. (Start/End): 394.458 / 396.809
Date: 1/30/20

Pre Test Data:

Barometric Press, in. Hg	30.09
Stack Area, sq. ft.	264
Sample Time/ Pt, min.	30 min/pt
Assumed Stack Press	
Assumed Moisture	5%
Assumed Molecular Wt	28

Equipment Info:

Meter No.	ES-15
Meter, Yd	1.0
Pitot, Cp	.84
CFM @ΔH = 1.0	.595
Probe I.D.	
Nozzle No./Dia	N/A
Filter No.	N/A

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	DWPH		Dal	
#2	DWPH		Dal	
#3	–		–	
#4	N/A			
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
Std	1055		.010	394.458	343		90	90		Ice	15.4	0	
	1100		.010	394.70	344		89	90				0	
	1105		.010	395.135	343		92	91				0	
	1110		.010	395.528	344		93	92			15.1	0	
	1115		.010	395.87	343		93	92		Ice		0	
	1120		.010	396.395	343		94	92				0	
	1125			396.809									
Total/Average													

Test Summary

Initial	[illegible]
Sample Vol., c.f.	[illegible]
Stack Press, iwg	
ΔP ___ iwg	ΔH .01 iwg
Meter Temp., °F	91.5
Stack Temp., °F	
Water Collected, g	
O_2/CO_2 Method	15.4/3.1 C
Chain of Cust. Info (init.):	
Impingers Loaded	ACP
Impingers Recovered	N/A
Filter Loaded	N/A
Filter Recovered	N/A
Probe Wash	N/A

Comments:
∞ corrected values
15.4/3.1

CARNOT 03/28/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBCT	Date	1/31/90
Test Number	4A-CT-FOR	Data By	ACB
Test Method	CARB 430	Sample Location	STACK
Fuel	DIST. OIL	Reference Temp (F)	60
Control Box #	ES-8	Unit	CT 3
Pitot Factor		Meter Cal Factor	0.9900
Stack Area (sq ft)	264.0	Sample Time (Min)	30
Bar Press (in Hg)	29.95	Nozzle Diam (in)	
Meter Vol (acf)	1.294	Meter Temp (F)	81.5
Stack Press (iwg)		Stack Temp (F)	
Vel Head (iwg)		O2 (%): from CEM	15.70
		from portable	15.70
Liquid Vol (ml)		CO2 (%): from CEM	4.00
		calculated	4.00
Meter Press (iwg)	0.01	Start/Stop Time	1527/1557

Std Sample Vol (SCF)	1.23
Metric Sample Vol (cubic meters)	0.03

PARTICU[illegible] TEST DATA

Client/Location SCE/Long Beach Unit CT3 Test No. 4A-LBCT-Form Method 430 Page 1

Sample Location Stacks Fuel Distillate Ambient Temp., °F _____ of 1

Operators Mattingan & Pearce Meter Vol. (Start/End) 888.684/889.978 Date 1/31/90

Pre Test Data:

Barometric Press, in. Hg	29.95
Stack Area, sq. ft.	264
Sample Time/ Pt, min.	30 min/sight pt
Assumed Stack Press	-.53
Assumed Moisture	6 %
Assumed Molecular Wt	28.8

Equipment Info:

Meter No.	ES-8
Meter, Yd	1.0
Pitot, Cp	.84
CFM @ΔH = 1.0	.518
Probe I.D.	Teflon
Nozzle No./Dia	N/A
Filter No.	N/A

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	DNPH		10 ml	
#2	DNPH		10 ml	
#3	–		–	
#4	N/A			
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
Stack	1527		.010	888.684	309		77	76		ICC	15.5	2	
North	1532		.010	888.778	328		79	78			15.5	2	
	1537		.010	889.128	329		82	80				2	
	1542		.010	889.387	332		83	82				2	
	1547		.010	889.465	332		85	84			15.3	2	
	1552		.010	889.750	332		85	87			15.0	2	
Stop	1557			889.978									

Test Summary

Initial SMH ✓ JB

Sample Vol., c.f. 1.294 ✓

Stack Press, iwg _____

ΔP ____ iwg ΔH .010 ✓ iwg

Meter Temp., °F 81.5 ✓

Stack Temp., °F _____

Water Collected, g _____

O_2/CO_2 Method 15.6/3.9 CEM

Chain of Cust. Info (init.):

Impingers Loaded ACB

Impingers Recovered JM

Filter Loaded –

Filter Recovered –

Probe Wash –

Comments:

corrected 15.7/4.0

CARNOT 03/28/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBCT	Date	1/31/90
Test Number	4B-CT-FOR	Data By	ACB
Test Method	CARB 430	Sample Location	STACK
Fuel	DIST. OIL	Reference Temp (F)	60
Control Box #	ES-8	Unit	CT 3
Pitot Factor		Meter Cal Factor	0.9900
Stack Area (sq ft)	264.0	Sample Time (Min)	30
Bar Press (in Hg)	29.95	Nozzle Diam (in)	
Meter Vol (acf)	1.234	Meter Temp (F)	90.9
Stack Press (iwg)		Stack Temp (F)	
Vel Head (iwg)		O2 (%): from CEM	15.70
		from portable	15.70
Liquid Vol (ml)		CO2 (%): from CEM	4.00
		calculated	4.00
Meter Press (iwg)	0.01	Start/Stop Time	1605/1635

Std Sample Vol (SCF)	1.15
Metric Sample Vol (cubic meters)	0.03

PARTICU TEST DATA

Client/Location SCE/Long Beach Unit CT3 Test No. 4B-LBCT-Fort Method 430 Page 1
Sample Location Stack Fuel Distillate Ambient Temp., °F of 1
Operators Pearce & Mulligan Meter Vol. (Start/End) 889.998/891.257 Date 1/31/90

Pre Test Data:
- Barometric Press, in. Hg 29.95
- Stack Area, sq. ft. 264
- Sample Time/ Pt, min. 30/single pt.
- Assumed Stack Press -.53
- Assumed Moisture 6%
- Assumed Molecular Wt 28.8

Equipment Info:
- Meter No. ES-8
- Meter, Yd ~~1.0~~ .99
- Pitot, Cp .84
- CFM @ΔH = 1.0 .598
- Probe I.D. Teflon
- Nozzle No./Dia N/A
- Filter No. N/A

Imp.	Matl	Wt(End)		Weight (Start)		Weight (g)
#1	DNPH		-	10 ml	=	
#2	DNPH		-	10 ml	=	
#3	—		-		=	
#4	N/A		-		=	
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	1605		.010	889.998	332		90	89		ICC	15.1	0	
	1610		.010	890.205	337		91	91				0	
	1615		.010	890.432	339		91	91			15.4	0	
	1620		.010	890.653	339		91	91				0	
	1625		.010	890.853	333		91	91			15.4	0	
	1630		.010	891.052	334		92	92			15.3	0	
Stop	1635			891.232									

Test Summary
- Initial BMH / JS
- Sample Vol., c.f. 1.236
- Stack Press, iwg
- ΔP ____ iwg ΔH .010 iwg
- Meter Temp., °F 90.9
- Stack Temp., °F
- Water Collected, g
- O_2/CO_2 Method 15.6/3.9 CE
- Chain of Cust. Info (init.):
  - Impingers Loaded ACB
  - Impingers Recovered JM
  - Filter Loaded —
  - Filter Recovered —
  - Probe Wash —
- Comments:
  - * corrected 15.7/4.0

Total/Average

CARNOT 03/28/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBCT	Date	1/31/90
Test Number	4C-CT-FOR	Data By	ACB
Test Method	CARB 430	Sample Location	STACK
Fuel	DIST. OIL	Reference Temp (F)	60
Control Box #	ES-8	Unit	CT 3
Pitot Factor		Meter Cal Factor	0.9900
Stack Area (sq ft)	264.0	Sample Time (Min)	30
Bar Press (in Hg)	29.95	Nozzle Diam (in)	
Meter Vol (acf)	0.869	Meter Temp (F)	91.9
Stack Press (iwg)		Stack Temp (F)	
Vel Head (iwg)		O2 (%): from CEM	15.70
		from portable	15.70
Liquid Vol (ml)		CO2 (%): from CEM	4.00
		calculated	4.00
Meter Press (iwg)	0.01	Start/Stop Time	1644/171

Std Sample Vol (SCF)	0.81
Metric Sample Vol (cubic meters)	0.02

PARTICU TEST DATA

Client/Location SCE / Long Beach
Sample Location Stack
Operators

Unit CT3
Fuel Distillate

Test No. 4C-LBCT-Form
Method 430
Ambient Temp., °F
Meter Vol. (Start/End) 891.252 / 892.101

Page 1 of 1
Date 1/31/90

Pre Test Data:

Barometric Press, in. Hg	29.95
Stack Area, sq. ft.	264
Sample Time/ Pt, min.	30
Assumed Stack Press	-155
Assumed Moisture	6.8
Assumed Molecular Wt	28.8

Equipment Info:

Meter No.	ES-8
Meter, Yd	~~.40~~ .99
Pitot, Cp	.84
CFM @ΔH = 1.0	.595
Probe I.D.	Teflon
Nozzle No./Dia	N/A
Filter No.	N/A

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	DNPH		10 ml	
#2	DNPH		10 ml	
#3	—			
#4	N/A			
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
Stand	1644		.010	891.232	340		91	91		Ice	150	0	
	1649		.010	891.372	345		92	92			15.0	0	
	1654		.010	891.5	348		92	92			15.4	0	
	1659		.010	891.625	348		92	93			15.4	0	
	1704		.010	891.823	348		92	93			15.1	0	
	1709		.010	891.964	348		91	92			15.1	0	
Stop	1714			892.101									

Test Summary

Initial [illegible]
Sample Vol., c.f. 0.8A ✓
Stack Press, iwg
ΔP ____ iwg ΔH .010 ✓ iwg
Meter Temp., °F 91.9 ✓
Stack Temp., °F
Water Collected, g
O_2/CO_2 Method 15.6/3.9 ✓
Chain of Cust. Info (init.):
Impingers Loaded ACB
Impingers Recovered JM
Filter Loaded —
Filter Recovered —
Probe Wash —
Comments:
* [illegible]

RADIAN CORPORATION

Radian Work Order P0-02-017

Analytical Report
02/23/90

Energy Systems Associates

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

Arlene Bell

Customer Work Identification Energy Systems Associates
Purchase Order Number 5718

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: PO-02-017

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

Sample ID:	1-LBCT-FORM (A&B)	2-LBCT-FORM (A&B)	3-LBCT-FORM (A&B)	4A-LBCT-FORM (A&B)
Factor:	5	5	5	5
Results in:	ug	ug	ug	ug
	01A	02A	03A	04A
Matrix:	air	air	air	air

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Formaldehyde	32.3	4.4	10.77 *	4.4	48.56	4.4	18.21 *	4.4

* 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.

Energy Systems Associates
Radian Work Order: PO-02-017

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

Sample ID:	4B-LBCT-FORM (A&B)	4C-LBCT-FORM (A&B)	FIELD SPIKE	FIELD BLANK A
Factor:	5	5	5	10
Results in:	ug	ug	ug	ug
	05A	06A	07A	08A
Matrix:	air	air	air	air

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Formaldehyde	20.83 *	4.4	6.2 *	4.4	25.8	4.4	18.54 *	8.9

* 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.

subtract blank of 18.54 µg from all samples but not lower than det. l.
field spike = 25.8 - 18.54 = 7.3 µg
= 98% of nominal value of 7.4 µg

RADIAN CORPORATION

Analytical Data Summary

Energy Systems Associates
Radian Work Order: PO-02-017

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

Sample ID:	MATRIX SPIKE	MATRIX SPIKE DUP	METHOD BLANK
Factor:	1	1	10
Results in:	%	%	ug
	09A	10A	10B
Matrix:	water	water	air

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Formaldehyde	105		113		ND	0.89		

ND Not detected at specified detection limit

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

Energy Systems Associates
Radian Work Order: P0-02-017

Sample Identifications and Dates

Sample ID	1-LBCT-FORM (A&B)	2-LBCT-FORM (A&B)	3-LBCT-FORM (A&B)	4A-LBCT-FORM (A&B)	4B-LBCT-FORM (A&B)	4C-LBCT-FORM (A&B)
Date Sampled						
Date Received	02/02/90	02/02/90	02/02/90	02/02/90	02/02/90	02/02/90
Matrix	air	air	air	air	air	air
	01	02	03	04	05	06
Aldehydes by HPLC						
Prepared	02/06/90	02/06/90	02/06/90	02/06/90	02/06/90	02/07/90
Analyzed	02/20/90	02/20/90	02/20/90	02/20/90	02/20/90	02/20/90
Analyst	LKK	LKK	LKK	LKK	LKK	LKK
File ID	NA	NA	NA	NA	NA	NA
Blank ID						
Instrument	V5000	V5000	V5000	V5000	V5000	V5000
Report as	received	received	received	received	received	received

RADIAN CORPORATION

Sample History

Energy Systems Associates
Radian Work Order: PO-02-017

Sample Identifications and Dates

Sample ID	FIELD SPIKE	FIELD BLANK A	MATRIX SPIKE	MATRIX SPIKE DUP		
Date Sampled						
Date Received	02/02/90	02/02/90	02/02/90	02/02/90		
Matrix	air	air	water	air		
	07	08	09	10		
Aldehydes by HPLC						
Prepared	02/07/90	02/07/90	02/07/90	02/07/90		
Analyzed	02/20/90	02/20/90	02/20/90	02/20/90		
Analyst	LKK	LKK	LKK	LKK		
File ID	NA	NA	NA	NA		
Blank ID						
Instrument	V5000	V5000	V5000	V5000		
Report as	received	received	received	received		
Aldehydes by HPLC						
Prepared				02/07/90		
Analyzed				02/20/90		
Analyst				LKK		
File ID				NA		
Blank ID						
Instrument				V5000		
Report as				received		

RADIAN
CORPORATION

Appendix A

Comments, Notes and Definitions

Energy Systems Associates
Radian Work Order: P0-02-017

ND This flag (or «) is used to denote analytes which are not detected at or above the specified detection limit. The value to the right of the < symbol is the method specified detection limit for the sample.

