Section 1.6
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State of California
AIR RESOURCES BOARD

Reference 14

Evaluation Test on a Wood Waste Fired Incinerator at Pacific Oroville Power Inc.

Engineering Evaluation Branch
Monitoring and Laboratory Division

Test Report No. C-88-050

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I. SUMMARY

On May 20, 1988, the Air Resources Board (ARB) received a request from Kenneth W. Kizer of the Department of Health Services (DHS) to conduct emission testing of wood-fired combustion devices operated at facilities in Oroville, California. The purpose of these tests was to assist DHS identify sources of airborne polychlorinated dibenzodioxins (PCDD) and polychlorinated dibenzofurans (PCDF) by quantifying the amount, if any, of PCDD/PCDF emitted from these combustion devices.

In response to DHS's request, the ARB's Monitoring and Laboratory Division conducted an evaluation test of Pacific Oroville Power Inc. (POPI), during the period between June 14 to June 23, 1988.

The evaluation test at POPI consisted of two parts: Part I, evaluating the toxic air contaminants emitted while the facility burned fuels allowed by existing permits, and Part II evaluating the toxic air contaminants emissions while the facility burned a mixture of permitted fuel supplemented by urban wood waste in the ratio of 70% permitted fuel and 30% urban wood waste. The emission test to evaluate the mixed fuel was requested by the Butte County Air Pollution Control District.

The incinerator was charged with the permitted fuel during the first week of sampling; the blended fuel was incinerated during the second week of sampling.

During the first week daily average oxygen and carbon dioxide concentrations ranged from 6.8 percent (%) and 13.1%, respectively, to 8.9% and 11.2%. During the second week daily average oxygen and carbon dioxide concentrations ranged from 6.0% and 14.1%, respectively, to 6.3% and 13.8%.

Polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) were detected in all of the semi-volatile organic sampling trains. The PCDD mass emission rate, based on 2,3,7,8 tetra chlorinated dibenzodioxin (TCDD) toxic equivalence developed by DHS, ranged from 1.030 to 1.390 nanograms per second (ng/sec) for the permitted fuel burn and from 0.308 to 0.492 ng/sec for the blended fuel burn. The PCDF mass emission rate, based on the same weighting scheme, ranged from 9.48 to 83.11 ng/sec for the permitted fuel burn and from 4.22 to 10.73 ng/sec for the blended fuel burn.

II. UNIT DESCRIPTION AND OPERATION

Pacific Oroville Power Inc. operates two ZURN spreader stocker wood-fired boilers in parallel. The steam generated in the boilers is fed to a turbine for generating electricity. Nominally, each boiler/generator consumes 16 tons of wood waste fuel per hour producing 110,000 pounds of steam per hour and 11 megawatts of electricity. Each boiler produces 110,000 pounds of steam per hour during peak demand periods, 105,000 during partial peak periods and 100,000 during off peak and super off peak periods.

During the first week of emissions testing each boiler was operated at a steady steam production rate of 110,000 pounds per hour while burning permitted fuel. During the second week of emissions testing each boiler was operated at a steady steam production rate of 105,000 to 108,000 pounds per hour while burning a 70:30 mixture of permitted fuel and urban woodwaste.

Each boiler exhaust gas stream is passed through a dedicated ENELCO "three field" electrostatic precipitator (ESP) air pollution control device. After exiting each of the ESPs, the two parallel ESP exhaust gas streams are ducted together and emitted to atmosphere through a common stack.

Pacific Oroville Power Inc. provided the following information and operating techniques for each of the emission test periods.

1) Special production/performance criteria
   a) Grate temperatures
   b) Fuel Distribution on the grate
   c) Ash carry-over
   d) Increased NOx production
   e) Production capability
   f) Stability of control systems

2) The following equipment should be in service:
   a) Steam driven feedwater pump
   b) Low pressure feedwater heater
   c) Deaerating feedwater heater
   d) High pressure feedwater heater
   e) Two circulating water pumps
   f) Three cooling tower fans

3) For two hours before and two hours after emissions testing print out the following from the Bailey Net 90:

   a) Every half hour - Plant Overview (4A)

   b) The following trend reports at two hour intervals:

      1. Boiler 1 Furnace (1A)
      2. Boiler 2 Furnace (2A)
      3. Boiler 1 Fuel/air (1B)
      4. Boiler 2 Fuel/air (2B)
      5. Stack Sampling (3H)
      6. Boiler Steam Flow (10B)

   c) At the end of the test, trend log #1 stack monitor - PLES - Oroville.

4) An hour before, an hour after, and every 4 hours while urban wood is being burned (or at other intervals as required by the Safety Supervisor), collect a fuel sample, (approximately 500 grams)

from the return conveyor. Label the sample, noting time and date. Save these samples for inspection and/or analysis.

5) Tune the boiler for optimum combustion in compliance with environmental permits.

6) During tuning, record all readings of CO, CO2, and O2 from the Teledyne. Simultaneously record NOx reading from the Bailey Net 90. Use the data sheet provided by the I&C Technician.

7) During tuning record all air changes on the comment sheet provided by the I&C Technician.

8) When tuning is complete, operate the boilers in a stable fashion for as long as requested by the ARB through the Safety Supervisor.

9) Collect required data in a complete and comprehensive package for the Safety Supervisor.

III. SAMPLING LOCATION AND SAMPLING METHODS

The sampling locations and sampling methods incorporated are delineated in the Protocol in Appendix I of the report.

IV. TEST RESULTS AND DISCUSSION

Emission testing was conducted during a two week period from June 14 to June 23, 1988. During the first week of source testing, the facility burned permitted fuel only. During the second week of source testing, the facility burned a mixture of permitted fuel and urban wood waste at a ratio of approximately 70:30. The test results for the two different fuels are discussed separately in this report.

A. PERMITTED FUEL BURN

1. Facility Operation Conditions

The boilers were operated at an average woodwaste equivalent burn rate of 110,000 pounds of steam per hour each. Oxygen and carbon dioxide concentrations, Table 2, indicated the boilers were operated at steady state conditions during the test.

Stack conditions for each test are shown in Table 1. Further test conditions can be found in Appendix II. These data, with appropriate gaseous pollutant data, were used to calculate pollutant concentrations and mass emission rates.

2. Gaseous Emissions

The average gaseous emission concentrations which bracket each test run are shown in Table 2. The corresponding mass emission rates of criteria gaseous pollutants are shown in Table 3.

Oxygen and carbon dioxide concentrations were steady at 6.8 and 13.0 percent respectively during the PCDD/PCDF testing on June 14 and 15. Oxygen concentrations ranged from 7.8 to 8.9 percent and carbon dioxide concentrations ranged from 12.2 to 11.2 percent respectively during the particulate matter testing on June 16.

Oxides of nitrogen concentrations measured during the test period and reported as NO_2 , corrected to 12 percent CO_2, ranged from 60 to 80 PPM. Similarly, sulfur dioxide concentrations, corrected to 12 percent CO_2, were less than one PPM.

Carbon monoxide concentrations, uncorrected, ranged from approximately 1300 to 1600 PPM. On numerous occasions during the test periods, the carbon monoxide stripchart pen reached the full scale maximum of 2500 PPM. Carbon monoxide readings above 2500 PPM could not be quantified. Conversely, when the pen was stuck it could be conjectured that the carbon monoxide readings might have been lower than the reported 1300 to 1600 PPM. The pen was stuck, noncontinuously, in the maximum position for 7% of the time on June 14, 13% on June 15 and 19% on June 16.

Total hydrocarbon concentrations, corrected to 12 percent CO_2, ranged from 37 to 48 PPM.

3. Emissions of Total Particulate Matter, Trace Metals and Volatile Organic Compounds

Total Particulate Matter

Total particulate matter concentrations are shown in Table 2. Table 4 shows the ARB Method 5 total particulate matter concentrations and mass emission rates separated into FRONT half/BACK half fractions.

As shown in Table 2, the concentration of total particulate matter ranged from 0.010 to 0.011 grains per dry standard cubic foot (gr/DSCF). These data include the probe rinse, filter catch, after filter rinse and impinger catch.

Trace Metals

The concentrations and corresponding mass emission rates for arsenic, cadmium, chromium, iron, manganese, nickel and lead are shown in Tables 5 and 6. The trace metal information was determined by analyzing the Method 5 sampling train filters using atomic absorption spectroscopy techniques. The tabulated laboratory analytical results are shown in Appendix IV.

As shown in Tables 5 and 6, the concentrations of trace metals ranged from 0.1 micrograms per dry standard cubic meter (ug/dscm) for arsenic to 113.1 ug/dscm for iron and the mass emission rates ranged from 5.1 micrograms per second (ug/sec) for arsenic to 3973 ug/sec for iron.

Volatile Organic Compounds (Bag Samples)

The concentrations and mass emission rates of volatile halogenated and aromatic organic compounds are shown in Tables 7 and 8. The tabulated laboratory data are contained in Appendix IV.

The results do not represent a complete analysis of all possible halogenated and aromatic volatile organic products. Organic compounds were selected for analysis based upon probability of presence and on ability of the laboratory to analyze for the selected compounds.

Only two compounds, benzene and toluene, were found to have concentrations significantly greater than the background concentrations for the ten compounds specified in the bag sample analyses.

As shown in Tables 7 and 8, concentrations ranged from 75 parts per billion (PPB) for toluene to 1200 PPB for benzene and the mass emissions ranged from 11 milligrams per second (mg/sec) for toluene to 143 mg/sec for benzene.

4. Dioxins and Furans

The Department of Health Services Hazardous Materials Laboratory (HML) analyzed dioxin/furan samples DT-1S, DT-2S and DT-3S. DT-4S was analyzed by ENSECO Cal Labs.

PCDDs and PCDFs were detected in all of the semi-volatile sampling trains. The laboratory analytical data are reported in Appendix V. The quantities of tetra- through octa chlorinated PCDD and PCDF homologues are also summarized in Appendix V. The calculated concentrations, corrected to 12 percent CO_2, and mass emission rates of tetra through octa- chlorinated PCDD and PCDF homologues are summarized in Tables 9 and 10. The corresponding toxic equivalent concentrations and mass emission rates using the DHS Weighting Scheme are summarized in Tables 11 and 12.

As shown in Table 9, PCDD concentrations ranged from 0.871 to 2.819 nanograms per dry standard cubic meter (ng/dscm) and the PCDF concentrations ranged from 2.668 to 16.86 ng/dscm.

As shown in Table 10, PCDD mass emission rates ranged from 35.15 to 112.0 nanograms per second (ng/sec) and the PCDF mass emission rates ranged from 104.1 to 693.6 ng/sec.

As shown in Table 11, the 2,3,7,8 TCDD Toxic Equivalent Concentrations ranged from 0.026 to 0.034 ng/dscm for PCDD and from 0.243 to 2.021 ng/dscm for PCDF.

As shown in Table 12, the 2,3,7,8, TCDD Toxic Equivalent emission rates ranged from 1.030 to 1.390 ng/sec for PCDD and the 2,3,7,8, TCDD Toxic Equivalent emission rates ranged from 9.48 to 83.11 ng/sec for PCDF.

5. Polynuclear Aromatic Hydrocarbons

Polynuclear aromatic hydrocarbons (PAHs) were not determined when the facility was burning the permitted fuel.

6. Chlorobenzene, Chlorophenols and PCBs

Chlorobenzenes, Chlorophenols and PCBs were not sampled for during the first week of testing.

7. Electrostatic Precipitator Waste Dust Samples

As shown in Table 13, PCDD concentrations in the ESP waste ash ranged from 24 picograms per gram (pg/g) to 264 pg/g and the PCDF concentrations ranged from 12 pg/g to 151 pg/g. The PCDD/PCDF laboratory analytical data for waste dust samples are presented in Appendix VIII.

TABLE 1

STACK CONDITIONS FOR INCINERATOR
AT PACIFIC OROVILLE POWER INC.

PERMITTED FUEL

DATE	RUN NO.	TIME	STACK GAS VELOCITY (FT/SEC)	STACK GAS FLOW RATE (DSCFM)	MOISTURE CONTENT (% BY VOL.)	STACK GAS TEMPERATURE (DEG. F)
6-14-88	DT-1S	1000-1700	65.1	76289	20.1	365
6-14-88	DT-2S	1100-1700	67.1	78916	20.1	363
6-15-88	DT-3S	0850-1600	69.2	80435	20.1	373
6-15-88	DT-4S	0850-1600	67.1	78078	20.1	371
6-16-88	PT-1S	0810-0920	62.1	74362	20.0	350
6-16-88	PT-2S	0950-1055	65.7	77919	20.3	355
6-16-88	PT-3S	1255-1400	68.0	79715	19.9	368

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TABLE 2

AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE, CARBON MONOXIDE, OXIDES OF NITROGEN, SULFUR DIOXIDE, TOTAL HYDROCARBONS AND PARTICULATE MATTER IN THE STACK GAS

DATE	RUN NO.	TIME	a/ PM	b/ O2	b/ CO2	ab/ CO	a/ NOX	a/ SO2	ac/ HC
			GR/DSCF	%	%	PPMV	PPMV	PPMV	PPMV
6-14-88	DT-1S	1000-1700	-	6.8	13.0	1338	69	<1	37
6-14-88	DT-2S	1100-1700	-	6.8	13.0	1338	69	<1	37
6-15-88	DT-3S	0850-1600	-	6.8	13.1	1466	78	<1	41
6-15-88	DT-4S	0850-1600	-	6.8	13.1	1466	78	<1	41
6-16-88	PT-1S	0810-0920	0.011	7.8	12.2	1475	59	<1	44
6-16-88	PT-2S	0950-1055	0.010	8.7	11.5	1461	63	<1	47
6-16-88	PT-3S	1255-1400	0.011	8.9	11.2	1446	64	<1	48

a/ PM,CO,NOX,SO2 AND HC data corrected to 12% CO2.

b/ O2,CO2 and CO values were used to determine the molecular weight of the stack gas and mass emission rates.

c/ HC data reported as propane.

Symbol (<) indicates below detectable limit.

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TABLE 3

DAILY AVERAGE
CRITERIA POLLUTANT EMISSIONS, LBS/HR

DATE	CO	NOx 1/	THC 2/	SO2
6-14-88	492	42	21	< 0.77
6-15-88	563	48	24	< 0.79
6-16-88	480	33	24	< 0.77

1/ reported as NO2
2/ reported as propane

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TABLE 4

CONCENTRATIONS AND MASS EMISSION
RATES OF PARTICULATE MATTER _1/

		CONCENTRATIONS (GR/DSCF)			MASS EMISSIONS (LB/HR)		
DATE	RUN NO.	FRONT	BACK	TOTAL	FRONT	BACK	TOTAL
6-16-88	PT-1S	0.005	0.006	0.011	3.079	3.912	6.991
6-16-88	PT-2S	0.004	0.005	0.010	2.884	3.650	6.534
6-16-88	PT-3S	0.006	0.005	0.010	3.878	3.192	7.070

_1/ FRONT indicates the amount of particulate matter found in the Method 5 probe rinse and filter catch. BACK indicates the amount of particulate matter found in the after-filter sample recovery.

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TABLE 5

TRACE METAL CONCENTRATIONS
AT 12 PERCENT CO2, ug/dscm

PERMITTED FUEL

SAMPLE ID	PT-1S	PT-2S	PT-3S
As	0.2	0.1	0.2
Cd	< 0.4	< 0.5	< 0.5
Cr	6.3	5.5	5.6
Fe	78.5	103.0	113.1
Mn	38.0	51.6	57.9
Ni	< 3.3	< 3.4	< 3.5
Pb	7.8	5.7	8.3

(<) Below limit of detection.

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TABLE 6

TRACE METAL MASS EMISSION RATES, ug/sec

PERMITTED FUEL

SAMPLE I	PT-1S	PT-2S	PT-3S
As	5.7	5.1	6.3
Cd	< 15.9	< 16.1	< 16.6
Cr	223.9	195.5	195.8
Fe	2802.2	3628.4	3972.8
Mn	1355.1	1819.3	2031.6
Ni	< 119.3	< 120.6	< 124.6
Pb	279.2	200.7	291.8

(<) Below limit of detection.

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TABLE 7

CONCENTRATIONS OF HALOGENATED AND AROMATIC
VOLATILE ORGANIC COMPOUNDS
(PPB, CORRECTED TO 12% CO2)

PERMITTED FUEL

SAMPLE ID	BS-1	BS-2	BS-3
DATE	6-15-88	6-15-88	6-15-88
TIME	0900	1110	1415
1. benzene	2.5E+02	8.7E+02	1.1E+03
2. toluene	< 9.2E-01	6.9E+01	8.9E+01
3. vinyl chloride	< 9.1E-01	< 9.1E-01	< 9.1E-01
4. freon 11	< 8.8E-01	< 8.8E-01	< 8.8E-01
5. chloroform	< 9.2E-01	< 9.2E-01	< 9.2E-01
6. 1,1,1-trichloroethane	< 9.0E-01	< 9.0E-01	< 9.0E-01
7. carbon tetrachloride	< 9.6E-01	< 9.6E-01	< 9.6E-01
8. 1,2-dichloroethane	< 1.8E+01	< 1.8E+01	< 1.8E+01
9. trichloroethene	< 9.2E-01	< 9.2E-01	< 9.2E-01
10. tetrachloroethene	< 9.2E-01	< 9.2E-01	< 9.2E-01
11. 1,2-dibromoethane	< 9.2E-01	< 9.2E-01	< 9.2E-01

(<) Less than reporting limit.

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TABLE 8

MASS EMISSION RATES OF HALOGENATED AND AROMATIC ORGANIC COMPOUNDS (mg/sec)

PERMITTED FUEL

SAMPLE ID	BS-1	BS-2	BS-3
DATE	6-15-88	6-15-88	6-15-88
TIME	0900	1110	1415
1. benzene	32.78	115.32	143.24
2. toluene	< 0.14	10.74	13.89
3. vinyl chloride	< 0.10	< 0.10	< 0.10
4. freon 11	< 0.20	< 0.20	< 0.20
5. chloroform	< 0.19	< 0.19	< 0.19
6. 1,1,1-trichloroethane	< 0.20	< 0.20	< 0.20
7. carbon tetrachloride	< 0.25	< 0.25	< 0.25
8. 1,2-dichloroethane	< 3.08	< 3.08	< 3.08
9. trichloroethene	< 0.21	< 0.21	< 0.21
10. tetrachloroethene	< 0.26	< 0.26	< 0.26
11. 1,2-dibromoethane	< 0.29	< 0.29	< 0.29

(<) Less than reporting limit.