* The asterisk(*) is used to flag results which are less than five times the method specified detection limit. Studies have shown that the uncertainty of the analysis will increase exponentially as the method detection limit is approached. These results should be considered approximate.

Energy Systems Associates
Radian Work Order: P0-02-017

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. 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), 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

E/A Energy Systems Associates A CORPORATION
15991 RED HILL AVE., SUITE 110, TUSTIN, CALIFORNIA 92680

SUBJECT Formaldehyde Blank Corrections JOB NO. 5
SCE/Long Beach CT II 3

SHEET NO.

COMPUTED BY A Bell DATE 3/28/90 CHECKED BY DATE

Re: Radian Report #
PO-02-017

Field Blank = 18.54 µg

Field Spike = 25.8 - 18.54 µg = 7.26 µg
= 98% of nominal value
of 7.4 µg

Subtract blanks to d.l. stated on lab report

Test #	Reported Value µg	µg Form corrected for blank
1-LBCT-Form	32.3	13.76
2-LBCT-Form	10.77	ND< 4.4
3-LBCT-Form	48.56	30.02
4A-LBCT-Form	18.21	ND< 4.4
4B-LBCT-Form	20.83	< 4.4
4C-LBCT-Form	6.2	ND< 4.4

126097

Appendix C.6

PAH

ENERGY SYSTEMS 02-May-90

AVERAGE PAH EMISSIONS

SPECIES	ug/dscm	lb/hr	lb/MMbtu
Naphthalene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Acenaphthylene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Acenaphthene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Fluorene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Phenanthrene	< 0.012	< 2.16E-05	< 2.69E-08
Anthracene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Fluoranthene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Pyrene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Benz(a)anthracene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Chrysene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Benzo(b+k)fluoranthene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Benzo(a)pyrene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Indeno(1,2,3-cd)pyrene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Dibenzo(a,h)anthracene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Benzo(g,h,i)perylene	ND< 0.009	ND< 1.65E-05	ND< 2.04E-08
Average Total PAH	< 0.136	< 2.52E-04	< 3.12E-07

Energy Systems Associates 02-May-90

PAH CALCULATIONS

CLIENT:	SCE/LONG BEACH CT	INITIALS:	ACB
		VMSTD(DSCF):	112.16
PROJECT NO:	53304	QSD(DSCF/MIN):	509595
TEST DATE:	1/31/90	CO2,%:	4.0
TEST NUMBER:	4-SV	O2,%:	15.7
T REF (F)	60	F Factor	9490
Fuel: oil			

SPECIES		ug/train		ug/dscm		lb/hr		lb/MMbtu
Naphthalene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Acenaphthylene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Acenaphthene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Fluorene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Phenanthrene		0.032		0.010		1.92E-05		2.40E-08
Anthracene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Fluoranthene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Pyrene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Benz(a)anthracene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Chrysene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Benzo(b+k)fluoranthene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Benzo(a)pyrene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Indeno(1,2,3-cd)pyrene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Dibenzo(a,h)anthracene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
Benzo(g,h,i)perylene	ND <	0.025	ND <	0.008	ND <	1.50E-05	ND <	1.87E-08
TOTAL PAH	<	0.382	<	0.120	<	2.29E-04	<	2.86E-07

Corrected for Field Blank

PAH CALCULATIONS

CLIENT:	SCE/LONG BEACH CT	INITIALS:	ACB
		VMSTD(DSCF):	103.22
PROJECT NO:	53304	QSD(DSCF/MIN):	497754
TEST DATE:	2/1/90	CO2,%:	3.8
TEST NUMBER:	5-SV	O2,%:	15.3
T REF (F)	60	F Factor	9490

Fuel: oil

SPECIES	ug/train	ug/dscm	lb/hr	lb/MMbtu
Naphthalene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Acenaphthylene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Acenaphthene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Fluorene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Phenanthrene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Anthracene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Fluoranthene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Pyrene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Benz(a)anthracene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Chrysene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Benzo(b+k)fluoranthene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Benzo(a)pyrene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Indeno(1,2,3-cd)pyrene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Dibenzo(a,h)anthracene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
Benzo(g,h,i)perylene	ND < 0.025	ND < 0.009	ND < 1.59E-05	ND < 1.89E-08
TOTAL PAH	< 0.375	< 0.128	< 2.39E-04	< 2.83E-07

Corrected for Field Blank

ENERGY SYSTEMS 02-May-90

PAH CALCULATIONS

CLIENT:	SCE/LONG BEACH CT	INITIALS:	ACB
		VMSTD(DSCF):	85.85
PROJECT NO:	53304	QSD(DSCF/MIN):	480300
TEST DATE:	2/1/90	CO2,%:	3.8
TEST NUMBER:	6-SV	O2,%:	15.5
T REF (F)	60	F Factor	9490
Fuel: oil			

SPECIES	ug/train	ug/dscm	lb/hr	lb/MMbtu
Naphthalene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Acenaphthylene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Acenaphthene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Fluorene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Phenanthrene	0.040	0.016	2.96E-05	3.77E-08
Anthracene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Fluoranthene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Pyrene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Benz(a)anthracene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Chrysene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Benzo(b+k)fluoranthene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Benzo(a)pyrene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Indeno(1,2,3-cd)pyrene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Dibenzo(a,h)anthracene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
Benzo(g,h,i)perylene	ND < 0.025	ND < 0.010	ND < 1.85E-05	ND < 2.36E-08
TOTAL PAH	< 0.390	< 0.160	< 2.88E-04	< 3.68E-07

Corrected for Field Blank

CARNOT 03/28/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBCT	Date	1/31/90
Test Number	4-LBCT-SV	Data By	ACB
Test Method	CARB 429	Sample Location	STACK
Fuel	DIST. OIL	Reference Temp (F)	60
Control Box #	ES-19	Unit	CT 3
Pitot Factor	0.840	Meter Cal Factor	1.0000
Stack Area (sq ft)	264.0	Sample Time (Min)	192
Bar Press (in Hg)	29.95	Nozzle Diam (in)	0.230
Meter Vol (acf)	120.741	Meter Temp (F)	101.5
Stack Press (iwg)	-0.50	Stack Temp (F)	335.5
Vel Head (iwg)	0.6138	O2 (%): from CEM	15.70
		from portable	15.70
Liquid Vol (ml)	262.1	CO2 (%): from CEM	4.00
		calculated	4.00
Meter Press (iwg)	1.11	Start/Stop Time	1348/1728

Std Sample Vol (SCF)	112.16
Metric Sample Vol (cubic meters)	3.18
Moisture Fraction	0.098
Stack Gas Mol Wt	28.16
Stack Gas Velocity (ft/sec)	54.59
Stack Flow Rate (wacfm)	864,649
Stack Flow Rate (dscfm)	509,595
Isokinetic Ratio (%)	104.85

PARTICU TEST DATA

Client/Location SCE / Long Beach Unit CT-3 Test No. 4-LBCT-5V Method 429 Page 1
Sample Location Stack Fuel Distillate Ambient Temp., °F 70 of 2
Operators Pearce & Mulligan Meter Vol. (Start/End) 400.571 / 521.312 Date 1/31/90

Pre Test Data:

Barometric Press, in. Hg	29.95
Stack Area, sq. ft.	264
Sample Time/ Pt, min.	180/8
Assumed Stack Press	-.55
Assumed Moisture	6%
Assumed Molecular Wt	28.8

Equipment Info:

Meter No.	ES-19
Meter, Yd	1.00
Pitot, Cp	.84
CFM @ΔH = 1.0	.595
Probe I.D.	10'/glass
Nozzle No./Dia	.230 OM
Filter No.	110-734

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1		717.0	470.5	241.5 ✓
#2	B&S H2O	600.5	608.5	-8.0 ✓
#3	—	485.0	485.0	0 ✓
#4	S/G	819.0	790.4	28.6 ✓
Total				~~261.6~~ 262.1 ✓

Impinger Box I.D. N/A
Integrated Bag I.D. N/A

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	.068	14	3m	04	
Post-Test	.014	14	3m	04	

Pre-Test Calibration

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

1.76

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~~ cogity
start	1348	0.61	1.07	400.571	334	225	92	82	225	53	15.8	7	55
North 6	1356	0.65	1.14	405.089	334	230	106	83	255	51	15.6	9	53
5	1404	0.79	1.39	410.138	343	258	110	84	260	50	15.8	11	51
4	1412	0.89	1.56	415.612	341	228	112	85	272	52	15.9	13	52
3	1420	0.75	1.32	421.369	339	228	114	85	258	50	15.9	12	52
2	1428	0.65	1.14	427.518	326	230	112	86	258	53		11	53
stop 1	1436			432.690									
start	1447	0.49	.86	432.690	329	226	89	83	225	54	16.0	7	54
west 6	1455	0.43	.75	436.980	327	228	102	83	233	58	15.9	7	58
5	1503	0.39	.68	441.387	326	230	102	83	269	54	15.9	6	54
4	1511	0.40	.70	443.98	324	236	102	83	260	55	15.7	6	55
3	1519	0.38	.66	450.725	321		105	84	259	52	15.5	6	52
2	1527	0.28	.45	454.870	328		107	85	266	54			54
stop 1	1535			457.150	35								
start	1542	0.58	1.02	457.187	332	226	106	87	272	54	15.3	9	54
south 6	1550	0.64	1.12	461.487	332	238	118	90	267	54	15.0	11	54
5	1558	0.74	1.50	466.868	339	228	121	94	268	54	16.2	13	51
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Test Summary

Initial SMH ✓ A
Sample Vol., c.f. 120.741
Stack Press, iwg -.5 ✓
ΔP .6138 iwg ΔH 1.11 iwg
Meter Temp., °F 101.52
Stack Temp., °F 335.5
Water Collected, g ~~261.6~~
O_2/CO_2 Method 15.4/3.9
Chain of Cust. Info (init.):
Impingers Loaded SMH
Impingers Recovered SMH
Filter Loaded SMH
Filter Recovered SMH
Probe Wash [illegible]
Comments:
8 VAC .005

PARTICO TEST DATA

Client/Location SCC / Long Beach Unit Ct 3 Test No. 4-LBCT-5V Method 429 Page 2
Sample Location STACK Fuel Distillate Ambient Temp., °F 70 of 2
Operators Mulligan & Pearce Meter Vol. (Start/End) 1 Date 1/31/9

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.