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TABLE 9

PCDD/PCDF CONCENTRATIONS IN STACK GAS
(ng/dscm corrected to 12% CO2)

RUN #	DT-1S	DT-2S	DT-3S	DT-4S
DIOXINS				
2,3,7,8-TCDD	(0.017	(0.017	(0.016	(0.004
Total TCDD	NA	NA	NA	(0.004
1,2,3,7,8-PeCDD	(0.010	(0.005	(0.008	0.009
Total PeCDD	0.204	0.380	0.974	0.308
1,2,3,4,7,8-HxCDD	(0.012	(0.005	0.021	0.014
1,2,3,6,7,8-HxCDD	0.019	(0.007	0.016	0.023
1,2,3,7,8,9-HxCDD	(0.009	(0.009	0.110	0.018
Total HxCDD	0.116	0.081	0.406	0.454
1,2,3,4,6,7,8-HpCDD	0.095	0.083	0.167	0.454
Total HpCDD	0.175	0.238	0.471	1.053
Total OCDD	0.425	0.173	0.357	1.004
Total PCDD	0.920 *	0.871 *	2.208 *	2.819 *
FURANS				
2,3,7,8-TCDF	0.170	0.414	1.201	0.026
Total TCDF	1.054	1.967	4.546	0.599
1,2,3,7,8-PeCDF	0.014	0.062	0.244	0.089
2,3,4,7,8-PeCDF	0.051	0.135	0.487	0.123
Total PeCDF	1.037	1.915	5.170	1.474
1,2,3,4,7,8-HxCDF	0.107	0.242	0.974	0.107
1,2,3,6,7,8-HxCDF	0.056	0.143	0.471	0.178
2,3,4,6,7,8-HxCDF	0.041	0.107	0.601	0.194
1,2,3,7,8,9-HxCDF	(0.003	(0.002	(0.006	(0.013
Total HxCDF	0.493	1.104	5.033	1.426
1,2,3,4,6,7,8-HpCDF	0.068	0.164	0.909	0.389
1,2,3,4,7,8,9-HpCDF	(0.002	0.005	(0.002	(0.009
Total HpCDF	0.068	0.190	1.072	0.486
Total OCDF	0.015	0.016	0.044	0.050
Total PCDF	2.668	5.191	16.86 *	4.035

NOTES
dscm - dry standard cubic meter at 68 F and one atmosphere
(indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit
NA - Not applicable

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TABLE 10

PCDD/PCDF MASS EMISSION RATES
(ng/sec)

RUN #	DT-1S	DT-2S	DT-3S	DT-4S
DIOXINS				
2,3,7,8-TCDD	(0.663	(0.696	(0.668	(0.16
Total TCDD	NA	NA	NA	(0.16
1,2,3,7,8-PeCDD	(0.398	(0.209	(0.334	0.37
Total PeCDD	7.96	15.31	40.06	12.23
1,2,3,4,7,8-HxCDD	(0.464	(0.209	0.868	0.54
1,2,3,6,7,8-HxCDD	0.730	(0.278	0.668	0.90
1,2,3,7,8,9-HxCDD	(0.332	(0.348	4.541	0.71
Total HxCDD	4.51	3.272	16.69	18.02
1,2,3,4,6,7,8-HpCDD	3.71	3.341	6.878	18.02
Total HpCDD	6.83	9.606	19.36	41.84
Total OCDD	16.58	6.96	14.69	39.91
Total PCDD	35.88 *	35.15 *	90.81 *	112.0 *
FURANS				
2,3,7,8-TCDF	6.633	16.71	49.41	1.03
Total TCDF	41.12	79.35	187.0	23.82
1,2,3,7,8-PeCDF	0.53	2.51	10.02	3.54
2,3,4,7,8-PeCDF	1.99	5.43	20.03	4.89
Total PeCDF	40.46	77.27	253.7	58.58
1,2,3,4,7,8-HxCDF	4.18	9.75	40.06	4.25
1,2,3,6,7,8-HxCDF	2.19	5.78	19.36	7.08
2,3,4,6,7,8-HxCDF	1.59	4.32	24.71	7.72
1,2,3,7,8,9-HxCDF	(0.13	(0.07	(0.27	(0.53
Total HxCDF	19.24	44.55	207.0	56.64
1,2,3,4,6,7,8-HpCDF	2.65	6.61	37.39	15.45
1,2,3,4,7,8,9-HpCDF	(0.07	0.21	(0.07	(0.37
Total HpCDF	2.65	7.66	44.07	19.31
Total OCDF	0.60	0.63	1.80	2.00
Total PCDF	104.1	209.5	693.6 *	160.3

NOTES
(indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit
NA - Not applicable

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TABLE 11

TOXIC EQUIVALENT CONCENTRATION USING CA DOHS WEIGHTING SCHEME
(corrected to 12% CO2)

RUN #	Toxic Equivalence Factor	DT-1S	DT-2S	DT-3S	DT-4S
		Toxic equivalent concentration (ng/dscm)			
DIOXINS					
2,3,7,8-TCDD	1.00	(0.017	(0.017	(0.016	(0.004
1,2,3,7,8-PeCDD	1.00	(0.010	(0.005	(0.008	0.009
1,2,3,4,7,8-HxCDD	0.03	(0.000	(0.0002	0.001	0.0004
1,2,3,6,7,8-HxCDD	0.03	0.001	(0.0002	0.0005	0.001
1,2,3,7,8,9-HxCDD	0.03	(0.0003	(0.0003	0.003	0.001
1,2,3,4,6,7,8-HpCD	0.03	0.003	0.002	0.005	0.014
Total PCDD		0.031 *	0.026 *	0.034 *	0.029
FURANS					
2,3,7,8-TCDF	1.00	0.170	0.414	1.201	0.026
1,2,3,7,8-PeCDF	1.00	0.014	0.062	0.244	0.089
2,3,4,7,8-PeCDF	1.00	0.051	0.135	0.487	0.123
1,2,3,4,7,8-HxCDF	0.03	0.003	0.007	0.029	0.003
1,2,3,6,7,8-HxCDF	0.03	0.002	0.004	0.014	0.005
2,3,4,6,7,8-HxCDF	0.03	0.001	0.003	0.018	0.006
1,2,3,7,8,9-HxCDF	0.03	(0.0001	(0.000	(0.0002	(0.0004
1,2,3,4,6,7,8-HpCD	0.03	0.002	0.005	0.027	0.012
1,2,3,4,7,8,9-HpCD	0.03	(0.0001	0.0002	(0.0000	(0.0003
Total PCDF		0.243 *	0.631 *	2.021 *	0.265
Total Toxic Equivalent (2,3,7,8-TCDD Equivalents)		0.274 *	0.656 *	2.055 *	0.293

NOTES
dscm - dry standard cubic meter at 68 F and one atmosphere
(indicates below limit of detection (MDL)
* - Total includes MDLs for isomers below the detection limit D-88-050

TABLE 12

TOXIC EQUIVALENT EMISSION RATES USING CA DOHS WEIGHTING SCHEME

RUN #		DT-1S	DT-2S	DT-3S	DT-4S
	Toxic Equivalence Factor	Toxic equivalent emission rate (ng/sec)			
DIOXINS					
2,3,7,8-TCDD	1.00	< 0.663	<0.696	<0.668	<0.161
1,2,3,7,8-PeCDD	1.00	< 0.398	<0.209	<0.334	0.367
1,2,3,4,7,8-HxCDD	0.03	< 0.014	<0.006	0.026	0.016
1,2,3,6,7,8-HxCDD	0.03	0.022	<0.008	0.020	0.027
1,2,3,7,8,9-HxCDD	0.03	< 0.010	<0.010	0.136	0.021
1,2,3,4,6,7,8-HpCDD	0.03	0.111	0.100	0.206	0.541
Total PCDD		1.218 *	1.030 *	1.390 *	1.133 *
FURANS					
2,3,7,8-TCDF	1.00	6.633	16.71	49.41	1.03
1,2,3,7,8-PeCDF	1.00	0.531	2.506	10.02	3.54
2,3,4,7,8-PeCDF	1.00	1.990	5.430	20.03	4.89
1,2,3,4,7,8-HxCDF	0.03	0.125	0.292	1.202	0.127
1,2,3,6,7,8-HxCDF	0.03	0.066	0.173	0.581	0.212
2,3,4,6,7,8-HxCDF	0.03	0.048	0.129	0.741	0.232
1,2,3,7,8,9-HxCDF	0.03	< 0.004	<0.002	<0.008	<0.016
1,2,3,4,6,7,8-HpCDF	0.03	0.080	0.198	1.122	0.463
1,2,3,4,7,8,9-HpCDF	0.03	< 0.002	0.006	<0.002	<0.011
Total PCDF		9.48 *	25.44 *	83.11 *	10.52 *
Total Toxic Equivalent (2,3,7,8-TCDD Equivalents)		10.70 *	26.47	84.50	11.66 *

NOTES

< indicates below limit of detection (MDL)

* - Total includes MDLs for isomers below the detection limit

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TABLE 13

TOTAL PCDD AND PCDF IN ESP ASH SAMPLES
PICOGRAMS PER GRAM (pg/g)

SAMPLE ID	ESP-1-3	ESP-2-4	ESP-1-9	ESP-2-10	ESP-1-15	ESP-2-16
DATE	6-14-88	6-14-88	6-15-88	6-15-88	6-16-88	6-16-88
TIME	1700	1700	1600	1600	1200	1200
DIOXINS						
2,3,7,8-TCDD	(0.98	2.10	(0.97	2.10	2.40	(2.00
Total TCDD	(0.98	67.00	(0.97	17.00	31.00	12.00
1,2,3,7,8-PeCDD	(1.70	6.20	(0.88	(1.80	(1.10	(0.80
Total PeCDD	(1.70	65.00	(0.88	12.00	12.00	5.60
1,2,3,4,7,8-HxCDD	(1.20	5.20	(1.20	(3.80	(1.60	(1.80
1,2,3,6,7,8-HxCDD	(1.20	5.00	(1.20	(3.80	(1.60	(1.80
1,2,3,7,8,9-HxCDD	(1.20	8.60	(1.20	(2.20	(1.60	(1.80
Total HxCDD	3.80	67.00	3.00	23.00	6.50	5.50
1,2,3,4,6,7,8-HpCDD	5.10	14.00	(3.60	14.00	6.20	9.10
Total HpCDD	5.50	24.00	(3.60	33.00	13.00	16.00
Total OCDD	23.00	41.00	16.00	51.00	29.00	36.00
Total PCDD	38.98 *	264.0	24.45 *	136.00	91.50	75.10
FURANS						
2,3,7,8-TCDF	2.00	4.50	1.00	9.30	3.20	2.10
Total TCDF	19.00	51.00	6.60	110.00	38.00	30.00
1,2,3,7,8-PeCDF	(1.10	1.20	(0.32	(2.00	(1.10	(1.20
2,3,4,7,8-PeCDF	(1.10	1.20	(0.32	(3.00	(1.50	(1.20
Total PeCDF	(1.10	80.00	(0.32	86.00	17.00	(1.20
1,2,3,4,7,8-HxCDF	(1.00	0.74	(0.83	(1.80	(1.20	(1.10
1,2,3,6,7,8-HxCDF	(1.00	0.78	(0.83	(1.80	(1.20	(1.10
2,3,4,6,7,8-HxCDF	(1.00	0.78	(0.83	(1.70	(1.20	(1.10
1,2,3,7,8,9-HxCDF	(1.00	(0.87	(0.83	(0.71	(1.20	(1.10
Total HxCDF	(1.00	7.50	(0.83	12.00	(1.20	(1.10
1,2,3,4,6,7,8-HpCDF	(1.50	(1.60	(2.60	(1.50	(2.60	(2.40
1,2,3,4,7,8,9-HpCDF	(1.50	(1.60	(2.60	(1.50	(2.60	(2.40
Total HpCDF	(1.50	2.90	(2.60	(1.50	2.40	(2.40
Total OCDF	(2.80	(2.60	(2.10	1.70	(4.10	(7.80
Total PCDF	26.40 *	85.00 *	12.45 *	151.20 *	84.70 *	42.60 *

NOTES

(indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit

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B. BLENDED FUEL BURN

1. Facility Operation Cond

The boilers were operated at an ave
of 105,000 to 108,000 pounds of steam pe
testing consisted of a mixture of permi
ratio of approximately 70:30. Oxygen an
Table 15, indicated the boilers were ope
during the test.

Stack conditions for each test are shown in Table 14. Further test conditions can be found in Appendix II. These data, with appropriate gaseous pollutant data, were used to calculate pollutant concentrations and mass emission rates.

2. Gaseous Emissions

The average gaseous emission concentrations which bracket each test run are shown in Table 15. The corresponding mass emission rates of criteria gaseous pollutants are shown in Table 16.

Oxygen concentrations ranged from 6.0 to 6.3 percent and carbon dioxide concentrations ranged from 14.1 to 13.8 percent respectively during the period from June 20 through June 23, 1988.

Oxides of nitrogen concentrations, reported as NO_2 and corrected to 12 percent CO_2 were steady at 70 PPMV. Sulfur dioxide concentrations, corrected to 12 percent CO_2, were less than one PPM.

Carbon monoxide concentrations, uncorrected, ranged from approximately 1400 to 1800 PPM. On numerous occasions during the test periods, the carbon monoxide stripchart pen reached the full scale maximum of 2500 PPM. Carbon monoxide readings above 2500 PPM could not be quantified. Conversely, when the pen was stuck it could be conjectured that the carbon monoxide readings might have been lower than the reported 1400 to 1800 PPM. The pen was stuck, noncontinuously, in the maximum position for 56% of the time on 6-20, 76% on 6-21, 52% on 6-22 and 53% on 6-23-88.

Total hydrocarbon concentrations, corrected to 12 percent CO_2 ranged from 26 to 35 PPM.

3. Emissions of Total Particulate Matter, Trace Metals and Volatile Organic Compounds

Total Particulate Matter

Total particulate matter concentrations are shown in Table 15. Table 17 shows the ARB Method 5 total particulate matter concentrations and mass emission rates separated into FRONT half/BACK half fractions.

As shown in Table 17, the concentration of total particulate matter was 0.011 grains per dry standard cubic foot (gr/DSCF). These data include the probe rinse, filter catch, after filter rinse and impinger catch.

On June 20, 1988 during particulate matter test PT-6S, electrostatic precipitator No. 1 experienced electrical problems for approximately 32 of the total 64 minute test period. This ESP malfunction led to noticeable visible emissions and resulted in an inordinately high grain loading captured by the Method 5 sampling train. Time constraints did not allow additional particulate matter testing.

Trace Metals

The concentrations and corresponding mass emission rates for arsenic, cadmium, chromium, iron, manganese, nickel and lead are shown in Tables 18 and 19, respectively. The trace metal information was determined by analyzing the Method 5 sampling train filters using atomic absorption spectroscopy techniques. The tabulated laboratory analytical results are shown in Appendix IV. As discussed above, trace metal emissions were shown to increase during test run PT-6S on June 20, 1988 as a result of the electrostatic precipitator malfunction.

As shown in Tables 18 and 19 the concentrations of trace metals ranged from 0.5 micrograms per dry standard cubic meter (ug/dscm) for arsenic to 83.8 ug/dscm for iron and the mass emission rates ranged from 26.8 micrograms per second (ug/sec) for arsenic to 3264 ug/sec for iron.

Volatile Organic Compounds (Bag Samples)

The concentrations and mass emission rates of volatile halogenated and aromatic organic compounds are shown in Tables 20 and 21. The tabulated laboratory data are contained in Appendix IV.

The results do not represent a complete analysis of all possible halogenated and aromatic volatile organic products. Organic compounds were selected for analysis based upon probability of presence and on ability of the laboratory to analyze for the selected compounds.

Only two compounds, benzene and toluene, were found to have concentrations significantly greater than the background concentrations for the ten compounds specified in the bag sample analyses.

As shown in Tables 20 and 21, concentrations ranged from 4.8 parts per billion (PPB) for toluene to 3900 PPB for benzene and the mass emissions ranged from 0.73 milligrams per second (mg/sec) for toluene to 506 mg/sec for benzene.

4. Dioxins and Furans

All of the Dioxin/Furan samples for the blended fuel were analyzed by ENSECO Cal Labs.

PCDDs and PCDFs were detected in all of the semi-volatile sample trains. The laboratory analytical data are reported in Appendix V. The quantities of tetra- through octa- chlorinated PCDD and PCDF homologues are also summarized in Appendix V. The calculated concentrations, corrected to 12 percent CO_2, and mass emission rates of tetra- through octra- chlorinated PCDD and PCDF homologues are summarized in Tables 22 and 23. The corresponding 2,3,7,8 TCDD toxic equivalent concentrations and mass emission rates using the California Department of Health Services Weighting Scheme are summarized in Tables 24 and 25.

As shown in Table 22, PCDD concentrations ranged from 0.279 to 0.863 nanograms per dry standard cubic meter (ng/dscm) and the PCDF concentrations ranged from 0.687 to 2.399 ng/dscm. The corresponding PCDD mass emission rates ranged from 11.48 to 36.73 nanograms per second (ng/sec) and the PCDF mass emission rates ranged from 28.47 to 95.87 ng/sec (see Table 23).

As shown in Table 24, 2,3,7,8 TCDD Toxic Equivalent concentrations ranged from 0.007 to 0.012 ng/dscm for PCDD and from 0.102 to 0.269 ng/dscm for PCDF. The 2,3,7,8 TCDD Toxic Equivalent emission rates ranged from 0.308 to 0.492 ng/sec for PCDD and from 4.22 to 10.73 ng/sec for PCDF (see Table 25).

5. Polynuclear Aromatic Hydrocarbons

Problems encountered with laboratory analyses of PAHs are discussed in Section V of the report.

The PAH laboratory analytical data are presented in Appendix VI. The calculated concentrations, corrected to 12 percent CO_2, and mass emission rates of the PAHs are summarized in Tables 26 and 27 respectively. Of the sixteen compounds analyzed for, ten compounds were substantially higher than the limits of detection.

As shown in Table 26, the total PAH concentrations ranged from 163 to 298 micrograms per dry standard cubic meter (ug/dscm) and the corresponding mass emission rates (Table 27) ranged from 6100 to 11,400 micrograms per second (ug/sec).

6. Chlorobenzenes, Chlorophenols and PCBs

Problems encountered with laboratory analyses of Chlorobenzenes, Chlorophenols and PCBs are discussed in Section V of the report.

The Chlorobenzene, Chlorophenol and PCB laboratory data are presented in Appendix VII. All the Chlorobenzenes were above the minimum detection level and most of the Chlorophenols were above the detection level. Monochlorobiphenyl was the only PCB that was above the detection level. The calculated concentrations, corrected to 12 percent CO_2, and mass emission rates are summarized in Tables 28 and 29 respectively.

As shown in Table 28, the total Chlorobenzene concentrations ranged from 257 to 694 nanograms per dry standard cubic meter (ng/dscm), the total Chlorophenol concentrations ranged from 495 to 1274 ng/dscm and the total PCB concentrations ranged from 33 to 69 ng/dscm.

As shown in Table 29, the total Chlorobenzene mass emission rates ranged from 10,700 to 26,560 nanograms per second (ng/sec), the total Chlorophenol mass emission rates ranged from 21,000 to 50,700 ng/sec and the total PCB mass emission rates ranged from 1300 to 2900 ng/sec.

7. Electrostatic Precipitator Waste Dust Samples

The PCDD/PCDF laboratory analytical data for waste dust samples are presented in Appendix VIII.

As shown in Table 30, PCDD concentrations in the ESP waste ash ranged from 1365 picograms per gram (pg/g) to 3190 pg/g and the PCDF concentrations ranged from 2866 pg/g to 11282 pg/g.

TABLE 15

AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE,
CARBON MONOXIDE, OXIDES OF NITROGEN, SULFUR DIOXIDE,
TOTAL HYDROCARBONS AND PARTICULATE MATTER
IN THE STACK GAS

BLENDED FUEL

DATE	RUN NO.	TIME	a/ PM	b/ O2	b/ CO2	ab/ CO	a/ NOX	a/ SO2	ac/ HC
			GR/DSCF	%	%	PPMV	PPMV	PPMV	PPMV
6-20-88	PT-4S	1430-1535	0.011	6.3	13.8	1217	70	<1	30
6-20-88	PT-5S	1525-1630	0.011	6.3	13.8	1217	70	<1	30
6-20-88	PT-6S	1720-1830	0.125*	6.3	13.8	1217	70	<1	30
6-21-88	RT-1S	0915-1200	-	6.1	13.9	1554	69	<1	35
		1330-1615	-	-	-	-	-	-	-
6-21-88	DT-6S	0915-1155	-	6.1	13.9	1554	69	<1	35
		1330-1615	-	-	-	-	-	-	-
6-22-88	RT-2S	0830-1200	-	6.3	13.8	1565	70	<1	26
6-23-88	RT-2S	0700-1000	-	-	-	-	-	-	-
6-22-88	DT-7S	0830-1110	-	6.3	13.8	1565	70	<1	26
6-23-88	DT-7S	0700-0940	-	-	-	-	-	-	-
6-23-88	RT-3S	1045-1700	-	6.0	14.1	1532	68	<1	34
6-23-88	DT-8S	1030-1700	-	6.0	14.1	1532	68	<1	34

a/ PM,CO,NOX,SO2 AND HC data corrected to 12% CO2.

b/ O2,CO2 and CO values were used to determine the molecular weight of the stack gas and mass emission rates.

c/ HC data reported as propane.

Symbol (<) indicates below detectable limit.

* ESP No.1 malfunction for 32 minutes of the 64 minute test period.(See page 21 of report)

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TABLE 14

STACK CONDITIONS FOR INCINERATOR
AT PACIFIC ORDVILLE POWER INC.

BLENDED FUEL

DATE	RUN NO.	TIME	STACK GAS VELOCITY (FT/SEC)	STACK GAS FLOW RATE (DSCFM)	MOISTURE CONTENT (% BY VOL.)	STACK GAS TEMPERATURE (DEG. F)
6-20-88	PT-4S	1430-1535	92.9	110169	19.1	363
6-20-88	PT-5S	1525-1630	66.9	79227	20.0	357
6-20-88	PT-6S	1720-1830	55.1	64781	21.0	351
6-21-88	RT-1S	0915-1200	58.3	70015	20.0	348
		1330-1615	-	-	-	-
6-21-88	DT-6S	0915-1155	61.7	73545	20.0	354
		1330-1615	-	-	-	-
6-22-88	RT-2S	0830-1200	61.8	73328	20.0	355
6-23-88	RT-2S	0700-1000	-	-	-	-
6-22-88	DT-7S	0830-1110	64.8	76777	20.0	357
6-23-88	DT-7S	0700-0940	-	-	-	-
6-23-88	RT-3S	1045-1700	65.1	76703	20.0	360
6-23-88	DT-8S	1030-1700	64.7	76172	20.0	361

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TABLE 16

DAILY AVERAGE
CRITERIA POLLUTANT EMISSIONS, LBS/HR

DATE	CO	NOx 1/	THC 2/	SO2
6-20-88	518	49	20	< 0.85
6-21-88	564	41	20	< 0.72
6-22-88	590	43	15	< 0.75
6-23-88	601	44	21	< 0.76

1/ reported as NO2
2/ reported as propane

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TABLE 17

CONCENTRATIONS AND MASS EMISSION
RATES OF PARTICULATE MATTER _1/

BLENDED FUEL

DATE	RUN NO.	CONCENTRATIONS (GR/DSCF) FRONT	BACK	TOTAL	MASS EMISSIONS (LB/HR) FRONT	BACK	TOTAL
6-20-88	PT-4S	0.003	0.010	0.012	2.395	9.336	11.731
6-20-88	PT-5S	0.002	0.011	0.013	1.376	7.332	8.708
6-20-88	PT-6S	0.138	0.007	0.144	76.365	3.613	78.978

_1/ FRONT indicates the amount of particulate matter found in the Method 5 probe rinse and filter catch. BACK indicates the amount of particulate matter found in the after-filter sample recovery.

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TABLE 18

TRACE METAL CONCENTRATIONS
AT 12 PERCENT CO2, ug/dscm

BLENDED FUEL

SAMPLE ID	PT-4S	PT-5S	PT-6S
As	0.5	0.6	5.6
Cd	< 0.3	< 0.4	2.1
Cr	3.7	4.5	38.6
Fe	54.6	58.7	83.8
Mn	20.5	18.5	46.2
Ni	< 2.2	< 2.7	16.3
Pb	6.5	6.4	81.2

(<) Below limit of detection.

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TABLE 19

TRACE METAL MASS EMISSION RATES, ug/sec

BLENDED FUEL

SAMPLE ID	PT-4S	PT-5S	PT-6S
As	28.8	26.8	196.7
Cd	< 17.1	< 15.8	73.5
Cr	218.8	193.9	1357.7
Fe	3263.8	2522.0	2945.7
Mn	1227.4	793.6	1622.8
Ni	< 128.6	< 118.2	574.6
Pb	387.9	276.8	2854.7

(<) Below limit of detection.

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TABLE 20

CONCENTRATIONS OF HALOGENATED AND AROMATIC VOLATILE ORGANIC COMPOUNDS
(PPB, CORRECTED TO 12% CO2)

BLENDED FUEL

	SAMPLE ID	BS-7	BS-8	BS-9
	DATE	6-20-88	6-20-88	6-20-88
	TIME	1410	1430	1600
1.	benzene	3.4E+03	2.8E+03	1.6E+03
2.	toluene	6.5E+01	8.4E+01	4.2E+00
3.	vinyl chloride	<8.6E-01	<8.6E-01	<8.6E-01
4.	freon 11	<8.3E-01	<8.3E-01	<8.3E-01
5.	chloroform	<8.7E-01	<8.7E-01	<8.7E-01
6.	1,1,1-trichloroethane	<8.5E-01	<8.5E-01	<8.5E-01
7.	carbon tetrachloride	<9.1E-01	<9.1E-01	<9.1E-01
8.	1,2-dichloroethane	<1.7E+01	<1.7E+01	<1.7E+01
9.	trichloroethene	<8.7E-01	<8.7E-01	<8.7E-01
10.	tetrachloroethene	<8.7E-01	<8.7E-01	<8.7E-01
11.	1,2-dibromoethane	<8.7E-01	<8.7E-01	<8.7E-01

(<) Less than reporting limit.

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TABLE 21

MASS EMISSION RATES OF HALOGENATED AND AROMATIC ORGANIC COMPOUNDS
(mg/sec)

BLENDED FUEL

	SAMPLE ID	BS-7	BS-8	BS-9
	DATE	6-20-88	6-20-88	6-20-88
	TIME	1410	1430	1600
1.	benzene	506.09	412.01	245.26
2.	toluene	11.48	14.85	0.73
3.	vinyl chloride	< 0.10	< 0.10	< 0.10
4.	freon 11	< 0.22	< 0.22	< 0.22
5.	chloroform	< 0.20	< 0.20	< 0.20
6.	1,1,1-trichloroethane	< 0.22	< 0.22	< 0.22
7.	carbon tetrachloride	< 0.27	< 0.27	< 0.27
8.	1,2-dichloroethane	< 3.29	< 3.29	< 3.29
9.	trichloroethene	< 0.22	< 0.22	< 0.22
10.	tetrachloroethene	< 0.28	< 0.28	< 0.28
11.	1,2-dibromoethane	< 0.31	< 0.31	< 0.31

(<) Less than reporting limit.

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TABLE 22

PCDD/PCDF CONCENTRATIONS IN STACK GAS
(ng/dscm corrected to 12% CO2)

RUN #	DT-6S	DT-7S	DT-8S
DIOXINS			
2,3,7,8-TCDD	(0.004	(0.001	(0.002
Total TCDD	(0.004	(0.001	0.004
1,2,3,7,8-PeCDD	(0.004	(0.005	0.003
Total PeCDD	0.063	(0.005	0.087
1,2,3,4,7,8-HxCDD	(0.006	(0.005	(0.007
1,2,3,6,7,8-HxCDD	(0.006	(0.007	(0.007
1,2,3,7,8,9-HxCDD	(0.008	(0.005	(0.007
Total HxCDD	0.080	0.133	0.015
1,2,3,4,6,7,8-HpCDD	0.113	0.139	(0.031
Total HpCDD	0.113	0.369	0.037
Total OCDD	0.294	0.354	0.135
Total PCDD	0.554 *	0.863 *	0.279
FURANS			
2,3,7,8-TCDF	0.054	0.032	0.026
Total TCDF	0.587	0.072	0.124
1,2,3,7,8-PeCDF	0.114	0.078	0.039
2,3,4,7,8-PeCDF	0.083	0.050	0.033
Total PeCDF	0.788	0.111	0.434
1,2,3,4,7,8-HxCDF	0.057	0.047	0.022
1,2,3,6,7,8-HxCDF	0.085	0.086	0.033
1,2,3,7,8,9-HxCDF	0.097	0.083	0.034
2,3,4,6,7,8-HxCDF	(0.004	(0.006	(0.002
Total HxCDF	0.587	0.325	0.217
1,2,3,4,6,7,8-HpCDF	0.294	(0.162	0.056
1,2,3,4,7,8,9-HpCDF	(0.017	(0.162	(0.008
Total HpCDF	0.340	(0.162	0.061
Total OCDF	0.096	0.018	(0.020
Total PCDF	2.399	0.687 *	0.857 *

NOTES
dscm - dry standard cubic meter at 68 F and one atmosphere
(indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit

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TABLE 23

PCDD/PCDF MASS EMISSION RATES
(ng/sec)

RUN #	DT-6S	DT-7S	DT-8S
DIOXINS			
2,3,7,8-TCDD	(0.161	(0.061	(0.102
Total TCDD	(0.161	(0.061	0.186
1,2,3,7,8-PeCDD	(0.173	(0.226	0.141
Total PeCDD	2.533	(0.226	3.582
1,2,3,4,7,8-HxCDD	(0.222	(0.202	(0.294
1,2,3,6,7,8-HxCDD	(0.222	(0.306	(0.294
1,2,3,7,8,9-HxCDD	(0.321	(0.196	(0.294
Total HxCDD	3.212	5.499	0.614
1,2,3,4,6,7,8-HpCDD	4.509	5.744	(1.279
Total HpCDD	4.509	15.28	1.535
Total OCDD	11.73	14.66	5.565
Total PCDD	22.15 *	35.73 *	11.48
FURANS			
2,3,7,8-TCDF	2.162	1.344	1.087
Total TCDF	23.47	2.994	5.117
1,2,3,7,8-PeCDF	4.571	3.238	1.599
2,3,4,7,8-PeCDF	3.335	2.077	1.343
Total PeCDF	31.50	4.582	17.91
1,2,3,4,7,8-HxCDF	2.285	1.955	0.896
1,2,3,6,7,8-HxCDF	3.397	3.544	1.343
1,2,3,7,8,9-HxCDF	3.891	3.421	1.407
2,3,4,6,7,8-HxCDF	(0.166	(0.262	(0.090
Total HxCDF	23.47	13.44	8.955
1,2,3,4,6,7,8-HpCDF	11.73	(6.721	2.303
1,2,3,4,7,8,9-HpCDF	(0.679	(6.721	(0.333
Total HpCDF	13.59	(6.721	2.495
Total OCDF	3.829	0.733	(0.832
Total PCDF	95.87	28.47 *	35.31 *

NOTES
(indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit

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TABLE 24

TOXIC EQUIVALENT CONCENTRATION USING CA DOHS WEIGHTING SCHEME
(corrected to 12% CO2)

RUN #		DT-6S	DT-7S	DT-8S
	Toxic Equivalence Factor	Toxic equivalent concentration (ng/dscm)		
DIOXINS				
2,3,7,8-TCDD	1.00	(0.004	(0.001	(0.002
1,2,3,7,8-PeCDD	1.00	(0.004	(0.005	0.003
1,2,3,4,7,8-HxCDD	0.03	(0.0002	(0.0001	(0.0002
1,2,3,6,7,8-HxCDD	0.03	(0.0002	(0.0002	(0.0002
1,2,3,7,8,9-HxCDD	0.03	(0.0002	(0.0001	(0.0002
1,2,3,4,6,7,8-HpCD	0.03	0.003	0.004	(0.001
Total PCDD		0.012 *	0.012 *	0.007
FURANS				
2,3,7,8-TCDF	1.00	0.054	0.032	0.026
1,2,3,7,8-PeCDF	1.00	0.114	0.078	0.039
2,3,4,7,8-PeCDF	1.00	0.083	0.050	0.033
1,2,3,4,7,8-HxCDF	0.03	0.002	0.001	0.001
1,2,3,6,7,8-HxCDF	0.03	0.003	0.003	0.001
1,2,3,7,8,9-HxCDF	0.03	0.003	0.002	0.001
2,3,4,6,7,8-HxCDF	0.03	(0.0001	(0.0002	(0.0001
1,2,3,4,6,7,8-HpCD	0.03	0.009	(0.005	0.002
1,2,3,4,7,8,9-HpCD	0.03	(0.001	(0.005	(0.0002
Total PCDF		0.269 *	0.177 *	0.102
Total Toxic Equivalent (2,3,7,8-TCDD Equivalents)		0.281 *	0.189 *	0.110

NOTES
dscm - dry standard cubic meter at 68 F and one atmosphere
(indicates below limit of detection (MDL)
* - Total includes MDLs for isomers below the detection limit

TABLE 25

TOXIC EQUIVALENT EMISSION RATES USING CA DOHS WEIGHTING SCHEME

RUN #		DT-6S	DT-7S	DT-8S
	Toxic Equivalence Factor	Toxic equivalent emission rate (ng/sec)		
DIOXINS				
2,3,7,8-TCDD	1.00	(0.161	(0.061	(0.102
1,2,3,7,8-PeCDD	1.00	(0.173	(0.226	0.141
1,2,3,4,7,8-HxCDD	0.03	(0.007	(0.006	(0.009
1,2,3,6,7,8-HxCDD	0.03	(0.007	(0.009	(0.009
1,2,3,7,8,9-HxCDD	0.03	(0.010	(0.006	(0.009
1,2,3,4,6,7,8-HpCDD	0.03	0.135	0.172	(0.038
Total PCDD		0.492 *	0.481 *	0.308 *
FURANS				
2,3,7,8-TCDF	1.00	2.162	1.344	1.087
1,2,3,7,8-PeCDF	1.00	4.571	3.238	1.599
2,3,4,7,8-PeCDF	1.00	3.336	2.078	1.343
1,2,3,4,7,8-HxCDF	0.03	0.069	0.059	0.027
1,2,3,6,7,8-HxCDF	0.03	0.102	0.106	0.040
1,2,3,7,8,9-HxCDF	0.03	0.117	0.103	0.042
2,3,4,6,7,8-HxCDF	0.03	(0.005	(0.008	(0.003
1,2,3,4,6,7,8-HpCDF	0.03	0.352	(0.202	0.069
1,2,3,4,7,8,9-HpCDF	0.03	(0.020	(0.202	(0.010
Total PCDF		10.73 *	7.34 *	4.22 *
Total Toxic Equivalent (2,3,7,8-TCDD Equivalents)		11.23	7.82	4.53 *

NOTES
(indicates below limit of detection (MDL)
* - Total includes MDLs for isomers below the detection limit

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TABLE 26

PAH CONCENTRATIONS IN STACK GAS
(ug/dscm at 12% CO2)

RUN #	RT-1S	RT-2S	RT-3S
Naphthalene	243.9	123.8	146.8
Acenaphthylene	20.91	10.79	<0.177
Acenaphthene	<0.174	<0.157	17.90
Fluorene	3.136	1.207	0.448
Phenanthrene	12.19	7.306	3.940
Anthracene	<0.174	0.746	0.287
Fluoranthene	8.015	4.447	1.200
Pyrene	7.841	3.653	<1.236
Benzo(a)anthracene	0.261	<0.157	<0.177
Chrysene	0.418	0.191	<0.177
Benzo(b)fluoranthene	<0.174	<0.157	<0.177
Benzo(k)fluoranthene	<0.174	<0.157	<0.177
Benzo(a)pyrene	<0.174	<0.157	<0.177
Dibenzo(a,h)anthracene	<0.174	<0.157	<0.177
Benzo(g,h,i)perylene	<0.174	<0.157	<0.177
Indeno(1,2,3-c,d)pyrene	<0.174	<0.157	<0.177
TOTAL	298.1 **	153.4 **	173.4 **

NOTES

dscm - dry standard cubic meter at 68 F and one atmosphere
< indicates below reporting limit
** - Total includes reporting limits for compounds not detected

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TABLE 27

PAH MASS EMISSION RATES
(ug/sec)

RUN #	RT-1S	RT-2S	RT-3S
Naphthalene	9338	4930	6246
Acenaphthylene	800.3	429.8	(7.540
Acenaphthene	(6.669	(6.257	761.6
Fluorene	120.0	48.03	19.04
Phenanthrene	466.8	290.7	167.5
Anthracene	(6.669	29.70	12.18
Fluoranthene	306.8	176.9	51.03
Pyrene	300.1	145.3	(52.55
Benzo(a)anthracene	10.00	(6.257	(7.540
Chrysene	16.00	7.584	(7.540
Benzo(b)fluoranthene	(6.669	(6.257	(7.540
Benzo(k)fluoranthene	(6.669	(6.257	(7.540
Benzo(a)pyrene	(6.669	(6.257	(7.540
Dibenzo(a,h)anthracene	(6.669	(6.257	(7.540
Benzo(g,h,i)perylene	(6.669	(6.257	(7.540
Indeno(1,2,3-c,d)pyrene	(6.669	(6.257	(7.540
TOTAL	11411 **	6108 **	7378 **

NOTES

(indicates below reporting limit
** - Total includes reporting limits for compounds not detected

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TABLE 28

CHLOROBENZENE, CHLOROPHENOL, AND PCB
CONCENTRATIONS IN STACK GAS
(ng/dscm at 12% CO2)

RUN #	RT-1S	RT-2S	RT-3S
CHLOROBENZENES			
Dichlorobenzene	302.1	182.4	131.6
Trichlorobenzene	315.5	52.25	91.86
Tetrachlorobenzene	49.66	14.92	11.63
Pentachlorobenzene	15.50	8.417	8.595
Hexachlorobenzene	10.97	11.11	13.60
TOTAL	693.8	269.1	257.3
CHLOROPHENOLS			
Monochlorophenol	476.9	(955.9	175.6
Dichlorophenols	(209.1	194.3	(278.9
Trichlorophenols	68.48	33.51	8.953
Tetrachlorlphenols	96.36	(66.70	15.93
Pentachlorophenol	40.77	24.14	15.75
TOTAL	891.6 **	1274. **	495.3 **
PCB			
Monochlorobiphenyl	20.91	(7.146	(5.193
Dichlorobiphenyl	(11.84	(4.764	13.60
Trichlorobiphenyl	(2.265	(0.555	11.63
Tetrachlorobiphenyl	(2.439	(1.588	(7.341
Pentachlorobiphenyl	(1.742	(3.970	(4.834
Hexachlorobiphenyl	(2.091	(2.858	(2.148
Heptachlorobiphenyl	(2.265	(2.382	(3.402
Octachlorobiphenyl	(2.613	(2.223	(3.939
Nonachlorobiphenyl	(3.310	(2.858	(6.625
Decachlorobiphenyl	(3.833	(4.446	(10.20
TOTAL	53.32 **	32.79 **	68.94 **

NOTES
dscm - dry standard cubic meter at 68 F and one atmosphere
(indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit

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TABLE 29

CHLOROBENZENE, CHLOROPHENOL, AND PCB
MASS EMISSION RATES
(ng/sec)

RUN #	RT-1S	RT-2S	RT-3S
CHLOROBENZENES			
Dichlorobenzene	11565	7262	5598
Trichlorobenzene	12078	2079	3907
Tetrachlorobenzene	1901	594.1	495
Pentachlorobenzene	593.6	334.9	366
Hexachlorobenzene	420.1	442.4	579
TOTAL	26558	10713	10945
CHLOROPHENOLS			
Monochlorophenol	18255	(38044	7472
Dichlorophenols	(8003.	7736.	(11867
Trichlorophenols	2621.	1333.	381
Tetrachlorlphenols	3688.	(2654.	678
Pentachlorophenol	1560.	960.7	670
TOTAL	34129 **	50729 **	21068 **
			0
PCB			0
Monochlorobiphenyl	800.3	(284.4	(221
Dichlorobiphenyl	(453.5	(189.6	579
Trichlorobiphenyl	(86.70	(22.12	495
Tetrachlorobiphenyl	(93.37	(63.20	(312
Pentachlorobiphenyl	(66.69	(158.0	(206
Hexachlorobiphenyl	(80.03	(113.7	(91
Heptachlorobiphenyl	(86.70	(94.81	(145
Octachlorobiphenyl	(100.0	(88.48	(168
Nonachlorobiphenyl	(126.7	(113.7	(282
Decachlorobiphenyl	(146.7	(176.9	(434
TOTAL	2041 **	(1305 **	(2932 **

NOTES
(indicates below limit of detection (MDL)
* - Total includes MDLs for compounds below limit of detection

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TABLE 30

TOTAL PCDD AND PCDF IN ESP ASH SAMPLES
PICOGRAMS PER GRAM (pg/g)

SAMPLE ID	ESP-1-23	ESP-2-24	ESP-1-28	ESP-2-29	ESP-1-33	ESP-2-34
DATE	6-21-88	6-21-88	6-22-88	6-22-88	6-23-88	6-23-88
TIME	1500	1500	1200	1430	1200	1200
DIOXINS						
2,3,7,8-TCDD	26	22	24	18	8.5	8.6
Total TCDD	310	280	360	240	94	150
1,2,3,7,8-PeCDD	50	36	42	32	10	14
Total PeCDD	360	240	350	230	71	110
1,2,3,4,7,8-HxCDD	27	26	30	17	10	12
1,2,3,6,7,8-HxCDD	41	29	34	23	15	16
1,2,3,7,8,9-HxCDD	39	25	32	20	10	14
Total HxCDD	420	330	390	290	170	200
1,2,3,4,6,7,8-HpCDD	430	390	420	330	170	210
Total HpCDD	900	860	890	740	390	460
Total OCDD	1100	1200	1200	980	640	680
Total PCDD	3090	2910	3190	2480	1365	1600
FURANS						
2,3,7,8-TCDF	520	280	380	240	110	180
Total TCDF	4200	3100	3900	2500	980	1600
1,2,3,7,8-PeCDF	280	160	220	130	52	85
2,3,4,7,8-PeCDF	1100	660	960	510	220	400
Total PeCDF	4000	2800	4000	2400	1100	1700
1,2,3,4,7,8-HxCDF	450	240	330	190	99	160
1,2,3,6,7,8-HxCDF	310	180	250	140	78	120
2,3,4,6,7,8-HxCDF	590	270	390	220	120	190
1,2,3,7,8,9-HxCDF	13	7.8	11	5.7	(1.9	4.3
Total HxCDF	2600	1500	2200	1200	640	980
1,2,3,4,6,7,8-HpCDF	250	150	210	120	63	93
1,2,3,4,7,8,9-HpCDF	37	22	30	16	10	13
Total HpCDF	420	250	350	200	110	160
Total OCDF	62	54	60	43	36	35
Total PCDF	11282	7704	10510	6343	2866	4475

NOTES

(indicates below limit of detection (MDL)
+ - Total includes MDLs for homologues below the detection limit

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V. QUALITY ASSURANCE/QUALITY CONTROL

The quality assurance/quality control procedures which were followed in this test are delineated in the test protocol presented in Appendix I. All of the QA/QC criteria for sampling and analytical procedures were followed for each test except for one particulate matter run during the second week of testing. This particular Method 5 run was made during an electrostatic precipitator malfunction and is discussed in the test results section of the report.