See page ONE

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 (Coil)
South 3	1614	0.72	1.26	478.209	339	236	127	97	257	52	15.4	12	52
2	1622	0.51	.98	484.023	333	275	125	97	262	52	15.4	9	52
Stop 1	1630			488.709									
Start	1640	0.68	1.19	488.709	340	225	110	96	275	50	15.0	10	50
East 6	1648	0.71	1.24	493.876	345	255	126	98	275	50	15.0	12	50
5	1656	0.80	1.40	499.089	348	240	127	100	274	48	15.4	13	48
4	1704	0.84	1.47	504.879	348	275	128	100	254	48	15.1	13	48
3	1712	0.79	1.39	510.734	348	232	125	99	241	48	15.5	13	48
2	1720	0.51	0.89	516.285	335	239	120	97	247	49	15.6	9	49
Stop 1	1728			521.312									

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:

CARNOT 03/28/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBCT	Date	2/1/90
Test Number	5-LBCT-SV	Data By	ACB
Test Method	CARB 429	Sample Location	STACK
Fuel	DIST. OIL	Reference Temp (F)	60
Control Box #	ES-19	Unit	CT 3
Pitot Factor	0.840	Meter Cal Factor	1.0000
Stack Area (sq ft)	264.0	Sample Time (Min)	192
Bar Press (in Hg)	30.05	Nozzle Diam (in)	0.230
Meter Vol (acf)	108.818	Meter Temp (F)	91.5
Stack Press (iwg)	-0.53	Stack Temp (F)	341.7
Vel Head (iwg)	0.5830	O2 (%): from CEM	15.30
		from portable	15.30
Liquid Vol (ml)	230.1	CO2 (%): from CEM	3.80
		calculated	3.80
Meter Press (iwg)	0.97	Start/Stop Time	0850/1318

Std Sample Vol (SCF)	103.22
Metric Sample Vol (cubic meters)	2.92
Moisture Fraction	0.094
Stack Gas Mol Wt	28.17
Stack Gas Velocity (ft/sec)	53.32
Stack Flow Rate (wacfm)	844,535
Stack Flow Rate (dscfm)	497,754
Isokinetic Ratio (%)	98.79

PARTICULATE TEST DATA

Client/Location: SCE/LONG BEACH
Sample Location: STACK
Operators: RJP/JM

Unit: CT-3
Fuel: DISTILLATE
Test No.: S-LDCT-CV
Ambient Temp., °F: ~60°F
Meter Vol. (Start/End): 531.394 / 1987.723
Method: SV
Page 1 of 2
Date 2/1/90

Pre Test Data:
- Barometric Press, in. Hg: 30.05
- Stack Area, sq. ft.: 24
- Sample Time/ Pt, min.: 100/8
- Assumed Stack Press: -.53
- Assumed Moisture: 10%
- Assumed Molecular Wt: 28.7

Equipment Info:
- Meter No.: 85-9
- Meter, Yd: 1.000
- Pitot, Cp: .84
- CFM @ΔH = 1.0: .595
- Probe I.D.: 10' 9/16
- Nozzle No./Dia: .230
- Filter No.: 110-735

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	—	685.1	- 488.5	= 196.6
#2	DI H2O	576.2	- 578.4	= -2.2
#3	—	480.3	- 480.3	= 0
#4	SG	863.6	- 839.3	= 24.3 + 11.4
Total			-	= ~~218~~ 230.1

Impinger Box I.D.: N/A
Integrated Bag I.D.: N/A

Leak Check:

	CFM	Vac.	Init.	Pitot	TBS
Pre-Test	.018	15	RP	OK	
Post-Test	.020	14	RP	OK	

Sample Train

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.	0737	1.0	524.732	85	70
Final	0742	1.0	527.714	86	71

1.62

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Cal Imp. Out	O_2	Vacuum	Static Press. iwg
E6	850	.41	.99	531.394	345	264	97	74		45		15	
5	858	.49	1.12	536.105	344	277	103	76	275	45	15.75	19	
4	906/914	.75	1.21	540.605	344	249	101	77	230	44		22	-.53
3	STOP			546.094									
2													
1													
E3	935	.84	1.36	893.605	349	279	85	69	223	48	15.3	13	
2	1003	.88	1.10	898.685	352	256	97	74	248	47	15.9	12	
1	1011	.24	.59	903.301	350	275	94	77	253		16.5	6	
	1019			906.585									
S6	1024	.57	.92	906.585	350	290	95	79	263	56	16.5	11	
5	1032	.68	1.10	910.990	347	230	102	82	264	55	15.5	11.5	
4	1040	.72	1.17	915.825	346	273	101	82	267	57	15.4	12	
3	1048	.80	1.30	920.684	345	249	103	83	264	60	15.5	13	
2	1056	.73	1.18	925.860	340	1	103	83	260	62	15.7	13	
1	1104	.48	.78	931.090	326	257	102	82	258	63	16.0	9	
	1112			935.169									
T / Average							90.50	77.92					

Test Summary
- Initial: SMH ✓
- Sample Vol., c.f.: 108.815
- Stack Press, iwg: -.53 ✓
- ΔP 0.5839 iwg ΔH 0.973 iwg
- Meter Temp., °F: 91.5 ✓
- Stack Temp., °F: 341.7 ✓
- Water Collected, g: 220.7
- O_2/CO_2 Method: 15.4/3.8
- Chain of Cust. Info (Init.):
  - Impingers Loaded: SMH
  - Impingers Recovered: SMH
  - Filter Loaded: SMH
  - Filter Recovered: SMH
  - Probe Wash: SMH/RP
- Comments: STOPPED @ 1914
  Final VAC. CALIBRATE Reset ΔH, checked all impinger
  CHANGED CONT. BIX. TIPS

PARTICULATE TEST DATA

Client/Location SCE / LONG BEACH
Sample Location STACK
Operators RP/JM

Unit GT-3
Fuel
Meter Vol. (Start/End) /

Test No. 5-LBCT-SV
Ambient Temp., °F

Method SV
Page 2 of 2
Date 2/1/90

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.

See Pg 1

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	1120	.48	.78	935.169	340	224	88	81	261	58	15.7	9	
5	1128	.42	.68	939.229	341	250	98	82	242	57		8	
4	1136	.39	.63	943.107	335	246	99	83	236	59	15.5	8	
3	1144	.38	.62	946.881	338	253	102	85	245	57	15.6	8	
2	1152	.33	.53	950.517	333	254	100	85	248	61		7	
1	1200	.23	.37	953.967	326	249	99	86	252	62	16.1	5	
	1208			956.917									
N 6	1230	.60	.99	936.917	342	225	95	86	248	61		11	
5	1238	.67	1.08	942.382	342	253	106	88	244	61		13	
4	1246	.82	1.32	947.032	341	240	109	87	249	62		13	
3	1254	.89	1.44	952.310	342	245	112	90	250	62		14	
2	1302	.80	1.30	957.589	340	248	112	89	249	64		14	
1	1310	.60	.99	963.207	342	254	110	93	262	64		12	
	1318			967.223									

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:

CARNOT 03/28/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBCT	Date	2/1/90
Test Number	6-LBCT-SV	Data By	ACB
Test Method	CARB 429	Sample Location	STACK
Fuel	DIST. OIL	Reference Temp (F)	60
Control Box #	ES-8	Unit	CT 3
Pitot Factor	0.840	Meter Cal Factor	0.9900
Stack Area (sq ft)	264.0	Sample Time (Min)	168
Bar Press (in Hg)	30.05	Nozzle Diam (in)	0.230
Meter Vol (acf)	90.699	Meter Temp (F)	87.1
Stack Press (iwg)	-0.50	Stack Temp (F)	342.3
Vel Head (iwg)	0.5437	O2 (%): from CEM	15.50
		from portable	15.50
Liquid Vol (ml)	192.2	CO2 (%): from CEM	3.80
		calculated	3.80
Meter Press (iwg)	0.92	Start/Stop Time	1446/1936

Std Sample Vol (SCF)	85.85
Metric Sample Vol (cubic meters)	2.43
Moisture Fraction	0.094
Stack Gas Mol Wt	28.17
Stack Gas Velocity (ft/sec)	51.50
Stack Flow Rate (wacfm)	815,803
Stack Flow Rate (dscfm)	480,300
Isokinetic Ratio (%)	97.32

PARTICUL TEST DATA

Client/Location: SCE LONG BEACH
Sample Location: STACK
Operators: Mulligan & Pearce

Unit: CT3
Fuel: OIL : DISTILLATE
Test No.: 6-LBCT-SV
Ambient Temp., °F: ~60°F
Meter Vol. (Start/End): 992.100 / 995.793

Method: 5V
Page 1 of 1
Date 2/1/90

Pre Test Data:
- Barometric Press, in. Hg: 30.05
- Stack Area, sq. ft.: 264
- Sample Time/ Pt, min.: 7min
- Assumed Stack Press: -.53
- Assumed Moisture: 10%
- Assumed Molecular Wt: 28.9

Equipment Info:
- Meter No.: ES-8
- Meter, Yd: ~~1.00~~ .9900
- Pitot, Cp: .84
- CFM @ΔH = 1.0: .558
- Probe I.D.: .230
- Nozzle No./Dia: 10' / glass
- Filter No.: 564

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	—	634.8	- 472.7	= 162.1 ✓
#2	DRY H_2O	562.4	- 566.0	= -3.6 ✓
#3	—	485.9	- 485.0	= 0.9 ✓
#4	SG	802.4	- 769.6	= 32.8 ✓
Total			- 774.6	=
Impinger Box I.D.				192.2 ✓
Integrated Bag I.D.				

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	.022	16	SMH	OK	
Post-Test	.010	16	SM		

Pre-Test Calibration

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

1.62

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	1446	.55	.89	992.100	344	248	98	87	236	52		8	
North 6	1453	.64	1.03	995.793	341	270	106	87	256	49		10	
5	~~1500~~	.72	1.16	000.143	340	230	107	87	255	49		12	
4	1507	.79	1.27	004.413	341	254	108	88	258	48		13	
3	1514	.78	1.26	008.654	339	232	105	86	260	48		13	
2	1521	~~.57~~	~~.92~~	013.321									
Stop 2	1528	.57	.92	013.321	347	255	98	85	225	48		10	
1	1654/1101			017.028									
start	~~1709~~ 1109	.26	.42	017.028	350	254	83	81	228	60		7	
west 6	1716	.20	.32	019.721	348	264	90	80	228	61		5	
5	1723	.26	.42	021.891	343	235	90	80	252	61		7	
4	1730	.30	.48	024.483	341	230	91	79	250	62		7	
3	1737	.22	.35	027.387	338	227	90	78	226	62		7	
2	1744	.10	.16	029.38	336	236	82	77	226	59		2	
Stop 1	1751			031.846									
Total/Average													

Test Summary
- Initial: SMH ✓
- Sample Vol., c.f.: 90.699
- Stack Press, iwg: -.5 ✓
- ΔP: .5437 iwg ΔH: .923 iwg
- Meter Temp., °F: ~~91.06~~ 87
- Stack Temp., °F: 342.3
- Water Collected, g: 192.2
- O_2/CO_2 Method: 15.5/3.8
- Chain of Cust. Info (init.):
  - Impingers Loaded: SMH
  - Impingers Recovered: ACB
  - Filter Loaded: SMH
  - Filter Recovered: ACB
  - Probe Wash: SMH/ACB
- Comments: L/C @ 8": .018
  * 15.5/3.8 corrected

PARTICULATE TEST DATA

Client/Location: SCE / Long Beach
Sample Location: STACK
Operators: Pearce & Mulligan

Unit: CT3
Fuel: Distillate
Test No.: 6-1BCP-SV
Method: S2
Ambient Temp., °F: 58°
Meter Vol. (Start/End): 1

Page 2 of 2
Date 2/1/90

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	A	G	C	L
#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	1758	.51	.82	031.846	334	253	87	76	254	58		11	-.5
Start 6	1805	.54	.87	036.57	341	270	93	77	237	58		10	
5	1812	.62	1.00	040.218	337	268	93	77	243	57		11	
4	1819	.73	1.18	043.598	343	256	94	77	241	57		12	
3	1826	.76	1.23	047.721	341	246	94	77	247	57		12	
2	1833	.66	1.06	051.612	341	241	94	77	245	56		12	
Stop 1	1840			056.167									
Start	1854	.60	.97	057.167	345	225	86	76	248	60		12	
6	1901	.61	1.03	060.023	346	275	94	77	247	58		12	
5	1908	.57	1.40	064.043	343	235	96	77	250	57		14	
4	1915	.54	1.36	068.673	349	235	96	76	246	57		14	
3	1922	.67	1.40	073.568	341	235	97	77	242	57		15	
2	1939	.72	1.16	078.593	346	223	95	77	257	57		12	
1	1936			082.799									
Total/Average		.5437	.923										

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:

EST DS-022

PARTICU TEST DATA

Client/Location: SCC/LD
Sample Location: Stack
Operators: RJR & JM

Unit: CO
Fuel:
Test No.: Blank-SV
Method: SV
Ambient Temp., °F:
Meter Vol. (Start/End): 1

Page 1 of 1
Date 2/1/90

Pre Test Data:
- Barometric Press, in. Hg: 30.05
- 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.: 481

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	—	524.6	- ~~524.6~~	
#2	H_2O	603.5	- 603.5	
#3	—	500.9	- 500.9	
#4	SG		- ~~244.6~~	
Total		813	- 813	

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

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	.010	8	[illegible]		
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
- 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: DHI
  - Impingers Recovered: DHI
  - Filter Loaded: ACB
  - Filter Recovered: ACB
  - Probe Wash: ACB/DHI
- Comments:

ANALYTICAL RESULTS REPORT

CLIENT INFORMATION
Name: ENERGY SYSTEMS ASSOCIATES
Project: PAH ANALYSIS OF MM5 TRAINS

LAB INFORMATION
Contact: HH
Project: AN398506
Date: Apr.03 1990

Notes: "-" = Not Analyzed
"<" = Less than MDL
"*" = Lab Accident

		Client ID:	4-LBCT-SV MM5 TRAIN	5-LBCT-SV MM5 TRAIN	6-LBCT-SV MM5 TRAIN	LBCT-BLK MM5 TRAIN
		Lab ID:	004056 90	004057 90	004058 90	004059 90
Component	MDL	Units				
Naphthalene	0.025	ug	<	<	<	<
Acenaphthylene	0.025		<	<	<	<
Acenaphthene	0.025		<	<	<	<
Fluorene	0.025		<	<	<	<
Phenanthrene	0.025		0.032	<	0.04	<
Anthracene	0.025		<	<	<	<
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			33	30	35	40
d10 Anthracene			44	37	33	50
d12 Chrysene			38	32	45	44
d12 Benzo(a)pyrene			44	69	32	77

CHAIN OF CUSTODY RECORD

RECORD NO. _____

PROJECT NO. _____ PROJECT LOCATION _____

FIELD SAMPLER
Name _____ Affiliation _____
Signature _____
Sample Storage _____
Comments _____

ZENON Environmental Inc
845 Harrington Court
Burlington, Ontario
L7N 3P3
(416)-639-6320

ANALYSES REQUESTED

Sample Code	Date Collected	Sample Description	Container Seq. No.	Container Size	Container Type	Sample Size	PAH-MMS										Field Procedures pH	Elect. Cond.	Preservatives
004056		4-LBCT-SV	4	x	SDOA		X												
			XAD		TRAP														
			FILTER																
004057		5-LBCT-SV	3	x	SDOA		X												
			XAD		TRAP														
			FILTER																
004058		6-LBCT-SV	2	x	SDOA		X												
			XAD		TRAP														
			FILTER																
004059		LBCT-FIELDBLANK	2	x	SDOA		X												
			XAD		TRAP														
			FILTER																

Custody Relinquished by _____ Date/Time _____
Received by _____ Affiliation _____
Sample Storage _____

Custody Relinquished by _____ Date/Time _____
Received by _____ Affiliation _____
Sample Storage _____

Client's Name: ESA

Address: _____

Appendix C.7

Fuel Analysis

E/A Energy Systems Associates A CORPORATION
15991 RED HILL AVE., SUITE 110, TUSTIN, CALIFORNIA 92680

SUBJECT SCE/Long Beach CT #3 JOB NO. 53304
Calculation of F Factor for natural gas
SHEET NO. ___ of ___
COMPUTED BY J. Bell DATE 4/18/90 CHECKED BY ___ DATE ___

Compound	Composition by volume or Mole %	Wt % C	H	N	O
CH_4	92.1	11.06	3.71		
C_2H_6	3.75	0.90	0.23		
C_3H_8	1.00	0.36	0.08		
n-C_4H_{10}	0.23	0.11	0.02		
i-C_4H_{10}	0.13	0.06	0.01		
n-C_5H_{12}	0.06	0.04	0.01		
i-C_5H_{12}	0.07	0.04	0.01		
C_6H_{14} +	0.10	0.07	0.01		
CO_2	1.00	0.12			0.32
[illegible]	1.51			0.42	
		12.76 +	4.08 +	0.42 +	0.32
MW = 17.58 = Total					
% by weight		72.58	23.21	2.39	1.82

$$Btu/lb = 1049.7/ft^3 \times \frac{379.5\ ft^3}{lb\text{-}mole} \times \frac{mole}{17.58\ lb}$$

$$= 22{,}660$$

$$F_{68} = \frac{10^6\,[3.64(23.21) + 1.53(72.58) + .14(2.39) - .46(1.82}{22{,}660}$$

$$= 8606\ dscf/10^6\ Btu$$

$$F_{60} = (8606)\frac{520}{528} = 8476\ dscf/10^6\ Btu$$

128097

So. Ca Gas. 10:30 A m , 1/22/90

C_6 +	-	0.10 %
Propane	-	1.00 %
I. Butane	-	0.13 %
n - Butane	-	0.23 %
I. Pentane	-	0.07 %
n - Pentane	-	0.06 %
N_2	-	1.51 %
CH_4	-	92.10 %
CO_2	-	1.00 %
Ethane	-	3.75 %

Heating value - ~~1~~ 1049.7 Btu/mcf.

SP Gr = 0.6092

- Gas analysis for CT 3/ Long Beach supplied by Southern California Gas Co. no location available to take a gas sample

EPA Fuel "F" factor calculations
SCE/LONG BEACH COMBUSTION TURBINE NO. 3

Reference temp, F:	60
Composition by wt, %:	
Carbon	84.07
Hydrogen	15.63
Nitrogen	0.19
Sulfur	0.055
Oxygen	0.2
Ash	0.01
Heating value, btu/lb:	19,250
F factor, dscf/mmbtu @ 0% O2:	9,490
Ash content, lb/mmbtu:	0.005

Curtis & Tompkins, Ltd., Analytical Laboratories. Since 1878
1250 S. Boyle Ave., Los Angeles, CA 90023. Phone (213) 269-7421. Fax (213) 268-5328

DATE RECEIVED: 02/09/90
DATE REPORTED: 03/14/90

LAB NUMBER: 25430

CLIENT: ENERGY SYSTEMS ASSOCIATES

REPORT ON: FOUR DISTILLATE OIL SAMPLES

PROJECT #: SUBMITTED BY CLIENT

LOCATION: SUBMITTED BY CLIENT

RESULTS: SEE ATTACHED

Laboratory Director

Curtis & Tompkins, Ltd.

LABORATORY NUMBER: 25430-3
CLIENT: ENERGY SYSTEMS ASSOCIATES
PROJECT #: SUBMITTED BY CLIENT
PROJECT #: SUBMITTED BY CLIENT
SAMPLE ID: 6A-LBCT-Fuel

DATE RECEIVED: 02/09/90
DATE ANALYZED: 02/15/90
DATE REPORTED: 03/15/90

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)	ND (0.05)	560
Chromium (VI)	ND (0.05)	--
Copper	ND (0.10)	25
Lead	ND (0.25)	5
Mercury	ND (0.10)	0.2
Manganese	ND (0.10)	350
Nickel	ND (0.05)	20
Selenium	ND (0.25)	1
Zinc	0.21	250

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES.

QA/QC DATA SUMMARY:

	RPD	SPIKE		RPD	SPIKE
Arsenic	21	101	Mercury	9	95
Beryllium	3	90	Manganese	2	98
Cadmium	19	84	Nickel	11	100
Chromium	1	101	Selenium	14	105
Copper	3	102	Zinc	3	99
Lead	13	97			

Curtis & Tompkins.

LABORATORY NUMBER: 25430-4
CLIENT: ENERGY SYSTEMS ASSOCIATES
PROJECT #: SUBMITTED BY CLIENT
PROJECT #: SUBMITTED BY CLIENT
SAMPLE ID: 6B-LBCT-Fuel

DATE RECEIVED: 02/09/9
DATE ANALYZED: 02/15/9
DATE REPORTED: 03/15/9

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)	ND (0.05)	560
Chromium (VI)	ND (0.05)	--
Copper	ND (0.10)	25
Lead	ND (0.25)	5
Mercury	ND (0.10)	0.2
Manganese	ND (0.10)	350
Nickel	ND (0.05)	20
Selenium	ND (0.25)	1
Zinc	0.09	250

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES.

QA/QC DATA SUMMARY:

	RPD	SPIKE		RPD	SPIKE
Arsenic	21	101	Mercury	9	95
Beryllium	3	90	Manganese	2	98
Cadmium	19	84	Nickel	11	100
Chromium	1	101	Selenium	14	105
Copper	3	102	Zinc	3	99
Lead	13	97			

Curtis & Tompkins, Ltd.

LABORATORY NUMBER: 25430-3
CLIENT: ENERGY SYSTEMS ASSOCIATES
PROJECT #: SUBMITTED BY CLIENT
LOCATION: SUBMITTED BY CLIENT
SAMPLE ID: 6A-LBCT-Fuel

DATE RECEIVED: 02/09/90
DATE ANALYZED: 03/07/90
DATE REPORTED: 03/14/90

ULTIMATE AND PROXIMATE ANALYSIS

PARAMETER	AS RECEIVED BASIS (% by Weight)
ASH CONTENT	<0.01
CARBON	74.84
CHLORINE	<0.01
HYDROGEN	13.84
NITROGEN	0.14
OXYGEN	11.14 ← by difference, an artifact of evaporation
SULFUR	0.04
CHLORINE BY X-RAY DIFF. (mg/L)	ND (30)
BTU/LB.	19,300

correct to .2% O (from Steam by BAW)

when reapportioned:

C: 84.18
H: 15.55
N: 0.16
O: 0.2
S: 0.05

AB 5/11/90

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES

Curtis & Tompkins

LABORATORY NUMBER: 25430-4
CLIENT: ENERGY SYSTEMS ASSOCIATES
PROJECT #: SUBMITTED BY CLIENT
LOCATION: SUBMITTED BY CLIENT
SAMPLE ID: 6B-LBCT-Fuel

DATE RECEIVED: 02/09/90
DATE ANALYZED: 03/07/90
DATE REPORTED: 03/14/90

ULTIMATE AND PROXIMATE ANALYSIS

PARAMETER	AS RECEIVED BASIS (% by Weight)
ASH CONTENT	<0.01
CARBON	73.31
CHLORINE	<0.01
HYDROGEN	13.75
NITROGEN	0.20
OXYGEN	12.69 ← by difference separation
SULFUR	0.05
CHLORINE BY X-RAY DIFF. (mg/L)	ND (30)
BTU/LB.	19,200

C: 83.96
H: 15.71
N: 0.22
O: 0.2
S: 0.06

BS 5/11

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES

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:

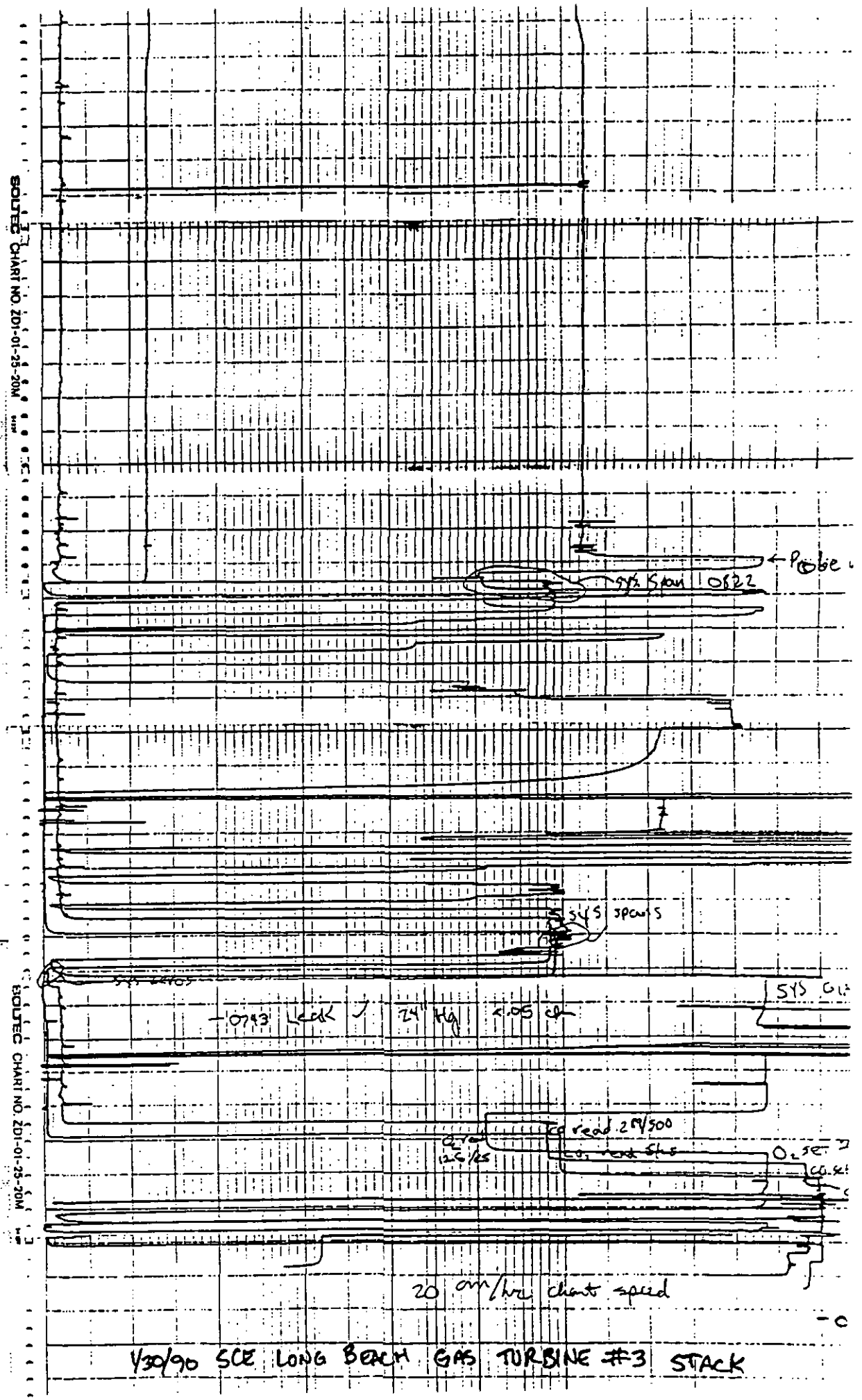
A_s	=	stack area, ft^2
Bwo	=	flue gas moisture content
$C_{12\% CO_2}$	=	particulate grain loading, gr/dscf corrected to 12% CO_2
C	=	particulate grain loading, gr/dscf
C_p	=	pitot calibration factor, dimensionless
Dn	=	nozzle diameter, in.
F	=	fuel F factor, dscf/10^6 Btu at 0% O_2
H	=	orifice pressure 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