The halogenated and aromatic volatile organic compound bag sample blank and spike values are shown in Appendix IV.

The PCDD and PCDF percent recoveries of internal standards and field spikes for week #1 are presented in Table 31 and Appendix V.

The PCDD and PCDF analyses of blank sampling trains for week #1 are presented in Table 32.

The percent recovery of internal standards for the electrostatic precipitator ash samples for week #1 are presented in Table 33.

The PCDD/PCDF emission rates for sampling runs DT-3S and DT-4S (Table 10) compare favorably, well within an order of magnitude. These two runs were made simultaneously with DT-3S being analyzed by HML and DT-4S being analyzed by ENSECO Cal Labs.

The PCDD and PCDF percent recoveries of internal standards and field spikes for week #2 are presented in Table 34 and Appendix V.

The PCDD and PCDF analyses of blank sampling trains for week #2 are presented in Table 35.

The percent recovery of internal standards for the electrostatic precipitator ash samples for week #2 are presented in Table 36.

The following problems were encountered with the laboratory analyses of Polynuclear Aromatic Hydrocarbons, Chlorobenzenes, Chlorophenols and PCBs.

The principal analytes found were naphthalene and methylnaphthalene. Naphthalene was reported while the methylnaphthalene was not since it was not included in the list of analytes requested. The levels for naphthalene, which was detected in many samples was many times higher than any other analyte detected. Since the masses used to quantitate the naphthalene, 128, and its internal standard, D8-naphthalene, 136, are the masses used to also identify and quantitate the chlorophenols, it is not possible to identify the 3-and, or 4-chlorophenol. It is possible to get results for 2-chlorophenol, since it elutes before the interfering naphthalene.

Most problems occurred during analysis of the PAHs by modified 8270 and the chlorophenols and benzenes by SIM. The amount of isotopes added for the

PAH analysis interfered with the quantitation of the chlorophenols and benzenes. The major interferences occurred predominantly with the chlorophenols. These interferences may result in false positives or negatives depending on the retention time and masses of the native, and isotope analyses.

The method blank had elevated levels of chlorophenols. These values were reported as the detection limits, and were used whenever a positive value was observed. Detection limits were calculated for each homologue and in many cases were at levels below the blank.

Identification was based on retention time and mass ratios. A height or area ratio was used and a positive calculation was performed using areas. Heights were used only if intereferences distorted the peak giving higher than normal areas. Alternatively, the secondary mass was used if the isotopes primary mass had interferences. This was evident with the dichlorobenzenes which had a ratio that indicated severe interferences. These interferences are yet to be determined, but are present in the standards and samples.

All the samples had high levels of background interferences which effected the reporting limits and quantitation of both the native analytes and the surrogates. A saturated peak with a retention time close to both the fluorophenol and D5-phenol was present in all the samples and a library search indicates that it is a trimethyl hexane, or a chlorinated ethane, or even a boric acid compound. This peak is very saturated and very wide which is the reason that a clean spectrum is not possible which results in poor library matches, and multiple identifications.

Isokinetic Sampling

It is assumed that a 2 percent error in isokinetic sampling will cause a 1 percent error in both concentration and pollutant mass rate emissions. The percentage of error may vary slightly depending on the magnitude of the true value and the different assumptions made. The isokinetic variation allowed by ARB test Method 5 is 100 $\pm$ 10 percent. If there is a high bias to the results, ie., I < 90 percent, then the results are defined as at or below the determined value. The largest variation in isokinetic sampling for particulate matter was during run number PT-3S on June 16, 1988 at 87.9 percent. Since the grain loading was calculated at 0.011 grains per dry standard cubic foot (gr/dscf) at 87.9 percent isokinetic, then the adjusted grain loading to an acceptable 90 percent isokinetic sampling rate would be 1.05 percent less than 0.011 gr/dscf or 0.01088 gr/dscf.

TABLE 31

PCDD/PCDF PERCENT RECOVERY OF INTERNAL STANDARDS AND FIELD SPIKES

Internal standards	DT-1S	DT-2S	DT-3S	DT-4S	DT-1B
13C-2,3,7,8-TCDF	50	97	118	76	66
13C-2,3,7,8-TCDD	NA	NA	NA	72	NA
13C-1,2,3,7,8-PeCDD	49	100	106	58	63
13C-1,2,3,6,7,8-HxCDD	87	126	106	68	ND
13C-1,2,3,4,6,7,8-HpCDD	50	93	103	55	69
13C-OCDD	46	85	102	30	93
Field spikes	**DT-1S**	**DT-2S**	**DT-3S**	**DT-4S**	**DT-1B**
37Cl-TCDD	NA	NA	NA	77	NA
13C-HpCDF	NA	NA	NA	50	NA

NA - Not applicable

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TABLE 32

PCDD/PCDF ANALYSIS OF BLANK SAMPLE TRAINS
(ng/sample)

	DT-5S
DIOXINS	
2,3,7,8-TCDD	<0.054
Total TCDD	<0.054
1,2,3,7,8-PeCDD	<0.170
Total PeCDD	<0.170
1,2,3,4,7,8-HxCDD	<0.039
1,2,3,6,7,8-HxCDD	<0.039
1,2,3,7,8,9-HxCDD	<0.039
Total HxCDD	<0.039
1,2,3,4,6,7,8-HpCDD	7.800
Total HpCDD	7.800
Total OCDD	1.400
Total PCDD	9.463 *
FURANS	
2,3,7,8-TCDF	0.019
Total TCDF	0.019
1,2,3,7,8-PeCDF	<0.057
2,3,4,7,8-PeCDF	<0.057
Total PeCDF	<0.057
1,2,3,4,7,8-HxCDF	<0.015
1,2,3,6,7,8-HxCDF	<0.015
2,3,4,6,7,8-HxCDF	<0.015
1,2,3,7,8,9-HxCDF	<0.015
Total HxCDF	<0.015
1,2,3,4,6,7,8-HpCDF	<0.100
1,2,3,4,7,8,9-HpCDF	<0.100
Total HpCDF	<0.100
Total OCDF	<0.240
Total PCDF	0.431 *

NOTES

< indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit

TABLE 33

PERCENT RECOVERY OF INTERNAL STANDARDS
ELECTROSTATIC PRECIPITATOR ASH SAMPLES

Internal standards	ESP-1-3	ESP-2-4	ESP-1-9	ESP-2-10	ESP-1-15	ESP-2-16
13C-2,3,7,8-TCDF	54	47	58	60	39	36
13C-2,3,7,8-TCDD	56	48	57	58	85	18
13C-1,2,3,7,8-PeCDD	61	53	62	48	85	30
13C-1,2,3,6,7,8-HxCDD	64	47	57	60	32	39
13C-1,2,3,4,6,7,8-HpCDD	53	36	40	50	19	28
13C-OCDD	32	22	22	31	9.9	15

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TABLE 34

PERCENT RECOVERY OF INTERNAL STANDARDS AND FIELD SPIKES

Internal standards	DT-6S	DT-7S	DT-8S	DT-9S
13C-2,3,7,8-TCDF	96	91	88	82
13C-2,3,7,8-TCDD	86	88	76	62
13C-1,2,3,7,8-PeCDD	72	76	56	71
13C-1,2,3,6,7,8-HxCDD	84	97	76	101
13C-1,2,3,4,6,7,8-HpCDD	60	64	58	77
13C-OCDD	37	41	36	27
Field spikes	**DT-6S**	**DT-7S**	**DT-8S**	**DT-9S**
37Cl-TCDD	NA	81	NA	NA
13C-HpCDF	NA	52	NA	NA

NA - Not applicable

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TABLE 35

PCDD/PCDF ANALYSIS OF BLANK SAMPLE TRAINS
(ng/sample)

	DT-9S
DIOXINS	
2,3,7,8-TCDD	< 0.0093
Total TCDD	< 0.0093
1,2,3,7,8-PeCDD	0.140
Total PeCDD	2.900
1,2,3,4,7,8-HxCDD	0.230
1,2,3,6,7,8-HxCDD	0.300
1,2,3,7,8,9-HxCDD	0.170
Total HxCDD	4.400
1,2,3,4,6,7,8-HpCDD	3.100
Total HpCDD	8.100
Total OCDD	7.700
Total PCDD	23.11 *
FURANS	
2,3,7,8-TCDF	0.220
Total TCDF	4.300
1,2,3,7,8-PeCDF	1.100
2,3,4,7,8-PeCDF	1.500
Total PeCDF	20.000
1,2,3,4,7,8-HxCDF	2.000
1,2,3,6,7,8-HxCDF	2.700
2,3,4,6,7,8-HxCDF	3.400
1,2,3,7,8,9-HxCDF	0.120
Total HxCDF	25.000
1,2,3,4,6,7,8-HpCDF	27.000
1,2,3,4,7,8,9-HpCDF	5.400
Total HpCDF	56.000
Total OCDF	43.000
Total PCDF	148.30

NOTES

< indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit

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TABLE 36

PERCENT RECOVERY OF INTERNAL STANDARDS
ELECTROSTATIC PRECIPITATOR ASH SAMPLES

Internal standards	ESP-1-23	ESP-2-24	ESP-1-28	ESP-2-29	ESP-1-33	ESP-2-34
13C-2,3,7,8-TCDF	52	56	62	46	37	55
13C-2,3,7,8-TCDD	59	62	57	54	37	54
13C-1,2,3,7,8-PeCDD	47	56	58	46	42	92
13C-1,2,3,6,7,8-HxCDD	69	67	67	59	48	60
13C-1,2,3,4,6,7,8-HpCDD	60	56	56	45	33	38
13C-OCDD	38	37	38	26	21	20

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Appendix I

Evaluation Test Protocol

State of California
AIR RESOURCES BOARD

EVALUATION TEST PROTOCOL

Emissions Test on a Wood Waste Fired Incinerator
at Pacific Oroville Power Inc.

Project No. C-88-050

Engineering Evaluation Branch
Monitoring and Laboratory Division

APPROVED:

A. C. Jenkins
Project Engineer

Peter Ouchida, Manager
Testing Section

Peter Ouchida for Chief
Engineering Evaluation Branch

Protocol: Emissions Test at Pacific Oroville Power Inc.
(ARB File No. C-88-050)

I. INTRODUCTION

An emissions test on a wood waste incinerator at the Pacific Oroville Power Inc. (POPI) Facility in Oroville, California will be conducted by the Air Resources Board (ARB) Engineering Evaluation Branch (EEB). The test will consist of two parts. Part one will be conducted during normal operation with typical wood waste as the fuel. Part two will be conducted during normal operation using "urban" wood waste as the fuel.

Testing during part one will include items A, B, C, D, F, and G listed in Section 1 of the protocol and delineated in Section III.

Testing during part two will include the aforementioned items in addition to item E.

Laboratory support will be provided by the Air and Industrial Hygiene Laboratory (AIHL), Hazardous Materials Laboratory (HML) of the Department of Health Services (DOHS) and ENSECO California Analytical Laboratories (Cal Labs).

The objectives of the test are:

A. Determine gaseous emissions including oxygen (O_2), carbon dioxide (CO_2), carbon monoxide (CO), sulfur dioxide (SO_2), oxides of nitrogen (NO_x), and total hydrocarbons (THC).

B. Determine flow rate and moisture content.

C. Determine emissions of volatile organics.

D. Determine emissions of dioxins and furans.

E. Determine emissions of PAHs, and PCBs,

total chlorobenzenes, and total chlorophenols.

F. Determine total particulate emissions including select trace metals.

G. Develop formaldehyde field test procedures.

II. PROCESS DESCRIPTION

A schematic of the stack and sampling locations is shown in Figure 1. The exhaust gas generated from the combustion of wood waste in two furnaces is ducted to heat recovery boilers to generate steam used for electricity generation. The boiler exhaust gas passes through two parallel electrostatic precipitators (ESP) and is then vented through the stack. During the time of testing, the biomass power plant is expected to be operating at or near full capacity and will not deviate from normal operation. POPI will provide ARB with the printouts of selected operating parameters on an hourly schedule.

III. SAMPLING PROCEDURE

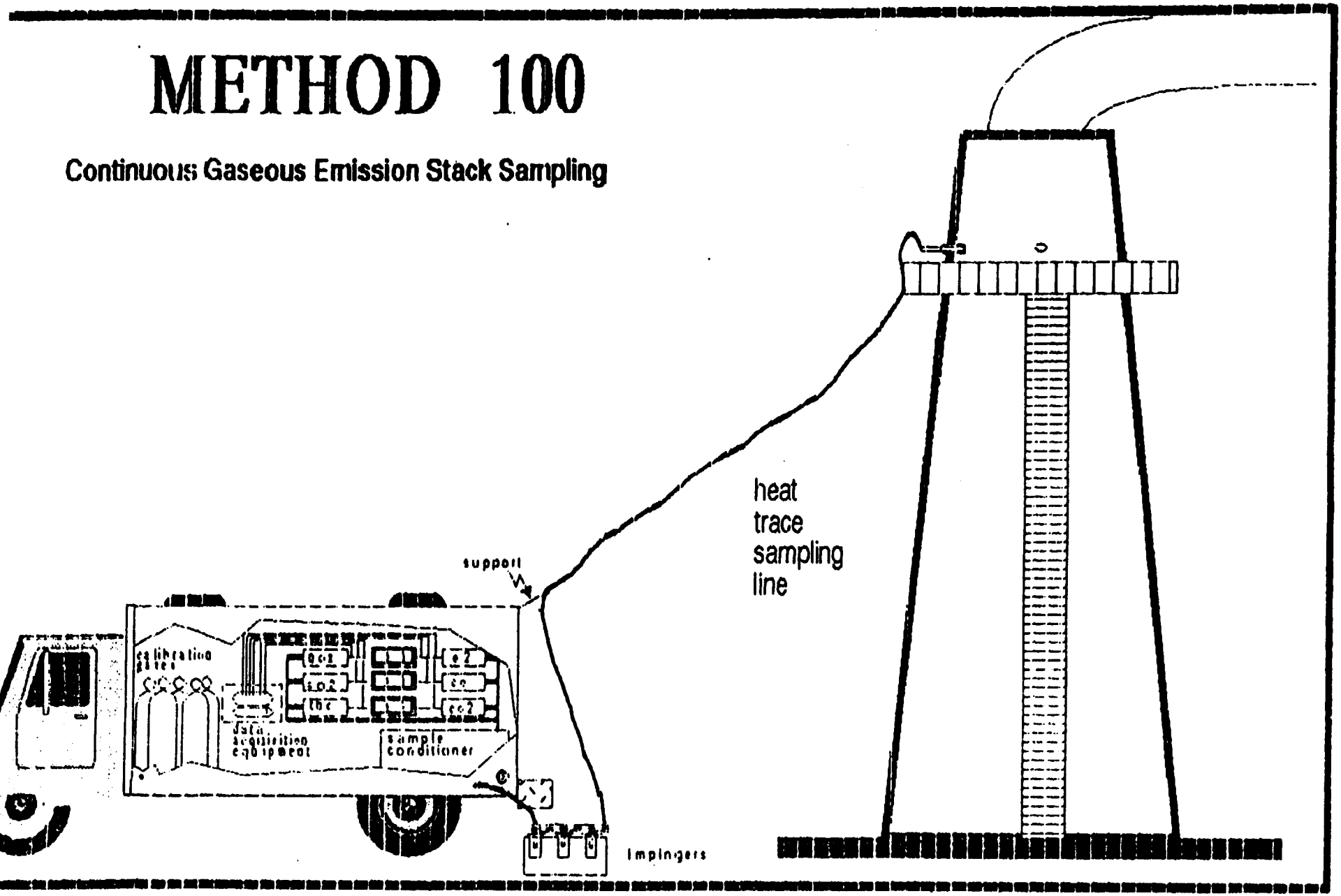
A. SAMPLING LOCATION

Sampling will be performed at the stack following the ESP. Sample ports at the stack have been provided by the operator. There are two 3-inch diameter ports at two locations. The spread between the ports is 90°. The platform for the ports is attached to the stack and is about 4 feet wide and surrounds the stack. Stack diameter is approximately 6 feet. Consoles and vans will be set up on the ground near the base of the stack and next to the ESP.

FIGURE 1

METHOD 100

Continuous Gaseous Emission Stack Sampling



Access to the sampling platform is by ladder with a center safety rail. Test vehicles can be parked at the base of the stack. (Support vehicles may be parked elsewhere.) An ARB jib can be attached to the sampling platform on the side where the test vehicles will be parked.

Lights and power (110 volt outlet) to operate the modified Method 5 water circulating pumps are available on the sampling platform. The two sampling consoles on the ground will be powered from available 110 volt power circuits near the baghouse or in the gas van. The gas van and mobile laboratory will have 440 volt 3-phase or 220 volt circuits available. Step-down transformers may be needed for these vans. The operator has indicated an electrician will be provided to connect power to the vehicles.

B. MEASUREMENT METHODS

The components to be analyzed, the sampling methods, and the analytical methods or the continuous analyzers detector principles are shown in Table 1. Additional information is given below.

1. Gaseous Emissions

Sampling for gaseous pollutants will be performed in accordance with "Method 100 - Procedures for Continuous Emission Stack Sampling" (Section 94114 of the California Code of Regulations). This test method is used for determining gaseous emissions from stationary sources.

For evaluating specific gaseous emissions, a sampling probe will be inserted into the stack at the same level as the Modified Method 5 sampling probe. The stack will be traversed with the

TABLE 1

SUMMARY OF APPLICABLE SAMPLING AND ANALYTICAL METHODS

COMPONENT TO BE ANALYZED	SAMPLING METHOD	ANALYTICAL METHOD or DETECTION PRINCIPLE
O_2	Continuous Analyzer	Paramagnetic
CO_2	Continuous Analyzer	NDIR
CO	Continuous Analyzer	NDIR
SO_2	Continuous Analyzer	Ultraviolet
NO_x	Continuous Analyzer	Chemiluminesence
Total Hydrocarbons	Continuous Analyzer	FID
Low Molecular Weight Organics	Grab Bag	GC/FID, GC/ECD, GC/PID
PAH's	Modified Method 5	GC/MS
PCB's Chlorobenzenes, & Chlorophenol	Modified Method 5	GC/FID, GC/ECD
Particulate Matter	Method 5	Gravimetric
Metals	Method 5	Atomic Absorption
Ashes/Slags	Grab (Specimen Jar)	GC/FID, GC/ECD
Fly Ash Collected by ESP	Grab (Specimen Jar)	GC/FID, GC/ECD
Fuel	Grab (Specimen Jar)	GC/FID, GC/ECD

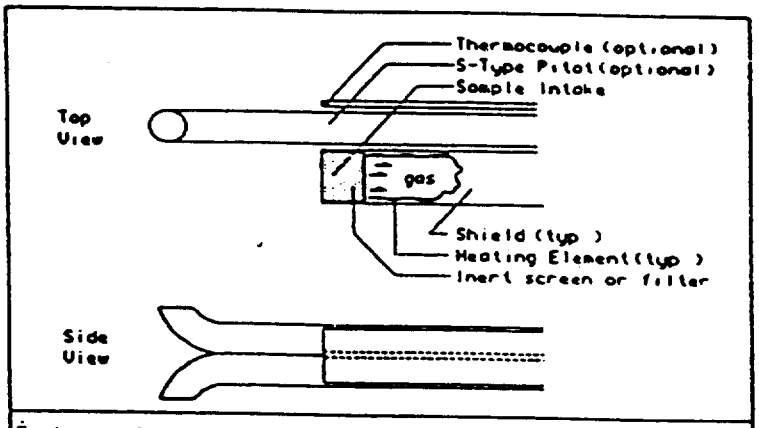
gas sampling probe to determine if there is a homogeneous flue gas stream. If the flue gas stream is determined to be homogeneous, a single point will be used for gas sampling in the stack. If the flue gas stream is not homogeneous, then multipoint traversing across the stack's cross section will be conducted.

The gas sampling assembly consists of a probe with a stainless steel tube, stainless steel mesh screen filter (protected by a stainless steel sheath), and heated Teflon-lined flexible tubing. The other end of that tubing is connected to a Thermo Electron (TECO) Model 600 sample conditioner. After the conditioner, the sample line is connected to a manifold from which the continuous analyzers, in a parallel plumbing arrangement, draw their sample. Data from the analyzers will be recorded on strip charts and a Hewlett-Packard data acquisition system. The controller for the data acquisition system is an HP Model 9825A calculator. See Figure 2 for a diagram of Method 100.