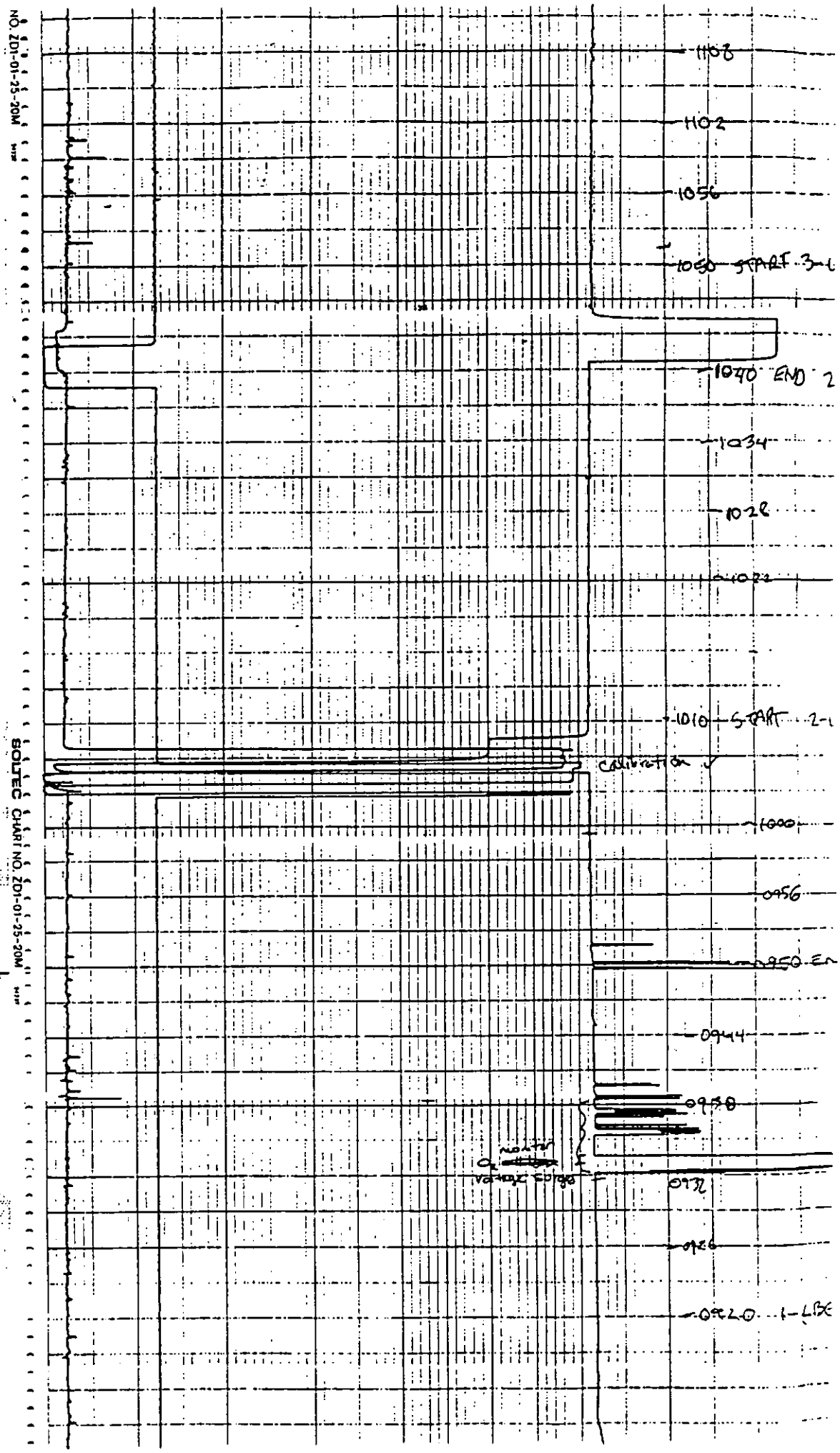
θ	=	sample time, min.
ΔP	=	average velocity head, iwg $= \left(\overline{\sqrt{\Delta P}}\right)^2$
P_{bar}	=	barometric pressure, in.Hg
Ps	=	stack absolute pressure, in.Hg.
Psg	=	stack static pressure, iwg
Q	=	wet stack gas flow rate at actual conditions, wacfm
Qsd	=	dry stack gas flow rate at standard 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

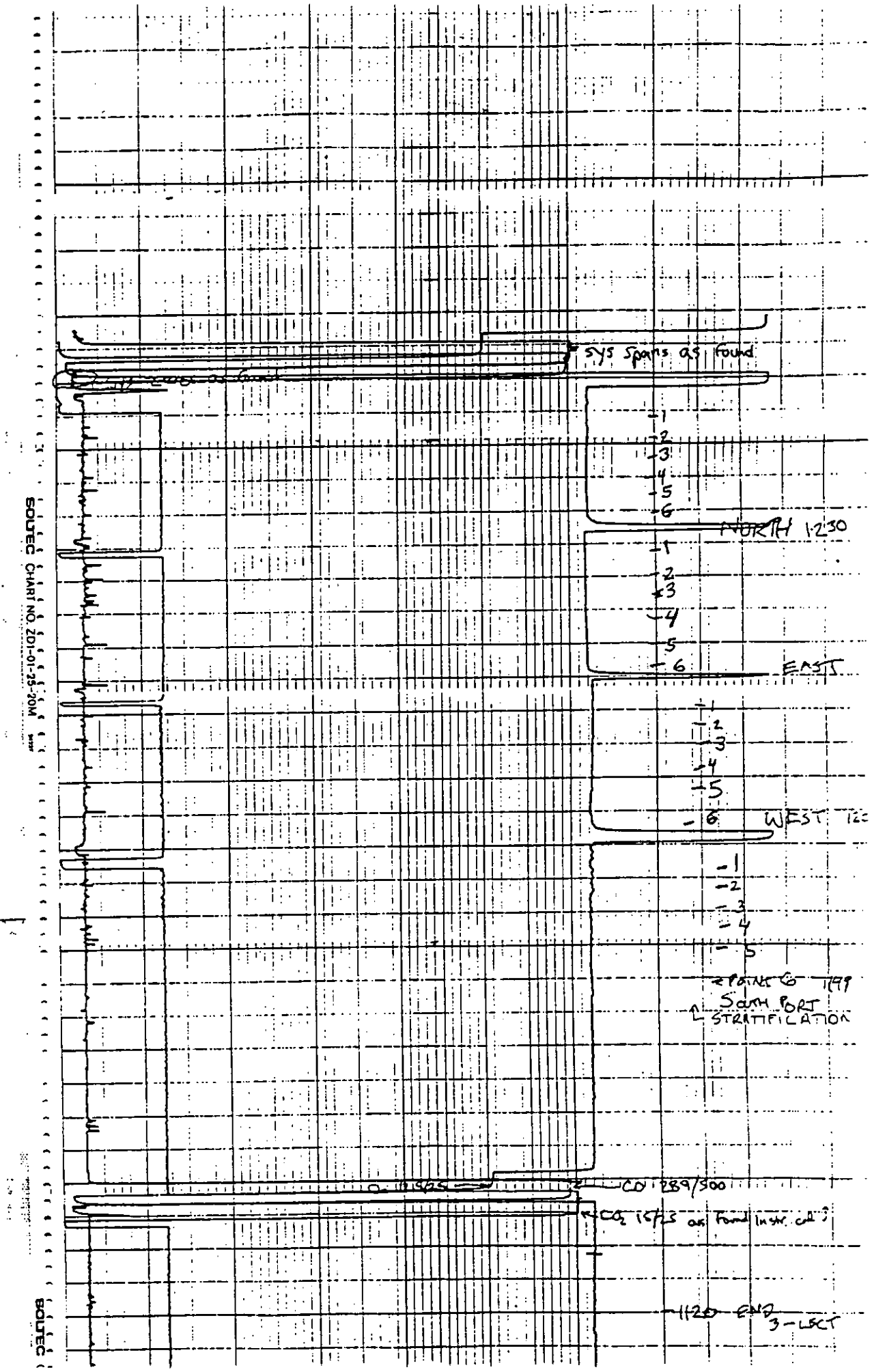
INSTRUMENT STRIP CHARTS



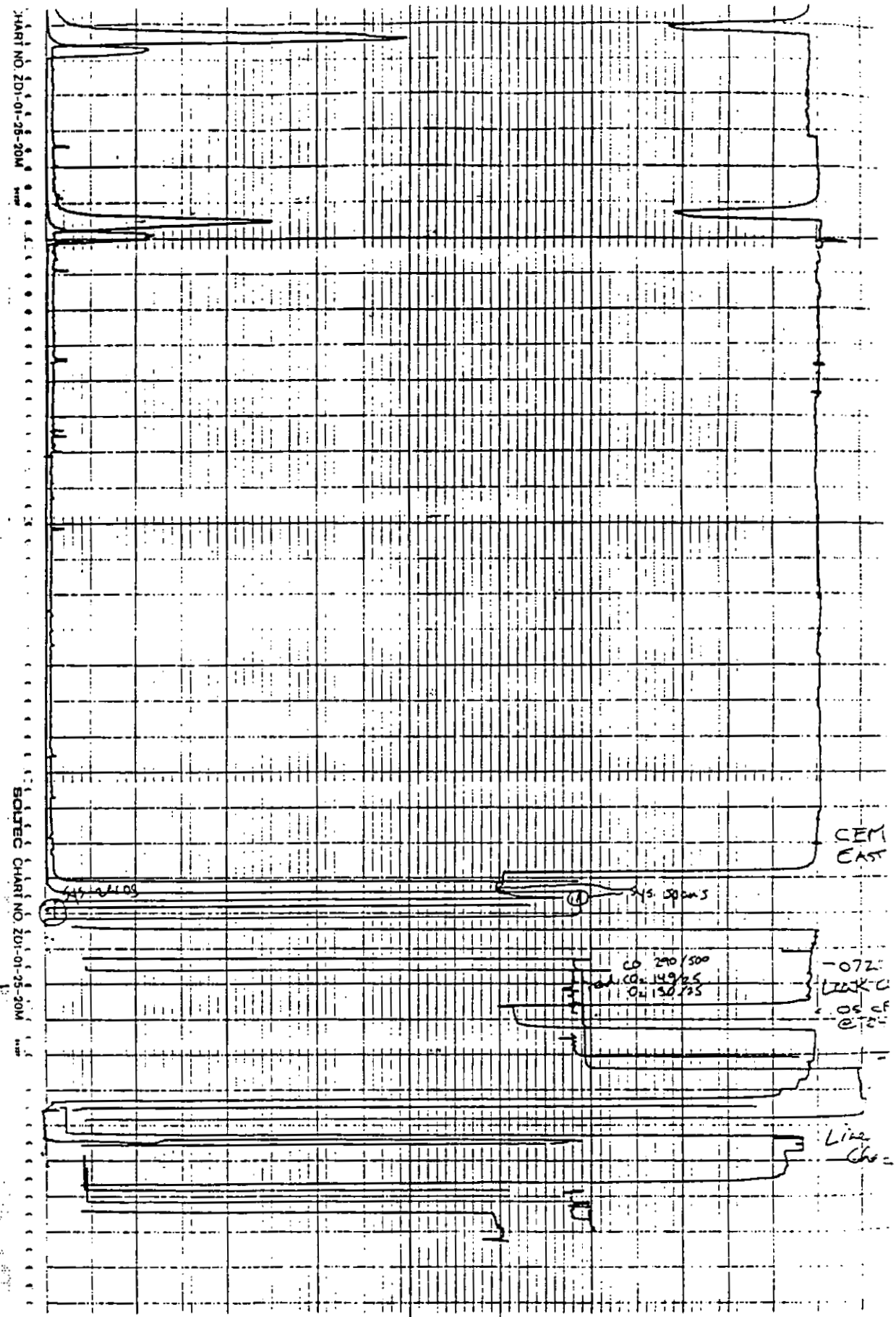
1/30/90 SCE LONG BEACH GAS TURBINE #3 STACK



NO. ZD1-01-25-20M
SOLTEC CHART NO. ZD1-01-25-20M
1108
1102
1056
1050 START 3-
1040 END 2
1034
1028
1022
1010 START 2-
calibration ✓
1000
0956
0950 EN
0944
0938
monitor
O_2
voltage surge
0932
0926
0920 1-LBE

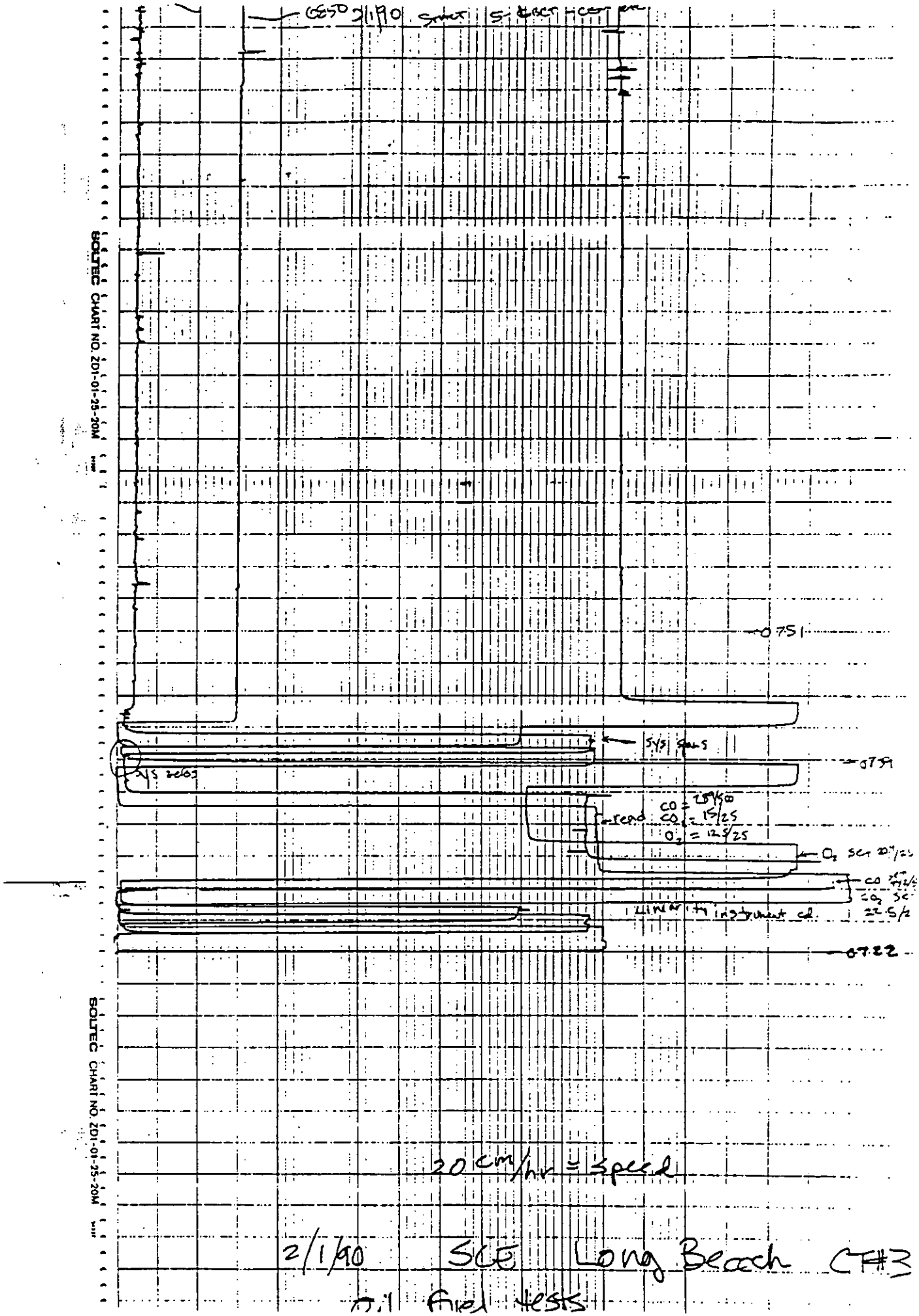


SYS Spans as found
1
2
3
4
5
6
NORTH 1230
1
2
3
4
5
6
EAST
1
2
3
4
5
6
WEST
1
2
3
4
5
POINT 6 1199
SOUTH PORT
STRATIFICATION
CO 289/500
CO2 15/25 as found instr. cal
1120 END
3-LSCT
SOLTEC CHART NO. ZD1-01-25-20M
SOLTEC