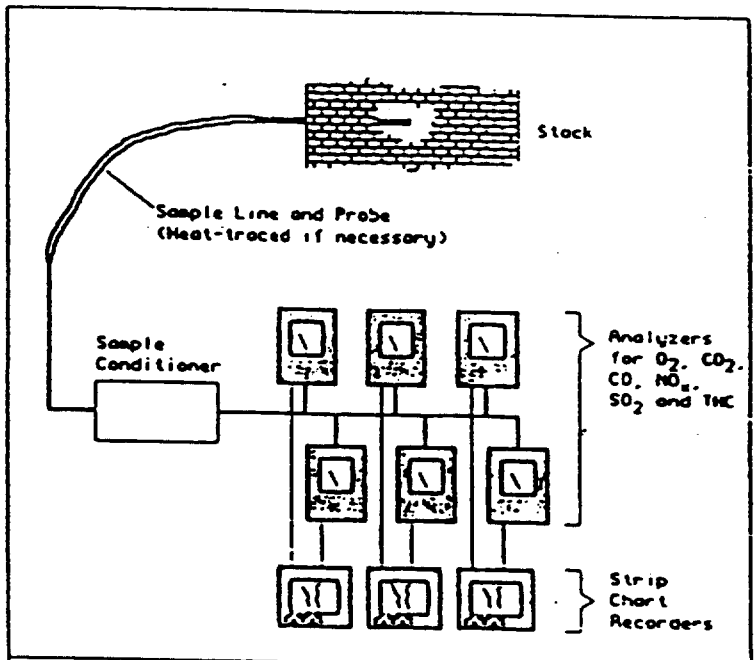
Oxygen content will be measured using a Teledyne analyzer utilizing an electrochemical technique. Carbon dioxide (Anarad Model AR-500) and carbon monoxide (Beckman Model 864) concentrations will be measured using non-dispersive infrared spectroscopy (NDIR). Sulfur dioxide concentrations will be measured with a Western Research Model #711 UV continuous analyzer using an ultraviolet photometry technique. Oxides of

FIGURE 2

ARB METHOD 100 APPARATUS



Features of typical Method 100 Probe. An adaptation of a particulate sampling probe is shown. Other configurations may be and are used in different situations.



Simplified schematic of Method 100 apparatus. Details not shown include calibration gas plumbing, analyzer exhaust plumbing, optional pitot and thermocouple arrangements, etc.

nitrogen concentrations will be measured using a TECO Model 10 chemiluminescent analyzer. Total hydrocarbon concentration will be measured using a Beckman Model 400 analyzer equipped with a flame ionization detector (FID). The analyzers will be calibrated in the ARB's Engineering Evaluation Branch facility before the emissions test and in the field before, after, and as needed during each test run.

2. Flow Rate and Moisture Content

Stack gas flow rate and moisture content will be determined by ARB Test Methods 2 and 4, respectively.

3. Volatile Organics

Grab samples will be collected into Tedlar bags in accordance with ARB Method 422 (Section 94132, Title 17 of the California Code of Regulations). These samples will be analyzed by gas chromatography using electron capture detector (GC/ECD) for all halogenated compounds except vinyl chloride and gas chromatography using photoionization detector (GC/PID) for vinyl chloride and benzene. Appendix I contains a list of specific volatile organic compounds to be analyzed. The sample train that will be used is shown in Figure 4. The bags will be checked for contamination with a gas chromatograph at the ARB Engineering Evaluation Branch facility. The bags will be transported to the facility site deflated. After a sample of stack gas has been

collected, the bags will be stored in a container to avoid exposure to sunlight until analyzed.

4. Dioxins and Furans

A modified Method 5 sampling train will be used for the collection of dioxins and furans. These trains will be specially cleaned and transported to the test site as a unit. Also, once sampling is completed, the probes and glass liners will be transported as a unit to the laboratory space provided by the Butte County Air Pollution Control District. The trains will be dismantled, rinsed and cleaned by an AIHL chemist. The rinse solutions and resin cartridges will be analyzed by HML and ENSECO Cal Labs. The modified Method 5 sampling train is shown in Figure 3. The dioxin and furan compounds are listed in Appendix II.

5. Semi-Volatile Organics

The modified Method 5 sampling train will be used to measure select semi-volatile organic compounds including PAHs, PCBs, total chlorobenzenes, and total chlorophenols. (See Appendix III for specific semi-volatile compounds.) The modified Method 5 sampling train is shown in Figure 3.

6. Particulate Matter

Particulate matter will be determined in accordance with ARB Method 5. The Method 5 train is shown in Figure 5. These trains may also be used to determine metals emissions which will require the following deviations:

a. Glass or quartz lined probes.

b. Teflon-coated glass fiber filters.

c. Glass storage for filters before and after sampling.

7. Metals

Samples will be collected as indicated by ARB Method 5 or Method 421 and analyzed for specific metals such as arsenic, chromium, selenium, and others. (See Appendix IV for a list of the specific metals.) Some metals must be collected with glass or quartz lined probes and/or Teflon-coated glass fiber filters that are stored in glass containers before and after sampling.

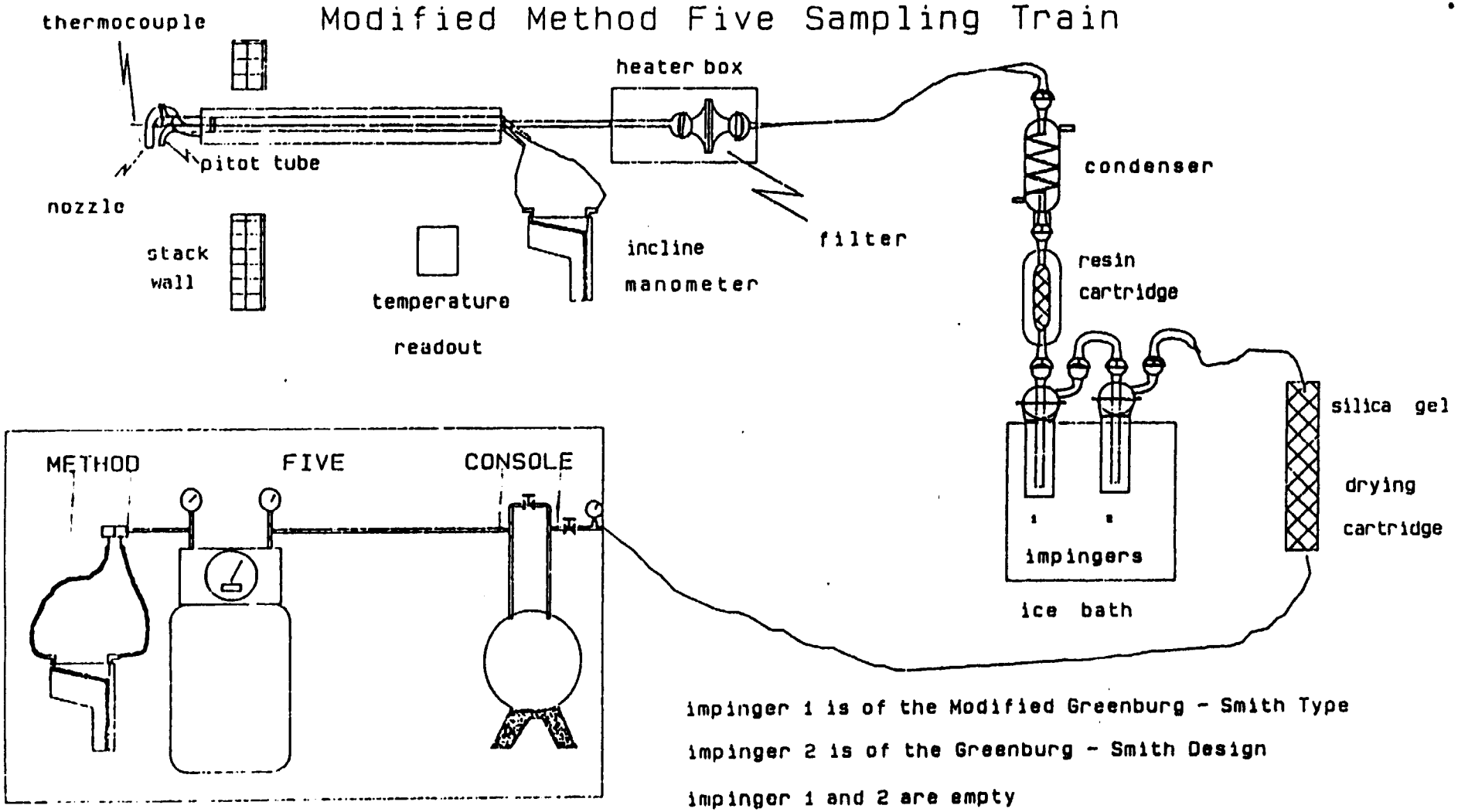
8. Formaldehydes

ARB staff is in the process of developing a field test procedure for formaldehydes. Sampling and analytical procedures for formaldehydes would be evaluated.

9. Sampling Identification Scheme

The sampling identification scheme is shown in Appendix V.

Figure 3



impinger 1 is of the Modified Greenburg - Smith Type

impinger 2 is of the Greenburg - Smith Design

impinger 1 and 2 are empty

FIGURE 4

Bag Sampling Train

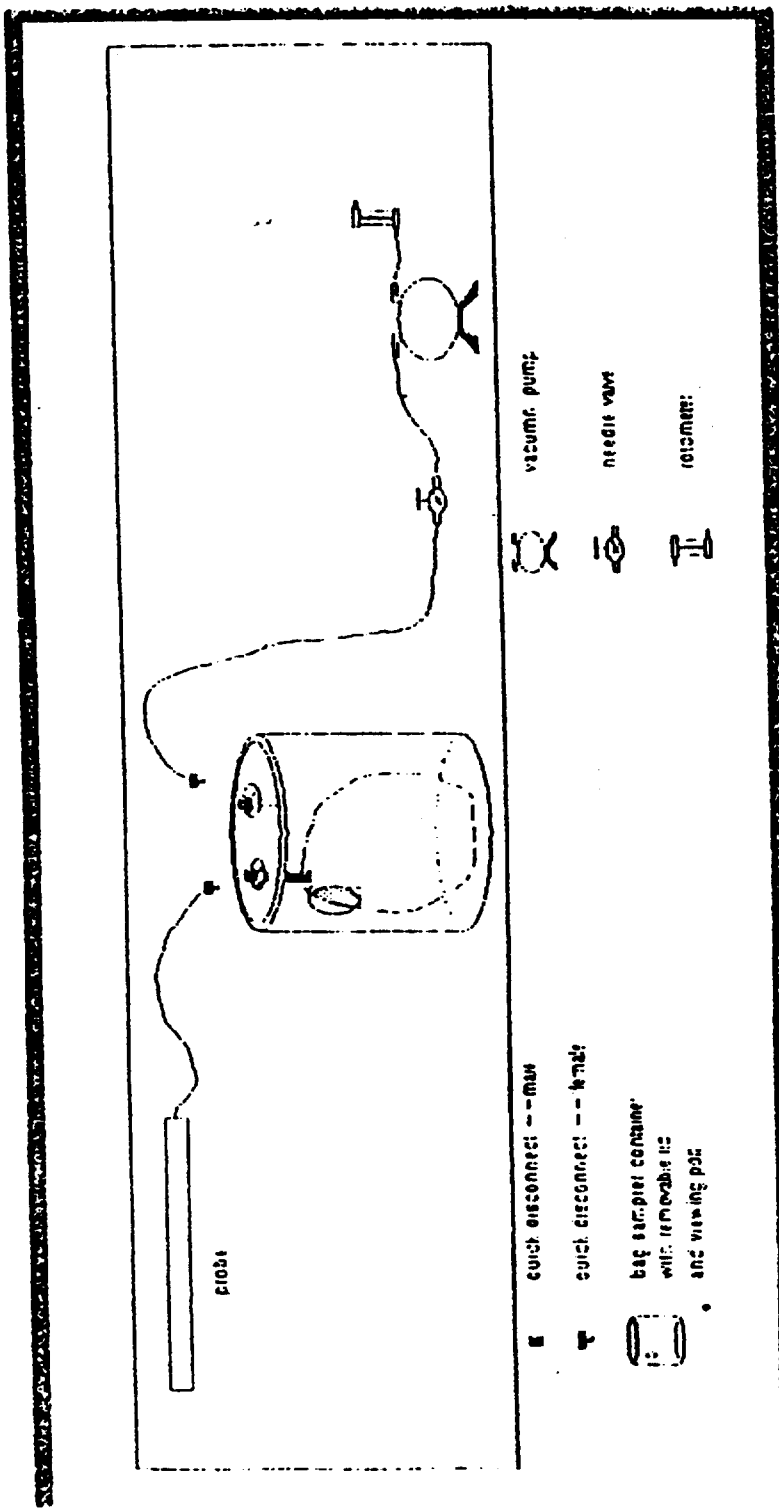
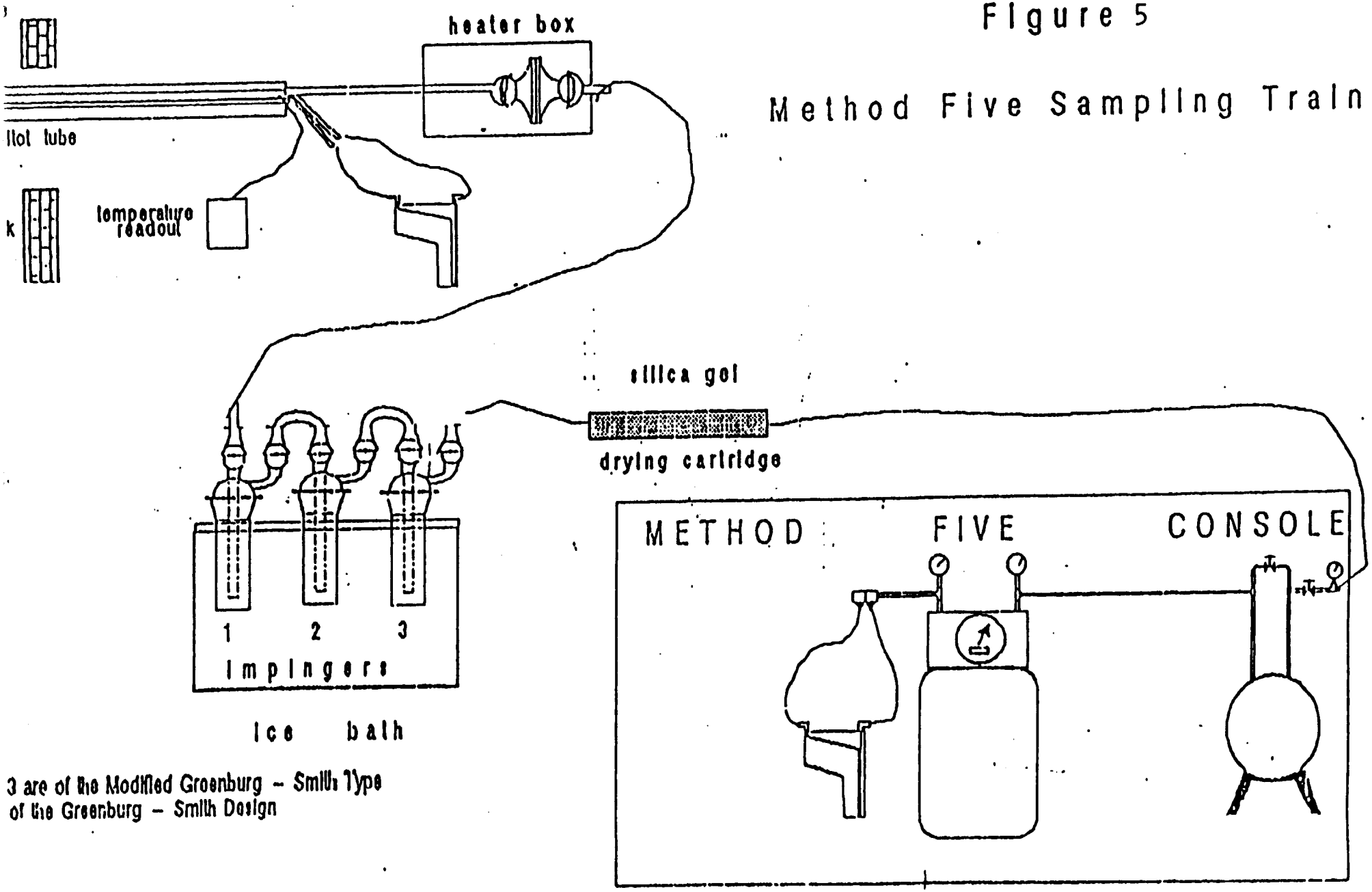


Figure 5

Method Five Sampling Train



3 are of the Modified Greenburg – Smith Type
of the Greenburg – Smith Design

IV. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Procedures to document the accuracy of reported sampling and analytical results have been established by the ARB in "Air Monitoring Quality Assurance, Volume VI, Standard Operating Procedures for Stationary Source Emission Monitoring and Testing" for most of the sampling procedures. These Quality Assurance (QA) procedures include the use of referee audit samples provided by independent laboratories, field and laboratory blank samples, and multi-point calibration of continuous monitors.

A. SPECIFIC SAMPLING QA/QC CONSIDERATIONS

1. Sampling Trains

Normal QA/QC measures, including leak checks, are to be taken as part of the sampling program for all sampling trains. This includes a blank of each sampling train which will be assembled, leak checked, disassembled and otherwise handled and analyzed as any other similar sampling train except no sample will be collected. Unused portions of sampling filters, impinger water, and rinse solvents will also be analyzed to determine background concentrations.

2. Adsorbent Samples

Several QA/QC measures are taken during the course of the sampling program. These include the following:

a) Resin blanks are taken into the field and kept with the sampling train.

b) To determine the total recovery efficiency of the organic module, a mixture of several organic compounds will be injected onto the resin. The amount of each compound recovered from the spiked resin is divided by the amount injected to get the recovery efficiency.

3. Bag Samples

Factors considered to affect the precision and accuracy of the measured concentrations include time between collection and analysis, bag handling, instrument accuracy, the sampling system, and the condition of the bags. The following procedures are used to evaluate the effects of the above variables:

a) Field and laboratory personnel maintain log sheets so that the time and handling between collection and analysis can be determined.

b) Instrument accuracy is determined by laboratory personnel against standards.

c) The deflated bags are transported to the facility until needed for sampling.

d) The bags are checked for contamination with a GC/ECD for halogenated compounds (Appendix I) and GC/PID for aromatics and vinyl chloride before they are used for sampling. Bag samples are used to measure volatile organic compounds, some of which can be affected by sunlight. Therefore, after a bag

sample is collected, the bag is stored in a container until it is analyzed to avoid exposure to sunlight.

B. CHAIN-OF-CUSTODY

A chain-of-custody sheet is to accompany all collected samples. A copy of the sample label is to be attached to the chain-of-custody sheet. All sample labels are to contain the job number, the date the sample was taken, the sample or run number, the sample location, the type of sample, the log number for the sample, and the labeler's initials.

Each sample custodian is responsible for insuring sample integrity until the sample is transferred to another person. Each sample custodian is also responsible for signing the chain-of-custody sheet when receiving and delivering the sample. The following people are also required to maintain chain-of-custody log books: field engineers, field chemists, and all laboratory receivers. Each laboratory has the option of using its own internal chain-of-custody record or continuing the field chain-of-custody for all samples received for this project.

When a field engineer turns over the samples to the sample transporter, the transporter initials the field engineer's log book for all samples received. If any samples are damaged or the integrity is questionable, a note is to be made on the sample chain-of-custody sheet and initialed by the person delivering the sample log book. Examples of log book, chains-of-custody sheet, and laboratory request forms are presented in the appendix.

V. LIST OF PARTICIPATING TEST PERSONNEL

Name	Title	Affiliation
1. A. Jenkins	Project Engineer	ARB
2. A. MacPherson	Engineer (Console)	ARB
3. J. LaBrue	Technician (Lead)	ARB
4. J. Rogers	Technician (Stack)	ARB
5. D. Fitzell	Chemist	ARB
6. B. Okamoto	Chemist	ARB
7. G. Lindner	Engineer	ARB
8. E. Jeung	Chemist	AIHL

VI. TEST SCHEDULE

1st Week

The facility will burn typical woodwaste at a rate commensurate with normal operating procedures. During the first week of testing the stack sampling will consist of the following:

A. Method 100 gaseous emissions (continuous)

B. Flow rate and moisture content (as required)

C. Volatile organics (3, 3-minute bag samples)

D. Dioxin/furan (4 runs @ 6-8 hours each)

E. Particulate emissions (3 runs, 1 hour samples)

F. Formaldehyde test procedures (as required)

2nd Week

The facility will burn "urban" wood waste at a rate required for steam generation to meet established operating requirements.