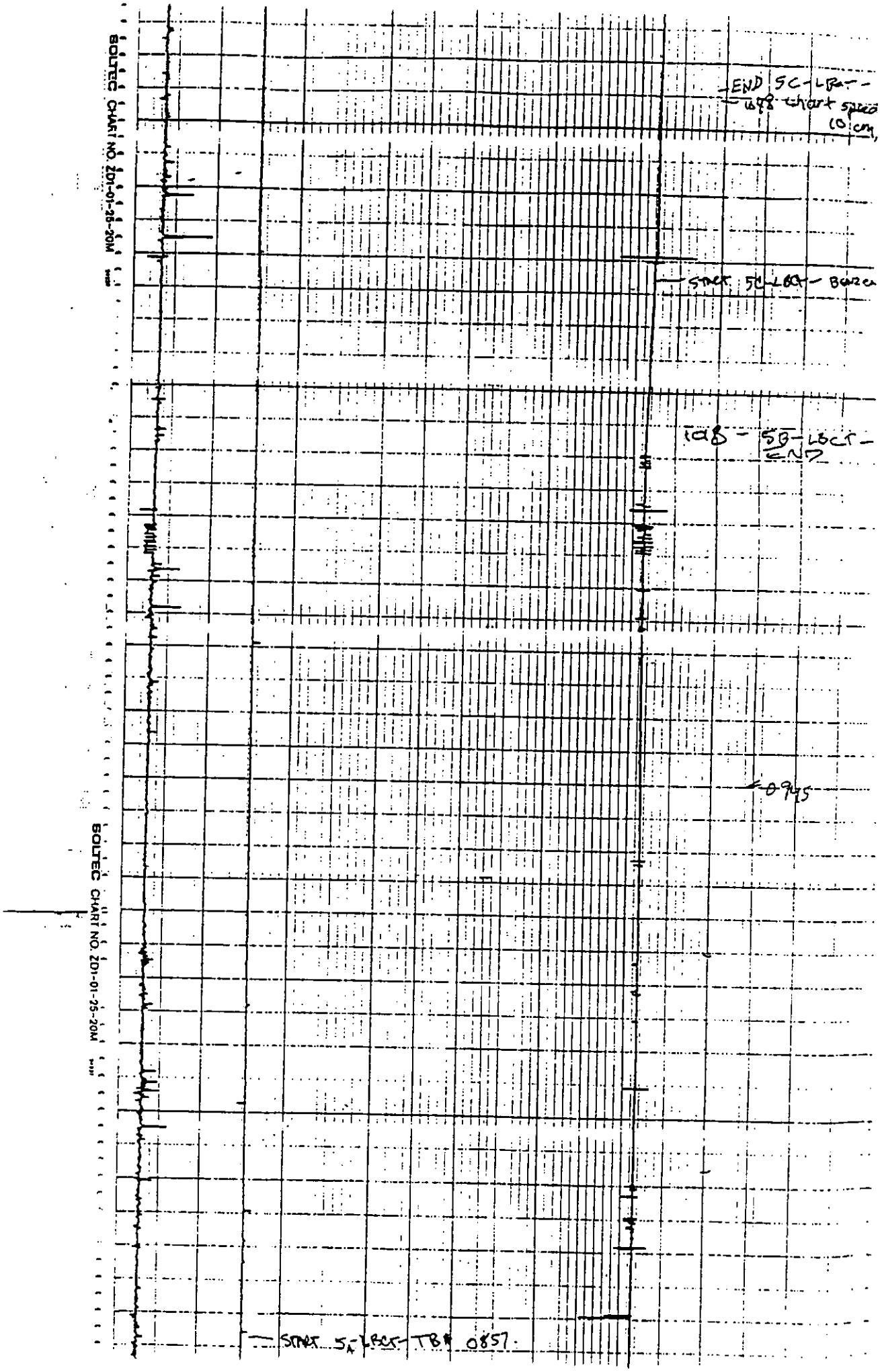


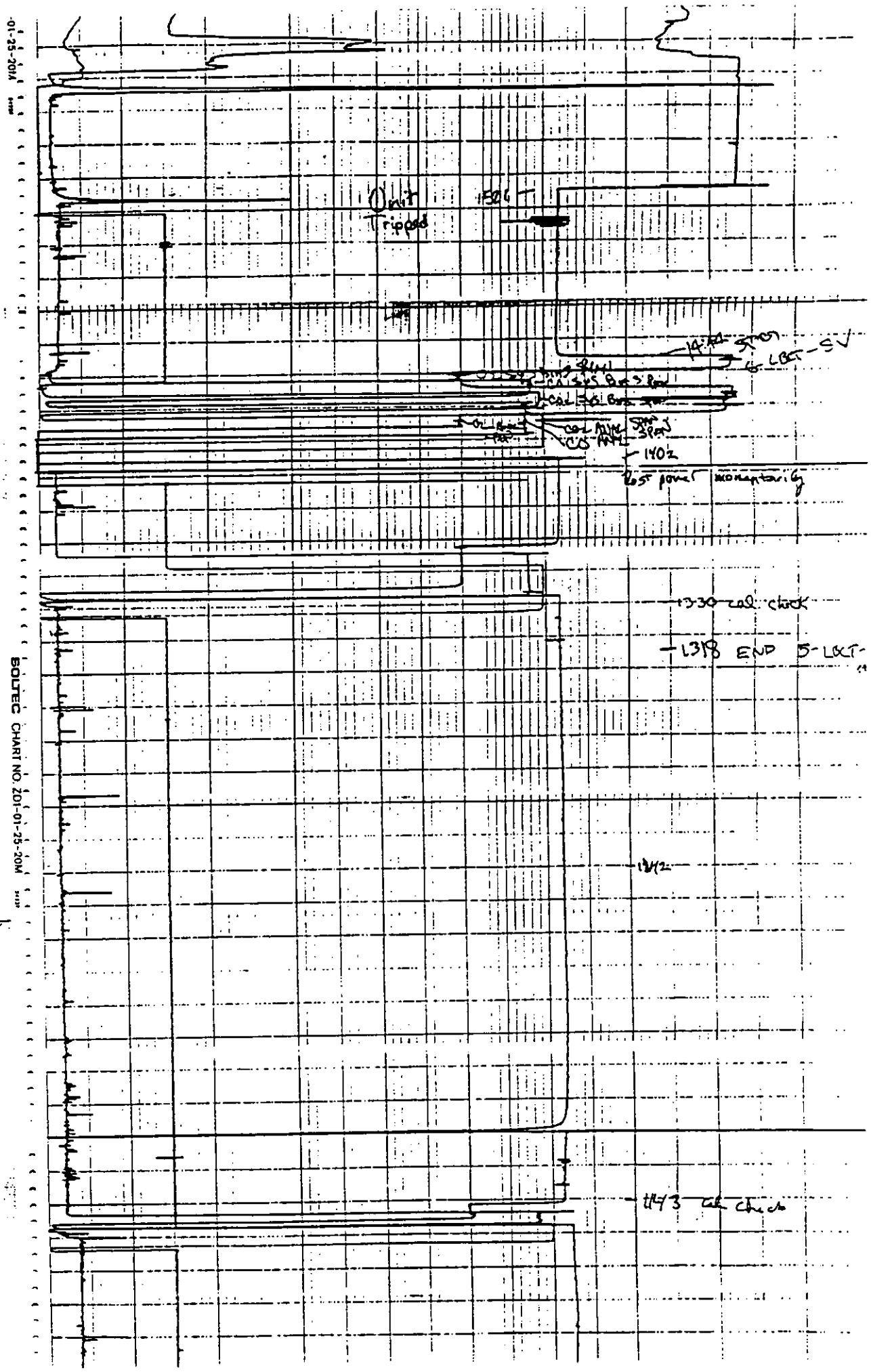
1/31/90 SCE Long Beach

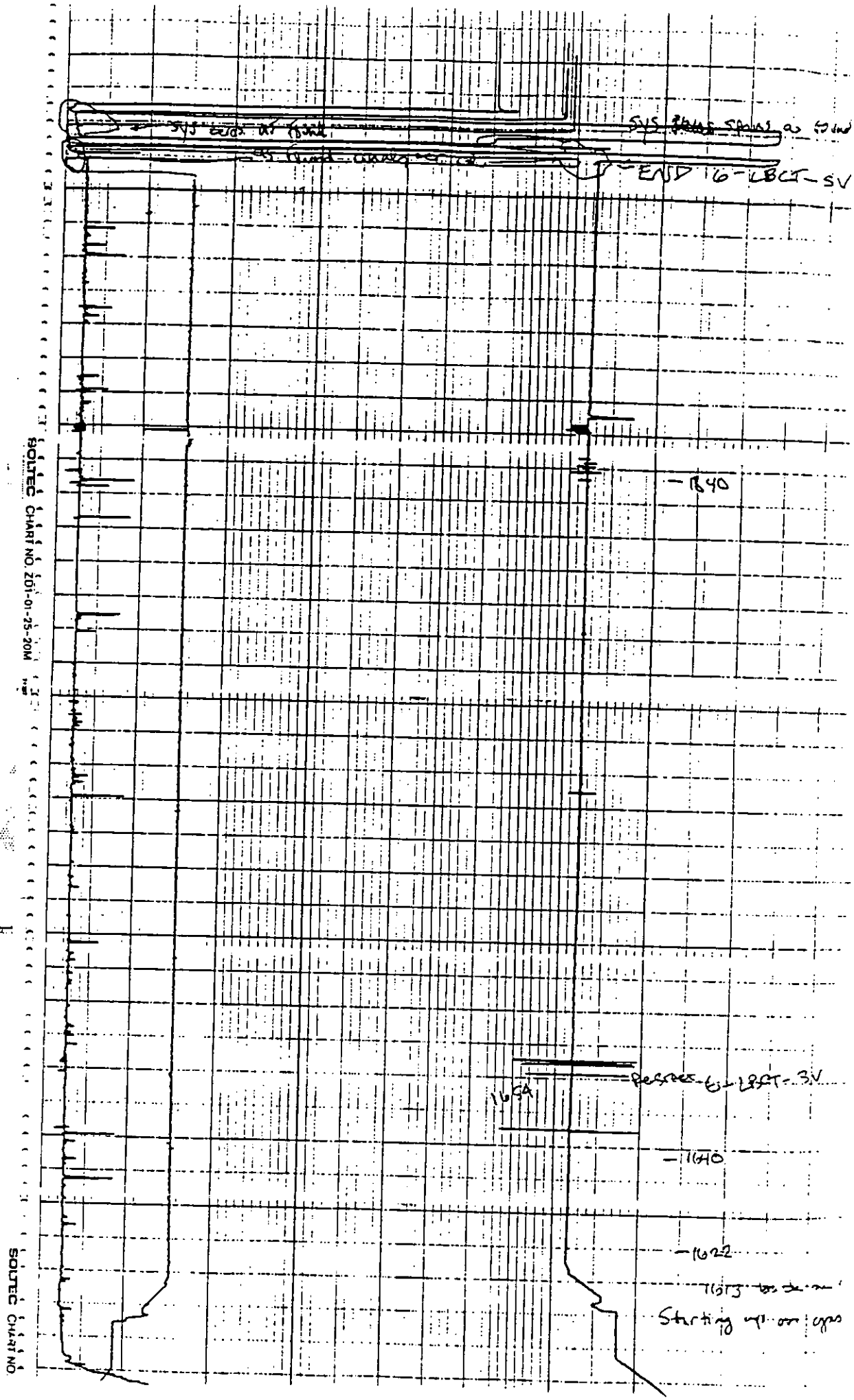
Combustion Turbine #3 Oil Fuel



0850 2/1/90 start
0751
sys spans
0759
sys zeros
read
CO = 289/500
CO2 = 15/25
O2 = 12.5/25
O2 set 20.4/25
CO set
CO2 set
22.5/2
Linearity instrument cal.
0722
20 cm/hr = speed
2/1/90 SCE Long Beach CT#3
Oil fired tests
SOLTEC CHART NO. ZD1-01-25-20M


SOLTEC CHART NO. ZD1-01-25-20M
END 5C-LBCT-
1098 chart speed
10 cm
START 5C-LBCT-
1098 - 5B-LBCT-
END
0945
SOLTEC CHART NO. ZD1-01-25-20M
START 5A-LBCT-TB# 0857


Unit Tripped
1506
6 LBCT-SV
1402
Lost power momentarily
1330 cal check
1318 END 5-LBCT-
1142
1143 cal check
SOLTEC CHART NO. ZD1-01-25-20M


SYS ~~[illegible]~~ SPOKE as found
END 16-LBCT-5V
1640
Respect 6-LBCT-3V
1654
1640
1622
1613
Starting up on gps
SOLTEC CHART NO. ZD1-01-25-20M
SOLTEC CHART NO.

APPENDIX F

CHAIN OF CUSTODY

P002017 ~~P002017~~

E∫A Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Samples: 53304/LBCT 3 / Analysis: Formaldehyde, Acetaldehyde, Benzaldehyde as per CARB 430

Sample No. (Project No. Test No.	Complete Description
✓ 1-LBCT-Form	Vials A and B - combine for analysis
✓ 2-LBCT-Form	Vials A and B - combine for analysis
✓ 3-LBCT-Form	Vials A and B - combine for analysis
✓ 4A-LBCT-Form	" "
✓ 4B-LBCT-Form	" "
✓ 4C-LBCT-Form	" "
✓ Field Spike	Vial B, 15 ml DNPH + 1 ml 7.4 µg/ml formaldehyde soln.
✓ Field Blank	A - For analysis
✓ Field Blank	B - Hold

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
[signature]	1000 2/1/90		

Samples shipped to: Radian
North Carolina

Samples shipped from ESA by: Fed-Ex Date 2/1/90
Carrier: Air Bill No.

Samples received by: Randy Harrington Date 2-5-90
Company: RADIAN

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

ESA DS-057

Lab # 37973
Truesdail

Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Samples: Project # 53304/LBCT

Sample No. (Project No. Test No.	Complete Description
1-LBCT-Benzene	Tedlar bag for benzene analysis/GC/PID ppb
2-LBCT-Benzene	"
3-LBCT-Benzene	"

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
[illegible]	1200 1/30/90		

Samples shipped to: Truesdail, Irvine, CA

Samples shipped from ESA by: _____ Date _____

Carrier: _____ Air Bill No. _____

Samples received by: Joe Barbitta Date 1/30/90

Company: Truesdail Labs.

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
5A/LBCT/BEN	10 liter TEDLAR BAG
5B/LBCT/BEN	"
5C/LBCT/BEN	"

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
Robert A. Zuber	13:45 2/2/90		

Samples shipped to: TRUESDAIL LABS
By Bob FINKEN

Samples shipped from ESA by: _____ Date _____

Carrier: _____ Air Bill No. _____

Samples received by: Becky Kirsch Date 2/2/90.

Company: Truesdail Laboratories INC

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

PAH by CARB 429

Samples:

Sample No. (Project No. Test No.	Complete Description (# bottles)
4-LBCT-SV	XAD-2 module, filter # 110-534,
	H_2O fraction (2) Organic fraction (2)
5-LBCT-SV	XAD-2 module, filter # 110-535,
	H_2O fraction (2) Organic fraction (1)
6-LBCT-SV	XAD-2 module, filter # 110-564
	H_2O fraction (1) Organic fraction (1)
LBCT-Field	blank XAD mod. filter # 110-481
	H_2O fraction (1) Organic fraction (1)
4-LBAX-SV	XAD-2 module, filter # 110-536
	H_2O fraction (2) Organic fraction (1)
5-LBAX-SV	XAD-2 module, filter # 110-531
	H_2O fraction (2) Organic fraction (1)

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
[illegible]	1300 2/11/90		

Samples shipped to: Zeron Environmental

Samples shipped from ESA by: Fed-Ex Date 2/12/90

Carrier: Air Bill No. 400-5584-6 (2 boxes) 400-5584-636

Samples received by: Date

Company:

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

Also: 6-LBAX-SV / XAD-2, filter # ~~110-531~~ 110-569
H_2O fraction (2), Organic (1)

LBAX-Field blank / XAD-2 filter # 110-531

ESA DS-057

Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Samples:

Sample No. (Project No. Test No.	Complete Description
4A-LBAX-fuel	Distillate Oil
4B-LBAX-fuel	
6A-LBCT-fuel	
6B-LBCT-fuel	

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
[illegible]	0800 2/9/90		

Samples shipped to: _____

Samples shipped from ESA by: Curtis & Tompkins Date 2/9/90

Carrier: [illegible] Air Bill No. _____

Samples received by: [illegible] Date _____

Company: Curt + Tompk

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

ESA DS-057

REAGENT CHAIN OF CUSTODY

Client: SCE / AB2588 / Long Beach CTIO Charge No.: 53304

Project Manager: Arlene / Sheila

REGENTS - Enter quantity and circle description

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

FILTERS - Quantity and Description

Glass Fiber 110mm 63mm 47mm 45mm 37mm → Toluene rinsed 110-734-737, 481, 564

Teflon 110mm

Hexane Rinsed

4 X ADrein modules w/ springs & sharpen

1 l acidic DNPH rec'd 1/26/90

100 ml formaldehyde soln 50000 X dilution

Weston bottles

10 ml pipette

5 ml pipette

1 ml pipette

ESA MSC-136

BOTTLES - Quantity

_____ 1000ml Nalgene

_____ 500ml Nalgene

_____ 250ml Nalgene

4 cases 500ml I-chem

_____ 1000ml Acid Washed

_____ 500ml Acid Washed

_____ 250ml Acid Washed

LAB SUPPLY CHECK LIST

2 Silica Gel

2 large Gloves (small and large)

6 teflon Wash Bottles

1 Foil

1 Baggies

✓ Sample Labels

✓ Pens

✓ Paper Towels

1 Scissors

1 Tweezers

✓ Probe Brushes

✓ 6 Teflon tape

Released By _____ Date 1/28/90

Received By _____ Date 1/29/90

Returned By _____ Date 2/7/90

+ 5 [illegible]

ESA MSC-136

Applied Utility Systems, Inc.

GAS TURBINE DATA ACQUISITION SHEET

LONG BEACH CT3

(Sheet 1 of 4)

Test #	1	2	3
A. General			
o Date	1/30/90	1/30/90	1/30/90
o Time of Test	0920	1030	1115
o Fuel	GAS	GAS	GAS
o DATA BY	M. ESCARCEGA		
B. Gaseous Species			
o Stack Excess O_2, %			
o NO_x, Raw (ppm)	—	—	—
o NO_x @ 15% O_2 (ppm)	—	—	—
o NO, Raw (ppm)	—	—	—
o NO @ 15% O_2 (ppm)	—	—	—
o CO, Raw (ppm)			
o CO @ 15% O_2 (ppm)			
o CO_2, Raw (%)			
o CO_2 @ 15% O_2 (%)			
C. Ambient Conditions			
o Barometric Pressure (psia)	29.91	29.87	29.87
o Ambient Temperature (dry bulb, °F)			
o Relative Humidity, %			

Applied Utility Systems, Inc.

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH CT 3

(Sheet 2 of 4)

Test #	1	2	3
D: Gas Turbine			
o Nominal Load	67	66	66
o Watthour Meter (sec) (time for 10 rev).	62.3	63.0	63.1
o MW = (4147.2)/time			
o Combustor Exit Temperature, °F	1730	1731	1732
o Gas Turbine Exit Temperature, °F	958	961	962
o Fuel Flow, MCFH	798	786	788
o Steam Injection Rate (Mlb/hr)	83	82	83
o I.P.	58	58	58
o H.P.	25	25	25
E. H.P. Boiler			
o Steam Flow (FR-401A) (A x 10^4 lb/hr)	212.1	215.0	214.4
o Feed Flow (FR-401B) (A x 10^4 lb/hr)	239	241.6	247.3
o Drum Level (LR-401) (in.)	22.6	22.6	22.5

A = meters recorded value

Applied Utility Systems, Inc.

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH CT 3

(Sheet 3 of 4)

Test #	1	2	3
o Drum Pressure (PIS-401B) (psi)	530	530	530
o Boiler Steam Level Pressure (PI-401A) (psi)	430	425	425
F. I.P. Boiler			
o Steam Flow (FR-402A) (A x 10^3 lb/hr)	51.3	51.2	51.1
o Feed Flow (FR-402B) (A x 10^3 lb/hr)	58.0	57.6	57.6
o Drum Level (LR-402) (in.)	15.1	16.2	16.5
o Drum Pressure (PIS-402) (psi)	235	235	235
G. L.P. Boiler			
o Steam Flow (FR-403A) (A x 10^3 lb/hr)	21.4	25.0	26.0
o Feed Flow (FR-403B) (A x 10^3 lb/hr)	26.3	23.8	22.0
o Drum Level (LR-403) (in.)	6.5	8.0	8.7
o Drum Pressure (PIS-403) (psi)	245	240	242

A = meters recorded value

Applied Utility Systems, Inc

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH CT 3

(Sheet 4 of 4)

Test #	1	2	3
H. Boiler Temperatures (TJR-1)			
1 o Boiler Gas Inlet, °F	919.3	925	926
2 o Boiler Gas Outlet, °F	353.6	353	352
3 o H.P. Economizer Outlet, °F	363	363	363
4 o H.P. Economizer Inlet, °F	246	247	249
5 o I.P. Economizer Outlet, °F	442	440	440
6 o Superheater Outlet, °F	728	730	731
I. Feed Water Pressures, (psi)			
o H.P. (405A)	460	460	
OUTSIDE o I.P.	200	200	
o L.P.	105	105	
J. Pressures			
o Furnace Inlet (PI-405D) (in. H_2O)	11.5	11.0	
o Furnace Outlet (PI-405E) (in. H_2O)	-1	-1	
OUTSIDE o H.P. Boiler (PI-401C) (psi)	490	490	
o I.P. Boiler (PI-402A) (psi)	210	210	
o L.P. Boiler (PI-403A) (psi)	85	85	

Applied Utility Systems, Inc.