A. Method 100 gaseous emissions (continuous)

B. Flow rate and moisture content (as required)

C. Volatile organics (3, 3-minute bag samples)

D. Dioxin/furan (3 runs @ 6-8 hours each)

E. Particulate emissions (3 runs, 1 hour samples)

F. Formaldehyde test procedures (as required)

G. Polynuclear aromatics (including polychlorinated biphenyls, chlorobenzenes, and chlorophenols) (3 runs @ 2 hours each)

TOTALS:

Volatiles	1	blank
	6	bags (3 normal fuel, 3 urban fuel).
Dioxin	2	blank resin (1 complete train for test series).
	7	sampling trains (5 resin cartridges will be spiked. HML will spike 3 and ENSECO Cal Labs will spike 2.
Reagents	1	sample per test of all reagents used in the field for blank analysis.
Semi-Volatiles	1	blank resin (1 complete train for test series).
	3	sampling trains
Particulates	1	blank (1 complete train for test series include trace metals)
	6	sampling trains.

VII. TEST NOTES

The following items are inserted to provide additional information or help clarify testing conditions. If there are any questions contact the project engineer, Al Jenkins.

1. The dioxin trains and the semi-volatile trains will be recovered as follows:

   Container #1 - Probe rinse and filter

   Container #2 - Resin cartridge, Teflon line rinse, and condenser rinse

   Container #3 - Rinse and catch of all other components.

2. Dioxin and semi-volatile blanks have been cleaned specifically for this test. On the last test day entire trains will be assembled, leak checked, disassembled, and recovered like an operating train. Do not label these samples as "blanks", but identify them as "samples".

3. A particulate blank will also be done. These blanks will be done like the dioxin/semi-volatile blanks. In addition, a blank filter, water sample, and solvent sample will be analyzed to determine background levels.

4. There will be no inlet samples.

5. Safety hats, ear protection, shoes (no tennis shoes or equivalent allowed), and glasses will be needed. Side shields for glasses are recommended because of flying dust. All testing personnel will be required to attend a safety meeting provided by the facility operator at 10:00 a.m. on June 13, 1988.

6. Emissions test personnel will be allowed lunch breaks. However, since there will be long term (6-8 hour) sample runs, lunch breaks may be split among test personnel to ensure continuous monitoring of the sampling equipment.

7. Emergency safety equipment (gray boxes) will be taken to the test site.

8. Desired span gases:

Gas	Concentration (approximate)
THC	90 ppm as propane
NO	80 ppm
CO_2	20%
CO	50 ppm
SO_2	95 ppm

APPENDIX I

Halogenated and Aromatic Organic Compounds to be Determined by Bag Sampling Method

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1,1,1-Trichloroethane
Tetrachloromethane
Trichlorofluoromethane
Trichloromethane
1,2-Dichloroethane
Trichloroethene
Chloroethene
Benzene
1,2-Dibromoethane
Tetrachloroethene

APPENDIX IV

Laboratory Request
AIR RESOURCES BOARD
Monitoring and Laboratory Division
Engineering Evaluation Branch

Request for Analytical Laboratory Support

To: ED JEUNG
AIHL

From: GEORGE LEW, CHIEF
ENGINEERING EVALUATION BRANCH

BACKGROUND INFORMATION

EEB Project No.: C-85-050 Project Name: P.O.P.I.
Source Location: OROVILLE Source Type: WOOD WASTE INCINERATOR
Scheduled Sampling Dates: 6-14-88 Thru 6-23-88
Project Engineer: A. C. JENKINS Telephone No.: (916) 323-1476

PRELIMINARY ANALYTICAL PLAN

Type of Sample (Resin,Tenax, Ted. Bag,etc.)	Estimated Number of Samples	Analysis Requested	Estimated Quantity (micrograms)
METHOD 5 PARTICULATE MATTER TRAIN	8	TOTAL PARTICULATE MATTER AND TRACE METALS DELINEATED IN APPENDIX III OF THE PROTOCOL Le, Pb, As, Nl, Mn, Fe, Cu, and Be	

COMMENTS:

PREPARED BY: Al Jenkins/Gloria Lindner DATE: July 8, 1988

APPENDIX V

SAMPLING IDENTIFICATION SCHEME

SAMPLING DEVICE	ALPHANUMERIC CODE
Particulate Matter Train	PT
Semi-Volatile Organics Train	RT
Dioxin/Furan Train	DT
Bag Sample	BS

SAMPLING LOCATION	
Outlet (Stack)	S
ESP Ash	ESPA
Fuel	F
Blank	B

Example:

RT-1S

Sampling Device

First Sample

Baghouse Outlet

9. Desired vehicles:

Vehicle	Purpose
Gas Van	Gaseous sampling
EPA Van	Make-up and store sampling trains
EEB Pickup	Extra sample train and span gas storage
Passenger Van	Crew support vehicle
Passenger Car	Crew support vehicle

APPENDIX II

Laboratory Request
AIR RESOURCES BOARD
Monitoring and Laboratory Division
Engineering Evaluation Branch

Request for Analytical Laboratory Support

To: MIKE MILLIE
ENSECO LABS

From: GEORGE LEW, CHIEF
ENGINEERING EVALUATION BRANCH

BACKGROUND INFORMATION

EEB Project No.: C-85-050 Project Name: P.O.P.I.
Source Location: OROVILLE Source Type: WOOD WASTE INCINERATOR
Scheduled Sampling Dates: 6-14-88 Thru 6-23-88
Project Engineer: A. C. JENKINS Telephone No.: (916) 323-1476

PRELIMINARY ANALYTICAL PLAN

Type of Sample (Resin, Tenax, Ted. Bag, etc.)	Estimated Number of Samples	Analysis Requested	Estimated Quantity (micrograms)
RESIN XAD-2	6	TOTAL HOMOLOGUES FOR TETRA THROUGH OCTACHLORINATED DIOXINS AND FURANS 2,3,7,8-SUBSTITUTED ISOMER ANALYSIS ONLY IF HOMOLOGUE ANALYSIS IS POSITIVE	NANOGRAMS

COMMENTS:

PREPARED BY: Al Jenkins/Gloria Lindner DATE: July 8, 1988

APPENDIX III

Laboratory Request
AIR RESOURCES BOARD
Monitoring and Laboratory Division
Engineering Evaluation Branch

Request for Analytical Laboratory Support

To: MIKE MILLIE
ENSECO LABS

From: GEORGE LEW, CHIEF
ENGINEERING EVALUATION BRANCH

BACKGROUND INFORMATION

EEB Project No.: C-85-050 Project Name: P.O.P.I.
Source Location: OROVILLE Source Type: WOOD WASTE INCINERATOR
Scheduled Sampling Dates: 6-14-88 Thru 6-23-88
Project Engineer: A. C. JENKINS Telephone No.: (916) 323-1476

PRELIMINARY ANALYTICAL PLAN

Type of Sample (Resin,Tenax, Ted. Bag,etc.)	Estimated Number of Samples	Analysis Requested	Estimated Quantity (micrograms)
RESIN XAD-2	4	POLYNUCLEAR AROMATIC HYDROCARBONS (PAH) POLYCHLORINATED BIPHENYLS (PCB) CHLOROBENZENES CHLOROPHENOLS	NANOGRAMS

COMMENTS:

PREPARED BY: Al Jenkins/Gloria Lindner DATE: July 8, 1988

Appendix II

Stack Testing Parameters

C-88-050; PACIFIC OROVILLE POWER; **DRAFT** 27/10/88; GLORIA L

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME: PACIFIC OROVILLE POWER
FILE NO.: C-88-050
RUN: PT-1S
DATE: 6-16-88
TIME: 0810/0920

SUMMARY OF TEST DATA

METER BOX NO.	4475	
DRY GAS METER CALIBRATION FACTOR	1.008	
METERED SAMPLE VOLUME:	38.12	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.78	inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.44	inches H2O
STANDARD ABS. PRESSURE:	29.92	in. Hg
N2 IN STACK:	79.9	percent
O2 IN STACK:	7.8	percent
CO IN STACK:	0.1500	percent
CO2 IN STACK:	12.2	percent
PITOT TUBE C-FACTOR:	0.83	
AVG. /(DELTA P PITOT PRESSURE):	0.88	/(inches H2O)
STACK TEMPERATURE:	350	deg.F
STACK PRESSURE:	29.73	inches Hg
STATIC PRESSURE:	-0.70	inches H2O
STACK DIAMETER:	84	inches
STACK AREA:	38.48	square feet
H2O IN IMPINGERS AND SILICA GEL:	206.9	milliliters
SAMPLING TIME:	64	minutes
NOZZLE DIAMETER:	0.25	inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT MOISTURE	20.0	percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.26	lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.81	lb/lbmole
CORRECTED SAMPLE VOLUME:	38.97	DSCF(68 deg.F)
STACK GAS VELOCITY:	62.1	feet/second
STACK GAS FLOW RATE:	74362	DSCFM(68 deg.F)
ISOKINETIC RATIO:	91.9	percent

PARTICULATE CONCENTRATION	grains/dscf	gr/dscf at 12% CO_2
Total	0.011	0.011
Front half	0.005	0.005
Back half	0.006	0.006
PARTICULATE EMISSION RATE	lb/hour	
Total	6.991	
Front half	3.079	
Back half	3.912	

Verified by: A. C. Jenkins Date: 11-2-88

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME: PACIFIC OROVILLE POWER
FILE NO.: C-88-050
RUN: PT-2S
DATE: 6-16-88
TIME: 0950/1055

SUMMARY OF TEST DATA

METER BOX NO.	4475	
DRY GAS METER CALIBRATION FACTOR	1.008	
METERED SAMPLE VOLUME:	39.48	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.78	inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.63	inches H2O
STANDARD ABS. PRESSURE:	29.92	in. Hg
N2 IN STACK:	79.7	percent
O2 IN STACK:	8.7	percent
CO IN STACK:	0.1400	percent
CO2 IN STACK:	11.5	percent
PITOT TUBE C-FACTOR:	0.82	
AVG. /(DELTA P PITOT PRESSURE):	0.94	/(inches H2O)
STACK TEMPERATURE:	355	deg.F
STACK PRESSURE:	29.73	inches Hg
STATIC PRESSURE:	-0.70	inches H2O
STACK DIAMETER:	84	inches
STACK AREA:	38.48	square feet
H2O IN IMPINGERS AND SILICA GEL:	218.5	milliliters
SAMPLING TIME:	64	minutes
NOZZLE DIAMETER:	0.25	inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT MOISTURE	20.3	percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.19	lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.71	lb/lbmole
CORRECTED SAMPLE VOLUME:	40.38	DSCF(68 deg.F)
STACK GAS VELOCITY:	65.7	feet/second
STACK GAS FLOW RATE:	77919	DSCFM(68 deg.F)
ISOKINETIC RATIO:	90.8	percent

PARTICULATE CONCENTRATION	grains/dscf	gr/dscf at 12% CO_2
Total	0.010	0.010
Front half	0.004	0.005
Back half	0.005	0.006
PARTICULATE EMISSION RATE	lb/hour	
Total	6.534	
Front half	2.884	
Back half	3.650	

Verified by: A.C. Johnson Date: 11-2-88

C-88-050; PACIFIC OROVILLE POWER; **DRAFT** 27/10/88; GLORIA L

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME: PACIFIC OROVILLE POWER
FILE NO.: C-88-050
RUN: PT-3S
DATE: 6-16-88
TIME: 1255/1400

SUMMARY OF TEST DATA

METER BOX NO.	4475	
DRY GAS METER CALIBRATION FACTOR	1.008	
METERED SAMPLE VOLUME:	39.08	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.78	inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.64	inches H2O
STANDARD ABS. PRESSURE:	29.92	in. Hg
N2 IN STACK:	79.8	percent
O2 IN STACK:	8.9	percent
CO IN STACK:	0.1350	percent
CO2 IN STACK:	11.2	percent
PITOT TUBE C-FACTOR:	0.84	
AVG. /(DELTA P PITOT PRESSURE):	0.94	/(inches H2O)
STACK TEMPERATURE:	368	deg.F
STACK PRESSURE:	29.73	inches Hg
STATIC PRESSURE:	-0.70	inches H2O
STACK DIAMETER:	84	inches
STACK AREA:	38.48	square feet
H2O IN IMPINGERS AND SILICA GEL:	210.7	milliliters
SAMPLING TIME:	64	minutes
NOZZLE DIAMETER:	0.25	inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT MOISTURE	19.9	percent	
STACK GAS MOLECULAR WEIGHT, DRY:	30.15	lb/lbmole	
STACK GAS MOLECULAR WEIGHT, WET:	27.73	lb/lbmole	
CORRECTED SAMPLE VOLUME:	39.97	DSCF(68 deg.F)	
STACK GAS VELOCITY:	68.0	feet/second	
STACK GAS FLOW RATE:	79715	DSCFM(68 deg.F)	
ISOKINETIC RATIO:	87.9	percent	
PARTICULATE CONCENTRATION	grains/dscf	gr/dscf at 12% CO_2	
Total	0.010	0.011	
Front half	0.006	0.006	
Back half	0.005	0.005	
PARTICULATE EMISSION RATE	lb/hour		
Total	7.070		
Front half	3.878		
Back half	3.192		

Verified by: A. C. Jenkins Date: 11-2-88

C-88-050; PACIFIC OROVILLE POWER; **DRAFT** 27/10/88; GLORIA L

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME: PACIFIC OROVILLE POWER
FILE NO.: C-88-050
RUN: PT-4S
DATE: 6-20-88
TIME: 1430/1535

SUMMARY OF TEST DATA

METER BOX NO.	0061	
DRY GAS METER CALIBRATION FACTOR	0.964	
METERED SAMPLE VOLUME:	54.74	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.68	inches Hg
AVG. DELTA H ORIFICE PRESSURE:	2.94	inches H2O
STANDARD ABS. PRESSURE:	29.92	In. Hg
N2 IN STACK:	79.8	percent
O2 IN STACK:	6.3	percent
CO IN STACK:	0.1400	percent
CO2 IN STACK:	13.8	percent
PITOT TUBE C-FACTOR:	0.84	
AVG. /(DELTA P PITOT PRESSURE):	1.30	/(inches H2O)
STACK TEMPERATURE:	363	deg.F
STACK PRESSURE:	29.63	inches Hg
STATIC PRESSURE:	-0.70	inches H2O
STACK DIAMETER:	84	inches
STACK AREA:	38.48	square feet
H2O IN IMPINGERS AND SILICA GEL:	268.9	milliliters
SAMPLING TIME:	64	minutes
NOZZLE DIAMETER:	0.25	inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT MOISTURE	19.1	percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.46	lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	28.08	lb/lbmole
CORRECTED SAMPLE VOLUME:	53.54	DSCF(68 deg.F)
STACK GAS VELOCITY:	92.9	feet/second
STACK GAS FLOW RATE:	110169	DSCFM(68 deg.F)
ISOKINETIC RATIO:	88.3	percent

PARTICULATE CONCENTRATION	grains/dscf	gr/dscf at 12% CO_2
Total	0.012	0.011
Front half	0.003	0.002
Back half	0.010	0.009

PARTICULATE EMISSION RATE	lb/hour
Total	11.731
Front half	2.395
Back half	9.336

Verified by: A.C. Gerlinger Date: 11-2-88

C-88-050; PACIFIC OROVILLE POWER; **DRAFT** 27/10/88; GLORIA L

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME: PACIFIC OROVILLE POWER
FILE NO.: C-88-050
RUN: PT-5S
DATE: 6-20-88
TIME: 1525/1630

SUMMARY OF TEST DATA

METER BOX NO.	4475	
DRY GAS METER CALIBRATION FACTOR	1.008	
METERED SAMPLE VOLUME:	41.07	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.68	inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.75	inches H2O
STANDARD ABS. PRESSURE:	29.92	In. Hg
N2 IN STACK:	79.8	percent
O2 IN STACK:	6.3	percent
CO IN STACK:	0.1400	percent
CO2 IN STACK:	13.8	percent
PITOT TUBE C-FACTOR:	0.82	
AVG. /(DELTA P PITOT PRESSURE):	0.96	/(inches H2O)
STACK TEMPERATURE:	357	deg.F
STACK PRESSURE:	29.63	inches Hg
STATIC PRESSURE:	-0.70	inches H2O
STACK DIAMETER:	84	inches
STACK AREA:	38.48	square feet
H2O IN IMPINGERS AND SILICA GEL:	221.8	milliliters
SAMPLING TIME:	64	minutes
NOZZLE DIAMETER:	0.25	inches
NOZZLE AREA:	0.00034	square feet

Stack Height

CALCULATED RESULTS

PERCENT MOISTURE	20.0	percent	
STACK GAS MOLECULAR WEIGHT, DRY:	30.46	lb/lbmole	
STACK GAS MOLECULAR WEIGHT, WET:	27.97	lb/lbmole	
CORRECTED SAMPLE VOLUME:	41.88	DSCF(68 deg.F)	
STACK GAS VELOCITY:	66.9	feet/second	
STACK GAS FLOW RATE:	79227	DSCFM(68 deg.F)	
ISOKINETIC RATIO:	92.7	percent	
PARTICULATE CONCENTRATION	grains/dscf	gr/dscf at 12% CO_2	
Total	0.013	0.011	
Front half	0.002	0.002	
Back half	0.011	0.009	
PARTICULATE EMISSION RATE	lb/hour		
Total	8.708		
Front half	1.376		
Back half	7.332		

Verified by: A. C. Gendine Date: 11-2-88

C-88-050; PACIFIC OROVILLE POWER; **DRAFT** 27/10/88; GLORIA L

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME: PACIFIC OROVILLE POWER
FILE NO.: C-88-050
RUN: PT-6S
DATE: 6-20-88
TIME: 1720/1830

SUMMARY OF TEST DATA

METER BOX NO.	4475	
DRY GAS METER CALIBRATION FACTOR	1.008	
METERED SAMPLE VOLUME:	32.61	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.68	inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.15	inches H2O
STANDARD ABS. PRESSURE:	29.92	in. Hg
N2 IN STACK:	79.8	percent
O2 IN STACK:	6.3	percent
CO IN STACK:	0.1400	percent
CO2 IN STACK:	13.8	percent
PITOT TUBE C-FACTOR:	0.82	
AVG. /(DELTA P PITOT PRESSURE):	0.79	/(inches H2O)
STACK TEMPERATURE:	351	deg.F
STACK PRESSURE:	29.63	inches Hg
STATIC PRESSURE:	-0.70	inches H2O
STACK DIAMETER:	84	inches
STACK AREA:	38.48	square feet
H2O IN IMPINGERS AND SILICA GEL:	187.3	milliliters
SAMPLING TIME:	64	minutes
NOZZLE DIAMETER:	0.25	inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT MOISTURE	21.0	percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.46	lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.85	lb/lbmole
CORRECTED SAMPLE VOLUME:	33.20	DSCF(68 deg.F)
STACK GAS VELOCITY:	55.1	feet/second
STACK GAS FLOW RATE:	64781	DSCFM(68 deg.F)
ISOKINETIC RATIO:	89.9	percent

PARTICULATE CONCENTRATION	grains/dscf	gr/dscf at 12% CO_2
Total	0.144	0.125
Front half	0.138	0.120
Back half	0.007	0.006

PARTICULATE EMISSION RATE	lb/hour
Total	78.978
Front half	76.365
Back half	3.613

Verified by: H. C. Gerhardt Date: 11-2-88

C-88-050; PACIFIC OROVILLE POWER; **DRAFT** 19/9/88; GLORIA L

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME:	PACIFIC OROVILLE POWER
FILE NO.:	C-88-050
RUN:	DT-1S
DATE:	6-14-88
TIME:	1000/1700

SUMMARY OF TEST DATA

METER BOX NO.	4475	
DRY GAS METER CALIBRATION FACTOR	1.008	
METERED SAMPLE VOLUME:	187.70	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.74	Inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.55	Inches H20
STANDARD ABS. PRESSURE:	29.92	In. Hg
N2 IN STACK:	80.1	percent
O2 IN STACK:	6.8	percent
CO IN STACK:	0.1450	percent
CO2 IN STACK:	13.0	percent
PITOT TUBE C-FACTOR:	0.83	
AVG. /(DELTA P PITOT PRESSURE):	0.92	/(Inches H20)
STACK TEMPERATURE:	365	deg.F
STACK PRESSURE:	29.69	Inches Hg
STATIC PRESSURE:	-0.70	Inches H20
STACK DIAMETER:	84	Inches
STACK AREA:	38.48	square feet
SAMPLING TIME:	320	minutes
NOZZLE DIAMETER:	0.25	Inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT MOISTURE	20.1	percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.35	lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.87	lb/lbmole
CORRECTED SAMPLE VOLUME:	191.69	DSCF(68 deg.F)
STACK GAS VELOCITY:	65.1	feet/second
STACK GAS FLOW RATE:	76289	DSCFM(68 deg.F)
ISOKINETIC RATIO:	88.7	percent

Verified by: A C Jenkins Date: 10-14-88

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME:	PACIFIC OROVILLE POWER
FILE NO.:	C-88-050
RUN:	DT-2S
DATE:	6-14-88
TIME:	1100/1700

SUMMARY OF TEST DATA

METER BOX NO.	0061	
DRY GAS METER CALIBRATION FACTOR	0.964	
METERED SAMPLE VOLUME:	193.42	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.74	Inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.64	Inches H20
STANDARD ABS. PRESSURE:	29.92	In. Hg
N2 IN STACK:	80.1	percent
O2 IN STACK:	6.8	percent
CO IN STACK:	0.1450	percent
CO2 IN STACK:	13.0	percent
PITOT TUBE C-FACTOR:	0.83	
AVG. /(DELTA P PITOT PRESSURE):	0.95	/(Inches H20)
STACK TEMPERATURE:	363	deg.F
STACK PRESSURE:	29.69	Inches Hg
STATIC PRESSURE:	-0.70	Inches H20
STACK DIAMETER:	84	Inches
STACK AREA:	38.48	square feet
SAMPLING TIME:	320	minutes
NOZZLE DIAMETER:	0.25	Inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT MOISTURE	20.1	percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.35	lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.87	lb/lbmole
CORRECTED SAMPLE VOLUME:	188.95	DSCF(68 deg.F)
STACK GAS VELOCITY:	67.1	feet/second
STACK GAS FLOW RATE:	78916	DSCFM(68 deg.F)
ISOKINETIC RATIO:	84.5	percent

Verified by: A C Jenkins Date: 10-14-88

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME:	PACIFIC OROVILLE POWER
FILE NO.:	C-88-050
RUN:	DT-3S
DATE:	6-15-88
TIME:	0850/1600

SUMMARY OF TEST DATA

METER BOX NO.	4475	
DRY GAS METER CALIBRATION FACTOR	1.008	
METERED SAMPLE VOLUME:	196.48	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.75	inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.65	inches H2O
STANDARD ABS. PRESSURE:	29.92	in. Hg
N2 IN STACK:	80.1	percent
O2 IN STACK:	6.8	percent
CO IN STACK:	0.1450	percent
CO2 IN STACK:	13.0	percent
PITOT TUBE C-FACTOR:	0.84	
AVG. /(DELTA P PITOT PRESSURE):	0.96	/(inches H2O)
STACK TEMPERATURE:	373	deg.F
STACK PRESSURE:	29.70	inches Hg
STATIC PRESSURE:	-0.70	inches H2O
STACK DIAMETER:	84	inches
STACK AREA:	38.48	square feet
SAMPLING TIME:	320	minutes
NOZZLE DIAMETER:	0.25	inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT MOISTURE	20.1	percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.35	lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.87	lb/lbmole
CORRECTED SAMPLE VOLUME:	200.77	DSCF(68 deg.F)
STACK GAS VELOCITY:	69.2	feet/second
STACK GAS FLOW RATE:	80435	DSCFM(68 deg.F)
ISOKINETIC RATIO:	88.1	percent

Verified by: A C Stanton Date: 10-14-88

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME:	PACIFIC OROVILLE POWER
FILE NO.:	C-88-050
RUN:	DT-4S
DATE:	6-15-88
TIME:	0850/1600

SUMMARY OF TEST DATA

METER BOX NO.	0061
DRY GAS METER CALIBRATION FACTOR	0.964
METERED SAMPLE VOLUME:	204.31 cubic feet
METER TEMPERATURE:	60 deg.F
STANDARD ABS. TEMPERATURE:	528 deg.R
BAROMETRIC PRESSURE:	29.75 inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.67 inches H20
STANDARD ABS. PRESSURE:	29.92 in. Hg
N2 IN STACK:	79.9 percent
O2 IN STACK:	6.8 percent
CO IN STACK:	0.1600 percent
CO2 IN STACK:	13.1 percent
PITOT TUBE C-FACTOR:	0.82
AVG. /(DELTA P PITOT PRESSURE):	0.96 /(inches H20)
STACK TEMPERATURE:	371 deg.F
STACK PRESSURE:	29.70 inches Hg
STATIC PRESSURE:	-0.70 inches H20
STACK DIAMETER:	84 inches
STACK AREA:	38.48 square feet
SAMPLING TIME:	320 minutes
NOZZLE DIAMETER:	0.25 inches
NOZZLE AREA:	0.00034 square feet

CALCULATED RESULTS

PERCENT MOISTURE	20.1 percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.37 lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.89 lb/lbmole
CORRECTED SAMPLE VOLUME:	199.67 DSCF(68 deg.F)
STACK GAS VELOCITY:	67.1 feet/second
STACK GAS FLOW RATE:	78078 DSCFM(68 deg.F)
ISOKINETIC RATIO:	90.3 percent

Verified by: A C Jenkins Date: 10-14-88

C-88-050; PACIFIC OROVILLE POWER; **DRAFT** 19/9/88; GLORIA L

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME:	PACIFIC OROVILLE POWER
FILE NO.:	C-88-050
RUN:	DT-6S
DATE:	6-21-88
TIME:	0915/1155
	1330/1615

SUMMARY OF TEST DATA

METER BOX NO.	4475	
DRY GAS METER CALIBRATION FACTOR	1.008	
METERED SAMPLE VOLUME:	192.47	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.84	Inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.61	inches H20
STANDARD ABS. PRESSURE:	29.92	In. Hg
N2 IN STACK:	79.8	percent
O2 IN STACK:	6.1	percent
CO IN STACK:	0.1800	percent
CO2 IN STACK:	13.9	percent
PITOT TUBE C-FACTOR:	0.84	
AVG. /(DELTA P PITOT PRESSURE):	0.87	/(Inches H20)
STACK TEMPERATURE:	354	deg.F
STACK PRESSURE:	29.79	Inches Hg
STATIC PRESSURE:	-0.70	inches H20
STACK DIAMETER:	84	Inches
STACK AREA:	38.48	square feet
SAMPLING TIME:	320	minutes
NOZZLE DIAMETER:	0.25	Inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT MOISTURE	20.0	percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.47	lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.97	lb/lbmole
CORRECTED SAMPLE VOLUME:	197.25	DSCF(68 deg.F)
STACK GAS VELOCITY:	61.7	feet/second
STACK GAS FLOW RATE:	73545	DSCFM(68 deg.F)
ISOKINETIC RATIO:	94.7	percent

Verified by: A C Jenkins Date: 10-14-88

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME:	PACIFIC OROVILLE POWER	
FILE NO.:	C-88-050	
RUN:	DT-7S	
DATE:	6-22-88	6-23-88
TIME:	0830/1110	0700/0940

SUMMARY OF TEST DATA

METER BOX NO.	4475	
DRY GAS METER CALIBRATION FACTOR	1.008	
METERED SAMPLE VOLUME:	203.60	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.76	inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.76	inches H2O
STANDARD ABS. PRESSURE:	29.92	in. Hg
N2 IN STACK:	79.7	percent
O2 IN STACK:	6.3	percent
CO IN STACK:	0.1800	percent
CO2 IN STACK:	13.8	percent
PITOT TUBE C-FACTOR:	0.84	
AVG. /(DELTA P PITOT PRESSURE):	0.91	/(inches H2O)
STACK TEMPERATURE:	357	deg.F
STACK PRESSURE:	29.71	inches Hg
STATIC PRESSURE:	-0.70	inches H2O
STACK DIAMETER:	84	inches
STACK AREA:	38.48	square feet
SAMPLING TIME:	320	minutes
NOZZLE DIAMETER:	0.25	inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT MOISTURE	20.0	percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.46	lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.96	lb/lbmole
CORRECTED SAMPLE VOLUME:	208.17	DSCF(68 deg.F)
STACK GAS VELOCITY:	64.8	feet/second
STACK GAS FLOW RATE:	76777	DSCFM(68 deg.F)
ISOKINETIC RATIO:	95.7	percent

Verified by: H C Jenkins Date: 10-14-88

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME:	PACIFIC OROVILLE POWER
FILE NO.:	C-88-050
RUN:	DT-8S
DATE:	6-23-88
TIME:	1030/1700

SUMMARY OF TEST DATA

METER BOX NO.	0061	
DRY GAS METER CALIBRATION FACTOR	0.964	
METERED SAMPLE VOLUME:	198.60	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.7	inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.52	inches H2O
STANDARD ABS. PRESSURE:	29.92	in. Hg
N2 IN STACK:	79.7	percent
O2 IN STACK:	6.0	percent
CO IN STACK:	0.1800	percent
CO2 IN STACK:	14.1	percent
PITOT TUBE C-FACTOR:	0.83	
AVG. /(DELTA P PITOT PRESSURE):	0.92	/(inches H2O)
STACK TEMPERATURE:	361	deg.F
STACK PRESSURE:	29.65	inches Hg
STATIC PRESSURE:	-0.70	inches H2O
STACK DIAMETER:	84	inches
STACK AREA:	38.48	square feet
SAMPLING TIME:	320	minutes
NOZZLE DIAMETER:	0.25	inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT-MOISTURE	20.0	percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.50	lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.99	lb/lbmole
CORRECTED SAMPLE VOLUME:	193.69	DSCF(68 deg.F)
STACK GAS VELOCITY:	64.7	feet/second
STACK GAS FLOW RATE:	76172	DSCFM(68 deg.F)
ISOKINETIC RATIO:	89.8	percent

Verified by: H C Jenkins Date: 10-14-88

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME:	PACIFIC OROVILLE POWER
FILE NO.:	C-88-050
RUN:	RT-1S
DATE:	6-21-88
TIME:	0915/1200
	1330/1615

SUMMARY OF TEST DATA

METER BOX NO.	0061	
DRY GAS METER CALIBRATION FACTOR	0.964	
METERED SAMPLE VOLUME:	178.70	cubic feet
METER TEMPERATURE:	60	deg.F
STANDARD ABS. TEMPERATURE:	528	deg.R
BAROMETRIC PRESSURE:	29.84	inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.18	inches H2O
STANDARD ABS. PRESSURE:	29.92	In. Hg
N2 IN STACK:	79.8	percent
O2 IN STACK:	6.1	percent
CO IN STACK:	0.1800	percent
CO2 IN STACK:	13.9	percent
PITOT TUBE C-FACTOR:	0.82	
AVG. /(DELTA P PITOT PRESSURE):	0.84	/(inches H2O)
STACK TEMPERATURE:	348	deg.F
STACK PRESSURE:	29.79	Inches Hg
STATIC PRESSURE:	-0.70	Inches H2O
STACK DIAMETER:	84	inches
STACK AREA:	38.48	square feet
SAMPLING TIME:	320	minutes
NOZZLE DIAMETER:	0.25	inches
NOZZLE AREA:	0.00034	square feet

CALCULATED RESULTS

PERCENT MOISTURE	20.0	percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.47	lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.97	lb/lbmole
CORRECTED SAMPLE VOLUME:	174.96	DSCF(68 deg.F)
STACK GAS VELOCITY:	58.3	feet/second
STACK GAS FLOW RATE:	70015	DSCFM(68 deg.F)
ISOKINETIC RATIO:	88.2	percent

Verified by: H C Jenkins Date: 10-14-88

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME:	PACIFIC OROVILLE POWER	
FILE NO.:	C-88-050	
RUN:	RT-2S	
DATE:	6-22-88	6-23-88
TIME:	0830/1210	0700/1000

SUMMARY OF TEST DATA

METER BOX NO.	0061
DRY GAS METER CALIBRATION FACTOR	0.964
METERED SAMPLE VOLUME:	197.90 cubic feet
METER TEMPERATURE:	60 deg.F
STANDARD ABS. TEMPERATURE:	528 deg.R
BAROMETRIC PRESSURE:	29.76 inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.43 inches H2O
STANDARD ABS. PRESSURE:	29.92 in. Hg
N2 IN STACK:	79.7 percent
O2 IN STACK:	6.3 percent
CO IN STACK:	0.1800 percent
CO2 IN STACK:	13.8 percent
PITOT TUBE C-FACTOR:	0.82
AVG. /(DELTA P PITOT PRESSURE):	0.89 /(inches H2O)
STACK TEMPERATURE:	355 deg.F
STACK PRESSURE:	29.71 inches Hg
STATIC PRESSURE:	-0.70 inches H2O
STACK DIAMETER:	84 inches
STACK AREA:	38.48 square feet
SAMPLING TIME:	320 minutes
NOZZLE DIAMETER:	0.25 inches
NOZZLE AREA:	0.00034 square feet

CALCULATED RESULTS

PERCENT MOISTURE	20.0 percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.46 lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.96 lb/lbmole
CORRECTED SAMPLE VOLUME:	193.35 DSCF(68 deg.F)
STACK GAS VELOCITY:	61.8 feet/second
STACK GAS FLOW RATE:	73328 DSCFM(68 deg.F)
ISOKINETIC RATIO:	93.1 percent

Verified by: A C Jenkins Date: 10-14-88

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

FIELD DATA SUMMARY

PROJECT NAME:	PACIFIC OROVILLE POWER
FILE NO.:	C-88-050
RUN:	RT-3S
DATE:	6-23-88
TIME:	1045/1700

SUMMARY OF TEST DATA

METER BOX NO.	4475
DRY GAS METER CALIBRATION FACTOR	1.008
METERED SAMPLE VOLUME:	164.70 cubic feet
METER TEMPERATURE:	60 deg.F
STANDARD ABS. TEMPERATURE:	528 deg.R
BAROMETRIC PRESSURE:	29.7 inches Hg
AVG. DELTA H ORIFICE PRESSURE:	1.22 inches H2O
STANDARD ABS. PRESSURE:	29.92 in. Hg
N2 IN STACK:	79.7 percent
O2 IN STACK:	6.0 percent
CO IN STACK:	0.1800 percent
CO2 IN STACK:	14.1 percent
PITOT TUBE C-FACTOR:	0.80
AVG. /(DELTA P PITOT PRESSURE):	0.96 /(inches H2O)
STACK TEMPERATURE:	360 deg.F
STACK PRESSURE:	29.65 inches Hg
STATIC PRESSURE:	-0.70 inches H2O
STACK DIAMETER:	84 inches
STACK AREA:	38.48 square feet
SAMPLING TIME:	320 minutes
NOZZLE DIAMETER:	0.25 inches
NOZZLE AREA:	0.00034 square feet

CALCULATED RESULTS

PERCENT MOISTURE	20.0 percent
STACK GAS MOLECULAR WEIGHT, DRY:	30.50 lb/lbmole
STACK GAS MOLECULAR WEIGHT, WET:	27.99 lb/lbmole
CORRECTED SAMPLE VOLUME:	167.84 DSCF(68 deg.F)
STACK GAS VELOCITY:	65.1 feet/second
STACK GAS FLOW RATE:	76703 DSCFM(68 deg.F)
ISOKINETIC RATIO:	77.2 percent

Verified by: A C Stanbuno Date: 10-14-88

Appendix III

Trace Metal Laboratory Data

TABLE

TRACE METALS, MICROGRAMS/SAMPLE

SAMPLE ID	PT-1S	PT-2S	PT-3S	PT-4S	PT-5S	PT-6S
As	0.18	0.16	0.19	0.84	0.85	6.05
Cd	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	2.26
Cr	7.04	6.08	5.89	6.38	6.15	41.75
Fe	88.11	112.82	119.52	95.17	79.99	90.58
Mn	42.61	56.57	61.12	35.79	25.17	49.90
Ni	< 3.75	< 3.75	< 3.75	< 3.75	< 3.75	17.67
Pb	8.78	6.24	8.78	11.31	8.78	87.78

(<) Below limit of detection.

C-88-050

TABLE

TRACE METAL CONCENTRATIONS, ug/dscm

SAMPLE ID	PT-1S	PT-2S	PT-3S	PT-4S	PT-5S	PT-6S
As	0.2	0.1	0.2	0.6	0.7	6.4
Cd	< 0.5	< 0.4	< 0.4	< 0.3	< 0.4	2.4
Cr	6.4	5.3	5.2	4.2	5.2	44.4
Fe	79.8	98.7	105.6	62.8	67.4	96.3
Mn	38.6	49.5	54.0	23.6	21.2	53.1
Ni	< 3.4	< 3.3	< 3.3	< 2.5	< 3.2	18.8
Pb	8.0	5.5	7.8	7.5	7.4	93.4

(<) Below limit of detection.

C-88-050

Appendix IV

Halogenated and Aromatic Volatile Organic Compound Laboratory Data

PACIFIC OROVILLE POWER ANALYTICAL RESULTS, PPB

NAME	BS-1	BS-2	BS-3	BS-4	BS-5
TYPE	STACK	STACK	STACK	BLANK	BLANK
VC	ND	ND	ND	ND	ND
BENZENE	270 ± 34%	950 ± 5.2% 640 ± 3.4*	1180 ±2.5% 1100*	1.80	4.70
TOL	NA	75	97	4.8	3.0
FRE 11	ND	ND	ND	ND	ND
CHLOR	ND	ND	ND	ND	ND
TCEA	ND	ND	ND	ND	ND
CT	ND	ND	ND	ND	ND
EDC	ND	ND^	ND^	ND	ND
PERC	ND	ND	ND	ND	ND
EDB	ND	ND	ND	ND	ND

PACIFIC OROVILLE POWER ANALYTICAL RESULTS CONT., PPB

NAME	BS-6	BS-7	BS-8	BS-9
TYPE	SPIKE	STACK	STACK	BLANK
VC	91.8	ND	ND	ND
BENZENE	39.5	3900 ± 15.4	3175 ± 13.4%	1890 ± 2.1
			2900*	2050*
TOL	NA	75	97	4.8
FRE 11	ND	ND	ND	ND
CHLOR	31	ND	ND	ND
TCEA	ND	ND	ND	ND
CT	35	ND	ND	ND
EDC	ND	ND	ND	ND
PERC	23	ND	ND	ND
EDB	ND	ND	ND	ND

*BENZENE CONFIRMATION NUMBERS DONE ON A CARBOWAX 20M COLUMN
EDC REPORTING LIMIT OF 100 PPB(V/V)

Appendix V

Dioxin/Furan Laboratory Data

TABLE

TOTAL PCDD AND PCDF IN GAS SAMPLES
(ng/sample)

	DT-1S	DT-2S	DT-3S	DT-4S	DT-1B
DIOXINS					
2,3,7,8-TCDD	(0.1	(0.1	(0.1	(0.03	(0.1
Total TCDD	NA	NA	NA	(0.03	NA
1,2,3,7,8-PeCDD	(0.06	(0.03	(0.05	0.06	(0.03
Total PeCDD	1.2	2.2	6.0	1.900	NA
1,2,3,4,7,8-HxCDD	(0.07	(0.03	0.13	0.08	(0.03
1,2,3,6,7,8-HxCDD	0.11	(0.04	0.1	0.14	(0.03
1,2,3,7,8,9-HxCDD	(0.05	(0.05	0.68	0.11	(0.03
Total HxCDD	0.68	0.47	2.5	2.80	NA
1,2,3,4,6,7,8-HpCDD	0.56	0.48	1.03	2.80	(0.03
Total HpCDD	1.03	1.38	2.9	6.50	NA
Total OCDD	2.5	1.0	2.2	6.20	(0.03
Total PCDD	5.41 *	5.05 *	13.60 *	17.40 *	0.03 *
FURANS					
2,3,7,8-TCDF	1.0	2.4	7.4	0.16	(0.03
Total TCDF	6.2	11.4	28	3.70	NA
1,2,3,7,8-PeCDF	0.08	0.36	1.5	0.55	(0.03
2,3,4,7,8-PeCDF	0.3	0.78	3.0	0.76	(0.03
Total PeCDF	6.1	11.1	38	9.10	NA
1,2,3,4,7,8-HxCDF	0.63	1.4	6.0	0.66	(0.03
1,2,3,6,7,8-HxCDF	0.33	0.83	2.9	1.10	(0.03
2,3,4,6,7,8-HxCDF	0.24	0.62	3.7	1.20	(0.03
1,2,3,7,8,9-HxCDF	(0.02	(0.01	(0.04	(0.08	(0.01
Total HxCDF	2.9	6.4	31	8.80	NA
1,2,3,4,6,7,8-HpCDF	0.4	0.95	5.6	2.40	(0.03
1,2,3,4,7,8,9-HpCDF	(0.01	0.03	(0.01	(0.05	(0.01
Total HpCDF	0.4	1.1	6.6	3.00	NA
Total OCDF	0.09	0.09	0.27	0.31	(0.03
Total PCDF	15.69	30.09	103.9 *	24.91	0.030 *

NOTES

(indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit
NA - Not applicable

C-88-050

TABLE

PCDD/PCDF CONCENTRATIONS IN STACK GAS
(ng/dscm)