GAS TURBINE DATA ACQUISITION SHEET

LONG BEACH CT 3

(Sheet 1 of 4)

Test #	4	4	4
A. General			
o Date	1/31/90	1/31/90	1/31/90
o Time of Test	1350	1500	1630
o Fuel	DISTILLATE	DISTILLATE	DISTILLATE
• DATA BY	M. ESCARCEGA & S. HAYTHORNWAITE		
B. Gaseous Species			
o Stack Excess O_2, %			
o NO_x, Raw (ppm)			
o NO_x @ 15% O_2 (ppm)			
o NO, Raw (ppm)			
o NO @ 15% O_2 (ppm)			
o CO, Raw (ppm)			
o CO @ 15% O_2 (ppm)			
o CO_2, Raw (%)			
o CO_2 @ 15% O_2 (%)			
C. Ambient Conditions			
o Barometric Pressure (psia)	29.95	29.95	
o Ambient Temperature (dry bulb, °F)			
o Relative Humidity, %			

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Applied Utility Systems, Inc.

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH CT 3

(Sheet 2 of 4)

Test #	4	4	4
D. Gas Turbine			
o Nominal Load	63	63	64
o Watthour Meter (sec) (time for 10 rev).	65.6	65.3	64.9
o MW = (4147.2)/time			
o Combustor Exit Temperature, °F	1724	1722	1721
o Gas Turbine Exit Temperature, °F	960	957	956
o Fuel Flow, ~~MCFH~~ GPM	105	105	110
o Steam Injection (TOTAL) Rate (Mlb/hr)	86	85	85
o I.P.	55	55	55
o H.P.	31	30	30
E. H.P. Boiler			
o Steam Flow (FR-401A) (A x 10^4 lb/hr)	204.0	206.7	206.8
o Feed Flow (FR-401B) (A x 10^4 lb/hr)	238.7	240.5	237.9
o Drum Level (LR-401) (in.)	23.4	23.5	23.5

A = meters recorded value

Applied Utility Systems, Inc.

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH CT 3

(Sheet 3 of 4)

Test #	4	4	4
o Drum Pressure (PIS-401B) (psi)	530	545	530
o Boiler Steam Level Pressure (PI-401A) (psi)	420	420	420
F. I.P. Boiler			
o Steam Flow (FR-402A) (A x 10^3 lb/hr)	48.3	48.5	48.3
o Feed Flow (FR-402B) (A x 10^3 lb/hr)	54.8	55.1	55.3
o Drum Level (LR-402) (in.)	16.5	16.5	16.6
o Drum Pressure (PIS-402) (psi)	235	235	235
G. L.P. Boiler			
o Steam Flow (FR-403A) (A x 10^3 lb/hr)	19.0	33.0	24.9
o Feed Flow (FR-403B) (A x 10^3 lb/hr)	23.3	30.2	25.6
o Drum Level (LR-403) (in.)	8.7	5.3	9.9
o Drum Pressure (PIS-403) (psi)	245	245	245

A = meters recorded value

Applied Utility Systems, Inc.

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH CT 3

(Sheet 4 of 4)

Test #	4	4	4
H. Boiler Temperatures (TJR-1)			
1 o Boiler Gas Inlet, °F	919	920	919
2 o Boiler Gas Outlet, °F	353	338	349
3 o H.P. Economizer Outlet, °F	365	365	365
4 o H.P. Economizer Inlet, °F	248	248	249
5 o I.P. Economizer Outlet, °F	436	435	436
6 o Superheater Outlet, °F	729	729	729
I. Feed Water Pressures, (psi)			
OUTSIDE o H.P. (405 A)	450	500	455
o I.P.	200	225	200
o L.P.	100	83	110
J. Pressures			
o Furnace Inlet (PI-405D) (in. H_2O)	11.0	11.0	11.0
DUTSIDE o Furnace Outlet (PI-405E) (in. H_2O)	-1.0	-1.0	-1.0
o H.P. Boiler (PI-401C) (psi)	480	485	480
o I.P. Boiler (PI-402A) (psi)	210	220	215
o L.P. Boiler (PI-403A) (psi)	75	60	70

Applied Utility Systems, Inc.

GAS TURBINE DATA ACQUISITION SHEET

LONG BEACH CT 3

(Sheet 1 of 4)

Test #	5	5	5
A. General			
o Date	2/1/90	2/1/90	2/1/90
o Time of Test	0900	1030	1230
o Fuel	DISTILLATE	→	→
• DATA BY	M. ESCARCEGA		
B. Gaseous Species			
o Stack Excess O_2, %			
o NO_x, Raw (ppm)	—	—	—
o NO_x @ 15% O_2 (ppm)	—	—	—
o NO, Raw (ppm)	—	—	—
o NO @ 15% O_2 (ppm)	—	—	—
o CO, Raw (ppm)			
o CO @ 15% O_2 (ppm)			
o CO_2, Raw (%)			
o CO_2 @ 15% O_2 (%)			
C. Ambient Conditions			
o Barometric Pressure (psia)			
o Ambient Temperature (dry bulb, °F)			
o Relative Humidity, %			

Applied Utility Systems, Inc

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH CT 3

(Sheet 2 of 4)

Test #	5	5	5
D. Gas Turbine			
o Nominal Load	65	64	64
o Watthour Meter (sec) (time for 10 rev).	63.6	64.6	64.1
o MW = (4147.2)/time			
o Combustor Exit Temperature, °F	1726	1725	1725
o Gas Turbine Exit Temperature, °F	956	958	957
o Fuel Flow, ~~MCFH~~ GPM	110	105	105
o Steam Injection (TOTAL) Rate (Mlb/hr)	83	83	83
o I.P.	51	51	51
o H.P.	32	32	32
E. H.P. Boiler			
o Steam Flow (FR-401A) (A x 10^4 lb/hr)	221.9	221.7	224.0
o Feed Flow (FR-401B) (A x 10^4 lb/hr)	241.0	240.6	240.1
o Drum Level (LR-401) (in.)	23.3	23.5	23.5

A = meters recorded value

Applied Utility Systems, Inc.

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH C.T 3

(Sheet 3 of 4)

Test #	5	5	5
o Drum Pressure (PIS-401B) (psi)	530	530	530
o Boiler Steam Level Pressure (PI-401A) (psi)	420	420	420
F. I.P. Boiler			
o Steam Flow (FR-402A) (A x 10^3 lb/hr)	50.5	50.7	50.7
o Feed Flow (FR-402B) (A x 10^3 lb/hr)	50.4	56.4	57.0
o Drum Level (LR-402) (in.)	16.6	16.7	16.4
o Drum Pressure (PIS-402) (psi)	235	235	235
G. L.P. Boiler			
o Steam Flow (FR-403A) (A x 10^3 lb/hr)	17.0	16.7	17.7
o Feed Flow (FR-403B) (A x 10^3 lb/hr)	18.6	21.0	26.5
o Drum Level (LR-403) (in.)	8.5	8.0	7.5
o Drum Pressure (PIS-403) (psi)	245	245	245

A = meters recorded value

Applied Utility Systems, Inc.

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH CT3

(Sheet 4 of 4)

Test #	5	5	5
H. Boiler Temperatures (TJR-1)			
1 o Boiler Gas Inlet, °F	916	918	919
2 o Boiler Gas Outlet, °F	355	355	352
3 o H.P. Economizer Outlet, °F	365	365	364
4 o H.P. Economizer Inlet, °F	249	249	249
5 o I.P. Economizer Outlet, °F	436	436	437
6 o Superheater Outlet, °F	735	735	735
I. Feed Water Pressures, (psi)			
o H.P.	450	450	450
OUTSIDE o I.P.	190	190	190
o L.P.	110	115	115
J. Pressures			
o Furnace Inlet (PI-405D) (in. H_2O)	11.0	11.5	11.0
OUTSIDE o Furnace Outlet (PI-405E) (in. H_2O)	-1.0	-1.0	-1.0
o H.P. Boiler (PI-401C) (psi)	485	485	485
o I.P. Boiler (PI-402A) (psi)	210	210	210
o L.P. Boiler (PI-403A) (psi)	90	100	100

GAS TURBINE DATA ACQUISITION SHEET

LONG BEACH CT 3

Test #	6	6	6	6		
A. General						
o Date	2/1/90	2/1/90	2/1/90	2/1/90		
o Time of Test	1500	1700	1830	1930		
o Fuel	DISTILLATE →					
o DATA By	M. ESCARCEGA					
B. Gaseous Species						
o Stack Excess O_2, %						
o NO_x, Raw (ppm)	—	—	—	—	—	—
o NO_x @ 15% O_2 (ppm)	—	—	—	—	—	—
o NO, Raw (ppm)	—	—	—	—	—	—
o NO @ 15% O_2 (ppm)	—	—	—	—	—	—
o CO, Raw (ppm)						
o CO @ 15% O_2 (ppm)						
o CO_2, Raw (%)						
o CO_2 @ 15% O_2 (%)						
C. Ambient Conditions						
o Barometric Pressure (psia)						
o Ambient Temperature (dry bulb, °F)						
o Relative Humidity, %						

NOTE: UNIT 3 TRIPPED ON FLAMEOUT @ 1521. TESTING STOPPED @ 1522. UNIT BACK ON @ 1551 ON GAS FUEL. UNIT BACK ON DISTILLATE @ 1613. TESTING RESUMED @ 1654.

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH CT 3

(Sheet 2 of 4)

Test #	6	6	6	6		
D. Gas Turbine						
o Nominal Load	64	64	65	65		
o Watthour Meter (sec) (time for 10 rev).	65.2	65.0	64.5	64.3		
o MW = (4147.2)/time						
o Combustor Exit Temperature, °F	1724	1725	1724	1724		
o Gas Turbine Exit Temperature, °F	958	957	956	955		
o Fuel Flow, ~~MCFH~~ GPM	105	105	105	105		
o Steam Injection (TOTAL) Rate (Mlb/hr)	83	83	83	83		
o I.P.	50	50	50	50		
o H.P.	33	33	33	33		
E. H.P. Boiler						
o Steam Flow (FR-401A) (A x 10^4 lb/hr)	226.5	217.0	218.3	221.1		
o Feed Flow (FR-401B) (A x 10^4 lb/hr)	239.1	232.9	240.1	238.8		
o Drum Level (LR-401) (in.)	23.5	24.8	24.8	24.9		

A = meters recorded value

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH CT 3

(Sheet 3 of 4)

Test #	6	6	6	6		
o Drum Pressure (PIS-401B) (psi)	530	530	530	530		
o Boiler Steam Level Pressure (PI-401A) (psi)	420	420	420	420		
F. I.P. Boiler						
o Steam Flow (FR-402A) (A x 10^3 lb/hr)	50.4	50.3	49.8	50.0		
o Feed Flow (FR-402B) (A x 10^3 lb/hr)	56.9	57.3	57.8	56.9		
o Drum Level (LR-402) (in.)	16.5	16.2	18.1	18.4		
o Drum Pressure (PIS-402) (psi)	235	235	235	235		
G. L.P. Boiler						
o Steam Flow (FR-403A) (A x 10^3 lb/hr)	19.6	12.9	16.9	18.5		
o Feed Flow (FR-403B) (A x 10^3 lb/hr)	22.1	23.8	26.8	25.2		
o Drum Level (LR-403) (in.)	7.0	9.1	7.5	4.9		
o Drum Pressure (PIS-403) (psi)	250	250	250	250		

A = meters recorded value

GAS TURBINE DATA ACQUISITION SHEET (CONTINUED)

LONG BEACH CT 3

(Sheet 4 of 4)

Test #	6	6	6	6		
H. Boiler Temperatures (TJR-1)						
1 o Boiler Gas Inlet, °F	919	913	914	914		
2 o Boiler Gas Outlet, °F	353	366	354	355		
3 o H.P. Economizer Outlet, °F	364	363	363	363		
4 o H.P. Economizer Inlet, °F	249	245	248	248		
5 o I.P. Economizer Outlet, °F	436	439	437	437		
6 o Superheater Outlet, °F	728	730	730	730		
I. Feed Water Pressures, (psi)						
o H.P.	450	460	460	460		
OUTSIDE o I.P.	190	190	190	190		
o L.P.	120	130	115	120		
J. Pressures						
o Furnace Inlet (PI-405D) (in. H_2O)	11.0	11.5	11.5	11.5		
OUTSIDE o Furnace Outlet (PI-405E) (in. H_2O)	-1.0	-1.0	-1.0	-1.0		
o H.P. Boiler (PI-401C) (psi)	485	495	495	495		
o I.P. Boiler (PI-402A) (psi)	210	210	210	21		
o L.P. Boiler (PI-403A) (psi)	95	120	95	95		