RUN #	DT-1S	DT-2S	DT-3S	DT-4S
DIOXINS				
2,3,7,8-TCDD	(0.018	(0.019	(0.018	(0.004
Total TCDD	NA	NA	NA	(0.004
1,2,3,7,8-PeCDD	(0.011	(0.006	(0.009	0.010
Total PeCDD	0.221	0.411	1.055	0.336
1,2,3,4,7,8-HxCDD	(0.013	(0.006	0.023	0.015
1,2,3,6,7,8-HxCDD	0.020	(0.007	0.018	0.025
1,2,3,7,8,9-HxCDD	(0.009	(0.009	0.120	0.019
Total HxCDD	0.125	0.088	0.440	0.495
1,2,3,4,6,7,8-HpCDD	0.103	0.090	0.181	0.495
Total HpCDD	0.190	0.258	0.510	1.149
Total OCDD	0.461	0.187	0.387	1.096
Total PCDD	0.997 *	0.944 *	2.392 *	3.077 *
FURANS				
2,3,7,8-TCDF	0.184	0.449	1.302	0.028
Total TCDF	1.142	2.131	4.925	0.654
1,2,3,7,8-PeCDF	0.015	0.067	0.264	0.097
2,3,4,7,8-PeCDF	0.055	0.146	0.528	0.134
Total PeCDF	1.124	2.075	6.684	1.609
1,2,3,4,7,8-HxCDF	0.116	0.262	1.055	0.117
1,2,3,6,7,8-HxCDF	0.061	0.155	0.510	0.195
2,3,4,6,7,8-HxCDF	0.044	0.116	0.651	0.212
1,2,3,7,8,9-HxCDF	(0.004	(0.002	(0.007	(0.015
Total HxCDF	0.534	1.196	5.453	1.556
1,2,3,4,6,7,8-HpCDF	0.074	0.178	0.985	0.424
1,2,3,4,7,8,9-HpCDF	(0.002	0.006	(0.002	(0.010
Total HpCDF	0.074	0.206	1.161	0.531
Total OCDF	0.017	0.017	0.047	0.055
Total PCDF	2.891	5.624	18.27 *	4.405

NOTES
dscm - dry standard cubic meter at 68 F and one atmosphere
(indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit
NA - Not applicable

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TABLE

TOXIC EQUIVALENT CONCENTRATION USING CA DOHS WEIGHTING SCHEME

RUN #		DT-1S	DT-2S	DT-3S	DT-4S
	Toxic Equivalence Factor	Toxic equivalent concentration (ng/dscm)			
DIOXINS					
2,3,7,8-TCDD	1.00	(0.018	(0.013	(0.018	(0.004
1,2,3,7,8-PeCDD	1.00	(0.011	(0.006	(0.009	0.010
1,2,3,4,7,8-HxCDD	0.03	(0.0004	(0.0002	0.001	0.0004
1,2,3,6,7,8-HxCDD	0.03	0.001	(0.0002	0.001	0.001
1,2,3,7,8,9-HxCDD	0.03	(0.0003	(0.0003	0.004	0.001
1,2,3,4,6,7,8-HpCDD	0.03	0.003	0.003	0.005	0.015
Total PCDD		0.034 *	0.028 *	0.037 *	0.031 *
FURANS					
2,3,7,8-TCDF	1.00	0.184	0.449	1.302	0.028
1,2,3,7,8-PeCDF	1.00	0.015	0.067	0.264	0.097
2,3,4,7,8-PeCDF	1.00	0.055	0.146	0.528	0.134
1,2,3,4,7,8-HxCDF	0.03	0.003	0.008	0.032	0.004
1,2,3,6,7,8-HxCDF	0.03	0.002	0.005	0.015	0.006
2,3,4,6,7,8-HxCDF	0.03	0.001	0.003	0.020	0.006
1,2,3,7,8,9-HxCDF	0.03	(0.0001	(0.0001	(0.0002	(0.0004
1,2,3,4,6,7,8-HpCDF	0.03	0.002	0.005	0.030	0.013
1,2,3,4,7,8,9-HpCDF	0.03	(0.0001	0.0002	(0.0001	(0.0003
Total PCDF		0.263 *	2.729 *	2.183 *	4.197 *
Total Toxic Equivalent (2,3,7,8-TCDD Equivalents)		0.297 *	2.757 *	2.226 *	4.228 *

NOTES

dscm - dry standard cubic meter at 68 F and one atmosphere

(indicates below limit of detection (MDL)

* - Total includes MDLs for isomers below the detection limit

C-88-050

TABLE

TOTAL PCDD AND PCDF IN BAS SAMPLES
(ng/sample)

	DT-6S	DT-7S	DT-8S	BLANK DT-9S
DIOXINS				
2,3,7,8-TCDD	(0.026	(0.010	(0.016	(0.0093
Total TCDD	(0.026	(0.010	0.029	(0.0093
1,2,3,7,8-PeCDD	(0.028	(0.037	0.022	0.140
Total PeCDD	0.410	(0.037	0.560	2.900
1,2,3,4,7,8-HxCDD	(0.036	(0.033	(0.046	0.230
1,2,3,6,7,8-HxCDD	(0.036	(0.050	(0.046	0.300
1,2,3,7,8,9-HxCDD	(0.052	(0.032	(0.046	0.170
Total HxCDD	0.520	0.900	0.096	4.400
1,2,3,4,6,7,8-HpCDD	0.730	0.940	(0.200	3.100
Total HpCDD	0.730	2.500	0.240	8.100
Total OCDD	1.900	2.400	0.870	7.700
Total PCDD	3.586 *	5.847 *	1.795	23.11 *
FURANS				
2,3,7,8-TCDF	0.350	0.220	0.170	0.220
Total TCDF	3.800	0.490	0.800	4.300
1,2,3,7,8-PeCDF	0.740	0.530	0.250	1.100
2,3,4,7,8-PeCDF	0.540	0.340	0.210	1.500
Total PeCDF	5.100	0.750	2.800	20.000
1,2,3,4,7,8-HxCDF	0.370	0.320	0.140	2.000
1,2,3,6,7,8-HxCDF	0.550	0.580	0.210	2.700
2,3,4,6,7,8-HxCDF	0.630	0.560	0.220	3.400
1,2,3,7,8,9-HxCDF	(0.027	(0.043	(0.014	0.120
Total HxCDF	3.800	2.200	1.400	25.000
1,2,3,4,6,7,8-HpCDF	1.900	(1.100	0.350	27.000
1,2,3,4,7,8,9-HpCDF	(0.110	(1.100	(0.052	5.400
Total HpCDF	2.200	(1.100	0.390	56.000
Total OCDF	0.620	0.120	(0.130	43.000
Total PCDF	15.32	4.660 *	5.520 *	148.30

NOTES

(indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit

TABLE

PCDD/PCDF CONCENTRATIONS IN STACK GAS
(ng/dscm)

RUN #	DT-6S	DT-7S	DT-8S
DIOXINS			
2,3,7,8-TCDD	(0.005	(0.002	(0.003
Total TCDD	(0.005	(0.002	0.005
1,2,3,7,8-PeCDD	(0.005	(0.006	0.004
Total PeCDD	0.073	(0.006	0.102
1,2,3,4,7,8-HxCDD	(0.006	(0.006	(0.008
1,2,3,6,7,8-HxCDD	(0.006	(0.008	(0.008
1,2,3,7,8,9-HxCDD	(0.009	(0.005	(0.008
Total HxCDD	0.093	0.153	0.018
1,2,3,4,6,7,8-HpCDD	0.131	0.159	(0.036
Total HpCDD	0.131	0.424	0.044
Total OCDD	0.340	0.407	0.159
Total PCDD	0.642 *	0.992 *	0.327
FURANS			
2,3,7,8-TCDF	0.063	0.037	0.031
Total TCDF	0.680	0.083	0.146
1,2,3,7,8-PeCDF	0.132	0.090	0.046
2,3,4,7,8-PeCDF	0.097	0.058	0.038
Total PeCDF	0.913	0.127	0.511
1,2,3,4,7,8-HxCDF	0.066	0.054	0.026
1,2,3,6,7,8-HxCDF	0.098	0.098	0.038
1,2,3,7,8,9-HxCDF	0.113	0.095	0.040
2,3,4,6,7,8-HxCDF	(0.005	(0.007	(0.003
Total HxCDF	0.680	0.373	0.255
1,2,3,4,6,7,8-HpCDF	0.340	(0.187	0.066
1,2,3,4,7,8,9-HpCDF	(0.020	(0.187	(0.009
Total HpCDF	0.394	(0.187	0.071
Total OCDF	0.111	0.020	(0.024
Total PCDF	2.779	0.791 *	1.006 *

NOTES
dscm - dry standard cubic meter at 68 F and one atmosphere
(indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit

C-88-050

TABLE

TOXIC EQUIVALENT CONCENTRATION USING CA DOHS WEIGHTING SCHEME

RUN #		DT-6S	DT-7S	DT-8S
	Toxic Equivalence Factor	Toxic equivalent concentration (ng/dscm)		
DIOXINS				
2,3,7,8-TCDD	1.00	(0.005	(0.002	(0.003
1,2,3,7,8-PeCDD	1.00	(0.005	(0.006	0.004
1,2,3,4,7,8-HxCDD	0.03	(0.000	(0.000	(0.000
1,2,3,6,7,8-HxCDD	0.03	(0.000	(0.000	(0.000
1,2,3,7,8,9-HxCDD	0.03	(0.000	(0.000	(0.000
1,2,3,4,6,7,8-HpCDD	0.03	0.004	0.005	(0.001
Total PCDD		0.014 *	0.013 *	0.009 *
FURANS				
2,3,7,8-TCDF	1.00	0.063	0.037	0.031
1,2,3,7,8-PeCDF	1.00	0.132	0.090	0.046
2,3,4,7,8-PeCDF	1.00	0.097	0.058	0.038
1,2,3,4,7,8-HxCDF	0.03	0.002	0.002	0.001
1,2,3,6,7,8-HxCDF	0.03	0.003	0.003	0.001
1,2,3,7,8,9-HxCDF	0.03	0.003	0.003	0.001
2,3,4,6,7,8-HxCDF	0.03	(0.000	(0.000	(0.000
1,2,3,4,6,7,8-HpCDF	0.03	0.010	(0.006	0.002
1,2,3,4,7,8,9-HpCDF	0.03	(0.001	(0.006	(0.000
Total PCDF		0.311 *	0.204 *	0.120 *
Total Toxic Equivalent (2,3,7,8-TCDD Equivalents)		0.325 *	0.217 *	0.129 *

NOTES

dscm - dry standard cubic meter at 68 F and one atmosphere

(indicates below limit of detection (MDL)

* - Total includes MDLs for isomers below the detection limit

C-88-050

TABLE

PCDD/PCDF ANALYSIS OF BLANK TRAINS
(ng/sample)

	DT-5S	DT-9S
DIOXINS		
2,3,7,8-TCDD	<0.054	<0.0093
Total TCDD	<0.054	<0.0093
1,2,3,7,8-PeCDD	<0.170	0.140
Total PeCDD	<0.170	2.900
1,2,3,4,7,8-HxCDD	<0.039	0.230
1,2,3,6,7,8-HxCDD	<0.039	0.300
1,2,3,7,8,9-HxCDD	<0.039	0.170
Total HxCDD	<0.039	4.400
1,2,3,4,6,7,8-HpCDD	7.800	3.100
Total HpCDD	7.800	8.100
Total OCDD	1.400	7.700
Total PCDD	9.463 *	23.11 *
FURANS		
2,3,7,8-TCDF	0.019	0.220
Total TCDF	0.019	4.300
1,2,3,7,8-PeCDF	<0.057	1.100
2,3,4,7,8-PeCDF	<0.057	1.500
Total PeCDF	<0.057	20.000
1,2,3,4,7,8-HxCDF	<0.015	2.000
1,2,3,6,7,8-HxCDF	<0.015	2.700
2,3,4,6,7,8-HxCDF	<0.015	3.400
1,2,3,7,8,9-HxCDF	<0.015	0.120
Total HxCDF	<0.015	25.000
1,2,3,4,6,7,8-HpCDF	<0.100	27.000
1,2,3,4,7,8,9-HpCDF	<0.100	5.400
Total HpCDF	<0.100	56.000
Total OCDF	<0.240	43.000
Total PCDF	0.431*	148.30

NOTES

< Indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit

TABLE

PERCENT RECOVERY OF INTERNAL STANDARDS AND FIELD SPIKES

Internal standards	DT-4S	DT-6S	DT-7S	DT-8S	DT-9S
13C-2,3,7,8-TCDF	76	96	91	88	82
13C-2,3,7,8-TCDD	72	86	88	76	62
13C-1,2,3,7,8-PeCDD	58	72	76	56	71
13C-1,2,3,6,7,8-HxCDD	68	84	97	76	101
13C-1,2,3,4,6,7,8-HpCDD	55	60	64	58	77
13C-OCDD	30	37	41	36	27

Field spikes	DT-4S	DT-6S	DT-7S	DT-8S	DT-9S
37Cl-TCDD	77		81		
13C-HpCDF	50		52		

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Appendix VI

Polynuclear Aromatic Hydrocarbon Laboratory Data

PAH ANALYSIS OF GAS SAMPLES
(ug/sample)

	RT-1S	RT-2S	RT-3S	RT-4S
Naphthalene	1400	780	820	6.3
Acenaphthylene	120	68	<0.99	<0.99
Acenaphthene	< 1.0	<0.99	100	<0.99
Fluorene	18.0	7.6	2.5	<0.99
Phenanthrene	70.0	46	22	<0.99
Anthracene	< 1.0	4.7	1.6	<0.99
Fluoranthene	46.0	28	6.7	<0.99
Pyrene	45.0	23	< 6.9	<0.99
Benzo(a)anthracene	1.5	<0.99	<0.99	<0.99
Chrysene	2.4	1.2	<0.99	<0.99
Benzo(b)fluoranthene	< 1.0	<0.99	<0.99	<0.99
Benzo(k)fluoranthene	< 1.0	<0.99	<0.99	<0.99
Benzo(a)pyrene	< 1.0	<0.99	<0.99	<0.99
Dibenzo(a,h)anthracene	< 1.0	<0.99	<0.99	<0.99
Benzo(g,h,i)perylene	< 1.0	<0.99	<0.99	<0.99
Indeno(1,2,3-c,d)pyrene	< 1.0	<0.99	<0.99	<0.99
TOTAL	1710 **	966 **	969 **	21.2 **

NOTES

RT-4S - Blank sampling train
< indicates below reporting limit
NA - Not applicable
* - Chemical interference
** - Total includes reporting limits for compounds not detected

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TABLE

PAH CONCENTRATIONS IN STACK GAS
(ug/dscm)

RUN #	RT-1S	RT-2S	RT-3S
Naphthalene	282.5	142.4	172.5
Acenaphthylene	24.22	12.41	<0.208
Acenaphthene	< 0.20	<0.180	21.04
Fluorene	3.63	1.388	0.526
Phenanthrene	14.13	8.401	4.629
Anthracene	< 0.20	0.858	0.336
Fluoranthene	9.29	5.113	1.409
Pyrene	9.08	4.200	<1.451
Benzo(a)anthracene	0.30	<0.180	<0.208
Chrysene	0.48	0.219	<0.208
Benzo(b)fluoranthene	< 0.20	<0.180	<0.208
Benzo(k)fluoranthene	< 0.20	<0.180	<0.208
Benzo(a)pyrene	< 0.20	<0.180	<0.208
Dibenzo(a,h)anthracene	< 0.20	<0.180	<0.208
Benzo(g,h,i)perylene	< 0.20	<0.180	<0.208
Indeno(1,2,3-c,d)pyrene	< 0.20	<0.180	<0.208
	345.3 **	176.5 **	203.8 **

NOTES

dscm - dry standard cubic meter at 68 F and one atmosphere
< indicates below reporting limit
** - Total includes reporting limits for compounds not detected

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Appendix VII

Chlorobenzenes, Chlorophenols and PCBs Laboratory Data

TABLE

CHLOROBENZENE, CHLOROPHENOL, AND PCB ANALYSIS OF GAS SAMPLES

(ng/sample)

	RT-1S	RT-2S	RT-3S	RT-4S
CHLOROBENZENES				
Dichlorobenzene	1734	1149	735	< 55
Trichlorobenzene	1811	329	513	< 14
Tetrachlorobenzene	285	94	65	11
Pentachlorobenzene	89	53	48	< 6
Hexachlorobenzene	63	70	76	< 11
TOTAL	3982	1695	1437	97 **
CHLOROPHENOLS				
Monochlorophenol	2737	<6019	981	21
Dichlorophenols	<1200	1224	<1558	<1035
Trichlorophenols	393	211	50	84
Tetrachlorlphenols	553	< 420	89	< 72
Pentachlorophenol	234	152	88	127
TOTAL	5117 **	8026 **	2766 **	1339 **
PCB				
Monochlorobiphenyl	120	< 45	< 29	< 3.9
Dichlorobiphenyl	< 68	< 30	76	< 17
Trichlorobiphenyl	< 13	< 3.5	65	< 8.9
Tetrachlorobiphenyl	< 14	< 10	< 41	< 5.6
Pentachlorobiphenyl	< 10	< 25	< 27	< 3.8
Hexachlorobiphenyl	< 12	< 18	< 12	< 6.7
Heptachlorobiphenyl	< 13	< 15	< 19	< 16
Octachlorobiphenyl	< 15	< 14	< 22	< 16
Nonachlorobiphenyl	< 19	< 18	< 37	< 29
Decachlorobiphenyl	< 22	< 28	< 57	< 47
TOTAL	306 **	207 **	385 **	154 **

NOTES

RT-4S = Blank sampling train
< indicates below reporting limit
NA - Not applicable
* - Chemical interference
** - Total includes reporting limits for compounds not detected

Appendix VIII

Electrostatic Precipitator Waste Ash Dioxin/Furan Laboratory Data

TABLE 33

TOTAL PCDD AND PCDF IN ESP ASH SAMPLES
PICOGRAMS PER GRAM (pg/g)

SAMPLE ID	ESP-1-23	ESP-2-24	ESP-1-28	ESP-2-29	ESP-1-33	ESP-2-34
DATE	6-21-88	6-21-88	6-22-88	6-22-88	6-23-88	6-23-88
TIME	1500	1500	1200	1430	1200	1200
DIOXINS						
2,3,7,8-TCDD	26	22	24	18	8.5	8.6
Total TCDD	310	280	360	240	94	150
1,2,3,7,8-PeCDD	50	36	42	32	10	14
Total PeCDD	360	240	350	230	71	110
1,2,3,4,7,8-HxCDD	27	26	30	17	10	12
1,2,3,6,7,8-HxCDD	41	29	34	23	15	16
1,2,3,7,8,9-HxCDD	39	25	32	20	10	14
Total HxCDD	420	330	390	290	170	200
1,2,3,4,6,7,8-HpCDD	430	390	420	330	170	210
Total HpCDD	900	860	890	740	390	460
Total OCDD	1100	1200	1200	980	640	680
Total PCDD	3090	2910	3190	2480	1365	1600
FURANS						
2,3,7,8-TCDF	520	280	380	240	110	180
Total TCDF	4200	3100	3900	2500	980	1600
1,2,3,7,8-PeCDF	280	160	220	130	52	85
2,3,4,7,8-PeCDF	1100	660	960	510	220	400
Total PeCDF	4000	2800	4000	2400	1100	1700
1,2,3,4,7,8-HxCDF	450	240	330	190	99	160
1,2,3,6,7,8-HxCDF	310	180	250	140	78	120
2,3,4,6,7,8-HxCDF	590	270	390	220	120	190
1,2,3,7,8,9-HxCDF	13	7.8	11	5.7	< 1.9	4.3
Total HxCDF	2600	1500	2200	1200	640	980
1,2,3,4,6,7,8-HpCDF	250	150	210	120	63	93
1,2,3,4,7,8,9-HpCDF	37	22	30	16	10	13
Total HpCDF	420	250	350	200	110	160
Total OCDF	62	54	60	43	36	35
Total PCDF	11282	7704	10510	6343	2866	4475

NOTES

< indicates below limit of detection (MDL)
* - Total includes MDLs for homologues below the detection limit

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TABLE 34

PERCENT RECOVERY OF INTERNAL STANDARDS
ELECTROSTATIC PRECIPITATOR ASH SAMPLES

Internal standards	ESP-1-23	ESP-2-24	ESP-1-28	ESP-2-29	ESP-1-33	ESP-2-34
13C-2,3,7,8-TCDF	52	56	62	46	37	55
13C-2,3,7,8-TCDD	59	62	57	54	37	54
13C-1,2,3,7,8-PeCDD	47	56	58	46	42	92
13C-1,2,3,6,7,8-HxCDD	69	67	67	59	48	60
13C-1,2,3,4,6,7,8-HpCDD	60	56	56	45	33	38
13C-OCDD	38	37	38	26	21	20

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